Air Quality Monitoring: Joint Report by RBBC and BAAG for 2007.

1. The following report presents the results from the 2007 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 2007 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 2007.

5. Concentrations of 38 µg m^{-3} were recorded at two sites on the estate towards the southern end of The Crescent, including the 'worst case' receptor at RB59.

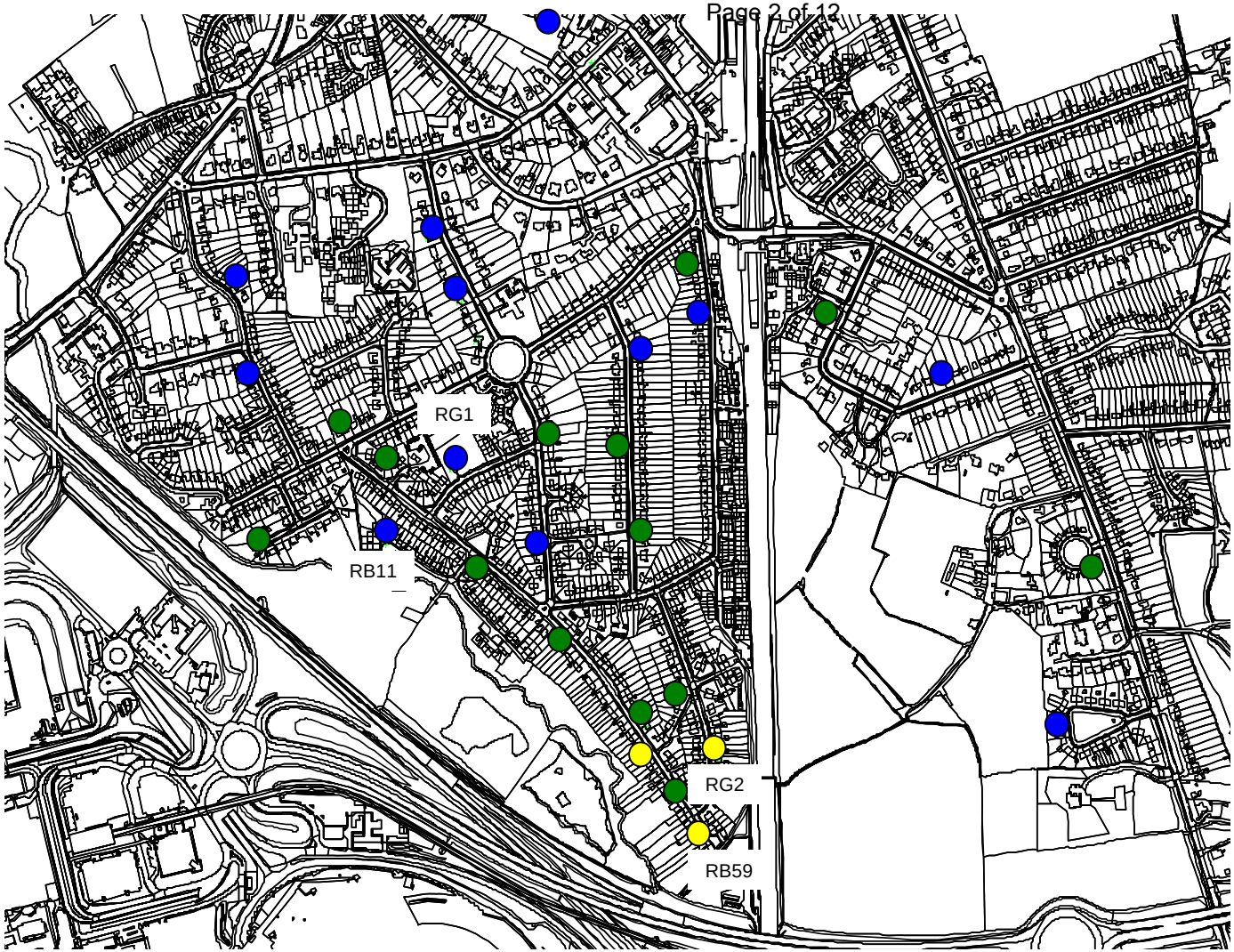
6. Local sources of pollution on the estate remained unchanged throughout 2007, and so the results are comparable to previous years monitoring work.

7. Data capture from the real time monitoring site RG1 was 99.1 %, and from site RG2 96.3 %, and so the data from these sites, along with the diffusion tube data is valid for compliance monitoring purposes.

8. Overall the results from 2007 are in line with predicted nitrogen dioxide concentrations for the Horley Gardens Estate i.e. elevated concentrations towards the south west corner of the estate either close to, or just over, the UK annual average air quality objective for nitrogen dioxide.

Annual Compliance Monitoring – PM_{10}.

9. The PM_{10} air quality standard was met on the Horley Gardens Estate in 2007, with an annual average concentration at RG1 of 20.6 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 6 days at RG1 had concentrations over 50 µg m^{-3}.



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)	15 µg m^{-3}
Hookwood: (Withey Meadows)	19 µg m^{-3}
Smallfield: (Ontario Close)	27 µg m^{-3}

Comparable sites elsewhere within the Borough:

Reigate:	26 µg m^{-3}
Banstead:	22 µg m^{-3}
Redhill:	29 µg m^{-3}
Merstham:	32 µg m^{-3}

Figure 1: Monitoring Results for Nitrogen Dioxide Concentrations across the Horley Gardens Estate in 2007.

Tube Correction Factor = 1.128 (n=12).

Trends in Pollutant Concentrations.
Nitrogen dioxide.

10. Nitrogen dioxide concentrations have been monitored at the worst case receptors, sites RB59 and RG2, on the Horley Gardens Estate since 2003 and 2004 respectively. As a three year rolling average is used in the trend analysis work (see the outline air quality paper to the sub committee of 11th January 2007 for the rationale for using this approach), at present there is only sufficient data to plot the first two points on the RG2 trend line (Figure 2).

11. Nevertheless, Figure 2 shows a clear downward trend in annual average nitrogen dioxide concentrations at the RG1 site, and the presence of a downward trend at the RB59 site, although this appears to be absent from the nearby RG2 site. As non airport sources of nitrogen dioxide make a significant contribution to RG1 (75 %[1]), and a smaller but still significant contribution to RB59 and RG2 (55 %), this downward trend at RG1 and RB59 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.

12. The reduction in nitrogen dioxide concentrations at Gatwick are not unique, as a similar pattern is seen across the south east where road traffic makes a significant contribution to the pollution problem.

13. At present there is insufficient data to examine the trend at RG2 with any degree of certainty, although if the pattern to date at RG2 (a real time analyser) is more representative of the trends in nitrogen dioxide than the RB59 site (a diffusion tube), then this suggests that the falls in non airport nitrogen dioxide concentrations seen away from the airport at RG1 are being off set by increasing emissions from the airport and hence the lack of change at RG2.

PM_{10}.

14. It is important to note that the airport is not a significant source of PM_{10}, and computer modelling[2] 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.

15. 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.

16. Using a three year rolling average to examine the trends in the data, there is evidence of a small downward trend from 2003 to 2007, with concentrations of 23.9 µg m^{-3} in 2003 and 22.2 µg m^{-3} in 2007 (Figure 3), reflecting a small improvement in non airport sources of PM_{10} pollution over this period.

[1] Figures are from Air Quality Modelling for Gatwick Airport 2002/3 (netcen/AEAT/ENV/R/1625/Issue 3 October 2004).
[2] Methodology for estimating NO_x, NO_2, and PM_{10} Concentrations in 2010 around London Gatwick Airport. netcen Issue 2 with Jan 06 data.

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).

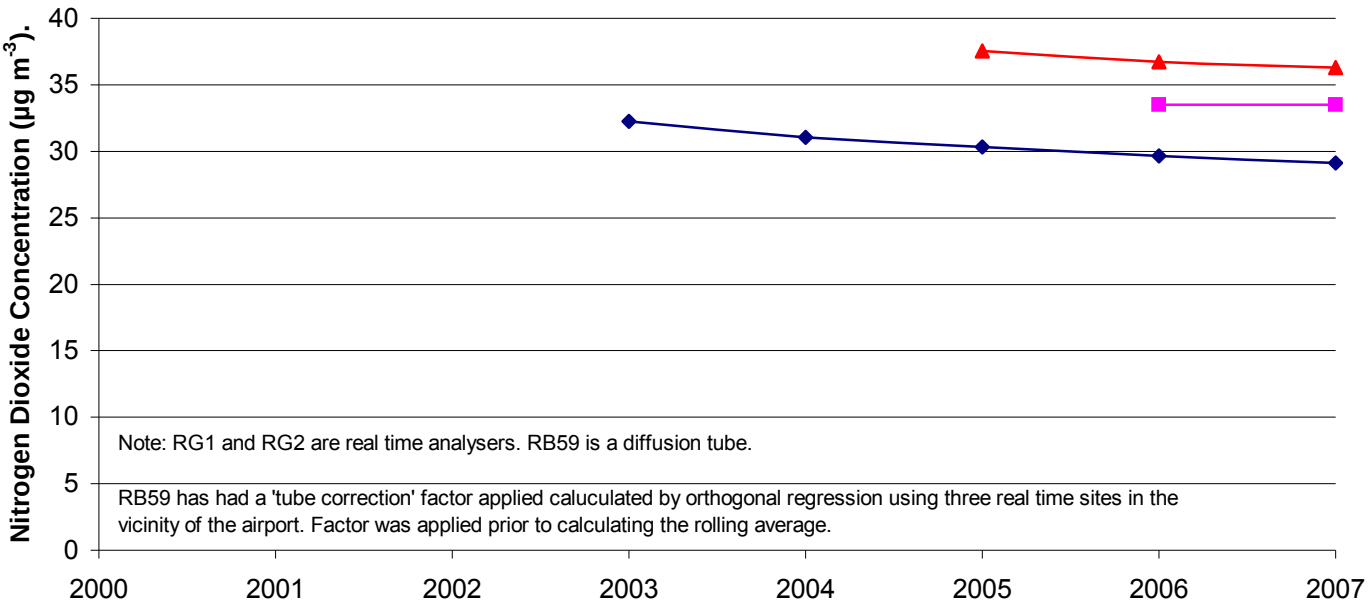
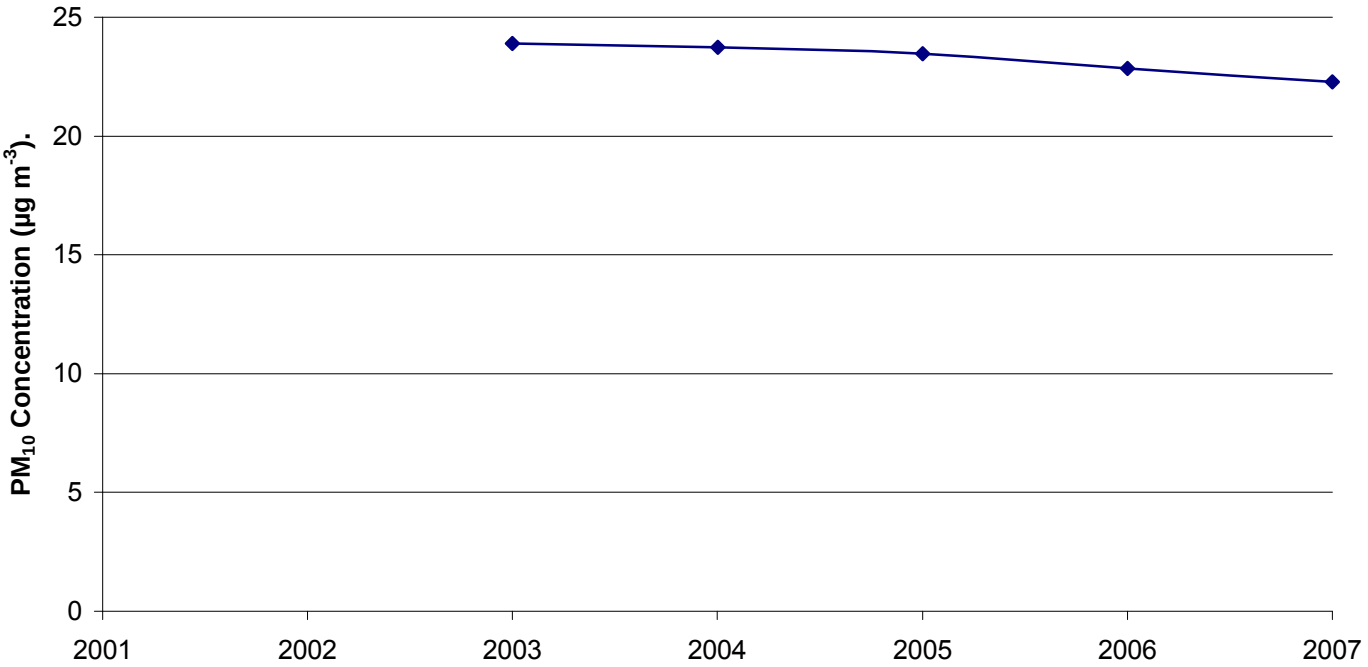


Figure 3: Three Year Rolling Annual Average PM_{10} Concentration at RG1, Michael Crescent, Horley.



On Airport Monitoring.

17. In the absence of relevant receptors[3] at the airport monitoring sites, it is largely academic whether or not the air quality standards are breached. However the monitoring results from 2007 (Table 1) indicate that the standards were met at the LGW3 monitoring station for PM_{10} and carbon monoxide, and just met for nitrogen dioxide.

	On Airport (LGW3)	Standard	Standard Met?
Annual Average nitrogen dioxide Concentration	40.0	40	Yes
Nitrogen Dioxide: No. of hours over 200 µg m^{-3}	1	18	Yes
Annual Average PM_{10} Concentration	25.3	40	Yes
PM_{10}: No. of days over 50 µg m^{-3}	18	35	Yes
Carbon Monoxide (Maximum daily running 8 hour mean)	2.6	10	Yes
All concentrations are in µg m^{-3}, except Carbon Monoxide mg m^{-3}. Data Capture: Nitrogen Dioxide 94 %, PM_{10} 95 %, CO 98 %.			

Table 1: Nitrogen Dioxide, PM_{10}, and Carbon Monoxide Concentrations on Airport in 2007.

18. 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.

19. During 2007 there were no changes of note in on airport sources of air pollution, and thus the results are comparable to 2006.

On Airport Pollutant Trends.

20. 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 rise in 2007.

21. 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).

22. However subsequent work presented to the committee in June 2007 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.

23. The airport switched back to the original servicing agent in 2006, and consequently both the rapid fall off in concentrations from 2003 and subsequent rise from 2006 are artefacts of the low concentrations in 2004 and 2005 rather than representing a real trend (Figure 4).

[3] '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.

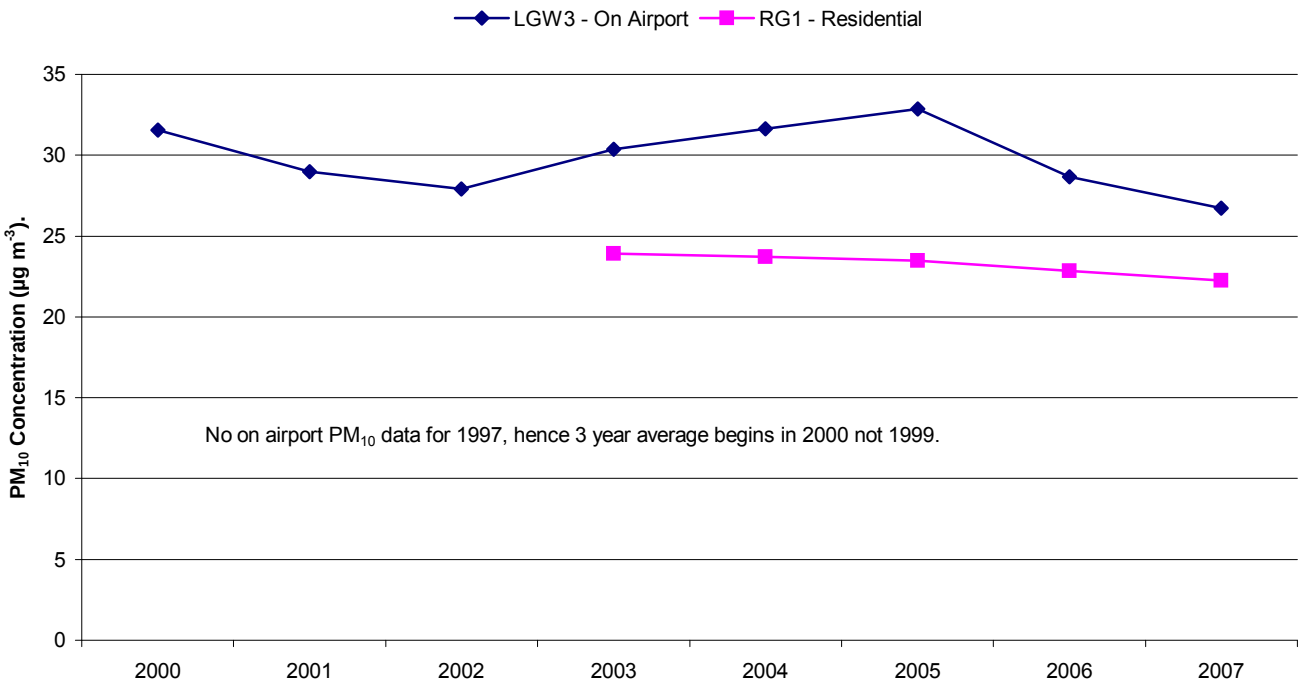
Figure 4: Three Year Rolling Annual Average Nitrogen Dioxide Concentration at LGW3, Gatwick Airpor

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
Annual Average	53.8	52.6	52.3	49.2	49.1	47.0	46.0	35.5	34.2	40.3	40.0
Data Capture	94.9	89.2	93.3	93.4	93.5	96.1	94.0	95.4	96.7	96.3	94.2
Hours Over 200 µg m-3	2	0	1	1	0	0	2	0	0	0	1
3 Year Rolling Average	LGW3		52.9	51.4	50.2	48.5	47.4	42.9	38.6	36.7	38.2
3 Year Rolling Average	RG1						32.3	31.1	30.3	29.6	29.1

* LGW3 nitrogen dioxide concentrations in 2004 and 2005 most likely reflect equipment problems rather than local concentrations.

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



24. An in depth statistical analysis (CUSUM analysis) of the LGW3 data in 2007 had also identified a lack of seasonality[4] in the LGW3 data pre 2003, which is present at the other monitors around the airport and in data from monitors across London and the south east. At this stage it is unclear what, if any, impact this finding has on the monitoring results from LGW3 pre 2003, but further analysis of the data is currently underway to see if a seasonal pattern is present in the 2007 data and the results of this work will be reported back to the committee in due course.

25. 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 a steady increase and then a fall in 2006 and 2007. If the annual averages for each year are examined (Table 3), then there have been some quite large step changes between 2002 and 2007.

26. However, as the concentration of PM_{10} at the residential monitoring site RG1 has not shown such dramatic changes (Appendix A), this suggests that much 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
Annual Average PM_{10} Concentration at LGW3	40	34.9	31.0[A]	28.7	27.2	27.8	36.1[B]	31.0	31.5	23.4	25.3

[A] In the 2005 report the 1999 annual average was reported as 21 µg m^{-3} due to a typographical error.
[B] The high concentrations seen in 2003 were most likely due to the prevailing weather conditions, as elevated concentrations were seen across the south east.

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

Benzene Monitoring Data.

27. 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 met the air quality standard in 2007 (Table 4). Table 4 also shows the on airport concentration of benzene in 2006, as this data was not available at the time of the last monitoring report.

	Concentration (µg m^{-3})	Standard	Standard Met?
Annual Average Benzene Concentration: Residential	2.5	5	Yes
Annual Average Benzene Concentration: Airport Monitor	1.6	5	Yes
Annual Average Benzene Concentration: Airport Monitor (2006)		5	Yes

All concentrations are in µg m^{-3}.

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

[4] 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.

Additional Monitoring Data.

Ozone.

28. 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.

29. 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.

30. At this stage there are only two full years of data from the ozone monitor, and so there is insufficient data to examine trends. However, the UK ozone objective was breached in the vicinity of the airport (Poles Lane, Crawley) in 2007.

	Number of exceedences in 2007.	Standard Met?	
		UK	EU
RG3: Poles Lane Crawley.	21	No	N/A*
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 years of data is available.			

Table 5: Number of exceedences of the Ozone standard in 2007.

31. An additional ozone monitor has been installed at RG1 (Horley Gardens Estate) for 2008, as part of a short term study of ozone concentrations north of the airport. The results of this work will be presented in the next monitoring report, although within two weeks of installation the monitor had recorded a breach of the ozone air quality standard.

Airborne Organic Compounds.

32. 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.

33. In summary:

i) The annual average air quality standard for nitrogen dioxide was met at relevant receptors in the vicinity of the airport during 2007 (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 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 downward trend, although a similar 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 2007 at LGW3 just met 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 2006 and 2007, though this is more an artefact of the significant falls seen between 2003 and 2004 rather than representing a significant increase in emissions from the airport.

vi) The average PM_{10} concentration measured on airport in 2007 showed a slight increase compared to 2006 although this increase is due more to the unusually low concentrations recorded in 2006, that were site specific to LGW3, rather than due to any increase in airport emissions

	Measured value	Standard	Standard Met?
Nitrogen Dioxide:			
Highest measured annual average residential concentration.	38	40	Yes
Annual Average nitrogen dioxide concentration Airport monitor.	40.0	40	Yes
PM_{10}:			
Annual Average PM_{10} Concentration: Residential Monitor.	20.6	40	Yes
PM_{10}: No. of days over 50 µg m^{-3}: Residential Monitor.	6	35	Yes
Annual Average PM_{10} Concentration: Airport Monitor.	25.3	40	Yes
PM_{10}: No. of days over 50 µg m^{-3}: Airport Monitor.	18	35	Yes
Benzene:			
Residential Benzene Monitor (Site RB 11).	2.5	5	Yes
On Airport Monitor Benzene Monitor (Site LGW3).	1.6	5	Yes
Ozone:			
RG3 Monitor to SW of Airport (Number of exccedences).	21	10	No
All concentrations are in µg m^{-3}.			

Table 6: Summary of Air Quality in the Vicinity of Gatwick Airport in 2007.

Appendix A: Summary of Annual Monitoring Results 1999 to 2007.

Nitrogen Dioxide

Site	Parameter	1999	2000	2001	2002	2003	2004	2005	2006	2007
RG1	Ann. Average (µg m^{-3})	-	-	34.1	31.3	31.4	30.5	29.1	29.4	28.9
RG2	Ann. Average (µg m^{-3})	-	-	-	-	-	33.8	34.3	32.4	33.8
RG3	Ann. Average (µg m^{-3})	-	-	-	-	-	-	-	19.4	20.9
LGW3	Ann. Average (µg m^{-3})	52.3	49.2	49.1	47.0	46.0	35.5	34.2	40.3	40.0
RB59	Ann. Average (µg m^{-3})	-	-	-	-	40	39	34	37	38
RG1	Data Capture (%)	-	-	99.0	100.0	99.7	99.6	98.0	98.5	99.1
RG2	Data Capture (%)	-	-	-	-	-	89.0	97.0	96.0	96.3
RG3	Data Capture (%)	-	-	-	-	-	-	-	97.8	98.8
LGW3	Data Capture (%)	93.3	93.4	93.5	96.1	94.0	95.4	96.7	96.3	94.3
RB59	Data Capture (%)	-	-	-	-	91.6	100	91.6	100	100
RG1	Hours Over 200 µg m^{-3}	-	-	0	0	0	0	0	0	0
RG2	Hours Over 200 µg m^{-3}	-	-	-	-	-	0	0	0	0
RG3	Hours Over 200 µg m^{-3}	-	-	-	-	-	-	-	0	0
LGW3	Hours Over 200 µg m^{-3}	1	1	0	0	2	0	0	0	1
RB59	Hours Over 200 µg m^{-3}	-	-	-	-	-	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	20.6
LGW3	Ann. Average (µg m^{-3})	31.0	28.7	27.2	27.8	36.1	31.0	31.5	23.3	25.3
RG1	Data Capture (%)	-	-	99.7	100	99.5	100	100	99.4	99.3
LGW3	Data Capture (%)	91.5	92.9	97.3	99.2	97.3	97.3	97.3	96.2	95.1
RG1	No. days over 50 µg m^{-3}	-	-	6	6	16	0	3	5	6
LGW3	No. days over 50 µg m^{-3}	35	28	20	17	65	36	30	7	18

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.

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.