Annual Air Quality Monitoring 2006

Marlborough District Council

Prepared for Marlborough District Council
by Emily Wilton
Environet Ltd
11 Lachie Griffin Rise
R D 1
Lyttelton

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Executive Summary

The main air contaminant of concern in Marlborough is PM_{10} (particles in the air less than 10 microns in diameter). Air quality monitoring for PM_{10} was carried out at Redwoodtown and Middle Renwick Road in Blenheim during 2006. Concentrations of PM_{10} were measured daily in Redwoodtown from 23 June using a Beta Attenuation Monitor (BAM) and every third day at both sites using a gravimetric high volume sampling.

On six days during 2006, measured PM_{10} concentrations exceeded the ambient air quality guideline and national environmental standard (NES) for PM_{10} of 50 µg m^{-3} (24-hour average). Four of these exceedences were measured using the BAM and two exceedences occurred were measured by the high-volume on days when BAM concentrations of 43 and 48 µg m^{-3} were recorded. No guideline or NES exceedences were recorded at the Middle Renwick Road (MRR) air monitoring site.

The maximum measured PM_{10} concentration (24-hour average) during 2006 was 63 µg m^{-3} and compares to a maximum 2005 value of 58 µg m^{-3} at the Redwoodtown site. The highest measured 24-hour average concentration in Redwoodtown was 81 µg m^{-3} and was measured at the Brooklyn Drive monitoring site during 2004. A comparison of hourly average PM_{10} concentrations to meteorological data on high pollution days show elevated concentrations typically occur when wind speeds are less than 2.5 m s^{-1} and winds are from a westerly direction.

A comparison of PM_{10} concentrations measured using the BAM and high-volume sampler shows a strong correlation (R^2= 0.9), with the high-volume method reporting slightly higher concentrations (around 7%) overall.

Annual average PM_{10} concentrations of around 17 µg m^{-3} (Redwoodtown) and 14 µg m^{-3} (MRR) were estimated for 2006. These compare with an annual average guideline of 20 µg m^{-3} (MfE, 2002).

Table of Contents

1 Introduction

The main air contaminant of concern in Marlborough is PM_{10} (particles in the air less than 10 microns in diameter). Historically, concentrations of PM_{10} have exceeded national environmental standards (NES) in Blenheim during the winter months. During 2006, concentrations of PM_{10} were measured at two sites in Blenheim, a site in Redwoodtown and a site at 106 Middle Renwick Road (MRR).

NES for ambient air quality (Table 1.1) were introduced in September 2004 (MfE, 2004). Based on air quality monitoring in other urban areas of New Zealand it would seem unlikely that concentrations of NES contaminants other than PM_{10} would be in breach. Consequently resources for air quality monitoring have been refocused on PM_{10}. The NES includes specifications for monitoring PM_{10} in areas such as Blenheim where breaches are likely.

In addition to the NES, MfE provides guidelines for ambient air quality (Table 1.2) and air quality indicator categories to assist in the presentation and management of air quality in New Zealand (Table 1.3). Air quality monitoring data in this report are presented relative to air quality guidelines and these indicator categories. These categories provide a useful perspective on the overall quality of the air and provide a valuable tool for evaluating trends in concentrations over time .

Previous air quality monitoring in the Marlborough District includes historical monitoring of PM_{10} at the MRR monitoring site, intermittent monitoring of PM_{10} at the Redwoodtown site, survey PM_{10} monitoring at Picton and Renwick during 2000 and 2002 respectively, visibility surveys and passive sampling for nitrogen oxides and sulphur oxides.

Table 1.1: National Environmental Standards for ambient air quality (MfE, 2004)

Contaminant	NES values		
	Concentration	Averaging Period	Allowable exceedences / year
Carbon monoxide	10 mg m^{-3}	8-hour	1
Particles (PM_{10})	50 µg m^{-3}	24-hour	1
Nitrogen dioxide	200 µg m^{-3}	1-hour	9
Sulphur dioxide [b]	350 µg m^{-3}	1-hour	9
Sulphur dioxide [b]	570 µg m^{-3}	1-hour	0
Ozone	150 µg m^{-3}	1-hour	0

Table.1.2: Ambient air quality guidelines for New Zealand (MfE, 2002)

Contaminant	2002 guideline values	
	Concentration[a]	Averaging Period
Carbon monoxide	30 mg m^{-3}	1-hour
	10 mg m^{-3}	8-hour
Particles (PM_{10})	50 µg m^{-3}	24-hour
	20 µg m^{-3}	Annual
Nitrogen dioxide	200 µg m^{-3}	1-hour
	100 µg m^{-3}	24-hour
Sulphur dioxide [b]	350 µg m^{-3}	1-hour
	120 µg m^{-3}	24-hour
Ozone	150 µg m^{-3}	1-hour
	100 µg m^{-3}	8-hour
Hydrogen sulphide [c]	7 µg m^{-3}	1-hour
Lead [d]	0.2 µg m^{-3} (lead content of PM_{10})	3-monthmoving, calculated monthly
Benzene (year 2002)	10 µgm^{-3}	Annual
Benzene (year 2010)	3.6 µgm^{-3}	Annual
1,3-Butadiene	2.4 µgm^{-3}	Annual
Formaldehyde	100 µgm^{-3}	30-minutes
Acetaldehyde	30 µgm^{-3}	Annual
Benzo(a)pyrene	0.0003 µgm^{-3}	Annual
Mercury (inorganic) [d]	0.33 µgm^{-3}	Annual
Mercury (organic)	0.13 µgm^{-3}	Annual
Chromium VI [d]	0.0011 µgm^{-3}	Annual
Chromium metal and chromium III	0.11 µgm^{-3}	Annual
Arsenic (organic) [d]	0.0055 µgm^{-3}	Annual
Arsine	0.055 µgm^{-3}	Annual

Notes:
[a] All values apply to the gas measured at standard conditions of temperature (0° C) and pressure (1 atmosphere).
[b] The sulphur dioxide guideline values do not apply to sulphur acid mist.
[c] The hydrogen sulphide value is based on odour nuisance and may be unsuitable for use in geothermal areas.
[d] The guideline values for metals are for inhalation exposure only; they do not include exposure from other routes such as ingestion. These other routes should be considered in assessments where appropriate.

Table 1.3: Environmental Performance Indicator categories for air quality (MfE, 2002)

Category	Value relative to guideline	Comment
Excellent	Less than 10% of the guideline	Of little concern: if maximum values are less than a tenth of the guideline, average values are likely to be much less
Good	Between 10% and 33% of the guideline	Peak measurements in this range are unlikely to affect air quality
Acceptable	Between 33% and 66% of the guideline	A broad category, where maximum values might be of concern in some sensitive locations but generally they are at a level which does not warrant urgent action
Alert	Between 66% and 100% of the guideline	This is a warning level, which can lead to exceedences if trends are not curbed
Action	More than 100% of the guideline	Exceedences of the guideline are a cause for concern and warrant action, particularly if they occur on a regular basis

2 Methodology

During 2006, two methods of monitoring PM_{10} were used. The historical gravimetric high-volume sampling, a method compliant with the MfE (2002) reference method specifications, was used at two sites in Blenheim. The high-volume sampling was carried out based on a one day in three sampling regime with samples collected over a 24-hour period from midnight to midnight. In addition, from 23 June a continuous beta attenuation monitor (Met One 1020 BAM) was operated at the Redwoodtown site. The latter instrument provides continuous hourly average PM_{10} concentrations. 24-hour average concentrations were calculated from the BAM data for the period midnight to midnight. Results are compared with the NES and with air quality indicator categories for PM_{10}.

Hourly average meteorological data, including temperature, wind speed and wind direction, were obtained from a NIWA site on the outskirts of Blenheim. Meteorological data were compared with PM_{10} on days when pollution was elevated.

2.1 Air quality monitoring sites

There are two permanent air quality monitoring sites located in Blenheim. Figure 2.1 shows the Middle Renwick Road (MRR) site (Air015), which provides a historical record of PM_{10} in Blenheim and is located to the north-west of Blenheim, and the Redwoodtown sites (Air016 – Bowling club and Air023 Brooklyn Drive), which are located to the south and south east within the main urban area. The location of the meteorological monitoring site used during 2006 is also shown in Figure 2.1.

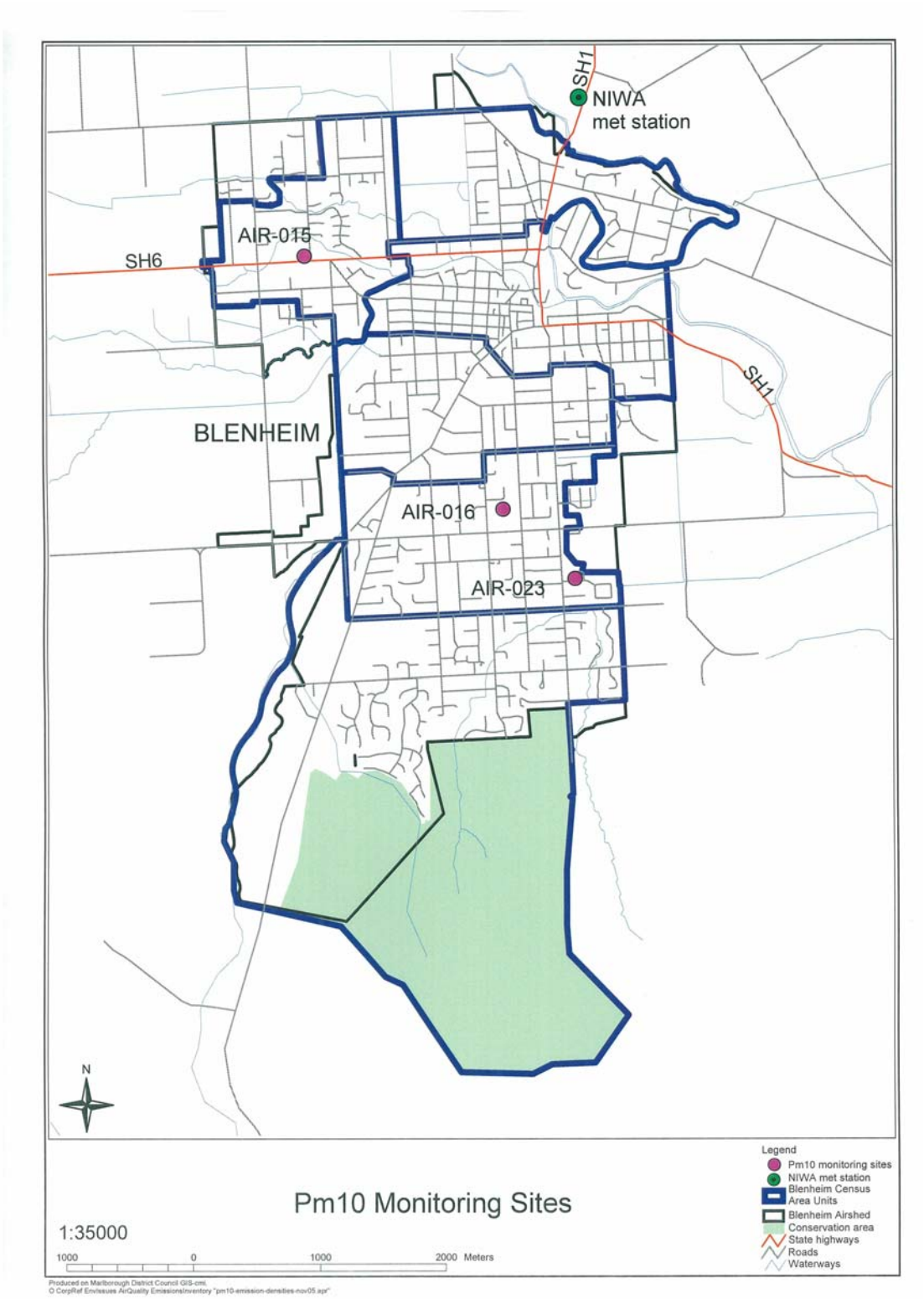


Figure 2.1: Location of air quality and meteorological monitoring sites in Blenheim for 2006.

2.1.1 Middle Renwick Road (MRR) monitoring site

The MRR air quality monitoring site was established in the back yard area of a Council site at 106 Middle Renwick Road. Figure 2.2 shows the surrounding area, and Figure 2.3 shows the high-volume sampler located at the MRR monitoring site. Site details are shown in Table 2.1.

Figure 2.2: Aerial photo of the MRR air quality monitoring site

Figure 2.3: PM_{10} monitor at the MRR air monitoring site

Table 2.1: Site summary details for the MRR air quality monitoring site

Site name	**Blenheim – 106 Middle Renwick Road**
Site contact details	Marlborough District Council
Description of site	Empty sealed back yard area
Site category	Residential neighbourhood
Purpose of site and sources	To measure ambient air concentrations of PM_{10} at the historical air quality monitoring site in Blenheim. Main source during the winter months is solid fuel burning for domestic heating.
Proposed duration of monitoring	Ongoing
Contaminants monitored	PM_{10}
Site co-ordinates	E 2589778 N 5964037
Date of site installation	January 2000
Meteorological characteristics of area	Low wind speeds occur regularly during the winter months. Temperature inversions are likely.
Sample frequency	One day in three from May 2005 One day in six prior to this during the summer and one day in three during the winter.
Inlet height	1.5 metres
Averaging period	24-hour

2.1.2 Redwoodtown Monitoring Site - Blenheim

The 2006 monitoring in Redwoodtown was carried out at the now permanent air quality monitoring site established at the Blenheim Bowling Club on Weld Street. Figures 2.4 and 2.5 show the surrounding area and the location of the monitoring site within the Bowling Club grounds. Summary site details are given in Table 2.2.

Figure 2.4: Aerial photo of the Redwoodtown air quality monitoring site

Figure 2.5: PM_{10} monitor at the Redwoodtown air quality monitoring site

Table 2.2: Site summary details for the Redwoodtown air quality monitoring site

Site name	Redwoodtown
Site contact details	Marlborough District Council
Description of site	The site is located at the Blenheim Bowling Club, which is to the south-east of central Blenheim. The surrounding area includes a bowling green, gravel petanque area and paved areas.
Site category	Residential neighbourhood
Purpose of site and sources	To measure worst-case ambient air concentrations of PM_{10} in Blenheim. The main source during the winter months is solid fuel burning for domestic heating. The site is downwind of a large residential area for meteorological conditions conducive to poor air quality.
Proposed duration of monitoring	Ongoing
Contaminants monitored	PM_{10}
Site co-ordinates	X = 2589778, y = 5964037
Date of site installation	January 2002 – intermittent monitoring until 2005
Meteorological characteristics of area	Low wind speeds occur regularly during the winter months. Temperature inversions are likely.
Sample frequency	One day in three
Inlet height	1.5 metres
Averaging period	24-hour

2.2 Quality assurance

The operation of high volume PM_{10} samplers and the changing of filters were carried out by MDC staff. Flow calibrations were carried out every 3-4 months, normally during the morning. Filters were couriered to Watercare Services Ltd, who carried out filter weighing in accordance with the New Zealand and Australia standard for high volume sampling. Watercare services hold IANZ accreditation, for HiVol PM_{10} sampling.

Transportation of filters occurs at the end of each month, with filters stored and transported in snaplock bags at ambient temperature. Quality assurance methods include the analysis of one field blank per site per month. Field blanks outside of the "acceptable" range (± 8 mg per filter) are noted in a report from Watercare Services.

Operation of the BAM is also carried out by MDC staff. Hourly data is recorded by the instrument and logged by an iQuest iRIS 320 datalogger. Results are telemetered hourly to MDC and stored in the hydrotel database.

3 Air quality monitoring in Blenheim

3.1 PM_{10} concentrations at Redwoodtown

Concentrations of PM_{10} exceeded the air quality guideline and NES for PM_{10} (50 µg m^{-3}, 24-hour average) on six occasions during 2006. Of these, four were measured using the BAM and two using the high-volume sampler. Figure 3.1 illustrates the 24-hour average BAM concentrations and shows the two days when high-volume concentrations also exceeded the NES. The latter two occurred on the 18 July and 11 August when concentrations of 45 µg m^{-3} and 43 µg m^{-3} were recorded as 24-hour average BAM concentrations.

The NES allow one exceedence of 50 µg m^{-3} (24-hour average) per year and requires any subsequent breach to be publicly notified within a month of it occurring. During 2006 MDC notified three breaches based on the result of the NES compliant monitoring method, which is the BAM. The additional high-volume monitoring was carried out during 2006 to establish a relationship between this “reference” method sampling and the new BAM sampler in Redwoodtown and was not intended as a NES compliance monitoring tool. Notwithstanding this, exceedences measured on this sampler are still valid and in theory subject to NES reporting criteria. The relationship between the BAM and high-volume sampler is evaluated in chapter four of this report.

The maximum measured concentration during this period was 63 µg m^{-3} and was measured by the high-volume sampler on 9 August. The corresponding BAM concentration was 59 µg m^{-3}. This compares with a 2005 maximum of 58 µg m^{-3} and a 2004 maximum of 81 µg m^{-3} (24-hour average).

It is possible guideline exeedences occurred at the Redwoodtown monitoring site prior to 23 June, as no continuous monitoring data were available during this period because of instrument malfunction. Gravimetric sampling during this period show no exceedences on the 33% of days sampled.

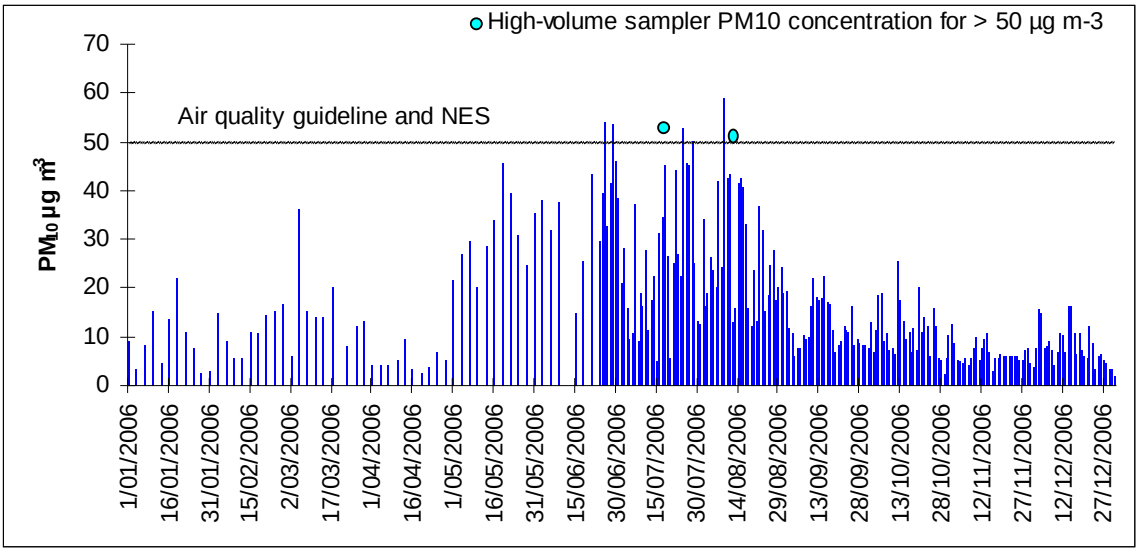


Figure 3.1: 24-hour average PM_{10} concentrations measured at Redwoodtown during 2006

Figure 3.2 compares daily and PM_{10} concentrations measured during 2005 and 2006 to the MfE air quality indicator categories (shown in Table 1.3). The majority of the PM_{10} concentrations measured were less than 66% of the air quality guideline, within the "acceptable" and "good" air quality categories. During 2006, around 10% of data were within the "alert" (66-100% of the guideline) category, with 3% of data above the guideline (Figure 3.2). Seasonal variations in the distribution of PM_{10} concentrations for 2005 and 2006 are shown in Figure 3.3.

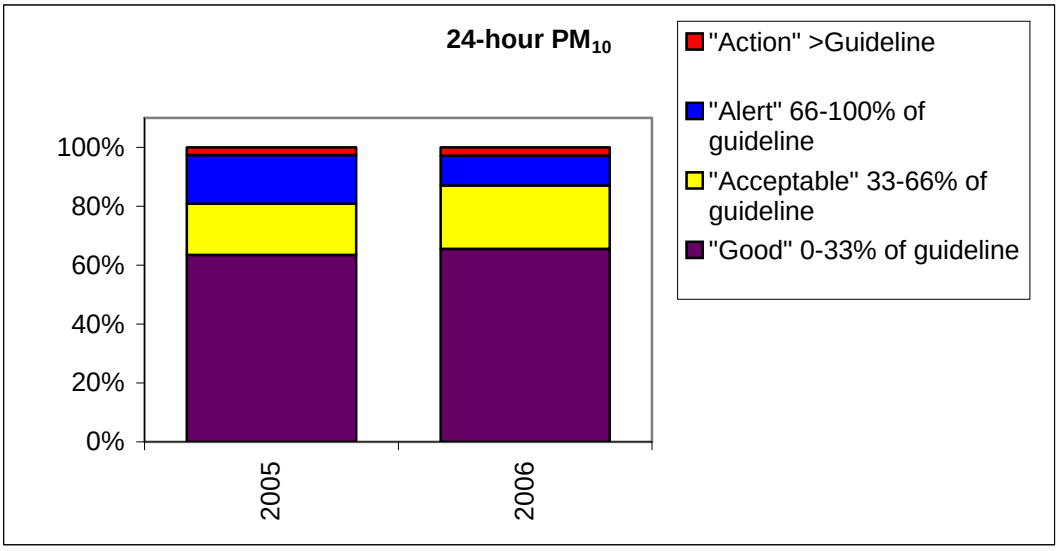


Figure 3.2: Comparison of PM_{10} concentrations measured at Redwoodtown during 2005 and 2006 to MfE air quality indicator categories

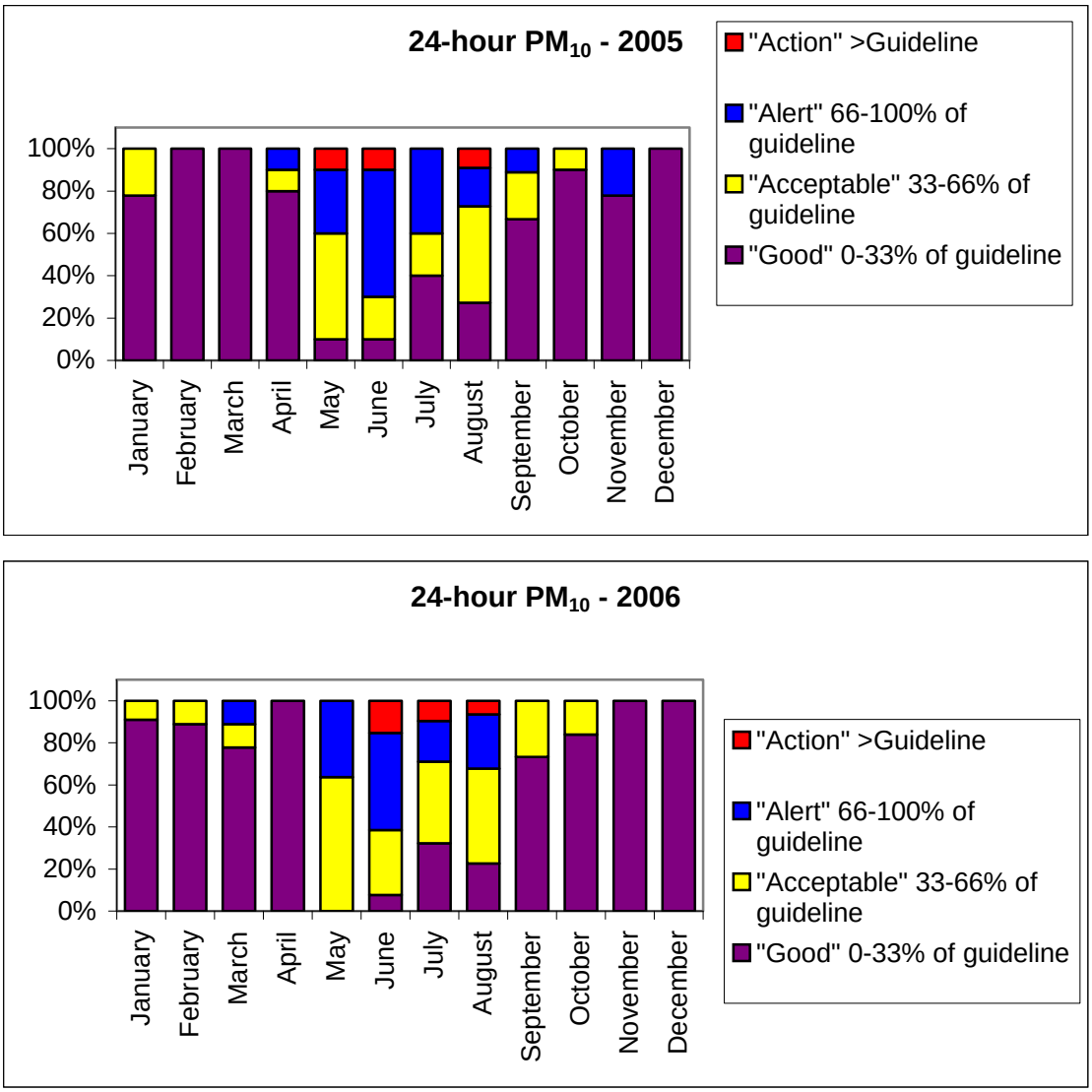


Figure 3.3: Comparison of daily PM_{10} concentrations each month during 2005 and 2006 to MfE air quality indicator categories

An annual average PM_{10} concentration of 17 µg m^{-3} was estimated for 2006 and compares to a 2005 estimate of 18 µg m^{-3}. The Ministry for the Environment specifies an annual average guideline for PM_{10} of 20 µg m^{-3}. The NES does not include an annual average concentration for PM_{10}.

Table 3.1 shows summary statistics for PM_{10} monitoring results from the Redwoodtown site since monitoring commenced in 2002. Note, however, that the monitoring period has varied from year to year, with 2005 being the first year when monitoring was conducted from January to December.

Table 3.1: Summary of PM_{10} concentrations measured at Redwoodtown from 2002-2006

	2002	2003	2004	2005	2006
"Good" 0-33% of guideline	18%	22%	46%	63%	66%
"Acceptable" 33-66% of guideline	62%	30%	22%	17%	21%
"Alert" 66-100% of guideline	10%	26%	20%	17%	10%
“Action” >Guideline	10%	22%	12%	3%	3%
Percentage of valid data	14%	7%	22%	32%	68%
Annual average (µg m-3)	-	-	22	18	17
Measured exceedences	5	6	10	3	6
Guideline exceedences (extrapolated for missing data based seasonal variations)	16	34	31	9	10
99.7 %ile concentration (µg m-3)	58	60	79	57	55
Annual maximum (µg m-3)	58	60	81	58	59
Number of records	50	27	82	115	247

An emission inventory carried out for Blenheim for 2005 indicates that domestic home heating is the main source of PM_{10} emissions, contributing around 85% of the daily wintertime PM_{10} (Wilton, 2005b). Other sources of PM_{10} in the urban areas of Blenheim include outdoor burning (6%), motor vehicles (7%) and industry (2%).

3.2 PM_{10} concentrations at the MRR site

Figure 3.4 shows the daily average PM_{10} concentrations measured at the MRR site during 2006. During 2006, no NES breaches were recorded at the MRR site. Prior to 2006, the only breaches measured at the site occurred in 2000 (56 µg m^{-3}) and 2003 (75 µg m^{-3}). The maximum measured PM_{10} concentrations at MRR during 2006 was 45 µg m^{-3}.

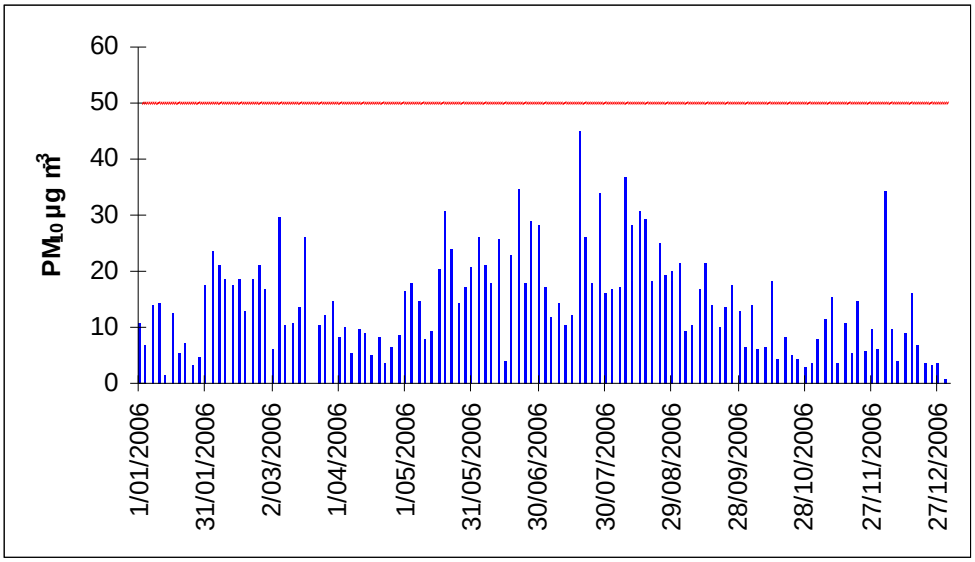


Figure 3.4: Daily winter PM_{10} concentrations measured at the MRR site during 2006.

Changes in PM_{10} concentrations relative to air quality indicator categories at MRR from 2001 to 2006 are shown in Figure 3.5. These data are shown by month to reduce bias in results associated with differences in sampling frequencies across seasons. Results suggest lower PM_{10} concentrations measured at the site during winter 2004.

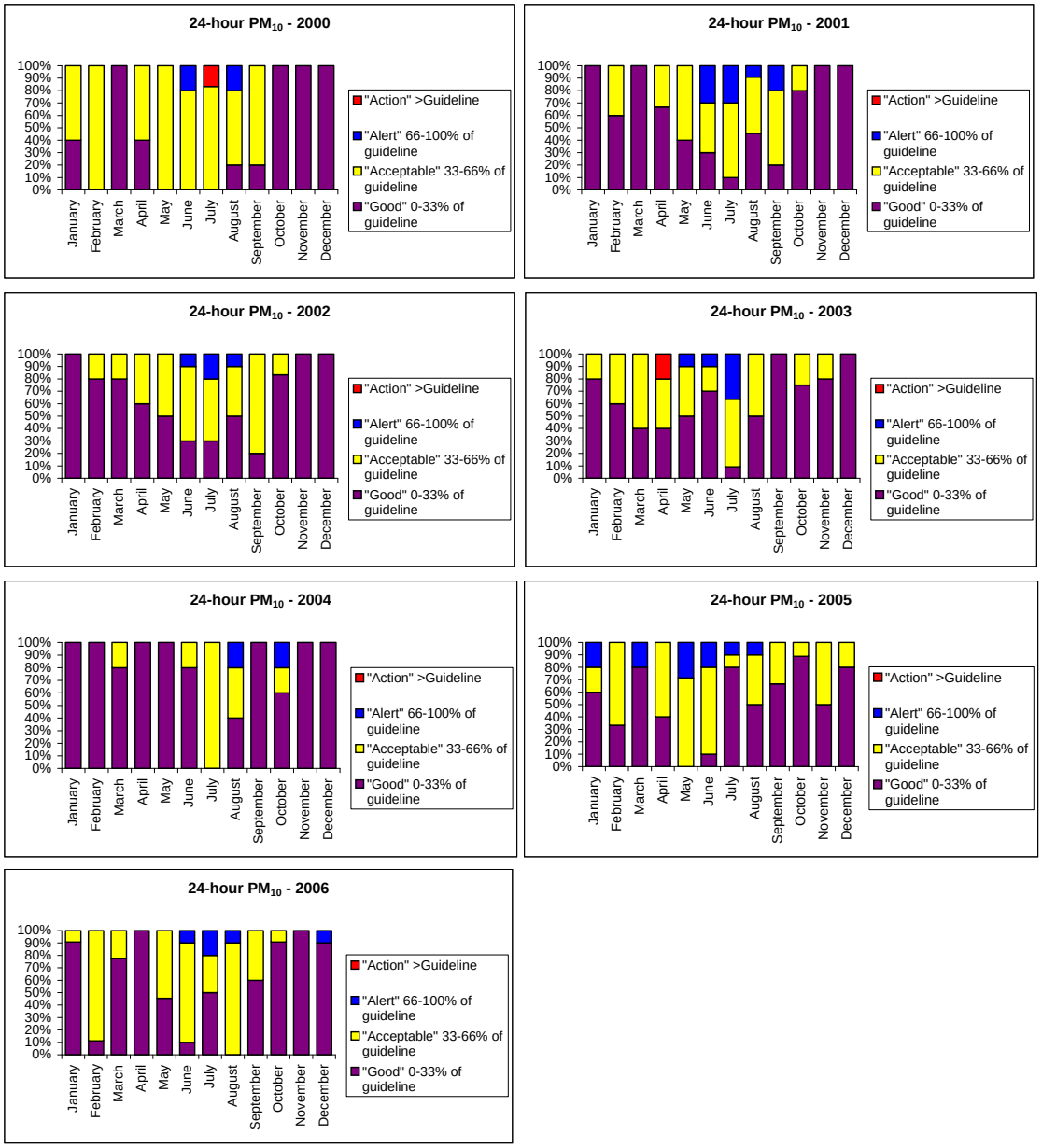


Figure 3.5: Comparison of PM_{10} concentrations measured at the MRR site from 2000 to 2006 to MfE air quality indicator categories

The estimated annual average PM_{10} concentration for MRR for 2006 is 14 µg m^{-3}.

Summary statistics for PM_{10} monitoring results are shown in Table 3.2.

Table 3.2: Summary of PM_{10} concentrations measured at the MRR monitoring site from 2000 to 2006

	2000	2001	2002	2003	2004	2005	2006
"Good" 0-33% of guideline	39%	55%	59%	58%	80%	55%	61%
"Acceptable" 33-66% of guideline	56%	34%	36%	33%	17%	37%	35%
"Alert" 66-100% of guideline	4%	11%	5%	7%	3%	9%	4%
"Action" >Guideline	2%	0%	0%	1%	0%	0%	0%
Percentage of valid data	15%	20%	22%	22%	16%	25%	33%
Annual average (µg m-3)	19	18	15	16	13	17	14
Measured exceedences	1	-	-	1	-	-	0
Guideline exceedences (extrapolated based seasonal variations)	6	0	0	6	0	0	0
99.7 %ile concentration (µg m-3)	53	46	40	67	46	47	42
Annual maximum (µg m-3)	56	48	41	75	49	49	45
Number of records	54	74	81	81	60	93	121

3.3 PM_{10} and meteorology in Blenheim

Variations in meteorological conditions and hourly average PM_{10} concentrations on days when the 24-hour average PM_{10} concentration exceeded 50 µg m^{-3} are shown in Figure 3.6.

The highest peak in PM_{10} concentrations occurred during the early evening, with concentrations increasing from around 5pm. This is fairly typical of diurnal profiles for elevated PM_{10} concentrations in urban areas of New Zealand. Higher concentrations occur at these times under low wind speeds. The observed peak in PM_{10} concentrations around 8-11am is also common in urban areas of New Zealand under meteorological conditions conducive to NES breaches.

On all days, winds were typically from the westerly direction. On three of the six days these changed to either northerly or north-east for the afternoon period. Temperatures ranged from less than zero degrees Celsius during the nighttime and morning, increasing to up to around 14 degrees Celsius during the afternoon.

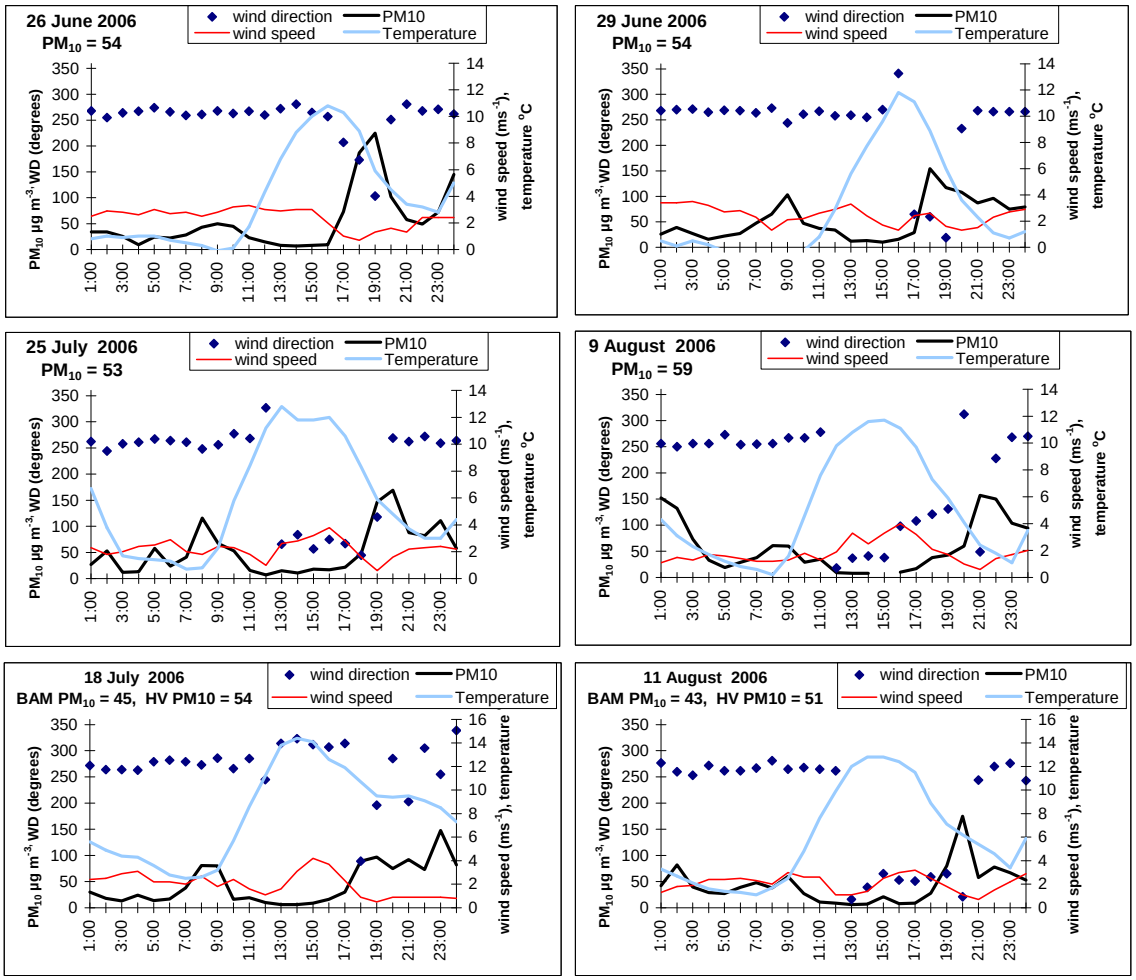
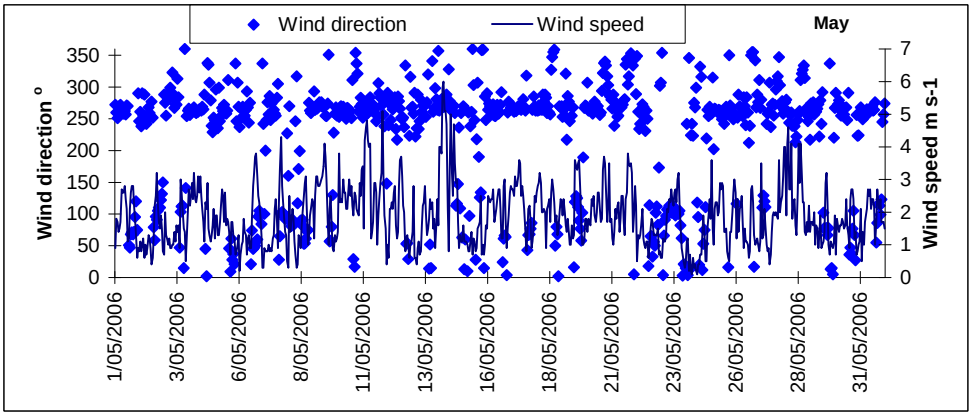


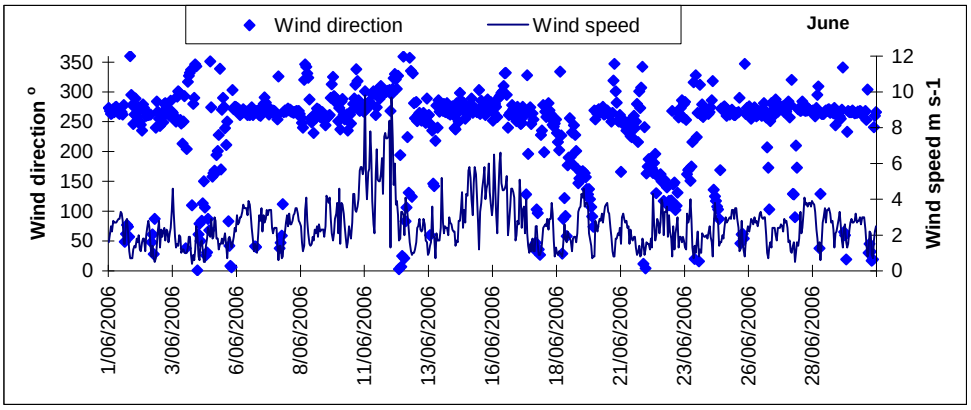
Figure 3.6: Hourly average PM_{10}, wind speed, wind direction and temperature on days when PM_{10} concentrations exceeded the NES at the Redwoodtown site

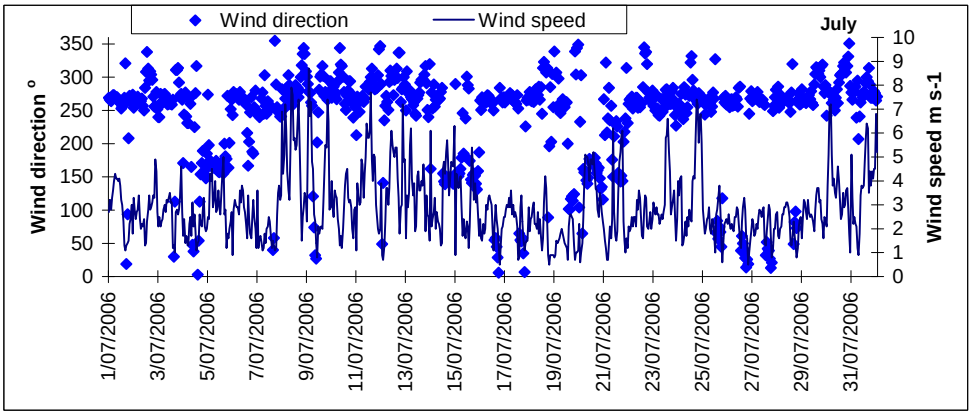
3.4 Meteorology in Blenheim from May to August

Hourly wind direction and wind speed, measured at the NIWA meteorological monitoring site on the outskirts of Blenheim (see Figure 2.1), are shown in Figure 3.7 for the months May to August 2006.

As with 2005, the predominant wind direction is westerly. The wind speed was greater than 2 m s^{-1} for much of the winter, although periods of low wind speeds are apparent at times. The greatest prevalence of low wind speeds for winter 2006 occurs in June. Unfortunately the continuous PM_{10} sampler was not operational until 23 June. Figure 3.7 suggests a number of calm meteorological days occurred early in June. One day in three sampling did not show guideline exceedences for the 6 days sampled between 1 and 23 June 2006.







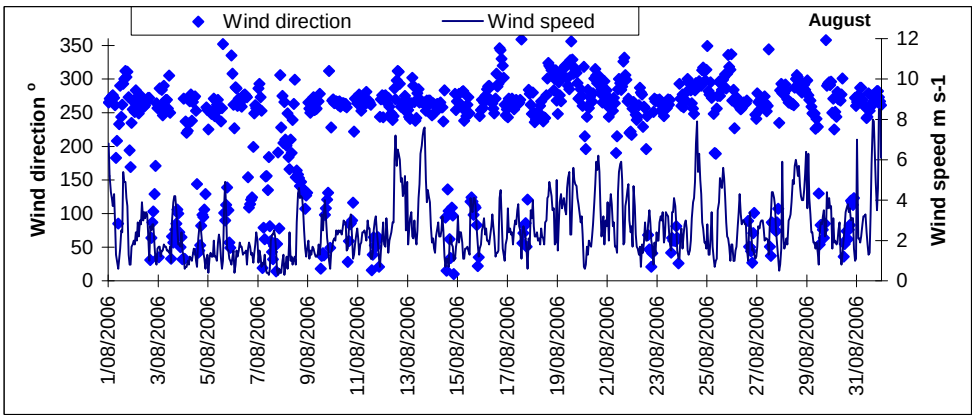


Figure 3.7: Hourly average wind speed and wind direction in Blenheim for May to August 2006

4 Correlation between the BAM and High-volume PM_{10} concentrations

From 23 June to 31 December, PM_{10} concentrations were measured using both the high-volume sampler (one day in three) and BAM (continuous) at the monitoring site in Redwoodtown. Figure 4.1 shows a good correlation between the two methods (R^2=0.9). The reduced major axis (RMA) regression equation for the relationship is shown as y = 0.93x, indicating that the BAM is measuring around 7% less than the high-volume sampler overall.

Results have been presented in this report for the PM_{10} concentrations as measured by the BAM which gave four exceedences of 50 µg m^{-3} (24-hour average). The high-volume sampler was not operating on any of the days the BAM recorded concentrations greater than 50 µg m^{-3}. Results for the high-volume sampler indicate two exceedences of 50 µg m^{-3}, all occurring on days when the BAM concentrations did not exceed 50 µg m^{-3}. The corresponding BAM concentrations on these days were 43 and 45 µg m^{-3}.

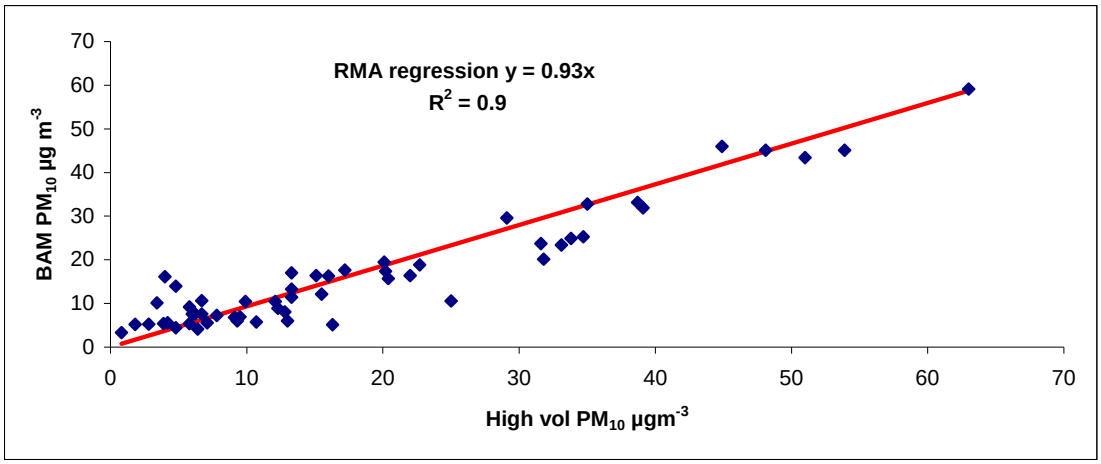


Figure 4.1: Comparison of PM_{10} concentrations measured using a BAM and High-volume sampler at Redwoodtown during 2006

5 Elevated PM_{10} concentrations during the non-winter months

During 2005, a number of elevated PM_{10} concentrations were recorded during the summer months. The highest of these was 47 µg m^{-3} and occurred during November. Because no hourly PM_{10} data were available, it was difficult to indicate likely causes of the elevated levels although high wind speeds (>4m s^{-1}) on these days meant it seemed likely that a wind related source (such as dust) might be responsible.

The highest summer concentrations post June 2006 occurred on 12 October. This value, 25 µg m^{-3}, was not as high as those recorded during 2005. Figure 5.1 shows the PM_{10} concentrations on this day increased coincidentally with an increase in wind speed, suggesting a wind-based source (such as dust) may have been responsible for the increase in concentrations.

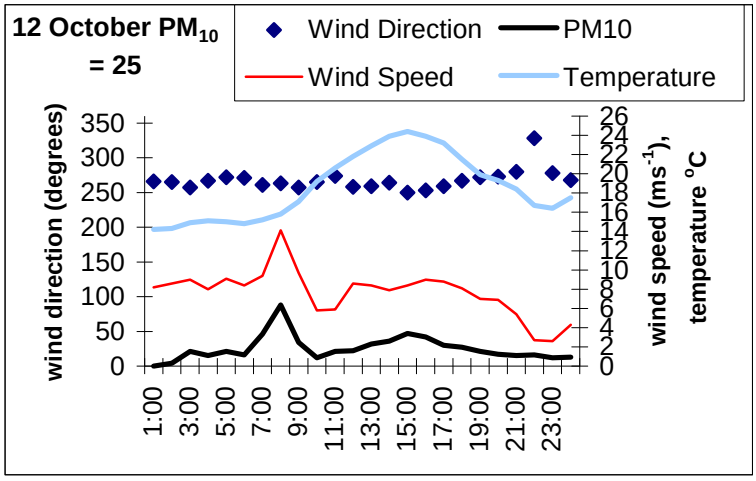


Figure 5.1: Hourly average wind speed, wind direction and temperature on day of highest summer PM_{10} value for 2006.

6 Summary

Air quality monitoring for PM_{10} was carried out at two monitoring sites in Marlborough during 2006. Two monitoring methods were used. These included the historical method of gravimetric sampling using high-volume samplers (a 24-hour based measurement for the period midnight to midnight) and a continuous Met One Beta Attenuation Monitor (BAM). The latter provided hourly average PM_{10} concentrations for the Redwoodtown monitoring site from 23 June 2006. The sampling frequency for the gravimetric sampling was one day in three at both the Redwoodtown and Middle Renwick Road (MRR) sites.

Air quality was good for most of the time, with only 13% of PM_{10} concentrations above 66% of the NES at the Redwoodtown site. Four exceedences of 50 µg m^{-3} (24-hour average) were recorded at this site by the BAM. The maximum measured PM_{10} concentration for 2006 was 63 µg m^{-3} and was measured on 9 August using the high-volume sampler. The corresponding BAM concentration was 59 µg m^{-3}. The previous maximum for the Redwoodtown site was 81 µg m^{-3} and was measured in 2004 at an alternative location in Redwoodtown.

Daily variations in PM_{10} concentrations on high pollution days were typical of urban air quality in New Zealand, with peak concentrations occurring during the evening and occurring under low wind speeds (<2.5 m s^{-1}).

A good correlation between the high-volume and BAM PM_{10} concentrations was observed at the Redwoodtown site (R^2 = 0.9) for 2006. Overall the BAM measured around 7% lower than the high-volume method.

Annual average PM_{10} concentrations for each site were estimated based on an extrapolation for missing data. For Redwoodtown, an annual average concentration of around 17 µg m^{-3} was estimated for 2006. This compares to estimated annual averages of 22 µg m^{-3} and 18 µg m^{-3} for 2004 and 2005 respectively. At the MRR site, the estimated annual average PM_{10} concentrations for 2006 was 14 µg m^{-3}. The estimated annual average PM_{10} concentrations for previous years at this site range from 13 to19 µg m^{-3}. The 2006 annual average concentration estimate is below the annual average guideline for PM_{10} of 20 µg m^{-3} (MfE, 2002).

References

Fisher, G., Rolfe, K., Kjellstrom, T., Woodward, A., Hales, S., Sturman, A., Kingham, S., Peterson, J., Shrestha, R., King, D., 2002. *Health effects due to motor vehicle air pollution in New Zealand*. Report to the Ministry of Transport.

Ministry for the Environment, 2002, *Ambient Air Quality Guidelines, May 2002.* Ministry for the Environment.

Ministry for the Environment, 2004, *National Environmental Standards for Air Quality,* Ministry for the Environment.

Wilton, E., 2005a, Annual Air Quality Monitoring Report - 2005. Marlborough District Council Report.

Wilton, E., 2005b, Blenheim Air Emission Inventory 2005. Marlborough District Council Report.