



WRE Population & Property Forecasts

Methodology & Outcomes

July 2020



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Acknowledgements

Demographic statistics used in this report have been derived from data from the Office for National Statistics, licensed under the Open Government Licence v.3.0.

Note: throughout this document the term 'forecast' is used as a generic term to encapsulate the range of trend projections and plan-led forecasts presented in the analysis.

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The authors of this report do not accept liability for any costs or consequential loss involved following the use of the data and analysis referred to here; this is entirely the responsibility of the users of the information presented in this report.



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1 Introduction

Context

- 1.1 The UK is at a watershed moment in its political, economic and demographic history. The country's decision to exit the European Union (EU) and the electoral mandate given to the new government, has been quickly followed by the unprecedented impact of the Coronavirus pandemic. Predicting when and how the UK recovers from the current crisis and the economic and demographic futures that will result, presents a real challenge. Amidst this uncertainty, the UK government has clearly stated its determination to accelerate the rate of house building, introducing targets and incentives to ensure that an aspirational objective of 300,000 new homes per year is achieved¹.
- 1.2 Robust evidence on future housing growth and demographic change, are key components of the Water Resources Planning Guidelines (WRPG)^{2,3}, issued by the Environment Agency (EA) and Natural Resources Wales, in collaboration with the Department for Environment, Food and Rural Affairs (Defra), the Welsh Government and Ofwat. These guidelines for the development of Water Resources Management Plans (WRMP) are now accompanied by similar documentation for the development of Drainage and Wastewater Management Plans (DWMP)⁴, for which housing and demographic evidence is of equal importance.
- 1.3 A key enhancement to previous WRMP cycles is the EA's development of a new national framework for water resource management, consisting of five regional water resource planning groups: Water Resources South East (WRSE), Water Resources East (WRE), Water Resources South West (WRSW), Water Resources West (WRW) and Water Resources North (WRN). Evidence on future housing and population growth are critical to the collective business planning process, informing each region's Statement of Regional Resource Position (SRRP) and the WRMP24 statements of each member of the regional alliances.

Regulatory Guidance

- 1.4 The WRPG provides a framework for water companies to follow when developing and presenting their WRMPs. The guidelines summarise the key requirements for population, property and occupancy forecasts that feed into WRMP evidence, emphasising the importance of using housing growth evidence from Local Plans:

¹ [MHCLG, Planning for the Future \(March 2020\)](#)

² [Water Resources Planning Guideline \(May 2016\)](#)

³ [Water Resources Planning Guideline, Interim Update \(July 2018\)](#)

⁴ [Drainage and Wastewater Management Plans \(September 2019\)](#)

“For companies supplying customers wholly or mainly in England you will need to base your forecast population and property figures on local plans published by the local council or unitary authority.” (section 5.3)

1.5 The WRPG acknowledges that councils may be at different stages of Local Plan development but states if a local council has:

- *“...a published adopted plan that is not being revised, you must take account of the planned property forecast. You will need to ensure your planned property forecast and resulting supply does not constrain the planned growth by local councils. If you adjust the planned property forecast and select a higher number, you will need to justify why you have selected a higher forecast and provide evidence.*
- *published a draft plan but it has not yet been adopted you must take account and use this as the base of your forecast. You should discuss with your local council whether it expects to make changes to the forecast for the adopted plan*
- *not started or published a draft plan you should use alternative methods such as household projections from Department of Communities and Local Government or derive your own analysis using methodologies outlined in UKWIR (2016) Population, household property and occupancy forecasting” (section 5.3)*

1.6 The WRPG highlights a number of additional requirements concerning the data inputs and assumptions used in the development of population, property and occupancy forecasts. It requests that water companies should:

- *“Clearly describe the assumptions and supporting information used to develop population, property and occupancy forecasts. You should demonstrate you have incorporated local council information (particularly in relation to their published adopted local plans) in England.*
- *explain the methods you have used to forecast property figures after the planning period used by local councils (for example from years 15 to 25 in the planning period).*
- *demonstrate how you have included other sources of information and amended your forecast accordingly” (section 5.3)*

1.7 The WRPG makes explicit reference to the likely uncertainty associated with demographic forecasts, requiring water companies to:

- *“Clearly describe any limitations in your forecast*
- *Demonstrate that you understand the uncertainty associated with your forecasts*
- *Clearly explain the assumptions, risks and uncertainties associated with the results.*
- *If you are using a planning period beyond 25 years and are basing decisions on this forecast, you should explain the range of uncertainties this long-range forecast will have and how your plan will adapt to these.” (section 5.3)*

- 1.8 WRMP demographic evidence must include an indication of the size of the population not captured in published statistics, with the guidance requesting that water companies should:

“explain the assumptions about how you have derived unaccounted population” (sect. 5.3)

- 1.9 Finally, the WRPG requests that the methodology for allocation of population and property forecasts to Water Resource Zones (WRZs) is made explicit, requesting that water companies:

“describe how you have allocated populations to the geographically different WRZs, e.g. using neighbourhood plans or census data to further subdivide the populations” (sect. 5.3)

- 1.10 To support the WRPG demographic guidance, UKWIR has produced a suite of documents which provide advice on the development of population, property and occupancy forecasting.⁵ The UKWIR documentation is in three forms: a **Guidance Manual**; a **Worked Example**; and a **Supplementary Report**. The latter includes a review of engagement with key industry stakeholders and a technical review of potential forecasting approaches that underpin the WRMP guidance methodology. The UKWIR Guidance Manual is not prescriptive in terms of methodological recommendations. It provides guidance on the issues that should be considered at each stage of development but provides scope for water companies to consider and apply methods they deem to be appropriate.

This Document

- 1.11 Edge Analytics is a Data Science specialist, applying a combination of research, data, technology and analytical models to generate insight that better informs business planning and decision-making. Edge Analytics has a particular expertise in demographic modelling and forecasting and has developed a suite of products to meet the regulatory requirements for evidence-based planning in the water industry.
- 1.12 This document provides a guide to the **VICUS** methodology that has been used to configure and deliver housing and population growth evidence to the water industry’s new regional planning framework, informing WRMP and DWMP processes for individual water companies.
- 1.13 Section 2 provides an overview of the **VICUS** framework, plus a summary of the mix of data sources required to inform the forecasting process: a combination of water industry data, Local Plan housing evidence (**Consilium**), plus population and related demographic statistics.
- 1.14 Section 3 describes the forecasting methodologies employed to derive and present the suite of scenarios, at macro- and micro-level and for a horizon that stretches to 2100.
- 1.15 Section 4 summarises the format and content of the forecasting output that has been produced to inform the WRMP and DWMP planning process, at regional, WRZ and micro-scales.

⁵ [WRMP19 - Methods - Population, Household Property and Occupancy Forecasting \(December 2015\)](#)

2 Framework & Data Inputs

Forecasting Framework

- 2.1 The VICUS forecasting framework for the configuration and delivery of population and property forecasts is illustrated below (Figure 1).

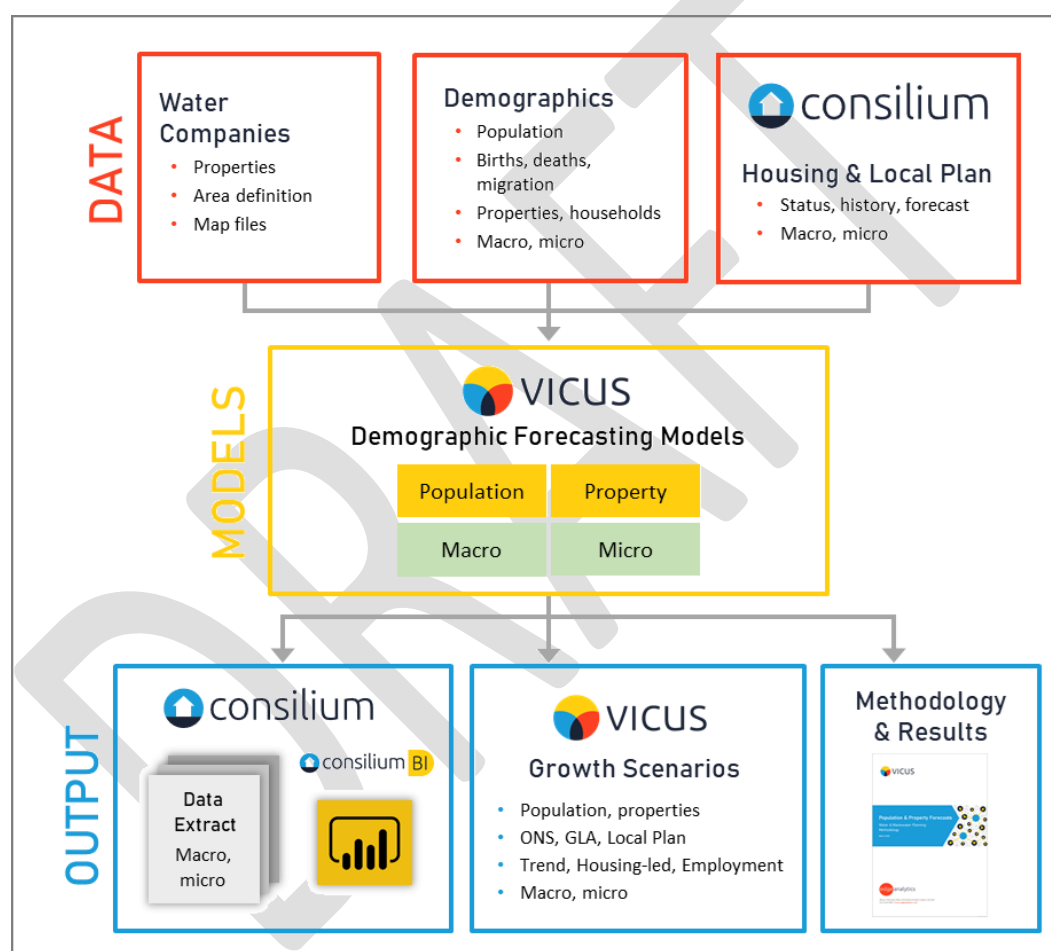


Figure 1: VICUS Forecasting Framework

- 2.2 Robust and timely data inputs are key to the forecasting process, including precise area definitions for water company geographies; Local Plan evidence from all local authorities; plus, historical and base-year demographic statistics on population, births, deaths, migration and properties.
- 2.3 The VICUS model combines all data inputs within best practice forecasting methodologies, enabling macro- and micro-level population and property growth scenarios to be derived under a wide range of assumptions, for scenario horizons that stretch to 2100.

- 2.4 The forecasting framework integrates key housing-led scenarios, alongside complementary evidence produced by the Office for National Statistics (ONS), the Greater London Authority (GLA) and the Welsh Government (WG).
- 2.5 Outputs from the process are delivered as (Microsoft Power BI) Dashboard summaries to encourage wider consumption; as detailed datasets to enable further scrutiny and analysis; and as documentation to ensure transparency and robustness of methodology.

Water Company Data

- 2.6 Water company geographies do not conform to the administrative areas for which population and other demographic statistics are typically available (e.g. district, ward, output area), so area-matching is a critical component of the forecasting framework.
- 2.7 Boundary files have been provided by individual water companies, for Water Resource Zone (WRZ) geographies (Figure 2) and for a variety of other water and wastewater areas. The Royal Mail's Postcode Address File (PAF) has provided the postcode-level property distributions from which the detailed 'lookup' between water industry and administrative geography has been made, enabling population and property growth forecasts to be apportioned for WRMP and DWMP purposes.

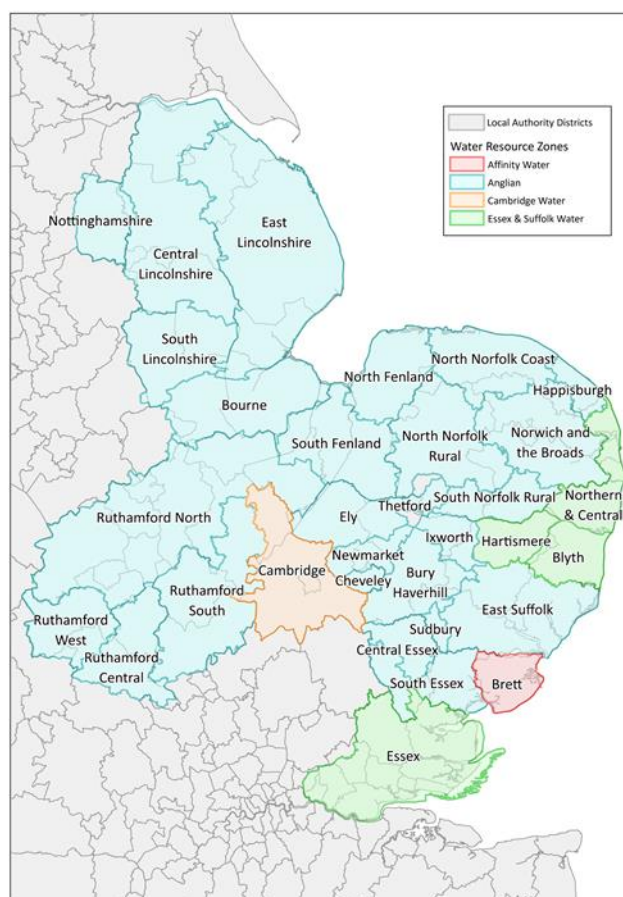


Figure 2: WRE Water Resource Zone Geography

Demographic Data & Assumptions

Population

- 2.8 Data on *historical* population change are drawn from ONS mid-year population estimates (MYE). This data records population by single year of age (0–90+) and sex, with 2018 being the latest MYE available.
- 2.9 Successive ONS sub-national population projections (SNPP) have different base population (e.g. the 2018-based projections have a 2018 base year). For ease of comparison, the scenarios presented within the VICUS framework have been recalibrated to ensure a consistent 2018 base-year population.
- 2.10 In the formulation of its growth scenarios, the Greater London Authority (GLA) has produced a modified set of MYE for its London boroughs, taking account of issues associated with the incorrect treatment of children in estimated migration flows to and from individual boroughs.

Fertility & Mortality

- 2.11 Historical statistics on births (by sex) and deaths (by age and sex) are drawn from the ONS MYE dataset. Age-specific fertility rates (ASFR) and age-specific mortality rates (ASMR) are derived from these historical birth and death statistics, in combination with area-specific population data.
- 2.12 Long term assumptions on changes in age-specific fertility and mortality are determined by the ONS National Population Projection (NPP) series, the latest of which is the 2018-based round of projections.
- 2.13 Forecasts of future births and deaths are based on the application of ASFR and ASMR schedules (and their associated long-term assumptions) to the changing 'population-at-risk' in an area.

Migration

- 2.14 Historical statistics on both internal and international migration are drawn from the ONS MYE dataset, providing inflow and outflow data by five-year age group and sex.
- 2.15 Different scenarios apply different assumptions on the future impact of migration, typically drawn from the 2001–2018 historical time-period (e.g. 5-year history, 10-year history, 18-year history).
- 2.16 Forecasts of internal migration are based on the application of age-specific migration rate schedules to the changing 'population-at-risk' in an area. International migration is forecast as a fixed annual balance between emigration and immigration effects.
- 2.17 ONS and GLA scenario assumptions on migration are reproduced within the VICUS framework. Housing-led scenarios use migration as the balancing factor which matches population growth to planned changes to an area's housing stock.

Households & Properties

- 2.18 The household and dwelling (property) implications of each population growth trajectory are estimated through the application of household representative rates, communal population statistics and a dwelling vacancy rate.
- 2.19 A household representative rate is defined as the *“probability of anyone in a particular demographic group being classified as being a household representative”*. The household representative rates used in the VICUS framework have been drawn from the Ministry for Housing, Communities and Local Government’s (MHCLG) 2014-based household projection model, which is underpinned by the ONS 2014-based sub-national population projection.
- 2.20 Following the financial crash of 2007/08, there has been a reduction in the rate of household formation amongst young adults. In the housing-led scenarios presented within the VICUS framework, the potential for a return to higher rates of household formation amongst young adults is considered, returning household representative rates to their 2001 levels by 2039.
- 2.21 Forecasts of household and property numbers exclude the population 'not-in-households', i.e. those living in communal establishments⁶. These data are drawn from the MHCLG 2014-based household projections, using statistics from the 2011 Census. For ages 0–74, the number of people not-in-households in each age group is fixed throughout the forecast period. For ages 75–85+, the proportion of the population not-in-households is recorded, so the population not-in-households for ages 75–85+ varies across the forecast period depending on the size of the age-group population.
- 2.22 The relationship between household and properties is modelled using a 'vacancy rate', sourced from the 2011 Census.
- 2.23 All scenarios have been calibrated to ensure a consistent 2020 property total. The base year property total for each individual output area (OA) has been drawn from the Royal Mail’s PAF. As a validation step and to avoid inappropriately small property numbers, 494 OAs (out of a total of 181,408 in England & Wales) had their PAF address count total replaced with a 2011 Census dwelling count.

Labour Force & Jobs

- 2.24 The relationship between population change and employment is modelled using key assumptions on economic activity, unemployment and commuting.
- 2.25 Economic activity (participation) rates are the proportion of the population that are actively involved in the labour force, either employed or unemployed and looking for work. For each area, economic activity rates by five-year age group (ages 16–89) and sex have been derived from Census statistics, with forecast adjustments made in line with the Office for Budget Responsibility’s (OBR) analysis of labour market trends in its 2018 Fiscal Sustainability Report⁷.

⁶ Communal establishments include prisons, residential care homes, student halls of residence and certain armed forces accommodation.

⁷ [OBR, Fiscal Sustainability Report 2018](#)

- 2.26 The unemployment rate is the proportion of unemployed people within the total economically active population. For each local authority area, historical unemployment rates are sourced from ONS model-based estimates, utilising data on unemployment benefit claimant counts.
- 2.27 A commuting ratio indicates the balance between the level of employment and the number of resident workers within a local authority area. A commuting ratio greater than 1.00 indicates that the size of the resident workforce exceeds the level of employment available in the area, resulting in a net out-commute. A commuting ratio less than 1.00 indicates that employment in the area exceeds the size of the labour force, resulting in a net in-commute.

Consilium Local Plan Data

- 2.28 The development of growth forecasts to inform WRMP24 plans must be underpinned by evidence on Local Plan housing growth for those Local Planning Authorities (LPA) that overlap the WRZ geography. The Local Plan development process is often lengthy and complex, with each LPA at a different stage of plan development. MHCLG and Homes England continue to apply pressure to accelerate housing delivery, whilst the UK's exit from the EU and the current pandemic crisis, create considerable uncertainty regarding future economic and demographic change.
- 2.29 Edge Analytics' **Consilium** database has been developed to enable the collection, processing, organisation and delivery of Local Plan evidence, for all LPAs across the UK (including National Parks and Development Corporations). Data is collected at a macro level, providing Local Plan evidence for individual LPAs, and at micro level, providing site-specific housing growth locations.
- 2.30 Local Plan evidence comes in a variety of forms, with considerable variation between LPAs. The Consilium database has sought to bring order, coherence and consistency to the evidence, with a classification of housing documentation and statistics detailed below (Table 1). This classification reflects the format and content of LPA evidence and includes historical **completions**, housing **need**, housing **requirement**, housing **supply** and planned **delivery**.
- 2.31 For each LPA that falls within WRZ boundaries, Consilium provides a summary of all Local Plan housing evidence, presenting information on: Local Plan status; historical and planned housing growth trajectories (including LPA and MHCLG completion statistics); housing need; housing requirements and targets; plus housing growth locations (site data). Also included within Consilium is the MHCLG's Housing Delivery Test and the latest LPA 5-year land supply calculations.
- 2.32 The site data provides geocoded information on housing growth locations, the number of planned units and the likely phasing (timing) of development. This information is key to the configuration and calibration of the micro-level, 'bottom-up' forecasts.
- 2.33 A 'Status Log' indicating the date at which Local Plan information was last accessed for each LPA is provided in Appendix B.

Table 1: Consilium - Housing Data Classification

1	Completions	Historical housing completions (net), sourced from Local Authority data and the MHCLG (Live Table 122).
2	Local Housing Need (LHN)	Minimum housing need, as calculated using the MHCLG 'standard method', which is based on the 2014-based household growth projections, with an adjustment to account for affordability.
3	Objective Assessment of Need (OAN)	A measure of future need, as calculated by the planning authorities (used prior to the introduction of the LHN).
4	Requirement	As set out in the NPPF, the housing requirement (provision target) identifies the extent to which the identified need can be met over the plan period.
5	5 Year Supply	The 5-year land supply is a calculation of whether there is a deliverable supply of homes to meet the planned housing requirement over the next 5 years.
6	HLA	The land availability assessment is carried out by planning authorities to assess the availability, suitability and achievability of sites and broad locations for potential housing development.
7	Planned Delivery	Planning authorities should produce a trajectory of expected housing delivery over the plan period, with the anticipated rate of development for specific sites (where appropriate). Housing trajectories are often published as part of the Local Plan and are updated annually in monitoring/land supply reports.

2.34 Consilium data is sourced from published documentation/statistics or directly from Councils, if not readily available. All site data is converted to a standard Consilium format, with all housing growth sites given a geocode (if not provided by the original source information).

2.35 Accompanying the forecasting outputs, the following Consilium data is provided:

- MS Excel spreadsheets / database extracts
- All relevant Local Plan documentation
- GIS files of housing growth sites (where available)
- Consilium-BI Dashboard powered by Microsoft's Power BI technology.

2.36 Examples of the macro- and micro-level Consilium data extracts are provided (Figure 3, Figure 4), together with an example of the Consilium-BI area reports: 'Housing & Population Growth History' and 'Local Plan Status & Housing Growth' (Figure 5, Figure 6).

Consilium: Local Plan Summary

Bedford					SUMMARY PAGE		Notes		Local Plan Status		Publication of Inspector's Recommendations (Reg 25)					Latest 5yr Supply					HDT						
District Code					E06000055		Last Updated		Part of Ox-Cam		Adopted Plan/Policies		The Council's Executive will consider the report on 8 January 2020					Data Source					Action:				
Local Council					Bedford Borough Council		2019-12-31				Date Adopted		2008-04-16					2019-05-00 - Bedford - 5yr Supply.pdf					None				
Joint/Strategic Planning Area					N/A		2019 Q4				Target (total)		16,270					Requirement					7.536				
Covered by a National Park?					No		Updated by				Target (p.a.)		814					Buffer? 5% or 20%					5%				
Is there any Sensitive Data?					YES		KN				Data Source		Plan					2001					No				
											Period		2001					Plan					5yr Supply calculation based on the				
											2019.06.18 - Bedford - HO		2019.06.18 - Bedford - HO										HDT Measurement				

Consilium: Housing Growth Locations

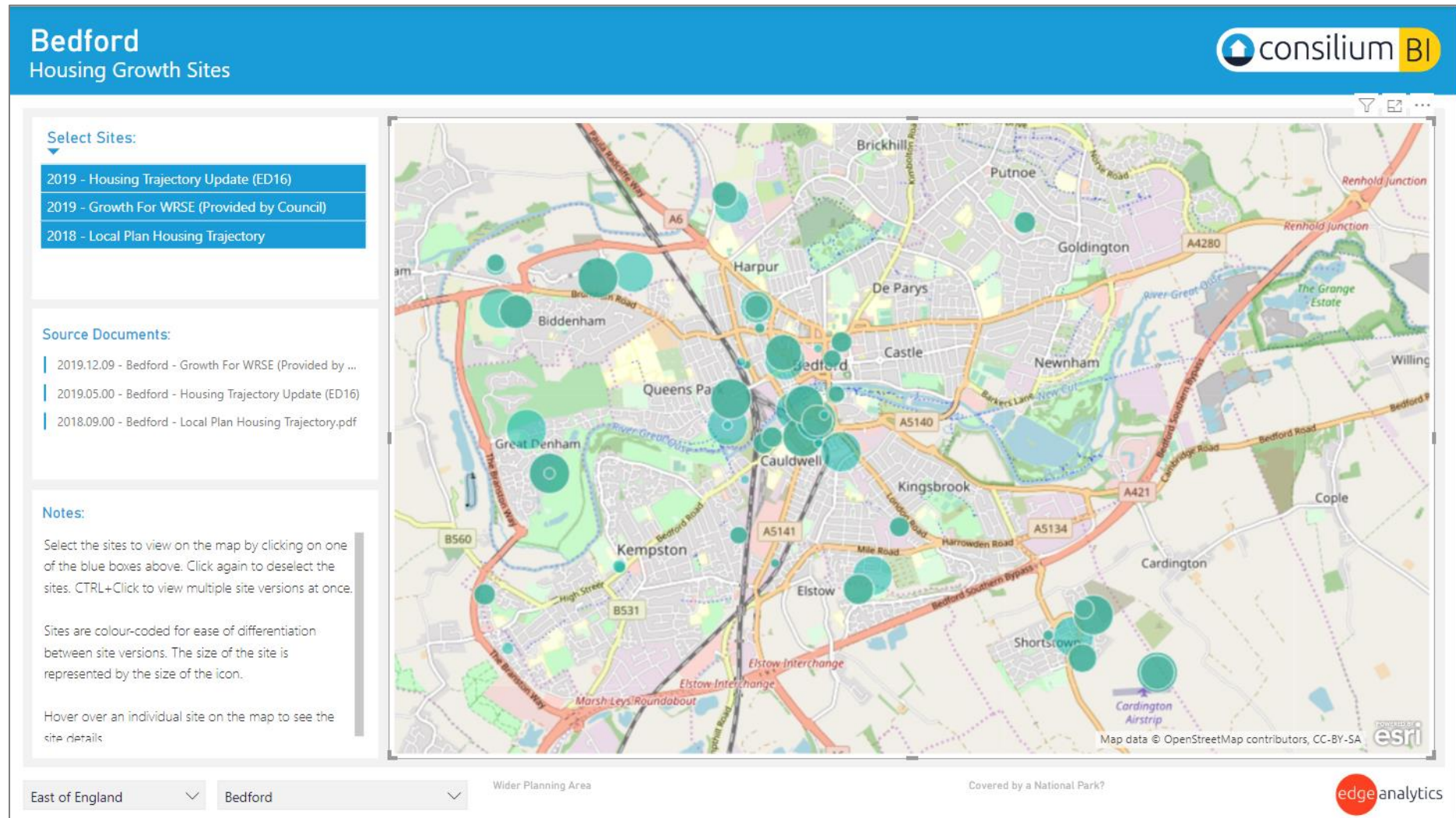


Figure 4: Consilium – Site Data – Example Only

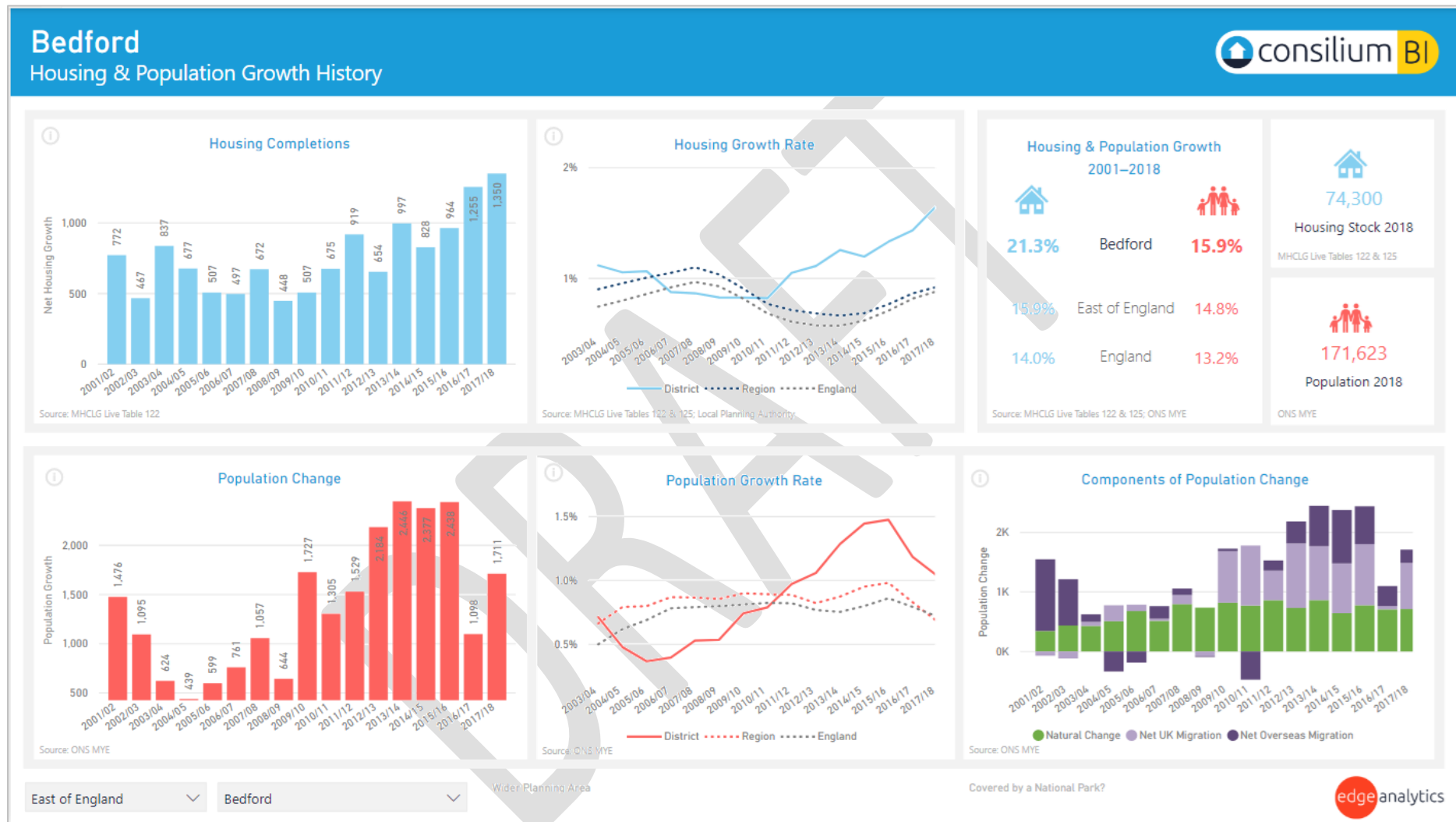


Figure 5: Consilium-BI Dashboard - Area History - Example Only

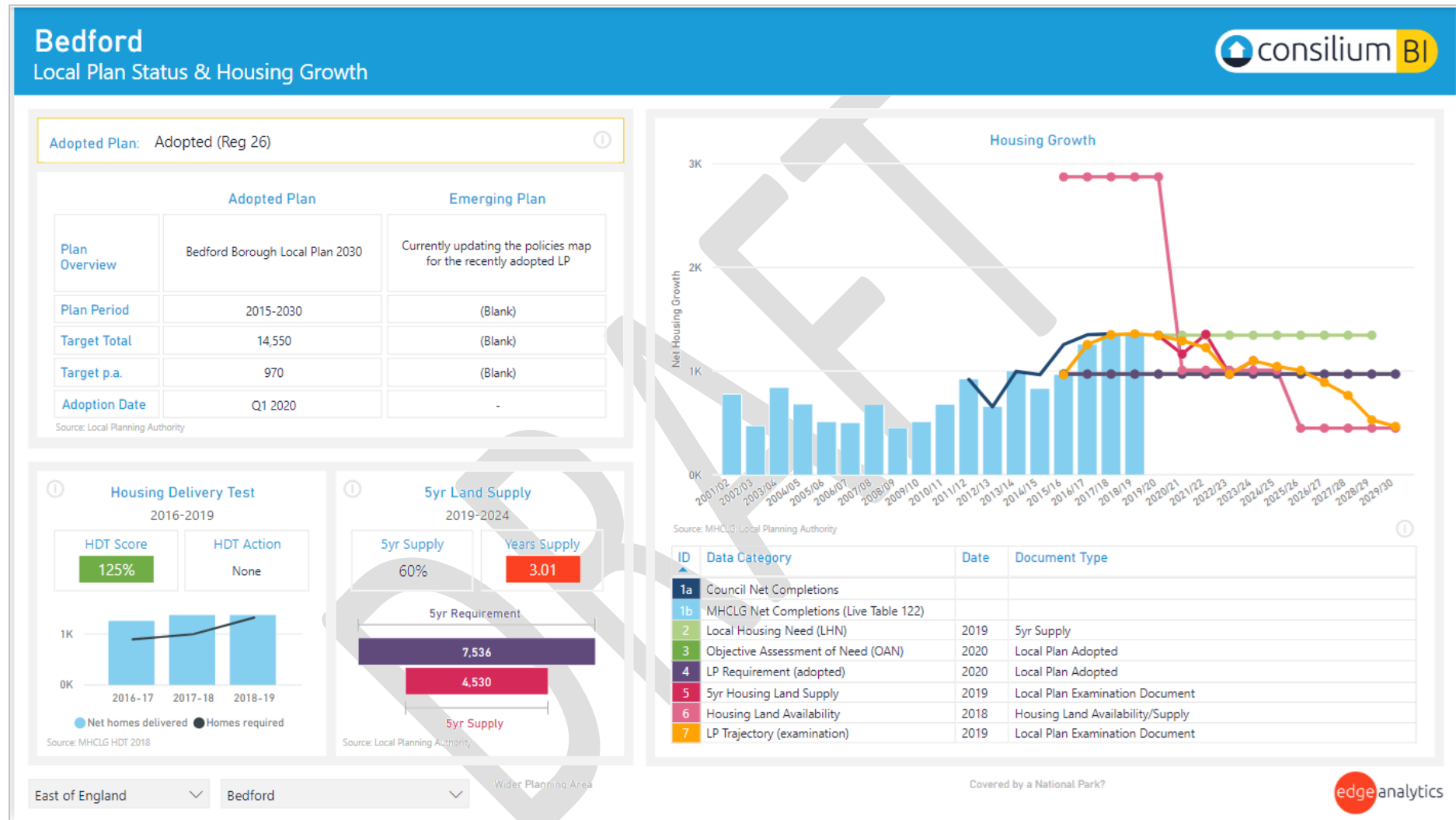


Figure 6: Consilium-BI Dashboard – Local Plan Status – Example Only

3 Methodology

Forecasting Models

- 3.1 The VICUS modelling framework combines a database of data inputs with a suite of forecasting software, enabling macro- and micro-level population and property growth scenarios to be derived under a wide range of assumptions, for scenario horizons that stretch to 2100 (Figure 1). The forecasting framework integrates housing-led scenarios, alongside trend projections which include published output from ONS, GLA and WG.
- 3.2 The key element of the framework is the cohort-component model, which uses fertility, mortality and migration components to derive population projections by single year of age, for each year of a (flexible) forecast period. The cohort-component method has a long and established history in demography and is widely used by national statistical agencies and the research community.
- 3.3 A household model and labour force model link directly to population output from the cohort component model, enabling the derivation of property and employment forecasts.
- 3.4 The household model uses a combination of household representative rates, communal population statistics and a dwelling vacancy rate to estimate the household and dwelling (property) implication of each population growth trajectory.
- 3.5 The labour force model uses key assumptions on age-specific rates of economic activity (participation), unemployment and commuting, to estimate the relationship between population change and employment.
- 3.6 Importantly, the household and labour force models can be run in 'housing-led' or 'employment-led' mode, using pre-determined forecasts of housing or employment to estimate the likely population growth associated with each. Migration provides the balancing factor, altering population growth to meet annual housing or employment growth targets.
- 3.7 The 'housing-led' approach is particularly important in the evaluation of alternative trajectories of housing growth derived from the range of Local Plan evidence published by LPAs. A 'housing-led' scenario is also an important element of the suite of output published by the GLA.
- 3.8 Where data on site-level housing developments is available from an LPA, the 'housing-led' approach reverts to a combined 'top-down' and 'bottom-up' methodology, aligning macro and micro forecasts of population change to the location and phasing (timing) of planned additions to the dwelling stock.
- 3.9 The use of micro-geographies in the forecasting methodology enables accurate aggregation of all scenario output to water company planning areas.

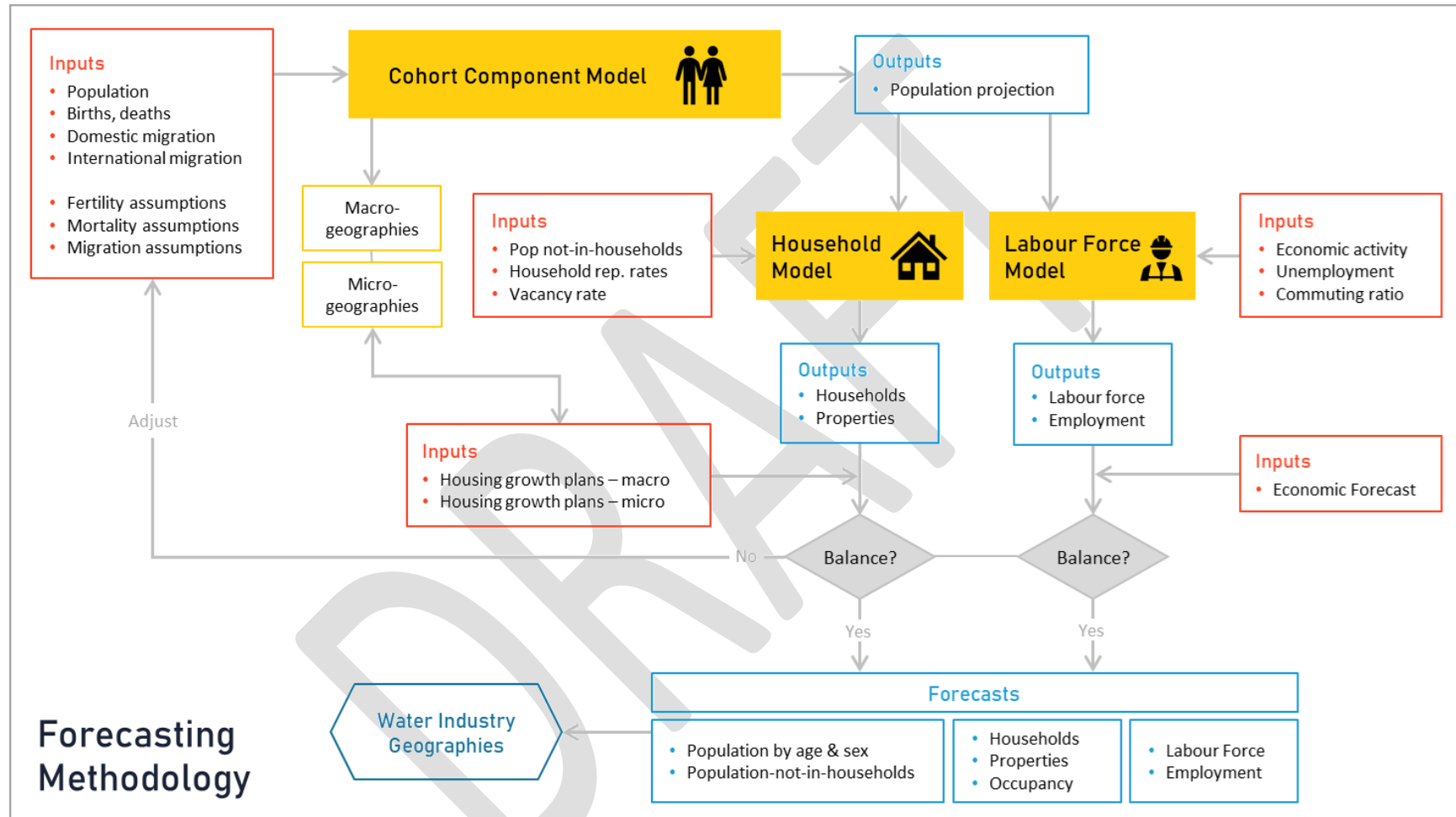


Figure 7: VICUS – Forecasting Methodology

Scenario Development

- 3.10 The VICUS framework has been used to configure and calibrate a range of scenarios, for both the 2020–2050 WRMP plan-period, plus the long-term 2020–2100 outlook. Each scenario has a growth trajectory for 2020–2050, coupled with three alternative growth scenarios for 2050–2100.
- 3.11 The range of outcomes is necessary to enable consideration of the uncertainty associated with the demographic components of population change, the effects of different scales and phasing of future housing growth, plus the impact of alternative data inputs and assumptions applied by ONS and GLA.
- 3.12 The 2020–2050 scenarios can be broadly classified into three groups (Table 2):
- **Trend projections (ONS, GLA)**
 - **Housing-led forecasts (Local Plan, GLA, OxCam)**
 - **Employment-led forecasts**
- 3.13 Growth scenarios for 2050–2100 are underpinned by fertility, mortality and migration assumptions from the ONS 2018-based NPP, configuring a principal, low and high growth outcome (Table 3).
- 3.14 For ease of comparison, the scenarios presented within the VICUS framework have been recalibrated to ensure a consistent 2018 base-year population (the latest MYE available from ONS). In addition, all scenarios have been calibrated to ensure a consistent 2020 property total, with base year property totals aligning to the Royal Mail's PAF statistics.
- 3.15 All scenarios produce statistics on population, households, population not-in-households and dwellings (properties) and occupancy. In addition, all 2020–2050 scenarios can produce output on estimated labour force and employment outcomes. A more detailed description of each of the scenarios follows, preceding an illustration of the range of growth outcomes for the WRE area of operations.

ONS & GLA Trend Projections

ONS Projections

- 3.16 ONS produces its sub-national population projections (SNPP) every two-years, following publication of the 'national' population projection (NPP)⁸. The NPP provides the constraining total for the SNPP. A cohort-component methodology underpins the formulation of the population projections.
- 3.17 ONS projections are classified by their base-date, with the latest round of projections being the 2018-based scenarios. At each successive round of the ONS projections, revisions to key assumptions on fertility, mortality and international migration are made, with the support of an expert panel of

⁸ [ONS Subnational Population Projections for England: 2018-based](#)

advisors⁹. The impact of these assumptions on the UK national projections in the 2014-based, 2016-based and 2018-based round of projections is illustrated in Appendix D.

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⁹ [National population projections, how the assumptions are set: 2018-based](#)

Table 2: VICUS – Scenario Definition, 2020–2050

ID	Scenario	Description	URL
Trend Projections	1	ONS 2014-based sub-national population projection (SNPP), using a six-year history (2008–2014) to derive local fertility, mortality and internal migration assumptions, with a long-term UK net international migration assumption of +185k p.a.	ONS 2014
	2	ONS 2016-based Principal sub-national population projection (SNPP), using a five-year history (2011–2016) to derive local fertility, mortality and internal migration assumptions, and a long-term UK net international migration assumption of +165k. In line with the ONS 2016-based national population projection (NPP), this round of projections includes a reduced UK fertility outlook compared to ONS-14 and a dampened rate of improvement in life expectancy compared to ONS-14.	ONS 2016
	3	ONS 2018-based Principal sub-national population projection (SNPP), using a five-year history (2013–2018) to derive local fertility & mortality assumptions and a long-term UK net international migration assumption of +190k. Unlike earlier rounds of SNPP, the 2018-based Principal projection uses a two-year history (2016–2018) of internal migration assumptions, following recent changes to the methodology used for its estimation, which have only covered the latest 2 years. In line with the ONS 2018-based national population projection (NPP), this round of projections includes a reduced UK fertility outlook compared to ONS-16 and a dampened rate of improvement in life expectancy compared to ONS-16.	ONS 2018
	4	ONS 2018-based Alternative Internal Migration sub-national population projection (SNPP), produced by ONS as a comparison with the Principal projection. It uses a five-year average of internal migration (2013–2018), combining 3 years of data based on the old methodology and 2 years based on the new methodology. All other assumptions are consistent with ONS-18.	
	5	ONS 2018-based High International Migration sub-national population projection (SNPP), incorporating a High long-term UK net international migration assumption of +290k p.a., with all other assumptions consistent with ONS-18.	
	6	ONS 2018-based Low International Migration sub-national population projection (SNPP), incorporating a Low long-term UK net international migration assumption of +90k p.a., with all other assumptions consistent with ONS-18.	
	7	ONS 2016-based 10yr Migration (all types) sub-national population projection, using a ten-year history (2008–2018) to derive internal migration assumptions, with all other assumptions consistent with ONS-18.	
	8	Greater London Authority (GLA) 2018-based Central population projection, incorporating: GLA's own adjustments to the mid-year population estimates of London Boroughs; local fertility and mortality assumptions, trended in line with the ONS 2018-based NPP assumptions; internal and international migration assumptions derived from a 10-year history (2008–2018). This scenario includes projections for London Boroughs and for all other local authority areas.	GLA
	9	GLA 2018-based long-term trend projection, incorporating internal and international migration assumptions derived from a 15-year history (2003–2018), with all other assumptions consistent with the Central scenario. This scenario includes projections for London Boroughs and for all other local authority areas.	
	10	GLA 2018-based short-term trend projection, incorporating internal and international migration assumptions derived from a 5-year history (2013–2018), with all other assumptions consistent with the Central scenario. This scenario includes projections for London Boroughs and for all other local authority areas.	
Housing-led Forecasts	11	GLA 2018-based Housing-led projection, based on data from the 2016 Strategic Housing Land Availability Assessment (SHLAA). Beyond 2041, housing growth is aligned to the 2035–2041 average. Whilst the housing-led approach is applied to each London Borough, the population projection for Greater London, in total, remains consistent with the Central scenario. This scenario includes projections for London Boroughs only and is combined with the Central scenario for all other local authority areas when aggregated to WRZ geographies.	GLA Housing

ID	Scenario	Description	URL
Housing-led Forecasts	12	Completions-18Y	MHCLG Live Table 122
	13	Completions-5Y	
	14	Housing-Need	
	15	Housing-Need-r	
	16	Housing-Req	
	17	Housing-Req-r	
	18	Housing-Plan	
	19	Housing-Plan-r	
Employment-Led Forecasts	20	Employment-1	
	21	Employment-2	
OxCam Housing-Led Forecasts	22	OxCam-1a-r	
	23	OxCam-1b-r	
	24	OxCam-2a-r	
	25	OxCam-2b-r	

- 3.18 To illustrate the impact of the 2018-based set of assumptions on growth outcomes, the 2014-based and 2016-based ONS projections are included in the VICUS scenario suite, for comparison.
- **ONS-14**
 - **ONS-16**
 - **ONS-18**
- 3.19 The inclusion of the 2014-based projection is important, as a considerable portion of the Local Plan evidence published by LPAs across England has been formulated using this growth scenario as a starting point in the housing need calculation.
- 3.20 Whilst the local variations in the relative contribution of international migration and natural change (births minus deaths) are influenced by the *national* assumptions applied, the *internal* migration variations have been influenced by a methodological change introduced in the 2018-based projections. ONS has implemented an improved process for recording student moves, post-graduation. As a result, internal migration profiles (particularly in local authorities with a University) have altered since 2016. The 2018-based 'Principal' projection has therefore used a two-year history (only) to calibrate its internal migration assumptions for each LPA, rather than the customary five-year history that has routinely been used in previous SNPP rounds.
- 3.21 To consider the effect of this methodological change upon population growth outcomes and to evaluate the potential for lower or higher assumptions on future growth through international migration, ONS has published four variant scenarios to accompany the ONS-18 Principal outcome. Given the uncertainty associated with international migration (in particular) in the post-Brexit and post-coronavirus world, each of these scenarios is presented for consideration within the VICUS suite:
- **ONS-18-Alt** (5-year internal migration history)
 - **ONS-18-10Y** (10-year migration history)
 - **ONS-18-High** (High international migration)
 - **ONS-18-Low** (Low international migration)
- 3.22 At a national (England) level, the ONS-18-Alt and ONS-18-10Y scenarios have identical outcomes to the ONS-18 Principal scenario, they only differ in the impact of the different internal migration assumptions at local authority level. Comparison between the ONS-18 suite of output and the equivalent GLA scenarios, is presented below.

GLA Population Projections

- 3.23 Alongside the ONS projections, the GLA also publishes its own suite of projections¹⁰. The latest round of scenarios is 2018-based and includes a 'Central' scenario, plus variants which consider both a short-term (5-year) and a long-term (15-year) history for the formulation of migration assumptions. Once again, a 'cohort-component' methodology underpins the formulation of the population projections.

¹⁰ [GLA Population and Household Projections](#)

- **GLA-18-Central**
- **GLA-18-15Y**
- **GLA-18-5Y**

- 3.24 These scenarios include projections not only for the 33 London Boroughs (LB) but also for all other local authority areas. The GLA methodology differs from the ONS approach in a number of key areas.
- 3.25 In formulating its own demographic analysis, the GLA has made adjustments to the ONS mid-year estimates for London Boroughs, primarily to account for what it has identified as over-inflation of individual cohorts of children aged 0–14. This results in a base-year (2018) population that differs from the ONS total for all London Boroughs. The VICUS methodology has rebased all scenarios to a common (ONS) base population in 2018, to facilitate a consistent comparison of growth trajectories.
- 3.26 With regard to migration, the GLA uses a 5-, 10- (Central) and 15-year history from which to derive scenario assumptions, compared to 2- (Principal), 5- and 10-year histories for the ONS projections. The GLA also derives its own area-specific fertility and mortality assumptions, but these follow the ONS trend throughout the projection period.

Housing-led Forecasts

- 3.27 Housing-led forecasts provide a different perspective on future population growth. Under these scenarios, the population impact of a pre-determined trajectory of housing growth is considered.
- 3.28 The starting point for a housing-led scenario is a trend projection, which is modified year-on-year to ensure reconciliation between population change and the capacity of the housing stock. The relationship between housing growth and population change is determined by the changing age-structure of the population, projected household representative rates (occupancy), a vacancy rate, plus the changing size of the population not-in-households.
- 3.29 In a housing-led forecast, if the demographic trend does not match the capacity of the housing stock, then the trend is altered, through higher or lower migration. If the capacity of the housing stock exceeds the population growth trend, then additional growth through migration will result. Likewise, if the capacity of the housing stock does not meet the requirements of the population growth trend, then growth is reduced through out-migration.
- 3.30 The VICUS framework incorporates a suite of housing-led forecasts, recognising the uncertainty associated with the future scale, distribution and phasing of growth across all English local authority areas. This suite of scenarios is designed to illustrate the likely population growth impact of different levels of housing growth and how these compare to the trend outcomes of the ONS and GLA scenarios.
- 3.31 A key component of any housing-led scenario is the average ‘occupancy’ associated with the changing housing stock. The general ‘ageing’ of the UK population results in a reduction in average household size, with the older population typically having smaller household sizes compared to the younger population. Since the financial crash of 2007/08, a counter trend brought about by both financial constraints and a mismatch between demand and supply of new homes, has seen a reduction in the

speed at which young adults are able to form new households, resulting in a dampening of the rate of occupancy reduction. These factors are considered in the housing-led scenario analysis.

- 3.32 The simplest housing-led scenario is one in which past rates of housing growth are continued. Using MHCLG's published data tables, in combination with Council statistics, the Consilium database has compiled a history of housing growth for each individual local authority. From this information, two VICUS scenarios have been configured. The first, a housing-led scenario based on a continuation of the rate of growth recorded in each local authority's 18-year housing completions history (2001–2019); the second, a housing-led scenario based on a 5-year completions history (2014–2019).

- **Completions-18Y**
- **Completions-5Y**

- 3.33 Under each of these scenarios the average annual housing growth calculated from the completions histories continues for the full duration of the 2020–2050 forecast period.

- 3.34 WRMP guidance has mandated that water companies need to consider population and property forecasts derived from the Local Plans published by LPAs. Local Plan development encompasses a complex mix of processes, documents and data. Consilium collates evidence from all LPAs, enforcing a consistent classification on the derived data (Table 1), enabling the formulation of scenarios that consider housing need, housing requirement and planned delivery.

- 3.35 The Planning Advisory Service (PAS) defines housing need as *"total housing that would be provided... if land supply was not constrained by planning"*. The 'Objective Assessment of Need' (OAN) was the original process established to formulate each local authority's housing need. To simplify the planning process, MHCLG introduced a 'standard method' for calculating a minimum local housing need (LHN), based on the 2014-based household growth projections, with an adjustment to account for affordability. Modifications to the LHN methodology are due for publication in 2020.

- 3.36 A housing requirement is defined in the National Planning Policy Framework (NPPF) and Planning Policy Guidance (PPG) as a 'policy target' (what policy requires), as opposed to housing need (what people or the market requires). A housing requirement identifies the extent to which an identified need can be met over the designated plan period.

- 3.37 Planned delivery of housing is also defined in the NPPF. All LPAs are required to produce a trajectory of expected housing delivery over a plan period, with the anticipated rate of development for specific sites (where appropriate). Housing trajectories are often published as part of the Local Plan and are updated annually in monitoring/land supply reports. It can be the case that these trajectories are supply-based and may be similar to the housing land *supply* figures.

- 3.38 Whilst LHN is deemed to be a 'minimum' housing need, the general trend is for housing need to present higher housing growth than the requirement, which in turn is often higher than the planned delivery. These rules do not hold in all cases. Three housing-led scenarios are presented:

- **Housing-Need**
- **Housing-Req**
- **Housing-Plan**

- 3.39 Local Plan evidence on future housing growth is typically formulated for 10–15-year period, shorter than the 2020–2050 outlook required by the WRMP. Under each scenario, following the final year of plan data available, projected housing growth in non-London local authority areas returns to a long-term annual growth average by 2050. This annual growth average has been derived from a combination of the ONS-14 and ONS-16 scenarios. For London Boroughs, housing growth returns to the GLA Central scenario long-term annual average by 2050.
- 3.40 With all housing-led scenarios, household representative rates, drawn from the MHCLG's 2014-based household model, determine the relationship between the changing age structure of the population and the number of households. However, these rates are based on time-period when household formation amongst young adults (in particular) was subject to both financial and supply constraints.
- 3.41 A key objective of all Local Plans is to redress the imbalance in the demand and supply of new homes and thus lift the rate of household formation amongst affected groups. To model the potential for a return to higher rates of household growth amongst young adults, household representative rates for 25–44 year-olds have been returned to their 2001 levels by 2039, remaining fixed thereafter. Three additional scenarios have been formulated to test the sensitivity of the household representative rate adjustments:
- **Housing-Need-r**
 - **Housing-Req-r**
 - **Housing-Plan-r**
- 3.42 The GLA includes its own housing-led outcome in its suite of scenarios¹¹. Its scenario is based on data from the 2016 Strategic Housing Land Availability Assessment (SHLAA) providing housing growth totals, with phasing, for each London Borough. Beyond 2041, housing growth is aligned to the 2035–2041 average.
- **GLA-Housing**
- 3.43 The GLA-Housing scenario adopts an alternative method for determining occupancy rates in the changing housing stock, setting upper and lower bounds for average household size in each local authority. Plus, whilst the housing-led approach is applied to each London Borough, the population projection for Greater London, in total, remains consistent with the GLA-18-Central scenario.
- 3.44 This scenario includes projections for London Boroughs only and is combined with the GLA-18-Central scenario for all other local authority areas when aggregated to WRZ geographies.

OxCam Arc Scenarios

- 3.45 The OxCam 'Arc' covers 26 Local Authority Districts (Appendix E), extending between Oxford, Milton Keynes and Cambridge. It has been identified as an area of huge economic potential^{12,13}. To support

¹¹ [GLA Housing-led Population Projections](#)

¹² Savills (2019) The Oxford-Cambridge Innovation Arc [Savills](#)

¹³ MHCLG (2019) The Oxford-Cambridge Arc, Government ambition and joint declaration between Government and local partners [OxCam Arc](#)

the Arc's economic growth potential, a requirement for up to one million new homes has been estimated to 2050, together with improvements to the transport infrastructure of the region. However, with the UK's exit from the European Union and the unprecedented, short-term effects of the COVID-19 crisis, there is considerable uncertainty around the timing of infrastructure and housing delivery.

- 3.46 Councils within the Arc are already seeking to manage significant increases in the rate of house building to meet targets set out in current Local Plans. Achievement of one million homes by 2050 would present a further step-change in housing delivery requirements.
- 3.47 An accompanying report¹⁴, presents housing-led scenarios for OxCam local authorities that are underpinned by current Local Plan evidence. In addition, the report examines the potential impact of higher housing growth across the OxCam Arc, achieving close to 1 million homes by 2050.
- 3.48 The OxCam *Housing & Population Growth* report focuses on the development of the Arc and identifies how different levels and distribution of new housing might impact upon population growth in both WRE and WRSE geographies.

Employment-led Scenarios

- 3.49 Demographic and economic change are intertwined and whilst fertility, mortality, migration and household occupancy effects can be modelled very effectively over long-term horizons, forecasting economic growth is more problematic and typically such forecasts have a much shorter, 1–5-year outlook horizon.
- 3.50 Economic forecasting within the current political and social environment is particularly challenging. There are a multitude of organisations that are engaged in the derivation of forecasts of short-term economic change. HM Treasury publishes a regular review of forecasts for the UK economy, with the latest release in April 2020, in the midst of COVID-19 lockdown. Short-term forecasts of GDP growth (and other variables) are 'averaged' from up to 40 financial and economic institutions. The latest average indicates -5.8% decline in UK GDP in 2020, with a +5% recovery in 2021. In both years, there is a 5 percentage-point range around the average, indicating the very uncertain economic outlook within a very short-term horizon.
- 3.51 The Office for Budget Responsibility (OBR) is the UK's official financial watchdog, providing "*independent and authoritative analysis of the UK's public finances*". Biannually, the OBR publishes 5-year forecasts for the UK economy to inform spring and autumn Budget Statements, accompanied by the annual publication of its Economic and Fiscal Outlook (EFO). The March 2020 EFO estimated average GDP growth of 1.4% to 2024, with an annual average employment growth of 0.5% between 2019–2024, plus a 1.5% annual rise in the unemployment rate.

¹⁴ Edge Analytics (2020) OxCam Housing & Population Growth, draft v1

- 3.52 The COVID-19 crisis has prompted the development of a coronavirus reference scenario, reflecting the HM Treasury evidence but with a sharper GDP decline and recovery in 2020/21, reverting to a 1.4% annual average, 2022–2024.
- 3.53 The current social and economic conditions have created an unprecedented but relatively short-term, interruption to normal life. Water resource planning needs to consider a much longer-term perspective on economic and demographic change. The GLA has previously published its own long-term projections of growth in employment across the 33 London Boroughs. The latest round of projections, published in 2017 estimated an average annual growth of 0.9% in workplace-based employment to 2030, declining to a 0.5% average to 2050.
- 3.54 In addition to its EFO output, the OBR also publishes its Fiscal Sustainability Report (FSR), providing a long-term outlook on economic change and its impact upon public debt¹⁵. Its long-term employment growth projections vary depending upon the degree to which international migration (and therefore the speed of population ageing) affects the UK economy. High migration outcomes estimate a 0.5% pa employment growth nationally to 2030, 0.4% to 2050. Under low-migration outcomes a 0.3% pa growth is projected across the UK to 2030, declining to 0.1% pa thereafter.
- 3.55 These forecasts of economic change are underpinned by a range of survey statistics which record historical change in employment, unemployment and business counts. These sources include: regional counts of workforce jobs by industry; Annual Population Survey (APS) workplace and labour force statistics; Business Register & Employment (BRES) survey; UK Business Count survey; and the 2011 Census. Achieving a consistent perspective on historical change from these datasets is challenging, particularly when drilling down to local areas, where sample surveys can produce large annual fluctuations.
- 3.56 Within the VICUS framework, the labour force model uses key assumptions on age-specific rates of economic activity, unemployment and commuting, to estimate the relationship between population change and employment. An employment-led scenario requires a trajectory of future employment growth, from which a population growth impact can be estimated.
- 3.57 Two employment-led scenarios have been derived for the WRE region, using a combination of: historical evidence, to determine growth ratios between England, London, the South East and the East of England; GLA projections, to benchmark London growth rates; and OBR forecasts, to provide a high and low outcome to long-term growth:
- **Employment-1**
 - **Employment-2**
- 3.58 Under the Employment-1 scenario, employment growth in each London borough grows at 1.0% per year to 2030, declining to 0.5% per year to 2050. At the same time, employment growth in all local authority districts outside London grows at a lower rate of 0.8% per year to 2030, reducing to 0.4% per year thereafter.

¹⁵ OBR (2018) Fiscal Sustainability Report [OBR July 2018](#)

- 3.59 Lower growth is modelled under the Employment-2 scenario, with employment growth in each London borough growing at 0.5% per year to 2030, declining to 0.25% per year to 2050. At the same time, employment growth in all local authority districts outside London grows at a lower rate of 0.4% per year to 2030, reducing to 0.2% per year thereafter.

Long-term Scenarios

- 3.60 For each of the 25 scenarios presented in Table 2, a long-term growth outlook is considered, extending the scenario horizon to 2100. Growth scenarios for the 2050–2100 period are aligned to the ONS 2018-based NPP, configuring a principal, low and high growth outcome (Table 3).

Table 3: VICUS – Scenario Definition, 2050–2100

Scenario	Description
Principal ('-P')	The Principal long-term scenario incorporates the mortality and fertility assumptions of the ONS 2018-based NPP Principal scenario, plus its Principal net international migration assumption of +190k p.a. for the UK in total.
Low ('-L')	The Low long-term scenario incorporates the mortality and fertility assumptions of the ONS 2018-based NPP Principal scenario, plus a Low net international migration assumption of +90k p.a. for the UK in total.
High ('-H')	The High long-term scenario incorporates the mortality and fertility assumptions of the ONS 2018-based NPP Principal scenario, plus a High net international migration assumption of +290k p.a. for the UK in total.

- 3.61 The key determinants of growth rates under these scenarios are assumptions relating to fertility, mortality and international migration. In each of the three long-term outcomes, fertility and mortality rates trends are consistent with the NPP Principal scenario. For international migration, the Principal scenario is based on an assumption of +190k annual net growth through international migration, with the High and Low variants assuming +290k and +90k per year respectively.

Macro- and Micro-level Alignment

- 3.62 Where data on site level housing developments is available, the housing-led forecasting approach is able to utilise both a combined 'top-down' and 'bottom-up' methodology. This means that micro-level forecasts of population change can be directly linked to the location of planned housing growth and the phasing over time of that growth.
- 3.63 A 'top-down' forecast is produced providing an indication of population and property growth for an aggregate area (local authority district). This is used as a constraint for a 'bottom-up' forecast which takes account of micro-level housing intelligence. The Consilium data provides information on the extent of new housing growth and its likely spatial and temporal distribution.

- 3.64 Housing allocations typically have a location and a likely phasing over time combined with information on site area and density. Used in combination with estimates of new dwelling occupancy this allows the population forecasts to reflect, at a micro scale, the impact of new housing developments.
- 3.65 For new housing allocations where specific geographical location detail is not provided the model allocates these sites across aggregate areas in proportion to the existing property distribution.
- 3.66 The Consilium site data is used in conjunction with digital map data and existing micro-level housing stock data for the proportional assignment of micro-level forecasts to various water planning geographies. These proportions are modified over time to take account of the revised distribution of properties resulting from planned new development sites.
- 3.67 Typically, site level trajectories are provided for a relatively short-term period. When site level data is no longer available the modelling approach reverts to a 'top-down' approach.

4 Scenario Output

Understanding Limitations

- 4.1 The UK is at a watershed moment in its political, economic and demographic history. The country's exit from the EU and the unprecedented global impact of the current pandemic, presents a significant challenge for predicting demographic futures for water resource planning. However, as the virus situation improves and the country returns to a new normal, the UK government will continue its objective of building up to 300,000 new homes per year. This will have important effects upon the growth and distribution of population in the WRE communities.
- 4.2 The analysis detailed in this report and in accompanying data deliverables, has presented a *suite* of trend projections, housing-led and employment-led forecasts which estimate the potential scale and distribution of future demographic change. In the interpretation of these outputs, it is important to recognise some of the methodological and data differences that exist between scenarios and therefore the challenge of producing the consistency required for effective comparison.
- 4.3 In all trend projections and housing-led forecasts, the future population of an area is strongly influenced by its base population. Projections of the number of adults, particularly the older-age population, are usually more reliable than those for children because of the challenges associated with the estimation of future levels of fertility and working-age migration.
- 4.4 The WRMP scenario horizon stretches to 2100. As the process of population change is cumulative, the reliability of growth scenarios will reduce over time. Furthermore, growth scenarios for areas with small populations will generally be less reliable than those for areas with large populations, because the former will typically be affected more by migration.
- 4.5 The ONS and GLA *projections* provide an illustration of what will happen if a pre-determined combination of assumptions on fertility, mortality and migration are met. Projections are trend-based and are, therefore, not policy-based forecasts of what local or national government expects to happen. There are many economic, political and social factors that could influence population change, including policies adopted by both national and local government, or factors that are outside of any government's control (e.g. coronavirus).
- 4.6 Appendix C illustrates the UK's national population projection accuracy since 1950. Historically, the UK population has risen more than projected, due to one or other of: under-estimation of international migration; a failure to anticipate higher fertility rates; or a failure to anticipate continued improvements in life expectancy. More recently, successive projections have demonstrated greater convergence, compared to earlier years.

- 4.7 The effects of dampened fertility and mortality assumptions upon population change are very evident in the successively lower growth outcomes of the ONS-14, ONS-16 and ONS-18 projections (Appendix D (i)). A return to higher rates of fertility and/or an upturn in the rate of improvement in life expectancy, would reverse the trend towards lower growth suggested by the ONS-18 outcomes.
- 4.8 The size of migration flows (both internal and international) and the uncertainty of future trends, means that migration assumptions have a greater influence upon growth outcomes than fertility and mortality assumptions.
- 4.9 In the absence of a population register, the estimation of international migration (into and out of the UK) has long presented a real challenge to ONS¹⁶. Estimating *base-year* immigration and emigration effects, both nationally and locally, requires a complex mix of data inputs and assumptions, and is subject to estimation methodologies that are under constant review. This methodological uncertainty in the base data, coupled with the considerable uncertainty that now exists around future population exchanges with the EU and other countries, makes the international migration assumption the most sensitive in all trend scenarios.
- 4.10 The UK government had originally hinted at a +100k per year target for net international migration but this has never been established as policy. The +190k per year within the ONS-18 principal scenario, is a more reasonable assumption of future international migration to the UK, ensuring the necessary replenishment of its workforce to compensate for the accelerating process of demographic ageing in the resident population.
- 4.11 In relation to *internal* migration flows, the financial crash of 2007/08 resulted in constraints on movement due to lending restrictions, acute housing affordability issues and an under-supply of new homes. This had a particular impact upon the net outflow of migrants from London, a situation that has now begun to reverse itself with the renaissance in house building. This should mean that later trend projections are a more reliable indicator of future internal migration outcomes. However, the ONS-18 projections incorporate the effects of a methodological change to the estimation of internal migration, which makes comparison with other scenarios more difficult.
- 4.12 There are also methodological differences between the ONS and GLA trend projections presented here, which make a direct comparison of growth outcomes a challenge. The GLA has modified its base year populations, has calculated its own base fertility and mortality parameters (although following the long-term ONS trend) and its own migration assumptions.
- 4.13 To improve comparability, the VICUS framework has sought to align base year population and property totals to ensure consistency of growth comparison across scenarios. This alignment reveals that, despite the ONS and GLA each presenting a 2018-based scenario configuration, the GLA trend scenarios result in higher growth outcomes for the UK standard regions which overlap WRE geographies (Appendix D (ii)).
- 4.14 Whilst projections provide an illustration of growth under a given set of fertility, mortality and migration assumptions, local planning policies can modify past trends. To illustrate how Local Plans

¹⁶ [ONS - Long-Term International Migration estimates methodology](#)

have been formulated to meet particular local needs/requirements for new housing growth, the housing-led scenarios are presented as a direct contrast to the trend outcomes. But there is inevitable inconsistency and uncertainty with regard to the evidence which underpins these scenarios.

- 4.15 Local Plans are at different stages of development and completeness. There is limited consistency of timing or content of Council Local Plan publications and data. And whilst some areas have plan data for 5 years, others for up to 15 years, the majority of Local Plan housing growth is weighted more heavily towards the short-term horizon. It has been necessary to fill the data gaps required for the WRMP 2050 planning horizon, using trend scenario evidence to estimate housing growth for the period after which plan data expires. These factors are reflected in the shape of the growth curves associated with the Housing-Plan scenarios.
- 4.16 The use of household representative rates as a determinant of occupancy is a key component of the modelling approach, applied across all scenarios, trend, housing-led and employment-led. These rates, drawn from MHCLG's 2014-based household model are available to 2039 only, remaining constant thereafter. Modification of these rates has enabled the estimation of population impacts resulting from higher rates of household formation amongst young adults, dampening the housing-led population growth in all cases. Whilst using a similar approach, the GLA has applied borough-specific rules to the control of occupancy in its housing-led scenario and has constrained the overall population growth total in this scenario to its Central trend outcome for London.
- 4.17 The development of employment-led forecasts is particularly challenging within the current political and social environment. And even within 'normal' conditions, economic forecasts typically have a much shorter, 1–5-year outlook horizon, compared to demographic scenarios. Nevertheless, two employment-led scenarios have been formulated, not as a definitive indication of likely economic trajectories, but to benchmark other demographic and housing-led scenarios against a higher and lower employment growth outcome.
- 4.18 The VICUS framework is able to configure employment-led scenarios, but it does so from a demographic perspective, balancing the relationship between employment growth and the size of the resident labour force using higher or lower migration. The methodology incorporates important projections of age-specific labour force participation rates, especially important for modelling higher female participation and the effects of state pension age (SPA) adjustments. However, it combines these with static measures of unemployment and commuting ratios, a necessary simplification of a complex modelling process.

Outcomes 2020–2050

- 4.19 Despite the methodological and data challenges detailed above, the VICUS framework provides a rigorous and robust basis for the configuration and comparison of a suite of WRE growth scenarios. Given the challenges of presenting a single, definitive outcome on future population and housing growth, the transparency of the VICUS approach is designed to encourage consideration of a 'range' of outcomes to support water resource planning.

- 4.20 A summary illustration of the suite of 2020–2050 growth scenarios is presented, for WRE in aggregate (Figure 8) and for each water company (Figure 9 – Figure 12).
- 4.21 The accompanying VICUS-BI dashboard provides further detail for individual WRZs, plus scenario output for the extended 2020–2100 forecast period. An additional Microsoft Excel workbook provides full detail on the data outputs from each scenario.
- 4.22 The range of 2020–2050 growth outcomes for the WRE, in total, suggests population growth in the range of 540,000 to 1.9 million, with accompanying dwelling growth of 14,802 – 33,971 dwellings per annum (dpa). This gives an average of approximately 1.3 million population growth (c. 18%) and 26,000 dpa over the 30-year plan period.
- 4.23 This is a wide range of outcomes that is characterised by high ‘plan-based’ growth outcomes compared to the trend projections of both ONS and GLA. At the lower end of the spectrum, the ONS-18-Low scenario presents an unrealistic growth projection. The ONS-18 *principal* projection presents an uncertain outcome itself, given the methodological differences in its approach to measuring internal migration. For this reason, a low variant on the principal outcome, which assumes a +90k per year international migration impact, should be disregarded.
- 4.24 In contrast, the ONS-14 and ONS-16 scenarios, in combination with the GLA scenarios, present a fairly tight range of outcomes, with population growth between 15.4% – 19.3% and associated dwelling growth of 23.3k – 27.1k dpa.
- 4.25 The inclusion of scenarios which consider future housing growth linked to past completion rates, provide a useful benchmark against the housing growth derived in the Housing-Plan trajectory. For the combined WRE geography, the Housing-Plan dwelling growth total is approximately 11% higher than that associated with a continuation of the completion rate from the last five years of evidence and 20% higher than a continuation of the completion rate averaged over the extended 2001–2019 period.
- 4.26 Housing-Need, Housing-Requirement and Housing-Plan scenarios present the highest growth outcomes. The Housing-Plan scenario suggests high growth to 2030 (typically the limit of robust Local Plan evidence), reducing thereafter as the annual housing growth returns to a level derived from trend projections. The reduction in the household representative rates of young adults over the plan period (Housing-Plan-r), enforces a lower occupancy to the housing stock, reducing the population growth associated with the same level of housing growth. The requirement for higher housing growth in Local Plans is underpinned by a drive to make new homes more affordable and accessible to young adults, so the modification to household representative rates provides a legitimate dampening of the population growth, reducing housing stock average occupancies in the process.
- 4.27 The employment-led scenarios estimate population growth of 8.2% – 15.7%, with the higher growth of the Employment-1 scenario relatively consistent with the ONS-16 scenario outcome. Dwelling growth associated with these scenarios is 15k – 23k dpa to 2050, with a potential 20% uplift on the dpa if higher rates of household formation amongst young adults is considered.

- 4.28 The trends evident in the WRE aggregate outcomes and the relationship between the different scenario outcomes, is generally replicated in the growth profiles for Anglian Water and Essex & Suffolk Water, less so for the smaller geographies of Cambridge Water and the Brett WRZ of Affinity Water.
- 4.29 For the Affinity Water Brett WRZ, an average population growth of approximately 30,620 (c. 19%) is estimated to 2050, coupled with a housing growth of 666 dpa. In this instance, the Housing-Plan-r scenario aligns quite closely to the ONS-18 population outcome, albeit with a higher annual average housing growth estimated from the ONS scenario. The relatively low growth associated with a continuation of past completion rates is very evident.
- 4.30 For Anglian Water, an average population growth of approximately 849,194 (c. 17.5%) is combined with a 16,713 dpa housing growth to 2050. The short-term (2020–2030) impact of higher housing growth in the Local Plan evidence is particularly significant.
- 4.31 Cambridge Water has an average population growth outcome of approximately 58,900 (c. 17.5%) to 2050, with a housing growth of 1,080 dpa. Again, the Housing-Plan scenario presents a high-growth outcome, in this instance maintaining consistency with the high completion rates that have been achieved in this area over the last 5 years.
- 4.32 For Essex & Suffolk Water, an average 2020–2050 population growth of 375,335 (19%) is associated with an average annual housing growth figure of 7,266 dpa. Housing Need and Requirements outcomes present the highest growth, with the Housing-Plan growth quite consistent with the ONS-14 population and dwelling growth.



Figure 8: VICUS-BI – Scenario Summary – WRE



Figure 9: VICUS-BI – Scenario Summary – Affinity Water (Brett WRZ)



Figure 10: VICUS-BI – Scenario Summary – Anglian Water

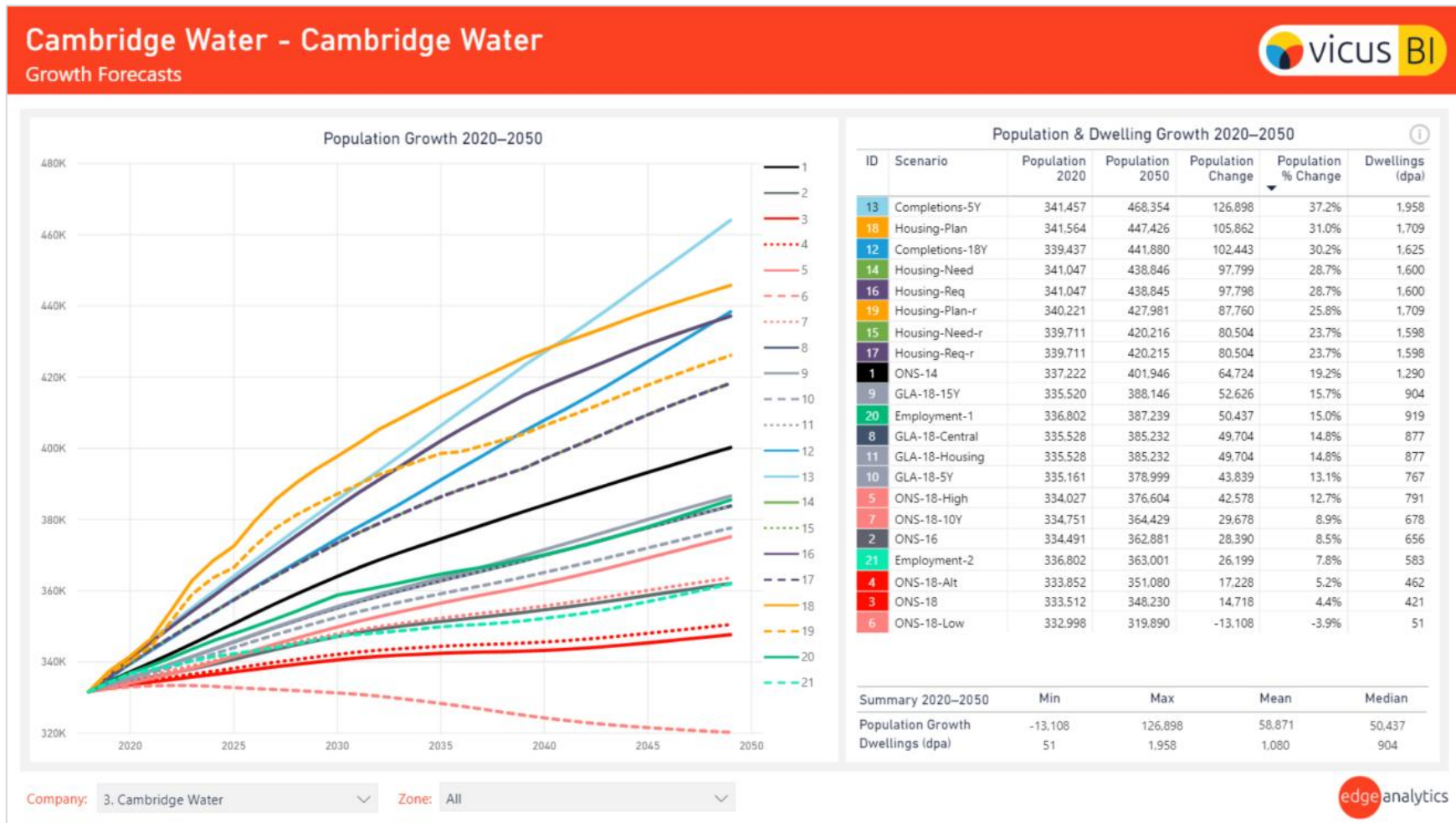


Figure 11: VICUS-BI - Scenario Summary - Cambridge Water



Figure 12: VICUS-BI - Scenario Summary - Essex & Suffolk Water

Outcomes 2020–2100

- 4.33 To support the requirement for a long-term outlook for water resource planning across the WRE region, the WRMP scenario horizon stretches to 2100. The accompanying VICUS-BI dashboard and Microsoft Excel workbook provide a full illustration and data detail on the range of growth outcomes for this extended outlook.
- 4.34 Inevitably, as the process of population change is cumulative, the reliability of growth scenarios will reduce over time. The long-term horizon, stretching from 2050–2100 is the period with greatest uncertainty. It is a period during which the large birth cohorts of the 1950s and 1960s will leave the population. Without a significant and continuing input from international migration, the UK's population and that of its local communities would quickly decline.
- 4.35 However, the 2020–2100 scenarios have been configured to first take account of the range of outcomes for the 2020–2050 plan period and then to consider longer-term growth aligned to ONS national population projections. For each of the scenarios presented for 2020–2050, a long-term growth outlook is considered, extending the scenario horizon to 2100, in alignment with the ONS 2018-based national population projection for the UK.
- 4.36 Three long-term trajectories are presented for each of the 2020–2050 scenarios: a principal, low and high growth outcome. The high and low variants of the long-term scenarios illustrate the potential extremes of growth under different assumptions of fertility, mortality and international migration.
- 4.37 In each of the three long-term outcomes, fertility and mortality rates trends are consistent with the NPP principal scenario. For international migration, the principal scenario assumes a +190k annual net growth through international migration, with the High and Low variants assuming +290k and +90k per year respectively. Whilst the robust prediction of likely growth through international migration post-2050 presents a significant challenge, the principal scenario is presented as the most prudent outlook for consideration in the long-term water resource planning process.
- 4.38 For the WRE region in total, the 18% average growth in population 2020–2050, is accompanied by a 14% average growth for 2050–2100 under the principal long-term outcome. This is equivalent to an average population growth of approximately 35% over the 2020–2100 plan period, an additional 2.6 million people on the base year total. The Low and High population growth averages for the full 2020–2100 horizon, range from 25–44%.
- 4.39 In terms of estimated housing growth, the average annual growth under the suite of Principal scenarios for the long-term horizon is approximately 19,650 dpa, ranging from 15,300 dpa to 23,600 dpa under the Low and High scenarios respectively.
- 4.40 Similar long-term outcomes for each water company and each WRZ are contained within the accompanying VICUS-BI and Microsoft Excel output.

Appendix A Glossary of Terms

APS	Annual Population Survey
ASFR	Age-specific fertility rate
ASMR	Age-specific mortality rate
BRES	Business Register & Employment survey
Defra	Department for Environment, Food and Rural Affairs
DWMP	Drainage and Wastewater Management Plan
DWP	Department for Works and Pensions
EA	Environment Agency
EFO	Economic and Fiscal Outlook
EU	European Union
GDP	Gross Domestic Product
GLA	Greater London Authority
H&T	Hidden and transient
LHN	Local Housing Need
LPA	Local Planning Authority
MHCLG	Ministry for Housing, Communities and Local Government
MYE	Mid-year population estimate
NPP	National Population Projection
NPPF	National Planning Policy Framework
OAN	Objective Assessment of Need
OBR	Office for Budget Responsibility
ONS	Office for National Statistics
OxCam	Oxford Cambridge Arc
PAF	Postcode Address File
PAS	Planning Advisory Service
PPG	Planning Policy Guidance
SHLAA	Strategic Housing Land Availability Assessment
SNPP	Sub-national Population Projection
SPA	State Pension Age
SRRP	Statement of Regional Resource Position
UK	United Kingdom
WG	Welsh Government
WRE	Water Resources East
WRMP	Water Resources Management Plan
WRN	Water Resources North
WRSE	Water Resources South East
WRSW	Water Resources South West
WRW	Water Resources West
WRZ	Water Resource Zone

Appendix B Local Authority Status Log

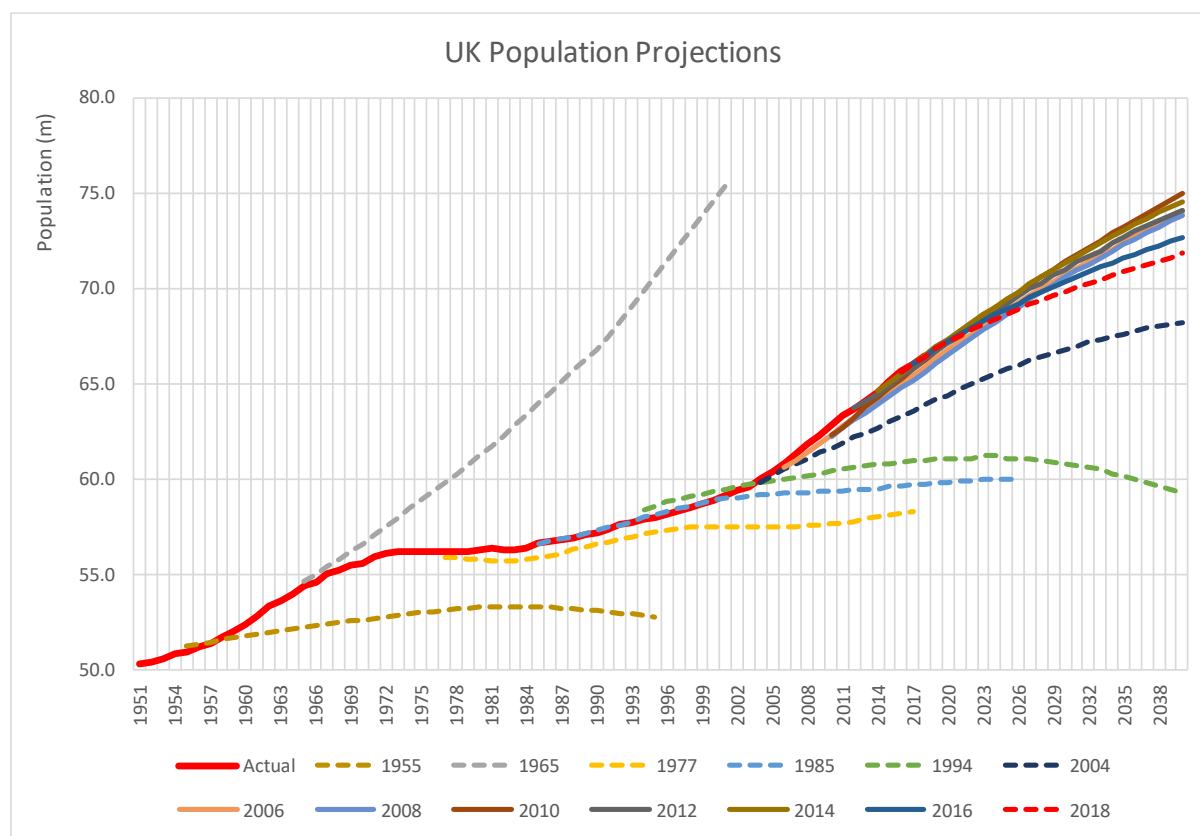
B.1 The activity log indicates the date at which Local Plan evidence was last accessed from each LPA and added to the Consilium database.

Area Name	Area Code	Region	WRE	OxCam	Last Updated
Aylesbury Vale	E07000004	South East	WRE	OxCam	12/05/2020
Babergh	E07000200	East of England	WRE		05/05/2020
Barking & Dagenham	E09000002	London	WRE		08/05/2020
Basildon	E07000066	East of England	WRE		21/04/2020
Bassetlaw	E07000171	East Midlands	WRE		04/05/2020
Bedford	E06000055	East of England	WRE	OxCam	03/05/2020
Boston	E07000136	East Midlands	WRE		28/04/2020
Braintree	E07000067	East of England	WRE		17/04/2020
Breckland	E07000143	East of England	WRE		21/04/2020
Brentwood	E07000068	East of England	WRE		05/05/2020
Broadland	E07000144	East of England	WRE		05/05/2020
Buckinghamshire	E10000002	South East	WRE	OxCam	17/03/2020
Cambridge	E07000008	East of England	WRE	OxCam	14/05/2020
Castle Point	E07000069	East of England	WRE		14/05/2020
Central Bedfordshire	E06000056	East of England	WRE	OxCam	06/05/2020
Central Lincolnshire	Central Lincs	East Midlands	WRE		28/04/2020
Chelmsford	E07000070	East of England	WRE		14/05/2020
Cherwell	E07000177	South East	WRE	OxCam	04/05/2020
Colchester	E07000071	East of England	WRE		27/04/2020
Corby	E07000150	East Midlands	WRE	OxCam	10/05/2020
Daventry	E07000151	East Midlands	WRE	OxCam	12/05/2020
Doncaster	E08000017	Yorkshire & Humber	WRE		23/04/2020
East Cambridgeshire	E07000009	East of England	WRE	OxCam	11/05/2020
East Lindsey	E07000137	East Midlands	WRE		04/05/2020
East Northamptonshire	E07000152	East Midlands	WRE	OxCam	10/05/2020
Epping Forest	E07000072	East of England	WRE		06/05/2020
Fenland	E07000010	East of England	WRE	OxCam	11/05/2020
Forest Heath	E07000201	East of England	WRE		04/05/2020
Great Yarmouth	E07000145	East of England	WRE		05/05/2020
Greater Cambridge	Gtr Cambridge	East of England	WRE	OxCam	05/05/2020
Greater Norwich	Gtr Norwich	East of England	WRE		22/04/2020
Harborough	E07000131	East Midlands	WRE		04/05/2020
Hartlepool	E06000001	North East	WRE		01/05/2020
Havering	E09000016	London	WRE		08/05/2020
Huntingdonshire	E07000011	East of England	WRE	OxCam	10/05/2020

Area Name	Area Code	Region	WRE	OxCam	Last Updated
Ipswich	E07000202	East of England	WRE		28/04/2020
Kettering	E07000153	East Midlands	WRE	OxCam	10/05/2020
King's Lynn & West Norfolk	E07000146	East of England	WRE		29/04/2020
Lincoln	E07000138	East Midlands	WRE		28/04/2020
Luton	E06000032	East of England	WRE	OxCam	10/05/2020
Maldon	E07000074	East of England	WRE		29/04/2020
Melton	E07000133	East Midlands	WRE		25/04/2020
Mid Suffolk	E07000203	East of England	WRE		29/04/2020
Milton Keynes	E06000042	South East	WRE	OxCam	04/05/2020
Newark & Sherwood	E07000175	East Midlands	WRE		25/04/2020
North East Lincolnshire	E06000012	Yorkshire & Humber	WRE		09/06/2020
North Hertfordshire	E07000099	East of England	WRE		11/05/2020
North Kesteven	E07000139	East Midlands	WRE		12/05/2020
North Lincolnshire	E06000013	Yorkshire & Humber	WRE		18/05/2020
North Norfolk	E07000147	East of England	WRE		29/04/2020
North Northamptonshire	N Northants	East Midlands	WRE		10/05/2020
Northampton	E07000154	East Midlands	WRE	OxCam	12/05/2020
Norwich	E07000148	East of England	WRE		22/04/2020
Peterborough	E06000031	East of England	WRE	OxCam	11/05/2020
Redbridge	E09000026	London	WRE		08/05/2020
Rochford	E07000075	East of England	WRE		29/04/2020
Rutland	E06000017	East Midlands	WRE		27/04/2020
South Cambridgeshire	E07000012	East of England	WRE	OxCam	14/05/2020
South Essex	S Essex	East of England	WRE		05/05/2020
South Holland	E07000140	East Midlands	WRE		28/04/2020
South Kesteven	E07000141	East Midlands	WRE		28/04/2020
South Norfolk	E07000149	East of England	WRE		05/05/2020
South Northamptonshire	E07000155	East Midlands	WRE	OxCam	05/05/2020
Southend-on-Sea	E06000033	East of England	WRE		30/04/2020
St Edmundsbury	E07000204	East of England	WRE		04/05/2020
Stevenage	E07000243	East of England	WRE		11/05/2020
Suffolk Coastal	E07000205	East of England	WRE		04/05/2020
Tendring	E07000076	East of England	WRE		01/05/2020
The Broads Authority	E26000007	National Park	WRE		11/06/2020
Thurrock	E06000034	East of England	WRE		30/04/2020
Uttlesford	E07000077	East of England	WRE		17/05/2020
Waveney	E07000206	East of England	WRE		04/05/2020
Wellingborough	E07000156	East Midlands	WRE	OxCam	10/05/2020
West Lindsey	E07000142	East Midlands	WRE		28/04/2020
West Northamptonshire	W Northants	East Midlands	WRE		12/05/2020

Appendix C Projection Accuracy

- C.1 The illustration below provides a summary of official UK population projections and their relationship to the actual trajectory of population change.



Source: ONS, OBR

- C.2 Historically, the UK population has risen more than projected, with one exception. The 1965-based population growth trajectory was based upon the continuation of the high fertility rates experienced in the early 1960s, which peaked in 1964, falling to a record low in 1977.
- C.3 In subsequent years, projections have typically under-estimated future population growth due to one or more of three factors: (i) the allocation of insufficient growth through international migration; (ii) a failure to anticipate a return to higher fertility rates; and (iii) a failure to anticipate the continued improvements in life expectancy (longevity).
- C.4 More recently, projections have demonstrated greater convergence, with lower international migration, plus reduced assumptions on long-term fertility rates and improvements in life expectancy, having a dampening effect upon population growth outcomes.

Appendix D ONS & GLA Projections

(i) ONS National Projections

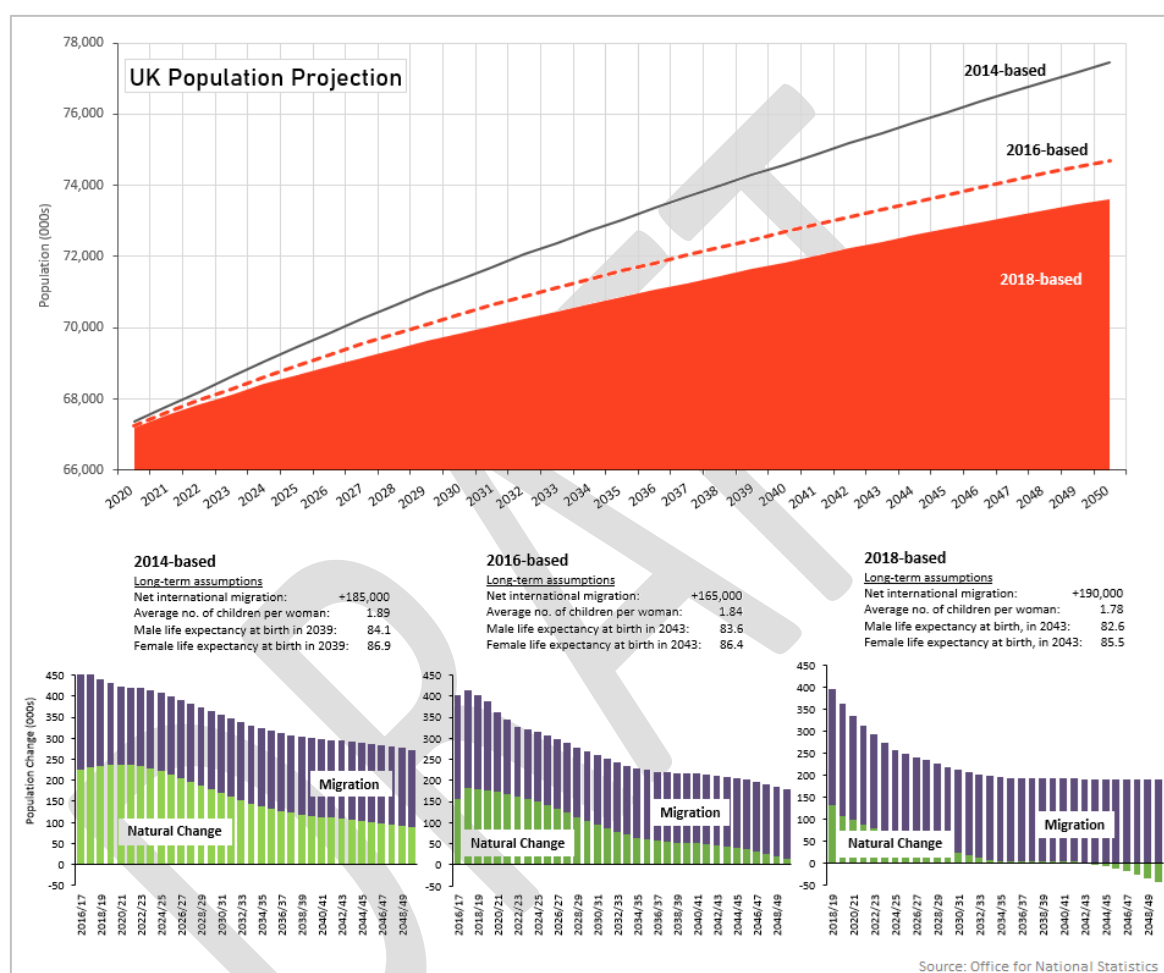


Figure 13: UK Population Projections

(ii) ONS vs GLA Projections Compared



Source: ONS, GLA

Figure 14: ONS & GLA 2018-based Projections Compared

Appendix E OxCam Geography

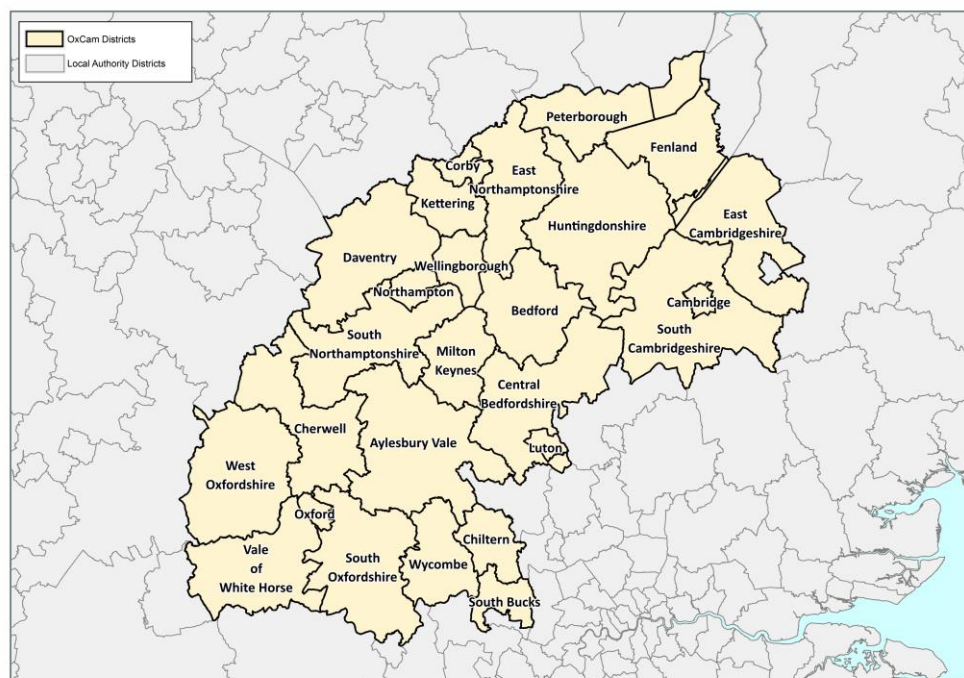
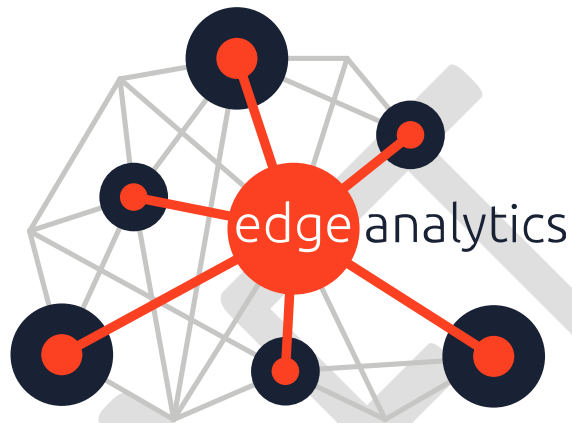


Figure 15: OxCam Area Definition



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