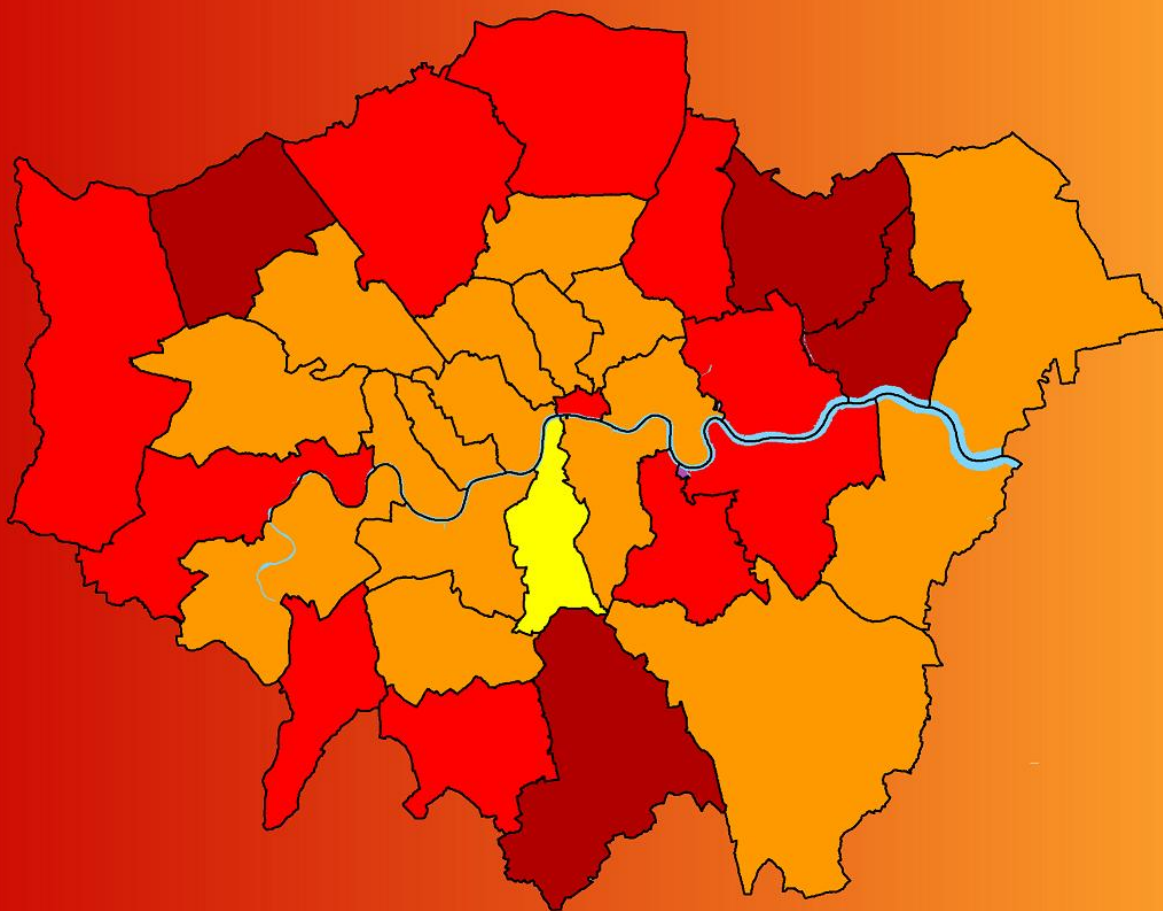


Data Management and Analysis Group

GLA 2006 Round Ethnic Group Projections



DMAG Briefing 2007-14

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GLA 2006 Round Ethnic Group Population Projections

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GLA Ethnic Group Population Projections

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Front Page

The map presented on the front page of this *Briefing* shows the change in the proportion of the black, Asian and minority ethnic group population by London Borough between 2001 and 2026. The legend and map are reproduced in the Appendix.

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Executive Summary

- These projections have been demographically modelled based on 2001 Census data; the most detailed source for information on ethnicity. Therefore modelled output is as a result of demographic trends present as at 2001. Specifically all migration flow structures relate to moves between 2000 and 2001. More recent migration patterns will not be reflected in these projections, for example EU accession migration from Eastern Europe (A8). At present, while there are statistics relating to the estimated inflows of A8 persons to the UK, there are no official statistics on the number of these migrants moving to London, or on those remaining resident in the UK.
- Modelled output is for ten ethnic groups that are aggregations of the 16 ethnic categories from the 2001 Census. Categories had to be aggregated to diminish the impact of statistical disclosure control on borough level 2001 Census output for some smaller ethnic groups. As a result the three White categories were aggregated to one.¹ It should therefore be noted that this White group represents an ethnically diverse population and hence includes, amongst others, White Britons, Australians and Europeans such as the Irish and Poles.
- The resident population of London is projected to increase after 2006 by 1.14 million to 8.71 million by 2026, an increase of 15 per cent.
- Over eighty-four per cent of the population increase is projected to be from BAME ethnic groups. This is as a result of the younger age structure of this population. However, this disguises the significant migrant churn of all ethnic groups that takes place in the capital.
- The White population is projected to increase by 3.5 per cent between 2006 and 2026, the smallest proportional increase of all the ethnic groups. The Black Caribbean ethnic group is projected to increase by 13 per cent, the second smallest proportional increase.
- The largest percentage increases are projected to be in the Other, Chinese and Bangladeshi ethnic groups, which will increase by 77 per cent, 51 per cent and 44 per cent respectively.
- Four ethnic groups will account for 64 per cent of the total population growth over the twenty-year period. These ethnic groups are the residual Other ethnic group (201 thousand or 18 per cent) the White ethnic group (178 thousand or 16 per cent), the Black African ethnic group (176 thousand or 15 per cent), and the Indian ethnic group (167 thousand or 15 per cent).
- By 2026 39 per cent of London's population is projected to be from a Black, Asian or minority ethnic group. (BAME). This compares with 32 per cent in 2006 and 29 per cent in 2001. As a comparison in 1991 the groups other than White were estimated to form 20 per cent of London's population. It is clear that while there is a significant increase in London's BAME population the growth rate is not accelerating dramatically when viewed as a proportion of London's total population.

¹ Details of 2001 Census analysis are available from the Data Management and Analysis Group at the Greater London Authority and at the following site: <http://www.london.gov.uk/gla/publications/factsandfigures.jsp>

- By 2026 eight London boroughs are projected to have BAME populations that represent over 50 per cent of the total, with Harrow, Redbridge, Tower Hamlets, Hounslow, Croydon and Ealing joining Brent and Newham that had more than 50 per cent BAME populations in 2001.
- At all ages, with the exception of the 25-29 year old age group, the BAME population will increase its share as a proportion of the total London population. Fifty-three per cent of 15-19 year olds in 2026 are projected to be from a BAME group compared with 42 per cent in 2006.
- The 25-29 year old age group is projected to remain static through the projection period, with 30 per cent of this age group from a BAME group in 2006 as well as at 2026. This is a result of high in migration into London from the rest of the UK, as well as the rest of the world that is ethnically predominantly White.
- By 2026 over 32 per cent of London's population aged over 60 is projected to be from a BAME group. In 2006 this was 18 per cent.
- Over 86 per cent of London's natural change throughout the projection period is attributable to the BAME groups. This is due to the younger age structure of the BAME groups and mainly a function of relatively fewer deaths, only 23 per cent of the London total being from the BAME population.
- Four London boroughs are projected to increase the proportion of their BAME population by over 20 percentage points between 2006 and 2026 namely Harrow, Croydon, Redbridge and Barking & Dagenham.
- Seventy-two per cent of the increase in the population of economically active ages is attributable to the BAME groups.

Background

These ethnic group population projections are an update of the previous round of GLA ethnic group projections, 2005 Round Interim Ethnic Group population projections as described in *DMAG Briefing 2006/22*. The 2006 Round Ethnic Group Population Projections are constrained to the 2006 Round Demographic Projections, RLP High². The output is available by aggregated ethnic groups, age and gender and is produced at borough level.

Between the 1991 Census and the 2001 Census the ethnic group categories were extended from ten to sixteen. However, a feasibility study conducted by the GLA Data Management and Analysis Group (DMAG) concluded that it would not be possible to produce a complete set of robust ethnic group population projections for 33 London boroughs at the detail of 16 ethnic groups.

The application of statistical disclosure control (SDC) procedures by the Office for National Statistics (ONS) on 2001 Census data meant that many of the cells required for detailed migration modelling were converted to zeros and threes. To eliminate many of these spurious cell values, ethnic group categories needed to be combined. This was done when the data were specially commissioned from ONS. Therefore, the SDC applied to small-number cells had an impact on the input data required for modelling. This issue was particularly evident for arriving at differential migration structures.

The size and composition of the Mixed ethnic categories proved to be a pivotal factor in the feasibility study. The size of these ethnic groups was deemed to be too small to produce robust population projections at the local authority level. This combined with other data limitations that prevented demographers from accurately modelling the unique way in which the Mixed ethnic groups were mainly growing, ie by births to a mother in one ethnic group being ascribed to a different group, would prevent meaningful and robust output. Hence the 16 ethnic group categories from the 2001 Census have been aggregated as represented in Table 1. Data from the modelling process is available for the aggregated categories only.

The methodology is broadly consistent with that used in the previous round of ethnic group projections except in the case of fertility modelling. These projections incorporate improved fertility modelling as described in the *DMAG Briefing 2005/21 Transgenerational Ethnicity*³. A brief description is available in the Appendix.

It should also be noted that these projections are based on 2001 Census data and hence migration patterns relevant to the year before Census Day in April 2001. As a result more recent migrant flows such as those resulting from the expansion of the European Union since 2004 are not reflected in the modelling methodology and therefore are not accounted for in the results. At the time of producing these projections data on migrants from new accession states had only been incorporated into the ONS mid year estimates for 2005 but are not specifically identified. Trends in the ONS mid-year estimates are incorporated into the borough level demographic projections. These ethnic group projections are consistent with the 2006 Round of Demographic Projections, RLP High.

² DMAG Briefing 2006-32 GLA 2006 Round Demographic Projections, John Hollis

³ DMAG Briefing 2005-21 Transgenerational Ethnicity, Baljit Bains, John Hollis and Vicky Clarke

Table 1: GLA projection categories and how they relate to the 2001 Census categories

GLA Aggregated Ethnic Group	ONS 2001 Census Ethnic Category
White	White: British White: Irish White: Other White
Black Caribbean	Black or Black British: Caribbean
Black African	Black or Black British: African
Black Other	Black or Black British: Other Black Mixed: White & Black Caribbean Mixed: White & Black African
Indian	Asian or Asian British: Indian
Pakistani	Asian or Asian British: Pakistani
Bangladeshi	Asian or Asian British: Bangladeshi
Other Asian	Mixed: White & Asian Asian or Asian British: Other Asian
Chinese	Chinese or Other: Chinese
Other	Mixed: Other Mixed Chinese or Other: Other

Greater London: An Overview

Total Change: Projected population change by ethnic group

The population of Greater London is projected to increase by 15.0 per cent between 2006 and 2026, an addition of 1.138 million people to London's current population. All ethnic groups are projected to increase in size between 2006 and 2026 however the extent to which each ethnic group increases varies considerably. For example, the White ethnic group is projected to increase by only 3.5 per cent between 2006 and 2026. The equivalent increase in the residual Other ethnic group is 76.6 per cent over the same time period, the largest proportional increase of all projected ethnic groups. Equivalent increases for the Chinese, Bangladeshi and Pakistani ethnic groups are 51.1 per cent, 44.0 per cent and 44.0 per cent respectively.

Table 2 shows the total projected population by ethnic group over the projection period. In addition to showing the proportional increase of each ethnic group population it also shows the distribution of that increase. Eighty-four per cent of the population increase between 2006 and 2026 is projected to be from ethnic groups other than White. The distribution of this increase varies between the black and minority ethnic groups considerably. The largest share of the growth is projected to be the residual Other ethnic group, which is expected to increase by over 200 thousand people and accounts for 17.6 per cent of the total increase. The White ethnic group forms 15.7 per cent of the total increase, the second largest share, and the Black African ethnic group 15.4 per cent of the total increase.

Table 3 shows how each ethnic group changes in terms of its population as a proportion of the total population of London. By 2026, 39.3 per cent of Londoners are projected to be from an ethnic group other than White, an increase from 32.5 per cent in 2006 and 28.9 per cent in 2001. Conversely 67.5 per cent of all Londoners in 2006 were from the White ethnic group. By 2026 this proportion is projected to decline by over 6 percentage points to 60.7 per cent. There are only two ethnic groups that are projected to decline with regards to their proportion of the total population; these are the White and Black Caribbean ethnic groups. The proportional decline in population of the Black Caribbean ethnic group is small at 0.08 per cent. All other ethnic groups are projected to increase in proportional size (the size of the ethnic group as a proportion of the total population). The largest increases are in the residual Other ethnic group (1.85 percentage points), the Black African ethnic group (1.23 percentage points) and the Indian ethnic group (1.05 percentage points).

Chart 1 represents graphically these proportional changes for all ethnic groups other than White.

Table 2: Total Population, All Projected Ethnic Groups, 2001-2026

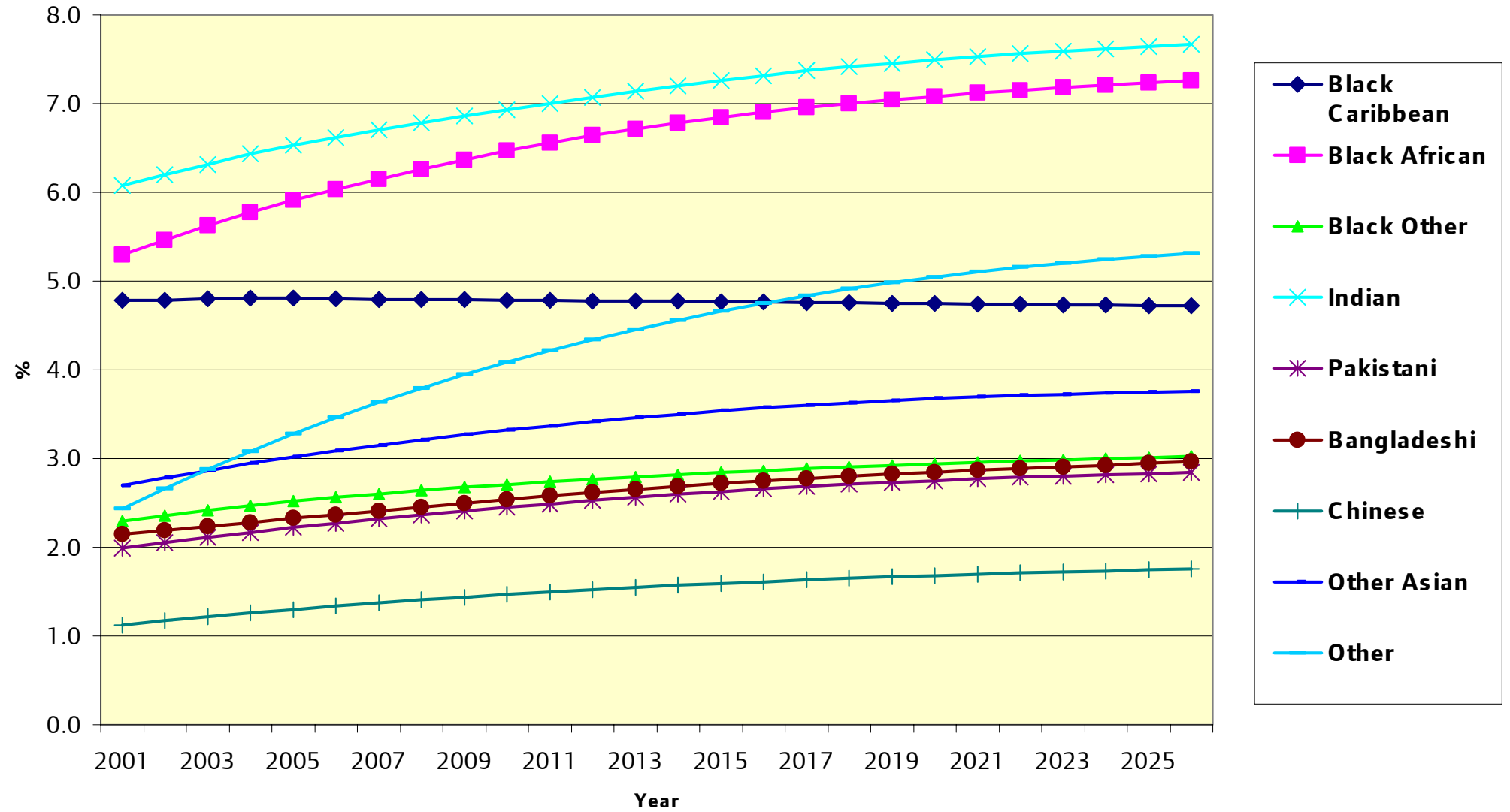
Total Population	2001	2006	2011	2016	2021	2026	2006-26 (Change)	2006-26 (% Change)	2006-26 (% of Change)
Total	7,322,400	7,571,900	7,894,600	8,193,000	8,467,300	8,710,300	1,138,400	15.03	100.00
White	5,209,900	5,108,100	5,113,100	5,146,700	5,209,300	5,286,300	178,200	3.49	15.65
Black Caribbean	350,000	363,400	377,400	390,200	401,400	411,300	47,900	13.18	4.21
Black African	387,700	456,800	517,800	565,400	602,700	632,500	175,700	38.46	15.43
Black Other	168,100	194,200	216,200	234,600	250,400	263,300	69,100	35.60	6.07
Indian	445,400	501,000	552,900	599,400	637,600	667,900	166,800	33.30	14.66
Pakistani	145,700	172,100	196,600	217,800	234,600	247,600	75,500	43.88	6.63
Bangladeshi	157,200	179,200	203,600	225,100	242,800	258,000	78,800	43.98	6.92
Other Asian	197,700	233,700	266,000	292,600	312,800	327,400	93,700	40.11	8.23
Chinese	82,200	101,300	118,200	132,100	143,500	153,000	51,700	51.08	4.55
Other	178,400	262,200	332,700	389,100	432,300	463,000	200,900	76.61	17.64
BAME	2,112,500	2,463,900	2,781,500	3,046,300	3,258,000	3,424,100	960,200	38.97	84.35

* figures may not add due to rounding

Table 3: Ethnic group populations as proportions of total population

Total Population (%)	2001	2006	2011	2016	2021	2026	2006-26 (Change)
White	71.15	67.46	64.77	62.82	61.52	60.69	-6.77
Black Caribbean	4.78	4.80	4.78	4.76	4.74	4.72	-0.08
Black African	5.29	6.03	6.56	6.90	7.12	7.26	1.23
Black Other	2.30	2.56	2.74	2.86	2.96	3.02	0.46
Indian	6.08	6.62	7.00	7.32	7.53	7.67	1.05
Pakistani	1.99	2.27	2.49	2.66	2.77	2.84	0.57
Bangladeshi	2.15	2.37	2.58	2.75	2.87	2.96	0.60
Other Asian	2.70	3.09	3.37	3.57	3.69	3.76	0.67
Chinese	1.12	1.34	1.50	1.61	1.70	1.76	0.42
Other	2.44	3.46	4.21	4.75	5.11	5.32	1.85
BAME	28.85	32.54	35.23	37.18	38.48	39.31	6.77

Chart 1: Change in Percentage of ethnic groups as a proportion of the total population

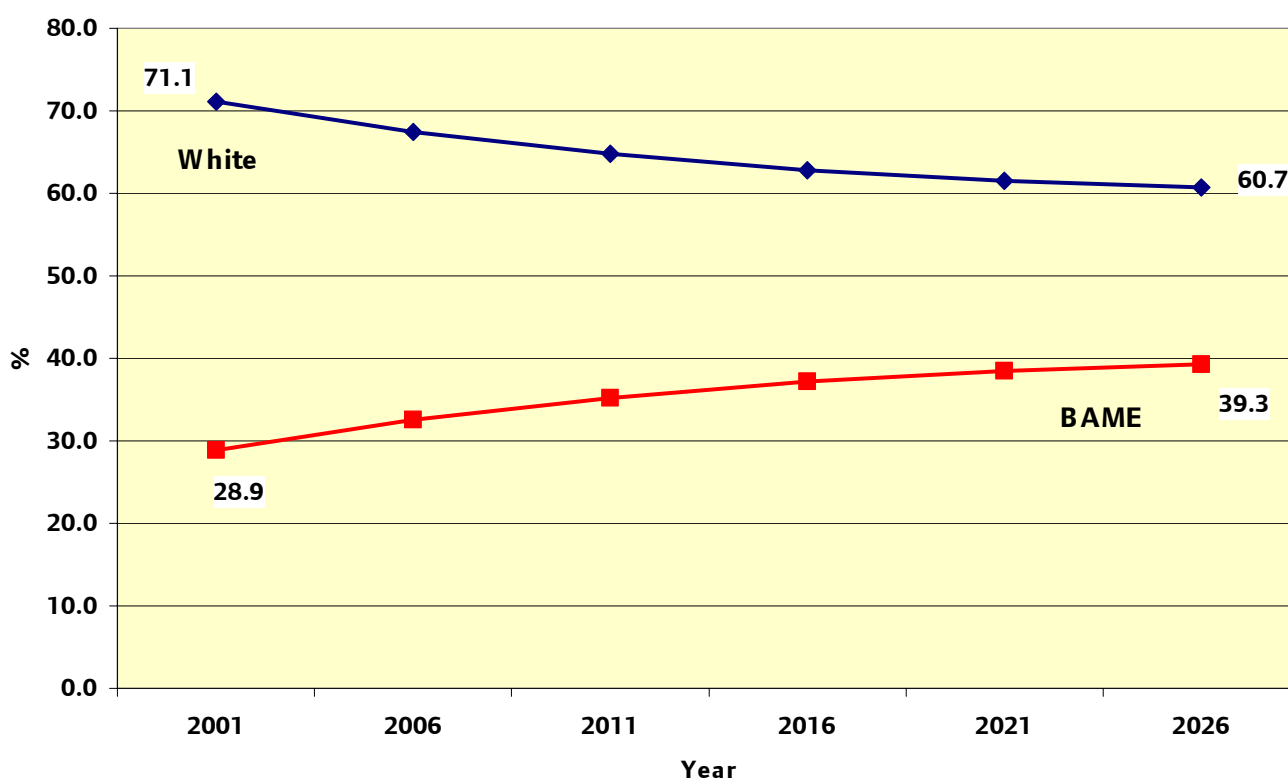


Ethnic Majority: A borough analysis

In 2001 28.9 per cent of London's population was from an ethnic group other than White. Two London Boroughs had black, Asian and minority ethnic (BAME) populations⁴ that made up more than 50 per cent of their total population; Brent and Newham.

By 2026 39.3 per cent of the London's projected population is expected to be from an ethnic group other than White. Chart 2 below shows that London is not projected to have a BAME majority population in the lifetime of these projections. The asymptotic nature of the curve suggests that this will not occur in the medium term.

Chart 2: Changes in the proportion of White and BAME population in London, 2001 to 2026



However, results from these projections show that by 2026 eight London boroughs will have black, Asian and minority ethnic populations that make up over 50 per cent of their total population shown in Chart 5.

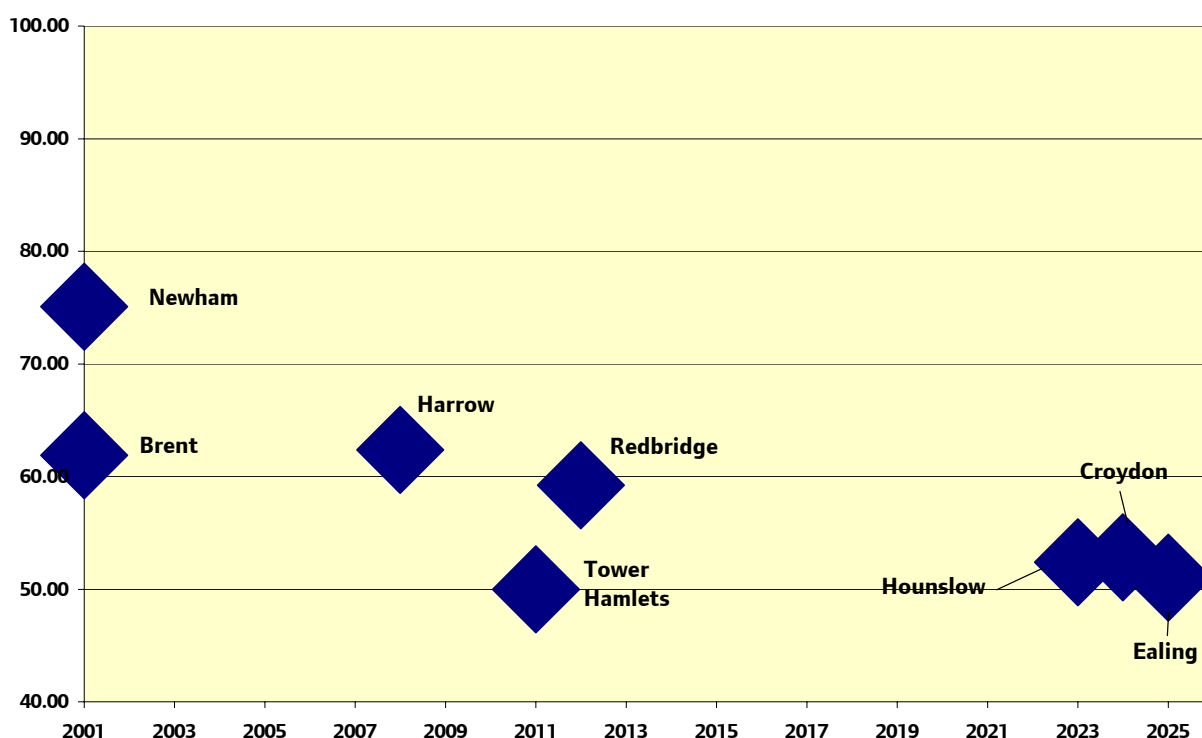
Chart 3 shows the timeline of which boroughs will have a majority BAME population. In addition the chart plots (along the y-axis) the BAME population as a proportion of the total as projected by 2026.

⁴ BAME refers to all ethnic group other than White. For example it is an aggregation of Black Caribbean, Black African, Black Other, India, Pakistani, Bangladeshi, Asian Other, all Mixed groups, Chinese and Other.

For example, Newham had an ethnic majority in 2001 (61 per cent), but by 2026 this is projected to increase to 75 per cent. The horizontal axis plots the timeline at which London boroughs are projected to have a BAME majority. The vertical axis projects the proportion of the BAME population for each borough as at 2026.

Harrow is projected to catch up with its neighbouring borough, Brent, over the projection period. Brent was one of the two boroughs with a BAME majority (of 54.6 per cent) in 2001 however by 2026 this majority is expected to increase to 61.9 per cent of the total population. Similarly Harrow is projected to have a 62.4 per cent BAME majority in 2026, however in 2001 the BAME population had represented only 41.3 per cent of all residents of Harrow.

Chart 3: Timeline of those London Boroughs with a BAME majority



Map 1 in Appendix 1 shows the percentage change in the proportion of BAME residents by London boroughs. Four London boroughs see their BAME population projected to increase by more than 20 per cent between 2006 and 2026; Harrow, Redbridge, Croydon and Barking & Dagenham. Three of these boroughs are shown in Chart 5.

Changes in Age Structure

Chart 4 shows the projected changes in the age structure of the BAME population. Specifically the chart plots the size that each five-year age band represents as a proportion of the total London population of that particular age group.

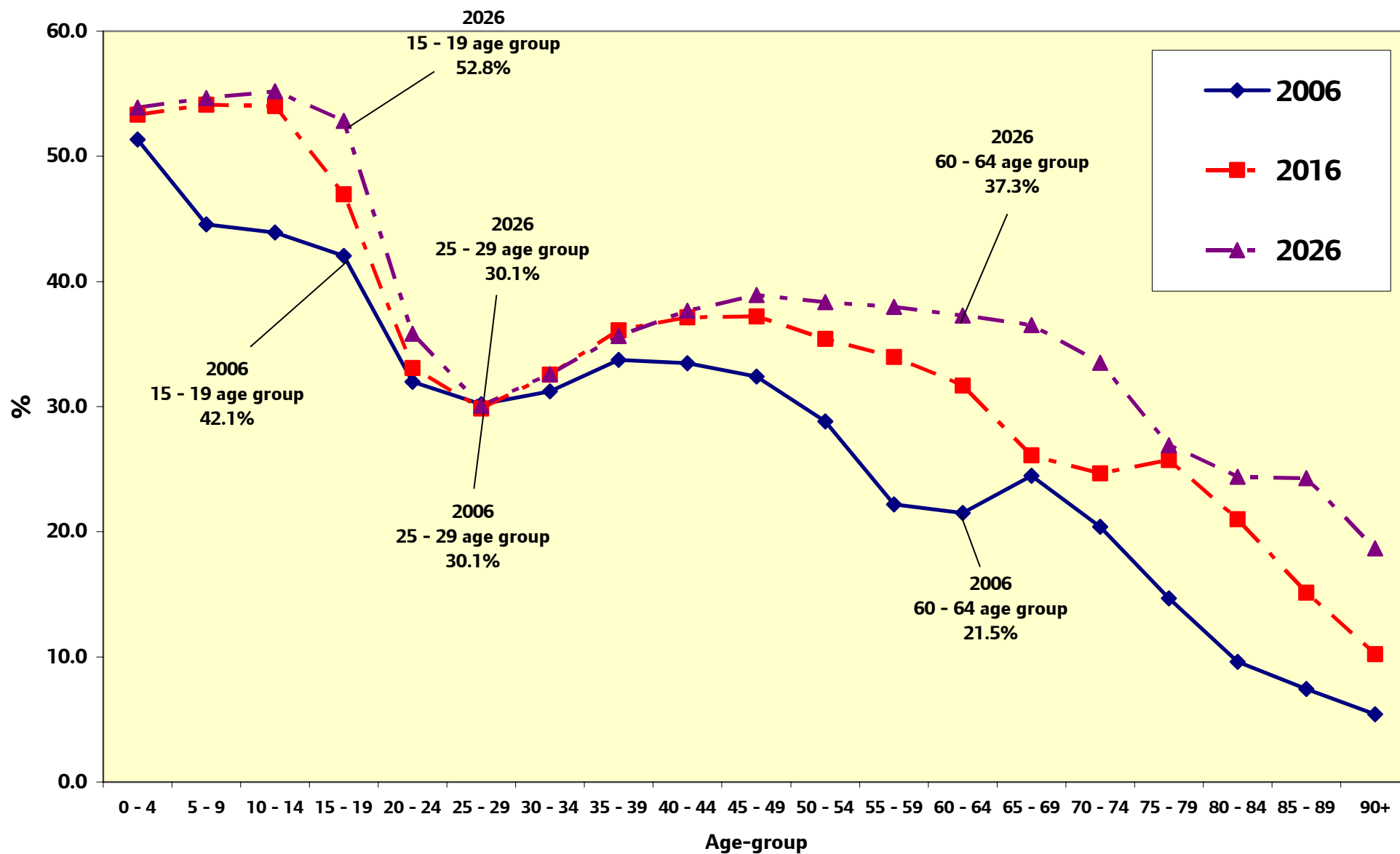
The age structure of London's BAME population is expected to change through the projection period both absolutely and in proportional terms. In the BAME population all five-year age groups bar one, will increase as a proportion of the total population of that age groups. For example, in 2006 the 15-19 year old BAME population represented 42.1 per cent of all Londoners aged 15-19. By 2026 this is projected to increase to 52.8 per cent.

There is also an ageing effect evident within the BAME population in the 20-year span of these projections. In 2006, 18.1 per cent of Londoners are aged 60 and over are from a BAME group. By 2026 this figure is projected to be over 32.3 per cent. In absolute terms the BAME population that is aged 60 or over will increase from 209 thousand people to 464 thousand.

This ageing effect is visible both in the more senior ages ie 75 plus as well as in the middle aged populations (50 plus). In 2006 the BAME population aged 60-64 years represented 22.3 per cent of the total population in that age group. By 2026 this will have increased to 37.3 per cent. This increase is as a direct result of larger cohorts aged 40-44 in 2006 who become 60-64 in 2026.

The only BAME age group that changes little in terms of its proportional size is the 25-29 age group. This group is projected to remain consistent over the projection period at 30.1 per cent however this disguises the significant migrant churn within this age group. Migration to the capital of individuals aged 25 to 29 is heavily dominated by White migrants, mainly from other parts of the UK but also from other parts of the world such as the USA, Europe and the Old Commonwealth. High in-migration in these age groups coupled with the young age structure of the BAME population ensures that London's population structure remains younger than the national population.

Chart 4: Changes in the age structure of the BAME population, Greater London

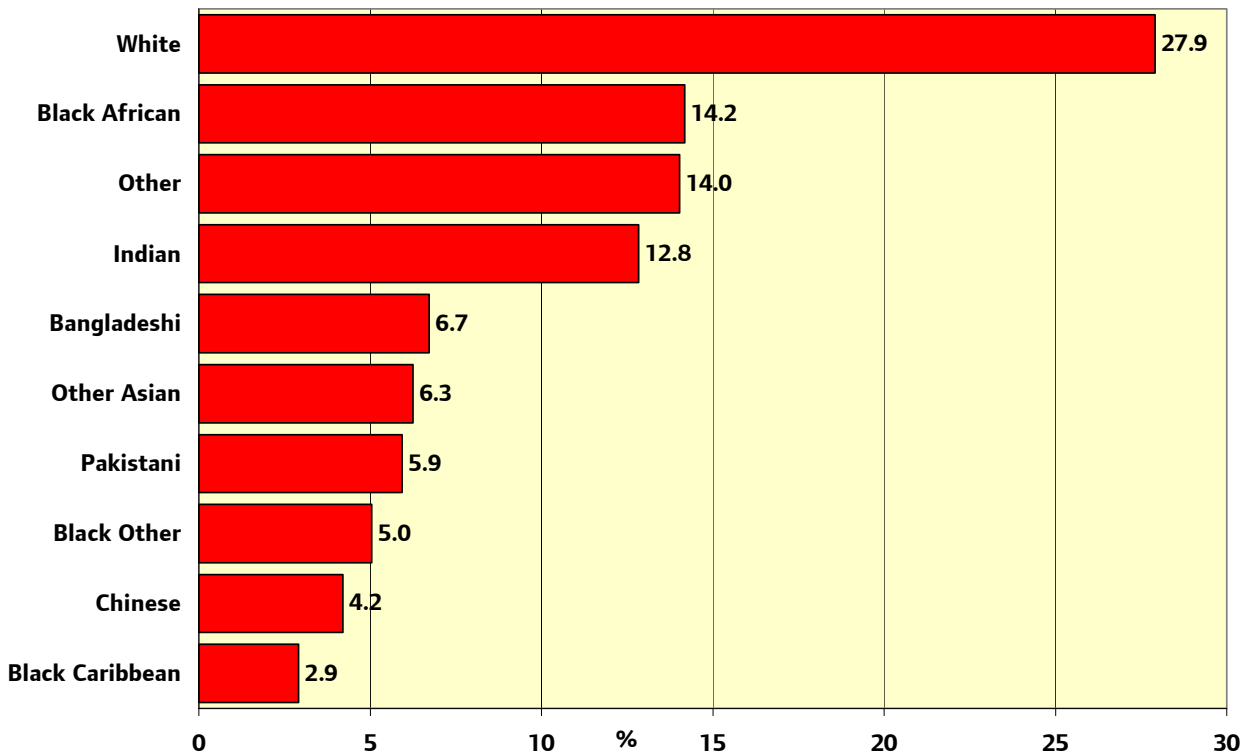


Economically Active Ages

London’s population in the economically active ages (population aged 16 to retirement age⁵) is projected to increase by over 738 thousand people between 2006 and 2026. Chart 5 shows the distribution of this increase across the each ethnic group.

The BAME population accounts for over 72 per cent of the increase in the economically active ages. All ethnic groups are projected to increase in the economically active ages. These increases range from over 60 per cent in the residual Other ethnic group to 5.9 percent for the White ethnic group. The White ethnic group will account for 27.9 per cent (206 thousand population) of the increase in the economically active ages. The Black African and Other ethnic group will account for 14.2 and 14.0 per cent respectively. The Black Caribbean population of economically active age is projected to show the smallest increase (2.9 per cent of the total increase).

Chart 5: Ethnic Distribution of the increase in the size of the economically active population (2006-2026)



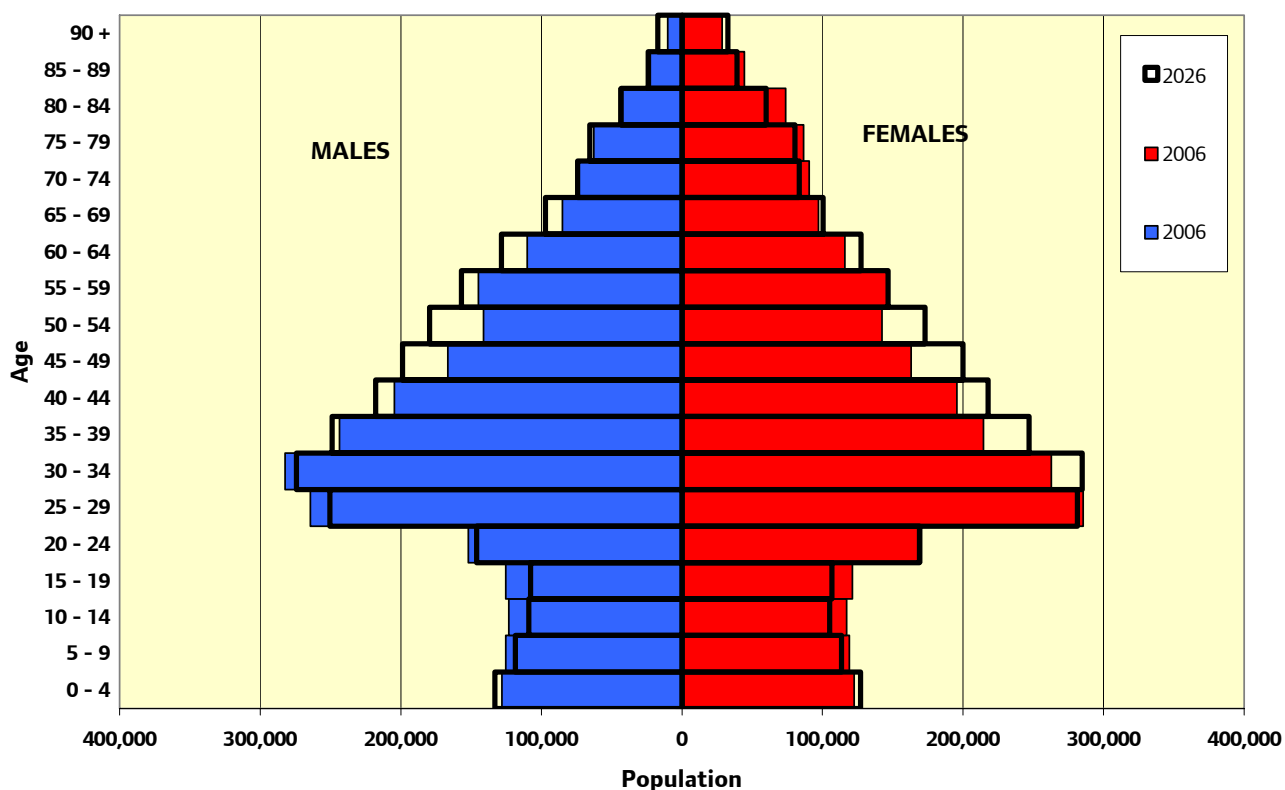
In 2006 those of economically active age within the White ethnic group are estimated to represent 68.6 per cent of all Londoners of this age group, however by 2026 this figure is projected to decline to 63.4 per cent. Conversely the BAME population will increase from 31.4 per cent of all people of economically active age to 36.6 per cent.

⁵ Retirement age is defined as age 60 for women and age 65 for men.

This compares with figures in the *London Plan* (February 2004) that projected growth in this age group to be around 516 thousand between 2001 and 2016 with 80 per cent attributable to the BAME groups. Those figures were crude calculations, not demographically modelled.

The population age structure of each ethnic group plays an important role in the projected population change. In particular the younger age structure of the black and minority ethnic population is the primary reason why over 72 per cent of the increase in economically active age group is from ethnic groups other than White. Those ethnic group populations that have relatively large cohorts of people of reproductive age will expect to experience increases through high birth numbers. The result is that these ethnic groups see rejuvenation in their populations over the projection period. However the age structure of the White population differs from most ethnic group populations because it has proportionally fewer young people and relatively larger cohorts of older people. The population pyramids below show these changing age structures.

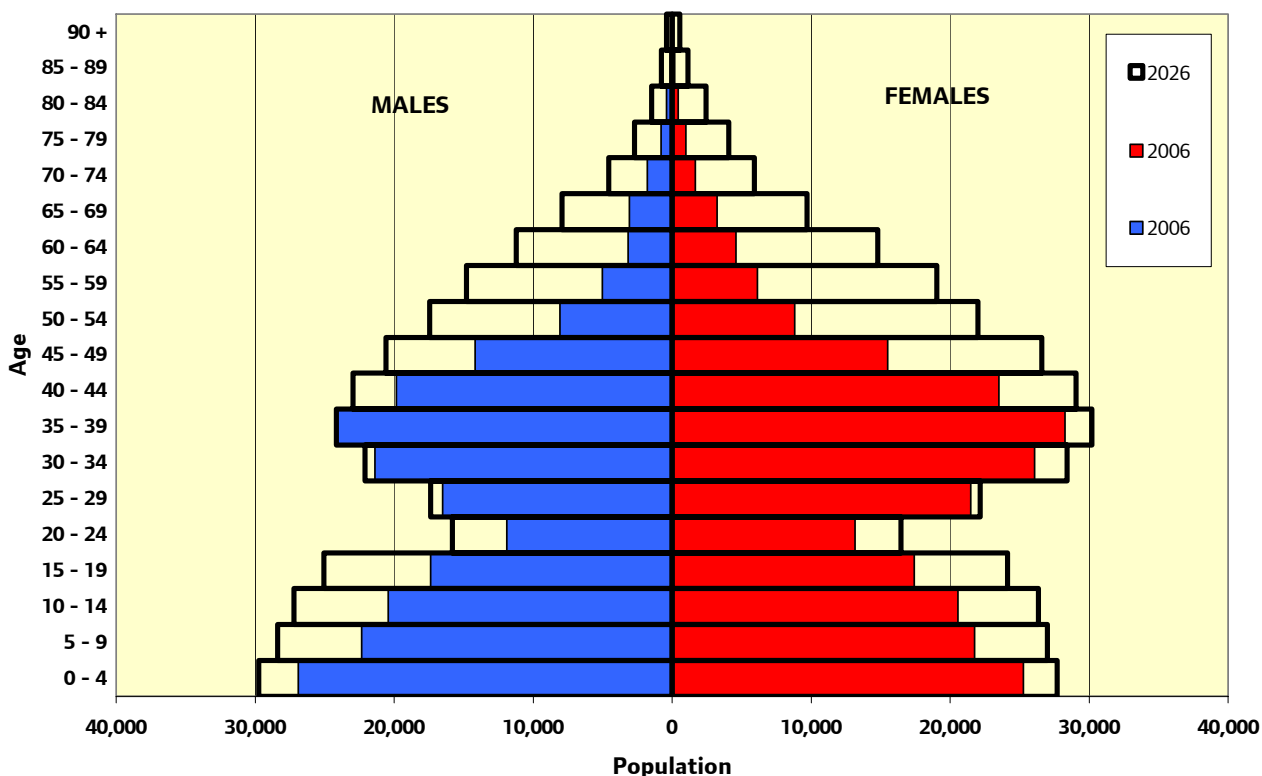
Chart 6: Population Pyramids: White Ethnic Group



The White ethnic group age structure changes little between 2006 and 2026 as shown in Chart 8. There is a slight increase in the youngest age groups (0-4) but declines in the 5 to 29 age groups by 2026. This is partly a result of smaller cohorts replacing larger cohorts through the projections larger cohorts then move to older ages, from 30 to 69. These variations are as a result of cohort effects. As small cohorts in 2006 age they represent correspondingly smaller cohorts 20 years later. The opposite is visible where cohorts are larger; those aged 20-34 in 2006 from the White ethnic groups will be aged 40-54 in 2026 and replace the 40-54 year olds in 2006, a comparatively smaller cohort

The Black African population has proportionally much larger cohorts of people at ages under 50 compared with the White ethnic group. Eighty-nine percent of the Black African population is below the age of 50. The equivalent figure for the White ethnic group is 70 per cent. The population pyramid below shows the effect of a young population as it changes through the projection period. By 2026 larger cohorts of young people are in the reproductive age groups compared with 2006. Consequently when these age groups have children, this results in a rejuvenated population that maintains its young age structure.

Chart 7: Population Pyramids: Black African Ethnic Group



Components of Population Change

All populations change over time with regards to fertility, survival and migration patterns. The demographic modelling methodology is described in more detail in Appendix 2 of the first DMAG Briefing that outlined ethnic group population projections⁶. Since the production of those projections, the fertility methodology was improved to incorporate work on how ethnicity varied between the mother and her child⁷

Chart 8 shows the components of change as they relate to the White ethnic group and the black, Asian and minority ethnic groups. The figures presented are aggregated figures for 2006 to 2026.

For example, natural change, the excess of births over deaths, plays a crucial part in the changing size and composition of populations over time. Natural change is highly dependent on the existing size and age composition of the population. London's population is projected to increase by 1.14 million between 2006 and 2026 and natural change is the main driver. Natural change will account for an additional 1.41 million people and net migration is projected to be a loss of 267 thousand people over the projection period

Chart 8: Distribution of Population Components of Change, 2006 to 2026

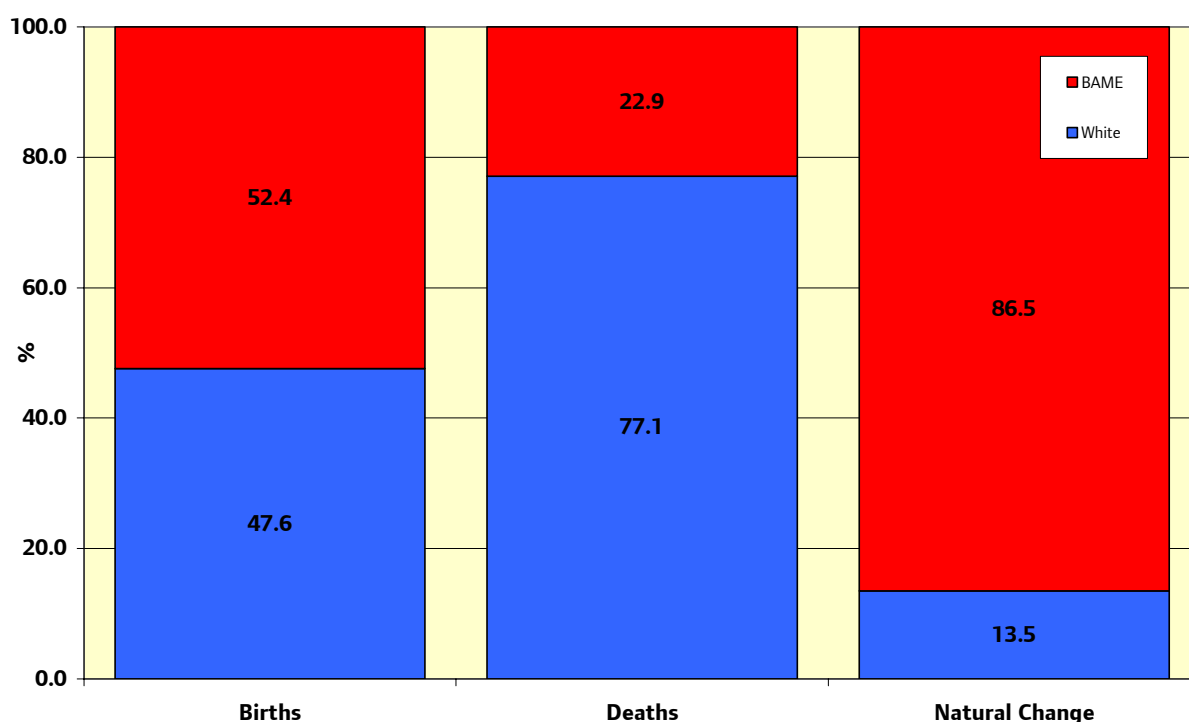


Chart 8 shows that 47.6 per cent of births over the projection period are attributable to the White ethnic groups with the remaining 52.4 per cent as BAME births. A large majority of the deaths are in the White population with only 22.9 per cent of deaths being from BAME groups. These differences are as a result of the differential age structure of the BAME and White populations as the projection

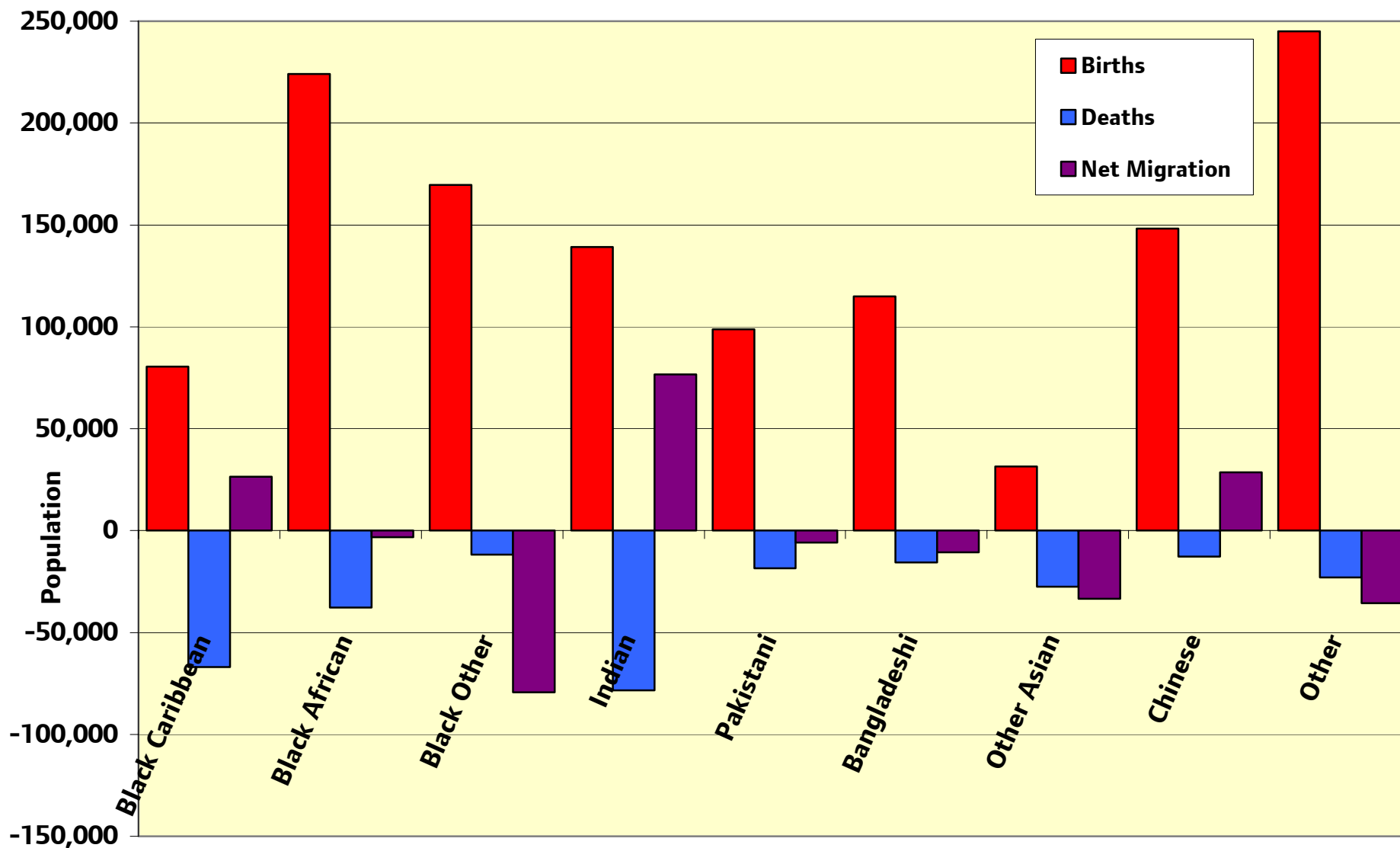
⁶ DMAG Briefing 2006/22 GLA 2005 Round: Interim Ethnic Group Population Projections, Baljit Bains and Ed Klodawski

⁷ DMAG Briefing 2005-21 Transgenerational Ethnicity, Baljit Bains, John Hollis and Vicky Clarke

methodology assumes no differences in mortality between groups. As a result the younger BAME population accounts for 86.5 per cent of the natural change in London and the White ethnic group accounts for just 13.5 per cent.

Chart 9 shows the extent to which each component of population change contributes to the change in the size of each ethnic group. Births are relatively higher amongst those ethnic groups that have a young population age structure where a higher proportion of the population is within reproductively active age groups. For example Black African, Black Other and the residual Other ethnic group all have higher numbers of births. Deaths are higher amongst ethnic groups with higher proportions of older people in their populations, for example the Black Caribbean and Indian ethnic groups. Those BAME groups with younger populations will have significant natural growth. Natural change for the White ethnic group is projected at 150 thousand between 2006 and 2026. The equivalent figures for the Black African and Black Other ethnic groups are 186 thousand and 158 thousand respectively. For other ethnic groups, natural change is relatively small and it is these groups that are showing signs of an ageing population, namely the Black Caribbean and Indian populations. These are also two ethnic groups that have been the longest established migrant communities in the UK and as a result have more individuals approaching retirement age compared with more recently migrated groups.

Chart 9: Aggregated Components of Change, 2006 to 2026, BAME only



Comparison between the 2006 Round and the 2005 Interim Round of Population projections

The following table shows the differences in output for every fifth projection year and each ethnic group. The values are the 2005 Round subtracted from the 2006 Round. For example in the 2005 Round of projections, the projected total population of London in 2026 is 8,327,900. In the 2006 Round the equivalent figure is 8,710,300. Hence in the last table the difference is shown as 382,400.

Table 4

2006 Round Ethnic Group Population Projections

	2001	2006	2011	2016	2021	2026	2006-26 (Change)	2006-26 (% Change)	2006-26 (% of Change)
Total	7,322,400	7,571,900	7,894,600	8,193,000	8,467,300	8,710,300	1,138,400	15.0	100.0
White	5,209,900	5,108,100	5,113,100	5,146,700	5,209,300	5,286,300	178,200	3.5	15.7
Black Caribbean	350,000	363,400	377,400	390,200	401,400	411,300	47,900	13.2	4.2
Black African	387,700	456,800	517,800	565,400	602,700	632,500	175,700	38.5	15.4
Black Other	168,100	194,200	216,200	234,600	250,400	263,300	69,100	35.6	6.1
Indian	445,400	501,000	552,900	599,400	637,600	667,900	166,900	33.3	14.7
Pakistani	145,700	172,100	196,600	217,800	234,600	247,600	75,500	43.9	6.6
Bangladeshi	157,200	179,200	203,600	225,100	242,800	258,000	78,800	44.0	6.9
Other Asian	197,700	233,700	266,000	292,600	312,800	327,400	93,700	40.1	8.2
Chinese	82,200	101,300	118,200	132,100	143,500	153,000	51,700	51.0	4.5
Other	178,400	262,200	332,700	389,100	432,300	463,000	200,800	76.6	17.6
BAME	2,112,500	2,463,900	2,781,500	3,046,300	3,258,000	3,424,100	960,200	39.0	84.3

2005 Round Interim Ethnic Group Population Projections

	2001	2006	2011	2016	2021	2026	2006-26 (Change)	2006-26 (% Change)	2006-26 (% of Change)
Total	7,322,400	7,538,400	7,816,400	8,049,700	8,180,400	8,327,900	789,500	10.5	100.0
White	5,209,900	5,115,200	5,105,400	5,109,900	5,098,400	5,124,700	9,500	0.2	1.2
Black Caribbean	350,000	362,200	375,600	386,300	391,700	398,100	35,900	9.9	4.5
Black African	387,700	453,400	512,100	555,200	581,600	604,300	150,900	33.3	19.1
Black Other	168,100	189,400	208,600	224,100	235,100	245,300	55,900	29.5	7.1
Indian	445,400	498,500	547,700	590,000	616,700	639,600	141,100	28.3	17.9
Pakistani	145,700	167,800	189,700	208,500	219,400	228,300	60,500	36.1	7.7
Bangladeshi	157,200	176,400	204,200	226,500	238,900	249,900	73,500	41.7	9.3
Other Asian	197,700	228,300	255,900	277,700	291,000	301,500	73,200	32.1	9.3
Chinese	82,200	101,000	117,000	129,700	138,500	146,200	45,200	44.8	5.7
Other	178,400	246,100	300,200	341,700	369,100	390,100	144,000	58.5	18.2
BAME	2,112,500	2,423,200	2,711,000	2,939,800	3,082,000	3,203,200	780,000	32.2	98.8

Difference	2001	2006	2011	2016	2021	2026	Change	Distribution of change
Total	-	33,500	78,200	143,400	287,000	382,400	348,900	
White	-	- 7,200	7,700	36,900	110,900	161,600	168,700	48.4
Black Caribbean	-	1,200	1,800	3,900	9,700	13,200	12,000	3.4
Black African	-	3,400	5,800	10,200	21,100	28,200	24,800	7.1
Black Other	-	4,700	7,600	10,500	15,300	18,000	13,200	3.8
Indian	-	2,500	5,200	9,300	20,800	28,300	25,800	7.4
Pakistani	-	4,300	6,900	9,200	15,200	19,300	15,000	4.3
Bangladeshi	-	2,800	- 600	- 1,400	3,900	8,100	5,300	1.5
Other Asian	-	5,400	10,100	14,900	21,800	25,900	20,500	5.9
Chinese	-	300	1,200	2,400	5,000	6,800	6,500	1.9
Other	-	16,000	32,500	47,400	63,200	72,900	56,800	16.3
BAME	-	40,600	70,500	106,500	176,100	220,800	180,200	51.6

* figures may not add due to rounding

Differences in output of the 2005 Round and 2006 Round projections are mainly due to the different constraints that were used for each projection. The 2005 Round was constrained to the 2005 Demographic projection and the 2006 constrained to the 2006 Round Demographic projections.

An additional change between these two rounds is that fertility was modelled differently in the 2005 Round compared with the 2006 Round. The changed methodology, transgenerational fertility is explained fully in the Appendix.

The 2006 Round constraint population was considerably higher than the constraint population for the 2005 Round. Although there was no difference at 2001, for 2006 the difference was over 33 thousand more population. By 2026 this is over 382 thousand more population. The total population change between 2006 and 2026 for each varied from 789 thousand in the 2005 round to over 1.138 million in the 2006 Round.

The ethnic distribution of this additional population of 349 thousand is shown in the lower table. Forty-eight per cent of the additional population is distributed to the White population with the remaining 52 per cent distributed to the BAME groups. The largest BAME proportions were 16.3 per cent to the Other residual population, 7.4 per cent to the Indian group and 7.1 per cent to the Black African group. This distribution is consistent with the distribution of the population growth in both rounds of projections in as far as the BAME distribution is dominated by the Black African, Indian and Other ethnic group.

Future Developments

The ethnic group population projections model is constantly being improved and further developed. Current development work is focussed on the disaggregation of the population projections for the White ethnic group into its constituent parts; White British, White Irish and White Other. These will be for Greater London only.

Other developments include resident labour force projections and household projections by ethnic group of the household representative. In the first instance these projections will only relate to Greater London as a whole. These are to be completed in time for the 2007 round of demographic projections, which are due to be published in January 2008

Availability of Output

Data from the 2006 Round RLP High ethnic group population projections are available on the Demography Extranet. The excel tables show populations by five year age bands and gender, for the ten aggregated ethnic groups, at every fifth projection year, for all boroughs, borough groups, and London as a whole. Variant RLP Low projections in the same format are available on request.

Data presented in this *Briefing* can be made available in other formats on request.

For data requests please contact Baljit Bains at the Greater London Authority.

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Appendix 1

Tables and Maps

Table 1	GLA Ethnic Group Population Projections, London Boroughs, 2006
Table 2	GLA Ethnic Group Population Projections, London Boroughs, 2016
Table 3	GLA Ethnic Group Population Projections, London Boroughs, 2026
Map 1:	Percentage Change in the proportion of BAME residents by London Borough, 2001-2026

Appendix Table 1: GLA Ethnic Group Population Projections, London Boroughs, 2006

	Total	White	Black Caribbean	Black African	Black Other	Indian	Pakistani	Bangladeshi	Other Asian	Chinese	Other
Camden	205,100	145,100	3,200	12,400	3,900	5,800	1,400	13,700	4,300	4,400	11,000
City of London	9,300	7,400	100	200	100	300	100	200	200	300	500
Hackney	218,100	129,000	20,300	26,200	11,100	7,900	1,900	6,700	3,800	2,800	8,600
Hammersmith and Fulham	177,500	135,700	8,400	8,900	5,500	2,600	2,000	1,200	4,700	1,600	7,100
Haringey	228,500	148,400	20,200	20,600	8,400	6,000	2,400	3,500	5,900	3,300	9,800
Islington	190,800	142,100	8,500	10,300	5,900	3,400	1,100	5,000	3,500	4,300	6,600
Kensington and Chelsea	169,500	132,000	3,800	5,900	3,400	3,700	1,300	1,200	4,000	3,800	10,300
Lambeth	283,700	177,800	31,300	33,200	14,400	5,000	2,700	2,500	5,000	3,400	8,500
Lewisham	260,700	160,400	33,800	28,000	13,500	5,300	1,300	1,300	6,200	3,600	7,500
Newham	260,100	85,100	18,300	38,900	8,000	31,500	26,000	25,900	11,600	3,500	11,300
Southwark	269,000	166,100	19,700	43,200	11,000	5,200	1,200	4,100	3,800	5,800	8,900
Tower Hamlets	223,300	113,500	4,800	6,600	3,600	4,000	1,400	74,200	3,700	6,000	5,400
Wandsworth	286,300	223,600	11,900	10,300	7,100	8,200	5,500	1,300	6,800	2,700	8,900
Westminster	215,900	155,000	5,700	6,600	4,500	8,600	2,200	5,500	7,200	6,000	14,500
Barking and Dagenham	169,100	128,500	4,800	14,200	4,400	5,000	4,300	1,200	2,200	2,000	2,700
Barnet	328,900	229,500	4,100	17,000	5,600	29,900	5,000	1,700	10,600	8,000	17,400
Bexley	218,000	193,100	2,300	7,600	2,600	5,300	400	500	2,500	1,300	2,500
Brent	276,800	117,900	27,700	22,600	9,900	53,100	11,800	1,100	17,500	3,300	11,800
Bromley	304,300	270,800	6,000	5,800	4,100	5,600	800	1,100	3,900	2,000	4,200
Croydon	337,200	210,600	31,100	20,900	11,900	27,700	9,700	2,300	12,900	2,000	8,100
Ealing	312,300	173,400	13,600	11,100	6,900	49,600	12,600	1,300	17,300	4,300	22,200
Enfield	288,100	204,500	17,500	17,900	7,400	12,800	2,200	4,500	9,300	3,000	8,900
Greenwich	234,000	166,100	7,700	24,700	6,400	10,800	2,700	1,600	5,200	3,600	5,400
Harrow	217,000	110,700	6,900	7,300	3,500	54,700	5,500	1,100	17,000	2,800	7,400
Havering	229,000	214,200	2,200	3,100	1,600	3,000	500	200	1,700	1,000	1,400
Hillingdon	248,100	181,200	4,200	7,200	3,500	27,800	5,000	2,000	9,300	2,200	5,800
Hounslow	222,800	131,800	2,900	6,700	3,500	44,300	10,900	1,900	8,700	2,100	10,100
Kingston upon Thames	154,000	122,400	1,000	1,900	1,200	6,600	2,400	500	6,400	2,700	8,900
Merton	195,000	140,100	7,600	7,400	4,300	8,800	5,000	2,000	9,800	2,900	7,200
Redbridge	249,100	137,900	10,800	11,100	4,500	40,200	20,100	6,300	11,800	2,100	4,300
Richmond upon Thames	182,200	162,800	700	1,000	1,800	5,100	800	600	3,400	1,300	4,800
Sutton	183,100	156,000	2,800	3,500	2,400	5,300	2,100	600	5,300	1,300	3,800
Waltham Forest	224,700	135,100	19,500	14,700	8,600	7,900	19,800	2,400	8,200	1,800	6,700
Greater London	7,571,900	5,108,100	363,400	456,800	194,200	501,000	172,100	179,200	233,700	101,300	262,200

*figures may not add due to rounding

Appendix Table 2: GLA Ethnic Group Population Projections, London Boroughs, 2016

	Total	White	Black Caribbean	Black African	Black Other	Indian	Pakistani	Bangladeshi	Other Asian	Chinese	Other
Camden	218,500	150,300	2,800	13,200	4,000	6,900	1,500	15,300	4,500	5,500	14,400
City of London	12,700	9,500	200	300	200	500	100	200	400	400	900
Hackney	241,100	141,000	19,500	28,800	13,200	8,600	1,700	7,900	4,600	3,400	12,300
Hammersmith and Fulham	189,200	141,300	7,900	9,700	6,200	2,500	2,300	1,500	6,200	1,900	9,700
Haringey	243,700	155,900	19,600	21,600	9,200	6,000	2,800	4,300	6,400	4,300	13,600
Islington	215,300	158,000	8,500	10,500	6,800	4,300	1,300	6,400	4,300	6,000	9,100
Kensington and Chelsea	182,100	140,600	3,400	5,800	3,400	4,300	1,400	1,200	4,100	5,100	12,800
Lambeth	309,100	194,400	29,700	36,500	16,200	4,900	2,800	3,100	6,200	3,600	11,600
Lewisham	280,600	158,500	38,500	35,100	16,700	7,400	1,600	1,300	7,600	3,800	10,000
Newham	328,400	91,500	20,500	53,300	10,000	38,300	37,200	35,900	16,500	5,800	19,400
Southwark	302,300	183,200	19,300	47,700	12,700	6,900	1,500	4,900	5,100	7,700	13,300
Tower Hamlets	287,400	146,400	4,800	7,600	4,300	6,000	1,800	91,800	5,200	10,500	8,900
Wandsworth	304,500	236,800	10,300	10,400	7,500	9,000	5,300	1,600	7,300	3,200	13,200
Westminster	234,800	164,700	5,200	6,100	4,800	11,100	2,600	5,400	8,100	7,700	19,100
Barking and Dagenham	191,800	123,400	7,100	25,300	7,500	7,300	6,600	2,300	3,400	4,100	4,900
Barnet	367,000	237,200	4,300	22,300	7,600	35,200	6,700	2,100	12,800	10,800	28,000
Bexley	221,000	186,800	3,100	12,500	4,100	5,200	400	600	3,100	1,200	4,000
Brent	302,400	119,700	27,400	25,500	11,500	62,300	13,700	1,100	21,400	4,100	15,700
Bromley	314,400	269,200	8,100	8,900	5,600	6,900	900	1,500	4,700	2,200	6,400
Croydon	352,200	185,500	38,700	28,700	15,400	37,300	13,400	3,000	16,400	2,000	11,900
Ealing	330,700	169,200	13,400	11,300	7,400	50,500	14,100	1,500	20,100	5,300	37,800
Enfield	293,600	187,600	20,900	22,700	9,200	15,000	2,700	5,800	11,300	4,300	14,200
Greenwich	276,400	176,100	9,300	40,300	9,000	13,400	4,100	2,200	8,400	5,400	8,200
Harrow	226,100	94,900	7,600	8,800	4,000	66,800	6,700	1,200	22,000	3,000	10,900
Havering	239,200	218,000	3,300	5,800	2,400	3,500	600	200	2,200	1,300	2,000
Hillingdon	252,900	164,900	5,500	10,700	4,600	33,900	6,600	2,800	13,100	2,600	8,300
Hounslow	231,800	119,200	3,000	7,400	4,000	54,900	12,800	3,300	9,700	2,300	15,200
Kingston upon Thames	163,900	120,400	1,200	2,600	1,400	8,200	2,900	700	8,100	3,800	14,600
Merton	199,500	135,900	8,000	8,100	5,100	9,500	5,500	2,400	11,600	3,300	9,900
Redbridge	270,400	124,100	13,100	14,600	5,400	51,300	28,000	9,600	15,700	2,400	6,200
Richmond upon Thames	188,100	164,300	700	1,200	2,300	6,100	800	600	4,200	1,300	6,600
Sutton	186,600	149,500	3,800	5,100	3,000	6,700	3,200	800	7,400	1,500	5,700
Waltham Forest	235,300	128,500	21,600	17,100	9,700	8,600	24,100	2,800	10,500	2,400	10,000
Greater London	8,193,000	5,146,700	390,200	565,400	234,600	599,400	217,800	225,100	292,600	132,100	389,100

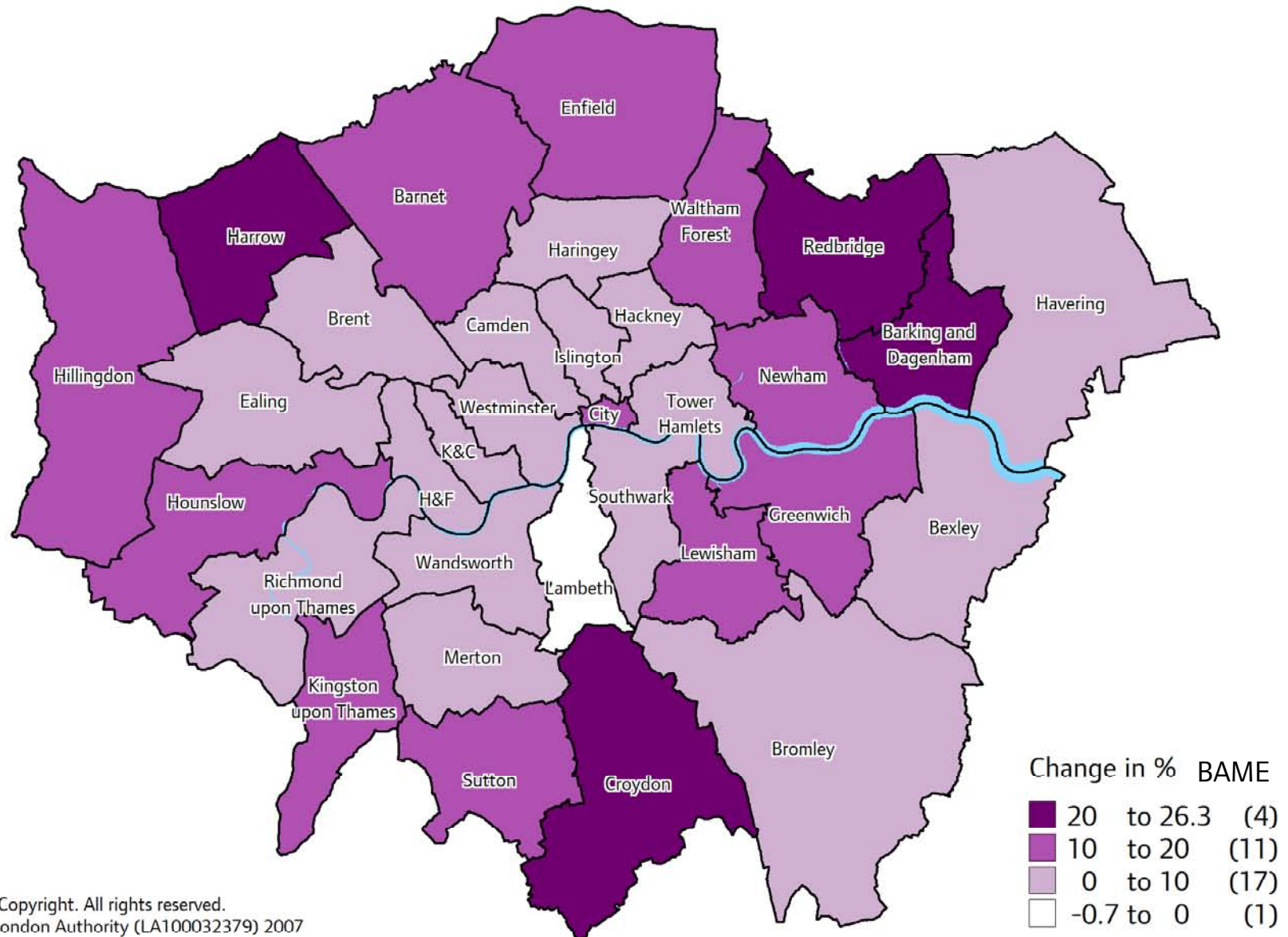
*figures may not add due to rounding

Appendix Table 3: GLA Ethnic Group Population Projections, London Boroughs, 2026

	Total	White	Black Caribbean	Black African	Black Other	Indian	Pakistani	Bangladeshi	Other Asian	Chinese	Other
Camden	241,700	165,900	2,900	14,600	4,300	7,900	1,700	16,100	5,100	6,300	16,800
City of London	14,400	10,500	200	300	200	700	100	200	400	500	1,100
Hackney	264,400	154,400	19,600	31,300	15,000	9,400	1,800	8,800	5,300	3,900	15,000
Hammersmith and Fulham	202,000	149,600	7,800	10,500	6,800	2,600	2,500	1,700	7,100	2,100	11,200
Haringey	264,300	168,900	19,800	23,200	10,000	6,300	3,000	4,800	7,000	5,100	16,100
Islington	236,700	173,100	8,700	10,900	7,600	4,800	1,400	7,500	4,900	7,100	10,600
Kensington and Chelsea	191,700	147,700	3,200	5,900	3,500	4,600	1,400	1,200	4,200	5,800	14,100
Lambeth	336,400	213,000	29,400	39,600	17,900	5,100	3,000	3,500	7,100	4,000	13,800
Lewisham	294,400	159,100	42,000	39,200	19,100	8,400	1,700	1,300	8,300	4,000	11,300
Newham	360,700	89,900	21,500	59,800	11,000	42,300	44,400	42,000	19,100	6,800	24,000
Southwark	339,700	205,700	19,900	52,900	14,300	8,200	1,700	5,300	6,100	9,200	16,400
Tower Hamlets	328,400	164,200	4,800	8,100	4,800	7,100	1,900	106,200	6,200	14,000	11,000
Wandsworth	321,200	249,900	9,500	10,600	7,700	9,600	5,200	1,700	7,700	3,500	15,800
Westminster	249,900	174,300	5,100	6,200	5,100	12,600	2,700	5,000	8,700	8,700	21,400
Barking and Dagenham	230,600	135,700	9,600	35,500	10,700	9,600	8,900	3,300	4,500	6,000	6,800
Barnet	385,600	239,100	4,300	24,300	8,800	38,500	7,600	2,300	13,800	12,600	34,200
Bexley	230,300	189,500	3,700	15,700	5,300	5,300	500	700	3,600	1,100	4,900
Brent	316,300	120,500	26,500	26,800	12,400	69,100	14,800	1,100	23,300	4,500	17,300
Bromley	327,900	274,600	9,700	10,900	6,700	7,800	900	1,900	5,300	2,300	7,800
Croydon	360,300	169,900	43,700	32,100	17,500	43,800	15,800	3,500	18,100	1,900	14,000
Ealing	346,300	169,600	13,200	11,500	7,700	51,800	15,200	1,700	21,700	6,000	48,000
Enfield	303,500	184,400	23,300	24,700	10,300	16,700	2,900	6,500	12,500	5,100	17,200
Greenwich	294,700	176,500	10,000	48,900	10,500	15,100	5,100	2,600	10,100	6,300	9,600
Harrow	230,600	86,800	7,800	9,100	4,200	74,300	7,100	1,200	24,400	3,100	12,600
Havering	248,200	222,700	3,900	7,600	2,900	3,800	600	200	2,600	1,500	2,400
Hillingdon	262,200	160,600	6,300	12,400	5,300	38,600	7,500	3,300	15,600	2,800	9,800
Hounslow	242,000	115,200	3,100	7,800	4,200	62,600	14,000	4,400	10,300	2,400	18,000
Kingston upon Thames	169,500	120,100	1,300	2,800	1,500	9,000	3,100	800	9,000	4,500	17,400
Merton	205,000	136,300	8,400	8,600	5,700	10,000	5,700	2,800	12,500	3,700	11,300
Redbridge	280,900	114,500	14,400	15,500	5,800	58,700	33,100	11,800	17,800	2,400	6,800
Richmond upon Thames	194,900	168,500	700	1,300	2,700	6,700	900	600	4,700	1,300	7,600
Sutton	191,800	148,500	4,500	6,000	3,500	7,600	4,000	900	8,700	1,500	6,600
Waltham Forest	244,000	127,300	22,700	18,000	10,400	9,100	27,000	3,000	12,000	2,800	11,700
Greater London	8,710,300	5,286,300	411,300	632,500	263,300	667,900	247,600	258,000	327,400	153,000	463,000

*figures may not add due to rounding

Appendix Map 1: Percentage Change in the proportion of BAME residents by London borough between 2001 and 2026



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Appendix 2

Demographic Modelling Methodology

The full GLA ethnic group projections methodology was described in *DMAG Briefing 2006/22*. However in the production of the 2006 Round of ethnic group population projections (EGPP) the fertility method was further enhanced. These developments are described below:

Birth: Transgenerational Ethnicity

In the 2005 Round of Interim Ethnic Projections, total births for a given projection year and single year of age of mother were derived from London-level age-specific fertility rates (ASFRs) for each of the ten aggregated ethnic groups (AEGs) (adjusted to borough-level AEG ASFRs using 2001 Census 0 year-old borough constraints) and the average of the female populations in the of the previous year and the projection year, by AEG. The ethnicity of the birth was assumed to be the same as that of the mother. The total births were then apportioned to male and female using London-level birth ratios for each AEG, which were derived from the 0 year-old base populations and which were held constant over the projection period. This is described more fully in *DMAG Briefing 2006/22, GLA 2005 Round: Interim Ethnic Group Population Projections*.

However, data from the 2001 Census indicate that the ethnicity of a child will often differ from that one or both of its parents. In fertility modelling terms it is important to know when ethnicity of the child differs from that of its mother. Therefore in the 2006 Round of Ethnic Projections the concept of transgenerational ethnicity of births was introduced into the modelling process to take this into account. The new births modelling process consists of three steps, the derivation of initial total births and constraining thereof, the application of transgenerational ethnicity to the constrained total births, and the apportionment of total births in each ethnic group into male and female.

Step 1 – Initial births

Initial births (male + female) by age band and ethnicity of mother in each borough for a given projection year were derived from London-level un-adjusted AEG ASFRs and the average of the female populations at the beginning and end of the projection year. This was at the 5-year age-band level for each AEG, ie 5-year age-band AEG ASFRs were applied to corresponding 5-year AEG total populations of women. Each number of initial births was then constrained by the corresponding borough number of total births from the 2006 Round main demographic model, for each projection year. This in effect adjusted the London-level AEG ASFRs to borough-level AEG ASFRs. Using notation consistent with *DMAG Briefing 2005/21*, this process can be described as follows:

$$B_{init}^B(x, e_1) = P_W^B(x, e_1) * f(x, e_1) \quad (1)$$

where B_{init}^B = initial number of births (male + female) at borough level;
 P_W^B = number of women at borough level;
 f = age-specific fertility rate (5-year age-bands);
 x = age band of mother;
 e_1 = ethnicity of mother.

Thus $B_{init}^B(x, e_1)$ is the initial births to mothers aged x and ethnicity e_1 ; $P_W^B(x, e_1)$ is the number of women aged x and ethnicity e_1 ; and $f(x, e_1)$ is the age-specific fertility rate of women of ethnicity e_1 .

Each number of constrained initial births, by age band and ethnicity of mother, $BB_{cons}(x, e_1)$, is then given by:

$$B_{cons}^B(x, e_1) = B_{init}^B(x, e_1) * B_{DEM}^B / \sum_{e_1} [B_{init}^B(x, e_1)] \quad (2)$$

where B_{DEM}^B is the borough number of total births from the main demographic model.

Step 2 – Transgenerational ethnicity of births

The concept of transgenerational ethnicity and the technical details of its components and their derivation are described fully in *DMAG Briefing 2005/21, Transgenerational Ethnicity*. This section gives an overview of the concept and describes its application in the Ethnic Group Population Projection (EGPP) model.

Transgenerational ethnicity is a method of apportioning the constrained total births in Step 1 into ethnicities of the infant that takes into account the ethnicities of both the mother and father. It has two components, the probability that the infant is of a certain ethnicity given the mother's ethnicity and age and the father's ethnicity, and the likelihood of the father being of a certain ethnicity given the mother's ethnicity and age.

2001 Census Commissioned Table C0200 relates the ethnicities of mothers, fathers and infants (children under 1 year old) in London, during the year preceding the Census. This information was used to derive probabilities for ethnicity of the infant depending on ethnicities of the mother and father (first component). Using notation consistent with *DMAG Briefing 2005/21*, these probabilities can be defined as:

$$C(e_2/x, e_1, e_3) = I(e_2/x, e_1, e_3) / \sum_{e_2} [I(e_2/x, e_1, e_3)] \quad (3)$$

where C = probability;
 I = number of infants from Table C0200 (male + female);
 x = age band of mother;
 e₁, e₂, e₃ = ethnicities of mother, infant and father respectively.

Thus, $C(e_2/x, e_1, e_3)$ is the probability that the infant will be of ethnicity e₂ if it's mother is aged x and of ethnicity e₁, and it's father is of ethnicity e₃.

For a given ethnicity and age band of mother there are ten possible ethnicities of partner (father) and ten possible ethnicities of infant, giving rise to a matrix of 100 probabilities of ethnicity of infant by ethnicity of father. In *DMAG Briefing 2005/21* ten aggregated ethnic groups and six age bands of mother (five 5-year and one 40+) were used, therefore 60 matrices, each of 100 probabilities, were derived. These matrices were integrated into the EGPP model. As the fertility component of the EGPP model uses seven 5-year age bands of mother (40-44 and 45+ instead of 40+) the ten matrices corresponding to 40+ mothers were applied to both 40-44 mothers and 45+ mothers in the model, so that the EGPP model incorporated 70 matrices in total.

The second component, the likelihood of a father being of a certain ethnicity, can be considered to depend on the "pool" or number of available males of that ethnicity and their age, in relation to ethnicity and age of the mother. In *DMAG Briefing 2005/21*, the 2001 Census outcomes of father's

ethnicity in relation to mother's ethnicity and age in Table C0200 were used in conjunction with Census data indicating potential fathers to derive relative risks for the ethnicity of the father. For each 5-year age-band of mother used in *DMAG Briefing 2005/21*, the pool of potential fathers was taken as a "corresponding" 10-year age-band male population, broken down by ethnicity. So for mothers aged 15-19 the pool of potential fathers was from the 15-24 male age band, and similarly through to mothers aged 45-49 for whom the pool of potential fathers was from the 45-54 male age band.

Hence,

$$R_{x, e_1}(e_3) = \frac{M(e_3/x, e_1)}{Q(e_3/x, e_1)} = \frac{K_{x, e_1}(X, e_3) / K_{x, e_1}(X, A)}{P_{M, x, e_1}(X, e_3) / P_{M, x, e_1}(X, A)} \quad (4)$$

where R = relative risk of ethnicity of father;
M = probability of ethnicity of father;
Q = relative pool of potential fathers by ethnicity;
K = number of fathers of known ethnicity (from Census Commissioned Table C0200);
P_M = number of males (from Census Table ST101);
X = wider age band of males associated with age band of mother x;
A denotes "all" (ie fathers, or males).

$R_{x, e_1}(e_3)$ is the relative risk of males of ethnicity e_3 being fathers of children borne by women of age x and ethnicity e_1 .

$M(e_3/x, e_1)$ is the probability that the father of a child borne by a woman aged x and of ethnicity e_1 will be of ethnicity e_3 .

$Q(e_3/x, e_1)$ is the relative pool of potential fathers of ethnicity e_3 within the overall pool of males of age X associated with mothers aged x and of ethnicity e_1 .

$K_{x, e_1}(X, e_3)$ and $K_{x, e_1}(X, A)$ are respectively the number of fathers of ethnicity e_3 and total number of fathers of known ethnicity in the group of fathers of age X associated with mothers aged x and of ethnicity e_1 .

$P_{M, x, e_1}(X, e_3)$ and $P_{M, x, e_1}(X, A)$ are respectively the number of males of ethnicity e_3 and total number of males in the pool of males of age X associated with mothers aged x and of ethnicity e_1 .

However, because the information in Commissioned Table C0200 was not perfect and the ethnicity of the father was not always known, it was necessary to adjust the relative risks to reflect the complete number of fathers (ie infants) in C0200. This also had to take account of cases where all fathers within a breakdown of infant's ethnicity were not known, ie there was no known father's ethnicity to scale with. The process used for adjustment was to apply the derived values of $R_{x, e_1}(e_3)$, $M(e_3/x, e_1)$, and $C(e_2/x, e_1, e_3)$ to the total number of infants, within each age band and ethnicity of mother, to predict ethnicity of all infants, in doing so minimising the differences between predicted and actual infant sub-totals of each ethnicity. This was done using the Solver optimising function in Microsoft Excel. The process is described in more detail in *DMAG Briefing 2005/21*. Resulting adjusted relative risks, denoted as $RR_{x, e_1}(e_3)$, were derived for each ethnicity of father in relation to ethnicity and age band of mother (for six age bands of mother, five 5-year and one 40+, as for the parameter $C(e_2/x, e_1, e_3)$ described above). Again, as the fertility component of the EGPP model uses

seven 5-year age bands of mother (40-44 and 45+ instead of 40+), the adjusted relative risks corresponding to 40+ mothers were applied to both 40-44 mothers and 45+ mothers in the model. In the model the adjusted relative risks were formatted in 70 10 x 1 matrices corresponding to the 70 matrices for the parameter $C(e_2/x, e_1, e_3)$, each matrix relating to an ethnicity and age band of mother, and consisting of ten ethnicities of father v one adjusted relative risk.

The parameters $RR_{x, e_1}(e_3)$, $M(e_3/x, e_1)$, and $C(e_2/x, e_1, e_3)$ were derived using London-level data, the level at which Commissioned Table CO200 was commissioned. It was impractical to commission at borough level because data values would have been much smaller and a much greater amount of data would have been subject to disclosure control, resulting in low robustness in any modelling process. Hence the objective of the transgenerational ethnicity methodology was to derive the parameters at London-level and apply them at borough level. The London-level values of parameter $C(e_2/x, e_1, e_3)$ can be regarded as stable, both through time and for different areas, but the parameter $M(e_3/x, e_1)$ is likely to vary with the characteristics of the male population. Equation (4) can be re-arranged to express the probability of father's ethnicity at borough level, M^B , in terms of borough-level relative pools of fathers Q^B or numbers of males P^B_{M, x, e_1} , to reflect differences in characteristics of the male population at borough level when applied in the EGPP model:

$$M^B(e_3/x, e_1) = RR_{x, e_1}(e_3) * Q^B(e_3/x, e_1) = RR_{x, e_1}(e_3) * P^B_{M, x, e_1}(X, e_3) / P^B_{M, x, e_1}(X, A) \quad (5)$$

The "transgenerational probability", or the probability that a birth to a woman aged x and of ethnicity e_1 , and whose partner is of ethnicity e_3 , will itself be ascribed to ethnicity e_2 , denoted by $T^B(x, e_1, e_3, e_2)$ at borough level (otherwise $T(x, e_1, e_3, e_2)$ at London level) can then be derived from:

$$T^B(x, e_1, e_3, e_2) = C(e_2/x, e_1, e_3) * M^B(e_3/x, e_1) \\ \text{ie} \\ T^B(x, e_1, e_3, e_2) = C(e_2/x, e_1, e_3) * RR_{x, e_1}(e_3) * P^B_{M, x, e_1}(X, e_3) / P^B_{M, x, e_1}(X, A) \quad (6)$$

The transgenerational probability from Equation (6) can then be applied to the constrained initial births derived by Equation (2) to distribute the latter into their own ethnicities, at borough level:

$$B^B(x, e_1, e_3, e_2) = B^B_{\text{cons}}(x, e_1) * T^B(x, e_1, e_3, e_2) \\ \text{ie} \\ B^B(x, e_1, e_3, e_2) = B^B_{\text{cons}}(x, e_1) * C(e_2/x, e_1, e_3) * RR_{x, e_1}(e_3) * P^B_{M, x, e_1}(X, e_3) / P^B_{M, x, e_1}(X, A) \quad (7)$$

In the EGPP model, Equation (7) was used to incorporate 70 matrices, each of 100 outcomes of ethnicity of births, ie each of ten ethnicities of births v ten ethnicities of father, corresponding to the 70 matrices of the parameter $C(e_2/x, e_1, e_3)$ and of the adjusted relative risks $RR_{x, e_1}(e_3)$, and relating to the 70 groupings of ethnicity and age band of mother. Within each matrix the value of each outcome was the number of births of a given ethnicity, and hence the total number of births of any given ethnicity arising from mothers of any given ethnicity and age band was the sum of the 10 outcomes of the given ethnicity of births, and similarly the sum of all 100 outcomes was the total number of births associated with the mother of the said ethnicity and age band. It should be noted that within each matrix the values of the majority of the 100 outcomes were 0 or very small.

So the sum of 10 matrix outcomes for a given ethnicity of birth was described by:

$$B^B(x, e_1, A, e_2) = \sum_{e_3} [B^B(x, e_1, e_3, e_2)] \quad (8)$$

where A denotes all ethnicities of father.

And the sum of 100 matrix outcomes for all ethnicities of births was described by:

$$B^B(x, e_1, A, A) = \sum_{e_3} \sum_{e_2} [B^B(x, e_1, e_3, e_2)] \quad (9)$$

where the additional A denotes all ethnicities of births e_2 , and $B^B(x, e_1, A, A)$ originated from $B^B_{\text{cons}}(x, e_1)$ in Equation (2), the initial constrained births to a woman of ethnicity e_1 and age band x .

It should be noted at this stage that the total number of births of a given ethnicity in the borough (the sum of 10 matrix outcomes for a given ethnicity of births in all 70 matrices) would be described by:

$$B^B(A, A, A, e_2) = \sum_x \sum_{e_1} \sum_{e_3} [B^B(x, e_1, e_3, e_2)] \quad (10)$$

And the sum of all births in the borough (the sum of all 100 matrix outcomes in all 70 matrices) would be described by:

$$B^B(A, A, A, A) = \sum_x \sum_{e_1} \sum_{e_3} \sum_{e_2} [B^B(x, e_1, e_3, e_2)] \quad (11)$$

However, because the probabilities for father's ethnicity, parameter $M(e_3/x, e_1)$ in Equation (4), were derived using London-level relative ethnic pools of males, unless borough-level relative ethnic pools of males happened to be the same then at borough level a matrix sum of all 100 birth outcomes associated with mothers of age band x and ethnicity e_1 , $B^B(x, e_1, A, A)$, derived by Equation (9) would not be equal to the original initial constrained births to these mothers, $B^B_{\text{cons}}(x, e_1)$, derived by Equation (2). This result was inevitable due to the impracticability of commissioning Census data at borough level instead of at London level, as stated previously, and therefore only having available London-level probabilities of father's ethnicity.

It was considered that the outcomes within a given matrix gave the best available distribution of transgenerational ethnicities of births, and that it was acceptable to constrain each component within a matrix (derived by Equation (7)) to return to the initial constrained total births for that matrix (derived as $B^B_{\text{cons}}(x, e_1)$ in Equation (2)). Hence, individual constrained matrix outcomes were described by:

$$B^B_{\text{cons}}(x, e_1, e_3, e_2) = B^B(x, e_1, e_3, e_2) * B^B_{\text{cons}}(x, e_1) / B^B(x, e_1, A, A) \quad (12)$$

The individual constrained matrix outcomes $B^B_{\text{cons}}(x, e_1, e_3, e_2)$ can be summed as in Equations (8), (9), (10) and (11) to give corresponding sub-totals or totals.

Hence, applying the summation criteria of Equation (10) to Equation (12), the (final) transgenerational total number of births of a given ethnicity in the borough would be described by:

$$B^B_{\text{cons}}(A, A, A, e_2) = \sum_x \sum_{e_1} \sum_{e_3} [B^B_{\text{cons}}(x, e_1, e_3, e_2)] \quad (13)$$

And, applying the summation criteria of Equation (11) to Equation (12), the (final) transgenerational total number of births in the borough would be described by:

$$B_{\text{cons}}^{\text{B}}(A, A, A, A) = \sum_x \sum_{e_1} \sum_{e_3} \sum_{e_2} [B_{\text{cons}}^{\text{B}}(x, e_1, e_3, e_2)] \quad (14)$$

The process of implementing transgenerational ethnicity described above was repeated for each projection year.

In summary, as stated before, the parameter $C(e_2/x, e_1, e_3)$, describing probability of ethnicity of birth depending on age and ethnicity of mother and ethnicity of father, was derived from 2001 Census data and was considered to be stable through time and for different areas. Hence, the 70 matrices of $C(e_2/x, e_1, e_3)$ that were applied to each borough and each projection year were the same. The parameter $M(e_3/x, e_1)$, the probability of ethnicity of father given the ethnicity of infant and age and ethnicity of mother, was also derived from Census data at London level, and was used to derive London-level adjusted relative risks of males of a given ethnicity being fathers of children borne by women of given age and ethnicity. The London-level adjusted relative risks were applied to each borough and in each projection year. However, the probability of ethnicity of father was applied in borough-level terms as the parameter $M^{\text{B}}(e_3/x, e_1)$, in conjunction with the London-level adjusted relative risks, as in Equation (5). In other words, the other inputs to $M^{\text{B}}(e_3/x, e_1)$ were borough-specific and projection year-specific male populations, and this had the effect of converting the London-level probabilities of ethnicity of father into borough-level ones, and of updating them each projection year to reflect changes in the borough male population. This process resulted in a new distribution of ethnicity of births for each age and ethnicity grouping of mother, which was then constrained to give the corresponding number of total births for each age and ethnicity grouping of mother at the start of the process.

Step 3 – Apportionment of ethnic total births into male and female

In this step the borough-level total number of births of each ethnicity were apportioned into males and females. This was done using London-level ethnic male and female birth ratios.

As described in *DMAG Briefing 2006/22, GLA Ethnic Group Population Projections*, Table C0195 – “Ethnic group of residents by sex and age” was commissioned and this gave ethnic population breakdowns by single years of age, at London and borough levels. This information was used to distribute the ONS Mid-Year Estimate populations by single years of age into the 16 Census ethnic categories, which were then aggregated to the 10 Aggregated Ethnic Groups (AEGs). This produced 2001 mid-year base ethnic populations by single years of age for the EGPP model. The London-level numbers of male and female 2001 mid-year 0-year olds for each AEG were used to determine ethnic male and female birth ratios.

Hence, the transgenerational total number of births of a given ethnicity in a borough, derived by Equation (13), was apportioned into ethnic male births by:

$$\text{Male } [B_{\text{cons}}^{\text{B}}(A, A, A, e_2)] = B_{\text{cons}}^{\text{B}}(A, A, A, e_2) * \frac{(\text{base London Total Male 0-year olds})_{e_2}}{(\text{base London Total 0-year olds})_{e_2}} \quad (15)$$

And, the transgenerational total number of births of a given ethnicity in a borough, derived by Equation (13), was apportioned into ethnic female births by:

$$\text{Female } [B_{\text{cons}}^{\text{B}}(A, A, A, e_2)] = B_{\text{cons}}^{\text{B}}(A, A, A, e_2) * \frac{(\text{base London Total Female 0-year olds})_{e_2}}{(\text{base London Total 0-year olds})_{e_2}} \quad (16)$$

The same London-level ethnic male and female birth ratios were used for each borough and each projection year.

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