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Air quality monitoring report for Hamilton, Tokoroa, Taupo, Te Kuiti, Putaruru, Matamata, Ngaruawahia and Turangi – 2012

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Executive summary

Air quality monitoring in the Waikato Region focuses primarily on concentrations of PM_{10}, the main air contaminant of concern. The National Environmental Standards for Air Quality (NESAQ) has set a maximum concentration limit for PM_{10} of 50 µg/m^3 when averaged over 24 hours (referred to as an ambient air quality standard). The NESAQ allows for one exceedance of this standard per rolling 12 month period. More than one exceedance within a rolling 12 month period is a breach of the standard. The NESAQ requires air quality monitoring to take place in areas that are likely to exceed the standard for PM_{10}.

The 2011 amendment to the NESAQ has introduced extended timeframes for Airsheds[1] to comply with the standard for PM_{10}. Airsheds are split in to three categories depending on the average number of exceedances the airshed has for the previous five year period. The first category includes airsheds with more than 10 exceedances a year. These airsheds must achieve no more than three exceedances by 1 September 2016 and no more than one exceedance by 1 September 2020. The Waikato Region has one such airshed that falls within this category, namely Tokoroa. The second category includes airsheds with more than one exceedance but less than 10 exceedances. This category of airshed must achieve no more than one exceedance by 1 September 2016. Based on the air quality monitoring data collected up to the end of 2012, the Waikato Region has three airsheds that fall within this category, namely Taupo, Te Kuiti and Putaruru. The third category includes all other airsheds which must continue to achieve no more than one exceedance of the standard.

During 2012, concentrations of PM_{10} were measured in eight out of the region's 20 gazetted airsheds with two stations located in the Hamilton airshed and one each in the Tokoroa, Taupo, Te Kuiti, Matamata, Putaruru, Ngaruawahia and Turangi airsheds. Monitoring of sulphur dioxide, benzene, toluene, ethylbenzene and xylenes was also carried out in Hamilton during 2012. This report compares PM_{10} concentrations measured in these airsheds to the NESAQ standard for PM_{10} and to the Ministry for the Environment's air quality guidelines and indicator categories.

The NESAQ PM_{10} standard was breached in Tokoroa (15 exceedances) and Te Kuiti (one exceedance) during 2012. The single exceedance in Te Kuiti during 2012 which reached 61 µg/m^3 triggered an NES breach as it was the second exceedance measured within a 12 month period (the first exceedance having occurred in late 2011). There were no breaches in the other six airsheds but there was one exceedance which reached a concentration of 53 µg/m^3 measured in Taupo.

In comparison with previous years, 2012 is the first year in which there has only been two breaching airsheds. Tokoroa recorded a similar number of breaches to 2011 and 2010 but the maximum measured concentration of 75 µg/m^3 was lower than the 2010 maximum of 99 µg/m^3. Despite this, there is no indication of an improving trend in PM_{10} concentrations in Tokoroa. However, concentrations of PM_{10} in Taupo, Te Kuiti and Putaruru all show indications of an improving trend based on statistical analysis of data over a six or more year monitoring period.

Table E1 shows summary PM_{10} data for all sites for 2012 including the maximum measured concentration, the number of exceedances of 50 µg/m^3, breaches of the NESAQ and the annual average PM_{10} concentration. The latter can be compared with an annual average guideline of 20 µg/m^3 (MfE, 2002).

[1] An airshed is an air quality management area that has been defined by a regional council or unitary authority as an area that potentially could or is known to breach the standards for air quality. These airshed designations must be gazetted by the Ministry for the Environment.

Concentrations of SO_2 were measured in Hamilton at the corner of Lorne Street and Ohaupo Road on the Waikato Hospital site adjacent to the Bloodbank Service from March 2012 to August 2012. The hourly measurements were well below the NESAQ for SO_2 of 350 µg/m^3 (hourly average) and the 24 hour averages were well below the ambient air quality guideline of 120 µg/m^3 and the World Health Organisation guideline of 20 µg/m^3 (24 hour average).
In Hamilton, concentrations of benzene were within the national guideline of 3.6 µg/m^3 and an improving or "levelling" trend is evident for annual average concentrations at all sites. The highest annual concentration was measured at the Greenwood Street monitoring site and was 2.7 µg/m^3. Concentrations of toluene, ethylbenzene and xylene were also well within acceptable international criteria.

Table E1 Summary of PM_{10} monitoring results for 2012.

Station	Maximum 24 hour concentration (µg/m$^{3)}$	Measured Exceedances	Number of NES breaches	Annual Average
Hamilton (Peachgrove Rd)	42	0	0	13.4
Hamilton (Ohaupo Rd)	41	0	0	13.5
Tokoroa	75	15	14	17.2
Taupo	53	1	0	12.9
Te Kuiti	61	1	1*	16.4
Matamata	36	0	0	12.5
Putaruru	38	0	0	11.9
Ngaruawahia	31	0	0	13.1
Turangi	31	0	0	10.0

*Breach based on two exceedances over previous 12 month period.

1 Introduction

The National Environmental Standards for Air Quality (NESAQ) has mandated ambient air quality standards (maximum concentration limits) for five contaminants along with averaging periods and number of allowable exceedances (refer to Table 1.1). A breach of the standards occurs when more than the allowable number of exceedances occurs within the specified period.

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 ambient air quality standard in Hamilton, Tokoroa, Taupo, Te Kuiti and Putaruru during winter months. The main source of PM_{10} concentrations in these areas during the winter months is solid fuel burning for domestic home heating.

In 2012, PM_{10} concentrations were measured in Hamilton, Tokoroa, Taupo, Te Kuiti, Matamata, Putaruru, Ngaruawahia and Turangi. In Hamilton additional monitoring was carried out for sulphur dioxide as well as benzene, ethyl benzene, toluene and xylenes. Monitoring of sulphur dioxide had not been carried out previously as part of the air quality monitoring programme. Prior to 2012, monitoring of PM_{10} has also taken place in Waihi[2].

The required target date for compliance with the NESAQ for PM_{10} was reviewed in 2011 and revised from 2013 to 2016 for most airsheds in New Zealand. Airsheds with more than one exceedance but less than 10 exceedances of the 50 µg/m^3 standard have to achieve no more than one exceedance by 1 September 2016. Airsheds that have more than 10 exceedances of 50 µg/m^3 have an interim target of no more than three exceedances by 1 September 2016 and a final target of no more than one exceedance by 1 September 2020. Based on monitoring data collected up to 2012, Tokoroa has to meet the interim 2016 target of no more than three exceedances and the 2020 target of no more than one exceedance. Taupo, Te Kuiti and Putaruru must achieve no more than one exceedance by 2016. All other airsheds within the Waikato region must always meet the standard of no more than one exceedance per rolling 12 month period i.e. the requirement for compliance is current.

Based on previous monitoring, most other contaminants are unlikely to be in breach of their respective NESAQ standards or ambient air quality guidelines in urban areas of the Waikato. Generally the majority of resources for air quality monitoring in the Waikato Region has focused on PM_{10}.

Table 1-1 National Environmental Standards for Air Quality (MfE, 2004).

Contaminant	NESAQ values		
	Concentration[a]	Averaging period	Allowable exceedances 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

The Ministry for the Environment provides guidelines for ambient air quality (refer to Table 1.2) and air quality indicator categories to assist in the presentation and management of

[2] The Waihi air quality monitoring site was disestablished at the beginning of 2012. Monitoring of PM_{10} in Waihi over the period 2008 to 2011 indicates that PM_{10} concentrations within the Waihi airshed are well below the NESAQ 24-hour standard of 50 µg/m^3. This disestablishment of monitoring sites where three years of monitoring has indicated no exceedances of the NESAQ is part of an ongoing monitoring strategy to re-deploy monitoring equipment in airsheds where air quality has not yet been monitored.

air quality in New Zealand (refer to 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 an indicative tool for evaluating trends in concentrations over time.

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

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

Notes for Tables 1.1 and 1.2:

[a] All values apply to the gas measured at standard conditions of temperature (0° C) and pressure (1 atmosphere).

[b] The sulphur dioxide guideline values do not apply to sulphur acid mist.

[c] The hydrogen sulphide value is based on odour nuisance and may be unsuitable for use in geothermal areas.

[d] The guideline values for metals are for inhalation exposure only; they do not include exposure from other routes such as ingestion. These other routes should be considered in assessments where appropriate.

Table 1-3 Environmental Performance Indicator categories for air quality (MfE, 2002).

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

1.1 Reporting period

The reporting period for PM_{10} is from 1 January to 31 December 2012 (a calendar year). In 2006 Waikato Regional Council 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. However, the 2011 and 2012 annual air quality reports have been prepared based on a reporting period of January to December. This is the same format as historical reports and is consistent with other regional council reporting around the country.

The reporting period for sulphur dioxide is 1 March 2012 to 31 August 2012 (a six month survey). The reporting period for benzene, toluene, ethylbenzene and xylenes (BTEX) is 21 December 2011 to 20 December 2012. Aligning the reporting period for BTEX with the calendar year is not feasible as it would require staff to deploy passive sampling equipment on 1 January. This 10 day misalignment with the calendar year is of little concern when reporting annual averages and it is not expected that there would be any difference in the annual averages if the passive samplers were instead deployed on 1 January each year.

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 existing Beta Attenuation Monitors (BAMs). Waikato Regional Council staff have used the results to determine site specific differences between methods and data and have adjusted accordingly, where appropriate, for gravimetric equivalence. Prior to 2007, data were not adjusted. Some adjustment equations were updated in 2010 as a result of additional monitoring and these equations have been used in the 2011 and 2012 reports.

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 2012 were based on the same adjustment for 2009 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. Equation 2.2 shows the adjustments made to the FH62 data for consistency with the gravimetric method.

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

Gravimetric sampling was conducted at the Gillies Street site in Taupo from March 2007. Concentrations of PM_{10} measured using the FH62 C14 BAM during 2011 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. This equation was updated in 2010.

Corrected PM_{10} = 1.106BAM - 2.38 **Equation 2.4**

Concentrations of PM_{10} at Hamilton (Ohaupo Road), Te Kuiti, Matamata, Ngaruawahia and Turangi sites were measured using an FH62 C14 BAM. No adjustments have been made to concentrations measured at these sites. In the case of Te Kuiti and Matamata, reference method 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 (Peachgrove Rd), 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 (Peachgrove Rd), Taupo and Matamata. Meteorological data was not available for the Putaruru, Ngaruawahia and Turangi sites. At sites where it was available, meteorological data were compared with PM_{10} on days when pollution was elevated.

Waikato Regional Council 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. The Partisol Model 2000 PM_{10} sampler at the Taupo site was operated by the Institute of Geological and Nuclear Sciences Ltd (GNS) on behalf of Waikato Regional Council.

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

3 Hamilton

3.1 Air quality monitoring in Hamilton

In Hamilton air quality has been measured at a monitoring site in Peachgrove Road located on the south-east side of Hamilton City since November 1997. 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). During 2012, PM_{10}, arsenic, benzene, ethyl-benzene, toluene and xylenes were measured at Peachgrove Road.

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. Data were adjusted for gravimetric equivalency based on the equation outlined in section two.

From March 2012, air quality has also been measured at a second monitoring site located adjacent to the NZ Blood Service at the Waikato Hospital on the corner of Ohaupo Road and Lorne Street. This site is traffic and industry focussed. During 2012 (from 5 April), daily and hourly average PM_{10} concentrations were measured at the site using a FH 62 BAM. From 1 March through to 31 August concentrations of SO_2 were measured at Ohaupo Road using an Ecotech EC 9850 SO_2 analyser (gas phase fluorescence). Operational aspects of the SO_2 monitoring including maintenance, calibration and quality assurance were carried out by Watercare Ltd for Waikato Regional Council.

Benzene, ethyl-benzene, toluene and xylenes (BTEX) have, in addition to the monitoring undertaken at the Peachgrove Rd site, also been monitored during recent years at other sites around Hamilton. These include Bridge Street, Claudelands Road, Peachgrove Road Intermediate School, Greenwood Street and Tristram Street.

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 shows the main (Peachgrove Road) air quality monitoring station site (eastern side) and the Ohaupo Road monitoring station site (western side).

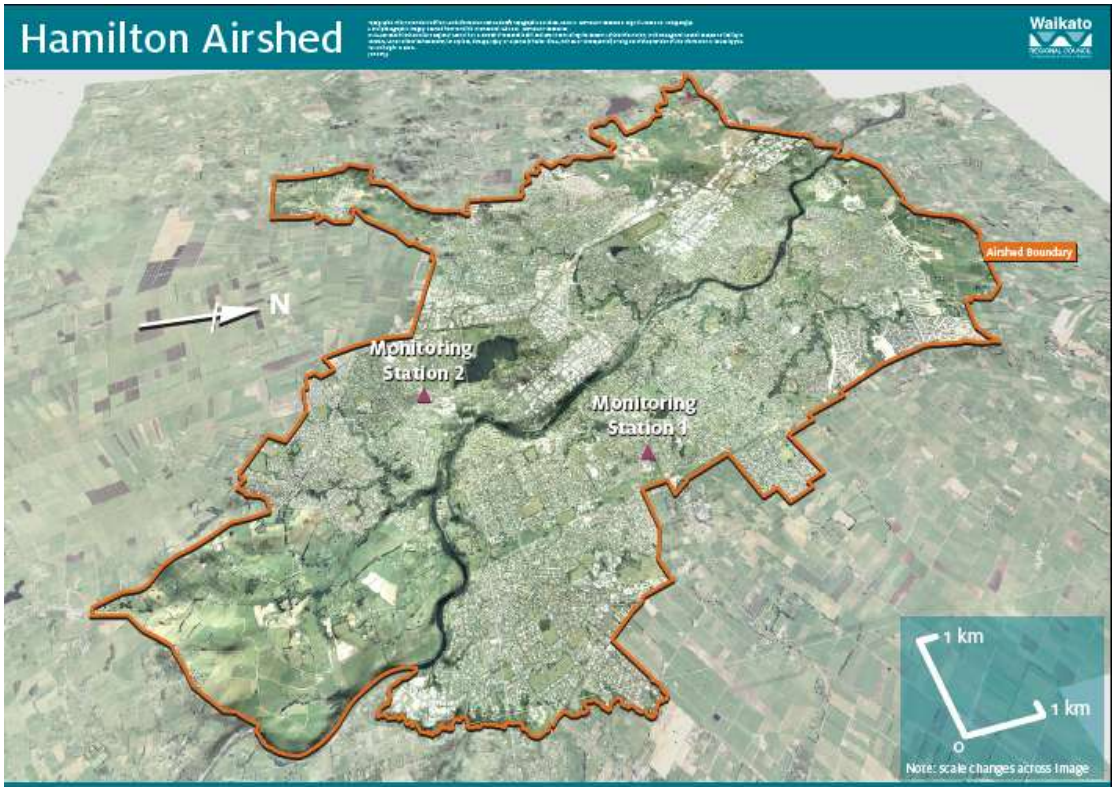


Figure 3-1: Hamilton Airshed and air quality monitoring station sites (Peachgrove Rd is Station 1 and Ohaupo Rd is Station 2).

3.2 PM_{10} concentrations for Hamilton

There were no exceedances of 50 µg/m^3 (24-hour average) measured in Hamilton during 2012. A maximum 24 hour average concentration of 42 µg/m^3 was measured on 10 July at the Peachgrove Road site and a maximum 24 hour average concentration of 41 µg/m^3 was measured on 18 July at the Ohaupo Road site. This compares with one exceedance (64 µg/m^3) during 2011, no exceedances (maximum 30 µg/m^3) during 2010 and two winter time exceedances of 54 µg/m^3 measured during 2009. A further exceedance in 2009 and the maximum PM_{10} concentration recorded at Hamilton reached 101 µg/m^3 and coincided with a dust storm event in Australia. Under the recent 2011 amendment to the NESAQ, an exceedance caused by an event such as the Australian dust storm of 2009, could now qualify for an exemption as per the exceptional circumstances regulation of the NESAQ (regulation 16A). However, the regulation does not allow for retrospective exemption so the 2009 exceedance must still be counted.

Daily PM_{10} concentrations measured at Hamilton during 2012 are shown in Figures 3.2 and 3.3.

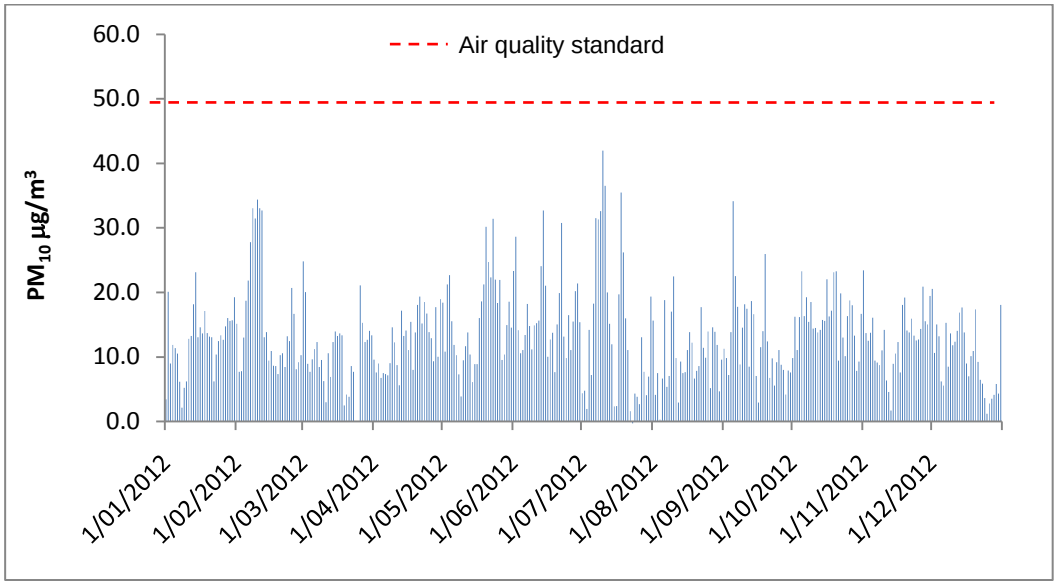


Figure 3-2: 24-hour average PM_{10} concentrations measured at Peachgrove Road during 2012.

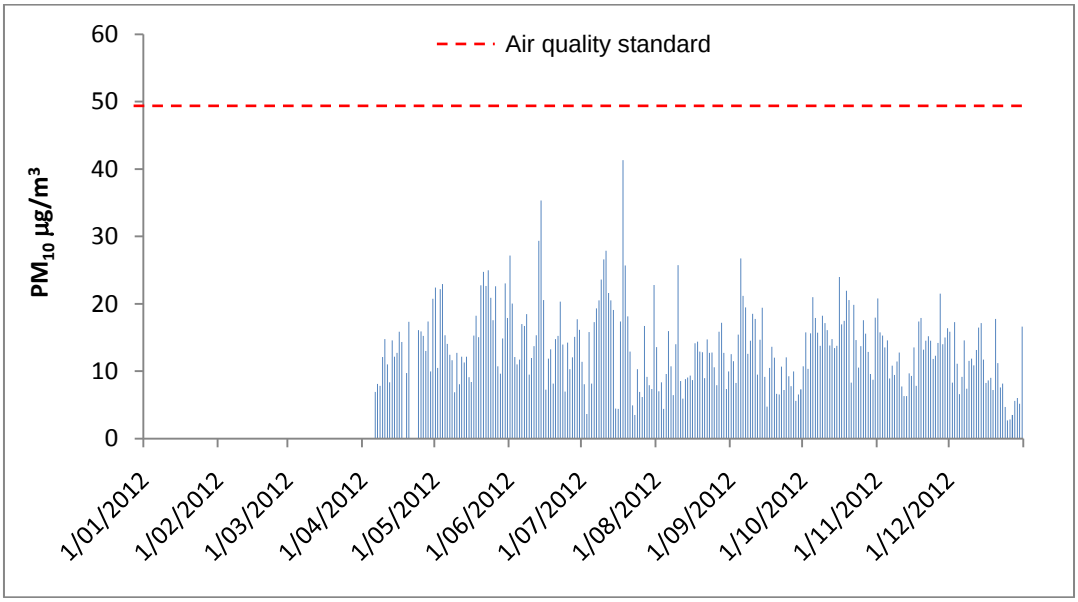


Figure 3-3: 24-hour average PM_{10} concentrations measured at Ohaupo Road during 2012.

Figure 3.4 compares daily PM_{10} concentrations measured from 2000 to 2012, for Peachgrove Road, to the MfE air quality indicator categories (shown in Table 1.3). During 2012 the majority of the PM_{10} concentrations measured were less than 66% of the air quality guideline.

Figure 3.5 shows the seasonal variations in the distribution of PM_{10} concentrations during 2012 for Peachgrove Road. Figure 3.6 shows the variations in the monthly PM_{10} concentrations during 2012 for Peachgrove Road and Ohaupo Road. While there does not appear to be any seasonal pattern with regards winter versus summer monthly averages, the monthly averaged data from the two monitoring sites are very similar.

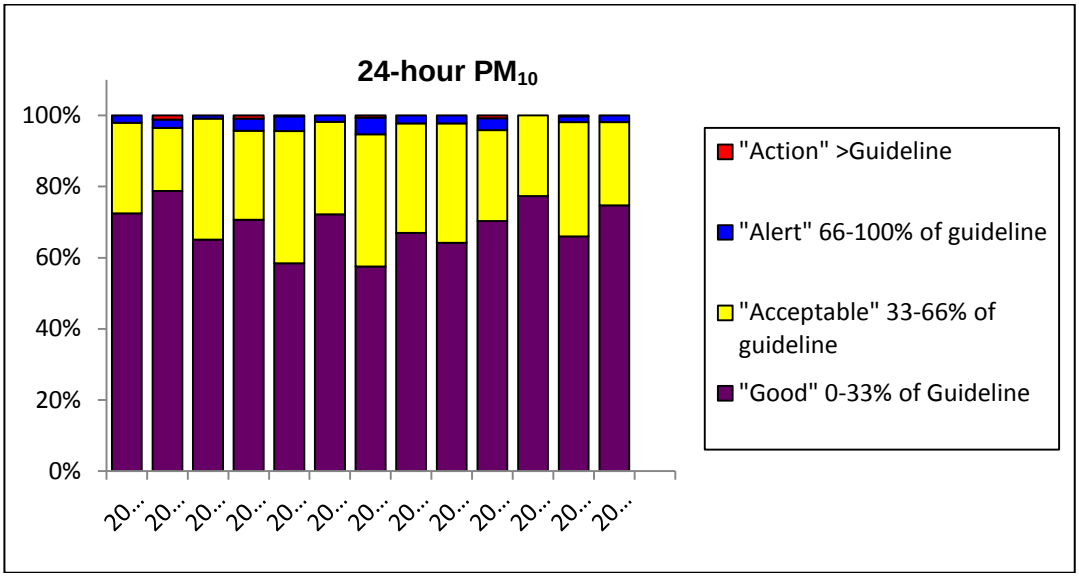


Figure 3-4: Comparison of PM_{10} concentrations measured at Peachgrove Road in Hamilton from 2000 to 2012 to air quality indicator categories.

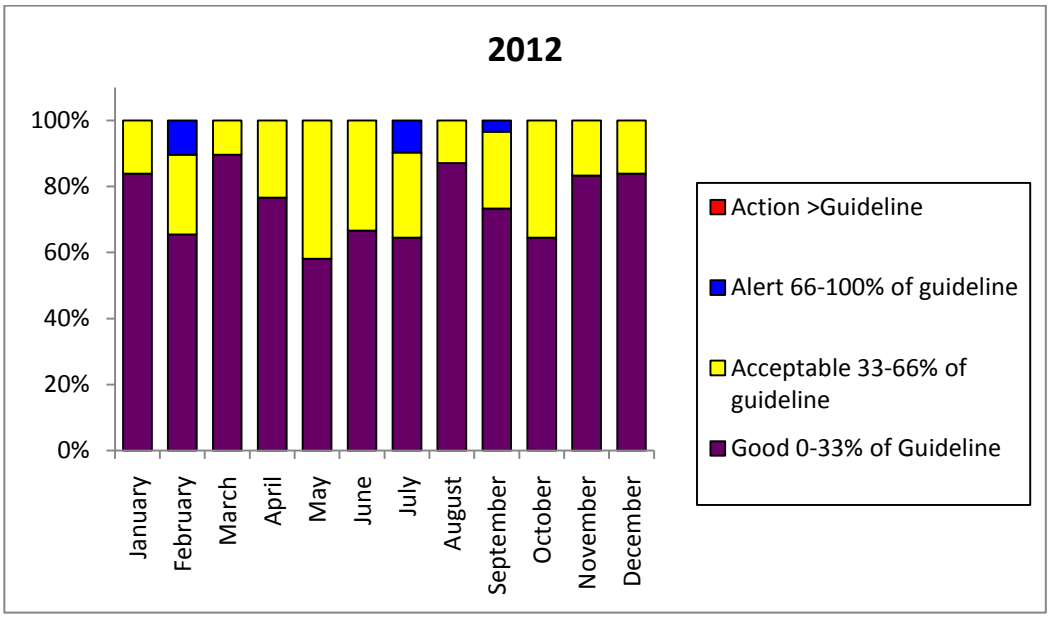


Figure 3-5: Comparison of daily PM_{10} concentrations measured at Peachgrove Road each month during 2012 to air quality indicator categories.

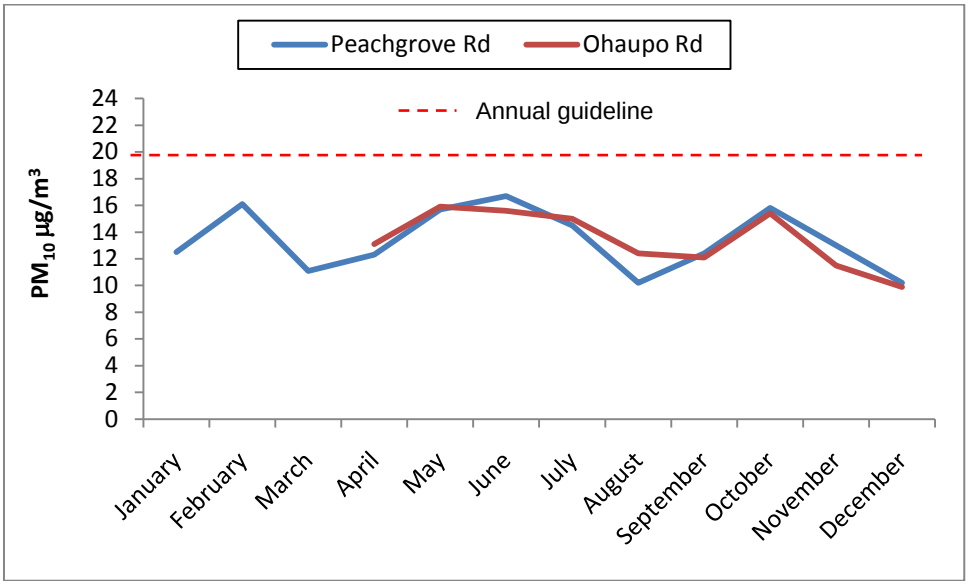


Figure 3-6: Comparison of monthly PM_{10} concentrations measured at Peachgrove Road and Ohaupo Road in Hamilton in 2012.

Figure 3.7 shows the number of days when 50 µg/m^3 was exceeded, the maximum concentration and the 99.7 percentile concentration from 2007 to 2012 for Peachgrove Road.

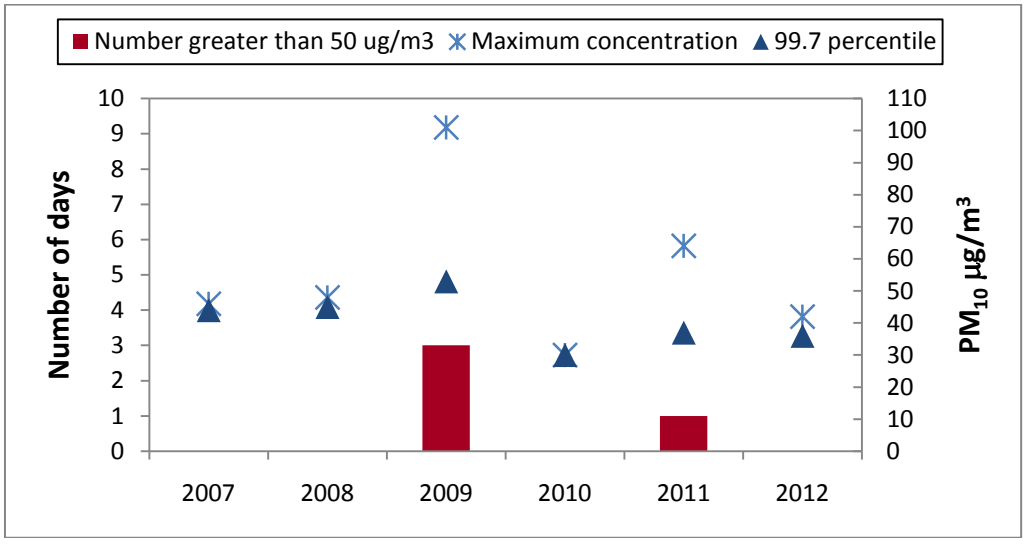


Figure 3-7: Number of days when 50 µg/m^3 was exceeded at Peachgrove Road compared with the maximum concentration and the 99.7 percentile concentration measured from 2007 to 2012.

The annual average PM_{10} concentration for Hamilton for 2012 was 13 µg/m^3 for both Peachgrove Road and Ohaupo Road and is similar in magnitude to previous years. 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 data from the Ohuapo Road site for 2012 and from the Peachgrove Road site from 2000 to 2012 are shown in Table 3.1 and 3.2 respectively. Since 2007 concentrations measured at the Peachgrove Road site 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 Ohaupo Road in Hamilton for 2012.

Indicator	2012
"Good" 0-33% of guideline	74.1%
"Acceptable" 33-66% of guideline	25.2%
"Alert" 66-100% of guideline	0.8%
“Action” >Guideline	0%
Percentage of valid data	72.7%
Annual average (µg/m^3)	13
Measured exceedances	0
99.7 %ile PM_{10} concentration (µg/m^3)	37
Annual maximum (µg/m^3)	41
Number of records	266

Table 3-2: Summary of PM_{10} concentrations measured at Peachgrove Road in Hamilton from 2000 to 2012[1].

Indicator	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
"Good" 0-33% of guideline	72.5%	78.5%	65.1%	70.7%	58.4%	72.2%	57.6%	67.0%	64.0%	70.2%	77.3%	65.9%	74.7%
"Acceptable" 33-66% of guideline	25.4%	17.6%	34%	25.0%	37.2%	26.0%	37.2%	30.8%	33.5%	25.6%	22.7%	32.1%	23.4%
"Alert" 66-100% of guideline	2.1%	2.3%	0.9%	3.4%	4.1%	1.8%	4.7%	2.2%	2.2%	3.3%	0%	1.6%	1.9%
“Action” >Guideline	0%	1.2%	0%	0.9%	0.3%	0%	0.6%	0%	0%	0.8%	0%	0.3%	0%
Percentage of valid data	91.3%	69.9%	92.6%	89.9%	94.0%	77.0%	99.5%	99.7%	99.5%	99.5%	98.9%	99.7%	99.5%
Annual average (µg/m^3)	14	14	15	15	16	14	17	15	15	14	13	14	13
Measured exceedances	0	3	0	3	1	0	2	0	0	3	0	1	0
99.7 %ile PM_{10} concentration (µg/m^3)	36	64	37	61	48	37	64	44	45	53	30	37	36
Annual maximum (µg/m^3)	48	76	40	71	62	40	75	46	48	101	30	64	42
Number of records	334	256	338	328	344	281	363	364	364	363	361	364	364

1. Data post 2006 is adjusted for gravimetric equivalency.
2. Note: data for 1998 and 1999 has been excluded from table due to formatting constraints.

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 2004. In 2005 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 2012 were within the Ministry for the Environment's 2010 annual guideline of 3.6 µg/m^3 (Table 3.3). The guideline prior to 2010 was 10 µg/m^3 (annual average). The highest average annual concentration during 2012 was 2.7 µg/m^3 and was measured at the Greenwood Street monitoring site (Figure 3.8). An improving or "levelling" trend is evident for annual average concentrations of benzene at all sites.

Large decreases in benzene concentrations were observed over the period 2004 to 2007. Prior to 2011, benzene concentrations had tapered relative to decreases observed from 2004 to 2007 (Figure 3.8). These earlier decreases were attributed to changes in fuel specifications and improved vehicle technology (Smith, 2007). Results for 2012 indicate either small decreases or negligible change at all sites compared with previous years.

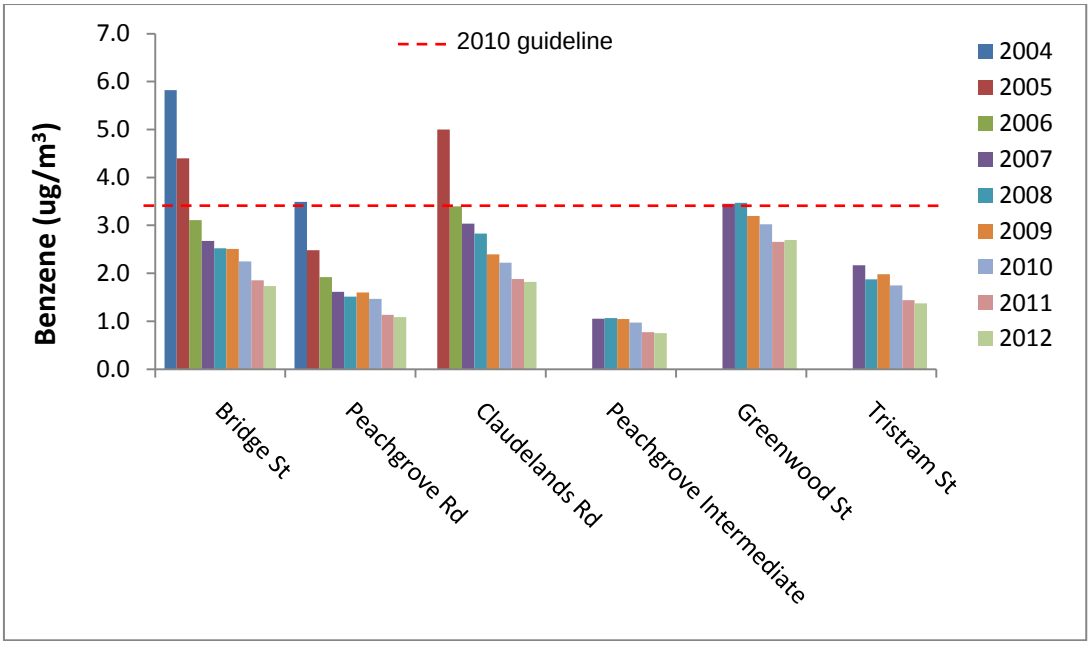


Figure 3-8: Annual average benzene measured at Hamilton sites (2004 to 2012).

Ethyl-benzene, toluene and xylene were also measured at the benzene monitoring sites for each year. An MfE document discussing amendments to the 1994 ambient air quality guidelines suggests an annual threshold of 190 µg/m^3 and 950 µg/m^3 for toluene and total xylenes respectively (MfE, 2000). The US EPA Reference Concentration for ethyl-benzene is 1000 µg/m^3 as an annual average. Concentrations of toluene, total xylenes and ethyl-benzene measured in Hamilton at all sites were significantly lower than the suggested MfE thresholds and US EPA Reference Concentration.

Table 3-3: Annual average concentrations of volatile organic compounds (VOCs) at Hamilton sites between 21 December 2011 to 18 December 2012.

VOC	Bridge St µg/m^3	Peachgrove Rd µg/m^3	Claudelands Rd µg/m^3	Peachgrove Intermediate µg/m^3	Greenwood St µg/m^3	Tristram St µg/m^3	Guideline[a] µg/m^3
Benzene	1.7	1.1	1.8	0.75	2.7	1.4	3.6 (10[a])
Ethyl-benzene	1.2	0.7	1.3	0.7	1.9	1.1	1000[b]
Toluene	8.5	4.9	8.9	3.9	16.2	8.2	190[b]
Total Xylenes	6.3	3.73	6.2	3.0	9.0	5.4	950[b]

[a] The historical guideline for benzene of 10 µg/m^3 reduced to 3.6 µg/m^3 in 2010.

[b] There are currently no guideline values for ethyl-benzene, toluene and xylenes. Threshold values for toluene and total xylenes used here are from proposed amendments to the 1994 ambient air quality guidelines. For ethyl-benzene, the US EPA Reference Concentration has been used.

3.4 Concentrations of sulphur dioxide

During 2012, hourly average concentrations of sulphur dioxide (SO_2) were well below the NES for SO_2. The NES for SO_2 is set at 350 µg/m^3 with nine allowable exceedances per year and an upper limit of 570 µg/m^3 with no allowable exceedances (Refer to Figure 3.9). The SO_2 concentrations averaged over 24 hours were also well below the NZ and regional ambient air quality guideline of 120 µg m^{-3} and the more stringent World Health Organisation guideline of 20 µg/m^3 (refer to Figure 3.10). Both 1-hour and 24-hour concentrations of SO_2 were less than 33% of the NES and NZ and regional ambient air quality guidelines and therefore fall within the good air quality indicator category.

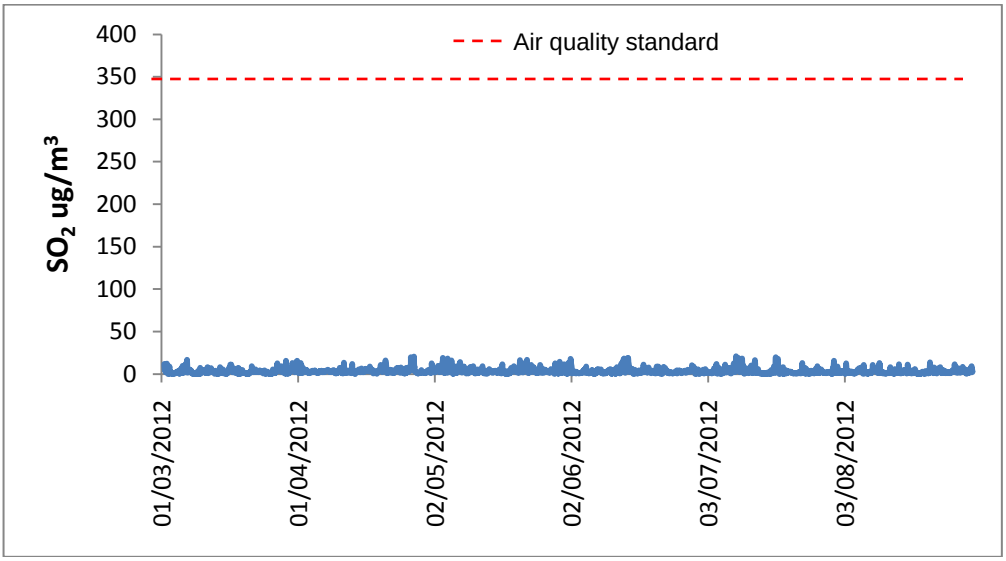


Figure 3-9: Hourly average SO_2 concentrations measured during 2012.

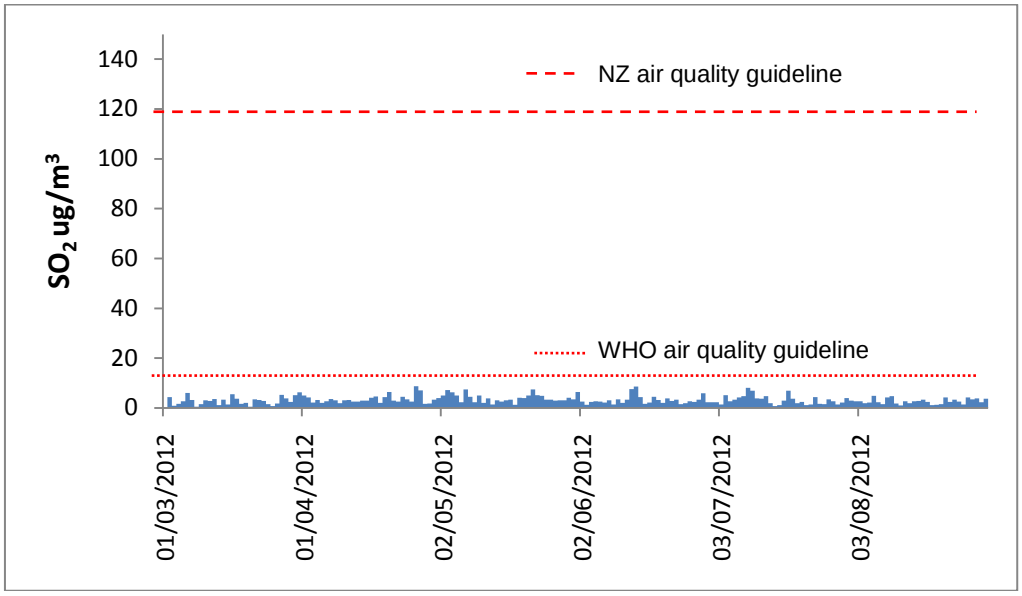


Figure 3-10: 24-hour average SO_2 concentrations measured during 2012.

Table 3-4: Summary of 1-hour average SO_2 concentrations measured during 2012.

Indicator	2012
"Good" 0-33% of guideline	100%
"Acceptable" 33-66% of guideline	0%
"Alert" 66-100% of guideline	0%
“Action” >Guideline	0%
Percentage of valid data	50%
Annual average (µg/m^3)	3.3
Measured exceedances	0
99.7 %ile PM_{10} concentration (µg/m^3)	18
Annual maximum (µg/m^3)	21
Number of records	4416

3.5 Comparison of meteorological conditions for 2012 to previous years

The frequency and extent of NES breaches from year to year depends largely on the prevalence of meteorological conditions conducive to elevated pollution, in particular low wind speeds, cooler temperatures and temperature inversions. Figure 3.11 and Figure 3.12 compares summary statistics for wind speed and temperature from 1998 to 2012. The significantly higher wind speed average of 8 m/s in 2009 indicates an anomaly with the data collected. Other Hamilton meteorological stations averaged around 3 m/s which is more consistent with that expected for the Peachgrove Rd data.

An evaluation of meteorological conditions and PM_{10} concentrations in Hamilton from 1998 to 2007 identified 24-hour average wind speed less than 0.74 m/s as the main meteorological characteristic of elevated PM_{10} concentrations (Wilton, 2007). Figure 3.13 compares the number of days during the winter months when these meteorological conditions occurred from 2000 to 2012 and the number of days each year when PM_{10} concentrations exceeded 50 µg/m^3. Even when excluding the results for 2009 (refer anomalous data issue discussed above) there does not appear to be

any clear evidence in recent years that elevated concentrations are linked to years when there is an increased number of days with low wind speeds over the winter season.

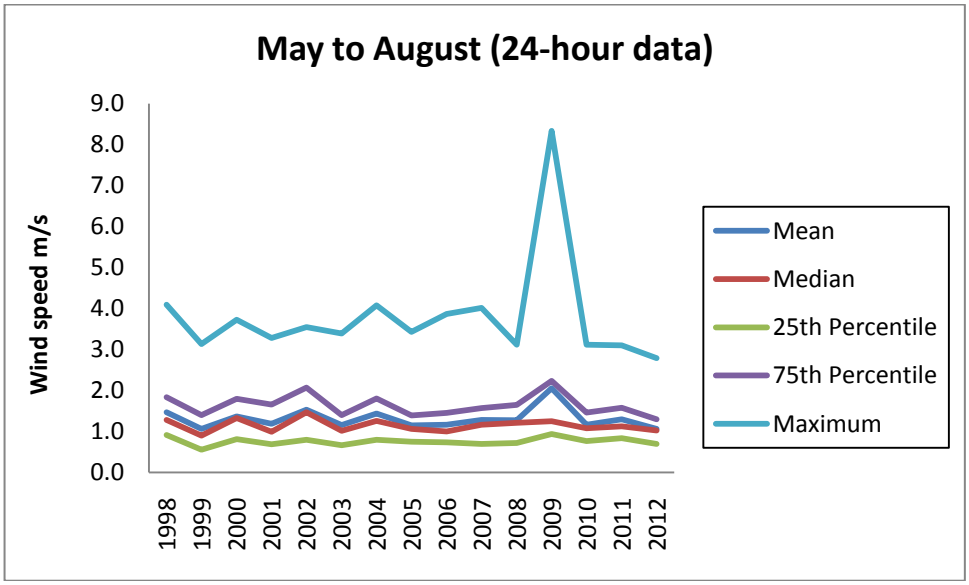


Figure 3-11: Summary wind speed data from 1998 to 2012 at the Peachgrove Road site.

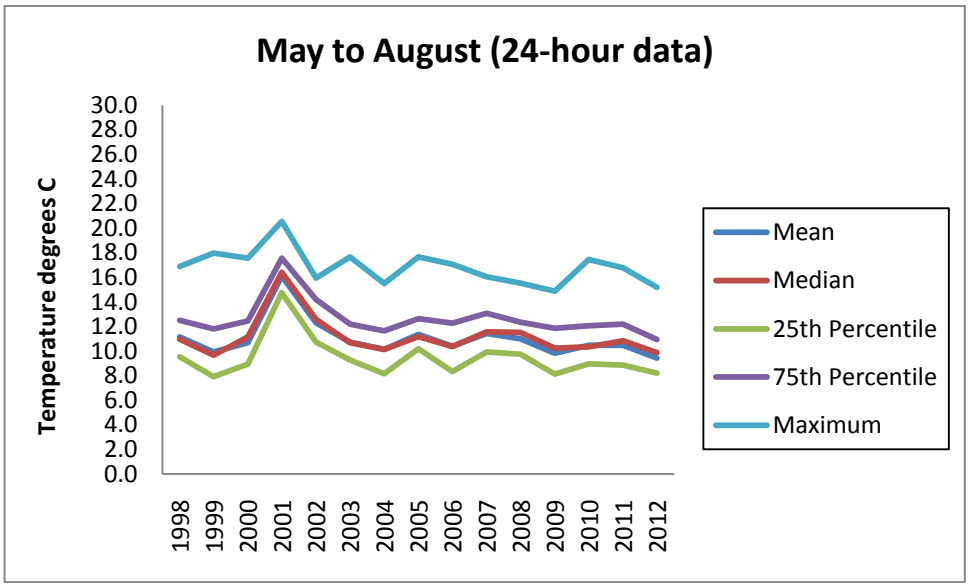


Figure 3-12: Summary temperature data from 1998 to 2012 at the Peachgrove Road site.

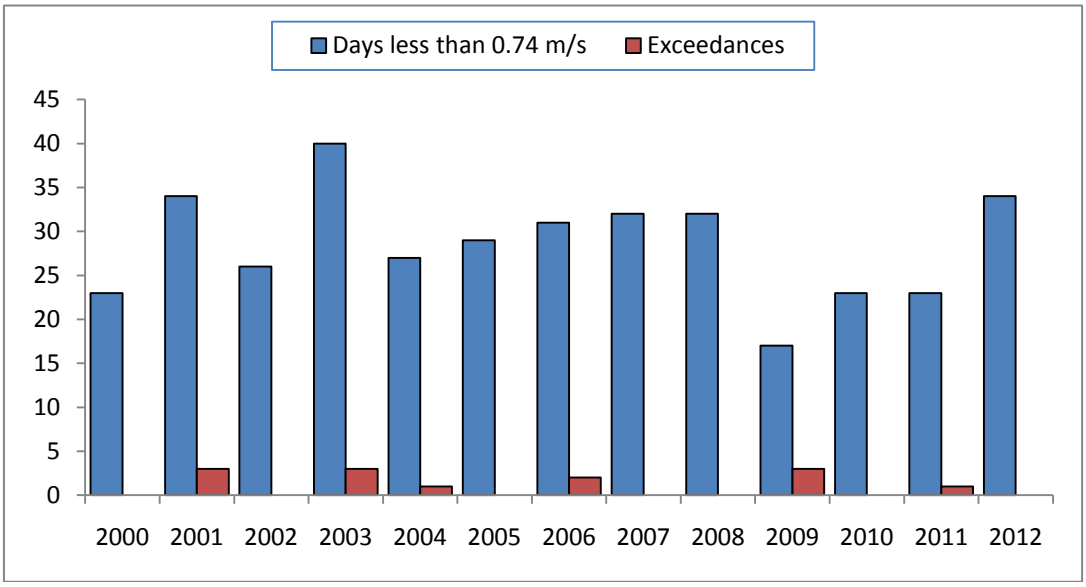


Figure 3-13: Number of days from May to August when the 24-hr average wind speed were less than 0.74 m/s and number of guideline exceedances per year.

3.6 Daily variations on high pollution day

Figure 3.14 shows the daily variations in PM_{10} concentrations and meteorological parameters on 10 July 2012 when the daily average PM_{10} concentration was at its highest for the year at 42 µg/m^3. Concentrations of PM_{10} were elevated around 8 to 10 am with a more distinct peak of up to 90 µg/m^3 between 6 to 11 pm consistent with the diurnal pattern usually observed for domestic woodburning. The daily wind speed averaged 0.4 m/s but was particularly low during the evening period (around 0.1 to 0.2 m/s).

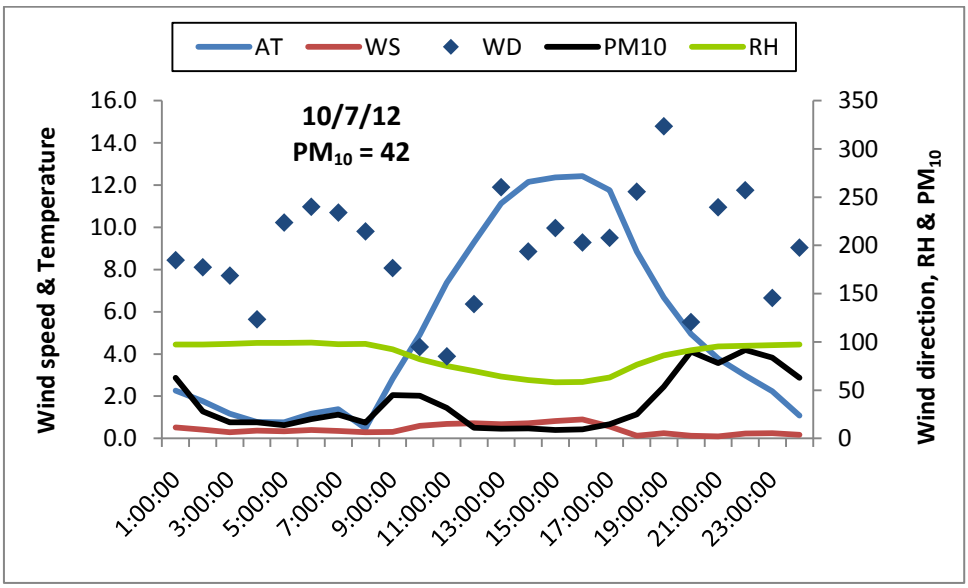


Figure 3-14: Daily variation in PM_{10} concentrations, wind speed, temperature and relative humidity on 10 July 2012 when the daily average PM_{10} concentration was 42 µg/m^3.

3.7 Trend analysis

Over time, air quality may improve, get worse, or remain the same. Peak levels of PM_{10} in any given airshed vary from winter to winter depending on meteorological conditions and human responses. For example, higher PM_{10} and more exceedances might be expected if a winter has a greater number of days when the wind speed is low and

there is vertical stability in the lower atmosphere. Over the short term this inter-annual variability will mask any genuine underlying trend toward better or worse air quality. A reasonably long monitoring record is needed to confirm or exclude the possibility of any underlying trend.

Seasonal Mann Kendall test for monotonic trends is the preferred approach for detecting underlying trends in variable environmental time-series data sets, and may suggest presence of an underlying trend which is not evident from visual inspection of the PM_{10} record or summary statistics. This method generates probability (p) values that are used to assess the likelihood that the apparent relationship is genuine, or comes about fortuitously as a result of a random alignment of variables. The conventional threshold for deciding whether a relationship is likely to be genuine is at a probability value of $p<0.05$ or lower, which corresponds to a 95% confidence level and greater. A negative MK-Stat indicates a decreasing trend.

Seasonal Mann Kendall test results (MK-Stat of -1.67 and p-value of 0.09) provide no evidence that PM_{10} concentrations in Hamilton (Peachgrove Rd) have been getting either better or worse over the winter seasons for the period 2006 to 2012.

4 Tokoroa

4.1 Air quality monitoring in Tokoroa

In Tokoroa, monitoring for PM_{10} has been carried out 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 the Billah Street site. In September 2005 the MET ONE instrument was replaced with a ThermoAndersen FH62 C14 BAM due to unacceptable data loss caused by frequent tape failure from the MET ONE. 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.

4.2 PM_{10} concentrations in Tokoroa

During 2012 there were 15 days when PM_{10} concentrations exceeded 50 µg/m^3. The dates and concentrations reached on these days are shown in Table 4.1. The maximum measured concentration was 75 µg/m^3 and compares with a maximum of 73 µg/m^3 and a total of 16 exceedances measured at the site during 2011. Daily PM_{10} concentrations measured at Tokoroa during 2012 are shown in Figure 4.2.

Table 4-1: Dates and concentrations for exceedances of 50 µg/m^3 in Tokoroa during 2012.

Date	PM_{10} µg/m^3	Rank	Date	PM_{10} µg/m^3	Rank
22/06/2012	75	1	22/05/2012	54	9
11/07/2012	66	2	13/07/2012	54	10
10/07/2012	64	3	17/06/2012	53	11
23/05/2012	59	4	20/05/2012	52	12
14/06/2012	58	5	8/07/2012	52	13
18/07/2012	58	6	10/08/2012	52	14
13/06/2012	56	7	9/07/2012	51	15
31/07/2012	55	8			

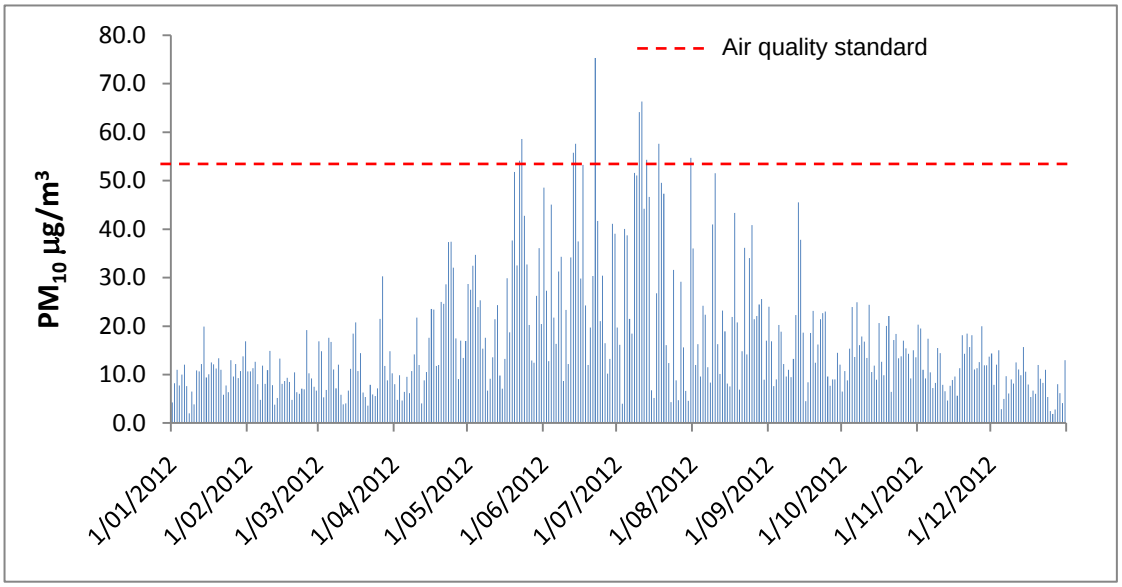


Figure 4-2: Daily winter PM_{10} concentrations measured in Tokoroa during 2012.

It is noted that the 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[3] 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).

[3] The newer BAM is more accurate when compared with the gravimetric reference method.

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 shows changes in PM_{10} concentrations relative to air quality indicator categories at the Tokoroa site from 2006 to 2012 with typically around 4 to 5% of daily averages falling within the action category.

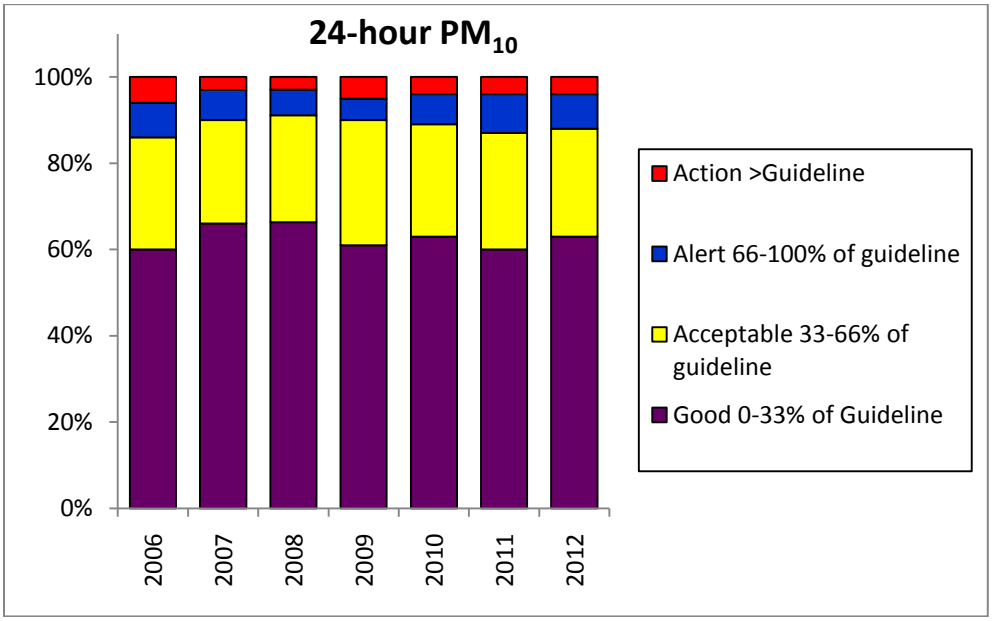


Figure 4-3: Comparison of PM_{10} concentrations measured in Tokoroa from 2006 to 2012 to air quality indicator categories.

Figure 4.4 shows the seasonal variations in the distribution of PM_{10} concentrations during 2012. There is a very evident seasonal pattern with regards winter versus summer daily averages with around four months of the year where the annual PM_{10} standard is exceeded.

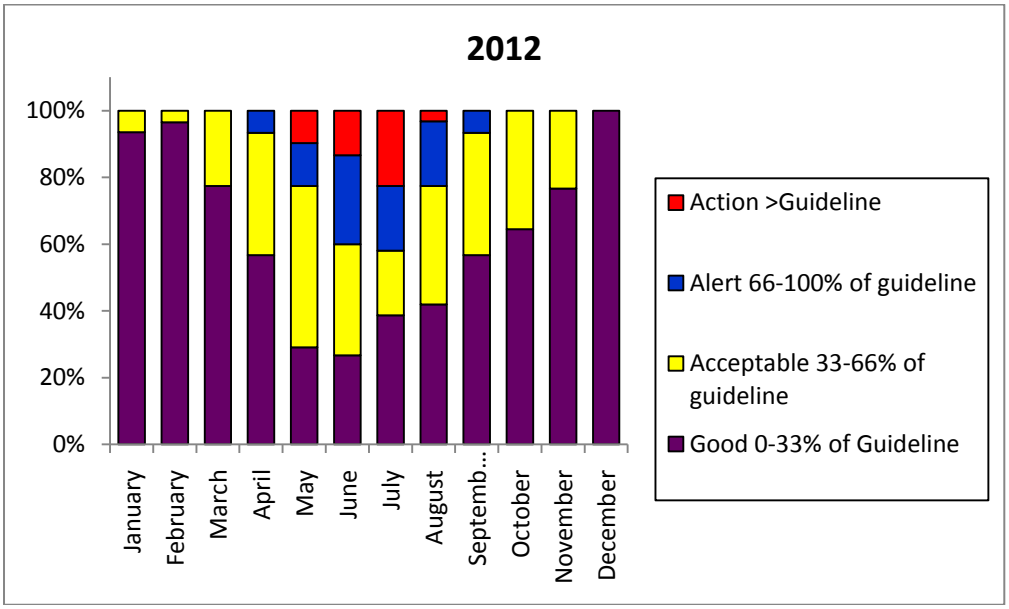


Figure 4-4: Comparison of daily PM_{10} concentrations each month during 2012 to air quality indicator categories.

The number of days when 50 µg/m^3 was exceeded, the maximum concentration and the 99.7 percentile concentration over the period 2006 to 2012 is presented in Figure 4.5. There is no indication of an improving trend with regards either the number of exceedances or the maximum and 99.7 percentile concentrations.

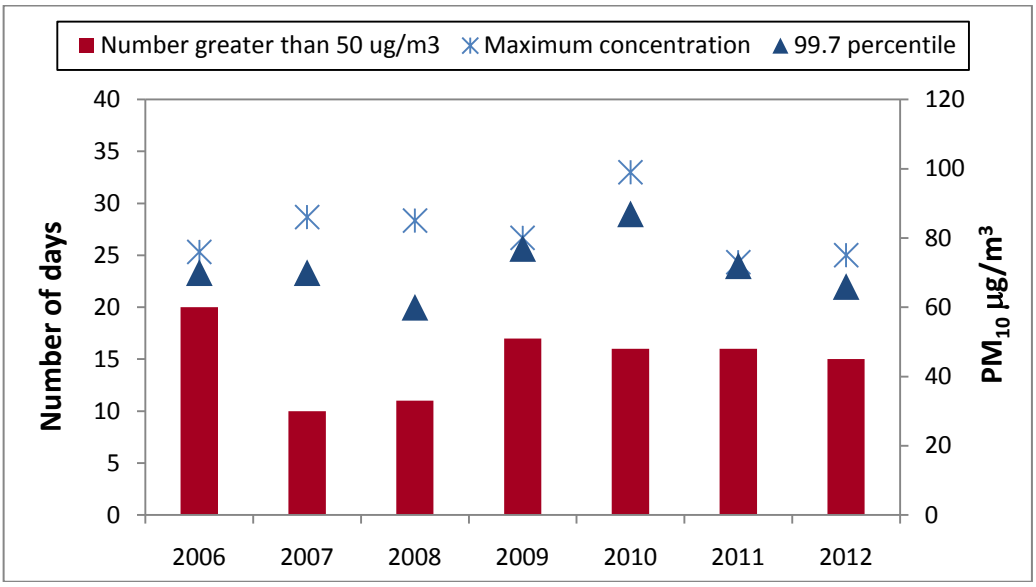


Figure 4-5: Number of days when 50 µg/m^3 was exceeded compared with the maximum concentration and the 99.7 percentile concentration measured from 2006 to 2012.

The annual average PM_{10} concentration for Tokoroa for 2012 was 18 µg/m^3. This is similar to other annual average concentrations. 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 2001 to 2012[1].

Indicator	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Good 0-33% of Guideline	12%	15%	25%	12%	28%	60%	66%	67%	61%	63%	60%	63%
Acceptable 33-66% of guideline	64%	71%	58%	54%	49%	26%	24%	25%	29%	26%	27%	25%
Alert 66-100% of guideline	17%	9%	13%	23%	13%	8%	7%	6%	5%	7%	9%	8%
Action > Guideline	8%	4%	4%	11%	9%	6%	3%	3%	5%	4%	4%	4%
Percentage of valid data	47%	97%	55	96	88%	99%	99%	99%	100%	99%	99%	100%
Annual average ($\mu g/m^3$)	27	24	24	31	25	19	16	17	18	18	18	17
Number exceedances	13	14	8	38	33	20	10	11	17	16	16	15
99.7 %ile concentration ($\mu g/m^3$)	70	66	59	92	83	70	70	60	77	87	72	66
Annual maximum ($\mu g/m^3$)	75	70	62	97	89	76	86	85	80	99	73	75
Number records	173	353	199	349	321	360	360	360	364	360	362	366

1. Data post 2005 is adjusted for gravimetric equivalency.

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

Figure 4.6 compares summary statistics for wind speed and temperature from 2006 to 2012. The data summary indicates a decreasing trend in wintertime wind speed data over this monitoring period, particularly with respect to the maximum wind speed. The maximum, mean and median wintertime air temperature shows a small decrease over the period 2008 to 2009.

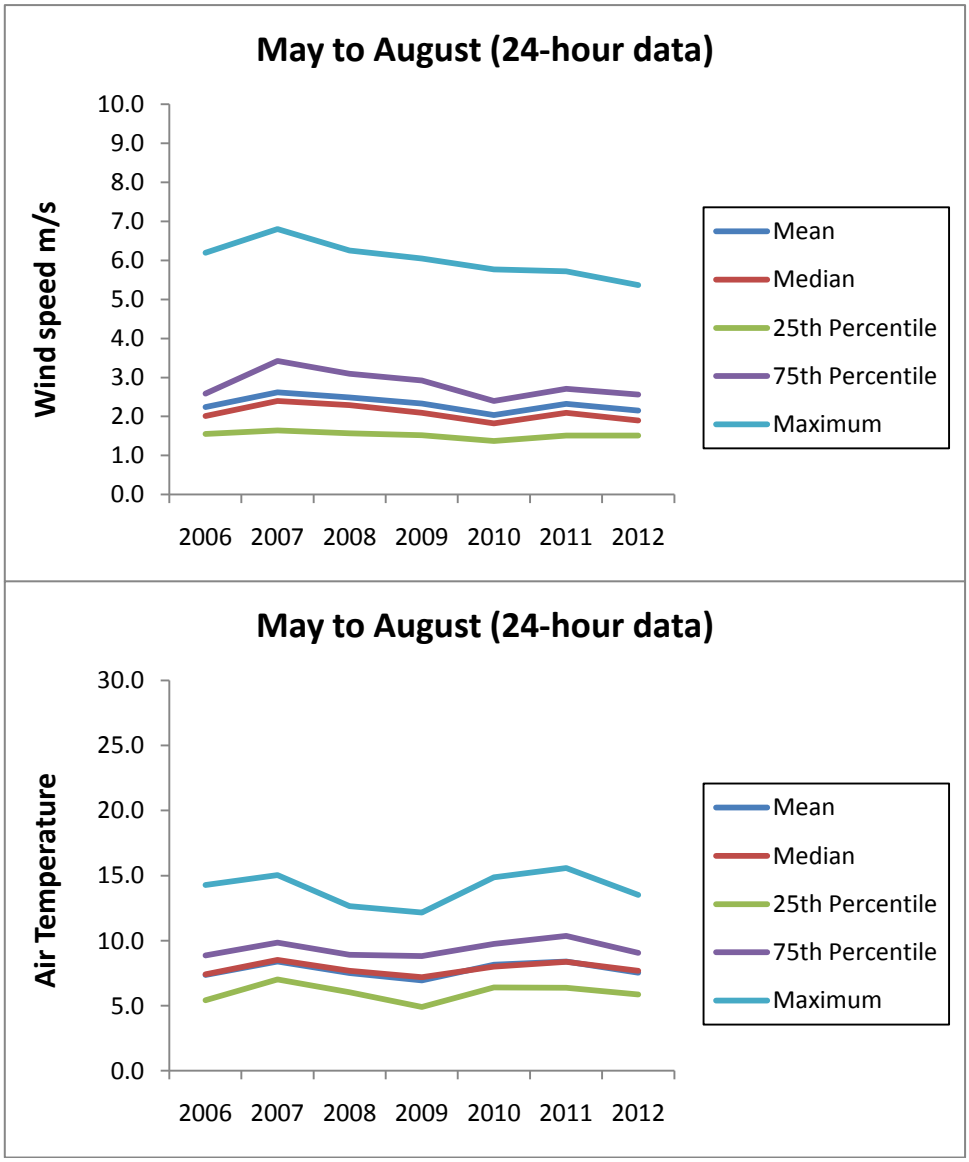


Figure 4-6: Summary wind speed and temperature data from 2006 to 2012 in Tokoroa.

Figure 4.7 (A&B) shows the variations in meteorological conditions and hourly average PM_{10} concentrations on the 15 days when the 24-hour average PM_{10} measured at Tokoroa exceeded 50 µg/m^3.

Generally, PM_{10} concentrations showed typical diurnal variations with a decrease in concentrations from midnight to 7am, a small peak around 9am and a more substantial increase in concentrations from 5pm.

High concentrations typically occur when the wind speeds and air temperature are low and the wind direction is from the south east.

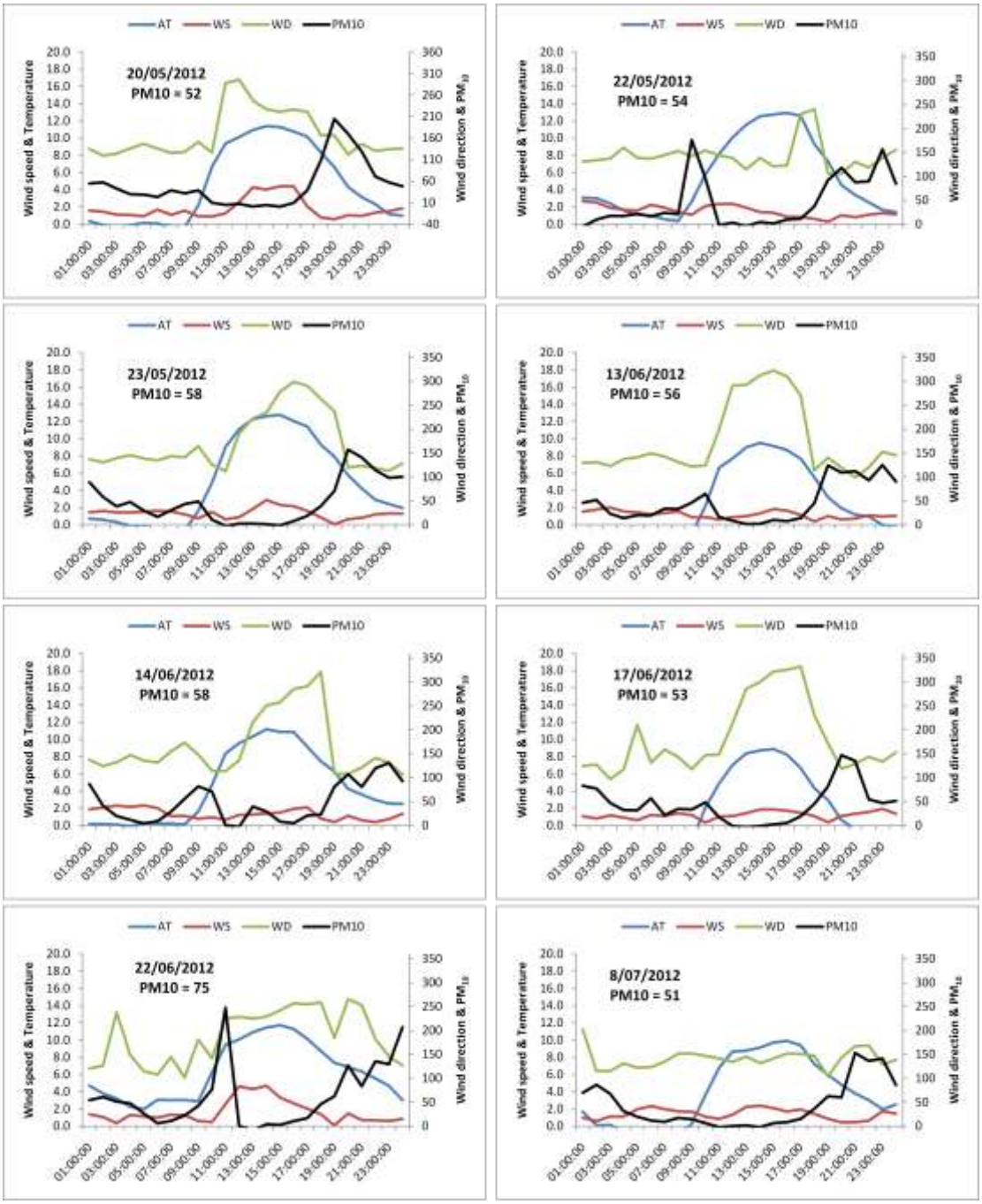


Figure 4-7A: Hourly average PM_{10}, wind speed, wind direction and temperature on days when PM_{10} concentrations exceeded the NES in Tokoroa.

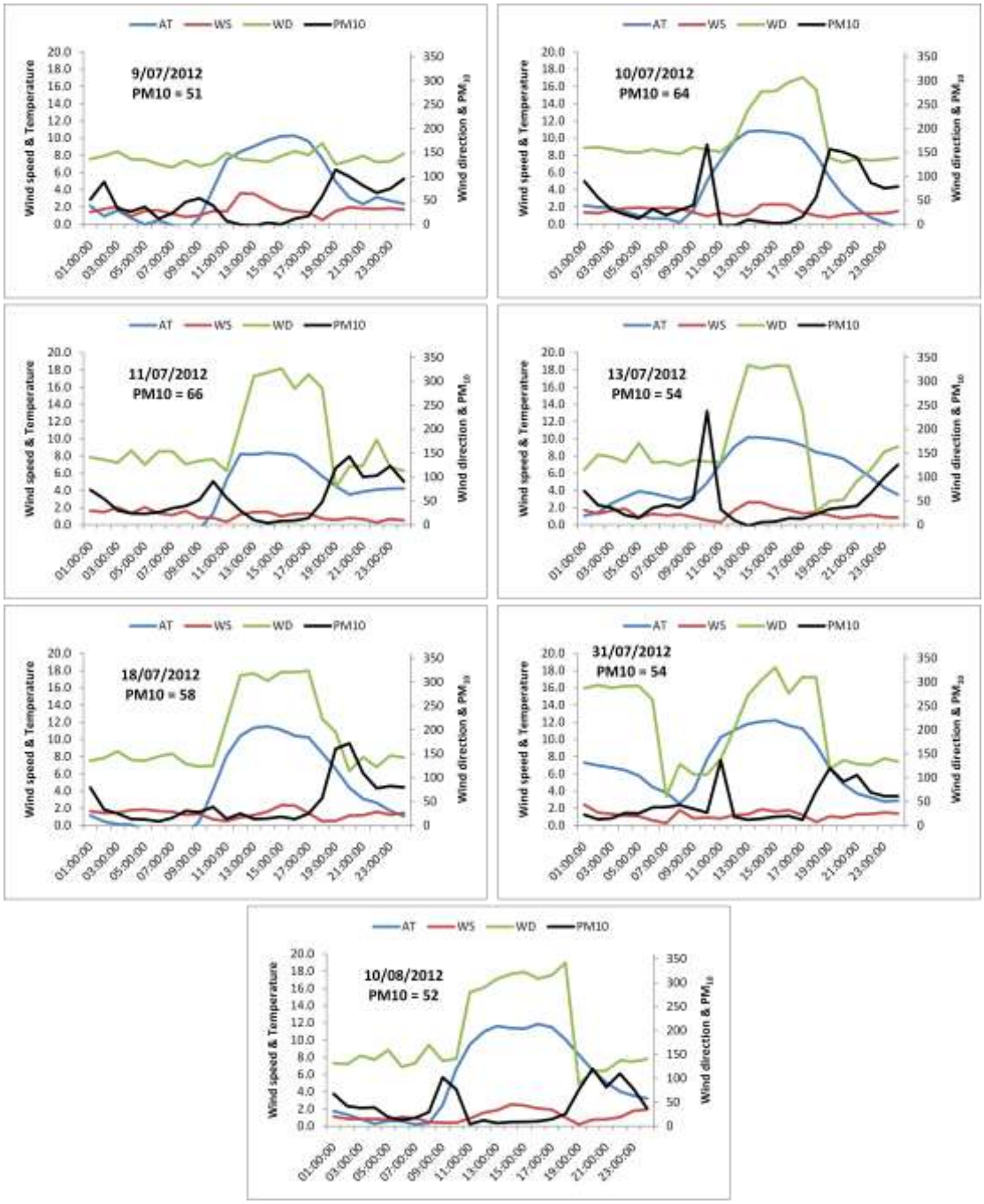


Figure 4-7B: Hourly average PM_{10}, wind speed, wind direction and temperature on days when PM_{10} concentrations exceeded the NES in Tokoroa.

4.4 Trend analysis

Over time, air quality may improve, get worse, or remain the same. Peak levels of PM_{10} in any given airshed vary from winter to winter depending on meteorological conditions and human responses. For example, higher PM_{10} and more exceedances might be expected if a winter has a greater number of days when the wind speed is low and there is vertical stability in the lower atmosphere. Over the short term this inter-annual variability will mask any genuine underlying trend toward better or worse air quality. A reasonably long monitoring record is needed to confirm or exclude the possibility of any underlying trend.

Seasonal Mann Kendall test for monotonic trends is the preferred approach for detecting underlying trends in variable environmental time-series data sets, and may suggest presence of an underlying trend which is not evident from visual inspection of the PM_{10} record or summary statistics. This method generates probability (p) values

that are used to assess the likelihood that the apparent relationship is genuine, or comes about fortuitously as a result of a random alignment of variables. The conventional threshold for deciding whether a relationship is likely to be genuine is at a probability value of $p<0.05$ or lower, which corresponds to a 95% confidence level and greater. A negative MK-Stat indicates a decreasing trend.

Seasonal Mann Kendall test results (MK-Stat of 0.84 and a p-value of 0.40) provide no evidence that PM_{10} concentrations in Tokoroa have been getting either better or worse over the period 2006 to 2012 (period over which gravimetric correction has been applied).

This is consistent with a recent analysis undertaken by Environet Ltd in 2013 where an assessment of the trend in PM_{10} concentrations over the period 2006 to 2012 when the impact of meteorological conditions was minimised indicated no evidence of significant trends (Wilton, 2013a).

Based on these analyses and the current and previous five year exceedance average of 15, it is not expected that Tokoroa will meet the interim NES 2016 target of no more than three exceedances without significant emission reductions. It has been estimated that an emission reduction of around 24% is required to meet the 2016 target and around 43% to meet the 2020 target (Wilton, 2011).

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

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 2006 a FH62 C14 BAM continuous PM_{10} monitoring station along with meteorological instrumentation was established at Taupo Primary School. The meteorological instruments measured wind speed, wind direction, air temperature, and relative humidity. 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 March 2007 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 $\mu g/m^3$ whereas the maximum recorded 24-hour PM_{10} concentration at the Gillies Avenue Reserve site (based on one day in three Partisol monitoring) was 89 $\mu g/m^3$. 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 exceedances) are greatest. The 2006 data reported in this report uses the partisol sampling results for Gillies Avenue. On 17 March 2007 the FH62 C14 BAM and meteorological instrumentation was moved from Taupo Primary School 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.

Figure 5-1: Taupo Airshed and air quality monitoring site.

5.2 PM_{10} concentrations in Taupo

Average daily PM_{10} concentrations measured at the Taupo Gillies Ave site during 2012 are shown in Figure 5.2. Only one exceedance of 50 µg/m^3 was recorded during 2012 and measured 53 µg/m^3 on the 18th of July.

The changes in PM_{10} concentrations relative to air quality indicator categories at the Taupo site from 2006 to 2012 are shown in Figure 5.3. Data are adjusted for gravimetric equivalency only since 2007 so comparison of trends with pre 2006 data are limited[4]. A slight increase in the proportion of PM_{10} concentrations in the 'good' category may have occurred since 2007.

[4] For 2006 the gravimetric partisol data from Gillies Ave were used in preference to the BAM primary school data.

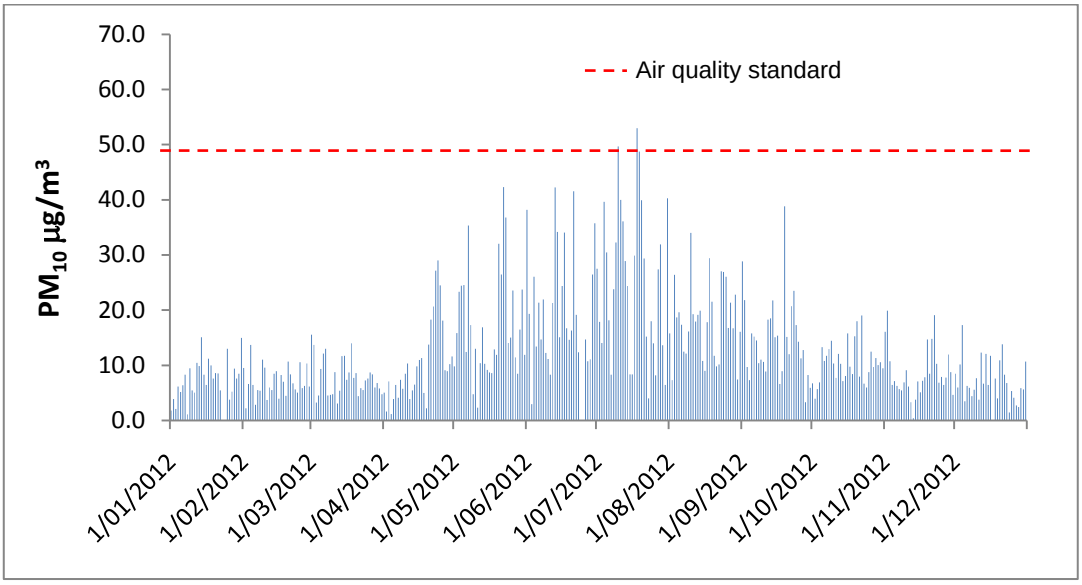


Figure 5-2: Daily winter PM_{10} concentrations measured at Taupo during 2012.

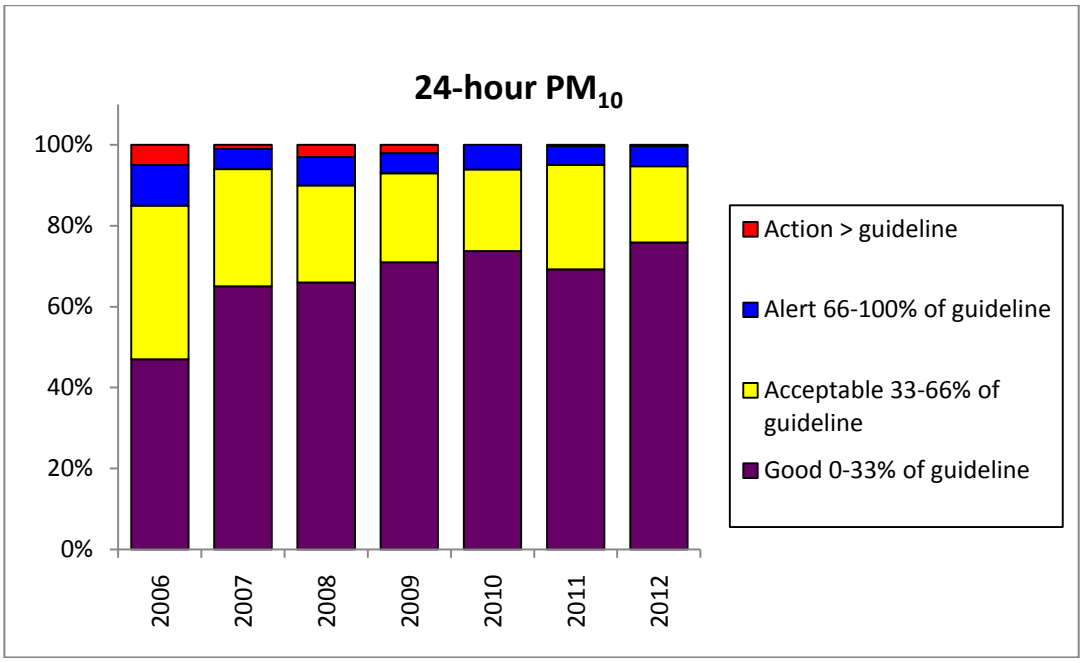


Figure 5-3: Comparison of PM_{10} concentrations measured at the Taupo site from 2006 to 2012 to air quality indicator categories.

Figure 5.4 shows the seasonal variations in the distribution of PM_{10} concentrations for 2012. Figure 5.5 shows the number of days when 50 µg/m^3 was exceeded, the maximum concentration and the 99.7 percentile for 2006 to 2012. The trend line slope for exceedances per year is negative with an R^2 value of 0.60. The trend line slope for 99.7 percentile concentrations per year is also negative with an R^2 value of 0.73. These indicators suggest that air quality has improved over the period 2006 to 2012. However, further discussion of this is provided in the trend analysis presented in Section 5.4 of this report.

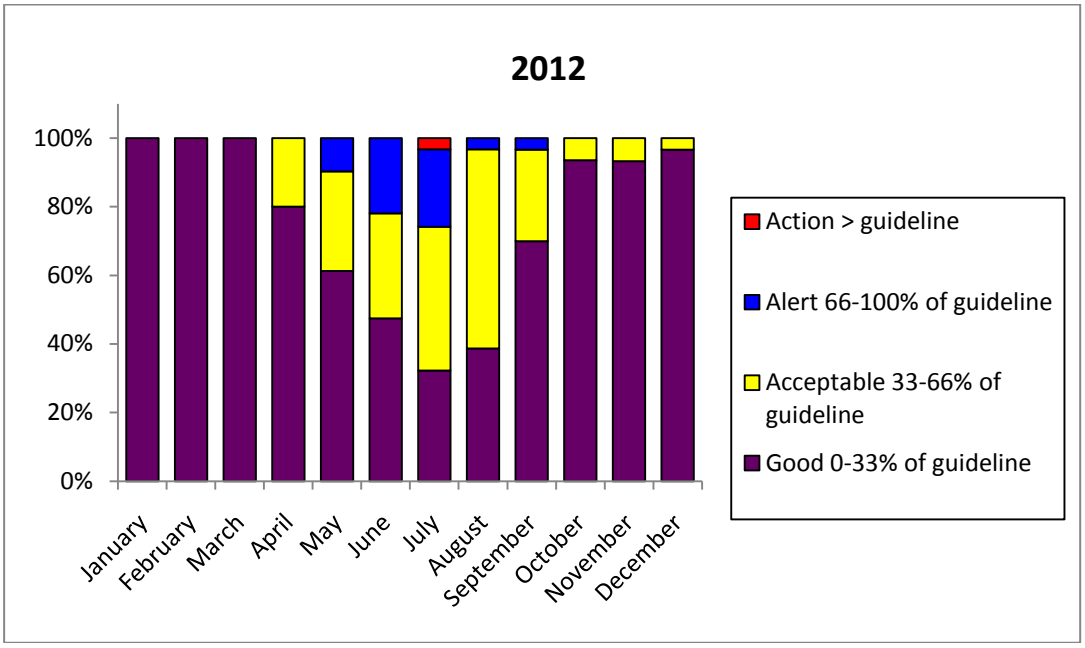


Figure 5-4: Comparison of daily PM_{10} concentrations each month during 2012 to air quality indicator categories.

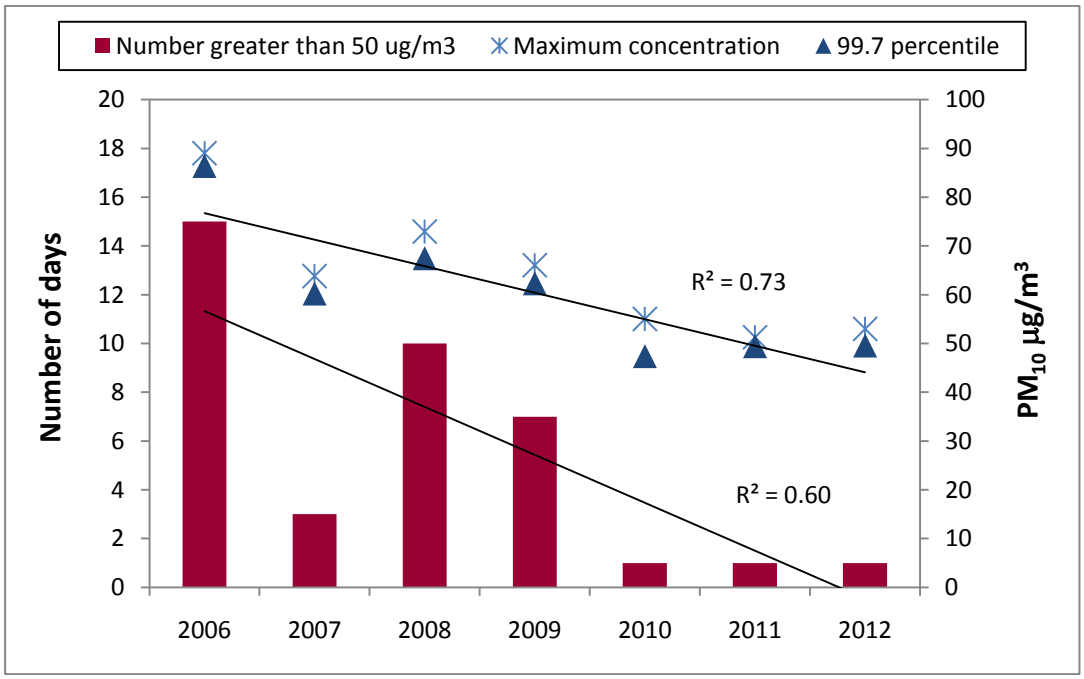


Figure 5-5: Number of days when 50 µg/m^3 was exceeded compared with the maximum concentration and the 99.7 percentile concentration measured from 2006 to 2012.

The annual average PM_{10} concentration for 2012 of 13 µg/m^3 is lower than the 14 µg/m^3 average for 2010 and 2011. Summary statistics for PM_{10} monitoring results for the period 2001 to 2012 are shown in Table 5.1.

Table 5-1: Summary of PM_{10} concentrations measured at the Taupo monitoring site from 2001 to 2012[1].

Indicator	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Good 0-33% of Guideline	43%	59%	52%	55%	56%	47%	65%	66%	71%	73%	69%	76%
Acceptable 33-66% of guideline	36%	33%	32%	30%	36%	38%	29%	24%	22%	20%	26%	19%
Alert 66-100% of guideline	18%	7%	12%	12%	7%	10%	5%	7%	5%	6%	5%	5%
Action > Guideline	2%	1%	4%	2%	1%	5%	1%	3%	2%	0%	0%	0%
Percentage of valid data	12%	21%	29%	29%	30%	27%	83%	99%	99%	100%	99%	99%
Annual average[2] ($\mu g/m^3$)	20	17	18	17	16	19	15	17	15	14	14	13
Number exceedances	1	3	12	6	3	15	3	10	7	1	1	1
99.7 %ile concentration ($\mu g/m^3$)	55	51	62	62	50	86	60	67	62	47	49	50
Annual maximum ($\mu g/m^3$)	57	54	62	65	52	89	64	73	66	55	51	53
Number records	44	76	106	105	111	98	303	362	363	364	361	362

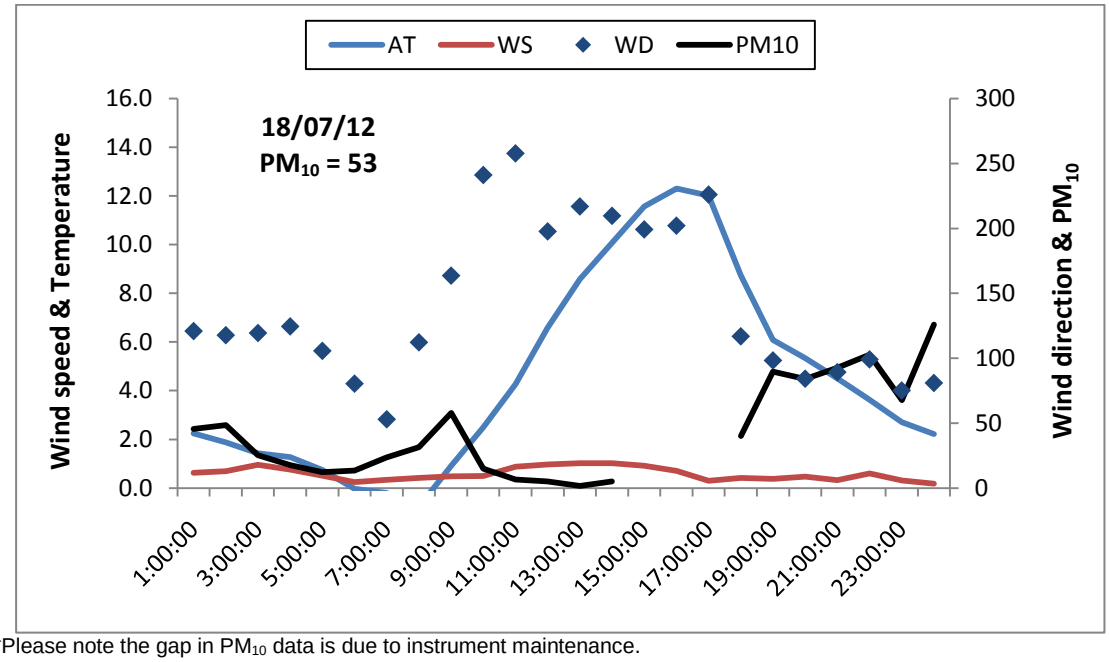
1. 2007 - 2008 data has been updated from that reported in the 2007 and 2008 reports based on a more recent (2009) adjustment factor. 2006 data were gravimetric at Gillies Ave. Data post 2006 has been adjusted for gravimetric equivalency. Note the 2008 monitoring report used a different equation and reported six exceedances of 50 $\mu g\ m^{-3}$ for 2007 compared with three exceedances reported here.
2. To avoid seasonal bias in missing data, annual averages for gravimetric data collected prior to 2007 have been calculated based on the average of the individual seasonal averages (i.e. Jan to Apr, May to Aug, Sep to Dec). Annual average calculations from 2007 onwards have been based on averaging of all data (it makes no difference which method is used because there is very little missing data).

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

Figure 5.6 shows variations in PM_{10} concentrations and meteorological data on 18 July, when the 24-hour average PM_{10} measured at Taupo exceeded 50 µg/m^3.

The pattern in PM_{10} concentrations is reasonably typical of high pollution episodes in urban areas of New Zealand. In particular there is a small morning peak in concentrations around 9am followed by a decrease for the majority of the daytime then an increase in concentrations around 6 pm. Concentrations were also elevated during the early morning period (midnight to 2 am) 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 (Wilton & Baynes, 2010). The July 2012 high pollution event was consistent with these wind patterns.



*Please note the gap in PM_{10} data is due to instrument maintenance.

Figure 5-6: Hourly average PM_{10}, wind speed, wind direction and temperature on the 18th of July when PM_{10} concentrations exceeded 50 µg/m^3 at Taupo.

5.4 Trend analysis

Over time, air quality may improve, get worse, or remain the same. Peak levels of PM_{10} in any given airshed vary from winter to winter depending on meteorological conditions and human responses. For example,if a winter has a greater number of days when the wind speed is low and there is vertical stability in the lower atmosphere then there is likely to be a greater frequency of elevated PM_{10} concentrations. Over the short term this inter-annual variability will mask any genuine underlying trend toward better or worse air quality. A reasonably long monitoring record is needed to confirm or exclude the possibility of any underlying trend.

Seasonal Mann Kendall test for monotonic trends is the preferred approach for detecting underlying trends in variable environmental time-series data sets, and may suggest presence of an underlying trend which is not evident from visual inspection of the PM_{10} record or summary statistics. This method generates probability (p) values that are used to assess the likelihood that the apparent relationship is genuine, or comes about fortuitously as a result of a random alignment of variables. The

conventional threshold for deciding whether a relationship is likely to be genuine is at a probability value of $p<0.05$ or lower, which corresponds to a 95% confidence level and greater. A negative MK-Stat indicates a decreasing trend.

Seasonal Mann Kendall test results (MK-Stat of -1.96 and p-value of 0.05) provides possible evidence that PM_{10} concentrations in Taupo have been decreasing over the period 2006 to 2012. If the same analysis is applied to the period 2001 to 2012 there is stronger evidence that PM_{10} concentrations in Taupo are decreasing as the p-value reduces to 0.01 which is less than 0.05. However, caution should be applied to interpreting a trend analysis over the period 2001 to 2012 because gravimetric sampling based on a one day in three sampling regime was used prior to 2006.

This finding is consistent with a recent analysis undertaken by Environet Ltd in 2013. An assessment of the trend in PM_{10} concentrations in Taupo over the period 2007 to 2012 when the impact of meteorological conditions was minimised indicated some evidence for a reduction in PM_{10} concentrations between 2009 and 2010. However, the report cautioned that while compliance with the NES has been achieved from 2010 to 2012, this is unlikely to be sustained should meteorological conditions similar to 2006 occur. Management measures to further reduce PM_{10} by around 14% are recommended for on-going NES compliance (Wilton, 2013a).

Based on this analysis and the current previous five year exceedance average of 4, it is possible that Taupo will meet the NES 2016 target of no more than one exceedance per 12 month period. But this will be dependent on meteorological conditions i.e. a particularly cold and calm winter could still result in more than one exceedance with in a 12 month period. Further reductions in emissions would provide a “safeguard” against future impacts of changes in meteorology.

6 Te Kuiti

6.1 Air quality monitoring in Te Kuiti

The Te Kuiti air quality monitoring site is located at the Te Kuiti City Council Offices off Queen Street. This site has been used continuously since 2003 to monitor PM_{10} and was also used for short term monitoring in 1998 to monitor PM_{10}. Results of the 1998 monitoring are not included in this air quality monitoring report due to the short term duration of the monitoring and uncertainties surrounding the data.

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).

A ThermoAndersen FH62 C14 BAM is used at this site. Data is recorded at ten minute intervals. Figure 6.1 shows the Te Kuiti Airshed and the location of the monitoring station in Te Kuiti.

Figure 6-1: Te Kuiti Airshed and air quality monitoring site.

6.2 PM_{10} concentrations in Te Kuiti

Figure 6.2 shows daily average PM_{10} concentrations measured in Te Kuiti during 2012. A single exceedance of 61 µg/m^3 was measured in Te Kuiti on 2 July 2012. This exceedance triggered an NES breach as it was the second exceedance measured within a 12 month period (the first exceedance having occurred on 9 December 2011). The number of exceedances in Te Kuiti had been reasonably consistent since 2007 at around 3-4 per year with the exception of 2006 when there were seven exceedances of 50 µg/m^3. During 2011 there were no winter time exceedances of 50 µg/m^3.

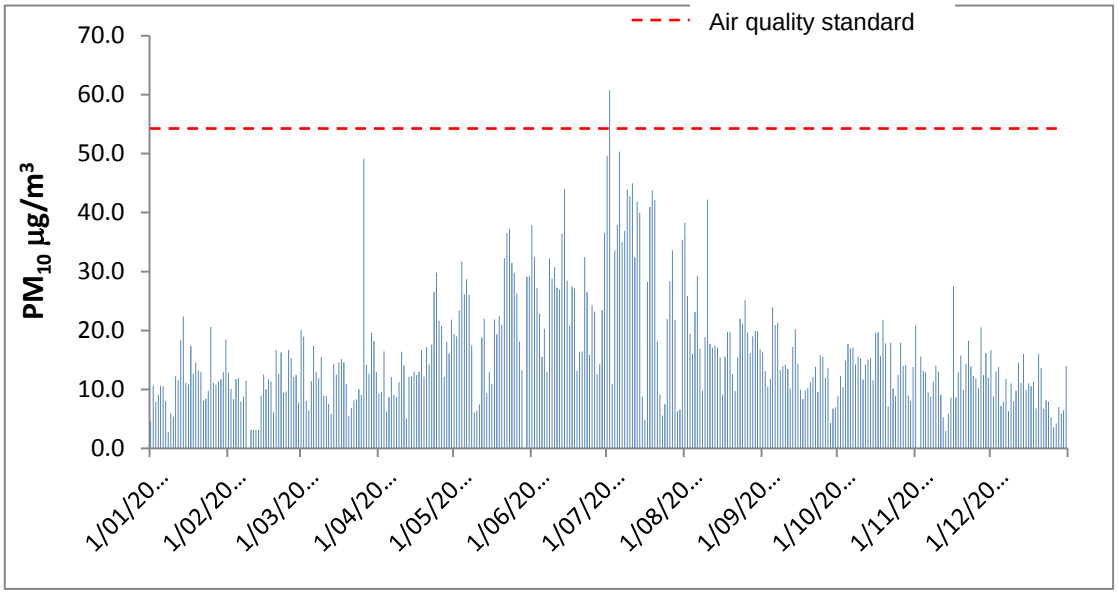


Figure 6-2: Daily winter PM_{10} concentrations measured at the Te Kuiti site during 2012.

A comparison of PM_{10} concentrations to air quality indicator categories from 2003 to 2012 in Te Kuiti is shown in Figure 6.3 and the seasonal variations in the distribution of PM_{10} concentrations for 2012 is shown in Figure 6.4.

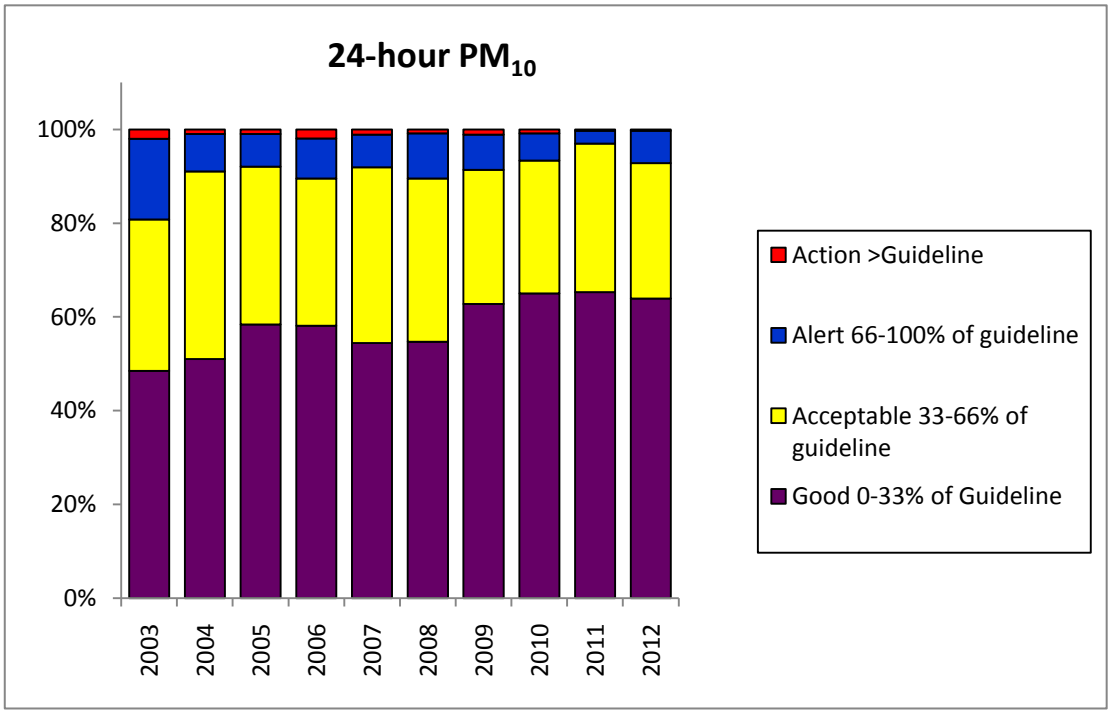


Figure 6-3: Comparison of PM_{10} concentrations measured at the Te Kuiti site from 2003 to 2012 to air quality indicator categories.

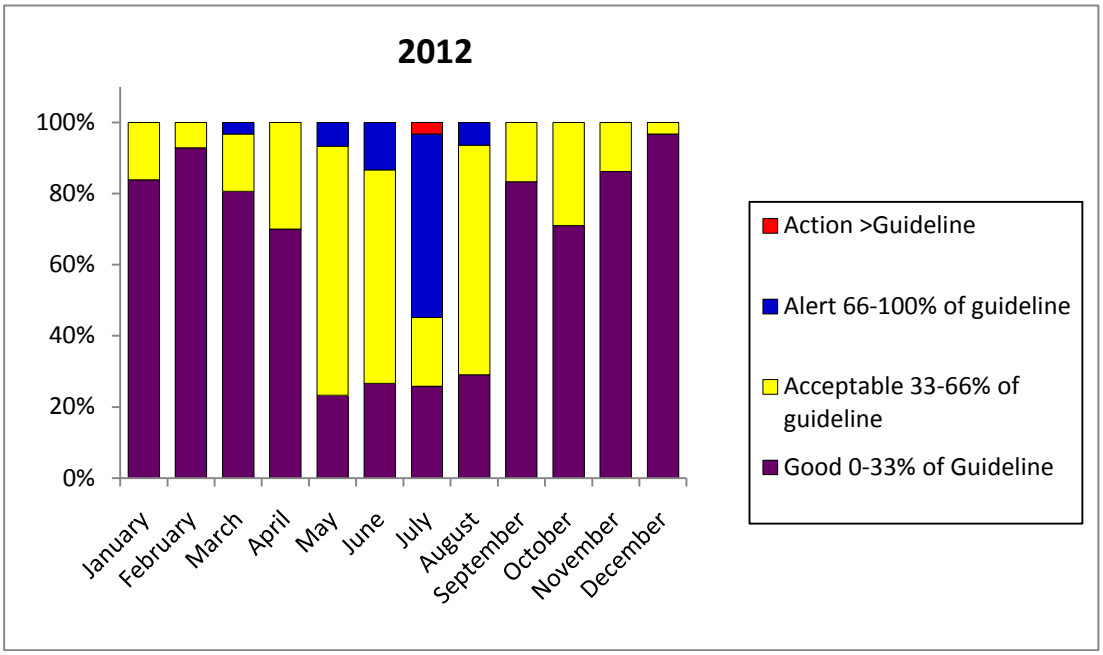


Figure 6-4: Comparison of daily PM_{10} concentrations each month during 2012 to air quality indicator categories.

Figure 6.5 shows the number of days when 50 µg/m^3 was exceeded, the maximum concentration and the 99.7 percentile concentration from 2006 to 2012. The trend line slope for exceedances per year is negative with an R^2 value of 0.81. The trend line slope for 99.7 percentile concentrations per year is also negative with an R^2 value of 0.63. These indicators suggest that air quality has improved over the period 2006 to 2012. This is further supported by the trend analysis presented in Section 6.4 of this report.

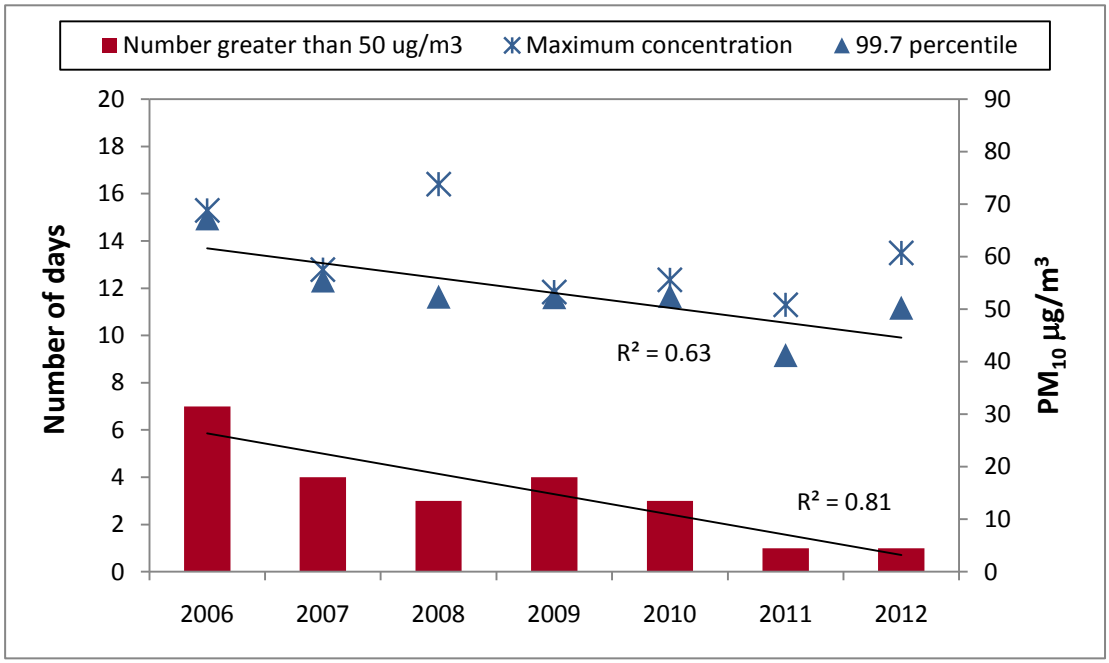


Figure 6-5: Number of days when 50 µg/m^3 was exceeded compared with the maximum concentration and the 99.7 percentile concentration measured from 2006 to 2012.

Summary statistics for PM_{10} monitoring data from the Te Kuiti site from 2003 to 2012 are shown in Table 6.1. In 2012 the annual average PM_{10} concentration in Te Kuiti was 16 µg/m^3 which is consistent with the last two years and lower than the previous annual

average of around 18 µg/m^3 for the period 2003 to 2009. 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. The summary also shows that since 2009 a greater proportion of PM_{10} data falls within the good indicator category (0 to 33% of guideline) compared with the period prior to 2009.

Table 6-1: Summary of PM_{10} concentrations measured at the Te Kuiti monitoring site from 2003 to 2012.

Indicator	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Good 0-33% of Guideline	48%	51%	59%	58%	54%	55%	63%	65%	65%	64%
Acceptable 33-66% of guideline	32%	40%	34%	31%	38%	35%	29%	28%	32%	29%
Alert 66-100% of guideline	17%	8%	7%	9%	7%	10%	8%	6%	3%	7%
Action >Guideline	2%	1%	1%	2%	1%	1%	1%	1%	0%	0%
Percentage of valid data	63%	95%	92%	100%	99%	99%	99%	99%	100%	99%
Annual average ($\mu g/m^3$)	18	18	17	18	18	18	17	16	15	16
Number exceedances	4	5	2	7	4	3	4	3	1	1
99.7 %ile concentration ($\mu g/m^3$)	56	56	52	67	55	52	52	53	41	50
Annual maximum ($\mu g/m^3$)	59	61	54	69	58	74	53	56	51	61
Number records	229	346	337	363	360	362	360	360	363	363

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

Figure 6.6 shows hourly variations in PM_{10} concentrations and meteorological variables on 2 July when the 24-hour average PM_{10} concentration exceeded 50 µg/m^3. The hourly PM_{10} profile is fairly typical of an urban PM_{10} pollution event with a broad peak that is centred around 11 pm to midnight which gradually reduces down over the early hours of the morning and a smaller peak around 9 to 10 am. The wind speeds and temperature are very low apart from a brief period in the middle of the day where elevated wind speed and temperature coincides with a decrease in PM_{10} concentrations.

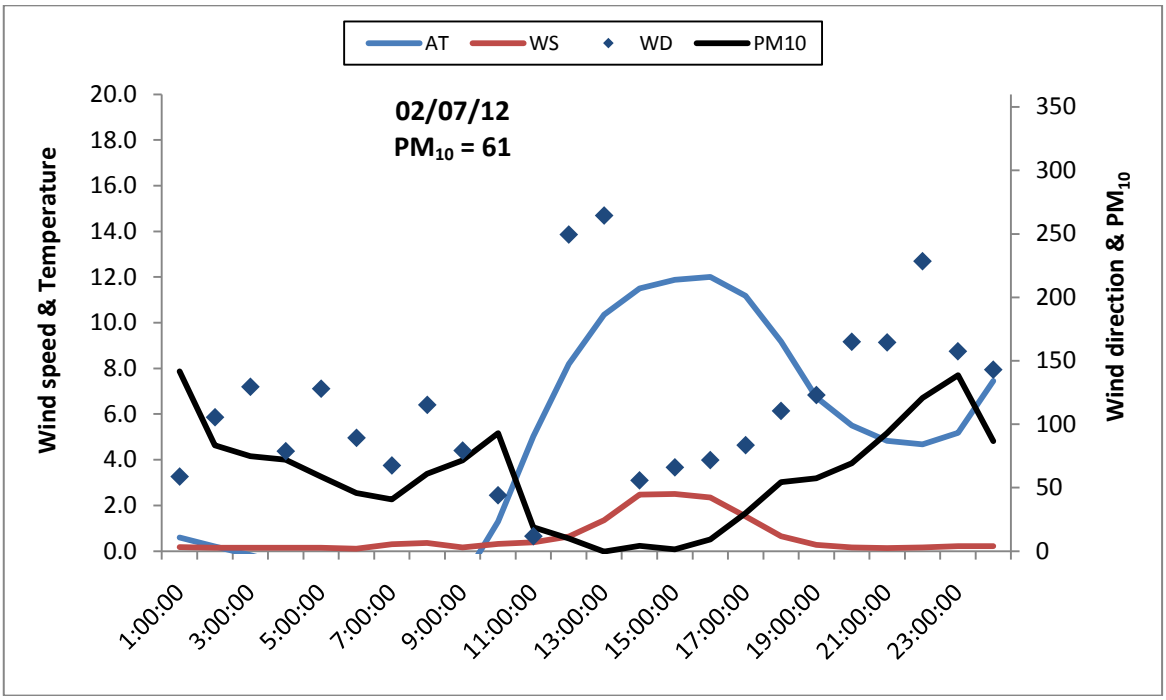


Figure 6-6: Hourly average PM_{10}, wind speed, wind direction, and temperature on 2 July when PM_{10} concentrations exceeded 50 µg/m^3 at Te Kuiti.

6.4 Trend analysis

Over time, air quality may improve, get worse, or remain the same. Peak levels of PM_{10} in any given airshed vary from winter to winter depending on meteorological conditions and human responses. Over the short term inter-annual variability will mask any genuine underlying trend toward better or worse air quality. A reasonably long monitoring record is needed to confirm or exclude the possibility of any underlying trend.

Seasonal Mann Kendall test for monotonic trends is the preferred approach for detecting underlying trends in variable environmental time-series data sets, and may suggest presence of an underlying trend which is not evident from visual inspection of the PM_{10} record or summary statistics. This method generates probability (p) values that are used to assess the likelihood that the apparent relationship is genuine, or comes about fortuitously as a result of a random alignment of variables. The conventional threshold for deciding whether a relationship is likely to be genuine is at a probability value of $p<0.05$ or lower, which corresponds to a 95% confidence level and greater. A negative MK-Stat indicates a decreasing trend.

Seasonal Mann Kendall test results (MK-Stat of -2.71 and p-value of 0.007)) provides evidence that PM_{10} concentrations in Te Kuiti have been decreasing over the period 2003 to 2012.

Based on this analysis and the current previous five year exceedance average of 2.4, it is likely that Te Kuiti will meet the NES 2016 target of no more than one exceedance per 12 month period. But this will be dependent on meteorological conditions i.e. a particularly cold and calm winter could still result in more than one exceedance with in a 12 month period.

7 Putaruru

7.1 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 monitoring site was established at the Bowling Club on Arapuni Street in Putaruru, in July 2006 (refer to Figure 7.1). 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.

Figure 7-1: Putaruru Airshed and air quality monitoring site.

A ThermoAndersen FH62 C14 BAM is used at this site. Data is recorded at ten minute intervals (refer to Figure 7.2).

Figure 7-2: Putaruru air quality monitor.

7.2 PM_{10} concentrations in Putaruru

There were no exceedances of 50 µg/m^3 (24-hour average) measured in Putaruru during 2012. A maximum 24 hour average concentration of 38 µg/m^3 was measured on 11 July. This compares with one exceedance (54 µg/m^3) during 2011. Daily average PM_{10} concentrations measured at Putaruru during 2012 are shown in Figure 7.3.

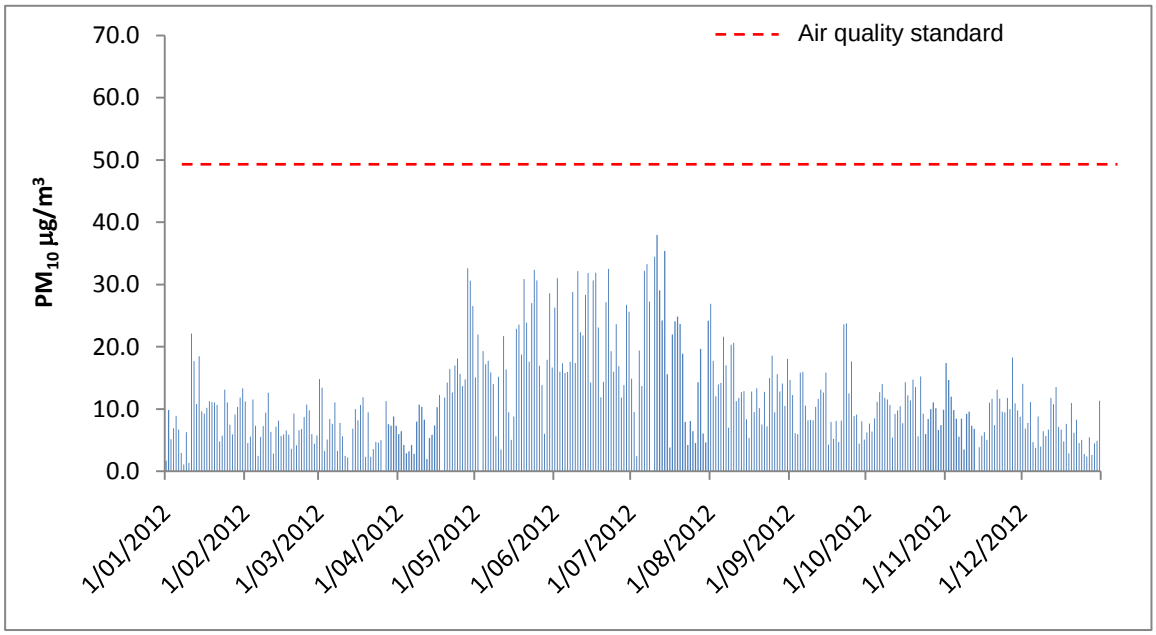


Figure 7-3: Daily winter PM_{10} concentrations measured at the Putaruru site during 2012.

Figure 7.4 compares PM_{10} concentrations measured at Putaruru from 2006 to 2012 to the MfE (2000) air quality indicator categories. Figure 7.5 shows seasonal variations in the distribution of PM_{10} concentrations for 2012. Like most urban areas of New Zealand the most degraded air quality occurs during the months May to August.

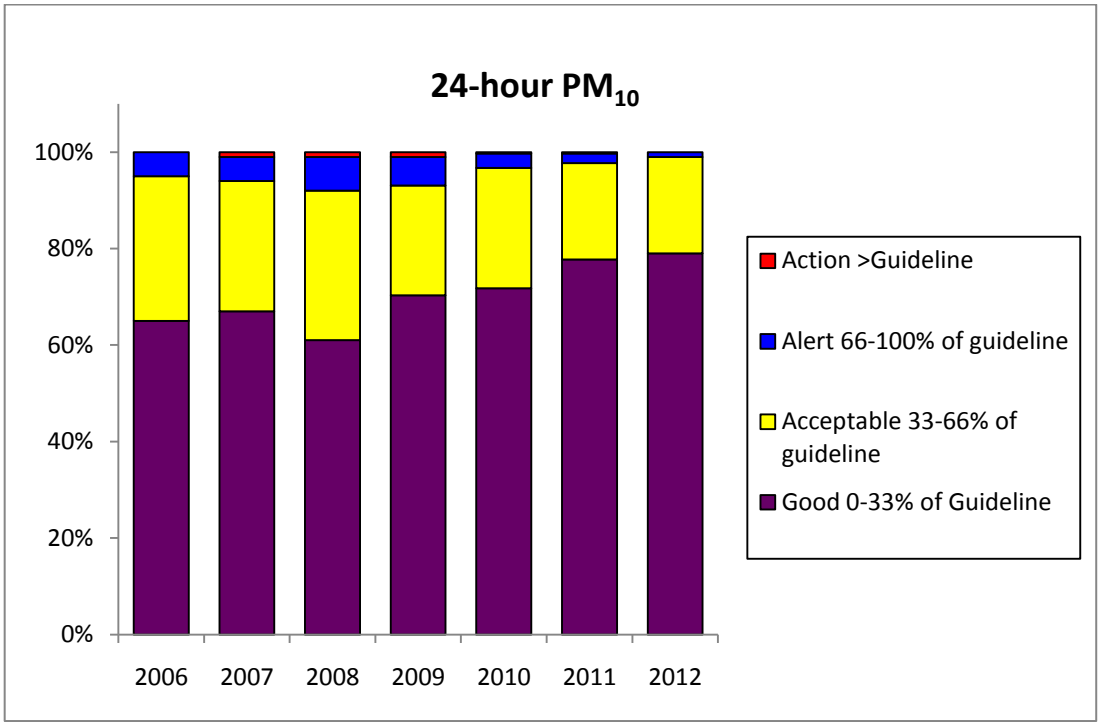


Figure 7-4: Comparison of PM_{10} concentrations measured at the Putaruru site from 2006 to 2012 to air quality indicator categories.

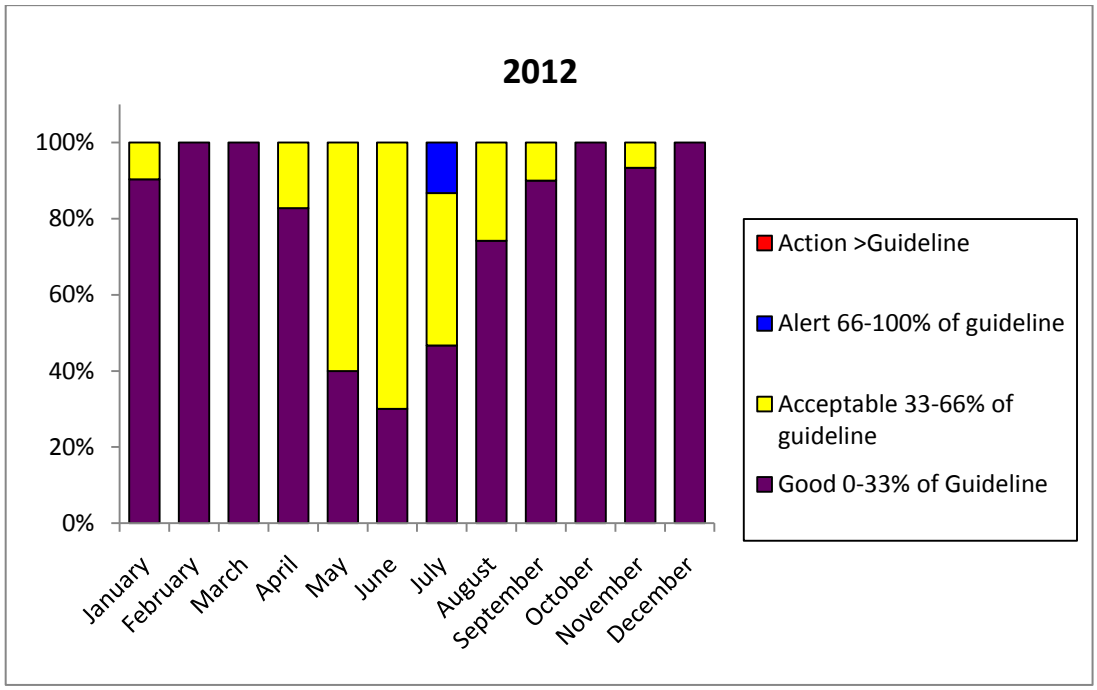


Figure 7-5: Comparison of daily PM_{10} concentrations for 2012 to air quality indicator categories.

Figure 7.6 shows the number of days when 50 µg/m^3 was exceeded, the maximum concentration and the 99.7 percentile concentration from 2007 to 2012. The 2006 data has been excluded from the comparison as monitoring only began half way through the winter season. A trend line analysis of the annual number of exceedances and the 99.7 percentile indicates a decrease in concentrations and this is further supported by the trend analysis presented in Section 7.3 of this report. The greatest number of exceedances and the highest PM_{10} concentrations occurred during 2008. However it is worth noting that in 2008, two of the four recorded exceedances were in summer (February) and came about as a result of dust created by roadworks during the unusual drought conditions.

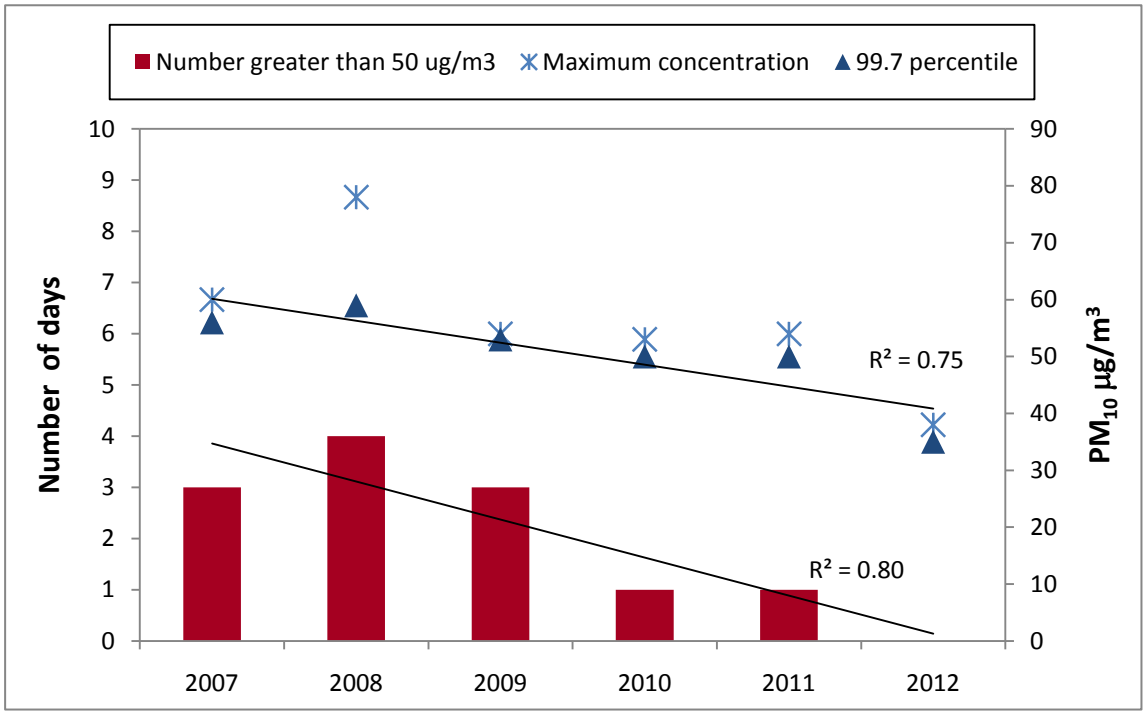


Figure 7-6: **Number of days when 50 µg/m^3 was exceeded compared with the maximum concentration and the 99.7 percentile concentration measured from 2007 to 2012.**

The annual average PM_{10} concentration for Putaruru for 2012 was 12 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 7.1.

Table 7-1: **Summary of PM_{10} concentrations measured at the Putaruru monitoring site from 2006 to 2012.**

Indicator	2006	2007	2008	2009	2010	2011	2012
Good 0-33% of Guideline	65%	67%	61%	71%	72%	78%	79%
Acceptable 33-66% of guideline	30%	27%	31%	23%	25%	20%	20%
Alert 66-100% of guideline	5%	5%	7%	6%	3%	2%	1%
Action > Guideline	0%	1%	1%	1%	0.3%	0.3%	0%
Percentage of valid data	46%	100%	100%	100%	100%	95%	99%
Annual average (µg/m^3)	n/a	15	17	14	14	13	12
Number exceedances	0	3	4	3	1	1	0
99.7 %ile (µg/m^3)	41	56	59	53	50	50	35
Annual maximum (µg/m^3)	42	60	78	54	53	54	38
Number records	166	365	364	364	363	346	361

7.3 Trend analysis

Over time, air quality may improve, get worse, or remain the same. Peak levels of PM_{10} in any given airshed vary from winter to winter depending on meteorological conditions and human responses. Over the short term this inter-annual variability will mask any genuine underlying trend toward better or worse air quality. A reasonably long monitoring record is needed to confirm or exclude the possibility of any underlying trend.

Seasonal Mann Kendall test for monotonic trends is the preferred approach for detecting underlying trends in variable environmental time-series data sets, and may

suggest presence of an underlying trend which is not evident from visual inspection of the PM_{10} record or summary statistics. This method generates probability (p) values that are used to assess the likelihood that the apparent relationship is genuine, or comes about fortuitously as a result of a random alignment of variables. The conventional threshold for deciding whether a relationship is likely to be genuine is at a probability value of $p<0.05$ or lower, which corresponds to a 95% confidence level and greater. A negative MK-Stat indicates a decreasing trend.

Seasonal Mann Kendall test results (MK-Stat of -2.18 and p-value of 0.03) provides evidence that PM_{10} concentrations in Putaruru have been decreasing over the period 2006 to 2012.

Based on this analysis and the current previous five year exceedance average of 1.8, it is likely that Putaruru will meet the NES 2016 target of no more than one exceedance per 12 month period. But this will be dependent on meteorological conditions i.e. a particularly cold and calm winter could still result in more than one exceedance with in a 12 month period.

8 Matamata

8.1 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 located at the Playcentre grounds on Farmers Road (refer to Figure 8.1). 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, ambient air temperature and relative humidity. The site was installed by Watercare Services Limited and is operated and maintained by Waikato Regional Council staff. The BAM continuously measures PM_{10} data and it is logged at ten minute intervals.

Figure 8-1: Matamata Airshed and air quality monitoring site.

8.2 PM_{10} concentrations in Matamata

Daily average PM_{10} concentrations measured at Matamata during 2012 are shown in Figure 8.2. The maximum measured PM_{10} concentration was 36 µg/m^3 and was measured on 12 July. Previous winter time maximums have been as high as 45 µg/m^3.

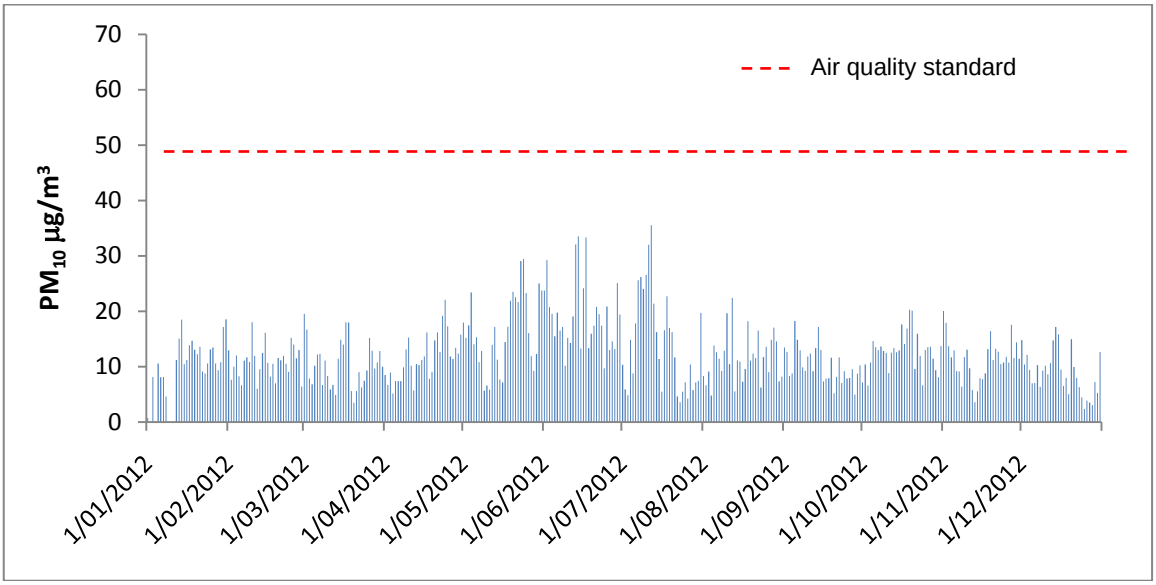


Figure 8-2: Daily winter PM_{10} concentrations measured at the Matamata site during 2012.

Figure 8.3 shows concentrations of PM_{10} measured at the Matamata air quality monitoring site almost all less than 66% of the NES. Figure 8.4 shows the seasonal variations in the distribution of PM_{10} concentrations for 2012. The number of days when 50 µg/m^3 was exceeded, the maximum concentration and the second highest concentration from 2006 to 2012 are shown in Figure 8.5. The highest PM_{10} concentration measured during 2009 of 93 µg/m^3 occurred as a result of the Australian dust storm. Under the recent 2011 amendment to the NESAQ, an exceedance caused by an event such as the Australian dust storm of 2009, could now qualify for an exemption as per the exceptional circumstances regulation of the NESAQ (regulation 16A). However, the regulation does not allow for retrospective exemption so the 2009 exceedance must still be counted.

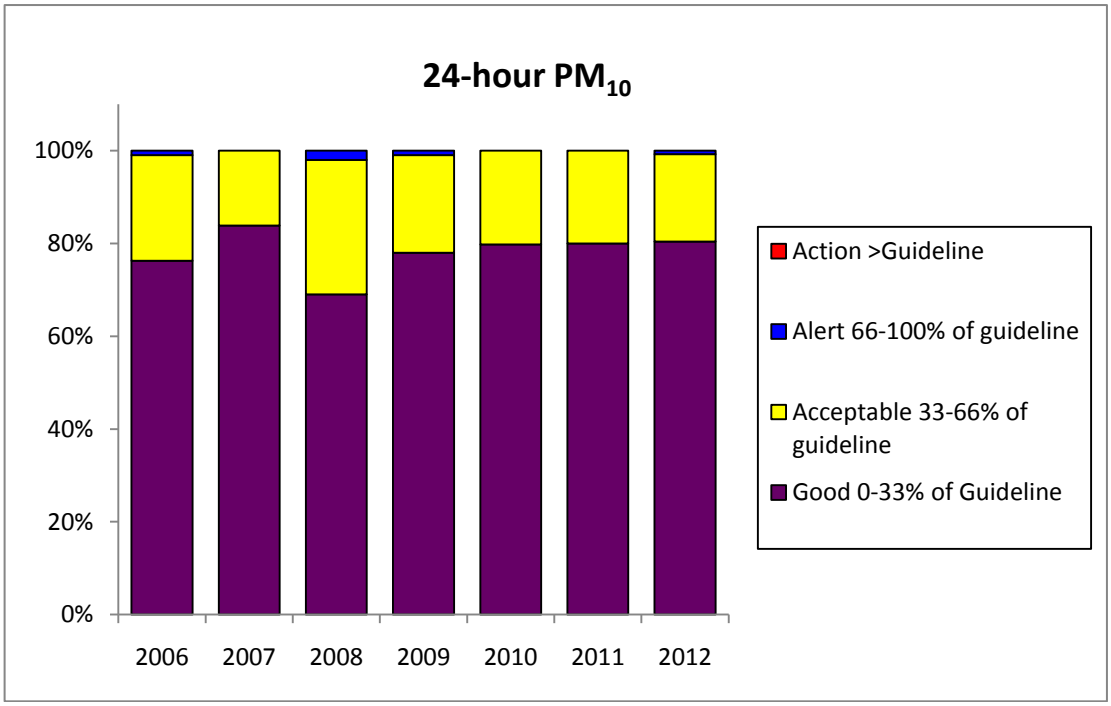


Figure 8-3: Comparison of PM_{10} concentrations measured at the Matamata site from 2006 to 2012 to air quality indicator categories.

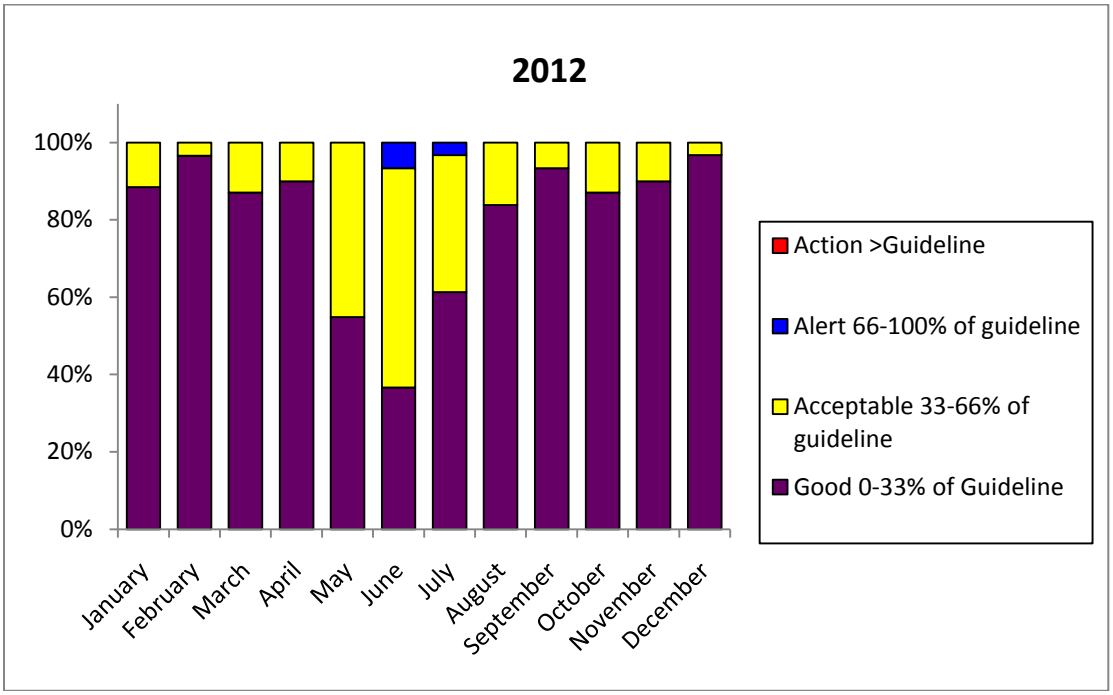


Figure 8-4: Comparison of daily PM_{10} concentrations each month during 2012 to air quality indicator categories.

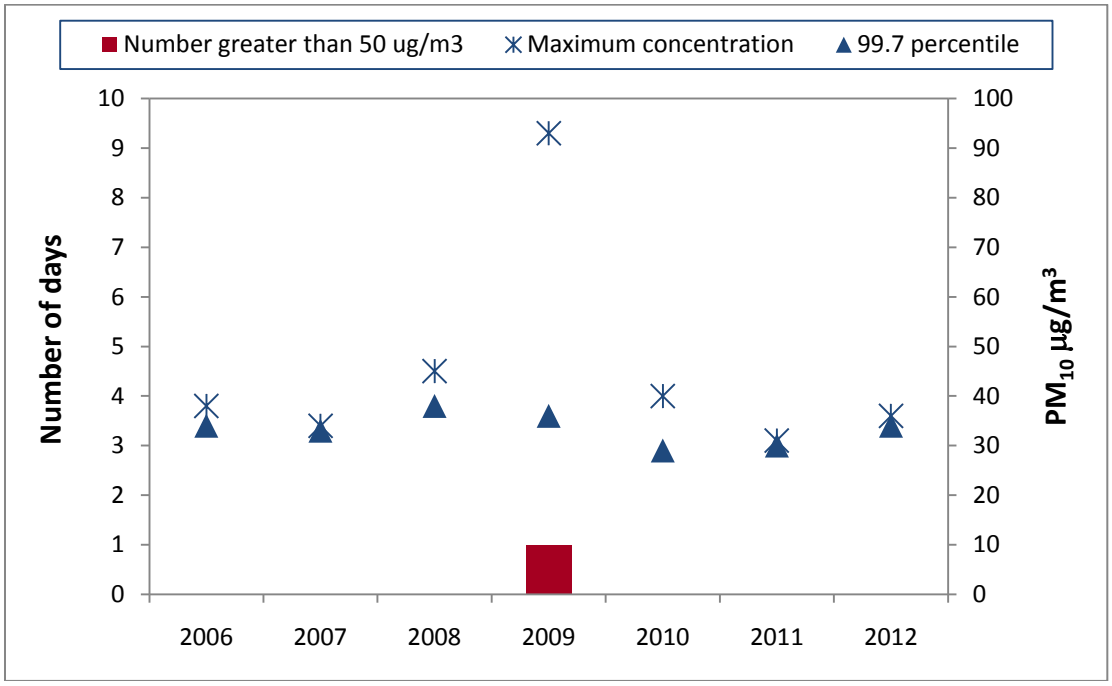


Figure 8-5: Number of days when 50 µg/m^3 was exceeded compared with the maximum concentration and the 99.7 percentile concentration measured from 2006 to 2012.

The annual average PM_{10} concentration for Matamata for 2012 is 12.5 µg/m^3 which is consistent with previous years except for 2008 which had an annual average of 15 µg/m^3. Summary statistics for PM_{10} monitoring results are shown in Table 8.1.

Table 8-1: Summary of PM_{10} concentrations measured at the Matamata monitoring site from 2005 to 2012.

Indicator	2005	2006	2007	2008	2009	2010	2011	2012
Good 0-33% of Guideline	81%	77%	83%	69%	78%	79%	80%	80%
Acceptable 33-66% of guideline	18%	23%	16%	29%	21%	20%	20%	19%
Alert 66-100% of guideline	1%	1%	0%	2%	1%	0%	0%	1%
Action > Guideline	0%	0%	0%	0%	0%	0%	0%	0%
Percentage of valid data	51%	99%	79%	100%	98%	99%	97%	99%
Annual average ($\mu g/m^3$)	12	13	12	15	13	13	12	13
Number exceedances	0	0	0	0	1	0	0	0
99.7 %ile concentration ($\mu g/m^3$)	34	34	33	38	36	29	30	34
Annual maximum ($\mu g/m^3$)	36	38	34	45	93	40	31	36
Number records	187	362	287	364	359	361	359	361

8.3 Daily variations in PM_{10} and meteorology on 14 June 2012

Daily variations in PM_{10} concentrations and meteorological variables on 14 June 2012 when the second[5] highest PM_{10} concentration of 34 µg m^{-3} (24-hour average) was recorded are shown in Figure 8.6. Elevated PM_{10} concentrations occur during the early evening under low wind speeds, falling temperature and a variable wind direction.

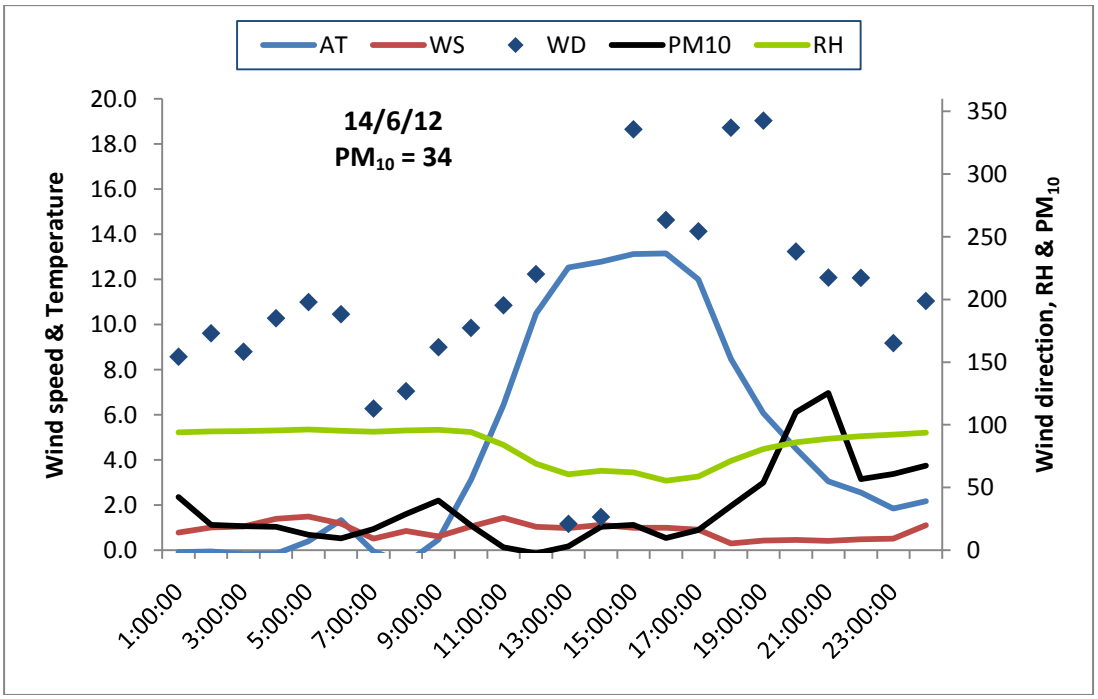


Figure 8-6: Hourly average PM_{10}, wind speed, wind direction, temperature and humidity on 14 June when the 24-hour average PM_{10} concentration was 34 $\mu g/m^3$ at Matamata.

[5] The maximum concentration was recorded on 12 July but three hours of data were missing in the middle of that day.

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 monitoring site was established at Herschel Street, about 50 metres away from the corner of Ellery Street and Herschel Street in Ngaruawahia (refer to Figure 9.1).

Figure 9-1: Ngaruawahia Airshed and monitoring site.

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

Figure 9-2: Ngaruawahia air quality monitor.

9.2 PM_{10} concentrations in Ngaruawahia

Figure 9.3 shows 24-hour average PM_{10} concentrations measured at the Ngaruawahia site during 2012. The maximum measured PM_{10} concentration in Ngaruawahia during 2012 was 31 µg/m^3 (24-hour average), which was measured on 11 July. This result is similar to the maximum concentration for 2010 of 29 µg/m^3,although it is lower than the winter maximum concentration for 2009 and 2011 which were 113 and 44 µg/m^3 respectively. The highest PM_{10} concentration measured during 2009 of 113 µg/m^3 occurred as a result of the Australian dust storm. Under the recent 2011 amendment to the NESAQ, an exceedance caused by an event such as the Australian dust storm of 2009, could now qualify for an exemption as per the exceptional circumstances regulation of the NESAQ (regulation 16A). However, the regulation does not allow for retrospective exemption so the 2009 exceedance must still be counted.

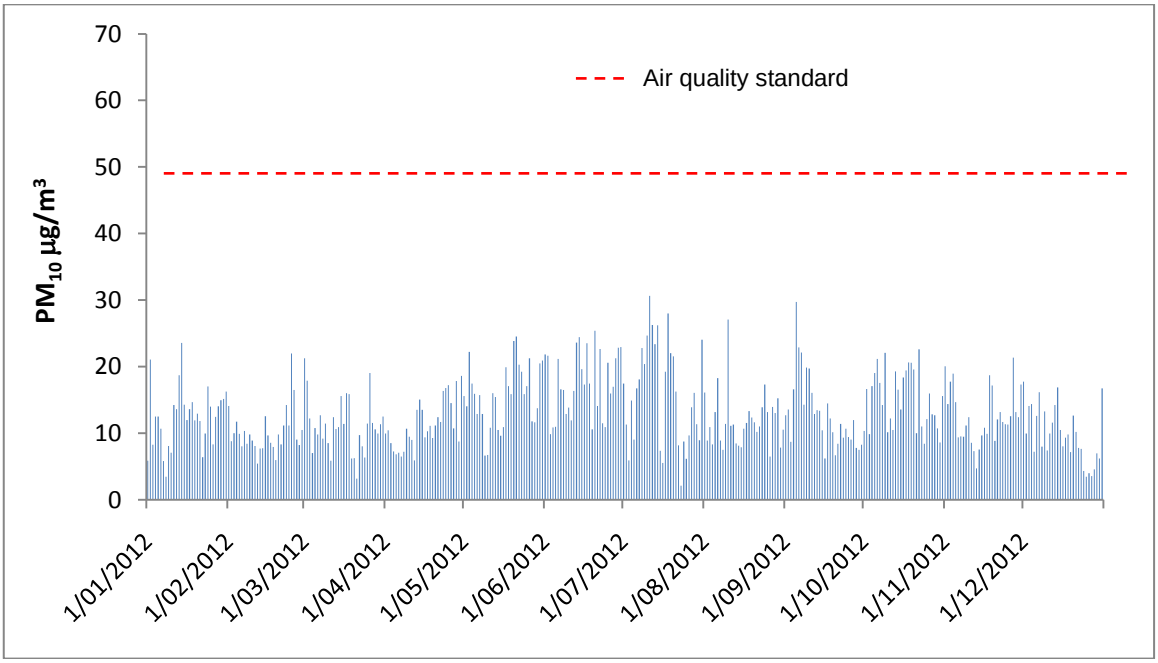


Figure 9-3: Daily winter PM_{10} concentrations measured at the Ngaruawahia site during 2012.

Figure 9.4 shows that during 2012, 100% of the PM_{10} concentrations measured at Ngaruawahia were within the 'acceptable' and 'good' air quality indicator categories (MfE, 2000). Seasonal variations in the distribution of PM_{10} concentrations are shown in Figure 9.5. Figure 9.6 compares the maximum and second highest PM_{10} concentrations and the number of days when 50 µg/m^3 was exceeded from 2008 to 2012. The one exceedance of 50 µg/m^3 measured at this site (2009) occurred as a result of the Australian dust storms.

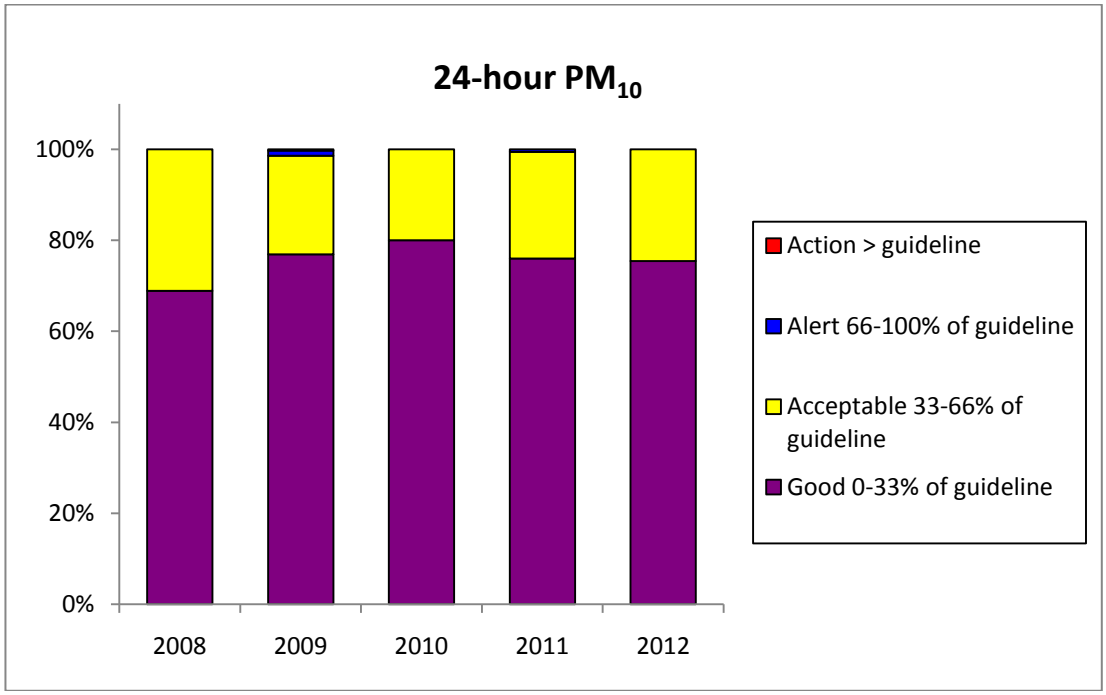


Figure 9-4: **Comparison of PM_{10} concentrations measured at the Ngaruawahia site from 2008 – 2012 to air quality indicator categories.**

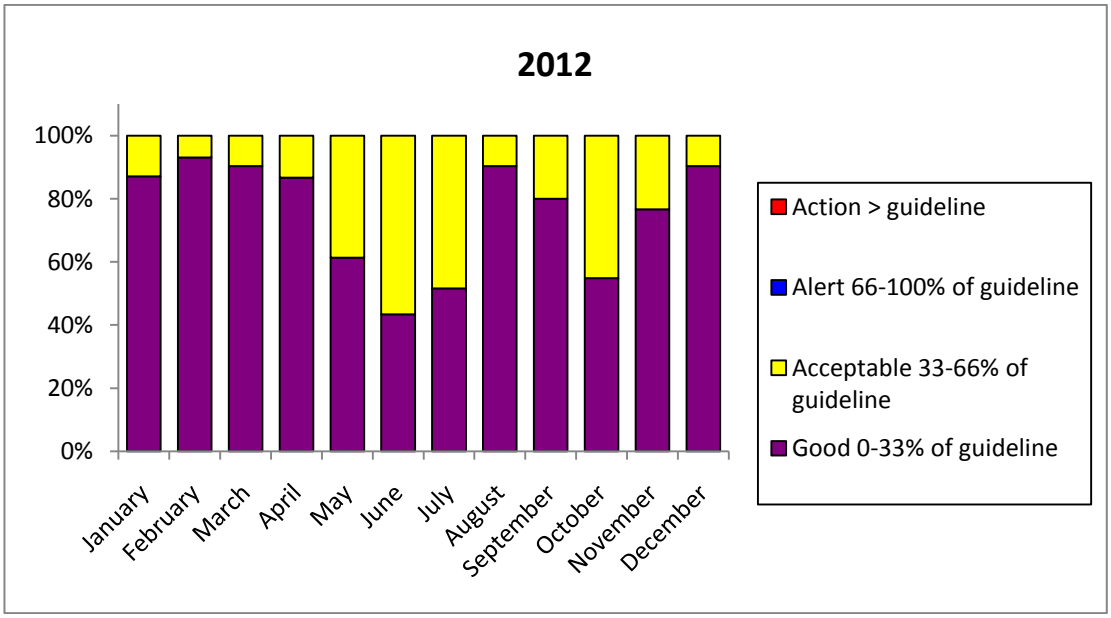


Figure 9-5: **Comparison of daily PM_{10} concentrations each month during 2012 to air quality indicator categories.**

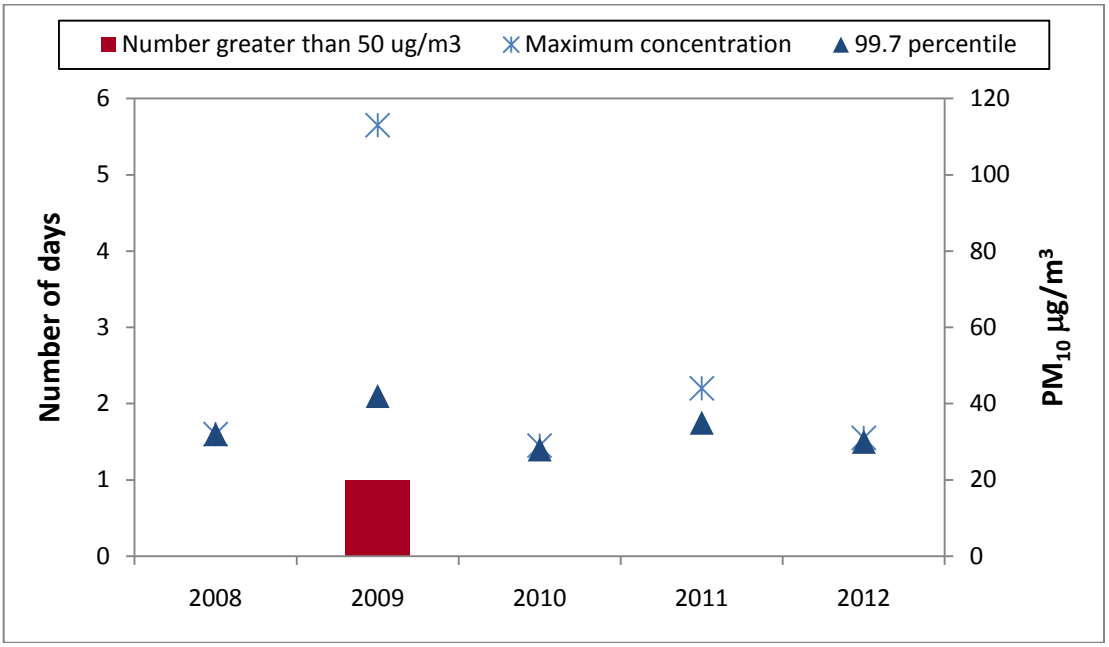


Figure 9-6: **Number of days when 50 µg/m^3 was exceeded compared with the maximum concentration and the 99.7 percentile concentration measured from 2008 to 2012.**

The annual average PM_{10} concentration for Ngaruawahia for 2012 was 13 µg/m^3. This was similar to all previous years of monitoring. 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 from 2008 to 2012.**

Indicator	2008	2009	2010	2011	2012
Good 0-33% of guideline	69%	77%	80%	76%	75%
Acceptable 33-66% of guideline	31%	22%	20%	23%	25%
Alert 66-100% of guideline	0%	1%	0%	1%	0%
Action > guideline	0%	0%	0%	0%	0%
Percentage of Valid data	65%	100%	97%	99%	100%
Annual Average (µg m^{-3})	14	14	13	13	13
Measured exceedances	0	1	0	0	0
99.7 %ile concentration	32	42	28	35	30
Annual Maximum (µg m^{-3})	32	113	29	44	31
Number of records	238	364	355	363	366

10 Turangi

10.1 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.

A monitoring site was established at 16 Ohuanga Road, Turangi (refer to Figure 10.1) in April 2009. Daily and hourly average PM_{10} concentrations are measured at the site using a FH 62 BAM.

Figure 10-1: Turangi Airshed and air quality monitoring site.

10.2 PM_{10} concentrations in Turangi

The maximum PM_{10} concentration in Turangi was 31 µg m^{-3} (24-hour average) and was recorded on 8th of July. No exceedances of 50 µg m^{-3} were measured at Turangi during 2012. Daily average PM_{10} concentrations measured at the Turangi site during 2012 are shown in Figure 10.2.

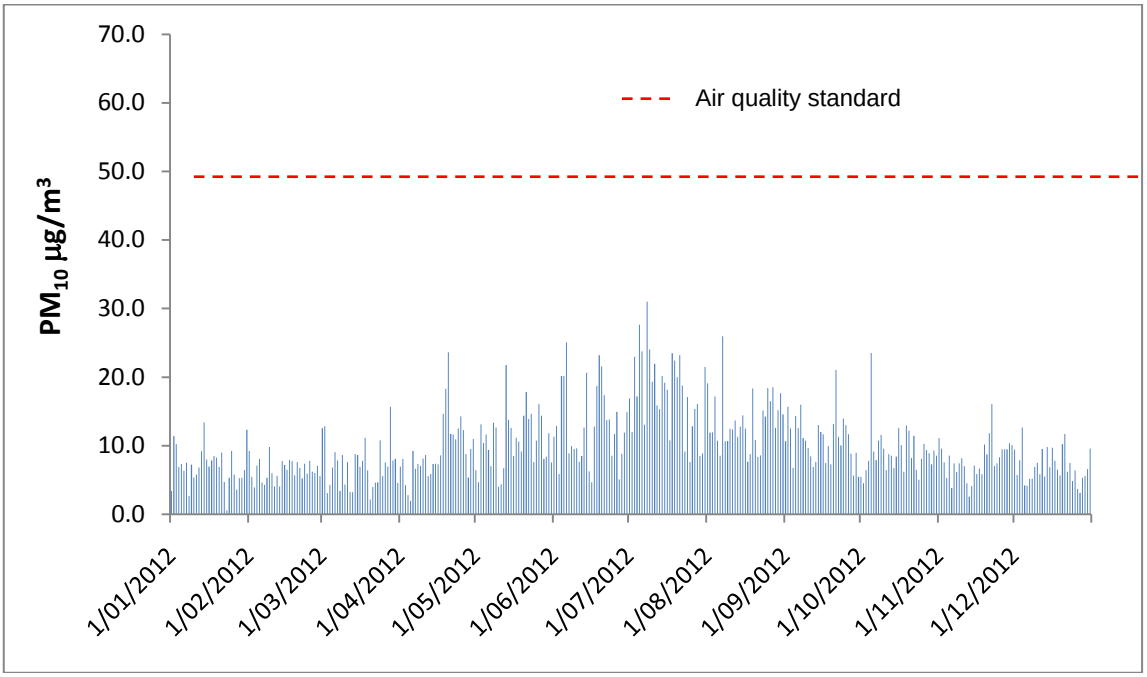


Figure 10-2: Daily average PM_{10} concentrations measured at the Turangi site for 2012.

Figure 10.3 shows concentrations of PM_{10} relative to air quality indicator categories at Turangi from 2009 to 2012. In 2012, 90% of days experienced PM_{10} concentrations within the 'good' category. On all other days PM_{10} was within the "acceptable" category.

Seasonal variations in the distribution of PM_{10} concentrations for 2012 are shown in Figure 10.4. Figure 10.5 shows there were no exceedances of 50 µg/m^3 from 2009 to 2012. It also shows the maximum concentration and the second highest concentration for each year.

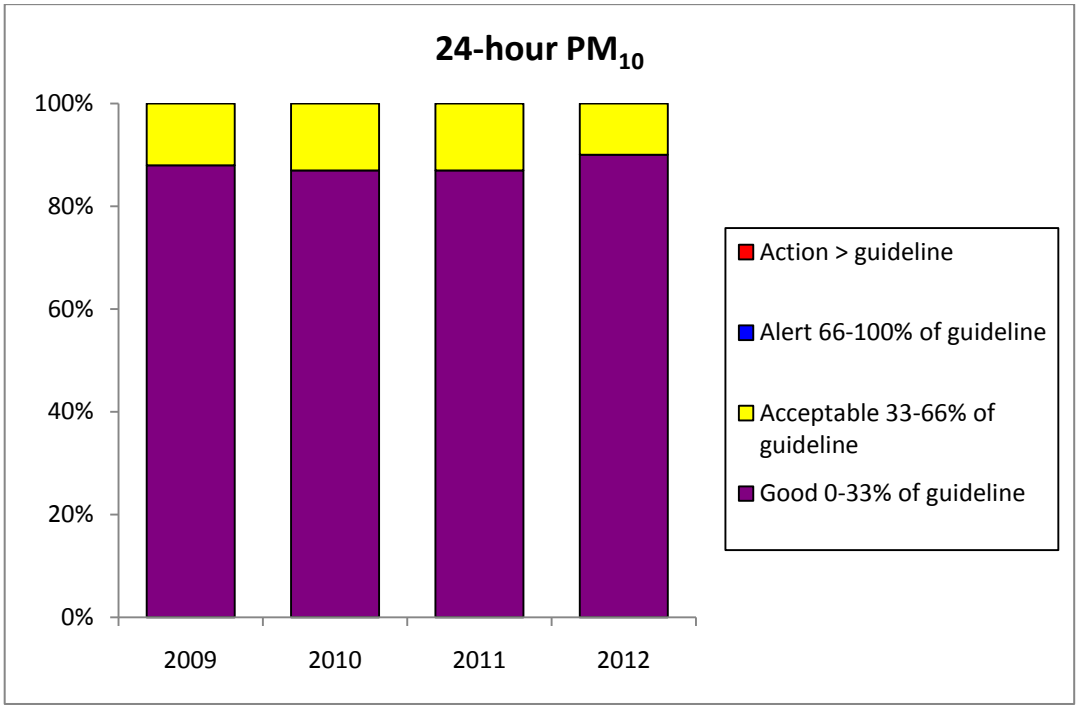


Figure 10-3: Comparison of PM_{10} concentrations measured at the Turangi site from 2009 to 2012 to air quality indicator categories.

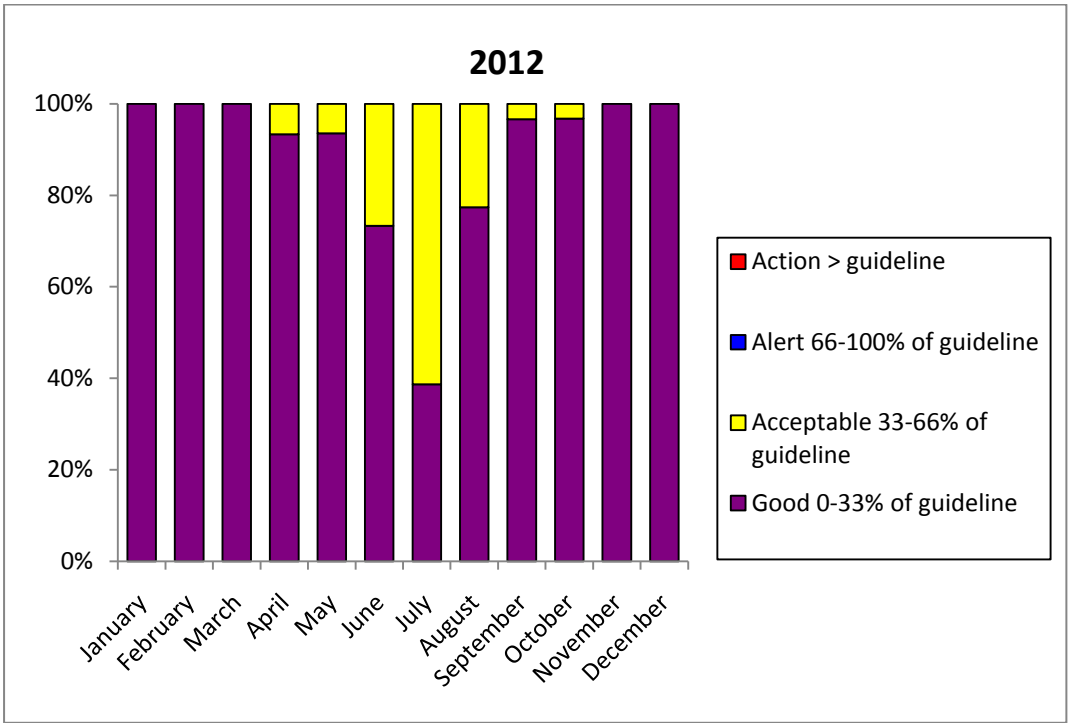


Figure 10-4: Comparison of daily PM_{10} concentrations for 2012 to air quality indicator categories.

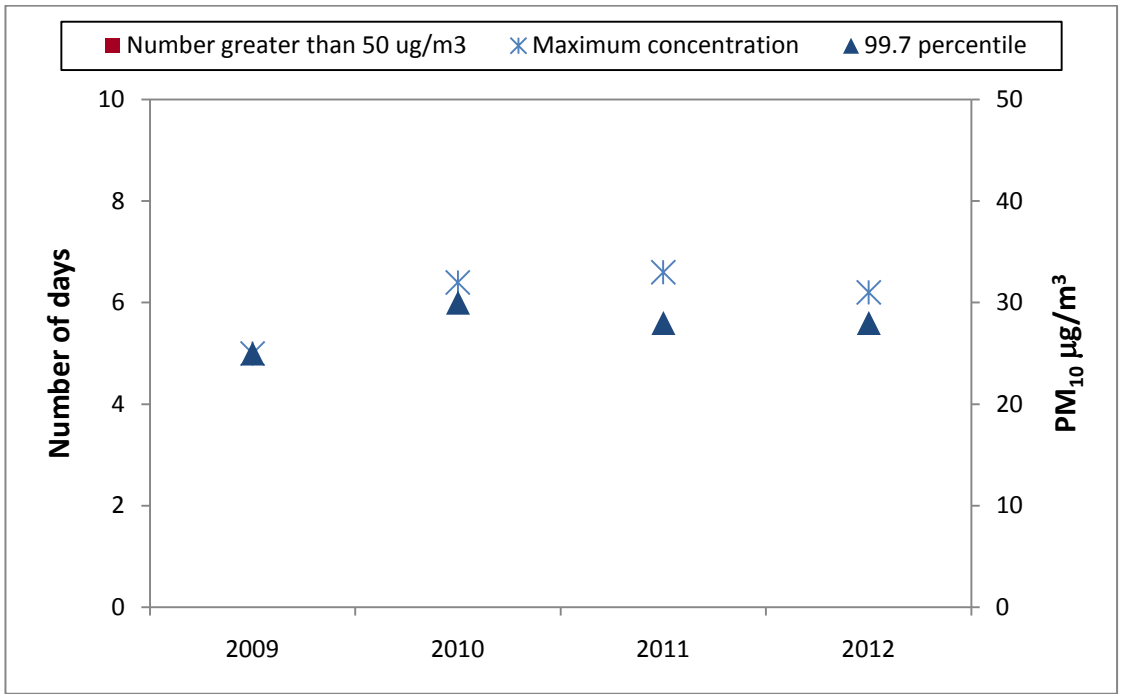


Figure 10-5: Number of days when 50 µg/m^3 was exceeded compared with the maximum concentration and the 99.7 percentile concentration measured from 2009 to 2012.

The annual average PM_{10} concentration for Turangi for 2012 is 10 µg/m^3 which is consistent with previous annual averages. Table 8.1 shows summary statistics for PM_{10} monitoring results from 2009 to 2012.

Table 10-1: Summary of PM_{10} concentrations measured at the Turangi monitoring site from 2009 to 2012.

Indicator	2009	2010	2011		2012
Good 0-33% of guideline	88%	87%	87%		90%
Acceptable 33-66% of guideline	12%	13%	13%		10%
Alert 66-100% of guideline	0%	0%	0%		0%
Action > guideline	0%	0%	0%		0%
Percentage of Valid data	79%	84%	85%		99%
Annual Average (µg m^{-3})	9	10	10		10
Measured exceedances	0	0	0		0
99.7 %ile concentration	25	30	28		28
Annual Maximum (µg m^{-3})	25	32	33		31
Number of records	288	305	312		362

11 Summary

During 2012 concentrations of PM_{10} were measured at air quality monitoring sites in Hamilton, Tokoroa, Taupo, Te Kuiti, Putaruru, Matamata, Ngaruawahia, and Turangi. Sulphur dioxide, benzene, toluene, xylenes and ethylbenzene were also measured in Hamilton.

More than one exceedance of 50 µg/m^3 as a 24-hour PM_{10} average within a rolling 12-month period constitutes a breach of the NES. The NES for PM_{10} was breached in Tokoroa and Te Kuiti in 2012. There were no breaches in any of the other airsheds although one exceedance of 50 µg/m^3 was measured in Taupo. There were no exceedances of the annual average guideline of 20 µg/m^3 for PM_{10} in any of the airsheds. The maximum measured PM_{10} concentrations, number of exceedances of 50 µg/m^3 and the annual average PM_{10} concentrations in all airsheds are shown in Table 11.1.

Table 11-1: Summary of PM_{10} monitoring results for 2012.

Site	Maximum measured concentration (µg/m^3)	Measured exceedances	Number of NES breaches	Annual Average
Hamilton (Peachgrove)	42	0	0	13 µg/m^3
Hamilton (Ohaupo Rd)	41	0	0	14 µg/m^3
Tokoroa	75	15	14	17 µg/m^3
Taupo	53	1	0	13 µg/m^3
Te Kuiti	61	1	1*	16 µg/m^3
Matamata	36	0	0	13 µg/m^3
Putaruru	38	0	0	12 µg/m^3
Ngaruawahia	31	0	0	13 µg/m^3
Turangi	31	0	0	10 µg/m^3

*A breach because it was the second exceedance within a 12 month period with the previous breach occurring in December 2011. The NES specifies no more than one exceedance within a rolling 12 month period rather than a calendar year.

A statistical analysis of seasonal PM_{10} data collected in Taupo, Te Kuiti and Putaruru indicates that concentrations have decreased over the previous six or more year period. No such decrease has been identified for Tokoroa or Hamilton. Refer to Table 11.2 for summary of trend and five year exceedance average.

Table 11-2: Five year exceedance average and trend analysis for the five worst airsheds.

Airshed	Five year average (2008 to 2012)	Trend
Hamilton	0.8	No change
Tokoroa	15	No change
Taupo	4	Decrease
Te Kuiti	2.4	Decrease
Putaruru	1.8	Decrease

Concentrations of SO_2 were measured in Hamilton from March 2012 to August 2012. No exceedances of 350 µg/m^3 (hourly average) were measured during this six month period.

In Hamilton, concentrations of benzene were within the guideline of 3.6 µg/m^3 with a maximum average annual concentration during 2012 of 2.7 µg/m^3 measured at the Greenwood Street monitoring site. An improving or "levelling" trend is evident for annual average concentrations of benzene at all sites. Concentrations of toluene, xylene and ethylbenzene were also well within acceptable levels.

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Wilton E 2013b in press. Assessing trends in PM_{10} concentrations at Taupo. Report prepared for Waikato Regional Council, Hamilton.

Appendices

The appendices to this report are the Excel spreadsheets of raw data and indicator calculations and are compiled in separate Waikato Regional Council documents which may be obtained on request from the Waikato Regional Council.

Description	Document Reference Number
Hamilton BTEX	1269117
Hamilton SO_2	2256770
Hamilton PM_{10}	2241995
Hamilton Meteorology	1058711
Taupo PM_{10}	1058716
Taupo Meteorology	1218406
Tokoroa PM_{10}	2165753
Tokoroa Meteorology	1058722
Te Kuiti PM_{10}	1058720
Te Kuiti Meteorology	1058717
Matamata PM_{10}	1058713
Matamata Meteorology	1058712
Putaruru PM_{10}	2165893
Ngaruawahia PM_{10}	1432934
Turangi PM_{10}	1620622