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Air Quality Monitoring Report for Hamilton, Tokoroa, Taupo,Te Kuiti, Matamata, Putaruru, Ngaruawahia, Waihi and Turangi – 2009

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Environment Waikato

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Executive Summary

In the Waikato Region the main contaminant of concern is PM_{10} (particles in the air less than 10 microns in diameter). The Ministry for the Environment specifies that the National Environmental Standard (NES) for PM_{10} of 50 µg m^{-3} (24-hour average) must be achieved by 2013. One exceedence of this standard is allowed per year, and any subsequent breach of the PM_{10} 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 PM_{10}.

During 2009, PM_{10} monitoring was carried out at Hamilton, Tokoroa, Taupo, Te Kuiti, Matamata, Putaruru, Ngaruawahia, Waihi and Turangi. Monitoring for benzene, toluene and xylenes also took place in Hamilton during 2009. The 2009 Air Quality Monitoring report compares PM_{10} concentrations to the NES for PM_{10} and to the Ministry for the Environment's air quality guidelines and indicator categories.

In Hamilton, there were three exceedences of 50 µg m^{-3} for PM_{10} during 2009. The maximum measured PM_{10} concentration of 101 µg m^{-3} was recorded on 25 September and coincides with a dust storm in Australia. This storm also resulted in concentrations in excess of 50 µg m^{-3} at Tokoroa (57 µg m^{-3}), Matamata (93 µg m^{-3}) and Ngaruawahia (113 µg m^{-3}). Table E1 shows summary PM_{10} data for all sites for 2009.

Table E1: Summary of PM_{10} monitoring results for 2009.

	Maximum measured concentration µg m^{-3}	Measured exceedences of 50 µg m^{-3}	Number of NES breaches	Annual Average
Hamilton	101* µg m^{-3}	3	2	14 µg m^{-3}
Tokoroa	80 µg m^{-3}	17	16	18 µg m^{-3}
Taupo	66 µg m^{-3}	7	6	17 µg m^{-3}
Te Kuiti	53 µg m^{-3}	4	3	17 µg m^{-3}
Matamata*	93 µg m^{-3}	1	0	13 µg m^{-3}
Putaruru	55 µg m^{-3}	2	1	15 µg m^{-3}
Ngaruawahia*	113 µg m^{-3}	1	0	14 µg m^{-3}
Waihi	32 µg m^{-3}	0	0	12 µg m^{-3}
Turangi	25 µg m^{-3}	0	0	9 µg m^{-3}

* non winter exceedences associated with dust storms in Australia.

Concentrations of benzene measured in Hamilton were within the 2009 guideline of 10 µg m^{-3} and the 2010 guideline of 3.6 µg m^{-3}. The highest annual concentration was measured at the Greenwood Street monitoring site and was 3.2 µg m^{-3}. Concentrations of toluene and xylene were well within acceptable levels.

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1 Introduction

1.1 Background

In the Waikato Region the main air contaminant of concern is PM_{10} (particles in the air less than 10 microns in diameter). Concentrations of PM_{10} have historically exceeded the National Environmental Standards for Ambient Air Quality (NES) in Hamilton, Tokoroa, Taupo, Putaruru and Te Kuiti during winter months.

In 2009, concentrations of PM_{10} were measured at nine sites in the Waikato Region. The sites include; Hamilton, Tokoroa, Taupo, Te Kuiti, Matamata, Putaruru, Ngaruawahia, Waihi and Turangi. In Hamilton additional monitoring for benzene, toluene and xylenes took place.

In 2004 the Ministry for the Environment (MfE) introduced the National Environmental Standard (NES) for air quality (Table 1.1). Air quality monitoring throughout New Zealand has shown that over 30 urban areas have measured PM_{10} concentrations that exceed the NES for PM_{10}. Based on this information and air quality monitoring of other contaminants in other urban areas, it would seem unlikely that national standards or guidelines for contaminants other than PM_{10} would be in breach. The exception to this may be benzo(a)pyrene concentrations of which appear to occur well in excess of guideline concentrations in Christchurch. The majority of resources for air quality monitoring in the Waikato Region have focused on PM_{10}.

The Ministry for the Environment also 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.

In the Waikato Region previous PM_{10} monitoring has taken place at Hamilton, Tokoroa, Taupo, Te Kuiti, Matamata, Putaruru, Ngaruawahia and Waihi. Passive sampling for benzene has been carried out since 2003 in Hamilton. Monitoring of PAHs was carried out in Hamilton in 2007 and 2008.

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) 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 (inorganic) [d] Arsine	0.0055 µg m^{-3} 0.055 µg m^{-3}	Annual Annual

Notes for Tables 1.1 and 1.2:

[a] All values apply to the gas corrected to 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 the MfE categories are primarily used as air quality indicators, the Waikato Regional Plan takes a further regulatory step by specifying designated policy responses that should correspond to each zone. Policy 3 of the Air Module of the Waikato Regional Plan contains regional ambient air quality categories and the designated response that the Council will take when developing air quality management framework. Policy 3 states that 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.

1.2 Reporting period

The reporting period for PM_{10} for most sites in this report is from 1 January to 31 December 2009. In Turangi the reporting period is from March to December 2009. The reporting period for benzene, toluene and xylenes is 17 December 2008 to 17 December 2009.

In 2006 Environment Waikato introduced a September to August reporting period. This reporting period was introduced for a number of reasons including ensuring that results were reported as soon as possible after the peak winter PM_{10} concentrations and to ensure compliance with the NES reporting requirements. The 2009 annual air quality report has been prepared based on a reporting period of January to December. This is the same format as historical reports.

2 Methodology

Measured concentrations of PM_{10} can be influenced by the method used to monitor $PM_{10.}$ From 2006 a number of air quality monitoring sites in the Waikato region have had gravimetric samplers run in conjunction with historical methods. Environment Waikato staff have used the results to determine site specific differences between methods and data were adjusted for gravimetric equivalence. Monitoring data for 2007 was adjusted based on equations detailed in the 2007 monitoring report (Wilton & Baynes, 2008). Prior to 2007 data were not adjusted. Adjustment equations were updated in 2008 as a result of additional monitoring and these equations have been used in the 2009 report.

In 2009, at the Peachgrove Road air quality monitoring site in Hamilton, PM_{10} concentrations were monitored using a Tapered Elemental Oscillation Microbalance (TEOM) with a sample temperature setting of 40 degrees centigrade. Concentrations of PM_{10} measured using the TEOM in 2009 were based on the same adjustment for 2008 reporting (equation 2.1).

Corrected PM_{10} = 1.19975 x RawTEOM - 3.9182 Equation 2.1

In Tokoroa, a ThermoAndersen FH62 C14 BAM has been used to monitor air quality since 2005. A Sequential Partisol gravimetric sampler was co-located at this site during 2007 to 2008. Equation 2.2 shows the adjustments made to the FH62 data for consistency with the gravimetric method.

Corrected PM_{10} = $10^{(1.09945 \log FH62 - 0.08595)}$ Equation 2.2

Gravimetric sampling was conducted at the Gillies Street site in Taupo from March 2007. Concentrations of PM_{10} measured using the BAM during 2009 were adjusted based on equation 2.3.

Corrected PM_{10} = 1.255BAM – 1.538 Equation 2.3

Air quality data at the Putaruru site has been adjusted based on Equation 2.4.

Corrected PM_{10} = 1.117B -1.6074 Equation 2.4

Concentrations of PM_{10} at Te Kuiti, Matamata, Ngaruawahia and Putaruru site were measured using an FH62 C14 BAM. No adjustments have been made to concentrations measured at these sites. In the case of Te Kuiti, two years of reference sampling has confirmed that no adjustment of BAM data is necessary. For the other towns, the possible need for any site-specific correction remains to be assessed.

At the Hamilton, Tokoroa, Taupo,Te Kuiti and Matamata air quality monitoring sites, meteorological data, including temperature, wind speed and wind direction were

collected. Relative humidity was also collected at Hamilton and Matamata. Meteorological data was not available for the Putaruru, Ngaruawahia, Waihi and Turangi sites. Meteorological data were compared with PM_{10} on days when pollution was elevated.

Environment Waikato staff have managed most sites in the Waikato air quality monitoring network since August 2005. Prior to that the monitoring network was operated and maintained by NIWA.

Hourly data from the BAM monitors are recorded and logged by an iQuest iRIS 320 datalogger. Results are telemetered hourly to Environment Waikato and stored in the hydrotel database. Calibration checks are periodically run on all telemetered instruments, and transient spikes due to calibration are removed from the ambient monitoring data record.

3 Hamilton

3.1 Air Quality Monitoring in Hamilton

In Hamilton, since November 1997, air quality has been measured at a monitoring site in Peachgrove Road located on the south-east side of Hamilton City. During 2009, PM_{10}, benzene, ethyl-benzene, toluene and xylenes were measured at Peachgrove Road. The site meets the requirements of the "Residential Peak" site classification as described in the '*Good Practice Guideline for Air Quality Monitoring and Data Management 2009'* report (MfE, 2009). Benzene, ethyl-benzene, toluene and xylenes (BTEX) have been monitored during recent years at Bridge Street, Claudelands Road, Hamilton Intermediate School, Greenwood Street and Tristram Street. Figure 3.1 shows the location of the main Peachgrove Road air quality monitoring site in Hamilton.

During 2009, PM_{10} monitoring at Peachgrove Road was carried out 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 ten minute averages and subsequently hourly averages and 24 hour averages were calculated 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. 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).

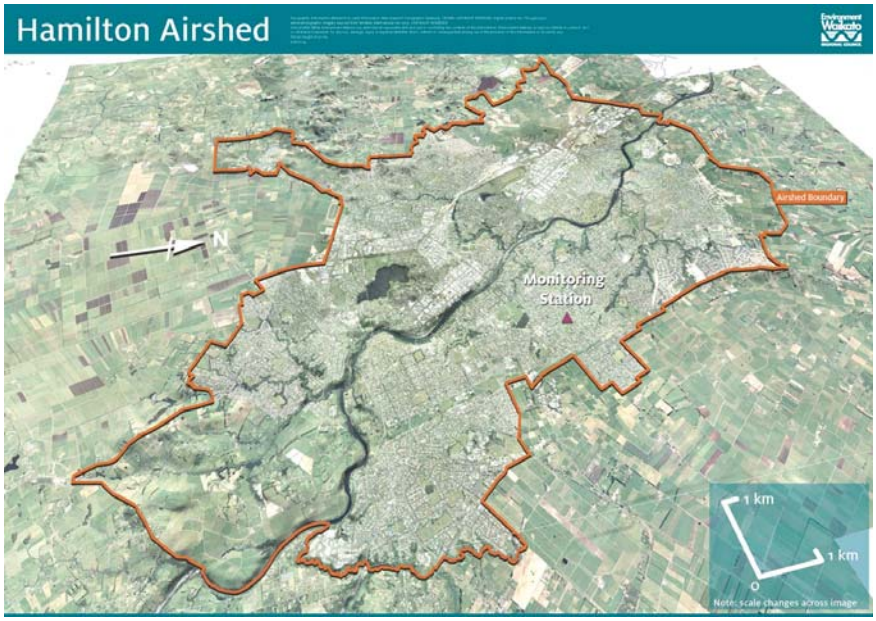


Figure 3.1: Hamilton Airshed and air quality monitoring site (Source: Environment Waikato, 2010).

3.2 PM_{10} concentrations for Hamilton

In Hamilton, there were three exceedences of 50 µg m^{-3} (24-hour average) during 2009. A maximum concentration of 101 µg m^{-3} was recorded on 25 September. This exceedence coincided with a dust storm event in Australia. Two other exceedences of the NES for PM_{10} occurred during winter, on 3 June (54 µg m^{-3}) and 19 June (54 µg m^{-3}). Two breaches of the NES were reported for Hamilton in 2009.

Figure 3.2 shows the 24-hour average PM_{10} concentrations measured at Hamilton during 2009. In comparison during 2007 and 2008 there were no exceedences of 50 µg m^{-3} or breaches of the NES for PM_{10}.

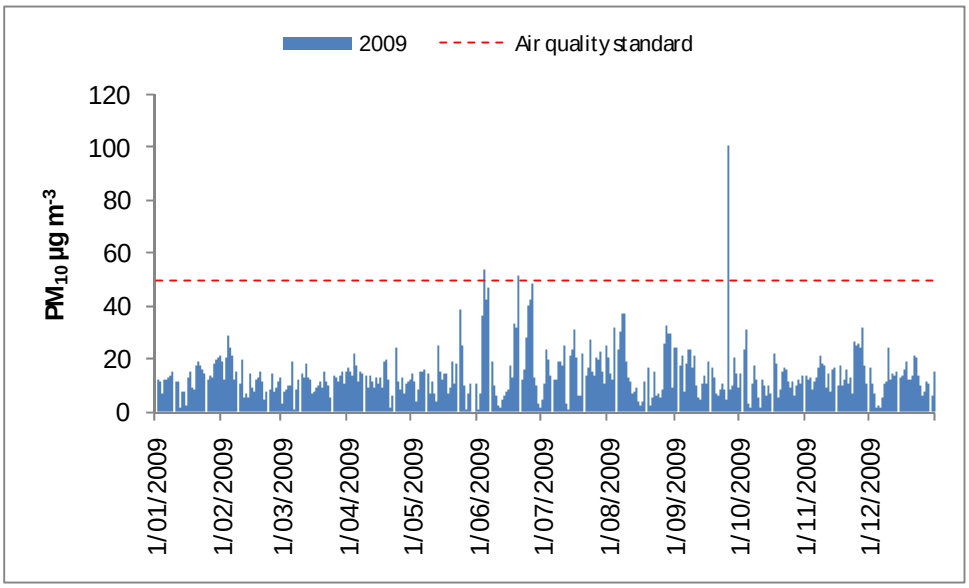


Figure 3.2: 24-hour average PM_{10} concentrations measured at Peachgrove Road during 2009.

Daily PM_{10} concentrations measured from 2000 to 2009 to the MfE air quality indicator categories (shown in Table 1.3) are compared in Figure 3.3. The majority of the PM_{10} concentrations measured were less than 66% of the air quality guideline, within the "acceptable" and "good" air quality categories. Only one percent of PM_{10} concentrations were in the alert category during 2009. Figure 3.4 shows the seasonal variations in the distribution of PM_{10} concentrations during 2009. Figure 3.5 shows the number of days when 50 µg m^{-3} was exceeded, the maximum concentration and the second highest concentration from 2006 to 2009.

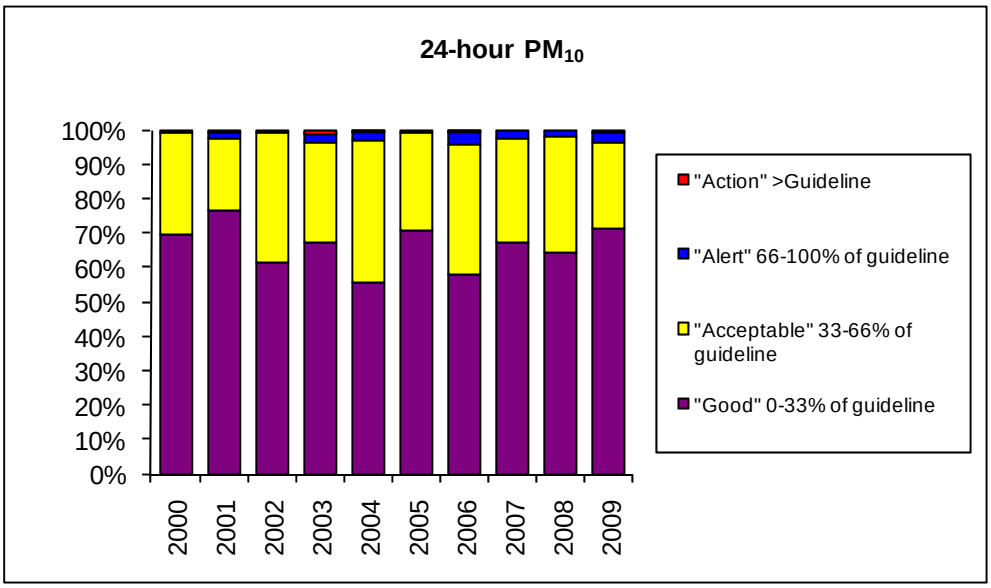


Figure 3.3: Comparison of PM_{10} concentrations measured at Peachgrove Road in Hamilton from 2000 to 2009 to air quality indicator categories.

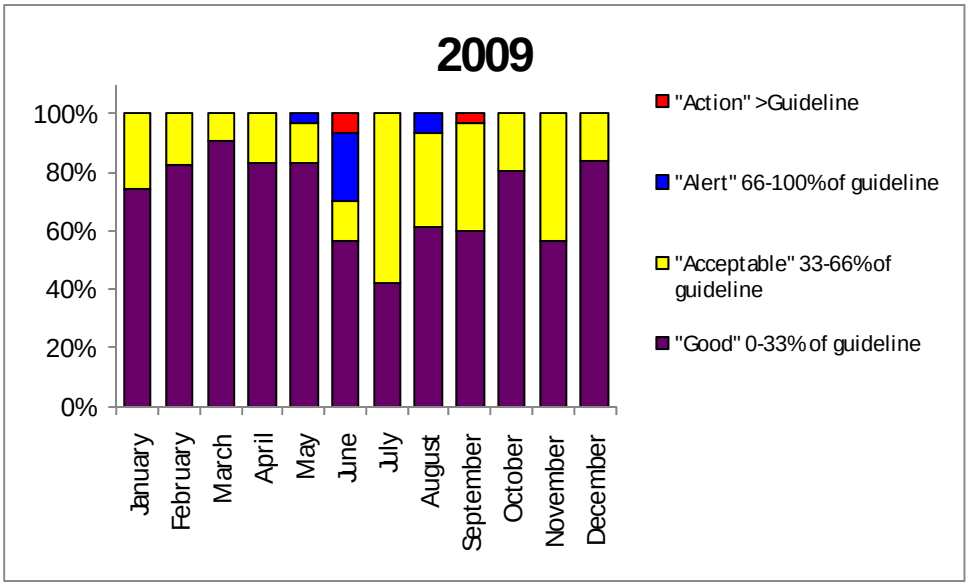


Figure 3.4: Comparison of daily PM_{10} concentrations each month for 2009 to air quality indicator categories.

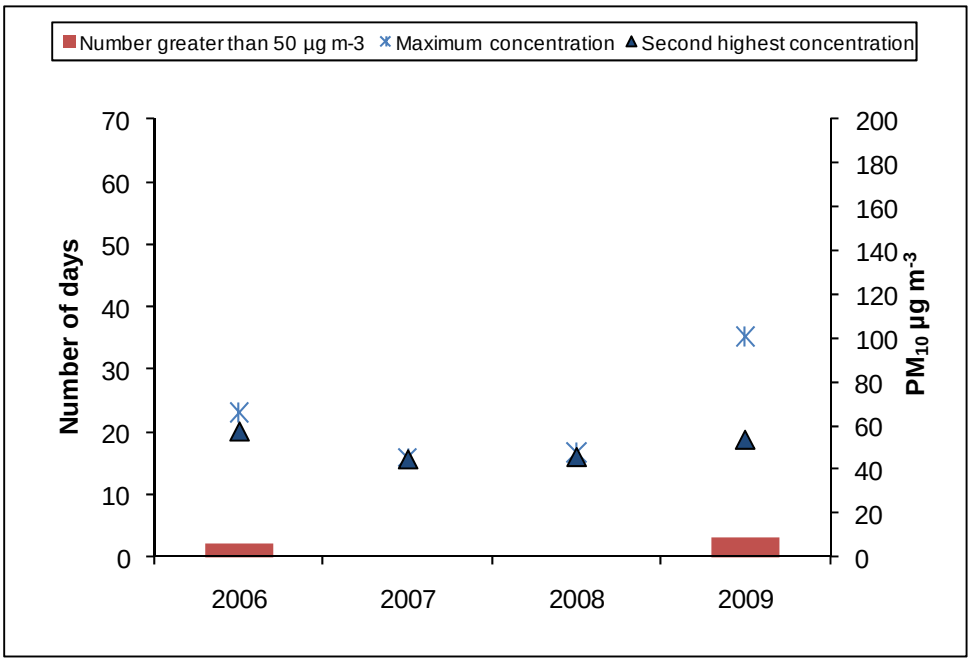


Figure 3.5: Number of days when 50 µg m^{-3} was exceeded, the maximum concentration and the second highest concentration from 2006 to 2009.

The annual average PM_{10} concentration for Hamilton for 2009 was 14 µg m^{-3} and is similar to previous year's data. The Ministry for the Environment specifies an annual average guideline for PM_{10} of 20 µg m^{-3}. An annual average PM_{10} concentration is not specified in the NES.

Summary statistics for PM_{10} monitoring results from the Hamilton site from 2000 are shown in Table 3.1. 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 PM_{10} concentrations measured at Peachgrove Road in Hamilton from 2000 to 2009.

	2000	2001	2002	2003	2004	2005	2006	2007*	2008	2009
"Good" 0-33% of guideline	70%	77%	61%	67%	56%	70%	58%	67%	64%	71%
"Acceptable" 33-66% of guideline	30%	21%	38%	29%	41%	29%	38%	30%	34%	25%
"Alert" 66-100% of guideline	1%	2%	1%	3%	3%	1%	4%	2%	2%	3%
“Action” >Guideline	0%	1%	0%	1%	0%	0%	1%	0%	0%	1%
Percentage of valid data	91%	70%	93%	91%	94%	77%	99%	66%	99%	99%
Annual average (µg m^{-3})	15	15	16	16	17	15	17	15	15	14
Measured exceedences	0	3	0	4	1	0	2	0	0	3
Annual maximum (24-hr average µg m^{-3})	43	67	36	62	55	37	66	46	48	101
Number of records	334	256	340	331	344	281	363	242	364	363

*Data post 2007 is adjusted for gravimetric equivalency.

3.3 Concentrations of Benzene, Toluene and Xylenes

In Hamilton, monitoring of benzene at the Peachgrove Road air monitoring site and at a high-density traffic area at Bridge Street has taken place since 2003. In 2004 an additional benzene sampling site was established at the intersection of Claudelands Road and Victoria Street (Claudelands Bridge). This is also a high density traffic area. Additional sites were established in 2006 in Tristram Street, Greenwood Street and at Hamilton Intermediate School.

Benzene concentrations measured at all locations in Hamilton during 2009 were within the Ministry for the Environment's 2009 guideline for benzene (10 µg m^{-3} per year) and met the 2010 annual guideline of 3.6 µg m^{-3} (Table 3.2). The highest average annual concentration during 2009 was 3.2 µg m^{-3} and was measured at the Greenwood Street monitoring site.

Results for 2009 suggest that the original decrease in benzene concentrations observed between 2003 and 2007 has tapered (Figure 3.6). These earlier decreases were attributed to changes in fuel specifications and improved vehicle technology (Smith, 2007).

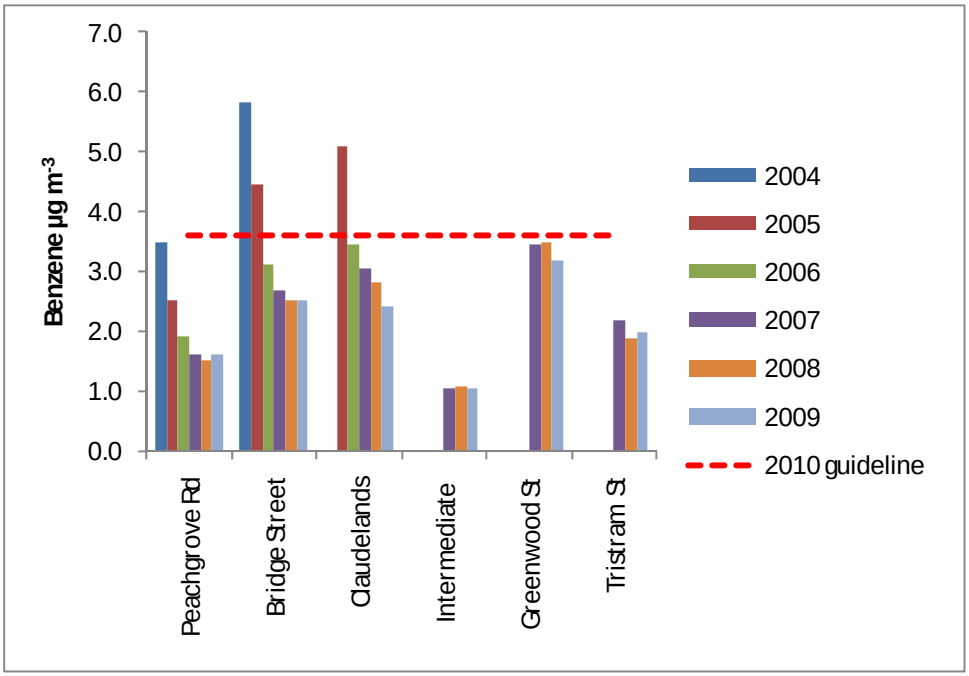


Figure 3.6: Annual average benzene measured at Hamilton sites ((February 2003 – February 2004) (July 2004 – July 2005), (September 2005 – September 2006), (December – December for 2007, 2008 and 2009)).

Toluene and xylene were also measured at the benzene monitoring sites for each year. A Ministry for the Environment (MfE) document discussing amendments to the 1994 ambient air quality guidelines suggests an annual threshold of 190 µg m^{-3} and 950 µg 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 2008 to December 2009.

	Bridge St	Peachgrove Road	Claudelands	Intermediate	Greenwood Street	Tristram Street	Guideline[a]
				$\mu g\ m^{-3}$			
Benzene	2.5	1.6	2.4	1.0	3.2	2.0	3.6 (10[a])
Toluene	10.6	6.8	10.7	4.6	15.4	9.3	190[b]
Total Xylenes	9.1	5.6	8.7	3.9	10.0	7.4	950[b]

[a] The 2009 guideline for benzene of 10 $\mu g\ m^{-3}$ reduced to 3.6 $\mu g\ m^{-3}$ 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 Daily variations in PM_{10} and meteorology on high pollution days

Figure 3.8 shows the variations in meteorological conditions and hourly average PM_{10} concentrations on the three days when the 24-hour average PM_{10} measured in Hamilton using the TEOM concentration exceeded 50 $\mu g\ m^{-3}$.

The dates these occurred on were 3 and 19 of June and 25 September and the corresponding PM_{10} concentrations (24-hour average) were, 54, 52 and 101 $\mu g\ m^{-3}$.

On 3 and 19 June PM_{10} concentrations were typical of a high pollution episode with a small morning and higher evening peak in concentrations coinciding with low wind speeds. On 25 September, when the NES breach coincided with the Australian dust storm, the daily variations in concentrations were not typical of urban air pollution in New Zealand. Figure 3.7 shows a large peak in concentrations extending from 5am to 11am on this day.

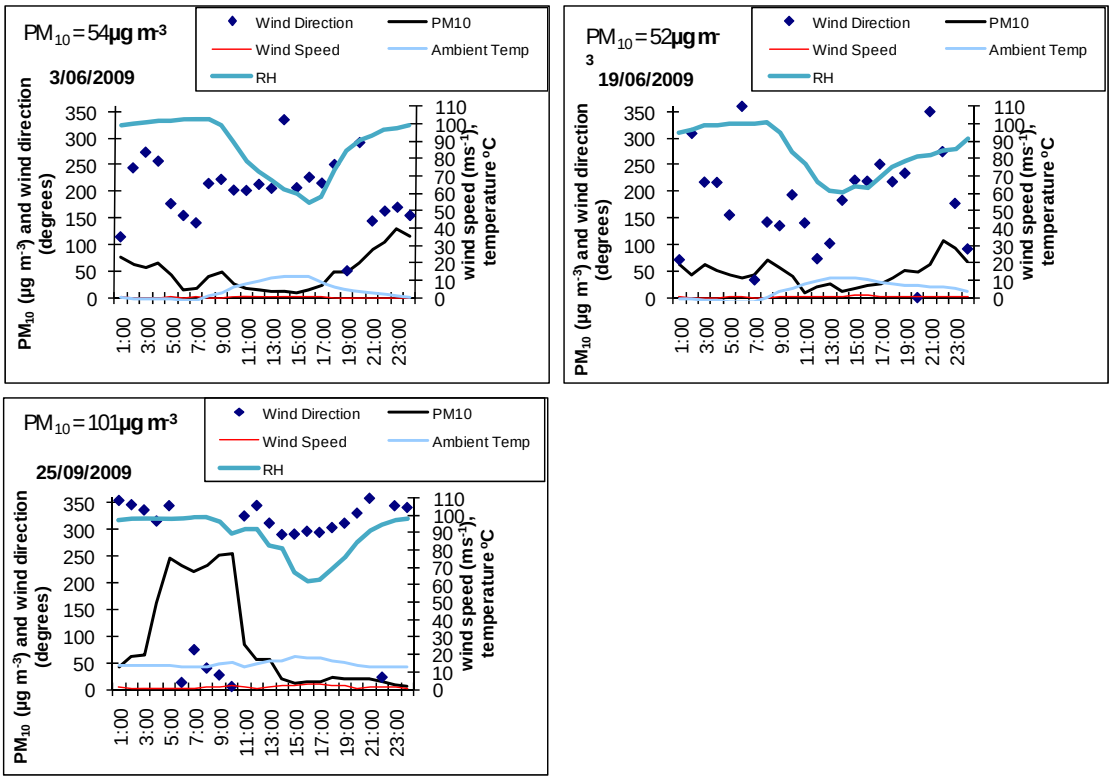


Figure 3.7: Hourly average PM_{10}, wind speed, wind direction, humidity and temperature on days when PM_{10} concentrations exceeded 50 µg m^{-3} at the Peachgrove Road site.

4 Tokoroa

4.1 Air Quality Monitoring in Tokoroa

In Tokoroa, monitoring for PM_{10} has been carried out in since 2001 at the Billah Street Reserve air quality monitoring site, located west of central Tokoroa. The monitoring site meets the requirements of the "Residential Neighbourhood" site classification as described in the *Good Practice Guideline for Air Quality Monitoring and Data Management 2009,* report (MfE, 2009).

In 1999, some air quality 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 in this air quality monitoring report due to uncertainties surrounding the monitoring method.

A MET ONE series 1020 BAM was used to monitor PM_{10} from 2001 to September 2005 at Billah Street site. In September 2005 the MET ONE instrument was replaced with a ThermoAndersen FH62 C14 BAM. The FH62 BAM records data at ten minute intervals. Figure 4.1 shows the Tokoroa Airshed and the location of the air quality monitor in Tokoroa.

Figure 4.1: Tokoroa Airshed and air quality monitoring site (Source: Environment Waikato, 2010).

4.2 PM_{10} concentrations in Tokoroa

Figure 4.2 shows daily average PM_{10} concentrations measured at the Tokoroa site during 2009. There were 17 measured PM_{10} concentrations that exceeded 50 µg m^{-3} using the FH62 BAM adjusted for gravimetric equivalency (Table 4.1). The maximum concentration of 80 µg m^{-3} (24-hour average) was measured on 22 June. This is similar in magnitude to the highest PM_{10} concentrations measured in 2007 (91 µg m^{-3}) and 2008 (85 µg m^{-3}).

Table 4.1: Dates and concentrations for 2009 exceedences of 50 µg m^{-3} in Tokoroa.

Date	PM_{10} µg m^{-3}	Rank	Date	PM_{10} µg m^{-3}	Rank
22 June 2009	80	1	18 June 2009	60	9
25 June 2009	77	2	16 July 2009	58	10
24 June 2009	71	3	2 June 2009	57	11
23 June 2009	69	4	19 June 2009	57	12
7 July 2009	66	5	25 Sept 2009	57	13
22 May 2009	63	6	5 June 2009	56	14
6 July 2009	61	7	17 June 2009	55	15
29 May 2009	61	8	21 June 2009	52	16
			3 June 2009	51	17

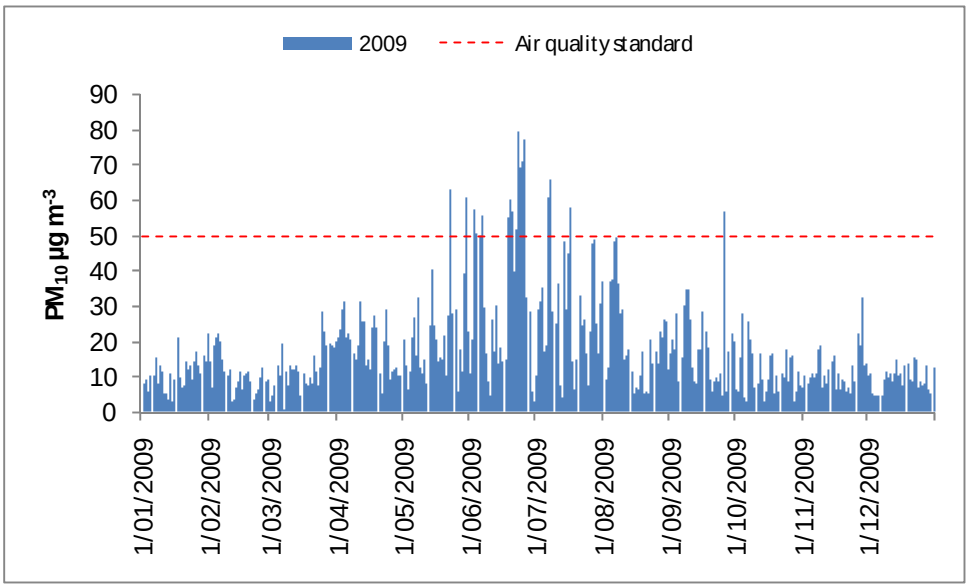


Figure 4.2: Daily winter PM_{10} concentrations measured in Tokoroa during 2009.

Figure 4.3 shows changes in PM_{10} concentrations relative to air quality indicator categories at the Tokoroa site from 2001 to 2009. Figure 4.4 shows the seasonal variations in the distribution of PM_{10} concentrations for 2009. In June 37% of days resulted in PM_{10} concentrations that were in the 'alert' category. The number of days when 50 µg m^{-3} was exceeded, the maximum concentration and the second highest concentration from 2006 to 2009 are shown in Figure 4.5.

It is noted that Met One BAM was changed to an FH62 BAM 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 µg 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 to 2005 may form a part of future work involving analysis of trends.

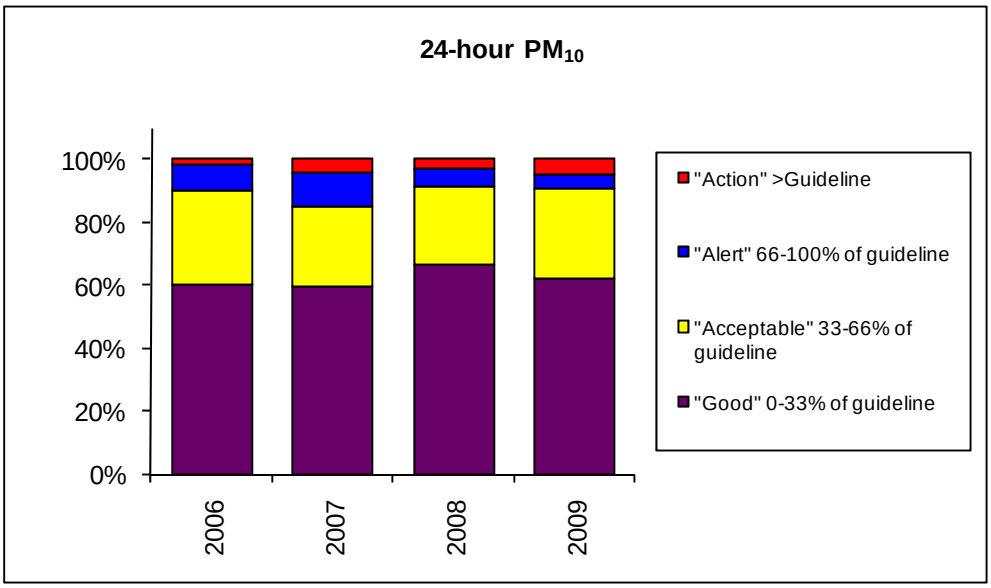


Figure 4.3: Comparison of PM_{10} concentrations measured in Tokoroa from 2006 to 2009 to air quality indicator categories.

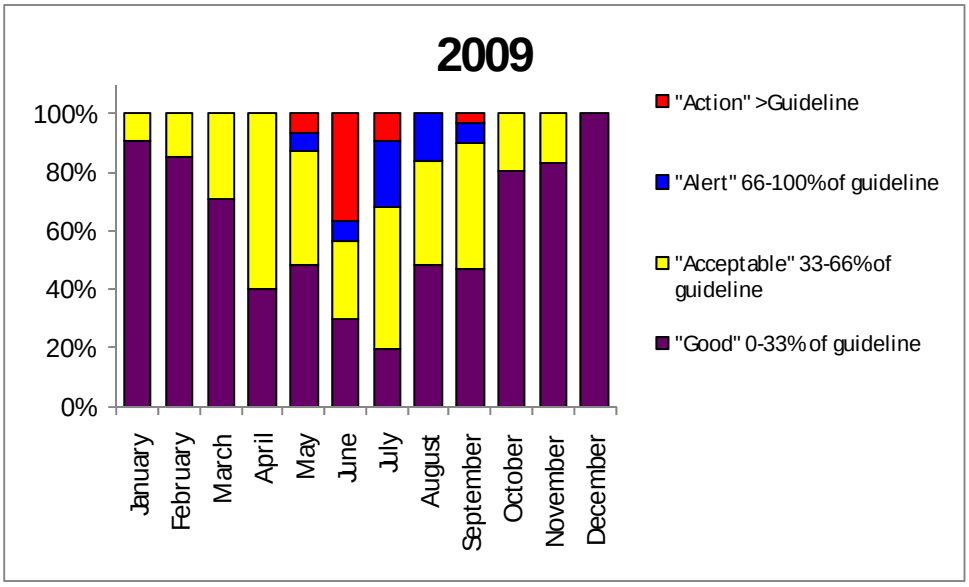


Figure 4.4: Comparison of daily PM_{10} concentrations each month during 2009 to air quality indicator categories.

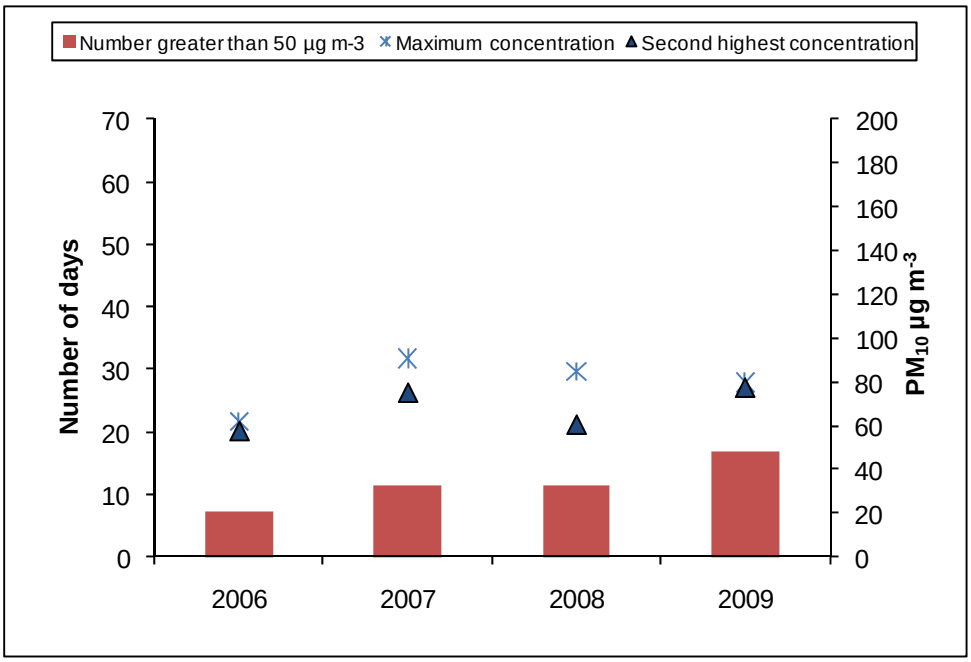


Figure 4.5: Number of days when 50 µg m^{-3} was exceeded, the maximum concentration measured and the second highest concentration from 2006 to 2009.

During 2009, the annual average PM_{10} concentration for Tokoroa was 18 µg m^{-3}. This is slightly higher than 2008 (16 µg m^{-3}) but similar to 2007 (19 µg m^{-3}) and 2006 (17 µg m^{-3}) annual averages. Table 4.2 shows the summary statistics for PM_{10} monitoring results.

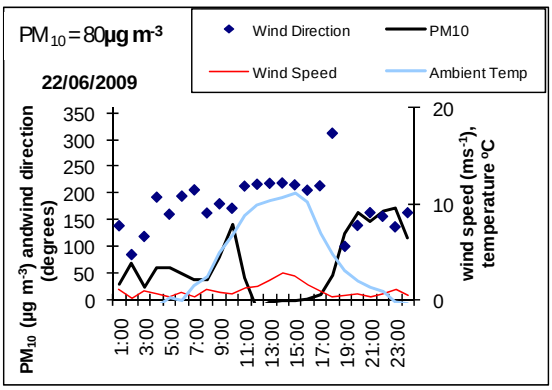
Table 4.2: Summary of PM_{10} concentrations measured at the Tokoroa monitoring site from 2006 to 2009.

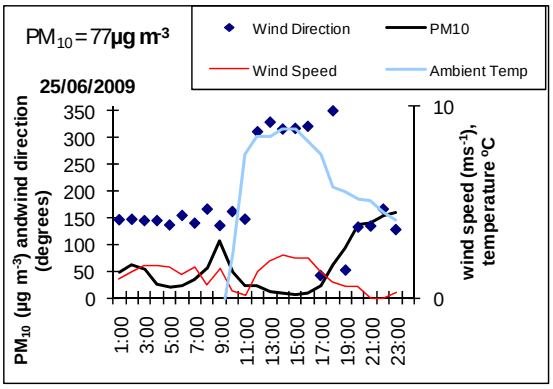
	2006	2007	2008	2009
"Good" 0-33% of guideline	60%	60%	66%	62%
"Acceptable" 33-66% of guideline	30%	25%	25%	29%
"Alert" 66-100% of guideline	8%	11%	5%	5%
“Action” >Guideline	3%	5%	3%	5%
Percentage of valid data	99%	66%	99%	100%
Annual average (µg m^{-3})	17	19	16	18
Measured exceedence	9	11	12	17
Annual maximum (µg m^{-3})	62	91	85	80
Number of records	360	241	361	364

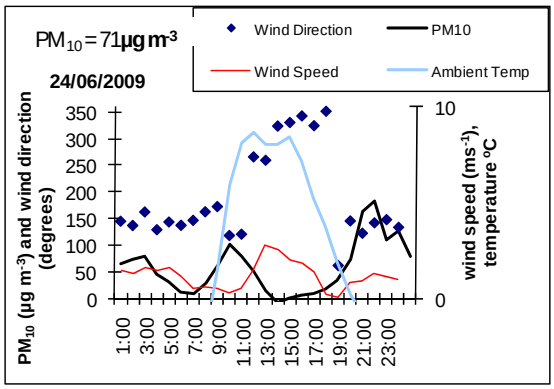
4.3 Daily variations in PM_{10} and meteorology on high pollution days

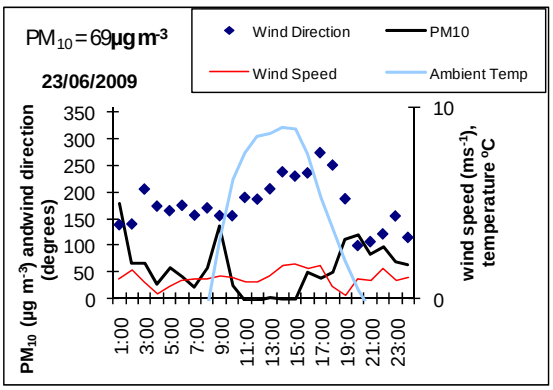
Figure 4.6 shows the variations in meteorological conditions and hourly average PM_{10} concentrations during winter when the 24-hour average PM_{10} measured at Tokoroa exceeded 50 µg m^{-3}. Figure 4.7 shows the meteorological conditions for 25 September when the 24-hour PM_{10} concentration measured 57 µg m^{-3} and coincides with a dust storm in Australia.

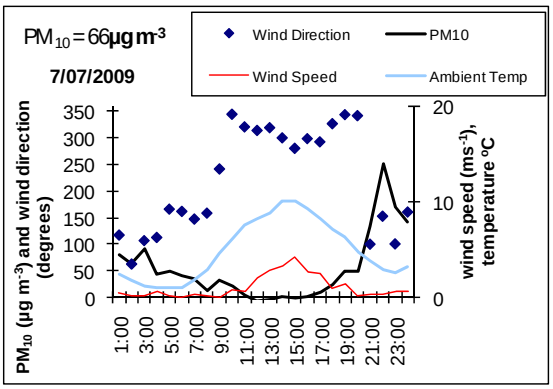
On most days, the highest peak in PM_{10} concentrations occurred during the evening period, with a second peak in concentrations occurring in the early morning both coinciding with low wind speeds and typically a south east wind direction. The exception to the latter is 5 June when concentrations were elevated during the early morning (12am-6am) and mid morning. A wind direction change around 11am resulted in lower evening concentrations than typical for a high pollution event.

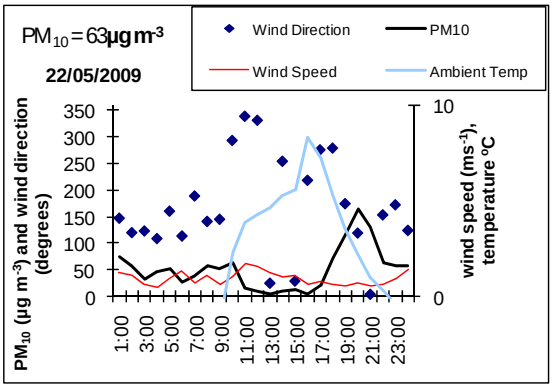

PM10 = 80µg m-3
22/06/2009
Wind Direction
PM10
Wind Speed
Ambient Temp
PM10 (µg m-3) andwind direction (degrees)
wind speed (ms-1), temperature °C

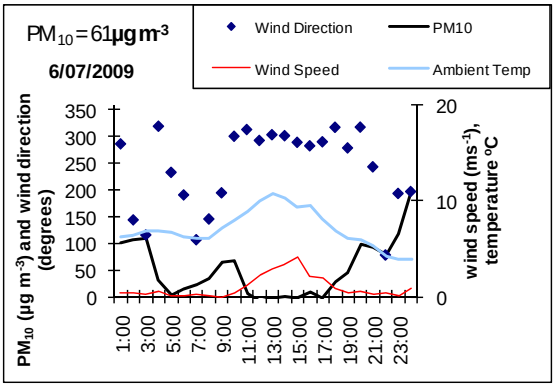

PM10 = 77µg m-3
25/06/2009
Wind Direction
PM10
Wind Speed
Ambient Temp
PM10 (µg m-3) andwind direction (degrees)
wind speed (ms-1), temperature °C

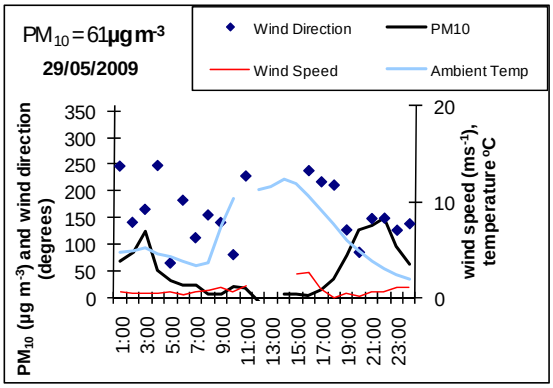

PM10 = 71µg m-3
24/06/2009
Wind Direction
PM10
Wind Speed
Ambient Temp
PM10 (µg m-3) and wind direction (degrees)
wind speed (ms-1), temperature °C


PM10 = 69µg m-3
23/06/2009
Wind Direction
PM10
Wind Speed
Ambient Temp
PM10 (µg m-3) andwind direction (degrees)
wind speed (ms-1), temperature °C


PM10 = 66µg m-3
7/07/2009
Wind Direction
PM10
Wind Speed
Ambient Temp
PM10 (µg m-3) and wind direction (degrees)
wind speed (ms-1), temperature °C


PM10 = 63µg m-3
22/05/2009
Wind Direction
PM10
Wind Speed
Ambient Temp
PM10 (µg m-3) and wind direction (degrees)
wind speed (ms-1), temperature °C


PM10 = 61µg m-3
6/07/2009
Wind Direction
PM10
Wind Speed
Ambient Temp
PM10 (µg m-3) and wind direction (degrees)
wind speed (ms-1), temperature °C


PM10 = 61µg m-3
29/05/2009
Wind Direction
PM10
Wind Speed
Ambient Temp
PM10 (µg m-3) and wind direction (degrees)
wind speed (ms-1), temperature °C

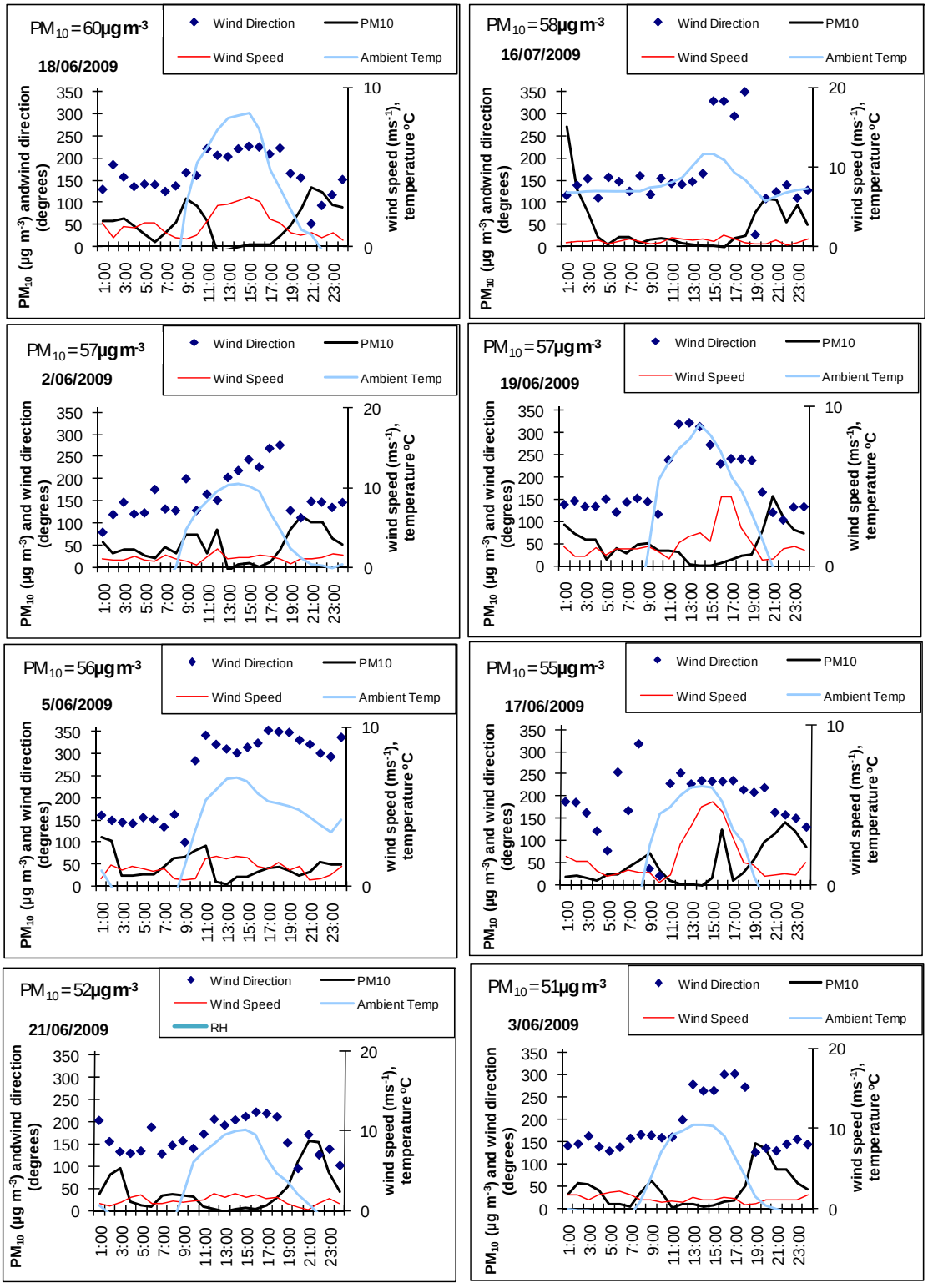


Figure 4.6: Hourly average PM_{10}, wind speed, wind direction and temperature on days when PM_{10} concentrations exceeded the NES at the Tokoroa site.

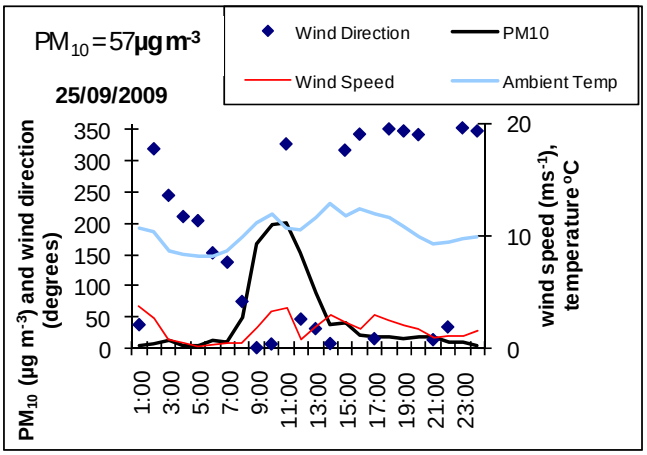


Figure 4.7: Hourly average PM_{10}, wind speed, wind direction and temperature on 25 September that coincides with an Australian dust storm.

5 Taupo

5.1 Air Quality Monitoring in Taupo

The air quality monitoring site for Taupo is located at Gillies Avenue Reserve in central Taupo and was established in November 2000. The site meets the requirements of the "Residential Neighbourhood" site classification as described in the '*Good Practice Guideline for Air Quality Monitoring and Data Management 2009'* report (MfE, 2009).

A FH62 C14 BAM has measured PM_{10} concentrations since March 2007. Gravimetric sampling using a Rupprecht and Patashnick Partisol Model 2000 PM_{10} sampler also took place at the Gillies Avenue Site during 2007 and 2008.

Prior to 2005, PM_{10} was monitored in Taupo on a one day in three basis at the Gillies Avenue Reserve site using a Rupprecht and Patashnick Partisol Model 2000 PM_{10} sampler. In January 2005 a FH62 C14 BAM continuous PM_{10} 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 PM_{10} sampler continued throughout 2006 to evaluate the spatial variation of PM_{10} concentrations between Gillies Avenue and Taupo Primary School.

The maximum recorded 24-hour PM_{10} concentration at the Taupo Primary School site in 2006 was 24.8 µg m^{-3} whereas the maximum recorded 24-hour PM_{10} 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 PM_{10} 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.

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.

Figure 5.1 shows the Taupo Airshed and the location of the monitoring site in Taupo.

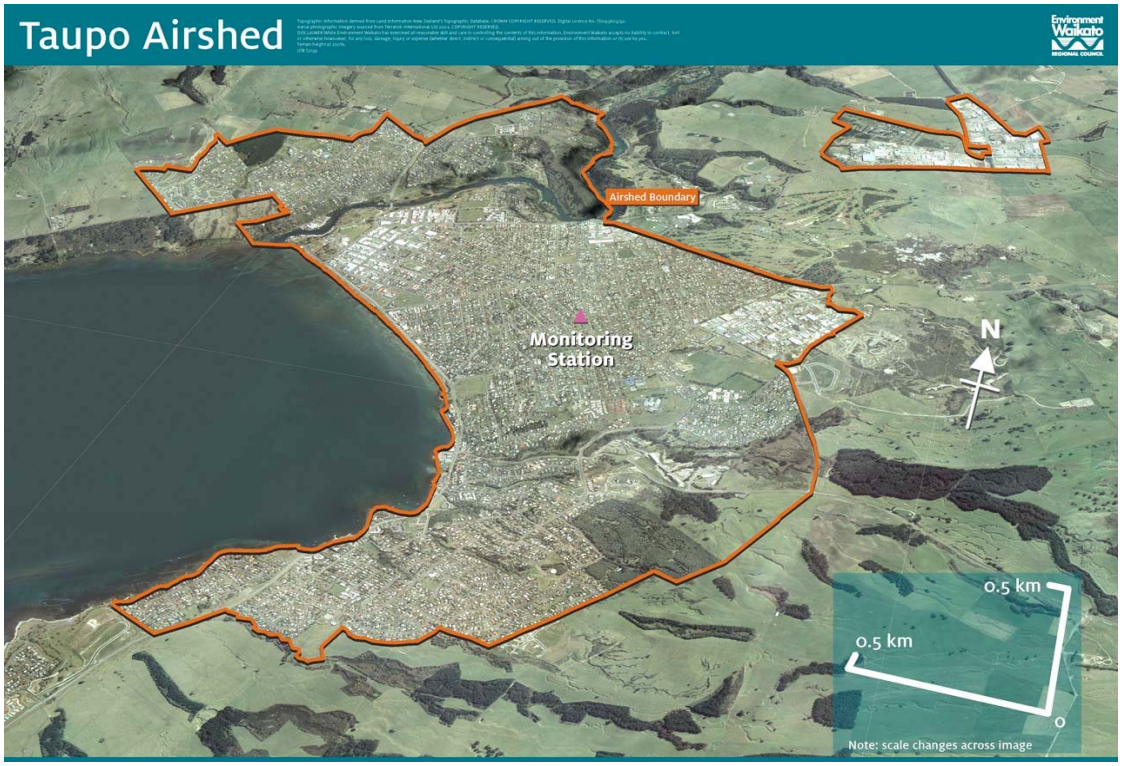


Figure 5.1: Taupo Airshed and air quality monitoring site (Source: Environment Waikato, 2010).

5.2 PM_{10} concentrations in Taupo

Figure 5.2 shows daily average PM_{10} concentrations measured at the Taupo site during 2009. Seven exceedences of 50 µg m^{-3} were recorded at the Taupo site, with a maximum measured PM_{10} concentration of 66 µg m^{-3} measured on 24 June. This is similar in magnitude to maximum concentrations measured in 2008 (73 µg m^{-3}) and 2007 (64 µg m^{-3}). Six breaches of the NES were reported for Taupo for 2009.

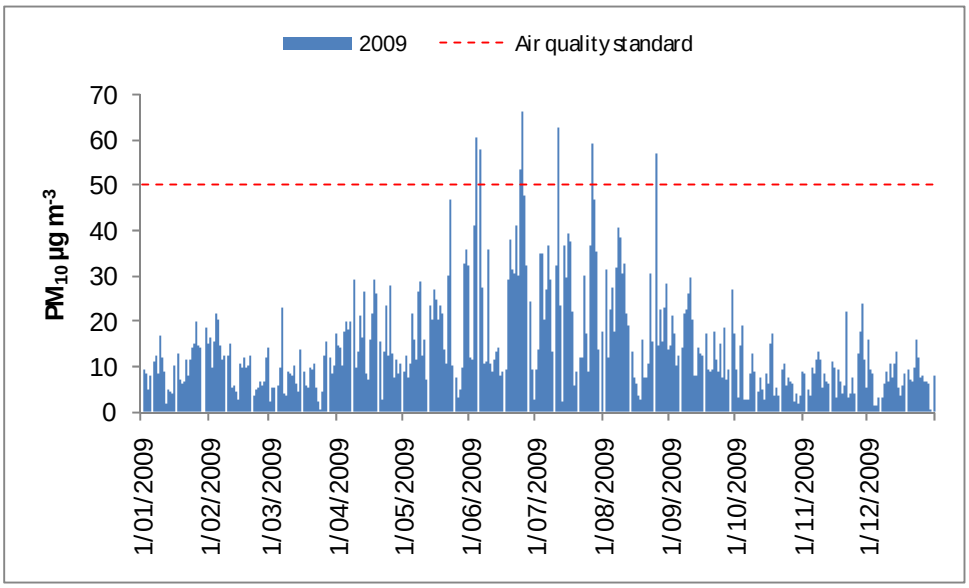


Figure 5.2: Daily winter PM_{10} concentrations measured at the Taupo site during 2009.

The changes in PM_{10} concentrations relative to air quality indicator categories at the Taupo site from 2006 to 2009 are shown in Figure 5.3. Results suggest that PM_{10} concentrations measured during 2006 were lower than the following years because of the change in monitoring location for that year, but most other years have a similar distribution in PM_{10} concentrations. Figure 5.4 shows the seasonal variations in the distribution of PM_{10} concentrations for 2009. Figure 5.5 shows the number of days when 50 µg m^{-3} was exceeded, the maximum concentration and the second highest concentration for 2006 to 2009.

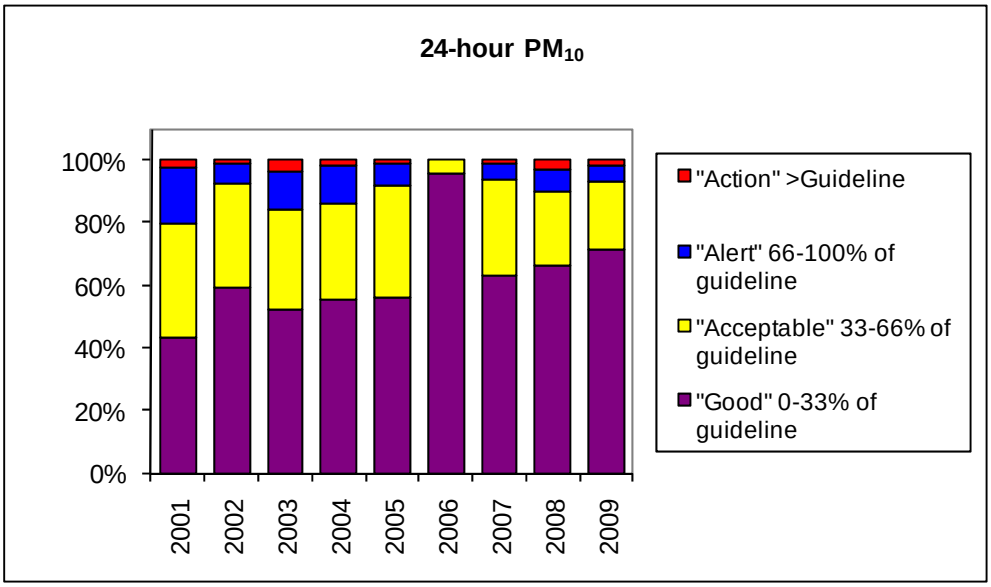


Figure 5.3: Comparison of PM_{10} concentrations measured at the Taupo site from 2001 to 2009 to air quality indicator categories.

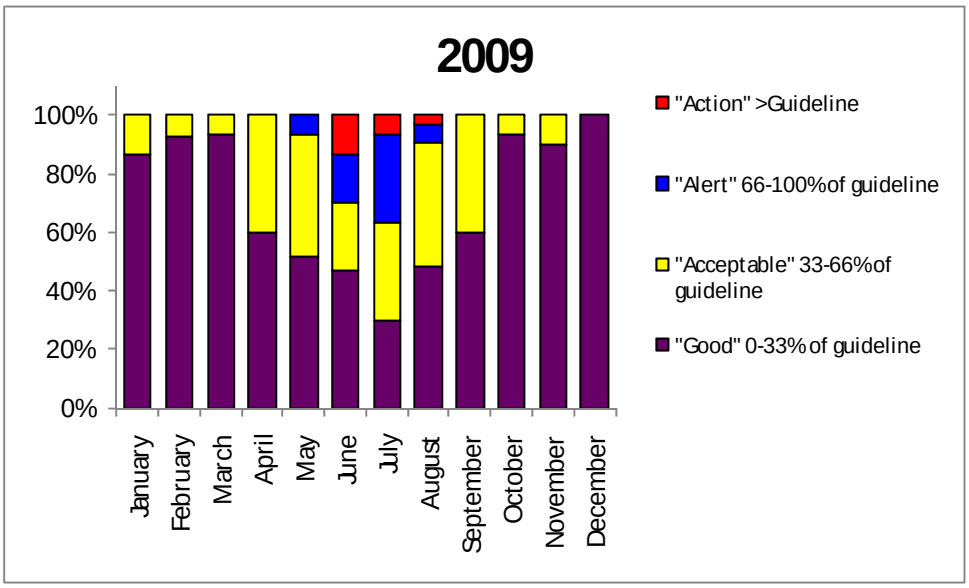


Figure 5.4: Comparison of daily PM_{10} concentrations each month during 2009 to air quality indicator categories.

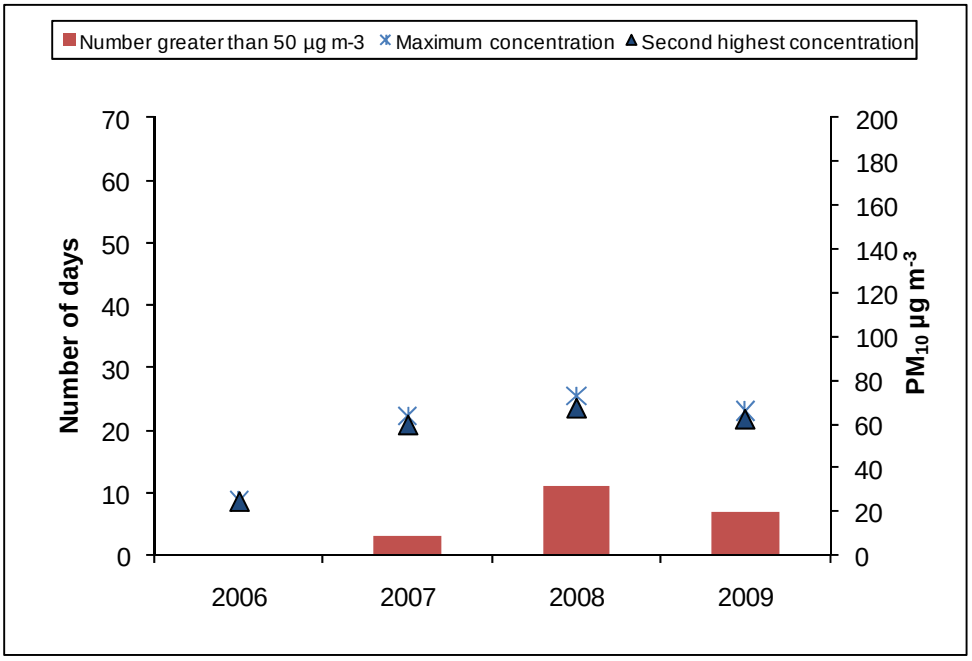


Figure 5.5: Number of days when 50 µg m^{-3} was exceeded, the maximum concentration measured using the BAM and the second highest concentration from 2006 to 2009.

The annual average PM_{10} concentration for 2009 is 15 µg m^{-3}, which is slightly lower than the 2008 annual average PM_{10} concentration of 17 µg m^{-3}. Summary statistics for PM_{10} monitoring results from 2001 to 2009 are shown in Table 5.1.

Table 5.1: Summary of PM_{10} concentrations measured at the Taupo monitoring site from 2001 to 2009*.

	2001	2002	2003	2004	2005	2006	2007	2008	2009
"Good" 0-33% of guideline	43%	59%	52%	55%	56%	96%	63%	66%	71%
"Acceptable" 33-66% of guideline	36%	33%	32%	30%	36%	4%	31%	24%	22%
"Alert" 66-100% of guideline	18%	7%	12%	12%	7%	0%	5%	7%	5%
“Action” >Guideline	2%	1%	4%	2%	1%	0%	1%	3%	2%
Percentage of valid data	12%	21%	29%	29%	30%	93%	78%	99%	99%
Annual average (µg m^{-3})	20	17	18	17	16	9	15	17	15
Exceedences (extrapolated)	7	6	12	6	3	0	3	11	7
Annual maximum (µg m^{-3})	57	54	62	65	52	25	64	73	66
Number of records	44	76	106	105	111	338	283	361	363

*2007 and 2008 data has been updated in this report based on a recent adjustment equation. Data prior to 2007 have not been adjusted for gravimetric equivalency. Note the 2008 monitoring report used a different equation and reported six exceedences of 50 µg m^{-3} for 2007 compared with three exceedences reported here.

5.3 Daily variations in PM_{10} and meteorology on high pollution days

Hourly average PM_{10} concentrations on days when the 24-hour average PM_{10} measured at Taupo exceeded 50 µg m^{-3} are shown in Figure 5.6. Exceedences (highest to lowest) occurred on 24 June, 10 July, 3 June, 26 July, 4 June and 23 June.

On most days daily variations in PM_{10} are consistent with typical high pollution episodes in urban areas of New Zealand whereby concentrations peak in the evening period with a smaller peak often occurring around 9am. Concentrations can also be elevated during the early morning period as a result of the evening pollution episode from the previous day.

In Taupo, high PM_{10} concentrations typically occur when the wind is from an easterly or south easterly direction and wind speeds are low. During the daytime the wind shifts to westerly, returning to east/south east during the evening.

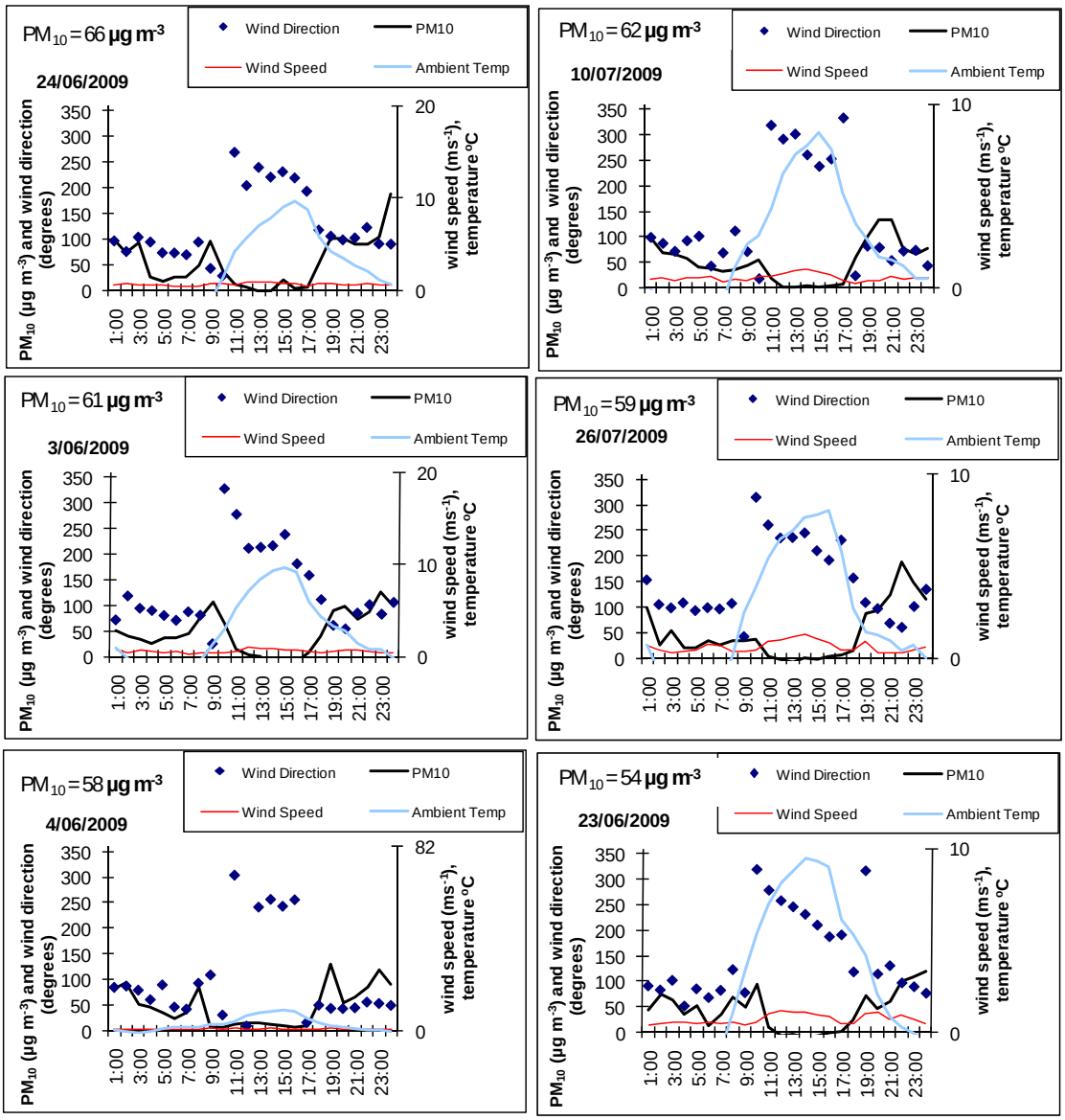


Figure 5.6: Hourly average PM_{10}, wind speed, wind direction and temperature on days when PM_{10} concentrations exceeded 50 µg m^{-3} at Taupo[1].

[1] A graph was not prepared for 24 August when PM_{10} concentrations exceeded 50 µg m^{-3} because the hourly BAM data were not considered valid on this day. The 24-hour average concentration of 57 µg m^{-3} was based on Sequential Partisol data on this day.

6 Te Kuiti

6.1 Air Quality Monitoring in Te Kuiti

During 2009, air quality monitoring in Te Kuiti took place at the Te Kuiti City Council Offices off Queen Street. This site has been used since 2003 and was used during 1998 to monitor PM_{10} (Figure 6.1). Wilton (2002) provides further descriptions of the air quality monitoring site, including a map and site layout in the *'Air Quality Monitoring Report – Waikato Region*' report. The site meets the requirements of the "Residential Neighbourhood" site classification as described in the '*Good Practice Guideline for Air Quality Monitoring and Data Management 2009'* report (MfE, 2009).

In 2009, concentrations of PM_{10} were measured at the site using a FH62 C14 BAM.

Figure 6.1: Te Kuiti Airshed and air quality monitoring site (Source: Environment Waikato, 2010).

6.2 PM_{10} Concentrations in Te Kuiti

Figure 6.2 shows the daily average PM_{10} concentrations measured at the Te Kuiti site in 2009. The maximum measured PM_{10} concentration was 53 µg m^{-3} (24-hour average) and was recorded on 4 June. Exceedences of 50 µg m^{-3} for PM_{10} also occurred on 10 July (52 µg m^{-3}), 24 July (51 µg m^{-3}) and 3 June (51 µg m^{-3}). There were three breaches of the NES in 2009 compared with two in 2008 and three in 2007.

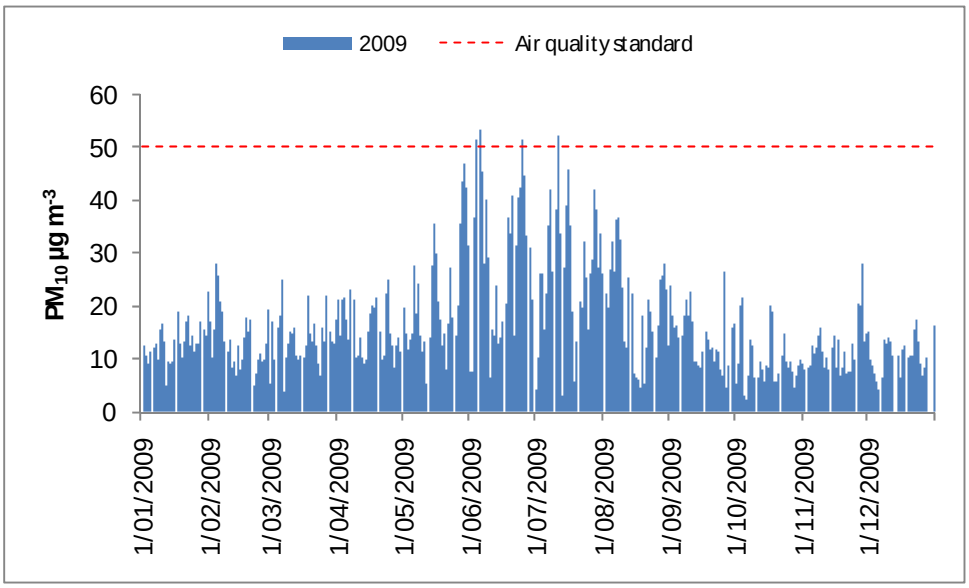


Figure 6.2: Daily winter PM_{10} concentrations measured at the Te Kuiti site during 2009.

Figure 6.3 shows the changes in PM_{10} concentrations from 2003 to 2009 relative to air quality indicator categories for Te Kuiti. Figure 6.4 shows the seasonal variations in the distribution of PM_{10} concentrations for 2009 and Figure 6.5 shows the number of days when 50 µg m^{-3} was exceeded, the maximum concentration and the second highest concentration from 2006 to 2009.

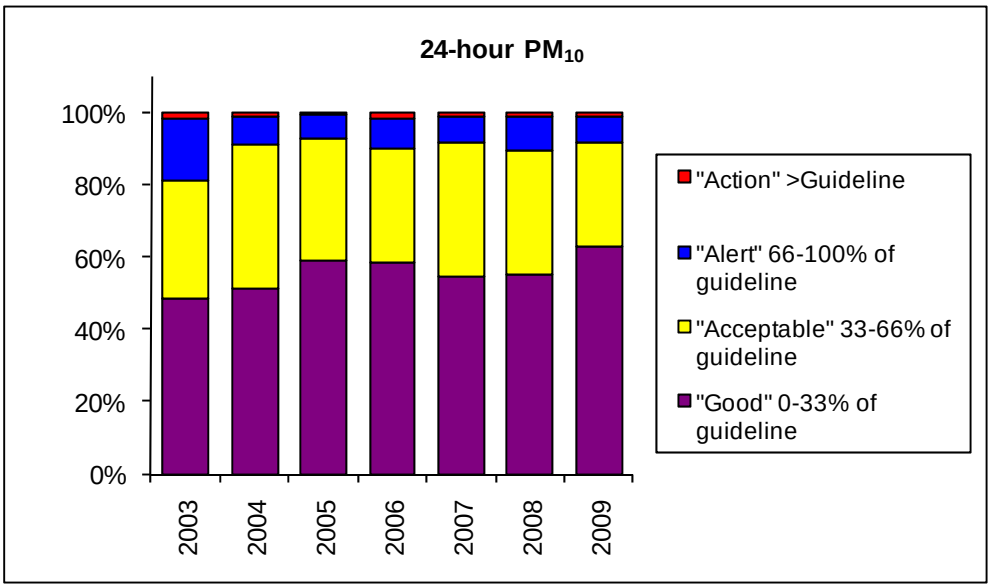


Figure 6.3: Comparison of PM_{10} concentrations measured at the Te Kuiti site from 2003 to 2009 to air quality indicator categories.

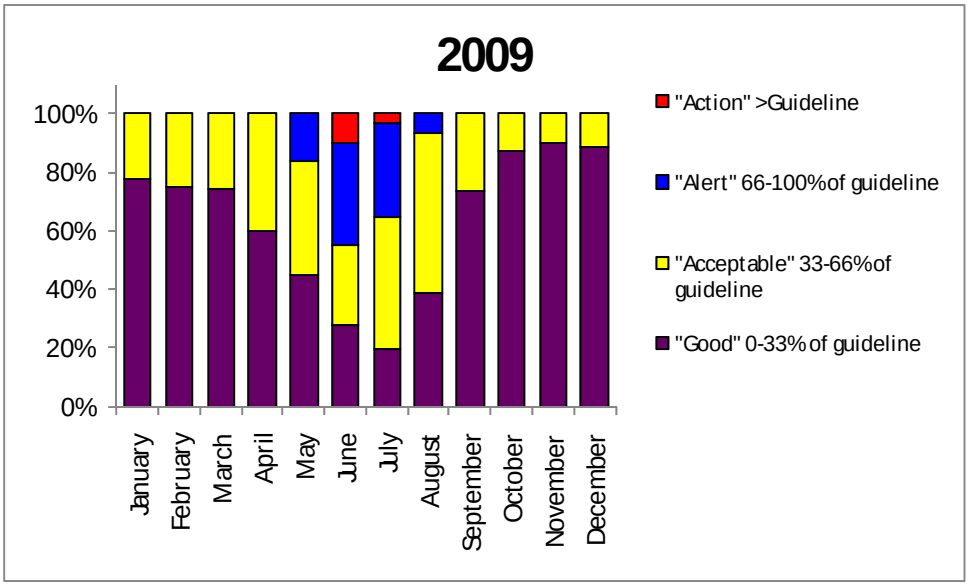


Figure 6.4: Comparison of daily PM_{10} concentrations each month during 2009 to air quality indicator categories.

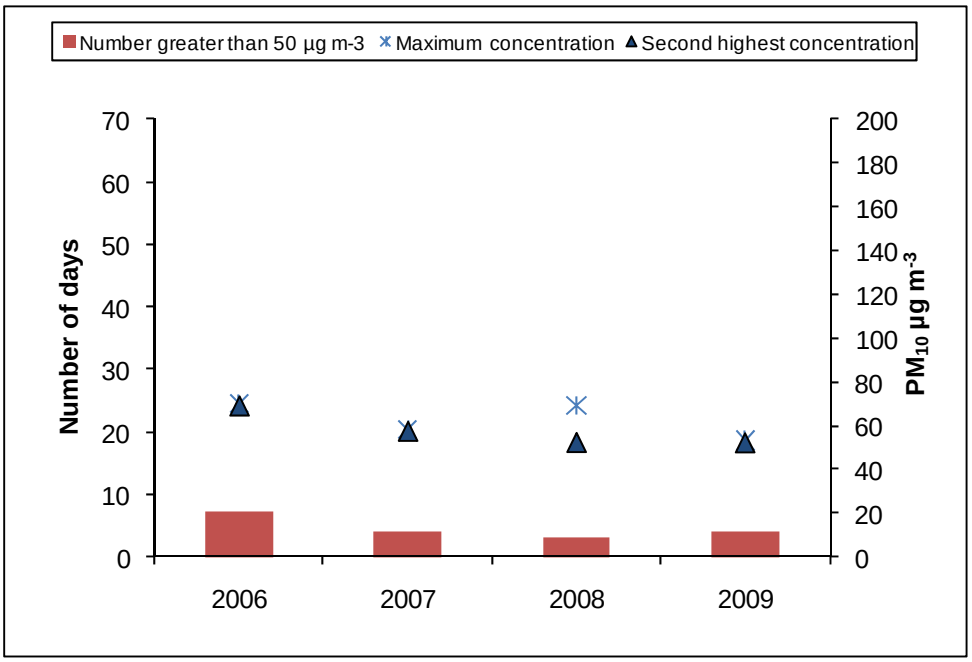


Figure 6.5: Number of days when 50 µg m^{-3} was exceeded, the maximum concentration measured and the second highest concentration from 2006 to 2009.

In 2009 the estimated annual average PM_{10} concentration is 17 µg m^{-3}. This is largely consistent with the annual average PM_{10} concentration for Te Kuiti from 2003 and 2008 (Table 6.1).

Table 6.1: Summary of PM_{10} concentrations measured at the Te Kuiti monitoring site from 2003 to 2009.

	2003	2004	2005	2006	2007	2008	2009
"Good" 0-33% of guideline	48%	51%	59%	58%	54%	55%	63%
"Acceptable" 33-66% of guideline	32%	40%	34%	31%	37%	35%	29%
"Alert" 66-100% of guideline	17%	8%	7%	9%	7%	9%	8%
“Action” >Guideline	1.7%	1.4%	1%	2%	1%	1%	1%
Percentage of valid data	63%	95%	92%	99%	79%	99%	99%
Annual average (µg m-3)	18	18	17	18	18	18	17
Measured exceedences	5	5	2	7	4	3	4
Annual maximum (µg m-3)	59	61	54	70	58	52	53
Number of records	229	346	337	363	287	362	360

6.3 Daily variations in PM_{10} and meteorology on high pollution days

Variations in hourly average PM_{10} and meteorological variables on days when 24-hour average PM_{10} concentrations exceeded 50 µg m^{-3} in Te Kuiti are shown in Figure 6.5. Daily variations in PM_{10} concentrations are typical of high pollution episodes in New Zealand and occur when wind speed is low. The wind direction during the evening period on these days appears to be generally from a southerly direction.

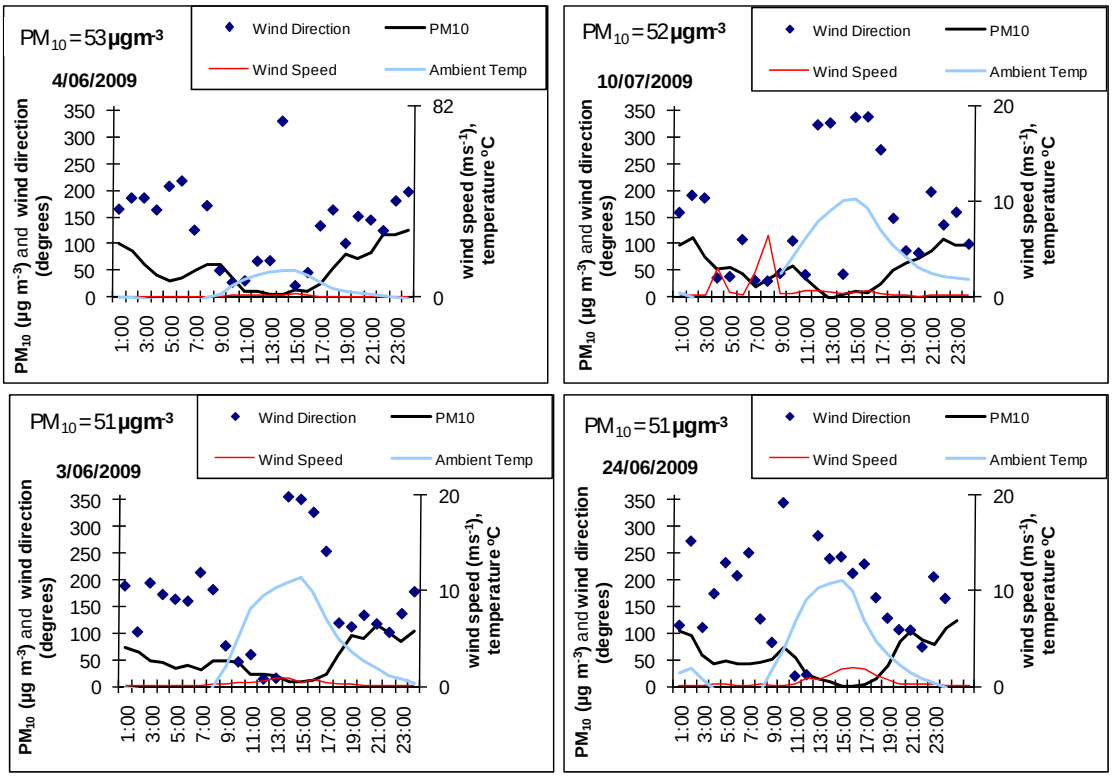


Figure 6.6: Hourly average PM_{10}, wind speed, wind direction, and temperature on days when PM_{10} concentrations exceeded 50 µg m^{-3} at Te Kuiti.

7 Matamata

7.1 Air Quality Monitoring in Matamata

Matamata is situated approximately 41 km east of Hamilton. Air quality monitoring in Matamata commenced in June 2005 at the air quality monitoring site is located at the Playcentre grounds on Farmers Road (Figure 7.1). The site meets the requirements of the 'Residential Neighbourhood' site classification as described in the *'Good Practice Guideline for Air Quality Monitoring and Data Management 2009'* report (MfE, 2009).

A FH62 C14 BAM measures PM_{10} concentrations at the Matamata Playcentre. 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 Limited and is operated and maintained by Environment Waikato staff. The BAM continuously measures PM_{10} data and it is logged at ten minute intervals.

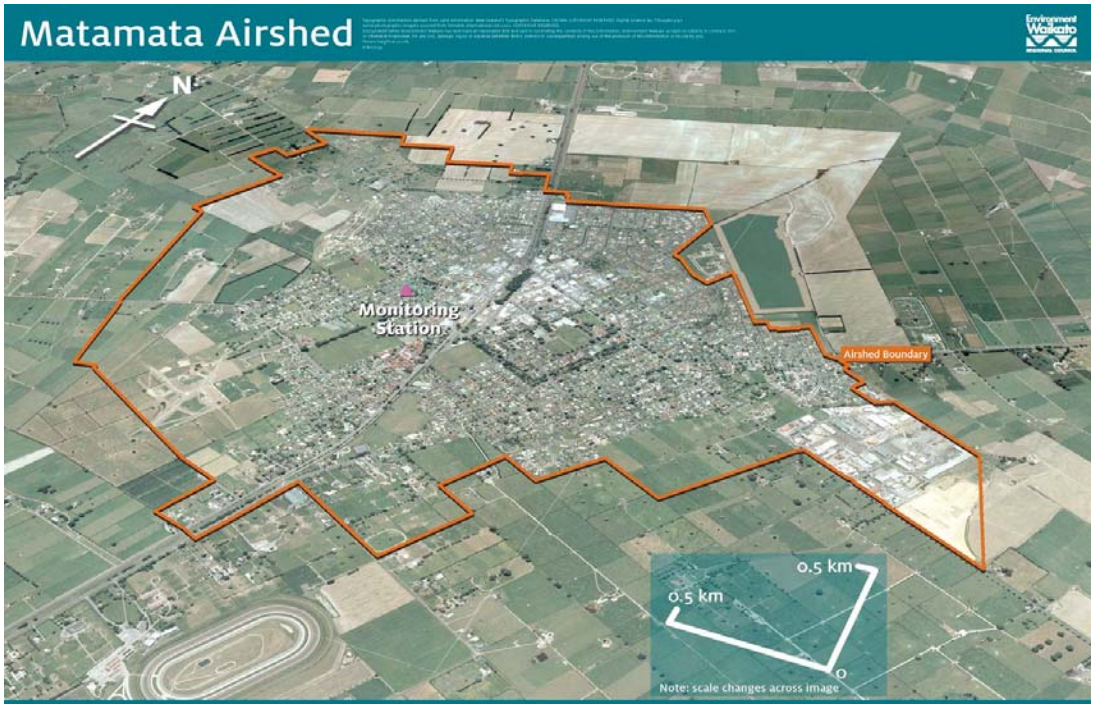


Figure 7.1: Matamata Airshed and air quality monitoring site (Source: Environment Waikato, 2010).

7.2 PM_{10} concentrations in Matamata

Figure 7.2 shows the daily average PM_{10} concentrations measured at the Matamata site for 2009. The maximum measured PM_{10} concentration was 93 µg m^{-3} and was measured on 25 September 2009. This date coincides with dust storms in Australia that impacted on air quality in certain parts of New Zealand. The second highest

PM_{10} concentration was 36 µg m^{-3} and was measured in June. The latter concentration is similar to the highest wintertime concentration during winter 2008 of 34 µg m^{-3}.

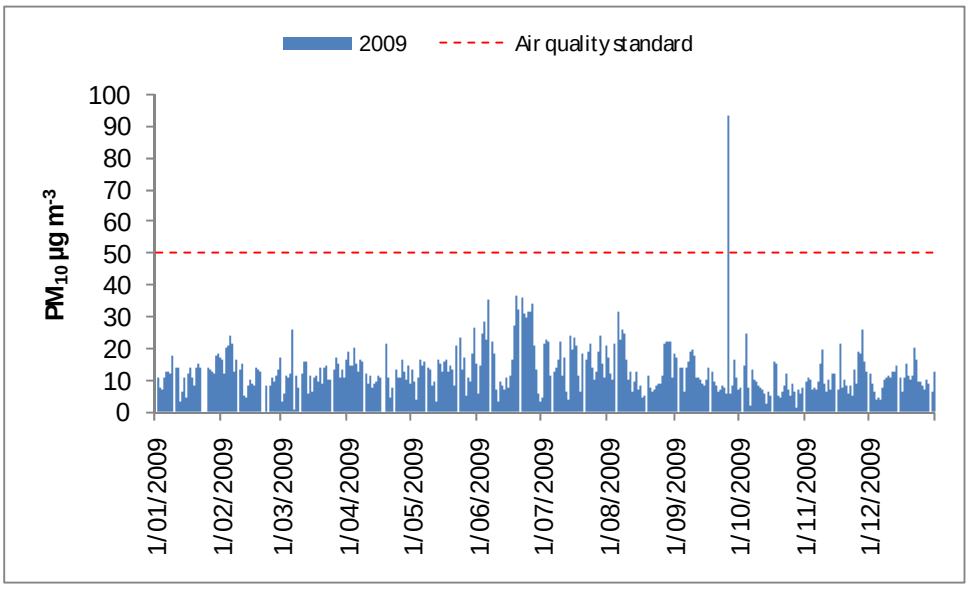


Figure 7.2: Daily winter PM_{10} concentrations measured at the Matamata site during 2009.

Concentrations of PM_{10} measured at the Matamata air quality monitoring site are compared to the MfE (2000) air quality indicator category in Figure 7.3. Concentrations are typically less than 66% of the NES. Figure 7.4 shows the seasonal variations in the distribution of PM_{10} concentrations for 2009. The number of days when 50 µg m^{-3} was exceeded, the maximum concentration and the second highest concentration from 2006 to 2009 are shown in Figure 7.5.

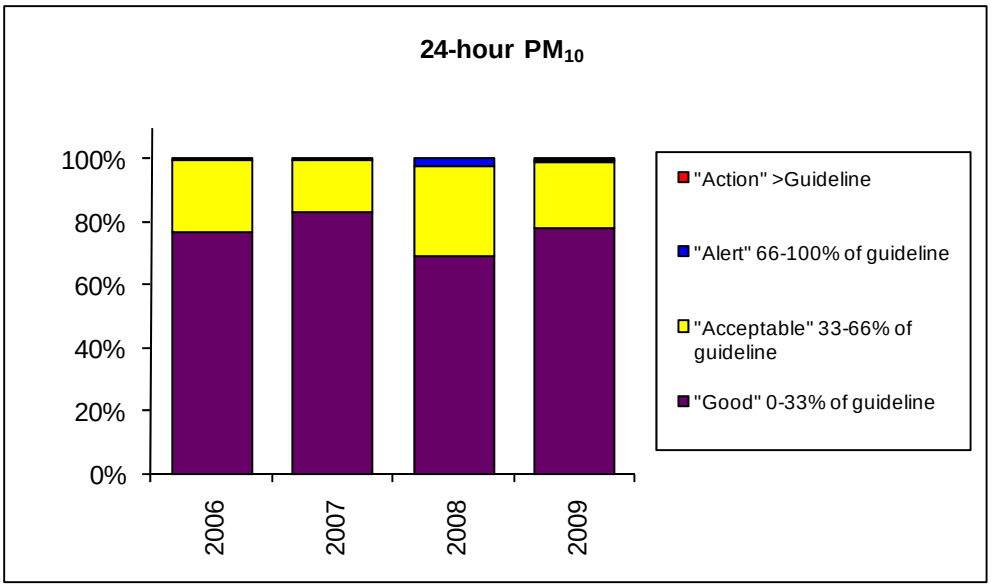


Figure 7.3: Comparison of PM_{10} concentrations measured at the Matamata site from 2006 to 2009 to air quality indicator categories.

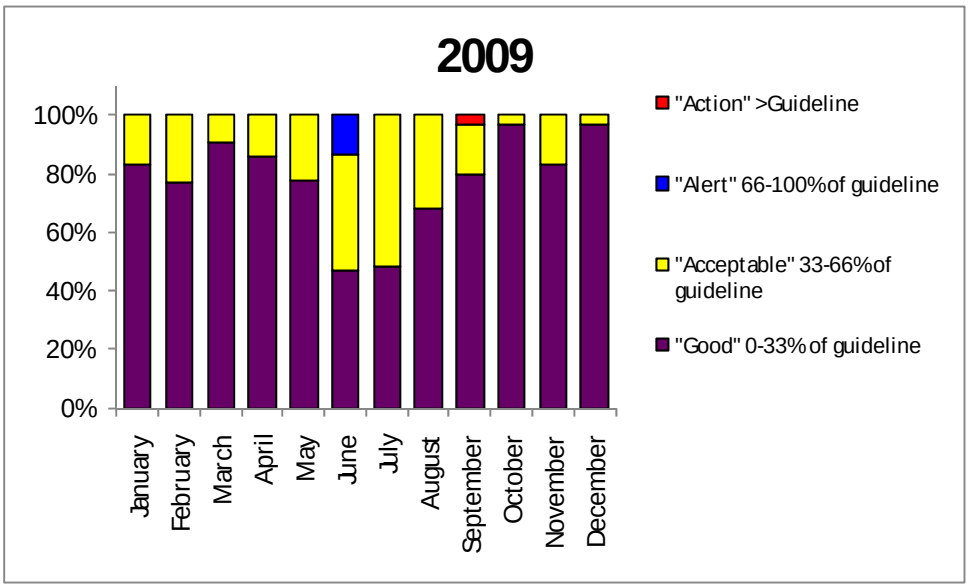


Figure 7.4: Comparison of daily PM_{10} concentrations each month during 2009 to air quality indicator categories.

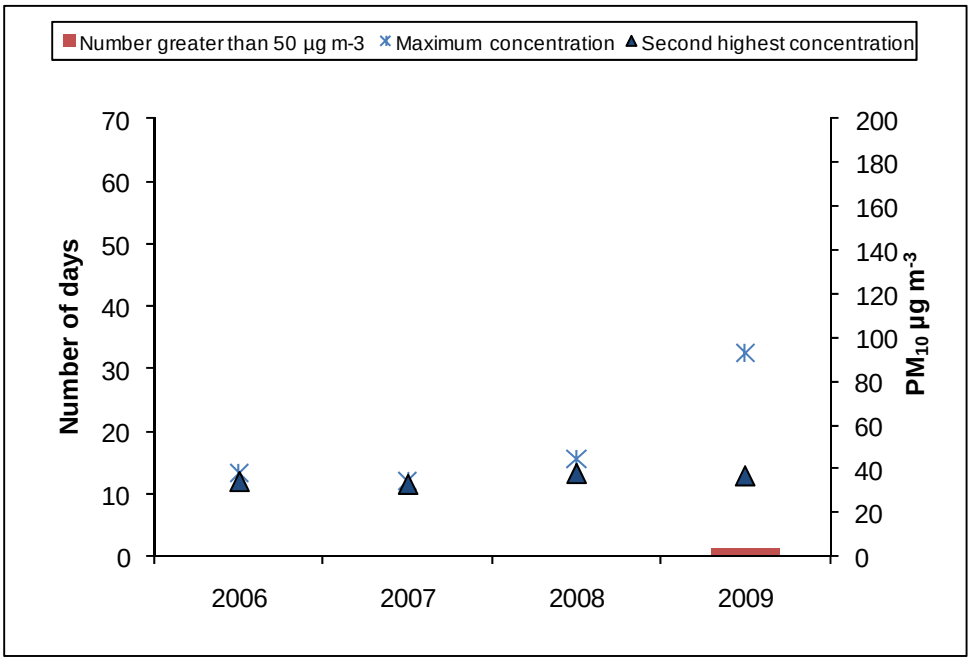


Figure 7.5: Number of days when 50 µg m^{-3} was exceeded, the maximum concentration and the second highest concentration from 2006 to 2009.

The annual average PM_{10} concentration for Matamata for 2009 is 13 µg m^{-3}. Summary statistics for PM_{10} monitoring results are shown in Table 7.1.

Table 7.1: Summary of PM_{10} concentrations measured at the Matamata monitoring site from 2005 to 2009.

	2005	2006	2007	2008	2009
"Good" 0-33% of guideline	81%	77%	83%	69%	78%
"Acceptable" 33-66% of guideline	18%	23%	16%	29%	21%
"Alert" 66-100% of guideline	1%	1%	0%	2%	1%
"Action" >Guideline	0%	0%	0%	0%	0%
Percentage of valid data	51%	99%	79%	100%	98%
Annual average (µg m^{-3})	12	13	12	15	13
Measured exceedences	0	0	0	0	1
Annual maximum (µg m^{-3})	36	38	34	45	93
Number of records	187	362	287	365	359

7.3 Daily variations in PM_{10} and meteorology on high pollution days

Daily variations in PM_{10} concentrations and meteorological variables on 25 September when concentrations measured 93 µg m^{-3} (24-hour average) are shown in Figure 7.6. Hourly average PM_{10} concentrations peaked at 7am and reached around 300 µg m^{-3}.

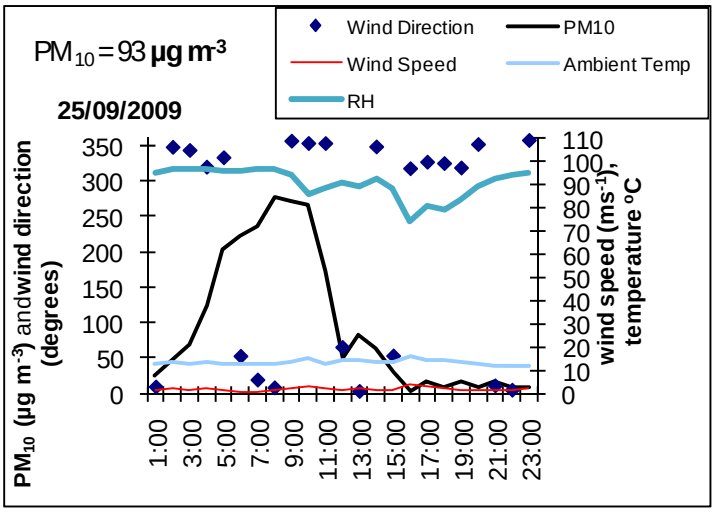


Figure 7.6: Hourly average PM_{10}, wind speed, wind direction, temperature and humidity on days when PM_{10} concentrations exceeded 50 µg m^{-3} at Matamata.

8 Putaruru

8.1 Air Quality Monitoring in Putaruru

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

A new monitoring site was established at the Bowling Club on Arapuni Street in Putaruru, in July 2006 (Figure 8.1). The map reference for the site is NZMS260 T15:533-457. Daily concentrations of PM_{10} have been measured since the site was established. Data is adjusted for gravimetric equivalency.

A FH62 C14 BAM measures PM_{10} concentrations at Putaruru (Figure 8.2).

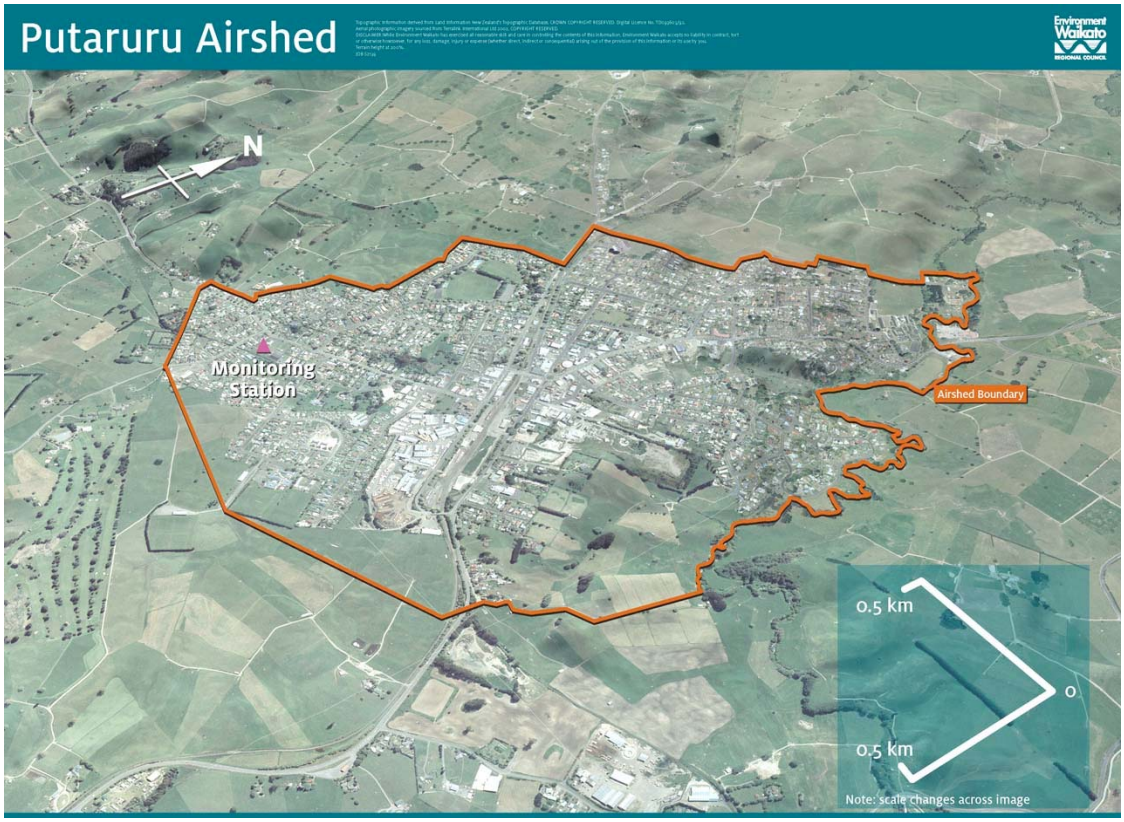


Figure 8.1: Putaruru Airshed and air quality monitoring site (Source: Environment Waikato, 2010).

Figure 8.2: Putaruru air quality monitor (Source: Environment Waikato, 2009).

8.2 PM_{10} Concentrations in Putaruru

Figure 8.3 shows the daily average PM_{10} concentrations measured at Putaruru during 2009. The maximum concentration of 55 µg m^{-3} was recorded on 22 and 23 June. A further exceedence of the 50 µg m^{-3} threshold occurred on 24 June (52 µg m^{-3}) giving two breaches of the NES for 2009. In 2008, two summer time exceedences of 50 µg m^{-3} were recorded. These exceedences were attributed to road works that were taking place near the air quality monitor. There were no measured winter time exceedences of the NES during 2008. Two exceedences of 50 µg m^{-3} were recorded during 2007 resulting in one breach of the NES.

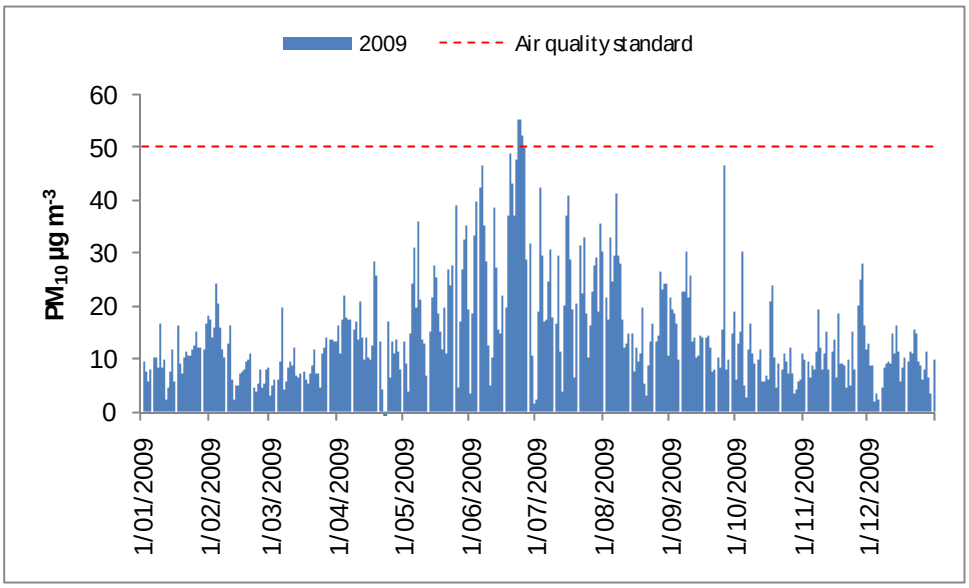


Figure 8.3: Daily winter PM_{10} concentrations measured at the Putaruru site during 2009.

Figure 8.4 compares PM_{10} concentrations measured at Putaruru to the MfE (2000) air quality indicator category. A similar distribution in PM_{10} concentrations across all years is observed. Figure 8.5 shows seasonal variations in the distribution of PM_{10} concentrations for 2009. Figure 8.6 shows the number of days when 50 µg m^{-3} was exceeded, the maximum concentration and the second highest concentration from 2006 to 2009.

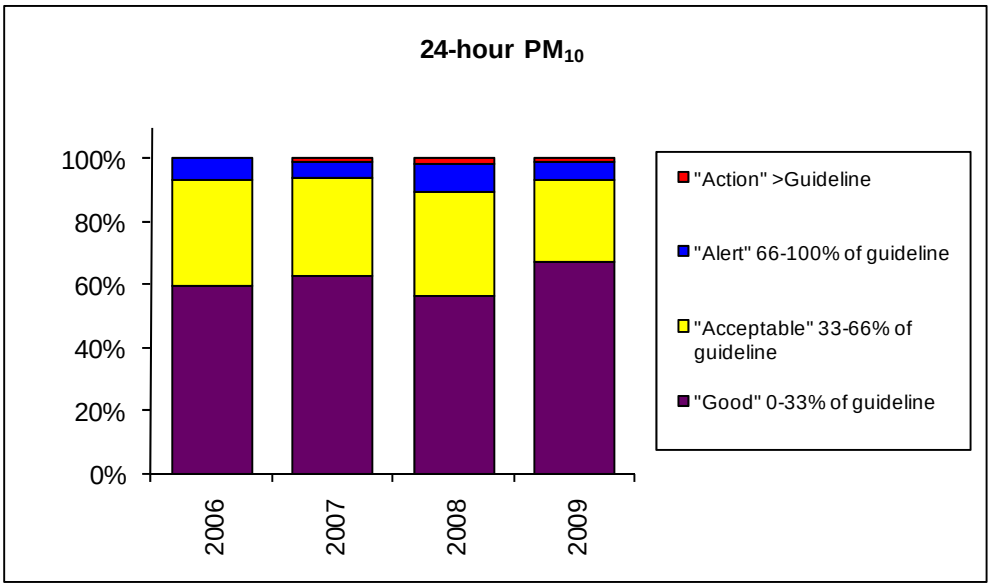


Figure 8.4: Comparison of PM_{10} concentrations measured at the Putaruru site from 2006 to 2009 to air quality indicator categories.

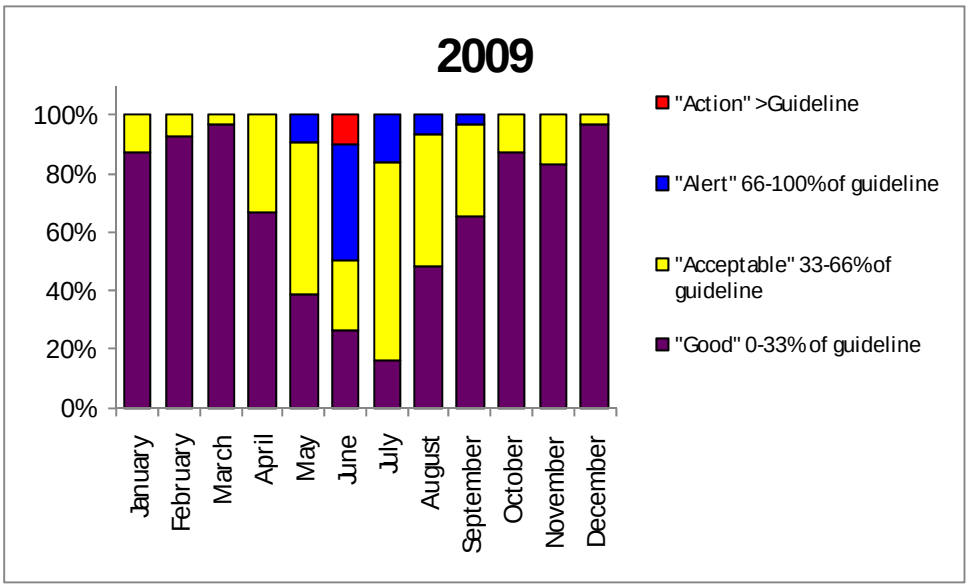


Figure 8.5: Comparison of daily PM_{10} concentrations for 2009 to air quality indicator categories.

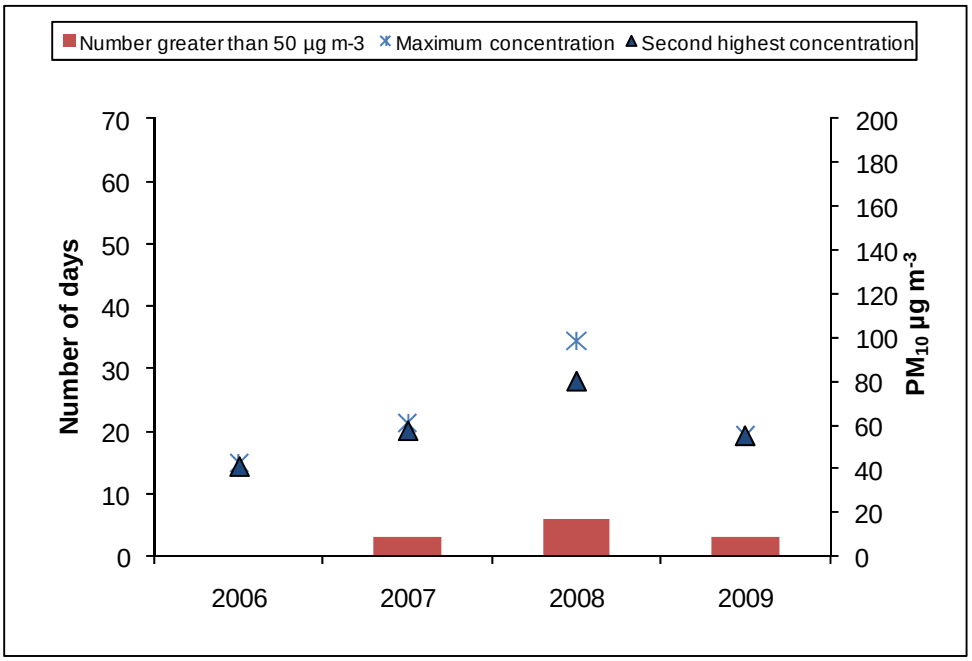


Figure 8.6: Number of days when 50 µg m^{-3} was exceeded, the maximum concentration and the second highest concentration from 2006 to 2009.

In 2009, the annual average PM_{10} concentration for Putaruru was 15 µg m^{-3}. This compares with an annual average PM_{10} guideline of 20 µg m^{-3} (MfE, 2002). Summary statistics for PM_{10} monitoring results are shown in Table 8.1.

Table 8.1: Summary of PM_{10} concentrations measured at the Putaruru monitoring site from 2006 to 2009.

	2006	2007	2008	2009
"Good" 0-33% of guideline	60%	62%	56%	67%
"Acceptable" 33-66% of guideline	34%	31%	33%	26%
"Alert" 66-100% of guideline	7%	5%	9%	6%
“Action” >Guideline	0%	1%	2%	1%
Percentage of valid data	45%	100%	99%	100%
Annual average (µg m^{-3})	16	16	18	15
Measured exceedences	0	3	4	3
Annual maximum (µg m^{-3})	42	56	45	55
Number of records	166	364	365	364

9 Ngaruawahia

9.1 Air Quality Monitoring in Ngaruawahia

Ngaruawahia is located 19 kilometres north west of Hamilton and is situated at the junction of the Waikato and Waipa Rivers in the central Waikato basin. 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).

A ThermoAndersen FH62 C14 BAM measures PM_{10} concentrations at Ngaruawahia (Figure 9.2).

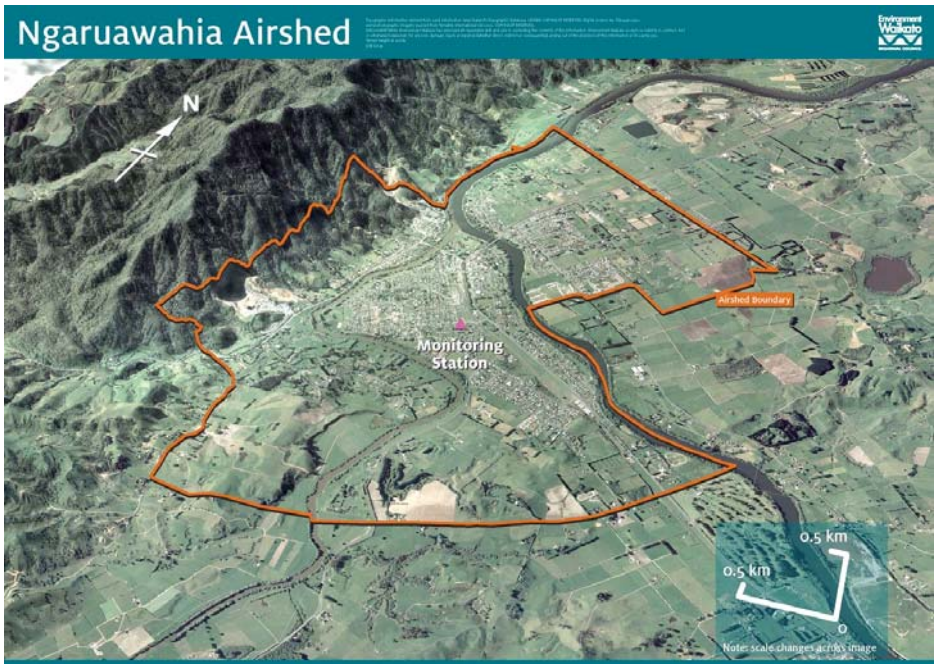


Figure 9.1: Ngaruawahia Airshed and monitoring site (Source: Environment Waikato, 2010).

Figure 9.2: Ngaruawahia air quality monitor (Source: Environment Waikato, 2009).

9.2 PM_{10} Concentrations in Ngaruawahia

The maximum measured PM_{10} concentration in Ngaruawahia during 2009 was 113 µg m^{-3} (24-hour average). This concentration was measured on the 25 September and coincides with the Australian dust storms. The second highest PM_{10} concentration of 43 µg m^{-3} was recorded on 25 June. The NES for PM_{10} was not breached in Ngaruawahia during 2009. No exceedences of 50 µg m^{-3} were measured during 2008. Air quality data for Ngaruawahia is not adjusted for gravimetric equivalency.

Daily average PM_{10} concentrations measured at the Ngaruawahia site during 2009 are shown in Figure 9.3.

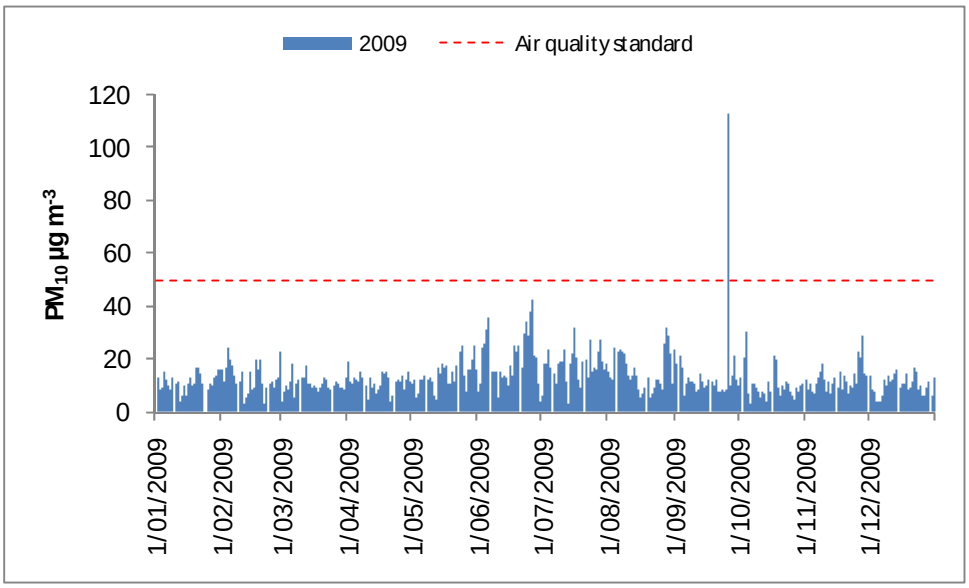


Figure 9.3: Daily winter PM_{10} concentrations measured at the Ngaruawahia site during 2009.

Concentrations of PM_{10} relative to air quality indicator categories at Ngaruawahia for 2009 are shown in Figure 9.4. Ninety nine percent of PM_{10} concentrations were within the 'acceptable' and 'good' categories. Seasonal variations in the distribution of PM_{10} concentrations are shown in Figure 9.5. The number of days when 50 µg m^{-3} was exceeded, the maximum concentration and the second highest concentration from 2008 to 2009 are shown in Figure 9.6.

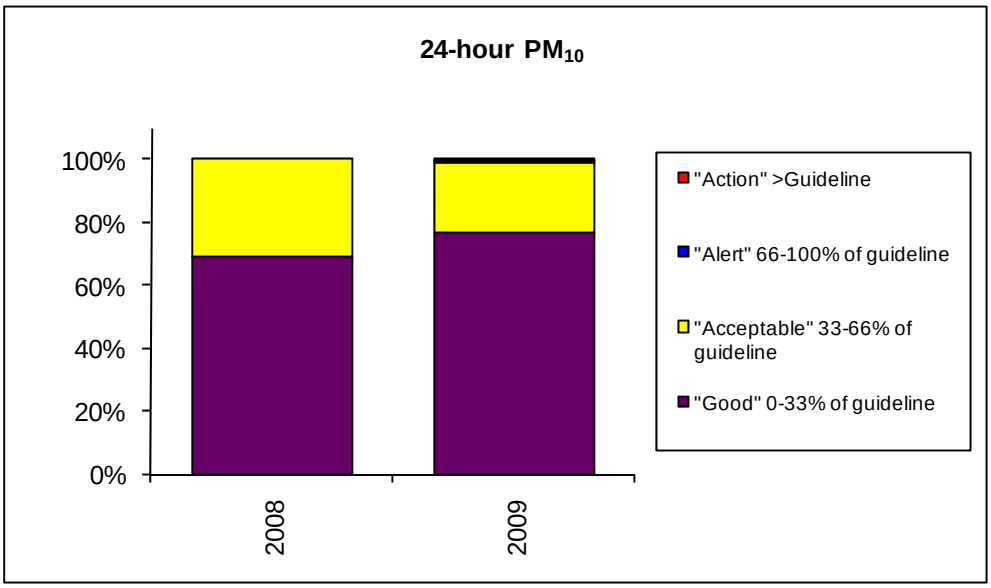


Figure 9.4: Comparison of PM_{10} concentrations measured at the Ngaruawahia site in 2008 and 2009 air quality indicator categories.

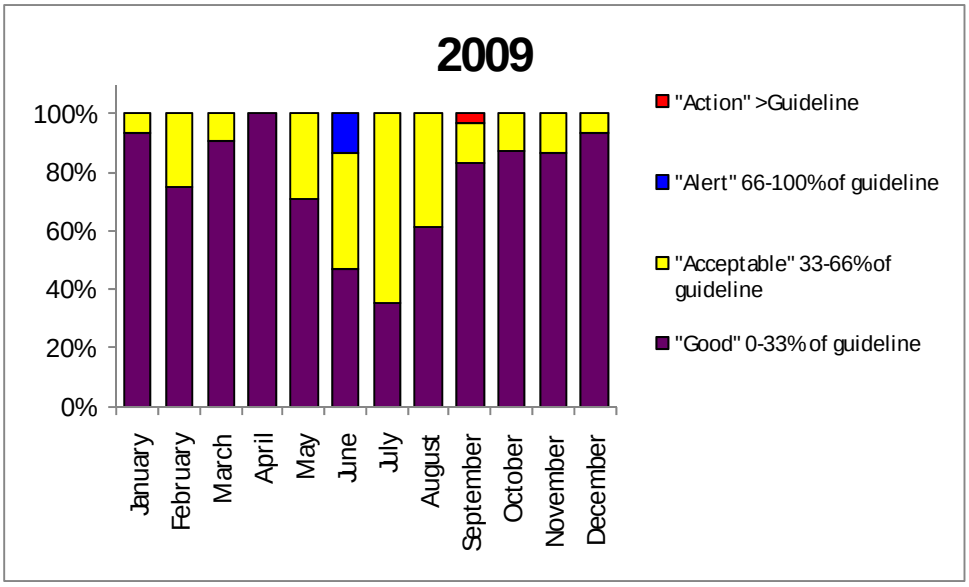


Figure 9.5: Comparison of daily PM_{10} concentrations each month during 2009 to air quality indicator categories.

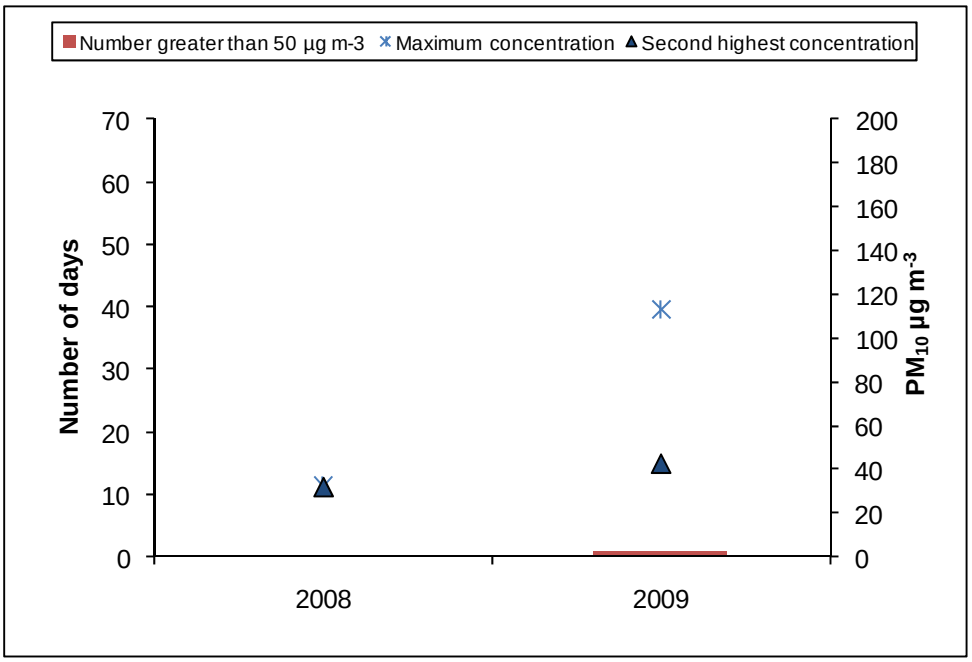


Figure 9.6: Number of days when 50 µg m^{-3} was exceeded, the maximum concentration and the second highest concentration in 2008 and 2009.

The annual average PM_{10} concentration for Ngaruawahia for 2009 is 14 µg m^{-3}, which is the same for 2008. Summary statistics for PM_{10} monitoring results are shown in Table 9.1.

Table 9.1: Summary of PM_{10} concentrations measured at the Ngaruawahia monitoring site for 2008 and 2009.

	2008	2009
"Good" 0-33% of guideline	69%	77%
"Acceptable" 33-66% of guideline	31%	22%
"Alert" 66-100% of guideline	0%	1%
“Action” >Guideline	0%	0%
Percentage of valid data	65%	100%
Annual average (µg m^{-3})	14	14
Measured exceedences	0	1
Annual maximum (µg m^{-3})	32	113
Number of records	238	364

10 Waihi

10.1 Air Quality Monitoring in Waihi

Waihi is located 66 kilometers north west of Hamilton and 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.

Figure 10.1 shows the monitoring site at Grey Street, Waihi, around 50 meters north of the corner of Dobson Street and Grey Street. Daily concentrations of PM_{10} have been measured since the site was established in 2008.

A Sequential Partisol Sampler is used to measure PM_{10} concentrations at Waihi (Figure 10.2).

Figure 10.1: Waihi Airshed and air quality monitoring site (Source: Environment Waikato, 2010).

Figure 10.2: Waihi air quality monitor (Source: Environment Waikato, 2009).

10.2 PM_{10} concentrations in Waihi

No exceedences of 50 µg m^{-3} were measured at the air quality monitoring site in Waihi during 2008. The maximum measured PM_{10} concentration was 37 µg m^{-3} and was measured on 27 November. The highest winter time PM_{10} concentration measured during 2009 was 33 µg m^{-3}. The maximum measured PM_{10} concentration for 2008 was 33 µg m^{-3}.

Daily average PM_{10} concentrations measured at the Waihi site during 2009 are shown in Figure 10.3.

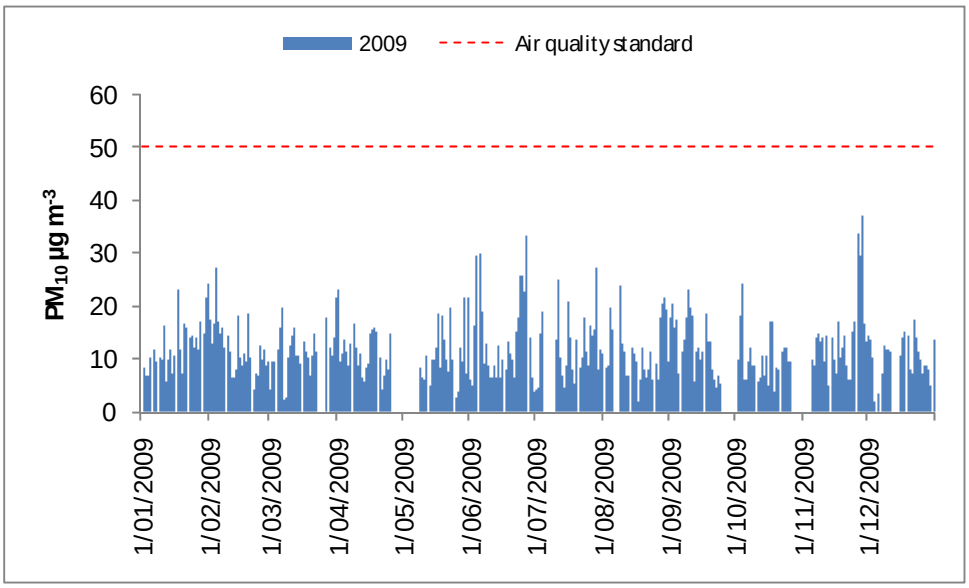


Figure 10.3: Daily winter PM_{10} concentrations measured at the Waihi site during 2009.

Figure 10.4 shows 2009 concentrations of PM_{10} relative to air quality indicator categories at Waihi. Figure 10.5 shows seasonal variations in the distribution of PM_{10} concentrations. Figure 10.6 shows the number of days when 50 µg m^{-3} was exceeded, the maximum concentration and the second highest concentration from 2008 to 2009.

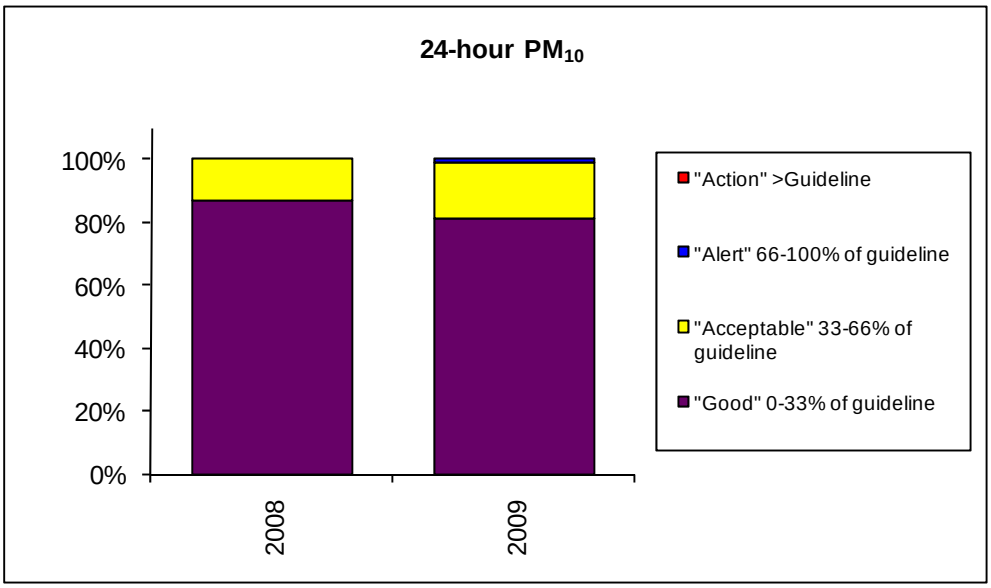


Figure 10.4: Comparison of PM_{10} concentrations measured at the Waihi site in 2008 and 2009 to air quality indicator categories.

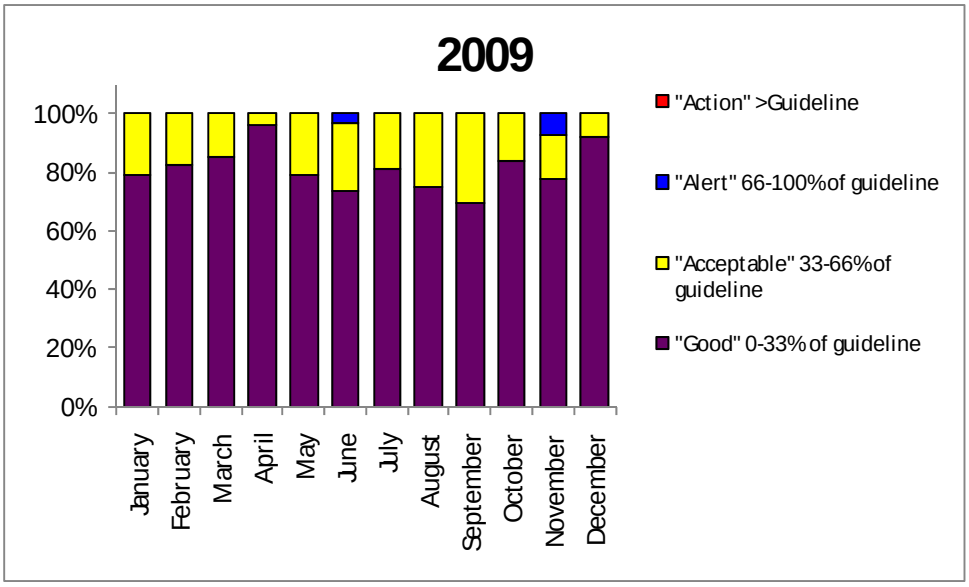


Figure 10.5: Comparison of daily PM_{10} concentrations during 2009 to air quality indicator categories.

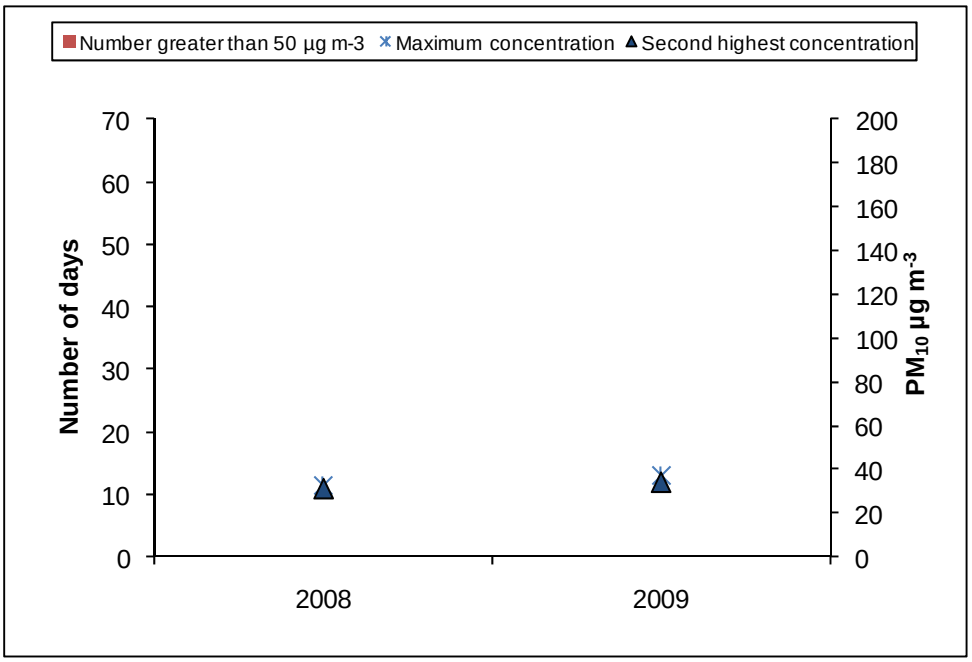


Figure 10.6: Number of days when 50 µg m^{-3} was exceeded, the maximum concentration and the second highest concentration in 2008 and 2009.

The estimated annual average PM_{10} concentration for Waihi for 2009 is 12 µg m^{-3}. Table 10.1 shows the summary statistics for PM_{10} monitoring results for 2008 and 2009.

Table 10.1: Summary of PM_{10} concentrations measured at the Waihi monitoring site for 2008 and 2009.

	2008	2009
"Good" 0-33% of guideline	87%	81%
"Acceptable" 33-66% of guideline	13%	18%
"Alert" 66-100% of guideline	0%	1%
“Action” >Guideline	0%	0%
Percentage of valid data	84%	87%
Annual average (µg m^{-3})	12	12
Measured exceedences	0	0
Annual maximum (µg m^{-3})	32	34
Number of records	309	317

11 Turangi

11.1 Air Quality Monitoring in Turangi

Turangi is located on the banks of the Tongariro River near the southern end of Lake Taupo and is 50 kilometres south west of Taupo. Turangi has a population of around 3500 and is the second largest population centre in the Taupo District. It is near the edge of the Kaimanawa Ranges.

In April 2009 a new monitoring site was established at 16 Ohuanga Road, Turangi (Figure 11.1). Daily and hourly average PM_{10} concentrations were measured using a BAM.

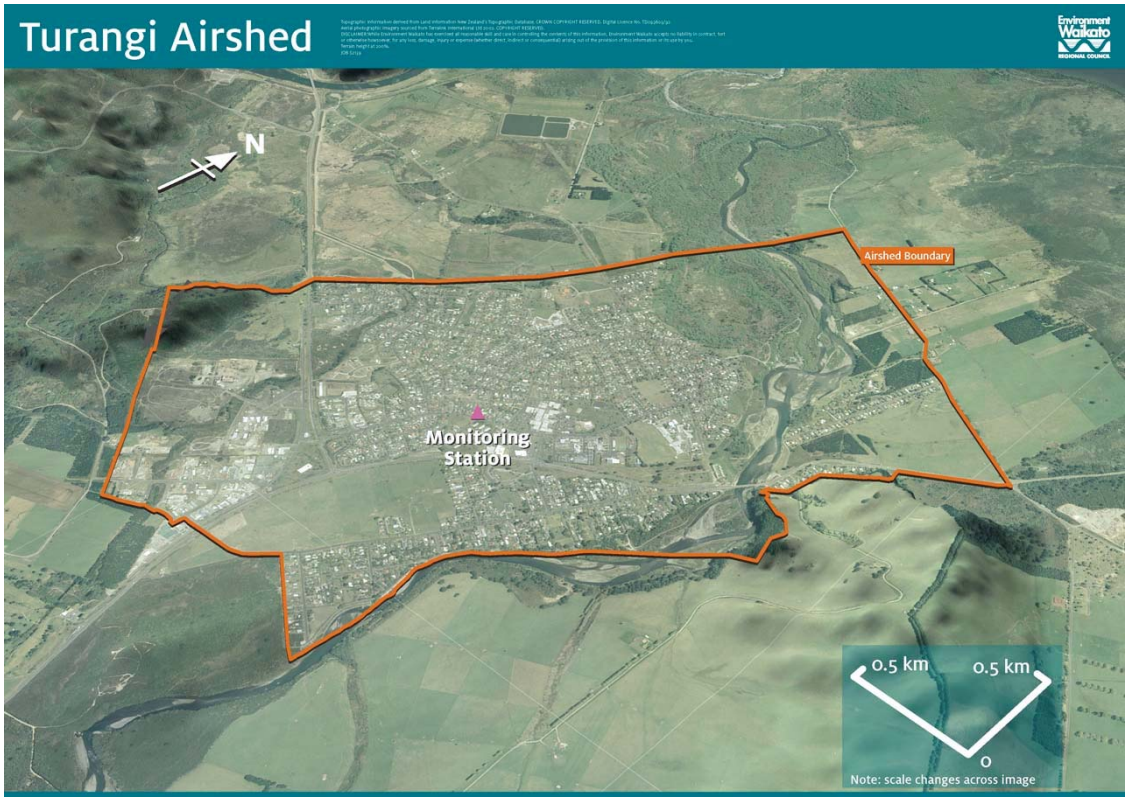


Figure 11.1: Turangi Airshed and air quality monitoring site (Source: Environment Waikato, 2010).

Figure 11.2: Turangi air quality monitor (Source: Environment Waikato, 2010).

11.2 PM_{10} Concentrations in Turangi

The maximum PM_{10} concentration in Turangi was 25 µg m^{-3} (24-hour average) and was recorded on 26 August. No exceedences of 50 µg m^{-3} were measured at Turangi during 2009.

Daily average PM_{10} concentrations measured at the Turangi site during 2009 are shown in Figure 11.3.

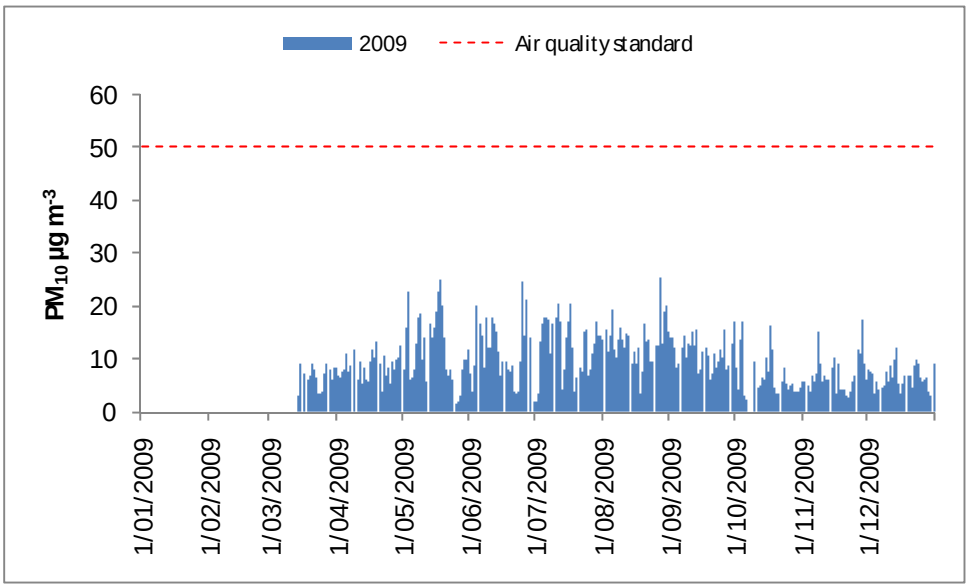


Figure 11.3: Daily winter PM_{10} concentrations measured at the Turangi site from March to December 2009.

Figure 11.4 shows concentrations of PM_{10} relative to air quality indicator categories at Turangi during 2009. Eighty eight percent of data is within the 'good' category. Seasonal variations in the distribution of PM_{10} concentrations are shown in Figure 11.5. Figure 11.6 shows the number of days when 50 µg m^{-3} was exceeded, the maximum concentration and the second highest concentration for 2009.

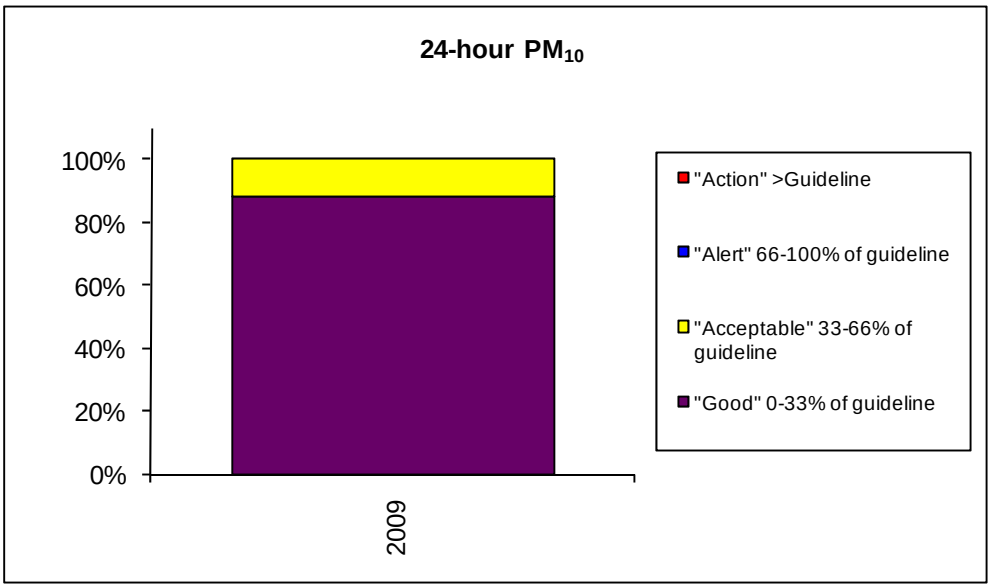


Figure 11.4: Comparison of PM_{10} concentrations measured at the Turangi site in 2009 to air quality indicator categories.

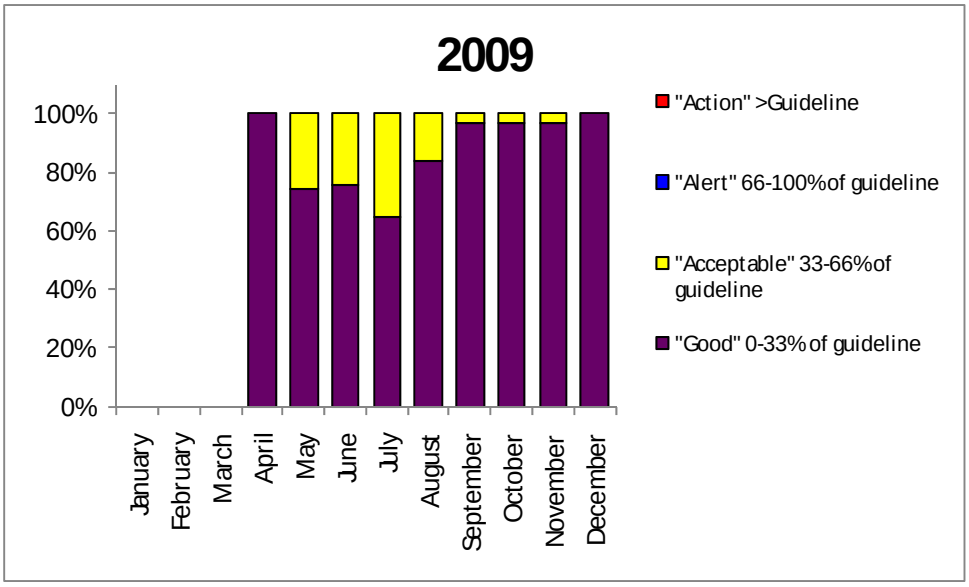


Figure 11.5: Comparison of daily PM_{10} concentrations for 2009 to air quality indicator categories.

The annual average PM_{10} concentration for Turangi for 2009 is 9 µg m^{-3}. Table 11.1 shows summary statistics for PM_{10} monitoring results.

Table 11.1: Summary of PM_{10} concentrations measured at the Turangi monitoring site for 2009.

	2009
"Good" 0-33% of guideline	88%
"Acceptable" 33-66% of guideline	12%
"Alert" 66-100% of guideline	0%
“Action” >Guideline	0%
Percentage of valid data	79%
Annual average (µg m^{-3})	9
Measured exceedences	0
Annual maximum (µg m^{-3})	25
Number of records	288

12 Summary

In 2009 Environment Waikato measured PM_{10} concentrations at air quality monitoring sites in Hamilton, Tokoroa, Taupo, Te Kuiti, Matamata, Putaruru, Ngaruawahia, Waihi and Turangi.

The NES for PM_{10} was exceeded in Hamilton, Tokoroa, Taupo, Te Kuiti and Putaruru. The maximum measured PM_{10} concentrations, number of exceedences of 50 µg m^{-3} and the annual average PM_{10} concentration are shown in Table 12.1. More than one exceedence of the 50 µg m^{-3} constitutes a breach of the NES. The annual average concentrations for each location are also shown and compare with the MfE guideline for annual averages of 20 µg m^{-3}.

Table 12.1: Summary of PM_{10} monitoring results for 2009.

	Maximum measured concentration µg m^{-3-}	Measured exceedences	Number of NES breaches	Annual Average
Hamilton*	101 µg m^{-3}	3	2	14 µg m^{-3}
Tokoroa*	80 µg m^{-3}	17	16	18 µg m^{-3}
Taupo	66 µg m^{-3}	7	6	17 µg m^{-3}
Te Kuiti	53 µg m^{-3}	4	3	17 µg m^{-3}
Matamata*	93 µg m^{-3}	1	0	13 µg m^{-3}
Putaruru	55 µg m^{-3}	2	1	15 µg m^{-3}
Ngaruawahia*	113 µg m^{-3}	1	0	14 µg m^{-3}
Waihi	32 µg m^{-3}	0	0	12 µg m^{-3}
Turangi	25 µg m^{-3}	0	0	9 µg m^{-3}

* one non-winter exceedence caused by PM_{10} that originated in Australian dust storm.

In Hamilton, concentrations of benzene were within the 2009 guideline of 10 µg m^{-3} and the 2010 guideline of 3.6 µg m^{-3}. The highest annual concentration was measured at the Greenwood Street monitoring site and was 3.2 µg m^{-3}. Concentrations of toluene and xylene were well within acceptable levels.

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