

Air Quality Monitoring 2008 for Hamilton, Tokoroa, Taupo, Te Kuiti, Matamata, Putaruru, Ngaruawahia and Waihi

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**Air Quality Monitoring
2008 for Hamilton,
Tokoroa, Taupo, Te Kuiti,
Matamata, Putaruru,
Ngaruawahia and Waihi**

Environment Waikato

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February 2009

Executive Summary

The main air contaminant of concern in the Waikato region is PM₁₀ (particles in the air less than 10 microns in diameter). The National Environmental Standard (NES) for PM₁₀ requires that by 2013 a maximum concentration of 50 µg m⁻³ (24-hour average) is not exceeded more than once a year. Under the NES any subsequent breach of the PM₁₀ standard must be publicly notified within a month of it occurring. The NES requires air quality monitoring to take place in areas that are likely to exceed the standard for PM₁₀.

During 2008, PM₁₀ monitoring was carried out at Hamilton, Tokoroa, Taupo, Te Kuiti, Matamata, Putaruru, Ngaruawahia and Waihi. Monitoring for benzene, toluene and xylenes and polycyclic aromatic hydrocarbons (PAHs) also took place in Hamilton. Dual measurements were undertaken at the Hamilton, Tokoroa, Taupo and Te Kuiti monitoring stations, allowing external validation and (where necessary) site-specific correction of PM₁₀ data from those locations.

Results from air quality monitoring throughout 2008 show that PM₁₀ concentrations in excess of the NES were measured in Tokoroa, Taupo, Te Kuiti and Putaruru. Twelve exceedences of the NES for PM₁₀ were recorded in Tokoroa and Taupo, and three exceedences were recorded in Te Kuiti. In Putaruru two concentrations in excess of 50 µg m⁻³ were recorded in the summer months and occurred as a result of roadworks. Overall, the highest measurement for the monitoring period was 85 µg m⁻³ (24-hour average) and was measured in Tokoroa. Taupo recorded a maximum PM₁₀ concentration of 76 µg m⁻³ (24-hour average). This represents the highest 24-hour average PM₁₀ concentration measured in Taupo with the previous maximum of 72 µg m⁻³ being measured in 2007. The maximum recorded PM₁₀ concentration for Te Kuiti was 69 µg m⁻³. The maximum wintertime PM₁₀ concentration for Putaruru was 50 µg m⁻³ (24-hour average), which is not considered an exceedence of 50 µg m⁻³.

Concentrations of PM₁₀ in Hamilton, Matamata, Ngaruawahia and Waihi were within the NES. Results suggest that it is unlikely that PM₁₀ concentrations in Matamata would be in breach of the NES in the near future.

The Ministry for the Environment's air quality guideline for annual ambient concentrations of PM₁₀ is 20 µg m⁻³. The annual average PM₁₀ concentrations for Hamilton, Tokoroa, Taupo, Te Kuiti, Matamata, Putaruru, Ngaruawahia and Waihi were 15, 16, 17, 18, 15, 18, 14 and 12 µg m⁻³ respectively.

Air quality monitoring of benzene, toluene and xylene was carried out at six monitoring sites in Hamilton. The highest average annual concentration during 2008 of 3.5 µg m⁻³ was measured at the Greenwood Street monitoring site and is within the 2010 guideline for benzene of 3.6 µg m⁻³ (annual average). Concentrations of toluene and xylene were well within acceptable levels.

Results of PAH monitoring in Hamilton indicated an annual average for benzo(a)pyrene of 0.40 ng m⁻³. With a 95% confidence interval of 0.20-0.60 ng m⁻³ this concentration is statistically indistinguishable from the guideline for benzo(a)pyrene of 0.3 ng m⁻³.

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1 Introduction

The main air contaminant of concern in the Waikato region is PM₁₀ (particles in the air less than 10 microns in diameter). Historically, concentrations of PM₁₀ have exceeded national environmental standards (NES) in Hamilton, Tokoroa, Taupo and Te Kuiti during the winter months.

During 2008, concentrations of PM₁₀ were measured at eight sites in the Waikato region. These were Hamilton, Tokoroa, Taupo, Te Kuiti, Matamata, Putaruru, Ngaruawahia and Waihi. Monitoring for benzene, toluene and xylenes and polycyclic aromatic hydrocarbons (PAHs) also took place in Hamilton.

National Environmental Standards 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 PM₁₀ would be in breach. Consequently most of the resources for air quality monitoring in the Waikato region have focused on PM₁₀. The NES includes specifications for monitoring PM₁₀ in areas where breaches are likely.

In addition to the NES, the Ministry for the Environment (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 Waikato region includes monitoring of PM₁₀ at Hamilton, Tokoroa, Taupo, Te Kuiti, and Matamata. Passive sampling for benzene has been carried out since 2003 in Hamilton. Monitoring for PAHs was also carried out from 2007 in Hamilton.

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

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

Notes for Tables 1.1 and 1.2:

^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

Although these Ministry for the Environment categories are primarily used as air quality indicators, at local government level the Waikato Regional Plan (WRP) takes a further regulatory step by specifying designated policy responses that should correspond to each zone. Under Section 6.1.3 of the WRP, air quality in the “Excellent” category is to be protected, while “Good” air quality is to be maintained or protected. “Acceptable” air quality is to be maintained. Air quality in the “Alert” category is to be maintained or enhanced. For air quality in the “Action” category, the only designated policy response is to aim to enhance (improve) the situation.

1.1 Reporting period

For PM₁₀, the reporting period used for most sites in this report is from 1 January 2008 to 31 December 2008. In Ngaruawahia the reporting period is from May to December 2008 and in Waihi the reporting period is February to December 2008. The reporting period for benzene, toluene and xylenes is 18 December 2007 to 16 December 2008. The reporting period for polycyclic aromatic hydrocarbons (PAHs) is from March 2007 to March 2008.

A September to August reporting period was introduced in 2006 by Environment Waikato for a number of reasons including ensuring that results are reported as soon as possible after the peak winter PM₁₀ concentrations as well as ensuring compliance with the reporting requirements under the NES. This report has been prepared based on the calendar year January to December, the same format as historical reports.

2 Methodology

The method used to monitor PM₁₀ concentrations can have some impact on the results obtained. Since 2006 a number of sites had gravimetric reference method samplers run in conjunction with historical methods. Results have been used to determine site specific differences between methods and data have been adjusted for gravimetric equivalence by Environment Waikato staff. Monitoring data for 2007 had been adjusted based on equations detailed in the 2007 monitoring report (Wilton & Baynes, 2008). Data prior to 2007 were not adjusted. Adjustment equations have been updated for 2008 as a result of additional monitoring.

During 2008 PM₁₀ concentrations at Peachgrove Road in Hamilton were monitored using a Tapered Elemental Oscillation Microbalance (TEOM) with a sample temperature setting of 40 degrees centigrade. Concentrations of PM₁₀ measured using the TEOM in 2008 were adjusted using equation 2.1.

$$\text{Corrected PM}_{10} = 1.19975 \times \text{RawTEOM} - 3.9182 \quad \text{Equation 2.1}$$

Since September 2005 the method of monitoring used at the Tokoroa site was a ThermoAndersen FH62 C14 BAM. A Sequential Partisol gravimetric sampler was co-located at this site since May 2007. Equation 2.2 shows the adjustments made to the FH62 2008 data for consistency with the gravimetric method.

$$\text{Corrected PM}_{10} = 10^{(1.09945 \log \text{FH62} - 0.08595)} \quad \text{Equation 2.2}$$

In Taupo, gravimetric sampling was conducted at the Gillies Street site from March 2007. Concentrations of PM₁₀ measured using the BAM during 2008 were adjusted based on equation 2.3.

$$\text{Corrected PM}_{10} = 10^{(1.06015 \log \text{BAM})} \quad \text{Equation 2.3}$$

Concentrations of PM₁₀ at Te Kuiti, Matamata, Ngaruawahia and Putaruru site were measured using (at each location) an ESM (Andersen) FH62 C14 Beta Attenuation Monitor (BAM). No adjustments have been made to concentrations measured at these sites. In the case of Te Kuiti, one year of reference sampling has been carried out, but results to date indicate that site-specific correction of the BAM readings will not be necessary. For the other towns, the possible need for any site-specific correction remains to be assessed. Co-location sampling for 2009 is scheduled for Putaruru, Te Kuiti and Taupo.

In Hamilton passive sampling for volatile organic compounds (VOCs) benzene, ethylbenzene, toluene and xylenes (BTEX) was carried out using 3M Passive Diffusion Monitors for the 12 month period 18 December 2007 to 16 December 2008.

Hourly average meteorological data, including temperature, wind speed and wind direction were obtained from each monitoring site in the Waikato region, except for

the Putaruru, Ngaruawahia and Waihi sites. Meteorological data were compared with PM₁₀ on days when pollution was elevated.

Most sites in the Waikato air quality monitoring network have been managed by Environment Waikato staff since August 2005. Prior to that the monitoring network was operated and maintained by NIWA. To the end of the period covered in this report, the Partisol Model 2000 PM₁₀ sampler at the Taupo site has been operated by the Institute of Geological and Nuclear Sciences Ltd (GNS) on behalf of Environment Waikato.

Hourly data from the BAM monitors are recorded by the instrument and logged by an iQuest iRIS 320 datalogger. Results are telemetered hourly to Environment Waikato and stored in the hydrotel database.

3 Hamilton

3.1 Air Quality Monitoring in Hamilton

Air quality in Hamilton has been measured at a monitoring site in Peachgrove Road since November 1997. Additional “traffic peak” monitoring sites at Bridge Street, Claudelands Road, Hamilton Intermediate School, Greenwood Street and Tristram Street have also been used in recent years to monitor concentrations of benzene, ethyl-benzene, toluene and xylenes (BTEX). The Peachgrove Road site is located on the south-east side of Hamilton City. During 2008, PM₁₀ and PAHs were measured at Peachgrove Road. The site meets the requirements of the “Residential Peak” site classification as described in *Good Practice Guideline for Air Quality Monitoring and Data Management* (MfE, 2000). The location of the air quality monitoring network in Hamilton is shown Figure 3.1.

During 2008, PM₁₀ monitoring at Peachgrove Road was carried out using a Tapered Elemental Oscillating Microbalance (TEOM) with a sample temperature setting of 40°C. The PM₁₀ data were collected at the Peachgrove Road site as ten minute averages and subsequent concentration of hourly averages were made from these data.

Passive sampling for the volatile organic compounds (VOCs) benzene, ethyl-benzene, toluene and xylenes was carried out using 3M Passive Diffusion Monitors at the six established Hamilton BTEX sites over the 12 month period from 18 December 2007 to 16 December 2008. The method used is as described in Stevenson and Narsey (1999) with filters being deployed for periods of three months. The analysis was carried out by Hill Laboratories in Hamilton. While this type of passive sampling is recommended as a screening method only, it is the most common approach to benzene monitoring in New Zealand and is significantly more cost effective than the method recommended by the Ministry for the Environment's ambient air quality guidelines (MfE 2002).

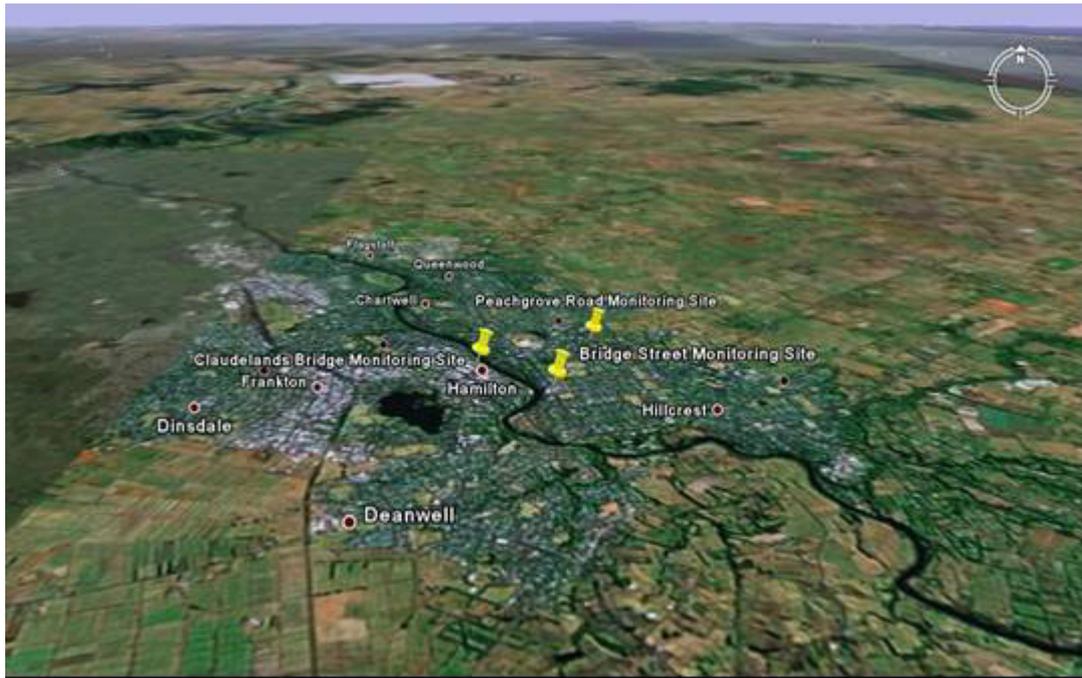


Figure 3.1: Hamilton air quality monitoring sites (Source: Google Earth 2008)

3.2 PM₁₀ Concentrations for Hamilton

No exceedences of the air quality guideline and the NES for PM₁₀ (50 µg m⁻³, 24-hour average) were recorded in Hamilton during 2008. Figure 3.2 shows the 24 hour average PM₁₀ concentrations measured at Hamilton during 2008. The highest measured PM₁₀ concentration was 48 µg m⁻³. This compares with the 2007 highest 24 hour average PM₁₀ concentration of 46 µg m⁻³.

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. In 2006 there were two exceedences of the NES and Environment Waikato notified one exceedence. No breaches were notified for Hamilton during 2007.

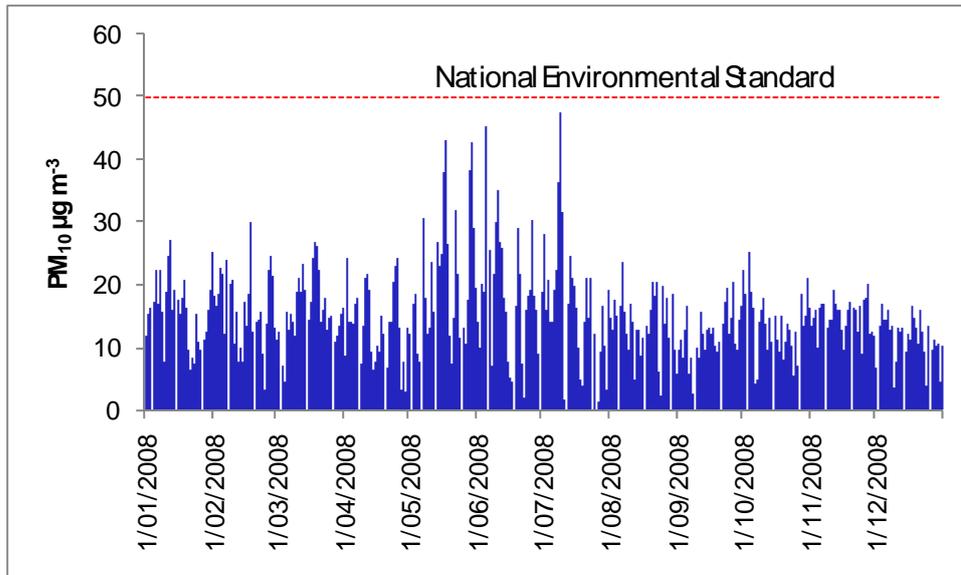


Figure 3.2: 24-hour average PM₁₀ concentrations measured at Peachgrove Road during 2008

Figure 3.3 compares daily PM₁₀ concentrations measured from 2000 to 2008 to the MfE air quality indicator categories (shown in Table 1.3). The majority of the PM₁₀ concentrations measured were less than 66% of the air quality guideline, within the “acceptable” and “good” air quality categories. The proportion of PM₁₀ concentrations in the alert or action categories for 2008 is similar to previous years at less than 5% of days. Seasonal variations in the distribution of PM₁₀ concentrations for 2008 are shown in Figure 3.4.

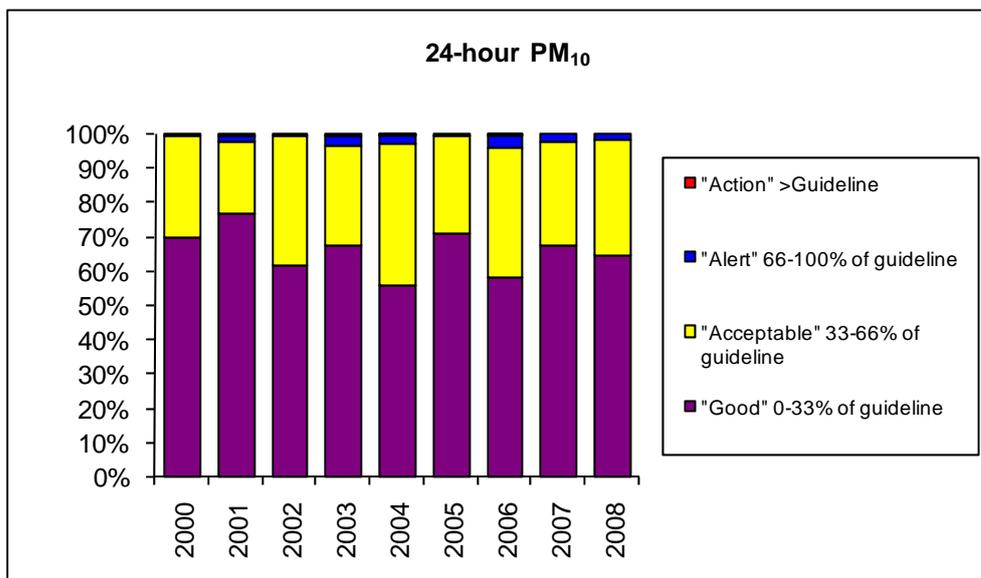


Figure 3.3: Comparison of PM₁₀ concentrations measured at Peachgrove Road in Hamilton from 2000 to 2008 to MfE air quality indicator categories

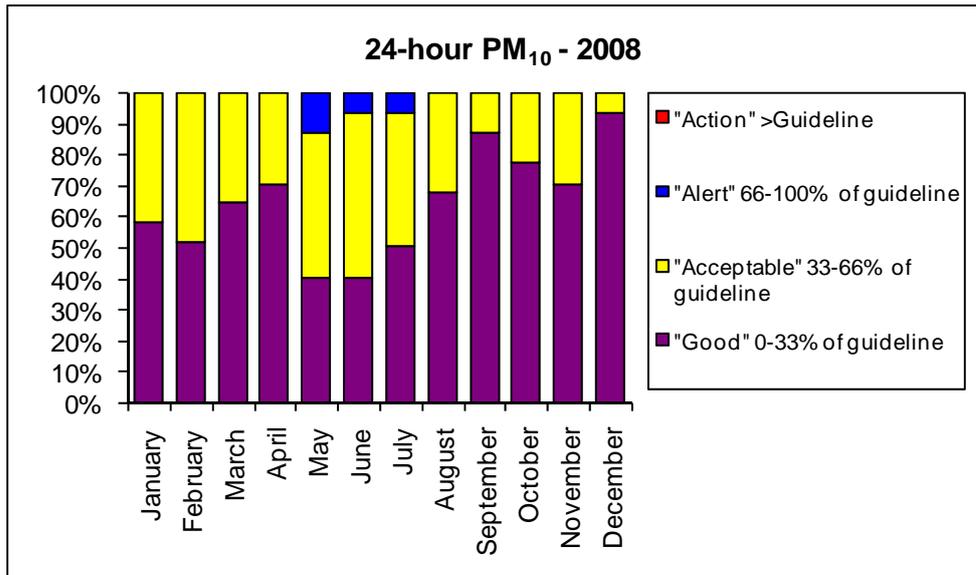


Figure 3.4: Comparison of daily PM₁₀ concentrations each month for 2008 to MfE air quality indicator categories

The annual average PM₁₀ concentration for Hamilton for 2008 was 15 µg m⁻³ and is similar to previous year's data. An annual average guideline for PM₁₀ of 20 µg m⁻³ is specified by MfE. The NES does not include an annual average concentration for PM₁₀.

Table 3.1 shows summary statistics for PM₁₀ monitoring results from the Hamilton site since monitoring commenced in 1998. Since 2007 concentrations have been adjusted for differences between the TEOM and gravimetric sampling methods as detailed in section 2 of this report.

Table 3.1: Summary of PM₁₀ concentrations measured at Peachgrove Road in Hamilton from 2000- 2008

	2000	2001	2002	2003	2004	2005	2006	2007	2008
"Good" 0-33% of guideline	70%	77%	61%	67%	56%	70%	58%	67%	64%
"Acceptable" 33-66% of guideline	30%	21%	38%	29%	41%	29%	38%	30%	34%
"Alert" 66-100% of guideline	1%	2%	1%	3%	3%	1%	4%	2%	2%
"Action" >Guideline	0%	1%	0%	1%	0%	0%	1%	0%	0%
Percentage of valid data	91%	70%	93%	91%	94%	77%	99%	66%	99%
Annual average ($\mu\text{g m}^{-3}$)	15	15	16	16	17	15	17	15	15
Measured exceedences	0	3	0	4	1	0	2	0	0
Annual maximum (24-hr average $\mu\text{g m}^{-3}$)	43	67	36	62	55	37	66	46	48
Number of records	334	256	340	331	344	281	363	242	364

3.3 Concentrations of Benzene, Toluene and Xylenes

Monitoring of benzene commenced in Hamilton in 2003 at the Peachgrove Road air monitoring site and at a high-density traffic area at Bridge Street. An additional benzene sampling site was established in 2004 at the intersection of Claudelands Road and Victoria Street (Claudelands Bridge). This is also a high density traffic area. Three additional sites were established in 2006 in Tristram Street, Greenwood Street and at Hamilton Intermediate School.

Benzene concentrations in Hamilton are within the Ministry for the Environment's current guideline for benzene of $10 \mu\text{g m}^{-3}$ per year (Table 3.2) and met the 2010 annual guideline of $3.6 \mu\text{g m}^{-3}$. The highest average annual concentration during 2008 was $3.5 \mu\text{g m}^{-3}$ and was measured at the Greenwood Street monitoring site.

Results for 2008 show that benzene concentrations have continued to decline since monitoring commenced in 2003 (Figure 3.5), although to a lesser extent than that observed between 2003 and 2006. No decreases were observed at the Hamilton Intermediate and Tristram Street sites between 2007 and 2008. Decreases in benzene concentrations are consistent with previous predictions (Smith, 2006) that suggest changes in fuel specifications and improved vehicle technology may result in a decrease in benzene from motor vehicles.

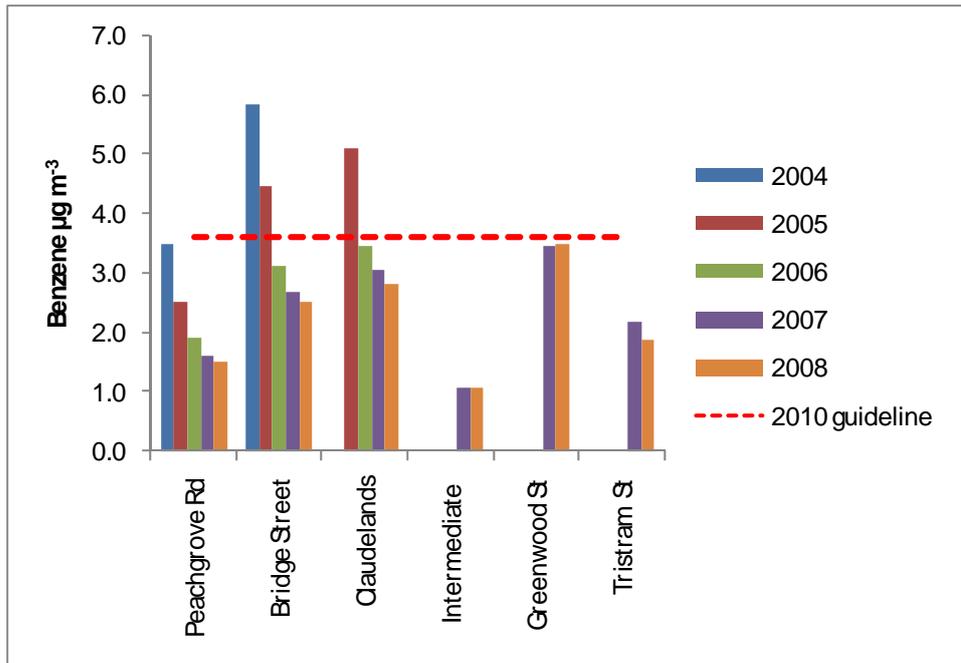


Figure 3.5: Annual average benzene measured at Hamilton sites for periods February 2003 – February 2004, July 2004 – July 2005, September 2005 – September 2006, December 2006 – December 2007 and December 2007 – December 2008.

Toluene and xylene were also measured at the benzene monitoring sites for each year. An MfE document discussing amendments to the 1994 ambient air quality guidelines suggests an annual threshold of $190 \mu\text{g m}^{-3}$ and $950 \mu\text{g m}^{-3}$ for toluene and total xylenes respectively (MfE, 2000). Concentrations of benzene and xylene measured in Hamilton at all sites were significantly lower than the thresholds suggested by MfE (2000).

Table 3.2: Annual average concentrations of volatile organic compounds (VOCs) at Hamilton sites between December 2007 – December 2008.

	Bridge St	Peachgrove Road	Claudlands	Intermediate	Greenwood Street	Tristram Street	Guideline ^a
$\mu\text{g m}^{-3}$							
Benzene	2.52	1.51	2.83	1.06	3.47	1.88	3.6 (10 ^a)
Toluene	10.60	6.32	12.01	4.32	17.76	8.76	190 ^b
Total Xylenes	9.05	5.05	9.95	3.38	11.55	6.83	950 ^b

^a The current guideline for benzene of 10 $\mu\text{g m}^{-3}$ will reduce to 3.6 $\mu\text{g m}^{-3}$ in 2010.

^b There are currently no guideline values for toluene and xylenes. Threshold values used here are from proposed amendments to the 1994 ambient air quality guidelines.

3.4 Concentrations of PAHs

Concentrations of 34 different polycyclic aromatic hydrocarbons (PAHs) were measured at the Peachgrove Road monitoring site from March 2007 to March 2008. Sampling was carried out by trapping PAHs on a combined glass fibre filter and PUF cartridge. The sampling period was 24 hours (midnight to midnight) and individual samples were obtained at a frequency of six days over the cooler winter period, and every twelve days over the warmer summer period. A total of 48 samples were collected and PAH concentrations were analysed by GCMS. Summary statistics for the monitoring are shown in Table 3.3

Results indicated an annual average for benzo(a)pyrene of 0.40 ng m^{-3} . With a 95% confidence interval of 0.20-0.60 ng m^{-3} this concentration is statistically indistinguishable from the guideline for benzo(a)pyrene of 0.3 ng m^{-3} .

The annual average for total PAHs based on the 34 measured was 53.4 ng m^{-3} . The total for the 16 EPA priority pollutant PAHs (identified with an asterisk in Table 3.3) was 40.6 ng m^{-3} . The 16 priority pollutant PAHs comprised 77% of the total PAHs measured on average. Figure 3.6 shows the ranked mean PAH concentrations and identifies phenanthrene as the PAH with highest concentrations on average.

Table 3.3: Summary statistics for PAH sampling from March 2007 to March 2008

PAH	No. of samples	Mean pg m^{-3}	Median pg m^{-3}	StdDev pg m^{-3}	Max pg m^{-3}
Naphthalene*	40	3038	908	7338	44973
2-Methylnaphthalene	41	1016	442	1908	11352
1-Methylnaphthalene	43	1285	403	2565	15653
Biphenyl	47	771	290	1057	3994
2,6-Dimethylnaphthalene	45	632	307	770	2704
2,3-Dimethylnaphthalene	43	398	160	489	1736

1,5-Dimethylnaphthalene	30	223	91	259	862
Acenaphthylene*	47	5571	1362	10252	57175
Acenaphthene*	45	519	161	825	4463
4-Methylbiphenyl	47	771	367	1011	4886
2,3,6-Trimethylnaphtha	47	612	309	731	3097
2,3,5-Trimethylnaphtha	46	406	181	560	2545
Fluorene*	47	4182	2699	4360	17510
1-Methylfluorene	48	2013	1562	1670	6742
Phenanthrene*	47	15126	12032	12577	56612
Anthracene*	48	2441	1613	2190	9506
2-Methylanthracene	47	774	542	630	2749
1-Methylphenanthrene	48	2013	1719	1620	7316
9-Methylanthracene	47	510	104	1016	4761
2-Phenylnaphthalene	48	1167	944	925	4103
Fluoranthene*	47	3245	2304	2370	9819
Pyrene*	47	3775	2883	2715	12156
9-Phenylanthracene	11	10	8	7	26
Benz[a]anthracene*	47	634	319	802	4261
Chrysene*	47	808	497	959	4791
Benzo[b]fluoranthene*	47	748	420	1006	5619
Benzo[k]fluoranthene*	46	197	150	229	1093
Benzo[e]pyrene	46	372	256	496	2822
Benzo[a]pyrene*	47	412	130	693	3765
Perylene	41	215	117	286	1197
9,10-Diphenylanthracene	0	-	-	-	-
Indeno[123-cd]pyrene*	47	745	368	855	3884
Dibenz[ah]anthracene*	36	111	59	154	654
Benzo[ghi]perylene*	47	593	310	745	3436
Total PAHs		53421	41916	55994	303709
16 EPA PAHs		40824	26924	43139	235952

* Included in the EPA 16 PAHs

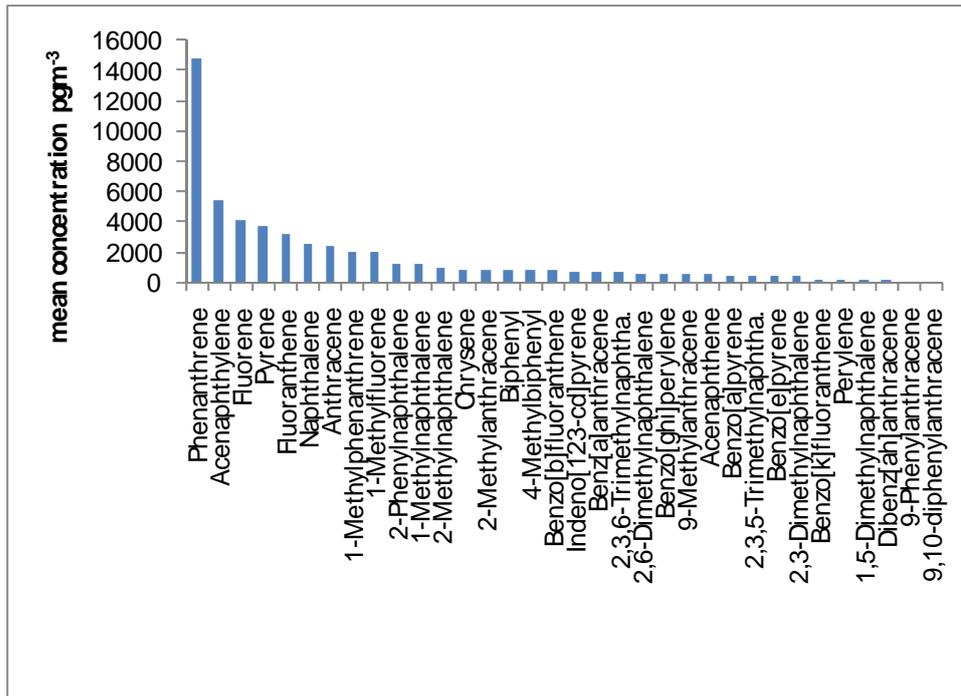


Figure 3.6: Average PAH concentrations measured in Hamilton from March 2007 to March 2008.

3.5 Meteorology in Hamilton

Variations in meteorological conditions and hourly average PM₁₀ concentrations on the eight days when the 24-hour average PM₁₀ measured in Hamilton using the TEOM concentration exceeded 66 µg m⁻³ (MfE “acceptable” air quality) are shown in Figure 3.7.

The dates these occurred on were 16, 17, 28, 29 May, 5 and 10 June and 8 and 9 July. The corresponding PM₁₀ concentrations (24-hour average) were 38, 43, 38, 43, 45, 35, 36 and 48 µg m⁻³.

On most of these days, PM₁₀ concentrations were elevated either during the evening period or the period from midnight to morning, as a result of the preceding evening’s pollution event, or in some cases both. Morning peaks are evident in a few days. On all days wind speeds were low.

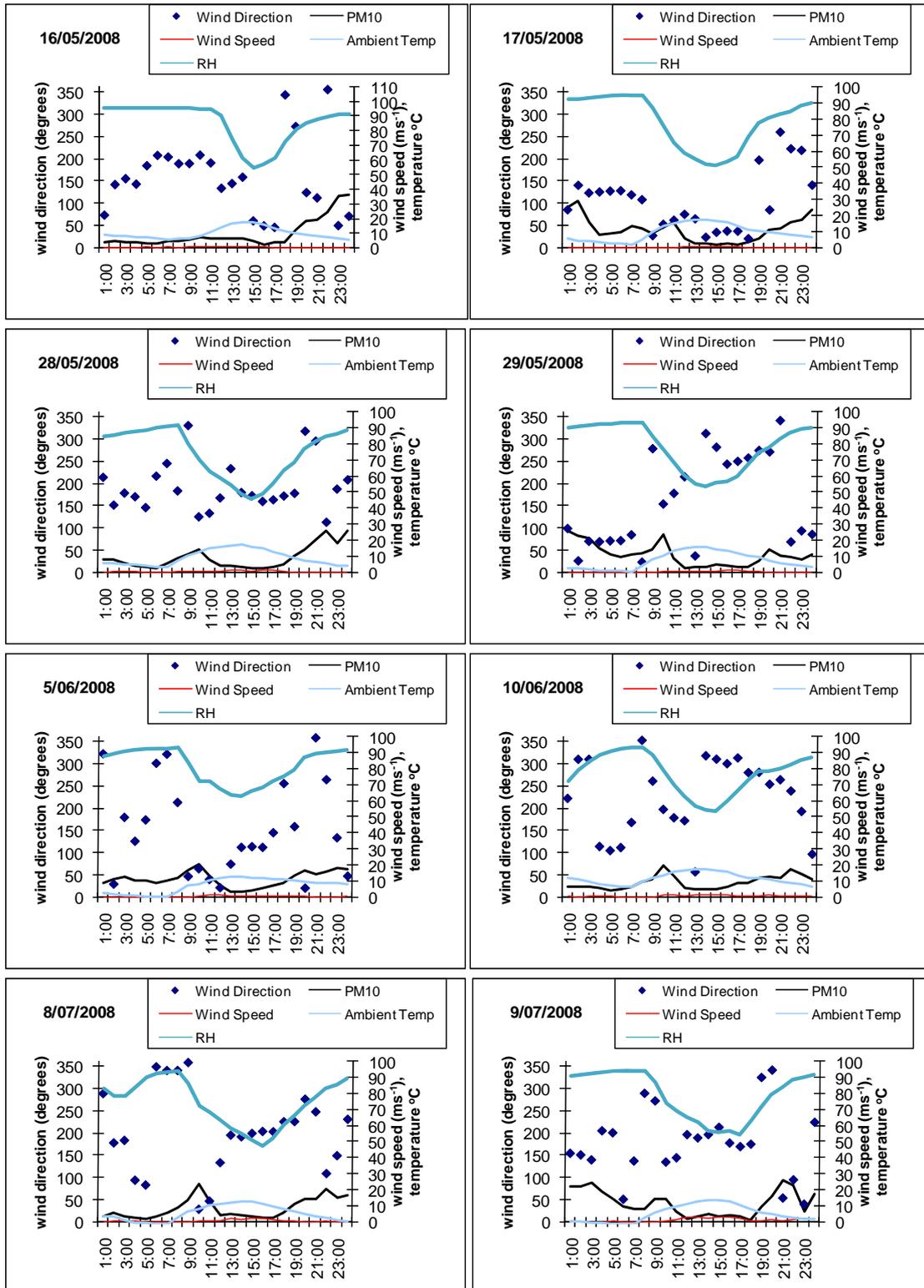


Figure 3.7: Hourly average PM_{10} , wind speed, wind direction and temperature on days when PM_{10} concentrations exceeded the 66% of the NES at the Peachgrove Road site

Hourly wind direction and wind speed, measured at Peachgrove Road, are shown in Figure 3.8 for the months May to August 2008. Results suggest a greater frequency of north and westerly winds and higher wind speeds during August than for the

preceding months. Southerly winds were most predominant during May and were often combined with low wind speeds.

As with 2007, May had the greatest frequency of low wind speeds with only a small proportion of days recording speeds greater than 2 ms^{-1} .

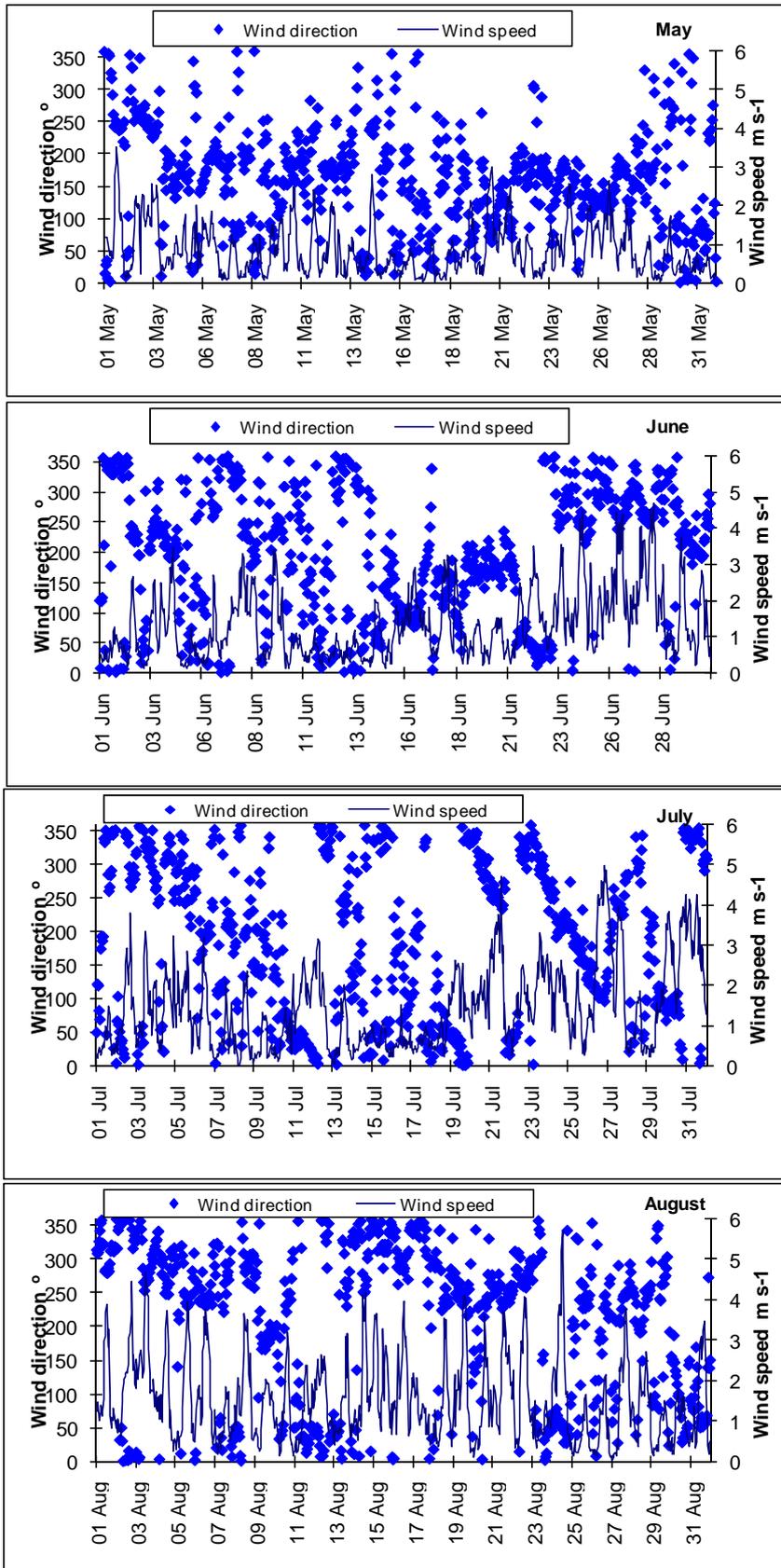


Figure 3.8: Hourly average wind speed and wind direction at the Peachgrove Road site for May to August 2008

4 Tokoroa

4.1 Air Quality Monitoring in Tokoroa

Air quality monitoring for PM₁₀ has been carried out in Tokoroa since 2001 at the Billah Street Reserve air quality monitoring site. This site is located west of central Tokoroa. Prior to this, in 1999 monitoring was carried out in Tokoroa at the South Waikato Council Offices, on the east side of the town. Results of the 1999 monitoring are not included because of uncertainties surrounding the monitoring method. The Billah Street site meets the requirements of the “Residential Neighbourhood” site classification as described in *Good Practice Guideline for Air Quality Monitoring and Data Management* (MfE, 2000).

From 2001 to September 2005, the monitoring method used to measure PM₁₀ concentrations at Billah Street was a MET ONE series 1020 Beta Attenuation Monitor (BAM). From September 2005 the monitoring method was a ThermoAndersen FH62 C14 BAM. The MET ONE instrument was replaced because of unacceptable data loss caused by frequent tape failure. PM₁₀ data were collected by the FH62 BAM at ten minute intervals. The location of the air quality monitor in Tokoroa is shown in Figure 4.1.

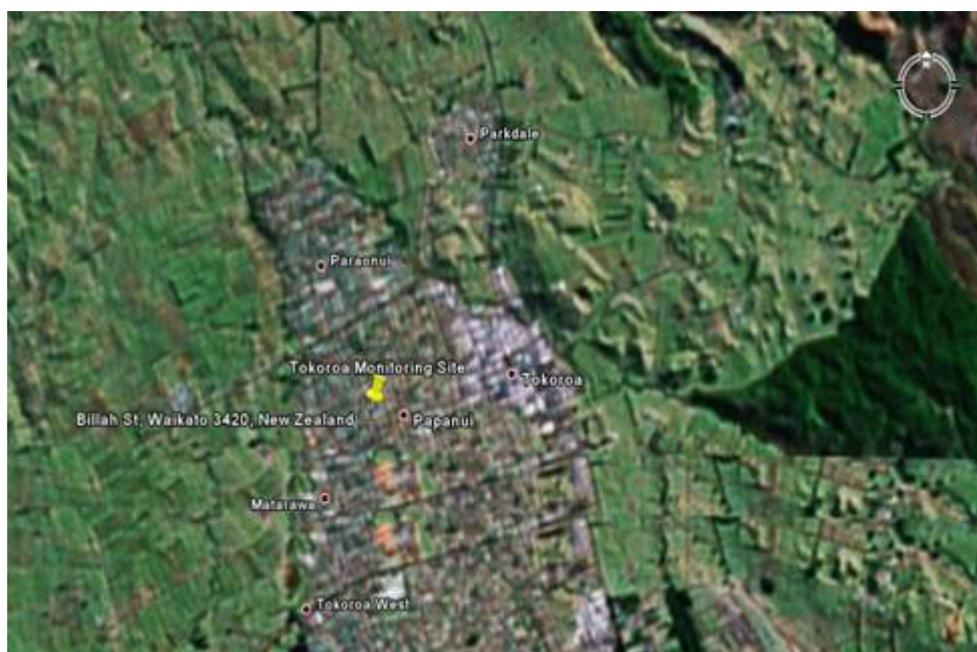


Figure 4.1: Tokoroa air quality monitoring site (Source: Google Earth 2008)

4.2 PM₁₀ concentrations in Tokoroa

Daily average PM₁₀ concentrations measured at the Tokoroa site during 2008 are shown in Figure 4.2. Concentrations in excess of the NES were measured on 12 occasions during 2008 using the FH62 BAM adjusted for gravimetric equivalency. A

further breach was measured on 5 June by the gravimetric sequential sampler ($64 \mu\text{g m}^{-3}$), when the BAM was not operational. The maximum PM_{10} concentration during winter 2008 was $85 \mu\text{g m}^{-3}$ and was recorded on 10 June. The maximum measured PM_{10} concentrations at the Tokoroa site during 2007 was $91 \mu\text{g m}^{-3}$.

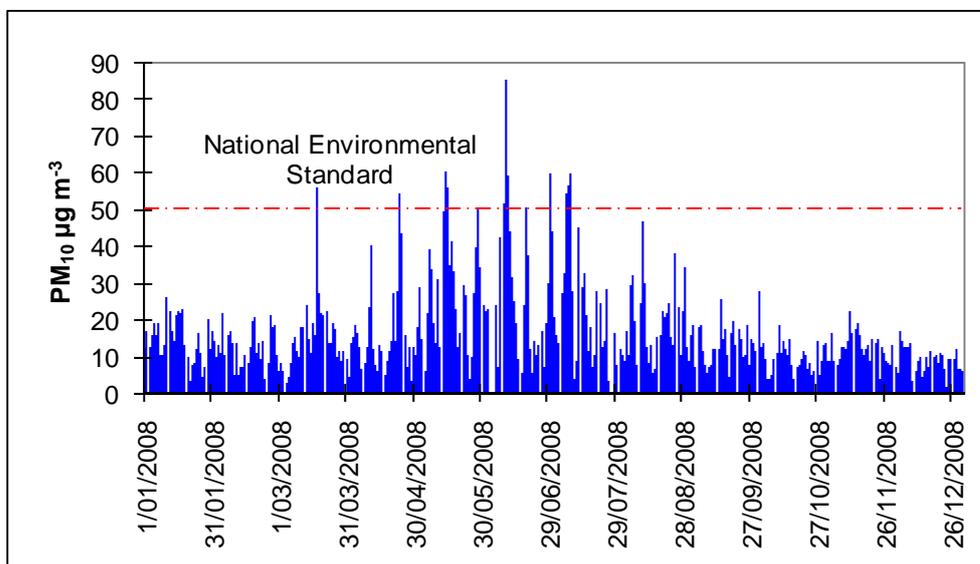


Figure 4.2: Daily winter PM_{10} concentrations measured in Tokoroa during 2008

Changes in PM_{10} concentrations relative to air quality indicator categories at the Tokoroa site from 2006 to 2008 are shown in Figure 4.3. In the case of Tokoroa, the Met One Beta-Attenuation Monitor (BAM) was changed to an FH62 instrument in September 2005, and a change in baseline readings was observed at that point (Smith, 2006). In 2007 and 2008, site-specific calibration against a gravimetric method was carried out. Comparison of results from the two co-located instruments now suggest that:

- The previous BAM was recording an artificially high baseline reading, because the new instrument is accurate (compared to the gravimetric standard method) at low PM_{10} concentrations, and
- The new BAM requires a significant upward correction across the mid and upper ranges, in the order of approximately 19% at a PM_{10} concentration of $50 \mu\text{g m}^{-3}$. Although site-specific calibration data is only available for the newer instrument, it is also likely that the older BAM would have required a similar range correction to bring its results into line with gravimetric results in Tokoroa (pers comm., Nick Kim, Environment Waikato, 2008).

The net result of these two corrections for all data collected in Tokoroa prior to September 2005 would be to reduce the annual average, but increase the peaks (and the non-compliance frequency).

In this report the approach taken has been to report only calibration-corrected data collected on the newer FH62 BAM during the monitoring years from 2006. Retrospective estimates of air quality in Tokoroa from 2001-2005 may form a part of future work involving analysis of trends. Seasonal variations in the distribution of PM₁₀ concentrations for 2008 are shown in Figure 4.4. Unlike previous years, in 2008 exceedences of 50 µg m⁻³ occurred during March and April (in addition to May, June and July).

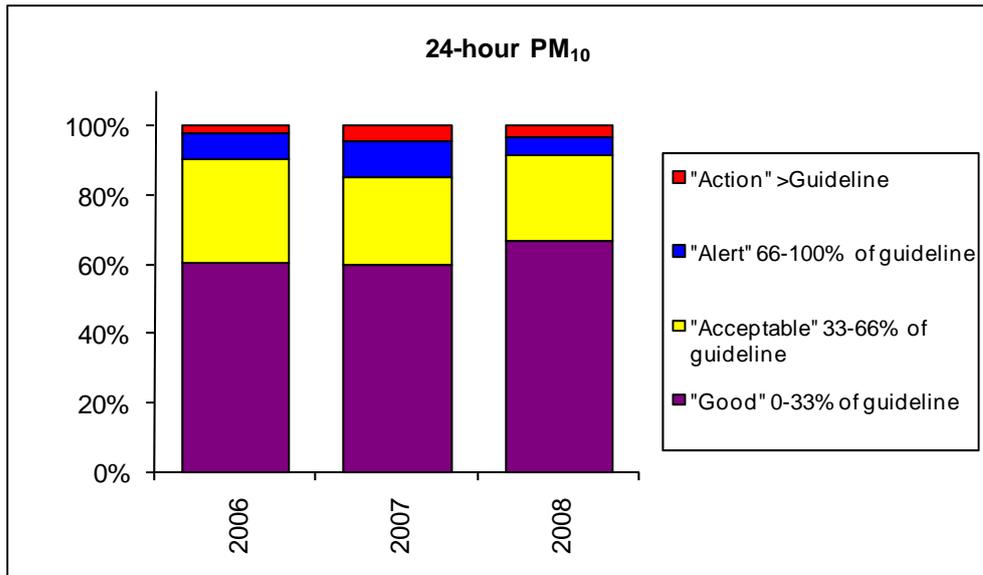


Figure 4.3: Comparison of PM₁₀ concentrations measured in Tokoroa from 2006 to 2008 to MfE air quality indicator categories

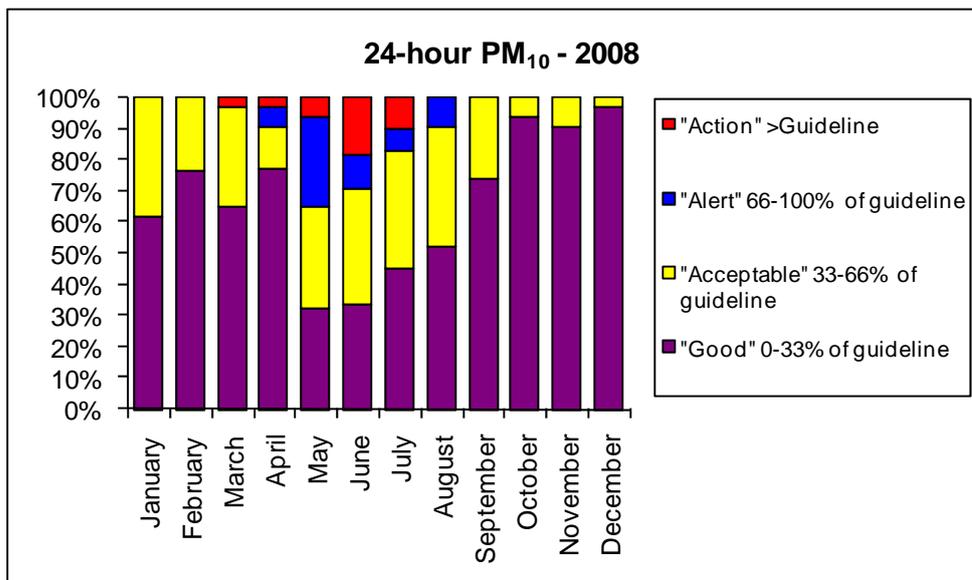


Figure 4.4: Comparison of daily PM₁₀ concentrations each month during 2008 to MfE air quality indicator categories

The estimated annual average PM₁₀ concentration for Tokoroa for 2008 is 16 µg m⁻³. This is similar to the 2006 and 2007 annual average but lower than for previous years. Summary statistics for PM₁₀ monitoring results are shown in Table 4.1.

Table 4.1: Summary of PM₁₀ concentrations measured at the Tokoroa monitoring site from 2006 to 2008.

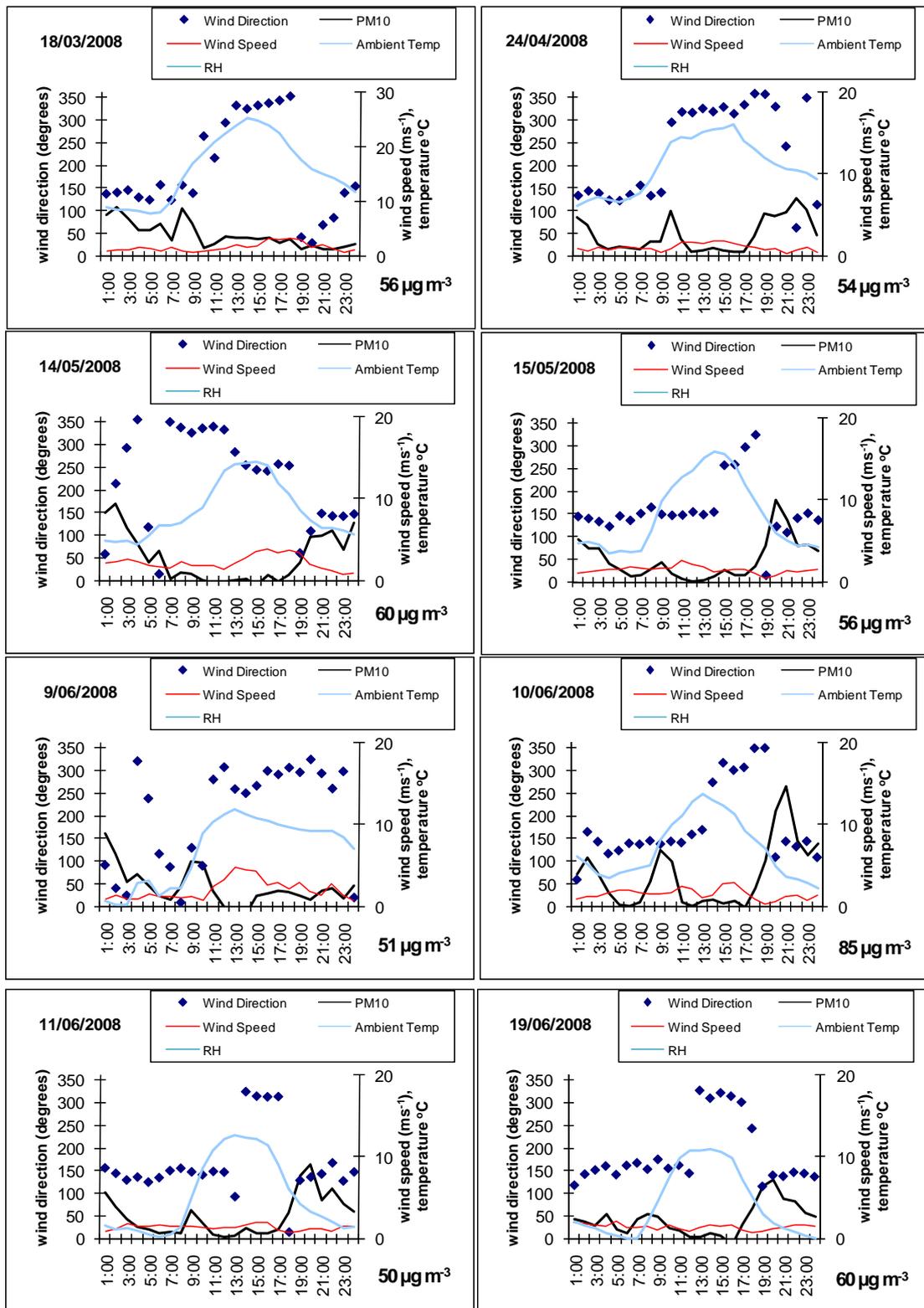
	2006	2007	2008
"Good" 0-33% of guideline	60%	60%	66%
"Acceptable" 33-66% of guideline	30%	25%	25%
"Alert" 66-100% of guideline	8%	11%	5%
"Action" >Guideline	3%	5%	3%
Percentage of valid data	99%	66%	99%
Annual average ($\mu\text{g m}^{-3}$)	17	19	16
Measured exceedence	9	11	12
Annual maximum ($\mu\text{g m}^{-3}$)	62	91	85
Number of records	360	241	361

4.3 Meteorology in Tokoroa

Variations in meteorological conditions and hourly average PM₁₀ concentrations on the 12 days when the 24-hour average PM₁₀ measured at Tokoroa exceeded 50 $\mu\text{g m}^{-3}$ are shown in Figure 4.5.

On most days, the highest peak in PM₁₀ concentrations occurred during the evening period, with a second peak in concentrations occurring in the early morning. This is fairly typical of diurnal profiles for elevated PM₁₀ concentrations in urban areas of New Zealand. Higher concentrations occur at these times under low wind speeds. On a few occasions the morning peak was higher than concentrations observed during the night time. In particular, on 8 July the morning peak reached 250 $\mu\text{g m}^{-3}$ compared with peak evening concentrations around 100 $\mu\text{g m}^{-3}$.

On most days, winds were typically from the south to south east direction when PM₁₀ concentrations were elevated. Temperatures ranged from less than zero degrees celsius during the nighttime and morning, increasing to up to around 15 degrees celsius during the afternoon.



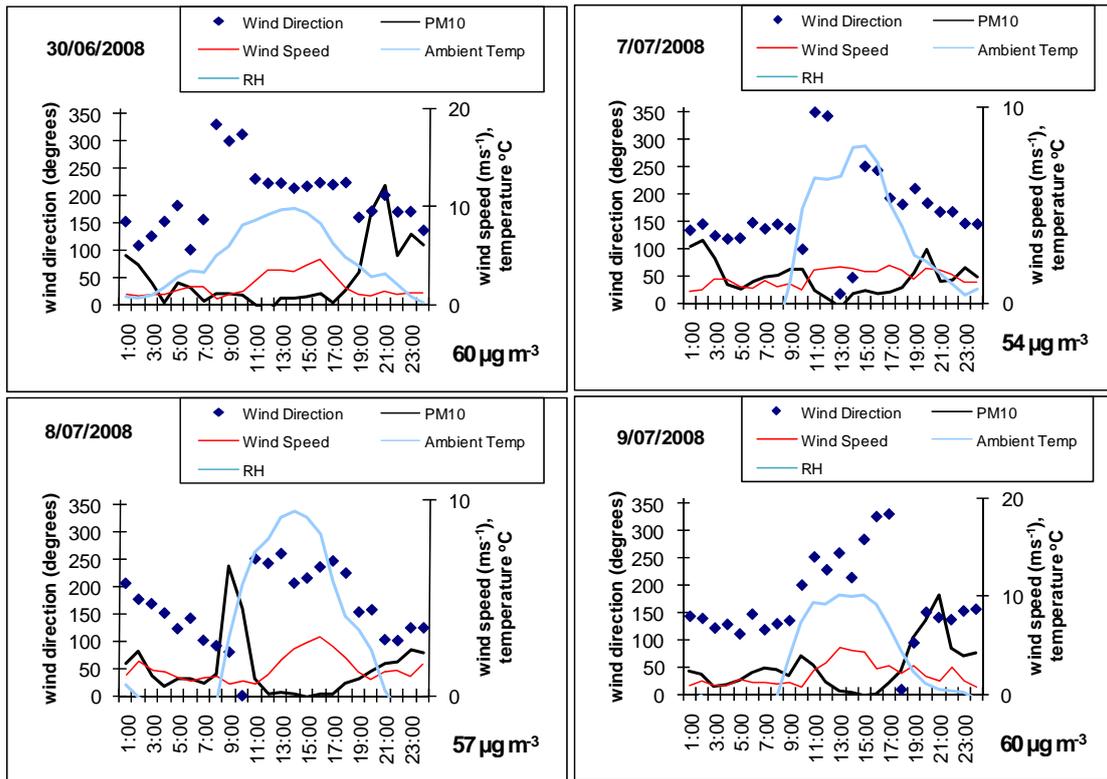


Figure 4.5: Hourly average PM₁₀, wind speed, wind direction and temperature on days when PM₁₀ concentrations exceeded the NES at the Tokoroa site

Hourly wind direction and wind speed, measured at the monitoring site in Tokoroa, are shown in Figure 4.6 for the months May to August 2008.

The main wind direction during May was south east and wind speeds were generally around 2 ms⁻¹. During June and July the wind was mostly north west or south east and wind speed was variable. August was predominantly north west winds with higher wind speed until around 25 August when the direction became south easterly with lower winds. Generally conditions conducive to elevated pollution were prevalent during May and June and not common during July and August.

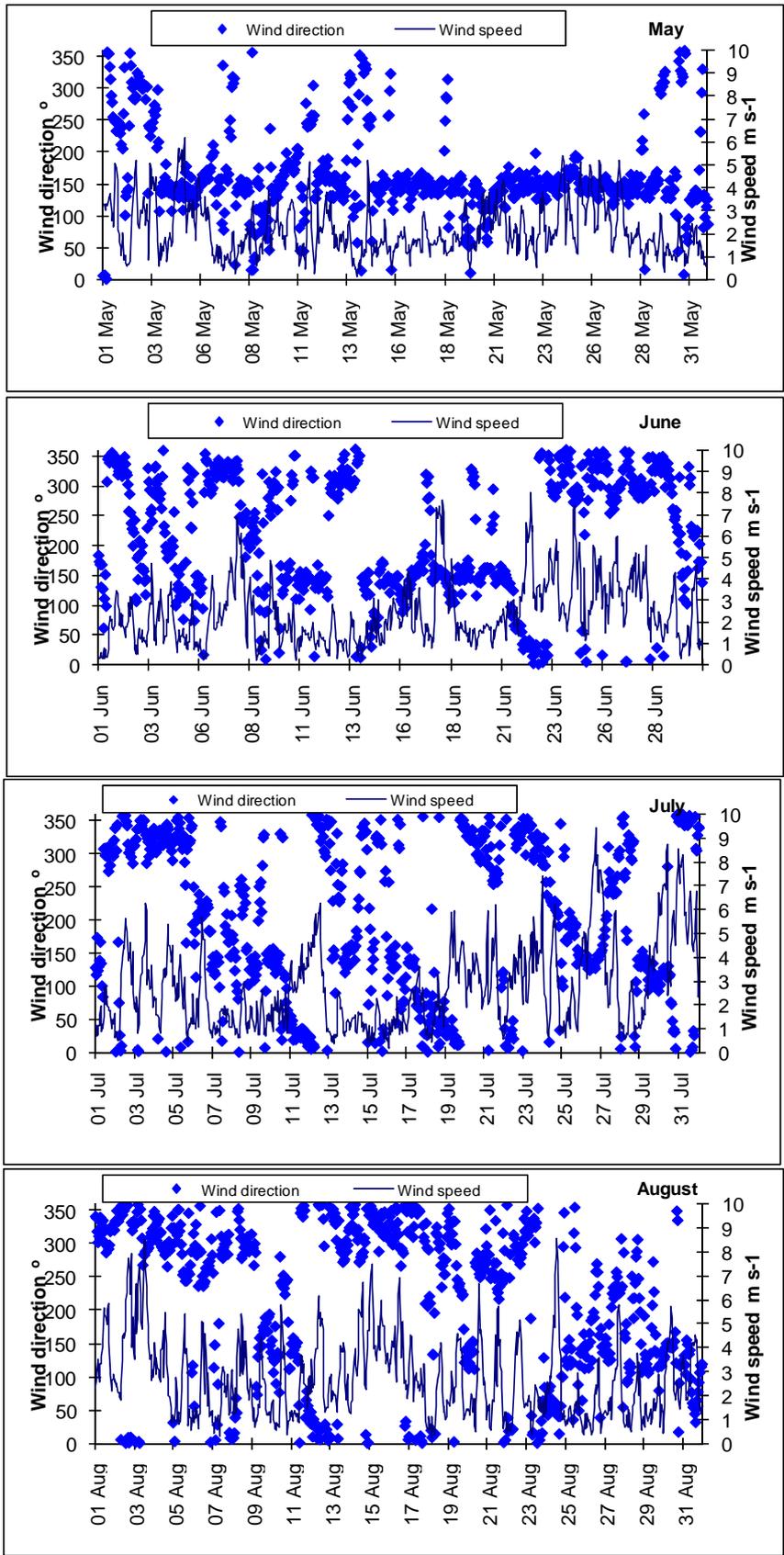


Figure 4.6: Hourly average wind speed and wind direction in Tokoroa for May to August 2008

5 Taupo

5.1 Air Quality Monitoring in Taupo

From March 2007, PM₁₀ concentrations were measured using a FH62 C14 BAM at the Gillies Avenue Reserve site. Gravimetric sampling using a Rupprecht and Patashnick Partisol Model 2000 PM₁₀ sampler also took place at the Gillies Avenue Site during 2007 and 2008. The site is located in central Taupo and was established as a monitoring site in November 2000. The site meets the requirements of the “Residential Neighbourhood” site classification as described in Good Practice Guideline for Air Quality Monitoring and Data Management (MfE, 2000).

Prior to 2005, PM₁₀ was monitored in Taupo on a 1-day-in-3 basis at the Gillies Avenue Reserve site using a Rupprecht and Patashnick Partisol Model 2000 PM₁₀ sampler. In January 2005 a FH62 C14 Beta Attenuation Monitor (BAM) continuous PM₁₀ monitoring station was established at Taupo Primary School. The site meets the requirements of the “Residential Neighbourhood” site classification (MfE, 2000).

Operation of the Gillies Avenue Reserve Partisol Model 2000 PM₁₀ sampler continued throughout 2006 to evaluate the spatial variation of PM₁₀ concentrations between Gillies Avenue and Taupo Primary School.

The maximum recorded 24 hour PM₁₀ concentration at the Taupo Primary School site in 2006 was 24.8 µg m⁻³ whereas the maximum recorded 24 hour PM₁₀ concentration at the Gillies Avenue Reserve site was 89 µg m⁻³. The results from the 2006 Monitoring Report (Smith, 2006) found that the Taupo Primary School site was not a suitable site for compliance with NES Regulation 15, that requires monitoring at the location where contaminant concentrations (or frequency of exceedences) are greatest. On 17 March 2007 the FH62 C14 BAM was moved from Taupo Primary School back to the Gillies Avenue Reserve site.

Gravimetric sampling using the Partisol Model 2000 PM₁₀ sampler also took place at the Gillies Avenue Site during 2008. The sampling regime was approximately one-day-in-three, with a midnight to midnight filter exposure period. The sampling was carried out by the Institute of Geological & Nuclear Sciences (GNS) on behalf of Environment Waikato. A total of 80 samples were collected during 2008.

Meteorological instrumentation was installed when the FH62 BAM was installed at the Primary School site in 2006. Wind speed, wind direction, air temperature, and relative humidity data were measured.

The location of monitoring sites in Taupo is shown in Figure 5.1.

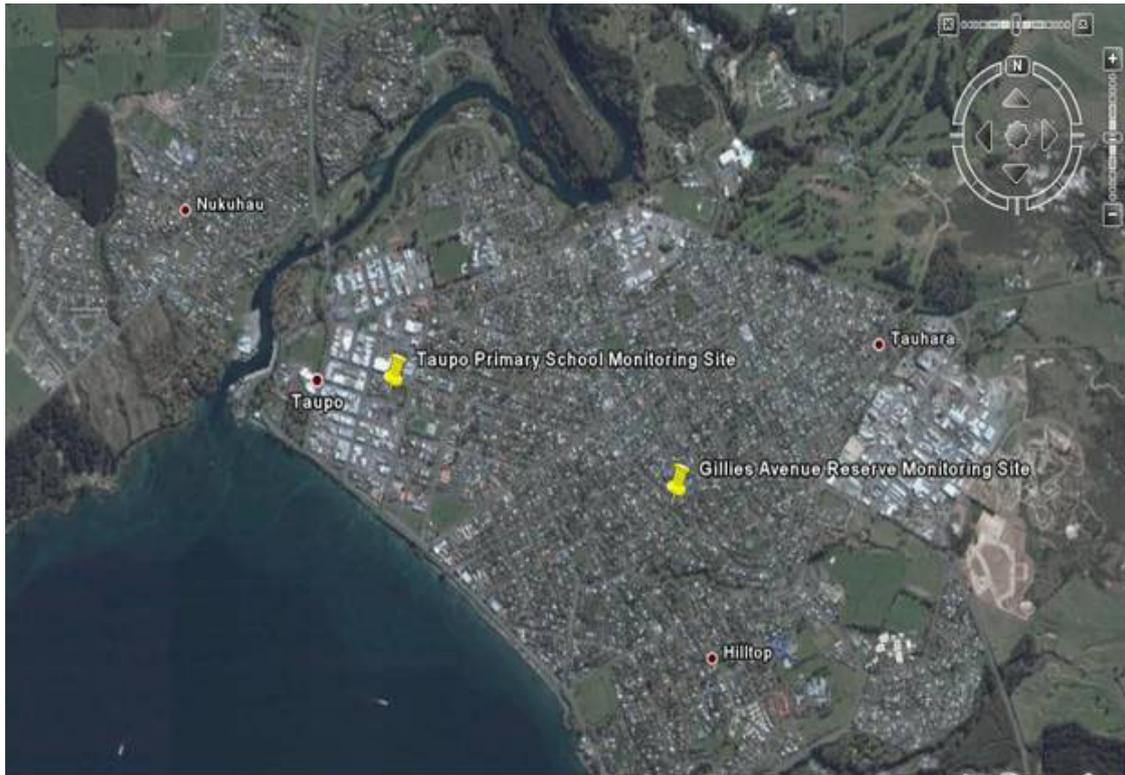


Figure 5.1: Taupo air quality monitoring site (Source: Google Earth 2008)

5.2 PM₁₀ concentrations in Taupo

Daily average PM₁₀ concentrations measured at the Taupo site during 2008 are shown in Figure 5.2. Twelve breaches of the NES were recorded at the Taupo site. The maximum measured PM₁₀ concentration during 2008 was 76 $\mu\text{g m}^{-3}$ and was recorded on 14 July 2008. The 2007 maximum PM₁₀ concentration was 72 $\mu\text{g m}^{-3}$.

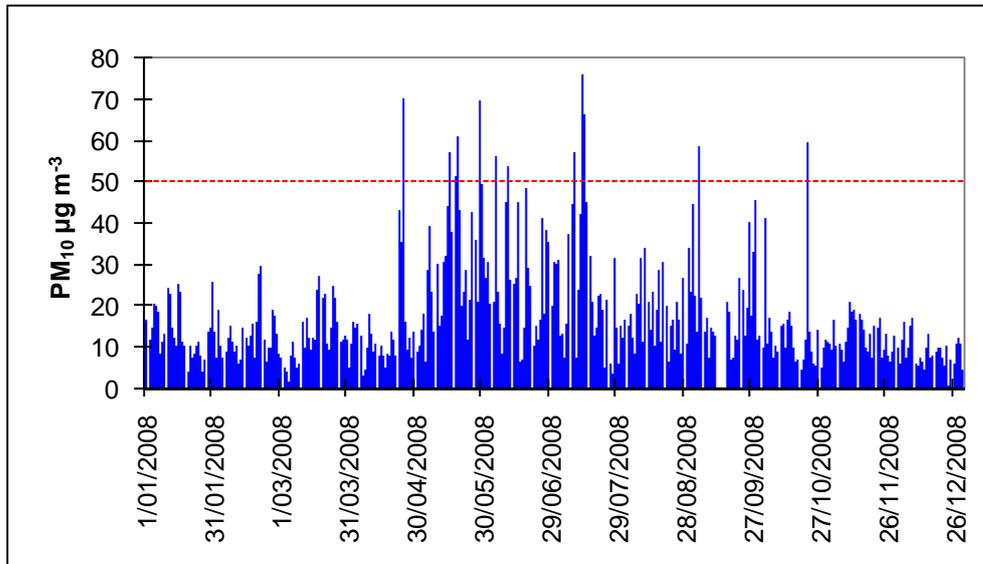


Figure 5.2: Daily winter PM₁₀ concentrations measured at the Taupo site during 2008

Changes in PM₁₀ concentrations relative to air quality indicator categories at the Taupo site from 2001 to 2008 are shown in Figure 5.3. Results suggest that PM₁₀ concentrations measured during 2006 were lower than other years because of the change in monitoring location for that year, but most other years have a similar distribution in PM₁₀ concentrations. Seasonal variations in the distribution of PM₁₀ concentrations for 2008 are shown in Figure 5.4.

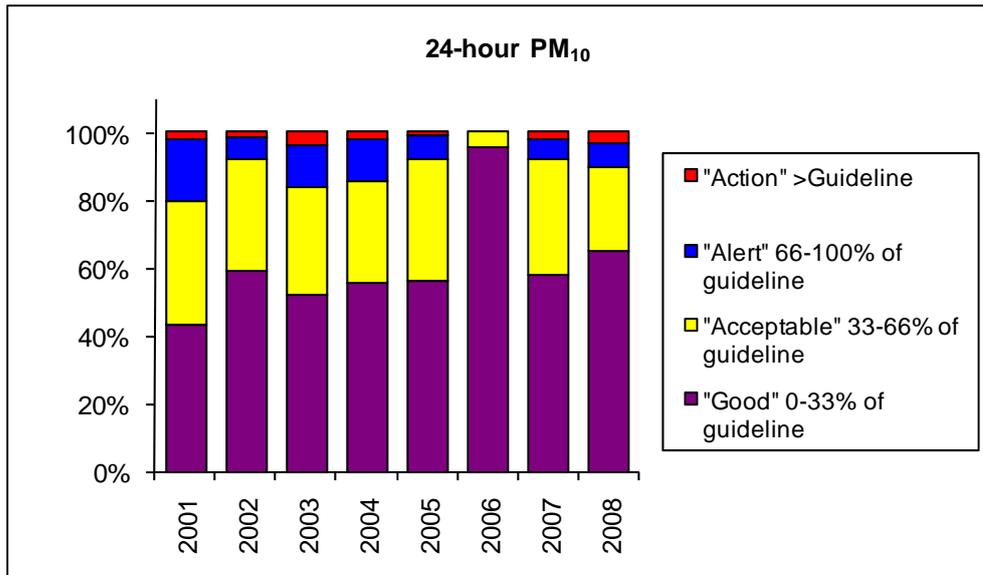


Figure 5.3: Comparison of PM₁₀ concentrations measured at the Taupo site from 2001 to 2008 to MfE air quality indicator categories

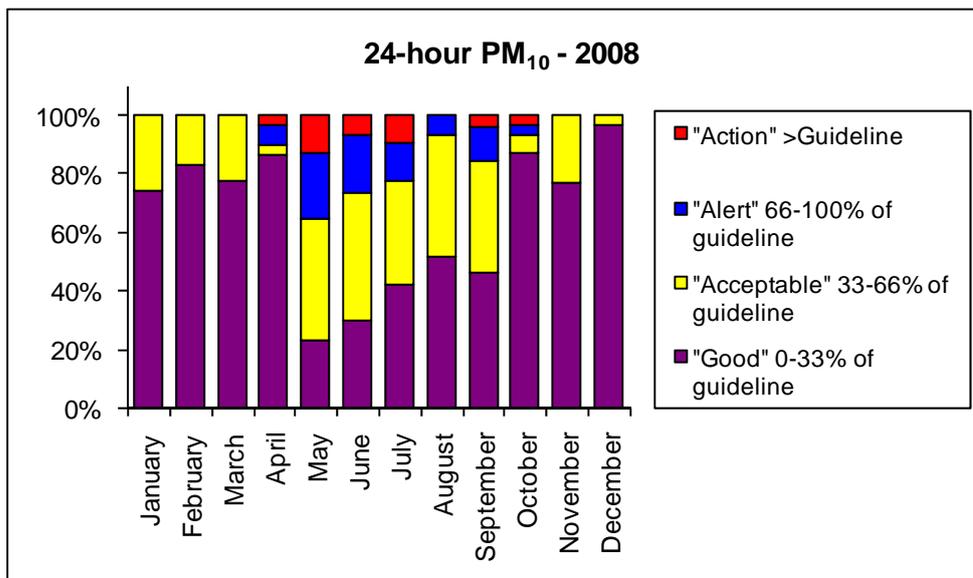


Figure 5.4: Comparison of daily PM₁₀ concentrations each month during 2008 to MfE air quality indicator categories

The annual average PM₁₀ concentration for Taupo for 2008 is 17 µg m⁻³. This compares with an air quality guideline for annual average PM₁₀ of 20 µg m⁻³ (MfE, 2000). Summary statistics for PM₁₀ monitoring results are shown in Table 5.1.

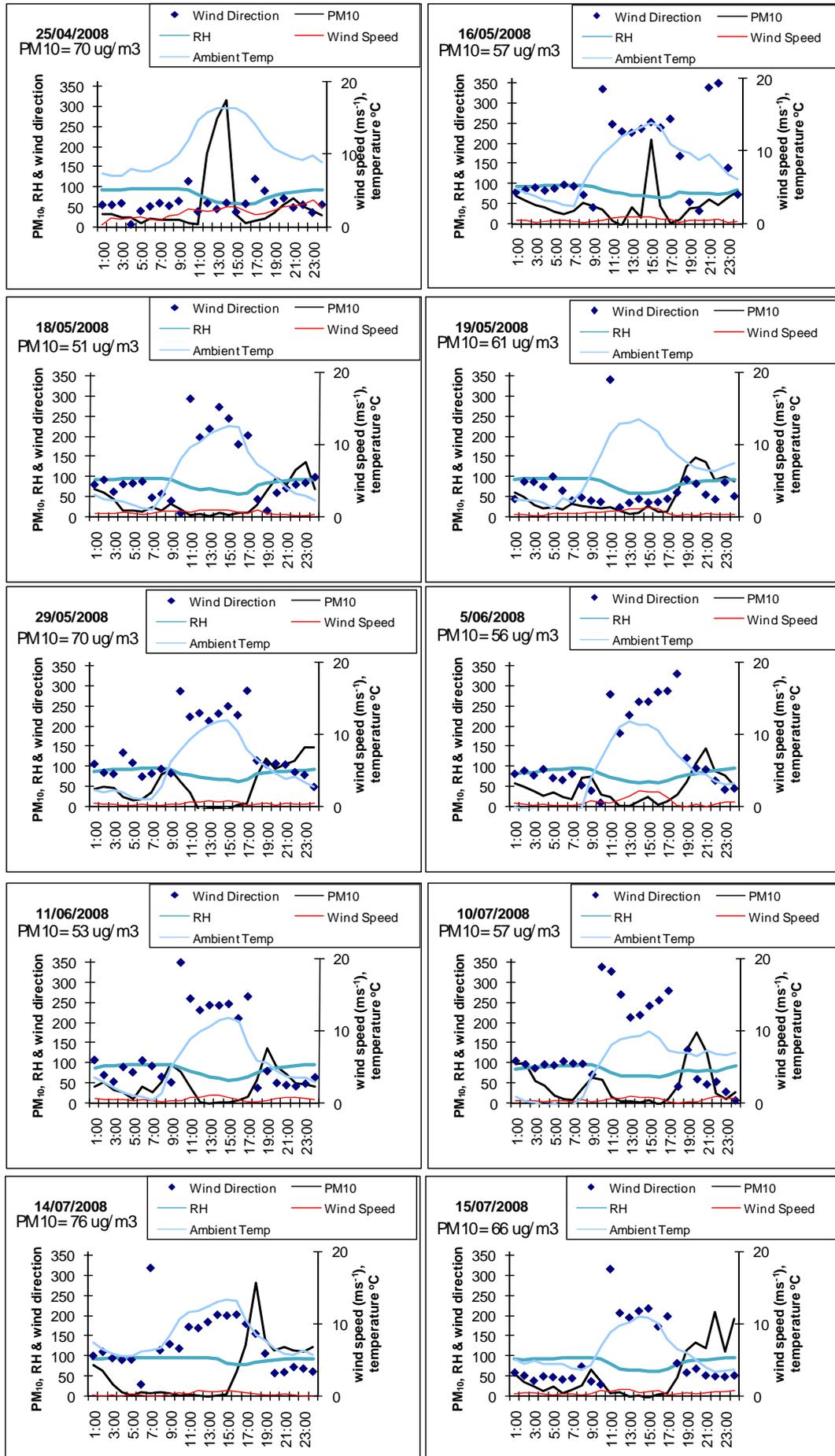
Table 5.1: Summary of PM₁₀ concentrations measured at the Taupo monitoring site from 2001 to 2008

	2001	2002	2003	2004	2005	2006	2007	2008
"Good" 0-33% of guideline	43%	59%	52%	55%	56%	96%	58%	65%
"Acceptable" 33-66% of guideline	36%	33%	32%	30%	36%	4%	34%	25%
"Alert" 66-100% of guideline	18%	7%	12%	12%	7%	0%	6%	7%
"Action" >Guideline	2%	1%	4%	2%	1%	0%	2%	3%
Percentage of valid data	12%	21%	29%	29%	30%	93%	75%	99%
Annual average ($\mu\text{g m}^{-3}$)	20	17	18	17	16	9	17	17
Exceedences (extrapolated)	7	6	12	6	3	0	6	12
Annual maximum ($\mu\text{g m}^{-3}$)	57	54	62	65.0	52	25	72	76
Number of records	44	76	106	105	111	338	274	362

5.3 Meteorology in Taupo

Figure 5.5 shows hourly average PM₁₀ concentrations on days when the 24-hour average PM₁₀ measured at Taupo exceeded 50 $\mu\text{g m}^{-3}$. Breaches of the NES on 24 April, 16 May and 22 October are not consistent with typical winter PM₁₀ pollution with peaks occurring during the daytime and for relatively short duration. On 22 October hourly PM₁₀ concentrations exceeded 700 $\mu\text{g m}^{-3}$.

The remaining 9 exceedences of 50 $\mu\text{g m}^{-3}$ in Taupo are consistent with typical high pollution events in urban areas of New Zealand with concentrations increasing from around 5pm and remaining elevated throughout the evening.



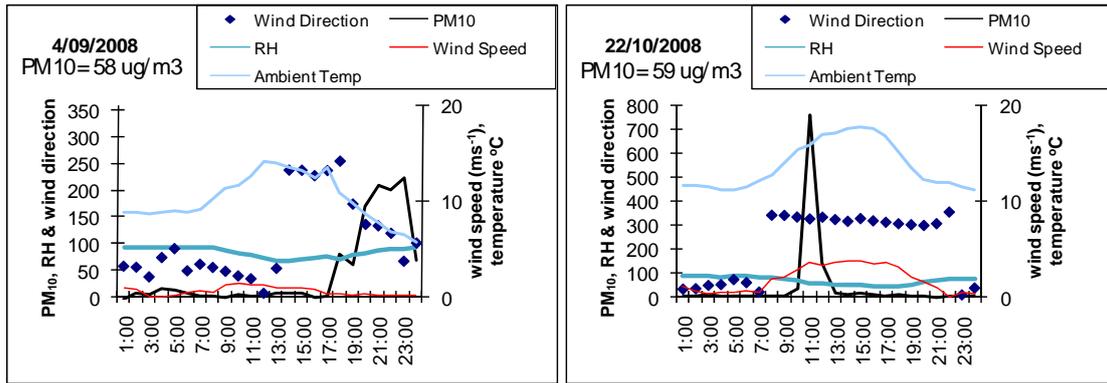


Figure 5.5: Hourly average PM₁₀, wind speed, wind direction and temperature on days when PM₁₀ concentrations exceeded the NES at the Taupo site

Hourly wind direction and wind speed, measured at the monitoring site in Taupo, are shown in Figure 5.6 for the months May to August 2008. The greatest prevalence of low wind speeds for winter 2008 occurs in the first half of the winter with wind speeds less than 2 ms⁻¹ for many days before 20 June. An additional period of low wind occurs around mid July.

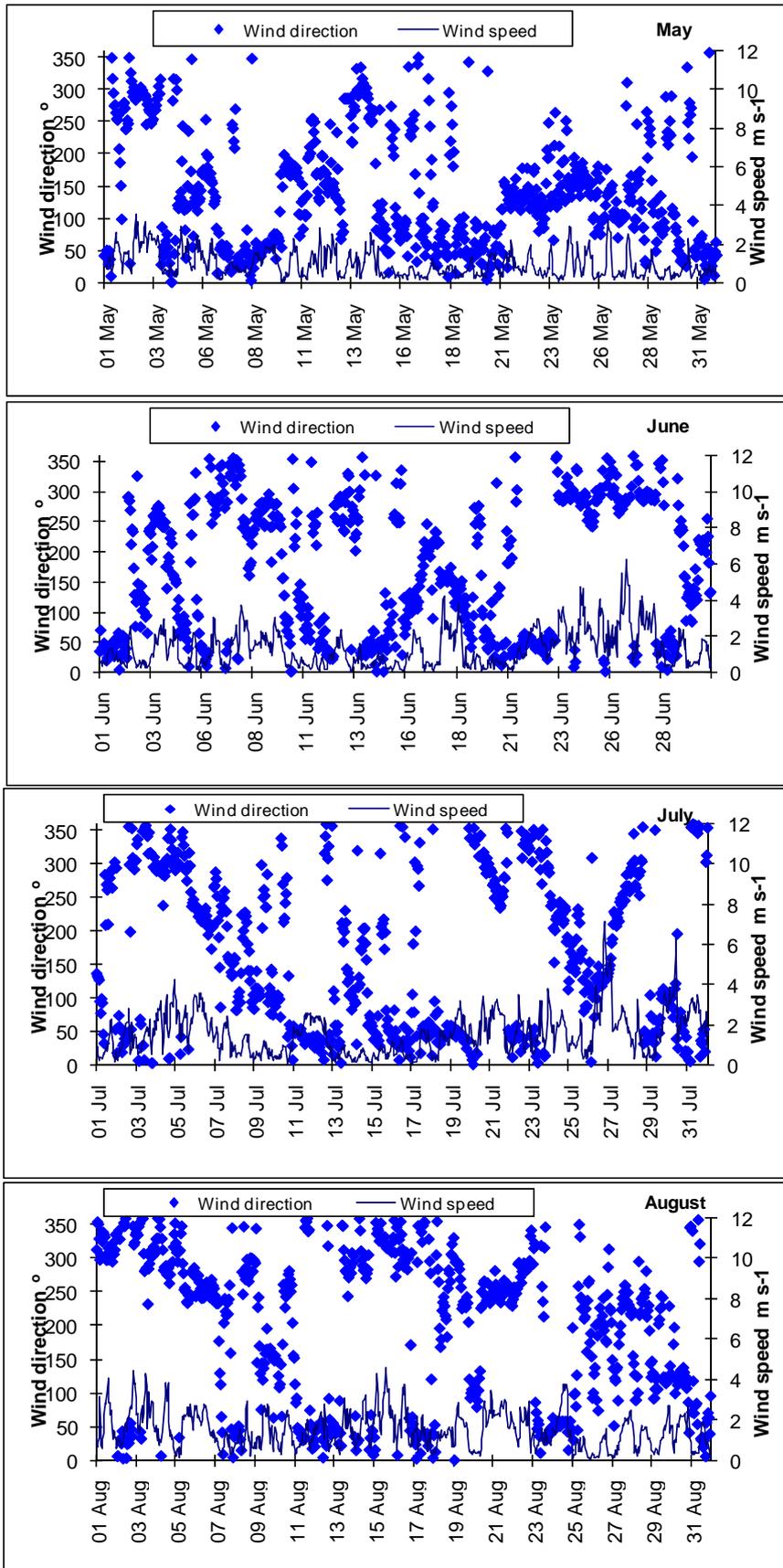


Figure 5.6: Hourly average wind speed and wind direction in Taupo for May to August 2008

6 Te Kuiti

6.1 Air Quality Monitoring in Te Kuiti

Air quality monitoring in Te Kuiti during 2005 was carried out at the Te Kuiti City Council Offices off Queen Street. This is the same site as used since 2003 and for the 1998 PM₁₀ monitoring (Figure 6.1). Further descriptions of the air quality monitoring site, including a map and site layout are given in the *“Air Quality Monitoring Report – Waikato Region”* (Wilton, 2002). The site meets the requirements of the “Residential Neighbourhood” site classification as described in *Good Practice Guideline for Air Quality Monitoring and Data Management* (MfE, 2000).

In 2008, concentrations of PM₁₀ were measured at the site using an ESM (Anderson) FH62 C14 Beta Attenuation Monitor (BAM). The site was operated and maintained by NIWA for Environment Waikato until August 2005 when the Waikato air quality network was subsequently managed by Environment Waikato staff.

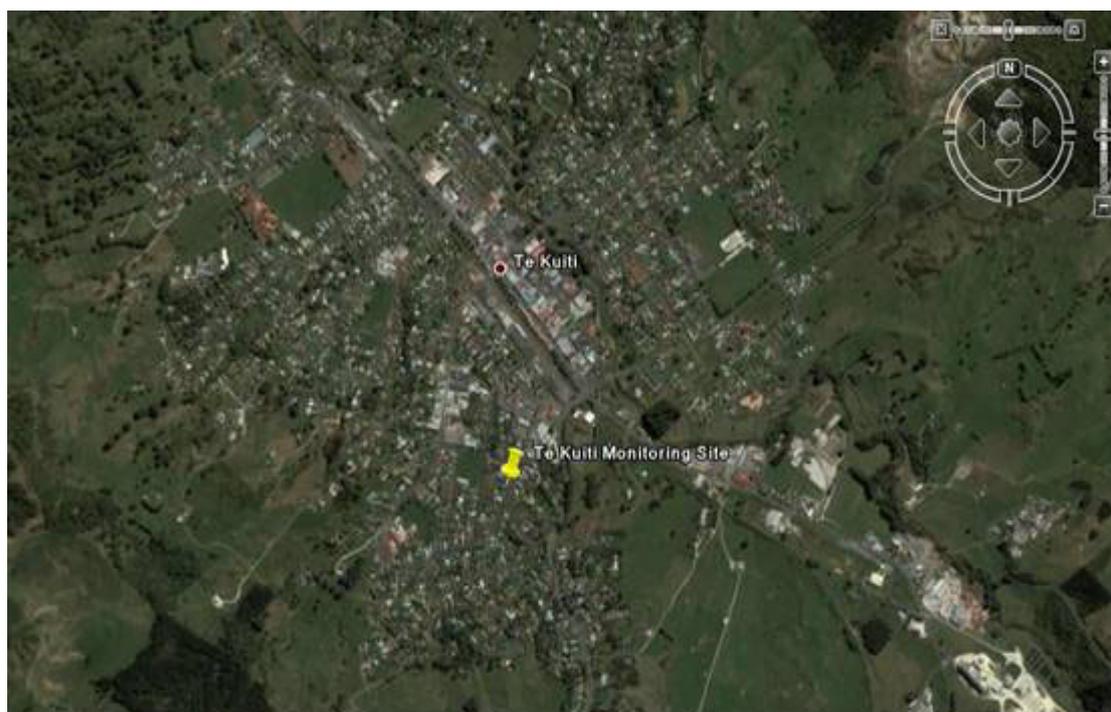


Figure 6.1: Te Kuiti air quality monitoring site (Source: Google Earth 2008)

6.2 PM₁₀ Concentrations in Te Kuiti

Daily average PM₁₀ concentrations measured at the Te Kuiti site during 2008 are shown in Figure 6.2. The maximum measured PM₁₀ concentration during 2008 was 69 µg m⁻³ and was recorded on 15 May 2008. Three breaches of 50 µg m⁻³ were recorded at the Te Kuiti site on 15 May, 20 June (53 µg m⁻³) and 8 July 2008 (51 µg m⁻³). In 2007 four breaches occurred and the highest concentration was 58 µg m⁻³.

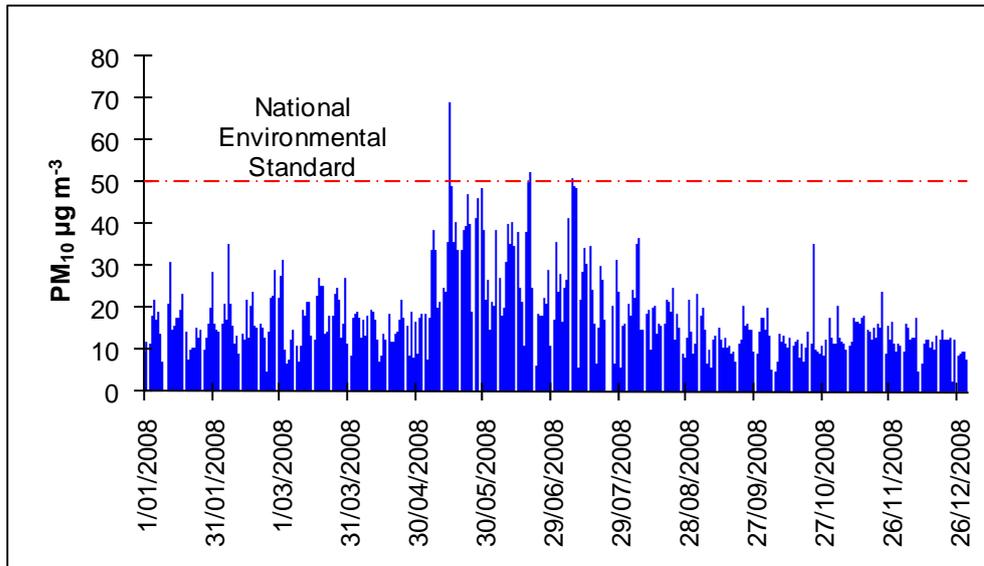


Figure 6.2: Daily winter PM₁₀ concentrations measured at the Te Kuiti site during 2008.

Changes in PM₁₀ concentrations relative to air quality indicator categories at Te Kuiti from 2001 to 2008 are shown in Figure 6.3. Results suggest a similar distribution of PM₁₀ concentrations from 2003 to 2008. Seasonal variations in the distribution of PM₁₀ concentrations for 2008 are shown in Figure 6.4.

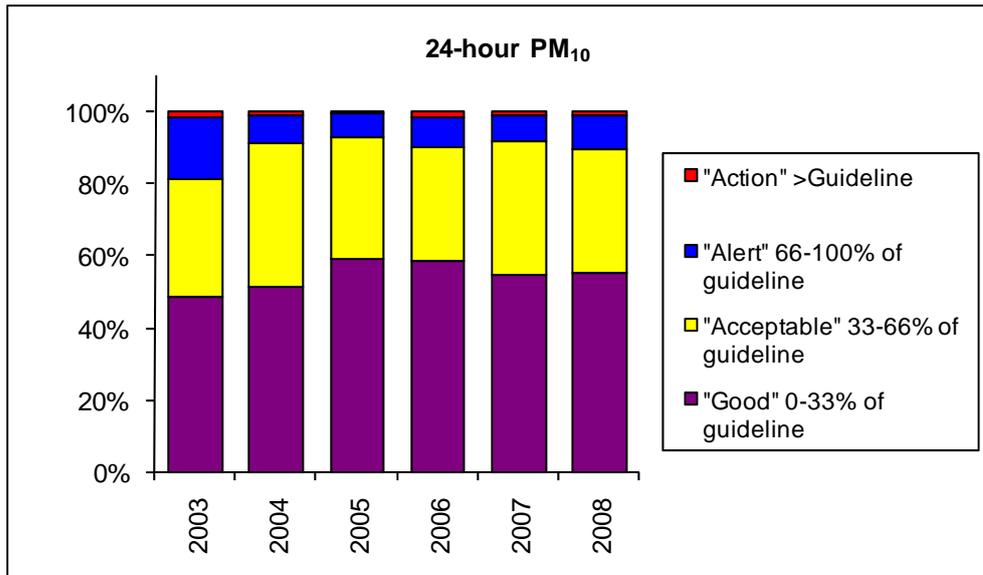


Figure 6.3: Comparison of PM₁₀ concentrations measured at the Te Kuiti site from 2000 to 2008 to MfE air quality indicator categories

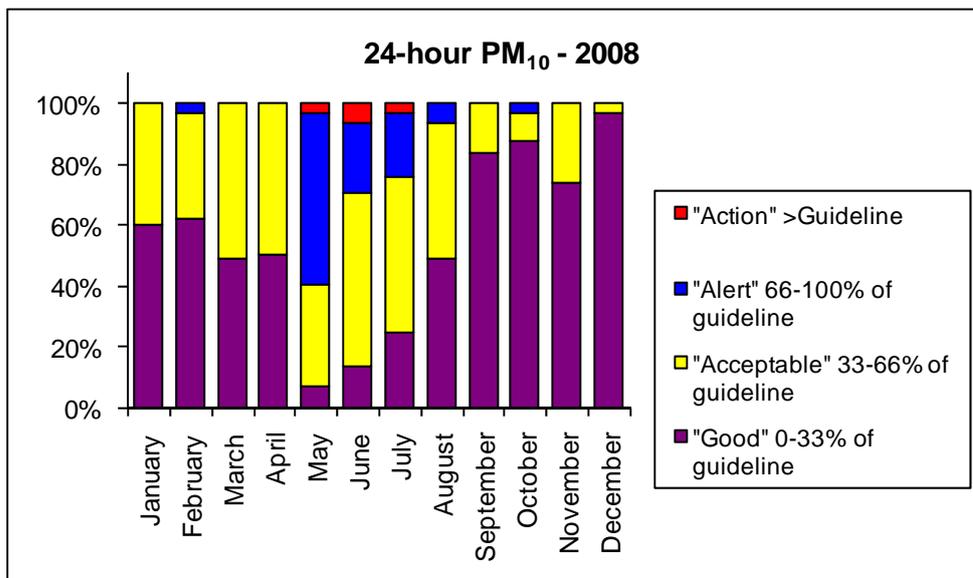


Figure 6.4: Comparison of daily PM₁₀ concentrations each month during 2008 to MfE air quality indicator categories

The annual average PM₁₀ concentration for Te Kuiti for 2008 is 18 µg m⁻³ and is largely consistent with annual average concentrations from 2003 to 2007. Summary statistics for PM₁₀ monitoring results are shown in Table 6.1.

Table 6.1: Summary of PM₁₀ concentrations measured at the Te Kuiti monitoring site from 2003 to 2008

	2003	2004	2005	2006	2007	2008
"Good" 0-33% of guideline	48%	51%	59%	58%	54%	55%
"Acceptable" 33-66% of guideline	32%	40%	34%	31%	37%	35%
"Alert" 66-100% of guideline	17%	8%	7%	9%	7%	9%
"Action" >Guideline	1.7%	1.4%	1%	2%	1%	1%
Percentage of valid data	63%	95%	92%	99%	79%	99%
Annual average (µg m ⁻³)	18	18	17	18	18	18
Measured exceedences	5	5	2	7	4	3
Annual maximum (µg m ⁻³)	59	61	54	70	58	52
Number of records	229	346	337	363	287	362

6.3 Meteorology in Te Kuiti

Figure 6.5 shows variations in hourly average PM₁₀ and meteorological variables on days when 24-hour average PM₁₀ concentrations exceeded the NES in Te Kuiti. The most notable feature of these is the very high PM₁₀ concentrations observed during the evening on 15 May. These peaked at 439 µg m⁻³ at 9 pm. The corresponding 24-hour average PM₁₀ concentration for this day was 69 µg m⁻³. Meteorological conditions during the period of elevated concentrations were extremely conducive to high concentrations with an average wind speed from 8pm to midnight of 0.1 ms⁻¹.

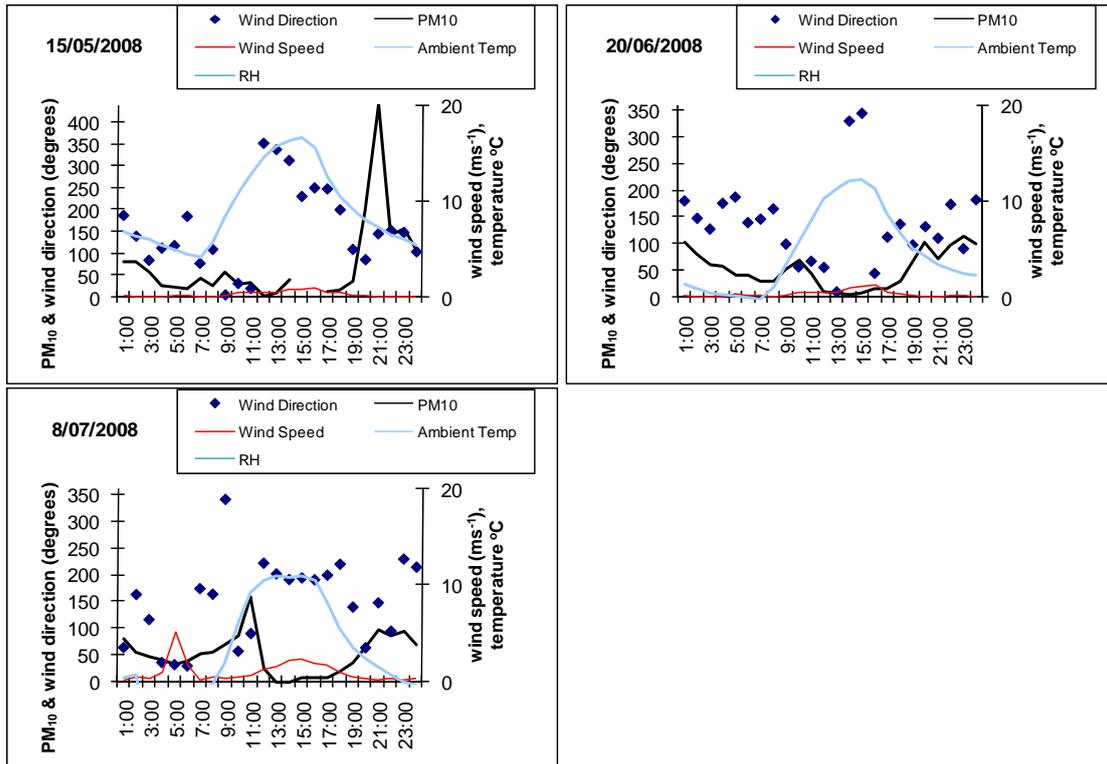


Figure 6.5: Hourly average PM₁₀, wind speed, wind direction and temperature on days when PM₁₀ concentrations exceeded the NES at the Te Kuiti site

Hourly wind direction and wind speed, measured at the monitoring site in Te Kuiti are shown in Figure 6.6 for the months May to August 2008. The wind direction is variable across all months with all wind direction featuring regularly. Wind speeds were low during May and June with a large proportion of days with winds consistently below 2 ms⁻¹.

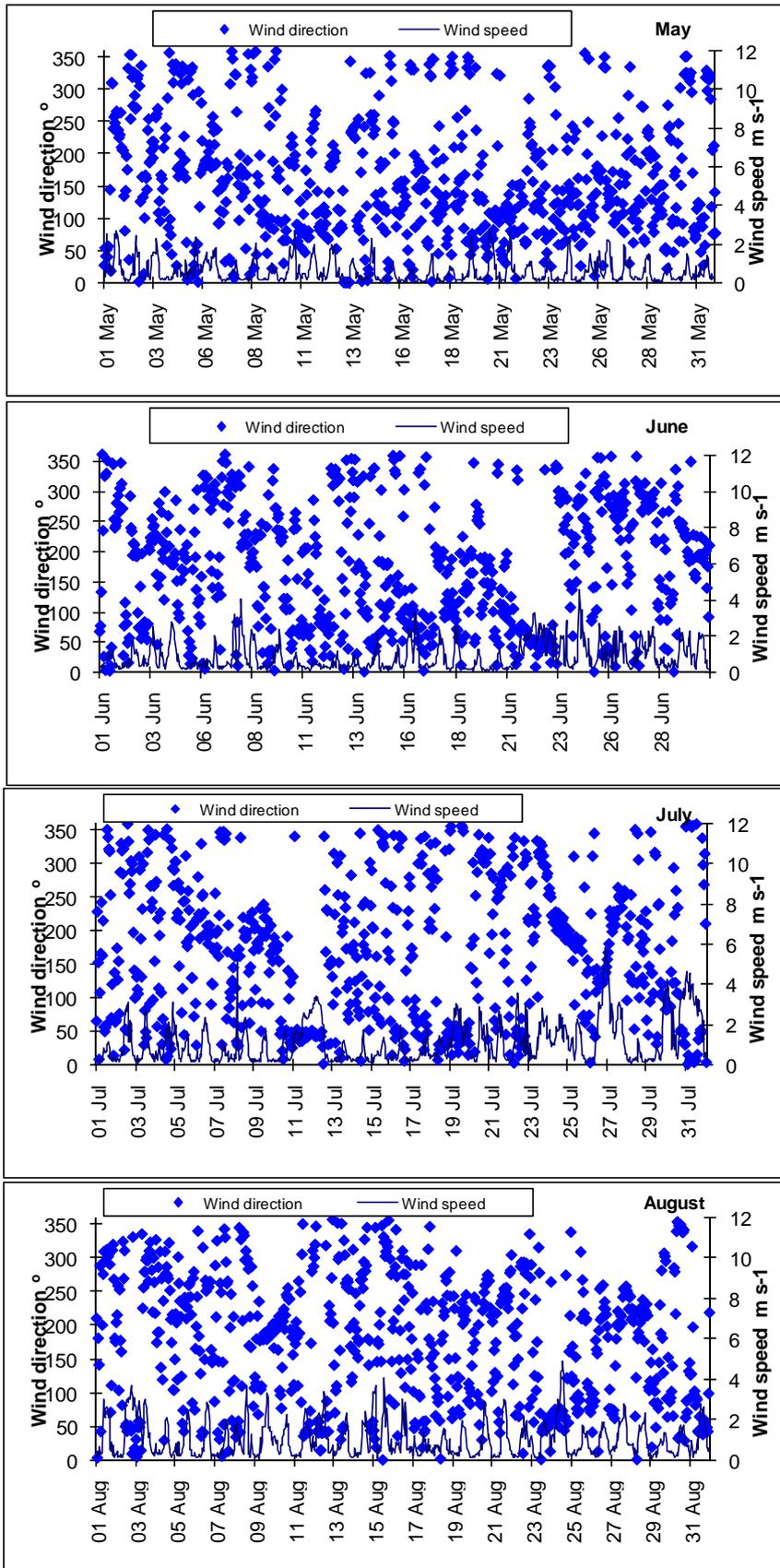


Figure 6.6: Hourly average wind speed and wind direction in Te Kuiti for May to August 2008

7 Matamata

7.1 Air Quality Monitoring in Matamata

Matamata is located approximately 41 km east of Hamilton. Air quality monitoring in Matamata commenced in June 2005 at the Matamata Playcentre grounds on Farmers Road (Figure 7.1). The Farmers Road site meets the requirements of the “Residential Neighbourhood” site classification as described in *Good Practice Guideline for Air Quality Monitoring and Data Management* (MfE, 2000).

The monitoring method used to measure PM₁₀ concentrations at Matamata Playcentre is a ThermoAndersen FH 62 C14 BAM. Meteorological data are also collected, including wind speed and direction at 6 meters, ambient air temperature and relative humidity. The site was installed by Watercare Services Ltd and is operated and maintained by Environment Waikato staff. The FH62 BAM continuously measures PM₁₀ data and it is logged at ten minute intervals.

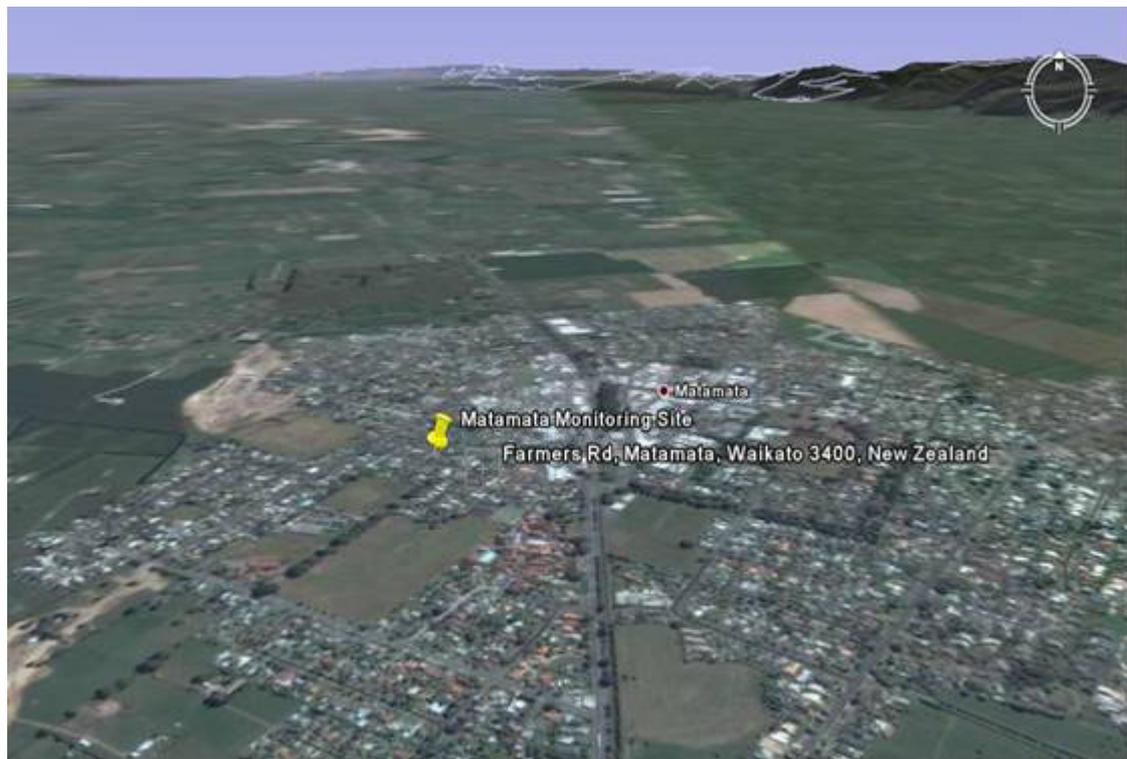


Figure 7.1: Matamata air quality monitoring site (Source: Google Earth 2008)

7.2 PM₁₀ Concentrations in Matamata

Daily average PM₁₀ concentrations measured at the Matamata site during 2008 are shown in Figure 7.2. The maximum measured PM₁₀ concentrations recorded at the Matamata site during 2008 was 45 µg m⁻³ and occurred on the 6 February 2008. The second highest PM₁₀ concentrations in Matamata also occurred during the summer

months (16 January) and measured $37 \mu\text{g m}^{-3}$. The highest winter time PM_{10} concentration was $34 \mu\text{g m}^{-3}$ and occurred on 10 June.

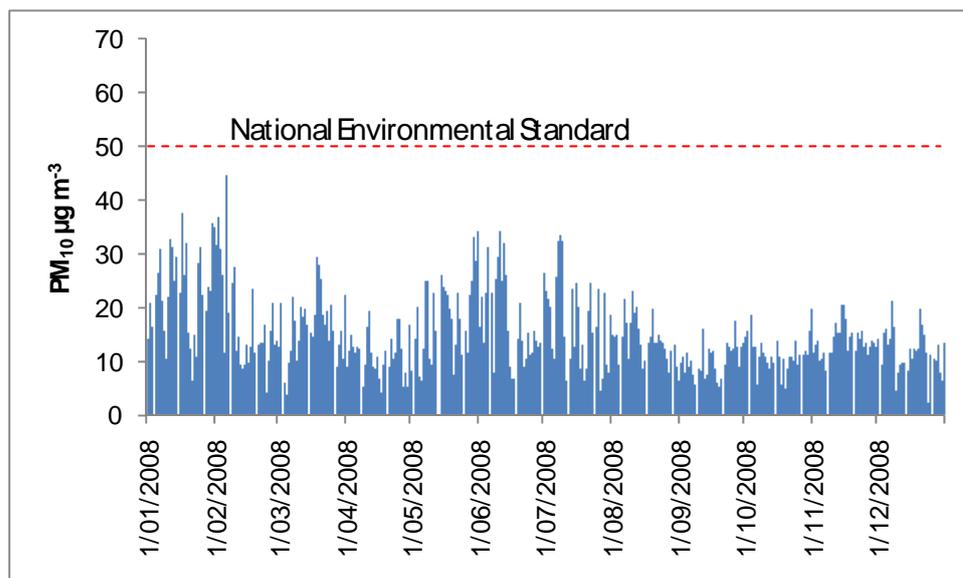


Figure 7.2: Daily winter PM_{10} concentrations measured at the Matamata site during 2008

Figure 7.3 compares daily variations in PM_{10} concentrations and meteorological variables on 6 February and 16 January, when PM_{10} concentrations were highest during the summer months to concentrations on 10 June when the highest winter concentrations were recorded. High concentrations on 16 January occurred under a northerly wind direction and winds around 2 ms^{-1} . Concentrations were highest at 7 pm but hourly concentrations did not exceed $100 \mu\text{g m}^{-3}$. In contrast on 6 February a distinct afternoon peak in PM_{10} concentrations was responsible for the high 24-hour average. On this day hourly average concentrations reached $261 \mu\text{g m}^{-3}$ at 3 pm. In the Waikato region, early 2008 was marked by a severe drought and the lowest rainfall on record during January. During this period, large dust storms were observed on the Hauraki Plains and at locations near Matamata. Such events are known to result in spikes in PM_{10} (Smith and Lee, 2003). It is suspected that the generally higher PM_{10} concentrations in January and February 2008 (Figure 7.2) may have been associated with more mobilisation of urban and rural dust caused by the unusually dry conditions. The drought ended on 14 April 2008.

On 10 June PM_{10} concentrations followed a more typical winter urban air pollution profile with concentrations increasing from around PM_{10} and peaking in the later evening at around 11 pm.

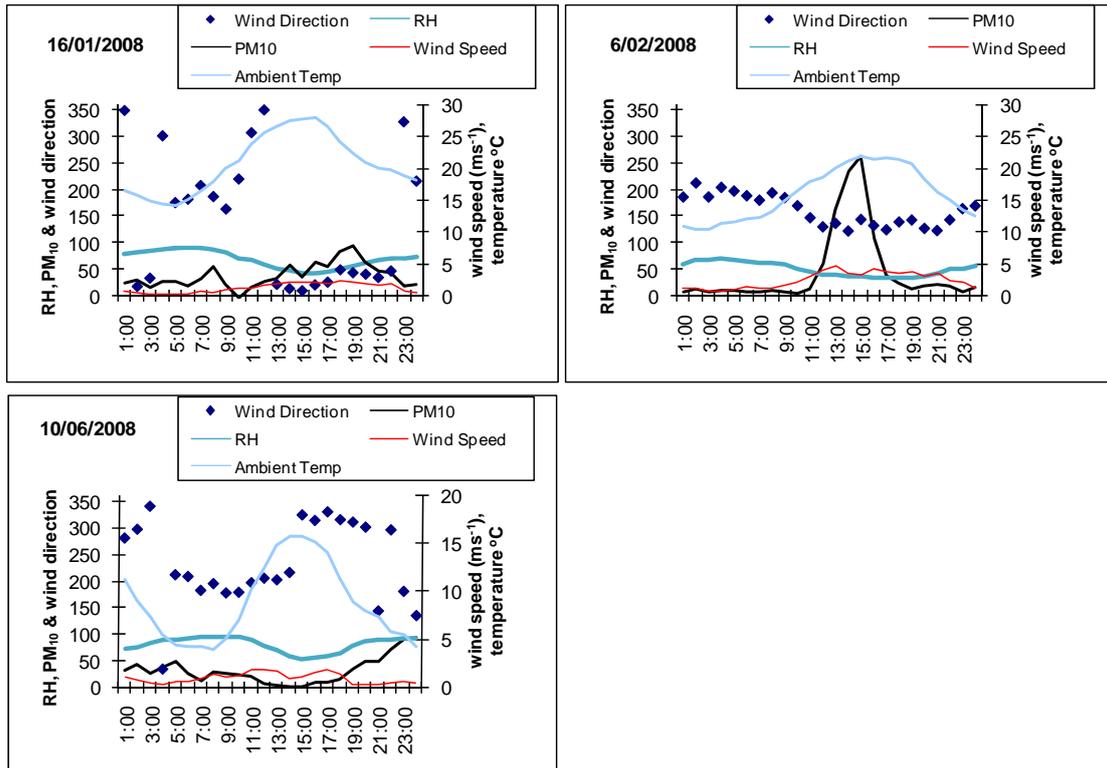


Figure 7.3: Daily variations in PM_{10} concentrations and meteorological variables on 6 February, 16 January and 10 June 2008.

Figure 7.4 compares PM_{10} concentrations measured at Matamata to the MfE (2000) air quality indicator category. Results suggest that PM_{10} concentrations measured at Matamata are typically less than 66% of the NES. Seasonal variations in the distribution of PM_{10} concentrations for 2008 are shown in Figure 7.5.

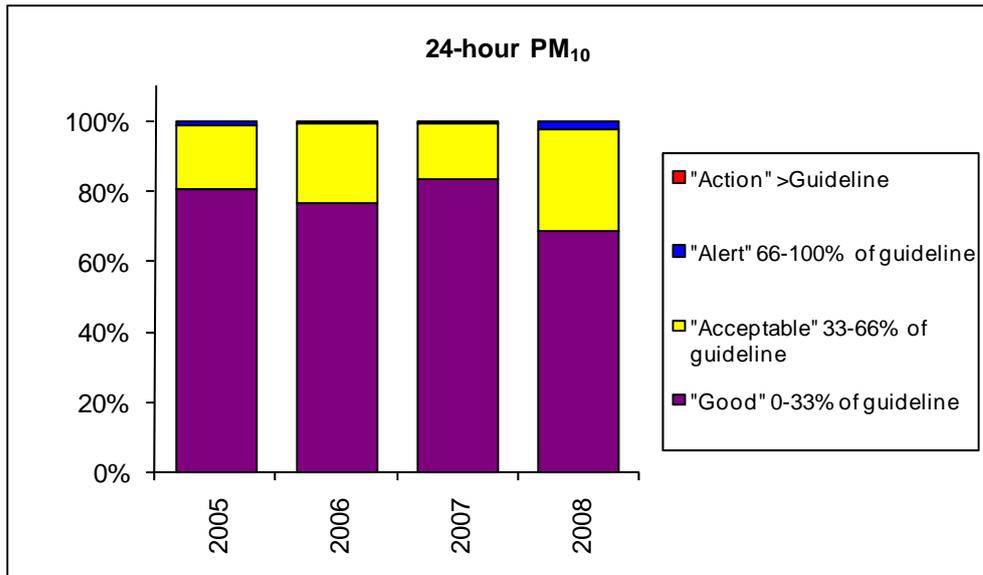


Figure 7.4: Comparison of PM₁₀ concentrations measured at the Matamata site from 2006 to 2008 to MfE air quality indicator categories

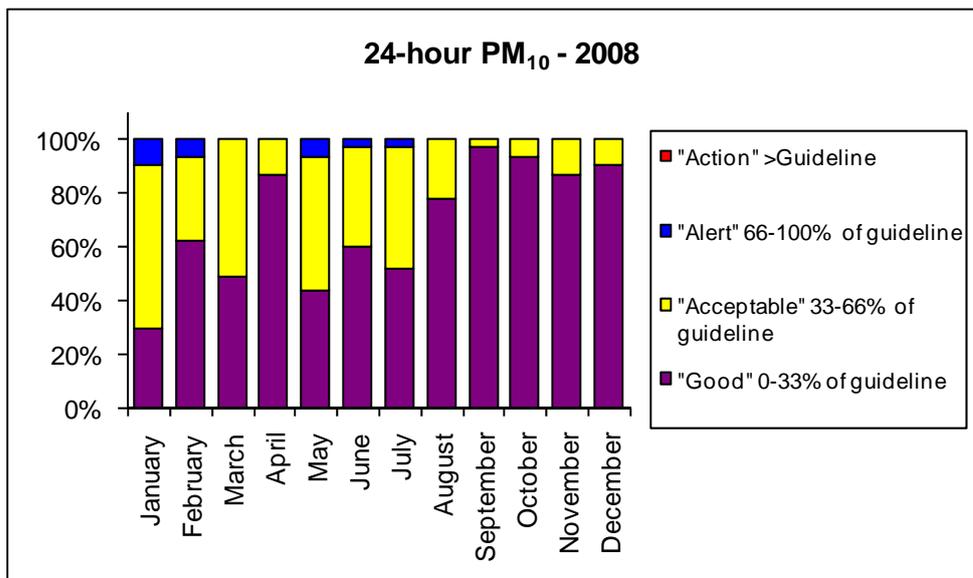


Figure 7.5: Comparison of daily PM₁₀ concentrations each month during 2008 to MfE air quality indicator categories

The annual average PM₁₀ concentration for Matamata for 2008 is 15 µg m⁻³. Summary statistics for PM₁₀ monitoring results are shown in Table 7.1.

Table 7.1: Summary of PM₁₀ concentrations measured at the Matamata monitoring site from 2006 to 2008.

	2006	2007	2008
"Good" 0-33% of guideline	77%	83%	69%
"Acceptable" 33-66% of guideline	23%	16%	29%
"Alert" 66-100% of guideline	1%	0%	2%
"Action" >Guideline	0%	0%	0%
Percentage of valid data	99%	79%	100%
Annual average ($\mu\text{g m}^{-3}$)	13	12	15
Measured exceedences	0	0	0
Annual maximum ($\mu\text{g m}^{-3}$)	38	34	45
Number of records	362	287	365

7.3 Meteorology in Matamata

Hourly wind direction and wind speed, measured at the Matamata site are shown in Figure 7.6 for the months May to August 2008.

Low wind speeds were apparent during May, the first half and June and the first half of July in Matamata. August also experienced consecutive days of wind speed less than 2 ms^{-1} regularly throughout the month. The results suggest that opportunities for NES breaches have occurred during 2008. It would therefore be reasonable to conclude based on the results of 2006 to 2008 that PM₁₀ concentrations in Matamata are unlikely to exceed the NES during the winter months in the near future.

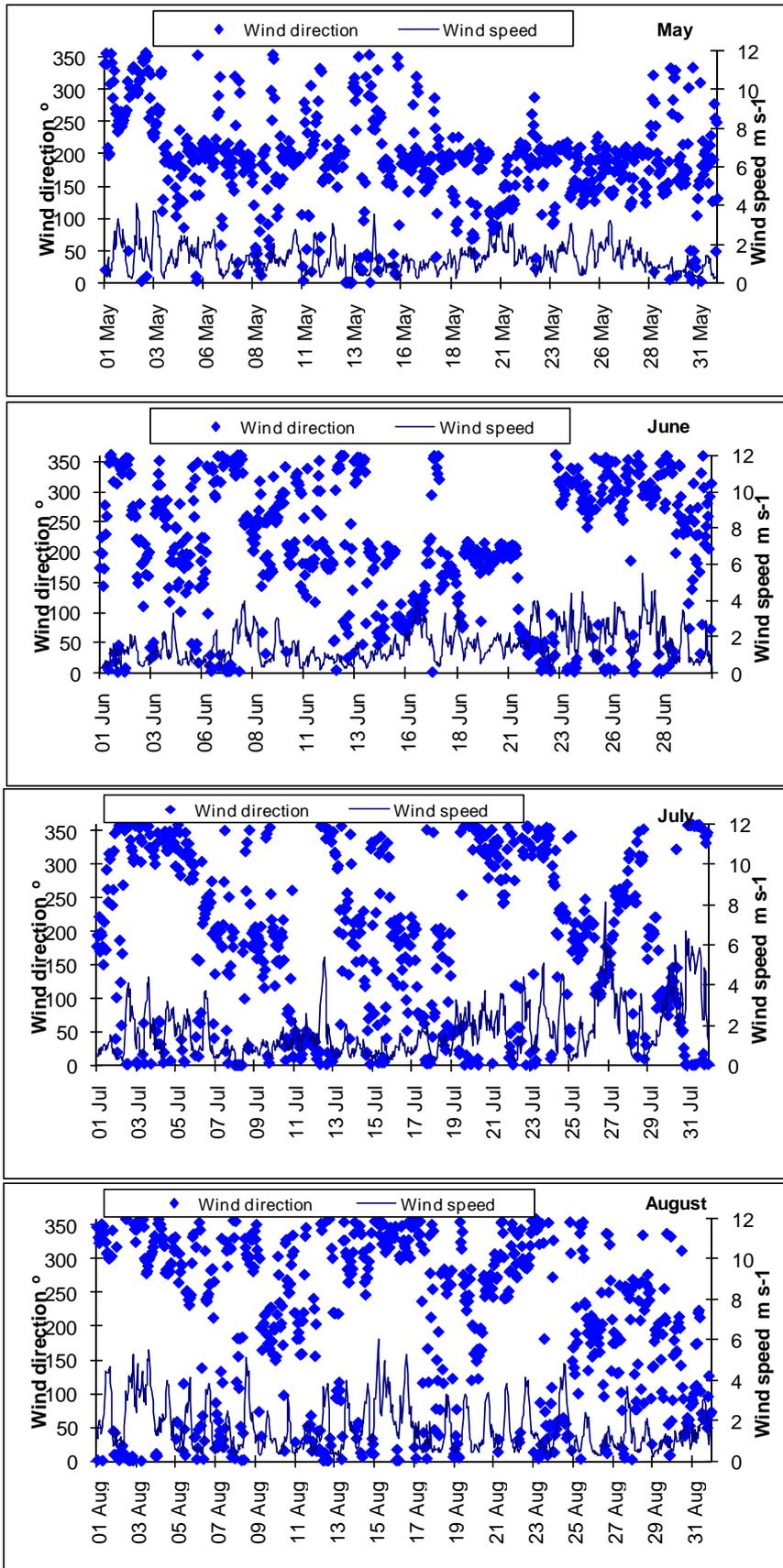


Figure 7.3: Hourly average wind speed and wind direction in Matamata for May to August 2008

8 Putaruru

8.1 Air Quality Monitoring in Putaruru

Putaruru is located in the South Waikato District, mid-way between Tokoroa and Tirau on State Highway One. The town, of around 3000 people, is 65 kilometres southeast of Hamilton and is close to Lake Arapuni on the Waikato River. Putaruru occupies a flat to gently undulating site, and to the east the land rises to the Mamaku Range.

In July 2006 a new monitoring site was established at the Bowling Club on Arapuni Street in Putaruru (Figure 8.1). The map reference for the site is NZMS260 T15:533-457. Daily concentrations of PM₁₀ have been measured since the site was established.

The monitoring method used to measure PM₁₀ concentrations at Putaruru is a ThermoAndersen FH62 C14 BAM (Figure 8.2).



Figure 8.1: Putaruru air quality monitoring site (Source: Google Earth 2008)



Figure 8.2: Putaruru air quality monitor (Source: Environment Waikato)

8.2 PM₁₀ Concentrations in Putaruru

Daily average PM₁₀ concentrations measured at the Putaruru site during 2008 are shown in Figure 8.3. Two breaches of the NES occurring in March 2008 were investigated by Environment Waikato staff and found to be caused by roadworks which were being carried out approximately 100 metres to the west of the monitoring

site. The highest winter time PM₁₀ concentration was 50 µg m⁻³ and occurred on 8 July. This does not constitute a breach of the NES. However, two breaches of the NES were recorded in 2007. Future adjustment of Putaruru data for gravimetric equivalency may increase the frequency of concentrations greater than 50 µg m⁻³.

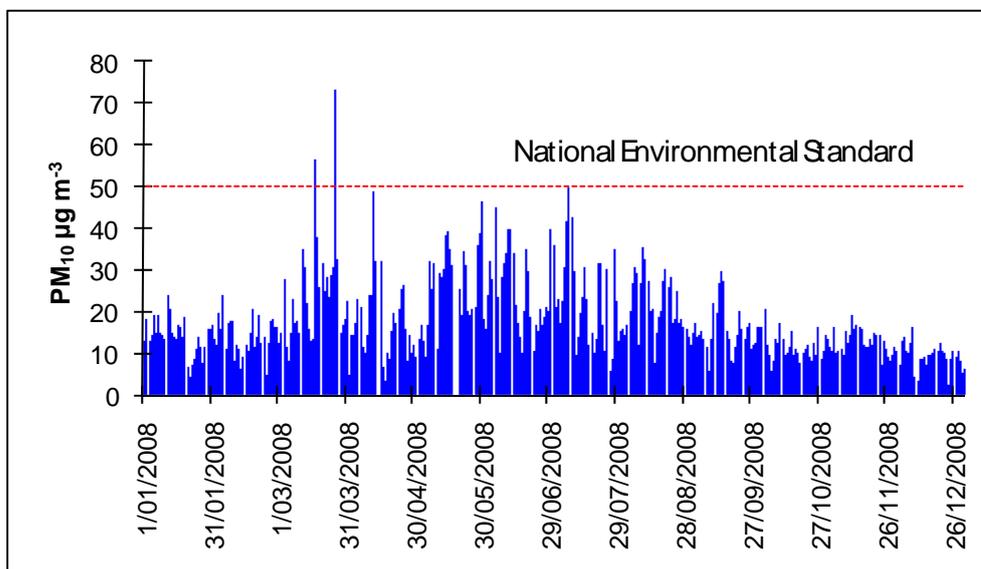


Figure 8.3: Daily winter PM₁₀ concentrations measured at the Putaruru site during 2008

Figure 8.4 compares PM₁₀ concentrations measured at Putaruru to the MfE (2000) air quality indicator category. Seasonal variations in the distribution of PM₁₀ concentrations for 2008 are shown in Figure 8.5.

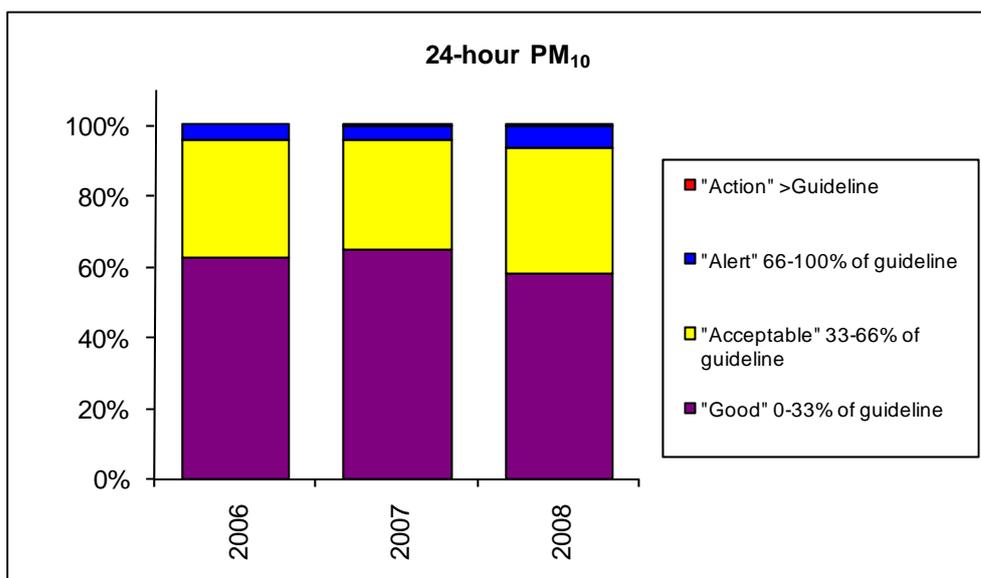


Figure 8.4: Comparison of PM₁₀ concentrations measured at the Putaruru site from 2006 to 2008 to MfE air quality indicator categories

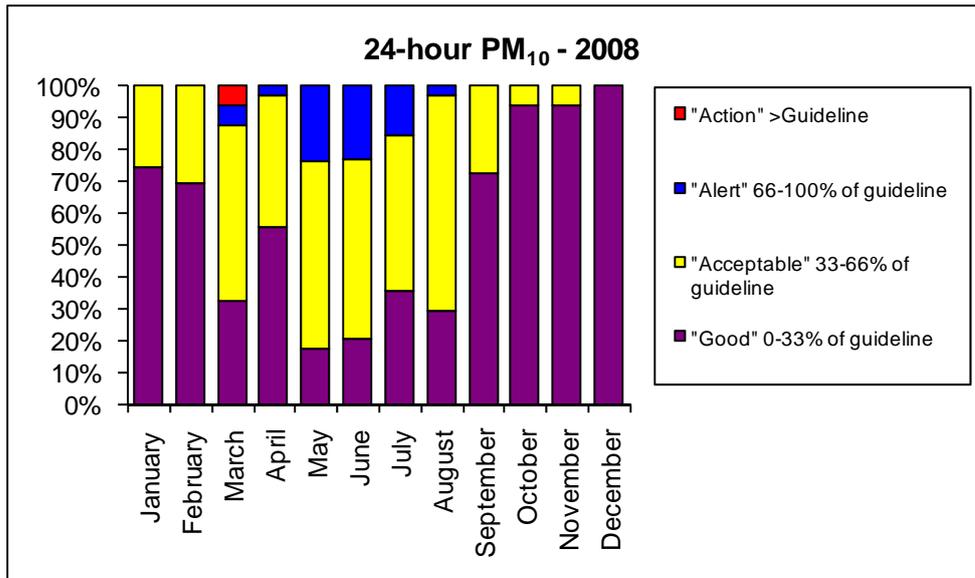


Figure 8.5: Comparison of daily PM₁₀ concentrations each month during 2008 to MfE air quality indicator categories

The annual average PM₁₀ concentration for Putaruru for 2008 is 18 µg m⁻³. Summary statistics for PM₁₀ monitoring results are shown in Table 8.1.

Table 8.1: Summary of PM₁₀ concentrations measured at the Putaruru monitoring site from 2006 to 2008.

	2006	2007	2008
"Good" 0-33% of guideline	62%	64%	58%
"Acceptable" 33-66% of guideline	34%	31%	35%
"Alert" 66-100% of guideline	4%	4%	6%
"Action" >Guideline	0%	1%	1%
Percentage of valid data	45%	100%	99%
Annual average (µg m ⁻³)	16	16	18
Measured exceedences	0	2	2
Annual maximum (µg m ⁻³)	40	56	45
Number of records	166	364	365

9 Ngaruawahia

9.1 Air Quality Monitoring in Ngaruawahia

Ngaruawahia is situated at the junction of the Waikato and Waipa Rivers in the central Waikato basin. The town is located 19 kilometres north west of Hamilton. To the west of the town the land is hilly, rising to the Hakarimata Range. In 2008 a new monitoring site was established at Herschel Street, about 50 metres away from the corner of Ellery Street and Herschel Street in Ngaruawahia (Figure 9.1). Sampling for daily concentrations of PM₁₀ took place from May to December 2008.

The monitoring method used to measure PM₁₀ concentrations at Ngaruawahia is a ThermoAndersen FH62 C14 BAM (Figure 9.2).

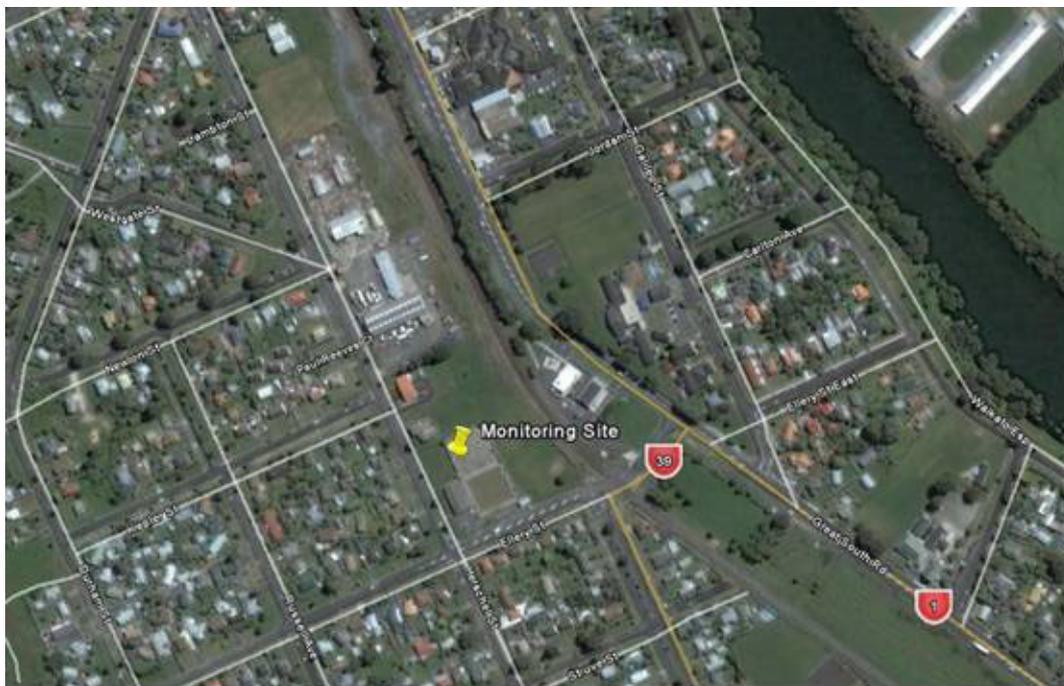


Figure 9.1: Location of Ngaruawahia monitoring site (Source: Google Earth 2009)



Figure 9.2: Ngaruawahia air quality monitor (Source: Environment Waikato)

9.2 PM₁₀ Concentrations in Ngaruawahia

No exceedences of $50 \mu\text{g m}^{-3}$ were measured at the air quality monitoring site in Ngaruawahia during 2008. The maximum measured PM₁₀ concentrations was $32 \mu\text{g m}^{-3}$ and was measured on 8 and 9 July. As no gravimetric monitoring has been undertaken in Ngaruawahia data have not been adjusted for gravimetric equivalency.

Figure 9.3 shows daily average PM₁₀ concentrations measured at the Ngaruawahia site during 2008.

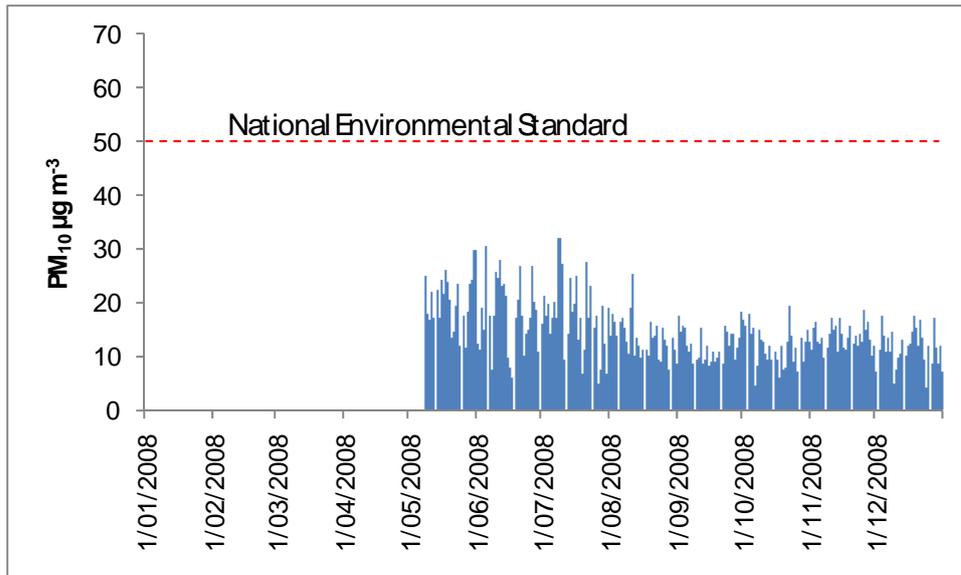


Figure 9.3: Daily winter PM₁₀ concentrations measured at the Ngaruawahia site during 2008.

Concentrations of PM₁₀ relative to air quality indicator categories at Ngaruawahia for 2008 are shown in Figure 9.4. Seasonal variations in the distribution of PM₁₀ concentrations are shown in Figure 9.5.

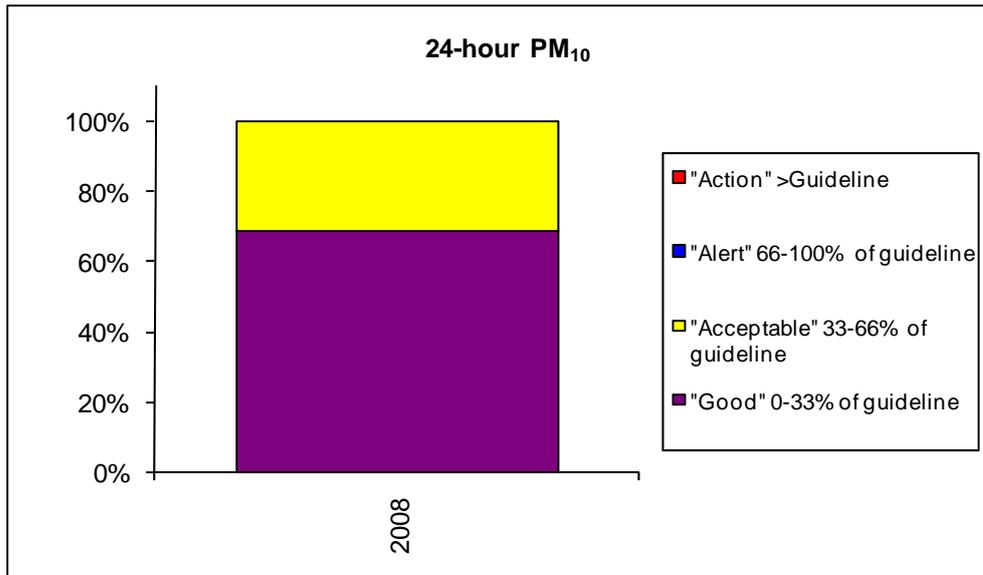


Figure 9.4: Comparison of PM₁₀ concentrations measured at the Ngaruawahia site in 2008 to MfE air quality indicator categories

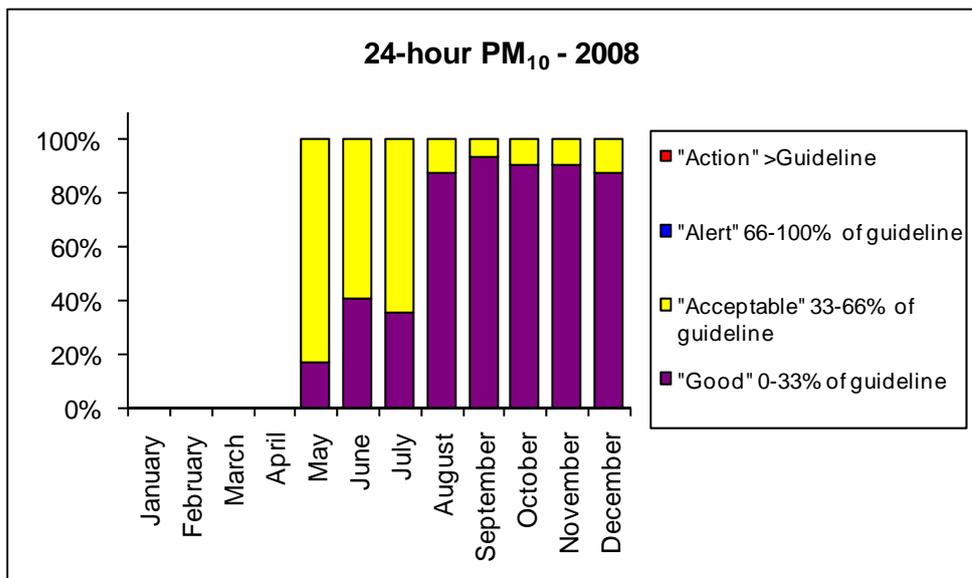


Figure 9.5: Comparison of daily PM₁₀ concentrations each month from May to December 2008 to MfE air quality indicator categories

The estimated annual average PM₁₀ concentration for Ngaruawahia for 2008 is 14 µg m⁻³. Summary statistics for PM₁₀ monitoring results are shown in Table 8.1.

Table 9.1: Summary of PM₁₀ concentrations measured at the Ngaruawahia monitoring site for 2008

	2008
"Good" 0-33% of guideline	69%
"Acceptable" 33-66% of guideline	31%
"Alert" 66-100% of guideline	0%
"Action" >Guideline	0%
Percentage of valid data	65%
Annual average ($\mu\text{g m}^{-3}$)	14
Measured exceedences	0
Annual maximum ($\mu\text{g m}^{-3}$)	32
Number of records	238

10 Waihi

10.1 Air Quality Monitoring in Waihi

Waihi is situated on the Ohinemuri River, a tributary of the Waihou River. The town occupies flat to gently undulating land. To the north and north-west are the lower hills of the Coromandel Range, and to the south-west and south are the Waitawheta hills. Waihi is located in 66 kilometers north west of Hamilton.

In early 2008 a new monitoring site was established at Grey Street, Waihi, around 50 meters north of the corner of Dobson Street and Grey Street (Figure 10.1). Daily concentrations of PM₁₀ have been measured since the site was established.

The monitoring method used to measure PM₁₀ concentrations at Waihi was a Sequential Partisol Sampler (Figure 10.2).

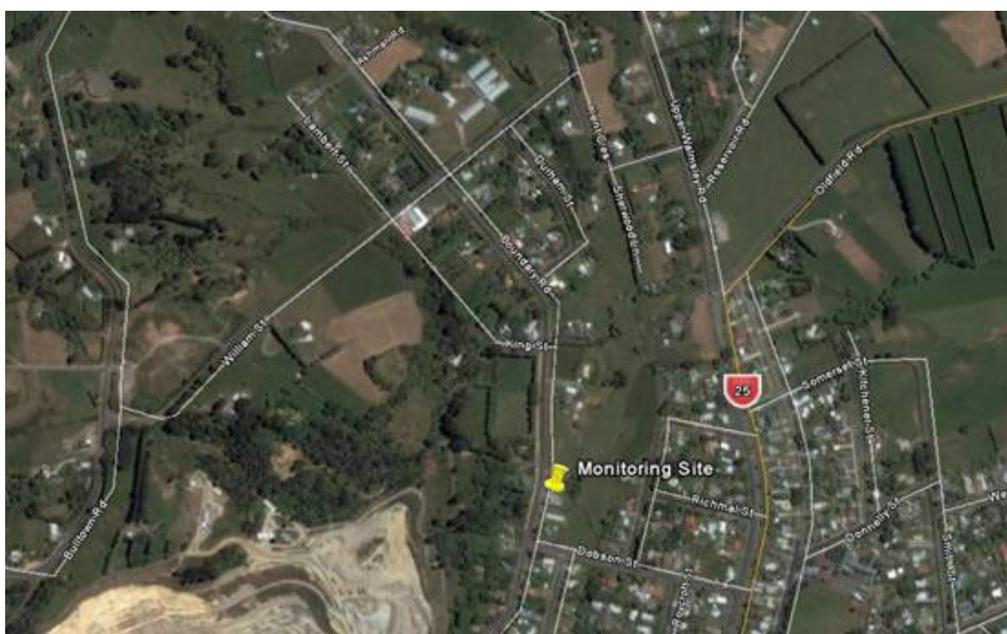


Figure 10.1: Location of Waihi monitoring site (Source: Google Earth 2009)



Figure 10.2: Waihi air quality monitor (Source: Environment Waikato)

10.2 PM₁₀ Concentrations in Waihi

No exceedences of 50 $\mu\text{g m}^{-3}$ were measured at the air quality monitoring site in Waihi during 2008. The maximum measured PM₁₀ concentration was 33 $\mu\text{g m}^{-3}$ and was measured on 26 September. The highest PM₁₀ concentration measured from May to August was 31 $\mu\text{g m}^{-3}$.

Figure 10.3 shows daily average PM₁₀ concentrations measured at the Waihi site during 2008.

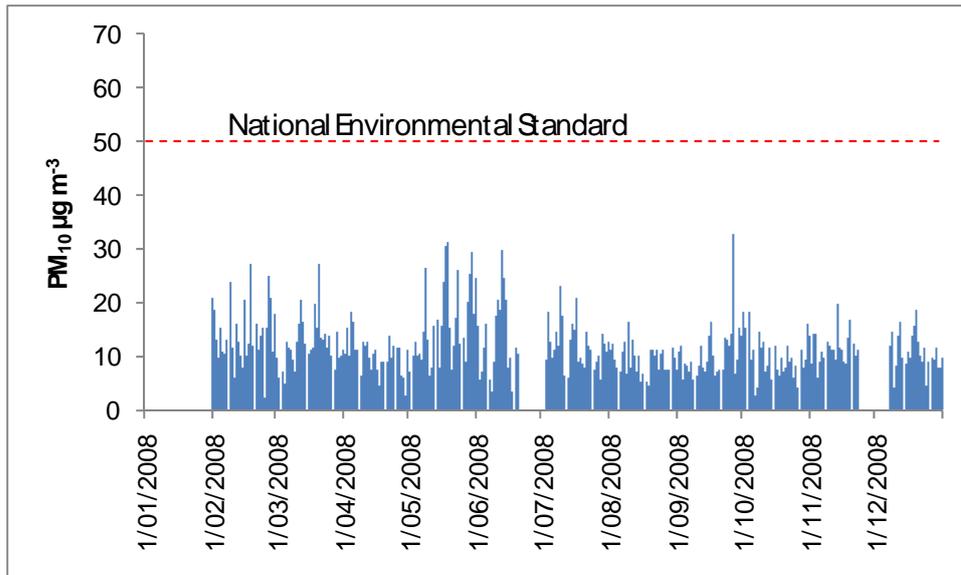


Figure 10.3: Daily winter PM₁₀ concentrations measured at the Waihi site during 2008.

Concentrations of PM₁₀ relative to air quality indicator categories at Waihi for 2008 are shown in Figure 10.4. Seasonal variations in the distribution of PM₁₀ concentrations are shown in Figure 8.5.

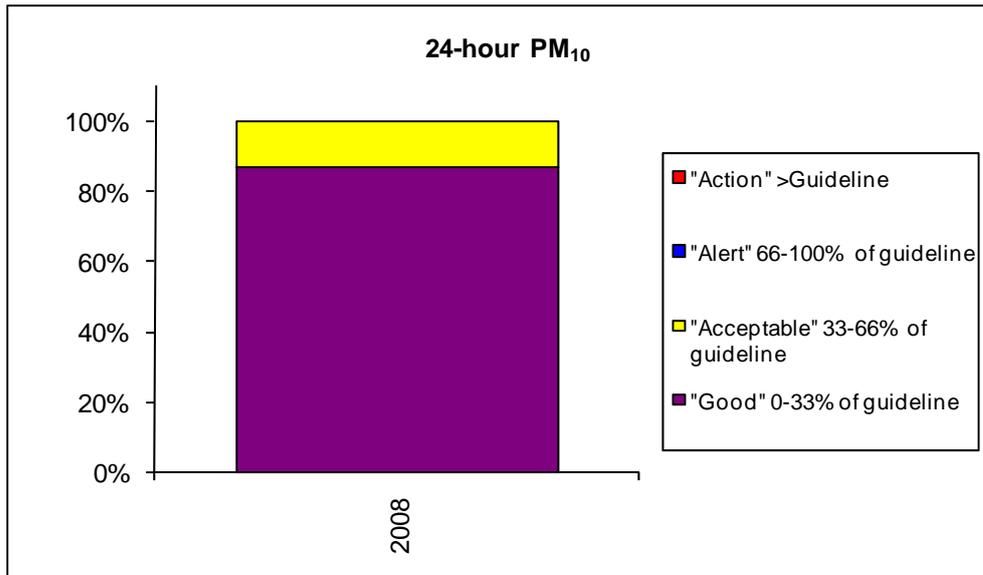


Figure 10.4: Comparison of PM₁₀ concentrations measured at the Waihi site in 2008 to MfE air quality indicator categories

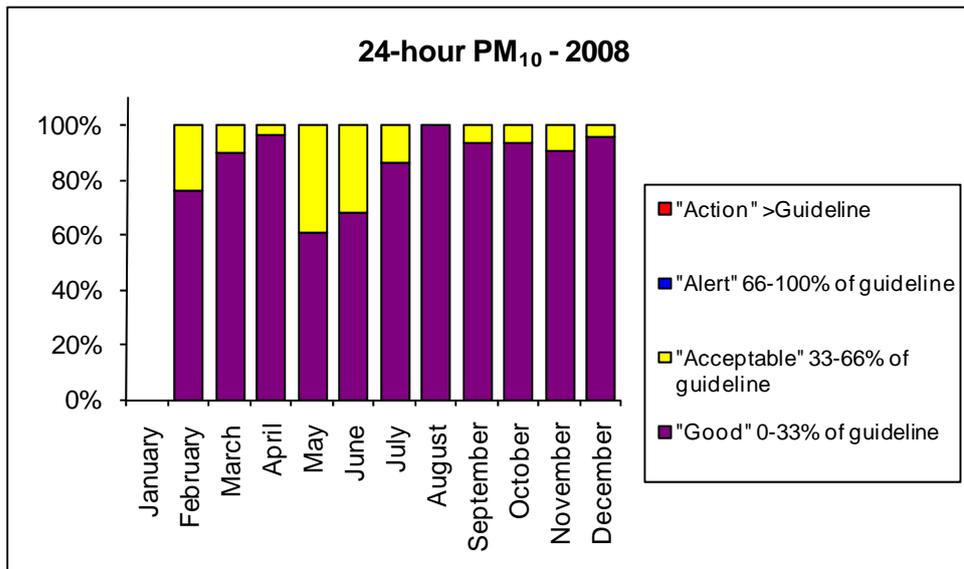


Figure 10.5: Comparison of daily PM₁₀ concentrations from February to December 2008 to MfE air quality indicator categories

The estimated annual average PM₁₀ concentration for Waihi for 2008 is 12 µg m⁻³. Summary statistics for PM₁₀ monitoring results are shown in Table 10.1.

Table 10.1: Summary of PM₁₀ concentrations measured at the Waihi monitoring site for 2008

	2008
"Good" 0-33% of guideline	87%
"Acceptable" 33-66% of guideline	13%
"Alert" 66-100% of guideline	0%
"Action" >Guideline	0%
Percentage of valid data	84%
Annual average ($\mu\text{g m}^{-3}$)	12
Measured exceedences	0
Annual maximum ($\mu\text{g m}^{-3}$)	32
Number of records	309

11 Summary

In 2008 PM₁₀ concentrations were measured at eight sites in the Waikato region. These were Hamilton, Tokoroa, Taupo, Te Kuiti, Matamata, Putaruru, Ngaruawahia and Waihi.

Concentrations of PM₁₀ in excess of the NES were measured in Tokoroa, Taupo, Te Kuiti and Putaruru. Table 11.1 shows the maximum measured PM₁₀ concentrations and number of exceedences of 50 µg m⁻³ in each location. More than one exceedence of the 50 µg m⁻³ constitutes a breach of the NES. The annual average concentration for each location are also shown and compared with the MfE guideline for annual averages of 20 µg m⁻³.

Table 11.1: Summary of PM₁₀ monitoring results for 2008

	Maximum measured concentration	Measured exceedences	Annual Average
	µg m ⁻³	µg m ⁻³	µg m ⁻³
Hamilton	48	0	15
Tokoroa	85	12	16
Taupo	76	12	17
Te Kuiti	69	3	18
Matamata	45	0	15
Putaruru	50	2*	18
Ngaruawahia	32	0	14
Waihi	33	0	12

* non winter exceedences associated with road work dust emissions that were exacerbated by a severe drought

Air quality monitoring of benzene, toluene and xylene was carried out at a number of monitoring sites in Hamilton. The highest average annual concentration during 2008 of 3.5 µg m⁻³ was measured at the Greenwood Street monitoring site and is within the 2010 guideline for benzene of 3.6 µg m⁻³ (annual average). Concentrations of toluene and xylene were well within acceptable levels.

Results indicated an annual average for benzo(a)pyrene in Hamilton of 0.40 ng m⁻³. With a 95% confidence interval of 0.20-0.60 ng m⁻³ this concentration is statistically indistinguishable from the guideline for benzo(a)pyrene of 0.3 ng m⁻³.

Meteorological data was available for the Hamilton, Tokoroa, Taupo, Te Kuiti, Matamata sites. An evaluation of the meteorological conditions at these sites shows all locations experienced low wind speeds during May. An evaluation PM₁₀ concentrations and meteorological conditions in Matamata suggests that it based on

the results of 2006 to 2008 that PM₁₀ concentrations are unlikely to exceed the NES during the winter months in the near future.

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