Method Statement: Demand Forecast

Version 5

August 2021

Title	Method Statement: Demand Forecast
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For the full library of WRSE Method Statements, please visit wrse.org.uk/library.

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 of 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 demand forecast Method Statement will contribute to the preparation process for the regional resilience plan.

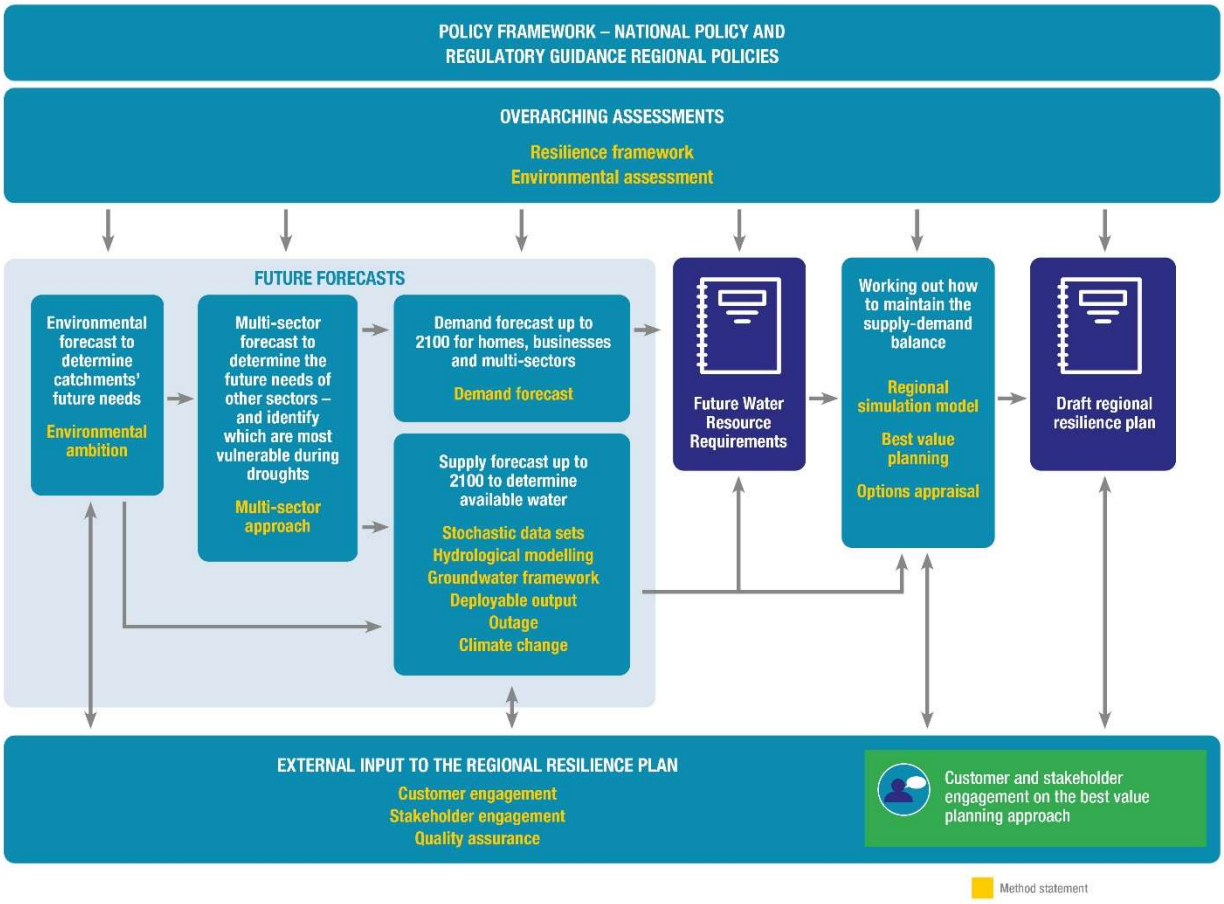
This document sets out the method by which we have forecast the future demand for water – from households, businesses, industry and other sectors – across the WRSE region and across a range of different scenarios which account for external influences like climate change.

Demand forecasting is a well-established process that follows regulatory guidance and industry best practice, with three components that, when combined, give us an estimate of the demand that we will need to meet in the future. These components are:

- Household demand - this is calculated from population and property forecasts combined with per capita consumption (PCC) and per household consumption (PHC) forecasts
- Non-household demand - this is based on a range of factors, including population and properties growth, climate and economic data

- Leakage – this includes both distribution network losses (made up of losses from large water mains, service reservoirs, and smaller distribution mains) and customer -side leaks on supply pipes

Figure ES1: Overview of the Method Statements and their role in the development of the WRSE regional resilience plan



The demand forecast is a key input to our Regional Simulation Model and our investment models, as detailed in our Regional Simulation Model and Best Value Planning Method Statements. The way demand forecasts are developed is influenced by Water Resources Planning Guideline from the Environment Agency.

1 Introduction

1.1 This document sets out the methodologies that have been used to develop demand forecasts for the Water Resources South East (WRSE) multi-sector, regional resilience plan covering the period from 2025 to 2100.

1.2 It is based on the Water Resources Planning Guideline (WRPG) issued by the Environment Agency in February 2021. The Environment Agency has also issued a number of supplementary guidance notes, but none are directly related to demand forecasting. The WRPG details which industry guidance reports should be followed or taken into account when deriving each forecast. The latest version also includes the need to consider the impacts of hot, dry weather (such as occurred in 2018 and 2020) and changes in demand due to Covid-19 impacts. The guidance specifies that potential impacts on the network should be assessed as well as the overall balance of demand against supply on a Water Resource Zone (WRZ) basis.

1.3 There are four components which are combined to derive a baseline forecast, as listed below:

i. Household Demand - which is derived from combining population and property forecasts with Per Capita Consumption (PCC) or Per Household Consumption (PHC) forecasts
ii. Non-Household Demand - which is derived from a range of other forecasts, including population and properties, climate and the economy, with these factors having differing significance for demand in different sectors
iii. Leakage - including both distribution network losses and customer-side supply pipe leaks
iv. Minor components – including water taken unbilled and distribution system operational use.

1.4 The combined demand forecast will then be modelled against climatic factors in order to produce forecasts under varying climatic scenarios. This aligns with the approach taken for the supply forecast, so that the outcomes are consistent under different drought severities. Droughts create a challenge due to both increased demand and reduced supplies and therefore it is vital that we plan for these scenarios.

1.5 Each company in the region has completed their demand forecast for the draft regional plan in accordance with the methodology in this document using 2019/20 as the base year. The original plan was to update this in the summer of 2021 to incorporate the 2020/21 annual reported data so it can be used as the base year for the final plan. However, due to the impact of Covid-19 restrictions, which has skewed demand from non-household to household and also created a significant geographical shift away from London, it was concluded that 2019/20 should remain as the base year. Analysis of the long-term effects of Covid-19 restrictions, for example on immigration and working patterns, is ongoing and will be used to refine future forecasts.

1.6 Both the demand and supply forecasts will be fed into the Regional System Simulation Model to identify areas where we have surplus water and areas where we face a supply-demand deficit.

1.7 There is also a link between the baseline demand forecasts and the options appraisal workstream. The development of demand management strategies, that aim to reduce demand, is dependent on measures that have been taken historically. For example, areas which have already undergone universal metering cannot benefit from further metering. See Options Appraisal Method Statement for more detail on how different demand management strategies have been created and developed alongside the supply side options.

1.8 In addition to demand from the public water supplies provided by water companies to households and businesses in their supply areas, water is abstracted by private licence holders for agricultural and industrial purposes. In some cases, these non-public water supply (NPWS) abstractors may also have access to the public water supply, in which case they can vary the balance between the two supplies. In other cases they may be entirely dependent on the NPWS sources. We have forecast the needs of this sector due to the potential requirement for increased resilience of public supplies, especially during droughts and since it affects the availability of water for abstraction in the catchment.

1.9 Uncertainty is accounted for using a range of methods, including triangular and probabilistic distributions, depending on the forecasts available for each component.

Roles and responsibilities

1.10 The Demand Forecast Sub-Group was made up of representatives from all six member water companies. All representatives participated in the selection of consultancy support through a tendering process, attended meetings and workshops with the consultants to review and approve reports and papers - including this Method Statement.

1.11 Overall responsibility for approval of reports and documents is with Alison Murphy (SES Water), who is a member of the WRSE Project Management Board, supported by Faisal Butt (Southern Water).

1.12 Final sign-off of reports for publication is the responsibility of Meyrick Gough, WRSE Technical Director.

1.13 The Multi-sector group steering group will help develop the other sectors' forecasts of water requirements for the future (see **Method Statement 1334 WRSE Multi-Sector Approach**). The findings from the non-household demand forecast studies will be shared with the other sectors and combined with their own knowledge to develop a series of forecasts.

Maintenance of Method Statement

1.14 This version of the Method Statement was produced following the completion of the demand forecast upload at the end of March 2021 and the issue of the final version of the WRPG.

1.15 It is intended that this document will be updated as additional work is completed and if any further guidance is issued by the regulators.

2 Demand forecast method

Household demand – population

2.1 It is recognised that having robust evidence of population growth and changes in demographics is critical to developing a household demand forecast. Using different data sources results in a wide range of results with uncertainty increasing with time.

2.2 The WRPG emphasises the importance of using Local Plans as evidence in deriving a growth forecast and specifies that the forecast 'must not constrain planned growth by local councils and strategic housing developments'. Where an alternative source of data is used, for example beyond the planning period of the Local Plan or where a Local Plan has not been published, the evidence used should be clearly set out and any assumptions clearly described. We have followed this requirement but have also considered additional projections to ensure we have included the most likely range of household demand growth up to the end of the century.

2.3 WRSE commissioned Edge Analytics to develop both population and property forecasts for all the WRZs in the region. They used the latest available Local Plan and Office for National Statistics (ONS) trend-based data, as well as other sources including those from the Greater London Authority (GLA). More detail on their methods is available here: Population & Property Forecasts - Methodology and Outcomes. Forecasts for household, non-household and hidden & transient categories were produced in May 2020 using the latest available data. A separate forecast for the Oxford-Cambridge (OxCam) area was also produced to assess the potential impact of this significant proposed housing plan with the aim of aligning forecasts with Water Resources East (WSE). The need to include an estimate for this development was specified in the WPRG. The process for the methodology is summarised in Figure 1. A map of the OxCam Arc overlaid on the WRSE Local Authority Districts is shown in Figure 2.

2.4 This work involved producing forecasts for a wide range of scenarios, by using a combination of trend, housing-led (incorporating housing need, housing requirements and actual planned scenarios) and employment-led forecasts, to account for the considerable uncertainty in the projections. Forecasts were produced under 19 main scenarios up to 2050 with three further projections (Principal, High and Low) for each scenario up to 2100. There are therefore 57 projections for each WRZ.

2.5 From the range of scenarios, there is a need to adopt one as a baseline growth forecast supported by a selected number of additional growth projections that allows us to fully account for uncertainty. Many scenarios have similar results and therefore including all 57 projections would have increased the complexity of the work without improving the reliability or accuracy of the forecasts.

Figure 1: Edge Analytics forecasting methodology

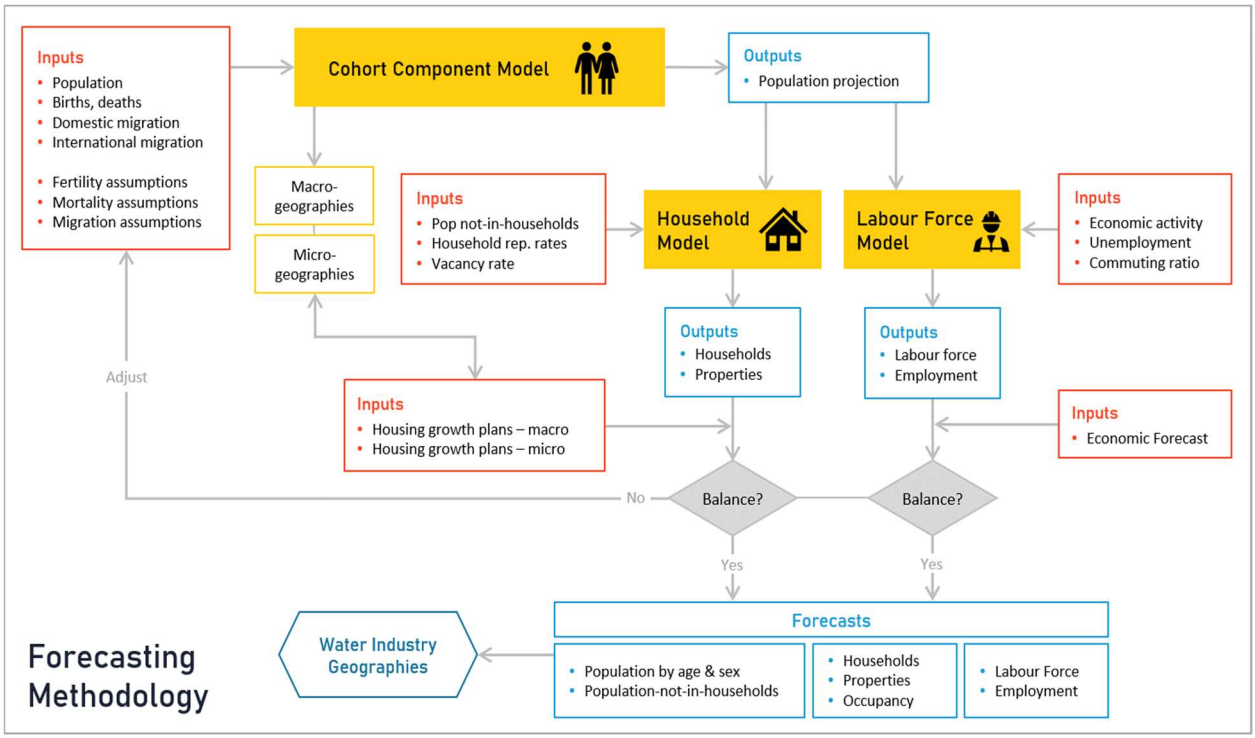
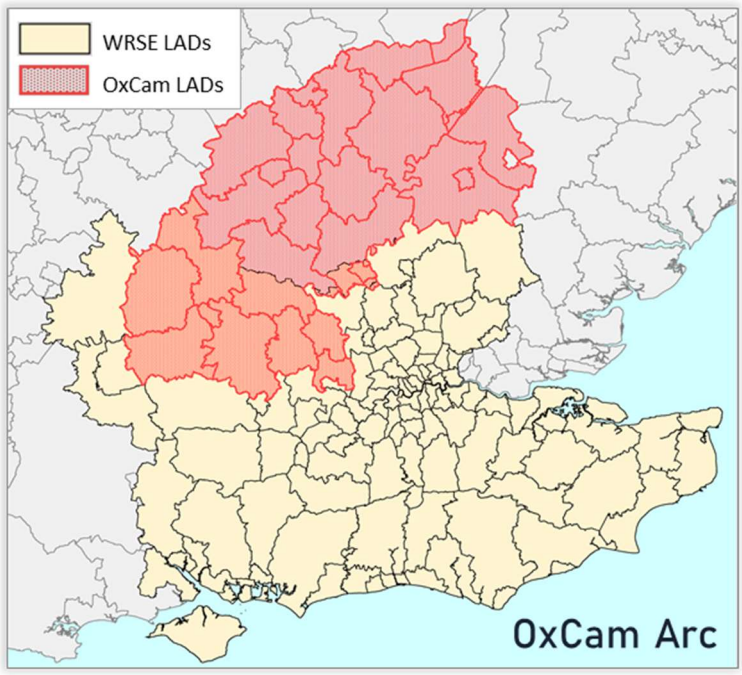


Figure 2: OxCam Arc with WRSE Local Authority Districts (LADs)



2.6 The preference was that the same growth forecast and additional growth scenarios are used across the region, however this was not possible as different factors are driving differences in the upper and lower forecasts in different WRZs and it is important to take these local differences into account.

2.7 The Housing Plan based projections have been developed using two approaches: a 'top-down' approach and a 'bottom-up' approach. The 'top-down' forecasts allocate growth based on location of existing housing stock, i.e. growth continues in locations where houses have already been built. The 'bottom-up' housing-plan forecasts take account of areas or sites where housing is identified for delivery in the future, not just where it currently exists. WRSE has adopted 'bottom-up' figures for the housing plan values as they represent a more realistic view of the locations of new growth and allocate growth to WRZs more accurately.

2.8 There was also a decision to be made on whether the forecast is based on population or household properties (dwellings). Population growth, particularly household population growth, is likely to be the main driver behind future demand in most WRZs where demand is forecast on a PCC basis rather than a PHC basis. The rate of growth for new properties primarily impacts household occupancy which also has an impact on PCC, since average PCC typically decreases with an increase in average occupancy.

2.9 For the hidden and transient population, each company has included figures from the mid-level estimates for irregular migrants, short-term residents and second addresses (not visitors) unless there is sufficient evidence that alternative figures (such as low- or high-level) provide a more robust forecast for their supply area or in selected WRZs. The figures are fixed across the planning period.

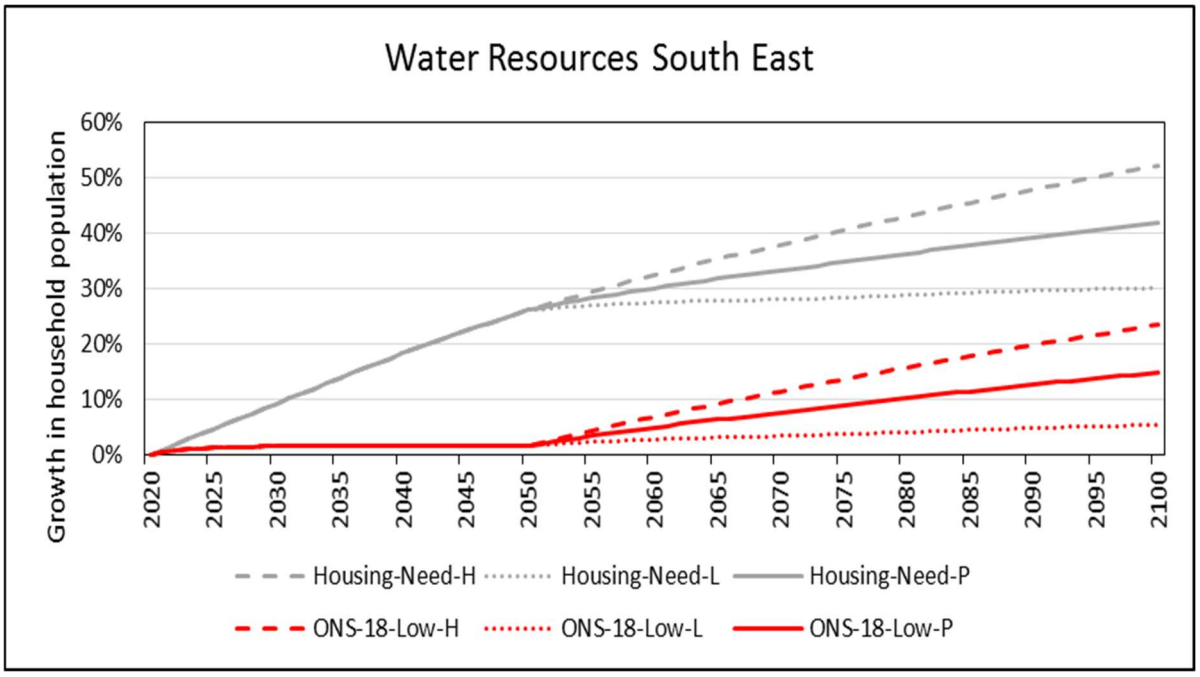
2.10 From the 57 projections (shown in Table 1), the minimum and maximum increase in total population at the WRSE level by 2050 are 2% and 26% respectively; the corresponding figures for 2100 are 5% and 52% respectively. A selection of these scenarios are shown graphically in Figure 3. The full range of projections (Principal, High and Low) in terms of % change for these two scenarios in Table 1 is shown in Figure 4. The main difference in the Principal, High and Low projections is due to the assumed trajectory post 2050 which is mainly linked to the predicted level of net international migration.

Table 1: Range in WRSE population

Measure	By 2050	By 2100	Projection
Minimum increase	2%	5%	ONS-18-Low-L
Maximum increase	26.3%	52%	Housing-Need-H
Average increase	17.2%	32.0%	All projections

Figure 3: Population growth 2020-2100

Figure 4: Range in WRSE household population for the Housing-Need and ONS-18 scenarios under Principal (P), High (H) and Low (L) projections



2.11 However, at WRZ level, there is considerable variation around this average with the minimum growth to 2100 ranging from -6% to 13% and the maximum growth from 16% to 46% for the same period. There is also a wide variation on which growth forecast produces the upper and lower boundaries of the range, with two scenarios producing the minimum forecast and five different scenarios providing the maximum forecast across the WRZs. This is detailed in Table 2.

2.12 Based on data and recommendations from Edge Analytics and the WRPG, WRSE has selected to use the Housing Plan Principal (P) scenario as the baseline growth forecast.

Table 2: Maximum and minimum increase in dwellings projected for 2100 at the WRZ level

Company / WRZ	Minimum growth	Minimum growth scenario	Maximum growth	Maximum growth scenario
Affinity Water	**18%**	**ONS-18-Low-L**	**78%**	**Housing-Need-r-H**
Colne	16%	ONS-18-Low-L	83%	Housing-Need-H
Dour	38%	ONS-18-10Y-L	76%	Housing-Req-r-H
Lee	18%	ONS-18-Low-L	76%	Housing-Need-r-H
Misbourne	15%	ONS-18-Low-L	66%	Housing-Need-r-H
Pinn	17%	ONS-18-Low-L	91%	Housing-Need-r-H
Stort	28%	ONS-18-Low-L	84%	Housing-Plan-H
Wey	7%	ONS-18-Low-L	63%	Housing-Req-H
Portsmouth Water	**22%**	**ONS-18-Low-L**	**60%**	**Housing-Need-r-H**
SES Water	**20%**	**ONS-18-Low-L**	**73%**	**Housing-Need-H**
South East Water	**25%**	**ONS-18-Low-L**	**70%**	**Housing-Need-r-H**
Ashford	36%	ONS-18-Low-L	83%	Housing-Plan-r-H
Bracknell	9%	ONS-18-Low-L	58%	Housing-Req-r-H
Cranbrook	41%	ONS-18-Low-L	87%	Housing-Plan-H
Eastbourne	34%	Completions-5Y-L	80%	Housing-Need-r-H
Farnham	16%	ONS-18-Low-L	62%	Completions-5Y-H
Haywards Heath	29%	ONS-18-Low-L	80%	Housing-Need-r-H
Maidstone	34%	ONS-18-Low-L	77%	Completions-5Y-H
Tunbridge Wells	28%	ONS-18-Low-L	75%	Housing-Need-r-H
Southern Water	**24%**	**ONS-18-Low-L**	**68%**	**Housing-Need-r-H**
Hampshire Andover	18%	ONS-18-Low-L	77%	Completions-5Y-H
Hampshire Kingsclere	12%	ONS-18-Low-L	75%	Housing-Req-H
Hampshire Rural	29%	ONS-18-Low-L	90%	Completions-5Y-H
Hampshire Southampton East	13%	ONS-18-Low-L	61%	Completions-5Y-H
Hampshire Southampton West	16%	ONS-18-Low-L	54%	Housing-Req-H
Hampshire Winchester	20%	ONS-18-Low-L	67%	Housing-Plan-r-H
Isle of Wight	25%	ONS-18-10Y-L	59%	Housing-Plan-r-H
Kent Medway East	28%	ONS-18-Low-L	82%	Housing-Plan-r-H
Kent Medway West	23%	ONS-18-Low-L	92%	Housing-Plan-P
Kent Thanet	36%	Completions-5Y-L	85%	Housing-Req-H
Sussex Brighton	15%	ONS-18-Low-L	66%	Housing-Need-r-H
Sussex Hastings	24%	ONS-18-Low-L	61%	Housing-Need-H
Sussex North	28%	ONS-18-Low-L	76%	Completions-5Y-H
Sussex Worthing	35%	ONS-18-Low-L	85%	Housing-Need-H
Thames Water	**18%**	**ONS-18-Low-L**	**71%**	**Housing-Need-r-H**
Guildford	4%	ONS-18-Low-L	63%	Housing-Plan-r-H
Henley	22%	ONS-18-Low-L	77%	Completions-5Y-H
Kennet Valley	7%	ONS-18-Low-L	58%	Completions-5Y-H
London	20%	ONS-18-Low-L	75%	Housing-Need-r-H
SWA	13%	ONS-18-Low-L	69%	Housing-Need-r-H
SWOX	16%	ONS-18-Low-L	71%	Completions-5Y-H
Oxford Cambridge Arc	**20%**	**ONS-18-Low-L**	**72%**	**Completions-5Y-H**
Water Resources South East	**20%**	**ONS-18-Low-L**	**71%**	**Housing-Need-r-H**

2.13 The group considered the option of using the 'r' version of the Housing Plan scenario, whereby it is assumed that there would be a return to high household growth rates by 2039 and therefore higher growth. Evidence from recent actual and short-term forecast housing completions and availability of sites showed that this scenario was less likely and therefore it was rejected in favour of the standard Housing Plan scenario.

2.14 In its Price Review determinations in 2019, Ofwat used historic trend rather than plan-based growth forecasts recommended in the WRPG. Therefore, it was decided that it would be useful to include the Completions-5Y scenario as a proxy for trend-based projection within the modelling.

2.15 For the remaining alternative scenarios, to account for the differences in the upper and lower forecasts between WRZs, it is proposed to use the maximum, median and minimum growth projections as additional scenarios unless these are already covered by one of the scenarios identified above. This means there would be a minimum of three and a maximum of six growth scenarios per WRZ.

2.16 A summary of the list of scenarios are given in Table 3.

Table 3: List of scenarios per water resource zone

Number	Scenario	Notes
1	Housing-Plan-P (bottom-up)	Baseline Forecast
2	Maximum growth projection	
3	Median growth projection	
4	Minimum growth projection	
5	Completions-5Y-P projection	Unless it is covered by the one of the projections above
6	Housing-Need-H projection	Unless it is covered by one of the projections above

2.17 It is proposed to use the same scenarios for dwellings (i.e. household properties) growth.

2.18 For the OxCam 'Arc' area, which covers both the WRSE and WRE regions, the housing projections are based on a specific housing projection with four scenarios based on two different levels of house building and two different geographical distributions (New Settlement and Expansion).

These result in a large step change in the Local Plan projections, involving close to 1 million new homes by 2050 in the upper growth scenario, although there is considerable uncertainty in the timing of the housing delivery. We have discussed the projections with WRE in order to co-ordinate on the selection of the scenarios to be included in the demand forecasts. Since all four scenarios are equally likely, it is not possible to select any one as a more likely forecast. Therefore all four projections will be modelled in both the WRSE and WRE assessments as additional 'alternative' scenarios.

2.19 It is not intended that the population and property forecasts will be updated for the regional plan in January 2022. The initial plan was to update the base year to the first year of the previous 5-year period (2020/21) as per previous WRMP forecasts. However, due to the impact of the Covid-19 lockdown this position has been reviewed as it is important that we get an accurate representation of the baseline water requirements for the different industries and households. It has been concluded that 2019/20 is a more reliable base year as it is pre-Covid impacts. Moving forward, any additional sources of data, for example from census releases by the ONS, will be reviewed and an assessment of materiality in terms of the impact on the forecasts undertaken.

2.20 Uncertainty is modelled using a triangular distribution on the central, maximum and minimum forecasts.

Household demand – Per Capita / Household Consumption (PCC/PHC)

2.21 The second component of household demand is the level of consumption measured on either a per person (capita) or a per household basis. The method should be aligned with the approach taken on growth, and will be based on a bottom-up method consistent with the WRPG that is appropriate to each company - depending on factors such as data availability and metering penetration.

2.22 The approach taken for the region is to align the policies, assumptions, assurance and framework for calculating PCC/PHC in order to have a broadly consistent method between companies, but without necessitating the use of the same mathematical model. This is a step change from previous regional plans whereby companies used their own assumptions and methods for estimating consumption, although most companies utilised similar datasets including the use of household consumption monitors, surveys and industry research. The introduction of the Ofwat consistent methodology approach in 2020/21 has led to some convergence of methods.

2.23 The calculation of household demand is based on unconstrained demand (i.e. with no restrictions on water use such has temporary use bans) in a dry year. Restrictions are included in the options appraisal as drought options. This ensures there is no double counting of the benefit of these measures in reducing demand. We have also calculated demand in a 'normal year' for each WRZ.

2.24 Whilst companies have made commitments on reducing PCC in the long term, for the purposes of the baseline forecast only those measures which are in the current period (2020 to 2025), and therefore funded in the Price Review 2019 process, are included. This is consistent with the WRPG. All other potential reductions in PCC are included in the Options Appraisal assessment - as a range of demand management strategies - so that the selection of demand- and supply-side options is based on the model outputs.

2.25 The assumptions used in the PCC/PHC forecasts align with the benefits calculated from demand management strategies, including both consumption and leakage reduction options. This ensures that there is no double-counting nor any gaps in the quantification of savings. As part of the Options Appraisal workstream (see **Method Statement1328 WRSE Options Appraisal**) WRSE has carried out an analysis of the level of alignment on the assumptions, assurance and framework utilised by each company to make recommendations on how companies should adapt their approach for the demand forecast and options appraisal stages of the regional plan, or, if this is not possible, how the plan can account for these differences. It is recognised that further steps may need to be taken in the next planning cycle where these cannot be practically taken given the short timescale of this plan.

2.26 One key area which affects demand management is the extent to which external interventions outside of the control of the companies, including changes in government policy, will influence household consumption. For example, studies have shown that consumption from white goods would significantly reduce if mandatory water labelling was introduced, and leakage from toilets, which is estimated to occur in around 5% of toilets, could also be minimised if a combination of amendments to current building regulations and practices were introduced. The potential impact of government interventions is therefore assessed as part of the demand management strategies referred to in Section 2.22.

Non-household demand from public water supply

2.27 Non-household demand is influenced by a range of factors which need to be assessed and modelled to produce a robust forecast that also accounts for a reasonable uncertainty range.

2.28 Like household demand, the non-household demand forecast is also based on unconstrained demand in a dry year. Various levels of restriction of use on non-households are included in the options appraisal as drought options. This ensures there is no double counting of the benefit of these measures.

2.29 WRSE commissioned Ovarro to review current methods employed by member companies and compare this to the draft WRPG and the recently published National Framework to form a preferred approach (Review of Non-Household Demand Forecast Methods – Final Report). They also assessed trends in non-public water supply needs over the planning period.

2.30 Their overall conclusion is that all companies were already in reasonable alignment with the preferred approach. Where there are areas of divergence, such as accounting for climate effects, these are relatively minor in terms of the proportional effect on the forecast.

2.31 WRSE commissioned Artesia to carry out a region-wide assessment of non-household and non-public water supply demand, following the conclusions of the Ovarro report, in order to maximise alignment between companies' forecasts. The latest Artesia report is available on request (email contact@wrse.org.uk). The aim was to produce a Central (baseline) forecast for each WRZ, alongside an upper and lower forecast to account for uncertainty, using a methodology which is relatively consistent across the companies as well as adhering to the planning guidelines.

2.32 The first stage of the work involved the segmentation of non-household properties into five sectors grouped in terms of the main factor(s) that drives growth:

i. Agriculture and other weather-dependant industries
ii. Non-service industries (excluding Agriculture)
iii. Service industries – population driven
iv. Service industries – economy driven
v. Unclassified

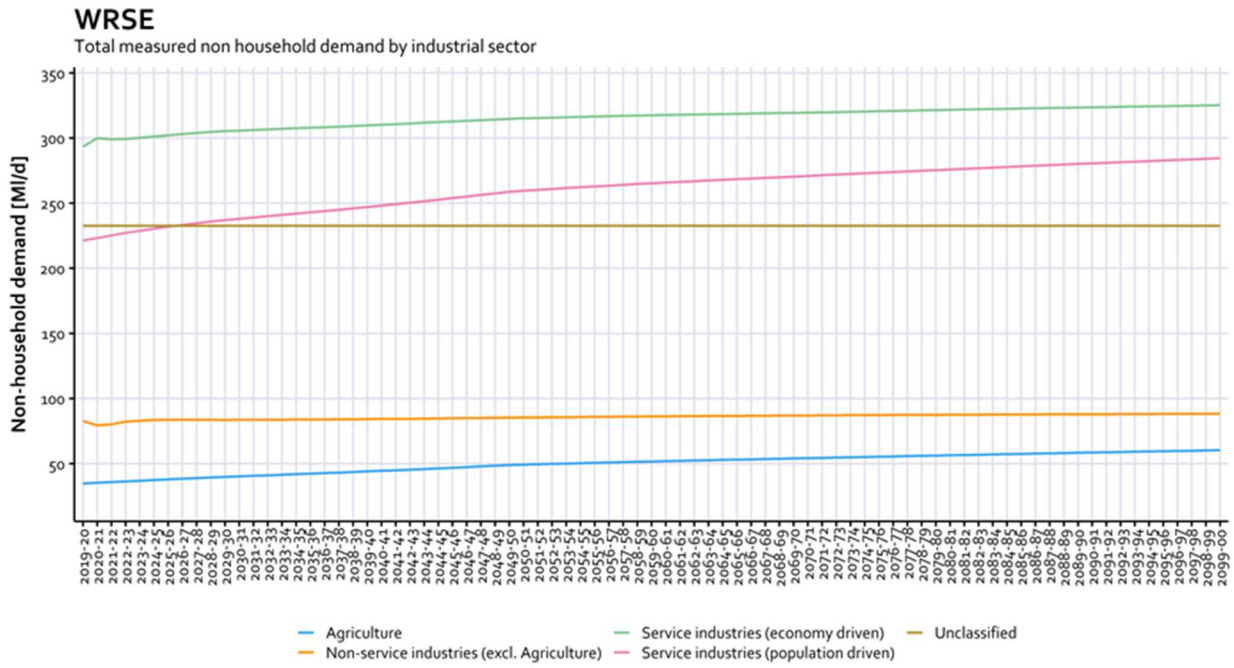
2.33 This was achieved using Standard Industrial Classification (SIC) codes, or equivalent classification systems, to assign properties to each of these sectors. The aim was to maintain the level of unclassified properties to less than 20% in each WRZ. Since market separation in 2017, SIC codes are held in the Central Market Operating System (CMOS) that is managed by Market Operator Services Ltd (MOSL), alongside consumption figures. Whilst there are significant gaps in the CMOS data and pre-CMOS data is increasingly becoming outdated and therefore cannot be relied upon, some pre-CMOS data was used to develop longer-term trends where necessary. Companies need to account for these gaps in the CMOS datasets to be able to utilise this data for forecasting purposes.

2.34 A baseline level of water efficiency (4% reduction in demand by 2050) was applied to the forecast in line with the National Framework low demand scenario. In the absence of further evidence, this would represent a reasonable assumption for a baseline water efficiency scenario driven by government policy to reduce water demand. Currently there is limited evidence that the introduction of an open market for non-household customers has driven a reduction in consumption above the historical trends, but the wholesalers continue to work jointly with retailers and track consumption of properties and sectors. Additional reductions in water use in non-households is assessed as an option and is covered within the demand strategies included in the options appraisal workstream.

2.35 For each of the sectors a different forecasting approach is required which takes into account the main explanatory factors that influence demand in that sector. These include climate, population growth (as used in the household demand forecast), employment and Gross Value Added (GVA). These factors have been compared with consumption data for each sector, where possible at a daily level in order to correlate the relationships using multi-linear regression (MLR) analysis. Due

to the limitations of the CMOS data, daily figures were only available for a selected group of properties, such as those which are logged for leakage monitoring purposes. A different approach is taken for the forecasts from 2025-2050, which can be correlated to available data, and post-2050 when a population or trend based approach is needed. The results are shown in Figure 5.

Figure 5: Public non-household demand forecast by sector

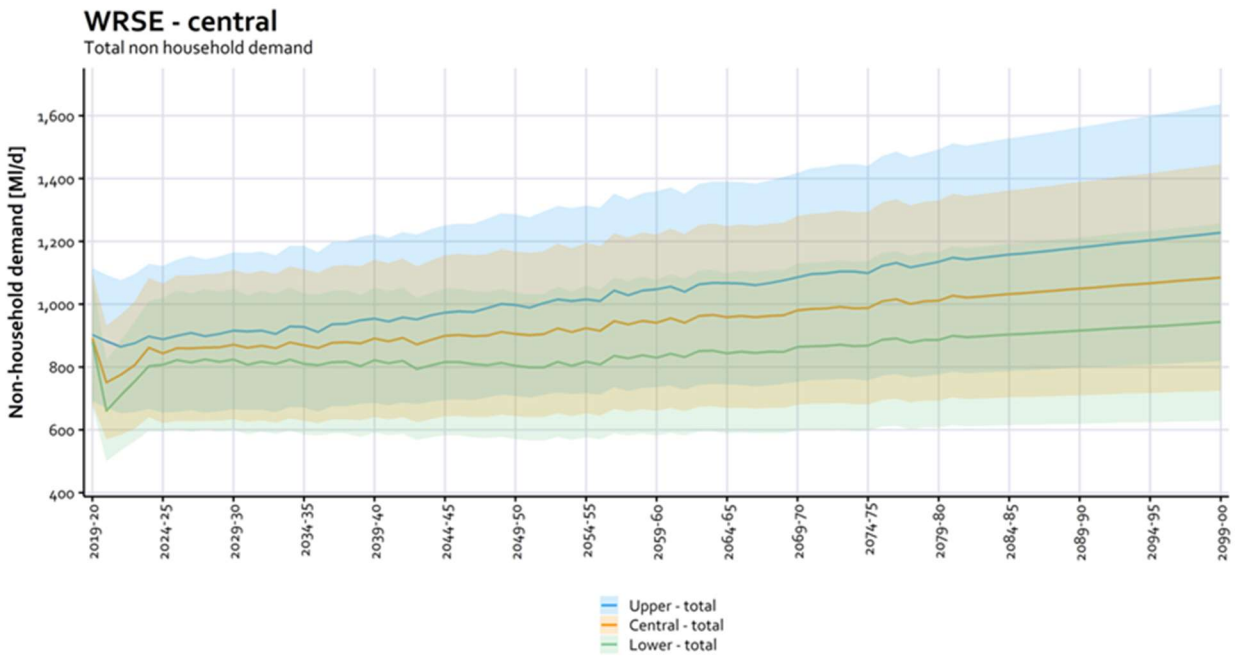


2.36 Non-standard customers with high demand requirements, such as airports, were treated separately where there was justification for doing so – i.e. a significant impact on demand in the relevant WRZ.

2.37 As with the household demand forecast, additional scenarios need to be tested to account for uncertainty in the datasets. This is detailed in Section 6 of the Ovarro report and Section 2.4 of the Artesia Report. For sectors driven by population growth, these scenarios align with those referred to in the household demand section above. Where the sector is predominantly driven by economic factors, usage during historic employment/unemployment or GVA metrics can be used to derive an upper and lower forecast, alongside the central forecast. It is noted that both Brexit and Covid-19 have the potential to affect the economy in a similar way as the 2008/09 recession, and therefore these scenarios have been modelled and the results included in the Artesia report. The upper and lower forecasts are shown against the central forecast in Figure 6. The early years, pre-2025, includes a significant amount of volatility due to a combination of Covid-19 impacts and Brexit, with uncertainty around recovery from these effects largely uncertain at this stage.

2.38 As with household demand, uncertainty has been modelled using a triangular distribution of the central, upper and lower forecasts.

Figure 6: Public Non-Household Demand Upper, Central and Lower Forecasts

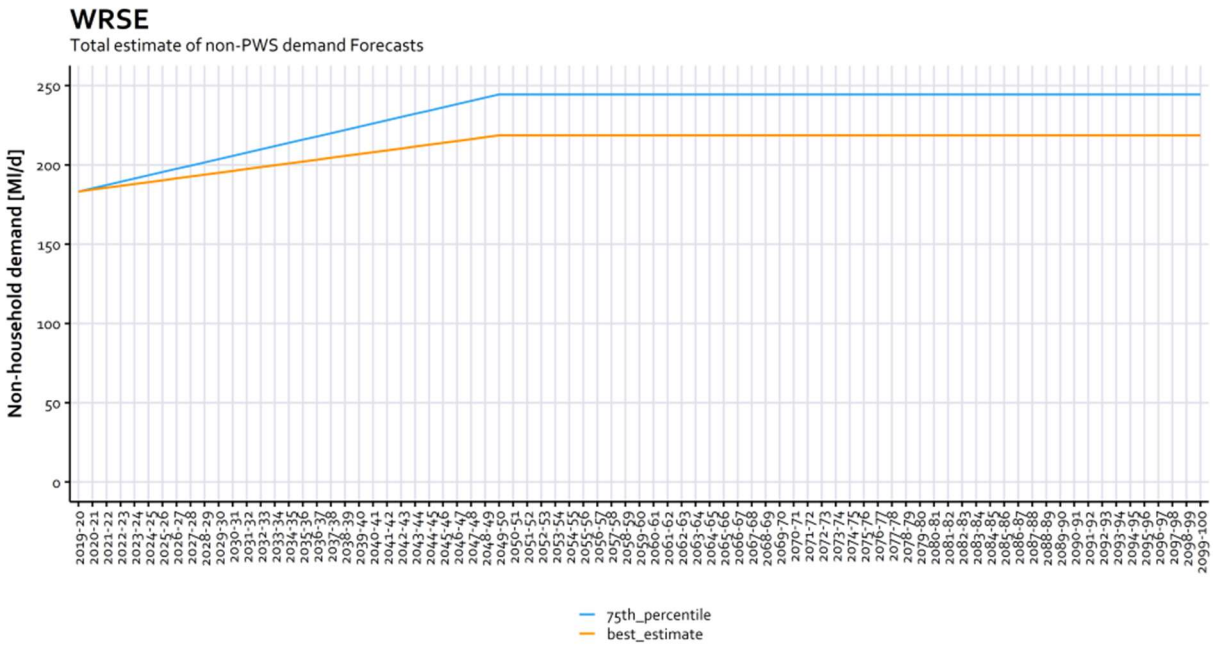


Non-household demand from non-public water supply

2.39 Forecasting demand from the non-public water supply sector is considerably more challenging given the lack of data. Whilst the impact on overall demand is relatively small, at a current level of around 150 million litres per day in comparison to an overall demand of 5 billion litres per day in the PWS sector, the WRSE member companies are working together with the Environment Agency and other stakeholders to better understand the locations and volumes associated with non-public consumptive abstraction of water and in particular any future changes to permitted direct abstraction. As well as to identify if abstractors are more likely to use public supplies in future, for example due to climate change.

2.40 The analysis carried out by Artesia involved further developing the analysis carried out by Wood plc on behalf of Defra and the Environment Agency by classifying abstractions into sectors such as spray irrigation and power generation. Non-consumptive data was removed and the best estimate of growth and 75 percentile growth applied and the results assigned to a WRZ. This is summarised in Figure 7 below.

Figure 7: Non-public water supply forecast



2.41 We have also set out our multisector approach in a separate Method Statement (**Method Statement 1334 WRSE Multi-Sector Approach**) and we will work with the multisector stakeholder group to develop an improved understanding of their requirements over the planning horizon by combining their knowledge of their business with the forecast information we gain from the non-household demand forecast.

Leakage and minor components

2.42 The Environment Agency published a supplementary guidance note on leakage in September 2020. In terms of this Method Statement, the relevant section is on baseline leakage calculations.

2.43 In line with the WPRG and the supplementary guidance note, WRSE has taken the same approach with forecasting baseline leakage as with PCC/PHC in that only those measures in the current Business Plan up to 2025 are included in the baseline forecast, with leakage remaining consistent thereafter, regardless of any increase in customer connections. It is assumed that planned reductions in leakage in the 2020-2025 period is achieved.

2.44 The introduction of the Ofwat consistent methodology has already required all water companies to broadly align in their methods. This methodology was used in the 2020-2025 Business Planning period. Therefore it was not considered necessary to carry out a joint assessment of leakage across the region.

2.45 However, there will remain areas where companies could take slightly different approaches which could affect the outcome of the options analysis. Therefore the group commissioned a gap analysis to be carried out by Mott MacDonald as part of the review of demand management assumptions, assurance and framework, to assist with the baseline forecast and options appraisal. This included an assessment of external factors which could affect leakage such as the introduction of supply pipe adoption by water companies. This is detailed further in **Method Statement 1328 WRSE Options Appraisal**.

2.46 Minor components include water taken unbilled and distribution system operational use including process water for treatment works. Companies will provide forecasts by applying their existing methodology since it is not considered that any differences will have a material impact on the forecasts.

Modelling climatic factors

2.47 The final component of the demand forecast is to assess the impact of weather on demand, as measured by distribution input (DI), by analysing historic trends and modelling them against a range of factors including population, leakage level, meter penetration, mains length and demand restrictions. This allows a 'normalised' demand to be derived which can be used for the baseline demand forecast under different climate scenarios.

2.48 The method used to model demand to take account of these factors was completed for WRSE by WRc (Dynamic Demand Modelling for WRSE). Key points from the methodology report are described below. Further analysis was carried out by Artesia to try to resolve the issue of WRZs where a good fit with the model was not achieved.

2.49 A weather series for each WRZ was created using HadUK 1km data points of minimum and maximum temperature and rainfall from 1981 to 2018, thus including a range of droughts including those where usage restrictions have been applied.

2.50 The modelling looked at both multi-year trends and within-year seasonal factors to explain the differences in demand. Most variables correlate with demand in a linear way, and the model showed that this form of modelling was able to produce good results in around two-thirds of WRZs. By applying a more complex type of modelling (involving machine learning), the results, as measured through a range of statistical metrics, produced a predicted demand that was good or excellent in the majority of cases, and adequate in all WRZs. An online modelling tool was provided to allow companies to use the datasets and algorithms to produce their own demand series under a range of weather-related variables.

2.51 The outputs from the assessments have also been modelled using stochastic climatic datasets to produce demand under different drought severities. These were matched with the climate scenarios used in the supply forecasts, thus creating a consistent series of potential supply-

demand balances which will be used in the hydrological modelling of supplies (see **Method Statement 1330 WRSE Hydrological Modelling**). A time series of minimum and maximum temperature rainfall was produced using the HadUK gridded weather data and the same 48-year stochastic series. A matrix is produced for each WRZ from which a predicted and normalised demand value can be calculated.

Planning scenarios

2.52 In addition to producing a range of demand forecasts to account for population growth (3-6 scenarios) and non-household demand (3 scenarios), there are a number of planning scenarios to consider.

2.53 As a minimum, for each WRZ an assessment of demand expressed as Normal Year Annual Average (NYAA) and Dry Year Annual Average (DYAA) is needed. In most cases a Dry Year Critical Period (DYCP) or a Dry Year Peak Week (DYPW) scenario is also required, to account for peak demand. An assessment of historical constraints including recent prolonged cold weather and hot weather periods (such as those experienced in 2018) is taken into account in determining the period required for the peak demand assessment.

2.54 For those WRZ where the autumn groundwater levels are assessed separately in the supply forecasts, an assessment of demand in a minimum deployable output (MDO) scenario should also be included.

2.55 We have accounted for the additional demand that will occur in a 1-in-200 and a 1-in-500 years drought through the analysis carried out by both WRc and Artesia, through the use of uplift factors that can be applied to normal and dry year annual average and critical peak demands.

2.56 As stated, the effect of demand management in addition to that included in the baseline demand forecasts is modelled as part of the Options Appraisal workstream. This includes both leakage and usage reductions through behaviour change and other inventions, plus the effect of national government interventions such as water labelling of water-using products.

3 Summary

3.1 WRSE has forecast demand under a range of scenarios to account for a reasonable level of uncertainty across the planning period. An initial demand forecast is required for the draft regional plan in September 2021. This will be updated to reflect the base year 2020/21 for the revised plan.

3.2 For population growth, between three and six scenarios have been calculated using both Local Authority housing plans and ONS trend data in order to assess demand needs across high to low growth scenarios. At a regional level, population forecasts vary between 5% and 52% by 2100. As each WRZ has differing levels of past and projected housing growth, as well as different demographics, the scenarios selected will vary across the region to reflect this.

3.3 For the OxCam housing forecast, which affect both the WRSE and WRE regions, all four scenarios of housing growth will be tested as alternative scenarios to the central forecast. This approach is the same as that to be taken by WRE.

3.4 Household consumption will be calculated using guidance set out in the WRPG and Ofwat consistent PCC methodology. To reduce inconsistencies in the household demand forecast over the region and assist with the assessment of the benefit of demand options at a further stage in the overall plan we have co-ordinated to align our approaches.

3.5 Non-household demand has been forecast by categorising customers into five sectors using the SIC code or other similar classification system. For each sector a different forecasting approach has been applied using the most dominant factor(s), with a central forecast produced alongside an upper and lower demand level.

3.6 Leakage is forecast using the Ofwat consistent methodology, with an alignment of assumptions used across companies wherever practicable. Demand from minor components will be based on existing individual company models.

3.7 To account for weather effects, historical recent demand has been modelled dynamically to determine the effect of both weather and a number of other variables. This allows a normalised demand level to be calculated from which the baseline forecast can be derived, and also the effect of stochastically modelled drought frequencies.

3.8 Demand has also been modelled against a range of planning scenarios, including normal year and dry years, and also periods of peak demand and minimum deployable output, where relevant, with uplift to account for the additional impact of 1-in-200 and 1-in-500 years drought severities.

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.