DRAFT WATER RESOURCES MANAGEMENT PLAN 2024

APPENDIX 6A – HEADROOM ANALYSIS

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Portsmouth Water: Headroom Analysis WRMP24

Overview

The purpose of this document is to outline the technical details and assumptions that underpin the Portsmouth Water (PRT) WRMP24 headroom analysis, starting from the outturn base year 2019/20, leading up to the planning base year 2024/25 and extending up to 2099/00. The outputs are subsequently used as an input into the WRSE investment modelling.

The analysis produces a profile for each of the three WRSE scopes as outlined in Table 1. There is an additional profile 'Full Target Headroom Alternative' (FTHR_ALT) which is included as an optional replacement for the FTHR profile submission.

The central demand forecast assumes the BL_H_Plan exceeds the Max (by 2100) scenario up to 2035. This means that in terms of the risk profile, the starting point is at the most extreme of the distribution. This has the impact of driving negative headroom. The FTHR partially addresses this by not including any upside risk until 2035, but even after this point, the distribution is still negatively skewed causing a negative step change. The FTHR ALT profile smooths the negative FTHR profile driven by the growth forecast. It does so by removing the upside risk which produces a more typical headroom profile; however, this also has the unavoidable impact of understating the upside risk.

Table 1 Scenario Scope

Component	Component description	Full target Headroom profile[1]	Environmental destination and Growth target headroom profile	Environmental destination, Growth, and climate changes target headroom profile
S1	Vulnerable surface water licences	✗[2]	✗	✗
S2	Vulnerable groundwater licences	✗[1]	✗	✗
S3	Time limited licences	✗[1]	✗	✗
S4	Bulk imports	✓	✓	✓
S5	Gradual pollution of sources causing a reduction in abstraction	✓[3]	✓[2]	✓[2]
S6	Accuracy of supply-side data / overall source yield	✓	✓	✓

[1] Including FTHR_ALT profile which addresses the negative headroom issue
[2] This should be included but Water Resource Management Plan Guidance prevents its inclusion
[3] This should be included but only if you haven't written down the deployable output of sources in the future due to deteriorating raw water trends

Component	Component description	Full target Headroom profile[1]	Environmental destination and Growth target headroom profile	Environmental destination, Growth, and climate changes target headroom profile
S7	Not used	×	×	×
S8	Uncertainty of impact of climate change on source yields	✓	✓	×
S9	Uncertain output from new resource developments	✓[4]	✓[3]	✓[3]
D1	Accuracy of sub-component data	✓	✓	✓
D2	Demand forecast variation	✓	×[5]	×[4]
D3	Uncertainty of climate change on demand	✓	✓	×
D4	Uncertain outcome from demand management measures	✓[3]	✓[3]	✓[3]

Document log

Document History

Version Name	Edited by	Date Edited	Description of Edits
PRT_BaselineDemandDocumentation_v1.01	MS	17/02/2022	Document creation
PRT_BaselineDemandDocumentation_v1.02	MS	30/01/2022	Covid component D2.4 added. New section added describing process for separating climate change impacts.

Review History

Version Name	Internal/External	Reviewed by	Date Reviewed	Comments
PRT_BaselineDemandDocumentation_v1.02	Internal	SC	31/3/2022	No changes proposed.

[4] This should be based on the schemes selected in the cost-efficient plan
[5] D2 – only include non-growth related components for the headroom forecast

Contents

Technical Documentation

1. Headroom model

1.1. There are several core files that form the headroom analysis, described as follows.

1.1.1. ***HeadroomWRPM24_v{*}.xlsx:*** contains the relevant input data, with each tab containing reflecting the individual headroom components and subcomponents, as well as the defined glidepath.

1.1.2. ***prt_headroom_model.py***: A python script which runs the Monte-Carlo headroom analysis (from the command line), using the relevant distribution inputs from HeadroomWRPM24.xlsx, produces the

1.1.3. ***prt-headroom-model.yml:*** a YAML file which bridges the HeadroomWRPM24.xlsx and prt_headroom_model.py files. Namely, it gives prt_headroom_model.py instruction where to locate the inputs from the Excel file, as well as defining the WRSE scenario scopes (FTHR, EDG, EDGC).

1.1.4. ***hr-env.yml:*** An Anaconda environment file for building the relevant Python environment required to run *prt_headroom_model.py*.

1.1.5. **ClimateChangeContribution_v{*}.xlsx:** Excel file for calculating/isolating the climate change impacts from all other components using the headroom outputs from '*prt-uncertainty-output.xlsx*' (see below).

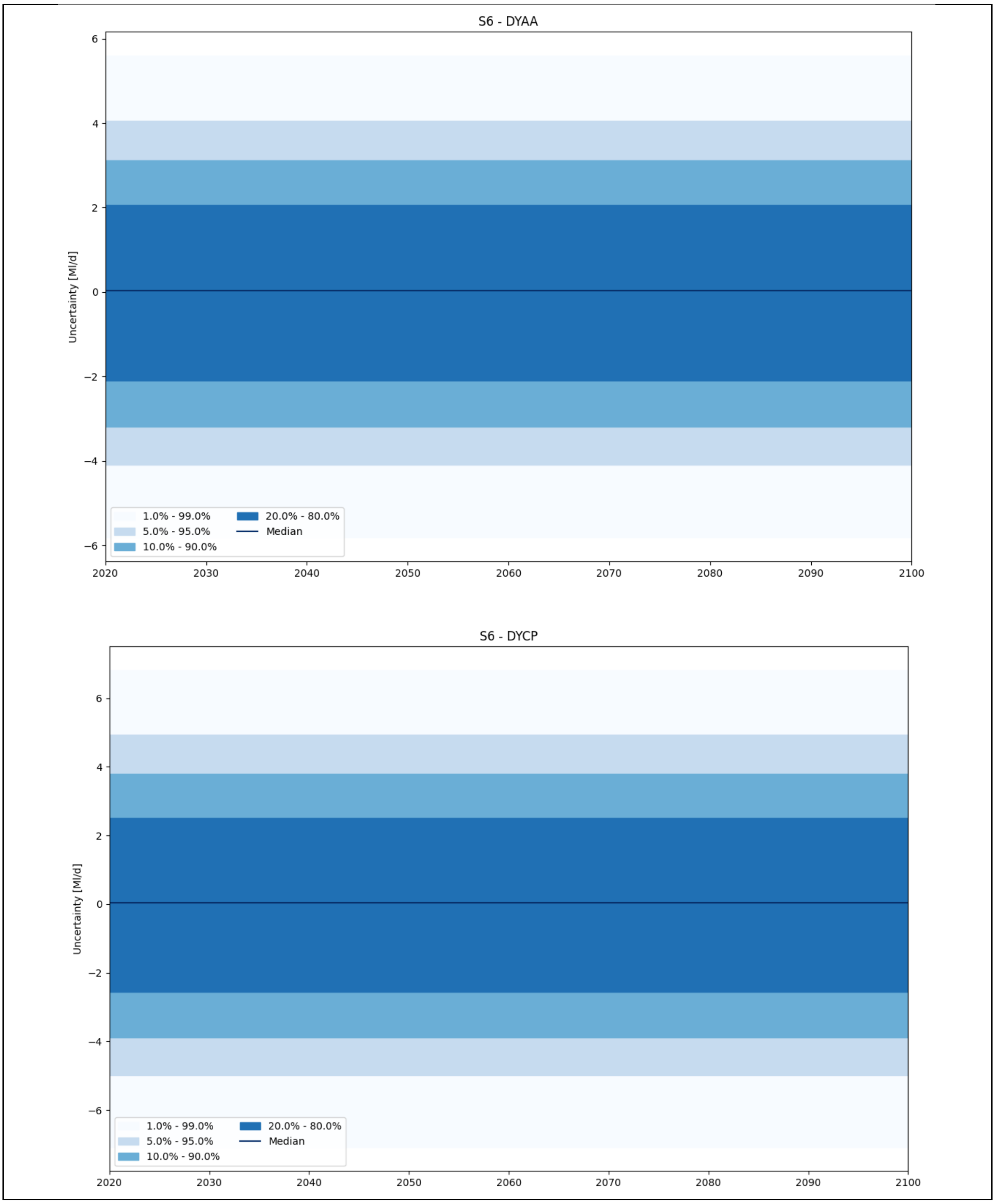
1.2. Once the model is run, the outputs are saved into the './results/' folder of the working directory. Outputs include:

*1.2.1.**prt-uncertainty-output.xlsx**: An Excel file containing the resulting distribution outputs for the percentiles as defined in prt-headroom-model.yml. Each tab contains a scenario output. The 'Glidepaths' tab shows the final output – the scenario outputs with the defined glidepath applied forming the input to WRSE.*

*1.2.2.**Plots***: A series of '.png' files showing the input and output distributions

2. Components

Component:	S6 - Accuracy of supply side data
Subcomponent:	-
Scenarios:	FTHR / EDG / EDGC
Last Revision:	17/02/2022
Input data:	Appendix 'F' Headroom Assessment Aug 2018.pdf (WRMP19) Supply_forecast_Portsmouth_PRT_A.xlsx Supply_forecast_Portsmouth_PRT_P.xlsx
Distribution:	Normal
Static:	True
Notes: • Same rule used for WRMP19, applied to new WRMP25 DOs. • Note that the yield assessments are consistent across both WRMPs.	
Output:	



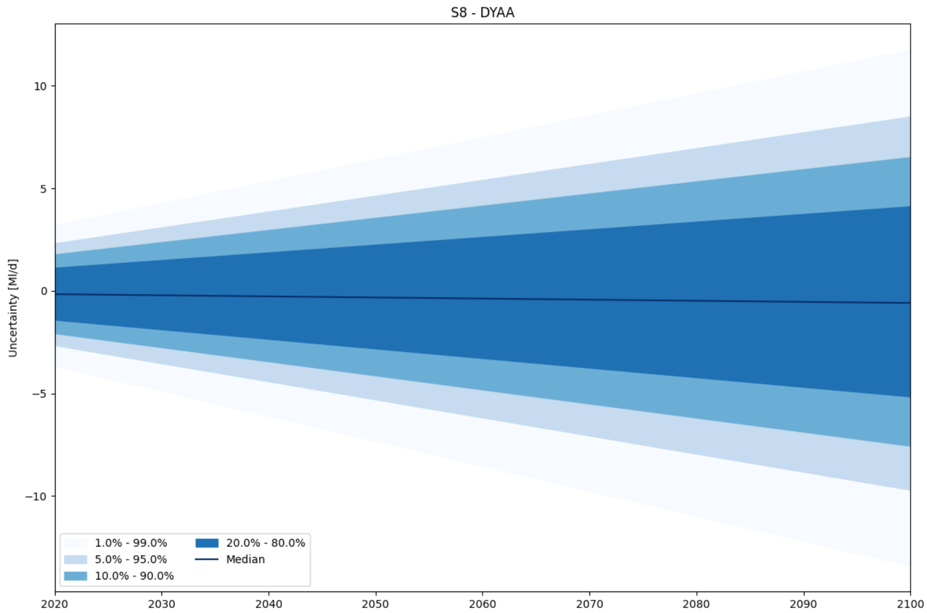
Component:	S8 - Uncertainty of impact of climate change on source yields
Subcomponent:	-
Scenarios:	FTHR / EDG / ~~EDGC~~
Last Revision:	17/02/2022
Input data:	Supply_forecast_Portsmouth_PRT_A.xlsx Supply_forecast_Portsmouth_PRT_P.xlsx ./background/climate_change_analysis/distributionAnalysis.py
Distribution:	Log-gamma (A), Logistic (P)

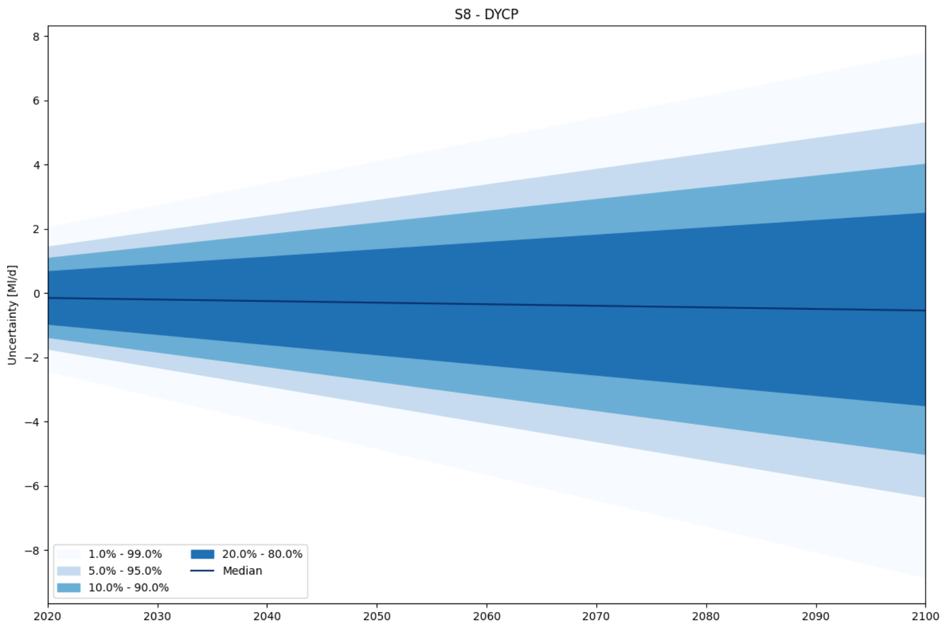
Static:	False

Notes:

- Over 100 distributions are fitted to the 20 WRSE climate 1:500 DO runs with the EA scaling factors applied. The best distribution is selected using the Kolmogorov–Smirnov test.
- The distributions are fitted separately for the AA and CP scenarios.

Output:



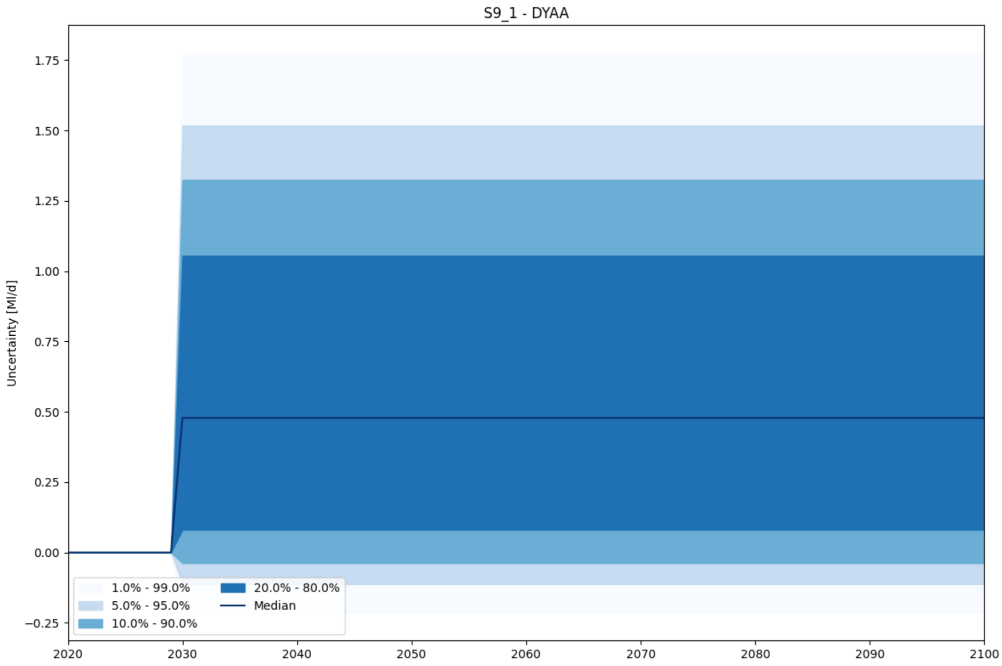


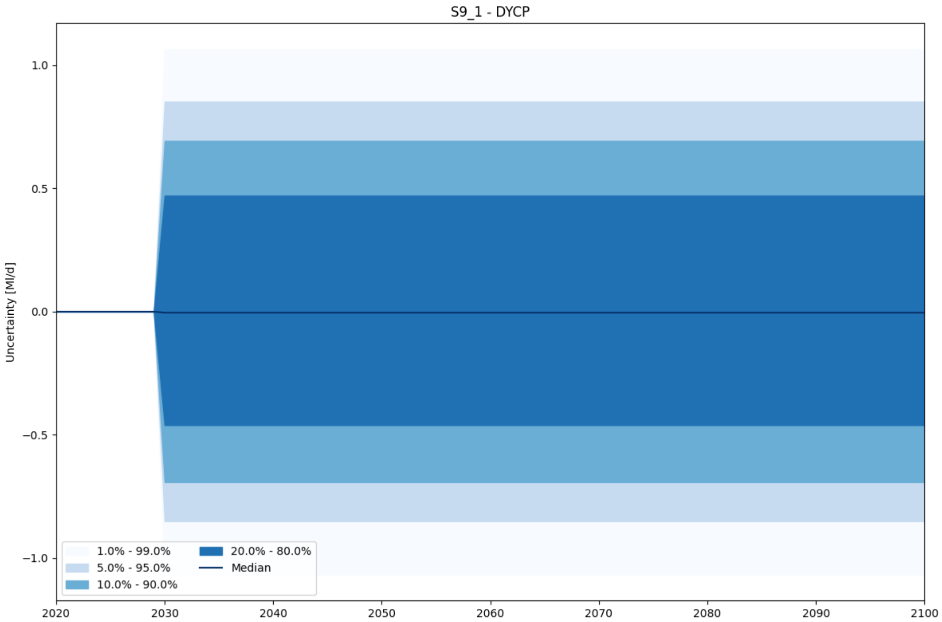
Component:	S9 Uncertain output from new resource developments
Subcomponent:	S9.1 Havant Thicket
Scenarios:	FTHR / EDG / EDGC
Last Revision:	17/02/2022
Input data:	Appendix 'F' Headroom Assessment Aug 2018.pdf (WRMP19) Portsmouth-Water-WRMP-Annual-Review-June-2021.pdf Target_approach_for_S9_D4.xlsx
Distribution:	Triangular
Static:	True

Notes:

- In the revised WRMP19, the DO for Havant Thicket was revised from 23Ml/d to 21Ml/d for the AA and 50Ml/d to 25Ml/d for the CP scenario.
- The operational assumptions that underpinned the WRMP19 headroom ranges are assumed too no longer be valid.
- As a result, the default WRSE option ranges for Reservoir development are assumed, i.e., +/- 5% with a triangular distribution.
- The scheme is to be implemented in 2029/30, hence there is no allowance prior to this year.

Output:



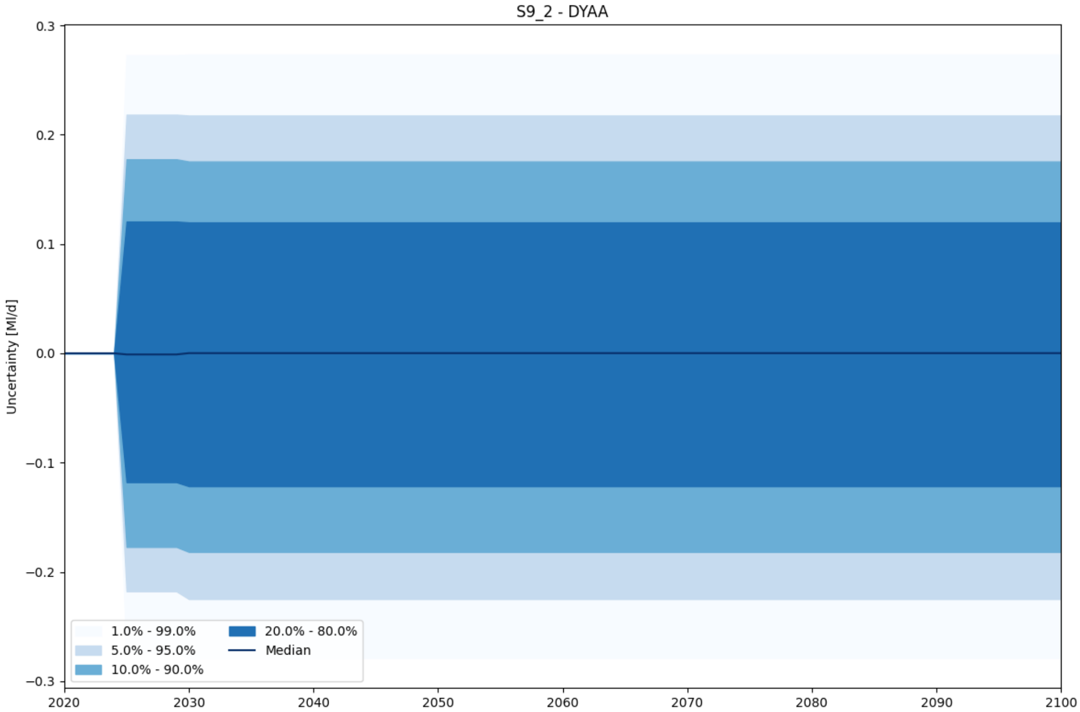


Component:	S9 Uncertain output from new resource developments
Subcomponent:	S9.2 GW Schemes
Scenarios:	FTHR / EDG / EDGC
Last Revision:	17/02/2022
Input data:	Portsmouth-Water-WRMP-Annual-Review-June-2021.pdf Target_approach_for_S9_D4.xlsx
Distribution:	Triangular
Static:	True

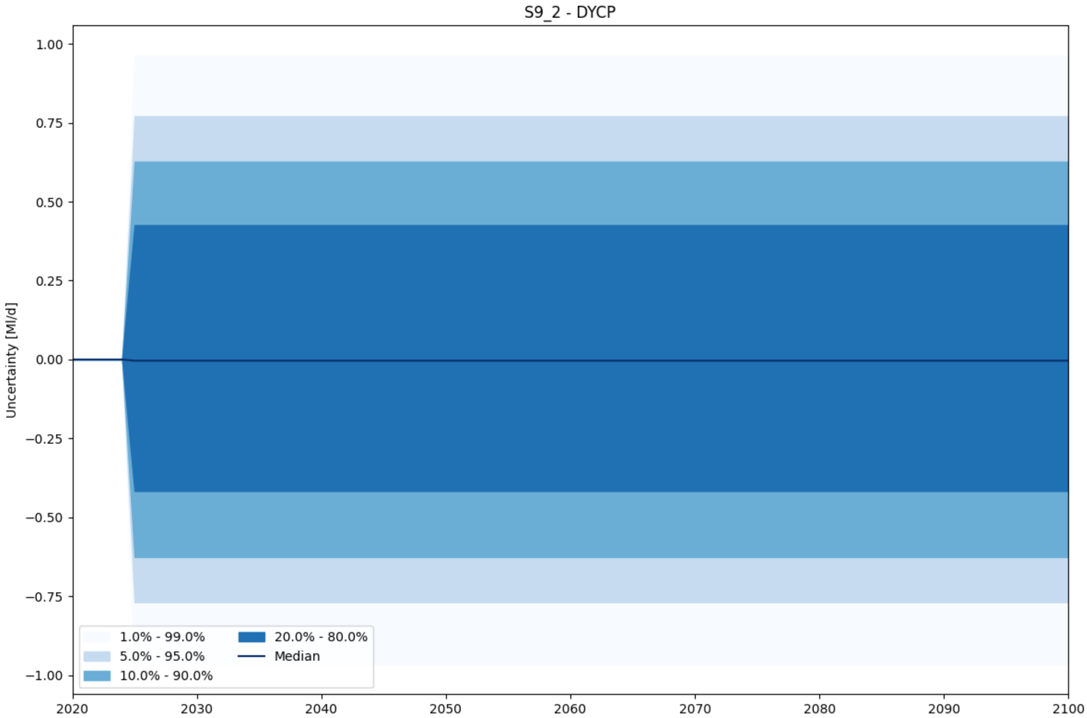
Notes:

- This component reflects the variation for the ‘Three GW schemes’ in addition to the ‘Maximising DO at Source J’ scheme.
- The AA and CP DOs (revised) are sourced from the from the PRT Annual Review 2021.
- The 5% value is based on the standard WRSE ranges for Groundwater sources.
- All schemes are assumed to be delivered by 2024/25.

Output:



S9_2 - DYAA
Uncertainty [Ml/d]
0.3
0.2
0.1
0.0
−0.1
−0.2
−0.3
2020
2030
2040
2050
2060
2070
2080
2090
2100
1.0% - 99.0%
5.0% - 95.0%
10.0% - 90.0%
20.0% - 80.0%
Median



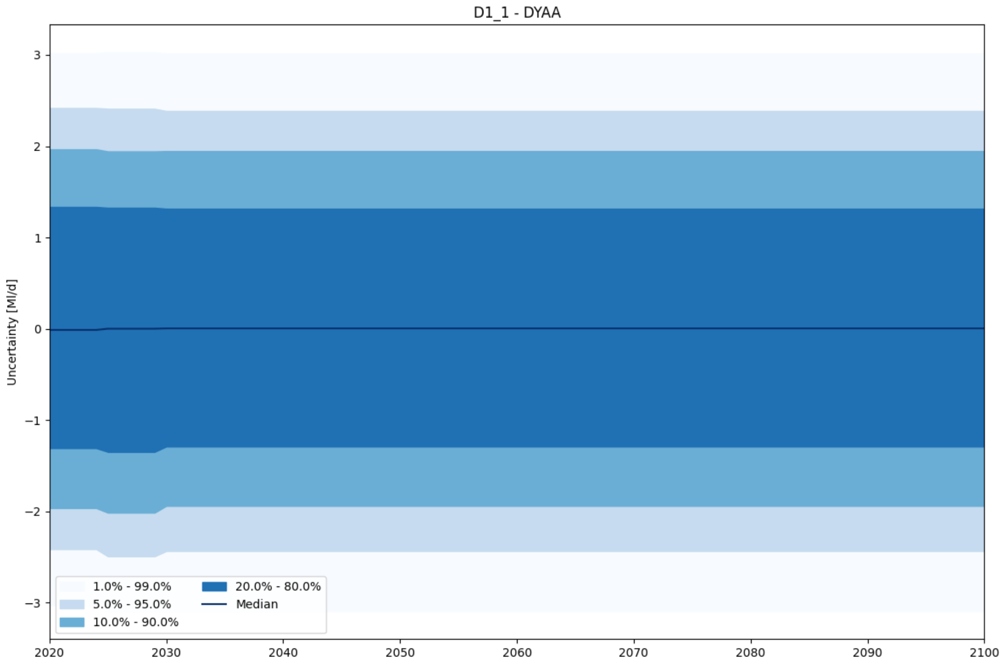
S9_2 - DYCP
Uncertainty [Ml/d]
1.00
0.75
0.50
0.25
0.00
−0.25
−0.50
−0.75
−1.00
2020
2030
2040
2050
2060
2070
2080
2090
2100
1.0% - 99.0%
5.0% - 95.0%
10.0% - 90.0%
20.0% - 80.0%
Median

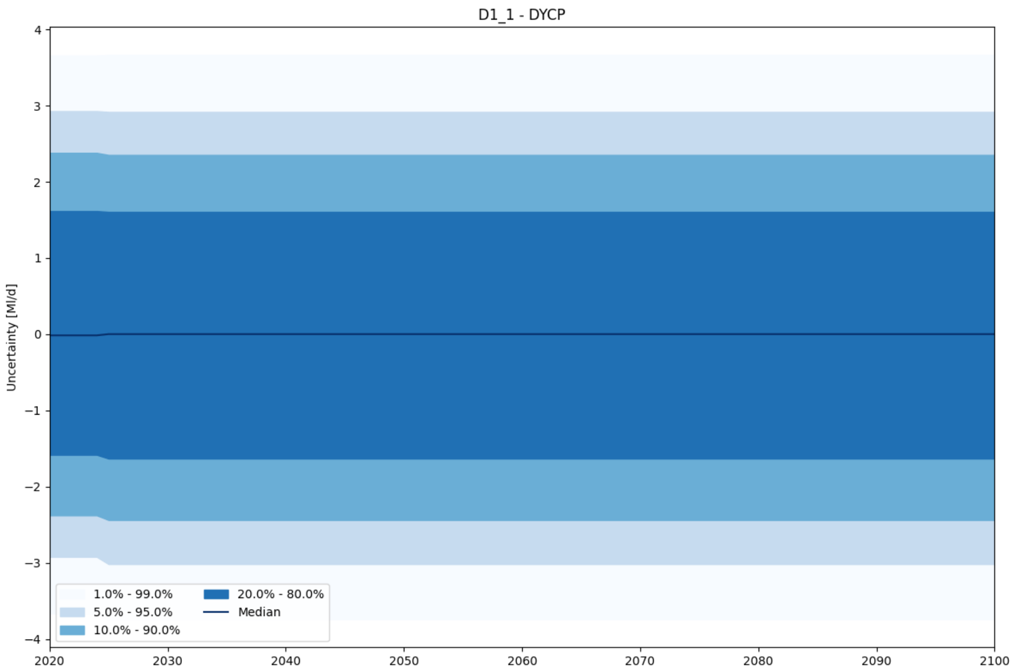
Component:	D1 Accuracy of sub-component data
Subcomponent:	D1 MLE
Scenarios:	FTHR / EDG / EDGC
Last Revision:	17/02/2022
Input data:	PRT MLE
Distribution:	Triangular
Static:	True

Notes:

- 2% variation assumed for accuracy of DI meters based on the annual MLE assumption.
- 1:10 DI assumed

Output:



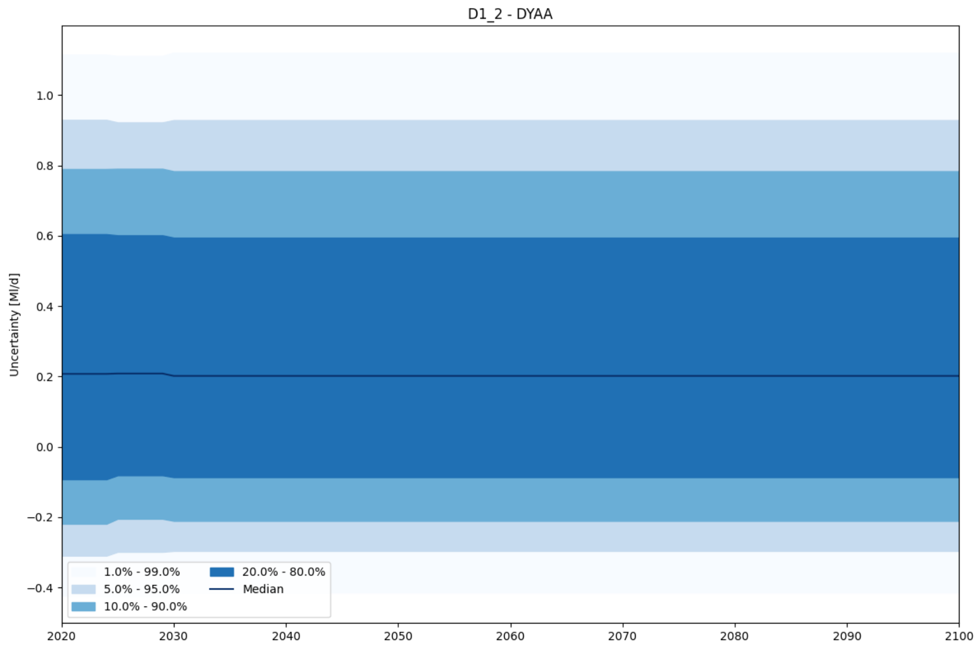


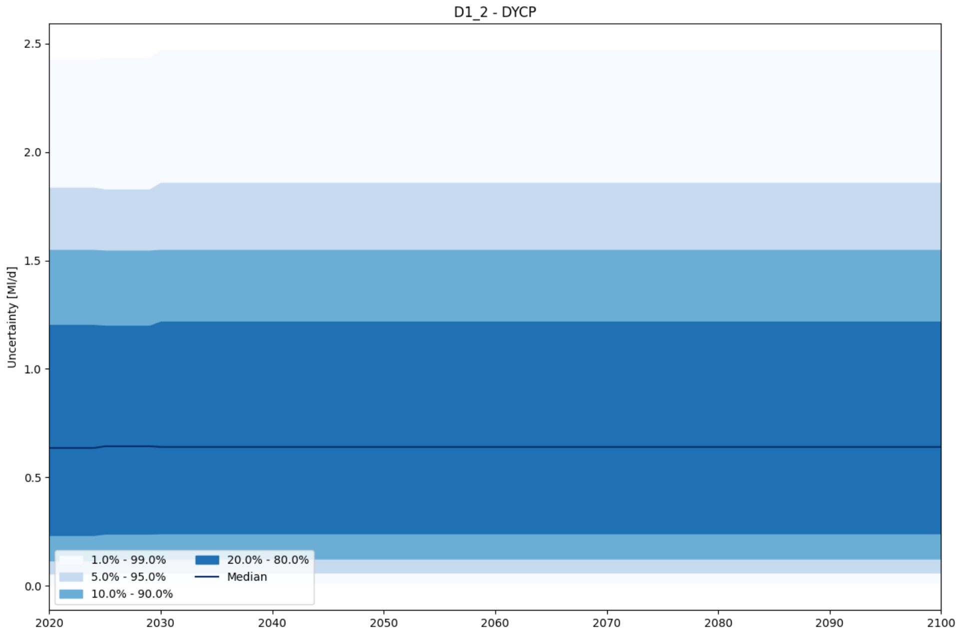
Component:	D1 Accuracy of sub-component data
Subcomponent:	D1.2 Uplift Uncertainty
Scenarios:	FTHR / EDG / EDGC
Last Revision:	17/02/2022
Input data:	DemandModel_WRMP24_v217.xlsx
Distribution:	Triangular (AA) Half Normal (CP)
Static:	True

Notes:

- Uncertainty associated with uplifting the outturn DI to the 1:10 Distribution Input.
- The demand model assumed an uplift factor derived from the WRSE/WRc stochastic DI series. Two versions of the stochastic data were created, Series 1 and Series 2. The central case assumes Series 3. In addition to the stochastic series, there is also a DI series based on the historic record which has been de-trended to the base year, produced internally at PRT.
- The upper and lower bands of the model assumed the difference between the minimum of maximum values from either the WRc/WRSE stochastic DI (Series 2) or the rebased historic outturn data around the central case (stochastic Series 3).
- As there is no upside risk associated with the CP scenario, a Half Normal distribution is used as not to put too much weight on the most extreme value. The maximum value is set as q95 of normal distribution.

Output:





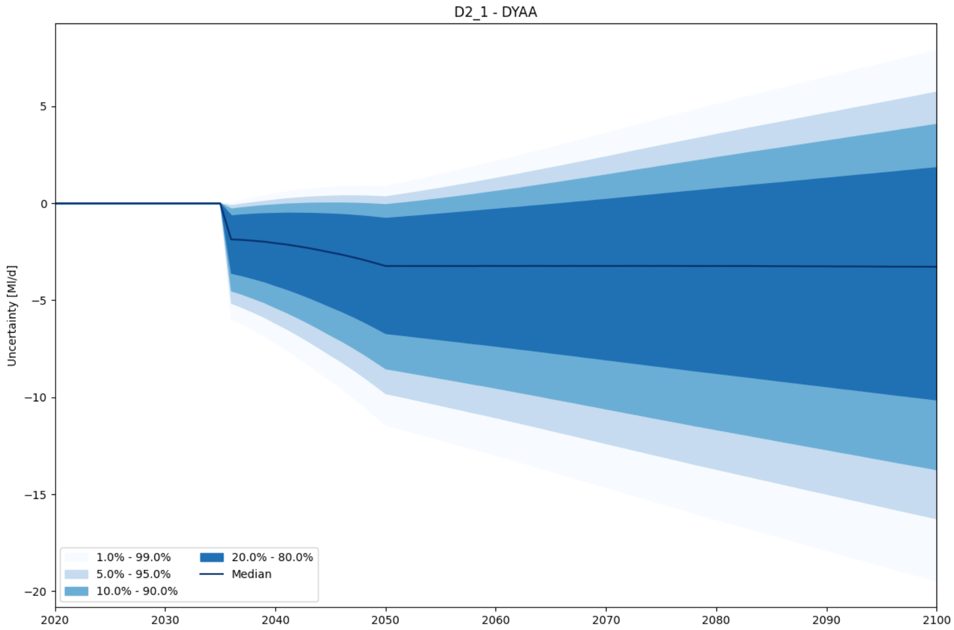
Component:	D2 - Demand forecast variation
Subcomponent:	D2.1 Growth Forecast D2.1 ALT Growth Forecast
Scenarios:	FTHR / ~~EDG~~ / ~~EDGC~~
Last Revision:	17/02/2022
Input data:	DemandModel_WRMP24_v217.xlsx
Distribution:	Triangular / Half Normal (ALT)
Static:	False

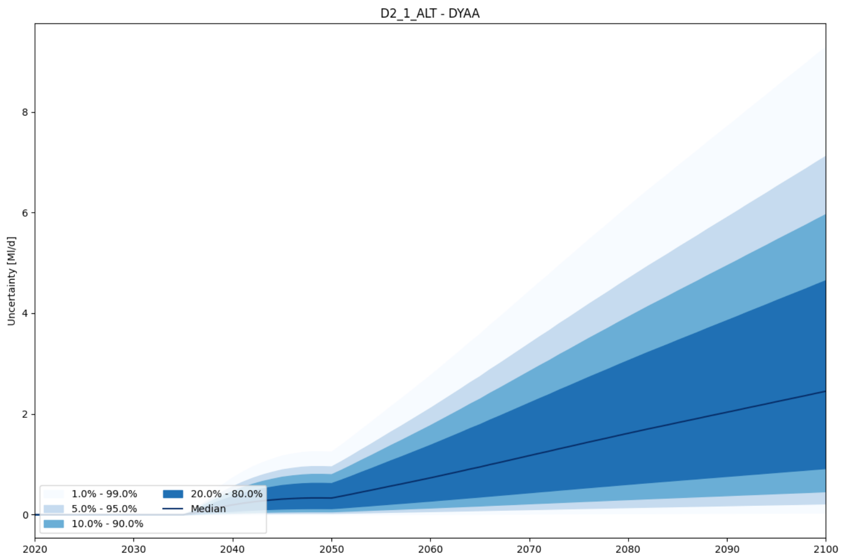
Notes:

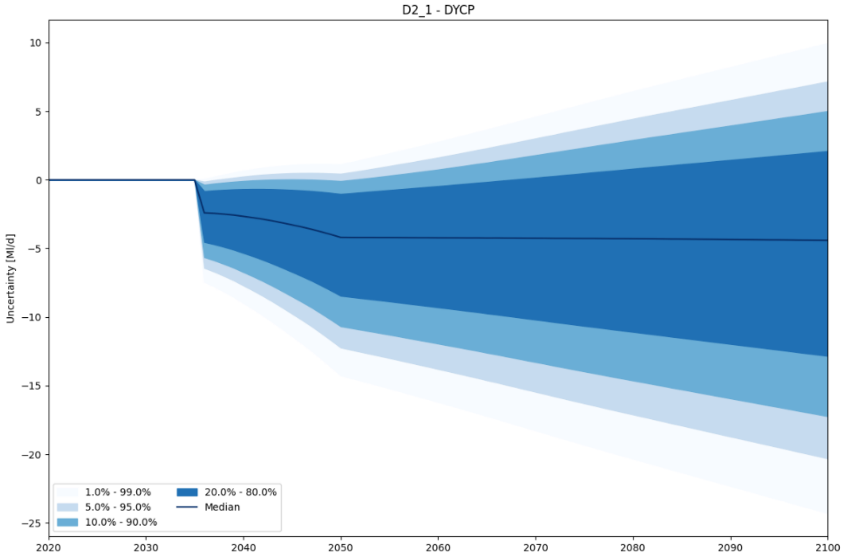
- This component reflects the uncertainty around the property and population forecast and resulting impact on DI.
- The central scenario used by WRSE is the 'BL_H_Plan', while the Min and Max (By 2100) scenarios are used as ranges around this plan.
- The central planning scenario is more extreme than the Max scenario up until 2035 when the Max (by 2100) starts to exceed the BL_H_Plan scenario. This leads to an unusual uncertainty profile which is not centred around zero.
- Two variations of this component are modelled:
  - D2.1 Growth Forecast: For the period leading up to 2035, no uncertainty allowance is assumed, and the upside is capped at the BL_H_Plan scenario.
  - D2.1 ALT Growth Forecast: An alterative approach whereby all upside risk is capped at the BL_H_Plan, assuming a half normal distribution as not to put too much weight on the extreme downside (given the upside is excluded). The q95 of the distribution is set to be the maximum value for the given year.
- Note that this issue only impacts the FTHR scenario as the component is dropped at the first branch point.

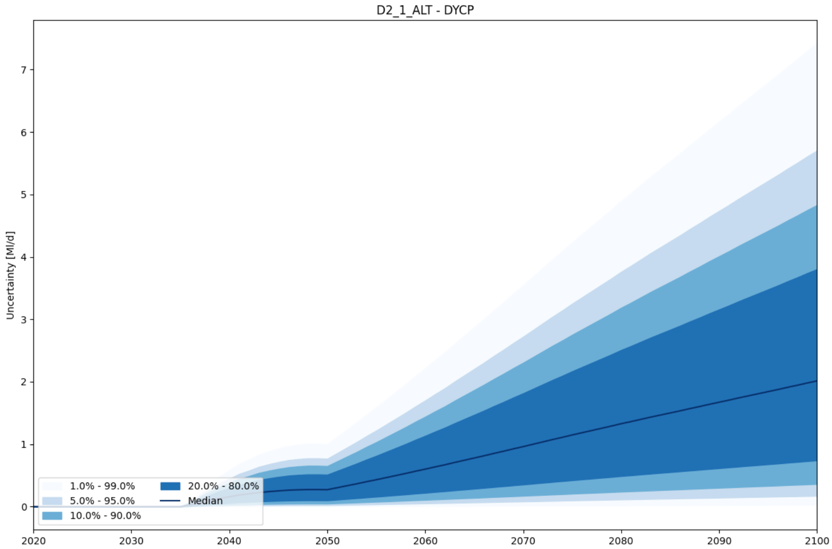
- In both scenarios, the artificial capping of the profile would statistically overstate the actual expected risk but results in the smoothing of the headroom profile.

Output:







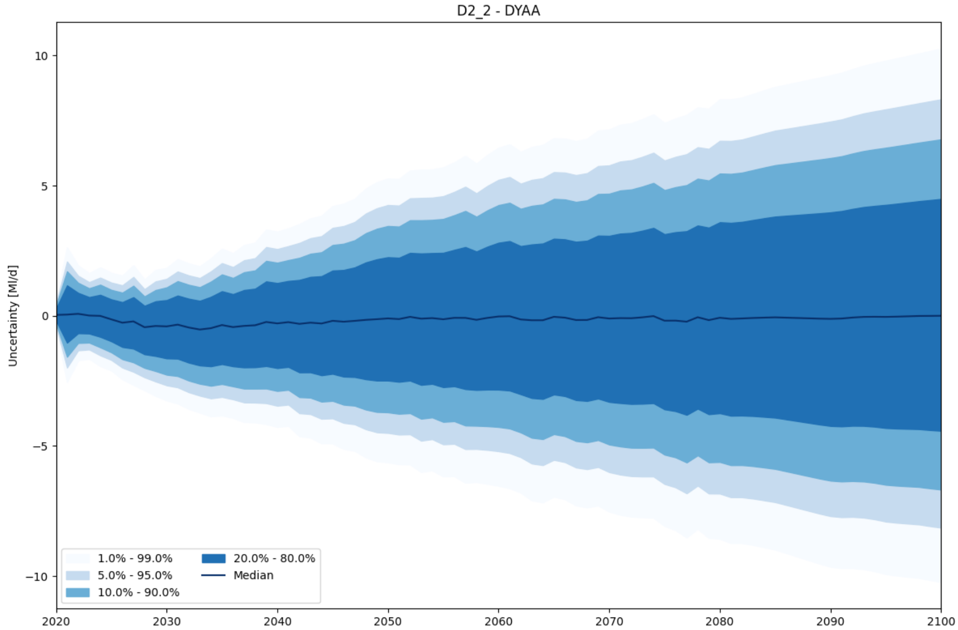


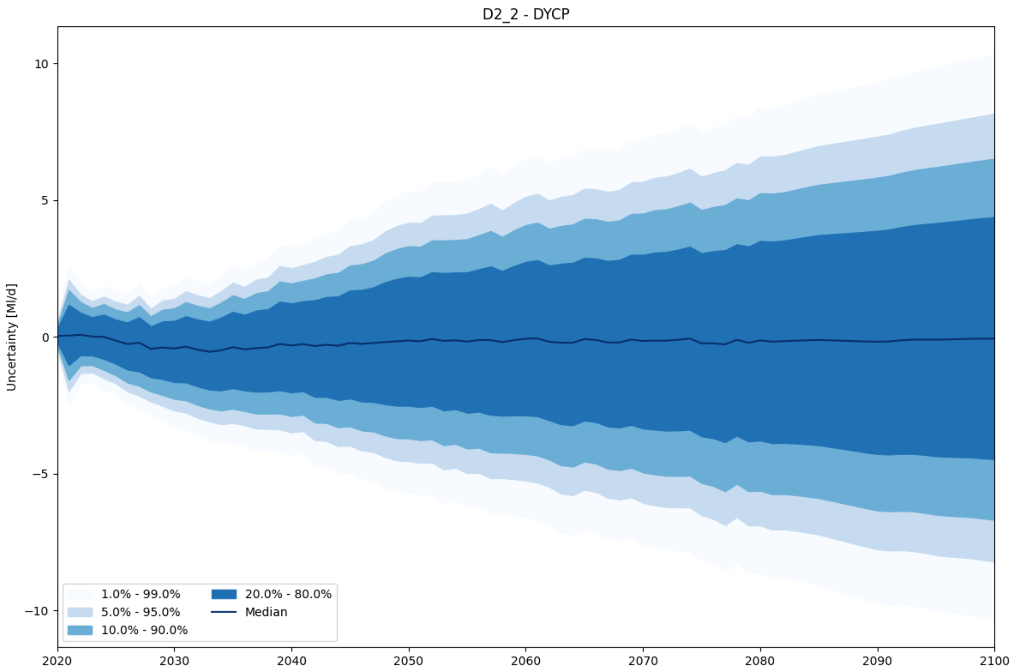
Component:	D2 - Demand forecast variation
Subcomponent:	D2.2 Non-Household consumption
Scenarios:	FTHR / EDG / EDGC
Last Revision:	17/02/2022
Input data:	DemandModel_WRMP24_v217.xlsx
Distribution:	Triangular
Static:	False

Notes:

- This component reflects the uncertainty around the Non-Household volume forecast as produced by Artesia for WRMP24.
- The ranges are extracted from the DemandModel_WRMP24_v217.xlsx
- The distributions are constant across the AA and CP scenarios.

Output:



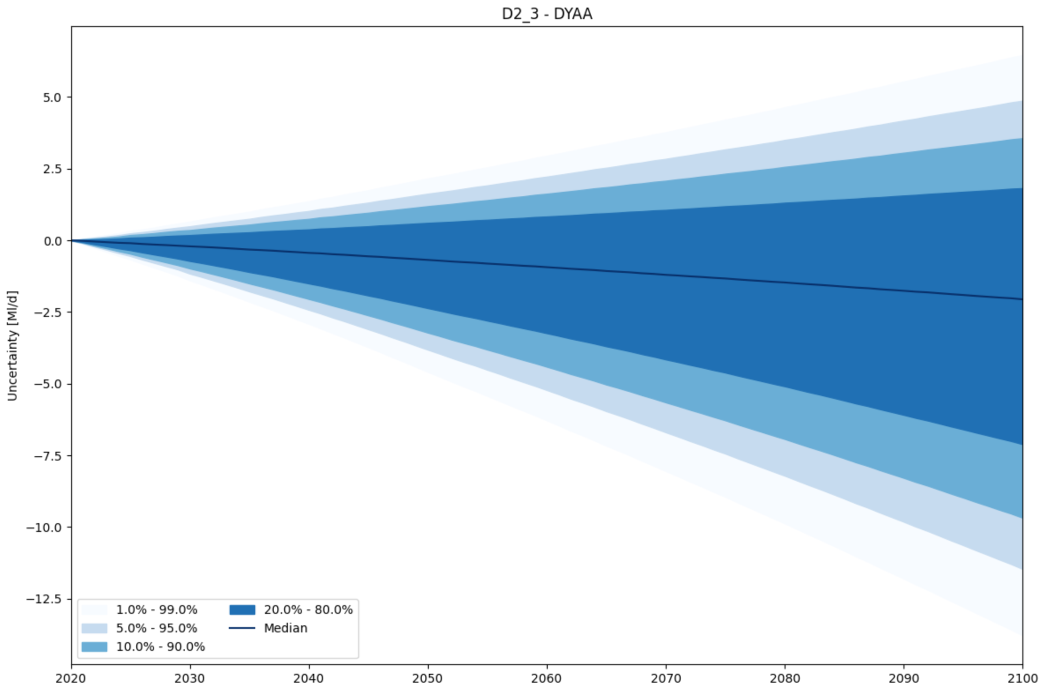


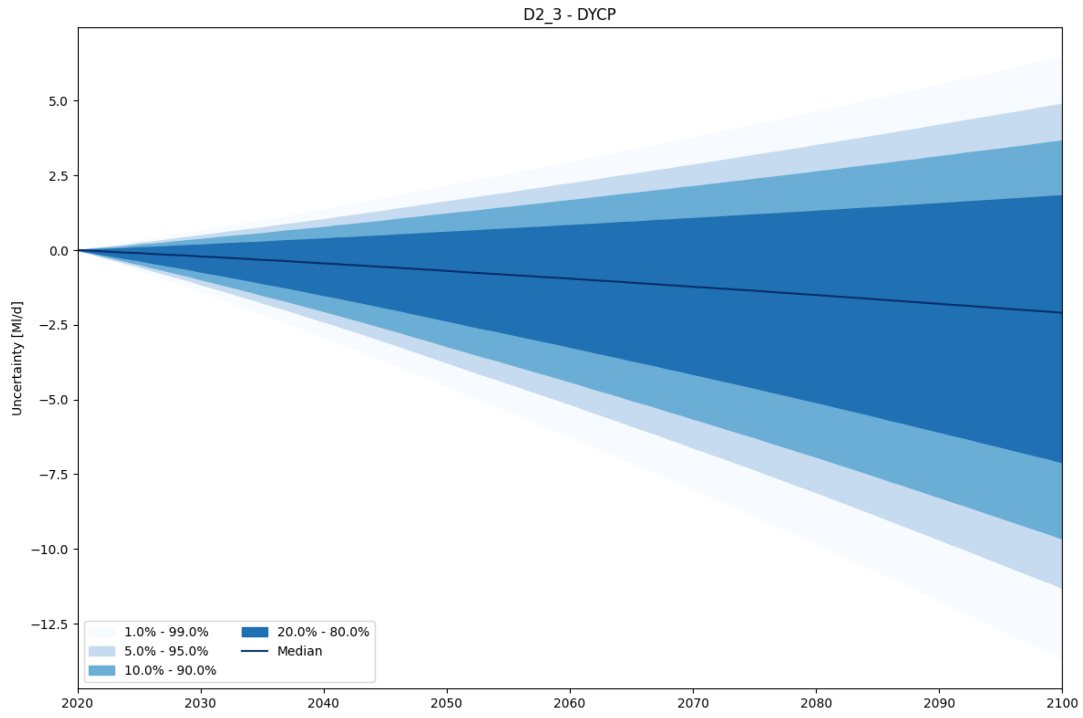
Component:	D2 - Demand forecast variation
Subcomponent:	D2.3 - Demand forecast variation: Natural Water Efficiency
Scenarios:	FTHR / EDG / EDGC
Last Revision:	17/02/2022
Input data:	DemandModel_WRMP24_v217.xlsx
Distribution:	Triangular
Static:	False

Notes:

- This component reflects the uncertainty associated with hands-off water efficiency and customer behaviour.
- On the one hand, households are expected to become more efficient over time as older, less water efficient devices are replaced. On the other hand, PRT has seen a recent trend in increasing PCC likely driven by changes in customer behaviour.
- In the central forecast, customer water use is assumed to be constant over the planning period – aside from those changes driven by changes in occupancy.
- For the Min/Max ranges, a +0.1 to -0.2 l/h/d (per year) delta is assumed.
- These changes are assumed to be driven by day to day usage rather than summer demands, therefore the assumptions for the AA scenario are also carried into the CP.

Output:





Component:	D2 - Demand forecast variation
Subcomponent:	D2.4 - Demand forecast variation: COVID19 Impact
Scenarios:	FTHR / EDG / EDGC
Last Revision:	30/03/2022
Input data:	DemandModel_WRMP24_v217.xlsx Artesia_collaborative-impact-of-COVID-19-on-consumption.pdf (Project reference: 2463, Report number: AR1403, 2021-05-21)
Distribution:	Triangular
Static:	False

Notes:

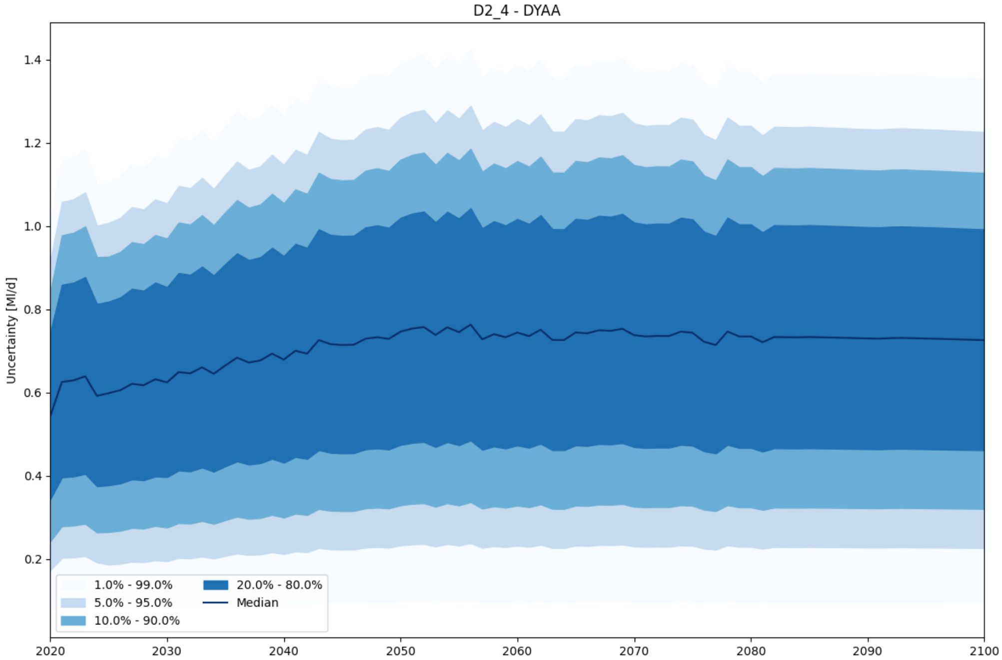
- This component assumes uncertainty arising from COVID-19 impacts under 'new normal' conditions impacting household and non-household demands.
- The distribution upper bound impacts are derived from the Artesia_collaborative-impact-of-COVID-19-on-consumption report for household and non-households and applied to Portsmouth Water volumes.
- Specifically, the estimated uplift ranges are assumed from Figures 41, 42, 57 and 58 of the Artesia report. The resulting percentage uplifts are presented below:

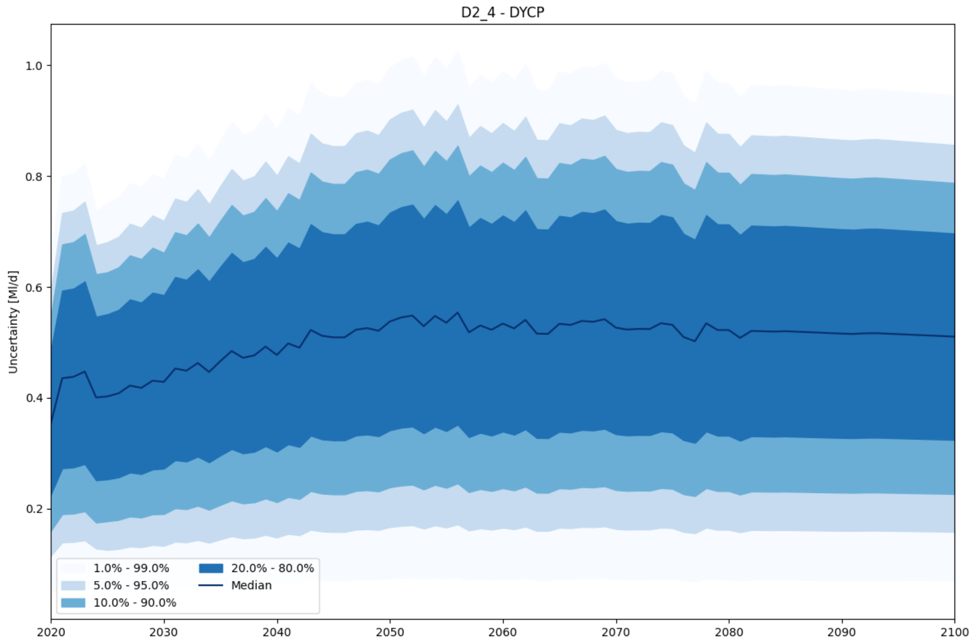
	Average (AA)			**Peak (CP)**		
	Low	**Mid**	**High**	**Low**	**Mid**	**High**
Household	0%	1.5%	3%	0%	1 %	2%
Non-Household	0%	-3.5%	-7%	0%	-3.5%	-7%

- The bounds of the Household and Non-household are summed together to form a single input distribution to the headroom analysis. This effectively assumes the impacts are fully correlated, i.e. when non-household demands decrease, the household demands proportionally increase.

- These factors are applied to the baseline demand forecast under the AA and CP conditions using volumes from v217 of the Portsmouth Water demand model. This results in the Covid-19 impact varying over time and are proportional the Household and Non-household impacts in the given year.
- Note that the Household impact is in part mitigated by a reduction in Non-Household consumption.

Output:



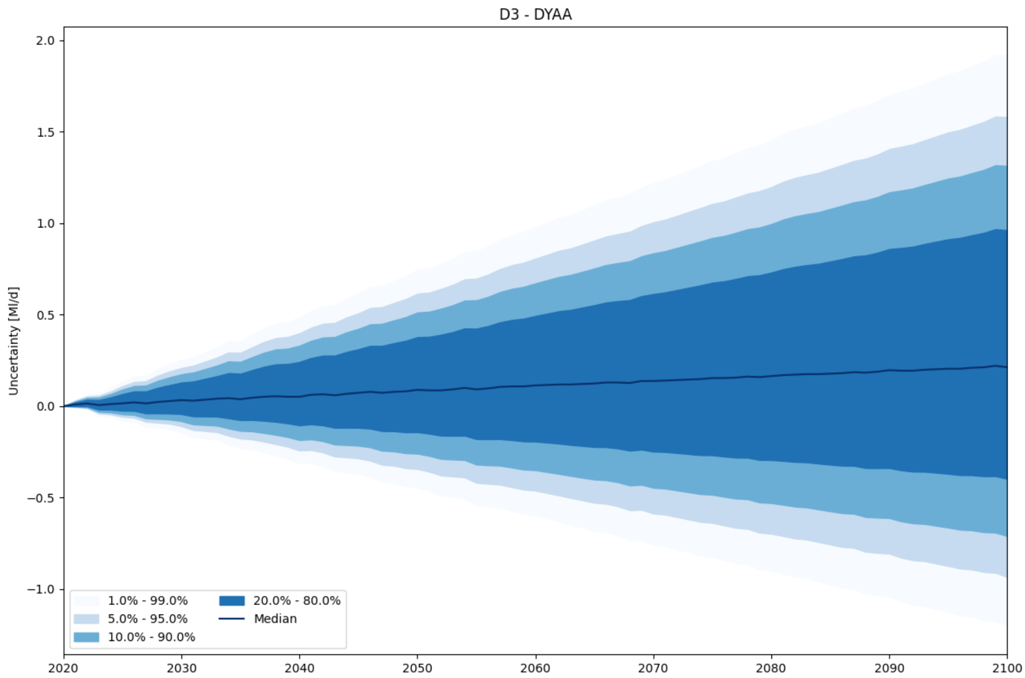


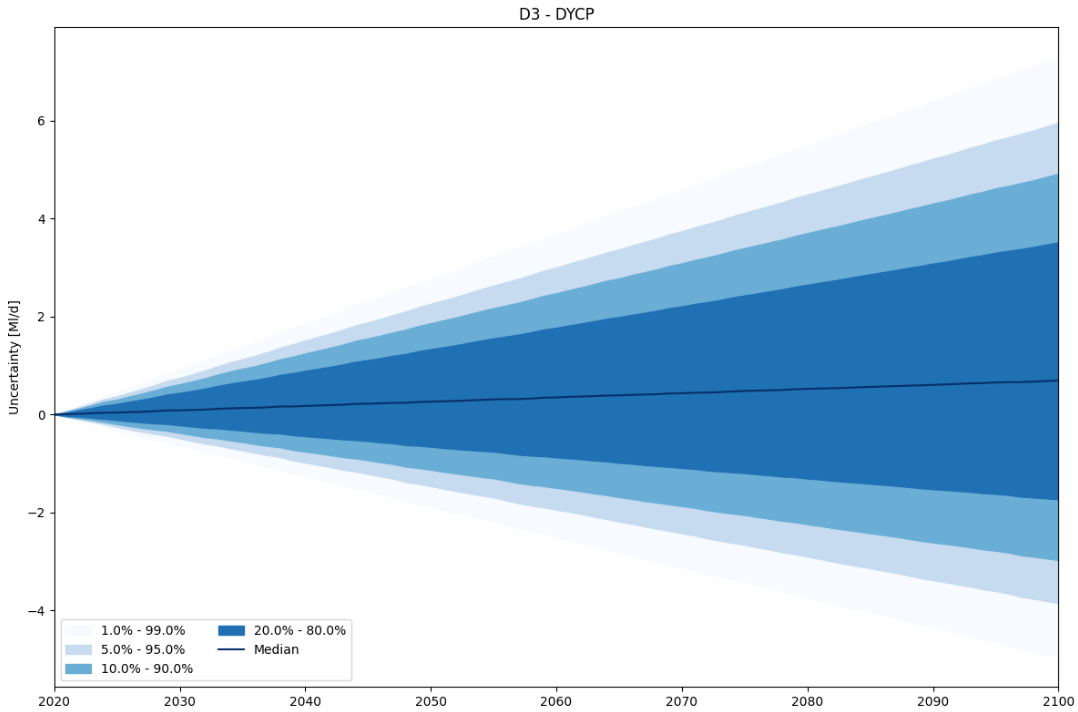
Component:	D3 - Impact of climate change on demand
Subcomponent:	-
Scenarios:	FTHR / EDG / ~~EDGC~~
Last Revision:	17/02/2022
Input data:	DemandModel_WRMP24_v217.xlsx
Distribution:	Triangular
Static:	False

Notes:

- This component reflects the changes in demand as a result of climate change.
- The values are extracted from the Demand Model and are based factors for South East England, derived from a 2013 UKWIR study.
- The p10 and p90 values factors are used to produce the Min/Max ranges.
- These factors are rebased to the base year and extrapolated over the planning period.
- The factors vary according to the AA and CP scenario.

Output:



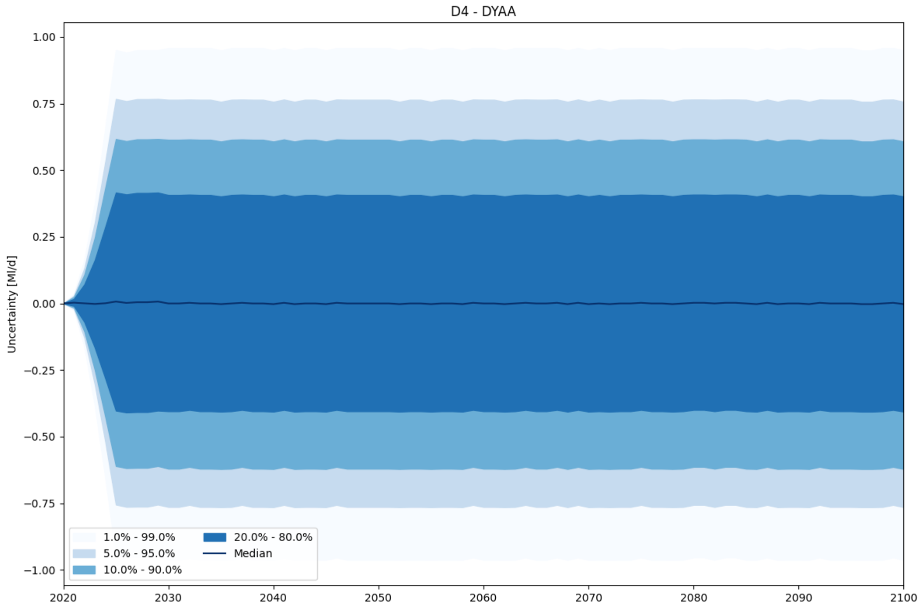


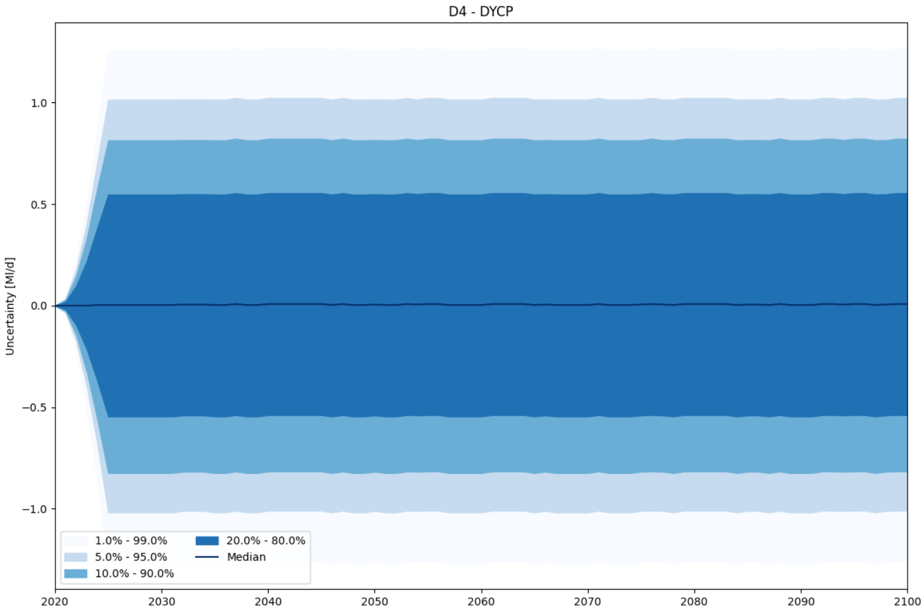
Component:	D4 - Demand management measures
Subcomponent:	-
Scenarios:	FTHR / EDG / EDGC
Last Revision:	17/02/2022
Input data:	DemandModel_WRMP24_v217.xlsx
Distribution:	Triangular
Static:	False

Notes:

- This component reflects the changes in demand as a result of the delivery of the AMP7 water efficiency schemes.
- The component varies up until 2025/26 when the schemes are assumed to be delivered, and the profile remains flat.

Output:





3. Glidepath

3.1. The adopted glidepath maintains that applied for WRMP19.

3.2. The profile starts at the 90th percentile, which is carried through to 2029/30.

3.3. From 2030/31 a 5% reduction per AMP (or 1% per year) is assumed until 2050/51 when the profile reaches the 70th percentile, which is then maintained through to 2099/00.

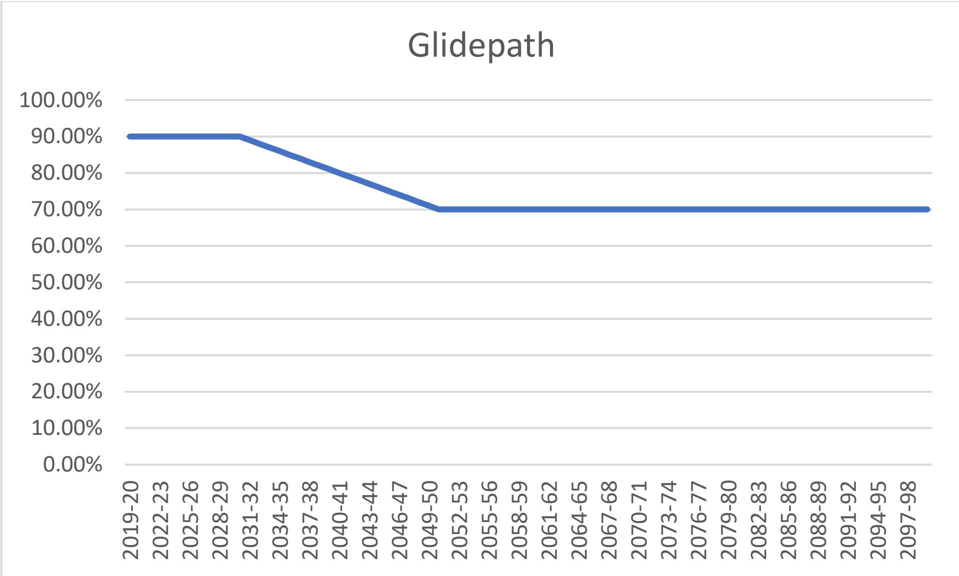


Figure 1 Adopted Glidepath

4. Result

4.1. The output of the analysis is four resulting profiles:

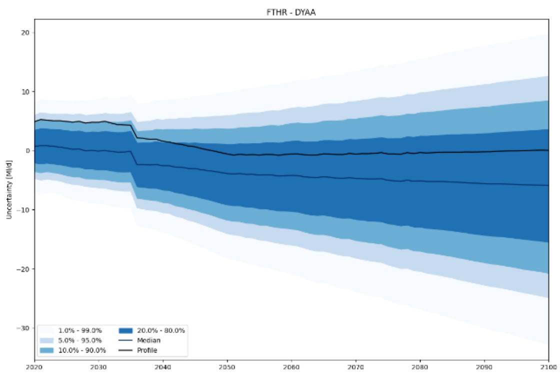
4.1.1. FTHR – Full Target Headroom

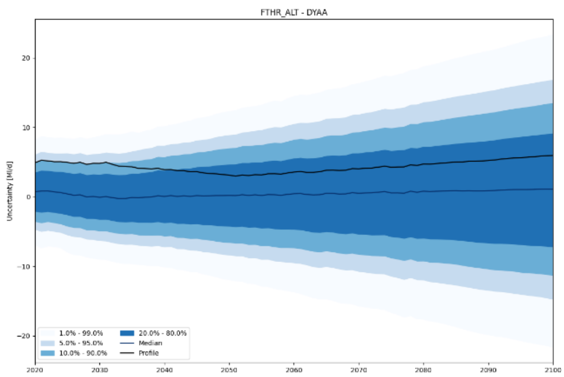
4.1.2. FTHR ALT – Full Target Headroom with adjusted demand from 2035/36, smoothing the profile.

4.1.3. EDG – Environmental Destination & Growth

4.1.4. EDGC - Environmental Destination, Growth & Climate Change

4.2. The resulting profiles are as follows:





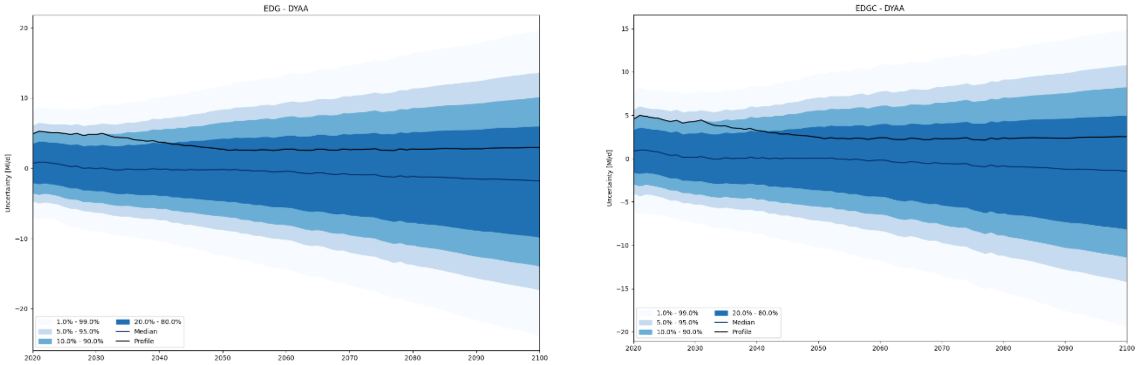


Figure 2 DYAA Profile

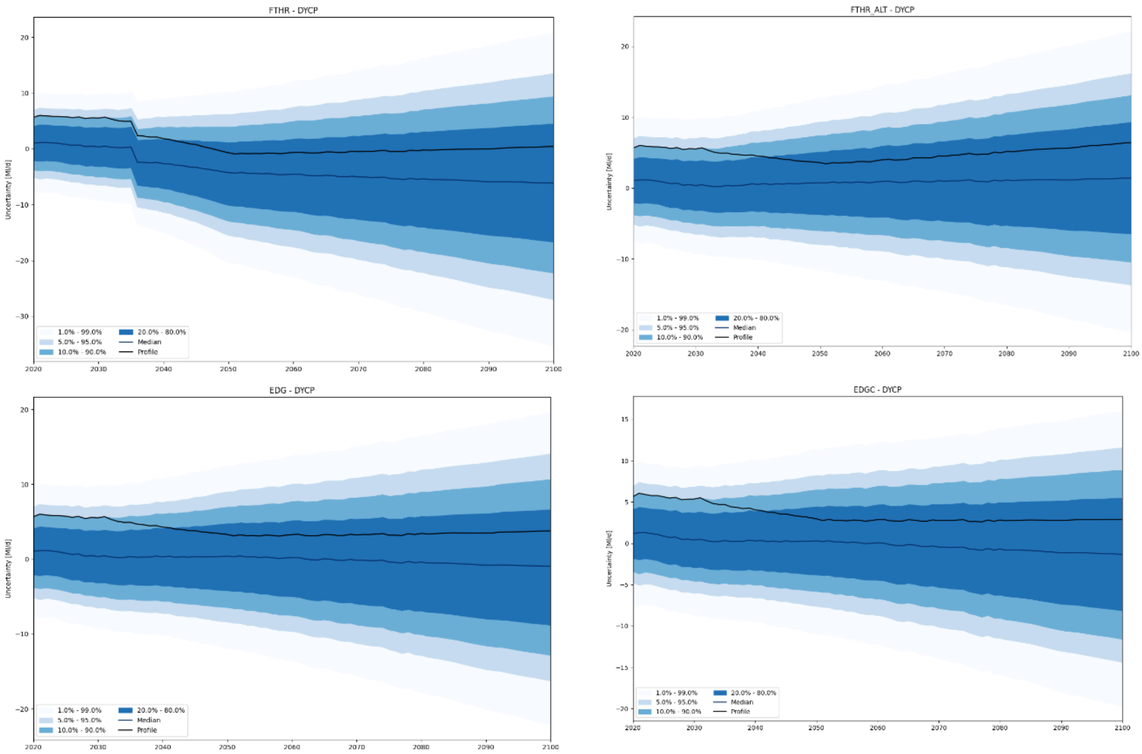


Figure 3 DYCP Profile

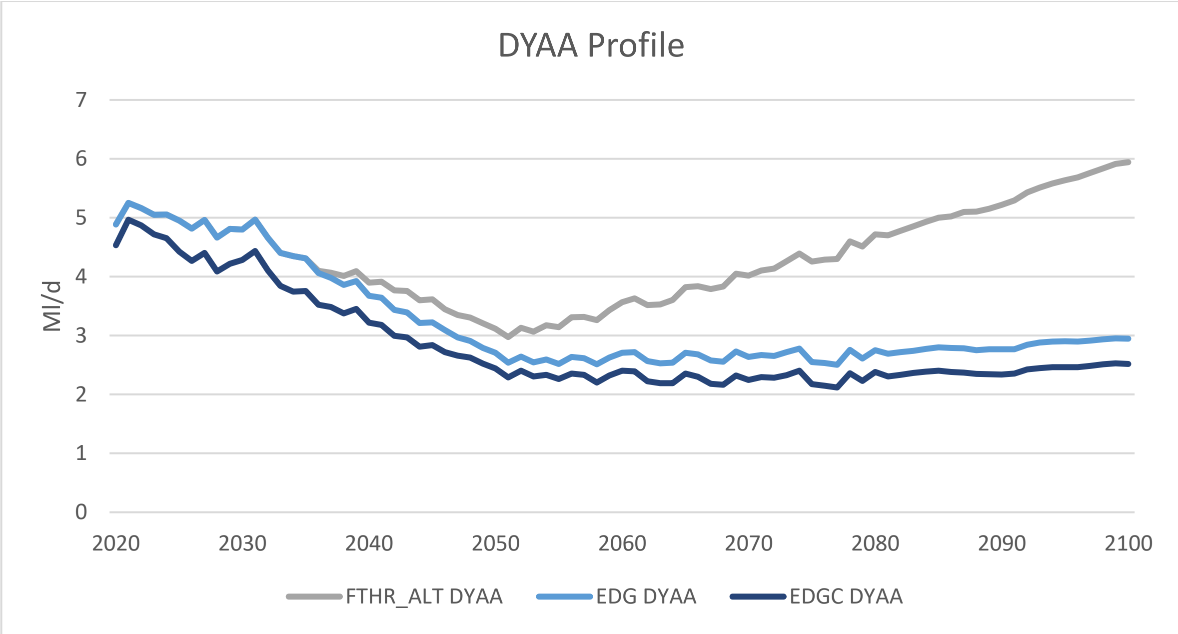


Figure 4 DYAA Profiles

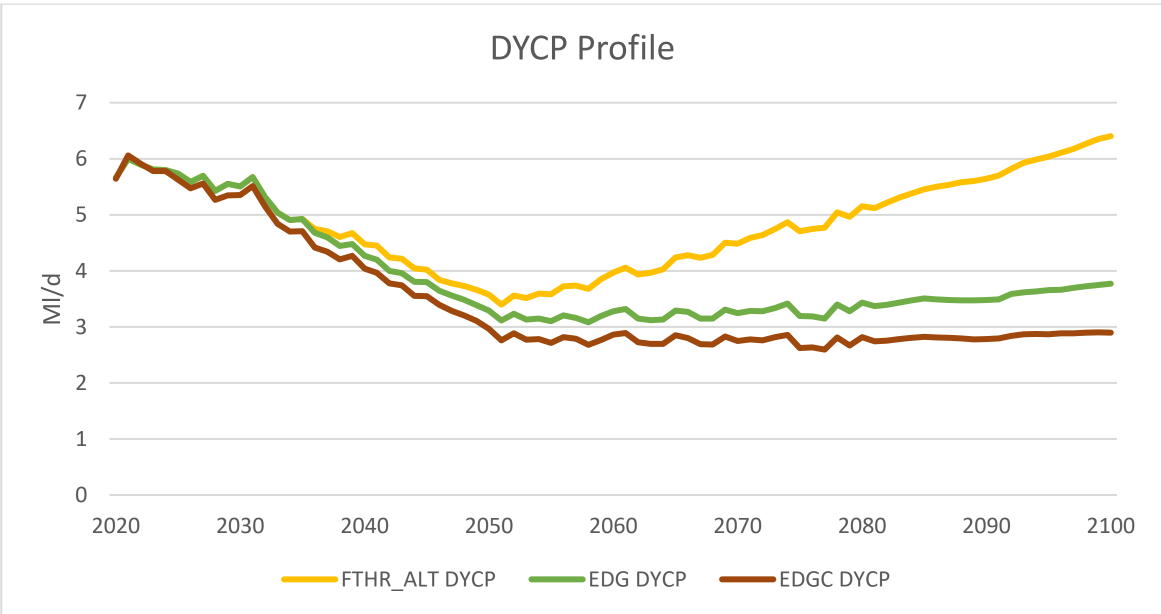


Figure 5 DYCP Profiles

5. Climate Change Impacts on Headroom

5.1. The WRSE input template 'New Demand Forecast Requirements.xlsx' requires the separation of climate change impacts from all other components.

5.2. As the only difference between the EDG and EDGC scenarios is the inclusion of climate change uncertainty, the contribution of climate change is the straightforward subtraction between the two scenarios.

5.3. Furthermore, as all scenarios use the same climate distribution assumptions, the estimated climate change impact can also be translated to the FTHR scenarios.

5.4. The calculations for this analysis are performed in the workbook *ClimateChangeContribution_v{*}.xlsx*.

5.5. It is assumes that the impact of climate change includes both the supply (S8) and demand (D3) components of climate change, although this is not clarified in the input template.

5.6. The EDGC scenario excludes climate change from the headroom analysis as it is instead modelled through the scenario testing. Therefore, for this scenario, the climate change contribution is always zero.

5.7. An example of the climate change headroom split is presented below:

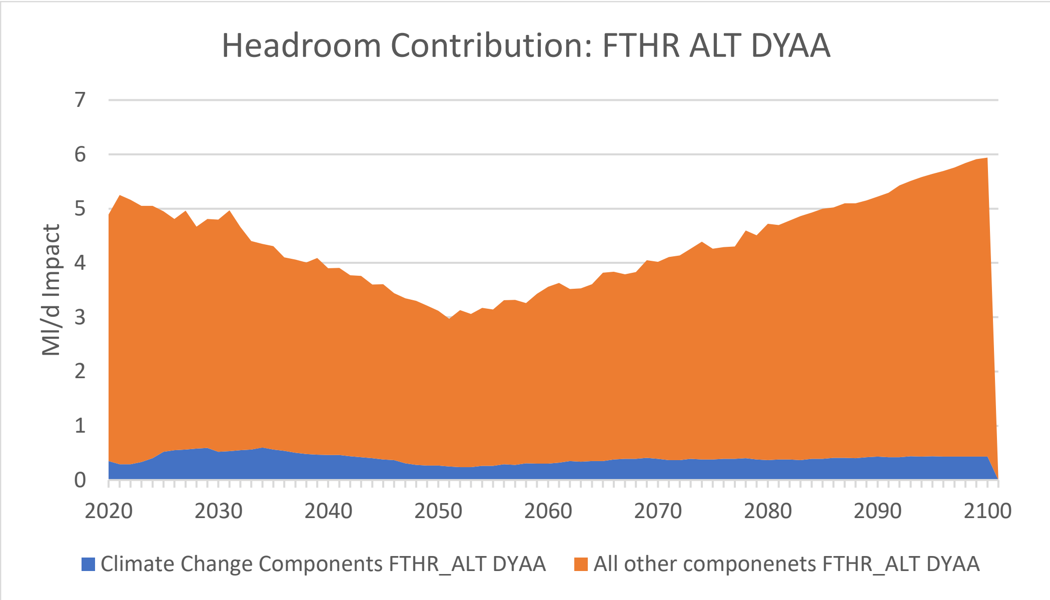


Figure 6 Example split for the FTHR ALT DYAA scenario

Target headroom appraoch for an adaptive plan

Version 1.1

February 2022

Title:	**Target headroom for adaptive plans**
Last updated	February 2022
Version	1.1
History of Changes made to this version	This technical report is based on the PowerPoint slides circulated to PMB and ECB regarding the approach and modelling results to date.
Author	MG
Reviewed by	WRSE companies
Approved by	SG
WRSE Director	MG

Table of Contents

1 WRSE approach to target headroom

1.1 Water Resources in the South East of England (WRSE) is creating a regional adaptive plan to meet the future water requirements of the various sectors in the region. The water sector is by far the biggest sector both in terms of their current usage and future requirements.

1.2 A series of forecasts have been developed for all the sectors. The forecasts for the water sector follow standard industry methodologies, whilst the forecasts for the other sectors have adopted water sector methods, where applicable, to create their forecast and where possible they have aligned the water sector non-household forecast approaches with their equivalent sector forecast.

1.3 All forecasts carry a certain amount of uncertainty, the water sector deals with a percentage of this uncertainty through a planning factor called headroom. There is an industry accepted methodology (UKWIR:……) which sets out this approach and how this is calculated.

1.4 The companies in the southeast have used this methodology to produce their headroom assessments for their WRMP19 plans, except for Southern Water who have developed an integrated risk model (Annex 5 of Southern Water's WRMP19) which develops an alternative approach to dealing with the uncertainty. The sectors outside the water industry do not incorporate headroom / risk analysis in their water requirements forecasts.

1.5 The purpose of this short technical note is to set out how the existing UKWIR methodology can be used in an adaptive planning approach to ensure that uncertainties are not double counted.

2 Adapting the UKWIR methodology

2.1 For the purpose of this section, it has been presumed that the reader is familiar with the UKWIR methodology.

2.2 The traditional approach to headroom is to identify the uncertainty in the supply demand components and include an allowance of this uncertainty onto the demand forecasts. This has been required because companies use to only use a single forecast of the future which they knew was uncertain but for planning purposes the single forecast approach is simpler and easier to discuss. The uncertainty associated with these forecasts were catered for in headroom which was then added to the demand forecast.

2.3 Uncertainty in future forecasts can arise in two key areas: accuracy of the components and the uncertainty arising from the range of potential future forecasts. For example, how accurate is the housing plan forecast really going to be.

2.4 The UKWIR methodology sets out how to calculate a combined uncertainty across several different factors or components, these being:

2.4.1 S1-Vulnerable surface water licences. Arises from concerns over the sustainability of surface water abstractions at the licenced rate and the likelihood that the licence will be revoked, reduced, or otherwise modified. **This component is not used as per WRMPG.**

2.4.2 S2-Vulnerable groundwater licences. Arises from concerns over the sustainability of groundwater abstractions at the licensed rate and the likelihood that the licence will be revoked, reduced or otherwise modified. **This component is not used as per WRMPG.**

2.4.3 S3-Time-limited licences. Relates to the uncertainty over whether the Environment Agency will renew, revoke or modify a time-limited licence. **This component is not used as per WRMPG.**

2.4.4 S4-Bulk imports. Although the reliability of bulk imports is subject to similar uncertainties to a company's own resources, the receiving company will have limited access to data to assess these uncertainties. Therefore, included as a separate component.

2.4.5 S5-Gradual pollution of sources causing a reduction in abstraction. The impact of gradual pollution on a source may be significant, even leading to abandonment of a source in some cases.

2.4.6 S6-Accuracy of supply-side data / overall source yield uncertainty. Data inaccuracy may render estimates of DO unreliable.

2.4.7 S7 – Not used

2.4.8 S8 -Uncertainty of impact of climate change on source yields. The impacts of climate change may alter source DOs. Although such impacts are included explicitly within the supply-demand balance, uncertainty in the estimates needs to be included in the headroom analysis.

2.4.9 S9-Uncertain output from new resource developments. This component is typically included for the final planning scenario. It relates to the uncertainty associated with the outputs of new source developments required to maintain service levels.

2.4.10 D1-Accuracy of sub-component data. There is a risk that the consumption data on which demand forecasts are based are of poor quality, leading to errors in demand prediction. The most important source of data in this regard is the distribution input flow meter measurements of variable accuracy that are summed to calculate the distribution input.

2.4.11 D2-Demand forecast variation. Arises from the risk that actual demand will depart from the dry year demand forecast used for the supply-demand balance due to uncertainties associated with growth in the household and non-household sectors and water efficiency behaviour.

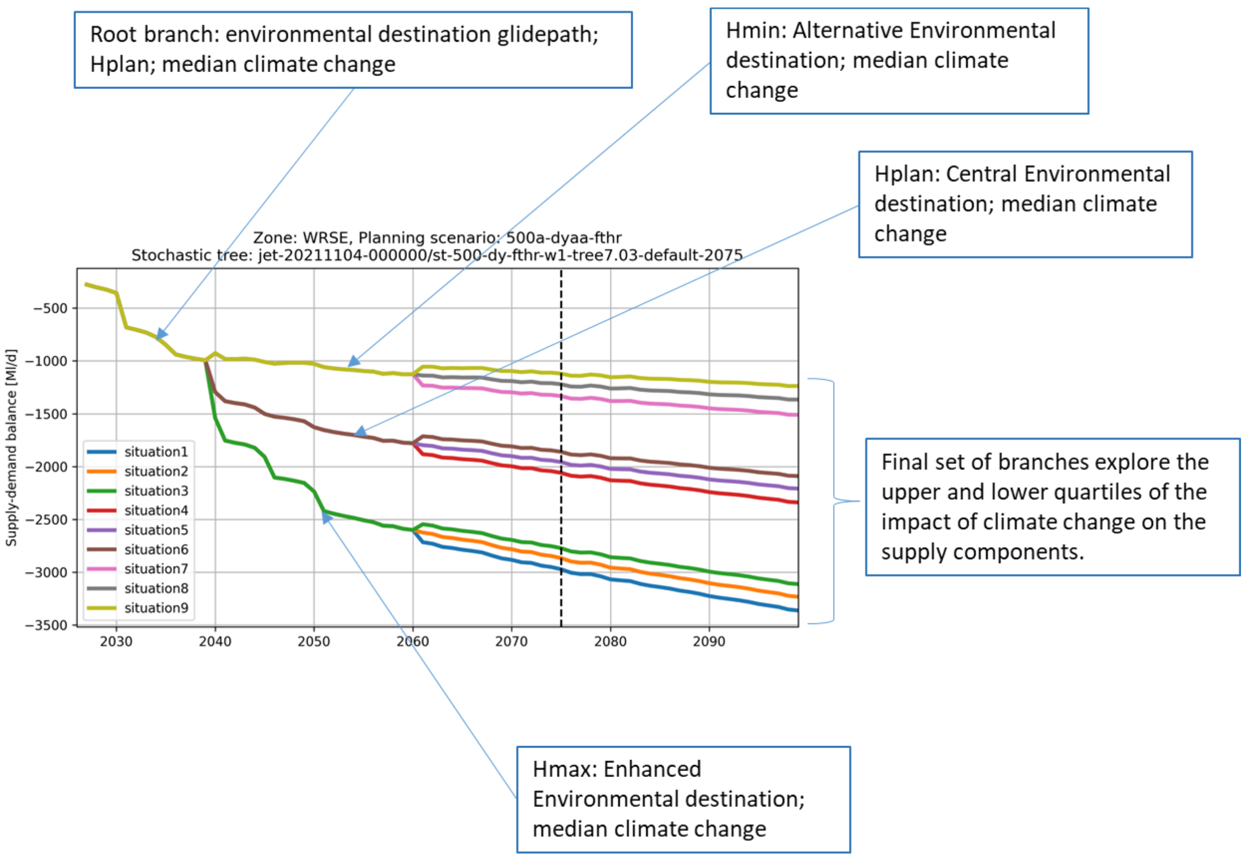
2.4.12 D3- Uncertainty of impact of climate change on demand. Arises from uncertainties regarding the estimates of climate change impacts on demand.

2.4.13 D4- Uncertain outcome from demand management measures. The size of reductions in demand that planned demand management measures may achieve is generally uncertain, and the date by which such demand reductions are realised even more so.

2.5 Companies will select which of these components are applicable to their headroom forecast, combine these components together, as set out in the methodology. This would provide the companies with a range of uncertainty and the companies would then assess an acceptable percentile risk glidepath, per AMP period, which defines the overall target headroom to be incorporated into their demand forecast.

2.6 When considering an adaptive planning approach, it is important to ensure that uncertainties are not double counted.

2.7 WRSE have moved to a root and branch type adaptive planning approach in the form of situation tress. A situation tree combines discrete forecasts which are combined to provide different root and branch pathways. The is shown in the figure below.



2.8 The three sets of branches in the regional plan set out the alternative forecasts explicitly. Therefore, the adaptive planning approach takes account of some of the uncertainty arising from a range of forecasts as it branches.

2.9 To avoid double counting risks, any components used to define a branch (environmental destination, growth, etc) should be taken out of the headroom assessment.

2.10 Therefore, the root part of the adaptive plan defined as the beginning of the plan (2025) to the first branch point (2040) would have full a full target headroom assessment.

2.11 After the root section the adaptive plan branches on environmental destination and growth forecasts but leaves climate change as a central or median estimate. Therefore, it would be appropriate to generate a target headroom profile which drops components S1, S2, S3 (if they had been used) and D2 components. This target headroom profile would be referred to as the EDG profile to indicate it has dropped components associated with Environmental Destination and Growth (EDG).

2.12 In the final set of branches in the adaptive plan the environmental, growth and climate change components are explored. Therefore, a third target headroom profile would be required in which S6 would be reduced to account for the upper and lower quartile impacts of climate change on the supply forecast. This target headroom profile would be referred to as the EDG profile to indicate it has dropped components associated with Environmental Destination and Growth (EDGS).

2.13 Depending how companies have calculated their base year target headroom they may consider using this value as an appropriate value for the subsequent branches. For example, if the influence of other growth forecasts, climate change uncertainty and environmental destination uncertainty are zero or negatable then this headroom allowance could be used in the final set of branches. The middle set of branches would have to have some allowance for climate change uncertainty as this isn't explored in the branches until the final set of branches.

2.14 Glidepaths remain the choice of companies however it is recommended that a comparison of these glidepaths is undertaken to ensure a level of consistency between the companies within the South East. If a company has a radically different glidepath then the reason for the differences is explored and justified if necessary.

3 Combining the target headroom profiles

3.1 In the section above we set out an approach which would provide three target headroom profiles. This allows different timing for the branches to be explored. Combining these profiles would be undertaken at each water resource zone.

3.2 The full target headroom profile would be used in the root branch; then the EDG target headroom would be used for the first set of branches and the EDGC target headroom profile would be used for the second set of branches. This combined headroom profile is referred to as the hybrid headroom profile.

3.3 The components used for each of the profiles are set out in the table below:

Component	Component description	Full target Headroom profile	Environmental destination and Growth target headroom profile	Environmental destination, Growth, and climate changes target headroom profile
S1	Vulnerable surface water licences	✗[1]	✗	✗
S2	Vulnerable groundwater licences	✗[1]	✗	✗
S3	Time limited licences	✗[1]	✗	✗
S4	Bulk imports	✓	✓	✓
S5	Gradual pollution of sources causing a reduction in abstraction	✓[2]	✓[2]	✓[2]

[1] This should be included but Water Resource Management Plan Guidance prevents its inclusion
[2] This should be included but only if you haven't written down the deployable output of sources in the future due to deteriorating raw water trends

Component	Component description	Full target Headroom profile	Environmental destination and Growth target headroom profile	Environmental destination, Growth, and climate changes target headroom profile
S6	Accuracy of supply-side data / overall source yield	✓	✓	✓
S7	Not used	✗	✗	✗
S8	Uncertainty of impact of climate change on source yields	✓	✓	✗
S9	Uncertain output from new resource developments	✓[3]	✓[3]	✓[3]
D1	Accuracy of sub-component data	✓	✓	✓
D2	Demand forecast variation	✓	✗[4]	✗[4]
D3	Uncertainty of climate change on demand	✓	✓	✗
D4	Uncertain outcome from demand management measures	✓[3]	✓[3]	✓[3]

3.4 The components S9 and S4 require the plan to be initially derived and then re-tested / optimised once the balance of these components are understood and their uncertainty is built into the target headroom analysis. This is an iterative process and companies should use the cost efficient

[3] This should be based on the schemes selected in the cost-efficient plan
[4] D2 – only include non-growth related components for the headroom forecast

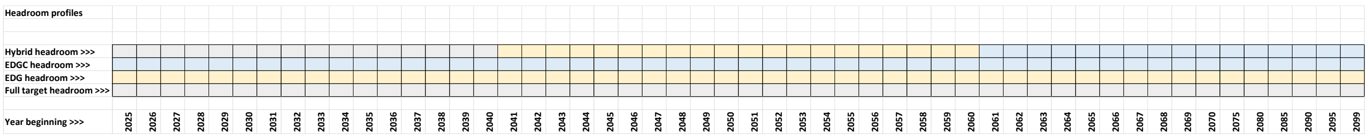
plan to provide them with an good view of the volume of supply and demand components that contribute to the overall investment plan. If the plan includes demand management policies and supply schemes, then the uncertainty of their outcomes should be included in target headroom. Theoretically the number of iterations that could be undertaken are infinite as the headroom is fine-tuned with each subsequent iteration.

3.5 As a way forward companies should compare the headroom assessment that was used to derive the plan with the updated headroom assessment that has been derived by updating estimates of D4 and S9 following the derivation of the plan. If there is a significant difference[5] in headroom, then a further iteration of the investment model should be undertaken.

3.6 Options which are being delivered in the current AMP, but as yet not commissioned should be included in S6 and D1. Schemes[6] which start in the current Amp but are delivered in the next AMP should also be included in the FTHR and reflected in the S6 and D1 components. All other schemes should be included in the D4 and S9 components.

3.7 This comparison should be undertaken for the root branch and second branches only. Differences in the final branches could be ignored as these are typically outside the WRMPG planning horizon of greatest interest (first 25 years of the plan) and they will be subject of further reviews and plan.

3.8 The transition from one profile to the next would be aligned with the branch points, as set out in the figure below.



3.9 This approach to integrating the target headroom profiles would be undertaken at a water resource zone level of granularity and for both the dry year annual average (DYAA) and dry year critical period (DYCP).

3.10 The combination of the headroom profiles might create a step change in headroom values between one profile to another profile. If this occurs, then the company(ies) in question will be asked if they want to revise the glidepaths between profiles.

3.11 All profiles will be loaded onto the Data Landing Platform (DLP).

[5] Refer to the materiality paper as a guidance to significance.
[6] Refer to the AMP7 and AMP8 WRSE list of schemes

4 Summary

4.1 The use of full target headroom in the adaptive plan can lead to a potential double counting of uncertainty.

4.2 This short technical note sets out a simple approach which allows companies to use the UKWIR methodology but adjust the components used in the calculation to prevent double counting of uncertainty.

4.3 The approach requires three target headroom profiles (FTHR, EDG and EDGC) would be derived for each planning scenario (DYAA & DYCP) at a WRZ. The regional model would create a hybrid target headroom profile by using the target headroom values from each of the three profiles submitted. In the root part of the adaptive plan full target headroom is utilised. In the first set of branches the EDG profile would be used and in the final set of branches EDGC profiles would be used.