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Air Quality Monitoring 2006

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Abstract

This report presents results of ambient air quality monitoring carried out by Environment Waikato for the 12 months to September 2006. In previous years, air quality monitoring results have been reported on a calendar year basis however, starting in 2006, results are now reported for 12 months ending 1 September. Monitoring sites were located in Hamilton, Tokoroa, Te Kuiti, Taupo and Matamata.

The main air contaminant of concern in the Waikato region is suspended particles (PM_{10}). In September 2004, the Ministry for the Environment introduced a National Environmental Standard (NES) for PM_{10} of 50 µg m^{-3} (24-hour average) with one allowable exceedence each year. The NES became effective from September 2005. In the 12 months to September 2006, concentrations of PM_{10} were measured at all locations, along with monitoring of benzene at three Hamilton sites.

The highest 24 hour average PM_{10} concentration for the 12 months to 1 September 2006 was 89 µg m^{-3} recorded at Taupo on 7 June 2006. Recorded concentrations of PM_{10} during 2006 exceeded the ambient air quality guideline of 50 µg m^{-3} on five occasions at Gillies Ave, Taupo. This might be extrapolated to around 15 exceedances over the year, because of the one-day-in-three monitoring schedule at Gillies Ave. Continuous PM_{10} monitoring at Taupo Primary School during 2006 failed to detect any PM_{10} exceedances, so the continuous monitoring station will be moved to a site that is more likely to represent the poorest air quality in the town.

Six PM_{10} exceedances were recorded at Te Kuiti for the 12 months to 1 September 2006 and the maximum 24 hour PM_{10} concentration was 69 µg m^{-3} measured on 28 June 2006. Two PM_{10} exceedances were recorded at Hamilton and the highest PM_{10} concentration of 68 µg m^{-3} was observed on 29 June 2006. In Tokoroa the highest PM_{10} concentration of 62 µg m^{-3} was observed on 29 June 2006 and nine PM_{10} exceedances were recorded for the year.

In Hamilton, Te Kuiti and Taupo, cool and calm conditions in 2006 were associated with higher PM_{10} concentrations and greater number of exceedances than during previous years. However, lower PM_{10} concentrations and decreased number of exceedances occurred in Tokoroa compared with previous years. The anomaly at Tokoroa is almost certainly a consequence of spuriously high PM_{10} data collected in 2004-2005 due to instrumentation error. Upgrade of the Tokoroa BAM in September 2005 has probably resolved this issue and subsequently resulted in accurate PM_{10} data.

The highest 24 hour PM_{10} concentration at Matamata was 34 µg m^{-3} on 7 June 2006 and no exceedances were recorded during the year.

Passive sampling of benzene at Hamilton for 12 months to 20 September 2006 showed concentrations were lower than results from previous years. For the first time since monitoring commenced in 2003, annual average benzene concentrations at all Hamilton sites were below the guideline value of 3.6 µg m^{-3} that will become operative in 2010. The most significant influence on ambient benzene concentrations in recent years is likely to have been the progressive reduction of benzene content in petrol from a nationally regulated limit of four per cent in 2002 to one per cent in January 2006.

1 Introduction

During 2006, air quality monitoring was carried out by Environment Waikato at the five locations monitored in 2005. These sites were in Hamilton, Matamata, Tokoroa, Te Kuiti and Taupo. Results from these sites are presented in this report. A new survey, or investigative, monitoring site was also established at Putaruru in July 2006. Results from the survey monitoring are not reported because only five weeks' data are available.

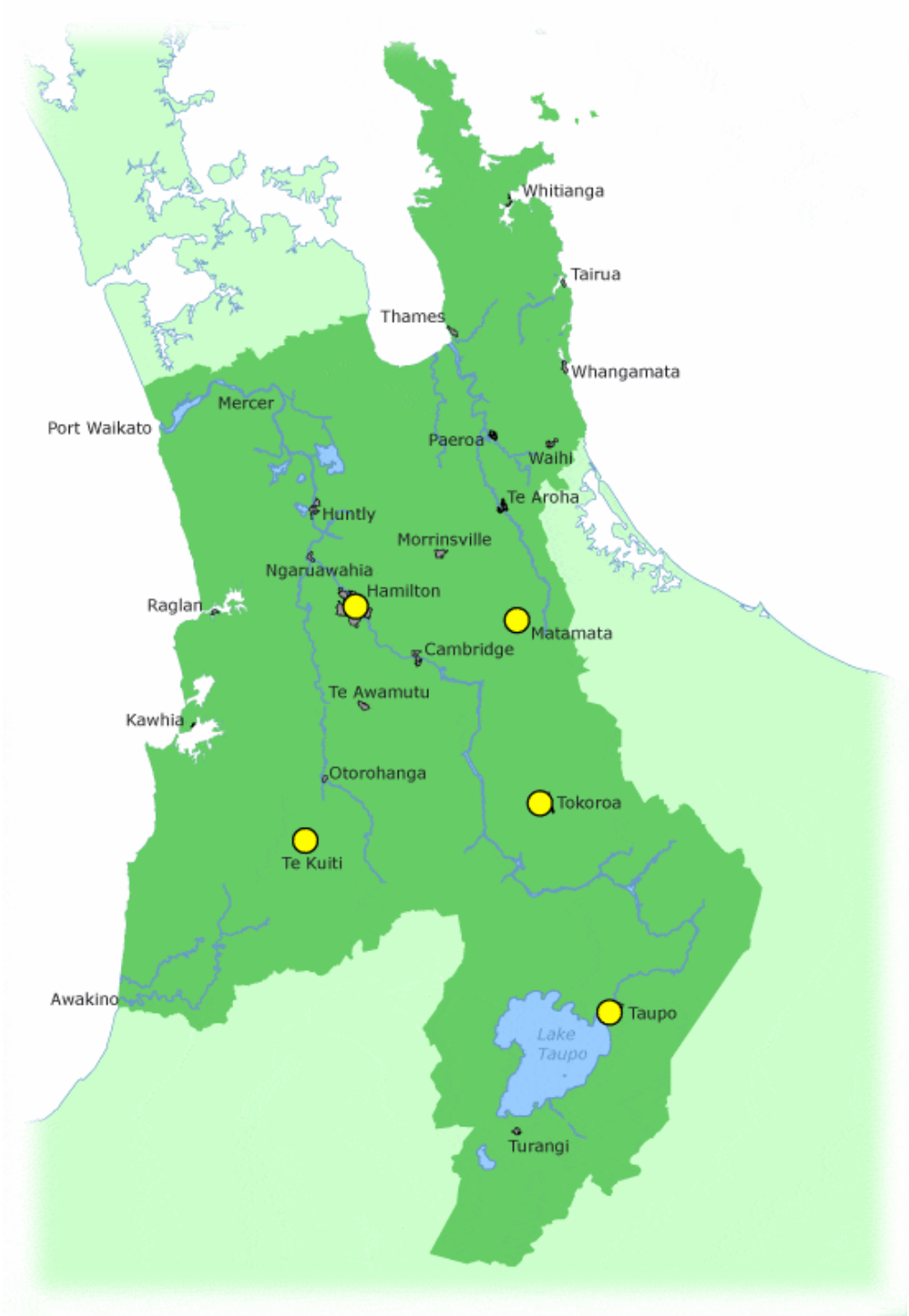


Figure 1-1: Location of Waikato air quality monitoring sites during 2006

The main air contaminant of concern in the Waikato Region is suspended particulate, commonly referred to as PM_{10}, which comprises particles in the air less than 10 microns in diameter. In September 2004, the Ministry for the Environment (MfE) introduced a National Environmental Standard (NES) for PM_{10} of 50 µg m^{-3} (24-hour average) with one allowable exceedence each year (MfE 2004). Table 1-1 shows the NES criteria for PM_{10} and other air contaminants. The NES became effective in September 2005.

In addition to the NES, air quality can be benchmarked against air quality guidelines (MfE 2002) and air quality indicator categories. The air quality guidelines for PM_{10} include an annual average concentration of 20 µg m^{-3}. There are other MfE guidelines with various averaging periods for contaminants including carbon monoxide (CO), nitrogen dioxide (NO_2), sulphur dioxide (SO_2), ozone and benzene (Table 1-2). In addition, it is common for air quality data to be presented relative to the MfE air quality indicator categories (Table 1-3).

Because the air quality monitoring sites, equipment and quality assurance procedures are described in detail elsewhere, only basic descriptions of these are included in this report. A more comprehensive review of air quality monitoring sites and equipment in the Waikato Region is available in *"Waikato Ambient Air Quality Monitoring Strategy 2006-2010*" (Smith, 2006). Further information on quality assurance procedures for the monitoring is presented in the *"Quality Assurance Procedures Manual - for ambient air quality monitoring at Environment Waikato"* (Wilton 2003). Further details of data processing and office procedures are described in "*Environment Waikato Environmental Processing and Reporting manual*" (Buchanan 2004).

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 [a]	350 µg m^{-3}	1-hour	9
Sulphur dioxide [a]	570 µg m^{-3}	1-hour	0
Ozone	150 µg m^{-3}	1-hour	0

Notes:
[a] The sulphur dioxide values do not apply to sulphur acid mist.

Table 1-2: Ambient air quality guidelines for New Zealand (MfE, 2002)

Contaminant	2002 guideline values[a]	
	Concentration	**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) Benzene (year 2010)	10 µg m^{-3} 3.6 µg m^{-3}	Annual 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] Mercury (organic)	0.33 µg m^{-3} 0.13 µg m^{-3}	Annual Annual
Chromium VI [d] Chromium metal and chromium III	0.0011 µg m^{-3} 0.11 µg m^{-3}	Annual Annual
Arsenic (organic) [d] Arsine	0.0055 µg m^{-3} 0.055 µg m^{-3}	Annual 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: Ministry for the Environment's Environmental Performance Indicator categories for air quality

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

1.1 Reporting period

Exceedances of the NES for PM_{10} in Waikato airsheds invariably occur during winter. In previous years, air quality monitoring results have been reported on a calendar year basis. In 2006, it was decided to report air quality monitoring results for 12 months ending 1 September 2006.

The main reason for the change in reporting period is to ensure results are reported as soon as possible after the peak winter season for PM_{10} concentrations. When reporting on a calendar year basis, timeframes for production of reports, along with peer review and release procedures, can delay the release of winter air quality data until the following winter. This is not ideal for management purposes. Reporting results for 12 months to 1 September will achieve more timely delivery of air monitoring results for the peak winter period.

Additionally, NES timeframes are often scheduled around 1 September. Regulations relating to monitoring and reporting of contaminant standards (Regulations 13-16) came into force on 1 September 2005. Regulations relating to resource consents and woodburner standards also became effective on 1 September 2005 (Regulations 17-24) and pathways to compliance are scheduled to end 1 September 2013 (Regulations 17-19).

Whereas the 2006 monitoring period is from 1 September 2005 to 1 September 2006, to be consistent with past monitoring reports and avoid confusion, data from previous years are reported here on a calendar year basis. This will make little difference to interannual comparisons, because PM_{10} exceedances invariably occur before September in any calendar year. Wherever data in this report deviate from the September to September reporting period, the applicable monitoring period will be clearly identified.

1.2 Dealing with missing data

Hourly averages were only calculated if 85% of the 10-minute data for the given averaging period were available. Likewise, 24-hour averages were discarded if less than 85% of hourly averages were available.

This is more demanding than the 75% data requirement recommended for averaging air quality data in *Good Practice Guide for Air Quality Monitoring and Data Management* (MfE 2000). However, the 85% criterion has been used because it is the

value specified in the *Hydrol* software used by Environment Waikato to store and process 10-minute data. Neither cut-point has been used for the reporting of monthly concentrations.

2 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 and Claudelands Bridge have also been used in recent years to monitor concentrations of benzene. The Peachgrove Road site is located on the south-east side of Hamilton City (Figure 2-1). During 2006, PM_{10} and benzene were measured at Peachgrove Road and the site is consistent with the "Residential Peak" site classification as described in *Good Practice Guideline for Air Quality Monitoring and Data Management* (MfE 2000).

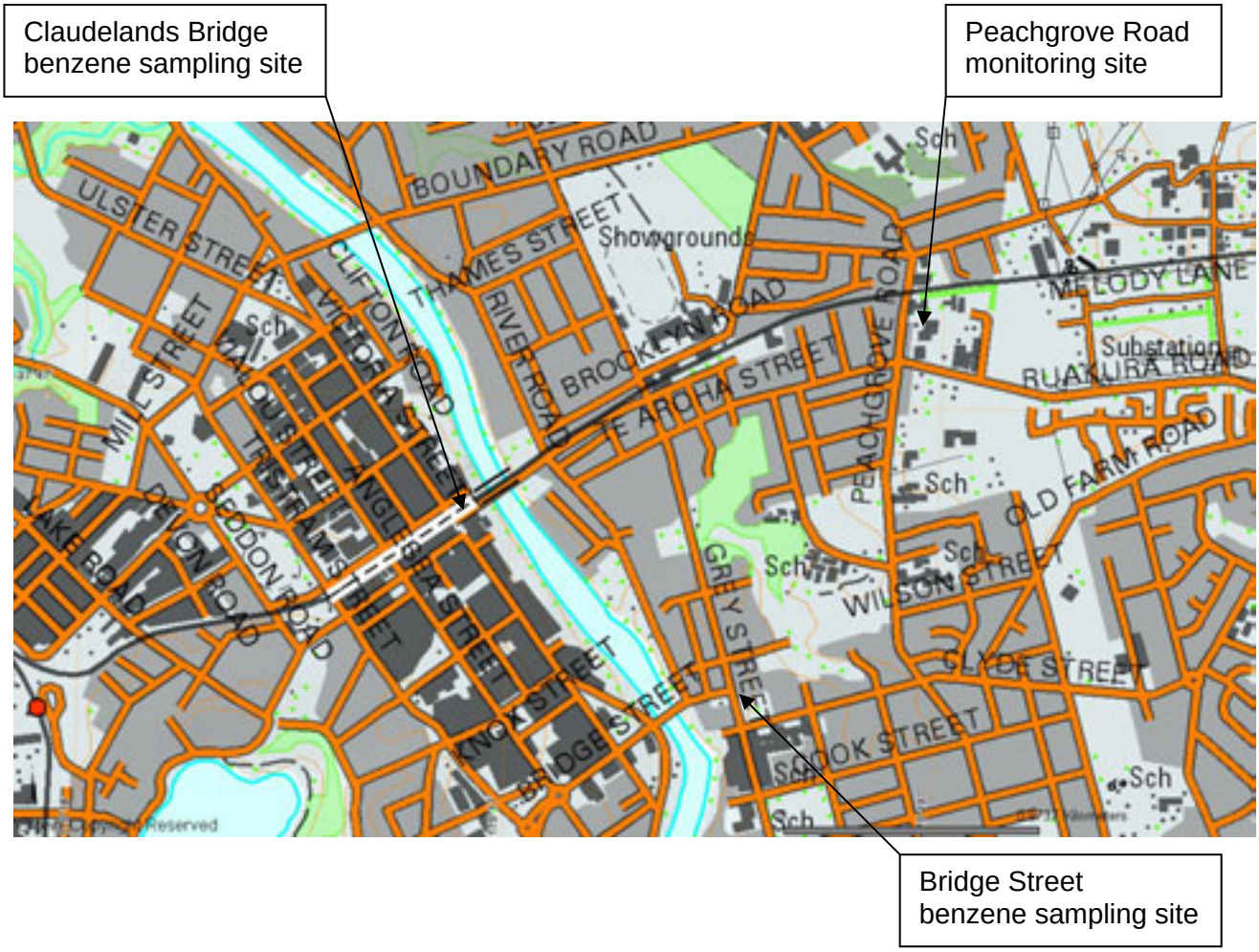


Figure 2-1: Location of Hamilton air quality monitoring sites

Map sourced from NZTopo*Online*, extracted August 2006, Crown Copyright Reserved

During 2006, PM_{10} concentrations at Peachgrove Road were monitored using a Tapered Elemental Oscillating Microbalance (TEOM) with a sample temperature setting of 40°C. The PM_{10} data were collected at the Peachgrove Road site as 10-minute averages and subsequent calculations of hourly averages were made from these data. Daily averages of PM_{10} data were available for 99% of days in 2006 and this represents a considerable improvement on the 2005 data capture of only 77%.

Sampling for the volatile organic compound (VOC) benzene was carried out using BTEX passive absorption badges for the 12 month period 20 September 2005 – 20 September 2006. The method used is as described in Stevenson and Narsey (1999) with badges 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).

The passive samplers used to evaluate three-monthly average levels of benzene also provide measurement of toluene and total xylenes. While benzene is the main VOC of concern in Hamilton, concentrations of toluene and xylenes are also reported here.

2.1 Concentrations of PM_{10}

Concentrations of PM_{10} measured at the Hamilton monitoring site for September 2005 – September 2006 are shown in Figure 2-2. The maximum measured PM_{10} concentration in Hamilton during the period was 68 µg m^{-3} (24-hour average) and was recorded on 29 June 2006.

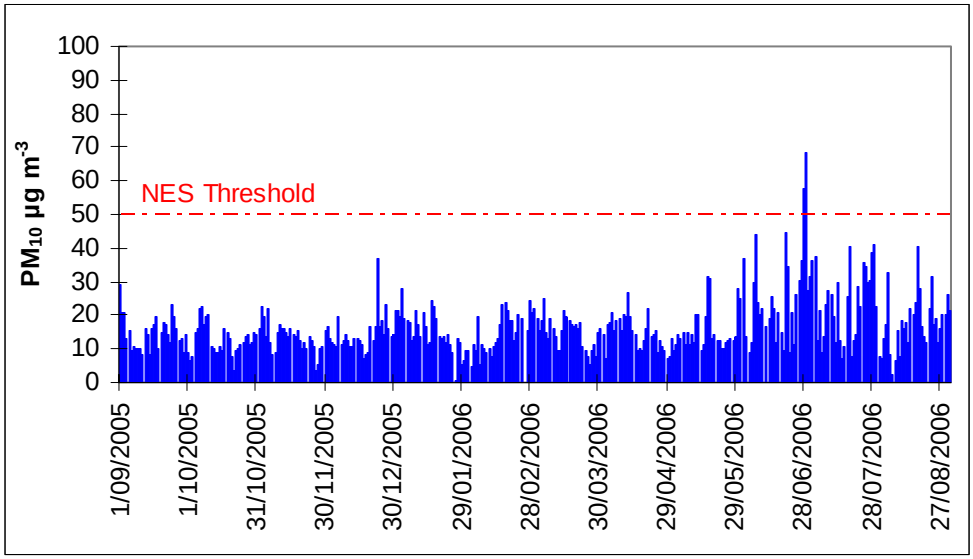


Figure 2-2: Daily PM_{10} concentrations measured in Hamilton during 2006

A comparison of the PM_{10} concentrations to the MfE air quality indicator categories is shown in Figure 2-3. "Alert" levels were exceeded in June, July and August 2006 and the NES limit was exceeded in June. One observation of 37 µg m^{-3} was also recorded in December 2005 and is within the "Alert" category.

Figure 2-4 and
Table 2-1 compare the distribution of PM_{10} concentrations in Hamilton during 2006 and summary statistics to results from previous years. No trends in PM_{10} concentrations are evident from these data, although the maximum 24-hour concentration of 68 µg m^{-3} recorded on 29 June 2006 was the highest since records began in 1998.

The annual average PM_{10} concentration for Hamilton for 2006 was 16 µg m^{-3} and is less than the MfE annual guideline for PM_{10} of 20 µg m^{-3}. This concentration is of similar magnitude to annual average concentrations 15-17 µg m^{-3} observed at Hamilton since monitoring began in 1998 (
Table 2-1).

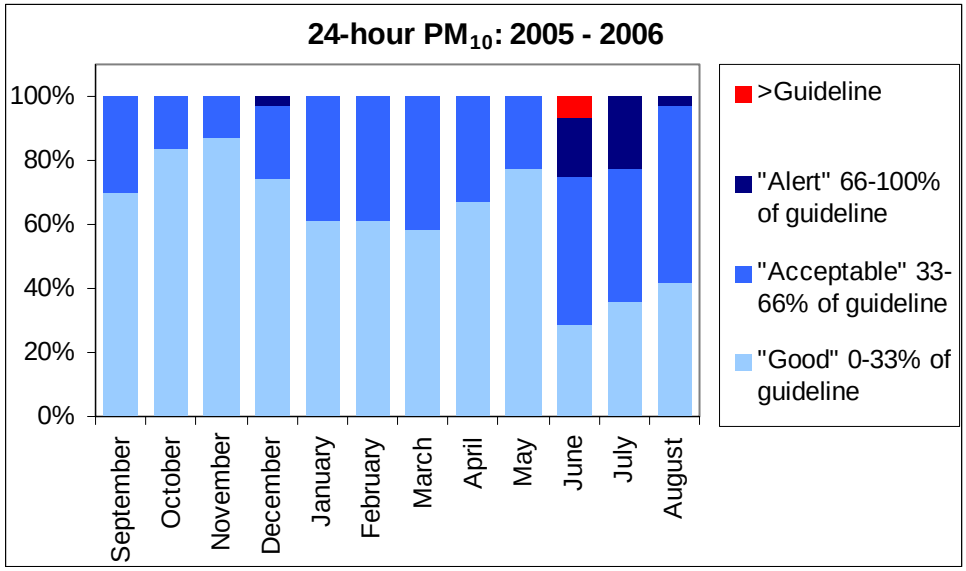


Figure 2-3: MfE air quality indicator categories for PM_{10} concentrations measured in Hamilton for twelve months to 1 September 2006

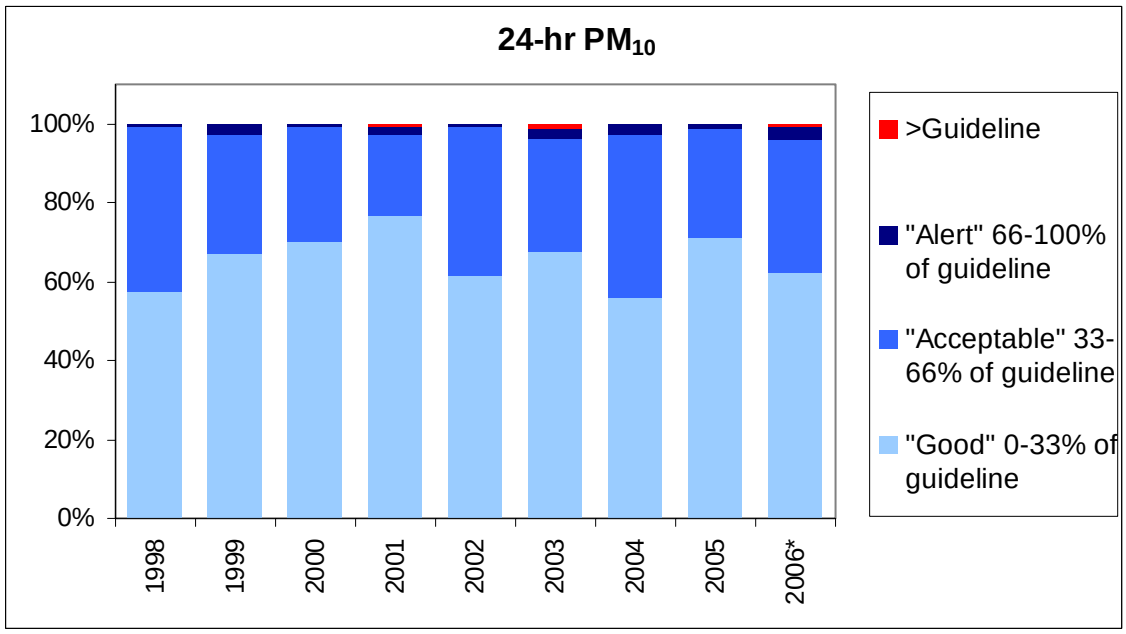


**Figure 2-4: Comparison of PM_{10} concentrations measured at Hamilton from 1998 to 2006 to MfE air quality indicator categories. ***Note that prior to 2006, reporting periods were calendar years.

Table 2-1: Summary statistics for PM_{10} data for Hamilton from 1998 to 2006. *Note that prior to 2006, reporting periods were calendar years.

	1998	1999	2000	2001	2002	2003	2004	2005	2006*
"Good" 0-33% of guideline	57%	67%	70%	77%	61%	67%	56%	71%	62%
"Acceptable" 33-66% of guideline	42%	31%	30%	21%	38%	29%	41%	28%	33%
"Alert" 66-100% of guideline	1%	3%	1%	2%	1%	3%	3%	1%	4%
“Action” >Guideline	0%	0%	0%	1%	0%	1%	0%	0%	1%
Percentage of valid data	47%	99%	91%	70%	93%	91%	94%	77%	99%
Annual average (µg m^{-3})	15.2	15.7	14.7	15.5	15.5	15.3	16.9	15.5	16.3
Guideline exceedences	0	0	0	3	0	4	1	0	2
99.7 %ile concentration (µg m^{-3})	33	43	33	57	34	54	43	36	57
Annual maximum (µg m^{-3})	35	44	43	67	36	62	55	37	68

An emission inventory study carried out in Hamilton for 2005 indicates that the main source of PM_{10} emissions is solid fuel burning for domestic home heating (Wilton 2005a).

2.2 Meteorology

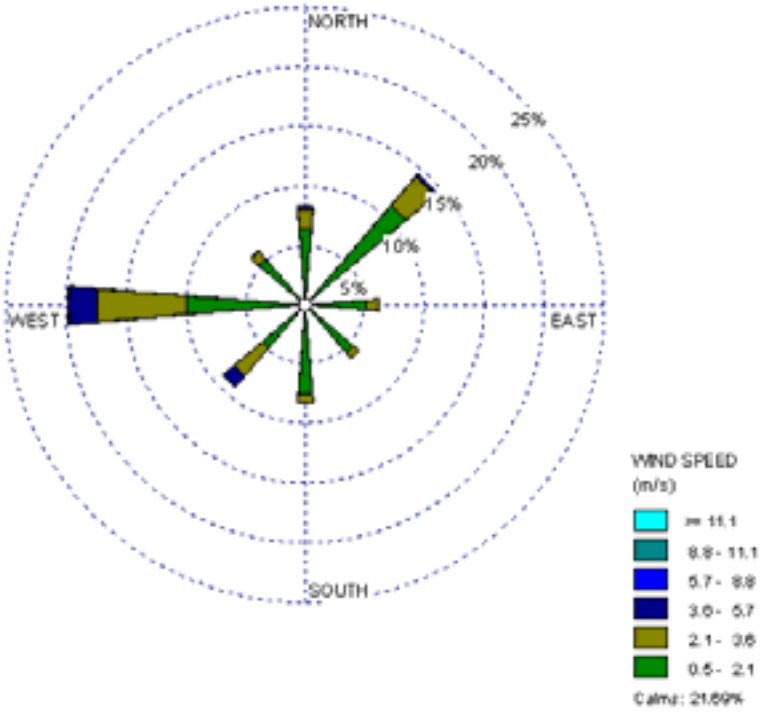
The windrose plots in Figure 2-5 are very similar and demonstrate that wind conditions during the full year 2006 (Figure 2-5b) were typical of those observed at Peachgrove Road since monitoring began in 1998.

However, PM_{10} exceedances occurred in June 2006 and Figure 2-6 shows there was a higher frequency of light southerly winds during this month compared to June data from previous years. Along with a high frequency of light winds during June 2006, the mean air temperature at Peachgrove Road for the month was a cool 8.5°C (Figure 2-7). This is 20 per cent lower than the average June air temperature for previous years.

A NIWA climate summary (NIWA, 2006) confirms that June 2006 was a cool month for Hamilton. At 7.2°C, the mean air temperature at Hamilton airport was 2°C lower than normal and is the second lowest recorded at the Station since monitoring began in 1971. NIWA (2006) noted that large temperature anomalies, more than 2°C below average, occurred in the Waikato region during June 2006 and reported that “it was particularly cold and frosty at night”.

The cold, frosty and calm periods during June 2006 produced conditions most likely to create air pollution. Emissions from domestic fires are frequently elevated because of increased fuel use during cold weather and dispersion of contaminants is retarded during calm or light wind. It is therefore not surprising that the maximum PM_{10} concentration recorded during June 2006 was the highest 24-hour observation since monitoring began in 1998.

(a)



(b)

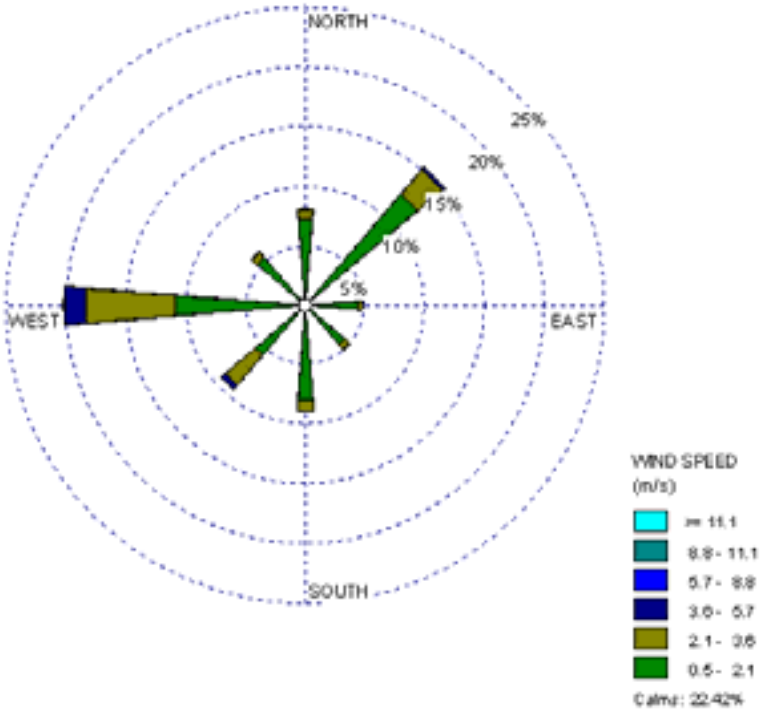
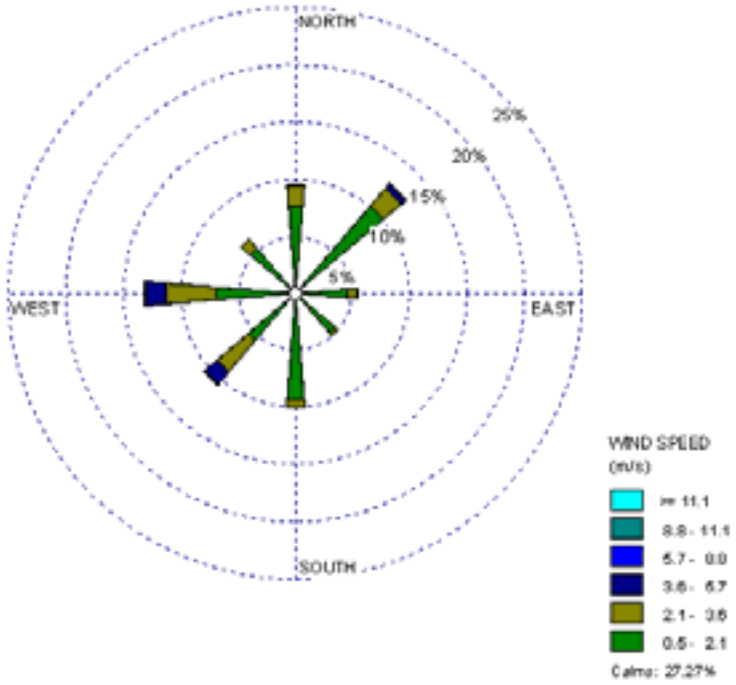


Figure 2-5: Windrose plots for Hamilton Peachgrove Road site during (a) Sept 1998-Sept 2005 and (b) Sept 2005-Sept 2006

(a)



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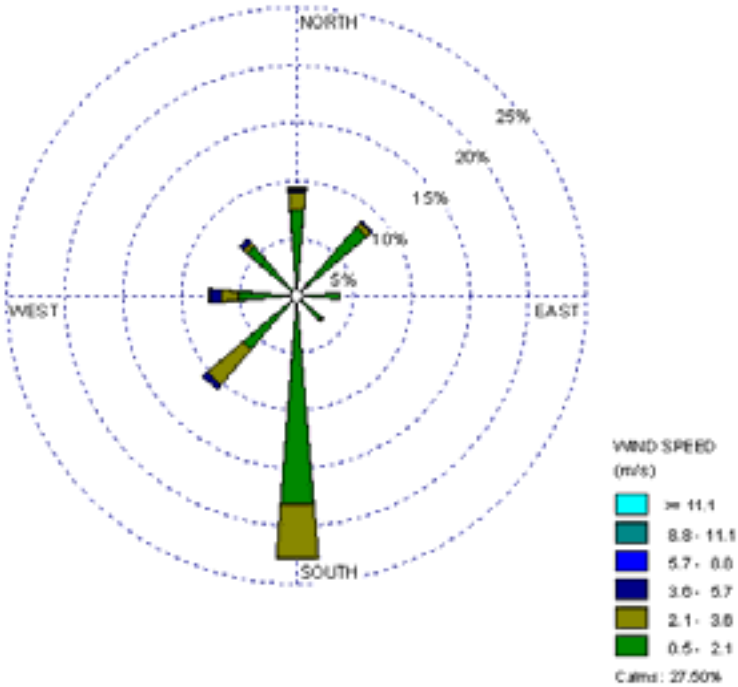


Figure 2-6: Windrose plots of June data from Hamilton Peachgrove Road site during (a) 1998-2005 and (b) 2006

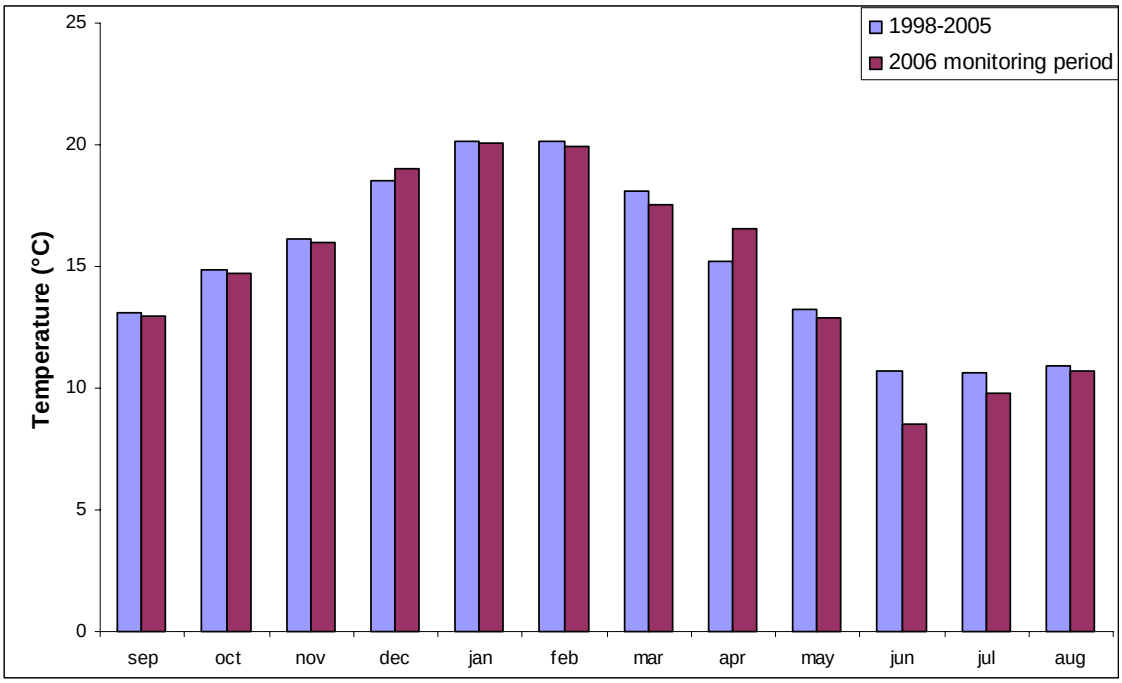


Figure 2-7: Monthly mean air temperatures for 2006 monitoring period (Sept 2005-Sept 2006) and ensemble monthly mean temperatures for the years 1998-2005 at Peachgrove Road, Hamilton

2.3 Concentrations of benzene, toluene and xylenes

In its most common form, benzene is a colourless liquid that occurs naturally in crude oil and is used for boosting octane levels in petrol. Atmospheric, or ambient, benzene is usually produced by evaporation and combustion processes such as burning fuels for transportation and heating, with possible health impacts including damage to DNA and carcinogenic effects. The MfE's current air quality guideline for benzene is 10 µg m^{-3} averaged over a year. However, in 2010 the annual guideline value will be lowered to 3.6 µg m^{-3}.

Passive sampling of benzene has been conducted since 2003 at various sites within Hamilton and Tokoroa. Concentrations at all sites have been within the current guideline of 10 µg m^{-3} per year. However, in 2004 and 2005, benzene levels measured at two of Hamilton's high-density traffic sites were above the 2010 guideline of 3.6 µg m^{-3} per year.

2.3.1 2005-06 monitoring results

Figure 2-1 shows the location of the sites at Peachgrove Road, Bridge Street and Claudelands Bridge where benzene sampling was undertaken for 12 months to 20 September 2006. During this period, concentrations at Peachgrove Road, Bridge Street and Claudelands Bridge were 1.9 µg m^{-3}, 3.1 µg m^{-3} and 3.4 µg m^{-3} respectively (Figure 2-8). At all three sites, concentrations were 23-32 percent lower than during the previous 12 months and were below the guideline that will apply in 2010.

The most significant influence on ambient benzene concentrations in Hamilton during recent years is likely to have been the progressive reduction of benzene content in petrol from a nationally regulated limit of four percent in 2002. In particular, a major reduction from three percent to one percent benzene in petrol was effected prior to January 2006, following changes made to New Zealand's Petroleum Products Specification Regulations by the Ministry of Economic Development.
Further changes in fuel quality, vehicle technology, traffic density or fleet composition may affect ambient benzene concentrations in future years. Passive sampling of benzene is therefore continuing at the three Hamilton sites to monitor trends in concentrations as 2010 approaches.

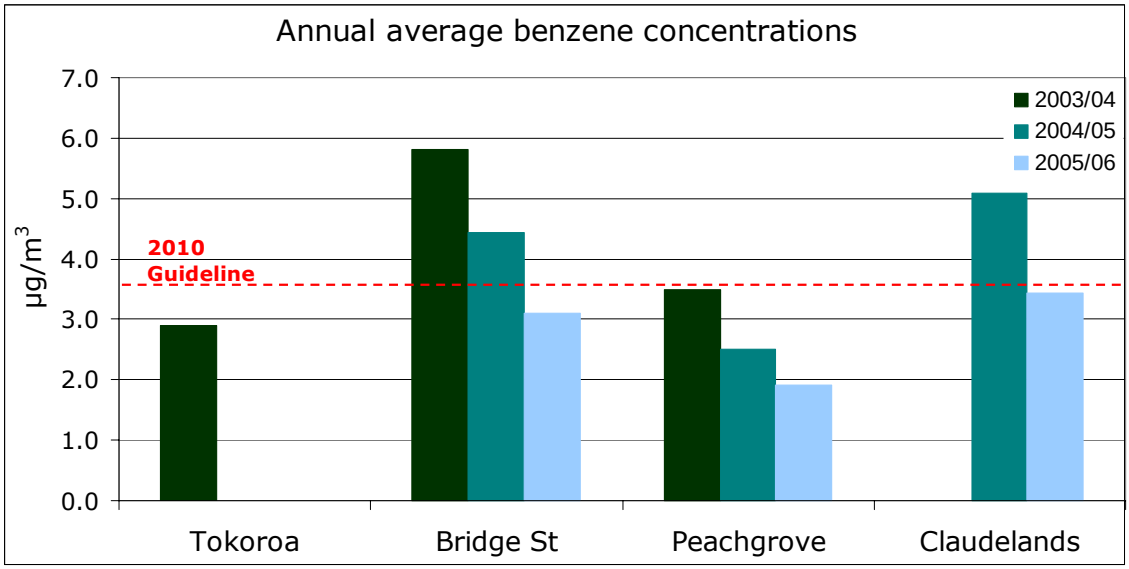


Figure 2-8: Annual average concentrations of benzene measured at Tokoroa and three Hamilton sites for periods: 3 Feb 2003 – 3 Feb 2004; 19 Jul 2004 – 19 Jul 2005 and 20 Sep 2005 – 20 Sep 2006.

Along with benzene, the passive samplers also enable the measurement of toluene and xylenes. While there are no current MfE guidelines for ambient concentrations of toluene and xylenes, a draft MfE *Good Practice Guide on Assessing Discharges to Air from Industry* (MfE, 2006) recommends using Australian NEPM (Australian NEPC, 2004) monitoring investigation levels for these contaminants. The annual average concentrations of these volatile organic compounds (VOCs) measured at the Hamilton sites were very much less than the NEPM investigation levels (Table 2-2). Of the VOCs monitored with the BTEX passive samplers, benzene remains the only contaminant of concern in Hamilton.

Table 2-2: Annual average concentrations of volatile organic compounds (VOCs) at Hamilton sites between Sept 2005 – Sept 2006. All units are µg m^{-3}.

	Peachgrove Road	Bridge St	Claudelands Bridge	Guideline value[a]
Benzene	1.9	3.1	3.4	3.6 (10[a])
Toluene	8.6	13.5	15.2	380[b]
total Xylenes	6.4	10.5	11.1	880[b]

[a] The current guideline for benzene is 10 µg m^{-3}, but this threshold will reduce to 3.6 µg m^{-3} in 2010.

[b] There are currently no New Zealand guideline values for toluene and xylenes. Instead, Australia's NEPM investigation levels (Australian NEPC, 2004) are used for these contaminants with conversion from ppm to µg m^{-3} using molecular weight of 92.13 g/mol and 106.16 g/mol for toluene and mixed xylenes respectively.

3 Air quality monitoring in Taupo

Prior to 2005, PM_{10} was monitored in Taupo on a 1-day-in-3 basis at the Gillies Avenue Reserve (Figure 3-1). The site is located in central Taupo and was established in November 2000. The site is consistent with the "Residential Neighbourhood" site classification as described in *Good Practice Guide for Air Quality Monitoring and Data Management* (MfE 2000).

In January 2005 a continuous monitoring PM_{10} monitoring station was commissioned at Taupo Primary School (Figure 3-1). The Taupo Primary site is consistent with the "Residential Neighbourhood" site classification. Operation of the Gillies Ave monitoring continued throughout 2006, to evaluate spatial variation of PM_{10} concentrations between Gillies Ave and Taupo Primary School. Regulation 15 of the NES requires monitoring of contaminants at locations within airsheds where the relevant standard is likely to be breached by the greatest margin or most frequently. Therefore it is important that continuous monitoring is conducted at a site where the worst air quality is likely to be experienced.

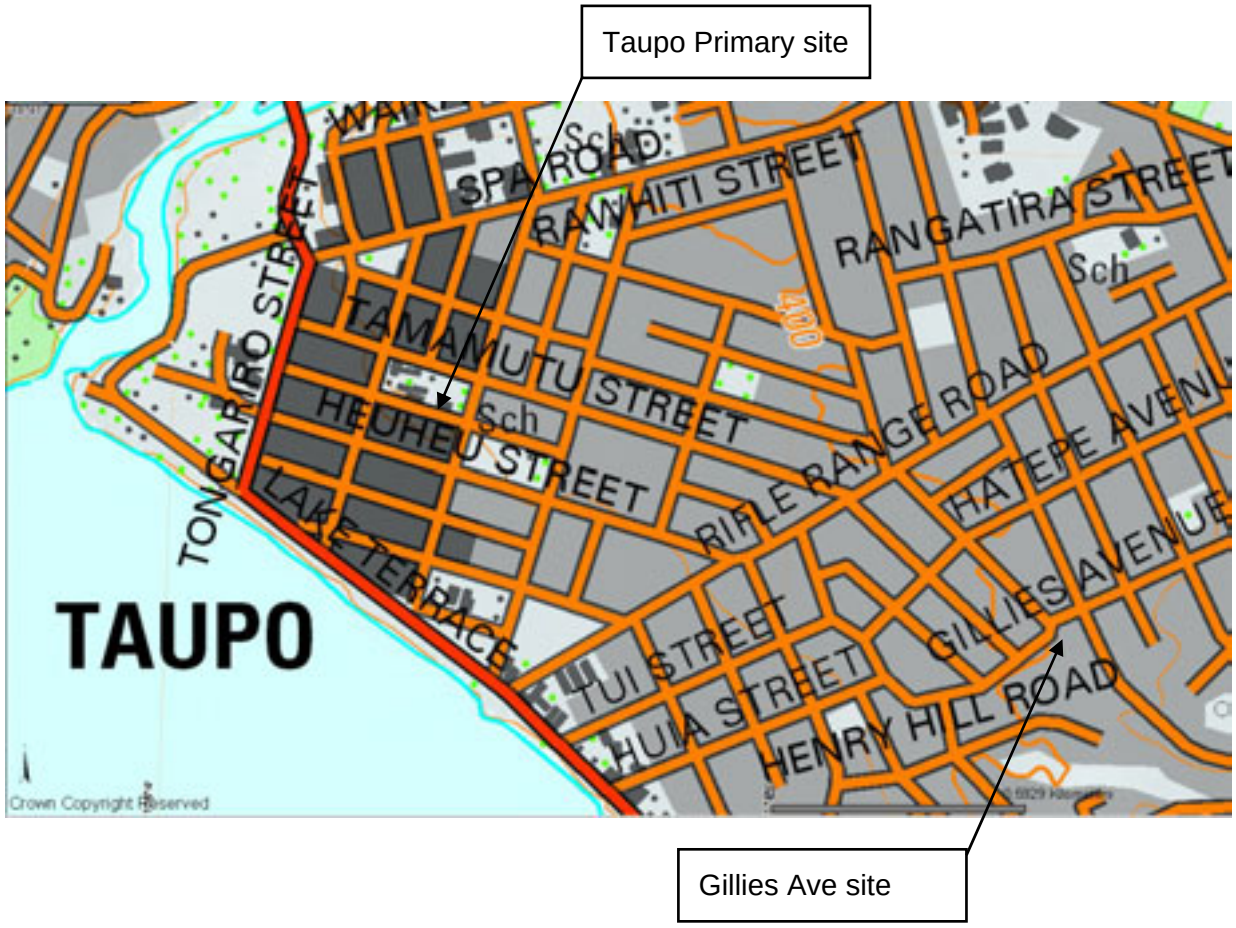


Figure 3-1: Location of Taupo PM_{10} monitoring sites during 2006

Map sourced from NZTopo*Online*, extracted August 2006, Crown Copyright Reserved

The monitoring method for measuring PM_{10} concentrations at Gillies Ave was gravimetric sampling using a Rupprecht and Patashnick Partisol Model 2000 PM_{10} sampler. The sampling regime during 2006 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 97 samples were collected at Gillies Ave during 2006.

Concentrations of PM_{10} were measured at the Taupo Primary continuous monitoring site using a ThermoAndersen FH62C14 Beta Attenuation Monitor (BAM). The Taupo Primary site was installed by Watercare Services Ltd and is operated and maintained by Environment Waikato staff.

Meteorological instrumentation is not installed at the Gillies Ave site, but windspeed, wind direction, air temperature and relative humidity data have been available for the Taupo Primary site since installation in January 2005.

3.1 Concentrations of PM_{10}

The highest 24-hour PM_{10} concentration recorded at the Taupo Primary site was 24.8 µg m^{-3}, so at this location the concentrations were consistently below the MfE "Alert" category.

At the Gillies Ave site, five exceedances of the 50 µg m^{-3} NES limit for PM_{10} were measured during 2006 (Figure 3-2). The data demonstrate that Taupo Primary School is not a suitable site for compliance with NES Regulation 15, which requires monitoring at the location where contaminant concentrations (or frequency of exceedances) are greatest. To achieve compliance with Regulation 15, arrangements are being made to relocate the continuous monitoring station. It is anticipated that permission may be obtained to locate the BAM station at Gillies Ave before winter 2007.

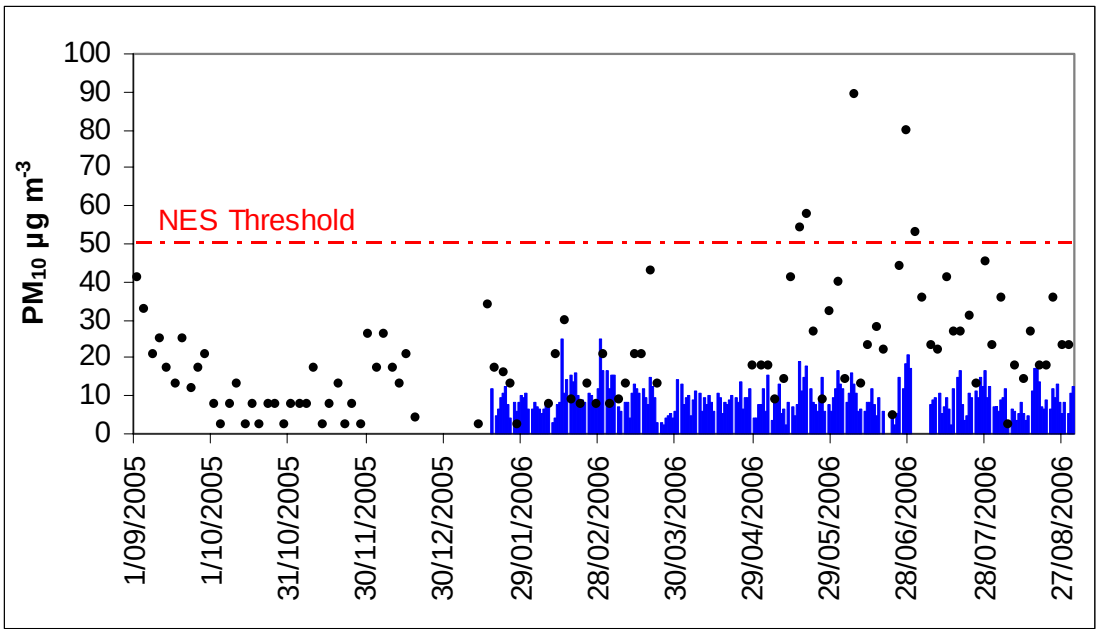


Figure 3-2: 24-hour average concentrations of PM_{10} in Taupo during 2006, measured with FH62 BAM at Taupo Primary School (bars) and gravimetric partisol at Gillies Ave (dots)

Monthly summaries of daily PM_{10} concentrations relative to the MfE air quality indicator categories are shown in Figure 3-3. Because of the one day in three sampling frequency, there is a small sample size of daily data for each month and some caution applies when interpreting seasonal trends. However, Figure 3-3 clearly shows that PM_{10} is of most concern in Taupo during the winter months. While "Alert" levels were exceeded at various times of the year, this category was reached most frequently during winter and the NES limit was exceeded in May, June and July 2006.

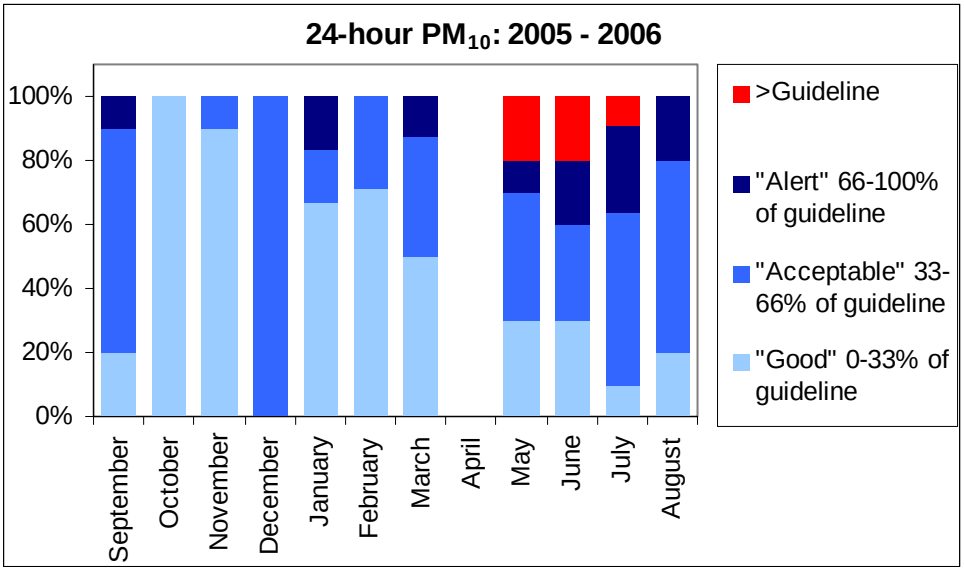


Figure 3-3: Comparison of PM_{10} concentrations measured in Taupo to MfE air quality indicator categories

Extrapolating the Gillies Ave data statistically for days when monitoring wasn't conducted suggests that around fifteen exceedances may have occurred during 2005 (Table 3-1). This is the highest number of exceedances recorded at Gillies Ave since monitoring began in 2001. Moreover, the maximum PM_{10} concentration of 89 µg m^{-3} observed on 7 June 2006 is the highest ever recorded at Taupo. Prior to 2006, the maximum 24-hour PM_{10} concentration was 65 µg m^{-3} recorded in 2004. The previous maximum was also exceeded on 28 June 2006 when a 24-hour PM_{10} concentration of 80 µg m^{-3} was measured at Gillies Ave.

One day in three sampling suggests that the annual average PM_{10} concentration for Taupo for 2004 was around 19 µg m^{-3}. This is effectively indistinguishable from the annual average guideline for PM_{10} of 20 µg m^{-3} (MfE 2002).

A comparison of PM_{10} data for Taupo from 2001 to 2006 is also shown in Figure 3-4. No interannual trends in PM_{10} concentrations are evident from these data.

Table 3-1: Summary statistics for PM_{10} data for Taupo from 2001 to 2006 *Note that prior to 2006, reporting periods were calendar years.

	2001	2002	2003	2004	2005	2006
"Good" 0-33% of guideline	43%	59%	52%	55%	56%	44%
"Acceptable" 33-66% of guideline	36%	33%	32%	33%	38%	38%
"Alert" 66-100% of guideline	18%	7%	12%	10%	5%	11%
"Action" >Guideline	2%	1%	4%	2%	1%	5%
Percentage of valid data	12%	21%	29%	29%	30%	27%
Annual average (µg m^{-3})	19.7	15.9	18.5	17.1	15.6	19.2
Guideline exceedences (extrapolated)	7	6	12	6	3	15
99.7 %ile concentration (µg m^{-3})	54	49	61	62	50	86
Annual maximum (µg m^{-3})	57	54	62	65	52	89

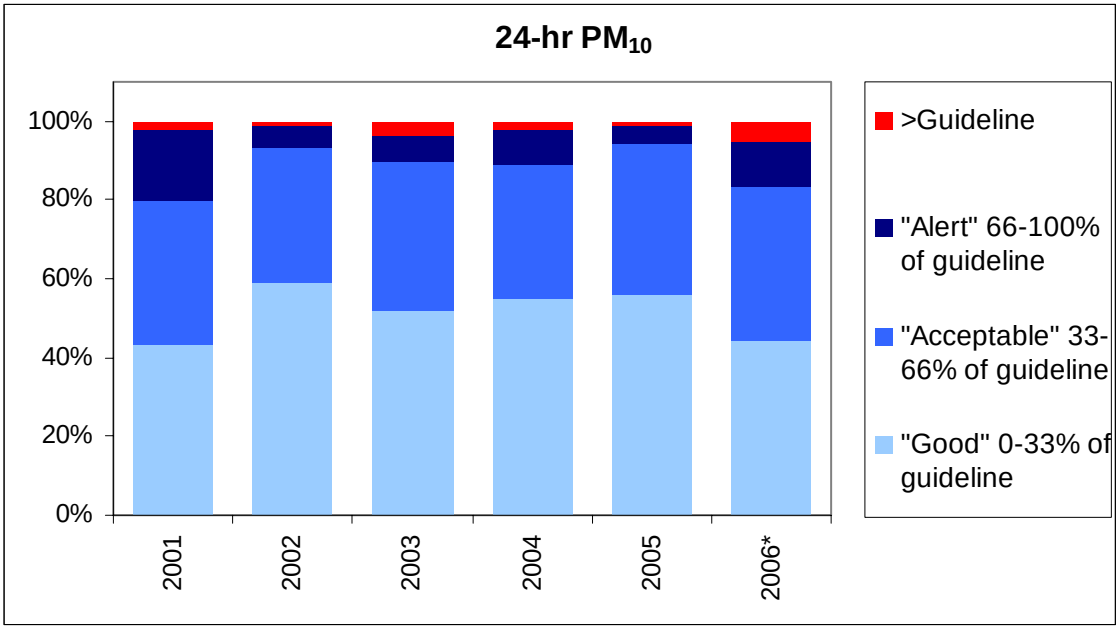


Figure 3-4: Comparison of PM_{10} concentrations measured in Taupo from 2001 to 2006 to MfE air quality indicator categories *Note that prior to 2006, reporting periods were calendar years.

An emission inventory study carried out in Taupo for 2004 indicates that the main source of PM_{10} emissions is solid fuel burning for domestic home heating (Wilton 2004).

3.2 Meteorology

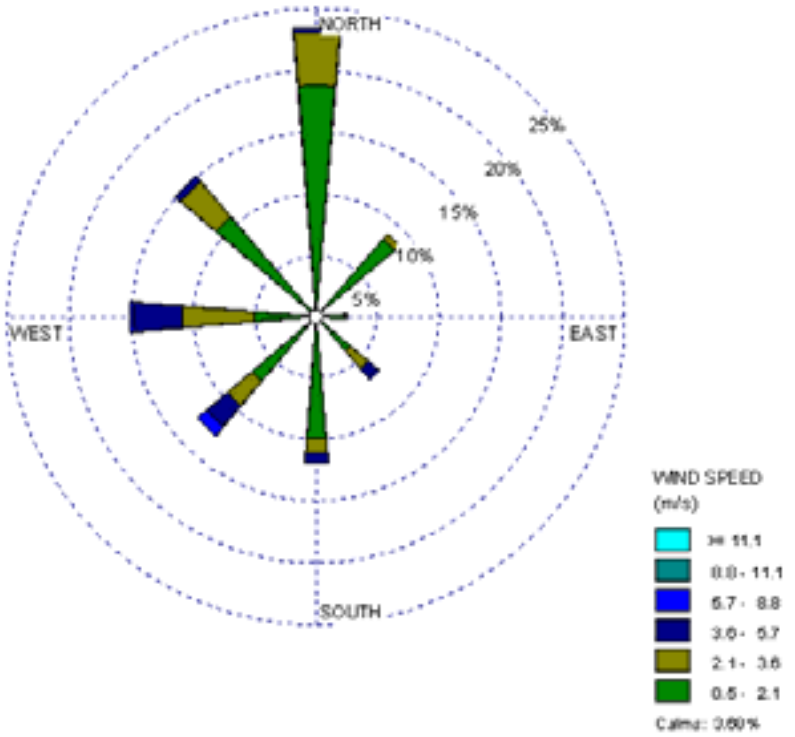
Meteorological data including air temperature, wind speed and direction were collected at the Taupo Primary site from January 2006.

Figure 6-2 shows that while wind was generally from the north and west between January and September 2006 Figure 6-2a, in June there was a higher frequency of southerly winds at Taupo. There was also a greater percentage of calm winds, less than 0.5 m s^{-1}) during June 2006 (5.6 per cent) compared with January to September (3.7 per cent).

The mean air temperature during June 2006 was a cool 6.4°C at Taupo Primary School (Figure 3-6). NIWA (2006) noted that large temperature anomalies, more than 2°C below average, occurred in the Waikato region during June 2006 and reported that “it was particularly cold and frosty at night”. At 5.6°C, the mean air temperature at Taupo airport was 1.7°C lower than normal and is the lowest recorded at that Station since monitoring began in 1976 (NIWA, 2006).

As with Hamilton, the cold, frosty and calm periods during June 2006 would have produced conditions most likely to create air pollution. Emissions from domestic fires are frequently elevated because of increased fuel use during cold weather and dispersion of contaminants is retarded during calm or light wind. It is therefore not surprising that the previous maximum PM_{10} concentration recorded at Taupo was exceeded twice during June 2006.

(a)



(b)

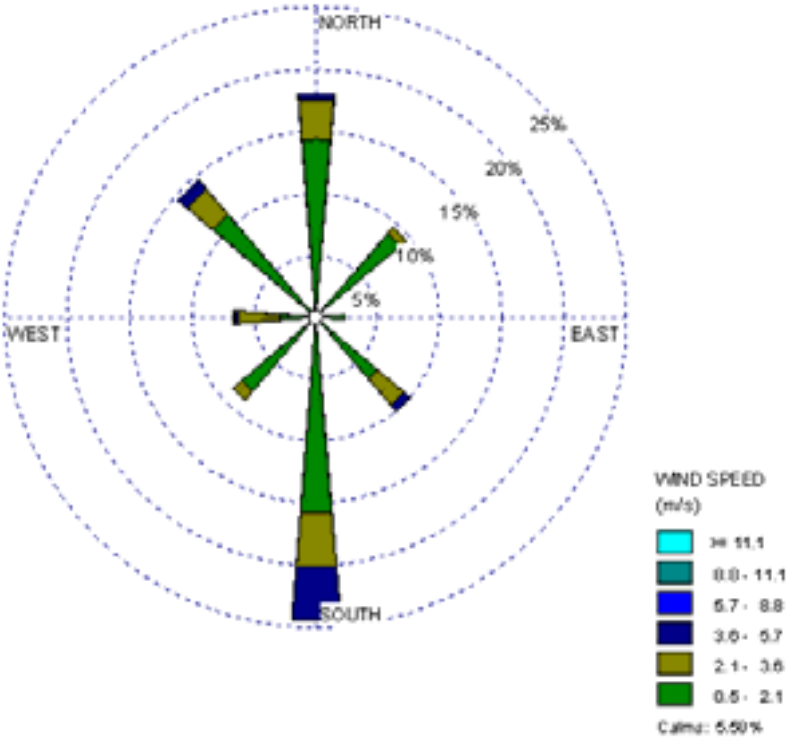


Figure 3-5: Windrose plots for Taupo Primary School during: (a) Jan-Sept 2006 and (b) June 2006

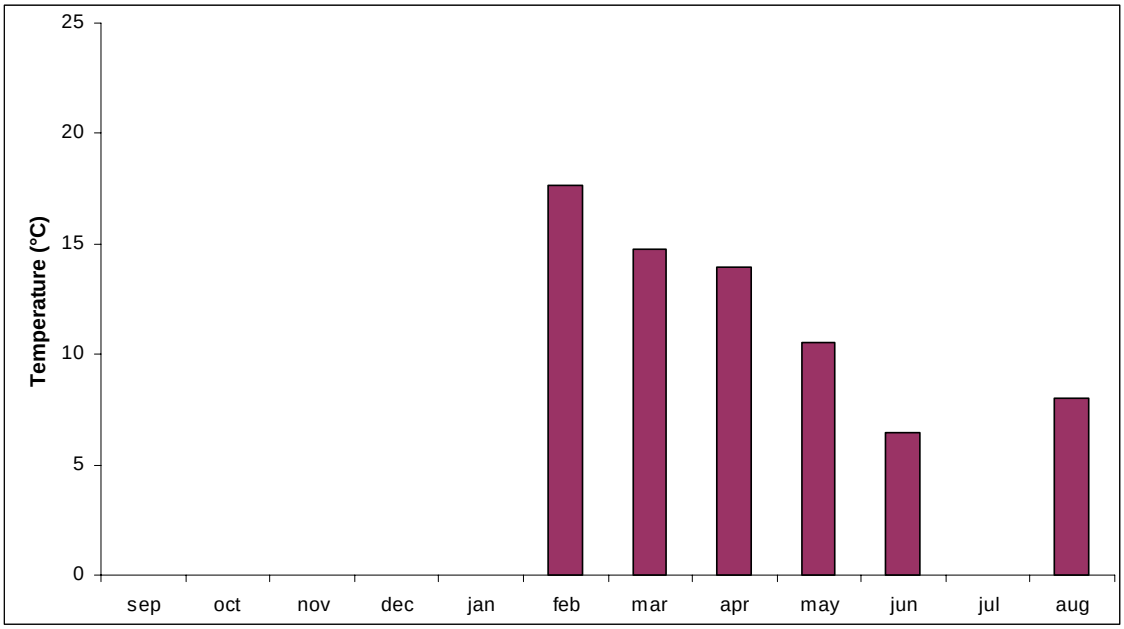


Figure 3-6: Monthly mean air temperatures Feb-Sept 2006 at Taupo Primary School.

4 Air quality monitoring in Te Kuiti

Air quality monitoring in Te Kuiti during 2006 was carried out at the Te Kuiti City Council Offices off Queen Street (Figure 4-1). This is the same site as used since 2003 and for the 1998 PM_{10} monitoring in Te Kuiti. The site is consistent with the "Residential Neighbourhood" site classification as described in *Good Practice Guide for Air Quality Monitoring and Data Management* (MfE 2000).

Concentrations of PM_{10} were measured at the site using a ThermoAndersen FH62C14 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.

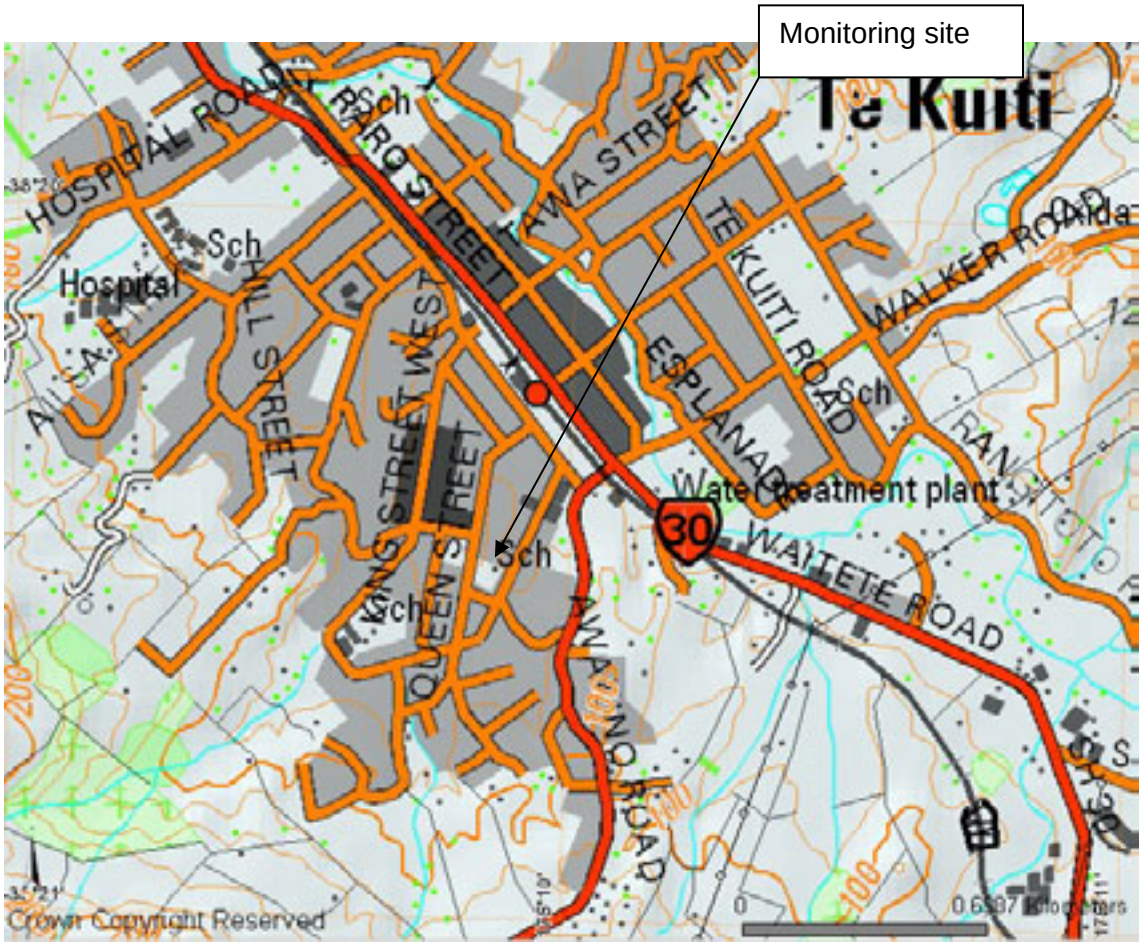


Figure 4-1: Location of the PM_{10} monitoring site at Te Kuiti

Map sourced from NZTopo*Online*, extracted August 2006, Crown Copyright Reserved

4.1 Concentrations of PM_{10}

Figure 4-2 shows that PM_{10} concentrations in excess of 50 µg m^{-3} occurred on six days during 2006. The maximum measured PM_{10} concentration was 69 µg m^{-3} (24-hour average) and occurred on 28 June 2006.

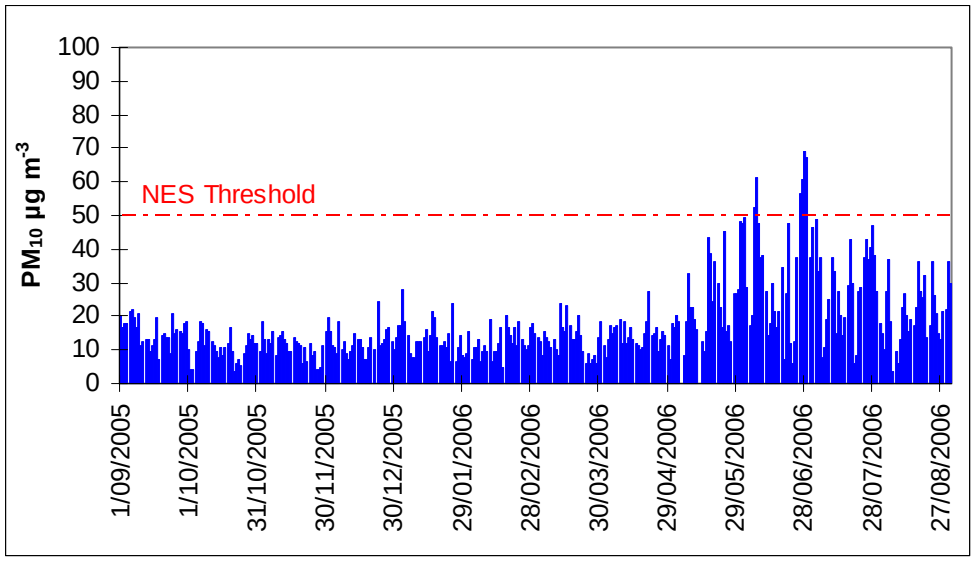


Figure 4-2: 24-hour average concentrations of PM_{10} in Te Kuiti during 2006

Seasonal variation of PM_{10} concentrations in Te Kuiti relative to the MfE air quality indicator categories are shown in Figure 4-3. As with other locations within the region, the poorest air quality occurs during the months May to August. All six exceedances of the 50 µg m^{-3} NES limit during 2006 occurred in June.

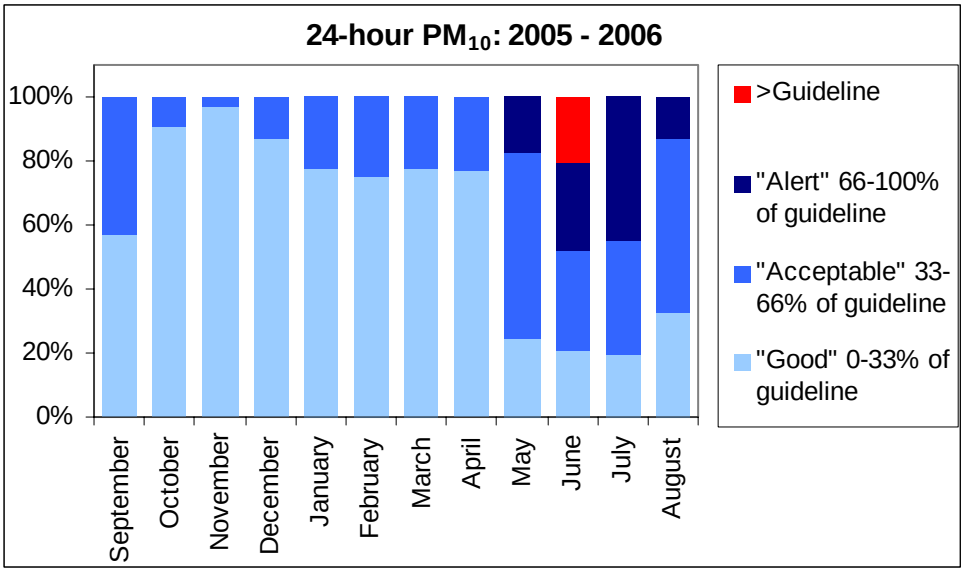


Figure 4-3: Comparison of PM_{10} concentrations measured in Te Kuiti to MfE air quality indicator categories

Figure 4-4 compares PM_{10} concentrations measured from 2003–2005. Previous monitoring of PM_{10} in Te Kuiti during 1998 is not shown because of differences in the monitoring method. However, summary statistics from 1998 as well as 2003–2005 are shown in Table 4-1. Note that the 1998 values are likely to under-represent PM_{10} concentrations relative to 2003–2005 because of the differences in the monitoring methods. The annual average PM_{10} concentration for Te Kuiti for 2005 was 17.5 µg m^{-3} (Table 4-1). This is similar to annual average PM_{10} concentrations observed during previous years at Te Kuiti and less than the MfE annual average guideline of 20 µg m^{-3} (MfE 2002).

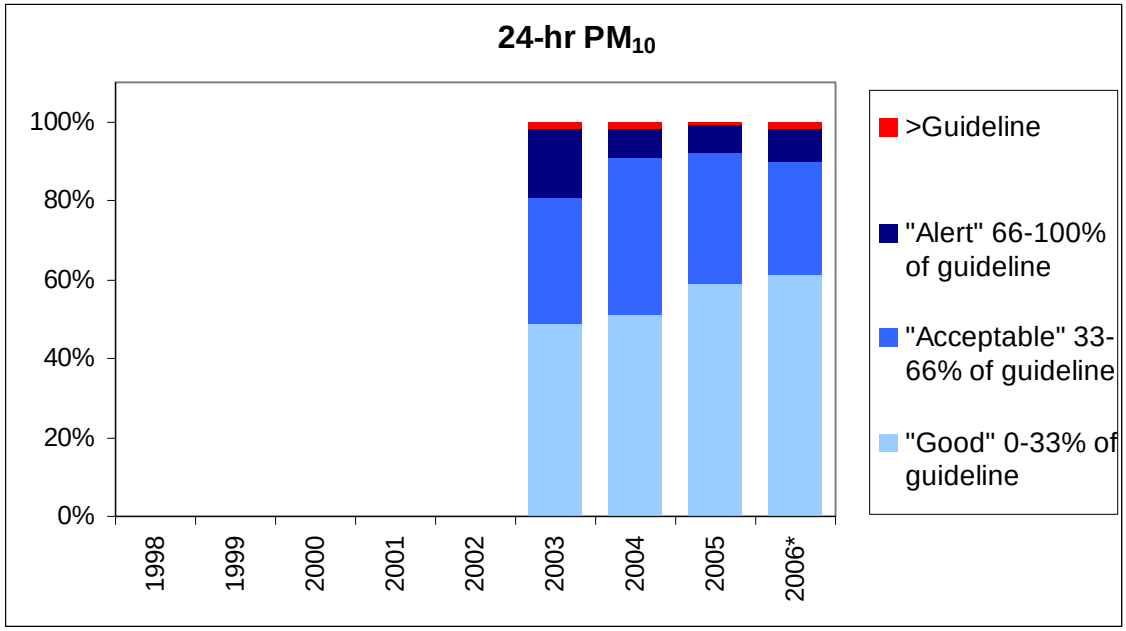


Figure 4-4: Comparison of PM_{10} concentrations measured from 2003-2006 in Te Kuiti to MfE air quality indicator categories *Note that prior to 2006, reporting periods were calendar years.

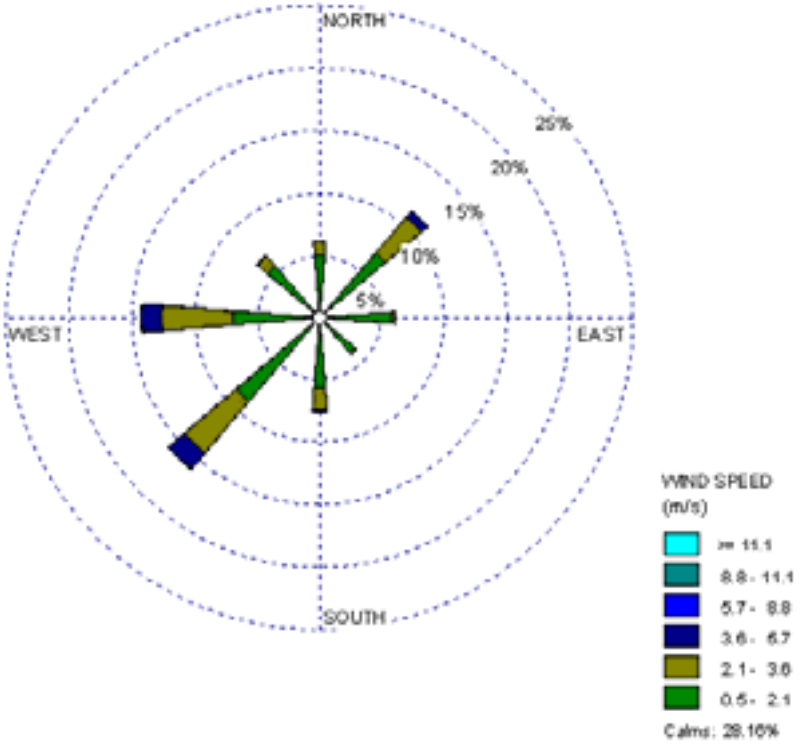
Table 4-1: Summary statistics for PM_{10} data for Te Kuiti for 1998 and 2003-2006 *Note that prior to 2006, reporting periods were calendar years.

	1998	2003	2004	2005	2006*
"Good" 0-33% of guideline	61%	48%	51%	59%	61%
"Acceptable" 33-66% of guideline	35%	32%	40%	34%	29%
"Alert" 66-100% of guideline	4%	17%	8%	7%	9%
"Action" >Guideline	0%	2%	1%	1%	2%
Percentage of valid data	53%	63%	95%	92%	99%
Annual average (µg m^{-3})	16	20.1	18.0	16.7	17.5
Guideline exceedences (extrapolated)	0	5	5	2	6
99.7 %ile concentration (µg m^{-3})	42	56	56	52	67
Annual maximum (µg m^{-3})	42	59	61	54	69

4.2 Meteorology

In general, wind at Te Kuiti is mostly from the west or southwest direction (Figure 4-5a). However, in 2006 there was a slightly lower frequency of wind from the southwest quarter and a subtle increase in wind from the south (Figure 4-5b). In June 2006 there was a higher frequency of calms and light wind from the south (Figure 4-6b), compared to June in previous years when stronger winds from the southwest were more common (Figure 4-6a).

(a)



(b)

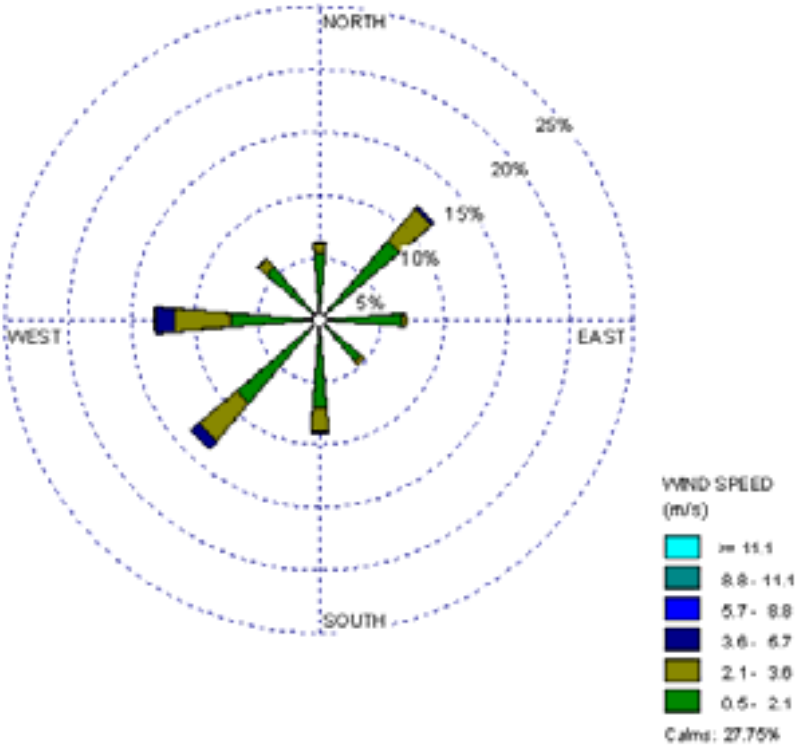
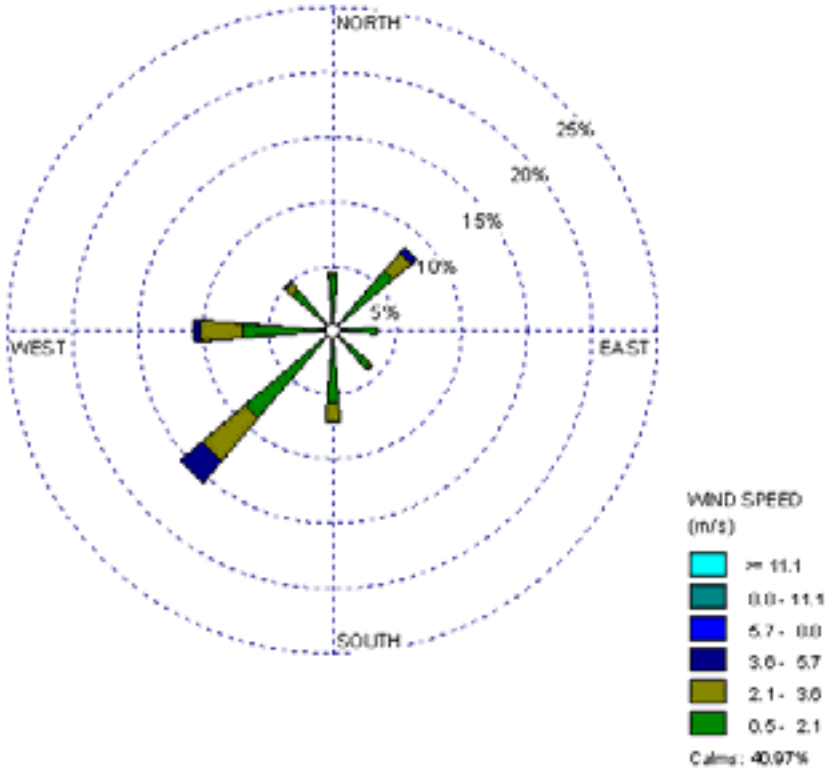


Figure 4-5: Windrose plots for Te Kuiti during: (a) 2003-2005 and (b) 2006

(a)



(b)

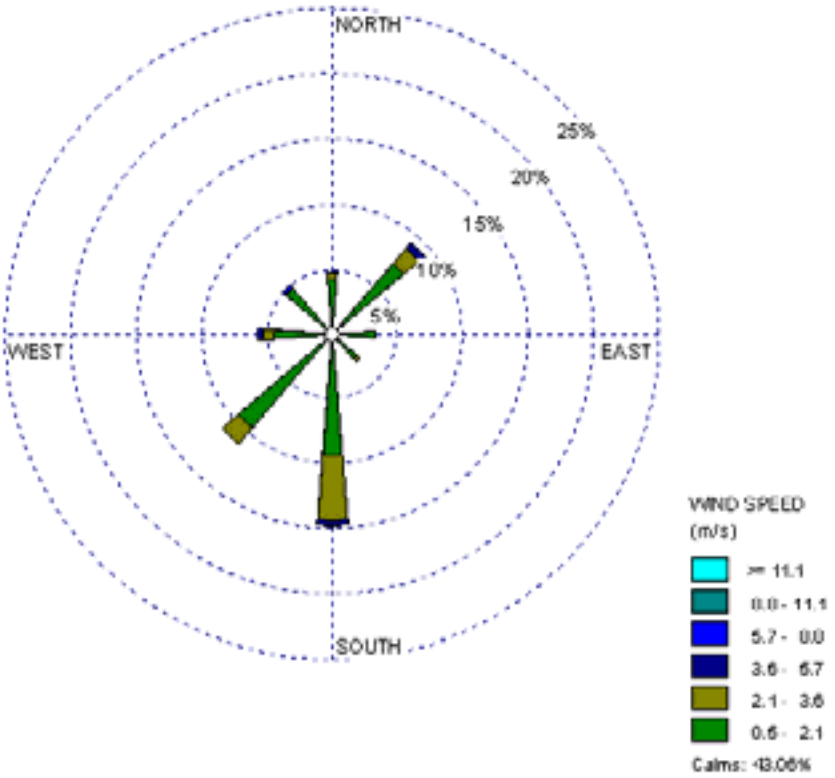


Figure 4-6: Windrose plots of June data for Te Kuiti during: (a) 2003-2005 and (b) 2006

The mean air temperature at Te Kuiti during June 2006 was 6.6°C (Figure 4-7). NIWA (2006) noted that large temperature anomalies, more than 2°C below average, occurred in the Waikato region during June 2006 and reported that "it was particularly cold and frosty at night". This is consistent with the data in Figure 4-7 that shows the mean air temperature during June 2006 was more than 30 per cent cooler than the mean June temperature for previous years.

As for Hamilton and Taupo, cold, frosty and calm periods, such as those during June 2006, would have generated conditions that produce elevated air pollution. Under these conditions, emissions from domestic fires are frequently elevated because of increased fuel use during cold weather and dispersion of contaminants is retarded during calm or light wind. It is therefore not surprising that the highest ever 24-hour PM_{10} concentrations and greatest number of exceedances at Te Kuiti occurred during June 2006.

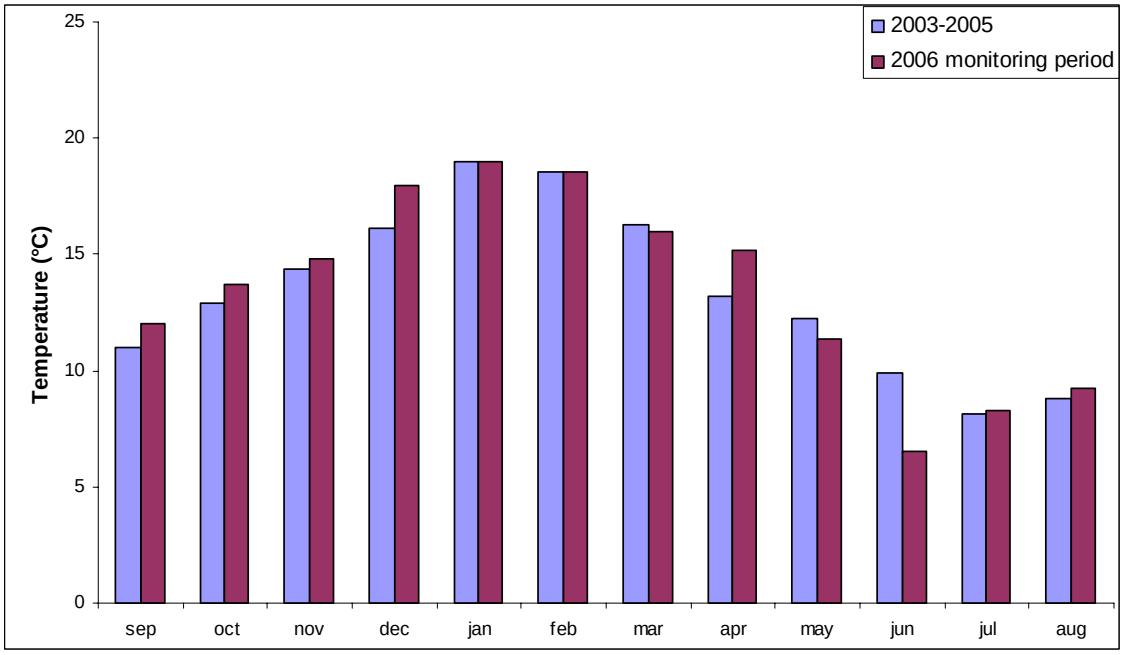


Figure 4-7: Monthly mean air temperatures for 2006 monitoring period (Sept 2005-Sept 2006) and ensemble monthly mean temperatures for the years 2003-2005 at Te Kuiti.

5 Air quality monitoring in Matamata

Air quality monitoring in Matamata commenced in June 2005 at the Matamata playcentre grounds on Farmers Road (Figure 5-1). The Farmers Road site is consistent with 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 PM_{10} concentrations at Matamata playcentre is a ThermoAndersen FH62C14 BAM. Meteorological data are also collected, including windspeed and direction at 6 m height, ambient air temperature and relative humidity. PM_{10} data are continuously measured by the FH62 BAM and logged at ten minute intervals. The site was installed by Watercare Services Ltd and is operated and maintained by Environment Waikato staff.

Figure 5-1: Location of Matamata playcentre monitoring site

Map sourced from NZTopo*Online*, extracted August 2006, Crown Copyright Reserved

Concentrations of PM_{10}

During 2006, there were no observations of PM_{10} concentrations in excess of 50 µg m^{-3} (Figure 5-2). The maximum measured PM_{10} concentration was 34 µg m^{-3} (24-hour average) and occurred on 7 June 2006.

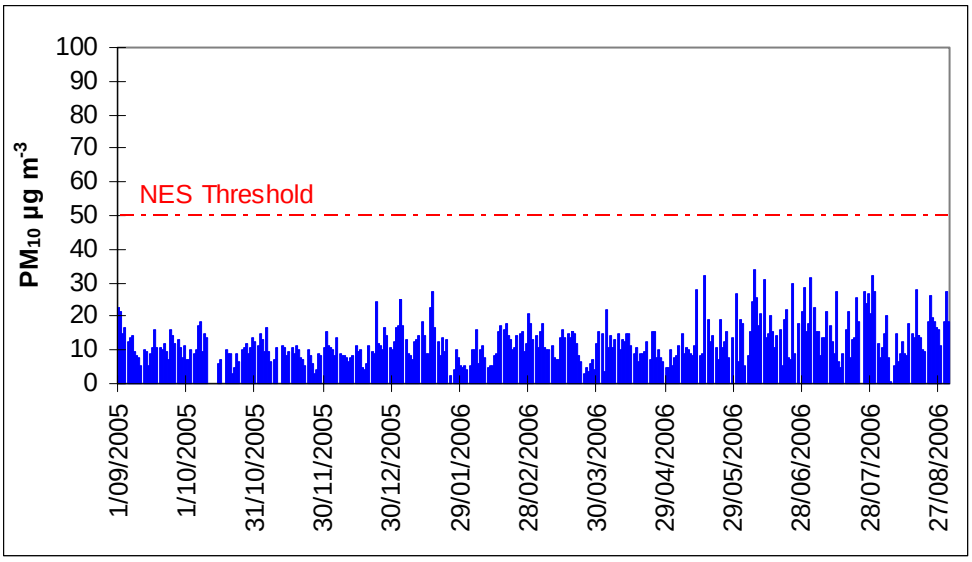


Figure 5-2: 24-hour average concentrations of PM_{10} in Matamata during 2006

The annual average PM_{10} concentration for Matamata for 2006 was 12.4 µg m^{-3}. This is less than the MfE annual average guideline of 20 µg m^{-3} (MfE 2002). Seasonal variation of PM_{10} concentrations in Matamata relative to the MfE air quality indicator categories are shown in Figure 5-3. As with other locations within the region, the poorest air quality occurs during winter although, with the exception of June, "Alert" levels were not reached during 2006.

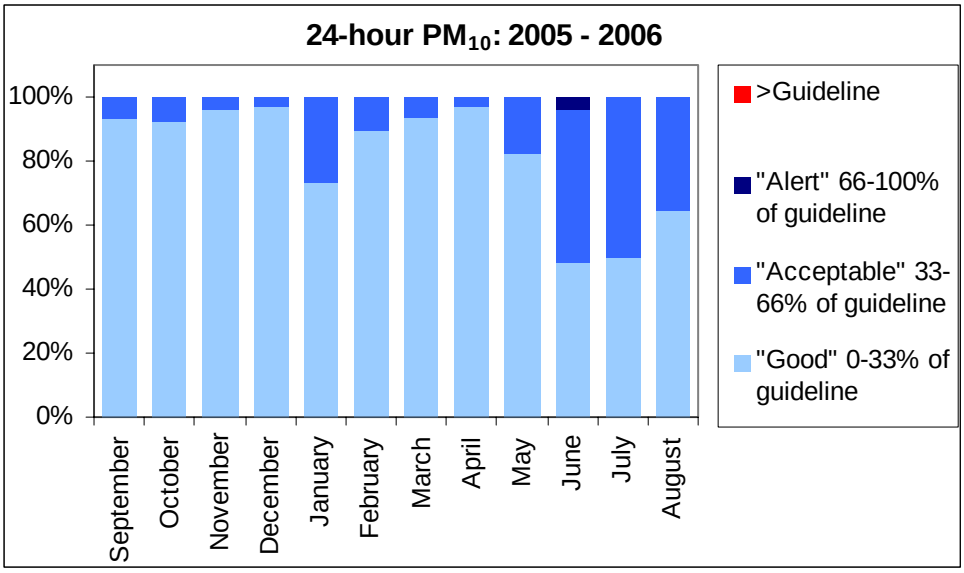


Figure 5-3: Comparison of PM_{10} concentrations measured in Matamata to MfE air quality indicator categories

Because the Matamata monitoring station has been operating for little more than 12 months, an interannual comparison is not possible. Summary statistics for 2006 are shown in Table 5-1.

Table 5-1: Summary statistics for Matamata PM_{10} data during the 2006 monitoring year (September 2005 – September 2006)

	PM_{10} 2006
"Good" 0-33% of guideline	81%
"Acceptable" 33-66% of guideline	18%
"Alert" 66-100% of guideline	0%
"Action" >Guideline	0%
Percentage of valid data	97%
Annual average (µg m^{-3})	12.4
Guideline exceedences (extrapolated)	0
99.7 %ile concentration (µg m^{-3})	32
Annual maximum (µg m^{-3})	34

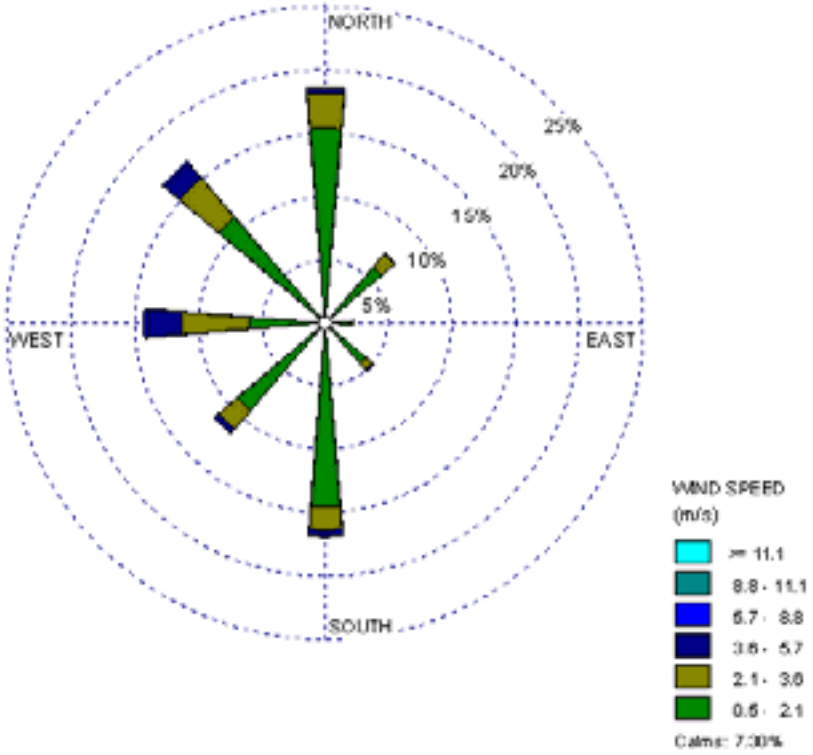
5.1 Meteorology

Windroses and ambient air temperature data are presented in Figure 5-4 and Figure 5-5 respectively.

The wind rose for 2006 (Figure 5-4a) shows that winds from the east were very rare, whereas light winds from the north or south were common throughout the year. Strongest winds were most common from the west and northwest. During June, the dominant wind direction was southerly and this is consistent with the June wind profile for Hamilton during June 2006 (Figure 2-6b).

The lowest monthly mean air temperature at Matamata during 2006 was 6.6°C for the month of June (Figure 5-5).

(a)



(b)

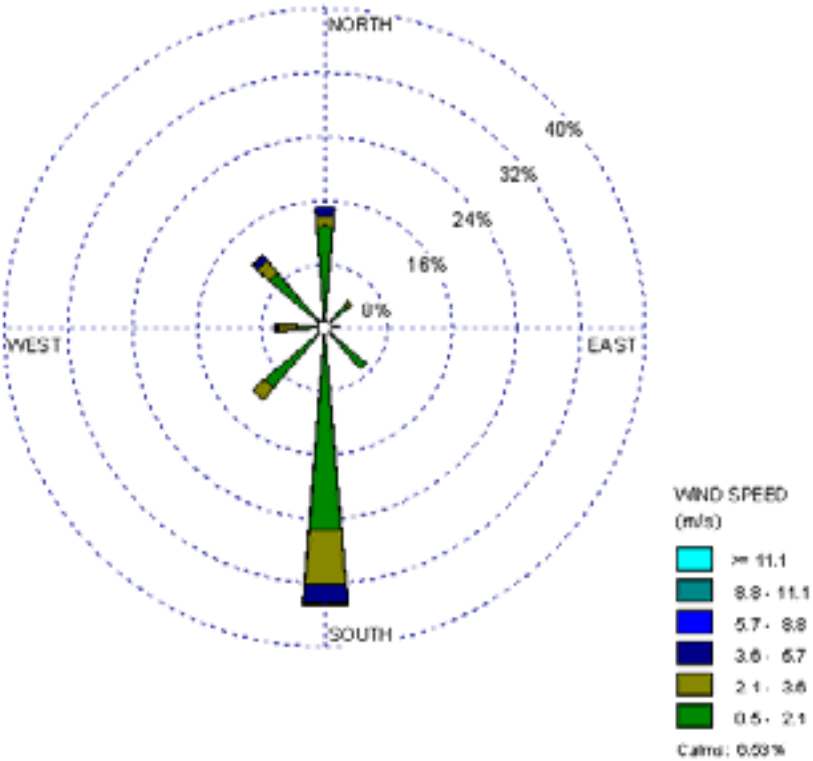


Figure 5-4: Windrose plot for data collected at Matamata during (a) Sept 2005-Sept 2006 and (b) June 2006

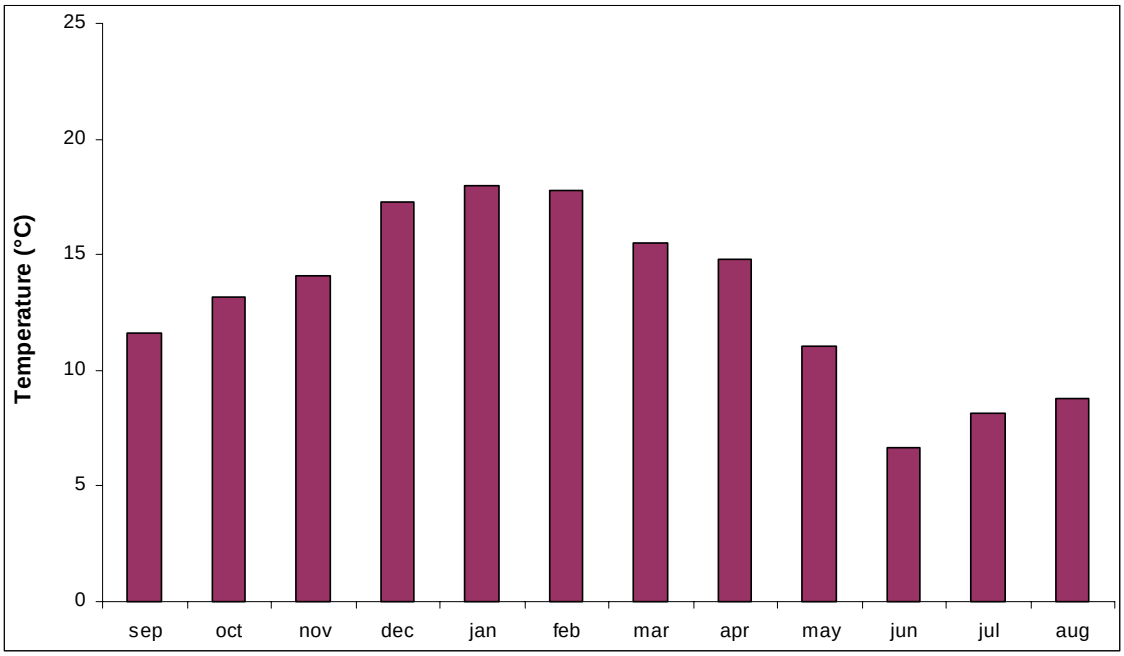


Figure 5-5: Monthly mean air temperatures for 2006 monitoring period (Sept 2005-Sept 2006) at Matamata.

6 Air quality monitoring in Tokoroa

Air quality monitoring for PM_{10} has been carried out in Tokoroa since 2001 at the Billah Street Reserve air quality monitoring site (Figure 6-1). This site is located in central Tokoroa to the west and was established in 2001. 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 is consistent with the "Residential Neighbourhood" site classification as described in *Good Practice Guideline for Air Quality Monitoring and Data Management* (MfE 2000).

Figure 6-1: Location of PM_{10} monitoring site at Billah Street, Tokoroa

Map sourced from NZTopo*Online*, extracted August 2006, Crown Copyright Reserved

From 2001 to September 2005, the monitoring method used to measure PM_{10} concentrations at Billah Street was a MET ONE series 1020 Beta Attenuation Monitor (BAM). From September 2005 the monitoring method was a ThermoAndersen FH62C14 BAM. The MET ONE instrument was replaced because of unacceptable data loss caused by frequent tape failure. Until August 2005, the site was operated and maintained by NIWA for Environment Waikato. Operation of the Waikato air quality network is now managed by Environment Waikato staff. PM_{10} data are collected by the FH62 BAM at ten minute intervals.

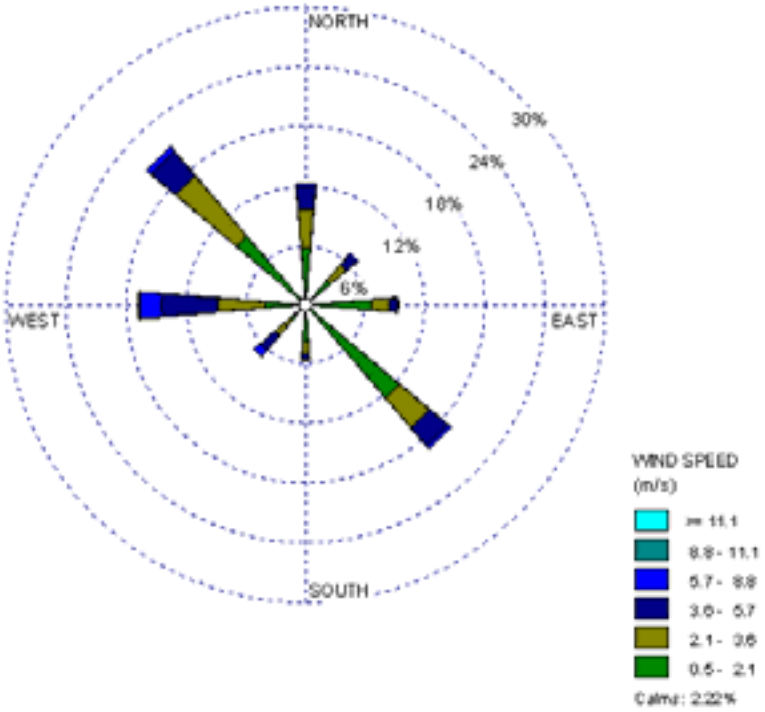
6.1 Meteorology

Meteorological data including air temperature, wind speed and direction were collected at the air quality monitoring site in Tokoroa.

Figure 6-2 shows that wind conditions during 2006 (Figure 6-2b) were similar to previous years (Figure 6-2a), with slightly higher frequency of northwest and southeast winds and less frequent westerly winds during 2006. Like other urban areas in the Waikato, June 2006 was characterised by a higher frequency of calm and light winds (Figure 6-3b) than for June in previous years (Figure 6-3a) at Tokoroa. Winds from the westerly quarter were less frequent in June 2006 than in previous years, while southerly winds and light south-easterlies were common. Generally, calm and light winds were more common during winter (June-August) of 2006 (Figure 6-4b) than in previous winters (Figure 6-4a).

As noted previously, NIWA (2006) reported that June 2006 was “particularly cold and frosty at night”. This assessment is consistent with the data in Figure 6-5 that shows the mean air temperature of 5.7°C at Tokoroa during June 2006 was 40 per cent cooler than the mean June temperature for previous years. The monthly mean air temperature for June 2006 was also lower than normal at other Waikato air quality monitoring sites.

(a)



(b)

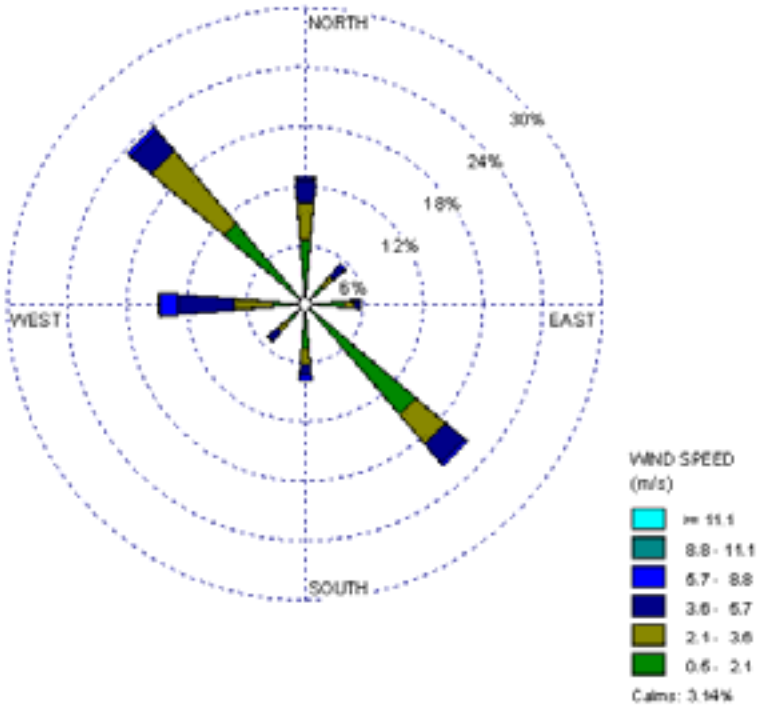
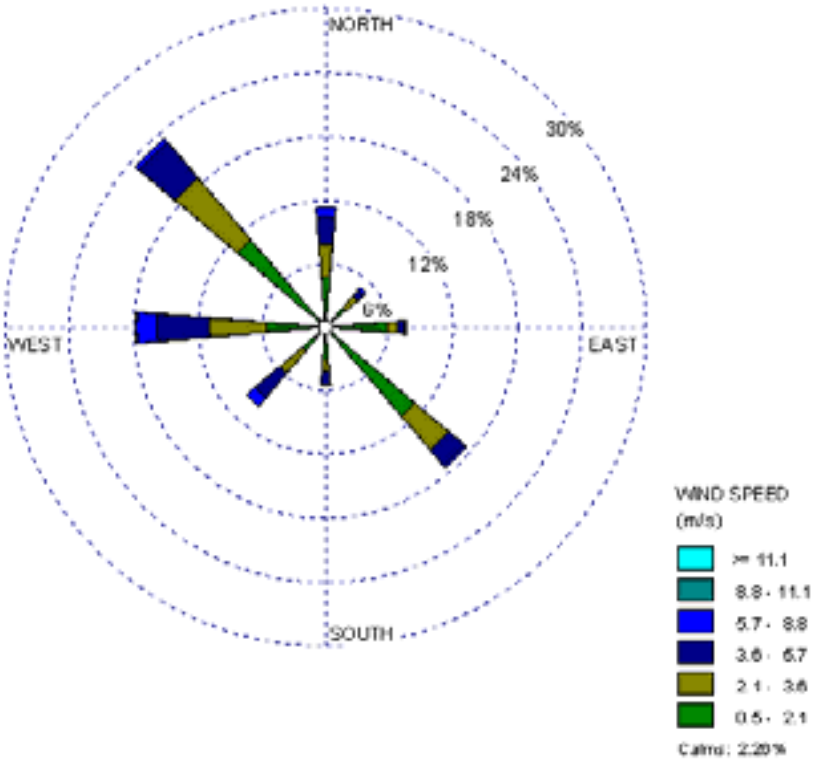


Figure 6-2: Windrose plots for Tokoroa during: (a) 2001-2005 and (b) 2006

(a)



(b)

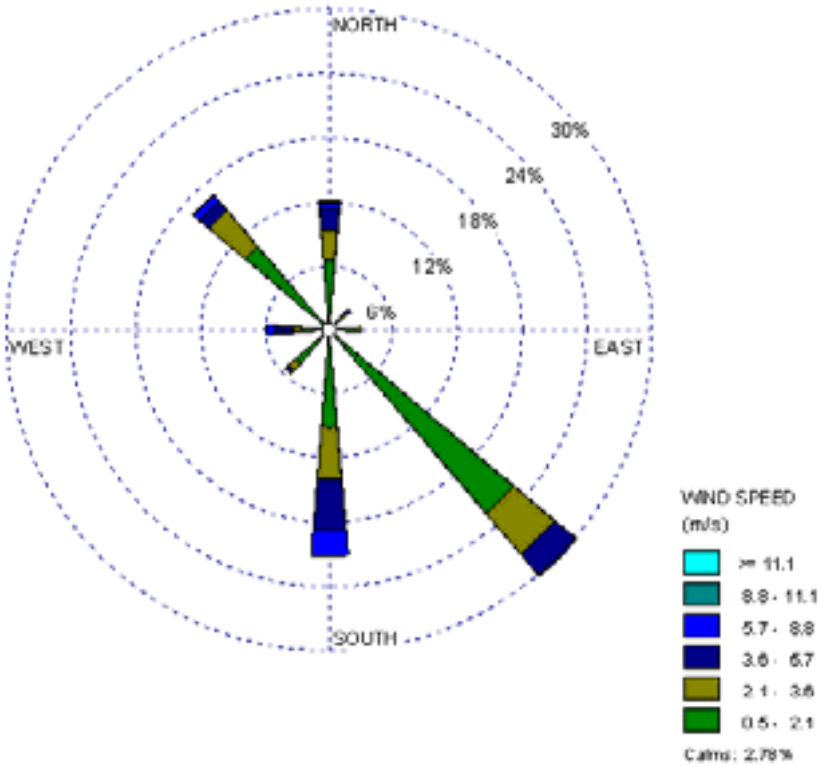
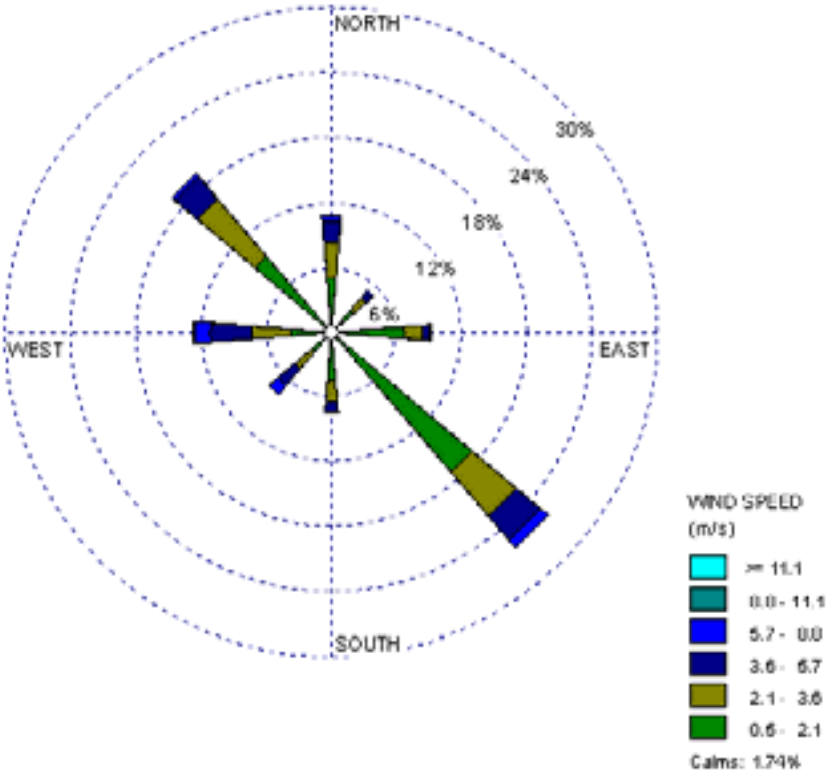


Figure 6-3: Windrose plots of June data from Tokoroa during: (a) 2001-2005; and (b) 2006

(a)



(b)

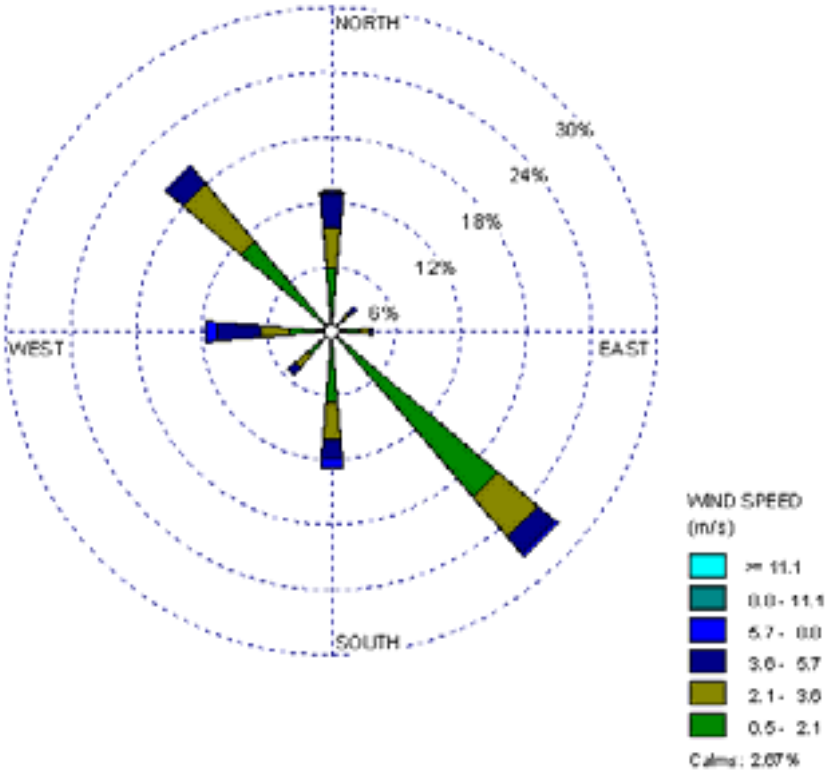


Figure 6-4: Windrose plots of winter (June-August) data from Tokoroa during: (a) 2001-2005; and (b) 2006

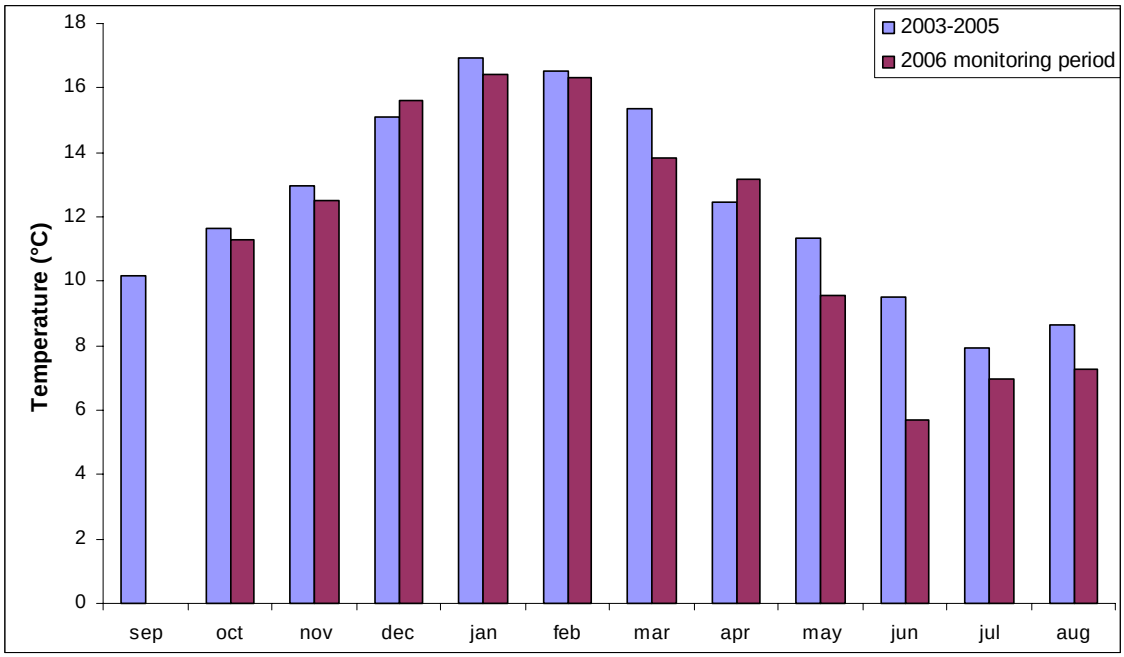


Figure 6-5: Monthly mean air temperatures for 2006 monitoring period (Sept 2005-Sept 2006) and ensemble monthly mean temperatures for the years 2003-2005 at Tokoroa.

6.2 Concentrations of PM_{10}

Concentrations of PM_{10} during 2006 exceeded the ambient air quality guideline of 50 µg m^{-3} (24-hour average) on nine occasions and the exceedances occurred between May and July 2006 (Figure 6-6). The maximum PM_{10} concentration measured in Tokoroa during 2006 was 62 µg m^{-3} and was recorded on 7 June.

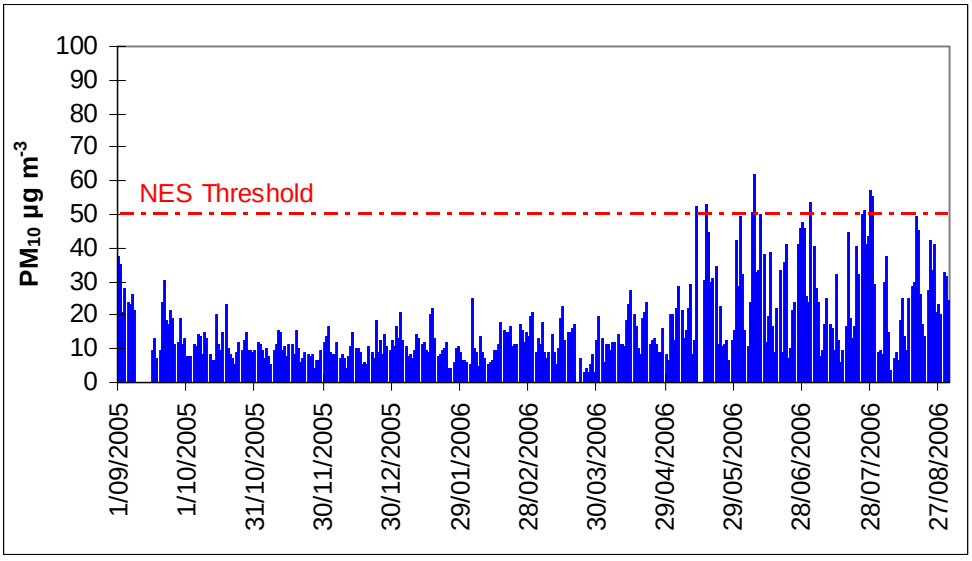


Figure 6-6: 24-hour average concentrations of PM_{10} in Tokoroa during 2006

Figure 6-7 compares PM_{10} concentrations measured in Tokoroa during 2006 to MfE air quality indicator categories for each month of the year. While the highest concentration was recorded during June, the PM_{10} events were most frequent in the month of July 2006.

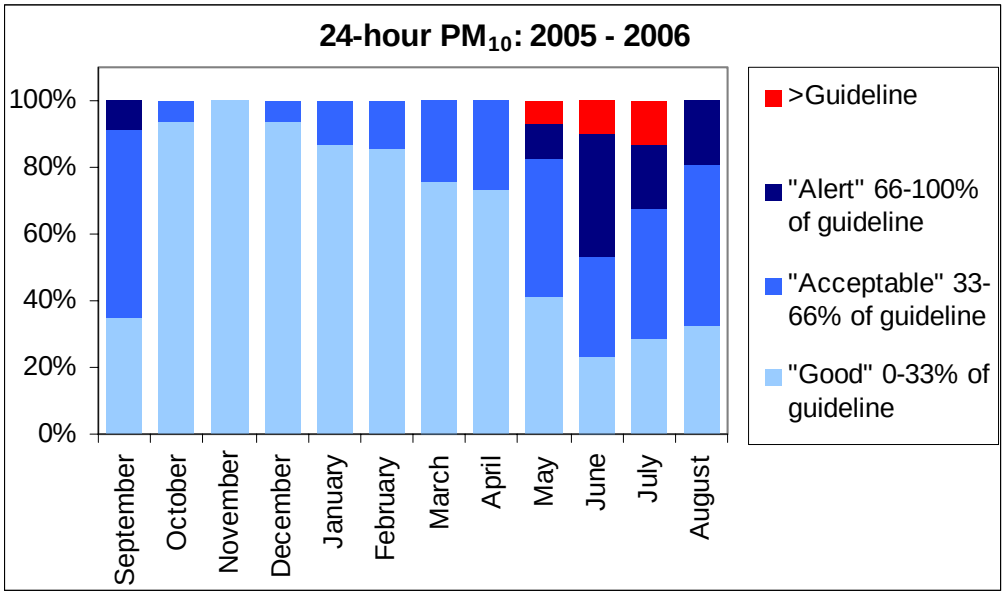


Figure 6-7: Comparison of PM_{10} concentrations measured in Tokoroa to MfE air quality indicator categories

Table 6-1 and Figure 6-8 compare PM_{10} concentrations measured during 2006 at Tokoroa to historic data. Prior to December 2003, much of the data for that calendar year are either absent or may be suspect[1], so comparison with data for 2003 is not undertaken.

For other years, reported PM_{10} concentrations at Tokoroa have consistently exceeded the annual average guideline for PM_{10} of 20 µg m^{-3} (MfE 2002) between 2001 and 2005. However, in 2006 the annual average concentration of 17 µg m^{-3} was below the annual guideline for the first time since monitoring commenced in Tokoroa. This is surprising because cooler temperatures (Figure 6-5) and calm or light winds (Figure 6-4) were more common in winter 2006 than in previous years. These conditions are conducive to elevated air pollution and higher PM_{10} concentrations would therefore have been expected in 2006 than previous years.

Table 6-1: Summary statistics for PM_{10} data for Tokoroa from 2001 to 2005
*Note that 2003 data are unavailable (see EWdoc#991860) and while 2004-2005 data are included here, these data should be regarded as suspect (see Section 6.3). †Also note, prior to 2006, reporting periods were calendar years.

	2001	2002	2003*	2004*	2005*	2006†
"Good" 0-33% of guideline	12%	15%	n/a	12%	32%	65%
"Acceptable" 33-66% of guideline	64%	71%	n/a	54%	46%	25%
"Alert" 66-100% of guideline	17%	10%	n/a	23%	13%	8%
“Action” >Guideline	8%	4%	n/a	12%	9%	3%
Percentage of valid data	47%	98%	n/a	96%	88%	97%
Annual average (µg m^{-3})	26.6	24.0	n/a	30.7	24.5	16.7
Guideline exceedences (extrapolated)	24	15	n/a	41	33	9
99.7 %ile concentration (µg m^{-3})	67	65	n/a	92	83	57
Annual maximum (µg m^{-3})	75	70	n/a	97	89	62

[1] see EWdoc#991860

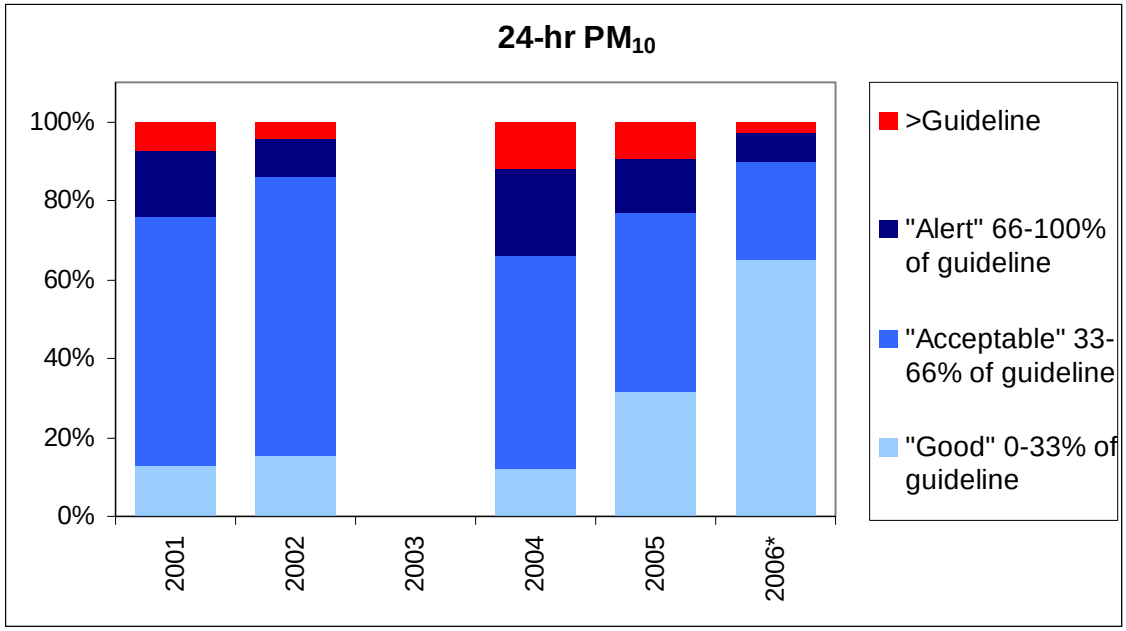


Figure 6-8: Comparison of PM_{10} concentrations measured in Tokoroa from 2001 to 2006 to MfE air quality indicator categories. *Note that prior to 2006, reporting periods were calendar years.

Because 2003 PM_{10} data are not reportable and only 47% of 24-hour averages for 2001 are valid (Table 6-1), data from these years are excluded from interannual comparisons. However, data for 2004 and 2005 may also be spurious and require exclusion from comparative analysis.

Wilton (2005b) noted an increase in baseline Tokoroa PM_{10} data after December 2003 and suggested the following reasons could possibly have been responsible for the anomaly:

i) increased emissions,
ii) variations in meteorological conditions, or
iii) instrumentation error.

Based on emission inventory data, Wilton (2005b, 2005c) discounted variation of PM_{10} emissions as a cause of higher concentrations in 2004-2005.

The 2006 monitoring data suggest that meteorological variations are also unlikely to have caused higher PM_{10} concentrations in 2004-2005. Whereas the number of exceedances and PM_{10} concentrations were lower in 2006 than previous years, meteorological conditions during 2006 were more likely to produce higher concentrations than in the previous two years.

Compared with previous years, higher PM_{10} concentrations were observed in 2006 at other Waikato monitoring sites where multi-year records are available. In Hamilton, Te Kuiti and Taupo, cool and calm conditions during 2006 were associated with higher PM_{10} concentrations and greater number of exceedances than during previous years, however the opposite was the case in Tokoroa.

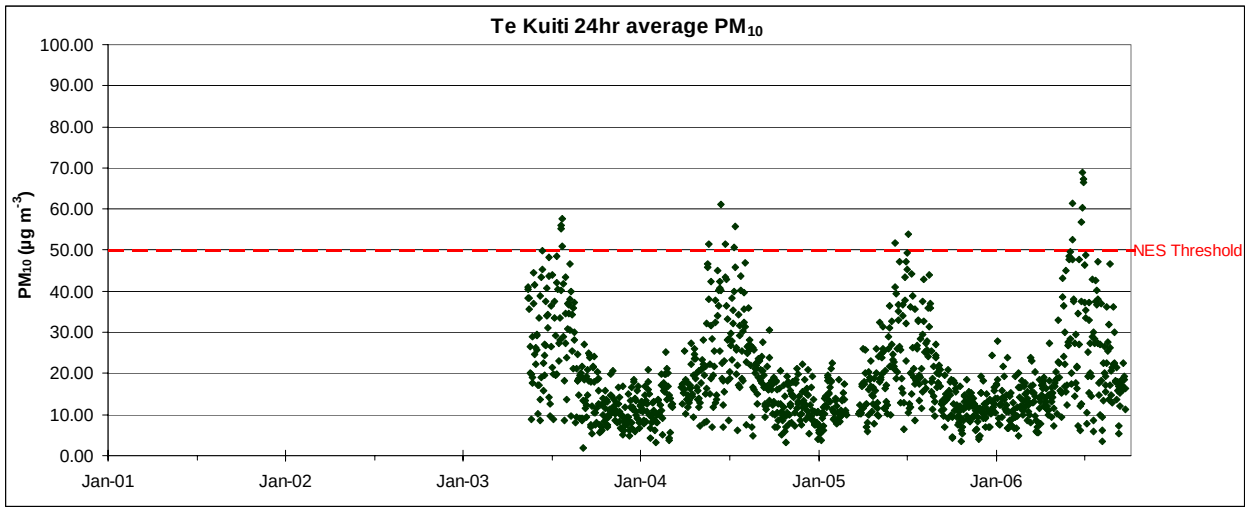
It is therefore more likely that instrumentation error was responsible for augmenting PM_{10} data at Tokoroa in 2004-2005. Upgrade of the Tokoroa BAM in September 2005 has probably resolved this issue and resulted in subsequently lower PM_{10} concentrations.

6.3 Anomalies in the Tokoroa data

6.3.1 Elevated baseline

With baseline 24 hour PM_{10} concentrations of around 10 µg m^{-3} and a handful of exceedances no greater than 70 µg m^{-3} during winter, the 2006 Tokoroa data in Figure 6-9a closely resemble data from Te Kuiti (Figure 6-9b). However, prior to replacement of the BAM in September 2005, the Tokoroa baseline and peak data are much higher than those at Te Kuiti. There is a sudden and obvious attenuation of data in September 2005 that coincides with the BAM replacement.

(a)



(b)

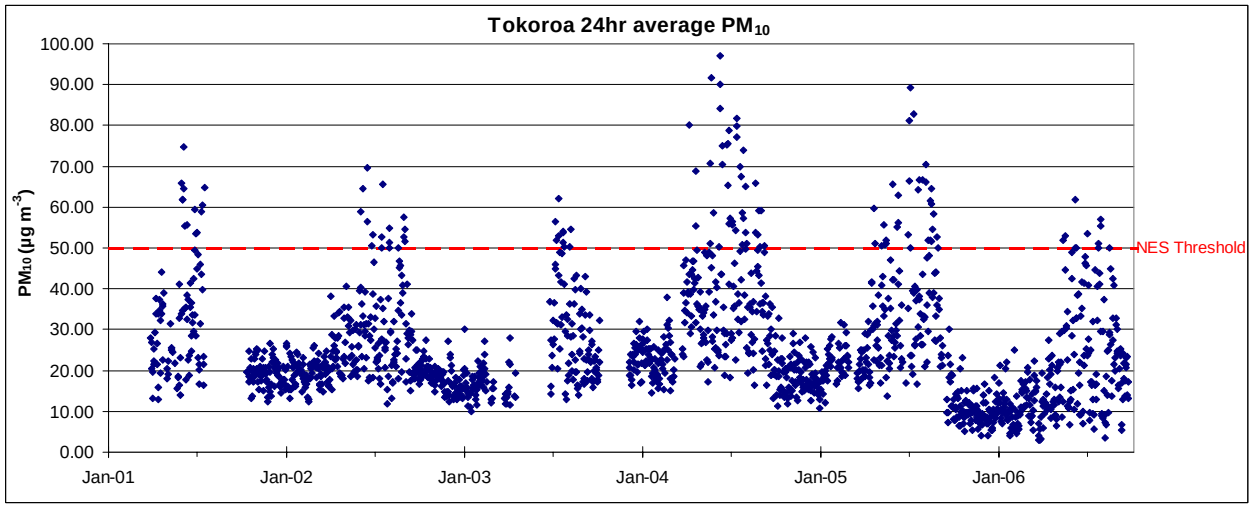


Figure 6-9: 24 hour average PM_{10} concentrations measured in (a) Te Kuiti and (b) Tokoroa from 2001 to 2006

To illustrate in a general sense, ratios of 24 hour PM_{10} concentrations at Tokoroa and Te Kuiti were calculated and averaged over six monthly periods September-February and March-August (Figure 6-10). The mean ratios during the 12 months to September 2006 are around one, which demonstrates that air quality in Tokoroa is generally very similar to that at Te Kuiti. Consequently, data from Te Kuiti may reasonably be used as a benchmark for quality assurance of Tokoroa data.

Before September 2005, the mean ratios show that Tokoroa data were generally 75-100 per cent higher than those from Te Kuiti and this confirms Wilton's (2005b) opinion that data collected by the Met-One BAM after December 2003 are suspect.

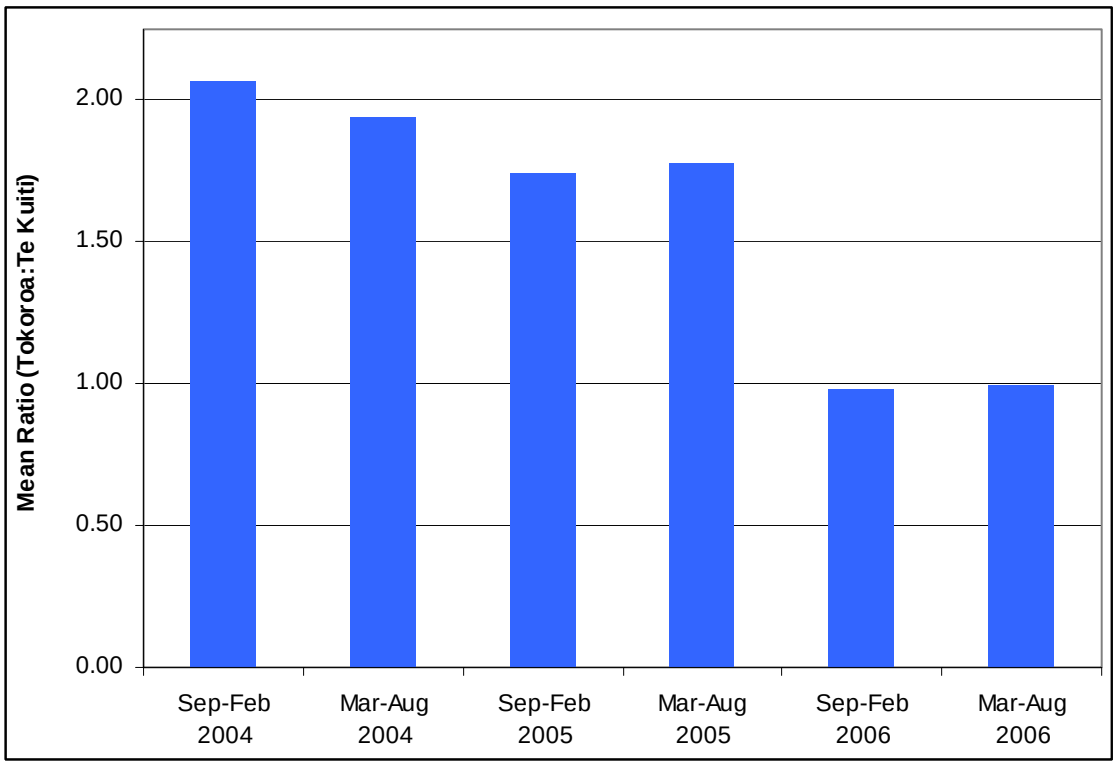


Figure 6-10: Ratios of Tokoroa:Te Kuiti 24-hour PM_{10} concentrations averaged over six month periods March-August and September-February.

One further possible explanation for the reduction of PM_{10} data in 2006 might be a reduction of emissions if Tokoroa residents have become more aware of air quality issues and are operating their heating appliances more effectively. However, the immediate decline of baseline data in September 2006 is coincident with the BAM replacement. Such a rapid decline of concentrations is very unlikely to have been effected by education or other modification to human behaviour in the town. The impact of human behaviour via operation of home heating appliances is also more likely to be seen in the winter data, not in September when use of domestic appliances and fuel use naturally declines due to warmer seasonal temperatures. The most plausible hypothesis is that the augmented data prior to September 2005 are a consequence of instrumentation issues.

Metadata supplied by NIWA instruments disclose that full annual servicing of the older MET ONE instrument was completed in March 2004 and March 2005, and the specification of this servicing included instrument calibration. There is no record of any changes to the instrument or datalogger settings in the metadata supplied by NIWA, so there is no explicit evidence of a problem with this instrument that may have caused variations in recorded concentrations. During installation, the FH62 BAM was calibrated by Environment Waikato staff under the supervision of experienced contractors (Watercare Services). Regular calibrations of the ThermoAndersen BAM are ongoing, to ensure continued validity of the FH62 data.

Because both instruments have been calibrated, legitimate adjustments to the historic MET-ONE data are not justifiable, even though the analysis here demonstrates that the data from this instrument are anomalously high. Instead, the Tokoroa PM_{10} data from December 2003 to September 2005 should be regarded as suspect and avoided in analyses and development of management strategies. At the very least, extreme caution should be used with these data.

6.3.2 Water treatment activities

During routine checking of data for quality assurance, semi-regular spikes were noticed in the dataset. The spikes usually occur on Tuesday and Friday mornings and examples are plotted in Figure 6-11. The source of these spikes has been identified as dust emissions from mixing of lime to treat the town water supply at the site (Figure 6-12).

Figure 6-13 shows that a liming spike occurred between 0900hr and 1000hr on 6 June 2006. The 24 hour PM_{10} concentration on this day was 50.12 µg m^{-3} and has been reported as an exceedance. If the liming spike is removed from the data and gap-filled by interpolating between data points, the 24 hour average concentration would be 44.2 µg m^{-3}. It is therefore reasonable to assume that without the impact of the liming activity, a PM_{10} exceedance would not have been observed on 6 June 2006.

A total of nine exceedances at Tokoroa are recorded in Table 6-1 for 2006. Other than 6 June 2006, there are no other days where a reported exceedance might have been avoided if the liming impact was prevented. Therefore, it may be assumed that without the liming activity, eight exceedances would have been recorded at Tokoroa during 2006.

It should be noted that the impact of the liming activity is likely to be localised around the air monitoring intake. Compared with PM_{10} concentrations measured at the water treatment site during liming events, atmospheric dispersion would result in much lower PM_{10} concentrations beyond the boundary.

Following discussions with South Waikato District Council, it has been advised that nothing feasible may be done to eliminate or mitigate the dust emissions from the liming activity. Instead, records of date and time of liming activity are provided to Environment Waikato for analysis of the impact of the liming emissions on the PM_{10} concentrations. Future reports will therefore follow the approach used here, with PM_{10} data reported as normal and a note made of the impact of liming activity on the number of exceedances.

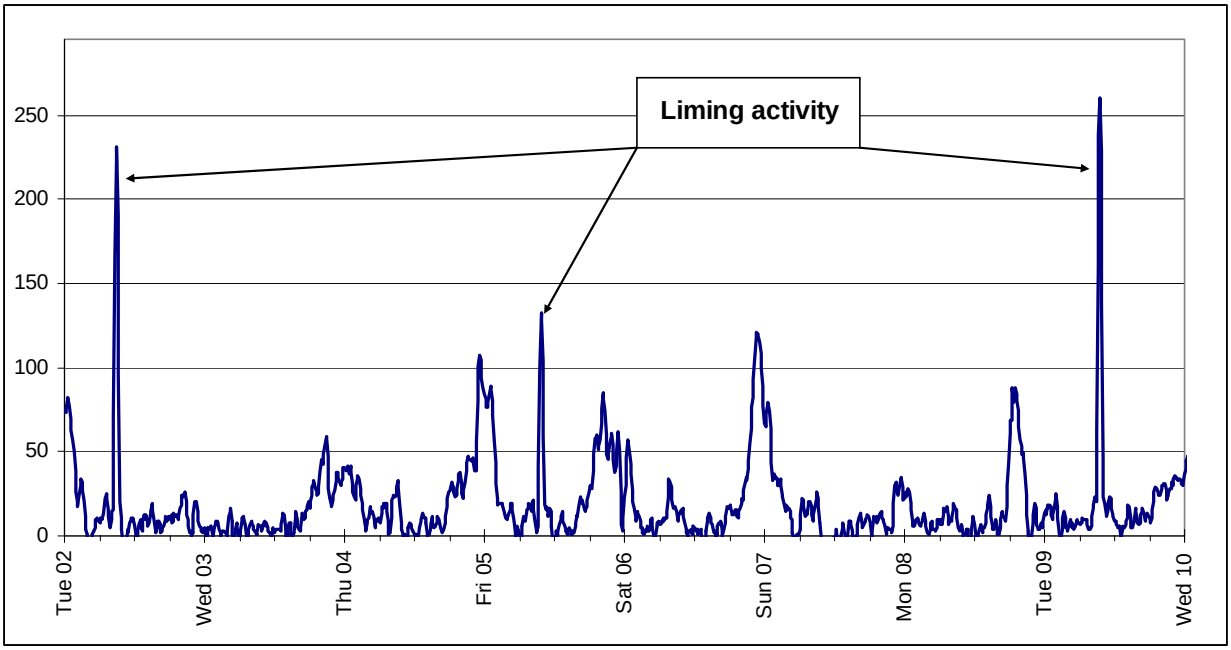


Figure 6-11: PM_{10} data collected at 10 minute intervals in Tokoroa between 2 May 2006 and 10 May 2006, showing spikes when liming occurred as part of water treatment near the sample tube intake.

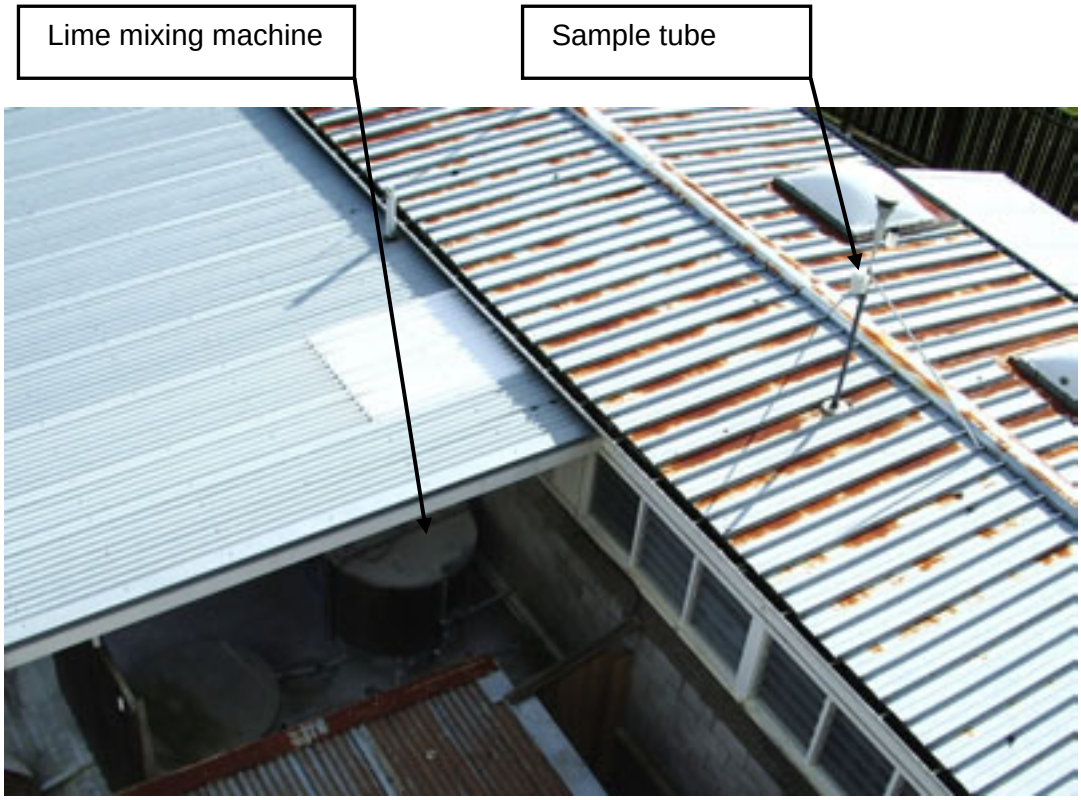
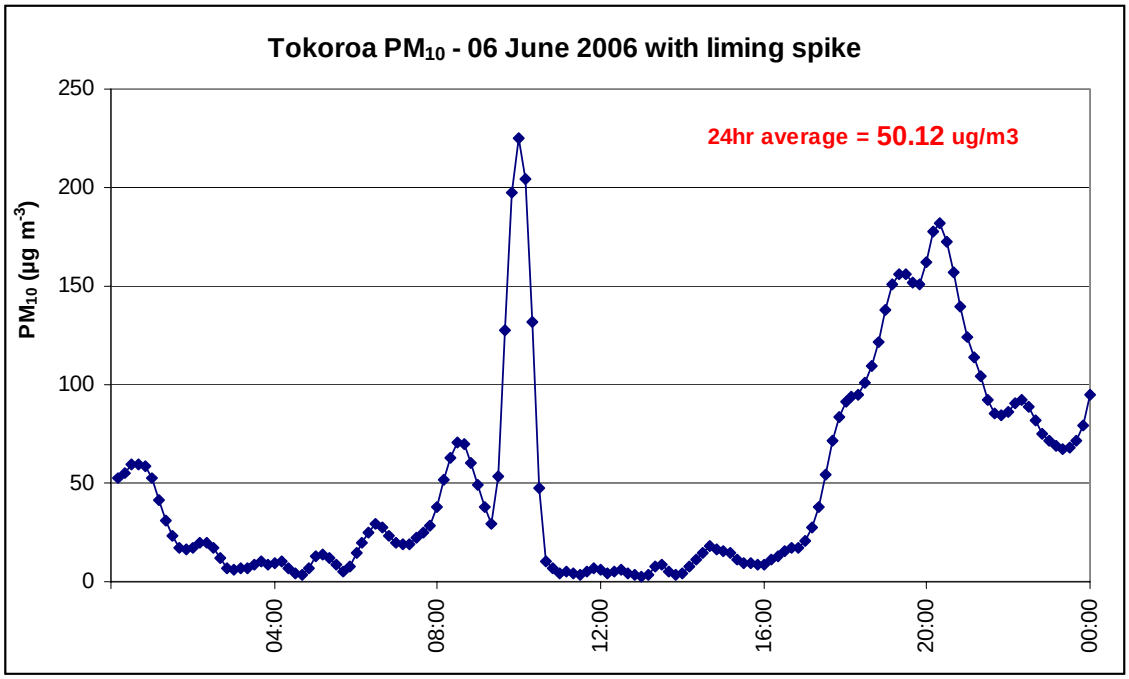


Figure 6-12: Tokoroa air quality sample tube intake and shed where mixing of chemicals for water treatment occurs.

(a)



(b)

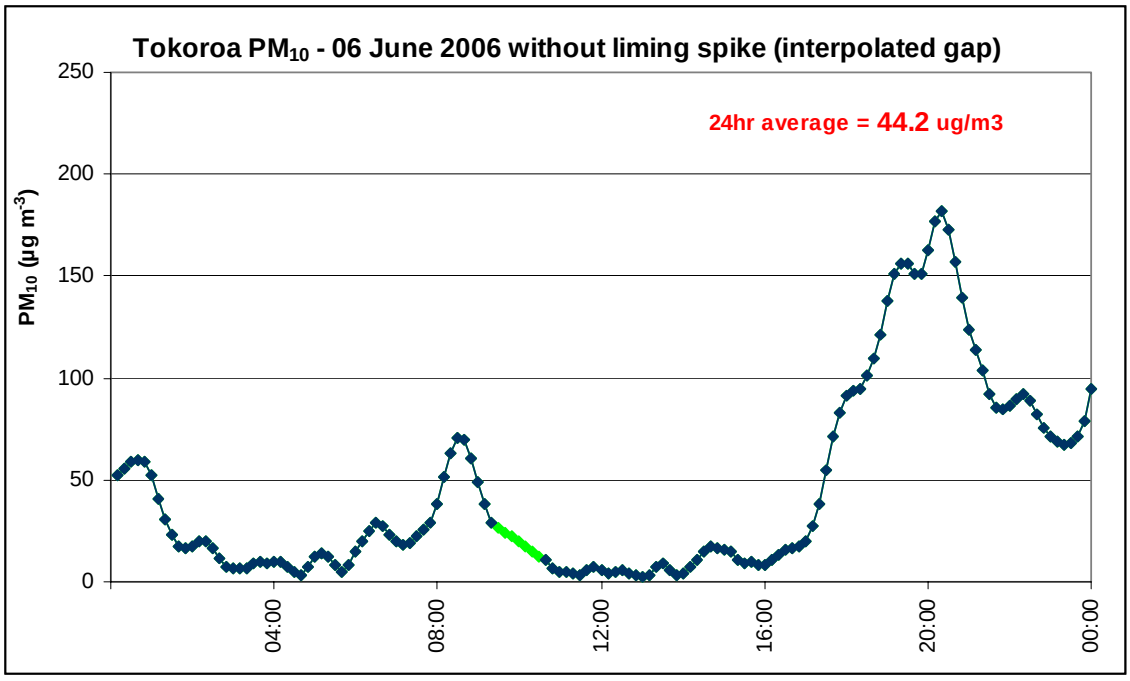


Figure 6-13: Ten minute PM_{10} data at Tokoroa on 6 June 2006 showing (a) spike caused by liming activity at the Tokoroa water treatment site and (b) removal of the liming spike and interpolation across the data gap. 24 hour average PM_{10} concentrations were (a) 50.1 µg m^{-3} and (b) 44.2 µg m^{-3} with and without the liming spike respectively.

Summary

In previous years, air quality monitoring results have been reported on a calendar year basis, however, starting in 2006, results are now reported for 12 months ending 1 September. Ambient air quality monitoring in the Waikato was carried out during 2006 at monitoring sites in Hamilton, Tokoroa, Taupo, Te Kuiti and Matamata. Contaminant monitoring focussed mostly on concentrations of PM_{10}, the main air pollutant of concern in the Waikato, although some passive sampling of benzene was also undertaken at Hamilton sites.

In the Waikato region, the highest 24 hour average PM_{10} concentration for the 12 months to 1 September 2006 was 89 µg m^{-3} recorded at Taupo on 7 June 2006. Recorded concentrations of PM_{10} during 2006 exceeded the ambient air quality guideline of 50 µg m^{-3} on five occasions at Gillies Ave, Taupo. This might be extrapolated to around 15 exceedances, because of the one-day-in-three monitoring schedule at Gillies Ave. Continuous PM_{10} monitoring at Taupo Primary School during 2006 failed to detect any PM_{10} exceedances, so the continuous monitoring station will be moved to a site that is more likely to represent the poorest air quality in the town.

Six PM_{10} exceedances were recorded at Te Kuiti for the 12 months to 1 September 2006 and the maximum 24 hour PM_{10} concentration was 69 µg m^{-3} measured on 28 June 2006. Two PM_{10} exceedances were recorded at Hamilton and the highest PM_{10} concentration of 68 µg m^{-3} was observed on 29 June 2006. In Tokoroa the highest PM_{10} concentration of 62 µg m^{-3} was observed on 29 June 2006 and nine PM_{10} exceedances were recorded for the year.

In Hamilton, Te Kuiti and Taupo, cool and calm conditions in 2006 were associated with higher PM_{10} concentrations and greater number of exceedances than during previous years. However, lower PM_{10} concentrations and decreased number of exceedances occurred in Tokoroa compared with previous years. The anomaly at Tokoroa is almost certainly a consequence of spuriously high PM_{10} data collected in 2004-2005 due to instrumentation error. Upgrade of the Tokoroa BAM in September 2005 has probably resolved this issue and resulted in subsequently accurate PM_{10} data.

The highest 24 hour PM_{10} concentration at Matamata was 34 µg m^{-3} on 7 June 2006 and no exceedances were recorded during the year.

Passive sampling of benzene at Hamilton for 12 months to 20 September 2006 showed concentrations were lower than results from previous years. For the first time since monitoring commenced in 2003, annual average benzene concentrations at all Hamilton sites were below the guideline value of 3.6 µg m^{-3} that will become operative in 2010. The most significant influence on ambient benzene concentrations in recent years is likely to have been the progressive reduction of benzene content in petrol from a nationally regulated limit of four per cent in 2002 to one per cent in January 2006.

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