GLAINTELLIGENCE

Update 2017-03

GLA Housing-led Projection Methodology

February 2017

Introduction

The GLA Demography Team produce a range of annually updated population projections at both borough and ward level for the 33 local authorities in the London region. Each round of projections includes a number of variants designed to meet a range of requirements, but in general variants form two groups:

- Trend projections — those based purely on trends in fertility, mortality and migration;
- Housing-led projections — those which incorporate a forecast housing development trajectory.

This update is concerned with the development of the GLA housing-led model and production of the 2015-based housing-led population projections at borough level. It is recommended that this Update be read alongside Update 2016-02[1] which provides detail on the GLA trend projection model.

The full set of GLA projections is available on the London Datastore as well as information on how the variant projections relate to one another (https://data.london.gov.uk/demographic-projections/).

Note on naming convention

From February 2017 the GLA has revised its naming convention for the population projections. Projections will now be labelled based on the latest mid-year estimate data which informs the projection. As such this set of projections is a 2015-based projection. This brings the naming convention in line with that used by ONS in their Sub-National Population Projections and is hopefully more intuitive for users.

This set of projections is labelled 'interim' in anticipation of a revised set of 2015-based projections which will inform the London Plan. Once released, in spring 2017, those projections will supersede this set.

Development of a revised Housing-led Model

The GLA's models and assumptions continue to evolve as new data are released and each new round of projections supersedes earlier rounds. In the case of the 2015-based projections significant changes have been made to the housing-led model methodology. This redevelopment follows and builds upon an earlier

[1] https://data.london.gov.uk/dataset/2015-round-population-projections/resource/8cb45509-626e-4845-acb0-f36383fc5704

phase of work to redevelop the trend model. The new housing-led model closely integrates with the trend model in order to produce a more consistent suite of projections.

Assumed housing development

The development forecast used in the model is based on data from the 2013 Strategic Housing Land Availability Assessment (SHLAA)[2]. This provides a view of borough-level development for the period to 2031. For the years 2012-2016, the London Development Database provides data on actual completions which replaces the SHLAA estimates for those years. For years 2032-2050, the rate of development is held constant at the rate seen in 2031. The input data, in the form of net increase in dwellings, is converted in the model to households using borough-specific rates taken from the 2011 census.

The London SHLAA is scheduled to be updated in 2017 and once available the new trajectory will be incorporated into updated projections.

Overview of methodology

The revised housing-led methodology can be broken down into a two-stage process.

In Stage 1 the GLA trend model is run and produces a set of rates and constraints consistent with the 2015-based central trend projection.

In Stage 2, for each year of the projection, an initial trend population is calculated by applying the rates calculated in stage 1 to the population at the start of the year. The resulting population is then reconciled with a target population based on available housing supply. Finally, the populations, and components, are constrained to be consistent with the outputs from Stage 1 of the process at the Housing Market Area (HMA) level. The definition of the HMA is set by the user and in the case of the 2015-based projection is simply an aggregation of the 33 London boroughs.

Stage 1

The GLA trend model is run from a starting point of the most recent ONS Mid-Year Estimate (2015). The model parameters are set to be consistent with those used to produce the 2015-based central trend projection. The model then runs forward to 2050 as described in the GLA trend methodology update (2016-02[3]).

The outputs from this model are local authority level populations, components of change (births, deaths and migration), and rates of fertility, mortality and migration all at single year of age (0 to 90+) and sex for the entire projection period. The housing-led model retains these outputs for use in Stage 2 of the modelling process.

Stage 2

The second stage of the model produces the housing-led population projections. As with stage one, the projections are produced from a starting point of the most recent ONS Mid-Year Estimate (2015).

[2] https://www.london.gov.uk/file/15569/download?token=M9dckY12
[3] https://data.london.gov.uk/dataset/2015-round-population-projections/resource/8cb45509-626e-4845-acb0-f36383fc5704

Each subsequent year's population is generated by first calculating a population based on past trends and then adjusting domestic migration in order that the total population is consistent with the forecast of available housing stock. The total population for the HMA is then constrained to the Stage 1 projection.

The cycle of events in Stage 2 that produces populations for each year of the projection period is described below and illustrated in Figure 1. A worked example of this process can be found in Appendix 1.

1) The cycle begins with the initial single year of age (0 to 90+) and sex population for local authorities. For the first year this is the ONS MYE, for subsequent years this is the projected population at the end of the previous cycle.

2) A trend-based population (single year of age by sex) is calculated by applying the fertility, mortality and migration rates obtained in Stage 1. The methodology for this as described in Update 2016-02.

3) The number of births, deaths and the international in and out migration components (by sex and single year of age) are constrained so that, at the level of the HMA, these components are consistent with the outputs from Stage 1. This is achieved by calculating and applying a set of age/sex-specific scaling factors to the components.

4) The trend-based population is recalculated by summing the constrained components and the original domestic migration flows. This process creates a Trend population which can be compared to available housing.

5) A Target population which is consistent with the available housing stock is calculated for each local authority. This is arrived at by multiplying the total forecast households from the input trajectory by an LA-specific average household size (AHS). The process of determining AHS is described separately below. The LA institutional population is added into the target population to arrive at a total target population. The target has no age/sex structure it is simply a total population figure.

6) The difference between the Target population and the Trend population is calculated. If the Trend population is lower than the Target population then the difference is added to the domestic in-migration component of the Trend projection. If the Trend population is higher than the Target population then the difference is added to the domestic out-migration component of the Trend projection.

7) The revised domestic flow is then divided by the original to obtain a scaling factor. This factor is then applied to the age structure of the original flow.

8) The age/sex structure of the population is calculated by summing the amended components. The projection total populations are now consistent with the Target projection populations at the local authority level.

9) The projected populations for each local authority within a defined HMA are constrained to the overall HMA trend-based population. Age/sex-specific scaling factors are applied to the populations in order that the population of the HMA is consistent with the output from the Stage 1 process.

10) Following the constraining process the components no longer sum to the total population[4]. Domestic net migration (at single year of age and sex) is calculated as a residual from the total population and

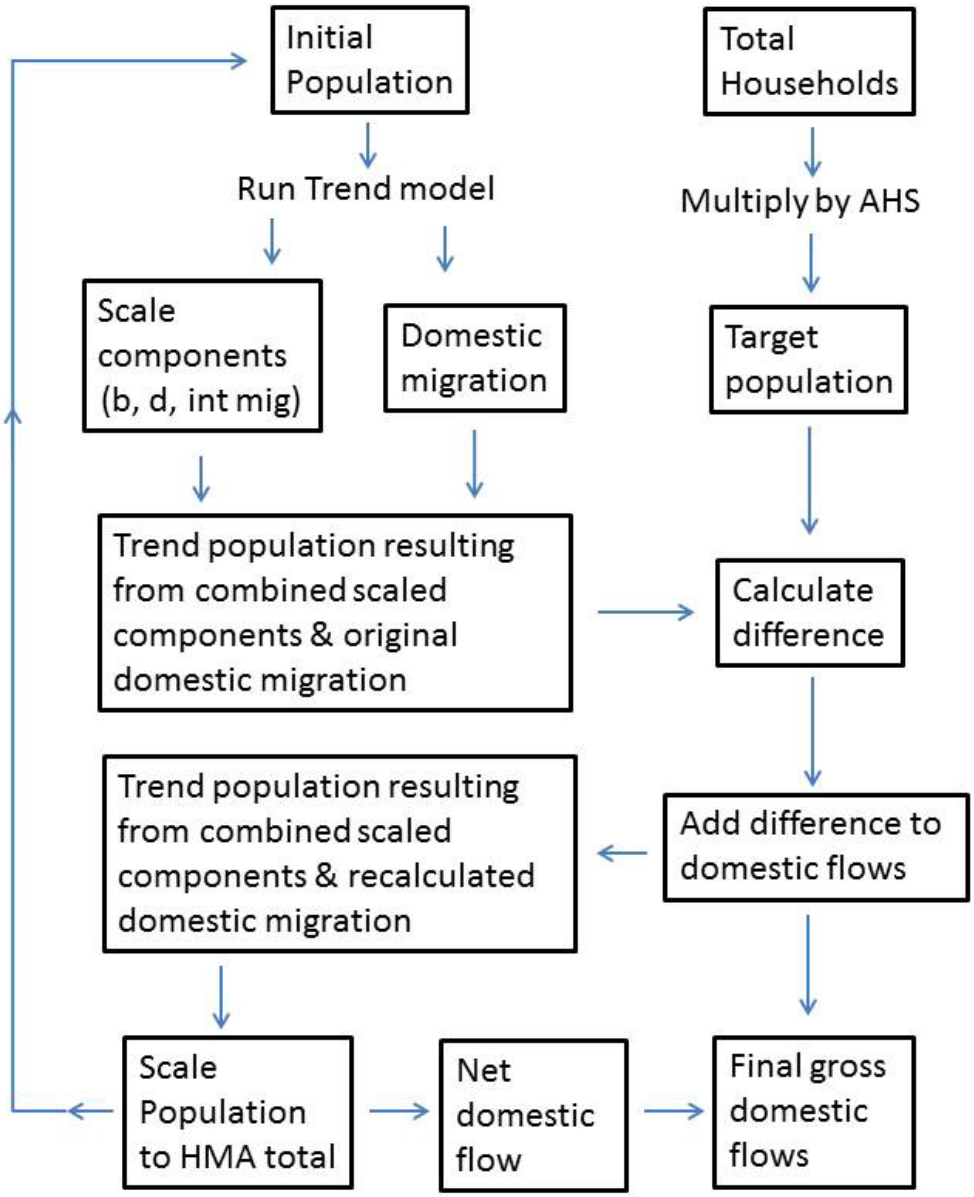
[4] This step of the process is not necessary to run the population projection; gross domestic flows are a reporting output from the model.

components. This is compared to the existing domestic migration. If the new net migration is higher than the existing value then the difference is added to the existing domestic in-migration component of the projection. If the new net migration is lower than the existing value then the difference is added to the existing domestic out-migration component.

11) The final population by single year of age and sex for each local authority is fed back into step 1 of the process as the initial population for the next year.

The model outputs estimated and projected population by single year of age and sex from 2011 to 2050. Additional reporting outputs include detailed components of change and inputs into other GLA models such as the small area model and ethnic group model.

Figure 1: Housing-led model flow chart



Source: GLA demography

Calculation of Average Household Size

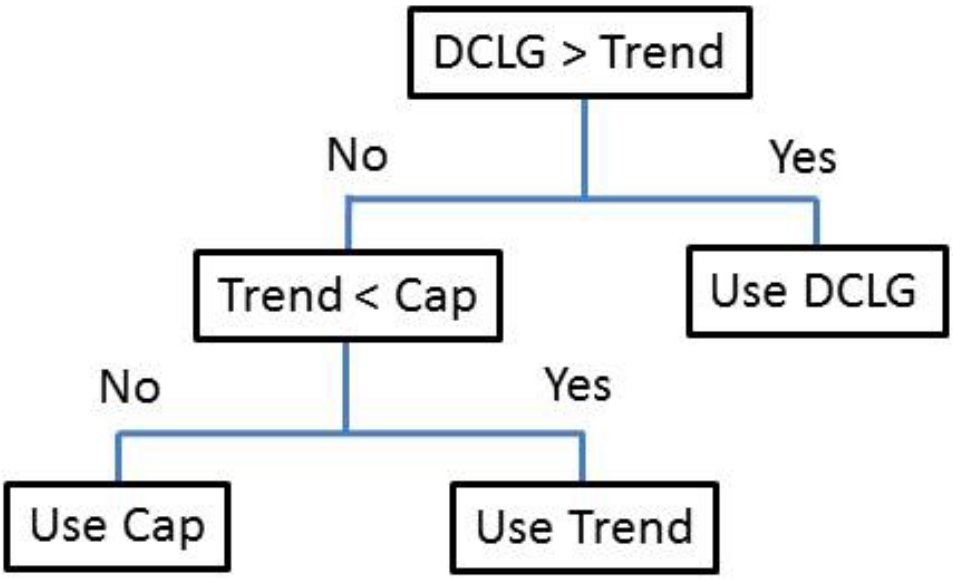
Average Household Size (AHS) for each local authority is used in the calculation of the Target population (see Stage 2 step 5 above). For each year of the projection AHS is calculated using a decision tree as illustrated in figure 2 below. The decision tree is used to select the appropriate AHS from a choice of three. They are:

- Trend AHS - The trend population calculated in step 4 minus the institutional population divided by the total households in the trajectory. Institutional population is projected in a way consistent with the Department for Communities and Local Government's (DCLG) household projection model[5]: remaining constant throughout the projection period for ages up to 75; for ages 75 and over the size of the institutional population is determined by applying a constant rate to the total population.

- Capped AHS - The trend AHS for a user-defined year (in the case of the 2015-based projection this is set at 2016). This cap is used to ensure that AHS cannot grow beyond a reasonable limit.

- DCLG AHS - The average household size calculated by applying a set of projected household representative rates to the population, consistent with the methodology of the DCLG household model.

Figure 2: AHS decision tree



Source: GLA demography

Average Household Size is used to convert assumed dwelling stock into population. The model input, in the form of forecast dwellings, is converted to households using census rates and then multiplied by an AHS to produce a total population which is consistent with the available housing.

[5] https://www.gov.uk/government/statistics/2014-based-household-projections-methodology

There are two contradictory trends in household size: projected decline in average household size arising from an increasing proportion of older people in the population (who typically form smaller households); and observed increases in estimated household size in much of London over the last fifteen years. These increases in household size have occurred through a range of mechanisms, which could be simplistically ascribed to demand for housing outstripping supply. The dynamics of the housing market are complex and would be hugely challenging to fully capture in a demographic model. Instead the model uses a series of rules to determine an appropriate household size for each local authority, with the aim of reconciling existing population trends with available housing stock and changes to the demographic profile of the population.

The AHS produced by applying household representative rates from the DCLG household model to the population are used unless they are lower than the AHS derived by dividing the modelled Trend population by the available household spaces. If the derived AHS is higher than the DCLG AHS then either the derived AHS for the current projection year is used, or the derived AHS for a specified 'cap' year is selected – whichever is lower. The cap acts to ensure that AHS never rises above a reasonable value. The cap in the 2015-based model is set at 2016, the first projection year. This ensures that AHS will only rise higher than current levels if projected population and household formation patterns imply an increase in household size.

Base populations and other input data

The inputs to the trend model, including an amended set of Mid-Year Estimates for the period 2002-2011, are described in detail in Update 2016-02. Additional inputs necessary for the household model are:

- Detailed tables from the 2014-based DCLG household projections
- Forecast housing development based on the Strategic Housing Land Availability Assessment (SHLAA)
- Estimated housing completions from the London Development Database
- Census household and dwelling estimates

Appendix A: Example projection

This appendix provides a worked example of the housing-led model for one projection year (2021) for the borough of Hammersmith and Fulham.

Trend Model

1) The GLA trend model produces a projection for all local authorities in London based consistent with the 2015-based central projection. A full projection for the period 2016-2050 is run. The outputs from this model are used as rates and constraints in the housing-led model.

Housing-led Model

This example uses 2021 as the current projection year. The model has been run from a starting point of 2015 and has then run through the projection loop five times. This example uses data from the sixth loop of the projection (year 2021).

Initial Population & Constrained Components

2) The starting population is the final population from the previous year's projection (2020) for H&F (189,508) disaggregated by sex and age (0 to 90+).

3) A trend projection is run from 2020 to 2021 giving a population for H&F of 190,340, disaggregated by sex and age. This is the 'initial' projection. This uses the age/sex/borough-specific rates for migration, births and deaths captured in step 1 above.

Average Household Size & Target Population

4) Average Household size is now calculated. This is done three times.
    a. Trend AHS : (Trend population – Institutional Population)/Households
       (189,508 – 1,845) / 87,598 = 2.142
    b. Capped AHS : The cap in the model has been set at 2016, the first year of the projection. The AHS cap is the Trend AHS for 2016. In this case 2.181
    c. DCLG AHS – taken from the DCLG household model, in this case 2.152.

5) The decision tree outlined in figure 2 is used to determine which of these three AHS values to use. In this case the chosen value is the DCLG AHS of 2.152.

6) A Target household population of 190,328 is arrived at by multiplying the Trend household population total from step 6 by the AHS value from step 8. The institutional population is added to this household population to arrive at a total Target population.

   (Households * AHS) + Institutional Pop = Target Pop
   (87,598 * 2.152) + 1,845 = 190,356

Constrain to HMA

7) The Housing Market Area (HMA) for the projection has been set as the 33 London Boroughs. The total births for the HMA for 2021 calculated in step 1 (131,968) is divided by the total number of births in the projection for the HMA (131,566). This provides a scaling factor (1.003) which is applied to all borough births.

   H&F initial births * HMA scaling factor = H&F constrained births
   2,461 * 1.003 = 2,468

8) The same approach is taken with deaths and international in and out migration. The difference being that for these three components there is an age structure. Therefore a scaling factor is calculated for each age (0 to 90+) and sex.

   The revised components, when totalled are now as follows:

Table 1: Revised Components

Component	Initial Value	Constrained Value
Births	2,461.07	2,468.58
Deaths	879.14	879.23
International In	5,889.30	5,889.30
International Out	5,638.91	5,669.21

GLA Housing-led model

9) The revised components are no longer consistent with the total population for H&F. Therefore the total population by sex and age is recalculated by summing the four constrained components and the initial domestic migration flows.

   For H&F overall this produces the following total population:

   2020 population + births – deaths + international in – international out + domestic in – domestic out = 2021 population
   189,508 + 2,469 – 879 + 5,889 – 5,669 + 17,293 – 18,294 = 190,317

Reconcile Target population with Trend population

10) The Target population is compared to the Trend population at the borough level.

    Trend – Target = Difference
    190,317 – 190,356 = -39

11) In this case the difference is negative meaning that the Trend projection is lower than the Target projection. The difference is therefore added to the domestic in migration component. In this case no adjustment is made to the domestic out migration.

    Initial domestic in + difference = revised domestic out
    17,293 + 39 = 17,332

12) A borough level scaling factor for out migration is calculated:

    Revised domestic / Initial domestic = scaling factor
    17,332 / 17,293 = 1.0022

13) The scaling factor is applied to the age/sex domestic outflows.

14) Summing each of the components now results in the Target population:

    2020 Population + births – deaths + international in – international out + domestic in – domestic out = 2021 population

189,508 + 2,469 – 879 + 5,889 – 5,669 + 17,332 – 18,294 = 190,356

Constrain to total population

15) The population by sex and age is now constrained to the total population of the HMA which was calculated in step 1. This is done for each age and sex (the example below uses females aged 32).

    The total population in the HMA of 32 year old females for 2021 is taken from step 1 (84,934). This is divided by the projected population of the HMA (85,045) which provides a scaling factor (0.998) to be applied to all boroughs.

    H&F population * HMA scaling factor = H&F constrained population (for females aged 32)
    1,967 * 0.998 = 1,964

    This process results in a total revised population for the borough of 190,847

Align Domestic Migration

16) The domestic migration must be amended so that the components sum to the total population. First a domestic net migration value is calculated from the constrained total population in step 15 and the components from steps 4 and 5. This is done for each age and sex. The example uses females aged 32.

    2021 population – 2020 population - births + deaths – international in + international out = Domestic net

    190,847 - 189,508 - 2,469 + 879 - 5,889 + 5,669 = -471

    This derived domestic net value is subtracted from the actual domestic flows calculated in step 13.

    (Dom In – Dom Out) – Derived net domestic = Difference
    17,332 - 18,294 - -471 = -491

    In this case the difference is negative meaning that net domestic migration must be increased. The difference is therefore add to the domestic inflow.

    Final inflow = Current inflow + difference
    5,889 + 471 = 6,360

    Final outflow = Current outflow
    5,669

Move to next projection year

17) The population calculated in step 15 is fed back into the beginning of the process to begin the next year's projection.

For more information please contact GLA Demography, GLA Intelligence
Greater London Authority, City Hall, The Queen's Walk, More London, London SE1 2AA
Tel: 0207 983 5523 e-mail: demography@london.gov.uk

MAYOR OF LONDON