Method Statement: Climate Change – Supply Side Methods

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Title	Method Statement: Climate Change – Supply Side Methods
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Summary of areas where substantive changes have been made as a result of consultation feedback	• Where option CC DO impact is calculated, pre-CC return periods used should be assessed with options in place • Clarifications on methodological points • Acknowledgement of limitations of approach
Summary of areas where substantive changes have been made as a result of revised Water Resource Planning Guidelines	None
Summary of other substantive changes made, and reasons for these	• Deletion of caveats – WRSE companies all ended up following the same climate change assessment method, and so caveats around use of different methods unnecessary
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A consultation on the WRSE Method Statements was undertaken in Autumn 2020 – the consultation details can be viewed on the WRSE engagement hq platform at https://wrse.uk.engagementhq.com/method-statements.

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Executive Summary

Water Resources South East (WRSE) is developing a multi-sector, regional resilience plan to secure water supplies for the South East until 2100.

We have prepared method statements setting out the processes and procedures we will follow when preparing all the technical elements for our regional resilience plan. We consulted on these early in the plan preparation process to ensure that our methods are transparent and, as far as possible, reflect the views and requirements of customers and stakeholders.

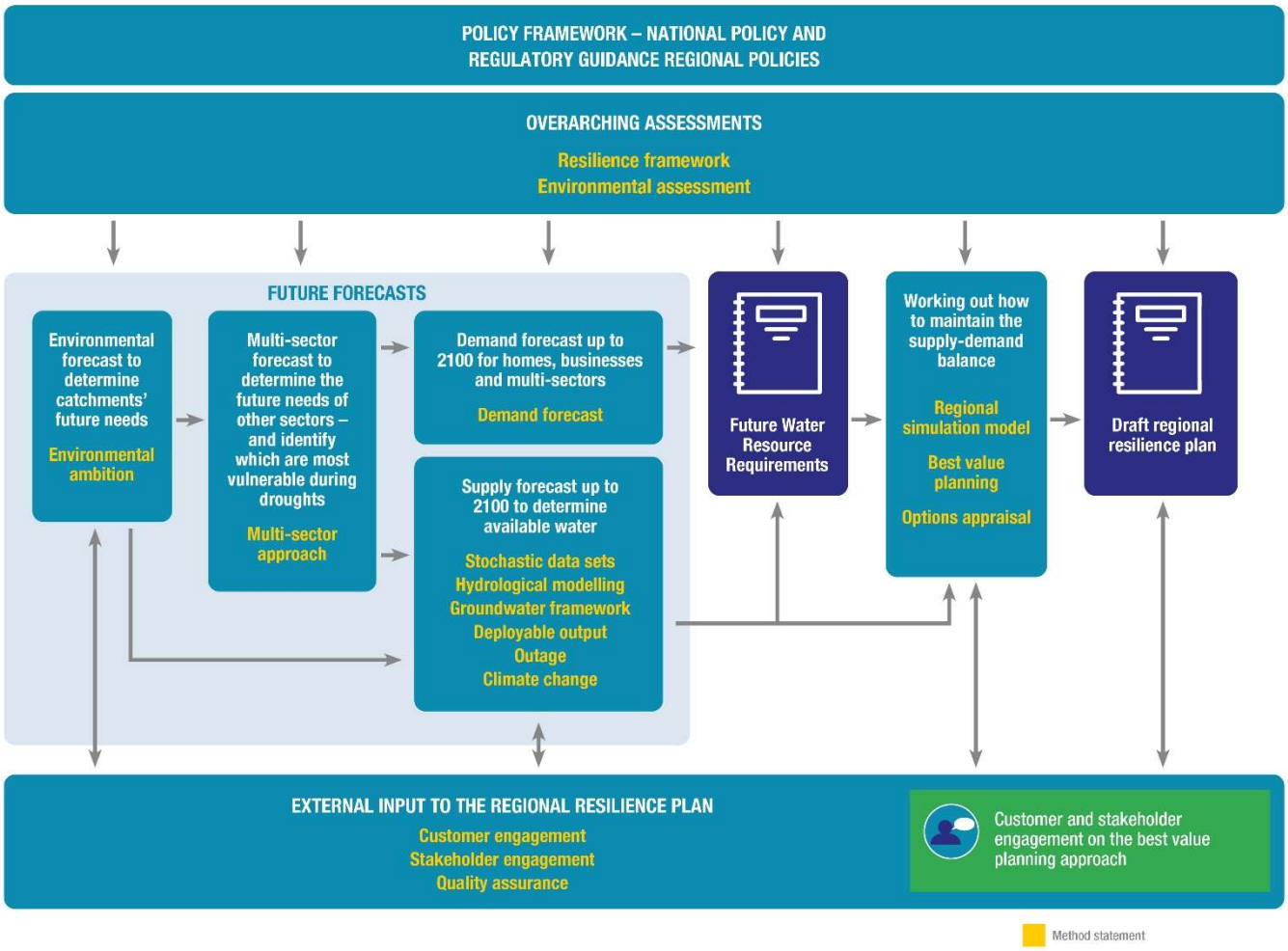
Figure ES1 illustrates how this method statement on supply-side climate change impacts will contribute to the preparation process for the regional resilience plan.

Water companies must ensure that their strategies are suitable for meeting future stresses and so must take account of the impacts that climate change will have on their supply systems. Current methods involve the calculation of 'deployable output impact' of climate change.

Since the production of WRMP19, there have been new datasets (UKCP18) produced which have potentially significant impacts for the methods used in determining the impact of climate change. Core messages from UKCP18 are very similar to UKCP09, with hotter, drier summers and warmer, wetter winters becoming more likely in a climate change impacted future, but the specific datasets available and importance of spatial coherence in regional planning bring new challenges in applying climate change projections in water resources planning.

This method statement describes how climate change impacts will be calculated as part of the WRSE regional plan.

Figure ES1: Overview of the method statements and their role in the development of the WRSE regional resilience plan



1 Introduction

1.1 Water companies must ensure that their Water Resource Management Plans (WRMPs) include an appropriate allowance for the impact that climate change will have on their supply capability over the period for which they are planning, in order that appropriate investment is made.

1.2 All companies in the UK have conducted analyses determining the impact of climate change on their supplies as part of WRMP19. These analyses involved a great deal of work and represent the most comprehensive supply-side climate change assessment that the UK water industry has undertaken to date. However, since these analyses have been conducted, the underlying data that was used has been updated, with the 'UKCP09' climate change projections being replaced with 'UKCP18' projections. Data from UKCP18 provides the most up to date climate change projections available for the UK, using the best climate models from the UK and around the world, and provides several datasets which can be used by the water industry to determine the range of outcomes that climate change may result in. UKCP18 is not, however, a completely 'like-for-like' replacement for UKCP09 and there are several important differences.

1.3 The Environment Agency (EA) has released new draft guidance associated with assessment of supply-side climate change impacts to incorporate guidance on using UKCP18 projections and on how to account for climate change impacts when also considering '1 in 500-year' drought.

1.4 This document will not provide a detailed description of the differences between the UKCP09 and UKCP18 datasets or EA guidance. There is a comparison of the different UKCP18 products and bias correction methods in a report by Atkins (2020a).

1.5 In WRMP19, WRSE companies used methods which are broadly aligned with one another and which follow EA guidance. There are, however, differences in some areas between company assessments which could have consequences when planning on a regional basis. This combined with the changes necessitated by new datasets and guidance have led WRSE to seek an aligned approach to climate change assessment across the region.

1.6 There are significant disparities between the forecast impact that climate change will have for companies' Water Resource Zones (WRZs) across the WRSE region, with central impacts of between 0 Ml/d and around 200 Ml/d.

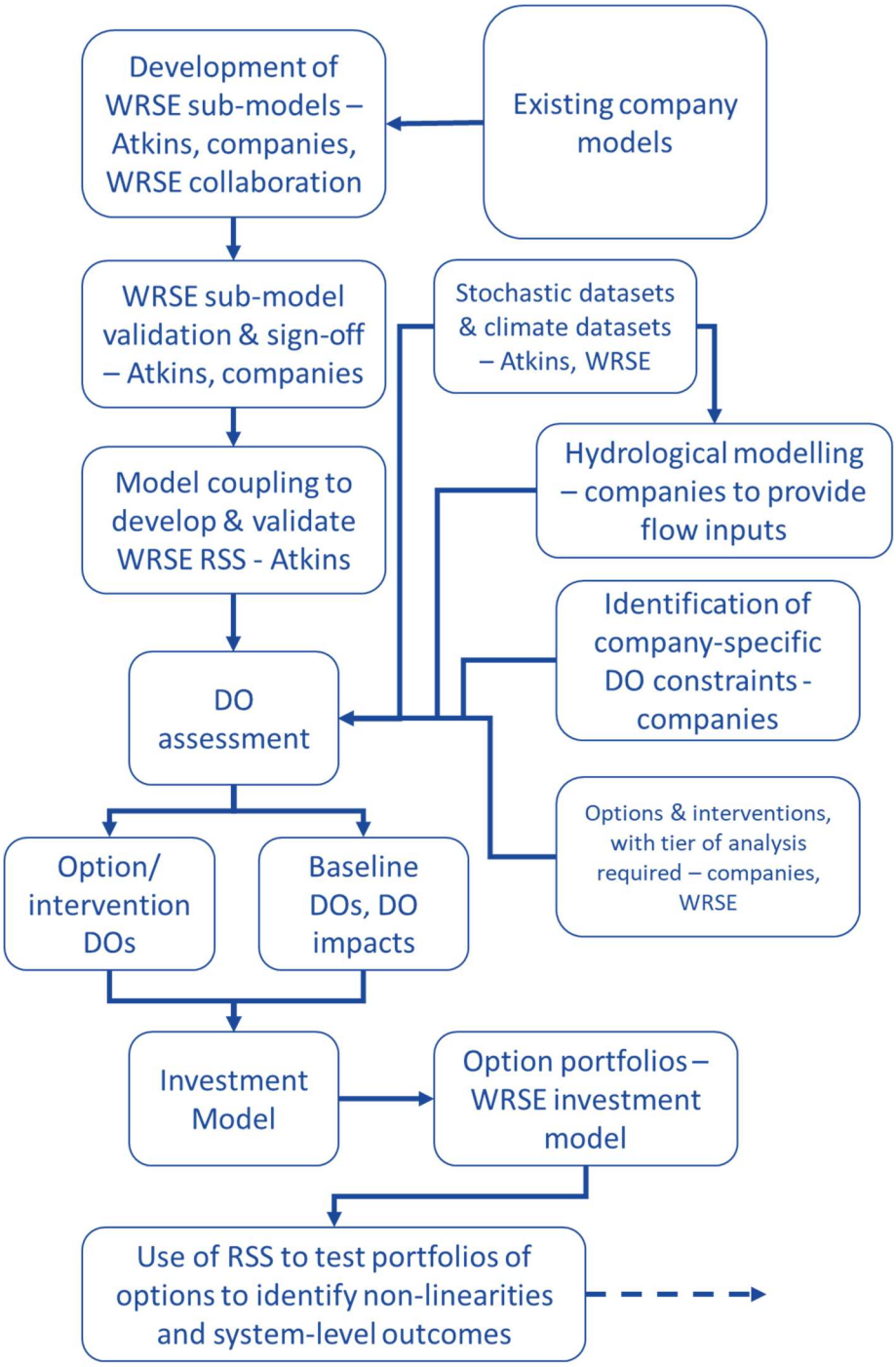
1.7 The methods used to determine the supply-side impact of climate change centre around the calculation of Deployable Output (DO) impact of climate change, i.e. the change in DO from the 'Baseline DO' for a given climate change scenario. This involves the use of 'perturbation factors' (monthly change factors for rainfall, potential evapotranspiration (PET), temperature, and sometimes flows associated with a given climate change scenario) which are applied to baseline records (these baseline records can be historical series, or stochastically generated weather sequences). Perturbed records are used to feed hydrological and hydrogeological models, which can in turn be used in water resources models to determine WRZ/system-level DO.

1.8 The methods outlined here are to be implemented using the WRSE Regional System Simulator (RSS), a water resources model (**Method Statement 1331 WRSE Regional Simulation Model**). While this climate change method statement aims to define a methodology to be applied across the WRSE region, it is recognised that the RSS may provide more acceptable results for some WRSE WRZs/sub-systems than others. As such, individual companies must decide whether the WRSE RSS and this method of determining climate change DO impact are suitable for determining climate change DO impact for each of their WRZs.

1.9 If companies consider that the WRSE model and/or method are not suitable for determining climate change DO impact in one or more of their WRZs, they may apply their own methods. If companies use an alternative to the WRSE method/model, they will need to provide climate change DO impacts, which are required for the integrated risk model and investment model, and which are, as far as possible, consistent with WRSE methods. If companies apply their own approaches, they should apply them to the same climate change data as is used in WRSE assessments and should ideally investigate the same scenarios that WRSE is investigating, in order to bring consistency. This is an acceptable approach, because the RSS will be used in two phases: an initial phase in which DO assessment is the focus, and a second phase in which the RSS will test the responses of portfolios of WRSE-wide options to different possible future states, including possible climate futures. This second phase of modelling will provide valuable information and requires use of the WRSE RSS rather than company-specific models.

1.10 Figure 1 is a flow chart showing an RSS-centric view of WRSE modelling that is being undertaken.

Figure 1: A view of the WRSE modelling process, centred around the regional system simulator



2 Methods and approach

UKCP18 Data

2.1 This section gives a brief overview of the UKCP18 products relevant to determining the impact of climate change on DO.

2.2 UKCP09 data was available for different emissions scenarios. These scenarios were classified based on the greenhouse gas emissions associated with different socio-economic scenarios and were classified as low, medium and high. These three scenarios were taken from a larger range of Intergovernmental Panel on Climate Change (IPCC) scenarios, for example the medium emissions scenario is otherwise known as SRESA1B. UKCP18 does not adopt the same approach. Instead, the projections are based on a value of radiative forcing (W/m^2) reflecting the increase in radiation that greenhouse gases bring, with the value defining a scenario being the radiative forcing in 2100 and a plausible pathway to this point. The scenarios available in UKCP18 are RCP2.6, RCP4.5, RCP6.0, RCP8.5, with higher values indicating more extreme climate change scenarios, as well as the 'medium' (SRESA1B) scenario consistent with UKCP09 which provides a point of comparison with UKCP09 projections (this scenario uses the same emissions inputs, and so differences in outputs are attributable to differences between models used for UKCP09 and UKCP18). However, not all products are available for all emissions scenarios.

2.3 It is worth noting that some water companies have previously found that it is not a given that increasing emissions lead to bigger DO impacts; some systems are vulnerable to multi-season drought and so the impact of more extreme 'wetter winters and drier summers' is not to continually reduce supply capability. In some cases, further summer drying has less and less effect, while increased winter rainfall can lead to more favourable conditions before summer drawdowns; this is also linked to the level of demand placed on storage within a water resources system.

2.4 **Probabilistic projections** are useful for showing the range of uncertainty present in climate projections, there being many samples available which capture the range of uncertainties associated with climate model outputs.

2.5 There are 3000 samples of climate change factors available for each climate change scenario in the UKCP18 probabilistic data, for every future time slice, which can be defined as a 20-year block or for an individual future year.

2.6 Data from probabilistic projections are available at 25km grid squares, but projections between these grid squares are not temporally or spatially coherent (i.e. there are not probabilistic time series available and, for example, probabilistic projection no.1 for two adjacent grid squares will not give results which are coherent with one another). There are, however, ways of using the probabilistic data and adding spatial coherence, for example assuming observed or modelled correlations between regions, but these methods have not been tested as part of the EA/HR Wallingford project (which informed EA guidance) or the WRSE/Atkins regional data tools projects. There are also spatially averaged projections available which

are coherent over larger areas, for instance river basins and countries. The 'England and Wales' region is the smallest scale at which probabilistic projections are available for the whole WRSE region. The England and Wales region is clearly significantly larger than the WRSE region and contains areas where the impacts of climate change could be significantly different to the South East.

2.7 Probabilistic data is available at a monthly timestep from 1960-2100 (UKCP09 data was only available for 30-year time slices).

2.8 Probabilistic projections are available for RCP2.6, RCP4.5, RCP6.0, RCP8.5, and also SRESA1B (the UKCP09 medium emissions scenario), and so there are projections available at a wide range of emissions scenarios. As projections are available for SRESA1B, a direct comparison between UKCP09 and UKCP18 is possible, but no other UKCP18 products can be compared directly with UKCP09.

2.9 The UKCP18 **global projections** are time series from 1900-2100. These provide worldwide climate projections. These projections are spatially and temporally coherent, which enables a coherent consideration of climate change impact over the WRSE region, and more widely.

2.10 There are 28 time series available. 13 of these use the CMIP5 ensemble, while 15 use the latest Met Office Hadley model. The Hadley model produces notably hotter climate projections than the CMIP5 ensemble, although most Hadley model members are within the range of probabilistic data, and so the Met Office have deemed them to be plausible.

2.11 Global projections are available at a 60km^2 resolution.

2.12 Currently global projections are only available for RCP8.5 (the highest emissions scenario). There is an ongoing project, being delivered by the Met Office, to deliver global projections for the RCP2.6 scenario which should deliver results during 2020, but is likely to be delivered too late to be incorporated into the first iteration of the WRSE regional plan.

2.13 **Regional projections** take the UKCP18 global projections as boundary conditions and downscale using a regional climate model. The results from these projections are of a higher resolution than the global projections, and are spatially and temporally coherent.

2.14 The regional projections are available for 12 of the 15 global projections from the Met Office Hadley model. These regional projections are available at a resolution of 12km^2 but only for the RCP8.5 (the highest emissions scenario). As stated earlier, however, more severe emissions scenarios do not necessarily imply more severe DO impacts in all cases.

2.15 The regional projections have been thoroughly reviewed (Atkins (2020a); Regional Water Resources Planning: Climate Data Tools), and a derived product has been developed, specifically bias corrected regional climate model time series and change factors.

2.16 There are two other products available from UKCP18: the **high-resolution projections** downscale results from the regional projections using a convective permitting model (meaning that summer storms are well represented) to give sub-daily projections available at up to 2.2km^2 resolution (only available through the

user interface at 5km^2 resolution); the **derived projections** take results from the global projections and derive results for RCP2.6 and also '2 degrees of warming' and '4 degrees of warming' scenarios.

2.17 Atkins (2020a) carried out a full SWOT (strengths, weaknesses, opportunities, threats) analysis of UKCP products and concluded that spatial coherence is an essential feature for regional water resources planning. Therefore, there is a preference for using regional and global projections for WRSE.

2.18 Key points to mention regarding UKCP18 data are: core messages from UKCP18 are very similar to UKCP09, with hotter, drier summers and warmer, wetter winters becoming more likely in a climate change impacted future (as such previous climate change impact assessments using UKCP09 are still valid as a useful guide); not all products are available at all emissions scenarios (spatially coherent projections are currently only available for RCP8.5, the highest emissions scenario); the newer Hadley model shows some significantly different results to the older CMIP5 ensemble for some key hydrological variables, and some results (for some areas/months, but including autumn precipitation in the South East) from the Hadley model sit outside the range of uncertainty suggested by the probabilistic projections. It is not currently known, however, whether these impacts will be coherent across the region, or more localised. It is not currently known whether this newer model is 'more correct' than the older models or not, although some papers have investigated this. The Met Office have published results from all models, and so without specific guidance WRSE will consider all models to be equally valid. It also cannot be known whether the same differences would exist were the model run using a lower emissions scenario, because these newer models have only been used under RCP8.5 (although this picture will become more clear when the global projections are released at RCP2.6).

2.19 WRSE have commissioned Atkins to produce several climate datasets for use in regional planning (Atkins 2020a 2020b). The outputs from this work package include: bias corrected outputs (and non-bias-corrected outputs) from the 12 regional projections, including time series of temperature and precipitation and bias corrected change factors for 2061-80 for UKCP river basins and more than 200 water supply basins across England and Wales; non bias corrected outputs from the 28 global projections (change factors for England & Wales); probabilistic data for the England & Wales area for RCP8.5 and A1B to provide a broader context and compare the different modelling products. The bias corrected RCM data have been rolled out in Water Resources North (WRN), Water Resources East (WRE) and West Country Water Resources Group (WcWRG). Therefore, the RCMs provide coherent datasets for application to any regional transfers between these regions.

2.20 Global model outputs can be downloaded from the UKCP interface for river basins and admin areas, without the need for accessing full datasets.

2.21 Climate modelling is of course ever evolving and new climate models are being built and used to develop new data. For example, a series of high-resolution European and global models are becoming available as part of CMIP6.

2.22 It is relatively quick to generate change factors for spatial extents given climate model outputs, and tools are available which can readily perform this task.

Environment Agency guidance: key points

2.23 This section gives a brief overview of new EA guidance regarding the assessment of climate change DO impacts. The Environment Agency has produced draft guidance on climate change, 1:500-year drought and stochastic datasets; all of these documents shape the approaches that WRSE will take. Water companies have been consulted on these supplementary guidance documents, and the documents will be publicly available from August 2020. It is also important to note that the 1:500-year drought supplementary guidance contains content on assessment of climate change impacts. It is important that the implications of these three pieces of supplementary guidance are considered as a whole, rather than individually.

2.24 EA guidance states that companies should continue to use a perturbation-based approach (supplementary guidance note on 1:500-year drought), whereby 'baseline' records are perturbed by change factors generated from climate projections. This is due to a change in the resilience standard for which companies must plan, whereby baseline DO should be calculated such that modelled emergency restrictions are not enforced more frequently than once every 500 years. The EA do not feel that a '1 in 500-year' severity climate change impacted drought can currently reasonably be determined directly from available UKCP18 data, and so have recommended continuing to adopt a perturbation approach. The potential downside in using a perturbation-based approach is that it does not allow for consideration of changes to the length of drought events that may occur due to climate change. This factor is of particular relevance to companies/regions vulnerable to short, very intense drought.

2.25 A new vulnerability assessment should be carried out by companies; this is slightly different to previous vulnerability assessments; in that it specifically considers investment planned due to climate change impacts. This assessment has been included due to the recognition that a great deal of work has been carried out using UKCP09 data. Where climate change does not drive significant investment, fully reassessing the impact of climate change using UKCP18 data is not proportionate (due to many of the core messages being the same as UKCP09) and so the EA have detailed 3 tiers of analysis which companies can follow.

2.26 **Tier 1:** where there is low vulnerability of a WRZ to climate change and low investment driven by climate change, and where there are no significant differences between UKCP09 and UKCP18 probabilistic projections, companies may reuse WRMP19 results for WRMP24 climate change assessments. When classifying a WRZ as 'tier 1', care should be taken that regional factors are considered. For example, if a zone is not impacted by climate change in isolation, but is likely to be a significant donor zone to other more vulnerable zones, tier 1 analysis would not be suitable.

2.27 **Tier 2:** where there is low/medium vulnerability of a zone to climate change, or some investment driven by climate change, or if there is a significant difference between UKCP09 and UKCP18 probabilistic projections, existing evidence must be enhanced with appropriate UKCP18 datasets. The method of assessment for this enhancement will vary dependent on evidence, investment and vulnerability, and could be anything from comparison of climatology to full system modelling.

2.28 **Tier 3**: if there is high vulnerability of a zone to climate change, a new climate change assessment must be carried out using UKCP18 projections, accounting for the full range of uncertainty within UKCP18. This is because it is recognised that no single product available from UKCP18 can adequately represent both spatial coherence and the range of uncertainty present in the projections as a whole. For tier 3, a number of UKCP18 products should be analysed using rainfall-runoff/groundwater/recharge modelling, and where possible be taken forward to water resources system modelling. It may not, however, be necessary to take a large number of scenarios though the whole modelling chain.

2.29 No changes are suggested regarding the methods used to determine the climate change impact associated with a given set of perturbation factors (i.e. use of rainfall-runoff/ groundwater/ recharge/ water supply models), other than that it must be demonstrated that selected drought events still reflect a 1 in 500-year level of risk once climate change perturbations have been applied (recognising that the impact of climate change can alter the relative severity of drought events in a record). This method and more generally approaches about how to combine the requirement for resilience to '1 in 500-year' drought in combination with planning for climate change brings a significant amount of uncertainty, and it will be interesting to compare a 'perturbed 1:500' drought against the most severe droughts in the transient UKCP18 time series. It is envisaged that initial results from climate change impact modelling will be able to inform methods for combining climate change and stochastics.

2.30 Reflecting on climate data in conjunction with stochastic data, bearing in mind the data that the stochastic data was trained on and the methods used in the generation of this data, can bring some interesting thoughts. For example, climate change signals for the South East of England present in the regional climate model outputs, particularly much reduced precipitation during the autumn period, may imply that certain 'types' of events are becoming more likely, but this won't necessarily be reflected in outcomes using a perturbation factor approach.

2.31 There is currently no guidance on how evidence from different sources and different emissions scenarios should be combined to determine a central impact of climate change or uncertainty in climate change impacts (i.e. there is no statement on whether more/less weight should be placed on different emissions scenarios). It is important to note that use of the Medium emissions scenario from UKCP09 was never explicitly mentioned in guidance, but use of the medium emissions scenario became an accepted norm for determining the central impact of climate change. It may well be that a norm is arrived upon for UKCP18 projections.

2.32 No changes are suggested regarding guidance on scaling of climate change impacts. Linear scaling from the baseline period to a period in the far future is recommended, but non-linear scaling may be used if this can be justified.

2.33 Supply-side options should be investigated to determine the impact of climate change on their deployable output benefit, using methods consistent with those used to assess the baseline climate change assessments for zones relevant.

2.34 For all tiers of analysis, regular communication and consultation with the EA is recommended. WRSE will consult regularly with the EA on climate change methodology.

Tiers of analysis

2.35 Companies will determine the tier of analysis to be applied for each of their WRZs. WRSE will not mandate the use of 'tier 3' assessment in all zones. As of April 2021, however, all companies have followed a 'Tier 3' approach, using consistent methods, models, and datasets. If companies use their own simulation models in this assessment, they should justify this.

2.36 WRSE companies may undertake additional analysis as they wish and may incorporate this into their supply forecasts.

Calculating DO impact for a climate change scenario

2.37 As with the deployable output methodology (**Method Statement 1320 WRSE Deployable Output**), the impact of climate change on DO will be calculated on a WRZ/sub-region level with coherent datasets and suitable boundary conditions used across the WRSE region. The implication here is that there will not be a 'regional DO' value calculated, nor a 'regional DO impact of climate change'.

2.38 Any scenario for which DO impact will be calculated will follow largely the same assessment process for each WRZ/sub-region. The starting point for this assessment is a single set of monthly perturbation factors (for rainfall, PET and temperature) to be applied to a baseline record.

2.39 Replicates which contain significant droughts (based on analysis of rainfall alongside preliminary results from hydrological and hydrogeological models) will be selected, and so the selection will not be representative of the whole stochastic sequence and so it is important to highlight that the DO impact of climate change method will be focussed on calculating the 'water resources yield' impact of climate change on a range of drought events (an 'English and Welsh'-type method). This differs from the 'Scottish DO method' used to calculate the baseline DO, which is based on analysis of the long time series available in the whole stochastic sequence. It is also important to stress that selected replicates will be treated as individual replicates, rather than being considered as a long time series. For spatially coherent climate change runs, a regionally coherent set of replicates will be chosen. These replicates will be chosen such that a range of drought return periods are contained within them, with checks done to ensure that droughts with baseline magnitudes of between 1 in 100-year and 1 in 500-year are chosen for all WRZs; some analysis has already been done to conduct this selection the basis of rainfall, but this will be supplemented with results from baseline DO runs.

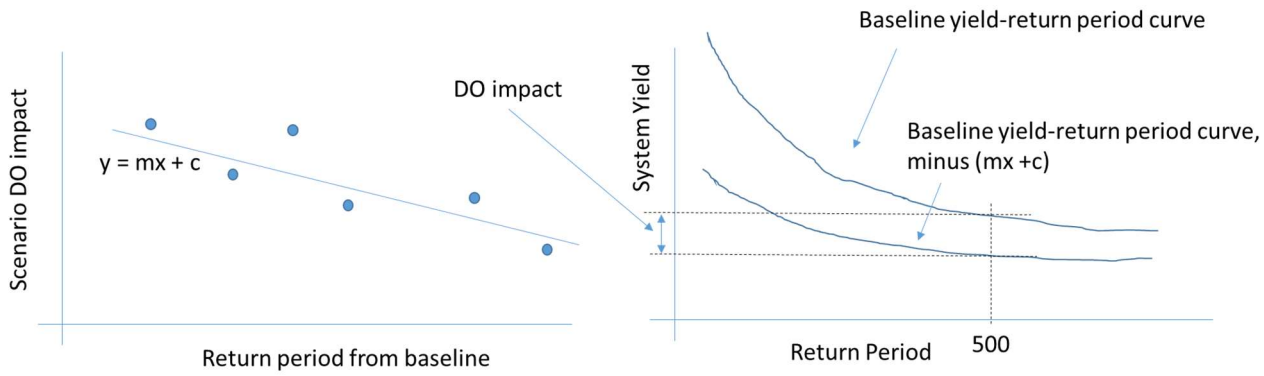
2.40 Companies will take change factors for rainfall & PET, for the 2070s (2061-2080 – the RCM outputs only extend to 2080) and apply these to input time series for rainfall-runoff, groundwater and recharge models. These results will be used as inputs to the regional simulator (the regional simulator requires flows & groundwater yields as inputs).

2.41 WRSE will then run the RSS. As with the DO methodology, when the DO impact of climate change is being found for one WRZ/sub-region, demand in all other WRZs/sub-regions will be held constant.

2.42 For each replicate selected, the baseline water resources yield will already be known. Yield here is a surrogate for DO and is the highest demand which can be placed on the system before the model suggests that emergency drought restrictions would be needed. This is similar to DO, but only accounts for the 'Level 4' (emergency drought restriction) trigger. It is assumed that this trigger will be the main constraint on DO for all zones. If this is not the case for a given zone/sub-region, this method will need to be adapted.

2.43 The water resources yield will then be found for climate change impacted input series for each selected replicate. This will allow for the calculation of the water resources yield impact of climate change for each selected replicate. When the water resources yield has been found for each selected replicate for a given scenario, the DO impact of the scenario will be calculated. Figure 2 shows this process graphically.

Figure 2: Calculation of DO impact of a climate change scenario



2.44 Baseline return period will be plotted against the water resources yield impact found for each replicate. If it is reasonable to do so (based on an R^2 threshold), a line will be fitted to this (in the example, a straight line is used; in practice a regression between the logarithm of the return period and DO impact has been used). The DO impact will be found as the change in system yield that this line of best fit implies at a return period of each of 100, 200, and 500 years. A check will also be undertaken to ensure that the '1 in 500-year' event with climate change factors is still reasonably representative of a '1 in 500-year' event accounting for climate change. If the climate change impacted yield of an event with a baseline return period of less than 500 years is lower than the yield value calculated using the method above, the DO impact for the scenario will be amended and will be calculated as the baseline '1 in 500-year' DO, minus the lowest yield of any drought with a baseline return period of less than 500 years. It is recognised that significant reordering of droughts may be a consequence of perturbing the stochastic record; however, we don't necessarily know how best to handle this as yet and will further refine methods when we begin to get results.

2.45 Where applicable, there may be other steps involved before/after these core steps. For example, where it is important, the impact of saline intrusion under climate change will be included, using groundwater modelling and climate projections consistent with warming inputs associated with the regional climate model projections used in the rest of this method.

2.46 If the impact of climate change on the DO of an option is being found, the 'Return period from baseline' should be the return period of each replicate with the option in place.

2.47 The use of a perturbation factor based approach, with consistent data being used in both hydrological and hydrogeological models, means that the overall impact of climate change on WRZ DO will be assessed, rather than the impact of surface water and groundwater source DOs separately.

2.48 There are limitations associated with the approach WRSE is taking. One such limitation is that the return period of drought events after climate change cannot be assessed (i.e. is the impact of climate change to make a previously extreme event relatively less severe, or vice versa?).

Use of different UKCP18 products

2.49 Figure 3 summarises WRSE's proposed use of different UKCP18 products.

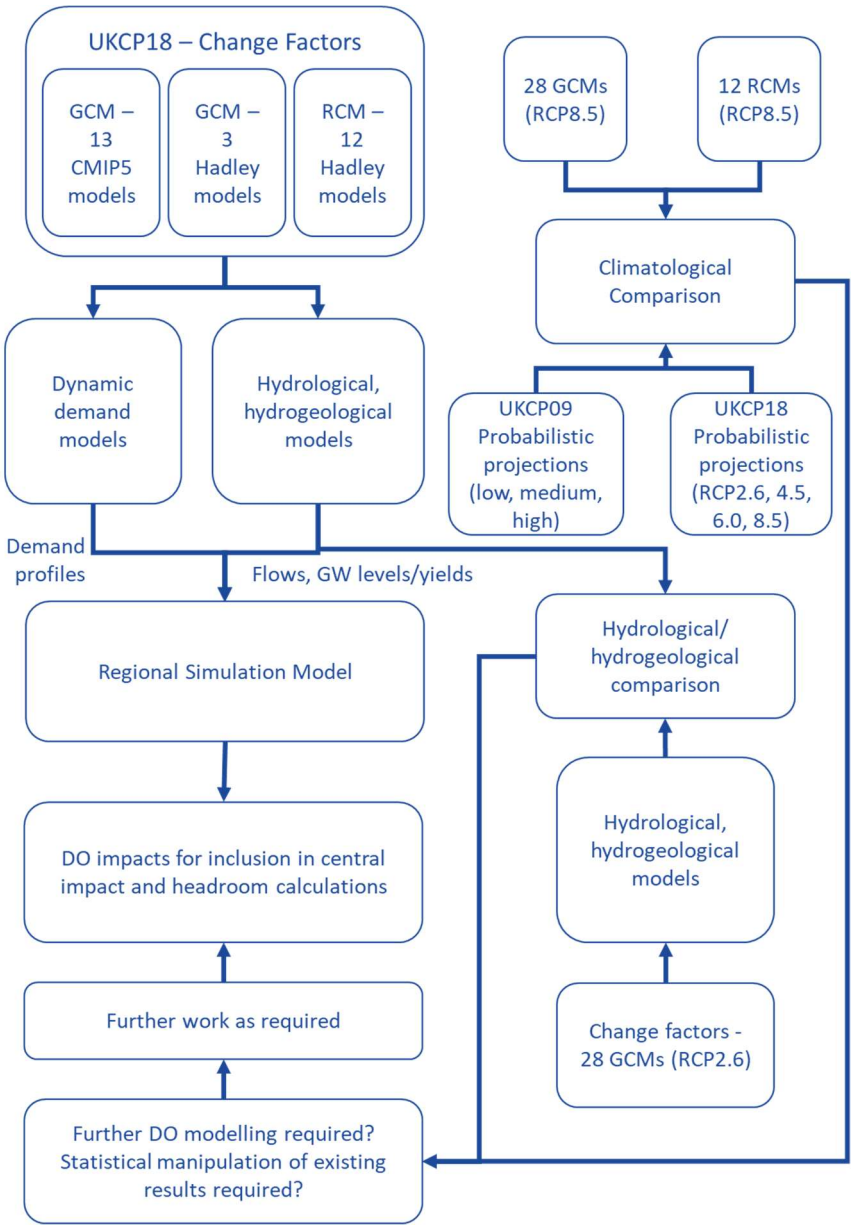
2.50 Conducting a full DO analysis for a single climate change scenario involves a significant amount of work and a large computational burden. As such, WRSE is looking to limit the number of climate change scenarios taken through the modelling chain required in determining the DO impact of climate change while still considering the full range of uncertainty present in UKCP18 data.

2.51 WRSE will carry out water resources system modelling to determine a DO impact for 28 climate change scenarios. These will be the 12 regional projections, the 3 global projections from the Hadley Model which were not run through the regional climate model, and the 13 global projections from the CMIP5 ensemble.

2.52 It will be assumed that the 28 projections are all equally likely, when considering the central impact of climate change on DO, and when determining the uncertainty of climate change impacts.

2.53 Work carried out by WRSE companies has so far suggested that the uncertainty in the range of projections contained within a single UKCP product may be greater than the difference between products (specifically, HR Wallingford carried out a rapid assessment of UKCP18 implications for Thames Water and returned this finding). It can also be seen that the probabilistic data for RCP8.5 covers a wide range of uncertainty, including the range of uncertainty present in other products for most variables; the RCMs and GCMs together appear to cover a similar range of projections as the probabilistic data in many respects, although some key hydrological outputs in the South East from the RCMs appear to be outside the range of the probabilistic projections. It may be that DO impacts from these 28 climate change scenarios are sufficient to capture the range of uncertainty present in the UKCP18 products (perhaps subject to some statistical manipulation based on other results), given that this will involve use of RCP8.5 in the far future, and given that initial analysis of this dataset shows a range of results.

Figure 3: WRSE's proposed use of different UKCP18 products



2.54 WRSE will gather existing evidence from assessments that have been carried out investigating the relative impacts of different UKCP09 and UKCP18 datasets to inform what further work is required.

2.55 WRSE will complement this with a comparative assessment of the climatology of UKCP09 and UKCP18 probabilistic projections, as well as a comparative assessment of the climatology of the probabilistic, global and regional projections produced for UKCP18.

2.56 When the global projections under the RCP2.6 scenario are available, WRSE will conduct hydrological and hydrogeological modelling for 5-10 zones across the region, with the most climate vulnerable zones chosen, while also ensuring good spatial coverage across the region. This modelling will be compared with results from RCP8.5. One of the main aims of this comparison will be to inform a view as to whether the effects seen in regional climate models (e.g. lower autumn precipitation in the South East) are seen in other emissions scenarios, or if that is something which is only seen under the highest emissions scenario.

2.57 WRSE is currently not proposing to do DO modelling using UKCP18 probabilistic projections, although DO scenarios using specific 'marker' scenarios (e.g. median) may be undertaken to ensure coherence with other results. If the results from any of the above climatological/hydrological studies imply that use of the 28 RCP8.5 spatially coherent projections does not cover the range of uncertainty associated with UKCP18 products, further DO runs may be undertaken.

2.58 It should be noted that the use of different UKCP18 datasets is subject to change, dependent on interaction with the Environment Agency. This is also dependent on outcomes from conversations between the inter-regional coordination group and the Environment Agency.

Scaling of climate change impacts

2.59 There will not be a consistent approach to scaling the impact of climate change across WRSE WRZs. This reflects the fact that the impacts of climate change will not necessarily occur at the same rate across the region.

2.60 The standard linear scaling approach suggested by the EA will be used unless a company suggests that this is not suitable for a given zone.

2.61 Companies may, however, choose their own scaling approaches, as appropriate for each zone.

2.62 The baseline used will be 1981-2000 in order that all products used can use the same baseline. This is also fairly representative of the baseline used for generation of stochastic sequences (1950-1997).

3 Summary

3.1 This method statement has outlined how climate change impacts will be calculated as part of the WRSE regional planning process.

3.2 Data available from UKCP18 climate projections has been described, including the different products available and their potential applicability in WRSE's regional planning.

3.3 Key points from draft guidance written by the Environment Agency have been identified and their implications explored.

3.4 The approach to determining the tiers of analysis required for different WRZs have been explained.

3.5 The method for calculating the DO impact of a single climate change scenario has been detailed.

3.6 Methods for incorporating different UKCP18 products have been explored and WRSE's proposed application of different UKCP18 products has been outlined. It should be noted that this is subject to change and is dependent on outcomes from interactions between the inter-regional coordination group and the Environment Agency.

3.7 Methods for scaling climate change impacts on DO have been detailed.

4 Next Steps

4.1 An initial version of this document was consulted upon between 1st August 2020 to 30th October 2020 and comments received during this time have been incorporated in this version.

4.2 We have also reviewed this document against the final WRPG and supplementary guidance notes issued by the regulators.

4.3 If any other further relevant guidance notes or policies are issued then we will review this Method Statement to see if it needs to be updated.

4.4 When we have finalised our Method Statement, we will ensure that we explain any changes we have made and publish an updated Method Statement on our website.

5 References

Atkins (2020a); Regional Water Resources Planning: Climate Data Tools

Atkins (2020b); Regional Climate Data Sets: WRSE Baseline Stochastic Roll Out (available on request)