



# HEATHROW COMMUNITY NOISE FORUM

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Englefield Green traffic analysis results

December 2015

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# EXECUTIVE SUMMARY

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# 1

## Executive summary

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As part of the engagement between Heathrow Airport Limited and the Community Noise Forum, flight paths through a series of penetration gates around the airport are being analysed. One of the gates that has been analysed was centred on Staines, extending approximately 16km from Sunbury-on-Thames at its south east extreme to Windsor Great Park at its north west end. Following on from the publication and discussion of a draft report describing this gate, local residents requested a more detailed analysis of the north western half of the gate extending approximately 4km either side of Englefield Green. The analysis was to be restricted to departures and cover the years 2005, and 2010 to 2015 inclusive. This report describes the analysis and associated conclusions relating to this Englefield Green (EG) gate.

When interpreting the results associated with height it is important to note that Englefield Green is approximately 150 feet higher than the height baseline at Heathrow, so aircraft will be 150 feet lower at Englefield Green than indicated.

During the analysis period, on average each year, the gate operated in the westerly direction for between 60% and 70% of days; in the easterly direction between 18% and 25% of days and had mixed easterly and westerly operations between 5% and 15% of days.

On **easterly operations**, the EG gate is clipped at its extreme south eastern end by traffic using the easterly Compton (CPT) standard instrument departure route (SID). From 2010 to 2015, the volume of easterly traffic crossing the gate on easterly days increased from approximately 4.4 flights to 9.5 flights per easterly day. These flights are widely distributed across the gate but bunched towards the south east end, over Staines and Egham. The flight paths are randomly distributed and show no SID structure. The trend on the lateral centre of gravity (mean position) of the broad traffic, swath shows a slight shift in the position towards the north west. However, the vertical centre of gravity (mean height) appears to have increased over the period suggesting an general increase in the height of flights crossing the gate. Few easterly departures cross the gate below 2000 feet although there is large variation in minimum height from day-to-day but with no underlying time-series trend. The daily minimum height (the height that the lowest flight crosses the gate each day) for these easterly departures varies widely from day-to-day from a 1500 feet to above 6000 feet.

## Executive summary

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The proportion of large aircraft in the easterly departure fleet has increased to more than 75% of the total in 2015 from around 33% in 2010. A380s now make up 1% of the traffic. Consistent with this increase, the proportion of long-haul destinations served by easterly departure traffic increased from 34% in 2010 and is now approaching 75%. In terms of the distribution of traffic across the day, there is peak in the traffic occurring between 10:00 hours and 17:00 hours. There is then a subsequent evening peak tailing off to 21:30 hours. These peaks are low - 0.5 flights per half-hour on easterly days – compared to westerly days, reflecting the relatively small volume of easterly traffic crossing the gate.

For **westerly departures**, the EG gate is crossed in the north western part by the Midhurst (MID) SID, around Windsor Great Park and from the centre towards to south east, around Englefield Green itself and Egham, by the westerly Dover (DVR) SID. Overall westerly traffic through the gate appears to have increased from approximately 227 flights per westerly day in 2010 to approximately 245 flights per westerly day in 2015. However, there are peaks in traffic in intermediate years: in 2012, corresponding to vectoring MID and DVR traffic during the Operational Freedoms trials and in 2014 corresponding to the departure trials. There was reduced traffic 2013.

The overall traffic mix has remained consistent at approximately two thirds medium sized aircraft and one third large aircraft. Within the large aircraft category, the proportion of A380s has increased from 1% in 2010 to 6% in 2015 with a corresponding decrease in the proportion of aircraft in the heavy category. Since the end of 2013, more of these larger aircraft are crossing the gate below 2000 feet. Initially this was probably due to increased volume during the trials but this continued during 2015. Consistent with the fleet mix, the destination mix for westerly departures crossing the EG gate has remained consistent over the analysis period, comprising approximately 60% short-haul and 30% ultra long-haul and long-haul flights.

Across the day the 2015 traffic profile across the day shows a peak between 07:00 hours and 11:00 hours made up mainly of medium aircraft reaching around 14 flights per hour, a similar peak in the late afternoon also comprising mainly medium aircraft and a slight higher peak of around 15 flights per hours at around 22:00. This latter peak has a high proportion of large aircraft.

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## Executive summary

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For the westerly **MID SID**, traffic volume has increased from 45 per westerly day in 2010 to 49 per westerly day in 2015 but with higher peaks in the intermediate years. Long-term, the lateral centre of gravity of the MID SID is at the north-eastern extreme of Windsor Great Park. and has, on average, moved very slightly to the north-west from 2005 to 2015 although there is considerable scatter from day-to-day. More recently after the end of the trials in late 2014, the lateral CoG of the MID SID has moved back towards the south-east, with a step movement in June 2015. There is a downward trend on the vertical centre of gravity of the MID SID from approximately 3800 feet in 2005 to approximately 3500 feet in 2015. There are very few MID SID flights crossing the gate below 1500 feet but the number crossing the gate between 1500 feet and 2000 feet is increasing. The daily minimum height (the height that the lowest flight crosses the gate each day) is decreasing: in 2014 and 2015 the lowest flights consistently approached 1500 feet. There is a cyclical pattern in the height of the MID SID indicating that flights are lower in summer than in winter. The departure trials had a marked impact on the distribution and structure of traffic using the MID SID and increased the traffic crossing the gate. After the trials ended, the structure and traffic levels reverted to those observed pre-trial.

For the westerly **DVR SID**, traffic volume increased from approximately 137 per westerly day in 2010 to approximately 156 per westerly day in 2015: there are intermediate traffic peaks in 2011 and 2012 higher than 2013 and 2014. The traffic volume appears to be cyclical: higher in summer than winter. The lateral centre of gravity of the DVR SID moved approximately 400m north west from 2005 to 2015 from Egham towards Englefield Green (half of this shift occurred between 2010 and 2015) and the trend has continued more recently.

The vertical centre of gravity of the DVR SID has remained consistent from 2005 to 2015 but is cyclical, varying by up to 1000 feet from winter (higher) to summer (lower). Very few DVR SID flights cross the gate below 1500 feet. On average the volume of flights crossing the gate between 1500 feet and 2000 feet is approximately five per day and does not vary over time but is higher in summer than winter. The daily minimum height (the height that the lowest flight crosses the gate each day) remains consistent from 2005 to 2014: and again is cyclical: generally lower in summer than in winter. More recently, since the start of 2014, the trend on minimum height is downwards with the lowest aircraft crossing the gate lower.

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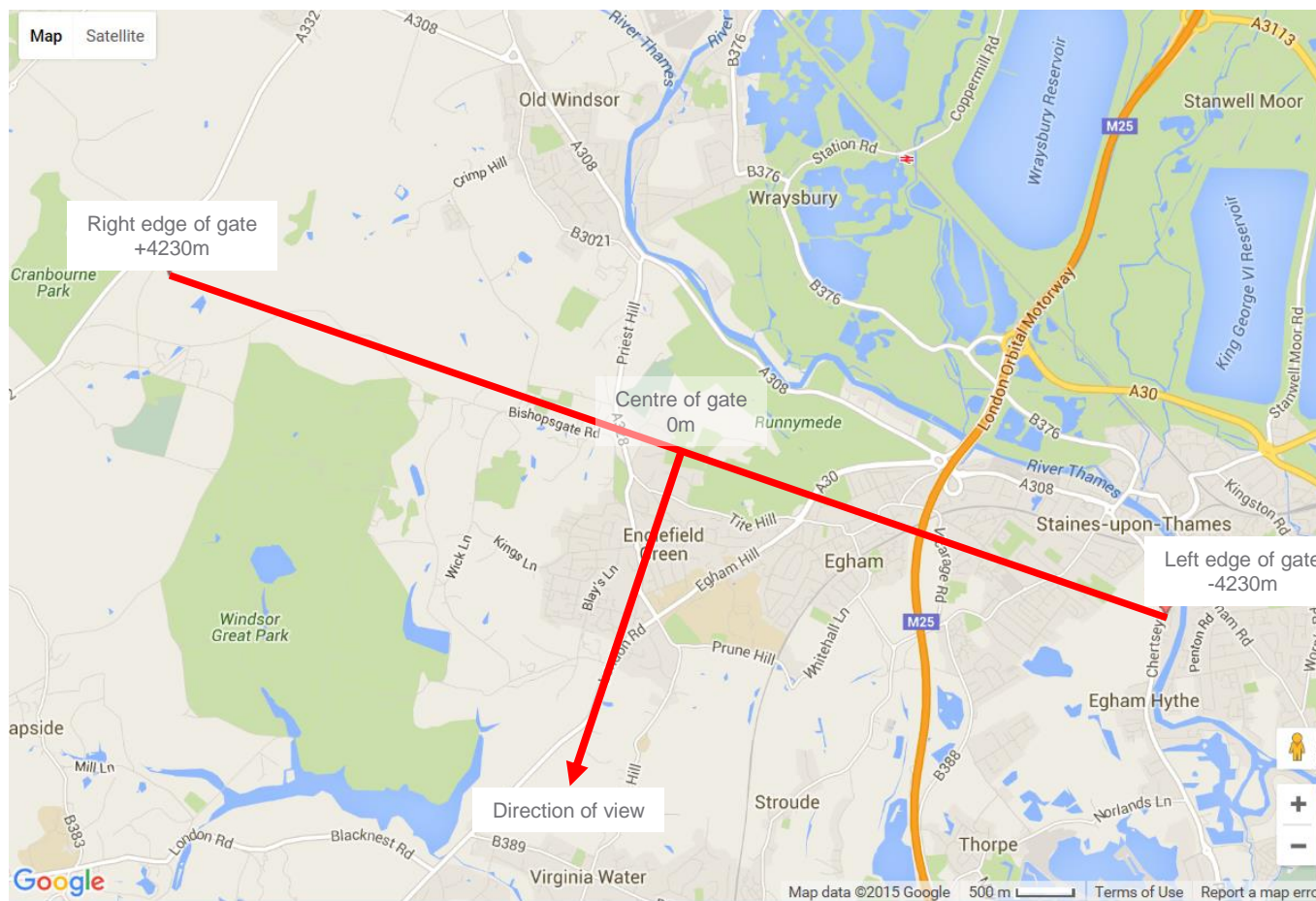
# INTRODUCTION

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# 2

The Englefield Green gate runs approximately north west-south east and is approximately 8km in extent ranging from Windsor Great Park to Egham Hythe

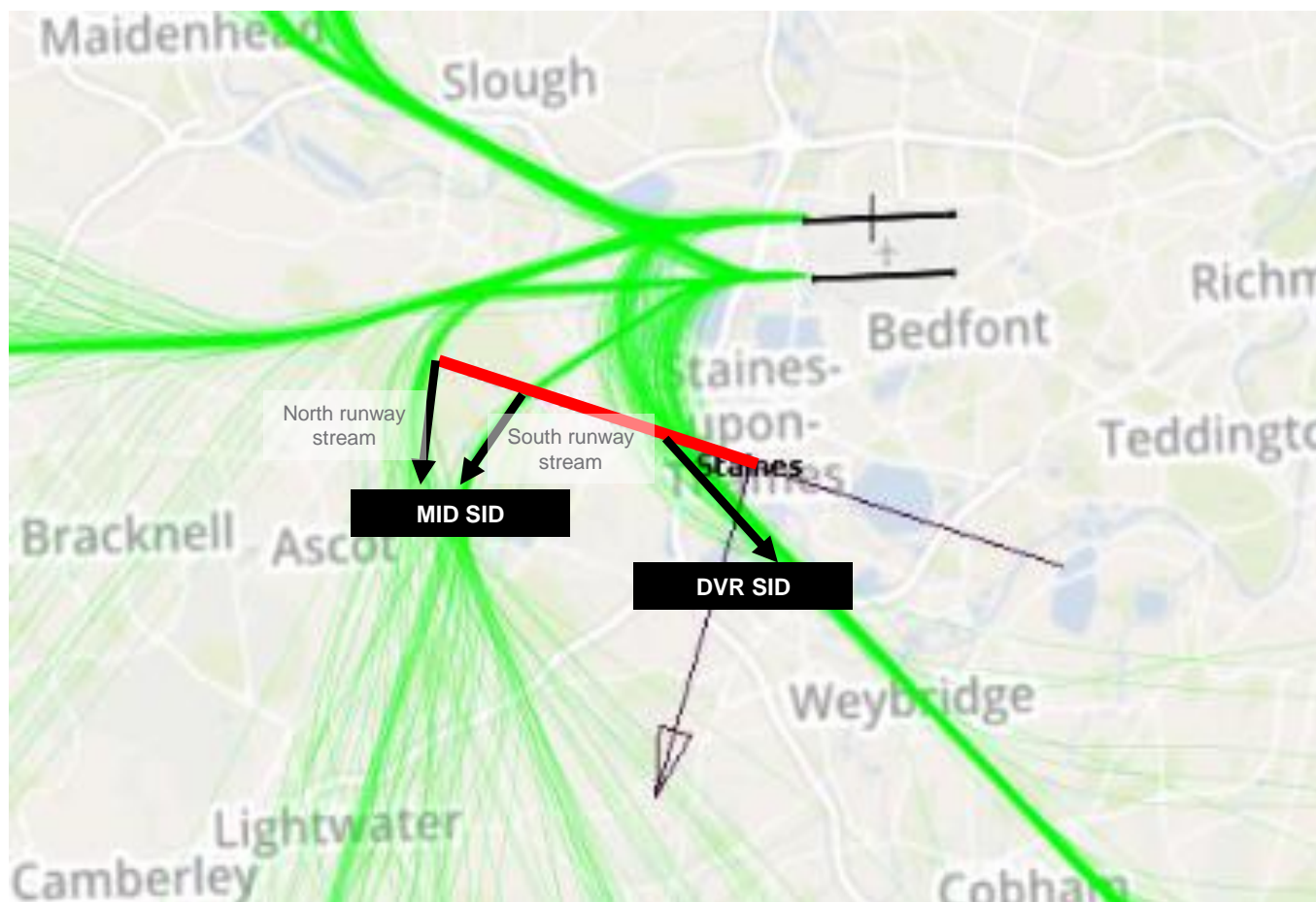
### Englefield Green gate location and extent





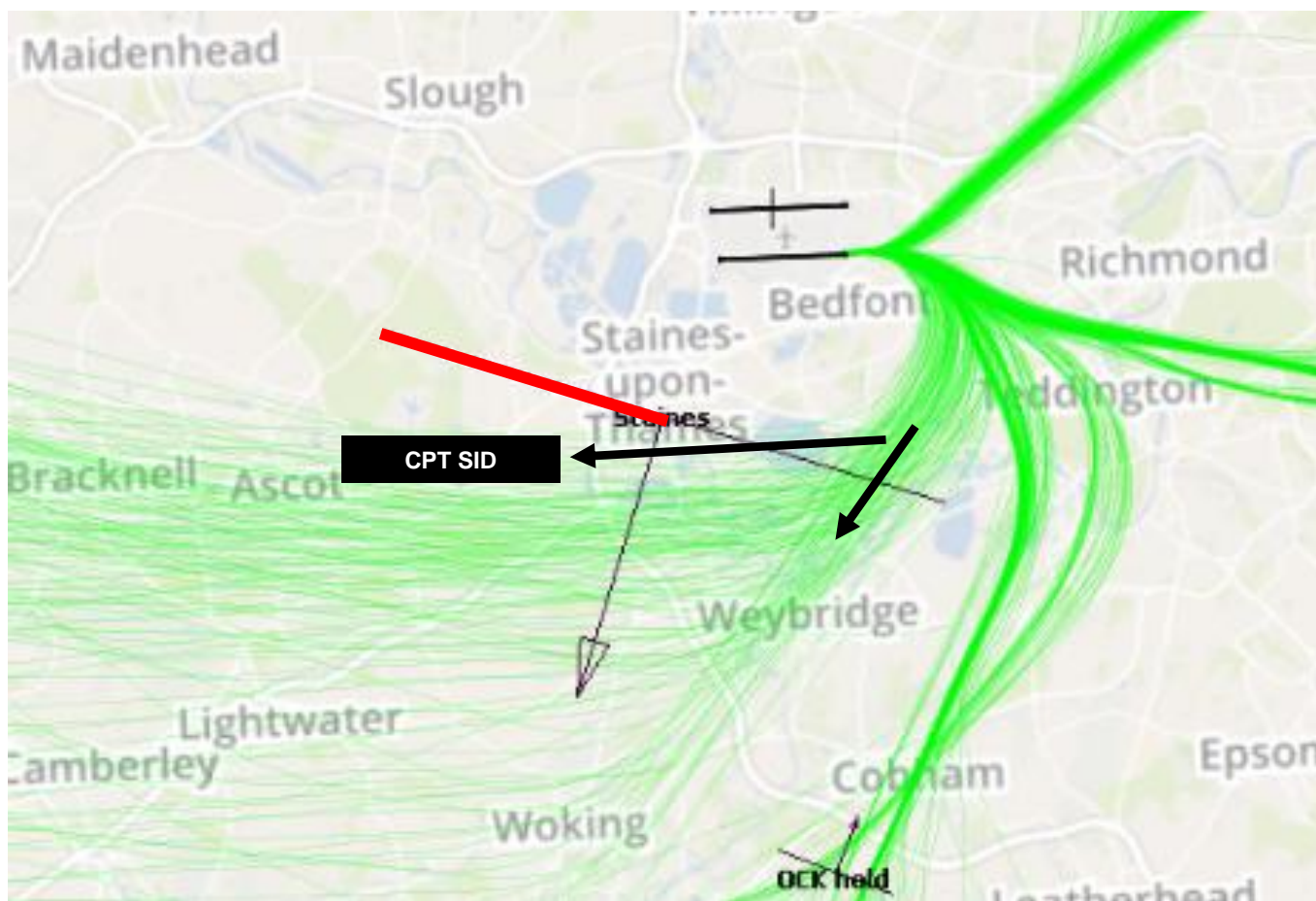
On westerlies, MID SID traffic crosses the north-western half of the gate in two separate streams and DVR SID traffic ranges from the centre towards the south-east

**Westerly departure traffic crossing the Englefield Green gate**



## On easterly departures, CPT SID traffic clips the extreme south-eastern part of the Englefield Green gate

Easterly departure traffic crossing the Englefield Green gate



## The analysis has investigated different characteristics of the departure traffic traversing the gate for the years 2005, and 2010 to 2015 inclusive

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- The proportion of days per year when the gate has westerly, easterly and mixed operations
- Traffic volume (number of flights) crossing the gate per day
  - for each day during 2005, and 2010 to 2015 inclusive
  - the average daily traffic for each year
  - the average distribution of traffic across the day in half-hour intervals by aircraft type
- The lateral and vertical distributions of the traffic crossing the gate for each year, including:
  - The lateral and vertical centres of gravity (average positions) of the traffic swaths
  - The minimum height at which the lowest aircraft crosses the gate each day
  - The number of flights crossing the gate below 1500 feet and between 2000 feet and 2500 feet per day
  - Gate penetration (scatter) plots showing the lateral and vertical position that each flight crosses the gate for each of the years analysed
- Heat maps showing the concentration or density of the traffic crossing the gate
- The aircraft fleet mix:
  - the relative proportions of A380, heavy and medium sized aircraft crossing the gate for each year analysed
  - gate penetration (scatter) plots for A380, heavy and medium sized aircraft showing the lateral and vertical position that each flight crosses the gate for each of the years analysed
- The mix of destinations – short-haul, medium-haul, long-haul and ultra long-haul – for the traffic crossing the gate for each year

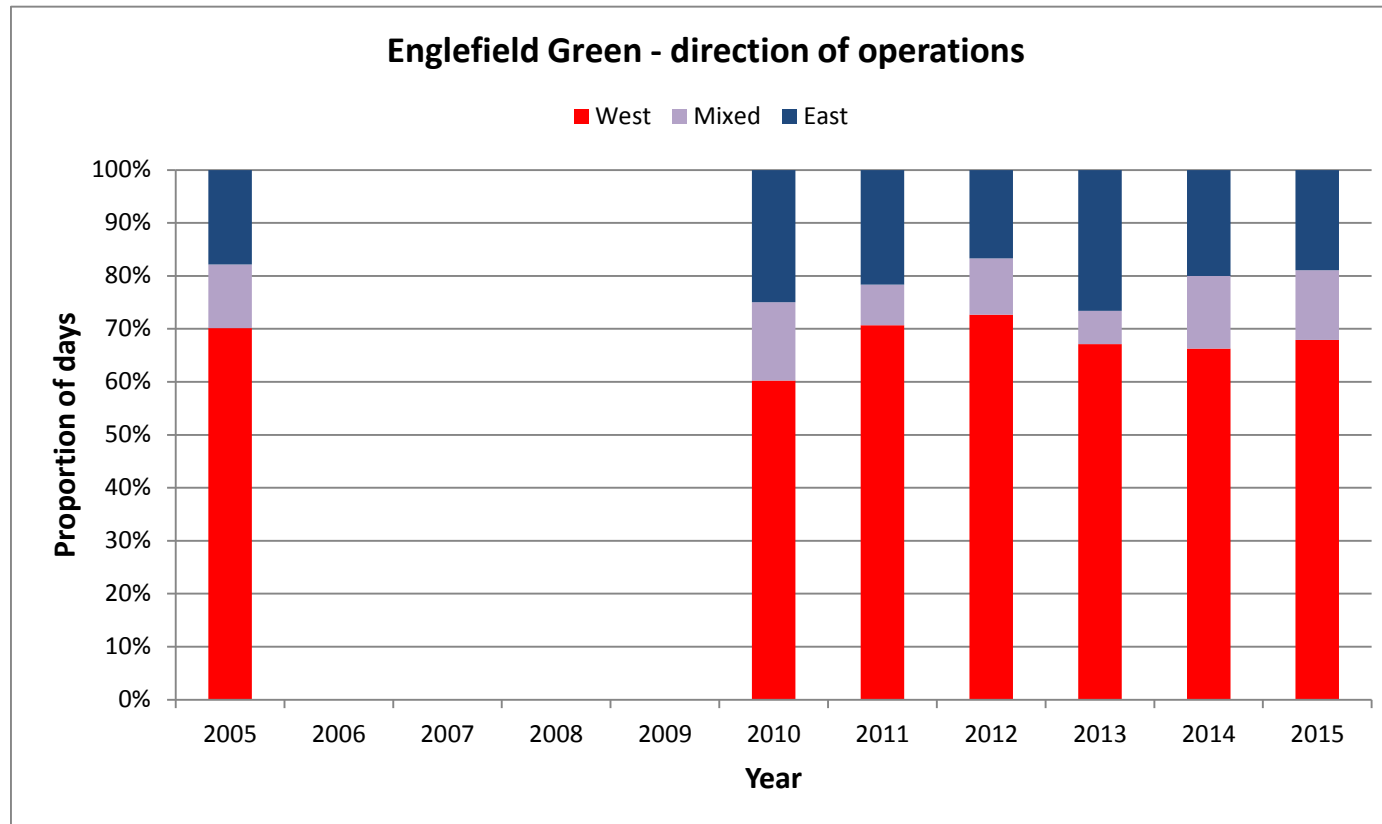


# EVOLUTION OF TRAFFIC CHARACTERISTICS FROM 2005 TO 2015

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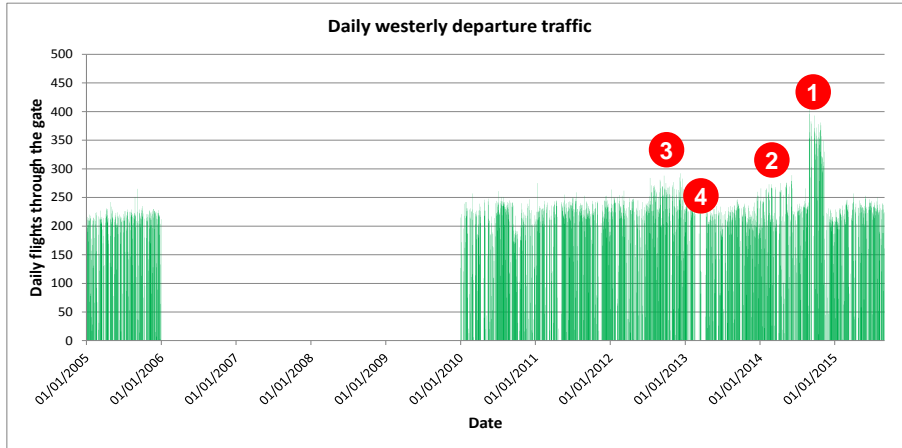
# 3

Typically, the gate operates on westerlies for between 60% and 70% of days; easterlies between 18% and 25% and mixed between 5% and 15% of days

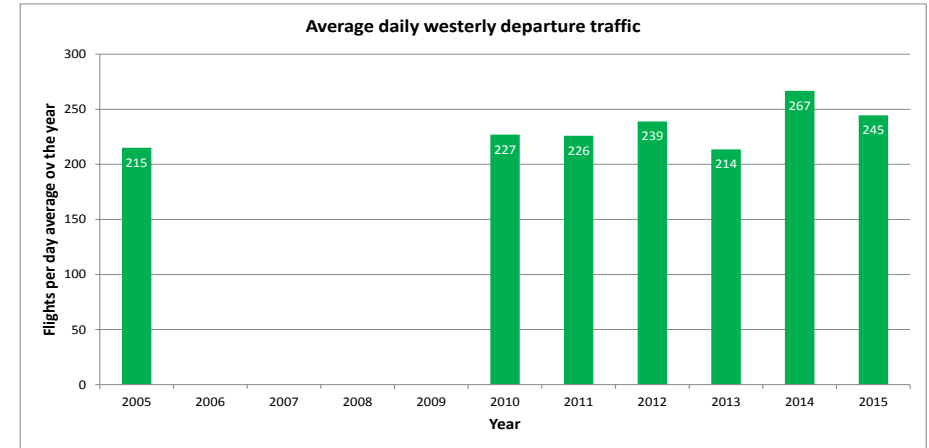


Westerly operations are defined as days when the airport operates solely in the westerly direction; similarly easterly operations are defined as days when the airport operates solely in an easterly direction. Mixed operations are defined as days when there are operations in both directions

## The daily volume of westerly departure traffic shows an upwards trend from 2010 to 2015 but was influenced strongly by the departure trials in 2014



There is a marked peak (labelled as 1) in traffic volume in late 2014, corresponding to the second westerly departure trial. There is also a smaller peak (2) in traffic earlier in 2014 corresponding to the first westerly departure (DOKEN) trial. There is also a peak (3) in late 2012, coinciding with the Operational Freedoms trial. There is a gap in westerly traffic volume in early 2013 (4)

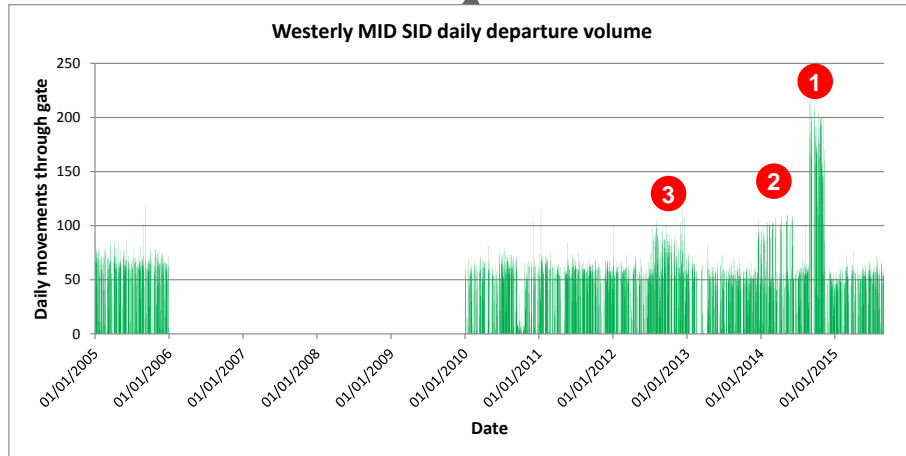
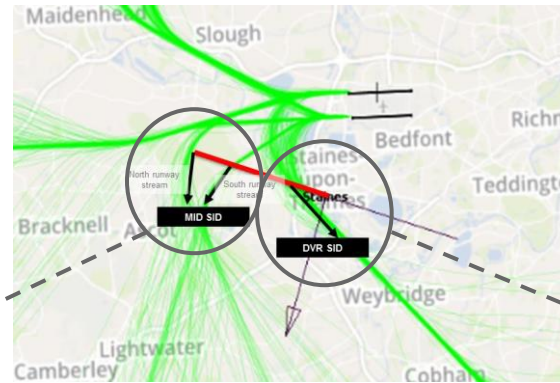


The overall traffic through the gate appears to have increased from 2010 at 227 flights per westerly day to 245 flights per westerly day in 2015.

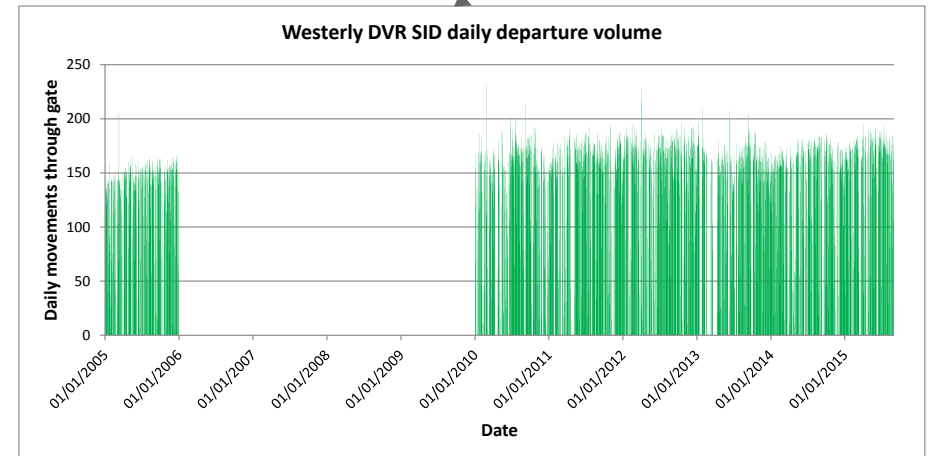
There are peaks in traffic in 2012, corresponding to vectoring MID and DVR traffic during the Operational Freedoms trials and in 2014 corresponding to the departure trials. There was reduced traffic 2013, likely due to the gap observed in early 2013, shown at (4) in the above left chart

Note: westerly daily averages are derived from days when the airport is operating in the westerly direction only, e.g. the annual daily average is the total westerly traffic crossing the gate per year divided by the number of westerly days for that year

## The volume of both westerly MID and DVR traffic crossing the gate has increased since 2010 with MID traffic being affected by trials in 2012, 2013 and 2014

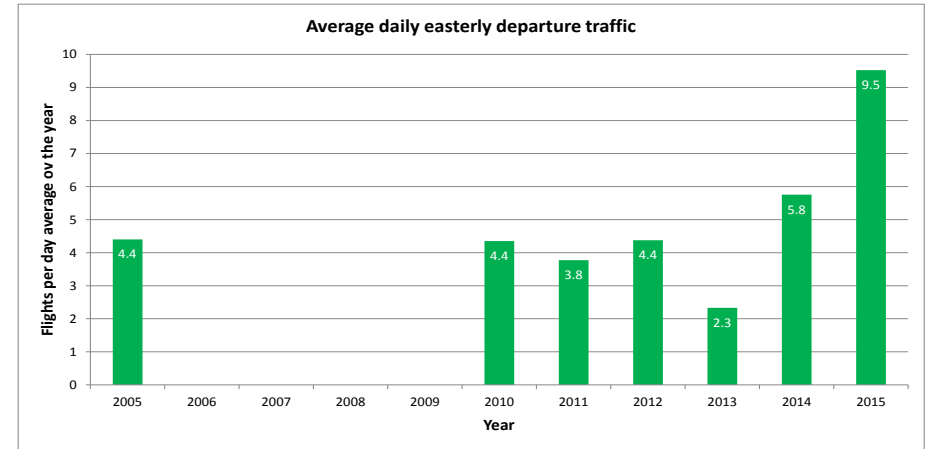
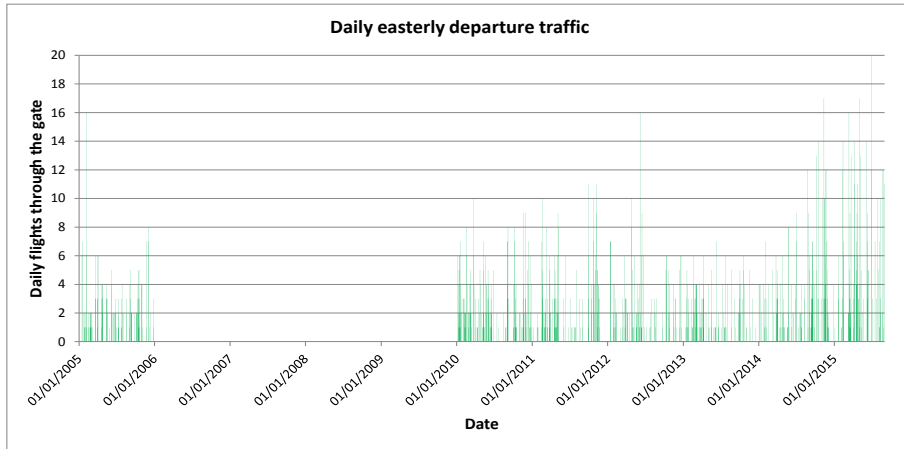


Peaks (1), (2) and (3) correspond to the second and first departure trials, and the Operational Freedoms trial respectively. Volume has increased from 45 per westerly day in 2010 to 49 per westerly day in 2015 but with higher peaks in the intermediate years.



Traffic volume increases from approximately 137 per westerly day in 2010 to approximately 156 per westerly day in 2015. The traffic volume appears to be cyclical: higher in summer than winter; and there are intermediate peaks in 2011 and 2012

## Easterly departure traffic through the gate has low volume but has doubled since 2010



**Note: different scales for easterly and westerly traffic volumes**

Easterly traffic was at a consistent level until late 2014 when it started to increase

Easterly traffic is at a much lower volume than in the previous analysis centred on Staines because the larger Staines gate captures much more of the easterly CPT SID traffic than the much smaller Englefield Greed gate, where the easterly CPT SID only clips the extreme south-eastern part of the gate

The average daily traffic through the gate on easterly days has more than doubled from 4.4 flights per day in 2010 to 9.5 flights per day in 2015

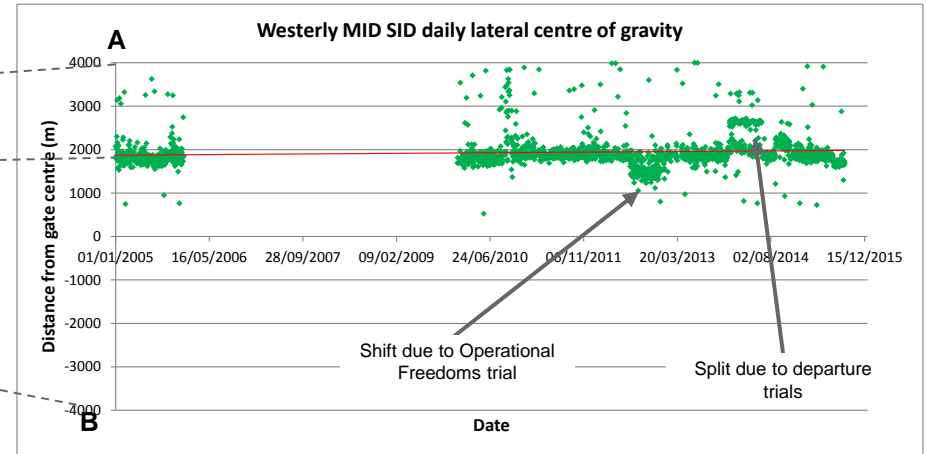
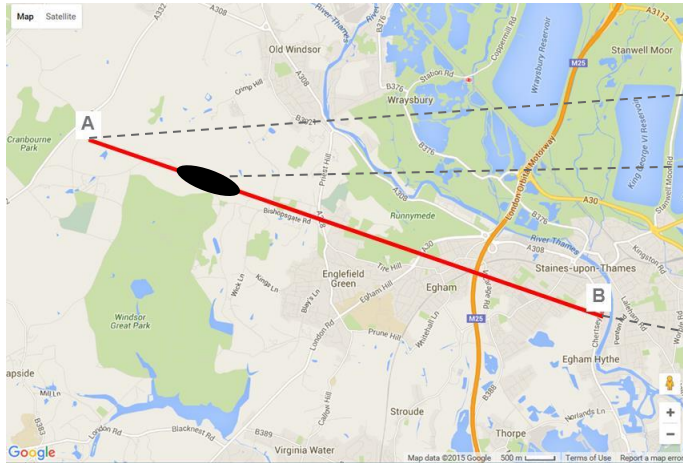
As with westerly departures, there was a reduction in traffic in 2013

Note: easterly daily averages are derived from days when the airport is operating in the easterly direction only, e.g. the annual daily average is the total easterly traffic crossing the gate per year divided by the number of easterly days for that year



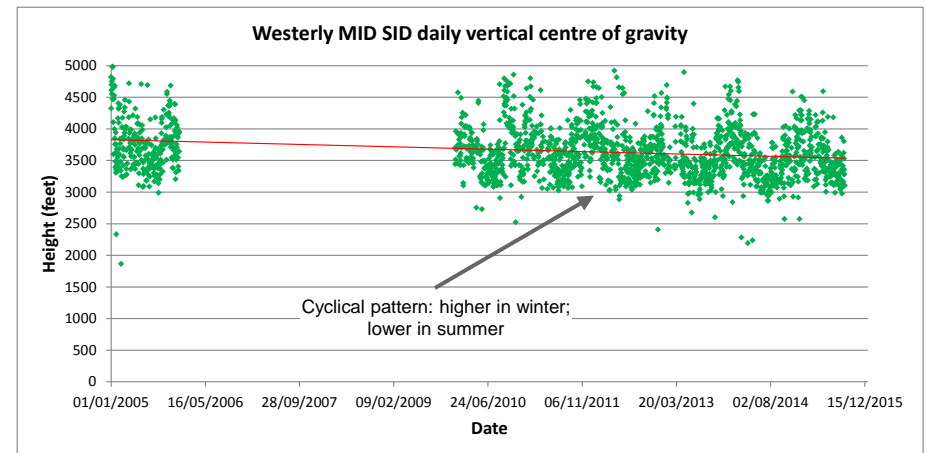
# Long-term the lateral centre of gravity of the MID SID has moved north-west slightly: the vertical centre of gravity has reduced from around 3800 feet to 3500 feet

## Approximate centre of gravity and extent of westerly MID SID



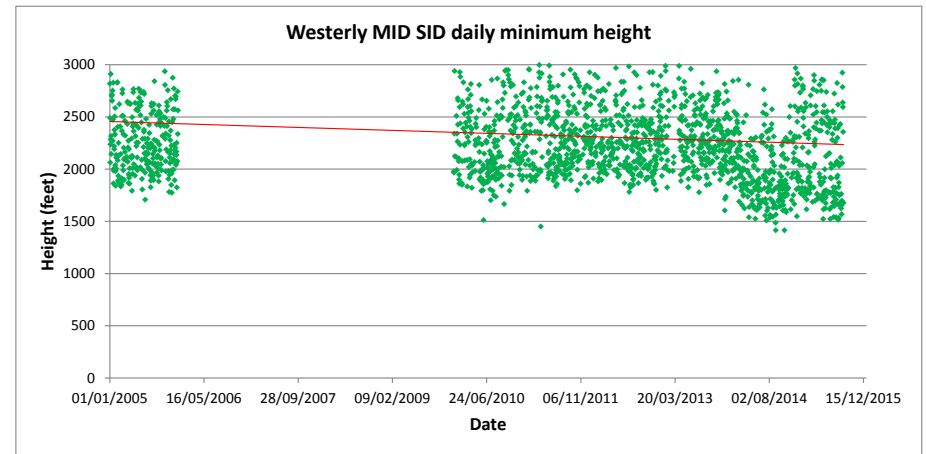
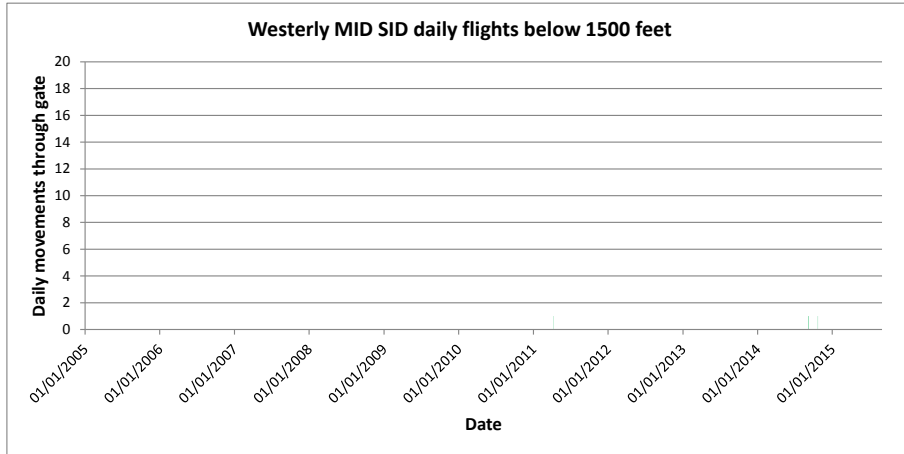
The lateral centre of gravity (CoG) of the MID SID is at the north-eastern extreme of Windsor Great Park. The position of the lateral CoG moves very slightly to the north-west from 2005 to 2015 and there is considerable scatter from day-to-day. The effects of the various trials shift the lateral CoG from its normal position.

There is a downward trend on the vertical CoG of the MID SID from approximately 3800 feet in 2005 to approximately 3500 in 2015. There is a cyclical pattern in the vertical CoG indicating that MID SID flights are lower in summer than in winter

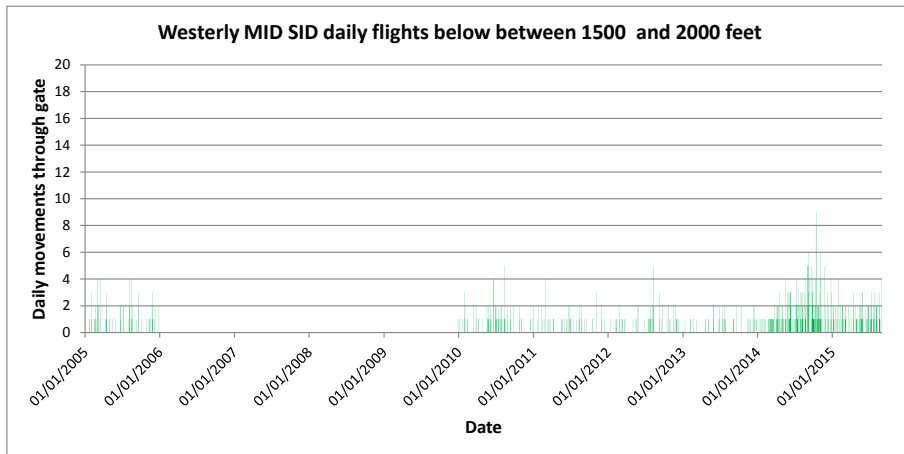


Note: Englefield Green is approximately 150 feet higher than Heathrow (the baseline for height measurement) so the actual height above the ground at the gate is approximately 150 feet less than that indicated in the charts

## The overall long term trend on the lowest flights using the MID SID is downwards



Note: Englefield Green is approximately 150 feet higher than Heathrow (the baseline for height measurement) so the actual height above the ground at the gate is approximately 150 feet less than that indicated in the charts

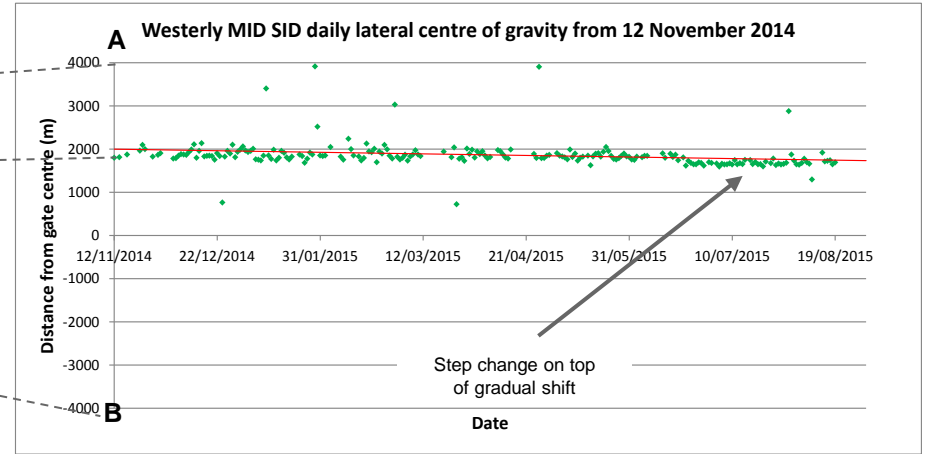
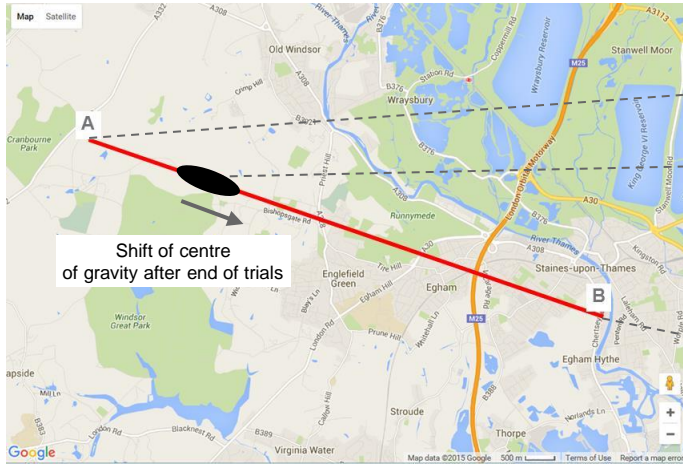


The left hand charts show that there are very few MID SID flights crossing the gate below 1500 feet but the number crossing the gate between 1500 feet and 2000 feet is increasing.

The chart, above, shows that the daily minimum height (the height that the lowest flight crosses the gate each day) is decreasing and that in 2014 and 2015 the lowest flights are consistently approaching 1500 feet

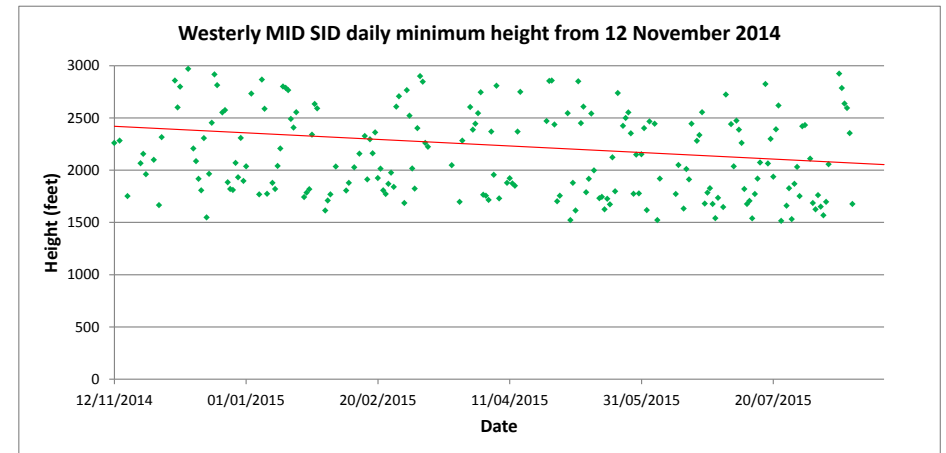
# Since the end of the trials in November 2014, there has been a shift of the MID SID towards the left of the gate and a decrease in minimum height

## Approximate centre of gravity and extent of westerly MID SID



Since the end of the trials in November 2014 there has been a shift of the CoG of the MID SID towards the centre of the gate. The shift was gradual to mid June 2015 when there was a perceptible step change.

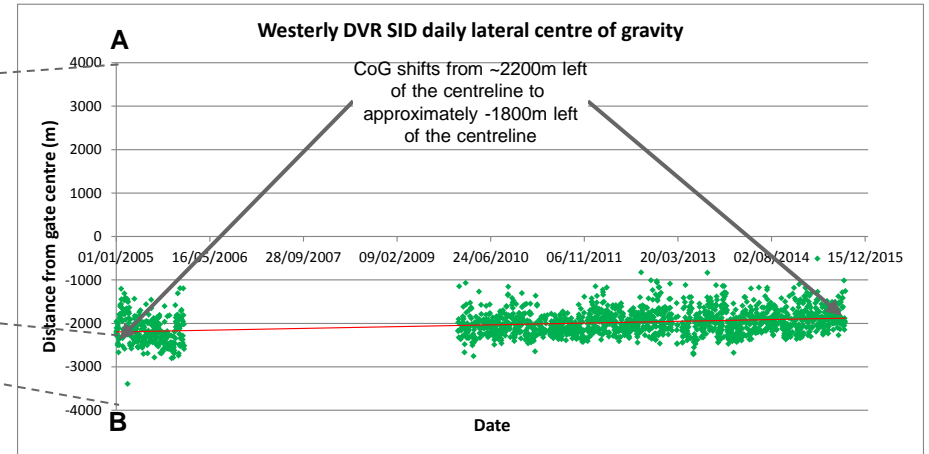
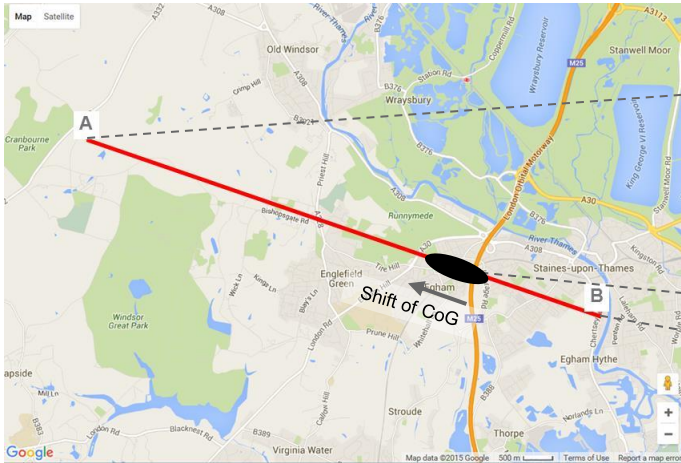
Also since the end of the trials, there has been a downward trend on the minimum height of MID flights crossing the gate.



Note: Englefield Green is approximately 150 feet higher than Heathrow (the baseline for height measurement) so the actual height above the ground at the gate is approximately 150 feet less than that indicated in the charts

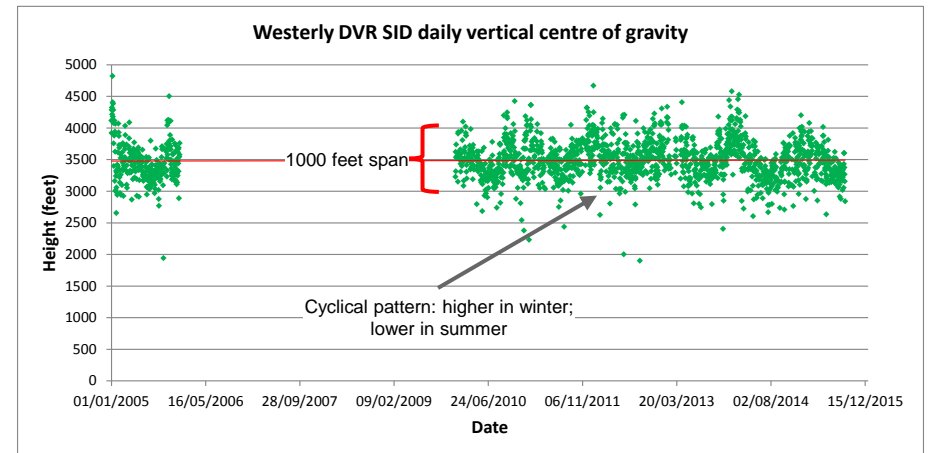
# The lateral centre of gravity (CoG) of the DVR SID has moved north west, although there is no trend on the vertical CoG, flights are higher in winter than in summer

## Approximate centre of gravity and extent of westerly DVR SID



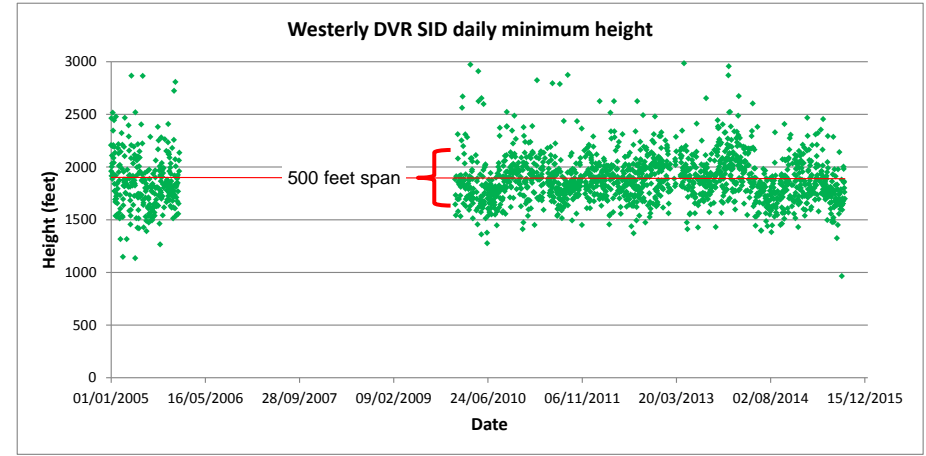
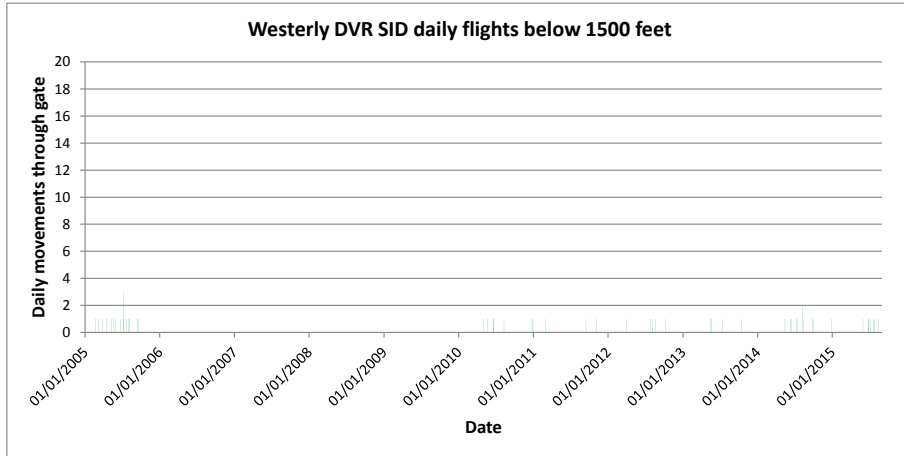
The lateral centre of gravity (CoG) of the DVR SID moves approximately 400m north west from 2005 to 2015 (200m north west from 2010 to 2015).

The vertical CoG of the DVR SID has remained consistent from 2005 to 2015 but is cyclical. The amplitude of the oscillations from winter to summer is approximately 1000 feet, indicating that on average in winter flights can be 1000 feet or more higher than flights in summer

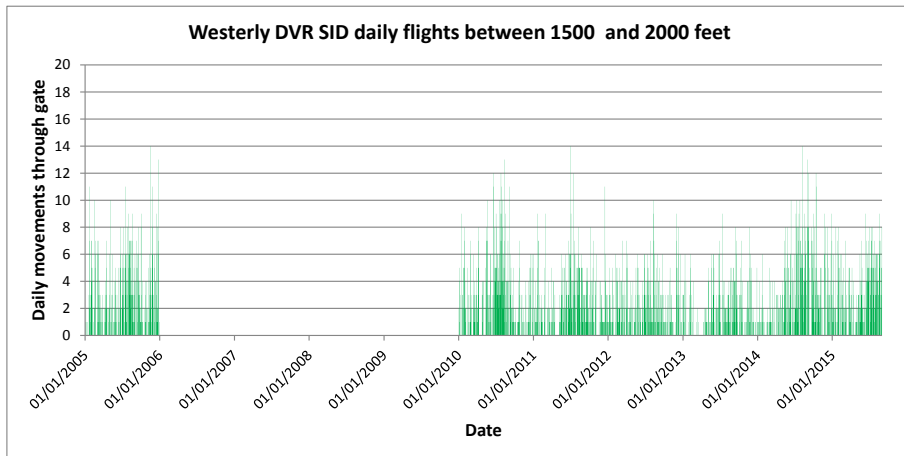


Note: Englefield Green is approximately 150 feet higher than Heathrow (the baseline for height measurement) so the actual height above the ground at the gate is approximately 150 feet less than that indicated in the charts

## There is no overall long term trend on the lowest flights but low flights in the summer appear more than 500 feet lower than low flights in the winter



Note: Englefield Green is approximately 150 feet higher than Heathrow (the baseline for height measurement) so the actual height above the ground at the gate is approximately 150 feet less than that indicated in the charts

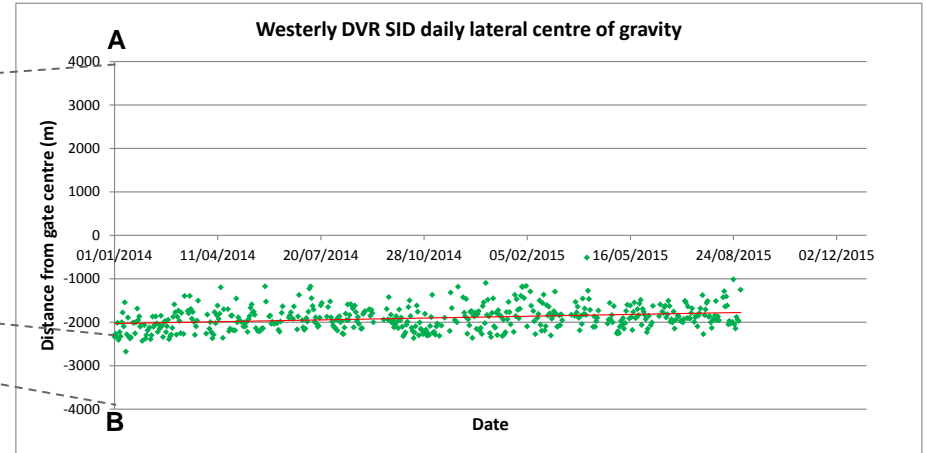
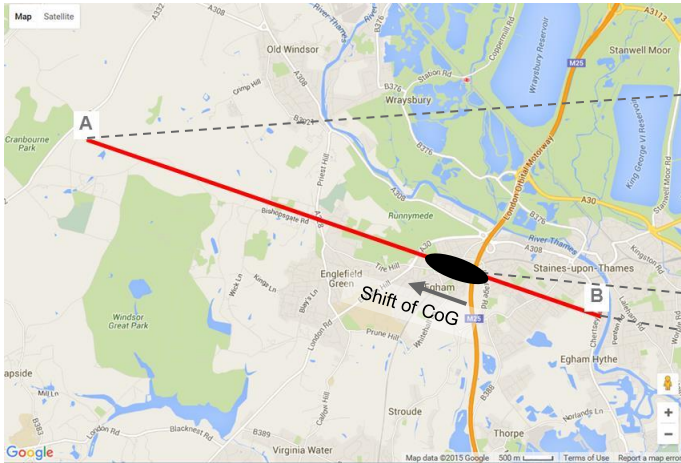


The left hand charts show that there are very few DVR SID flights crossing the gate below 1500 feet. The volume of flights crossing the gate between 1500 feet and 2000 feet does not vary over time but is higher in summer than winter.

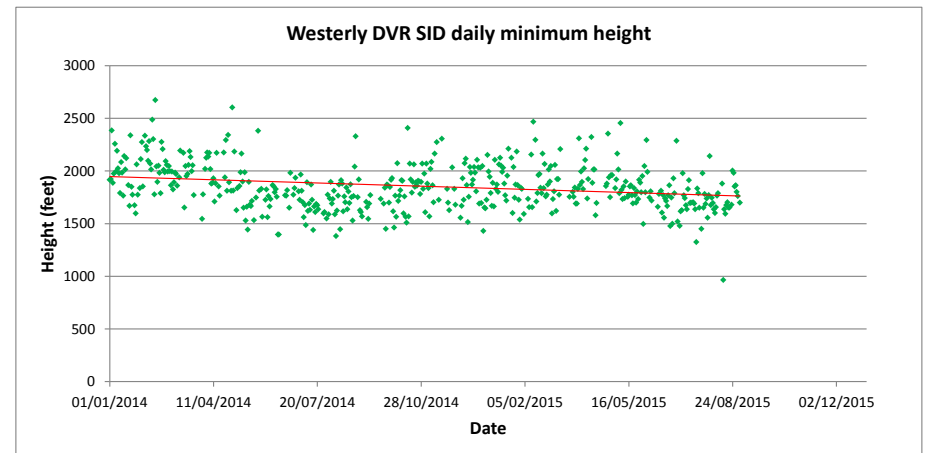
The chart, above, shows that the daily minimum height (the height that the lowest flight crosses the gate each day) is constant from 2005 to 2015 but is generally lower in summer than in winter

in the shorter term since the beginning of 2014, the centre of gravity of the DVR SID has shifted north-west and the lowest flights have got lower

### Approximate centre of gravity and extent of westerly DVR SID

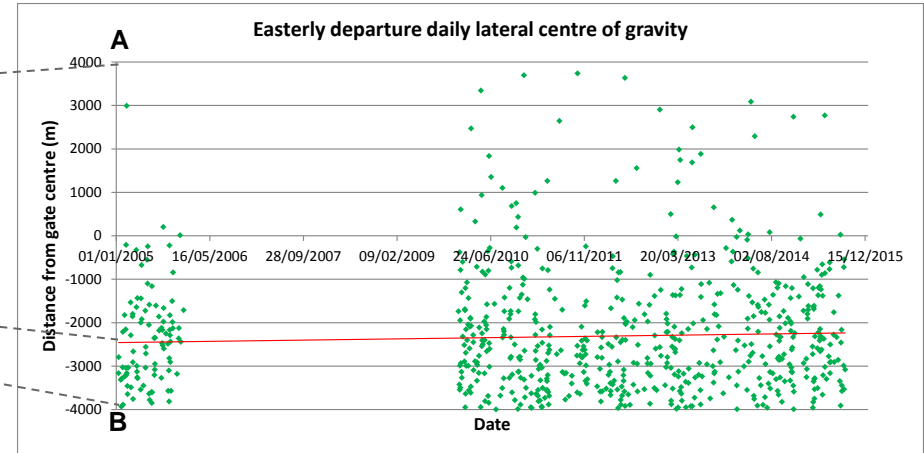
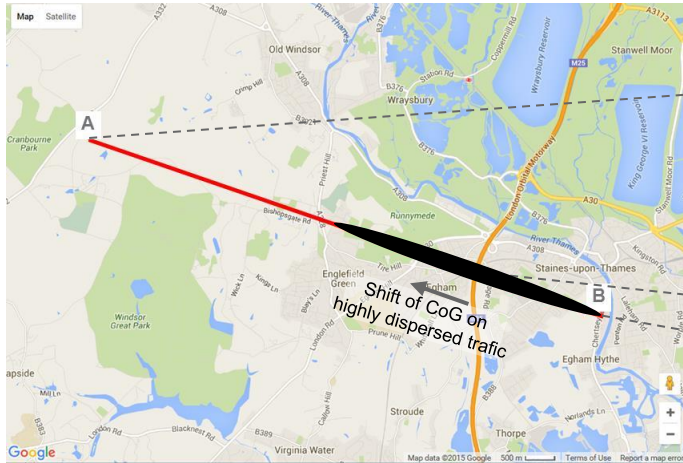


Since the beginning of 2014, there is a trend for a shift of the CoG of the DVR SID towards the centre of the gate. There is also a downward trend on the minimum height of the DVR traffic crossing the gate as well as the underlying cyclical nature of the pattern.



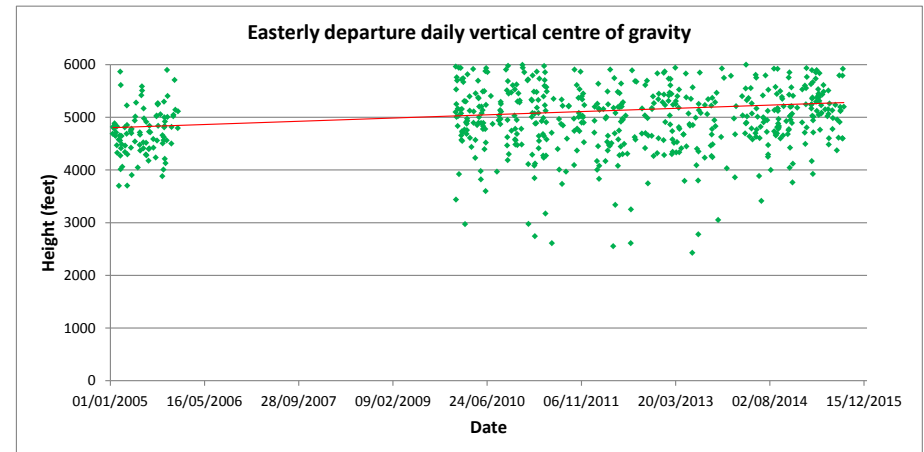
# The small number of easterly departures crossing the gate are widely scattered in position and height

## Approximate centre of gravity and extent of easterly CPT SID



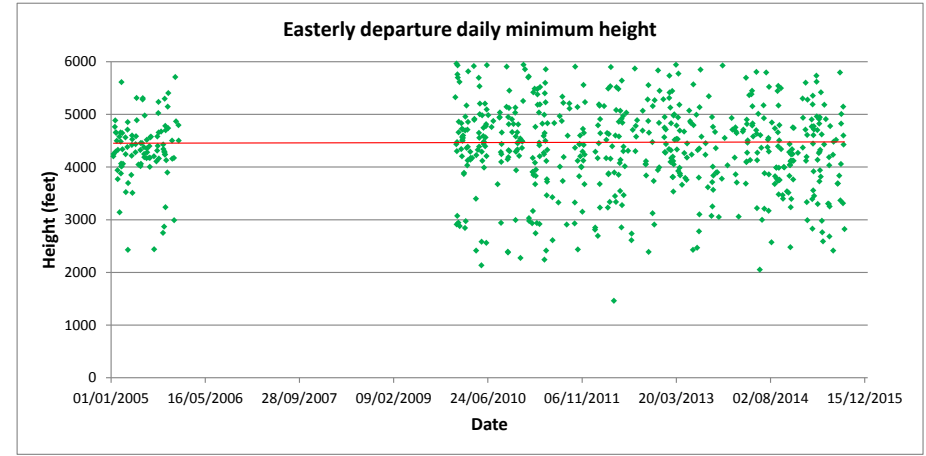
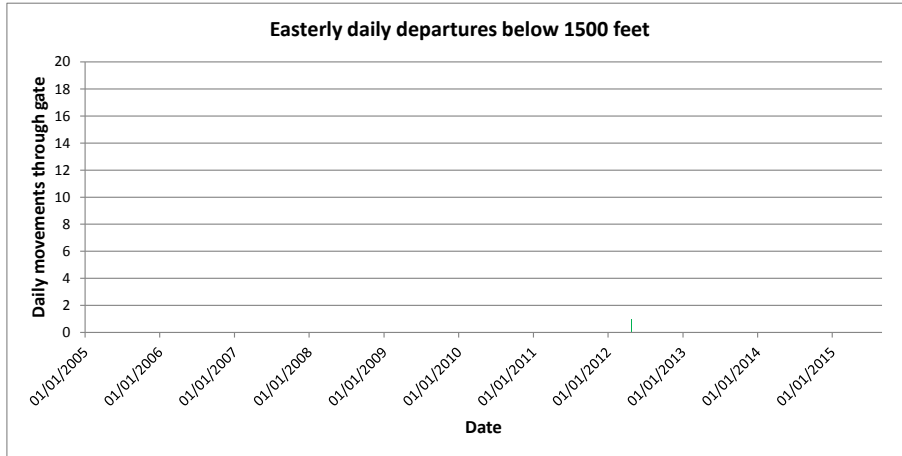
Easterly CPT SID traffic is generally spread across the south eastern half of the gate but there is a very large day-to-day variation in the lateral centre of gravity (CoG). This spread is likely due to the small number of easterly flights traversing the gate. The underlying trend on this highly dispersed traffic is towards the north west

There is also a large spread on the vertical CoG but with an underlying upward trend

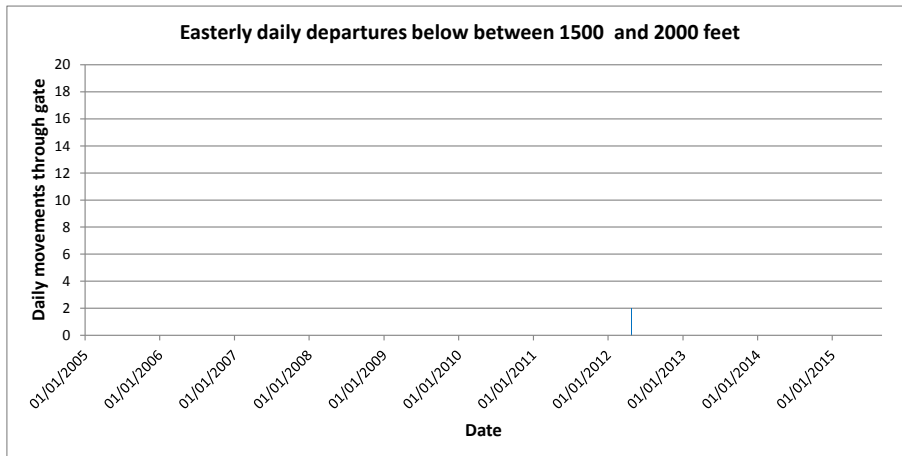


Note: Englefield Green is approximately 150 feet higher than Heathrow (the baseline for height measurement) so the actual height above the ground at the gate is approximately 150 feet less than that indicated in the charts

## Easterly departures only very rarely cross the gate below 2000 feet: there is large variation in minimum height from day-to-day with no underlying trend



Note: Englefield Green is approximately 150 feet higher than Heathrow (the baseline for height measurement) so the actual height above the ground at the gate is approximately 150 feet less than that indicated in the charts



The left hand charts show that there are very few easterly CPT SID flights crossing the gate below 2000 feet.

The chart, above, shows that the daily minimum height (the height that the lowest flight crosses the gate each day) is varies widely from day-to-day from a minimum of 1500 feet to a maximum of above 6000 feet



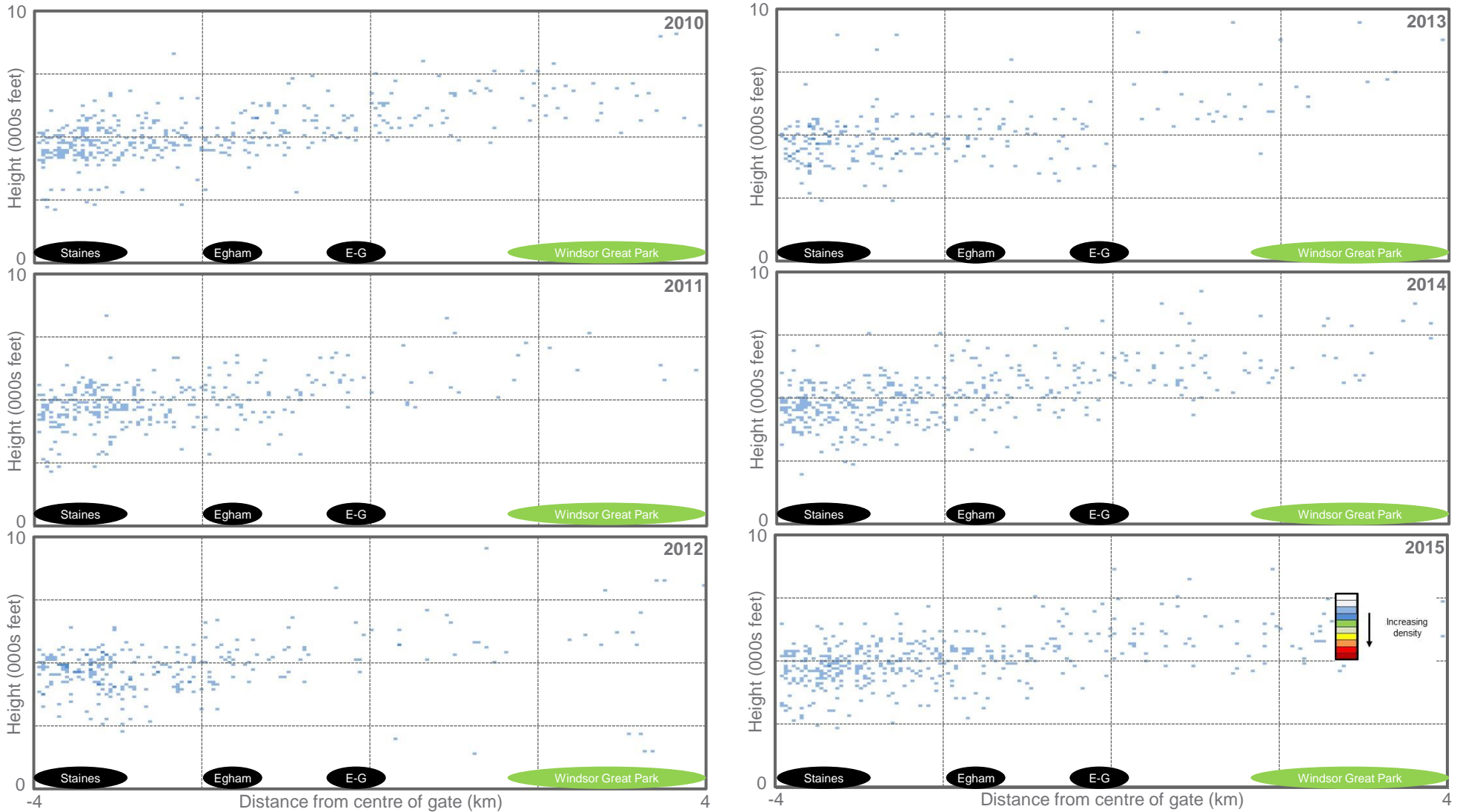


# DEPARTURE CHARACTERISTICS ON EASTERLY OPERATIONS

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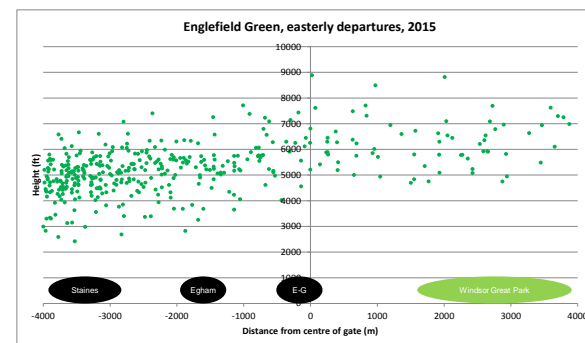
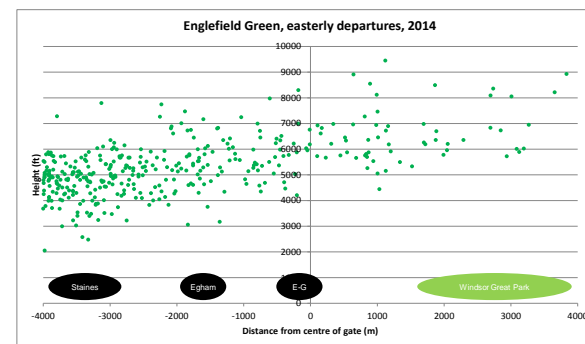
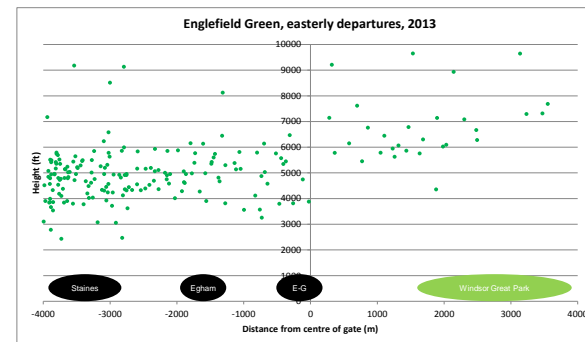
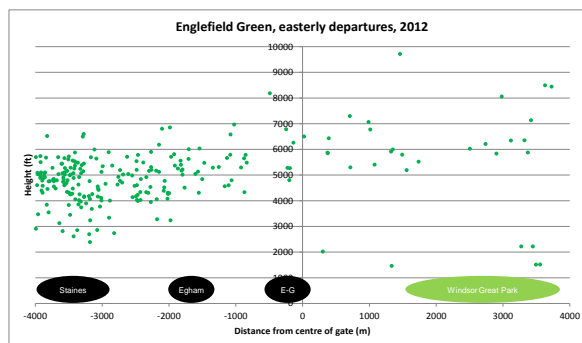
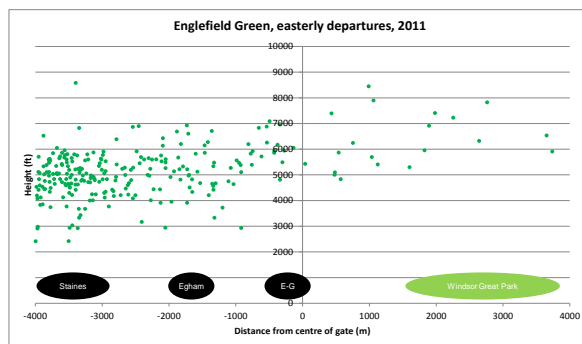
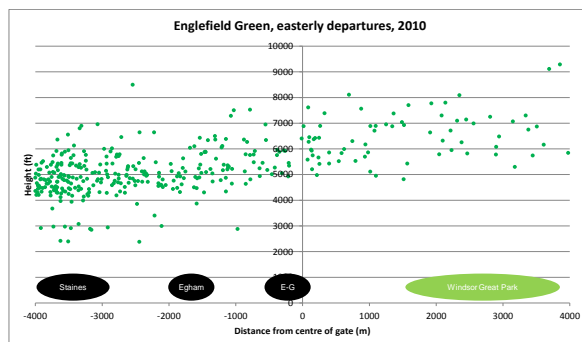
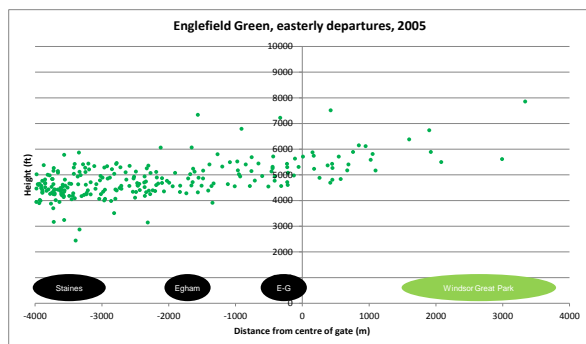
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# The intensity patterns for easterly departures crossing the gate do not have a defined SID structure and show little variation from 2005 to 2015

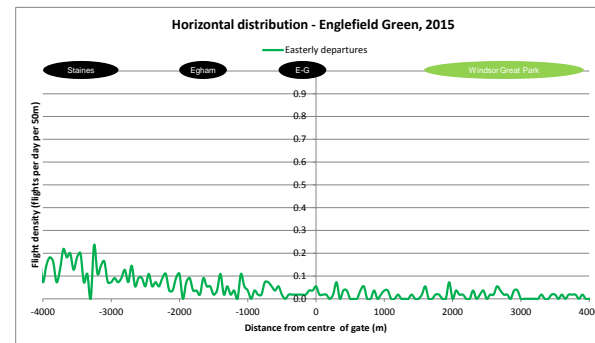
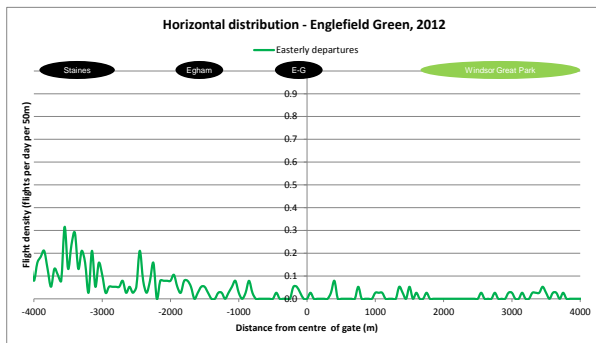
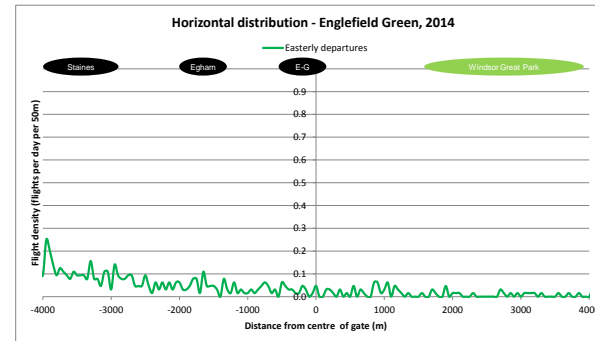
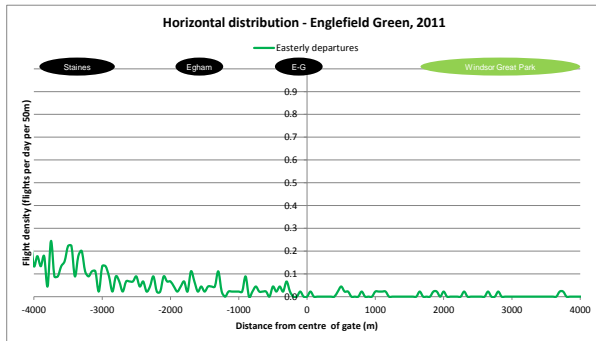
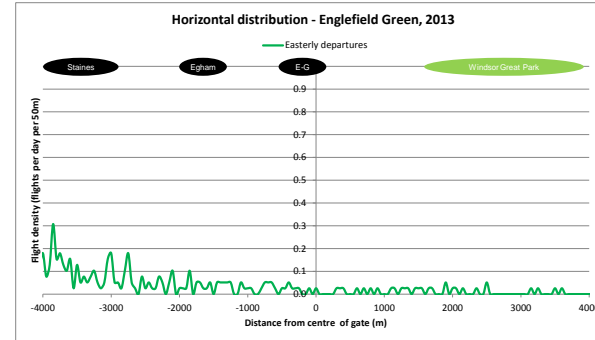
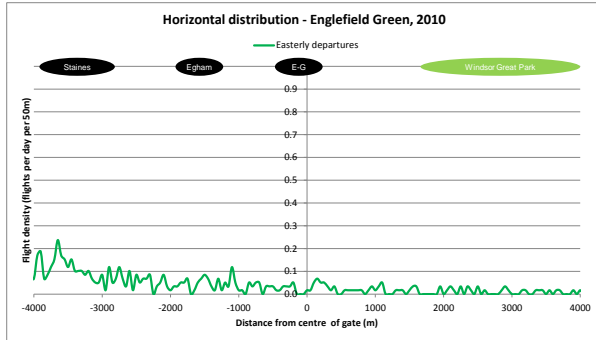


## Similarly the scatter plots for easterly traffic crossing the gate show little variation across the years

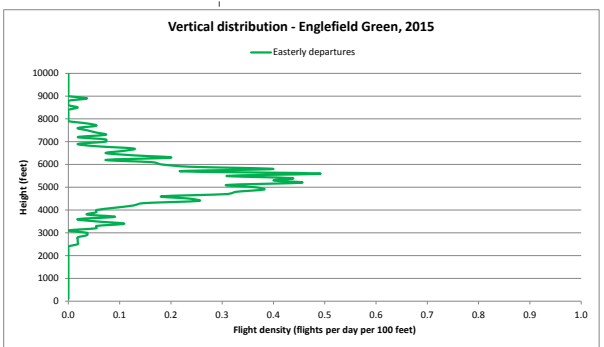
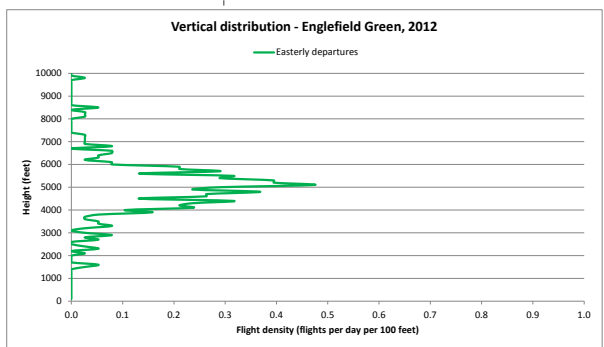
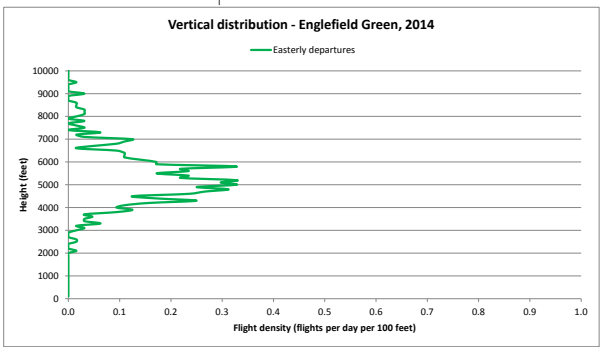
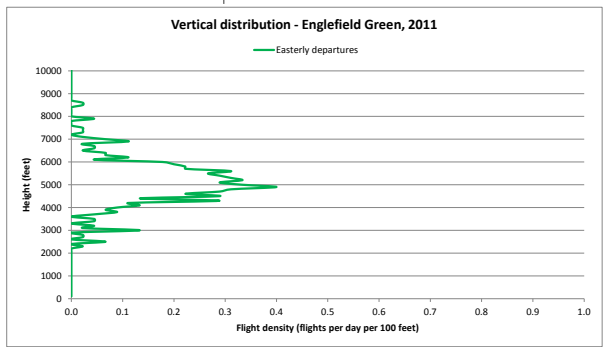
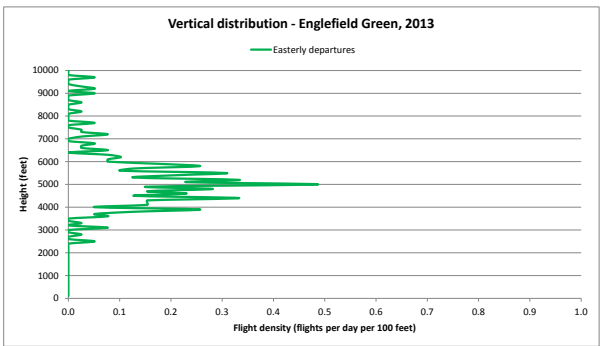
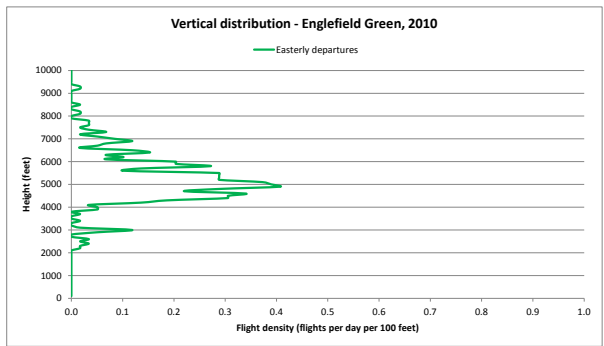
Most easterly departure traffic crosses the south eastern half of the gate but is distributed randomly with no apparent SID structure or concentration



# The horizontal traffic distributions confirm the low level and, other than bunching towards the south east, the random nature of easterly traffic crossing the gate

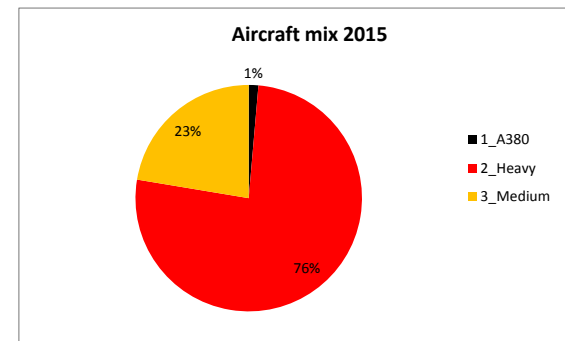
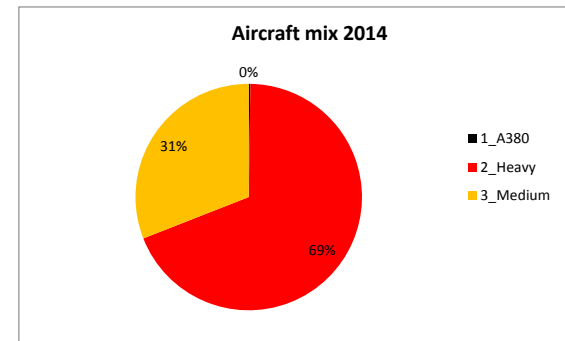
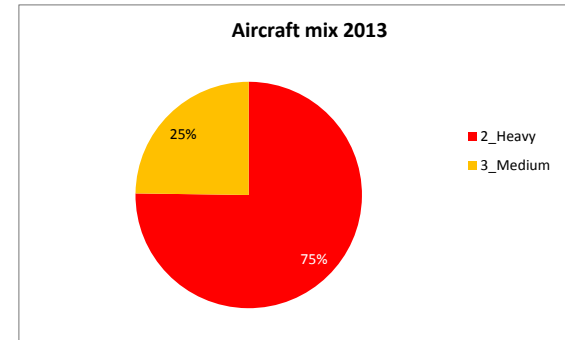
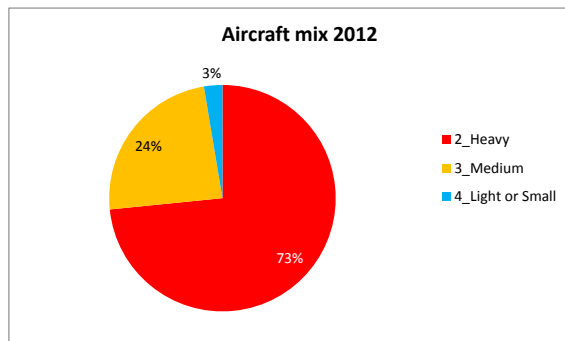
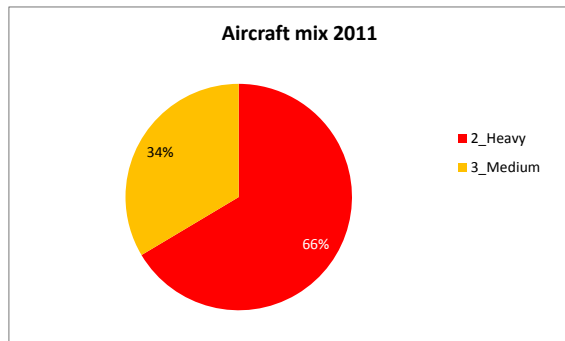
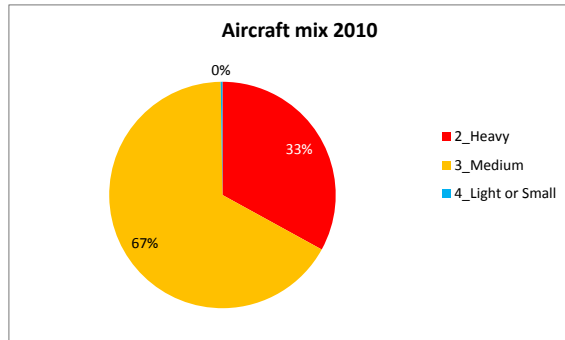


# Vertical distributions show the most likely easterly departure height at the gate is around 5000 feet but that this ranges from 2000 feet to over 9000 feet

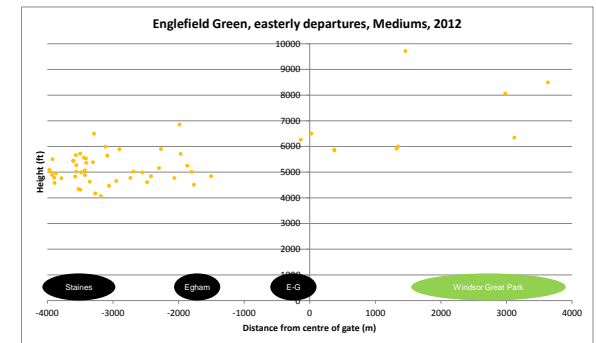
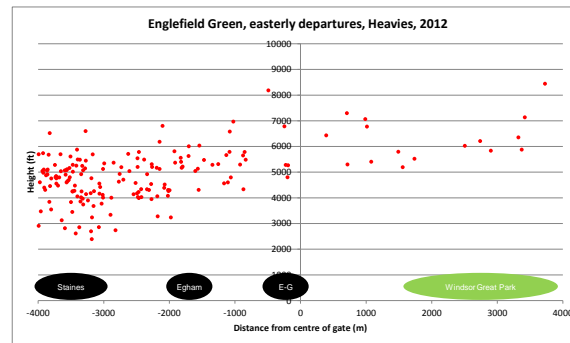
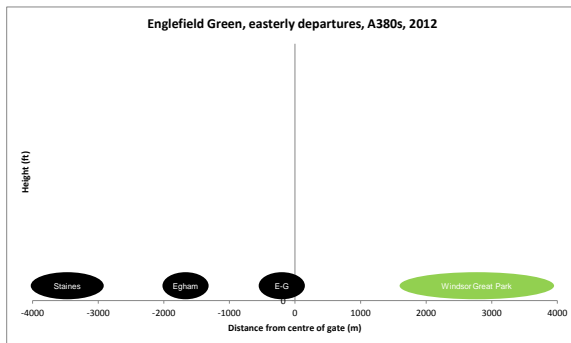
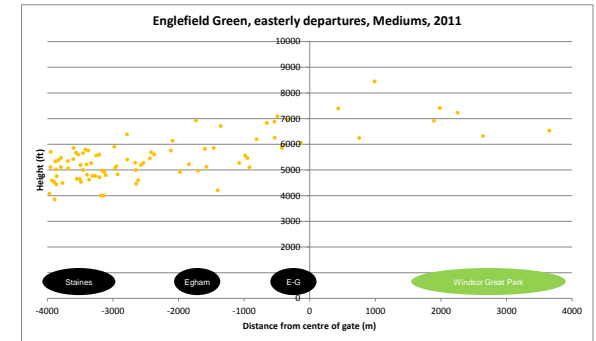
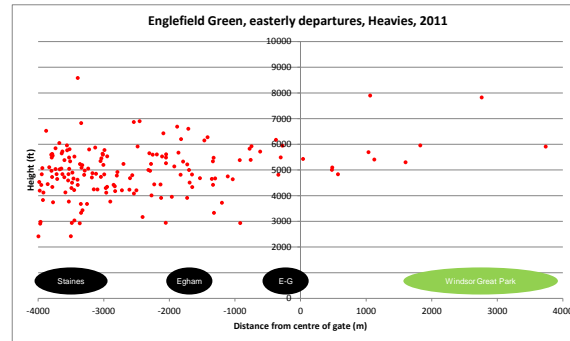
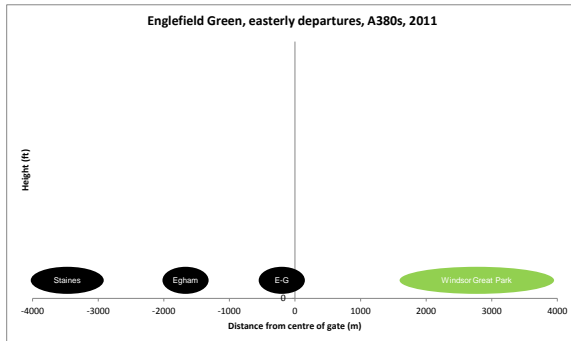
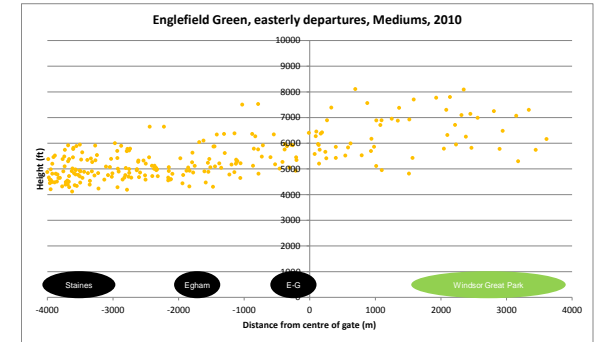
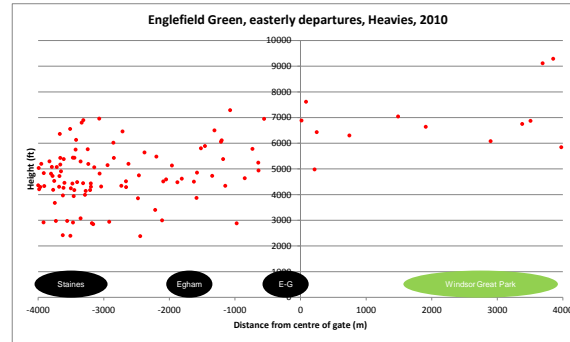
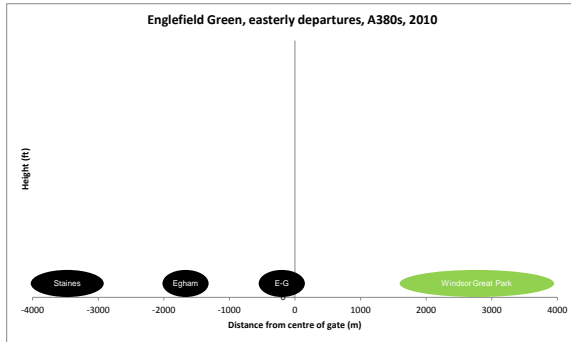


Note: Englefield Green is approximately 150 feet higher than Heathrow (the baseline for height measurement) so the actual height above the ground at the gate is approximately 150 feet less than that indicated in the charts

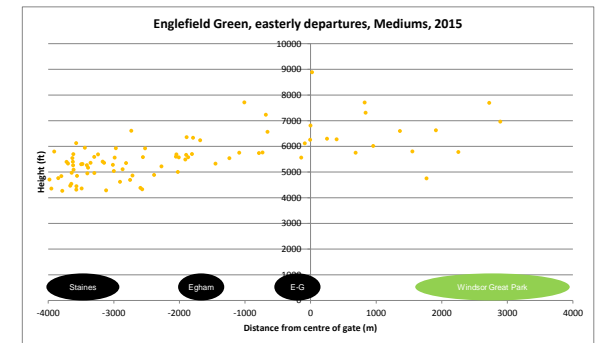
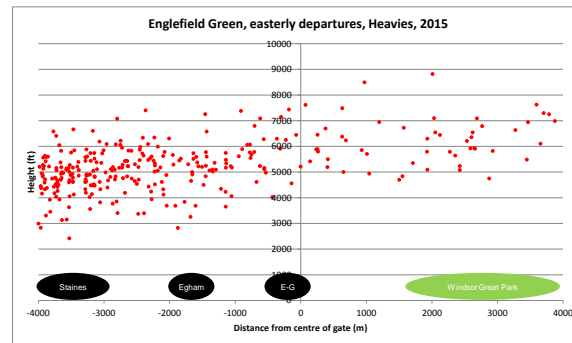
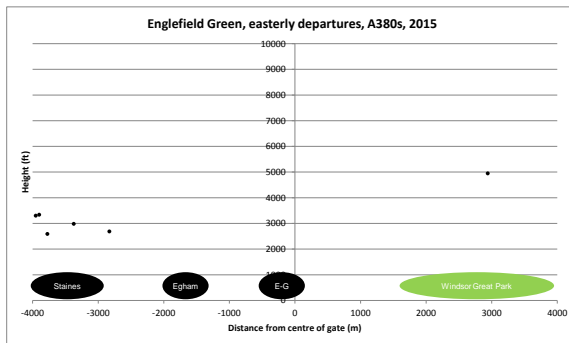
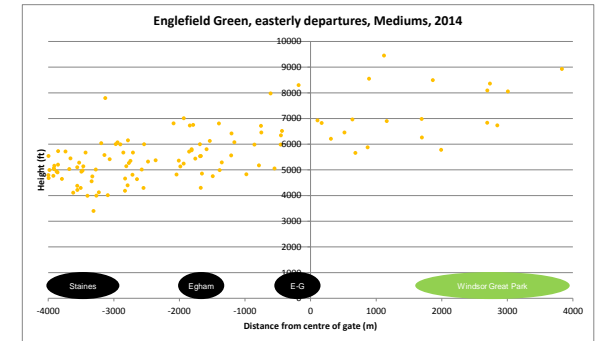
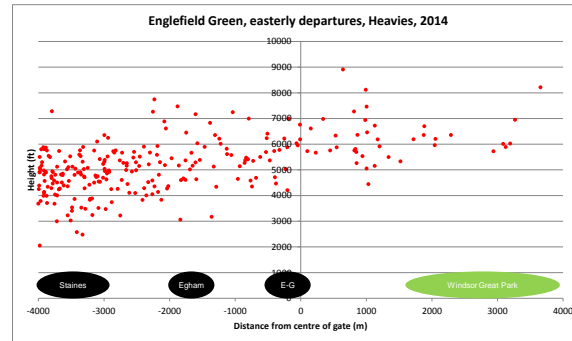
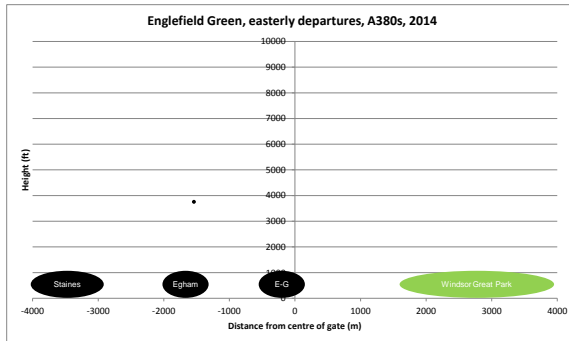
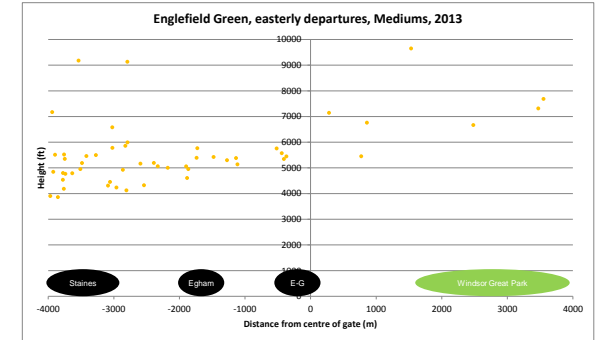
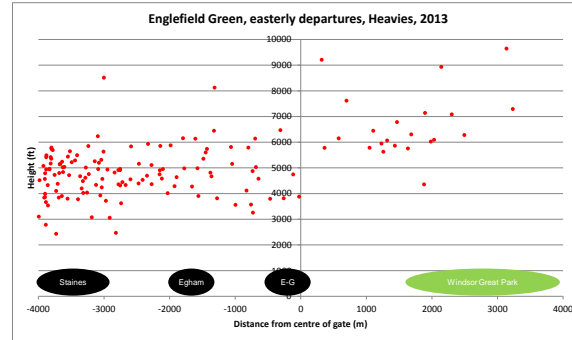
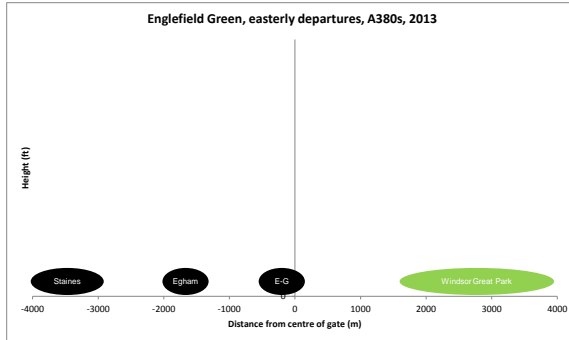
The proportion of large aircraft in the easterly departure fleet has increased to more than 75% from around 33%, with A380s making up 1%



# There does not appear to be any bunching by size of aircraft

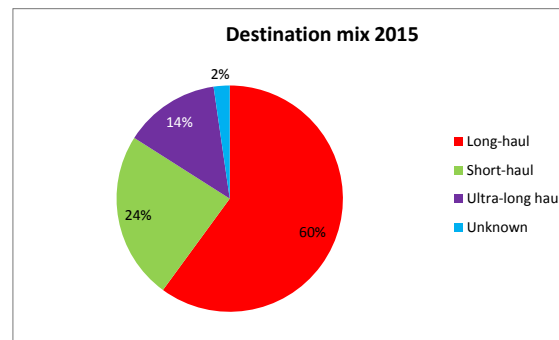
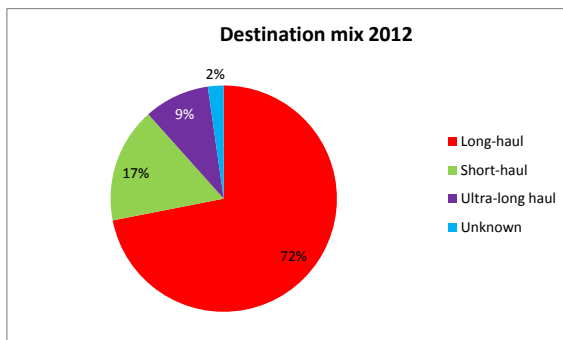
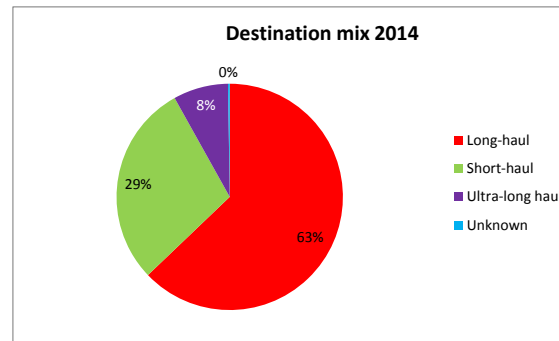
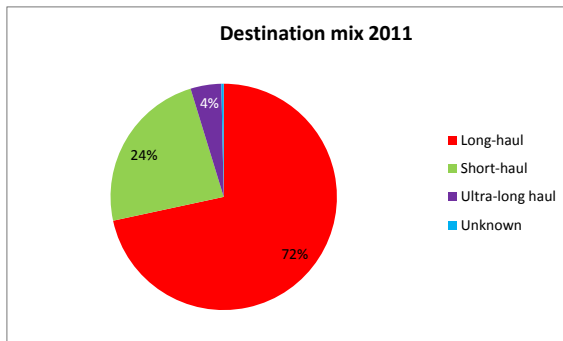
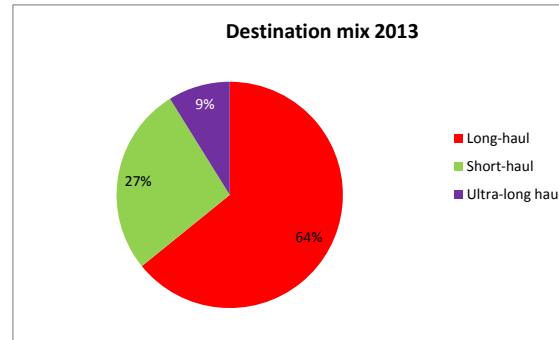
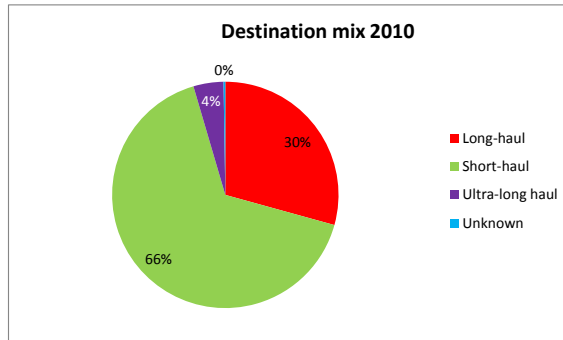


# There does not appear to be any bunching by aircraft size





The proportion of long-haul destinations served by easterly departure traffic has increased from 34% in 2010 and is now approximately 74%



Short-haul destinations typically have flight times shorter than three hours

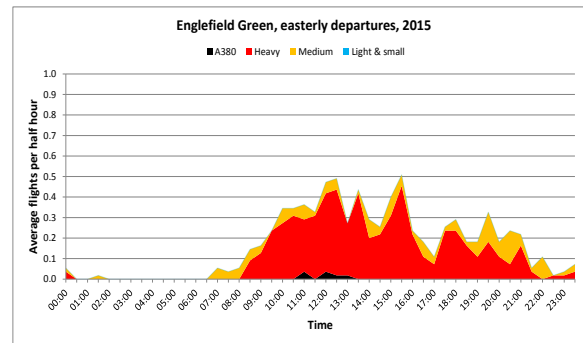
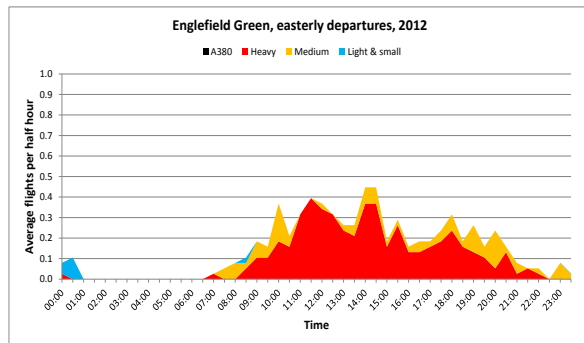
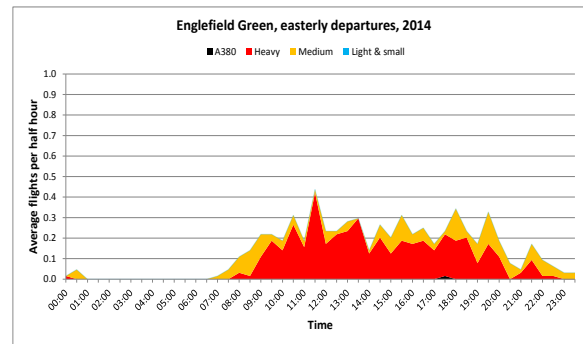
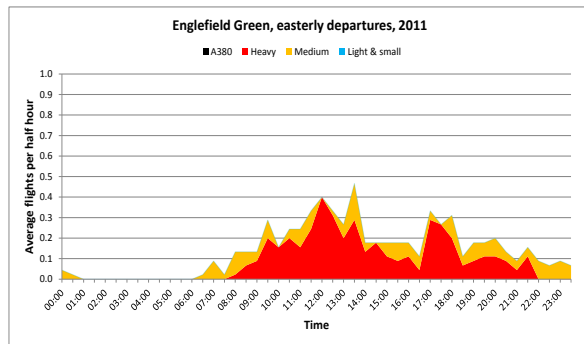
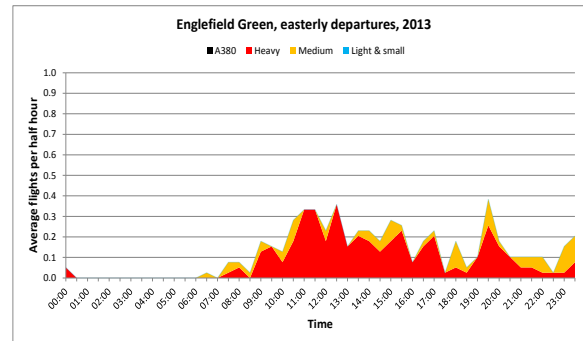
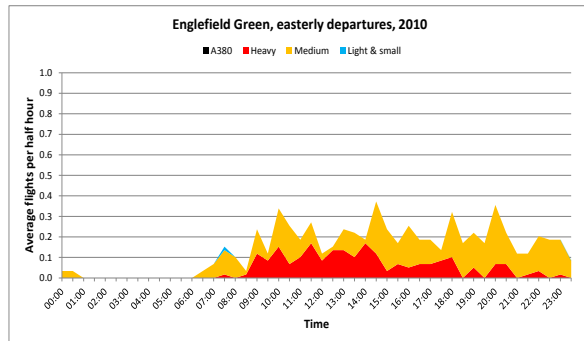
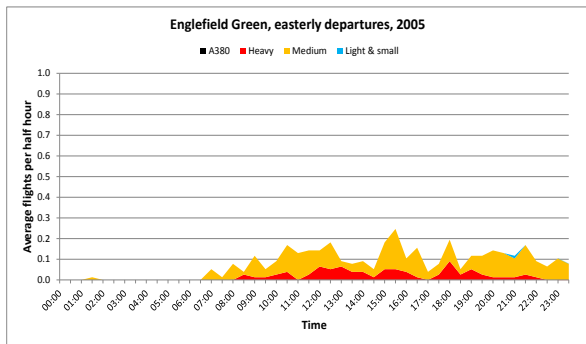
Medium-haul destinations typically have flight times between three and six hours

Long-haul destinations typically have flight times between six and nine hours

Ultra long-haul destinations typically have flight times greater than nine hours

Destinations marked as “unknown” do not have a recognised airport code associated with the flight in the data used for analysis

The peak in the traffic occurs between 10:00 hours and 17:00 hours: there is then an evening peak tailing off to 21:30 hours



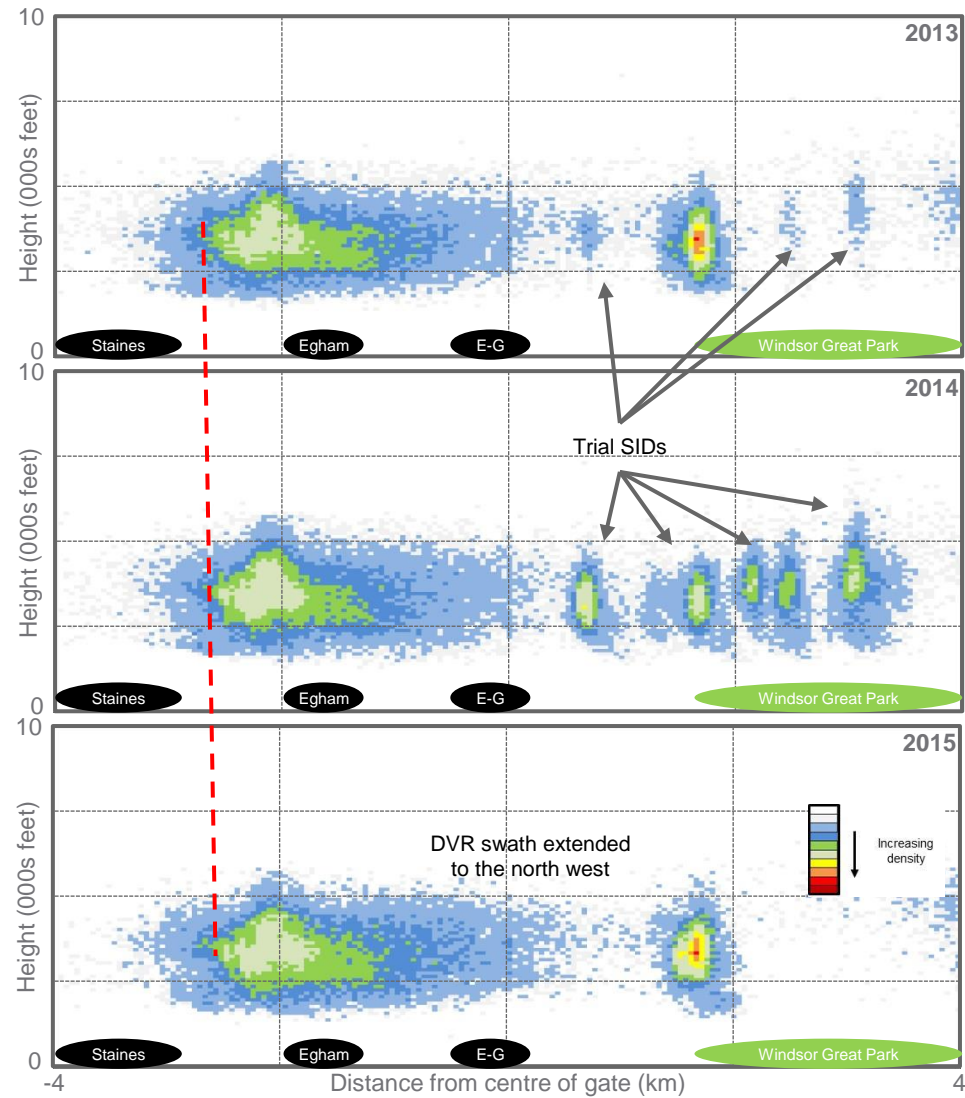
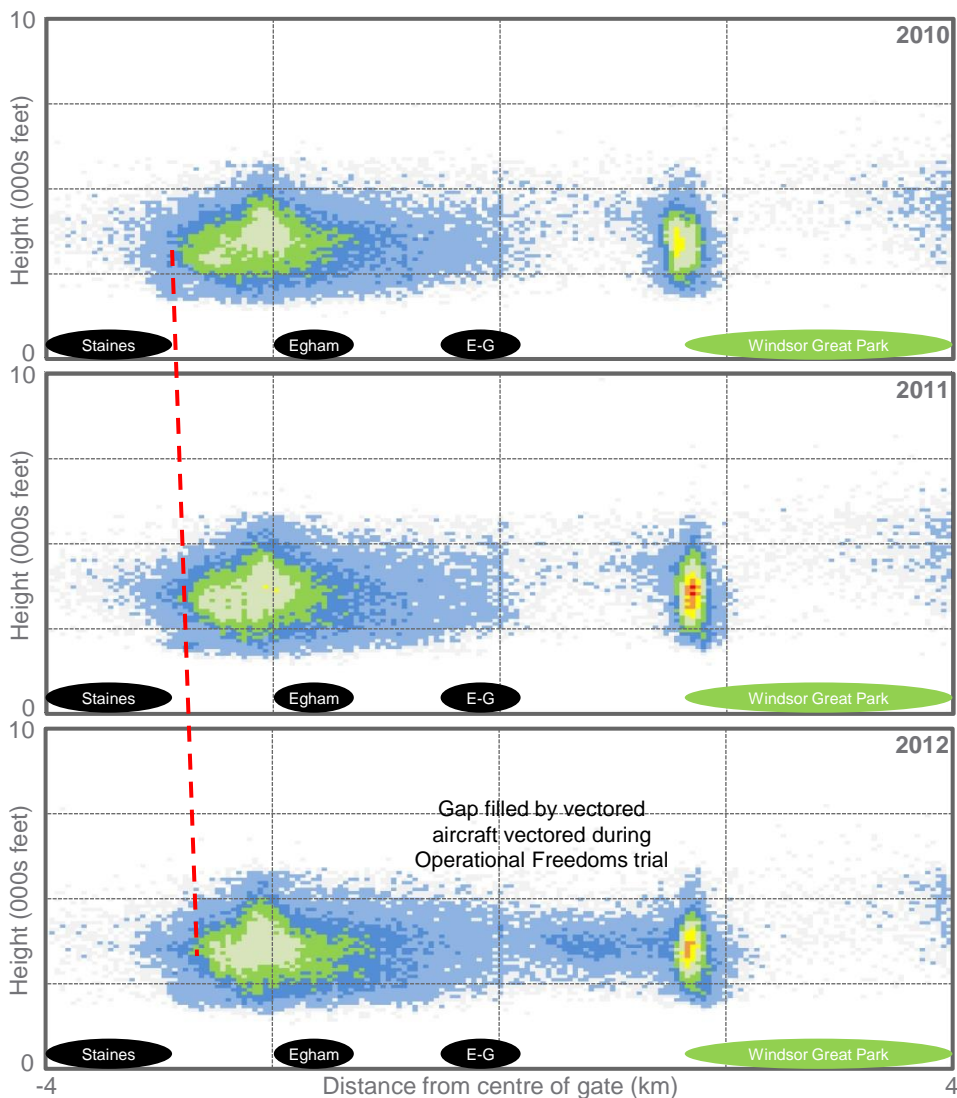


# DEPARTURE CHARACTERISTICS ON WESTERLY OPERATIONS

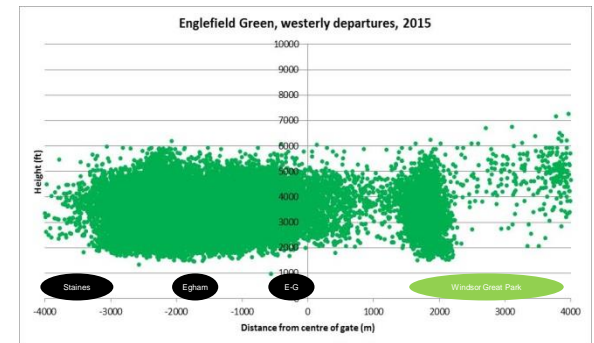
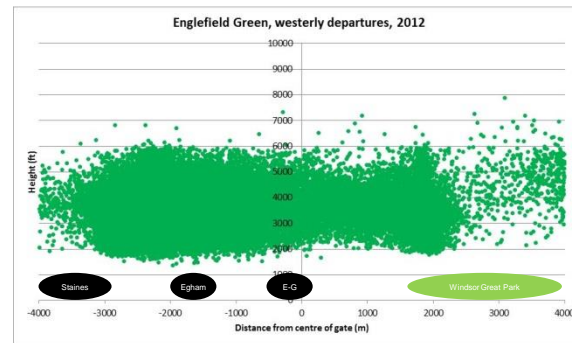
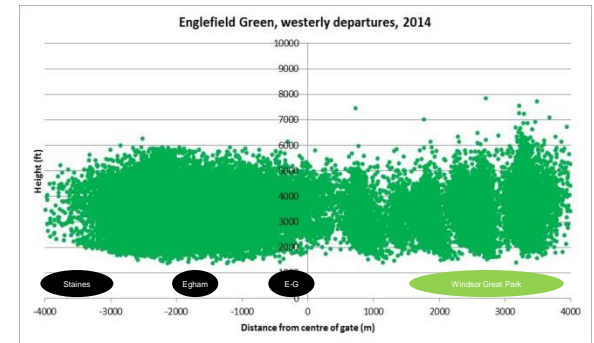
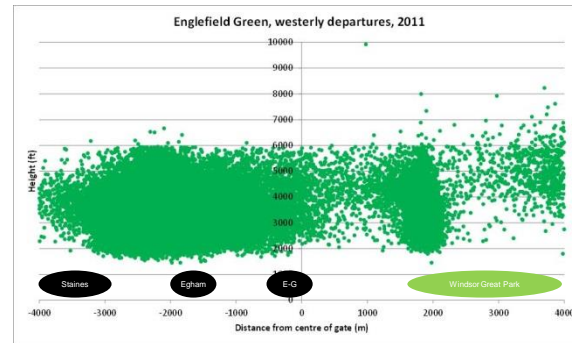
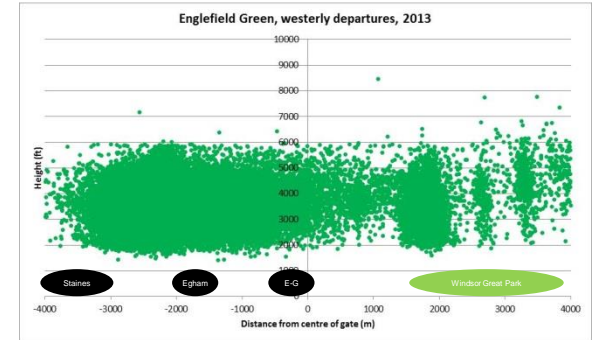
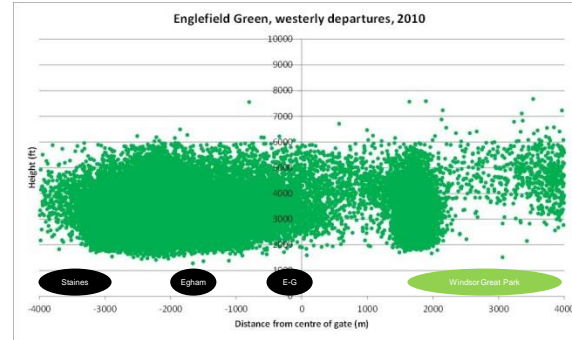
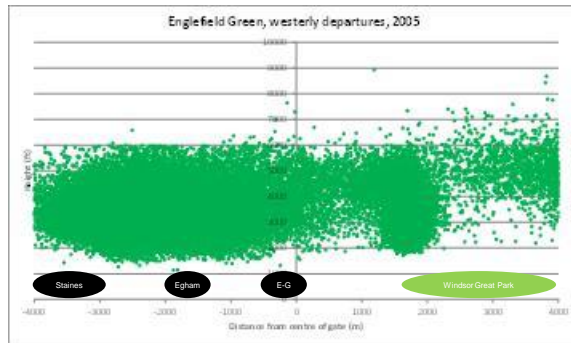
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# 5

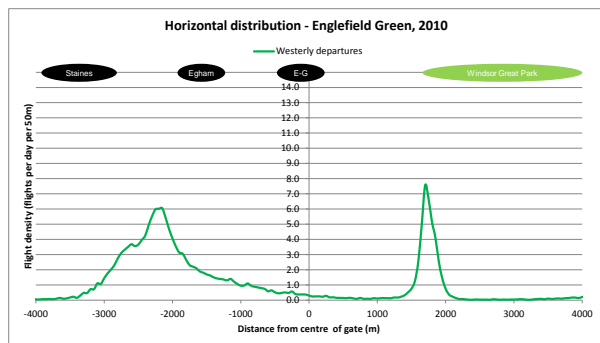
# Heat maps show clearly the DVR and MID SID structure as well as the impact of the trials: there is a trend for the DVR SID to move to the north west



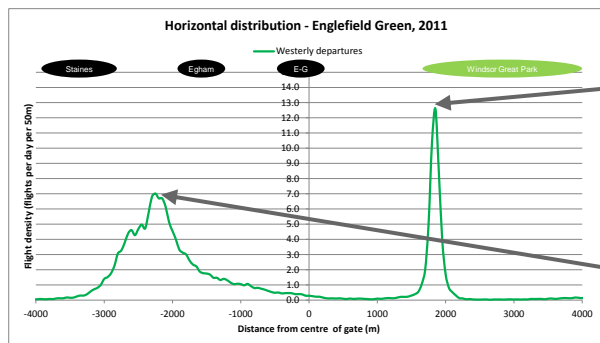
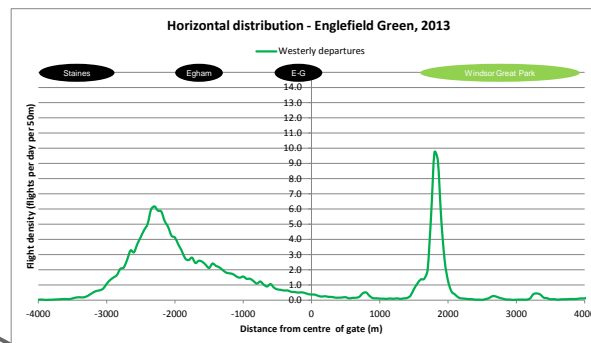
# Westerly departure scatter plots are consistent over the analysis period but show increased density at the north western end of the gate during the trials in 2014



# Lateral distributions show maximum concentration (highest peaks) in 2011 and 2014 and also the broadening of the DVR swath in 2015

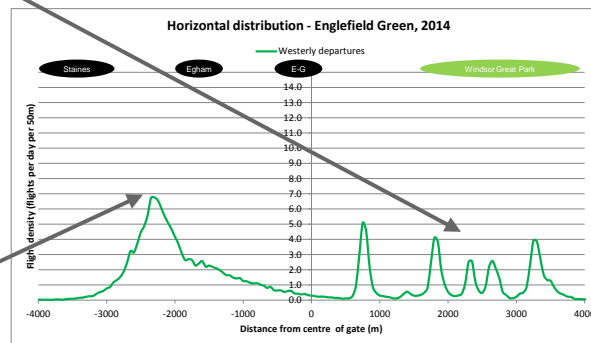


Traffic redistributed across departure trial SIDs resulting in reduction in density in the MID SID core

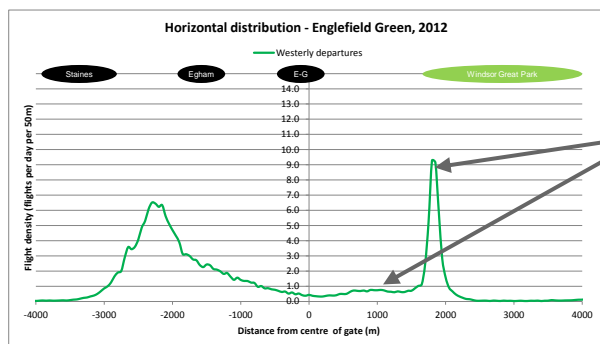


MID SID at maximum density in 2011

DVR SID at maximum density in 2011 & 2014

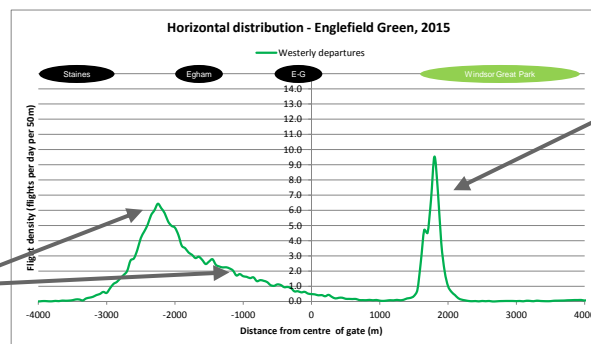


MID SID reverts to pre-trial structure and density increases compared to 2014

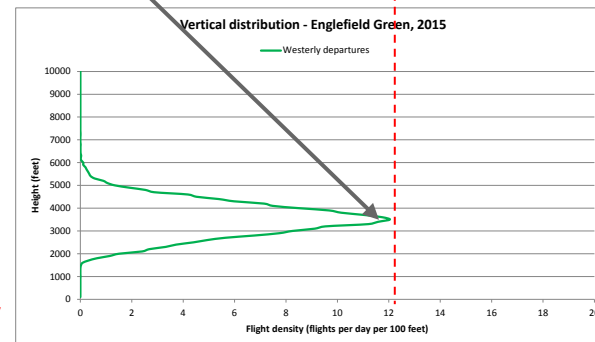
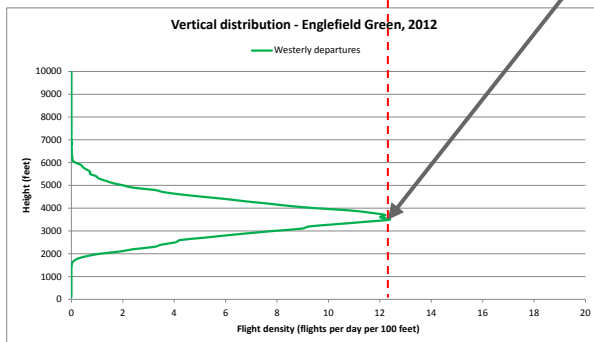
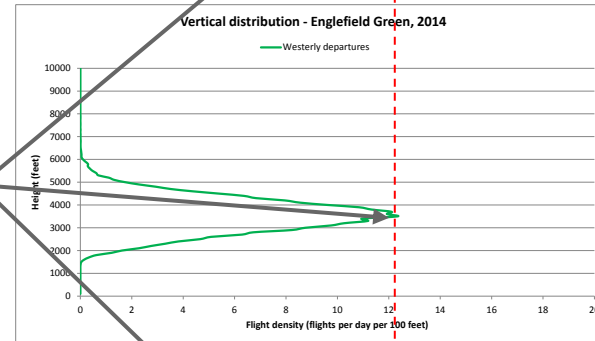
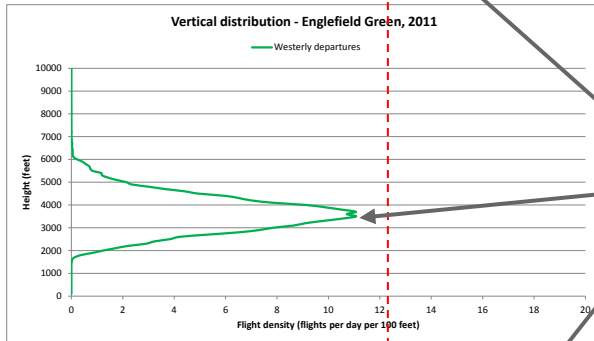
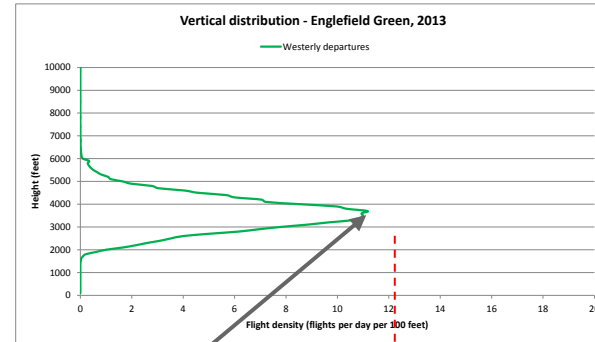
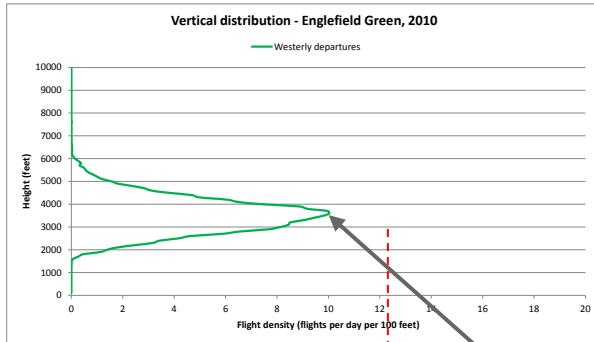


Spreading of MID SID, perhaps due to early vectoring during the Operational Freedoms trial

Increased intensity between the DVR SID peak and the centre of the gate & slightly reduced intensity at peak compared to 2014



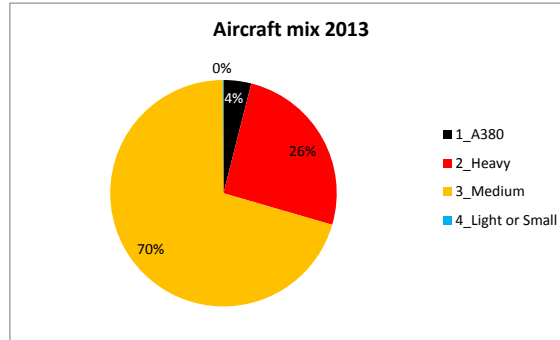
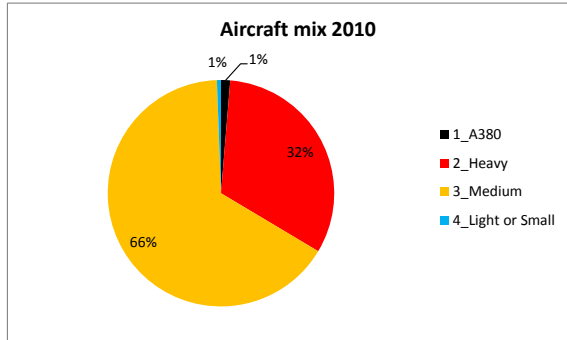
# Westerly departure traffic is concentrated at approximately 3500 feet, ranging from a minimum height of approximately 1500 feet to 6000 feet



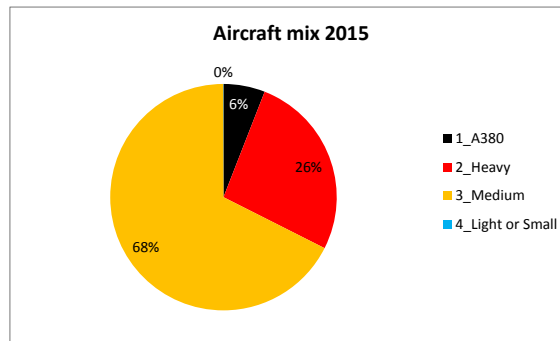
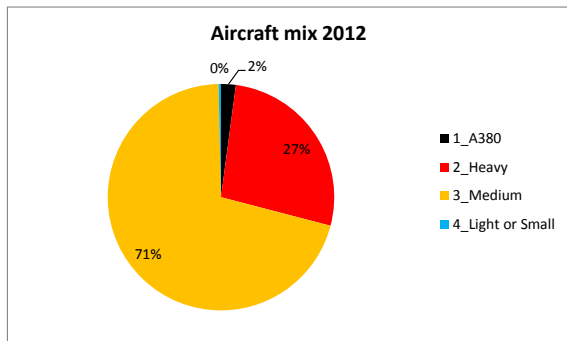
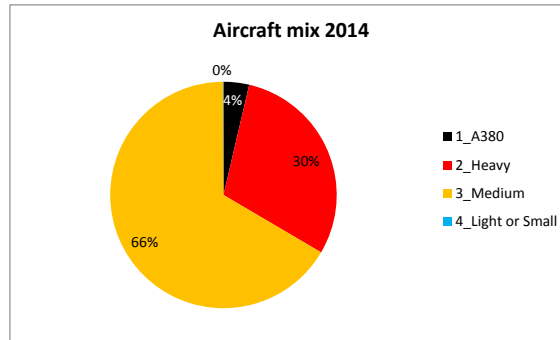
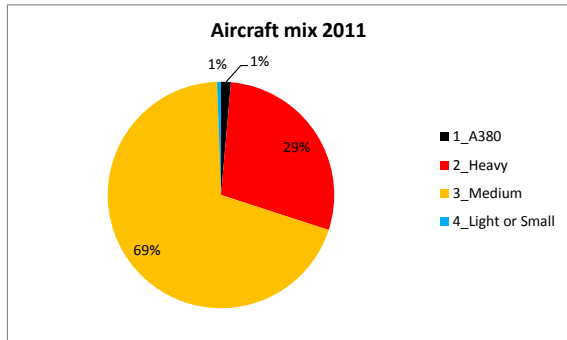
Peak in departures distribution at approximately 3500 feet

Note: Englefield Green is approximately 150 feet higher than Heathrow (the baseline for height measurement) so the actual height above the ground at the gate is approximately 150 feet less than that indicated in the charts

# The traffic mix is approximately two thirds medium aircraft and one third large aircraft with the proportion of A380s increasing

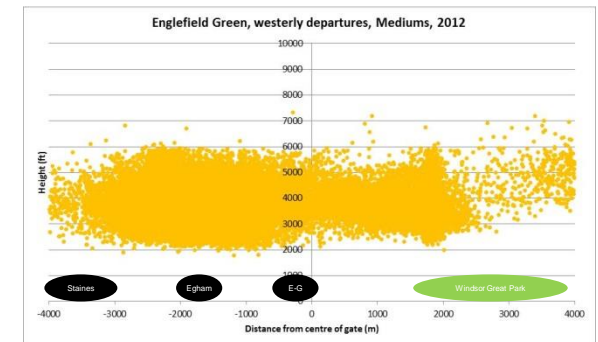
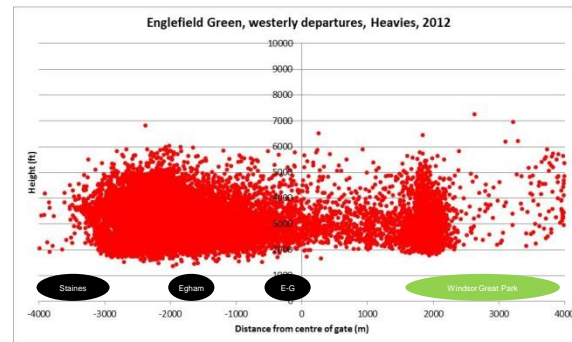
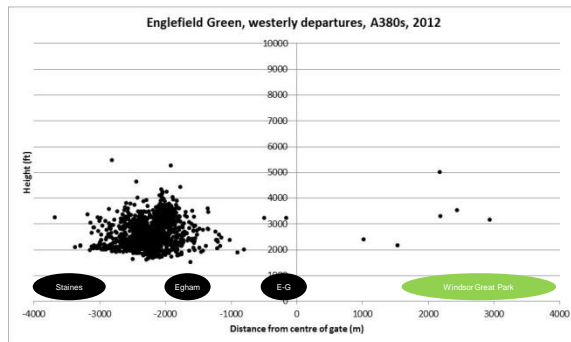
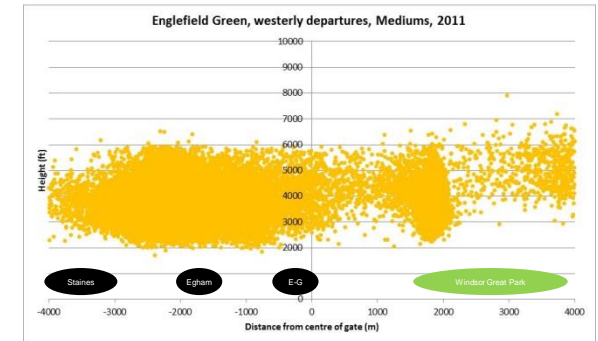
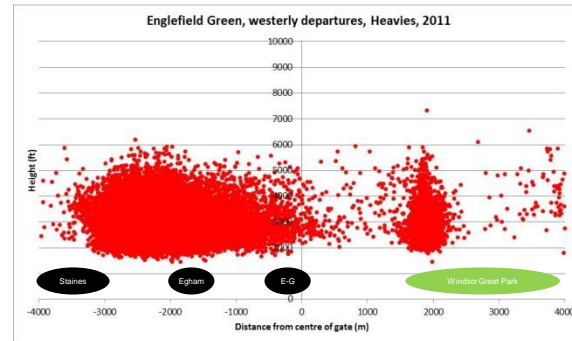
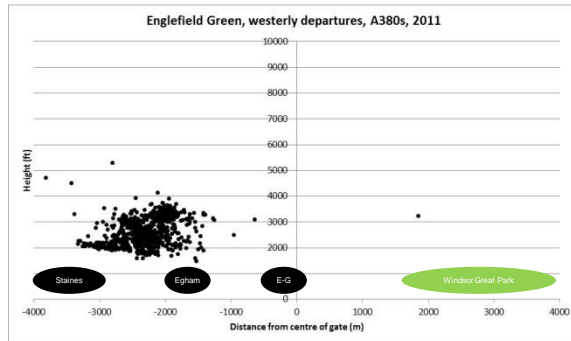
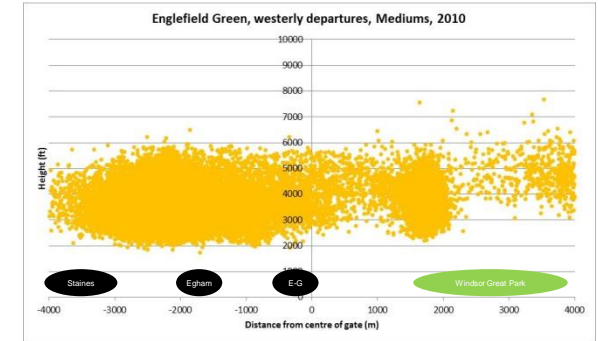
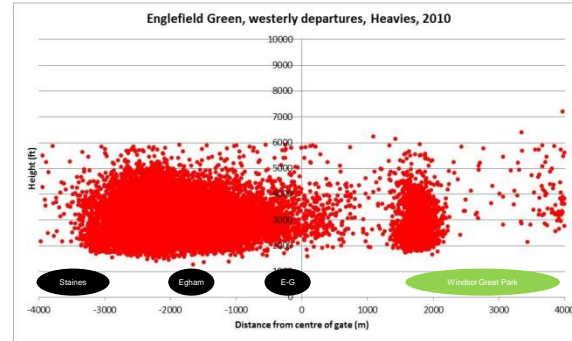
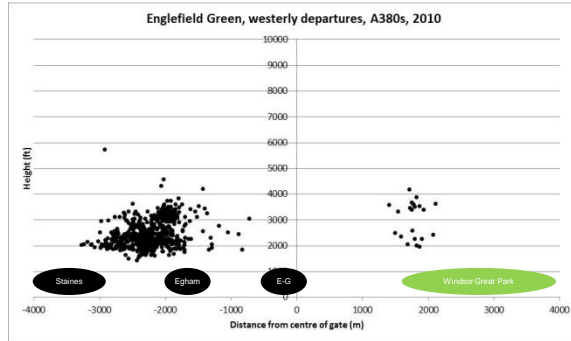


The proportion of medium aircraft in the mix has stayed approximately the same of the analysis period whereas around 5% of heavy aircraft have been replaced by A380s since 2010

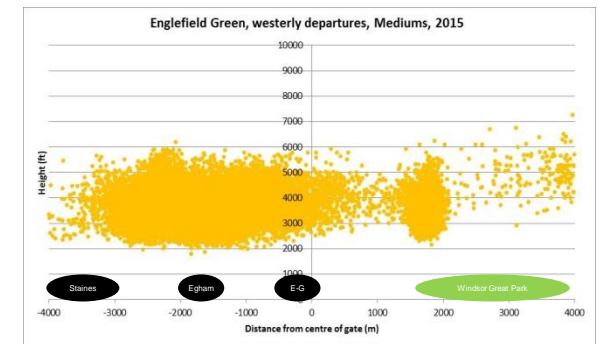
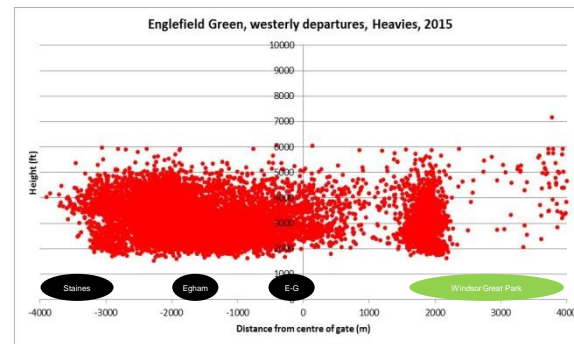
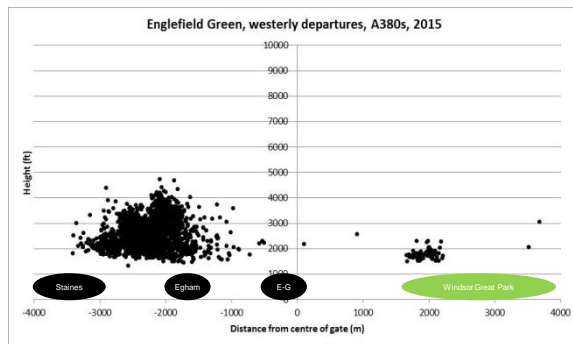
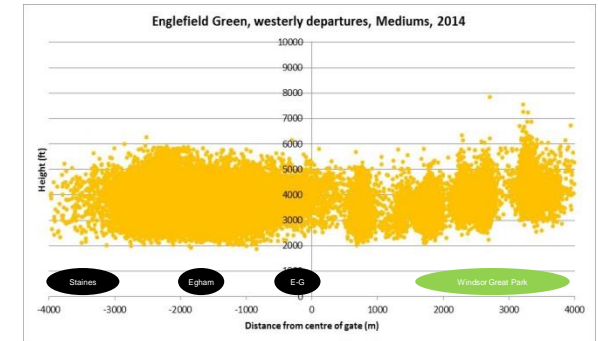
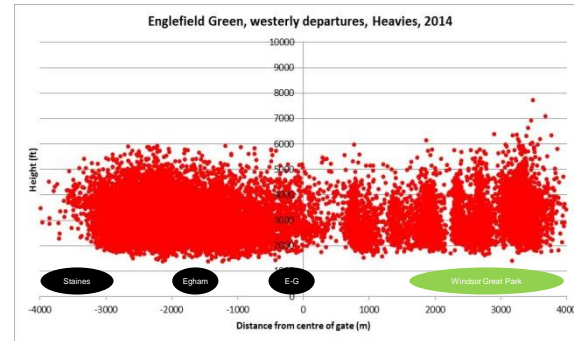
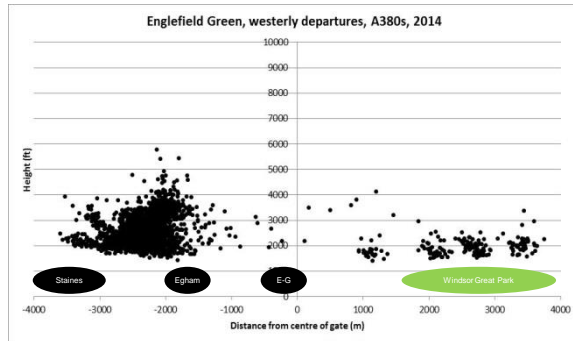
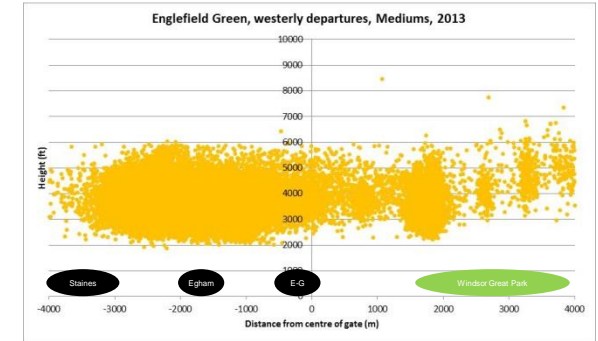
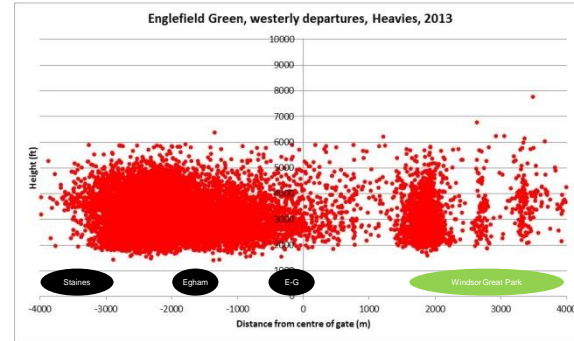
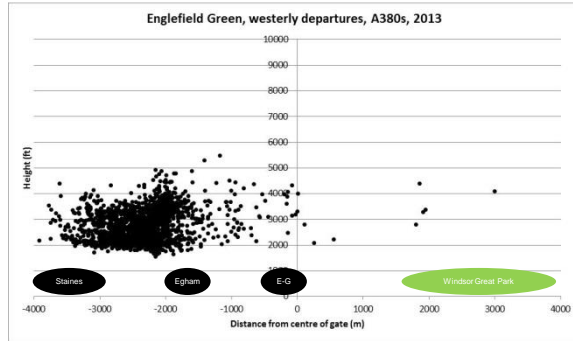




# During the period 2010 to 2012, A380s tended to be bunched at the south east end of the gate in the DVR SID and at the lower end of the height spectrum

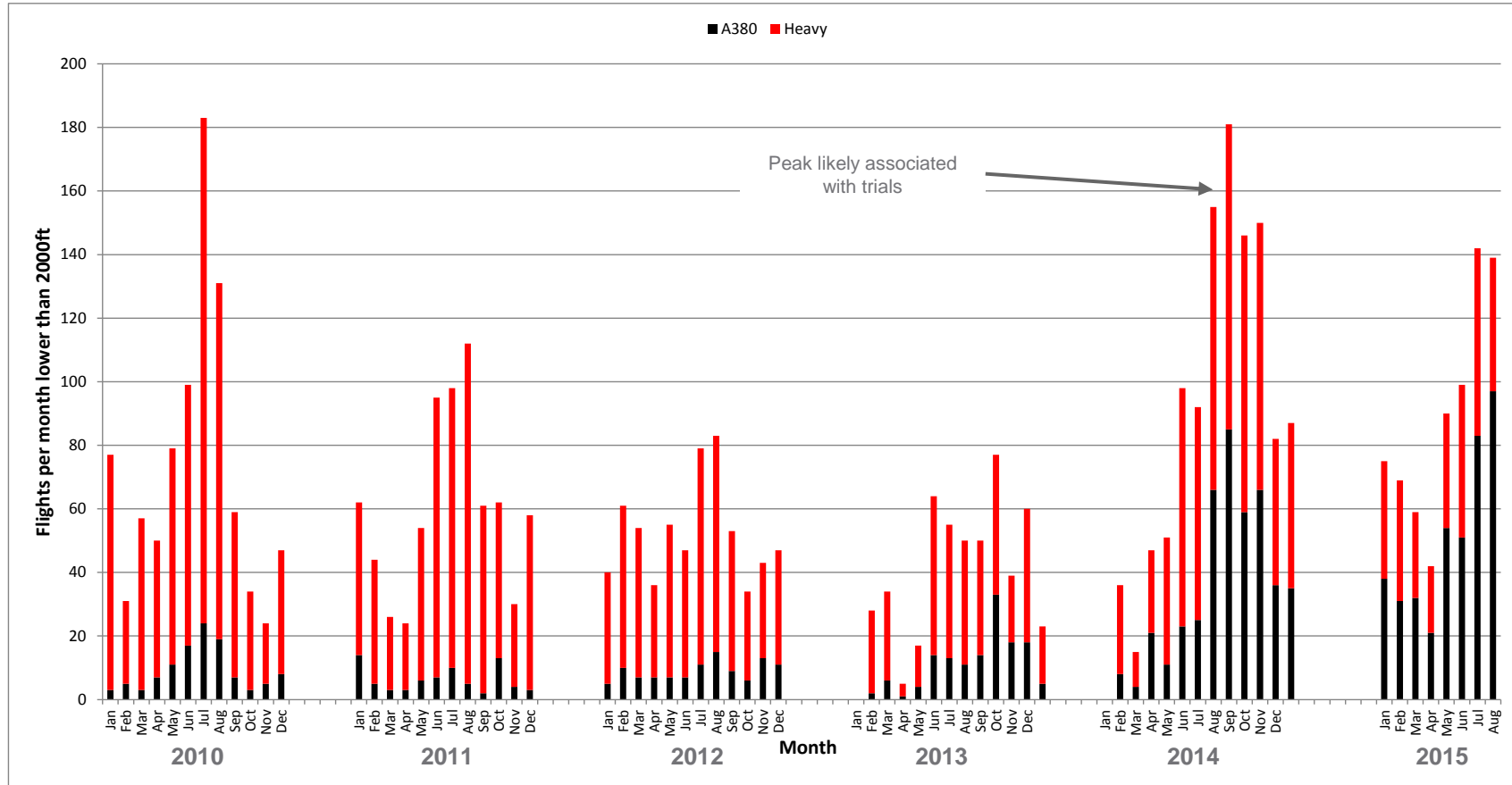


# From 2013 to 2015, A380s have also started using the MID SID but to a lesser extent than DVR: again they are generally at lower heights than other aircraft



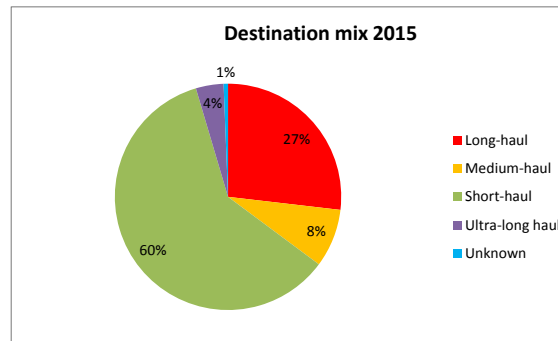
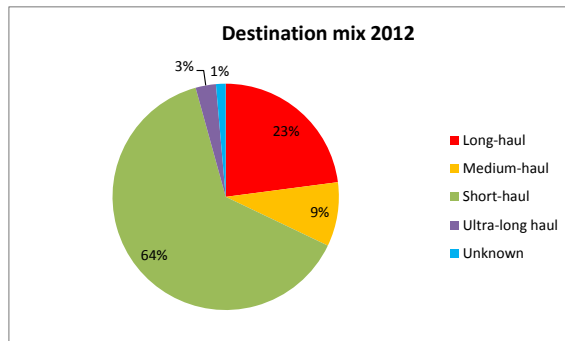
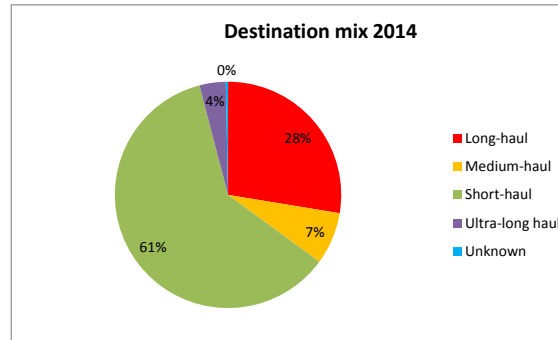
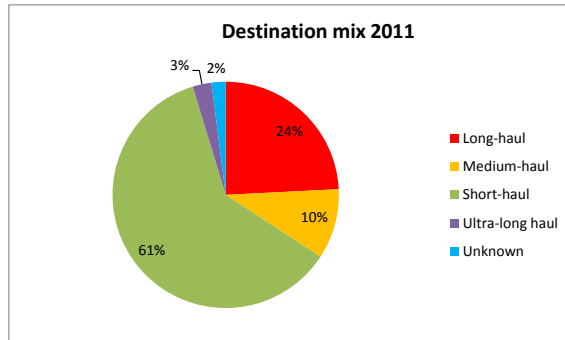
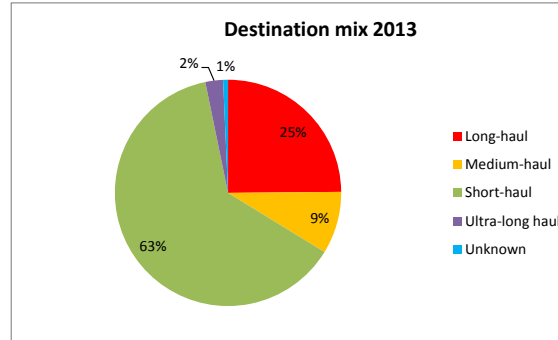
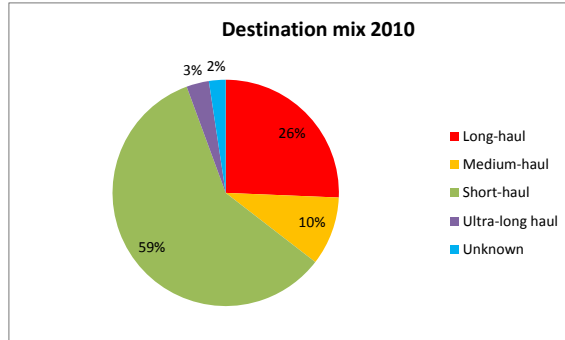
The number of large aircraft crossing the gate below 2000ft on westerlies was high in 2014 due to the trials and was nearly as high in 2015

Monthly number of large aircraft crossing the gate below 2000 feet



In line with the cyclical nature of low flying aircraft, more large cross the gate at lower hieght in summer than in winter. After a decrease in 2012 and 2013 from a peak in 2010, the number of large aircraft crossign the gate below 2000feet on westerly operations increased markedly in 2014, probably due to the increased traffic volume crossing the gate during the trial period. This level has been maintained in 2015 when there were no trials.

## The destination mix appears consistent over the analysis period, with approximately 60% short-haul and 30% ultra long-haul and long-haul flights



Short-haul destinations typically have flights times shorter than three hours

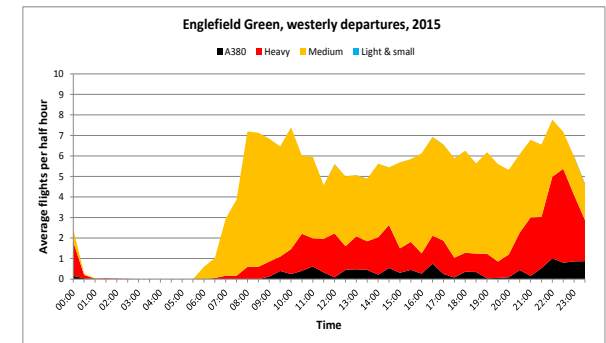
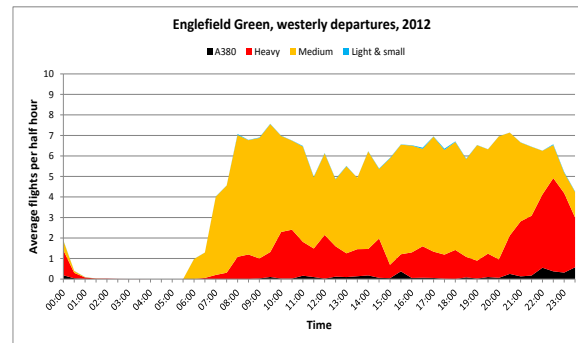
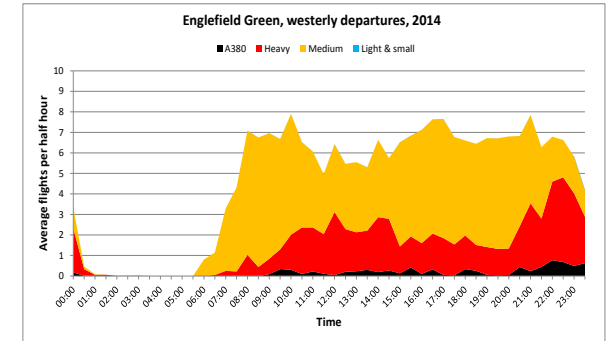
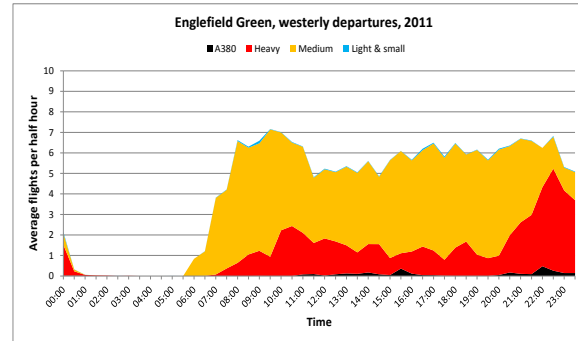
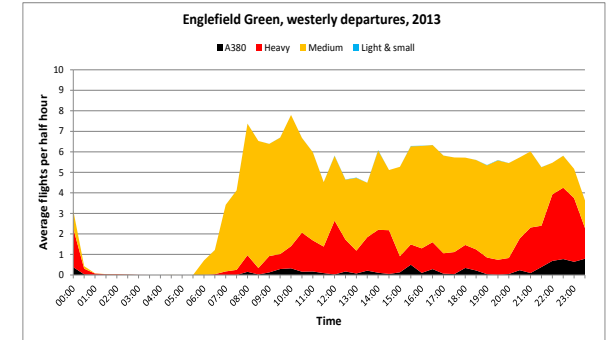
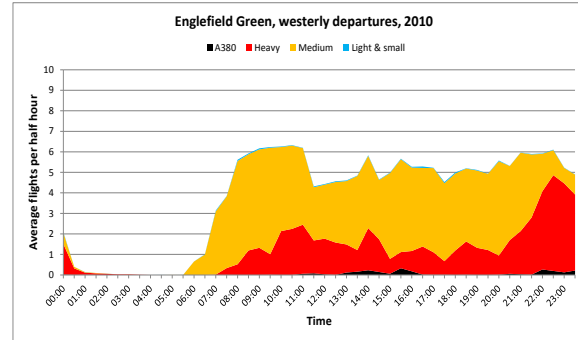
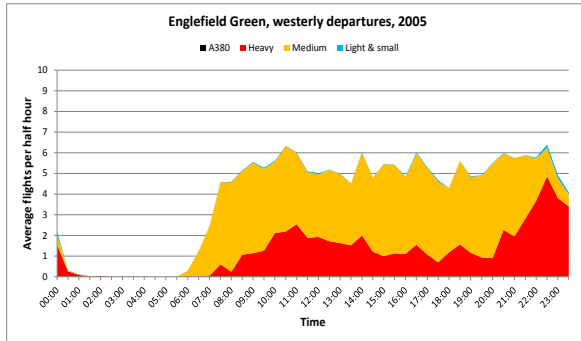
Medium-haul destinations typically have flight times between three and six hours

Long-haul destinations typically have flight times between six and nine hours

Ultra long-haul destinations typically have flight times greater than nine hours

Destinations marked as “unknown” do not have a recognised airport code associated with the flight in the data used for analysis

After a peak between 07:00 hours and 11:00 hours, the traffic profile is flat over the remainder of the day but the proportion of heavy aircraft is greatest late at night





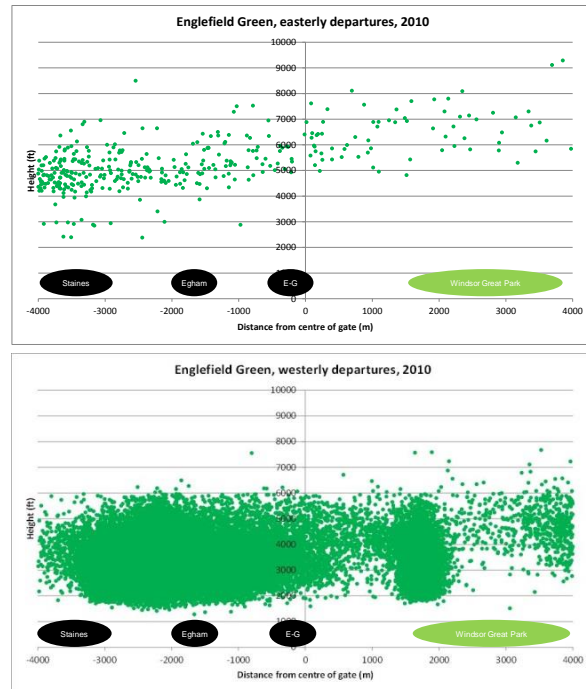
# ANNEX ANALYSIS APPROACH

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# A

# The spatial distribution of flights (the swath) is indicated on scatter plots with the flights classified by easterly or westerly operations or aircraft category

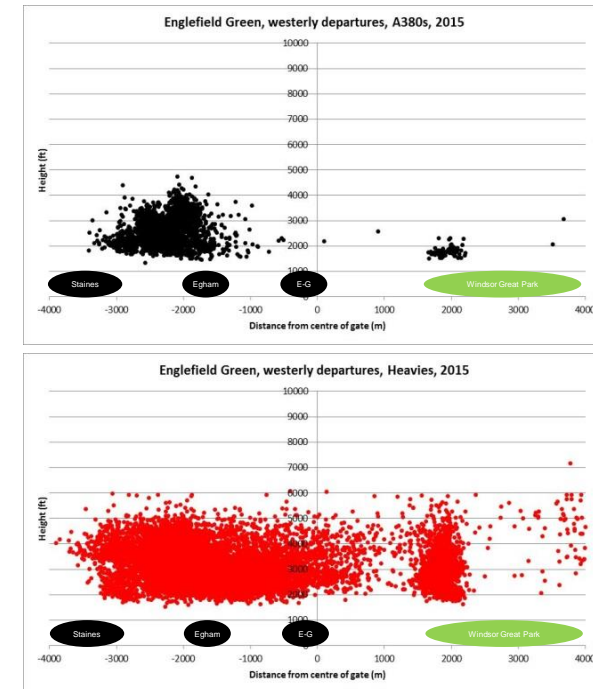
## Scatter plots for easterly & westerly operations



Each point represents the coordinates of a single flight crossing the gate during the analysis period: the horizontal axis is distance from the centre line (negative to the left, positive to the right) and the vertical axis is height above the ground

Flights are colour coded according red for arrivals and green for departures. Easterly and westerly operations are analysed separately

## Scatter plots for aircraft type

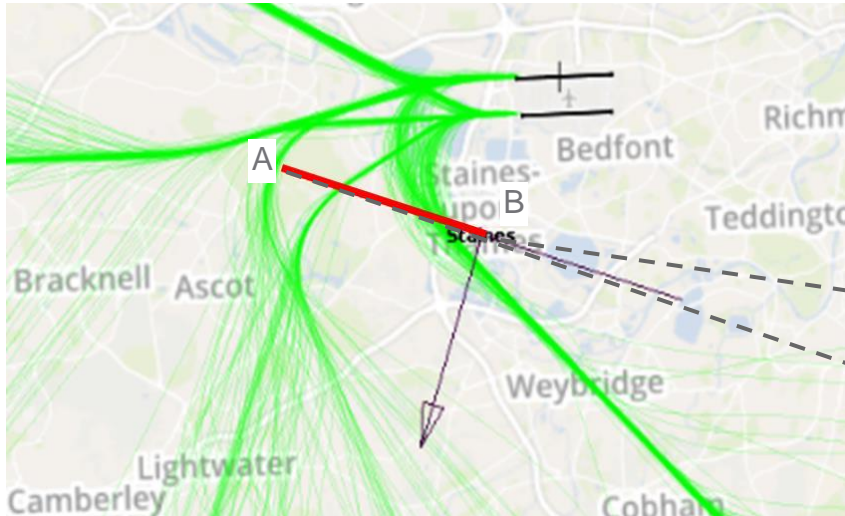


Again each point represents the coordinates of a single flight crossing the gate during the analysis period. In this case, however, all flights, east, west, arrivals and departures are shown on the same graph. Flights are colour coded gate according to the type of aircraft

- red for heavy aircraft
- gold for medium aircraft
- black for A380s

# Penetration gate analysis investigates the spatial distribution of flight paths passing through the window in space defined by the gate

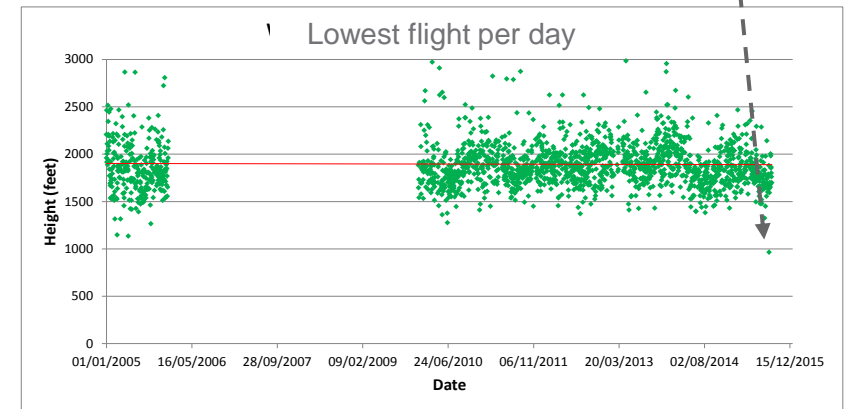
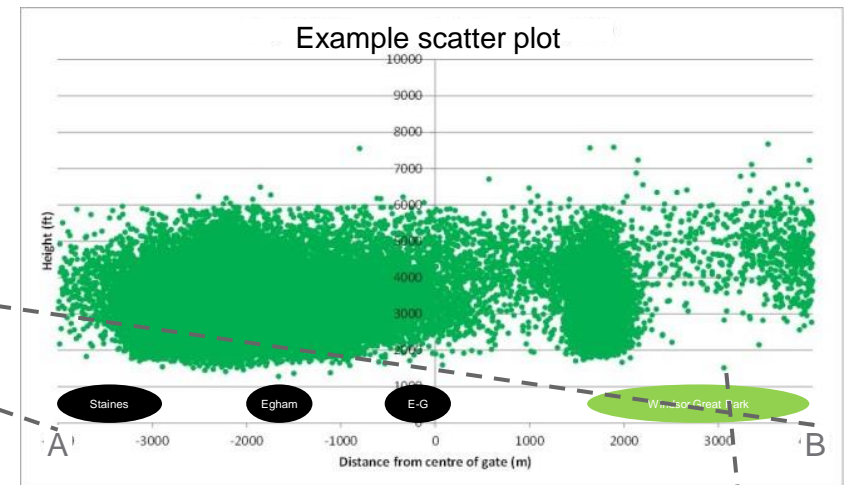
## Position of the gate relative to the associated departure flows



Each point on the upper right-hand chart represents the position of an individual flight crossing the gate. The gate distribution or flight path swath is the pattern of points where flights pierce the gate over a period of time, in this case calendar year.

The lowest flight in the swath each day has been used as a measure of variation in the height of aircraft piercing the gate during the analysis period. Each point on the lower right hand chart represents the lower limit of the swath (lowest flight) on a daily basis. The solid line is the best straight line fit as a guide to the eye of the overall trend of the lowest flight

## Spatial distribution of flight paths within the window defined by the gate





## The density or intensity of flights across the gate is calculated and displayed as a heat map

The simple scatter plots show the position of each flight passing through the gate during the analysis period

Because there are large numbers of flights crossing the gate during each analysis period, the points on the plot are superimposed and give little indication on the density or intensity of flights across the gate

Heat maps have been produced by counting the number of flights per pixel crossing the gate to give a measure of flight density across the gate

The heat maps are normalised to the number of days affected during each measurement period so that different measurement periods and different gates are directly comparable

Heat maps are divided into pixels, approximately 50m horizontally by 30m vertically

The unit of intensity is flights per day per pixel

