Air Quality Monitoring: Joint Report by RBBC and BAAG for 2008.

1. The following report presents the results from the 2008 air pollution monitoring program undertaken on, and in the vicinity of, Gatwick Airport.

2. Committee members are reminded that details of:
   - the legislation,
   - the rationale for the monitoring of certain pollutants,
   - and factors to bear in mind when examining the data e.g. the impact of the weather, and / or changes in the source of a pollutant, were covered in a separate report to the GP sub committee on 11th January 2007.

Off Airport Monitoring at Relevant Receptors on the Horley Gardens Estate.
Annual Compliance Monitoring – Nitrogen Dioxide.

3. The annual average concentration of nitrogen dioxide across the Horley Gardens Estate in 2008 is shown in Figure 1.

4. Concentrations were below the UK annual average objective of 40 µg m^{-3} (micrograms per cubic metre), and so the UK air quality standards were met within the Horley air quality management area (AQMA) in 2008.

5. The highest concentrations measured on the estate were 35.1 µg m^{-3} and 36 µg m^{-3} at two sites towards the southern end of The Crescent, including the 'worst case' receptor at RB59.

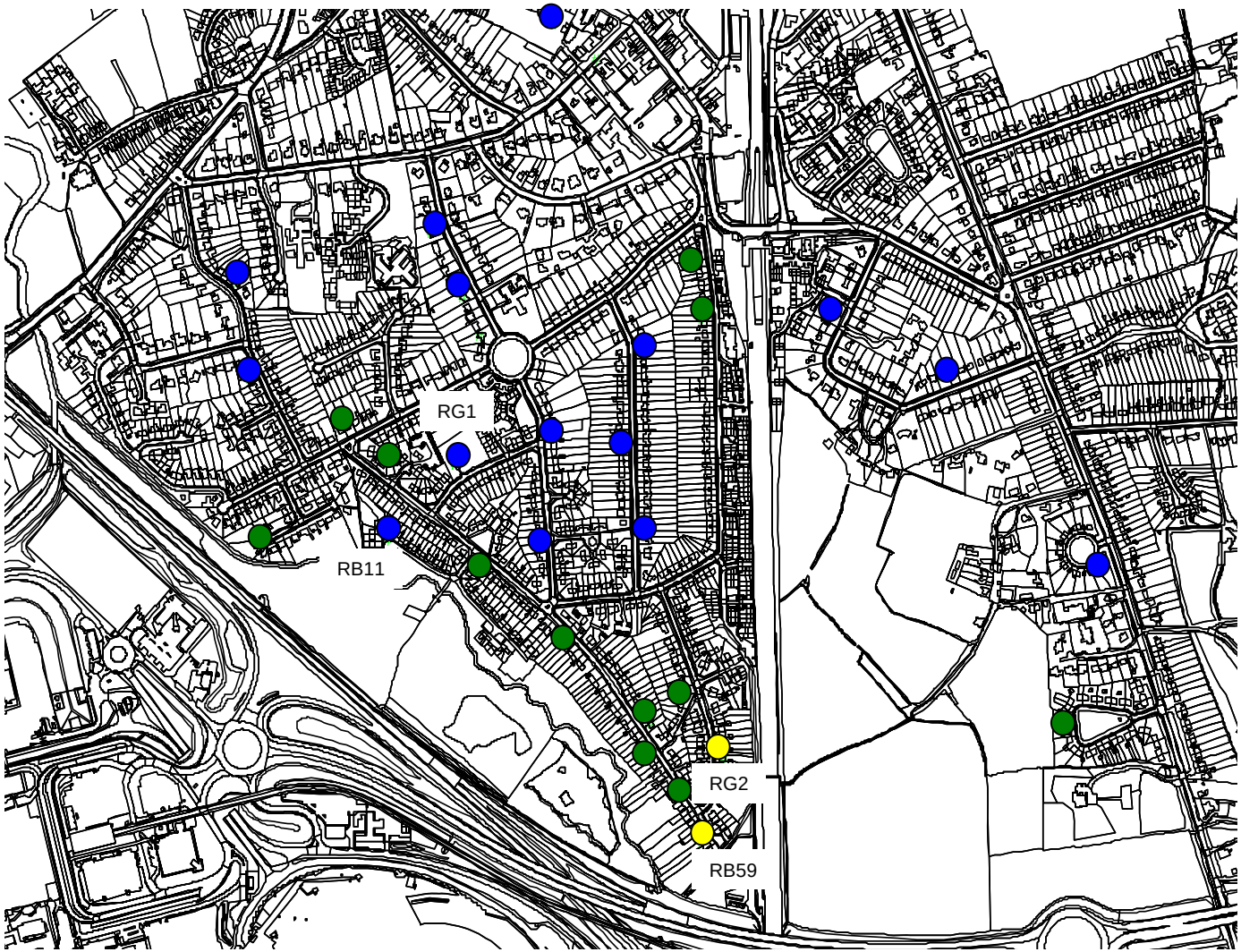
6. Local sources of pollution on the estate remained unchanged throughout 2008, and so the results are comparable to previous years monitoring work.

7. Data capture from the real time monitoring site RG1 was 99.4 %, and from site RG2 92.4 %, and so the data from these sites, along with the diffusion tube data is valid for compliance monitoring purposes.

8. Overall the results from 2008 are in line with predicted nitrogen dioxide concentrations for the Horley Gardens Estate i.e. elevated concentrations towards the south east corner of the estate either close to, or just over, the UK annual average air quality objective for nitrogen dioxide. However, the prevailing weather conditions in 2008 have meant that the concentrations in general were at the lower end of their 'typical' range, in common with monitoring sites elsewhere e.g. in Reigate, Banstead, Redhill, and Hookwood.

9. Although passenger numbers and aircraft movements at Gatwick declined by 2.9 % and 1.1 % respectively in 2008, compared to 2007 (Appendix A), such a change would have no measurable impact[1] on concentrations on the Horley Gardens Estate.

[1] netcen FAST modelling for BAAG (2006).



Key:

- 20.1 to 25 µg m^{-3}
- 25.1 to 30 µg m^{-3}
- 30.1 to 35 µg m^{-3}
- 35.1 to 40 µg m^{-3}
- 40.1 to 44 µg m^{-3}

North

0 250 m

Other sites in the vicinity of the Of the Airport:

Charlwood: (Russ Hill)	14 µg m^{-3}
Hookwood: (Withey Meadows)	17 µg m^{-3}
Smallfield: (Ontario Close)	26 µg m^{-3}

Comparable sites elsewhere within the Borough:

Reigate:	23 µg m^{-3}
Banstead:	21 µg m^{-3}
Redhill:	22 µg m^{-3}
Merstham:	30 µg m^{-3}

Figure 1: Monitoring Results for Nitrogen Dioxide Concentrations across the Horley Gardens Estate in 2008.

Tube Correction Factor = 1.02 (n=12).

Annual Compliance Monitoring – PM_{10}.

10. The PM_{10} air quality standard was met on the Horley Gardens Estate in 2008, with an annual average concentration at RG1 of 20.5 µg m^{-3}, which was within the expected range of 20 to 25 µg m^{-3}. The air quality standard permits an annual average PM_{10} concentration of 40 µg m^{-3}, and also allows for 35 days where concentrations may exceed 50 µg m^{-3}, and during 2007 only 4 days at RG1 had concentrations over 50 µg m^{-3}.

11. The PM_{10} monitoring undertaken on the Horley Gardens Estate (RG1), and on airport (LGW3), in common with most of the UK, uses an instrument called a tapered element oscillating microbalance (TEOM). Historically TEOM measurements taken across the UK, including around Gatwick, have not met EU requirements for PM_{10} monitoring. However, in 2008 DEFRA released a new method of 'correcting' the TEOM data called the Volatile Correction Method (VCM)[2], and data corrected in this way is now considered equivalent to the EU reference method.

12. The change has no significant impacts for PM_{10} monitoring either on, or around, the airport as concentrations were already significantly below the legal limit value, with an annual mean concentration of 20.5 µg m^{-3} under the old approach, and 19.7 µg m^{-3} under the new approach, and 4 days over 50 µg m^{-3} under the old method and 5 days over 50 µg m^{-3} under the new method.

13. In future reports it is proposed that PM_{10} data in the compliance monitoring section be reported using this new approach, although data in the trends section and data table (Appendix B) will continue to be reported using the 'old methodology', to allow historical comparisons, along with the data corrected using the new approach.

Trends in Pollutant Concentrations.

Nitrogen dioxide.

14. A three year rolling average concentration is used in the trend analysis work, to help remove the year to year fluctuations in concentrations caused by the prevailing weather conditions, and the data to date (Figure 2) shows a clear downward trend in annual average nitrogen dioxide concentrations at the RG1 site.

15. At the 'worst case' receptors closer to the airport (RG2, RB59) the trend is less clear cut with stable / falling concentrations at RG2, and largely stable concentrations at RB59 where the three year trend is back at 2006 levels.

16. As non airport sources of nitrogen dioxide make a significant contribution to RG1 (75 %[3]), and a smaller but still significant contribution to RB59 and RG2 (55 %), this downward trend at RG1 and potentially RG2 is as expected, given that computer modelling indicates that non airport sources of nitrogen dioxide are predicted to fall until around 2010 to 2015 driven mainly by improvements in road vehicle engine technology.

17. The reductions in nitrogen dioxide concentrations at Gatwick (notably RG1) are not unique, as a similar pattern is seen at background sites across the south east.

[2] www.volatile-correction-model.info.

[3] Figures are from Air Quality Modelling for Gatwick Airport 2002/3 (netcen/AEAT/ENV/R/1625/Issue 3 October 2004).

Figure 2: Three year Rolling Annual Average Nitrogen Dioxide Concentration at RG1, Michael Crescent Horley (Blue diamond), RG2, The Crescent Horley (Purple square), and RB59 (Red triangle).

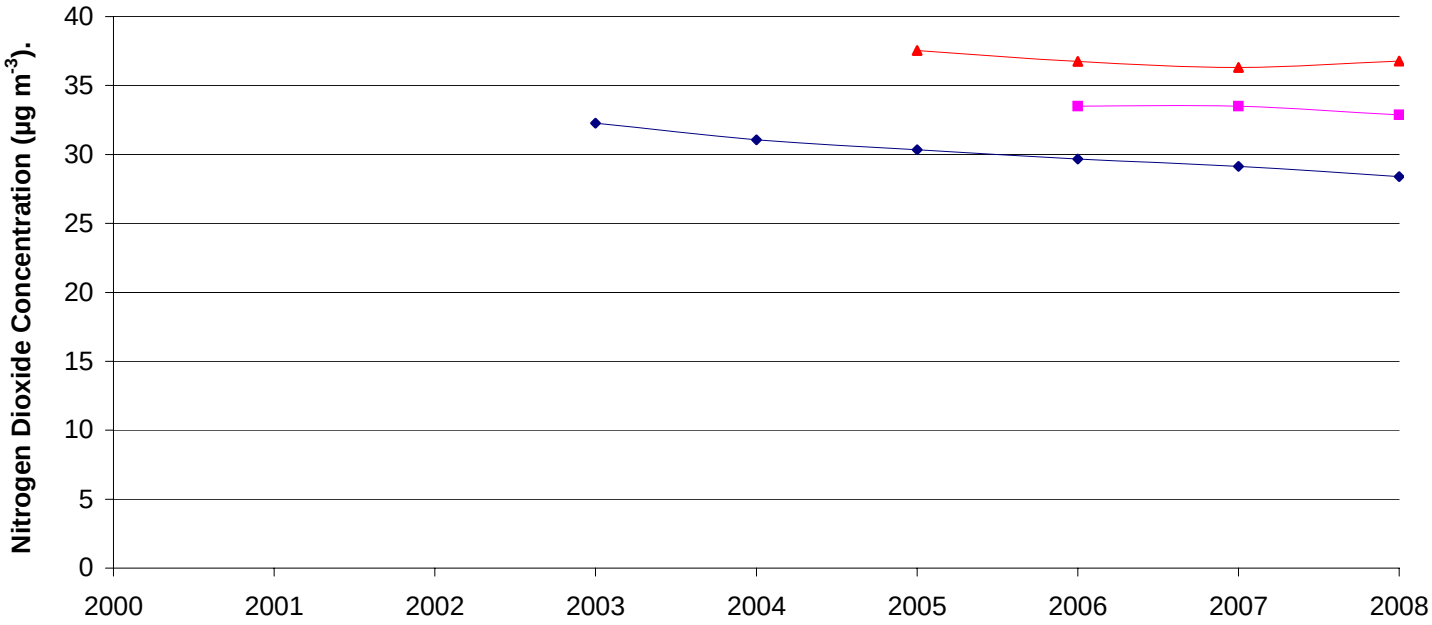
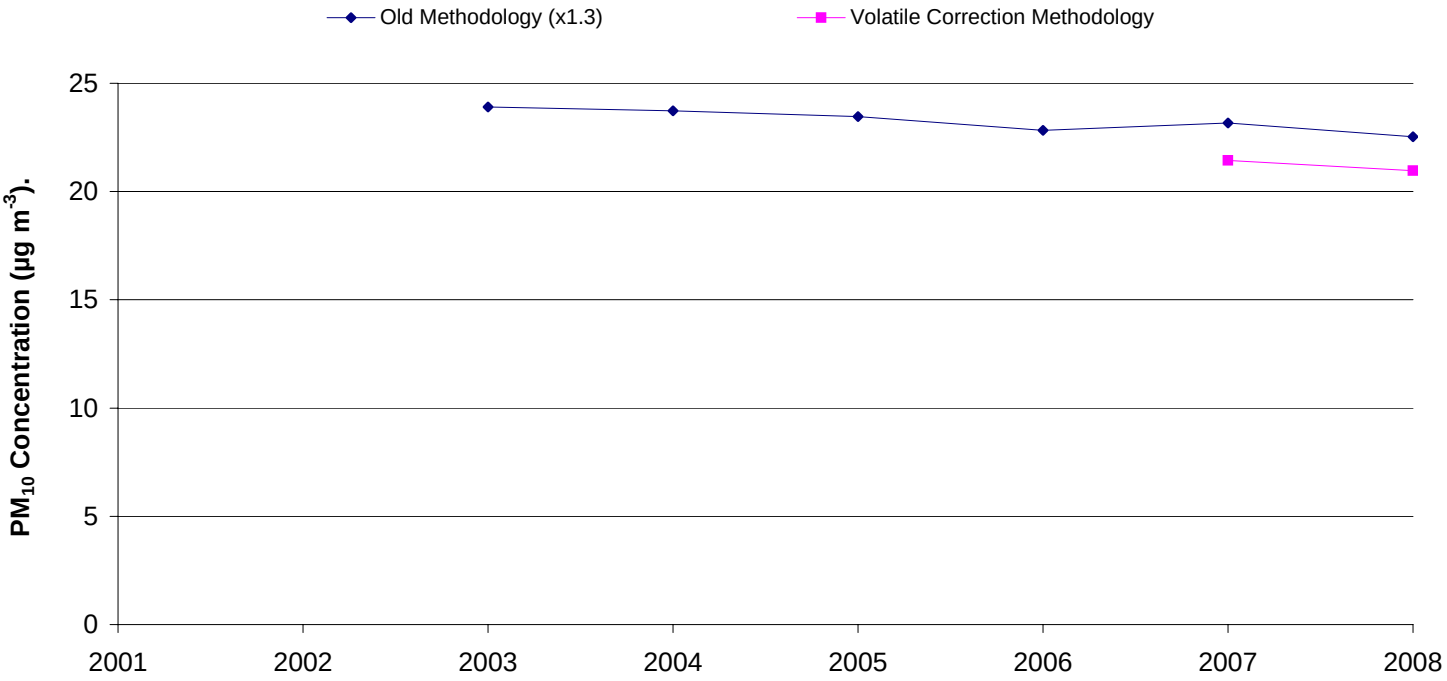


Figure 3: Three Year Rolling Annual Average PM_{10} Concentration at RG1, Michael Crescent, Horley.



PM_{10}.

18. It is important to note that the airport is not a significant source of PM_{10}, and computer modelling[4] indicates that the airport is responsible for no more than 1 – 2 µg m^{-3} of the total PM_{10} concentration at the worst affected properties on the Horley Gardens Estate.

19. The main purpose of monitoring PM_{10} on the Horley Gardens Estate is to examine trends in the PM_{10} concentration, as the UK Government is aiming to reduce people's exposure to particulate matter in the longer term even where the air quality standards are met.

20. Using a three year rolling average to examine the trends in the data, there is evidence of a small downward trend from 2003 to 2008, with concentrations of 23.9 µg m^{-3} in 2003 and 22.5 µg m^{-3} in 2008 (Figure 3), reflecting a small improvement in non airport sources of PM_{10} pollution over this period.

21. Figure 3 also demonstrates the impact of the new volatile correction method introduced by DEFRA on the PM_{10} concentrations. The overall effect of the method in general is to lower annual average concentrations slightly, which is seen elsewhere in the UK, although the method also tends to increase the number of days where concentrations are over 50 µg m^{-3} (Appendix B).

On Airport Monitoring.

22. In the absence of relevant receptors[5] at the airport monitoring sites, it is largely academic whether or not the air quality standards are breached. However the monitoring results from 2008 (Table 1) indicate that the standards were met at the LGW3 monitoring station for PM_{10}, carbon monoxide, and nitrogen dioxide.

	On Airport (LGW3)	Standard	Standard Met?
Annual Average nitrogen dioxide Concentration	34.8	40	Yes
Nitrogen Dioxide: No. of hours over 200 µg m^{-3}	0	18	Yes
Annual Average PM_{10} Concentration (Volatile Correction Method)	23.4 (21.8)	40	Yes
PM_{10}: No. of days over 50 µg m^{-3} (Volatile Correction Method)	13 (16)	35	Yes
Carbon Monoxide (Maximum daily running 8 hour mean)	2.2	10	Yes
All concentrations are in µg m^{-3}, except Carbon Monoxide mg m^{-3}. Data Capture: Nitrogen Dioxide 97 %, PM_{10} 93 %, CO 95 %.			

Table 1: Nitrogen Dioxide, PM_{10}, and Carbon Monoxide Concentrations on Airport in 2008.

23. It should be pointed out that while the LGW3 monitor is of limited use for compliance monitoring, it is of particular use for verifying the computer modelling work used to make forward predictions about air quality at the airport.

24. During 2008 there were no changes of note in on airport sources of air pollution, aside from a small decrease in passenger numbers and aircraft movements, and thus the results are comparable to 2007.

[4] Methodology for estimating NO_x, NO_2, and PM_{10} Concentrations in 2010 around London Gatwick Airport. netcen Issue 2 with Jan 06 data.

[5] 'Relevant receptors' were discussed in the outline air quality paper presented to the GP sub committee in January 2007. However, for the purposes of this of this report relevant exposure can be taken as residential housing, or in the case of the 1 hour nitrogen dioxide objective where a member of the public might be present for 1 hour or more.

On Airport Pollutant Trends.

25. Figure 4 shows the 3 year rolling average nitrogen dioxide concentration at the on airport monitor LGW3, and the data from the residential monitor RG1 for comparison. The graph shows a steady improvement in nitrogen dioxide concentrations at the LGW3 monitor, and then a rapid drop from 2003 onwards, followed by a smaller improvement in 2006, and a subsequent rise in 2007 and 2008.

26. The sudden fall in the annual average nitrogen dioxide concentrations in 2004 and 2005 (Table 2), which is reflected in the 3 year rolling average data (Figure 4), was noted but unexplained in the 2005 monitoring report (GP sub committee January 2007). Subsequent work indicated that the falls in 2004 and 2005 were more likely to have been due to the change in contractor servicing the equipment in 2003, than 'real' improvements in air quality on airport (GP sub committee June 2007), and this appeared to be confirmed by a rise in concentrations in 2006 when the original servicing agent was reappointed.

27. However, nitrogen dioxide concentrations have fallen significantly in 2008, compared to 2006 and 2007 (Table 2), to levels last seen in 2004 / 2005. At this stage it is unclear if this reduction in concentrations is due to a combination of the weather and the reduction in passengers and aircraft movements, or is due to changes in a localised pollution source close to the monitoring station.

28. Following on from the in depth statistical analysis (CUSUM analysis) of the LGW3 data in 2007 to identify possible causes of the sudden fall in concentrations in 2004, which identified a lack of seasonality[6] in the LGW3 data pre 2003, it remains unclear what, if any, impact this finding has on the monitoring results from LGW3 pre 2003, as an analysis of the 2006 and 2007 data sets for seasonality proved inconclusive as a larger data set was required. Therefore a repeat analysis on the entire data set will be undertaken in two years time.

29. Figure 5 shows the three year rolling annual average PM_{10} concentrations at the airport monitor, and PM_{10} data from the residential monitor for comparison. The graph shows a steady improvement in PM_{10} concentrations on airport until 2002, at which point there is an increase, driven mainly by a sharp increase in 2003, and then falls in concentrations from 2006 to 2008. If the annual averages for each year are examined (Table 3), then there have been some quite large step changes 2002 to 2006, although concentrations have remained consistently low since 2006.

30. However, as the concentration of PM_{10} at the residential monitoring site RG1 has not shown such dramatic changes (Appendix B), this suggests that most of the variability in the concentrations on airport is due to a local site specific factor, rather than any major change in overall airport emissions or the background PM_{10} concentration across the south east.

	Standard	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Annual Average PM_{10} Conc. at LGW3	40	34.9	31.0	28.7	27.2	27.8	36.1[A]	31.0	31.5	23.4 (21.1)	25.3 (23.7)	23.4 (21.8)

[A] The high concentrations seen in 2003 were most likely due to the prevailing weather conditions, as elevated concentrations were seen across the south east.
Figures in brackets are concentrations calculated using the volatile correction methodology.

Table 3: Annual Average PM_{10} Concentrations at on airport monitor LGW 3 (µg m^{-3}).

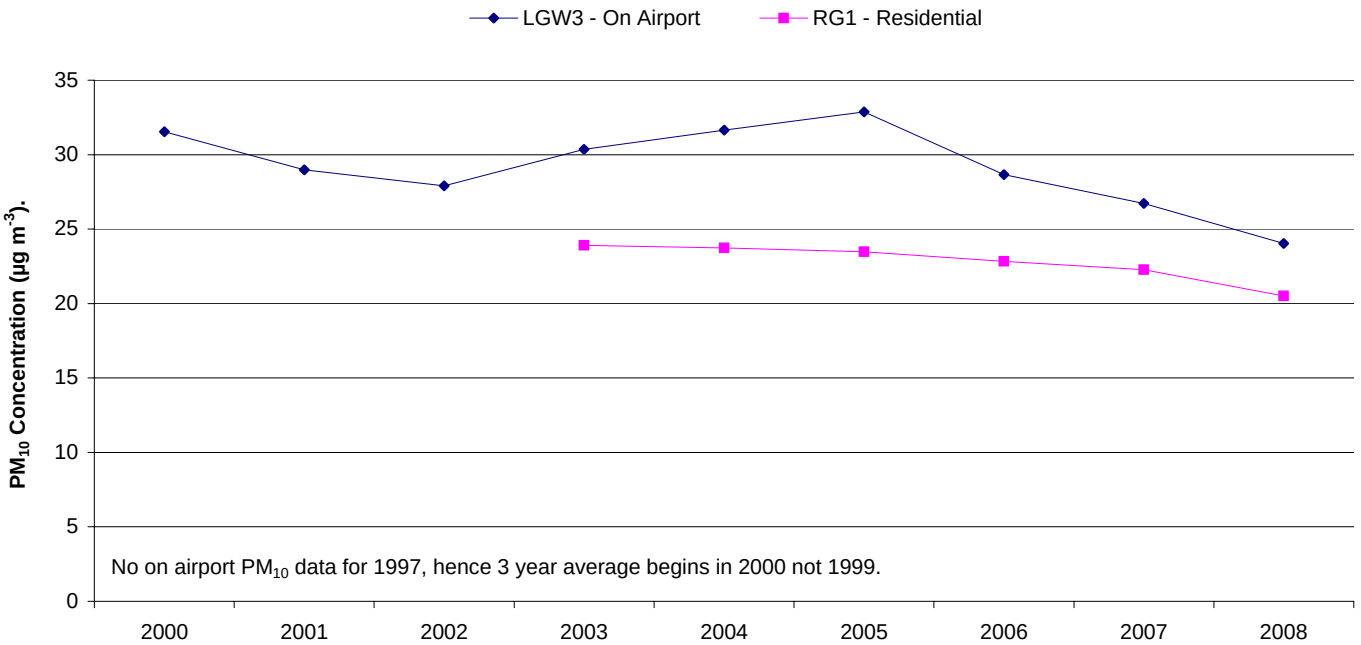
[6] In any monitoring data the concentration varies continually throughout the year in relation to the seasons, and this shows up very clearly in CUSUM analysis. However, at LGW3 until mid 2003 there is a complete lack of this seasonality, and yet it is present at RG1, and at other monitors in the south east.

Figure 4: Three Year Rolling Annual Average Nitrogen Dioxide Concentration at LGW3, Gatwick Airport.

Table 2: Annual and Three Year Annual Average Nitrogen Dioxide Concentrations (µg m^{-3}).

LGW3	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Annual Average	53.8	52.6	52.3	49.2	49.1	47.0	46.0	35.5	34.2	40.3	40.0	34.8
Data Capture	94.9	89.2	93.3	93.4	93.5	96.1	94.0	95.4	96.7	96.3	94.2	96.8
Hours Over 200 µg m-3	2	0	1	1	0	0	2	0	0	0	1	0
3 Year Rolling Average	LGW3		52.9	51.4	50.2	48.5	47.4	42.9	38.6	36.7	38.2	38.4
3 Year Rolling Average	RG1						32.3	31.1	30.3	29.6	29.1	28.4

Figure 5: Three Year Rolling Annual Average PM_{10} Concentration at LGW3, Gatwick Airport.



Benzene Monitoring Data.

31. The concentration of Benzene is measured at one site (RB11) on the Horley Gardens Estate, and at one site on airport (LGW3). As expected measurements at both the residential site and on airport site (Table 4) met the air quality standard in 2008.

	Concentration (µg m^{-3})	Standard	Standard Met?
Annual Average Benzene Concentration: Residential	2.3	5	Yes
Annual Average Benzene Concentration: Airport Monitor	1.0	5	Yes

Table 4: Annual Average Benzene Concentrations on the Horley Gardens Estate at RB11, and on Airport at LGW3 (Non pumped BTEX Tubes).

Additional Monitoring Data.

Ozone.

32. Ozone monitoring began to the SW of the airport in 2005 at the RG3 site in Poles Lane Crawley. The aim of this site is to monitor long term trends in ozone concentrations in the vicinity of the airport.

33. Although the airport is not responsible for local ozone pollution, ozone plays an important role in the formation of nitrogen dioxide, which is the main pollutant of concern in the vicinity of the airport. Therefore examining the long term ozone trend is important for understanding nitrogen dioxide concentrations in both the short and longer term.

34. At this stage there is only two and a half years of data from the ozone monitor, and so at present there is insufficient data to examine trends, or calculate compliance with the EU ozone standard. However, the UK ozone objective was breached in the vicinity of the airport (Poles Lane, Crawley) in 2008 for the third successive year.

	Number of exceedences in 2008.	Standard Met?	
		UK	EU
RG3: Poles Lane Crawley.	41	No	N/A*
RG1: Michael Crescent.	32	No	-
Standards:			
UK: Daily Max. of running 8 hour mean of 100 µg m^{-3}.	10 max.	-	-
EU: Daily Max. of running 8 hour mean of 120 µg m^{-3} (averaged over 3 years).	25 max.	-	-
* The EU standard applies from 31/12/10, and is averaged over 3 years. At present only 2.5 years of data is available.			

Table 5: Number of exceedences of the Ozone standard in 2008.

35. An additional ozone monitor was also installed at RG1 (Horley Gardens Estate) between May and October 2008, as part of a short term study of ozone concentrations north of the airport. Despite the ozone monitor only being in place for 6 months, albeit in the main ozone 'season', the UK ozone standard was breached.

Airborne Organic Compounds.

36. BAA Gatwick have undertaken a series of 'grab' samples in previous years to look at a range of organic pollutants. As samples were only taken on four days per year the results were of limited use in examining pollutant trends at the airport, and could not be used for compliance monitoring purposes. Therefore the airport ceased to collect such samples at the end of 2006.

Summary.

37. In summary:

i) The annual average air quality standard for nitrogen dioxide was met at relevant receptors in the vicinity of the airport during 2008 (Table 6), as were the air quality standards for other pollutants under the local authority air quality management regime (Table 6).

ii) Ozone concentrations to the south west and north east of the airport did not meet the UK air quality standard, although the airport is not responsible for local ozone pollution.

iii) Trend analysis of the nitrogen dioxide concentrations at properties most at risk of breaching the air quality objective (RB59) show a flat to downward trend, although a similar downward trend is seen at a 'background' site (RG1). This decrease in pollution is most likely due to improvements in road vehicle emissions, and is in line with predictions for non airport nitrogen dioxide pollution at Gatwick and across the south east.

iv) The concentration of nitrogen dioxide measured on airport in 2008 at LGW3 meets the UK air quality objective of 40 µg m^{-3}. The concentrations of the other pollutants measured at LGW3 also met the relevant air quality standards.

v) The three year rolling annual average trend analysis of the on airport nitrogen dioxide concentrations shows a small increase in concentrations between 2007 and 2008, though this is more an artefact of the significant falls seen in 2005 rather than representing an increase in emissions from the airport.

vi) The average PM_{10} concentration measured on airport in 2008 showed a slight decrease compared to 2007, although concentrations are comparable to those measured in 2006, reflecting the natural year to year variability in PM_{10} concentrations rather than any change in airport emissions or local source changes.

	Measured value	Standard	Standard Met?
Nitrogen Dioxide:			
Highest measured annual average residential concentration.	36	40	Yes
Annual Average nitrogen dioxide concentration Airport monitor.	34.8	40	Yes
PM_{10}:			
Annual Average PM_{10} Concentration: Residential Monitor. (VCM value)	20.5 (19.7)	40	Yes
PM_{10}: No. of days over 50 µg m^{-3}: Residential Monitor. (VCM value)	4 (5)	35	Yes
Annual Average PM_{10} Concentration: Airport Monitor. (VCM value)	23.4 (21.8)	40	Yes
PM_{10}: No. of days over 50 µg m^{-3}: Airport Monitor. (VCM value)	13 (16)	35	Yes
Benzene:			
Residential Benzene Monitor (Site RB 11).	2.3	5	Yes
On Airport Monitor Benzene Monitor (Site LGW3).	1.0	5	Yes
Ozone:			
RG3 Monitor to SW of Airport (Number of exccedences).	41	10	No
All concentrations are in µg m^{-3}.			

Table 6: Summary of Air Quality in the Vicinity of Gatwick Airport in 2008.

Appendix A.

Figure A.1: Passenger and Aircraft Movement Trends at Gatwick Airport.

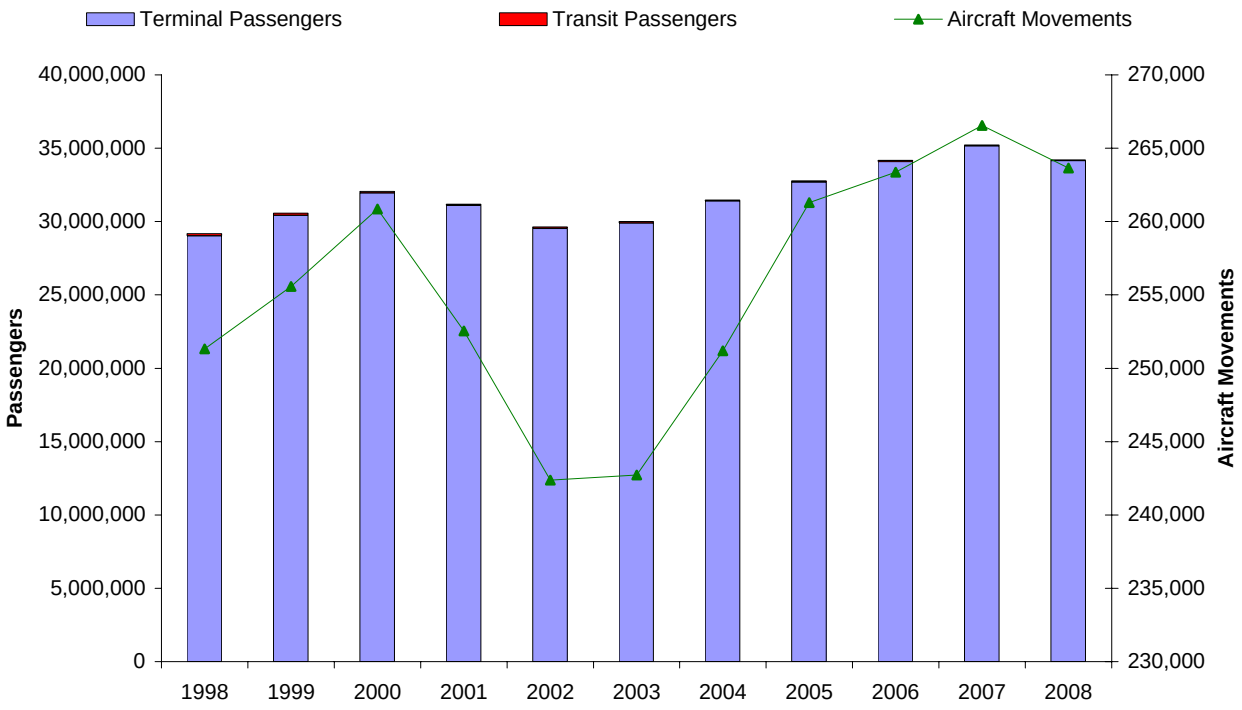


Table A.1: Annual Passenger Numbers and Aircraft Movements at Gatwick Airport.

	Number of Passengers			No. of Aircraft Movements
	Terminal	Transit	Total	
1998	29,032,838	140,292	29,173,130	251,321
1999	30,409,860	153,761	30,563,621	255,570
2000	31,947,524	119,601	32,067,125	260,859
2001	31,096,563	85,207	31,181,770	252,543
2002	29,517,894	109,515	29,627,409	242,379
2003	29,893,288	111,974	30,005,262	242,731
2004	31,391,352	75,418	31,466,770	251,195
2005	32,693,005	82,690	32,775,695	261,292
2006	34,080,345	83,234	34,163,579	263,363
2007	35,165,404	50,709	35,216,113	266,550
2008	34,162,014	43,873	34,205,887	263,653

Data from Civil Aviation Authority. www.caa.co.uk/docs/80/airport_data

Appendix B: Summary of Annual Monitoring Results 1999 to 2008.

Nitrogen Dioxide

Site	Parameter	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
RG1	Ann. Average (µg m^{-3})	-	-	34.1	31.3	31.4	30.5	29.1	29.4	28.9	26.9
RG2	Ann. Average (µg m^{-3})	-	-	-	-	-	33.8	34.3	32.4	33.8	32.4
RG3	Ann. Average (µg m^{-3})	-	-	-	-	-	-	-	19.4	20.9	18.9
LGW3	Ann. Average (µg m^{-3})	52.3	49.2	49.1	47.0	46.0	35.5	34.2	40.3	40	34.8
RB59	Ann. Average (µg m^{-3})	-	-	-	-	40	39	34	37	38	35
RG1	Data Capture (%)	-	-	99.0	100.0	99.7	99.6	98.0	98.5	99.1	99.4
RG2	Data Capture (%)	-	-	-	-	-	89.0	97.0	96.0	96.3	92.8
RG3	Data Capture (%)	-	-	-	-	-	-	-	97.8	98.8	99.2
LGW3	Data Capture (%)	93.3	93.4	93.5	96.1	94.0	95.4	96.7	96.3	94.3	96.8
RB59	Data Capture (%)	-	-	-	-	91.6	100	91.6	100	100	100
RG1	Hours Over 200 µg m^{-3}	-	-	0	0	0	0	0	0	0	0
RG2	Hours Over 200 µg m^{-3}	-	-	-	-	-	0	0	0	0	0
RG3	Hours Over 200 µg m^{-3}	-	-	-	-	-	-	-	0	0	0
LGW3	Hours Over 200 µg m^{-3}	1	1	0	0	2	0	0	0	1	0
RB59	Hours Over 200 µg m^{-3}	-	-	-	-	-	N/A	N/A	N/A	N/A	N/A

Particulate Matter (PM_{10})											
RG1	Ann. Average (µg m^{-3})	-	-	22.8	23.2	25.7	22.3	22.4	23.8	23.3***	20.5
	Ann. Average VCM* (µg m^{-3})								21.2	22.0	19.7
LGW3	Ann. Average (µg m^{-3})	31.0	28.7	27.2	27.8	36.1	31.0	31.5	23.3	25.3	23.4
	Ann. Average VCM* (µg m^{-3})								21.1	23.7	21.8
RG1	Data Capture (%)	-	-	99.7	100	99.5	100	100	99.4	99.3	99.0
	Data Capture VCM** (%)								96.4	98.1	99.0
LGW3	Data Capture (%)	91.5	92.9	97.3	99.2	97.3	97.3	97.3	96.2	95.1	93.4
	Data Capture VCM** (%)								93.6	93.6	93.4
RG1	No. days over 50 µg m^{-3}	-	-	6	6	16	0	3	5	9***	4
	No. days over 50 µg m^{-3} (VCM)								6	18	5
LGW3	No. days over 50 µg m^{-3}	35	28	20	17	65	36	30	7	18	13
	No. days over 50 µg m^{-3} (VCM)								10	23	16

Locations:

RG1 is located on the Horley Gardens Estate in Michael Crescent (NE of the Airport). RG2 is located on the Horley Gardens Estate in The Crescent (NE of the Airport).

RG3 is located to the SW of the airport in Poles Lane, Crawley. RB59 is a diffusion tube (not a real time site) located at the southern most end of the Horley Gardens Estate to the NE of the Airport.

*for details on volatile correction methodology see www.volatile-correction-model.info. Spreadsheets downloaded 05/05/09.

** as the VCM requires data from three other sites VCM data capture can be lower than from the site of interest.

*** In the monitoring report on the 2007 data this was 20.6 µg m^{-3}, with 6 days over 50 µg m^{-3}. However data was subsequently revised upwards in final QA/QC audit.

Abbreviations and Definitions

AQMA	Air Quality Management Area.
BAA	British Airports Authority (Gatwick).
CO	Carbon Monoxide.
m^3	cubic metre.
mg	milligram (1 thousandth of a gram).
NETCEN	National Environmental Technology Centre, UK.
ng	nanogram (1 billionth of a gram).
NO_2	Nitrogen Dioxide.
NO_x	Oxides of Nitrogen (mainly NO and NO_2 expressed as NO_2 equivalent).
O_3	Ozone.
PM	Particulate Matter.
PM_{10}	Essentially particles under 10 µm in diameter. Officially defined as the size fraction below 10µm in aerodynamic diameter, which has a cut off point at 50% of the particles which are 10µm in aerodynamic diameter.
ppb	part(s) per billion.
ppm	part(s) per million.
TEOM	Tapered Element Oscillating Microbalance. (Device for measuring PM_{10} concentrations in real time).
µg	microgram (1 millionth of a gram).
$\mu g/m^3$	microgram(s) per cubic metre
$\mu g\ m^{-3}$	microgram(s) per cubic metre, This scientifically is the correct form to use rather than $\mu g/m^3$, though either can be used.
VCM	Volatile Correction Method. (used to correct PM_{10} measurements made using a TEOM. This results in data equivalent to measurements made using the European Union's 'preferred' PM_{10} monitoring technique.