

# 7 Results and Discussion

## 7.1 Site performance and quality assurance

Continuously monitored pollutant's instrument performance during 2005 was generally very good with all sites having data capture rates well over 90 percent.

Valid NO<sub>2</sub>, SO<sub>2</sub>, CO, and PM<sub>10</sub> data from the Greers Road, Burnside site were below 90 percent for the month of February due to data-logger problems early in the month (8 to 11 February 2005) and at the end of the month (25 to 28 February 2005). Valid data capture rates for these pollutants were greater than 90 percent for 2005.

Overall site performance is shown in Table 3 below based on 10-minute averages for continuously monitored data. Percent data capture is the percent of total instrument availability and includes downtime for calibration and routine maintenance. Percent valid data is defined as the percent valid data following quality assurance eg, invalidation of data resulting from calibrations, routine maintenance, spurious data and excessively negative data.

**Table 3: Percentage valid and capture data 2005**

Analyte	Site	Percentage valid data (V) and percentage data capture (C)																											
		January		February		March		April		May		June		July		August		September		October		November		December		Annual			
		V	C	V	C	V	C	V	C	V	C	V	C	V	C	V	C	V	C	V	C	V	C	V	C	V	C		
CO	Burnside	94.9	99.5	69.3	77.7	95.1	100	95.3	100	94.7	100	95.2	100	95.6	100	95.6	100	91.7	100	94.3	100	97.6	100	97.66	100	95.7	98.1		
NO <sub>2</sub>	Penrose	94.3	99.3	87.5	99.4	95.9	100	95.6	100	95.5	100	98.4	100	98.0	100	98.5	100	98.4	100	98.5	100	86.1	100	97.9	100	93.5	100		
NO <sub>2</sub>	Burnside	96.1	99.5	69.1	77.5	94.9	100	95.3	100	94.8	100	95.3	100	95.0	100	95.3	100	91.3	100	94.2	100	98.4	100	98.0	100	93.5	98.1		
NO <sub>2</sub>	Kowhai	96.7	99.6	93.4	99.8	96.3	100	96.9	100	96.7	100	95.3	100	96.1	100	95.9	100	96.3	100	96.7	100	97.1	100	98.1	100	96.6	100		
SO <sub>2</sub>	Penrose	95.3	99.3	92.4	99.4	96.8	100	96.1	100	96.9	100	98.4	100	98.3	100	98.3	100	97.8	100	98.1	100	97.2	100	95.1	100	97.0	100		
SO <sub>2</sub>	Burnside	96.0	99.5	69.2	77.5	94.8	100	95.3	100	94.9	100	95.3	100	95.7	100	95.5	100	91.5	100	94.3	100	96.3	100	92.4	100	93.0	98.0		
PM <sub>10</sub>	Burnside	98.9	100	65.6	77.5	98.3	100	95.0	100	97.6	100	98.4	100	88.5	100	99.1	100	96.2	100	98.8	100	98.7	100	98.8	100	94.5	98.1		
PM <sub>10</sub>	Kowhai	98.5	100	94.8	99.8	98.2	100	98.9	100	98.4	100	98.6	100	97.8	100	98.9	100	99.1	100	99.0	100	98.5	100	97.7	100	98.5	100		
PM <sub>10</sub>	Penrose	98.7	99.3	95.7	99.4	98.8	100	98.4	100	87.8	100	99.2	100	95.7	100	99.2	100	99.3	100	99.1	100	99.2	100	98.7	100	99.7	100		
VOC	Penrose	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100		
VOC	Burnside	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100		
VOC	St Albans	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100		
TSP	St Albans	100	100	75	75	100	100	100	100	100	100	100	100	75	75	100	100	100	100	100	100	100	100	100	100	100	95.8	95.8	
TSP	Penrose	100	100	75	75	100	100	100	100	100	100	100	100	50	50	100	100	100	100	100	100	100	100	100	100	100	93.8	93.8	
TSP	Kowhai	75	75	25	25	100	100	100	100	100	100	100	100	100	100	80	80	75	75	100	100	100	100	100	100	100	87.9	87.9	
Lead	St Albans	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	80	80	75	75	100	100	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	85.0	85.0	
Lead	Penrose	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	75	75	50	50	100	100	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	75.0	75.0	
Lead	Kowhai	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	100	100	100	100	80	80	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	93.3	93.3	

Notes: V = valid data; C = percent total captured data (includes calibration and invalid data).

## 7.2 Carbon monoxide (CO) 2005

CO was monitored at Greers Road, Burnside. One-hour and eight-hour averages have been calculated from 10-minute averages recorded by the instruments.

The maximum results and their dates are described below.

Site	1-hour max (mg/m <sup>3</sup> )	99.9 percentile 1-hour (mg/m <sup>3</sup> )	8-hour max (mg/m <sup>3</sup> )	99.9 percentile 8-hour (mg/m <sup>3</sup> )
Greers Road, Burnside	10.5 (29 June – 01:00)	8.3	8.1 (29 June – 03:20)	5.4

Results are given in Figures 6 to 9.

Concentrations of CO at Greers Road Burnside were below the ambient air quality 1-hour guideline (30 mg/m<sup>3</sup>) and 8-hour national environmental standard (10 mg/m<sup>3</sup>) during 2005.

## 7.3 Nitrogen oxides (NO<sub>2</sub> and NO) 2005

Oxides of nitrogen were monitored at Gavin Street, Penrose; Kowhai Intermediate, Kingsland; and Greers Road, Burnside. One hour and 24-hour averages have been calculated from 10-minute averages recorded by the instruments.

The maximums for NO<sub>2</sub> and their dates for each site are described below.

Site	1-hour max (µg/m <sup>3</sup> )	99.9 percentile 1-hour (µg/m <sup>3</sup> )	24-hour max (µg/m <sup>3</sup> )	99.5 percentile 24-hour (µg/m <sup>3</sup> )
Gavin Street, Penrose	236.0 (19 Dec 12:00)	88.7	52.5 (19 Dec)	50.5
Kowhai Intermediate School, Kingsland	103.3 (21 Jun 18:00)	72.7	47.2 (5 Aug)	45.5
Greers Road, Burnside	83.3 (28 Jun 11:00)	73.2	49.9 (28 Jun)	38.0

Nitrogen dioxide results are in Figures 10 to 15 (Kowhai), 16 to 21 (Gavin Street), and 22 to 27 (Burnside).

There was one exceedance of the NO<sub>2</sub> ambient air quality 1-hour standard (200 µg/m<sup>3</sup>) at Gavin Street, Penrose on 19 December 2005. The NES allow for nine 1-hour NO<sub>2</sub> exceedances in a 12-month period. There were no exceedances of the 24-hour guideline (100 µg/m<sup>3</sup>) during 2005 at any site in Auckland or Christchurch.

## 7.4 Sulphur dioxide (SO<sub>2</sub>) 2005

Sulphur dioxide was monitored at Gavin Street, Penrose and Greers Road, Burnside. One-hour and 24-hour averages have been calculated from 10-minute averages recorded by the instruments.

The maximums for SO<sub>2</sub> and their dates for each site are described below.

Site	1-hour max (µg/m <sup>3</sup> )	99.9 percentile 1-hour (µg/m <sup>3</sup> )	24-hour max (µg/m <sup>3</sup> )	99.5 percentile 8-hour (µg/m <sup>3</sup> )
Gavin Street, Penrose	54.2 (21 Oct 10:00)	42.0	20.7 (21 Oct)	17.7
Greers Road, Burnside	42.2 (26 May 12:00)	32.9	14.0 (28 Jun)	12.7

Results for Gavin Street, Penrose, are shown in Figures 28 and 29 and Greers Road, Burnside, are shown in Figures 30 and 31. There were no exceedances of the SO<sub>2</sub> ambient air quality 1-hour standard (350 µg/m<sup>3</sup>) or the 24-hour guideline (125 µg/m<sup>3</sup>) during 2005 at any site.

## 7.5 Volatile organic compounds (VOC) January – December 2005

Monitoring of VOCs was conducted at four sites: Kowhai Intermediate School, Kingsland; Gavin Street, Penrose; Greers Road, Burnside; and Coles Place, Christchurch. VOC monitoring utilises passive sampling badges exposed over a three-month period. A set of results for each 2005 quarter are shown in Tables 4 to 7. See monitoring method in section 4.

The benzene guideline is 10 µg/m<sup>3</sup> as an annual average with an average value of 3.6 µg/m<sup>3</sup> to be achieved by 2010. The 2005 six-month and 12-month averages are described below.

Site	Six-month average (January – June 2005) benzene (µg/m <sup>3</sup> )	2005 annual average benzene (µg/m <sup>3</sup> )
Coles Place, St Albans	3.1	2.1
Greers Road, Burnside	2.4	1.9
Gavin Street, Penrose	2.2	1.9
Kowhai Intermediate School, Kingsland	2.5	2.2

**Table 4: VOC results (January – March 2005)**

January February March 2005 Analyte	Limit of detection ( $\mu\text{g}/\text{m}^3$ )	Results ( $\mu\text{g}/\text{m}^3$ )			
		Coles Place	Burnside	Gavin Street	Kowhai
<b>Target VOCs</b>					
ethanol	ND				
isopropyl alcohol	ND				
acetone	ND				
pentane	ND				
dichloromethane	ND				
butan-2-one	ND				
hexane	0.5	0.6	1.2	1.1	1.2
ethyl acetate	ND				
trichloromethane	ND				
1,1,1-trichloroethane	ND				
n-butanol	ND				
benzene	0.3	1.0	0.8	1.6	1.8
2-methylhexane	ND				
2,3-dimethylpentane	ND				
3-methylhexane	ND				
heptane	0.5		0.6		
trichloroethene	0.5				0.6
propyl acetate	0.6			0.8	
methylcyclohexane	ND				
4-methylpentan-2-one	ND				
toluene	0.3	3.8	3.7	7.2	7.5
octane	ND				
tetrachloroethene	ND				
butyl acetate	ND				
ethylbenzene	0.3	0.5	0.4	1.1	0.9
m+p-xylene	0.3	1.4	1.2	2.8	2.7
styrene	ND				
o-xylene	0.3	0.6	0.5	1.1	1.1
nonane	ND				
alpha pinene	ND				
propylbenzene	ND				
1,3,5-trimethylbenzene	ND				
beta pinene	ND				
decane	0.6			0.9	
1,2,4-trimethylbenzene	0.6	0.7		1.2	1.1
limonene	ND				
undecane	0.8			1.5	
dodecane	ND				

**Table 5 VOC results (April – June 2005)**

April May June 2005 Analyte	Limit of detection ( $\mu\text{g}/\text{m}^3$ )	Results ( $\mu\text{g}/\text{m}^3$ )			
		Coles Place	Burnside	Gavin Street	Kowhai
<b>Target VOCs</b>					
ethanol	ND				
isopropyl alcohol	ND				
acetone	ND				
pentane	1.9	2.5	1.9	2.3	2.2
dichloromethane	ND				
butan-2-one	ND				
hexane	0.4	1.8	1.7	1.5	1.6
ethyl acetate	ND				
trichloromethane	ND				
1,1,1-trichloroethane	ND				
n-butanol	ND				
benzene	0.2	5.1	4.0	2.8	3.2
2-methylhexane	0.5	0.8	0.7	0.6	0.6
2,3-dimethylpentane	ND				
3-methylhexane	0.5	1.0	0.8	0.7	0.6
heptane	0.4	0.8	0.9	0.7	0.5
trichloroethene	0.4				0.8
propyl acetate	0.5		0.5	0.9	
methylcyclohexane	ND				
4-methylpentan-2-one	ND				
toluene	0.3	13.3	10.2	12.5	11.1
octane	ND				
tetrachloroethene	ND				
butyl acetate	ND				
ethylbenzene	0.2	1.9	1.4	1.6	1.2
m+p-xylene	0.2	6.7	4.9	5.0	4.9
styrene	ND				
o-xylene	0.3	2.6	2.0	2.0	1.8
nonane	0.5	0.5	0.4	0.6	0.6
alpha pinene	0.5	0.6	0.9	0.6	
propylbenzene	ND				
1,3,5-trimethylbenzene	0.6	0.8	0.6	0.7	0.7
beta pinene	0.6	0.7	1.1	0.8	
decane	0.6	0.6	0.5	0.9	0.7
1,2,4-trimethylbenzene	0.6	2.3	1.8	2.0	2.0
limonene	ND				
undecane	0.8			1.0	
dodecane	ND				

**Table 6: VOC results (July – September 2005)**

July August September 2005 Analyte	Limit of detection ( $\mu\text{g}/\text{m}^3$ )	Results ( $\mu\text{g}/\text{m}^3$ )			
		Coles Place	Burnside	Gavin Street	Kowhai
<b>Target VOCs</b>					
ethanol	ND				
isopropyl alcohol	ND				
acetone	ND				
pentane	2.2			2.1	
dichloromethane	ND				
butan-2-one	ND				
hexane	0.5	1.4	1.0	1.4	1.4
ethyl acetate	0.5			0.5	
trichloromethane	ND				
1,1,1-trichloroethane	ND				
n-butanol	ND				
benzene	0.3	1.6	2.1	2.3	2.7
2-methylhexane	0.5			0.5	0.5
2,3-dimethylpentane	ND				
3-methylhexane	0.5	0.7	0.6	0.6	0.6
heptane	0.5	0.8		0.6	0.5
trichloroethene	0.5				0.7
propyl acetate	0.5			0.5	
methylcyclohexane	ND				
4-methylpentan-2-one	ND				
toluene	0.3	5.6	7.3	9.2	9.2
octane	ND				
tetrachloroethene	ND				
butyl acetate	0.6			0.6	
ethylbenzene	0.3	0.7	0.9	1.4	1.1
m+p-xylene	0.3	2.6	3.5	4.6	4.5
styrene	ND				
o-xylene	0.3	1.0	1.4	1.7	1.6
nonane	ND				
alpha pinene	ND				
propylbenzene	ND				
1,3,5-trimethylbenzene	0.6			0.6	0.6
beta pinene	ND				
decane	0.6			0.7	0.5
1,2,4-trimethylbenzene	0.6	0.9	1.2	1.6	1.7
limonene	ND				
undecane	0.8			1.0	
dodecane	ND				

**Table 7: VOC results (October – December 2005)**

October November December 2005 Analyte	Limit of detection ( $\mu\text{g}/\text{m}^3$ )	Results ( $\mu\text{g}/\text{m}^3$ )			
		Coles Place	Burnside	Gavin Street	Kowhai
<b>Target VOCs</b>					
ethanol	ND				
isopropyl alcohol	ND				
acetone	ND				
pentane	ND				
dichloromethane	ND				
butan-2-one	ND				
hexane	0.5	0.5	0.9	0.8	0.8
ethyl acetate	0.4			0.4	
trichloromethane	ND				
1,1,1-trichloroethane	ND				
n-butanol	ND				
benzene	0.3	0.6	0.5	0.9	1.0
2-methylhexane	ND				
2,3-dimethylpentane	ND				
3-methylhexane	0.5				
heptane	0.5				
trichloroethene	ND				
propyl acetate	0.5			0.5	
methylcyclohexane	ND				
4-methylpentan-2-one	ND				
toluene	0.3	3.2	2.8	5.7	6.5
octane	ND				
tetrachloroethene	ND				
butyl acetate	ND				
ethylbenzene	0.3	0.4	0.3	0.7	0.7
m+p-xylene	0.3	1.6	1.2	2.4	2.6
styrene	ND				
o-xylene	0.3	0.6	0.5	0.9	0.9
nonane	ND				
alpha pinene	ND				
propylbenzene	ND				
1,3,5-trimethylbenzene	ND				
beta pinene	ND				
decane	0.6			0.6	
1,2,4-trimethylbenzene	0.6	0.6	0.0	1.0	0.9
limonene	ND				
undecane	0.8			0.8	
dodecane	ND				

## 7.6 PM<sub>10</sub> 2005

PM<sub>10</sub> is monitored at Greers Road, Burnside, using a thermo FH62-C14 beta gauge. PM<sub>10</sub> results measured by Auckland Regional Council at Gavin Street, Penrose and Kowhai Intermediate, Kingsland sites, also using thermo FH62-C14 beta gauges, are also included in this report. Twenty four-hour averages have been calculated from 10-minute averages recorded by the instruments. All PM<sub>10</sub> data is reported at standard temperature and pressure (0°C and 101.3 kPa).

The maximums for PM<sub>10</sub> and their dates for each site are described below.

Site	24-hour maximum (µg/m <sup>3</sup> )	99.5 percentile 24-hour (µg/m <sup>3</sup> )
Gavin Street, Penrose	44.7 (10 June)	33.4
Kowhai Intermediate, Kingsland	49.0 (11 June)	35.7
Greers Road, Burnside	98.4 (28 June)	77.0

There were no exceedances of the ambient air quality standard (50 µg/m<sup>3</sup>) at Gavin Street, Penrose or Kowhai Intermediate, Kingsland during the 12-month period.

At Greers Road, Burnside there were 18 exceedances of the 24-hour standard. Each exceedance and the date is listed in Table 8 below. Charts describing 24-hour averaged data for 2005 for each site are shown in Figures 32 to 33 (Kowhai), 34 to 35 (Gavin Street), and 36 and 37 (Burnside). As there were exceedances at the Christchurch site, more data analysis was carried out in Figures 38 to 41. All exceedances occurred over the winter period, a time when wood burning is widely used to heat homes. As reported by Environment Canterbury, cold winter conditions strongly influence air pollution in the region. A total of 14 exceedances occurred during the period June to July, with only four exceedances occurring during the months of April, May and August 2005.

**Table 8: Greers Road, Burnside PM<sub>10</sub> exceedances of the daily NES 2005**

Date	Burnside PM <sub>10</sub> (µg/m <sup>3</sup> )
28/04/05	60.5
09/05/05	51.8
10/05/05	50.0
07/06/05	77.0
08/06/05	61.8
09/06/05	56.4
12/06/05	59.8
18/06/05	53.4
19/06/05	50.7
27/06/05	61.1
28/06/05	98.4
29/06/05	91.6
01/07/05	61.7
10/07/05	60.8
11/07/05	64.4
22/07/05	57.0
27/07/05	56.9
14/08/05	59.1

Note : National environmental standard for PM<sub>10</sub> = 50 µg/m<sup>3</sup>.

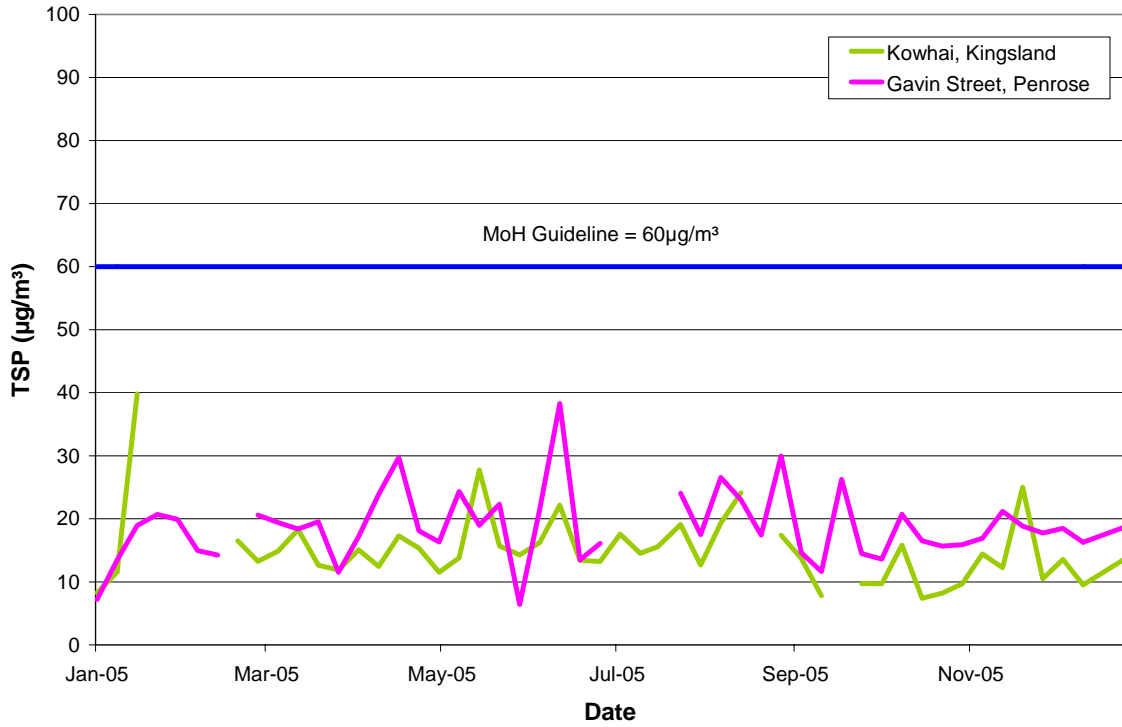
## 7.7 Total suspended particulates (TSP) 2005

TSP is measured as a seven-day average from Gavin Street, Penrose; Kowhai Intermediate, Kingsland; and Coles Place, St Albans. Maximum results are shown in the table below.

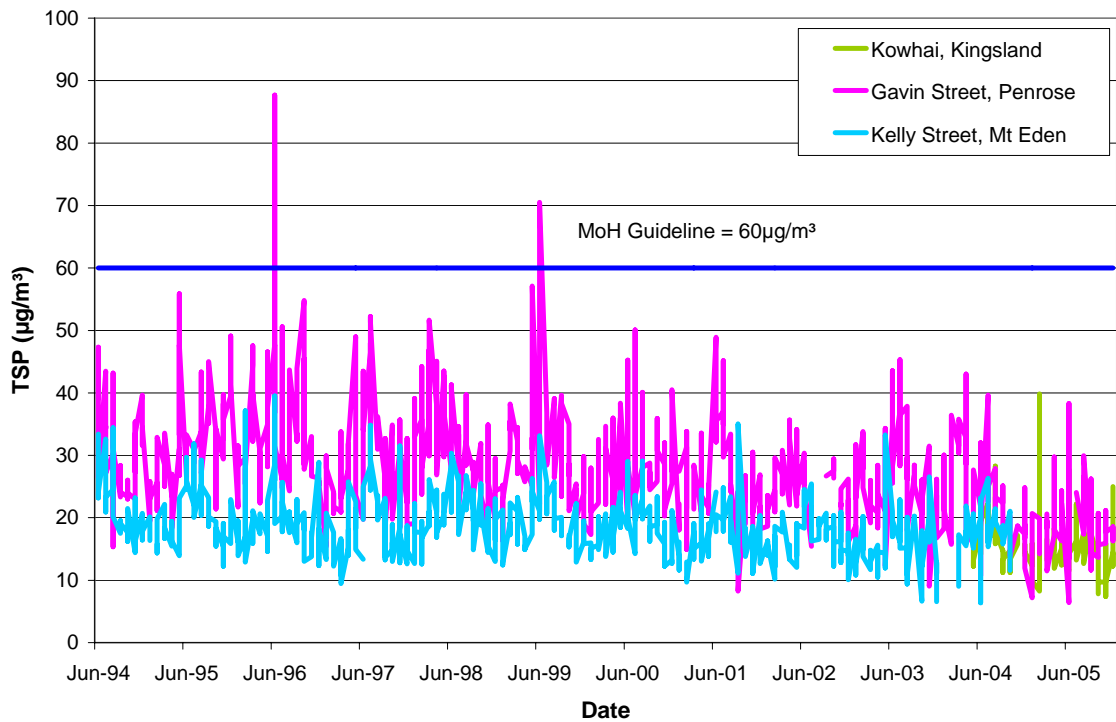
Site	Maximum seven-day average (µg/m <sup>3</sup> )
Gavin Street, Penrose	38 (15 June)
Kowhai Intermediate, Kingsland	40 (19 January)
Coles Place, St Albans	52 (30 June)

There were no exceedances of the Ministry of Health's guideline of 60 µg/m<sup>3</sup> at any site. The data from each site is described in Figures 1 and 2 below.

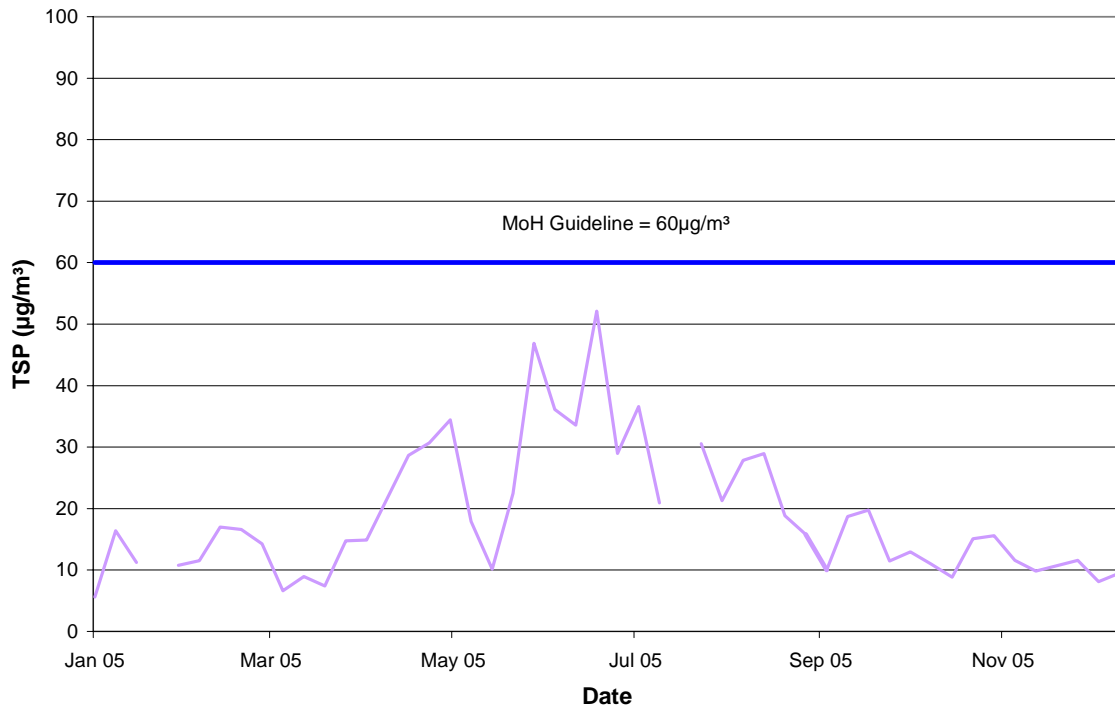
**Figure 1: Auckland TSP seven-day average 2005**



**Figure 2: Auckland TSP seven-day average 1994 – 2005**



**Figure 3: Christchurch TSP seven-day average 2005**



**Figure 4: Christchurch TSP seven-day average 2002 – 2005**

