

# Air Quality Monitoring Report for Hamilton, Tokoroa, Taupo, Te Kuiti, Matamata, Putaruru, Ngaruawahia, Waihi and Turangi – 2010

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**Air Quality Monitoring  
Report for Hamilton,  
Tokoroa, Taupo, Te Kuiti,  
Matamata, Putaruru,  
Ngaruawahia, Waihi and  
Turangi – 2010**

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**Environment Waikato**

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**March 2011**

## Executive Summary

The main air contaminant of concern in the Waikato and most other urban areas of New Zealand is PM<sub>10</sub> (particles in the air less than 10 microns in diameter). The Ministry for the Environment specifies that the National Environmental Standard (NES) for PM<sub>10</sub> of 50 µg m<sup>-3</sup> (24-hour average, one allowable exceedence per year) must be achieved by September 2016 in all urban areas of the Waikato with the exception of Tokoroa. Tokoroa is required to achieve three exceedences by September 2016 and reduce PM<sub>10</sub> to meet the NES by September 2020. The NES requires air quality monitoring to take place in areas that are likely to exceed the standard for PM<sub>10</sub>.

During 2010, PM<sub>10</sub> 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. This report compares PM<sub>10</sub> concentrations measured in these areas to the NES for PM<sub>10</sub> and to the Ministry for the Environment's air quality guidelines and indicator categories.

The NES was breached in Tokoroa and Te Kuiti but concentrations in all other areas were compliant with the NES. In comparison, in 2009, concentrations breached the NES in Hamilton, Tokoroa, Te Kuiti, Taupo and Putaruru. In 2010 in Tokoroa PM<sub>10</sub> concentrations were higher than for previous years with a maximum concentration of 97 µg m<sup>-3</sup> and around 16 exceedences of 50 µg m<sup>-3</sup>. Table E1 shows summary PM<sub>10</sub> data for all sites for 2010.

Table 1.1: Summary of PM<sub>10</sub> monitoring results for 2010.

|             | Maximum measured concentration µg m <sup>-3</sup> | Measured exceedences | Number of NES breaches | Annual Average        |
|-------------|---|----------------------|------------------------|-----------------------|
| Hamilton    | 30  | 0                    | 0                      | 13 µg m <sup>-3</sup> |
| Tokoroa     | 99  | 16                   | 15                     | 18 µg m <sup>-3</sup> |
| Taupo       | 55  | 1                    | 0                      | 14 µg m <sup>-3</sup> |
| Te Kuiti    | 56  | 3                    | 2                      | 16 µg m <sup>-3</sup> |
| Matamata    | 40  | 0                    | 0                      | 13 µg m <sup>-3</sup> |
| Putaruru    | 53  | 1                    | 0                      | 14 µg m <sup>-3</sup> |
| Ngaruawahia | 29  | 0                    | 0                      | 13 µg m <sup>-3</sup> |
| Waihi       | 45  | 0                    | 0                      | 12 µg m <sup>-3</sup> |
| Turangi     | 32  | 0                    | 0                      | 10 µg m <sup>-3</sup> |

Concentrations of benzene measured in Hamilton during 2010 were within the guideline of 3.6 µg m<sup>-3</sup> (annual average). The highest concentration was measured at the Greenwood Street monitoring site and was 3.0 µg m<sup>-3</sup>. Concentrations of toluene and xylene were well within acceptable levels.

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## 1 Introduction

In the Waikato Region the main air contaminant of concern is PM<sub>10</sub> (particles in the air less than 10 microns in diameter). Concentrations of PM<sub>10</sub> have historically exceeded the National Environmental Standards for Ambient Air Quality (NES) in Hamilton, Tokoroa, Taupo, Te Kuiti and Putaruru during winter months. The main source of PM<sub>10</sub> concentrations in these areas during the winter months is solid fuel burning for domestic home heating.

In 2010 PM<sub>10</sub> concentrations were measured in 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 NES (Table 1.1). In 2011 the target date for achieving the NES was revised from 2013 to 2016 for most airsheds in New Zealand. A further extension was allowed for areas that experienced more than 10 exceedences of 50 µg m<sup>-3</sup> with the compliance date for those areas set at September 2020 with an interim target of no more than three exceedences by September 2016. Tokoroa was identified as qualifying for the more lenient timeframe. All other non-complying areas within the Waikato are required to meet the NES by September 2016.

Other contaminants are unlikely to be in breach of their respective NES or guideline concentrations in urban areas of the Waikato. The exception to this may be benzo(a)pyrene concentrations of which appear to occur well in excess of guideline concentrations in Christchurch, and may occur at guideline values in Hamilton (Wilton and Baynes, 2009). The majority of resources for air quality monitoring in the Waikato Region have focused on PM<sub>10</sub>.

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 an indicative tool for evaluating trends in concentrations over time.

In the Waikato Region previous PM<sub>10</sub> monitoring has taken place at Hamilton, Tokoroa, Taupo, Te Kuiti, Matamata, Putaruru, Ngaruawahia, Waihi and Turangi. 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 <sup>a</sup> | Averaging Period | Allowable exceedences per year |
| Carbon monoxide               | 10 mg m <sup>-3</sup>      | 8-hour           | 1                              |
| Particles (PM <sub>10</sub> ) | 50 µg m <sup>-3</sup>      | 24-hour          | 1                              |
| Nitrogen dioxide              | 200 µg m <sup>-3</sup>     | 1-hour           | 9                              |
| Sulphur dioxide <sup>b</sup>  | 350 µg m <sup>-3</sup>     | 1-hour           | 9                              |
| Sulphur dioxide <sup>b</sup>  | 570 µg m <sup>-3</sup>     | 1-hour           | 0                              |
| Ozone                         | 150 µg m <sup>-3</sup>     | 1-hour           | 0                              |

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

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



Notes for Tables 1.1 and 1.2:

<sup>a</sup> All values apply to the gas measured at standard conditions of temperature (0° C) and pressure (1 atmosphere).

<sup>b</sup> The sulphur dioxide guideline values do not apply to sulphur acid mist.

<sup>c</sup> The hydrogen sulphide value is based on odour nuisance and may be unsuitable for use in geothermal areas.

<sup>d</sup> 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.

## 1.1 Reporting period

The reporting period for PM<sub>10</sub> is from 1 January to 31 December 2010. In Turangi the reporting period is from January to 23 November 2010 as the site was decommissioned in November for relocation to another site. The reporting period for benzene, toluene and xylenes is 18 December 2009 to 17 December 2010.

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<sub>10</sub> concentrations and to ensure compliance with the NES reporting requirements. The 2010 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<sub>10</sub> can be influenced by the method used to monitor PM<sub>10</sub>. 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 provided adjusted 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 2010 report.

In 2010, at the Peachgrove Road air quality monitoring site in Hamilton, PM<sub>10</sub> concentrations were monitored using a Tapered Elemental Oscillation Microbalance (TEOM) with a sample temperature setting of 40 degrees centigrade. Concentrations of PM<sub>10</sub> measured using the TEOM in 2010 were based on the same adjustment for 2009 reporting (equation 2.1).

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

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.

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

Gravimetric sampling was conducted at the Gillies Street site in Taupo from March 2007. Concentrations of PM<sub>10</sub> measured using the BAM during 2010 were adjusted based on equation 2.3.

$$\text{Corrected PM}_{10} = 1.255\text{BAM} - 1.538 \quad \text{Equation 2.3}$$

Air quality data at the Putaruru site has been adjusted based on Equation 2.4. This equation was updated in 2010.

$$\text{Corrected PM}_{10} = 1.106\text{BAM} - 2.38 \quad \text{Equation 2.4}$$

Concentrations of PM<sub>10</sub> at Te Kuiti, Matamata, Ngaruawahia and Turangi 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 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. In Waihi PM<sub>10</sub> concentrations are measured using a gravimetric partisol sampler.

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, Taupo and Matamata. Meteorological data was not available for the Putaruru, Ngaruawahia, Waihi and Turangi sites. At sites where it was available, meteorological data were compared with PM<sub>10</sub> 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. The Partisol Model 2000 PM<sub>10</sub> sampler at the Taupo site has been operated by the Institute of Geological and Nuclear Sciences Ltd (GNS) on behalf of Environment Waikato.

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

---

## 3 Hamilton

### 3.1 Air Quality Monitoring in Hamilton

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 2010, PM<sub>10</sub>, benzene, ethyl-benzene, toluene and xylenes were measured at Peachgrove Road.

Benzene, ethyl-benzene, toluene and xylenes (BTEX) have also been monitored during recent years at other sites in Hamilton. These include Bridge Street, Claudelands Road, Hamilton Intermediate School, Greenwood Street and Tristram Street. Figure 3.1 shows the main (Peachgrove Road) air quality monitoring site in Hamilton.

During 2010, PM<sub>10</sub> monitoring at Peachgrove Road was carried out using a Tapered Elemental Oscillating Microbalance (TEOM) with a sample temperature setting of 40°C. The PM<sub>10</sub> 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.

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).

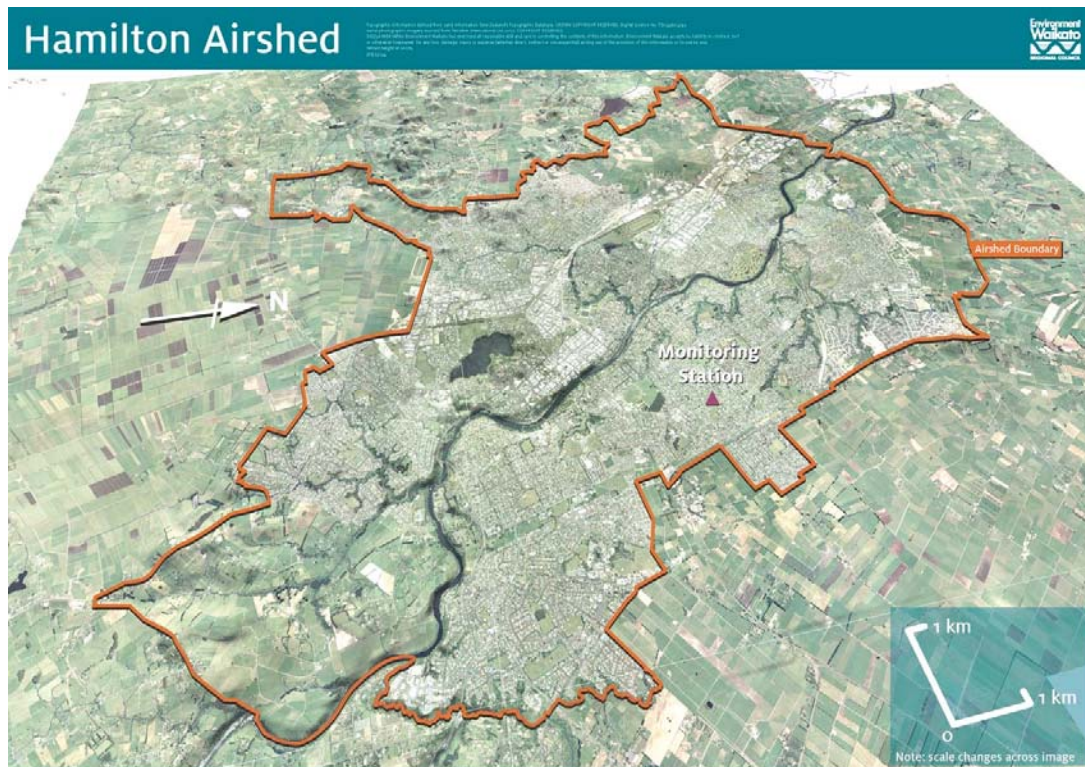


Figure 3.1: Hamilton Airshed and air quality monitoring site (Source: Environment Waikato, 2010).

### 3.2 $PM_{10}$ concentrations for Hamilton

In 2010 there were no exceedences of  $50 \mu\text{g m}^{-3}$  (24-hour average) in Hamilton. A maximum concentration of  $30 \mu\text{g m}^{-3}$  was recorded and compares with two winter time maximums of  $54 \mu\text{g m}^{-3}$  measured during 2009. A further exceedence in 2009 and the maximum  $PM_{10}$  concentration recorded at Hamilton reached  $101 \mu\text{g m}^{-3}$  and coincided with a dust storm event in Australia.

Daily  $PM_{10}$  concentrations measured at Hamilton during 2010 are shown in Figure 3.2.

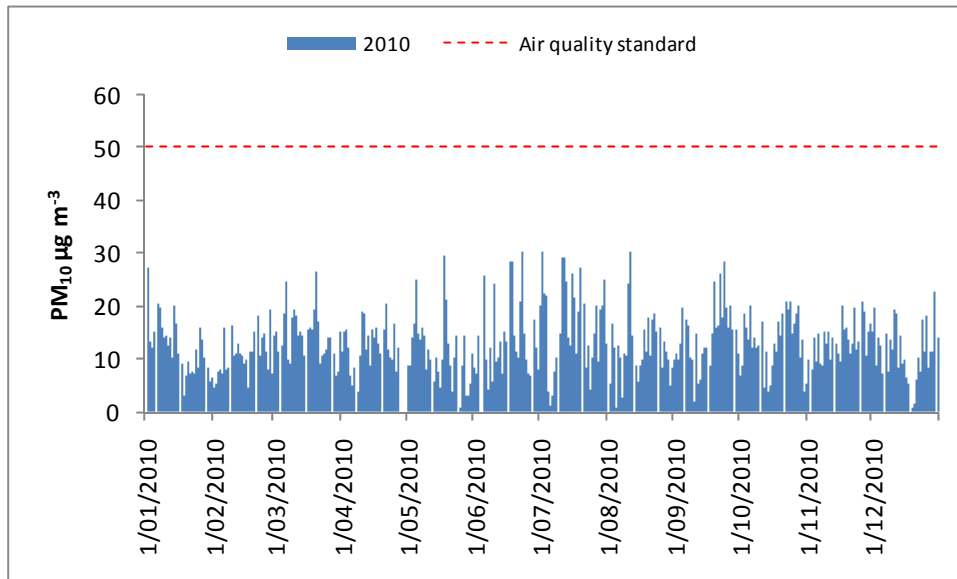


Figure 3.2: 24-hour average PM<sub>10</sub> concentrations measured at Peachgrove Road during 2010.

Figure 3.3 compares daily PM<sub>10</sub> concentrations measured from 2000 to 2010 to the MfE air quality indicator categories (shown in Table 1.3). During 2010 all of the PM<sub>10</sub> concentrations measured were less than 66% of the air quality guideline. Figure 3.4 shows the seasonal variations in the distribution of PM<sub>10</sub> concentrations during 2010. Figure 3.5 shows the number of days when 50 µg m<sup>-3</sup> was exceeded, the maximum concentration and the second highest concentration from 2006 to 2010.

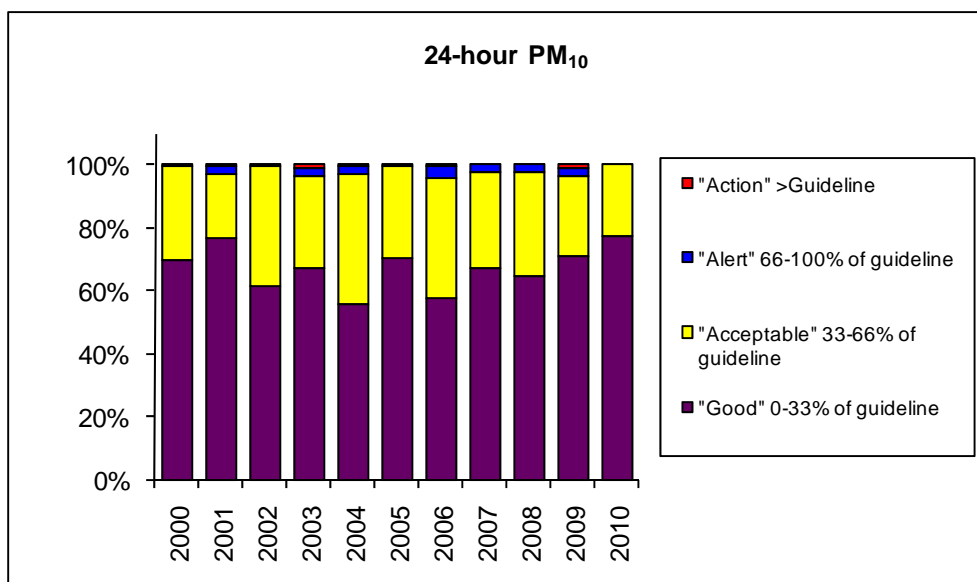


Figure 3.3: Comparison of PM<sub>10</sub> concentrations measured at Peachgrove Road in Hamilton from 2000 to 2010 to air quality indicator categories.

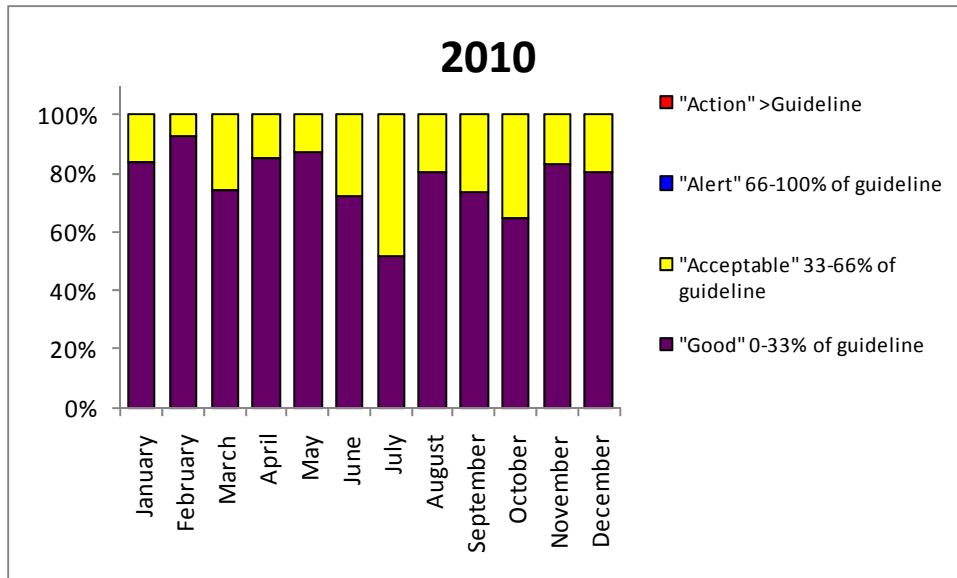


Figure 3.4: Comparison of daily PM<sub>10</sub> concentrations each month for 2010 to air quality indicator categories.

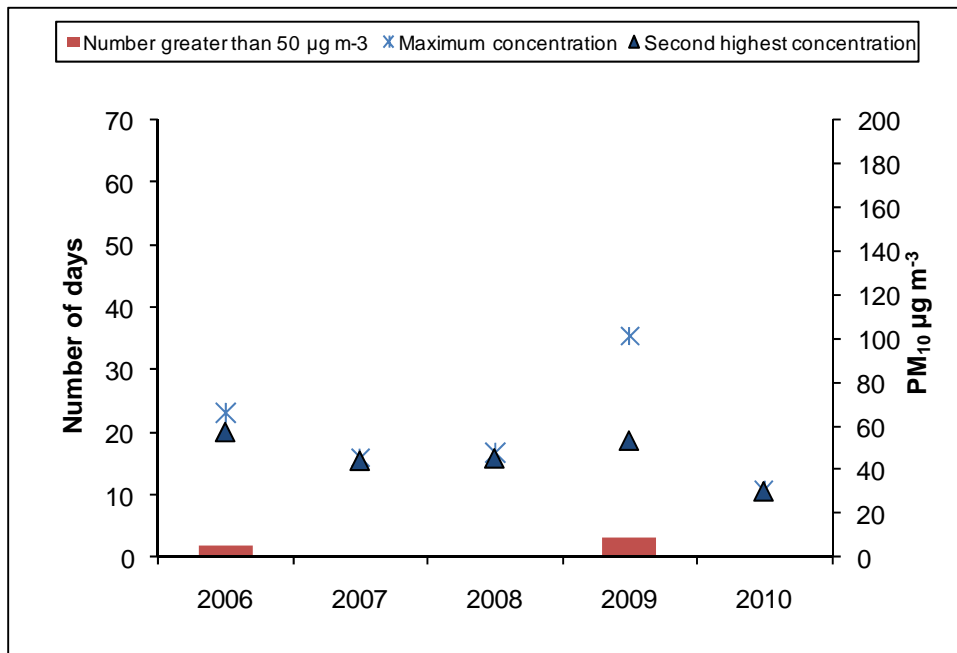


Figure 3.5: Number of days when 50 µg m<sup>-3</sup> was exceeded, the maximum concentration and the second highest concentration from 2006 to 2010.

The annual average PM<sub>10</sub> concentration for Hamilton for 2010 was 13 µg m<sup>-3</sup> and it is similar in magnitude to previous years. The Ministry for the Environment specifies an annual average guideline for PM<sub>10</sub> of 20 µg m<sup>-3</sup>. An annual average PM<sub>10</sub> concentration is not specified in the NES.

Summary statistics for PM<sub>10</sub> monitoring results from the Hamilton site from 2000 to 2010 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<sub>10</sub> concentrations measured at Peachgrove Road in Hamilton from 2000 to 2010.

|  | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007* | 2008 | 2009 | 2010 |
|--|------|------|------|------|------|------|------|-------|------|------|------|
| "Good" 0-33% of guideline  | 70%  | 77%  | 61%  | 67%  | 56%  | 70%  | 58%  | 67%   | 64%  | 71%  | 77%  |
| "Acceptable" 33-66% of guideline                                       | 30%  | 21%  | 38%  | 29%  | 41%  | 29%  | 38%  | 30%   | 34%  | 25%  | 23%  |
| "Alert" 66-100% of guideline   | 1%   | 2%   | 1%   | 3%   | 3%   | 1%   | 4%   | 2%    | 2%   | 3%   | 0%   |
| "Action" >Guideline  | 0%   | 1%   | 0%   | 1%   | 0%   | 0%   | 1%   | 0%    | 0%   | 1%   | 0%   |
| Percentage of valid data   | 91%  | 70%  | 93%  | 91%  | 94%  | 77%  | 99%  | 66%   | 99%  | 99%  | 99%  |
| Annual average ( $\mu\text{g m}^{-3}$ )                                | 15   | 15   | 16   | 16   | 17   | 15   | 17   | 15    | 15   | 14   | 13   |
| Measured exceedences   | 0    | 3    | 0    | 4    | 1    | 0    | 2    | 0     | 0    | 3    | 0    |
| Second highest PM <sub>10</sub> concentration ( $\mu\text{g m}^{-3}$ ) |      |      |      |      |      |      | 58   | 44    | 45   | 54   | 30   |
| Annual maximum (24-hr average $\mu\text{g m}^{-3}$ )                   | 43   | 67   | 36   | 62   | 55   | 37   | 66   | 46    | 48   | 101  | 30   |
| Number of records  | 334  | 256  | 340  | 331  | 344  | 281  | 363  | 242   | 364  | 363  | 361  |

\*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 2010 were within the Ministry for the Environment's 2010 annual guideline of  $3.6 \mu\text{g m}^{-3}$  (Table 3.2). The guideline prior to 2010 was  $10 \mu\text{g m}^{-3}$  (annual average). The highest average annual concentration during 2009 was  $3.0 \mu\text{g m}^{-3}$  and was measured at the Greenwood Street monitoring site.

Benzene concentrations since 2008 have tapered relative to earlier observed decreases (Figure 3.6). These earlier decreases were attributed to changes in fuel specifications and improved vehicle technology (Smith, 2007). An additional possible factor in the most recent data is that increased petrol prices may have caused a reduction in vehicle use.

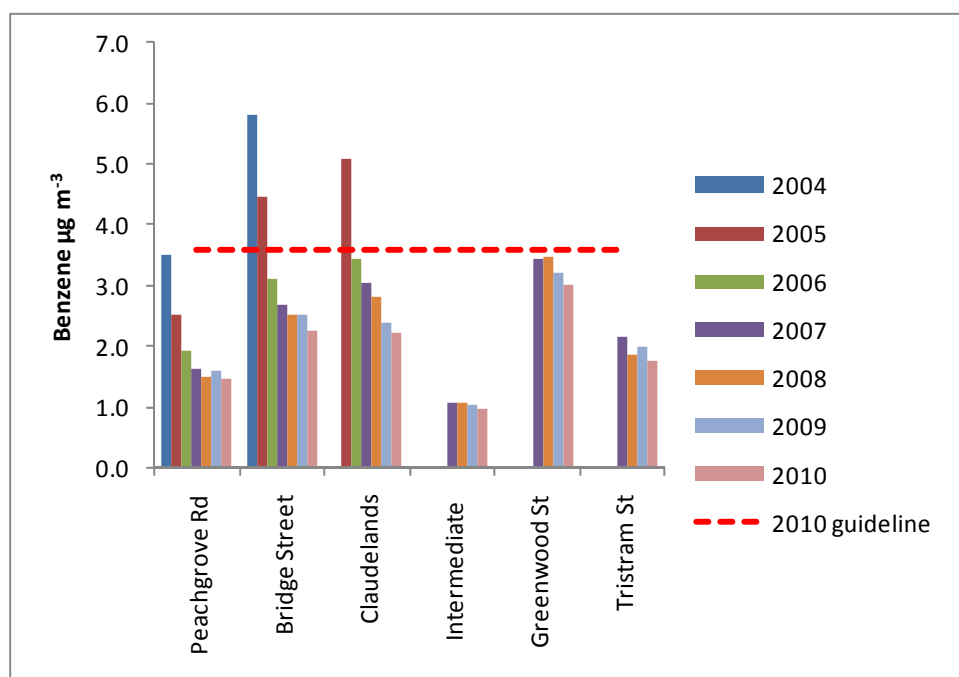


Figure 3.6: Annual average benzene measured at Hamilton sites ((February 2003 – February 2004) (July 2004 – July 2005), (September 2005 – September 2006), (December – December for 2007 - 2010)).

Toluene and xylene were also measured at the benzene monitoring sites for each year. An MfE document discussing amendments to the 1994 ambient air quality guidelines suggests an annual threshold of  $190 \mu\text{g m}^{-3}$  and  $950 \mu\text{g m}^{-3}$  for toluene and total xylenes respectively (MfE, 2000). Concentrations of toluene 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 2009 to December 2010.

|                      | Bridge St | Peachgrove Road | Claudelands | Intermediate | Greenwood Street | Tristram Street | Guideline <sup>a</sup> |
|----------------------|-----------|-----------------|-------------|--------------|------------------|-----------------|------------------------|
| $\mu\text{g m}^{-3}$ |           |                 |             |              |                  |                 |                        |
| Benzene              | 2.2       | 1.5             | 2.2         | 1.0          | 3.0              | 1.7             | 3.6 (10 <sup>a</sup> ) |
| Toluene              | 10.4      | 6.7             | 10.1        | 4.2          | 15.6             | 9.3             | 190 <sup>b</sup>       |
| Total Xylenes        | 8.3       | 5.1             | 8.0         | 3.3          | 10.2             | 6.8             | 950 <sup>b</sup>       |

<sup>a</sup> The historical guideline for benzene of  $10 \mu\text{g m}^{-3}$  reduced to  $3.6 \mu\text{g m}^{-3}$  in 2010.

<sup>b</sup> 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 Comparison of meteorological conditions for 2010 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 3.7 compares summary statistics for wind speed and temperature from 1998 to 2010.

An evaluation of meteorological conditions and  $\text{PM}_{10}$  concentrations in Hamilton from 1998 to 2007 identified 24-hour average wind speed less than  $0.74 \text{ ms}^{-1}$  as the main meteorological characteristic of elevated  $\text{PM}_{10}$  concentrations (Wilton, 2007). Figure 3.8 compares the number of days during the winter months when these meteorological conditions occurred from 2000 to 2010 and the number of days each year when  $\text{PM}_{10}$  concentrations exceeded  $50 \mu\text{g m}^{-3}$ . Results suggest both 2009 and 2010 had a slightly lower prevalence of days when  $\text{PM}_{10}$  concentrations might typically be elevated but that in 2009 a greater proportion of these experienced high pollution (Figure 3.9).

An alternative but similar approach is to look at the proportion of each grouping of  $\text{PM}_{10}$  concentrations ( $10 \mu\text{g m}^{-3}$  increments) in which the wind speed (24-hour) is less than  $0.74 \text{ ms}^{-1}$ . Figure 3.10 shows that these conditions are met on all days when  $\text{PM}_{10}$  concentrations exceed  $50 \mu\text{g m}^{-3}$  and on most days when the concentrations are between 40 and  $50 \mu\text{g m}^{-3}$ .

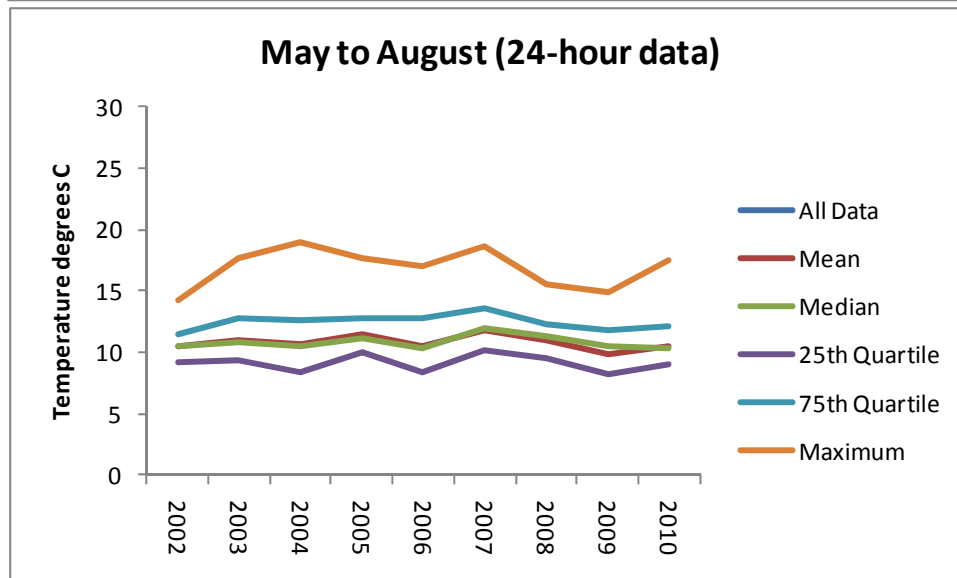
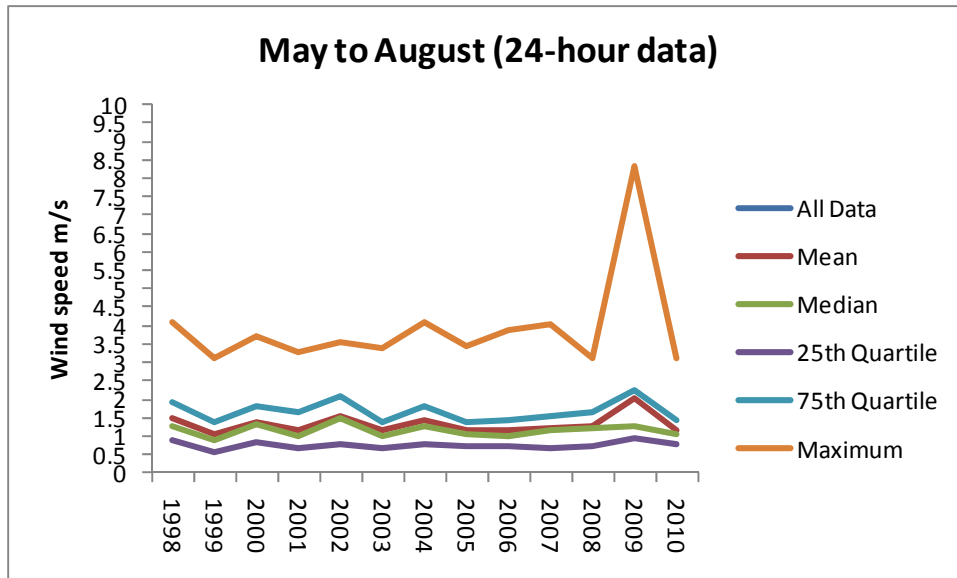


Figure 3.7: Summary wind speed and temperature data from 1999 to 2010 at the Peachgrove Road site.

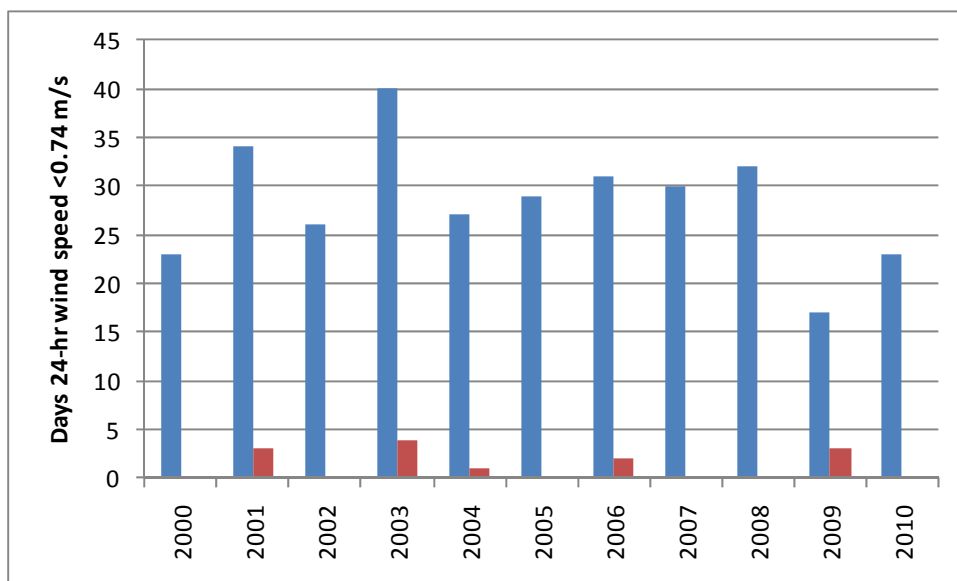


Figure 3.8: Number of days from May to August when the 24-hr average wind speed were less than  $0.74 \text{ ms}^{-1}$  (blue bar) and no of guidelines exceedences per year (red bar).

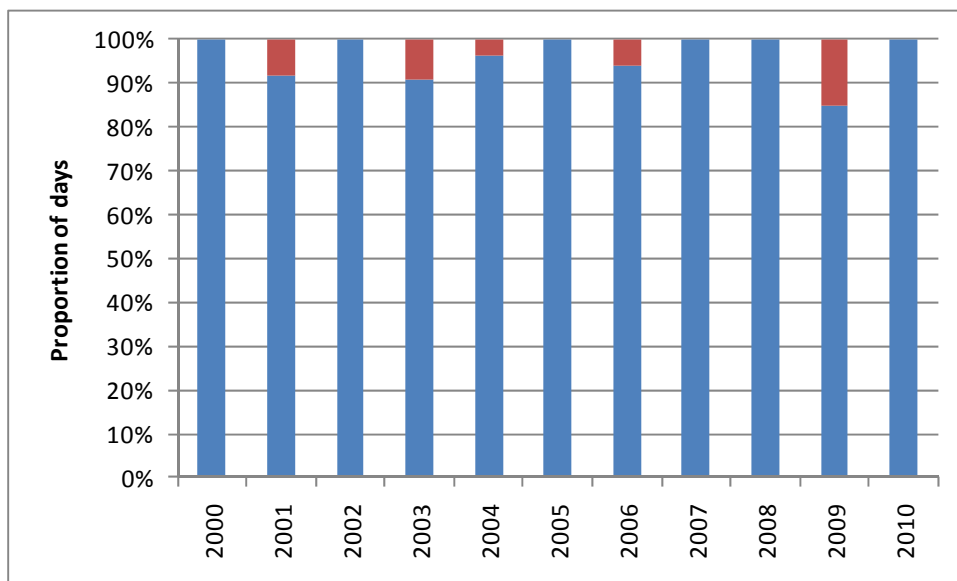


Figure 3.9: Proportion of days when wind speed was less than  $0.74 \text{ ms}^{-1}$  that  $\text{PM}_{10}$  concentrations were less than  $50 \mu\text{g m}^{-3}$  (blue bar) and proportion that exceeded  $50 \mu\text{g m}^{-3}$  (red bar).

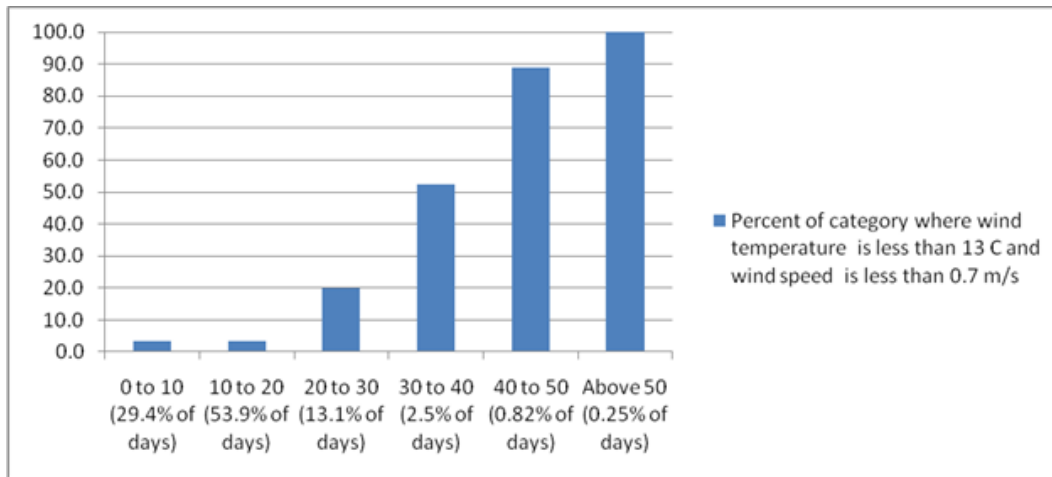


Figure 3.10: Proportion of days when the 24-hour average wind speed is less than  $0.74 \text{ ms}^{-1}$  for  $10 \mu\text{g m}^{-3}$  increments of  $\text{PM}_{10}$ .

## 4 Tokoroa

### 4.1 Air Quality Monitoring in Tokoroa

In Tokoroa, monitoring for PM<sub>10</sub> 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<sub>10</sub> from 2001 to September 2005 at 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 (Source: Environment Waikato, 2010).

## 4.2 PM<sub>10</sub> concentrations in Tokoroa

Daily average PM<sub>10</sub> concentrations in Tokoroa for 2010 are shown in Figure 4.2. There were 16 days when PM<sub>10</sub> concentrations exceeded 50 µg m<sup>-3</sup>. The dates and concentrations reached on these days are shown in Table 4.1. Table 4.2 shows that the maximum of 99 µg m<sup>-3</sup> was the highest measured since 2005.

Table 4.1: Dates and concentrations for 2010 exceedences of 50 µg m<sup>-3</sup> in Tokoroa.

| Date      | PM <sub>10</sub> µg m <sup>-3</sup> | Rank | Date      | PM <sub>10</sub> µg m <sup>-3</sup> | Rank |
|-----------|-------------------------------------|------|-----------|-------------------------------------|------|
| 13-Jul-10 | 99                                  | 1    | 9-Jul-10  | 59                                  | 9    |
| 2-Jul-10  | 87                                  | 2    | 11-Aug-10 | 59                                  | 10   |
| 16-Jun-10 | 82                                  | 3    | 28-Jun-10 | 57                                  | 11   |
| 22-Jun-10 | 71                                  | 4    | 29-Jul-10 | 56                                  | 12   |
| 17-Jun-10 | 65                                  | 5    | 28-Jul-10 | 54                                  | 13   |
| 10-Aug-10 | 64                                  | 6    | 15-Jul-10 | 54                                  | 14   |
| 9-Jun-10  | 63                                  | 7    | 30-Jul-10 | 52                                  | 15   |
| 1-Jul-10  | 61                                  | 8    | 10-Jul-10 | 52                                  | 16   |

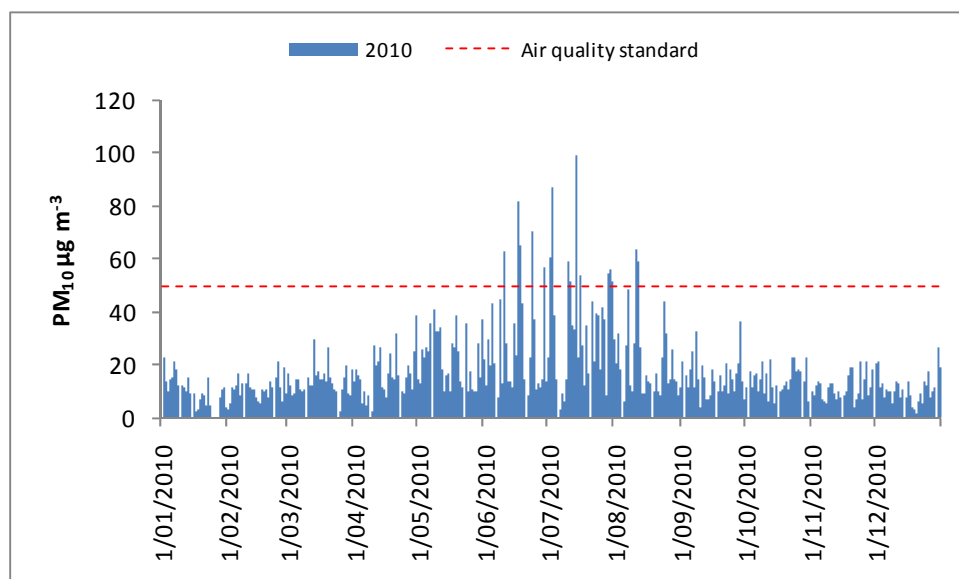


Figure 4.2: Daily winter PM<sub>10</sub> concentrations measured in Tokoroa during 2010.

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<sub>10</sub> 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<sub>10</sub> concentration of 50 µg m<sup>-3</sup>. 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 shows changes in PM<sub>10</sub> concentrations relative to air quality indicator categories at the Tokoroa site from 2001 to 2010. Figure 4.4 shows the seasonal variations in the distribution of PM<sub>10</sub> concentrations for 2010. July was the worst month for PM<sub>10</sub> concentrations in Tokoroa during 2010 with 29% of PM<sub>10</sub> concentrations in the 'action' category and a further 29% in the 'alert' category. The number of days when 50 µg m<sup>-3</sup> was exceeded, the maximum concentration and the second highest concentration from 2006 to 2010 are shown in Figure 4.5.

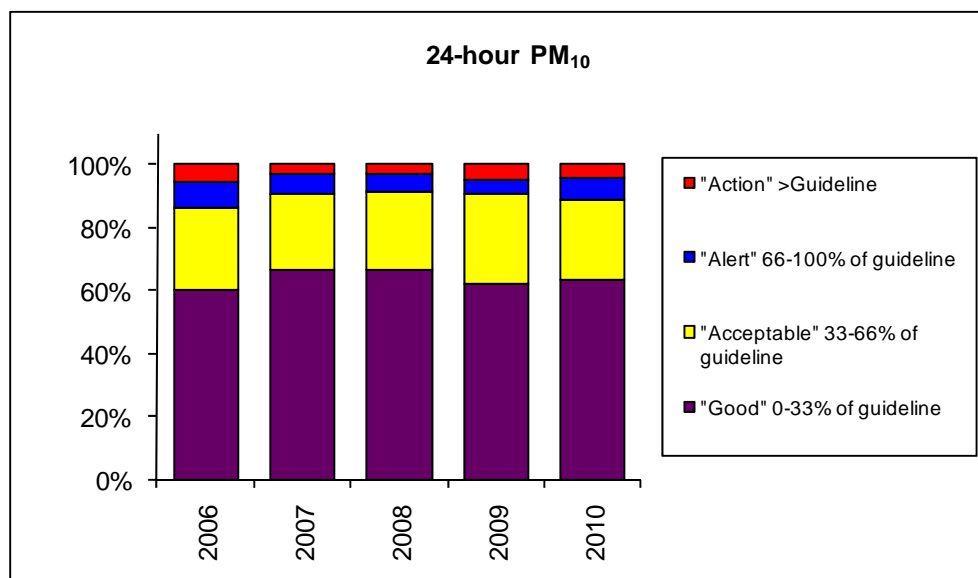


Figure 4.3: Comparison of PM<sub>10</sub> concentrations measured in Tokoroa from 2006 to 2010 to air quality indicator categories.

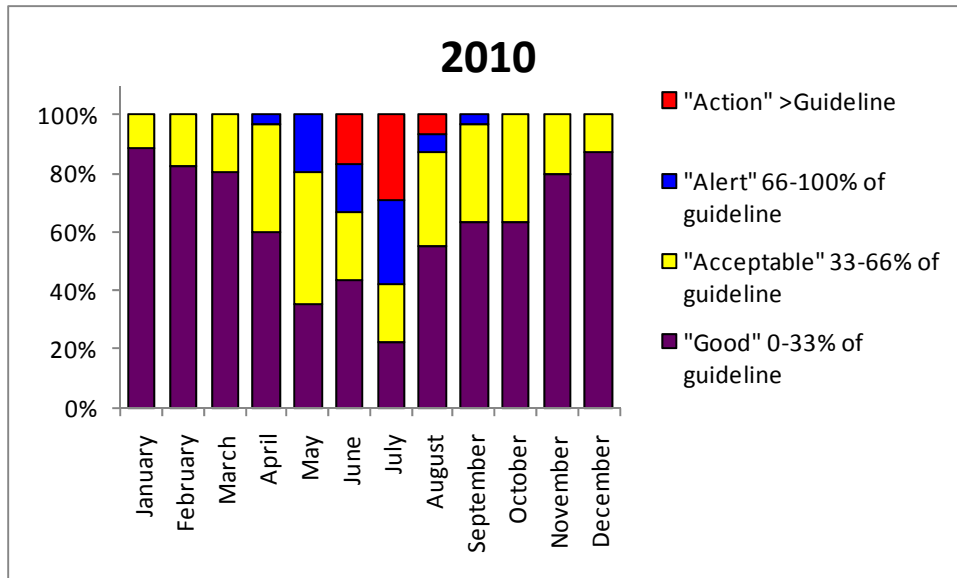


Figure 4.4: Comparison of daily PM<sub>10</sub> concentrations each month during 2010 to air quality indicator categories.

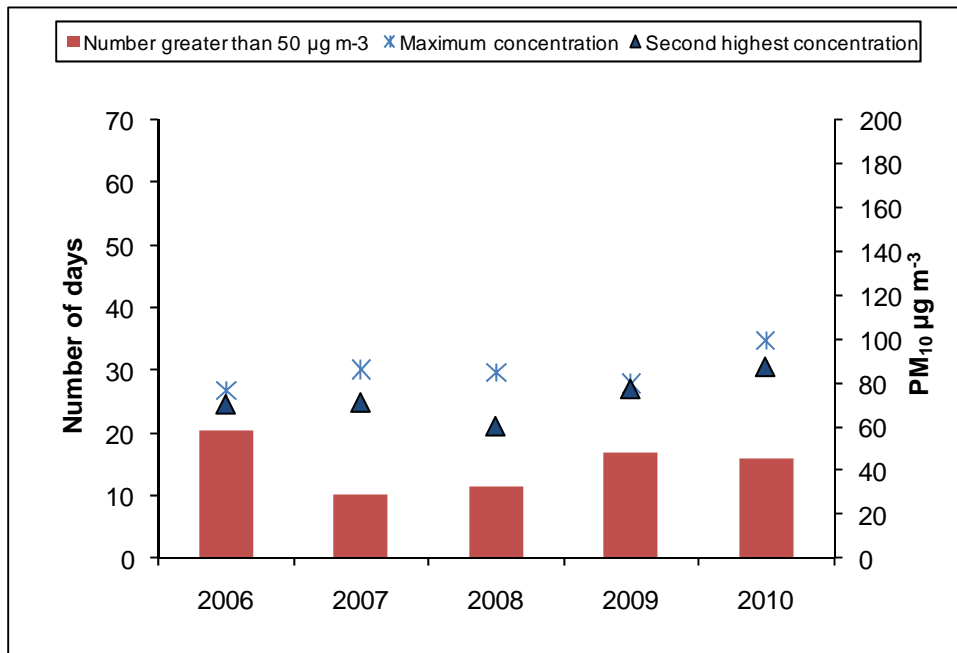


Figure 4.5: Number of days when 50 µg m<sup>-3</sup> was exceeded, the maximum concentration measured and the second highest concentration from 2006 to 2010.

The annual average PM<sub>10</sub> concentration for Tokoroa for 2010 was 18 µg m<sup>-3</sup>. This is similar to other annual average concentrations. Table 4.2 shows the summary statistics for PM<sub>10</sub> monitoring results.

Table 4.2: Summary of PM<sub>10</sub> concentrations measured at the Tokoroa monitoring site from 2001 to 2010.

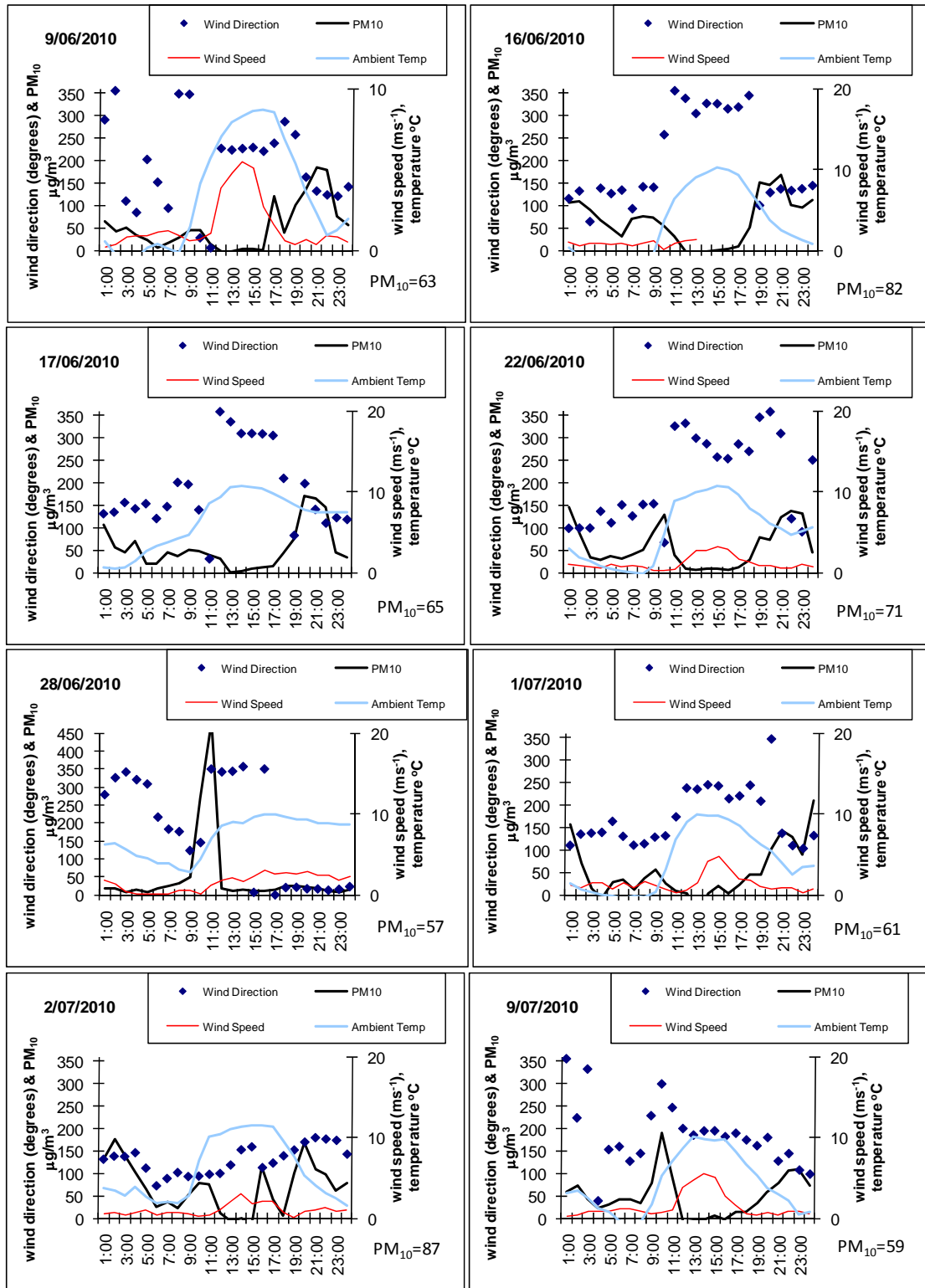
|  | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 |
|--|------|------|------|------|------|------|------|------|------|------|
| "Good" 0-33% of guideline  | 12%  | 15%  | 25%  | 12%  | 32%  | 60%  | 66%  | 67%  | 62%  | 63%  |
| "Acceptable" 33-66% of guideline                                       | 64%  | 71%  | 58%  | 54%  | 46%  | 26%  | 24%  | 25%  | 29%  | 26%  |
| "Alert" 66-100% of guideline   | 17%  | 10%  | 11%  | 23%  | 13%  | 8%   | 7%   | 6%   | 5%   | 7%   |
| "Action" >Guideline  | 8%   | 4%   | 5%   | 12%  | 9%   | 6%   | 3%   | 3%   | 5%   | 4%   |
| Percentage of valid data   | 47%  | 98%  | 55%  | 96%  | 88%  | 99%  | 99%  | 99%  | 100% | 99%  |
| Annual average ( $\mu\text{g m}^{-3}$ )                                | 27   | 24   | 24   | 31   | 25   | 19   | 16   | 17   | 18   | 18   |
| Measured exceedence  | 24   | 15   | 18   | 41   | 33   | 20   | 10   | 11   | 17   | 16   |
| Second highest PM <sub>10</sub> concentration ( $\mu\text{g m}^{-3}$ ) | 75   | 70   | 62   | 97   | 89   | 70   | 71   | 60   | 77   | 87   |
| Annual maximum ( $\mu\text{g m}^{-3}$ )                                | 66   | 66   | 56   | 92   | 66   | 76   | 86   | 85   | 80   | 99   |
| Number of records  | 173  | 357  | 201  | 351  | 320  | 360  | 360  | 360  | 364  | 360  |

### 4.3 Daily variations in PM<sub>10</sub> and meteorology on high pollution days

Figure 4.6 shows the variations in meteorological conditions and hourly average PM<sub>10</sub> concentrations on the 16 days when the 24-hour average PM<sub>10</sub> measured at Tokoroa exceeded 50 µg m<sup>-3</sup>.

The maximum PM<sub>10</sub> concentration occurred on the 13 July and on this day PM<sub>10</sub> concentrations peaked mid morning and remained high for the majority of the day. Both the extent of the 9am peak and the continued elevated daytime concentrations are atypical of urban air pollution occurring as a result of domestic home heating in New Zealand. The increase in concentrations between 5 pm and midnight on this day is typical. A localised source of PM<sub>10</sub> may have contributed to the elevated concentrations on this day. Another unusual event occurred on 28 June 2010. On this day the breach of 50 µg m<sup>-3</sup> occurs because of an extreme peak (>400 µg m<sup>-3</sup>, hourly average) in PM<sub>10</sub> concentrations around 9 am.

On most days, the highest peak in PM<sub>10</sub> 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.



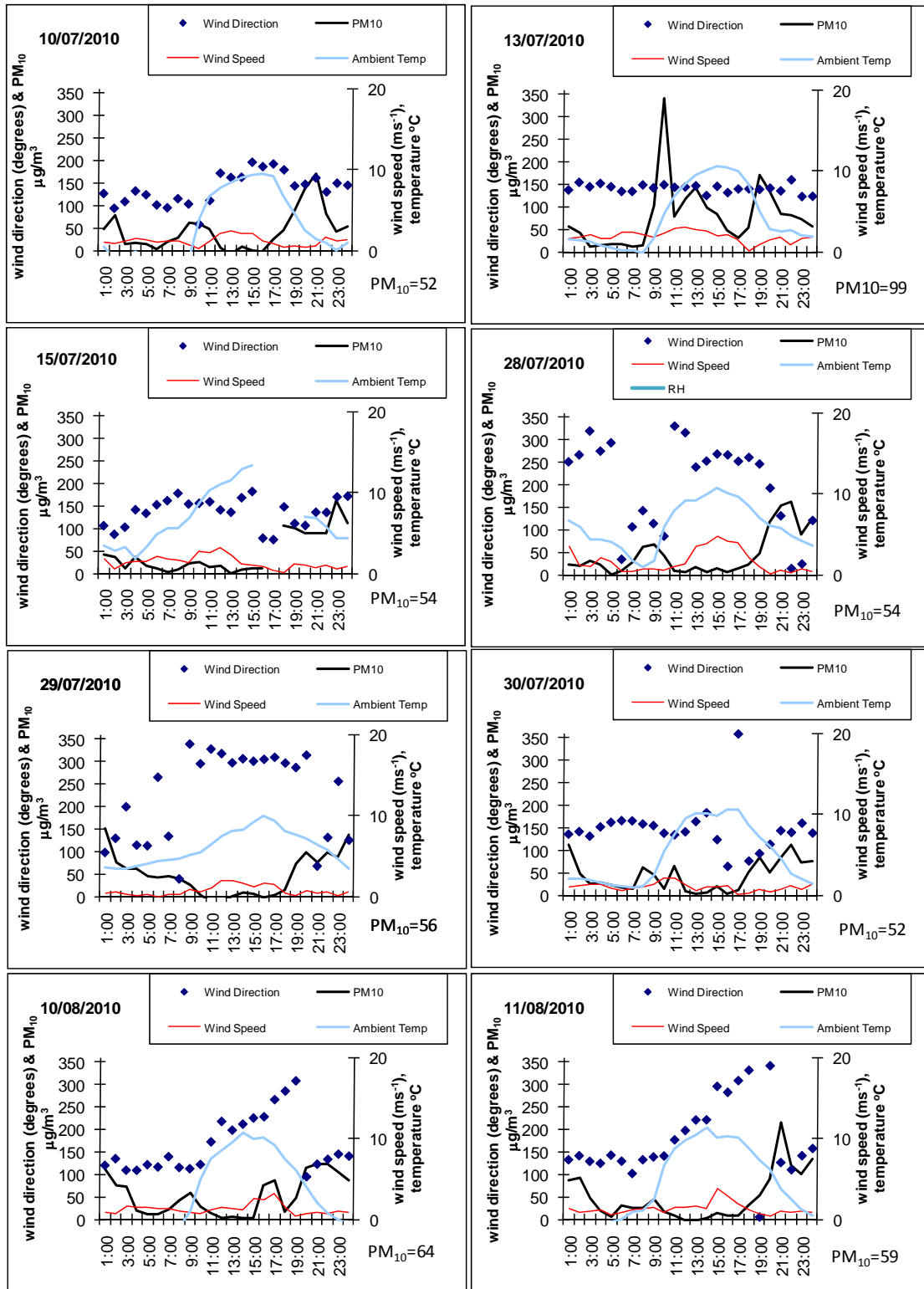


Figure 4.6: Hourly average  $\text{PM}_{10}$ , wind speed, wind direction and temperature on days when  $\text{PM}_{10}$  concentrations exceeded the NES at the Tokoroa site.

## 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<sub>10</sub> concentrations since March 2007. Gravimetric sampling using a Rupprecht and Patashnick Partisol Model 2000 PM<sub>10</sub> sampler also took place at the Gillies Avenue Site during 2007 and 2008.

Prior to 2005, PM<sub>10</sub> 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<sub>10</sub> sampler. In January 2006 a FH62 C14 BAM continuous PM<sub>10</sub> 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<sub>10</sub> sampler continued throughout 2006 to March 2007 to evaluate the spatial variation of PM<sub>10</sub> concentrations between Gillies Avenue and Taupo Primary School.

The maximum recorded 24-hour PM<sub>10</sub> concentration at the Taupo Primary School site in 2006 was 24.8 µg m<sup>-3</sup> whereas the maximum recorded 24-hour PM<sub>10</sub> concentration at the Gillies Avenue Reserve site (based on one day in three Partisol monitoring) was 89 µg m<sup>-3</sup>. 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. The 2006 data reported in this report uses the partisol sampling results for Gillies Avenue. 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<sub>10</sub> 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<sub>10</sub> concentrations in Taupo

Figure 5.2 shows daily average PM<sub>10</sub> concentrations measured at the Taupo Gillies Ave site during 2010. Only one exceedence of 50  $\mu\text{g m}^{-3}$  was recorded during 2010. The maximum measured PM<sub>10</sub> concentration was 55  $\mu\text{g m}^{-3}$  and was measured on 16 June.



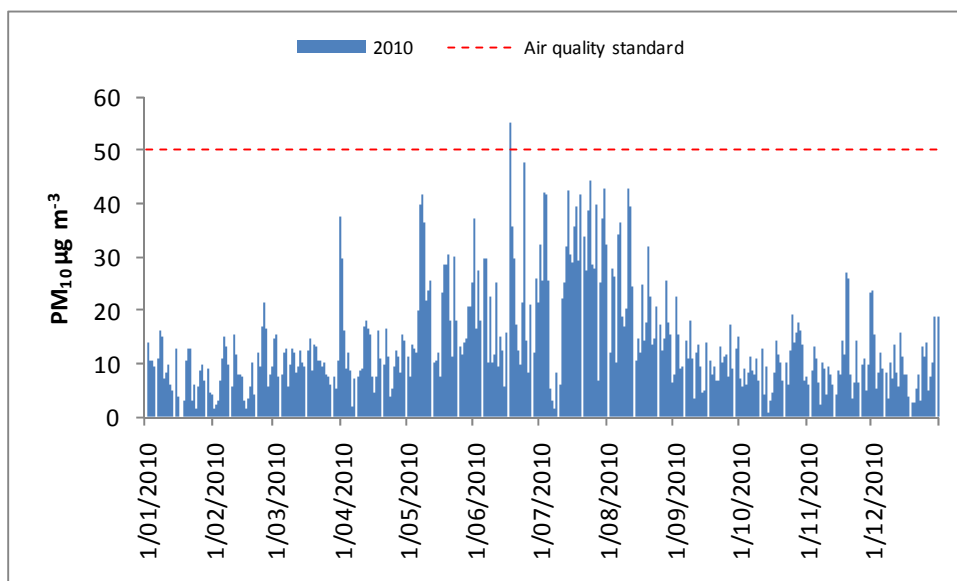


Figure 5.2: Daily winter PM<sub>10</sub> concentrations measured at Taupo during 2010.

The changes in PM<sub>10</sub> concentrations relative to air quality indicator categories at the Taupo site from 2006 to 2010 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<sup>1</sup>. A slight increase in the proportion of 'PM<sub>10</sub> concentrations in the 'good' category may have occurred since 2007.

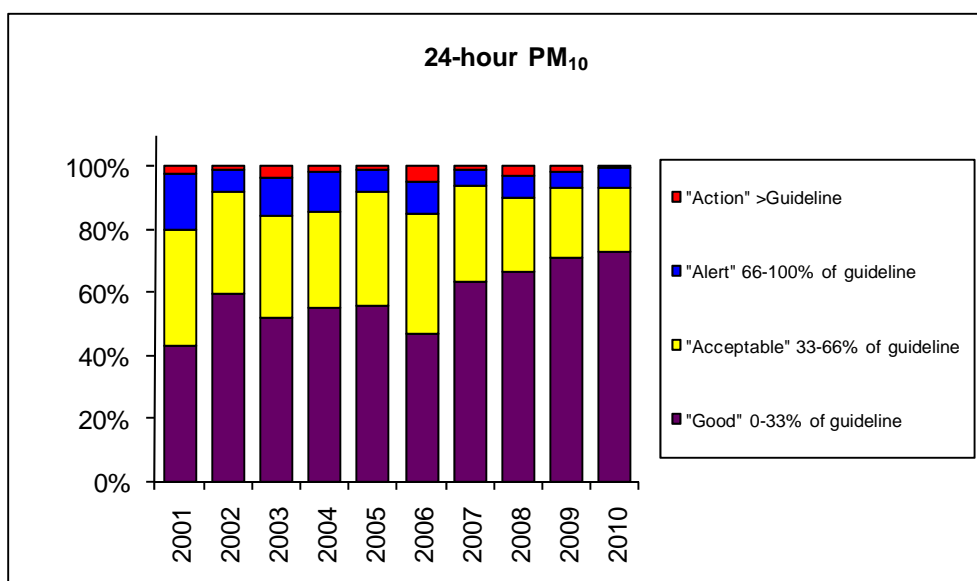


Figure 5.3: Comparison of PM<sub>10</sub> concentrations measured at the Taupo site from 2001 to 2010 to air quality indicator categories.

<sup>1</sup> For 2006 the gravimetric partisol data from Gillies Ave were used in preference to the BAM primary school data.

Figure 5.4 shows the seasonal variations in the distribution of PM<sub>10</sub> concentrations for 2010. Figure 5.5 shows the number of days when 50 µg m<sup>-3</sup> was exceeded, the maximum concentration and the second highest concentration for 2006 to 2010.

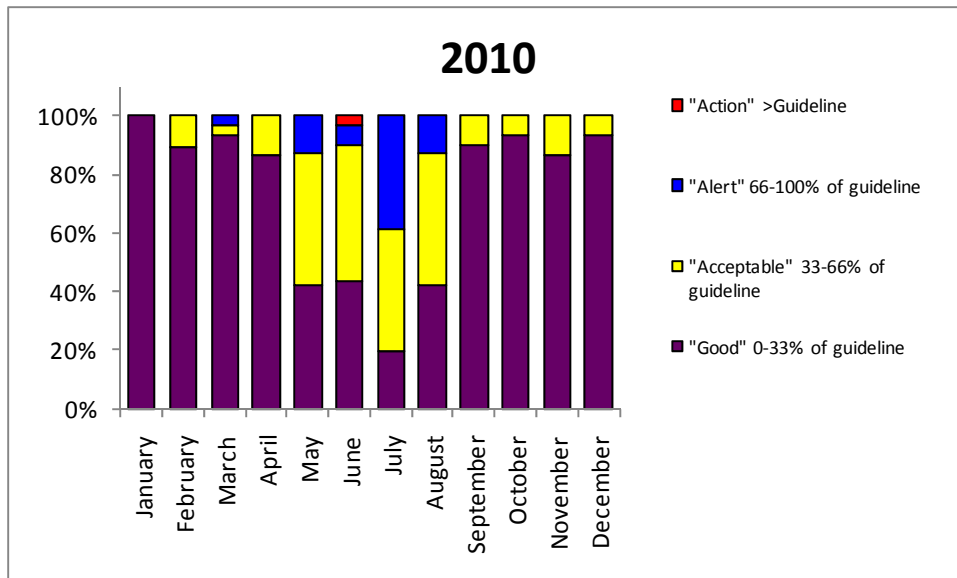


Figure 5.4: Comparison of daily PM<sub>10</sub> concentrations each month during 2010 to air quality indicator categories.

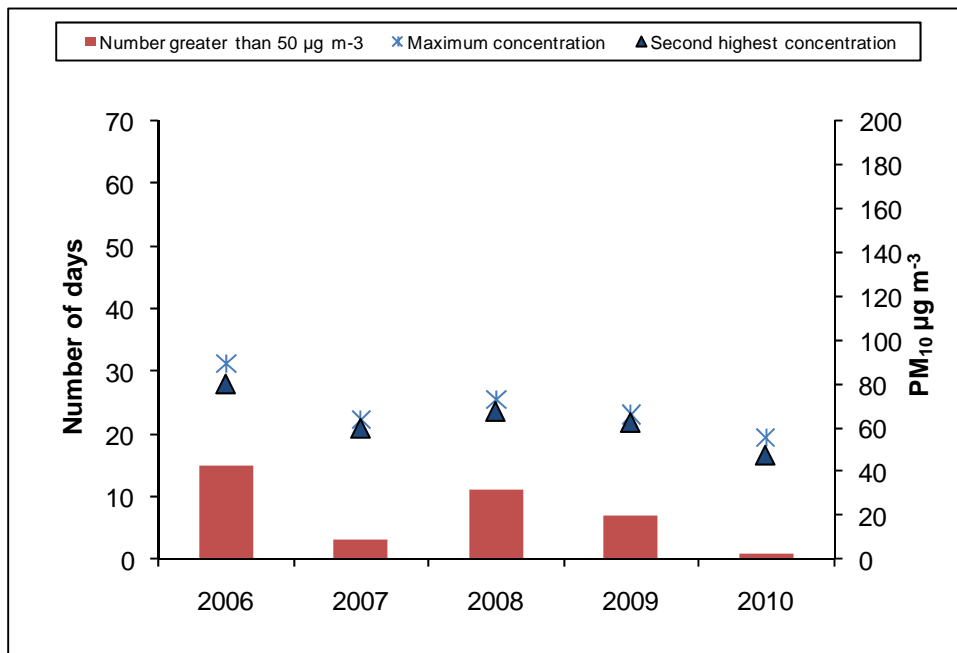


Figure 5.5: Number of days when 50 µg m<sup>-3</sup> was exceeded, the maximum concentration measured using the BAM and the second highest concentration from 2006 to 2010.

The annual average PM<sub>10</sub> concentration for 2010 is 14 µg m<sup>-3</sup>, which is similar to the 2009 annual average and lower than the 2008 annual average PM<sub>10</sub> concentration of 17 µg m<sup>-3</sup>. Summary statistics for PM<sub>10</sub> monitoring results from 2001 to 2010 are shown in Table 5.1.

Table 5.1: Summary of PM<sub>10</sub> concentrations measured at the Taupo monitoring site from 2001 to 2010\*.

|  | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 |
|--|------|------|------|------|------|------|------|------|------|------|
| "Good" 0-33% of guideline  | 43%  | 59%  | 52%  | 55%  | 56%  | 47%  | 63%  | 66%  | 71%  | 73%  |
| "Acceptable" 33-66% of guideline                                       | 36%  | 33%  | 32%  | 30%  | 36%  | 38%  | 31%  | 24%  | 22%  | 20%  |
| "Alert" 66-100% of guideline   | 18%  | 7%   | 12%  | 12%  | 7%   | 10%  | 5%   | 7%   | 5%   | 6%   |
| "Action" >Guideline  | 2%   | 1%   | 4%   | 2%   | 1%   | 5%   | 1%   | 3%   | 2%   | 0%   |
| Percentage of valid data   | 12%  | 21%  | 29%  | 29%  | 30%  | 27%  | 78%  | 99%  | 99%  | 100% |
| Annual average ( $\mu\text{g m}^{-3}$ )                                | 20   | 17   | 18   | 17   | 16   | 19   | 15   | 17   | 15   | 14   |
| Exceedences (extrapolated)   | 7    | 6    | 12   | 6    | 3    | 15   | 3    | 11   | 7    | 1    |
| Second highest PM <sub>10</sub> concentration ( $\mu\text{g m}^{-3}$ ) | 45   | 41   | 61   | 55   | 45   | 80   | 60   | 68   | 62   | 48   |
| Annual maximum ( $\mu\text{g m}^{-3}$ )                                | 57   | 54   | 62   | 65   | 52   | 89   | 64   | 73   | 66   | 55   |
| Number of records  | 44   | 76   | 106  | 105  | 111  | 98   | 283  | 361  | 363  | 364  |

\*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 prior to 2006 have not been adjusted for gravimetric equivalency. Note the 2008 monitoring report used a different equation and reported six exceedences of  $50 \mu\text{g m}^{-3}$  for 2007 compared with three exceedences reported here.

### 5.3 Daily variations in PM<sub>10</sub> and meteorology on high pollution days

Daily variations in PM<sub>10</sub> concentrations and meteorological data on 16 June, when the 24-hour average PM<sub>10</sub> measured at Taupo exceeded 50 µg m<sup>-3</sup> are shown in Figure 5.6.

The pattern in PM<sub>10</sub> 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 can also be elevated during the early morning period (midnight to 6 am) as a result of the evening pollution episode from the previous day.

In Taupo, high PM<sub>10</sub> 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 June 2010 high pollution event was consistent with these wind patterns.

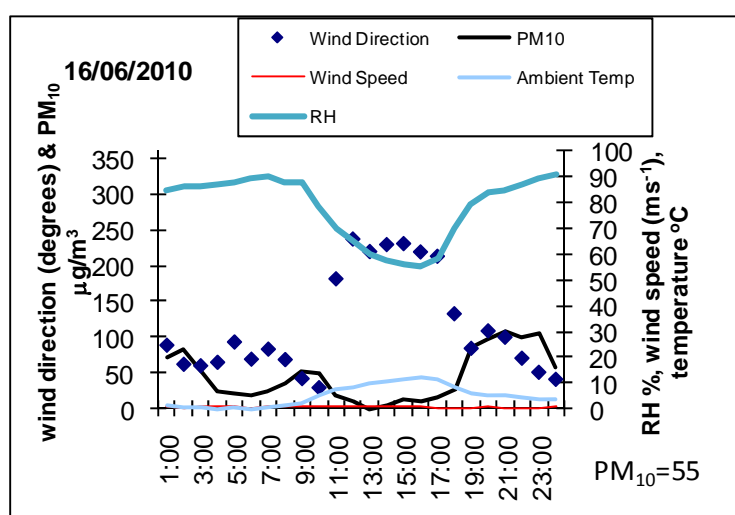


Figure 5.6: Hourly average PM<sub>10</sub>, wind speed, wind direction and temperature on 16 June when PM<sub>10</sub> concentrations exceeded 50 µg m<sup>-3</sup> at Taupo.

## 6 Te Kuiti

### 6.1 Air Quality Monitoring in Te Kuiti

The Te Kuiti air quality monitoring sites is located 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<sub>10</sub> (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).

The monitoring method used at the sites is an FH62 C14 BAM.



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

### 6.2 PM<sub>10</sub> Concentrations in Te Kuiti

Daily average PM<sub>10</sub> concentrations measured in Te Kuiti are shown in Figure 6.2. There were three exceedences of 50  $\mu\text{g m}^{-3}$  occurring on 16 June and 11 and 12 July 2010. The maximum measured concentration was 56  $\mu\text{g m}^{-3}$  (12 July). The number of exceedences in Te Kuiti has been reasonably consistent since 2007 at around 3-4 per year. The exception is 2006 when there were seven exceedences of 50  $\mu\text{g m}^{-3}$ .

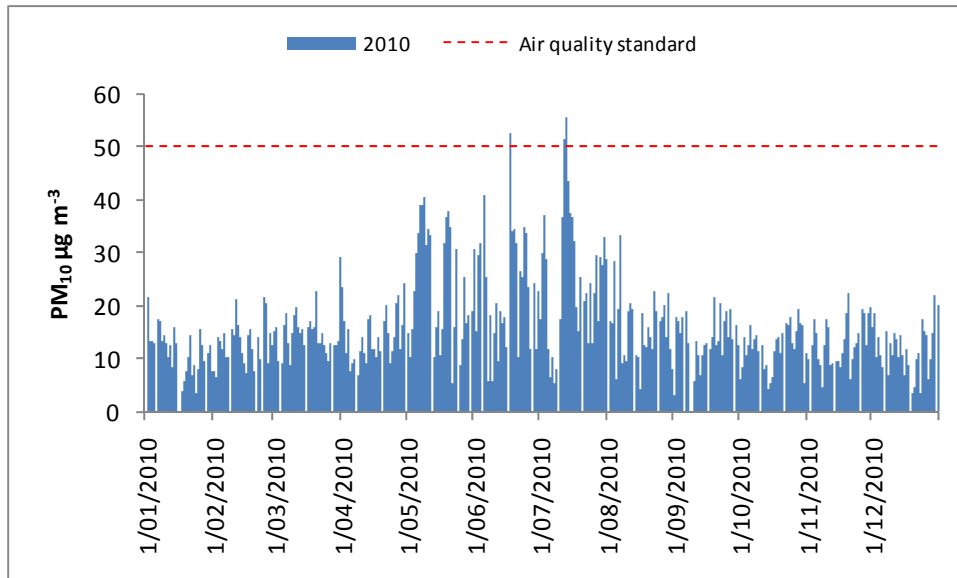


Figure 6.2: Daily winter PM<sub>10</sub> concentrations measured at the Te Kuiti site during 2010.

A comparison of PM<sub>10</sub> concentrations to air quality indicator categories from 2003 to 2010 in Te Kuiti is shown in Figure 6.3. Figure 6.4 shows the seasonal variations in the distribution of PM<sub>10</sub> concentrations for 2010 and Figure 6.5 shows the number of days when 50 µg m<sup>-3</sup> was exceeded, the maximum concentration and the second highest concentration from 2006 to 2010.

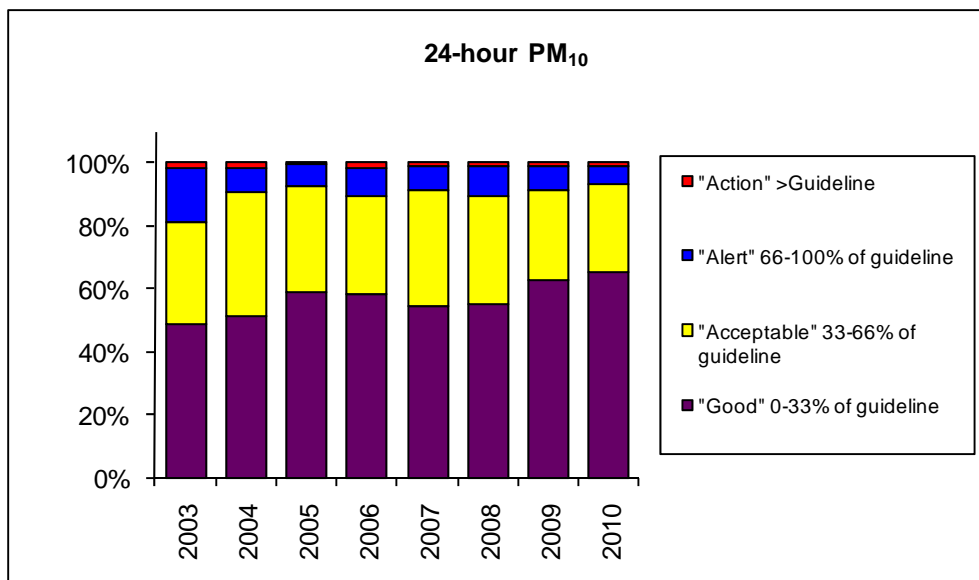


Figure 6.3: Comparison of PM<sub>10</sub> concentrations measured at the Te Kuiti site from 2003 to 2010 to air quality indicator categories.

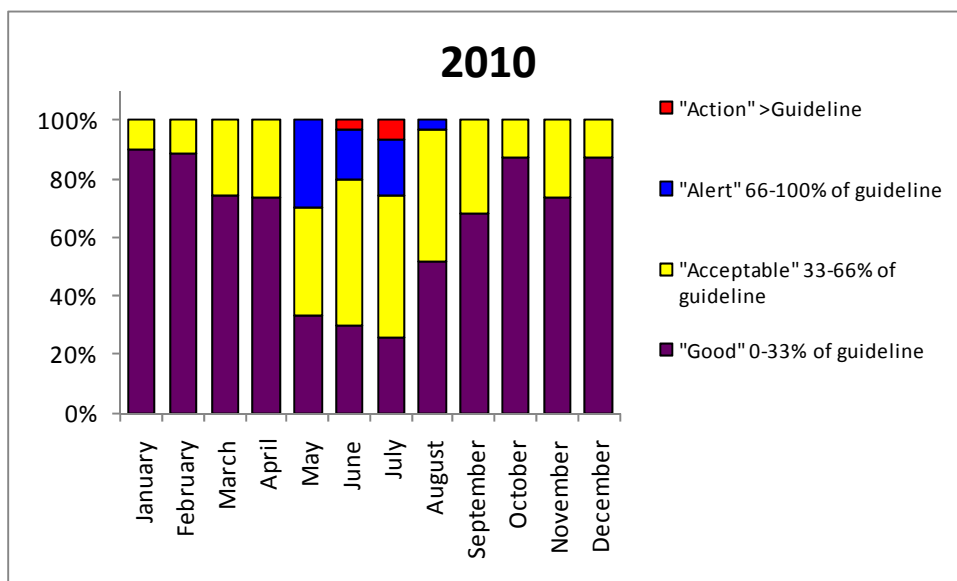


Figure 6.4: Comparison of daily PM<sub>10</sub> concentrations each month during 2010 to air quality indicator categories.

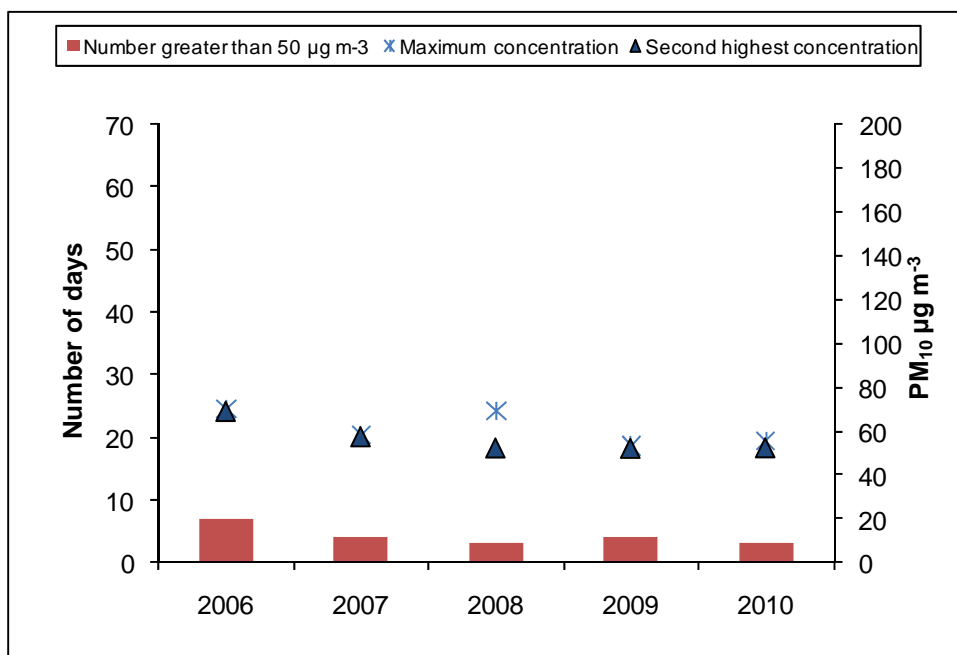


Figure 6.5: Number of days when 50 µg m<sup>-3</sup> was exceeded, the maximum concentration measured and the second highest concentration from 2006 to 2010.

In 2010 the annual average PM<sub>10</sub> concentration in Te Kuiti was 16 µg m<sup>-3</sup>. Table 6.1 shows that PM<sub>10</sub> concentrations in Te Kuiti are reasonably consistent from 2003 to 2010. The highest peak (24-hour average) concentration was measured in 2006 along with the greatest number of exceedences.

Table 6.1: Summary of PM<sub>10</sub> concentrations measured at the Te Kuiti monitoring site from 2003 to 2010.

|   | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 |
|---|------|------|------|------|------|------|------|------|
| "Good" 0-33% of guideline               | 48%  | 51%  | 59%  | 58%  | 54%  | 55%  | 63%  | 65%  |
| "Acceptable" 33-66% of guideline        | 32%  | 40%  | 34%  | 31%  | 37%  | 35%  | 29%  | 28%  |
| "Alert" 66-100% of guideline            | 17%  | 8%   | 7%   | 9%   | 7%   | 10%  | 8%   | 6%   |
| "Action" >Guideline                     | 2%   | 1%   | 1%   | 2%   | 1%   | 1%   | 1%   | 1%   |
| Percentage of valid data                | 63%  | 95%  | 92%  | 99%  | 79%  | 99%  | 99%  | 99%  |
| Annual average ( $\mu\text{g m}^{-3}$ ) | 18   | 18   | 17   | 18   | 17   | 18   | 17   | 16   |
| Exceedences                             | 5    | 5    | 2    | 7    | 4    | 3    | 4    | 3    |
| Second highest concentration            | 56   | 56   | 52   | 69   | 58   | 53   | 52   | 53   |
| Annual maximum ( $\mu\text{g m}^{-3}$ ) | 59   | 61   | 54   | 70   | 58   | 69   | 53   | 56   |
| Number of records                       | 229  | 346  | 337  | 363  | 287  | 361  | 360  | 360  |

### 6.3 Daily variations in PM<sub>10</sub> and meteorology on high pollution days

Figure 6.5 shows hourly variations in PM<sub>10</sub> concentrations and meteorological variables on days when 24-hour average PM<sub>10</sub> concentrations exceeded  $50 \mu\text{g m}^{-3}$ . The daily variations in PM<sub>10</sub> concentrations shown are typical of high pollution episodes in New Zealand that occur when wind speed is low.

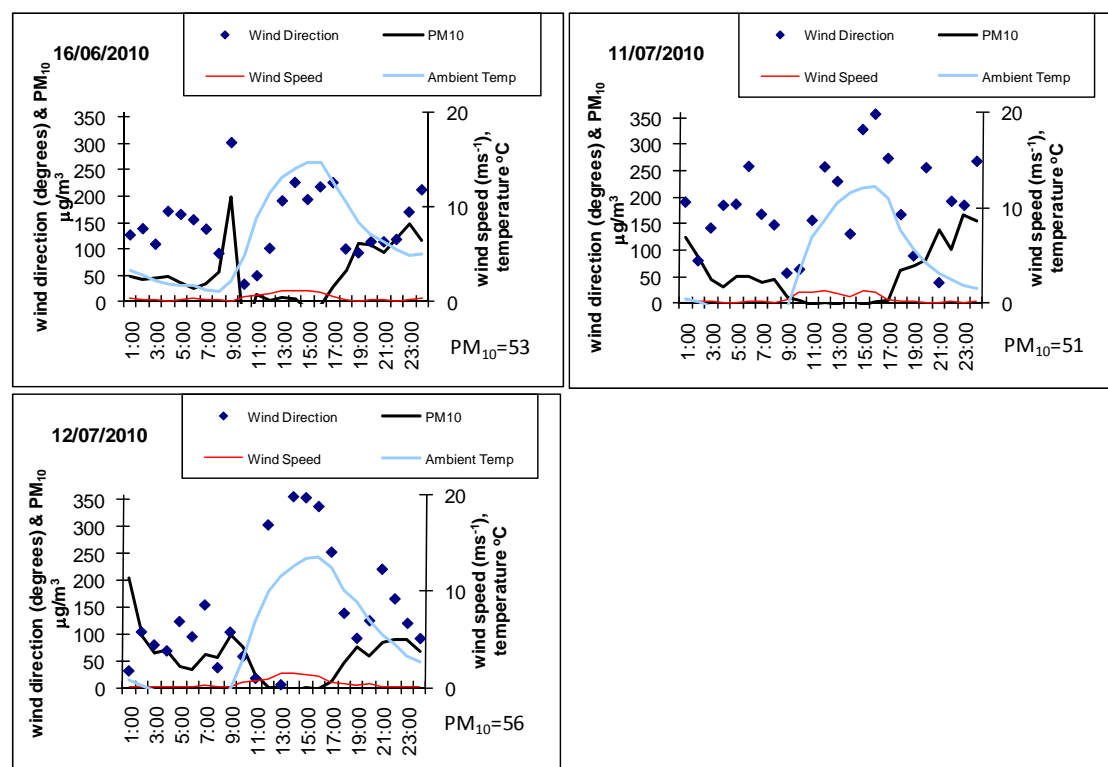


Figure 6.6: Hourly average PM<sub>10</sub>, wind speed, wind direction, and temperature on days when PM<sub>10</sub> concentrations exceeded  $50 \mu\text{g m}^{-3}$  at Te Kuiti.



## 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 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<sub>10</sub> 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 Environment Waikato staff. The BAM continuously measures PM<sub>10</sub> data and it is logged at ten minute intervals.

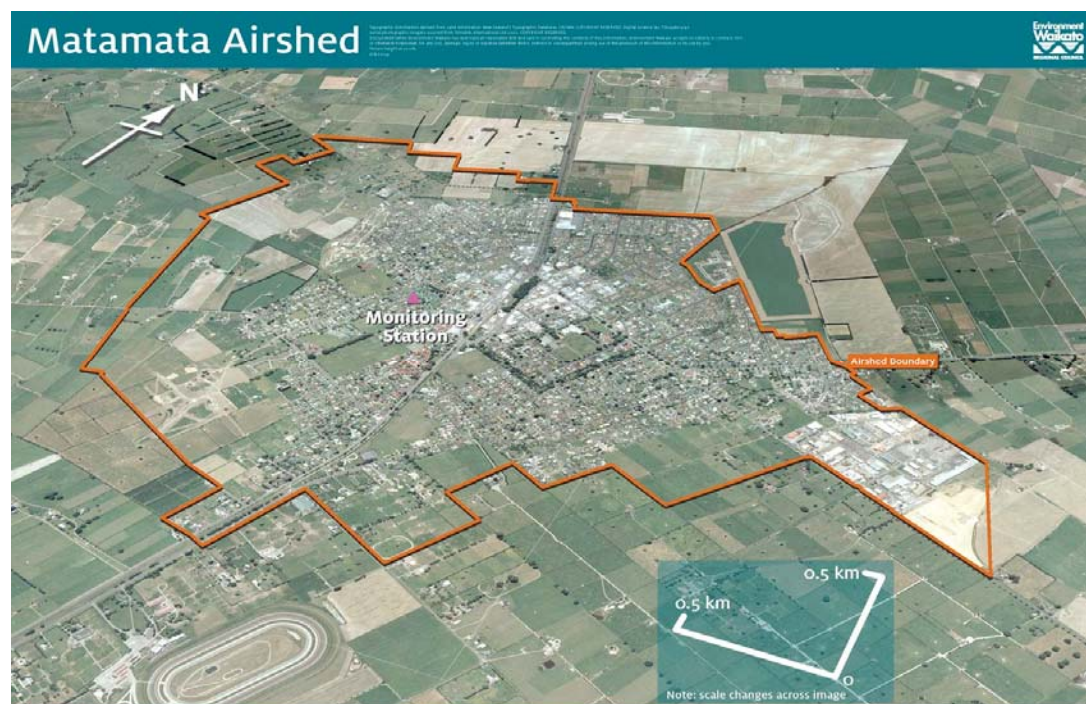


Figure 7.1: Matamata Airshed and air quality monitoring site (Source: Environment Waikato, 2010).

### 7.2 PM<sub>10</sub> concentrations in Matamata

Daily average PM<sub>10</sub> concentrations measured at Matamata during 2010 are shown in Figure 7.2. The maximum measured PM<sub>10</sub> concentration was 40  $\mu\text{g m}^{-3}$  and was measured on 11 April 2010. This is similar to previous winter time maximums of around 34-36  $\mu\text{g m}^{-3}$ .

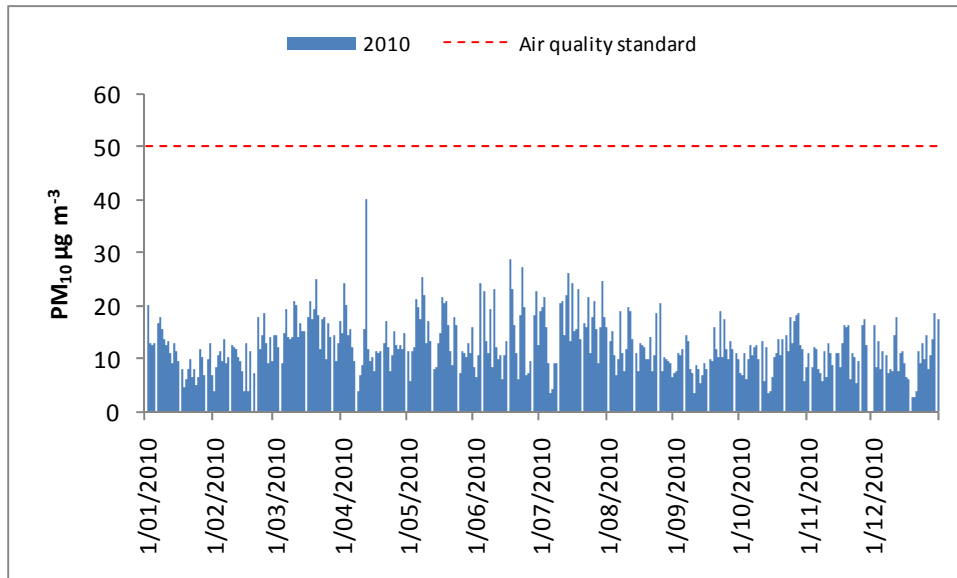


Figure 7.2: Daily winter PM<sub>10</sub> concentrations measured at the Matamata site during 2010.

Figure 7.3 shows concentrations of PM<sub>10</sub> measured at the Matamata air quality monitoring site are largely less than 66% of the NES. Figure 7.4 shows the seasonal variations in the distribution of PM<sub>10</sub> concentrations for 2010. The number of days when 50 µg m<sup>-3</sup> was exceeded, the maximum concentration and the second highest concentration from 2006 to 2010 are shown in Figure 7.5. The highest PM<sub>10</sub> concentration measured during 2009 was an anomaly in that it occurred as a result of the Australian dust storm.

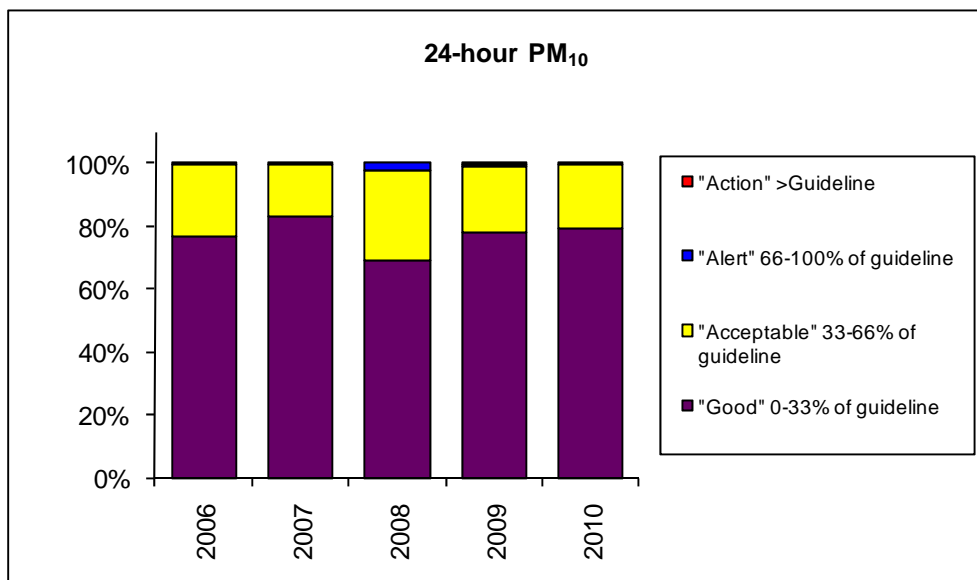


Figure 7.3: Comparison of PM<sub>10</sub> concentrations measured at the Matamata site from 2006 to 2010 to air quality indicator categories.

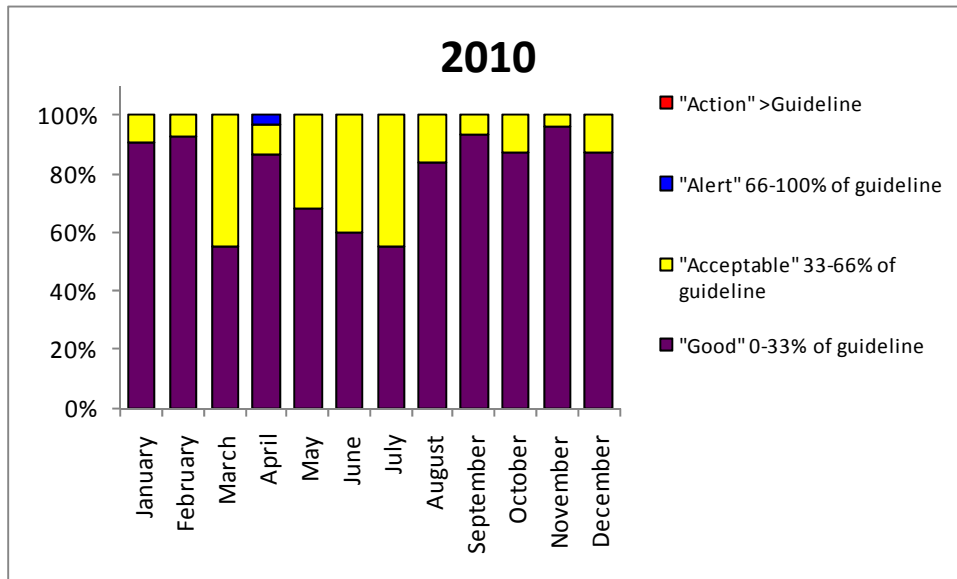


Figure 7.4: Comparison of daily PM<sub>10</sub> concentrations each month during 2010 to air quality indicator categories.

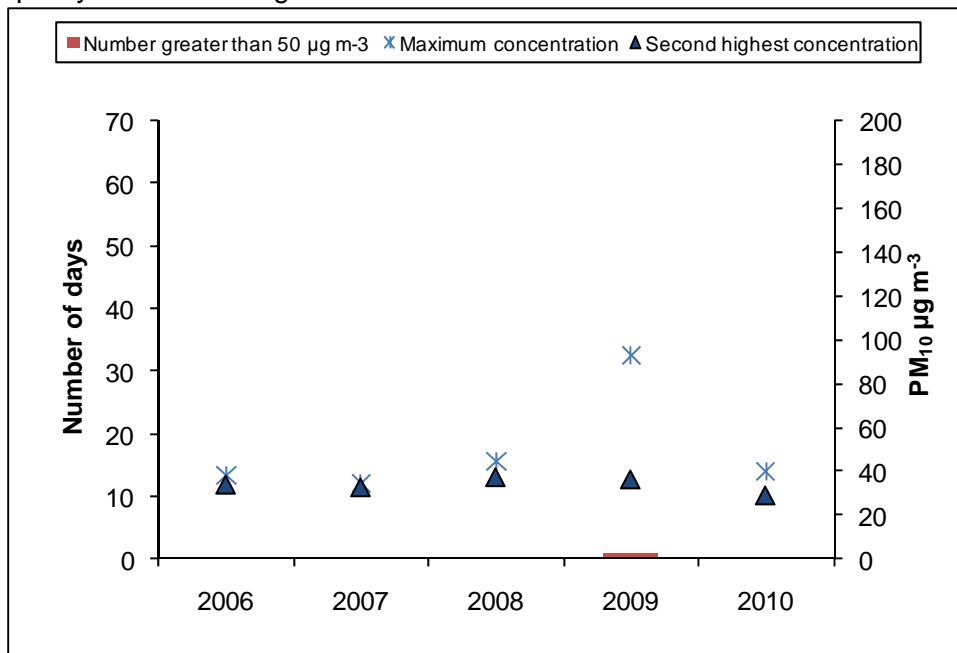


Figure 7.5: Number of days when 50 µg m<sup>-3</sup> was exceeded, the maximum concentration and the second highest concentration from 2006 to 2010.

The annual average PM<sub>10</sub> concentration for Matamata for 2010 is 13 µg m<sup>-3</sup>. Summary statistics for PM<sub>10</sub> monitoring results are shown in Table 7.1.

Table 7.1: Summary of PM<sub>10</sub> concentrations measured at the Matamata monitoring site from 2005 to 2010.

|   | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 |
|---|------|------|------|------|------|------|
| "Good" 0-33% of guideline               | 81%  | 77%  | 83%  | 69%  | 78%  | 79%  |
| "Acceptable" 33-66% of guideline        | 18%  | 23%  | 16%  | 29%  | 21%  | 20%  |
| "Alert" 66-100% of guideline            | 1%   | 1%   | 0%   | 2%   | 1%   | 0%   |
| "Action" >Guideline                     | 0%   | 0%   | 0%   | 0%   | 0%   | 0%   |
| Percentage of valid data                | 51%  | 99%  | 79%  | 100% | 98%  | 99%  |
| Annual average ( $\mu\text{g m}^{-3}$ ) | 12   | 13   | 12   | 15   | 13   | 13   |
| Exceedences                             | 0    | 0    | 0    | 0    | 1    | 0    |
| Second highest concentration            | 34   | 34   | 33   | 38   | 36   | 29   |
| Annual maximum ( $\mu\text{g m}^{-3}$ ) | 36   | 38   | 34   | 45   | 93   | 40   |
| Number of records                       | 187  | 362  | 287  | 364  | 359  | 361  |

### 7.3 Daily variations in PM<sub>10</sub> and meteorology on high pollution days

Daily variations in PM<sub>10</sub> concentrations and meteorological variables on 11 April when the highest PM<sub>10</sub> concentration of 40  $\mu\text{g m}^{-3}$  (24-hour average) was recorded are shown in Figure 7.6. The peak concentrations occur between 2am and 8am and were not preceded by high concentrations during the evening of 10 April. The wind direction was southerly during this time and the wind speeds were low.

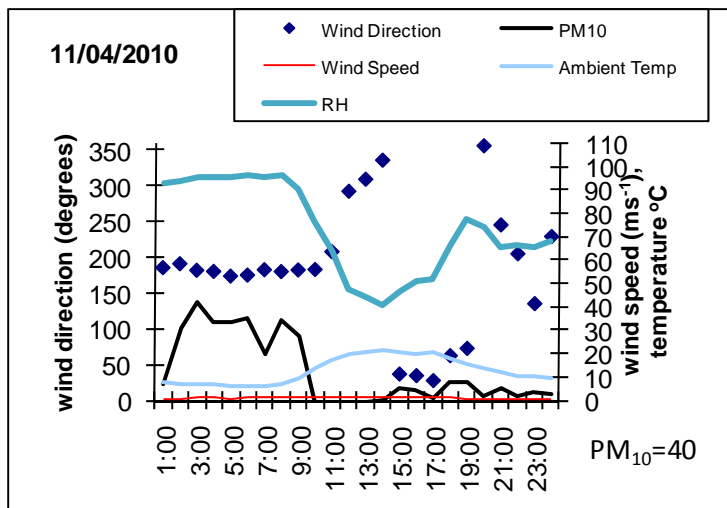


Figure 7.6: Hourly average PM<sub>10</sub>, wind speed, wind direction, temperature and humidity on 11 April when the 24-hour average PM<sub>10</sub> concentration was 40  $\mu\text{g m}^{-3}$  at Matamata.

## 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<sub>10</sub> have been measured since the site was established. Data is adjusted for gravimetric equivalency.

A FH62 C14 BAM measures PM<sub>10</sub> concentrations at Putaruru (Figure 8.2).

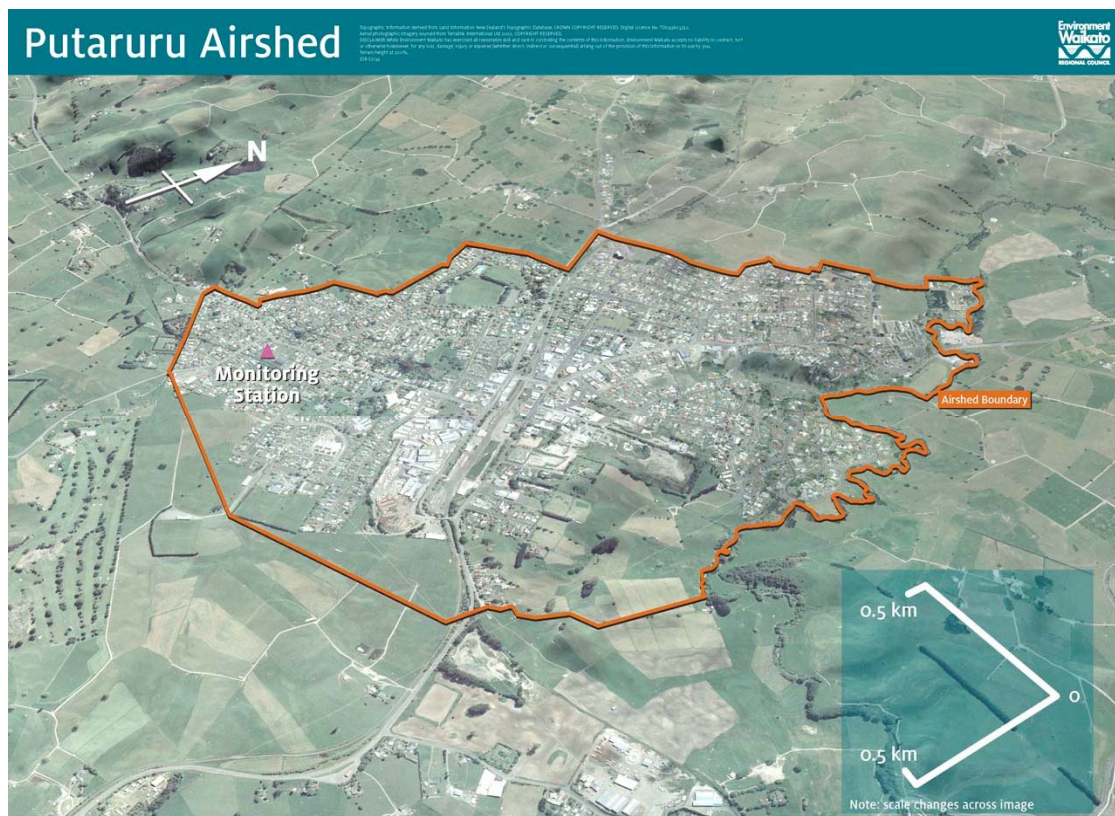


Figure 8.1: Putaruru Airshed and air quality monitoring site (Source: Environment Waikato, 2010).





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

## 8.2 PM<sub>10</sub> Concentrations in Putaruru

Daily average PM<sub>10</sub> concentrations measured at Putaruru during 2010 are shown in Figure 8.3. The maximum concentration of 53  $\mu\text{g m}^{-3}$  was recorded on 15 July. This was the only measured exceedence of 50  $\mu\text{g m}^{-3}$  (24-hour average) and does not constitute a breach of the NES, which allows one exceedence of 50  $\mu\text{g m}^{-3}$  per year.

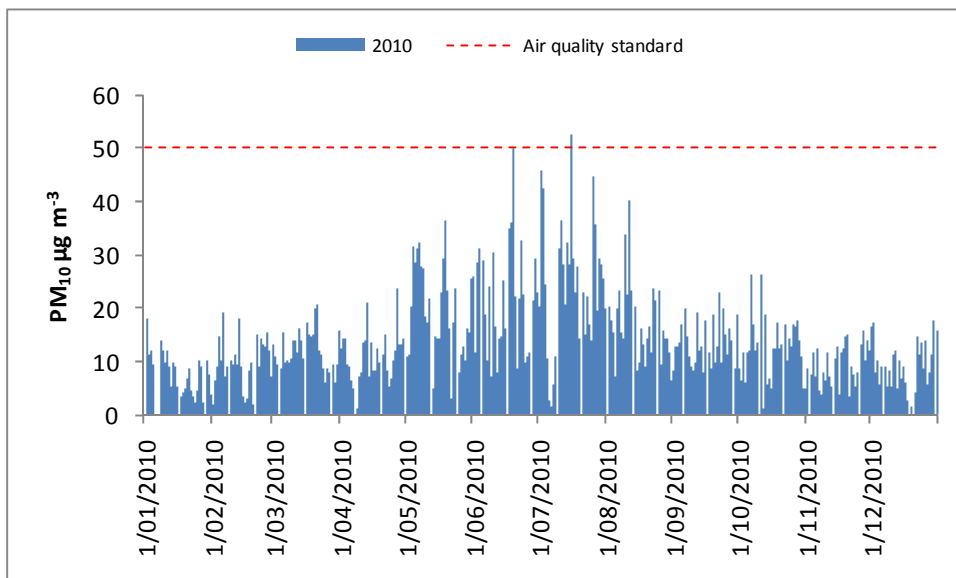


Figure 8.3: Daily winter PM<sub>10</sub> concentrations measured at the Putaruru site during 2010.

Figure 8.4 compares PM<sub>10</sub> concentrations measured at Putaruru from 2006 to 2010 to the MfE (2000) air quality indicator categories. Figure 8.5 shows seasonal

variations in the distribution of PM<sub>10</sub> concentrations for 2010. As with other areas the months of June and July record the highest PM<sub>10</sub> concentrations with May, August and September all showing higher concentrations than the summer months. Figure 8.6 shows the number of days when 50 µg m<sup>-3</sup> was exceeded, the maximum concentration and the second highest concentration from 2006 to 2010. The greatest number of exceedences and the highest PM<sub>10</sub> concentrations occurred during 2008; however it is worth noting that in 2008, two of the four recorded exceedences were in summer (February) and came about as a result of dust created by roadworks during the unusual drought conditions.

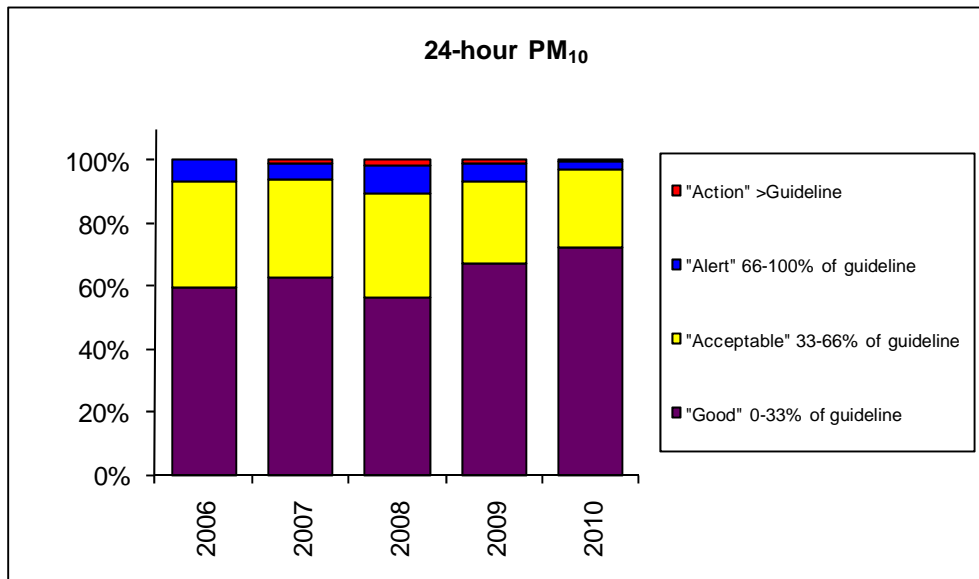


Figure 8.4: Comparison of PM<sub>10</sub> concentrations measured at the Putaruru site from 2006 to 2010 to air quality indicator categories.

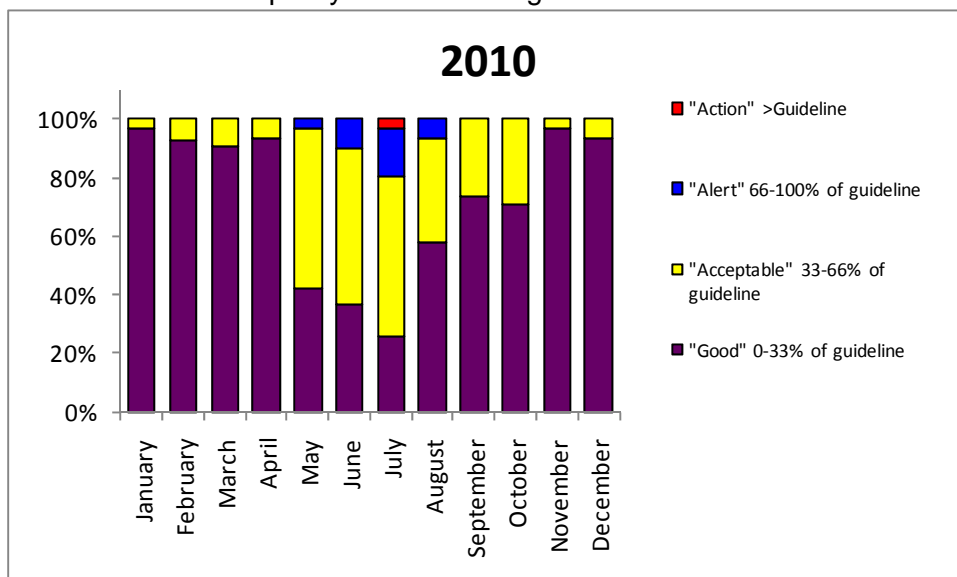


Figure 8.5: Comparison of daily PM<sub>10</sub> concentrations for 2010 to air quality indicator categories.

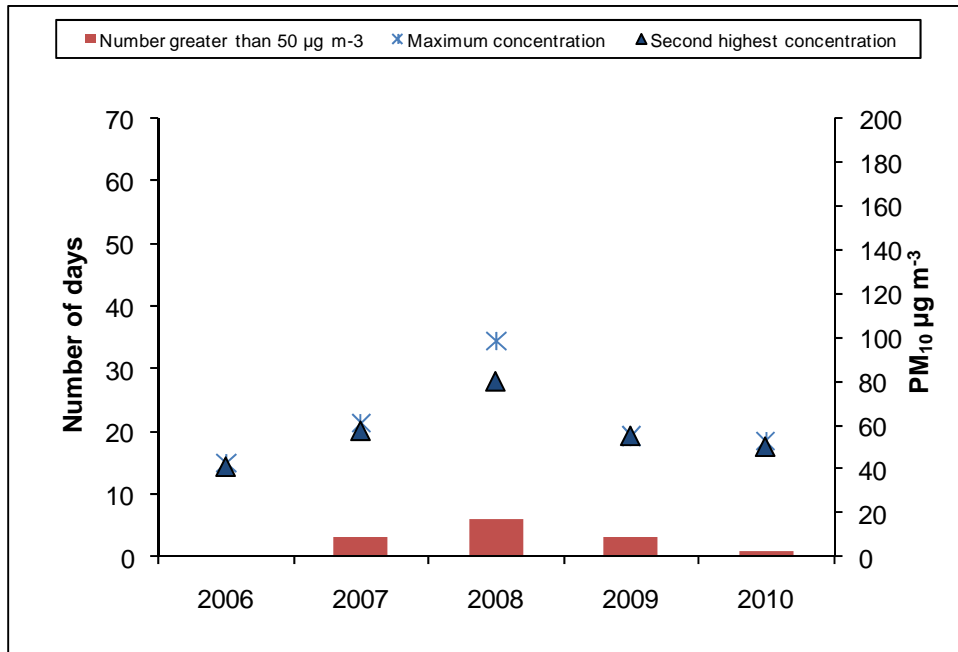


Figure 8.6: Number of days when  $50 \mu\text{g m}^{-3}$  was exceeded, the maximum concentration and the second highest concentration from 2006 to 2010.

The annual average  $\text{PM}_{10}$  concentration for Putaruru for 2010 was  $14 \mu\text{g m}^{-3}$ . This compares with an annual average  $\text{PM}_{10}$  guideline of  $20 \mu\text{g m}^{-3}$  (MfE, 2002). Summary statistics for  $\text{PM}_{10}$  monitoring results are shown in Table 8.1.

Table 8.1: Summary of  $\text{PM}_{10}$  concentrations measured at the Putaruru monitoring site from 2006 to 2010.

|   | 2006 | 2007 | 2008 | 2009 | 2010 |
|---|------|------|------|------|------|
| "Good" 0-33% of guideline               | 60%  | 62%  | 56%  | 67%  | 72%  |
| "Acceptable" 33-66% of guideline        | 34%  | 31%  | 33%  | 26%  | 25%  |
| "Alert" 66-100% of guideline            | 7%   | 5%   | 9%   | 6%   | 3%   |
| "Action" >Guideline                     | 0%   | 1%   | 2%   | 1%   | 0%   |
| Percentage of valid data                | 45%  | 100% | 100% | 100% | 99%  |
| Annual average ( $\mu\text{g m}^{-3}$ ) | n/a  | 16   | 18   | 15   | 14   |
| Exceedences                             | 0    | 3    | 4    | 3    | 1    |
| Second highest concentration            | 41   | 57   | 61   | 55   | 50   |
| Annual maximum ( $\mu\text{g m}^{-3}$ ) | 43   | 61   | 64   | 55   | 53   |
| Number of records                       | 166  | 365  | 365  | 364  | 363  |



## 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<sub>10</sub> concentrations at Ngaruawahia (Figure 9.2).

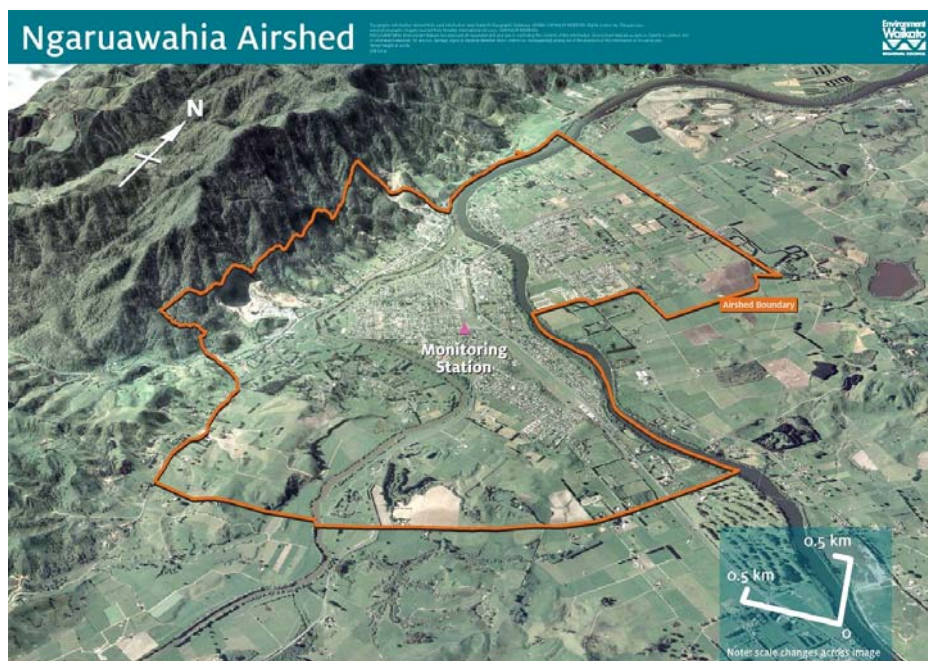


Figure 9.1: Ngaruawahia Airshed and monitoring site (Source: Environment Waikato, 2010).



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

## 9.2 PM<sub>10</sub> Concentrations in Ngaruawahia

The maximum measured PM<sub>10</sub> concentration in Ngaruawahia during 2010 was 29  $\mu\text{g m}^{-3}$  (24-hour average) and compares with a winter maximum of 43  $\mu\text{g m}^{-3}$  measured during 2009. Air quality data for Ngaruawahia is not adjusted for gravimetric equivalency.

Daily average PM<sub>10</sub> concentrations measured at the Ngaruawahia site during 2010 are shown in Figure 9.3.

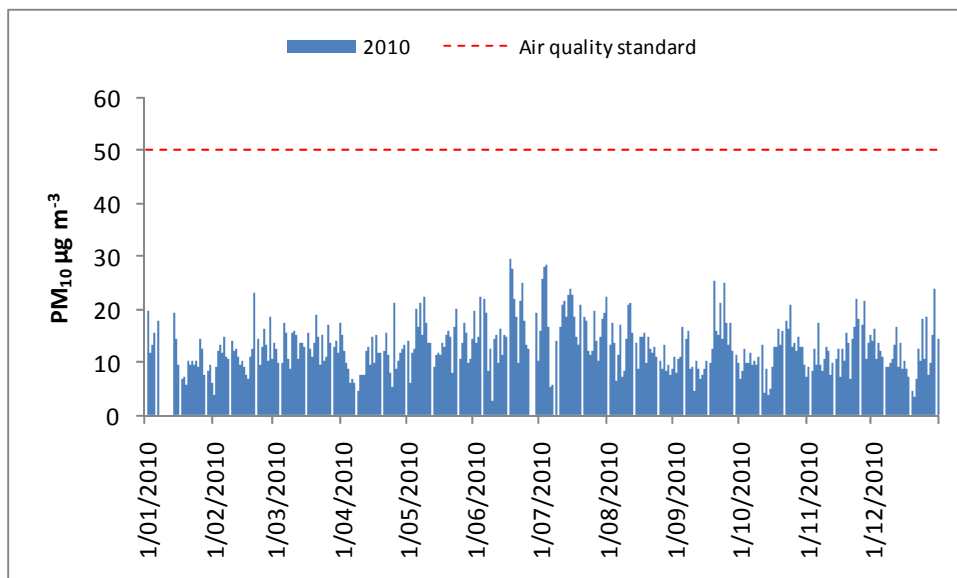


Figure 9.3: Daily winter PM<sub>10</sub> concentrations measured at the Ngaruawahia site during 2010.

During 2010 all of the PM<sub>10</sub> concentrations measured at Ngaruawahia were within the 'acceptable' and 'good' air quality indicator categories (MfE, 2000). Seasonal variations in the distribution of PM<sub>10</sub> concentrations are shown in Figure 9.5. Figure 9.1 compares the maximum and second highest PM<sub>10</sub> concentrations and the number of days when 50 µg m<sup>-3</sup> was exceeded from 2008 to 2010. The one exceedence of 50 µg m<sup>-3</sup> measured at this site (2009) occurred as a result of the Australian dust storms.

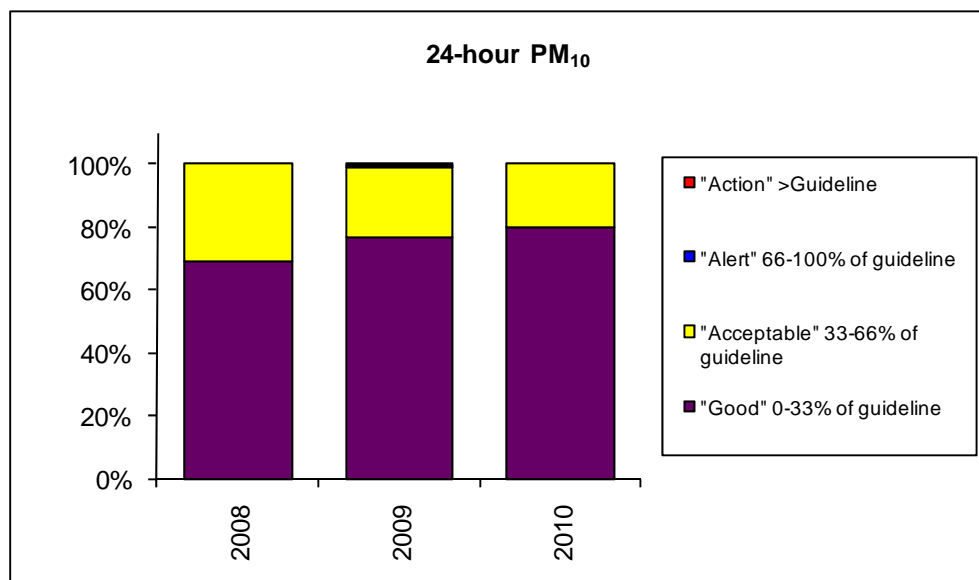


Figure 9.4: Comparison of PM<sub>10</sub> concentrations measured at the Ngaruawahia site from 2008 – 2010 to air quality indicator categories.

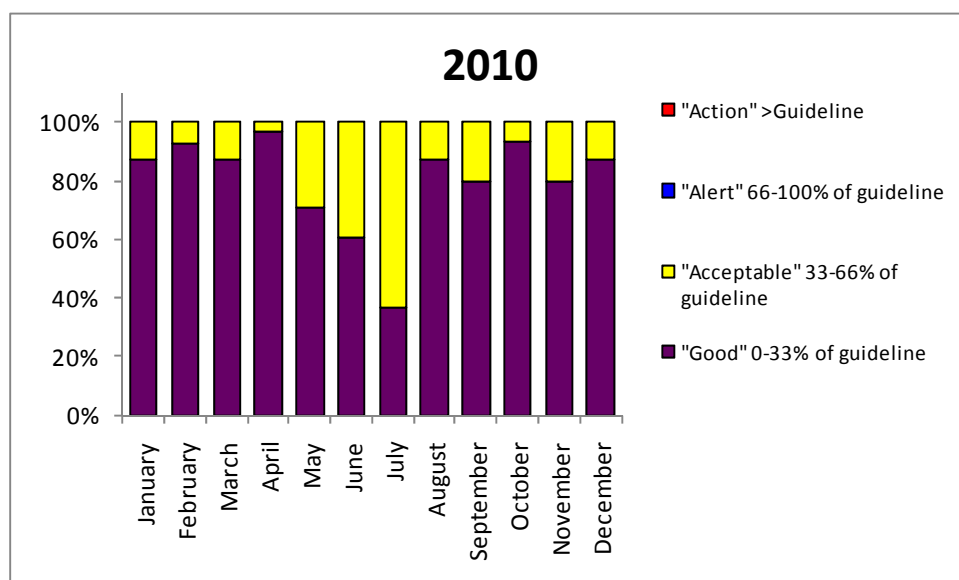


Figure 9.5: Comparison of daily PM<sub>10</sub> concentrations each month during 2010 to air quality indicator categories.

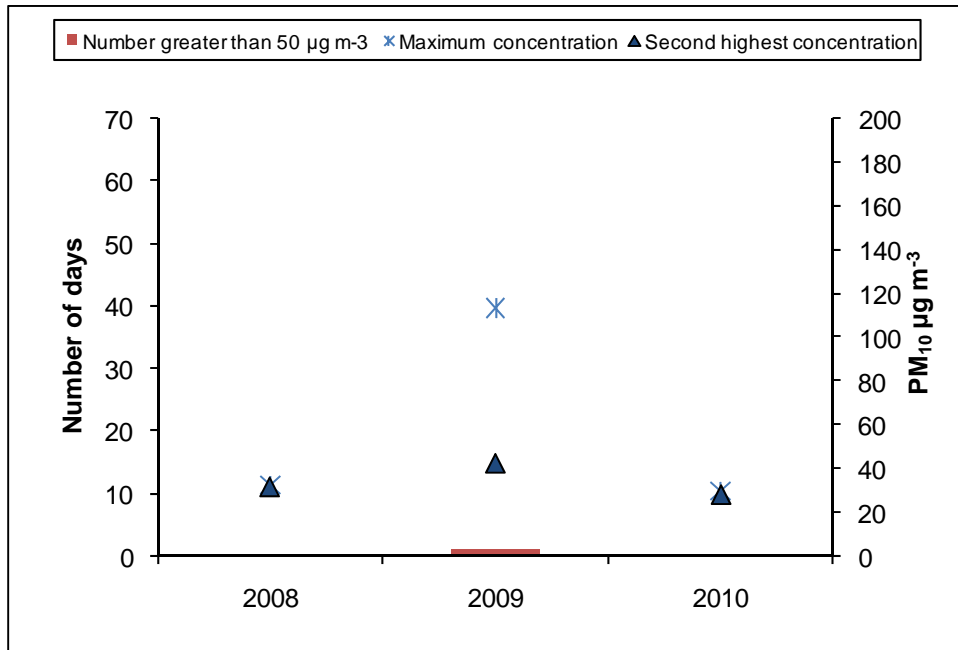


Figure 9.6: Number of days when 50 µg m<sup>-3</sup> was exceeded, the maximum concentration and the second highest concentration from 2008 to 2010.

The annual average PM<sub>10</sub> concentration for Ngaruawahia for 2010 is 13 µg m<sup>-3</sup>. Summary statistics for PM<sub>10</sub> monitoring results are shown in Table 9.1.

Table 9.1: Summary of PM<sub>10</sub> concentrations measured at the Ngaruawahia monitoring site from 2008 to 2010.

|                                      | 2008 | 2009 | 2010 |
|--------------------------------------|------|------|------|
| "Good" 0-33% of guideline            | 69%  | 77%  | 80%  |
| "Acceptable" 33-66% of guideline     | 31%  | 22%  | 20%  |
| "Alert" 66-100% of guideline         | 0%   | 1%   | 0%   |
| "Action" >Guideline                  | 0%   | 0%   | 0%   |
| Percentage of valid data             | 65%  | 100% | 97%  |
| Annual average (µg m <sup>-3</sup> ) | 14   | 14   | 13   |
| Measured exceedences                 | 0    | 1    | 0    |
| Second highest concentration         | 32   | 43   | 28   |
| Annual maximum (µg m <sup>-3</sup> ) | 32   | 113  | 29   |
| Number of records                    | 237  | 364  | 355  |



## 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<sub>10</sub> have been measured since the site was established in 2008.

A Sequential Partisol Sampler is used to measure PM<sub>10</sub> 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<sub>10</sub> concentrations in Waihi

No exceedences of  $50 \mu\text{g m}^{-3}$  were measured at the air quality monitoring site in Waihi during 2010. A cluster of higher than average PM<sub>10</sub> concentrations were recorded around 10-16 July (Figure 10.3). The highest of these and the maximum PM<sub>10</sub> concentrations measured at Waihi during 2010 was  $45 \mu\text{g m}^{-3}$ . Previous maximum winter PM<sub>10</sub> concentrations have been around  $33 \mu\text{g m}^{-3}$ .

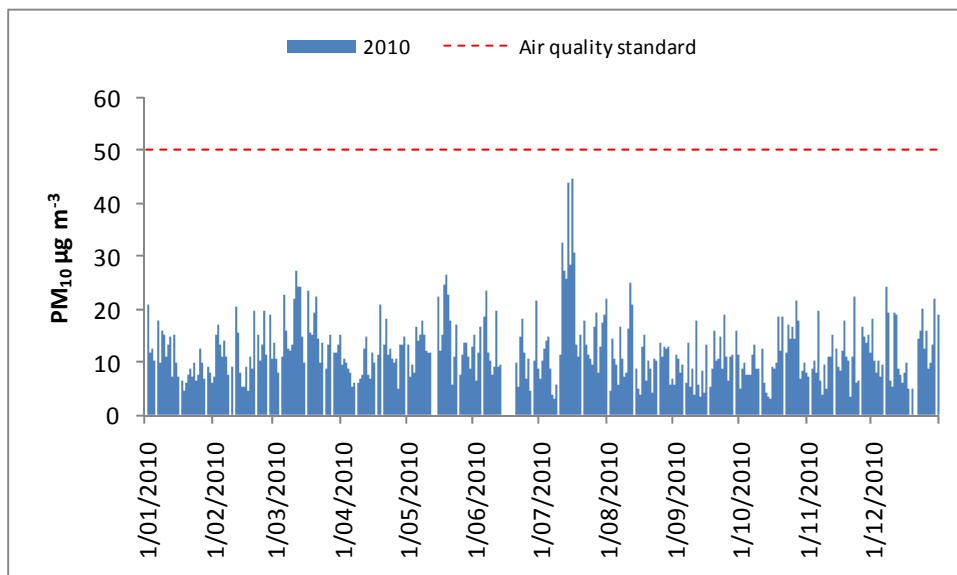


Figure 10.3: Daily winter PM<sub>10</sub> concentrations measured at the Waihi site during 2010.

Figure 10.4 shows 2010 concentrations of PM<sub>10</sub> relative to air quality indicator categories at Waihi. Figure 10.5 shows seasonal variations in the distribution of

PM<sub>10</sub> concentrations. Figure 10.6 shows the number of days when 50 µg m<sup>-3</sup> was exceeded, the maximum concentration and the second highest concentration from 2008 to 2010.

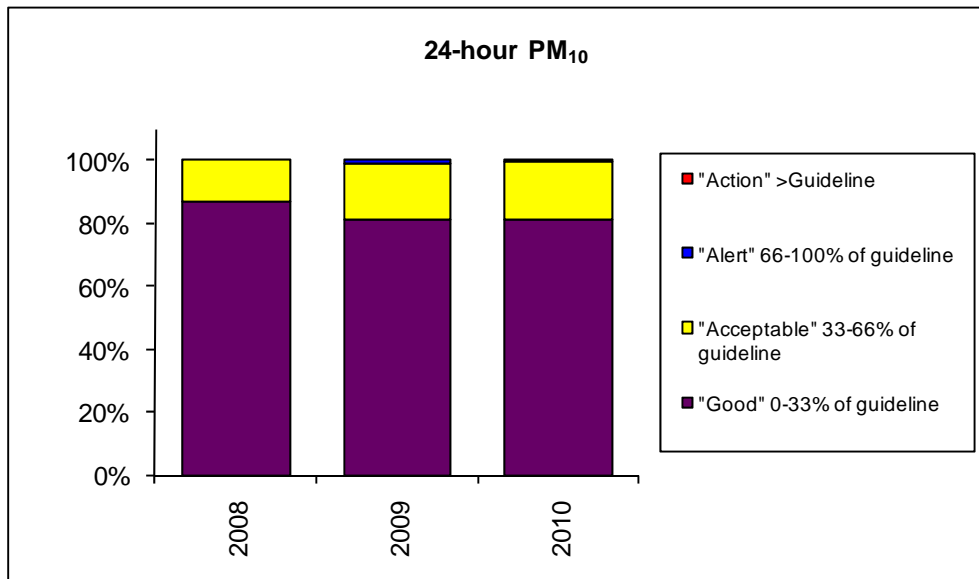


Figure 10.4: Comparison of PM<sub>10</sub> concentrations measured at the Waihi site from 2008 to 2010 to air quality indicator categories.

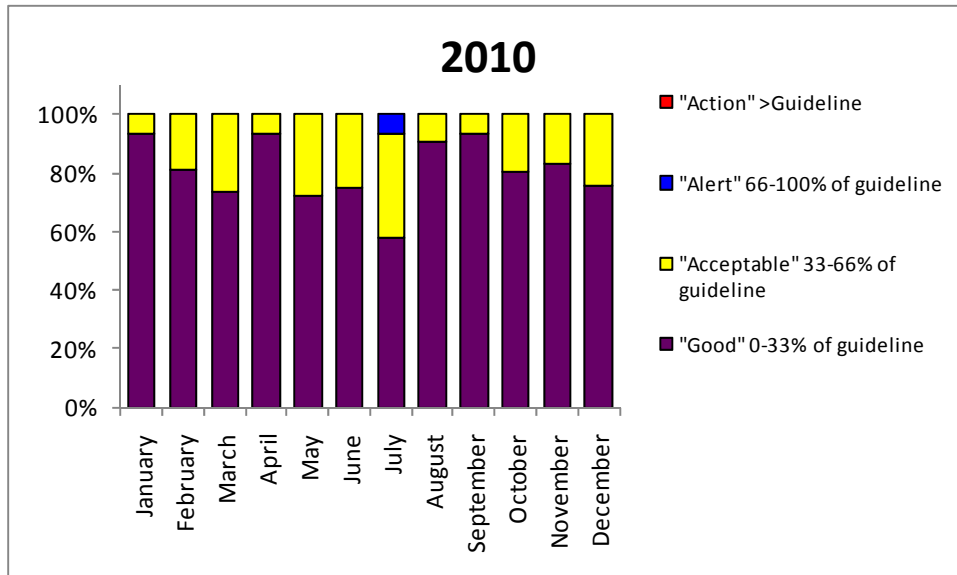


Figure 10.5: Comparison of daily PM<sub>10</sub> concentrations during 2010 to air quality indicator categories.

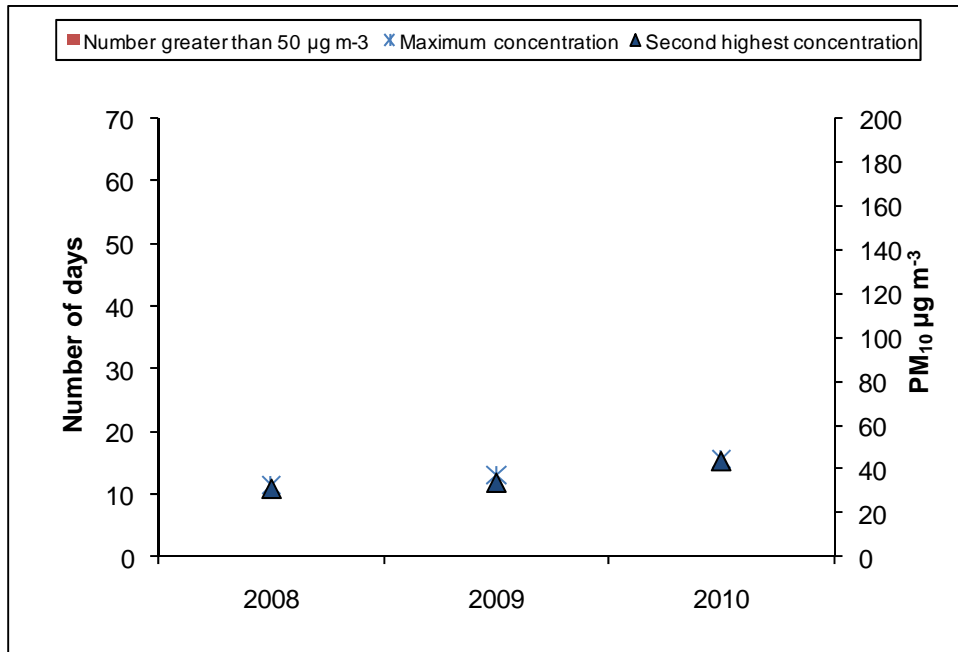


Figure 10.6: Number of days when 50 µg m<sup>-3</sup> was exceeded, the maximum concentration and the second highest concentration from 2008 to 2010.

The estimated annual average PM<sub>10</sub> concentration for Waihi for 2010 is 12 µg m<sup>-3</sup>. Table 10.1 shows the summary statistics for PM<sub>10</sub> monitoring results from 2008 to 2010.

Table 10.1: Summary of PM<sub>10</sub> concentrations measured at the Waihi monitoring site from 2008-2010.

|                                      | 2008 | 2009 | 2010 |
|--------------------------------------|------|------|------|
| "Good" 0-33% of guideline            | 87%  | 81%  | 81%  |
| "Acceptable" 33-66% of guideline     | 13%  | 18%  | 19%  |
| "Alert" 66-100% of guideline         | 0%   | 1%   | 1%   |
| "Action" >Guideline                  | 0%   | 0%   | 0%   |
| Percentage of valid data             | 84%  | 87%  | 96%  |
| Annual average (µg m <sup>-3</sup> ) | 12   | 12   | 12   |
| Measured exceedences                 | 0    | 0    | 0    |
| Second highest concentration         | 31   | 34   | 44   |
| Annual maximum (µg m <sup>-3</sup> ) | 33   | 37   | 45   |
| Number of records                    | 308  | 317  | 351  |



## 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.

A monitoring site was established at 16 Ohuanga Road, Turangi (Figure 11.1) in April 2009. Daily and hourly average  $PM_{10}$  concentrations are measured at the site using a FH 62 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<sub>10</sub> Concentrations in Turangi

The maximum PM<sub>10</sub> concentration in Turangi was 32  $\mu\text{g m}^{-3}$  (24-hour average) and was recorded on 14 July. No exceedences of 50  $\mu\text{g m}^{-3}$  were measured at Turangi during 2010.

Daily average PM<sub>10</sub> concentrations measured at the Turangi site during 2010 are shown in Figure 11.3.

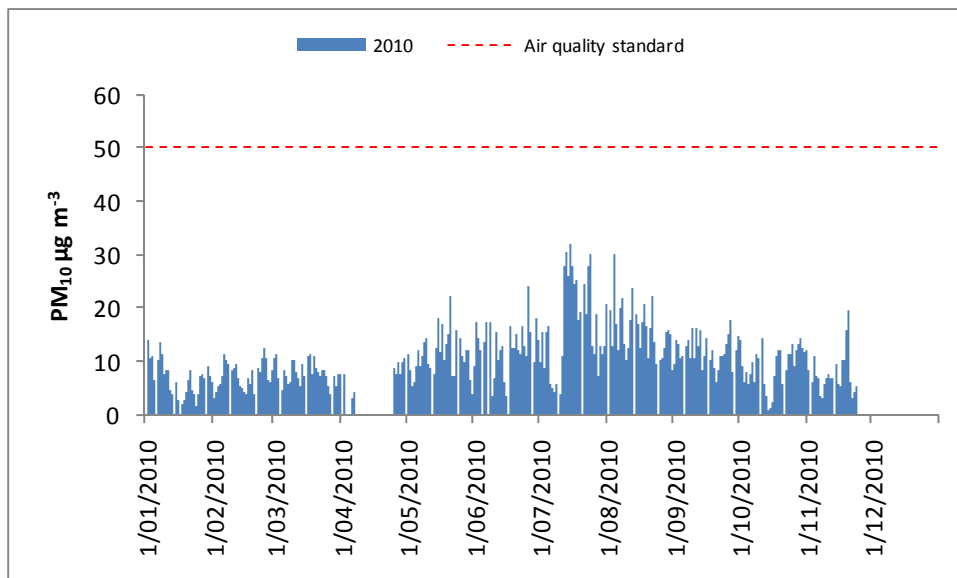


Figure 11.3: Daily winter PM<sub>10</sub> concentrations measured at the Turangi site for 2010.

Figure 11.4 shows concentrations of PM<sub>10</sub> relative to air quality indicator categories at Turangi during 2009 and 2010. Eighty eight percent of data is within the 'good' category. Seasonal variations in the distribution of PM<sub>10</sub> concentrations for 2010 are shown in Figure 11.5. Figure 11.6 shows no exceedences of 50 µg m<sup>-3</sup> for 2009 or 2010 and the maximum concentration and the second highest concentration for each year.

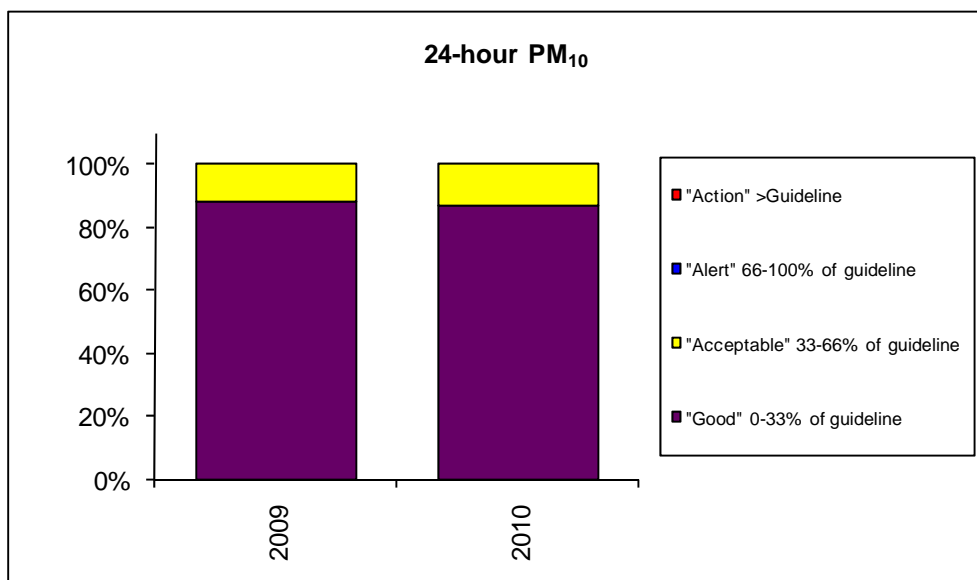


Figure 11.4: Comparison of PM<sub>10</sub> concentrations measured at the Turangi site in 2010 to air quality indicator categories.

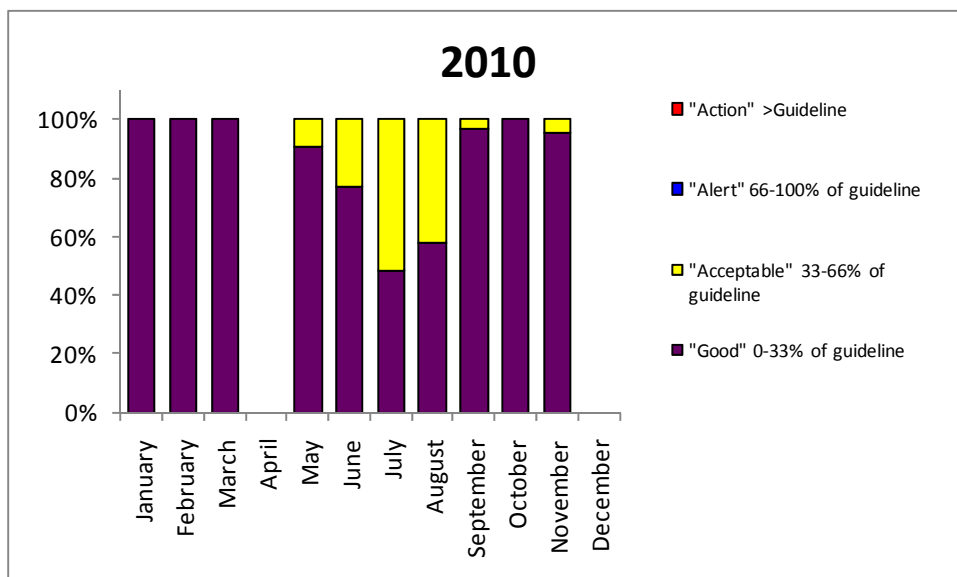


Figure 11.5: Comparison of daily PM<sub>10</sub> concentrations for 2010 to air quality indicator categories.

The annual average PM<sub>10</sub> concentration for Turangi for 2010 is 10 µg m<sup>-3</sup>. Table 11.1 shows summary statistics for PM<sub>10</sub> monitoring results for 2009 and 2010.

Table 11.1: Summary of PM<sub>10</sub> concentrations measured at the Turangi monitoring site for 2010.

|   | 2009 | 2010 |
|---|------|------|
| "Good" 0-33% of guideline               | 88%  | 87%  |
| "Acceptable" 33-66% of guideline        | 12%  | 13%  |
| "Alert" 66-100% of guideline            | 0%   | 0%   |
| "Action" >Guideline                     | 0%   | 0%   |
| Percentage of valid data                | 79%  | 84%  |
| Annual average ( $\mu\text{g m}^{-3}$ ) | 9    | 10   |
| Measured exceedences                    | 0    | 0    |
| Second highest concentration            | 25   | 30   |
| Annual maximum ( $\mu\text{g m}^{-3}$ ) | 25   | 32   |
| Number of records                       | 288  | 305  |

## 12 Summary

Concentrations of PM<sub>10</sub> were measured at air quality monitoring sites in Hamilton, Tokoroa, Taupo, Te Kuiti, Matamata, Putaruru, Ngaruawahia, Waihi and Turangi during 2010.

In 2010 the NES for PM<sub>10</sub> was breached in Tokoroa and Te Kuiti. The maximum measured PM<sub>10</sub> concentrations, number of exceedences of 50 µg m<sup>-3</sup> and the annual average PM<sub>10</sub> concentration at all sites are shown in Table 12.1. More than one exceedence of the 50 µg m<sup>-3</sup> constitutes a breach of the NES. The annual average concentration for each location are also shown and can be compared with an annual average guideline of 20 µg m<sup>-3</sup> (MfE, 2002).

Table 12.1: Summary of PM<sub>10</sub> monitoring results for 2010.

|             | Maximum measured concentration µg m <sup>-3</sup> | Measured exceedences | Number of NES breaches | Annual Average        |
|-------------|---|----------------------|------------------------|-----------------------|
| Hamilton    | 30  | 0                    | 0                      | 13 µg m <sup>-3</sup> |
| Tokoroa     | 99  | 16                   | 15                     | 18 µg m <sup>-3</sup> |
| Taupo       | 55  | 1                    | 0                      | 14 µg m <sup>-3</sup> |
| Te Kuiti    | 56  | 3                    | 2                      | 16 µg m <sup>-3</sup> |
| Matamata    | 40  | 0                    | 0                      | 13 µg m <sup>-3</sup> |
| Putaruru    | 53  | 1                    | 0                      | 14 µg m <sup>-3</sup> |
| Ngaruawahia | 29  | 0                    | 0                      | 13 µg m <sup>-3</sup> |
| Waihi       | 45  | 0                    | 0                      | 12 µg m <sup>-3</sup> |
| Turangi     | 32  | 0                    | 0                      | 10 µg m <sup>-3</sup> |

In Hamilton, concentrations of benzene were within the guideline of 3.6 µg m<sup>-3</sup>. The highest annual concentration was measured at the Greenwood Street monitoring site and was 3.0 µg m<sup>-3</sup>. Concentrations of toluene and xylene were well within acceptable levels.

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