

TRANSFIELD SERVICES

Lane Cove Tunnel & Falcon Street Gateway

Monthly Air Quality Report

DOCUMENT No: TMF-2035-EV-0017



IN TUNNEL AIR QUALITY MONITORING VALIDATED DATA FOR JUNE 2009

FOR THE

LANE COVE TUNNEL



&

FALCON STREET GATEWAY



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Issue Date:

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Approved by:

Name: Brennan Daly

Position: Motorway Manager

Name: Chris Bryett (Approved QA signatory)

Position: Senior Environmental Specialist

Signature:

Knowledge Mgrs: Mitchell Clark

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1. INTRODUCTION

The Lane Cove Tunnel commenced operation on 25 March 2007. Transfield Services (Australia) Pty Ltd are contracted by Connector Motorways to undertake the day to day operation and maintenance of the Tunnel. As a core part of this contract, Transfield are responsible for the maintenance of the air quality monitoring system inside the tunnel which ensures that the carbon monoxide (CO) levels inside the Tunnel are always kept to within acceptable levels and limits stipulated by the Department of Planning. Continual measurements of CO inside the tunnel are recorded, validated and reported publicly by Transfield on a monthly basis.

This report presents the results of these measurements for the period 00:00 hrs on 1 June 2009 to midnight on 30 June 2009 using data that has been subjected to a validation process.

1.1. Facility Address

The Lane Cove Tunnel is a 3.5km underground road tunnel running between portals at the Gore Hill Freeway in Artarmon NSW just east of the Pacific Highway and Epping Road near its junction with Mowbray Road. It also has access ramps onto and off the Pacific Highway at Artarmon.

The air quality data from the in-tunnel sensors is stored and processed at the Motorway Control Centre located at 5 Sirius Road, Lane Cove West, NSW, 2066.

2. SUMMMARY

2.1. Compliance with Limits

During the period 1 June 2009 to 30 June 2009, CO levels inside the tunnel were within the limit stipulated by the Department of Planning. The results are presented in full in section 5 of this report.

2.2. Data Availability

The percentage of time the instruments were on-line was 74%. The data capture was below 100% mainly due to 4 instruments (out of 28) which were placed offline during most of the monitoring period for operational reasons. A total of 10 sensors were placed off line periodically for calibration which was carried out during overnight carriageway closures 15 – 25 June 2009.

In addition all instruments were placed off line during washing of the tunnel wall lining which was carried out overnight from 8 -10 June 2009

Overall however, the data capture rate should be sufficient to ensure representative reporting of CO levels experienced in the tunnel.

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3. DEFINITIONS & ABBREVIATIONS

Term	Definition
AM-6	A method standard recommended by the NSW EPA (DEC) for the sampling and analysis of carbon monoxide in ambient air. The method conforms to AS 3580.7.1 1992.
CO	carbon monoxide – a toxic gas present in motor vehicle exhausts
NSW EPA	New South Wales Environment Protection Authority, now incorporated into the Department of Environment and Conservation (DEC)

4. EXPLANATION OF MONITORING

4.1. Method of Analysis

Carbon monoxide (CO) levels are measured inside the tunnel using a network of 28 separate CO monitors attached to the walls of both eastbound and westbound tunnels. The monitors measure CO using an analytical method known as non-dispersive infra red absorption with gas filter correlation. Basically this involves projecting an infra-red beam across a 3 metre section of the tunnel and measuring the amount of infra-red light absorbed by CO molecules in the path of the beam. The quantity of infra-red light absorbed is proportional to the concentration of CO in the path of the beam. The monitors used were specially designed for use in road tunnels where access for routine essential maintenance is restricted by the need to minimise traffic disruption. Similar monitors are widely used in other road tunnels in Australia and worldwide.

This method of analysis is similar to the standard method AM-6 outlined in “NSW EPA 2001, Approved Methods for Sampling and Analysis of Pollutants in New South Wales.” However the method differs from the standard principally by the use of the open beam type instrument as described above in place of a closed analytical cell and sample delivery pump as typically used in ambient air monitoring stations. This deviation from the standard method has been approved by the Department of Planning on the advice of an independent consultant with specialist expertise in the field of air quality monitoring.

The number and locations of the CO monitors has been selected using computer generated modelling to provide a representative profile of CO levels inside the tunnel.

4.2. Presentation of Measurement Results

The monitors provide continual measurements of CO at the point location in the tunnel where they are installed. These measurements are termed **single point concentrations**.

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The monitoring system has also been configured using continuous measurements of traffic flow from speed sensors in the tunnel to calculate the exposure to CO of a theoretical motorist travelling through the tunnel every minute using every possible entry/exit portal combination. These measurements are termed **exposure concentrations**.

4.3. Limits

The Department of Planning have stipulated Limits which air quality inside the tunnel must meet. These limits relate to the maximum concentration of carbon monoxide (CO) in air inside the tunnel and are presented in table 1 below:

Table 1: Department of Planning stipulated limits for CO inside tunnel

Single Point Concentration Limit (as 3 Minute Rolling Average)	Exposure Concentration Limit (as 15 Minute Rolling Average)	Exposure Concentration Limit (as 15 Minute Rolling Average)
200 ppm CO	87 ppm CO	50 ppm CO

4.4. Calibration and Maintenance

All instruments were calibrated following installation and will continue to be routinely calibrated on a schedule not exceeding 12 months between re-calibrations. The sensors are maintained according to a schedule recommended by the manufacturer. To minimise traffic disruption to motorists and provide a safe working environment for instrument technicians, maintenance and calibration is usually only performed during scheduled night time maintenance closures of the tunnel.

4.5. Data Validation

The monitoring data is subjected to a validation procedure prior to reporting where it is inspected to ensure that it is representative of CO levels experienced inside the tunnel at the time of measurement.

5. RESULTS

The results of the monitoring are tabulated in table 2 and plotted in figure 1.

The figures presented in table 2 (and figure 1) are the maximum values recorded for all sections of the tunnel for each hourly period starting from the times tabulated.

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Table 2: Results of In Tunnel Air Quality Monitoring from 01 June to 30 June 2009

		Max Single Point CO Concentration (3 Minute Rolling Average) ppm	Max CO Exposure Concentration (15 Minute Rolling Average) ppm	Max CO Exposure Concentration (30 Minute Rolling Average) ppm
		Limits		
Date	Time	200	87	50
01-Jun-2009	+00:00	2.1	0.2	0.1
01-Jun-2009	+01:00	2.0	0.2	0.1
01-Jun-2009	+02:00	1.2	0.2	0.1
01-Jun-2009	+03:00	2.4	0.3	0.1
01-Jun-2009	+04:00	3.1	0.2	0.1
01-Jun-2009	+05:00	9.0	0.8	0.4
01-Jun-2009	+06:00	26.8	1.8	0.9
01-Jun-2009	+07:00	21.3	1.2	0.6
01-Jun-2009	+08:00	22.8	0.7	0.3
01-Jun-2009	+09:00	26.2	3.1	1.6
01-Jun-2009	+10:00	22.1	0.5	0.2
01-Jun-2009	+11:00	11.6	0.7	0.4
01-Jun-2009	+12:00	8.2	0.7	0.4
01-Jun-2009	+13:00	12.0	0.5	0.2
01-Jun-2009	+14:00	15.4	0.7	0.3
01-Jun-2009	+15:00	15.0	0.8	0.4
01-Jun-2009	+16:00	16.9	0.8	0.4
01-Jun-2009	+17:00	16.0	0.7	0.3
01-Jun-2009	+18:00	23.4	0.6	0.3
01-Jun-2009	+19:00	6.1	0.5	0.2
01-Jun-2009	+20:00	3.2	0.4	0.2
01-Jun-2009	+21:00	2.2	0.3	0.1
01-Jun-2009	+22:00	2.2	0.2	0.1
01-Jun-2009	+23:00	2.6	0.3	0.2
02-Jun-2009	+00:00	4.1	0.3	0.2
02-Jun-2009	+01:00	3.2	0.4	0.2
02-Jun-2009	+02:00	4.2	0.2	0.1
02-Jun-2009	+03:00	3.2	0.4	0.2
02-Jun-2009	+04:00	2.2	0.8	0.4
02-Jun-2009	+05:00	7.0	0.6	0.3
02-Jun-2009	+06:00	20.5	2.2	1.1
02-Jun-2009	+07:00	15.8	1.3	0.7
02-Jun-2009	+08:00	22.7	0.8	0.4
02-Jun-2009	+09:00	21.8	1.1	0.5
02-Jun-2009	+10:00	12.3	0.5	0.3
02-Jun-2009	+11:00	11.6	1.9	1.6
02-Jun-2009	+12:00	12.1	1.2	0.9
02-Jun-2009	+13:00	15.0	0.6	0.3
02-Jun-2009	+14:00	20.3	0.8	0.4
02-Jun-2009	+15:00	15.8	0.9	0.4
02-Jun-2009	+16:00	16.0	1.0	0.5
02-Jun-2009	+17:00	16.6	0.6	0.3

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02-Jun-2009	+18:00	24.5	1.1	0.6
02-Jun-2009	+19:00	12.1	0.3	0.2
02-Jun-2009	+20:00	8.1	1.0	0.5
02-Jun-2009	+21:00	6.3	0.4	0.2
02-Jun-2009	+22:00	4.2	0.4	0.2
02-Jun-2009	+23:00	2.2	1.0	0.6
03-Jun-2009	+00:00	3.1	0.3	0.3
03-Jun-2009	+01:00	2.2	0.5	0.2
03-Jun-2009	+02:00	1.4	0.5	0.5
03-Jun-2009	+03:00	1.4	0.5	0.5
03-Jun-2009	+04:00	2.4	0.5	0.5
03-Jun-2009	+05:00	7.5	0.9	0.4
03-Jun-2009	+06:00	25.2	1.7	0.8
03-Jun-2009	+07:00	14.2	1.5	0.7
03-Jun-2009	+08:00	18.6	0.9	0.5
03-Jun-2009	+09:00	18.1	1.5	0.8
03-Jun-2009	+10:00	16.1	0.5	0.3
03-Jun-2009	+11:00	12.1	3.5	1.8
03-Jun-2009	+12:00	8.2	0.9	0.5
03-Jun-2009	+13:00	11.4	1.3	0.8
03-Jun-2009	+14:00	15.1	0.7	0.4
03-Jun-2009	+15:00	18.4	1.1	0.5
03-Jun-2009	+16:00	18.9	0.8	0.4
03-Jun-2009	+17:00	22.5	0.8	0.4
03-Jun-2009	+18:00	18.9	0.6	0.3
03-Jun-2009	+19:00	5.2	0.4	0.2
03-Jun-2009	+20:00	3.1	0.3	0.1
03-Jun-2009	+21:00	2.2	0.8	0.6
03-Jun-2009	+22:00	2.5	0.6	0.5
03-Jun-2009	+23:00	2.5	0.6	0.5
04-Jun-2009	+00:00	4.2	0.4	0.3
04-Jun-2009	+01:00	3.2	0.4	0.3
04-Jun-2009	+02:00	2.2	0.2	0.2
04-Jun-2009	+03:00	2.2	0.2	0.2
04-Jun-2009	+04:00	4.2	0.8	0.7
04-Jun-2009	+05:00	9.2	0.9	0.4
04-Jun-2009	+06:00	25.3	2.1	1.0
04-Jun-2009	+07:00	15.8	1.7	0.9
04-Jun-2009	+08:00	17.1	1.5	0.7
04-Jun-2009	+09:00	20.5	0.7	0.4
04-Jun-2009	+10:00	11.8	0.6	0.3
04-Jun-2009	+11:00	12.1	0.6	0.3
04-Jun-2009	+12:00	11.2	0.5	0.3
04-Jun-2009	+13:00	12.1	0.6	0.3
04-Jun-2009	+14:00	22.5	0.8	0.4
04-Jun-2009	+15:00	22.4	1.2	0.6
04-Jun-2009	+16:00	18.1	0.9	0.5
04-Jun-2009	+17:00	20.9	0.9	0.4
04-Jun-2009	+18:00	24.0	0.6	0.3
04-Jun-2009	+19:00	21.1	0.3	0.2
04-Jun-2009	+20:00	3.9	0.5	0.2
04-Jun-2009	+21:00	2.9	1.2	0.7

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04-Jun-2009	+23:00	4.2	0.4	0.2
05-Jun-2009	+00:00	4.9	0.6	0.5
05-Jun-2009	+01:00	3.2	0.4	0.4
05-Jun-2009	+02:00	3.2	0.2	0.1
05-Jun-2009	+03:00	3.2	0.2	0.1
05-Jun-2009	+04:00	3.2	0.2	0.1
05-Jun-2009	+05:00	11.4	0.8	0.4
05-Jun-2009	+06:00	20.8	1.7	0.8
05-Jun-2009	+07:00	22.3	1.5	0.8
05-Jun-2009	+08:00	21.1	0.8	0.4
05-Jun-2009	+09:00	19.6	0.9	0.4
05-Jun-2009	+10:00	13.2	0.7	0.4
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05-Jun-2009	+17:00	25.0	0.7	0.3
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05-Jun-2009	+21:00	2.6	0.2	0.1
05-Jun-2009	+22:00	2.2	0.3	0.1
05-Jun-2009	+23:00	2.0	0.2	0.1
06-Jun-2009	+00:00	3.2	0.4	0.2
06-Jun-2009	+01:00	3.2	0.6	0.3
06-Jun-2009	+02:00	2.2	0.5	0.2
06-Jun-2009	+03:00	2.2	0.2	0.1
06-Jun-2009	+04:00	3.0	0.4	0.2
06-Jun-2009	+05:00	3.2	0.4	0.2
06-Jun-2009	+06:00	6.5	0.7	0.3
06-Jun-2009	+07:00	7.1	0.6	0.3
06-Jun-2009	+08:00	4.6	0.6	0.3
06-Jun-2009	+09:00	5.5	0.6	0.3
06-Jun-2009	+10:00	8.9	0.7	0.3
06-Jun-2009	+11:00	8.2	0.5	0.2
06-Jun-2009	+12:00	12.0	0.6	0.3
06-Jun-2009	+13:00	10.0	0.4	0.2
06-Jun-2009	+14:00	9.2	0.5	0.2
06-Jun-2009	+15:00	8.5	0.8	0.4
06-Jun-2009	+16:00	9.0	1.5	0.7
06-Jun-2009	+17:00	7.8	0.5	0.3
06-Jun-2009	+18:00	5.1	0.5	0.2
06-Jun-2009	+19:00	4.1	0.5	0.2
06-Jun-2009	+20:00	2.2	0.3	0.2
06-Jun-2009	+21:00	3.1	0.4	0.2
06-Jun-2009	+22:00	3.0	0.4	0.2
06-Jun-2009	+23:00	4.6	0.3	0.2
07-Jun-2009	+00:00	2.5	0.4	0.2
07-Jun-2009	+01:00	2.4	0.3	0.2

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07-Jun-2009	+04:00	2.2	0.3	0.1
07-Jun-2009	+05:00	3.2	0.4	0.2
07-Jun-2009	+06:00	2.2	0.2	0.1
07-Jun-2009	+07:00	3.1	0.4	0.2
07-Jun-2009	+08:00	2.4	0.4	0.2
07-Jun-2009	+09:00	4.1	0.4	0.2
07-Jun-2009	+10:00	5.8	0.4	0.2
07-Jun-2009	+11:00	6.5	0.5	0.2
07-Jun-2009	+12:00	9.1	0.8	0.4
07-Jun-2009	+13:00	5.5	0.5	0.2
07-Jun-2009	+14:00	5.7	0.7	0.4
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07-Jun-2009	+20:00	4.1	0.2	0.1
07-Jun-2009	+21:00	5.1	0.4	0.2
07-Jun-2009	+22:00	5.1	0.9	0.8
07-Jun-2009	+23:00	2.3	1.0	0.8
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08-Jun-2009	+01:00	1.5	0.2	0.1
08-Jun-2009	+02:00	2.2	0.3	0.1
08-Jun-2009	+03:00	2.2	0.2	0.1
08-Jun-2009	+04:00	3.2	0.3	0.2
08-Jun-2009	+05:00	2.2	0.3	0.1
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08-Jun-2009	+22:00	3.2	2.0	1.8
08-Jun-2009	+23:00	4.0	2.1	2.0
09-Jun-2009	+00:00	2.3	2.1	1.4
09-Jun-2009	+01:00	2.2	0.8	0.8
09-Jun-2009	+02:00	2.1	0.3	0.3
09-Jun-2009	+03:00	1.4	0.3	0.3
09-Jun-2009	+04:00	2.2	0.8	0.5
09-Jun-2009	+05:00	9.1	0.8	0.4

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09-Jun-2009	+06:00	18.2	2.9	2.8
09-Jun-2009	+07:00	14.4	2.9	2.8
09-Jun-2009	+08:00	22.8	0.9	0.5
09-Jun-2009	+09:00	17.5	1.1	0.8
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09-Jun-2009	+19:00	6.9	2.9	2.4
09-Jun-2009	+20:00	7.4	1.0	1.0
09-Jun-2009	+21:00	3.1	0.7	0.7
09-Jun-2009	+22:00	1.5	0.0	0.0
09-Jun-2009	+23:00	6.0	0.0	0.0
10-Jun-2009	+00:00	2.2	0.3	0.1
10-Jun-2009	+01:00	0.8	0.3	0.3
10-Jun-2009	+02:00	1.2	0.3	0.2
10-Jun-2009	+03:00	2.2	0.9	0.6
10-Jun-2009	+04:00	3.4	0.5	0.3
10-Jun-2009	+05:00	7.1	0.9	0.4
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10-Jun-2009	+07:00	14.6	1.2	0.6
10-Jun-2009	+08:00	22.0	1.0	0.5
10-Jun-2009	+09:00	18.4	0.6	0.3
10-Jun-2009	+10:00	15.0	0.6	0.3
10-Jun-2009	+11:00	7.8	1.2	1.1
10-Jun-2009	+12:00	10.1	1.1	0.9
10-Jun-2009	+13:00	14.9	0.4	0.2
10-Jun-2009	+14:00	16.1	0.7	0.4
10-Jun-2009	+15:00	15.5	2.0	1.6
10-Jun-2009	+16:00	15.9	2.4	2.2
10-Jun-2009	+17:00	19.5	0.6	0.3
10-Jun-2009	+18:00	20.8	0.5	0.2
10-Jun-2009	+19:00	3.4	0.3	0.1
10-Jun-2009	+20:00	3.2	0.5	0.2
10-Jun-2009	+21:00	6.2	0.5	0.3
10-Jun-2009	+22:00	5.2	0.5	0.3
10-Jun-2009	+23:00	2.3	0.3	0.1
11-Jun-2009	+00:00	3.2	0.3	0.1
11-Jun-2009	+01:00	5.2	0.2	0.1
11-Jun-2009	+02:00	6.2	0.2	0.1
11-Jun-2009	+03:00	5.5	0.3	0.1
11-Jun-2009	+04:00	6.1	0.5	0.2
11-Jun-2009	+05:00	9.1	0.8	0.4
11-Jun-2009	+06:00	18.3	1.7	0.8
11-Jun-2009	+07:00	12.2	1.1	0.6
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11-Jun-2009	+09:00	23.1	0.6	0.3

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11-Jun-2009	+10:00	13.2	0.6	0.3
11-Jun-2009	+11:00	10.5	0.4	0.2
11-Jun-2009	+12:00	12.1	0.6	0.3
11-Jun-2009	+13:00	16.8	0.5	0.3
11-Jun-2009	+14:00	21.4	0.7	0.3
11-Jun-2009	+15:00	21.8	1.0	0.5
11-Jun-2009	+16:00	27.0	0.9	0.5
11-Jun-2009	+17:00	27.4	0.9	0.4
11-Jun-2009	+18:00	25.4	0.6	0.3
11-Jun-2009	+19:00	16.3	0.4	0.2
11-Jun-2009	+20:00	7.1	0.5	0.3
11-Jun-2009	+21:00	4.1	2.0	1.5
11-Jun-2009	+22:00	4.2	0.3	0.2
11-Jun-2009	+23:00	4.2	0.5	0.3
12-Jun-2009	+00:00	2.2	0.5	0.4
12-Jun-2009	+01:00	1.8	0.2	0.1
12-Jun-2009	+02:00	3.6	0.1	0.1
12-Jun-2009	+03:00	1.5	0.1	0.1
12-Jun-2009	+04:00	3.4	0.3	0.2
12-Jun-2009	+05:00	8.2	0.8	0.4
12-Jun-2009	+06:00	24.8	1.8	0.9
12-Jun-2009	+07:00	17.4	1.2	0.6
12-Jun-2009	+08:00	19.7	0.8	0.4
12-Jun-2009	+09:00	19.0	0.8	0.4
12-Jun-2009	+10:00	15.1	0.5	0.2
12-Jun-2009	+11:00	13.1	0.7	0.3
12-Jun-2009	+12:00	16.1	0.5	0.2
12-Jun-2009	+13:00	16.9	0.7	0.3
12-Jun-2009	+14:00	21.6	1.6	0.8
12-Jun-2009	+15:00	20.7	1.0	0.5
12-Jun-2009	+16:00	21.1	0.9	0.5
12-Jun-2009	+17:00	31.7	0.9	0.5
12-Jun-2009	+18:00	32.6	0.7	0.4
12-Jun-2009	+19:00	10.2	0.5	0.3
12-Jun-2009	+20:00	3.7	0.5	0.2
12-Jun-2009	+21:00	3.2	0.3	0.2
12-Jun-2009	+22:00	2.2	0.3	0.1
12-Jun-2009	+23:00	1.8	0.7	0.5
13-Jun-2009	+00:00	2.2	1.1	1.0
13-Jun-2009	+01:00	4.2	0.3	0.3
13-Jun-2009	+02:00	7.3	0.3	0.2
13-Jun-2009	+03:00	7.2	0.3	0.1
13-Jun-2009	+04:00	5.1	0.3	0.2
13-Jun-2009	+05:00	5.1	0.3	0.2
13-Jun-2009	+06:00	8.6	0.7	0.3
13-Jun-2009	+07:00	7.2	0.6	0.3
13-Jun-2009	+08:00	7.2	0.6	0.3
13-Jun-2009	+09:00	7.6	0.5	0.3
13-Jun-2009	+10:00	8.1	0.4	0.2
13-Jun-2009	+11:00	9.1	0.5	0.2
13-Jun-2009	+12:00	12.4	0.6	0.3
13-Jun-2009	+13:00	12.5	0.5	0.3

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13-Jun-2009	+14:00	10.1	0.5	0.2
13-Jun-2009	+15:00	11.8	0.4	0.2
13-Jun-2009	+16:00	7.1	0.5	0.3
13-Jun-2009	+17:00	8.6	2.8	1.4
13-Jun-2009	+18:00	5.1	1.7	0.8
13-Jun-2009	+19:00	3.4	0.5	0.2
13-Jun-2009	+20:00	4.9	0.3	0.1
13-Jun-2009	+21:00	3.2	0.3	0.1
13-Jun-2009	+22:00	5.1	0.5	0.3
13-Jun-2009	+23:00	2.1	1.0	0.8
14-Jun-2009	+00:00	2.7	1.7	1.5
14-Jun-2009	+01:00	3.4	1.0	0.9
14-Jun-2009	+02:00	4.2	1.4	1.1
14-Jun-2009	+03:00	5.0	0.3	0.1
14-Jun-2009	+04:00	5.1	0.4	0.2
14-Jun-2009	+05:00	7.2	0.3	0.2
14-Jun-2009	+06:00	5.7	0.4	0.2
14-Jun-2009	+07:00	5.4	0.4	0.2
14-Jun-2009	+08:00	6.8	0.5	0.3
14-Jun-2009	+09:00	8.1	0.7	0.4
14-Jun-2009	+10:00	4.8	0.4	0.2
14-Jun-2009	+11:00	6.2	0.5	0.3
14-Jun-2009	+12:00	13.2	2.2	1.1
14-Jun-2009	+13:00	8.5	0.8	0.4
14-Jun-2009	+14:00	4.8	0.4	0.2
14-Jun-2009	+15:00	7.0	0.9	0.4
14-Jun-2009	+16:00	8.2	0.7	0.3
14-Jun-2009	+17:00	12.0	1.0	0.5
14-Jun-2009	+18:00	13.7	0.6	0.3
14-Jun-2009	+19:00	2.3	0.4	0.2
14-Jun-2009	+20:00	10.6	0.3	0.1
14-Jun-2009	+21:00	3.1	0.3	0.2
14-Jun-2009	+22:00	2.2	0.2	0.1
14-Jun-2009	+23:00	2.7	0.2	0.1
15-Jun-2009	+00:00	4.8	0.2	0.1
15-Jun-2009	+01:00	2.2	0.2	0.1
15-Jun-2009	+02:00	1.4	0.1	0.1
15-Jun-2009	+03:00	2.2	0.2	0.1
15-Jun-2009	+04:00	3.2	0.3	0.1
15-Jun-2009	+05:00	5.8	0.6	0.3
15-Jun-2009	+06:00	35.3	2.0	1.0
15-Jun-2009	+07:00	34.3	1.4	0.7
15-Jun-2009	+08:00	24.9	1.1	0.5
15-Jun-2009	+09:00	34.2	1.2	0.8
15-Jun-2009	+10:00	31.5	0.7	0.3
15-Jun-2009	+11:00	7.2	0.6	0.3
15-Jun-2009	+12:00	3.8	0.5	0.2
15-Jun-2009	+13:00	13.2	0.5	0.2
15-Jun-2009	+14:00	12.3	0.4	0.2
15-Jun-2009	+15:00	11.2	0.6	0.3
15-Jun-2009	+16:00	13.1	0.9	0.5
15-Jun-2009	+17:00	10.8	1.1	0.4

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15-Jun-2009	+18:00	10.4	0.6	0.3
15-Jun-2009	+19:00	3.1	0.4	0.2
15-Jun-2009	+20:00	4.0	0.6	0.3
15-Jun-2009	+21:00	3.3	0.3	0.1
15-Jun-2009	+22:00	4.6	0.4	0.2
15-Jun-2009	+23:00	1.6	0.1	0.1
16-Jun-2009	+00:00	2.2	0.2	0.1
16-Jun-2009	+01:00	3.2	0.1	0.1
16-Jun-2009	+02:00	3.2	0.5	0.2
16-Jun-2009	+03:00	3.2	0.1	0.1
16-Jun-2009	+04:00	4.5	0.3	0.1
16-Jun-2009	+05:00	6.4	0.8	0.4
16-Jun-2009	+06:00	27.1	2.0	1.0
16-Jun-2009	+07:00	18.0	1.0	0.5
16-Jun-2009	+08:00	10.0	0.6	0.3
16-Jun-2009	+09:00	6.7	1.3	0.8
16-Jun-2009	+10:00	4.4	0.7	0.3
16-Jun-2009	+11:00	5.1	0.5	0.3
16-Jun-2009	+12:00	4.2	0.4	0.2
16-Jun-2009	+13:00	4.2	0.5	0.3
16-Jun-2009	+14:00	8.0	0.6	0.3
16-Jun-2009	+15:00	20.4	1.2	0.6
16-Jun-2009	+16:00	20.4	0.8	0.4
16-Jun-2009	+17:00	16.1	0.9	0.4
16-Jun-2009	+18:00	15.1	0.6	0.3
16-Jun-2009	+19:00	3.2	0.3	0.2
16-Jun-2009	+20:00	3.2	0.3	0.1
16-Jun-2009	+21:00	3.1	0.3	0.2
16-Jun-2009	+22:00	3.2	0.2	0.1
16-Jun-2009	+23:00	5.2	0.7	0.5
17-Jun-2009	+00:00	2.6	0.3	0.4
17-Jun-2009	+01:00	2.2	0.9	0.8
17-Jun-2009	+02:00	1.9	0.2	0.3
17-Jun-2009	+03:00	1.3	0.2	0.2
17-Jun-2009	+04:00	3.2	0.4	0.2
17-Jun-2009	+05:00	6.0	0.7	0.4
17-Jun-2009	+06:00	26.9	1.8	0.9
17-Jun-2009	+07:00	19.2	1.4	0.7
17-Jun-2009	+08:00	12.2	0.9	0.4
17-Jun-2009	+09:00	10.3	0.8	0.4
17-Jun-2009	+10:00	12.1	0.8	0.4
17-Jun-2009	+11:00	5.0	0.6	0.3
17-Jun-2009	+12:00	6.6	0.9	0.5
17-Jun-2009	+13:00	7.4	1.4	1.2
17-Jun-2009	+14:00	13.9	0.7	0.7
17-Jun-2009	+15:00	18.3	1.0	0.5
17-Jun-2009	+16:00	19.0	0.8	0.4
17-Jun-2009	+17:00	18.2	0.6	0.3
17-Jun-2009	+18:00	5.0	0.5	0.3
17-Jun-2009	+19:00	5.1	0.5	0.3
17-Jun-2009	+20:00	7.3	0.3	0.2
17-Jun-2009	+21:00	2.2	0.2	0.1

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17-Jun-2009	+22:00	3.2	0.3	0.2
17-Jun-2009	+23:00	3.2	0.8	0.8
18-Jun-2009	+00:00	1.7	0.8	0.8
18-Jun-2009	+01:00	1.4	0.1	0.1
18-Jun-2009	+02:00	1.4	0.1	0.1
18-Jun-2009	+03:00	1.7	0.1	0.1
18-Jun-2009	+04:00	3.2	0.3	0.2
18-Jun-2009	+05:00	6.3	0.6	0.3
18-Jun-2009	+06:00	21.9	4.0	2.4
18-Jun-2009	+07:00	18.9	5.0	3.1
18-Jun-2009	+08:00	12.8	3.0	1.5
18-Jun-2009	+09:00	8.4	1.0	0.5
18-Jun-2009	+10:00	7.0	0.7	0.4
18-Jun-2009	+11:00	7.8	1.3	0.7
18-Jun-2009	+12:00	5.7	1.0	0.5
18-Jun-2009	+13:00	6.0	1.1	0.5
18-Jun-2009	+14:00	14.4	0.7	0.4
18-Jun-2009	+15:00	18.3	1.4	0.7
18-Jun-2009	+16:00	19.2	1.4	0.7
18-Jun-2009	+17:00	15.6	1.6	0.8
18-Jun-2009	+18:00	7.1	1.4	0.7
18-Jun-2009	+19:00	2.5	0.4	0.2
18-Jun-2009	+20:00	2.3	0.3	0.1
18-Jun-2009	+21:00	4.1	0.5	0.3
18-Jun-2009	+22:00	5.0	0.4	0.2
18-Jun-2009	+23:00	3.7	0.1	0.1
19-Jun-2009	+00:00	2.2	0.2	0.1
19-Jun-2009	+01:00	3.2	0.1	0.1
19-Jun-2009	+02:00	5.1	0.3	0.2
19-Jun-2009	+03:00	3.2	0.2	0.1
19-Jun-2009	+04:00	15.2	0.5	0.3
19-Jun-2009	+05:00	8.0	0.8	0.4
19-Jun-2009	+06:00	22.6	5.8	2.9
19-Jun-2009	+07:00	25.3	3.6	2.5
19-Jun-2009	+08:00	11.6	1.9	0.9
19-Jun-2009	+09:00	10.3	1.3	0.7
19-Jun-2009	+10:00	13.1	0.8	0.4
19-Jun-2009	+11:00	12.2	0.6	0.3
19-Jun-2009	+12:00	8.0	0.6	0.3
19-Jun-2009	+13:00	6.1	1.3	0.9
19-Jun-2009	+14:00	16.1	1.8	1.4
19-Jun-2009	+15:00	15.6	1.3	0.6
19-Jun-2009	+16:00	16.6	1.5	0.8
19-Jun-2009	+17:00	15.1	0.9	0.5
19-Jun-2009	+18:00	33.5	0.9	0.5
19-Jun-2009	+19:00	15.2	0.9	0.4
19-Jun-2009	+20:00	8.3	0.9	0.4
19-Jun-2009	+21:00	6.4	0.4	0.2
19-Jun-2009	+22:00	5.9	0.3	0.2
19-Jun-2009	+23:00	5.1	0.2	0.1
20-Jun-2009	+00:00	2.4	0.9	0.5
20-Jun-2009	+01:00	2.6	0.3	0.2

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20-Jun-2009	+02:00	4.7	0.5	0.3
20-Jun-2009	+03:00	4.2	0.2	0.1
20-Jun-2009	+04:00	5.0	0.3	0.1
20-Jun-2009	+05:00	5.1	0.4	0.2
20-Jun-2009	+06:00	8.2	0.7	0.4
20-Jun-2009	+07:00	8.1	0.8	0.4
20-Jun-2009	+08:00	6.4	0.6	0.3
20-Jun-2009	+09:00	8.7	1.1	1.0
20-Jun-2009	+10:00	9.5	0.8	0.9
20-Jun-2009	+11:00	6.4	0.8	0.8
20-Jun-2009	+12:00	5.7	0.9	0.9
20-Jun-2009	+13:00	4.7	0.9	0.9
20-Jun-2009	+14:00	6.2	1.1	1.0
20-Jun-2009	+15:00	5.9	0.6	0.4
20-Jun-2009	+16:00	3.1	0.5	0.2
20-Jun-2009	+17:00	6.7	0.9	0.4
20-Jun-2009	+18:00	5.7	0.6	0.3
20-Jun-2009	+19:00	2.2	0.3	0.1
20-Jun-2009	+20:00	4.2	0.4	0.2
20-Jun-2009	+21:00	5.9	0.5	0.2
20-Jun-2009	+22:00	6.2	0.4	0.2
20-Jun-2009	+23:00	4.5	0.3	0.2
21-Jun-2009	+00:00	3.2	0.4	0.2
21-Jun-2009	+01:00	2.5	0.3	0.2
21-Jun-2009	+02:00	2.7	0.4	0.2
21-Jun-2009	+03:00	3.2	0.3	0.1
21-Jun-2009	+04:00	4.6	0.3	0.1
21-Jun-2009	+05:00	6.6	0.5	0.2
21-Jun-2009	+06:00	6.1	0.4	0.2
21-Jun-2009	+07:00	3.2	0.3	0.2
21-Jun-2009	+08:00	4.8	0.4	0.2
21-Jun-2009	+09:00	3.9	0.4	0.2
21-Jun-2009	+10:00	3.3	0.4	0.2
21-Jun-2009	+11:00	7.3	0.7	0.4
21-Jun-2009	+12:00	3.8	0.5	0.2
21-Jun-2009	+13:00	5.2	0.6	0.3
21-Jun-2009	+14:00	6.8	0.9	0.4
21-Jun-2009	+15:00	5.0	0.4	0.2
21-Jun-2009	+16:00	6.0	0.7	0.3
21-Jun-2009	+17:00	8.2	1.3	0.8
21-Jun-2009	+18:00	9.2	0.5	0.2
21-Jun-2009	+19:00	3.0	0.4	0.2
21-Jun-2009	+20:00	3.2	0.4	0.2
21-Jun-2009	+21:00	2.2	0.3	0.1
21-Jun-2009	+22:00	3.2	0.3	0.2
21-Jun-2009	+23:00	1.2	0.2	0.1
22-Jun-2009	+00:00	2.2	0.2	0.1
22-Jun-2009	+01:00	1.2	0.2	0.1
22-Jun-2009	+02:00	1.2	0.1	0.1
22-Jun-2009	+03:00	1.2	0.2	0.1
22-Jun-2009	+04:00	2.8	0.3	0.1
22-Jun-2009	+05:00	10.9	1.2	0.6

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22-Jun-2009	+06:00	26.8	3.9	2.0
22-Jun-2009	+07:00	31.4	4.0	2.0
22-Jun-2009	+08:00	9.0	2.1	1.0
22-Jun-2009	+09:00	7.0	1.1	0.6
22-Jun-2009	+10:00	7.2	0.6	0.3
22-Jun-2009	+11:00	2.9	0.5	0.5
22-Jun-2009	+12:00	4.8	0.7	0.4
22-Jun-2009	+13:00	4.2	0.9	0.7
22-Jun-2009	+14:00	7.8	1.0	0.9
22-Jun-2009	+15:00	20.2	1.7	1.6
22-Jun-2009	+16:00	19.5	1.6	1.6
22-Jun-2009	+17:00	14.0	0.6	0.3
22-Jun-2009	+18:00	6.1	0.9	0.4
22-Jun-2009	+19:00	2.2	0.3	0.1
22-Jun-2009	+20:00	2.4	0.4	0.2
22-Jun-2009	+21:00	2.8	0.3	0.1
22-Jun-2009	+22:00	2.7	0.3	0.1
22-Jun-2009	+23:00	2.3	0.2	0.1
23-Jun-2009	+00:00	31.4	27.3	13.7
23-Jun-2009	+01:00	7.0	0.5	0.3
23-Jun-2009	+02:00	2.2	0.4	0.2
23-Jun-2009	+03:00	3.7	0.2	0.1
23-Jun-2009	+04:00	2.2	0.4	0.2
23-Jun-2009	+05:00	7.3	0.8	0.4
23-Jun-2009	+06:00	23.8	6.9	4.6
23-Jun-2009	+07:00	22.8	4.0	3.8
23-Jun-2009	+08:00	11.1	4.3	4.2
23-Jun-2009	+09:00	9.3	1.0	0.7
23-Jun-2009	+10:00	7.9	0.8	0.8
23-Jun-2009	+11:00	13.3	1.5	0.8
23-Jun-2009	+12:00	8.2	0.9	0.4
23-Jun-2009	+13:00	6.1	0.5	0.2
23-Jun-2009	+14:00	14.7	0.7	0.3
23-Jun-2009	+15:00	14.6	1.2	0.6
23-Jun-2009	+16:00	14.4	1.1	0.5
23-Jun-2009	+17:00	14.6	2.9	2.2
23-Jun-2009	+18:00	6.1	0.5	0.2
23-Jun-2009	+19:00	3.2	0.5	0.2
23-Jun-2009	+20:00	5.1	3.1	2.4
23-Jun-2009	+21:00	3.2	0.3	0.1
23-Jun-2009	+22:00	2.7	0.8	0.4
23-Jun-2009	+23:00	80.0	8.7	4.4
24-Jun-2009	+00:00	1.4	0.6	0.3
24-Jun-2009	+01:00	1.8	0.2	0.1
24-Jun-2009	+02:00	1.4	0.2	0.1
24-Jun-2009	+03:00	1.3	0.1	0.0
24-Jun-2009	+04:00	1.3	0.2	0.1
24-Jun-2009	+05:00	10.1	1.3	0.6
24-Jun-2009	+06:00	25.7	5.0	2.6
24-Jun-2009	+07:00	14.3	5.4	4.7
24-Jun-2009	+08:00	10.1	3.3	4.1
24-Jun-2009	+09:00	8.0	1.2	0.6

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24-Jun-2009	+10:00	11.0	1.0	0.5
24-Jun-2009	+11:00	10.2	0.9	0.4
24-Jun-2009	+12:00	8.5	1.0	0.5
24-Jun-2009	+13:00	4.1	0.5	0.3
24-Jun-2009	+14:00	14.2	0.7	0.4
24-Jun-2009	+15:00	17.4	1.1	0.5
24-Jun-2009	+16:00	17.2	1.6	0.8
24-Jun-2009	+17:00	17.2	1.3	0.6
24-Jun-2009	+18:00	9.8	0.6	0.3
24-Jun-2009	+19:00	4.1	0.4	0.2
24-Jun-2009	+20:00	3.1	0.4	0.2
24-Jun-2009	+21:00	2.1	0.3	0.1
24-Jun-2009	+22:00	1.9	0.2	0.1
24-Jun-2009	+23:00	1.4	0.2	0.1
25-Jun-2009	+00:00	2.1	0.3	0.2
25-Jun-2009	+01:00	1.4	0.3	0.1
25-Jun-2009	+02:00	1.4	0.2	0.1
25-Jun-2009	+03:00	8.6	0.4	0.2
25-Jun-2009	+04:00	8.8	0.5	0.2
25-Jun-2009	+05:00	10.4	0.8	0.4
25-Jun-2009	+06:00	22.7	4.1	2.4
25-Jun-2009	+07:00	25.8	3.0	1.7
25-Jun-2009	+08:00	12.2	2.6	1.3
25-Jun-2009	+09:00	8.9	1.3	0.7
25-Jun-2009	+10:00	6.9	0.8	0.4
25-Jun-2009	+11:00	5.6	2.3	1.9
25-Jun-2009	+12:00	6.7	4.7	4.1
25-Jun-2009	+13:00	8.8	6.3	5.4
25-Jun-2009	+14:00	13.3	0.6	0.3
25-Jun-2009	+15:00	16.3	1.2	0.6
25-Jun-2009	+16:00	15.1	1.2	0.6
25-Jun-2009	+17:00	15.4	1.2	0.6
25-Jun-2009	+18:00	14.2	1.0	0.5
25-Jun-2009	+19:00	4.8	0.5	0.2
25-Jun-2009	+20:00	5.1	0.5	0.3
25-Jun-2009	+21:00	5.1	0.5	0.3
25-Jun-2009	+22:00	5.9	0.2	0.1
25-Jun-2009	+23:00	11.9	1.1	0.8
26-Jun-2009	+00:00	4.2	1.1	1.1
26-Jun-2009	+01:00			
26-Jun-2009	+02:00	1.9	1.0	0.7
26-Jun-2009	+03:00	2.0	0.2	0.2
26-Jun-2009	+04:00	1.8	0.3	0.1
26-Jun-2009	+05:00	7.0	0.6	0.3
26-Jun-2009	+06:00	31.6	5.5	2.8
26-Jun-2009	+07:00	28.8	3.7	2.7
26-Jun-2009	+08:00	12.5	1.9	0.9
26-Jun-2009	+09:00	6.1	0.9	0.5
26-Jun-2009	+10:00	8.6	0.6	0.3
26-Jun-2009	+11:00	13.8	1.0	0.5
26-Jun-2009	+12:00	12.8	1.3	0.7
26-Jun-2009	+13:00	10.6	0.5	0.3

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26-Jun-2009	+14:00	12.5	1.1	0.5
26-Jun-2009	+15:00	13.6	1.3	0.7
26-Jun-2009	+16:00	13.5	1.4	0.7
26-Jun-2009	+17:00	14.2	1.2	0.6
26-Jun-2009	+18:00	12.6	1.1	0.5
26-Jun-2009	+19:00	4.7	0.5	0.2
26-Jun-2009	+20:00	4.1	0.4	0.2
26-Jun-2009	+21:00	4.1	0.3	0.1
26-Jun-2009	+22:00	5.1	0.5	0.2
26-Jun-2009	+23:00	4.2	0.3	0.2
27-Jun-2009	+00:00	4.8	0.4	0.2
27-Jun-2009	+01:00	3.1	0.4	0.2
27-Jun-2009	+02:00	3.1	0.3	0.2
27-Jun-2009	+03:00	1.5	0.3	0.1
27-Jun-2009	+04:00	3.9	0.4	0.2
27-Jun-2009	+05:00	3.7	0.5	0.2
27-Jun-2009	+06:00	11.1	1.0	0.5
27-Jun-2009	+07:00	12.1	0.6	0.3
27-Jun-2009	+08:00	6.4	1.1	0.7
27-Jun-2009	+09:00	12.7	0.7	0.3
27-Jun-2009	+10:00	10.2	0.9	0.4
27-Jun-2009	+11:00	13.0	0.6	0.3
27-Jun-2009	+12:00	7.1	1.1	0.6
27-Jun-2009	+13:00	5.3	0.5	0.3
27-Jun-2009	+14:00	5.2	0.5	0.3
27-Jun-2009	+15:00	3.8	0.4	0.2
27-Jun-2009	+16:00	7.3	0.8	0.4
27-Jun-2009	+17:00	6.4	0.7	0.3
27-Jun-2009	+18:00	6.9	0.8	0.4
27-Jun-2009	+19:00	3.8	0.3	0.2
27-Jun-2009	+20:00	6.2	0.5	0.2
27-Jun-2009	+21:00	10.0	1.0	0.5
27-Jun-2009	+22:00	8.9	0.5	0.2
27-Jun-2009	+23:00	4.8	1.0	0.5
28-Jun-2009	+00:00	7.2	0.4	0.2
28-Jun-2009	+01:00	2.2	0.3	0.1
28-Jun-2009	+02:00	3.0	0.4	0.2
28-Jun-2009	+03:00	3.2	0.4	0.2
28-Jun-2009	+04:00	2.4	0.4	0.2
28-Jun-2009	+05:00	5.1	0.4	0.2
28-Jun-2009	+06:00	9.2	0.6	0.3
28-Jun-2009	+07:00	11.1	0.7	0.4
28-Jun-2009	+08:00	10.9	0.4	0.2
28-Jun-2009	+09:00	6.1	0.5	0.3
28-Jun-2009	+10:00	2.1	0.3	0.1
28-Jun-2009	+11:00	2.3	0.5	0.3
28-Jun-2009	+12:00	4.2	0.5	0.3
28-Jun-2009	+13:00	5.1	0.6	0.3
28-Jun-2009	+14:00	6.1	0.6	0.3
28-Jun-2009	+15:00	6.2	0.8	0.4
28-Jun-2009	+16:00	4.2	0.4	0.2
28-Jun-2009	+17:00	9.1	1.0	0.5

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28-Jun-2009	+18:00	2.2	0.2	0.1
28-Jun-2009	+19:00	4.2	0.5	0.2
28-Jun-2009	+20:00	3.1	0.2	0.1
28-Jun-2009	+21:00	3.2	0.3	0.1
28-Jun-2009	+22:00	6.2	0.5	0.2
28-Jun-2009	+23:00	5.7	0.3	0.1
29-Jun-2009	+00:00	6.2	0.3	0.1
29-Jun-2009	+01:00	4.2	0.1	0.1
29-Jun-2009	+02:00	3.2	0.1	0.1
29-Jun-2009	+03:00	3.2	0.1	0.1
29-Jun-2009	+04:00	3.2	0.2	0.1
29-Jun-2009	+05:00	15.7	1.2	0.6
29-Jun-2009	+06:00	27.0	4.7	2.4
29-Jun-2009	+07:00	32.7	6.4	3.7
29-Jun-2009	+08:00	10.8	2.0	1.1
29-Jun-2009	+09:00	8.9	1.9	1.1
29-Jun-2009	+10:00	4.4	0.4	0.2
29-Jun-2009	+11:00	5.1	0.8	0.4
29-Jun-2009	+12:00	8.1	0.8	0.4
29-Jun-2009	+13:00	25.5	1.1	0.6
29-Jun-2009	+14:00	7.6	1.2	0.6
29-Jun-2009	+15:00	13.0	0.6	0.3
29-Jun-2009	+16:00	15.2	1.3	0.7
29-Jun-2009	+17:00	14.2	1.3	0.6
29-Jun-2009	+18:00	12.3	1.0	0.5
29-Jun-2009	+19:00	4.2	0.8	0.4
29-Jun-2009	+20:00	4.4	0.4	0.2
29-Jun-2009	+21:00	5.9	0.5	0.2
29-Jun-2009	+22:00	3.1	0.3	0.1
29-Jun-2009	+23:00	1.6	0.5	0.3
30-Jun-2009	+00:00	1.5	0.2	0.1
30-Jun-2009	+01:00	1.1	0.1	0.1
30-Jun-2009	+02:00	1.4	0.1	0.1
30-Jun-2009	+03:00	1.2	0.2	0.1
30-Jun-2009	+04:00	1.2	0.2	0.1
30-Jun-2009	+05:00	8.9	1.1	0.5
30-Jun-2009	+06:00	23.4	5.8	3.0
30-Jun-2009	+07:00	23.4	6.8	3.7
30-Jun-2009	+08:00	12.4	3.4	2.3
30-Jun-2009	+09:00	8.6	1.9	0.9
30-Jun-2009	+10:00	7.9	0.8	0.4
30-Jun-2009	+11:00	8.5	0.6	0.3
30-Jun-2009	+12:00	8.9	1.2	0.6
30-Jun-2009	+13:00	6.0	0.6	0.3
30-Jun-2009	+14:00	10.9	0.7	0.3
30-Jun-2009	+15:00	15.9	2.8	1.4
30-Jun-2009	+16:00	15.0	1.0	0.5
30-Jun-2009	+17:00	15.1	1.6	0.8
30-Jun-2009	+18:00	12.6	3.1	1.5
30-Jun-2009	+19:00	4.7	0.5	0.3
30-Jun-2009	+20:00	6.2	1.3	0.9
30-Jun-2009	+21:00	7.1	1.8	1.2

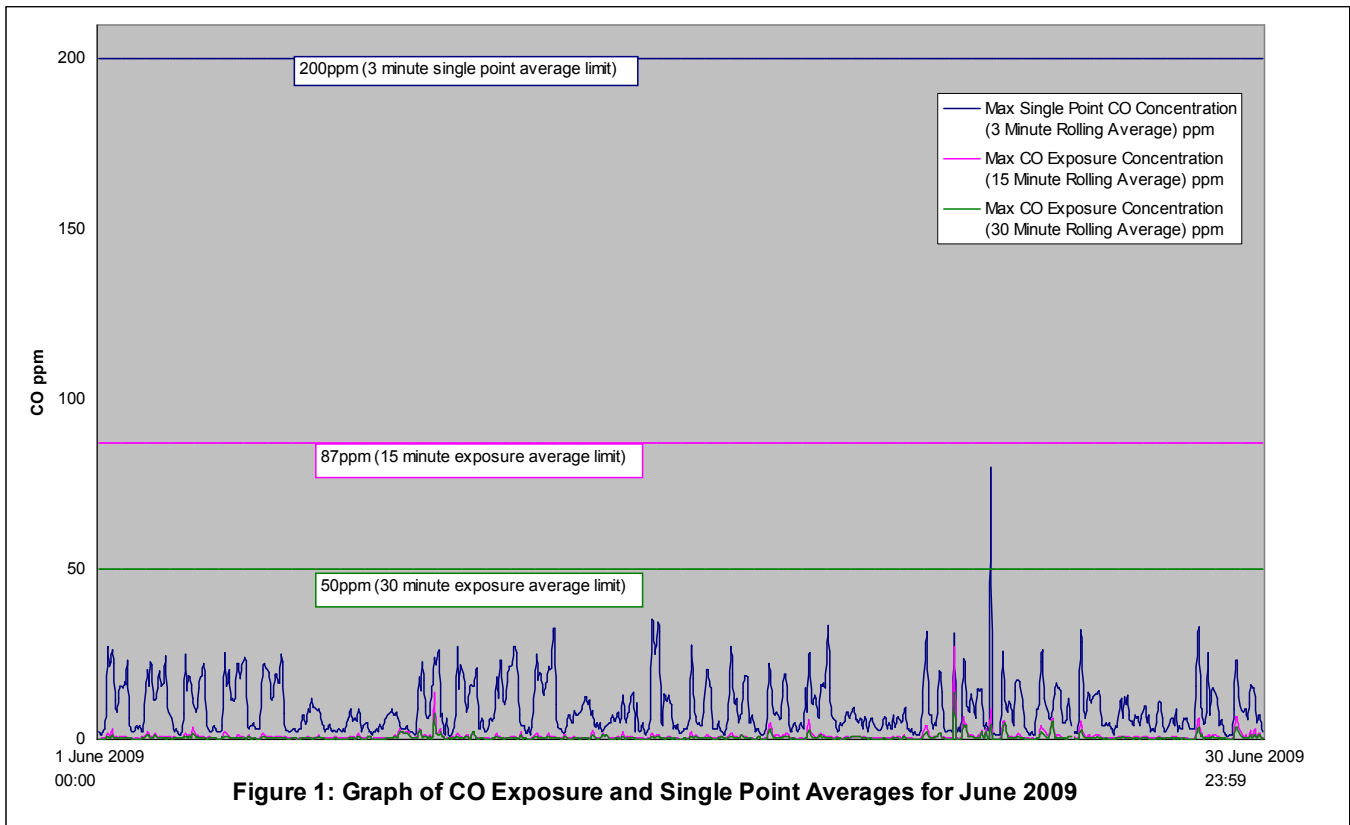
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30-Jun-2009	+22:00	4.1	0.3	0.1
30-Jun-2009	+23:00	2.2	0.6	0.3



5.1. Factors Affecting Results.

It has been noted that an elevated 3 minute average reading was recorded on Tuesday 23 June 2009 at 23:00 in the eastbound carriageway. The cause was not determined however the eastbound carriageway was closed to traffic for maintenance at the time of the reading.

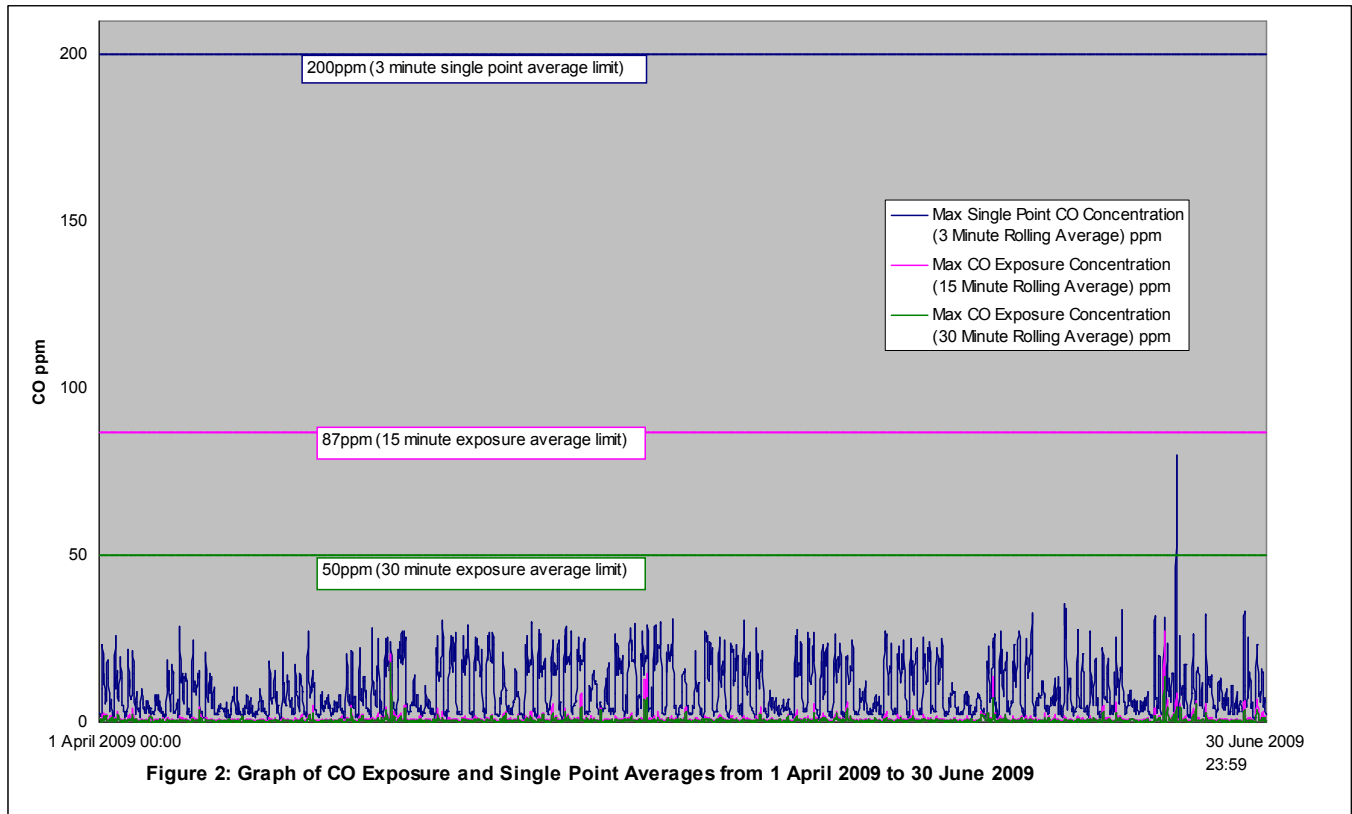
Measurements recorded at 1am on 26 June 2009 have not been presented as they were affected by a sensor calibration performed at the time.

5.2. Three Monthly Trend

Figure 2 presents a plot illustrating the trend in CO levels from 01 April to 30 June 2009

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5.3. Uncertainty

The uncertainty for the measurement of CO has been calculated at $\pm 12\%$.