

Heathrow DET09 Steeper Departure Trial

Interim Trial Presentation

Trial Data: January - June 2018



Heathrow
Making every journey better

The Trial

Heathrow are trialling a steeper Standard Instrument Departure (SID) for runway 09R DET departures to understand the effect of the climb gradient on noise re-distribution as well as any operational effects on their airline customers and Air Traffic Control (ATC).

The trial SID remains based on conventional navigation with no change to the lateral track over the ground. The steeper gradient will be realised by the addition of altitude attainment points at existing DME distances.

The gradient for the trial was chosen following preliminary analysis of 10 months' radar data of heavy departures on the DET1J SID from runway 09R.

The proposed trial increases the SID gradient required **between 1000ft and 4000ft from 4% to 5%**.

From 4th January 2018, all runway 09 DET departures have been issued with the steeper SID for the duration of the trial which is running for 12 months.

Heathrow have deployed 20 NMTs in the vicinity of the SID track which will provide data for the trial analysis. The full array of 20 NMTs have been deployed and capturing data since 1st June 2017.

13,773 DET2Z Departures

138 Avg Number of Departures Per Day (during Easterly Ops)

5,393 (39.15%) Heavy Departures



2018 London Heathrow

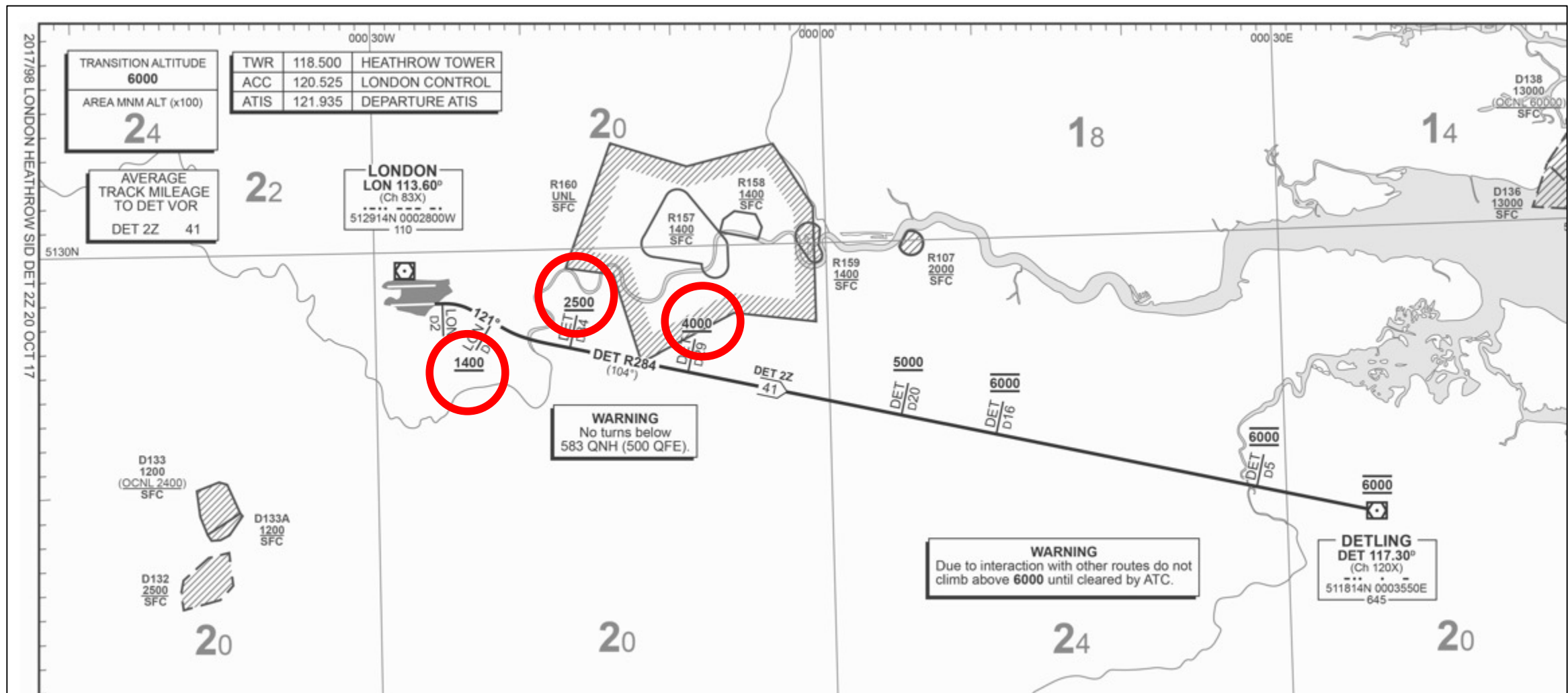
Jan – Jun 2018 compared to Jan – Jun 2017



Passengers
+5.7%



Cargo (mt)
+2.2%



- Level restriction of 1,400ft added at LON D4
- Level restriction of 2,500ft added at DET D34
- Level restriction increased from 3,000ft to 4,000ft at DET D29

Results so far...



The number of aircraft achieving 1400ft at LON D4 has **improved**



The number of aircraft achieving 2500ft at DET D34 has **improved**



The number of aircraft achieving 4000ft at DET D29 has **improved**



The number of aircraft maintaining a 5% climb rate has **improved**

...**but**, a small % of aircraft did not achieve the trial SID level restrictions and/or maintain a 5% climb rate. This is explored in the following slides

Heavy Aircraft Performance

- Airbus A340
- Boeing 767
- Airbus A380
- Boeing 777

Aircraft whose average height has improved

Aircraft whose average height has deteriorated

- Airbus A330
- Boeing 747
- Airbus A350
- Boeing 787

Airline Feedback

Airlines were notified of their individual performance during the first 6 months of the trial and asked to provide feedback as to why individual flights had failed to make a level restriction or maintain a 5% climb rate.

They were also asked to provide details of any operational changes they had made.

The following reasons were given...

Airline Feedback

- We were advised that **crews will only get an alert in the cockpit if the Flight Management System (FMS) predicts the aircraft will be more than 250ft below the level restriction.** It is understood that this tolerance is specific to a particular FMS and therefore could affect both Boeing and Airbus.
- Several commented that strong tailwinds and high temperatures have been a factor in aircraft failing to make the level restrictions.
- A greater level of thrust reduction employed by the crews owing to a short sector and light aircraft may have resulted in a failure.
- During May an airline reported that they had changed their take off flap settings to a different configuration to try and enable a better climb performance. Analysis of radar data from May 2018 – September 2018 has shown a slight improvement in their climb performance.

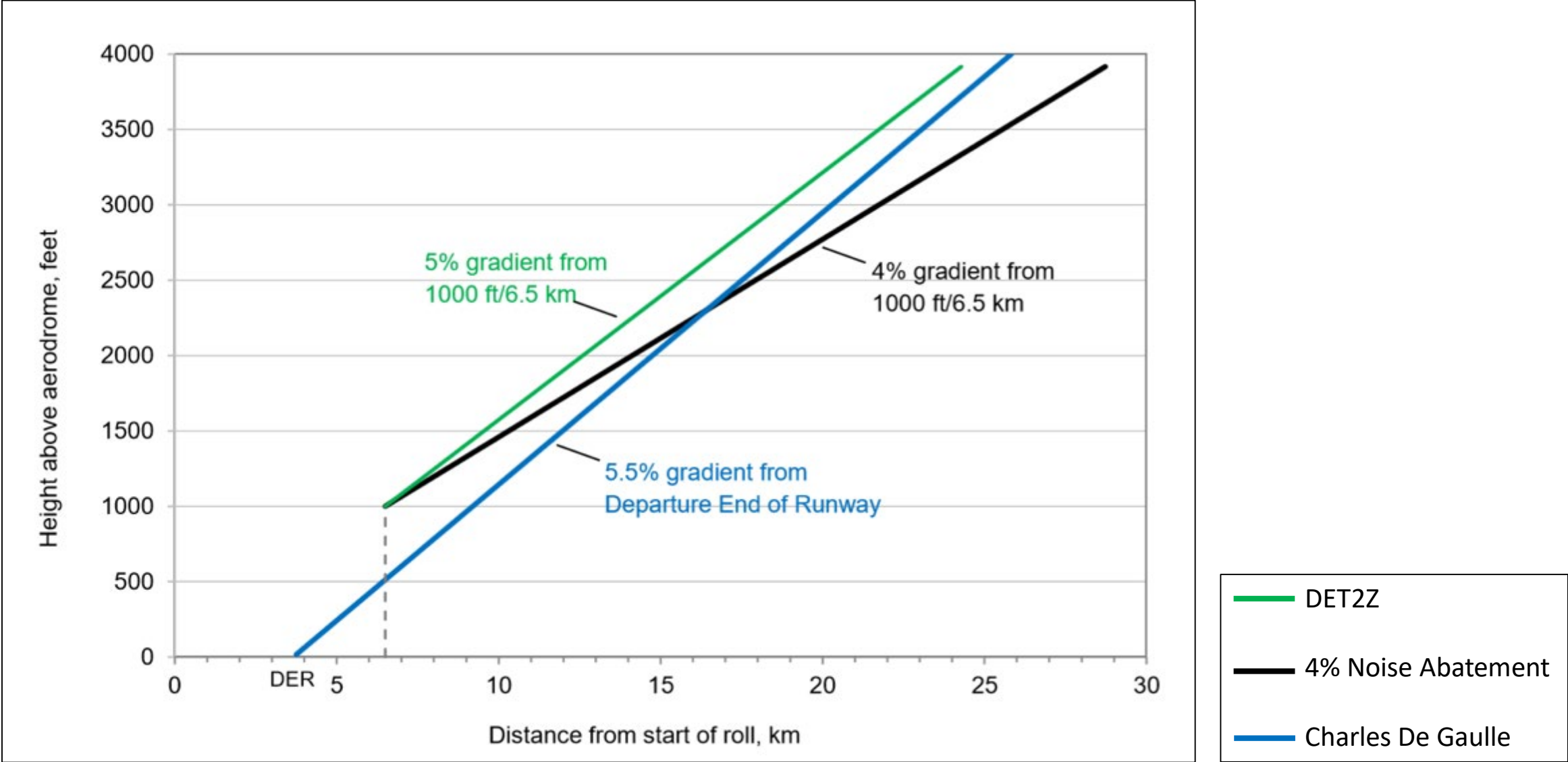
Community Feedback

Local community groups have questioned why the minimum climb gradient at Heathrow is limited to 4% whereas other international airports specify steeper climb gradients.

Paris Charles de Gaulle has a climb gradient of 5.5%. This is measured from 5m above the Departure End of the Runway (DER) whereas London Heathrow's noise abatement requirement of 4% is measured from 1000ft at 6.5KM from Start of Roll.

If measured the same way, the climb gradient for the DET2Z SID would be 8.83% until LON D4, 6.55% to DET D34 and 5.82% until DET D29.

Comparison of the Different Methods of Measuring a Climb Gradient



Noise Analysis

As expected, average noise is very slightly **reduced** beneath the flight path with some small average **increases** observed to the sides.

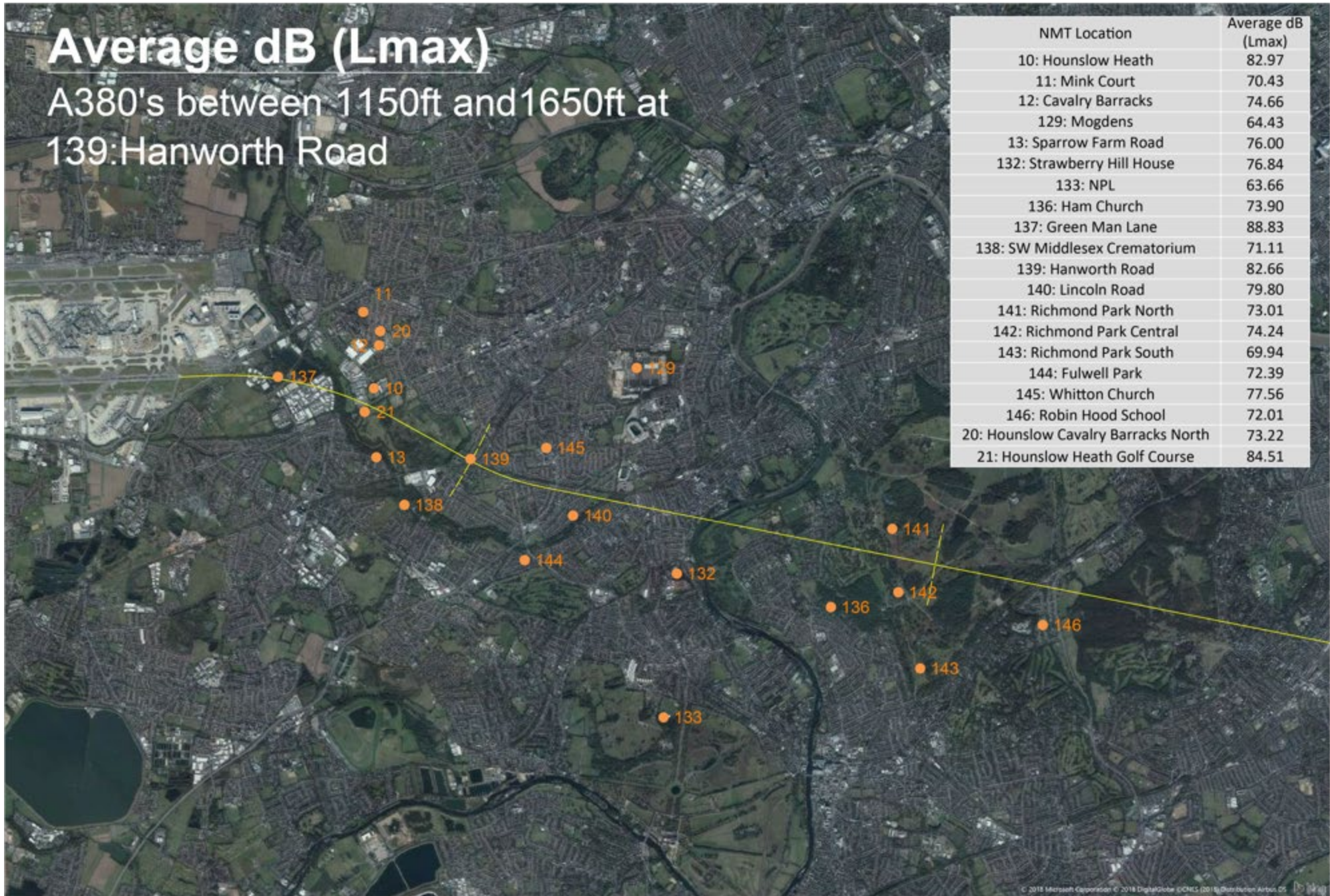
The results are less defined when the flight paths diverge.

The following slides demonstrate the effect the aircraft's altitude has on the distribution of noise across all A380 departures

Average dB (Lmax)

A380's between 1150ft and 1650ft at
139: Hanworth Road

NMT Location	Average dB (Lmax)
10: Hounslow Heath	82.97
11: Mink Court	70.43
12: Cavalry Barracks	74.66
129: Mogdens	64.43
13: Sparrow Farm Road	76.00
132: Strawberry Hill House	76.84
133: NPL	63.66
136: Ham Church	73.90
137: Green Man Lane	88.83
138: SW Middlesex Crematorium	71.11
139: Hanworth Road	82.66
140: Lincoln Road	79.80
141: Richmond Park North	73.01
142: Richmond Park Central	74.24
143: Richmond Park South	69.94
144: Fulwell Park	72.39
145: Whitton Church	77.56
146: Robin Hood School	72.01
20: Hounslow Cavalry Barracks North	73.22
21: Hounslow Heath Golf Course	84.51



Difference dB (Lmax)

A380's between 1650ft and 2150ft at
139:Hanworth Road

Difference dB (Lmax)	
Dark Green	-3 to -2.4
Medium Green	-2.4 to -1.8
Light Green	-1.8 to -1.2
Very Light Green	-1.2 to -0.6
White	-0.6 to 0
Light Pink	0 to 0.6
Medium Pink	0.6 to 1.2
Dark Pink	1.2 to 1.8
Red	1.8 to 2.4
Dark Red	2.4 to 3

Compared to
previous slide

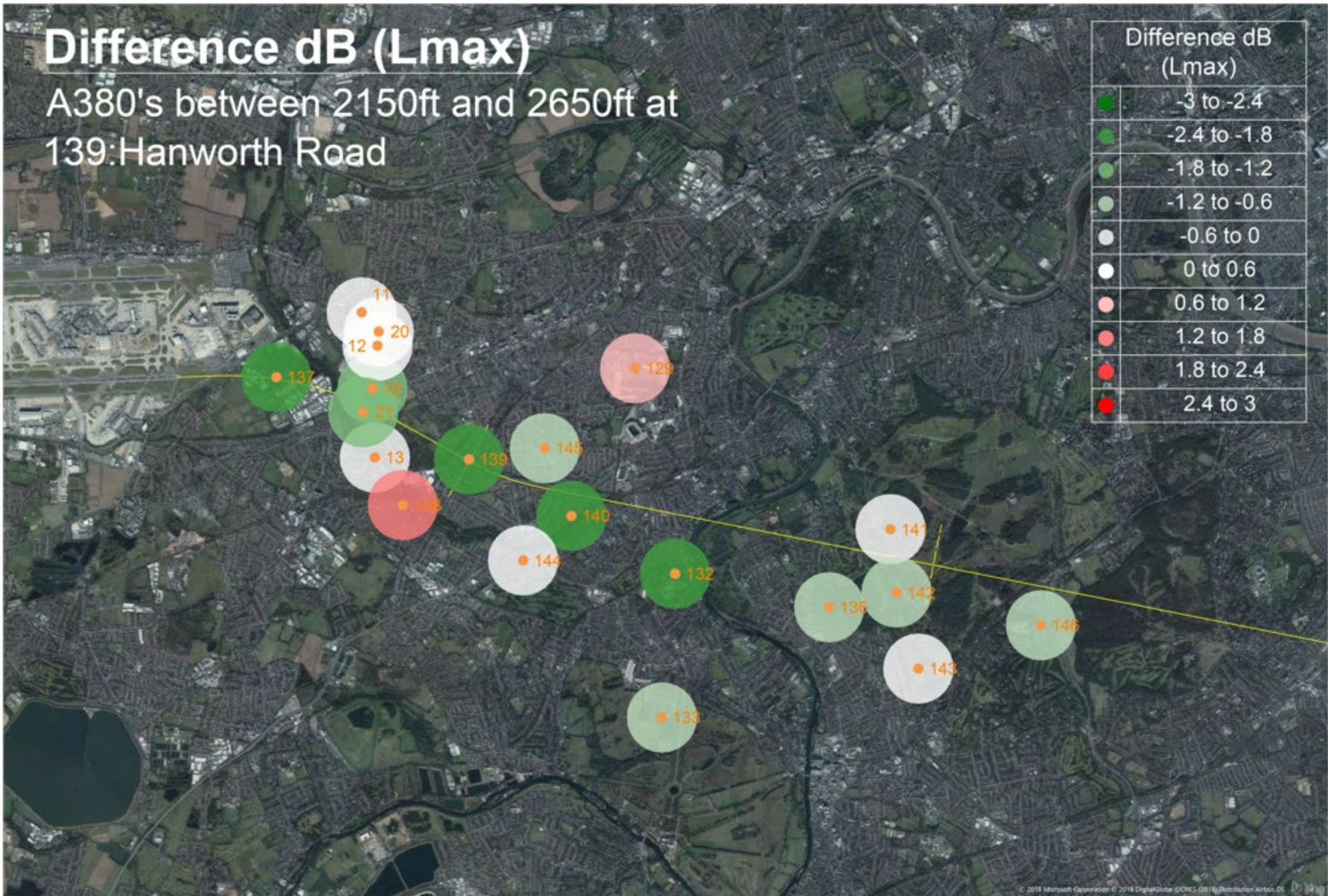


Difference dB (Lmax)

A380's between 2150ft and 2650ft at
139:Hanworth Road

Difference dB (Lmax)	
Dark Green	-3 to -2.4
Medium Green	-2.4 to -1.8
Light Green	-1.8 to -1.2
Very Light Green	-1.2 to -0.6
White	-0.6 to 0
Light Pink	0 to 0.6
Medium Pink	0.6 to 1.2
Dark Pink	1.2 to 1.8
Red	1.8 to 2.4
Dark Red	2.4 to 3

Compared to
previous slide

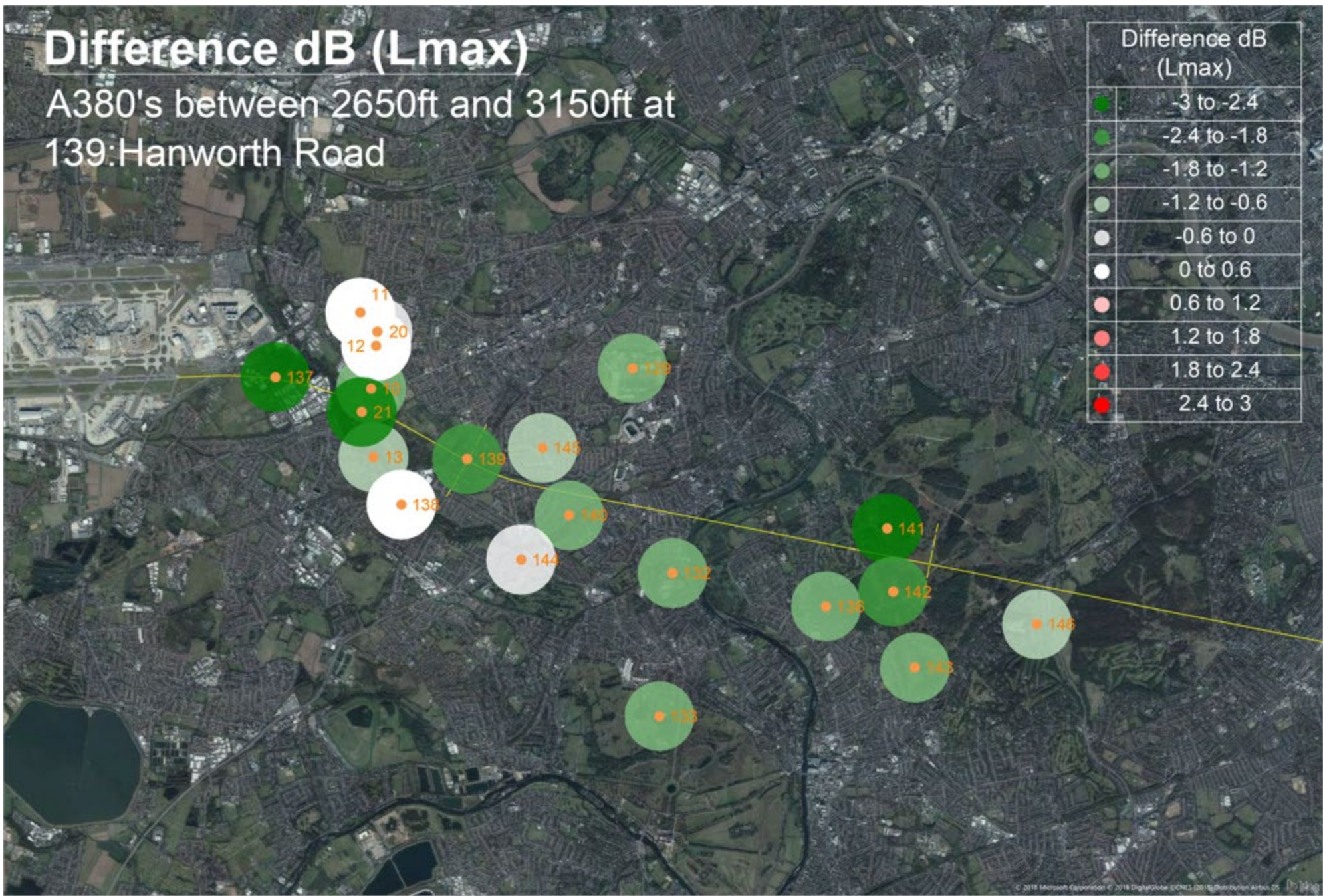


Difference dB (Lmax)

A380's between 2650ft and 3150ft at
139:Hanworth Road

Difference dB (Lmax)	
Dark Green	-3 to -2.4
Medium Green	-2.4 to -1.8
Light Green	-1.8 to -1.2
Very Light Green	-1.2 to -0.6
White	-0.6 to 0
Light Pink	0 to 0.6
Light Red	0.6 to 1.2
Red	1.2 to 1.8
Dark Red	1.8 to 2.4
Very Dark Red	2.4 to 3

Compared to
previous slide

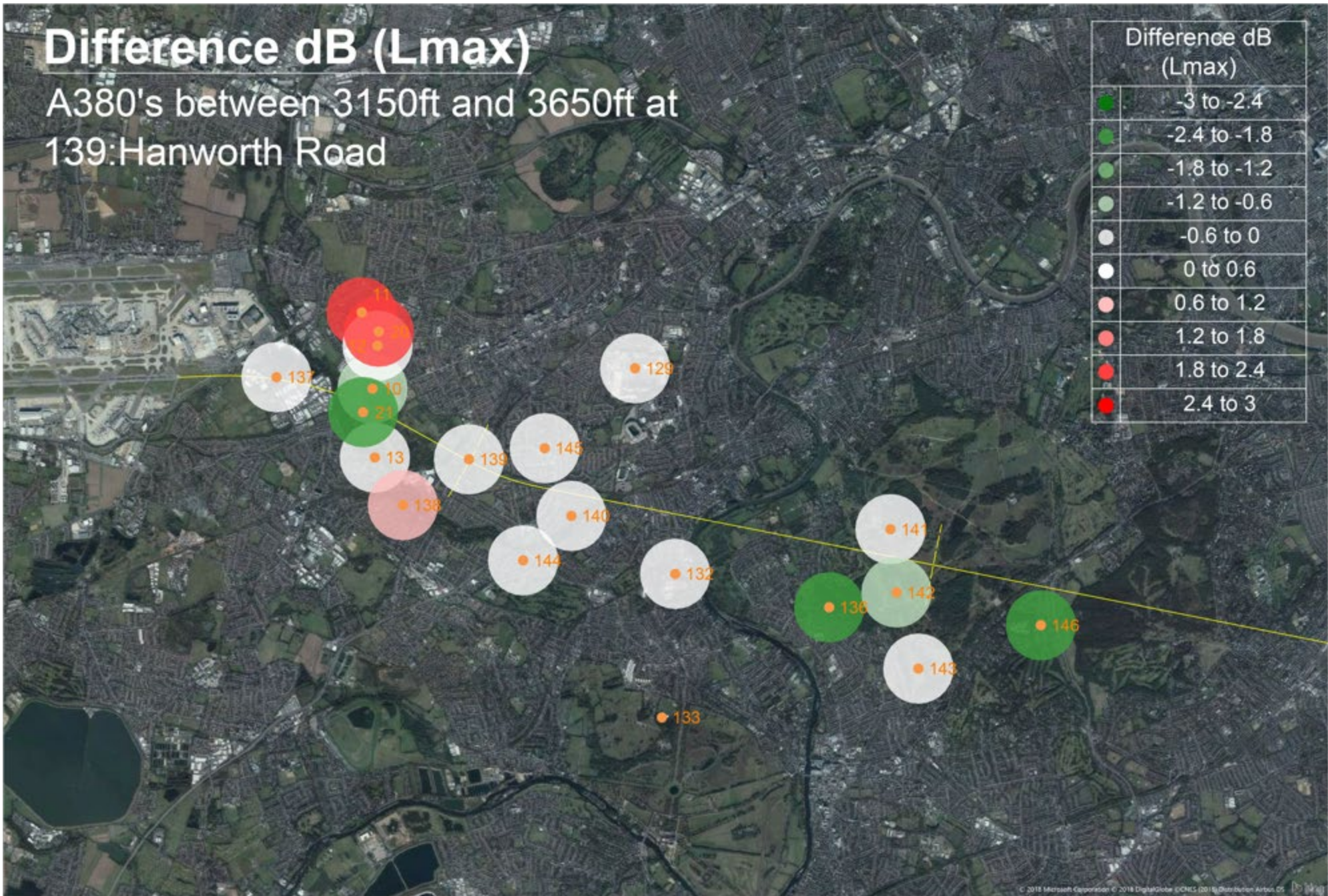


Difference dB (Lmax)

A380's between 3150ft and 3650ft at
139:Hanworth Road

Difference dB (Lmax)	
Dark Green	-3 to -2.4
Medium Green	-2.4 to -1.8
Light Green	-1.8 to -1.2
White	-1.2 to -0.6
White	-0.6 to 0
White	0 to 0.6
Light Pink	0.6 to 1.2
Red	1.2 to 1.8
Red	1.8 to 2.4
Dark Red	2.4 to 3

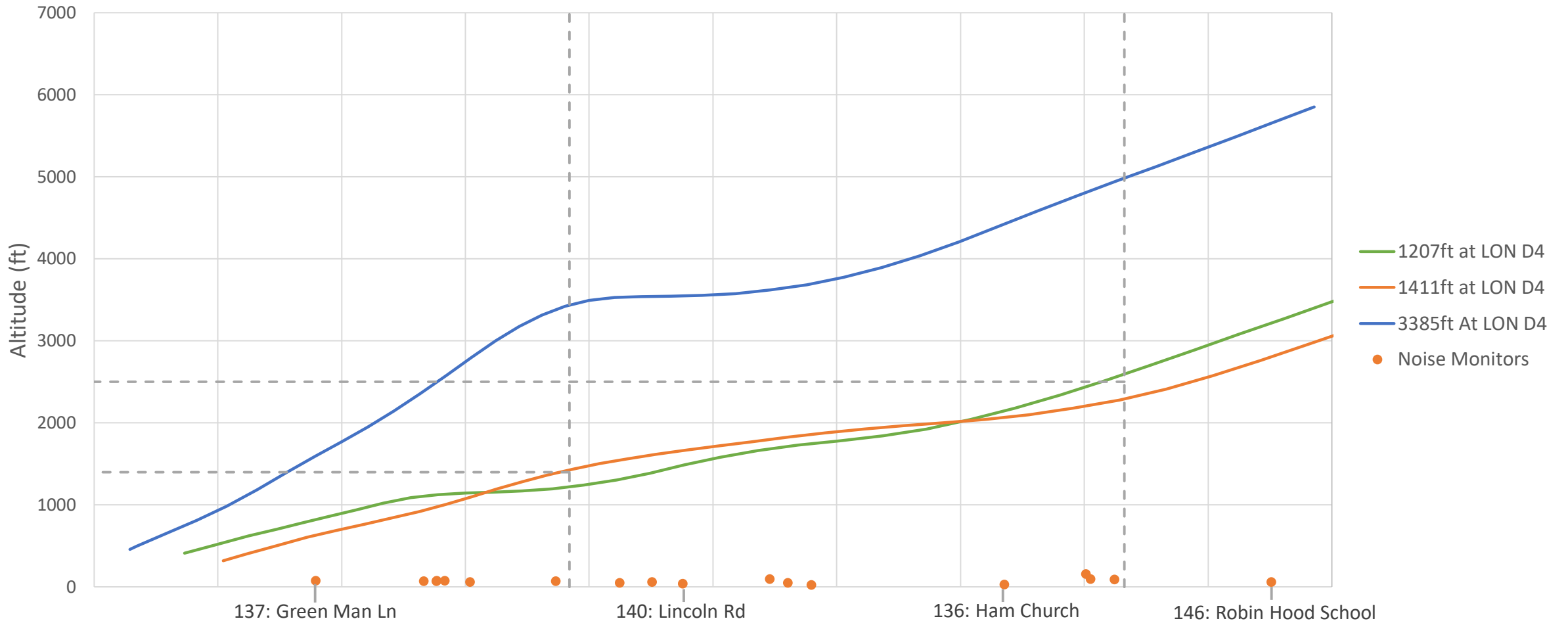
Compared to
previous slide



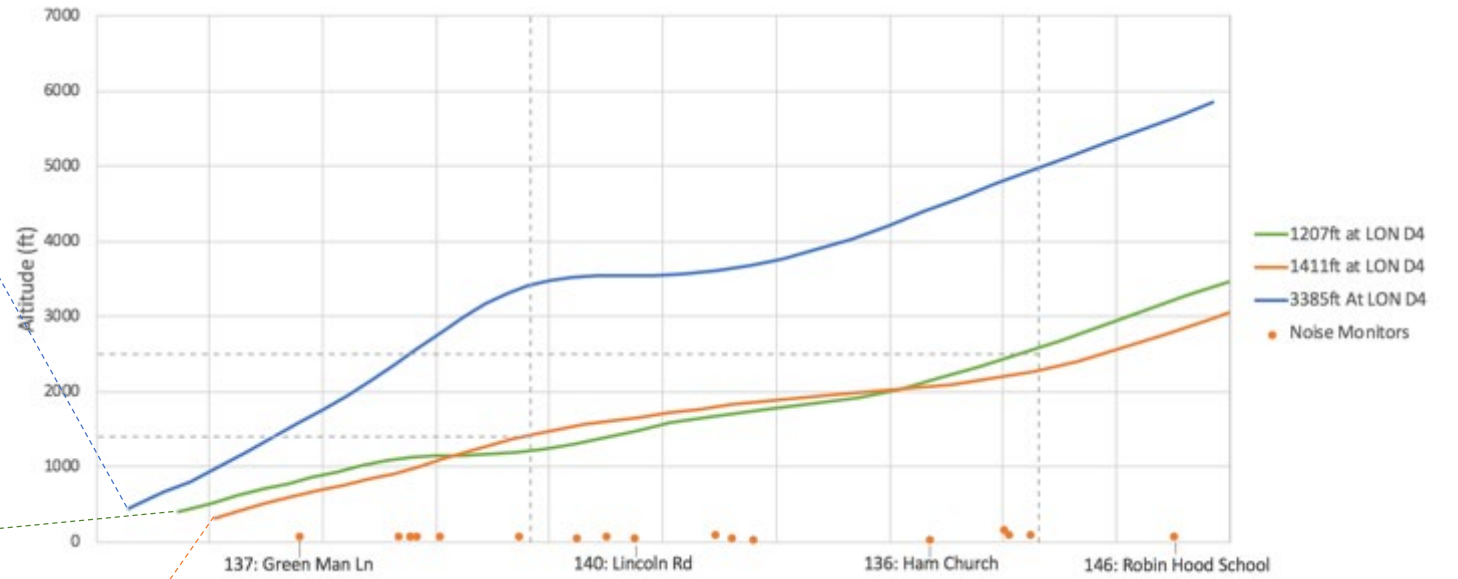
A380 Basic comparison

The following slides show the noise distribution for three A380 flights to Dubai. The first flight was below the 1400ft level restriction at LON D4. The second was approximately at the level restriction and the third flight was well above it.

Vertical Profile of Three Example Flights
Aircraft Type: A380
Destination: Dubai



Runway Take-off Point Comparison



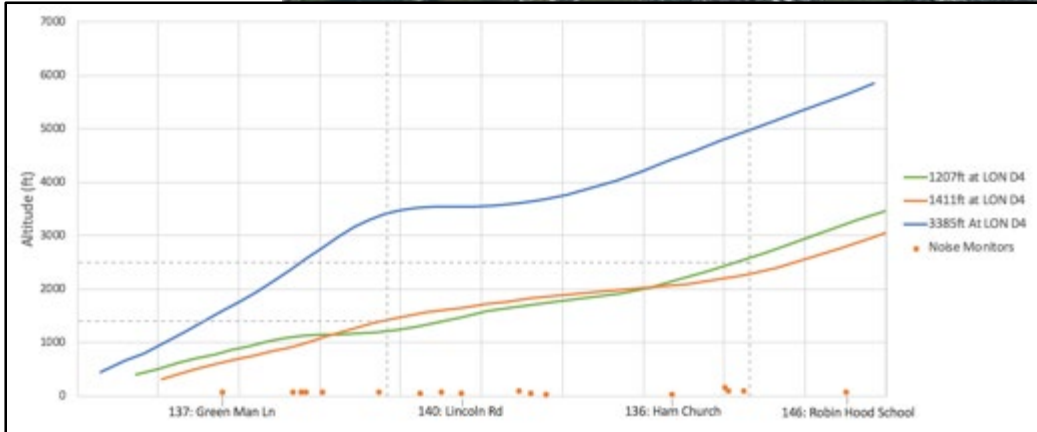
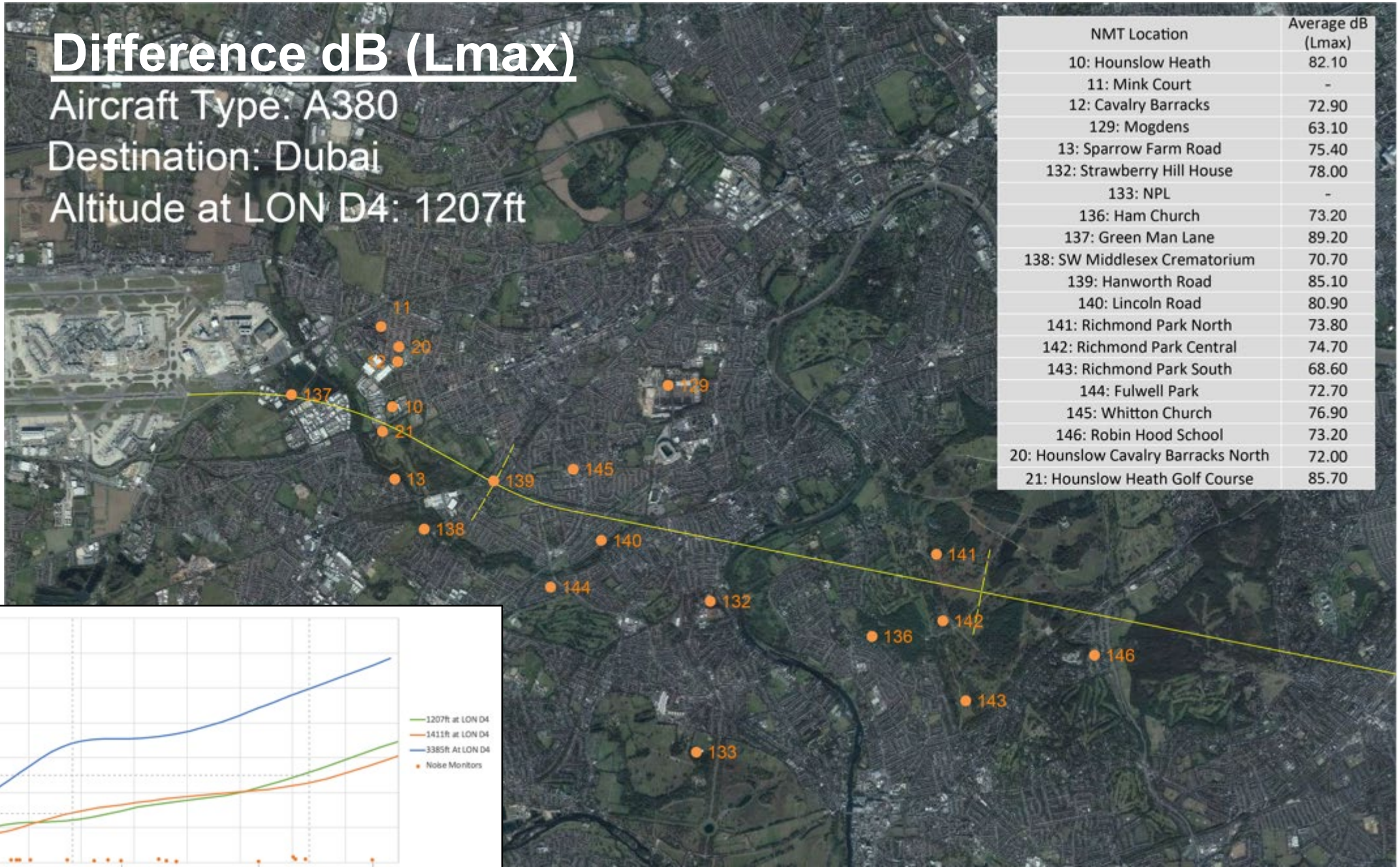
Difference dB (Lmax)

Aircraft Type: A380

Destination: Dubai

Altitude at LON D4: 1207ft

NMT Location	Average dB (Lmax)
10: Hounslow Heath	82.10
11: Mink Court	-
12: Cavalry Barracks	72.90
129: Mogdens	63.10
13: Sparrow Farm Road	75.40
132: Strawberry Hill House	78.00
133: NPL	-
136: Ham Church	73.20
137: Green Man Lane	89.20
138: SW Middlesex Crematorium	70.70
139: Hanworth Road	85.10
140: Lincoln Road	80.90
141: Richmond Park North	73.80
142: Richmond Park Central	74.70
143: Richmond Park South	68.60
144: Fulwell Park	72.70
145: Whitton Church	76.90
146: Robin Hood School	73.20
20: Hounslow Cavalry Barracks North	72.00
21: Hounslow Heath Golf Course	85.70



Compared to previous slide

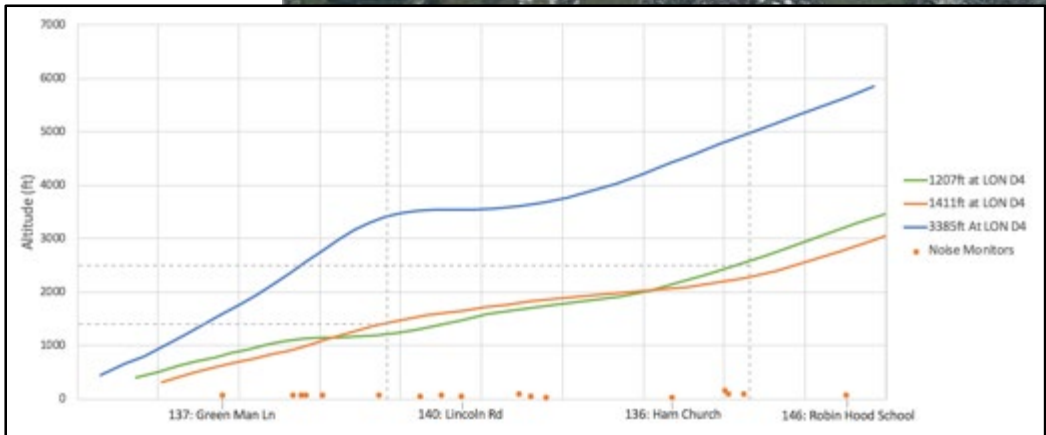
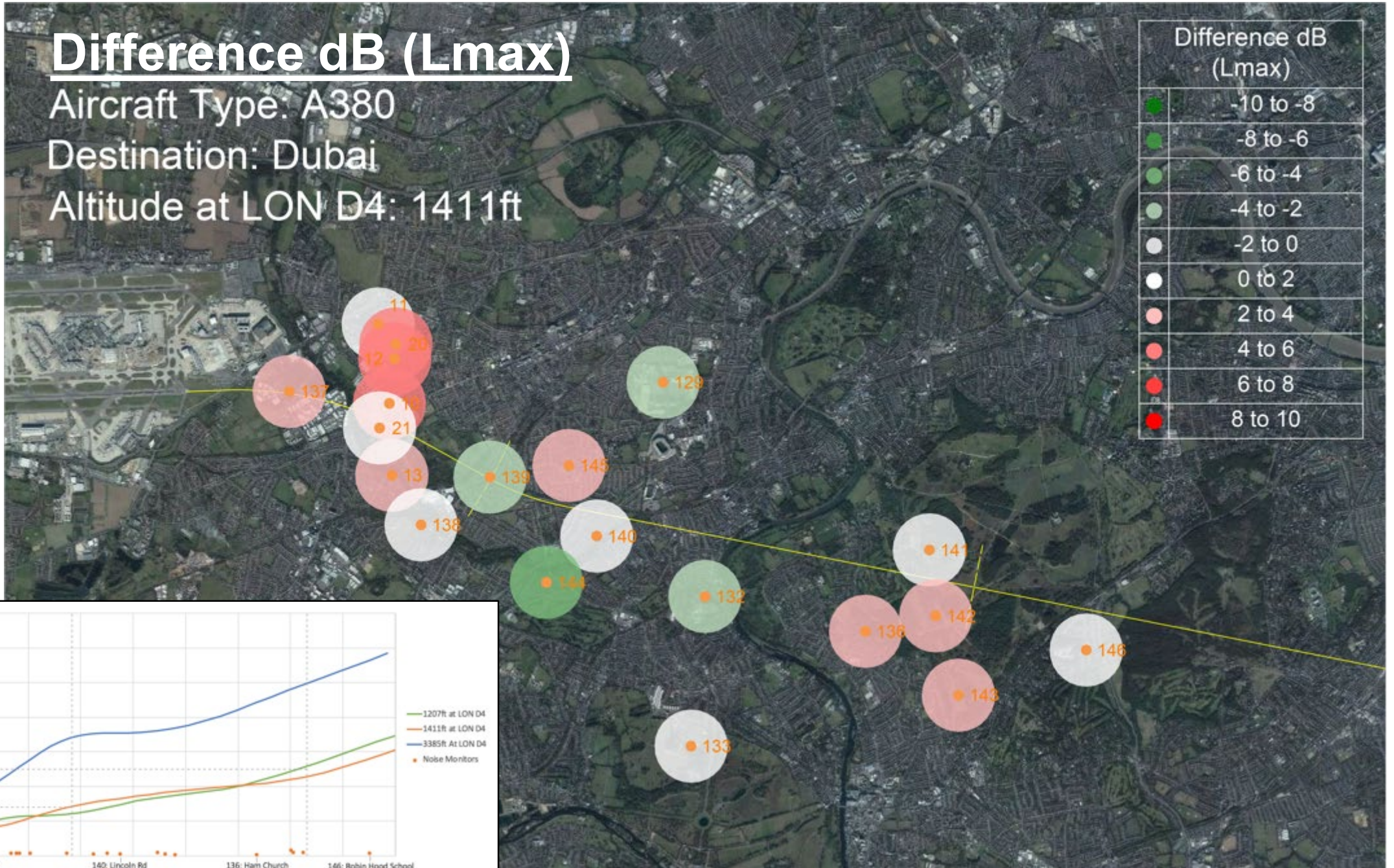
Difference dB (Lmax)

Aircraft Type: A380

Destination: Dubai

Altitude at LON D4: 1411ft

Difference dB (Lmax)	
Dark Green	-10 to -8
Green	-8 to -6
Light Green	-6 to -4
White	-4 to -2
White	-2 to 0
White	0 to 2
Light Pink	2 to 4
Pink	4 to 6
Red	6 to 8
Dark Red	8 to 10



Compared to previous slide

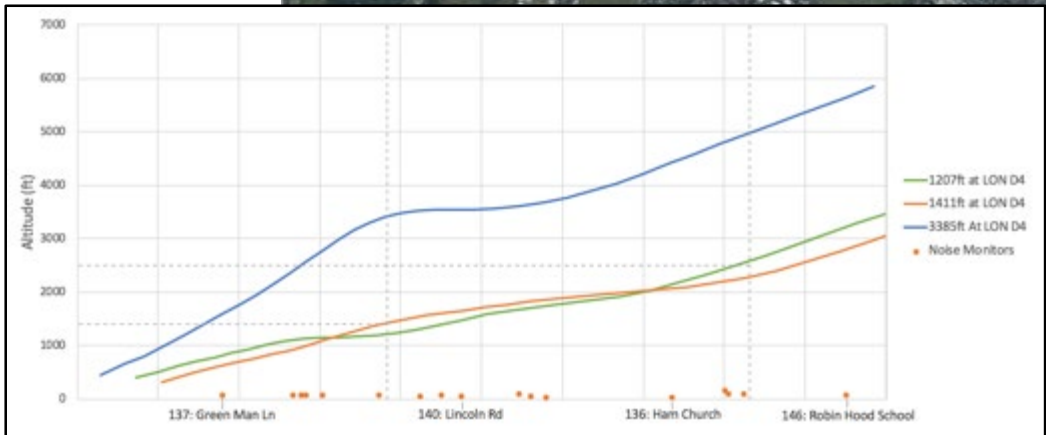
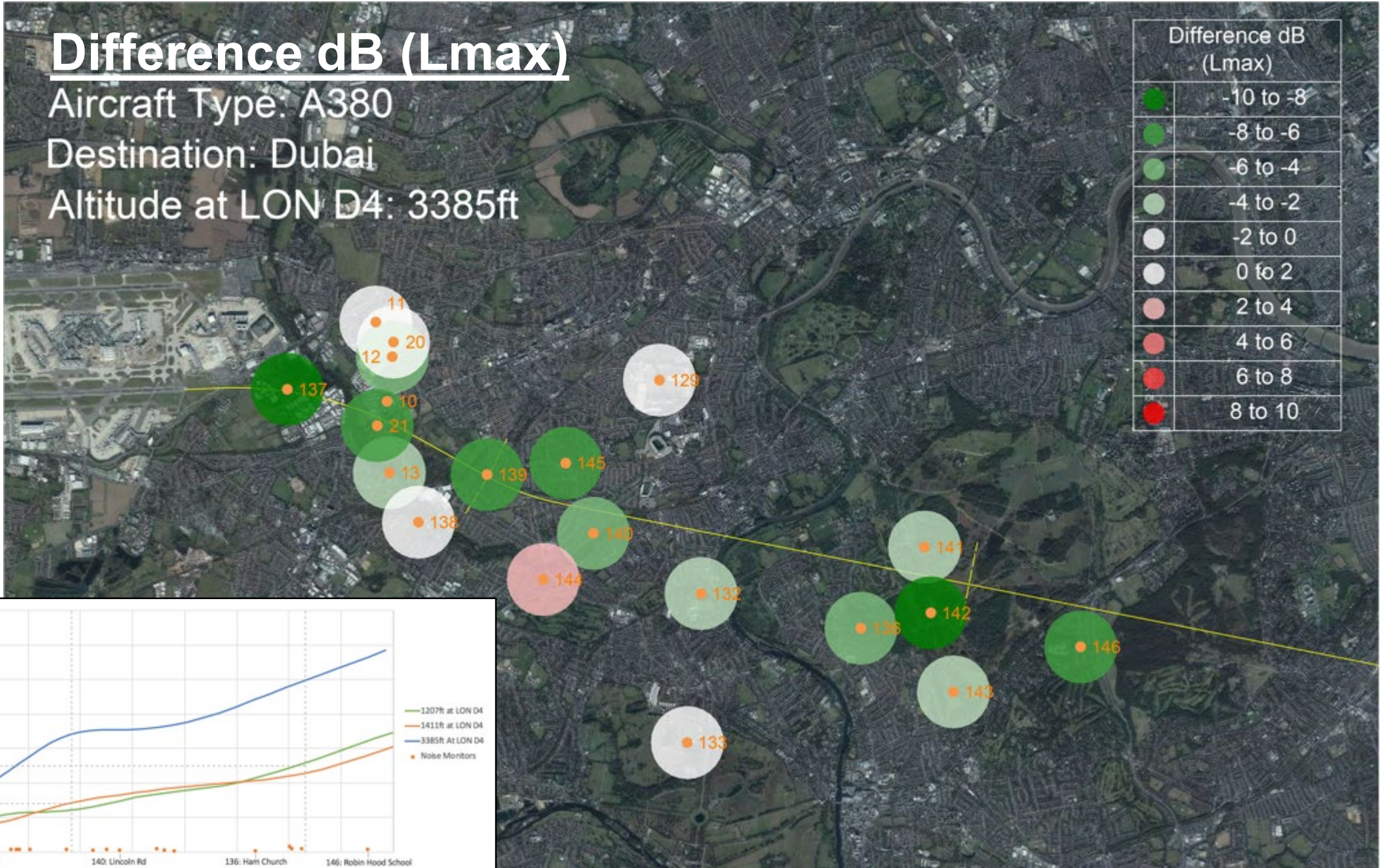
Difference dB (Lmax)

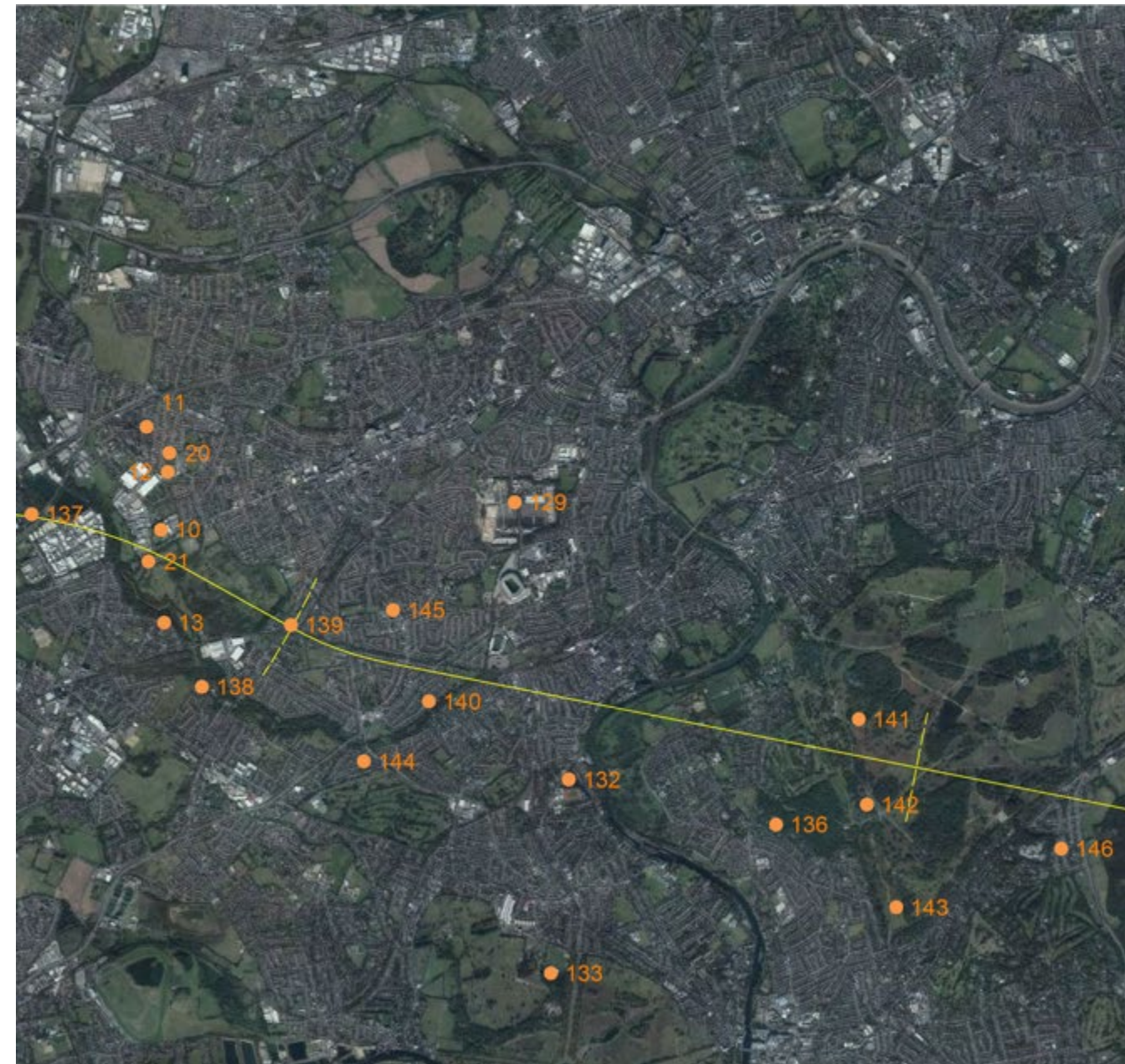
Aircraft Type: A380

Destination: Dubai

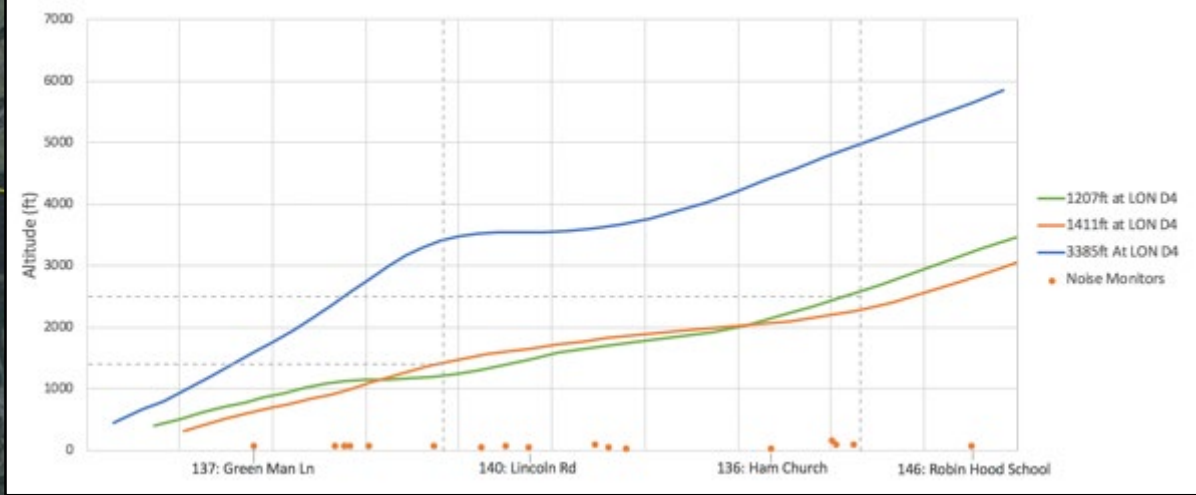
Altitude at LON D4: 3385ft

Difference dB (Lmax)	
Dark Green	-10 to -8
Medium Green	-8 to -6
Light Green	-6 to -4
Very Light Green	-4 to -2
White	-2 to 0
Light Pink	0 to 2
Red	2 to 4
Dark Red	4 to 6
Red	6 to 8
Dark Red	8 to 10





	1207ft at LON D4		1411ft at LON D4		3385ft at LON D4	
	Avg Lmax (dB)	+/-	Avg Lmax (dB)	+/-	Avg Lmax (dB)	+/-
10: Hounslow Heath	82.10	-	86.70	4.60	75.50	-11.20
11: Mink Court	-	-	71.90	-	71.70	-0.20
12: Cavalry Barracks	72.90	-	78.30	5.40	72.90	-5.40
129: Mogdens	63.10	-	60.30	-2.80	62.00	1.70
13: Sparrow Farm Road	75.40	-	77.80	2.40	75.10	-2.70
132: Strawberry Hill House	78.00	-	75.20	-2.80	71.30	-3.90
133: NPL	-	-	-	-	-	-
136: Ham Church	73.20	-	75.20	2.00	69.30	-5.90
137: Green Man Lane	89.20	-	91.80	2.60	83.10	-8.70
138: SW Middlesex Crematorium	70.70	-	72.40	1.70	72.90	0.50
139: Hanworth Road	85.10	-	81.90	-3.20	74.30	-7.60
140: Lincoln Road	80.90	-	79.20	-1.70	74.50	-4.70
141: Richmond Park North	73.80	-	72.70	-1.10	69.60	-3.10
142: Richmond Park Central	74.70	-	77.60	2.90	69.20	-8.40
143: Richmond Park South	68.60	-	71.70	3.10	68.60	-3.10
144: Fulwell Park	72.70	-	68.40	-4.30	70.70	2.30
145: Whitton Church	76.90	-	79.60	2.70	73.30	-6.30
146: Robin Hood School	73.20	-	73.80	0.60	67.00	-6.80
20: Hounslow Cavalry Barracks North	72.00	-	76.00	4.00	74.50	-1.50
21: Hounslow Heath Golf Course	85.70	-	85.40	-0.30	78.20	-7.20



Lessons learned so far...

Even though the SID now requires increased altitude restrictions there are still some aircraft not making those restrictions.

2017 (1st Jan – 31st Aug)

Number of heavy aircraft less than 100ft below a level restriction: **60 out of 9,816**

Number of heavy aircraft less than 250ft below a level restriction: **11 out of 9,816**

2018 (1st Jan – 30th Jun)

Number of heavy aircraft less than 100ft below a level restriction: **48 out of 13,773**

Number of heavy aircraft less than 250ft below a level restriction: **11 out of 13,773**

Lessons learned so far...

It appears that some crews may not be alerted to an altitude 'failure' unless it is more than **250ft** from the restriction.

Several airlines commented that the warmer summer may have had a detrimental effect on aircraft performance. Meteorological analysis will be included in the final trial report.

Since airlines have been notified of their trial performance, a notable improvement has been observed. This trend is expected to continue for the remainder of the trial.