



**MARLBOROUGH  
DISTRICT COUNCIL**

# **Annual Air Quality Monitoring Report – Blenheim 2017**

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## Executive Summary

Particulate is main air pollutant of concern in urban areas of New Zealand. The main measures of particulate are PM<sub>10</sub> (particles less than 10 microns in diameter) and PM<sub>2.5</sub> (particles less than 2.5 microns in diameter). In 2017 monitoring of both size fractions was carried out in Redwoodtown and at the historical monitoring site in Middle Renwick Road (MRR) PM<sub>10</sub> monitoring was also conducted. The main source of particulate in Blenheim during the winter is solid fuel burning for domestic home heating.

Monitoring data for PM<sub>10</sub> were compared to the National Environmental Standard for Air Quality (NES) of 50 µg m<sup>-3</sup> (24-hour average) and to the Ministry for the Environment's air quality guidelines and indicator categories. Comparisons are made with historical data to determine the likelihood of trends in concentrations.

Concentrations of PM<sub>10</sub> breached the NES on 10 occasions in Redwoodtown with 11 exceedences of 50 µg m<sup>-3</sup> (the NES allows for one exceedance per year). Blenheim was required to comply with the NES for PM<sub>10</sub> by winter 2017. The maximum measured concentration during 2017 was 76 µg m<sup>-3</sup>. The annual average PM<sub>10</sub> concentrations was 19 µg/m<sup>3</sup> and is the highest recorded at the site since continuous monitoring commenced in 2005.

Concentrations of PM<sub>2.5</sub> exceeded 25 µg/m<sup>3</sup> (24-hour average reporting guideline and WHO guideline) on 72 occasions. The annual average PM<sub>2.5</sub> concentration was 14 µg/m<sup>3</sup>. This compares with the current WHO guideline for PM<sub>2.5</sub> of 10 µg/m<sup>3</sup>.

The maximum PM<sub>10</sub> concentration measured at the MRR site was 26 µg m<sup>-3</sup> for 2017. The annual average concentration for this site was estimated to be 11 µg/m<sup>3</sup> for 2017 and compares with 11 in 2016 and 13 µg/m<sup>3</sup> for 2013-2015. An evaluation of trends at the MRR site suggests a decrease in annual average PM<sub>10</sub> concentrations at this site between 2000 and 2008 but no further reductions are evident since 2009.

Management measures to reduce PM<sub>10</sub> concentrations to meet the NES have been included in the Proposed Marlborough Environment Plan (notified June 2016). Measures are based on a 2012 assessment which predicted concentrations would reduce from 2012–2017 in the absence of regulation. Potential reasons for the reductions not occurring include higher than anticipated emissions from newer burners and underestimated population increase in the airshed area from 2006-2013. Given the trend from 2012-2017 it would seem unlikely that the management options specified in the notified air plan would be effective in reducing PM<sub>10</sub> concentrations to meet the NES.



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## 1. Introduction

The main air contaminant of concern in Blenheim and other urban areas of New Zealand is particulate or particles in the air. The main indicator of particulate used has been PM<sub>10</sub>, particles in the air less than 10 microns in diameter and this size fraction forms the basis of the National Environmental Standard (NES). For the past decade, however, the scientific community has been of the view that the smaller of these particles, those less than 2.5 microns in diameter are a stronger indicator of health.

Table 1.1 shows the contaminant, the concentration, averaging period and allowable exceedances as required by the NES (Ministry for Environment, 2004). The NES for PM<sub>10</sub> is set at 50 µg m<sup>-3</sup> with one allowable exceedence per 12-month period. Compliance with this target was required by September 2016 in Blenheim. All other areas in Marlborough must remain compliant with the NES.

The Ministry for the Environment are in the process of reviewing the NES for particulate, however, with a focus on the most appropriate form and averaging period. It is likely that the revised NES will be for the PM<sub>2.5</sub> size fraction and annual average concentrations. A likely implication is the need for PM<sub>2.5</sub> monitoring either in addition to or instead of PM<sub>10</sub> monitoring. The implications for the current PM<sub>10</sub> requirements are unclear at this stage.

This report summarises concentrations of PM<sub>10</sub> that were measured at two sites in Blenheim during 2017. The main site for reporting PM<sub>10</sub> relative to National Environmental Standards is at the Redwoodtown Bowling Club. A second-long term monitoring site in Blenheim is located at Middle Renwick Road (MRR).

Air quality monitoring in the Marlborough Region includes monitoring of PM<sub>10</sub> at the MRR monitoring site, intermittent monitoring of PM<sub>10</sub> at the Redwoodtown Bowling Club site, survey PM<sub>10</sub> monitoring in Renwick during 2000 and 2002, monitoring for PM<sub>10</sub> in Picton during 2008 and 2009, visibility surveys and passive sampling for nitrogen oxides and sulphur oxides. From 2007 to early 2008, PM<sub>10</sub> concentrations were measured at the Croquet Club in Redwoodtown in addition to the main monitoring site at the Bowling Club. A site on Brooklyn Street in Redwoodtown was temporarily used to measure PM<sub>10</sub> concentrations during 2004.

Air quality monitoring data in other urban areas of New Zealand indicates that it would seem unlikely that concentrations of NES contaminants other than PM<sub>10</sub> would be in breach in Blenheim. Concentrations of other contaminants even in large urban areas are typically within the NES and guideline concentrations. Because emissions of other contaminants in Blenheim are far lower than large urban areas such as Christchurch, it would seem unlikely that concentrations of other key urban air pollutants would be in breach of the NES or air quality guidelines. The exception to this may be benzo(a)pyrene concentrations, which appear to occur well in excess of guideline concentrations in Christchurch.

The Ministry for the Environment also provides guidelines for ambient air quality (Ministry for Environment, 2002). Table 1.2 shows the ambient air quality guidelines and Table 1.3 details the air quality indicator categories to assist in the presentation and management of air quality in New Zealand. 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 air quality and provide a valuable tool for evaluating trends in concentrations over time.

**Table 1.1: National Environmental Standards for Ambient Air Quality (MfE, 2004).**

| Contaminant                   | NES values             |                  |                              |
|-------------------------------|------------------------|------------------|------------------------------|
|                               | Concentration          | Averaging Period | Allowable exceedences / year |
| 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               | 350 µg m <sup>-3</sup> | 1-hour           | 9                            |
| Sulphur dioxide               | 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   | Averaging Period                      |
| Carbon monoxide                  | 30 mg m <sup>-3</sup>   | 1-hour                                |
|                                  | 10 mg m <sup>-3</sup>   | 8-hour                                |
| Particles (PM <sub>10</sub> )    | 50 µg m <sup>-3</sup>   | 24-hour                               |
|                                  | 20 µg m <sup>-3</sup>   | Annual                                |
| Nitrogen dioxide                 | 200 µg m <sup>-3</sup>  | 1-hour                                |
|                                  | 100 µg m <sup>-3</sup>  | 24-hour                               |
| Sulphur dioxide <sup>b</sup>     | 350 µg m <sup>-3</sup>  | 1-hour                                |
|                                  | 120 µg m <sup>-3</sup>  | 24-hour                               |
| Ozone                            | 150 µg m <sup>-3</sup>  | 1-hour                                |
|                                  | 100 µg m <sup>-3</sup>  | 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><br>(lead content of PM <sub>10</sub> ) | 3-month moving,<br>calculated 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 Table 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  |

An emission inventory for Blenheim was updated in 2017 to provide a more recent estimate of the sources of PM<sub>10</sub> and other contaminant emissions (Wilton, 2017). The results of the inventory indicated that domestic home heating was the main source of PM<sub>10</sub> emissions, contributing to around 90% of the daily wintertime PM<sub>10</sub>. Motor vehicles contributed to 1% of PM<sub>10</sub> emissions, outdoor burning contributed to 8% and industry contributed to 1% of total wintertime emissions.

## 2. Methodology

Air quality monitoring of particulate in Blenheim during 2017 was carried out at the two historical monitoring sites (Redwoodtown and Middle Renwick Road (MRR)). At the Redwoodtown Bowling Club site in Blenheim, two 5014i beta attenuation monitors (BAM) were used to measure PM<sub>10</sub> and PM<sub>2.5</sub> as well as a high-volume sampler measuring PM<sub>10</sub>. The purpose of the high-volume sampler was to determine the relationship of the samplers to the high-volume reference method.

At the MRR site a gravimetric high-volume sampler, a method compliant with the NES reference method specifications, was used. High-volume sampling was carried out on a one day in three sampling regime with samples collected over a 24-hour period from midnight to midnight. Although compliant in terms of the principles of operation, the high-volume sampler is difficult to operate continuously because of the requirement for filter change at midnight. Consequently, this method as used at the MRR site was not compliant with the NES. The site was historically classified as a residential neighbourhood monitoring site in accordance with the Ministry for the Environment's Good Practice Guide for Air Quality Monitoring (Ministry for the Environment, 2009) but has been revised to traffic peak owing to its proximity to the road.

Prior to 2016, meteorological data, including wind speed, wind direction were obtained from a NIWA site on the outskirts of Blenheim. Ambient temperature data was collected at the Bowling Club site in Redwoodtown. All meteorological data (wind speed, temperature and wind direction) are now monitored at the Redwoodtown monitoring site.

## 2.1. Air quality monitoring sites

Figure 2.1 shows the MRR site, which provides a historical record of PM<sub>10</sub> in Blenheim and is located to the north-west of Blenheim, the Redwoodtown Bowling Club site which has been operational since 2002, and the NIWA metrological monitoring site, which was used for meteorological data prior to 2016.

In 2007 a site at the Croquet Club was established for the purposes of evaluating the relationship between Brooklyn Street area PM<sub>10</sub> and PM<sub>10</sub> concentrations measured at the Bowling Club. This was considered important because PM<sub>10</sub> concentrations of the magnitude measured during 2004 at Brooklyn Street had not been measured at the Bowling Club and because the reductions required in PM<sub>10</sub> concentrations in Blenheim had been dependent on the Brooklyn Street results. The results from work undertaken in 2007 and reported in the '2007 Air Quality Monitoring Report' (Wilton, 2008) indicated that the Brooklyn Street site was likely to be affected by localised sources of PM<sub>10</sub> and should not be used for air quality management purposes. Details of the Croquet Club site are outlined in '2008 Air Quality Monitoring Report' (Wilton & Baynes, 2009).



Figure 2.1: Location of air quality sites and NIWA metrological site in Blenheim.

### 2.1.1. Middle Renwick Road (MRR) monitoring site

The MRR air quality monitoring site was established in 2000 at the backyard area of a Council site at 106 Middle Renwick Road. An aerial picture of the MMR site and its surrounds are shown in Figure 2.2, and Figure 2.3 shows the high-volume sampler located at the MRR monitoring site. Table 2.1 provides site details for the site.



Figure 2.2: Aerial photo of the MRR air quality monitoring site (red arrow points to monitoring location).



Figure 2.3: PM<sub>10</sub> monitor at the MRR air monitoring site.

Table 2.1: Site summary details for the MRR air quality monitoring site.

| Site name                              | Blenheim – 106 Middle Renwick Road  |
|--|---|
| Site contact details                   | Marlborough District Council  |
| Description of site                    | Grass lawn near to roadside. Mixed use area with proximity to industrial, residential and high traffic count road.  |
| Site category                          | Traffic peak  |
| Purpose of site and sources            | To measure ambient air concentrations of PM <sub>10</sub> at the historical air quality monitoring site in Blenheim. Main source during the winter months is solid fuel burning for domestic heating. |
| Proposed duration of monitoring        | Ongoing   |
| Contaminants monitored                 | PM <sub>10</sub>  |
| Site co-ordinates                      | E1678182 N5404327   |
| Date of site installation              | January 2000  |
| Meteorological characteristics of area | Low wind speeds occur regularly during the winter months. Temperature inversions are likely.  |
| Sample frequency                       | One day in three from May 2005 One day in six prior to this during the summer and one day in three during the winter.   |
| Inlet height                           | 1.5 metres  |
| Averaging period                       | 24-hour   |



### 2.1.2. Redwoodtown – Bowling Club Monitoring Site

In 2010 air quality monitoring took place at the main air quality monitoring site at the Blenheim Bowling Club on Weld Street in Redwoodtown. Figures 2.4 and 2.5 show the surrounding area and the location of the monitoring site within the Bowling Club grounds. Summary site details are given in Table 2.2.



**Figure 2.4: Aerial photo of the Redwoodtown – Bowling Club air quality monitoring site (note: blue arrow depicts monitoring site).**



Figure 2.5: PM<sub>10</sub> monitor at the Redwoodtown – Bowling Club air quality monitoring site.

**Table 2.2: Site summary details for the Redwoodtown – Bowling Club air quality monitoring site.**

| Site name                              | Redwoodtown – Bowling Club   |
|--|--|
| Site contact details                   | Marlborough District Council   |
| Description of site                    | The site is located at the Blenheim Bowling Club, which is to the south-east of central Blenheim. The surrounding area includes a bowling green, gravel petanque area and paved areas.   |
| Site category                          | Residential neighbourhood  |
| Purpose of site and sources            | To measure worst-case ambient air concentrations of PM <sub>10</sub> in Blenheim. The main source during the winter months is solid fuel burning for domestic heating. The site is downwind of a large residential area for meteorological conditions conducive to poor air quality. |
| Proposed duration of monitoring        | Ongoing  |
| Contaminants monitored                 | PM <sub>10</sub>   |
| Site co-ordinates                      | E1679764 N5402328  |
| Date of site installation              | Monitoring from 2000-2003. Permanent site since 2005.  |
| Meteorological characteristics of area | Low wind speeds occur regularly during the winter months. Temperature inversions are likely.   |
| Sample frequency                       | Continuous   |
| Inlet height                           | 3.5 metres   |
| Averaging period                       | 24-hour and hourly   |

## 2.2. Quality assurance

Marlborough District Council staff operated the high volume PM<sub>10</sub> samplers, including filter changing.

Flow calibrations were carried out every month, normally during the morning. Filters were couriered to Hill Laboratories, who undertook filter weighing in accordance with the New Zealand and Australia standard for high volume sampling. Hill Laboratories hold IANZ accreditation, for high volume PM<sub>10</sub> sampling.

Transportation of filters occurs at the end of each month, with filters stored and transported in snaplock bags at ambient temperature. Quality assurance methods include the analysis of one field blank per site per month. Field blanks outside of the “acceptable” range ( $\pm 8$  mg per filter) are noted in a report from Hills Laboratory.

Operation of the BAM is also carried out by MDC staff. Ten minute data is recorded by the instrument and logged by an iQuest iRIS 350 datalogger. The BAM filter spot is moved on every eight hours. Results are telemetered hourly to MDC and stored in the hilltop database. Annual calibrations are carried out by Lear Siegler.

### 3. Air quality monitoring in Blenheim

#### 3.1. PM<sub>10</sub> concentrations at the MRR site

Figure 3.1 shows daily average PM<sub>10</sub> concentrations measured at the MRR site during 2017. The maximum measured 24-hour average PM<sub>10</sub> concentration was 26 µg m<sup>-3</sup> and was measured on 16 June 2017. The corresponding concentration at Redwoodtown was 66 µg m<sup>-3</sup>.

Figure 3.2 shows a reasonable correlation between gravimetric PM<sub>10</sub> concentrations measured at MRR during 2017 with those in Redwoodtown with the latter measuring less than half of the concentrations at Redwoodtown. The correlation is similar to that observed for 2016.

Concentrations of PM<sub>10</sub> at MRR have exceeded 50 µg m<sup>-3</sup> on only a few years. In 2008 the maximum concentration recorded was 51 µg m<sup>-3</sup>. The only other years that concentrations above 50 µg m<sup>-3</sup> have been recorded at this site are 2000 (56 µg m<sup>-3</sup>), 2003 (75 µg m<sup>-3</sup>) and 2008 (51 µg m<sup>-3</sup>).

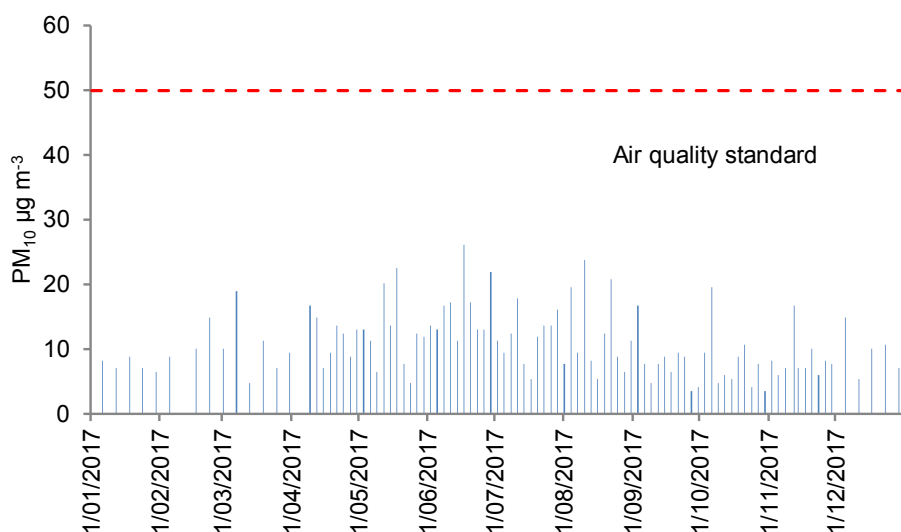
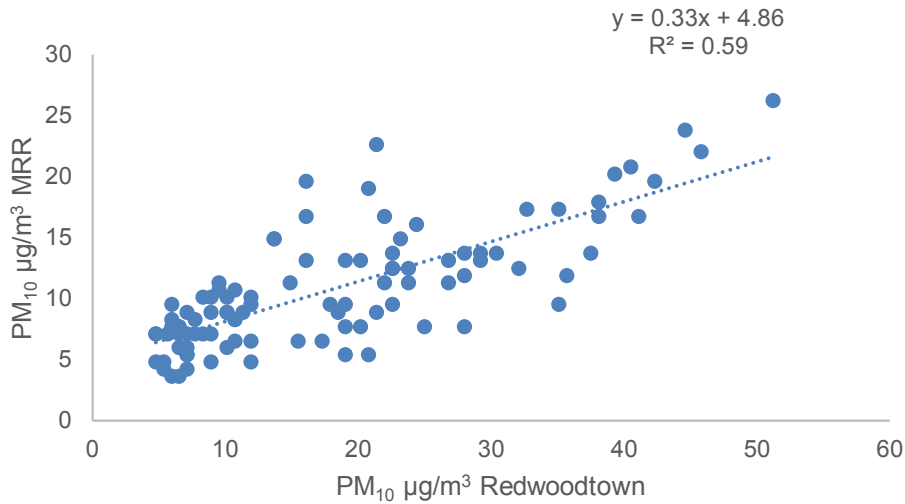


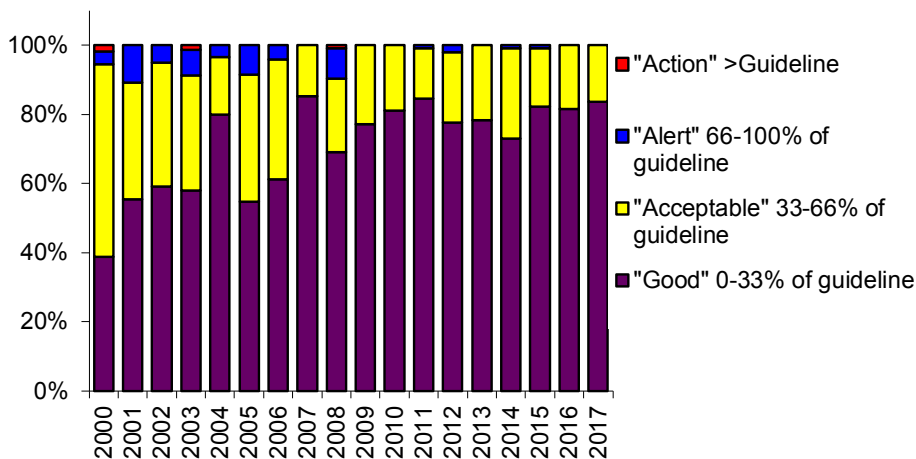
Figure 3.1: Daily winter PM<sub>10</sub> concentrations measured at the MRR site during 2017.



**Figure 3.2: Relations between daily winter PM<sub>10</sub> concentrations at the MRR site and at Redwoodtown during 2017.**

Figure 3.3 shows changes in PM<sub>10</sub> concentrations relative to MfE air quality indicator categories (shown in Table 1.3) at the MRR site from 2000 to 2017. Data indicate improving PM<sub>10</sub> concentrations at the MRR monitoring site between 2000 and 2011 with no further improvement evident after this time. Data for 2017 are similar to those for 2015 and 2016 with less than 20% of the concentrations above 16.5 µg/m<sup>3</sup> (33% of the NES).

Monthly variations in PM<sub>10</sub> concentrations compared to air quality indicators for 2016 are shown in Figure 3.4. Figure 3.5 shows the number of days when the NES was exceeded, the maximum concentration and the second highest concentration for 2017 and for previous years.



**Figure 3.3: Comparison of PM<sub>10</sub> concentrations measured at the MRR site from 2000 to 2017 to air quality indicator categories.**

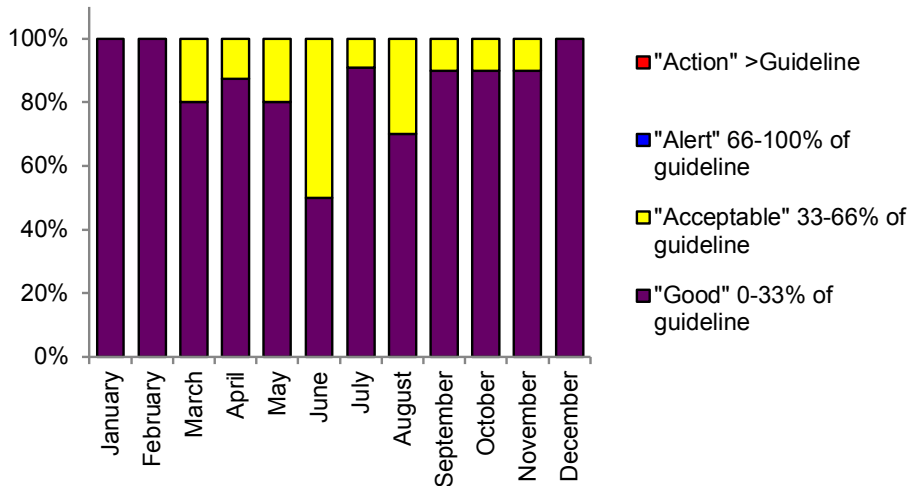


Figure 3.4: Comparison of daily PM<sub>10</sub> concentrations each month during 2017 to air quality indicator categories at the MRR site.

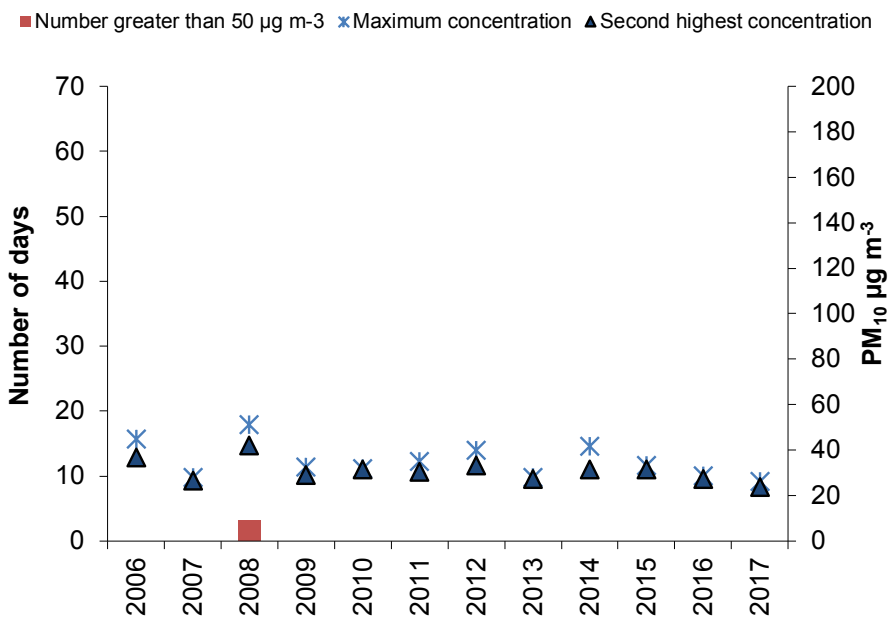


Figure 3.5: Number of days when the NES was exceeded, the maximum concentration and the second highest concentration from 2006 to 2017 at the MRR site.

The estimated annual average PM<sub>10</sub> concentration for the MRR site for 2017 is 10.7 µg m<sup>-3</sup> compared with around 13 µg/m<sup>3</sup> for 2013-2015. Figure 3.6 shows a downward trend in annual average PM<sub>10</sub> concentrations at MRR since 2000. However, trends between 2000 and 2008 dominate this with data suggesting negligible changes in annual average PM<sub>10</sub> since 2009. The Ministry for the Environment's annual average PM<sub>10</sub> guideline is 20 µg m<sup>-3</sup>. There is currently no NES for annual average PM<sub>10</sub> concentrations.

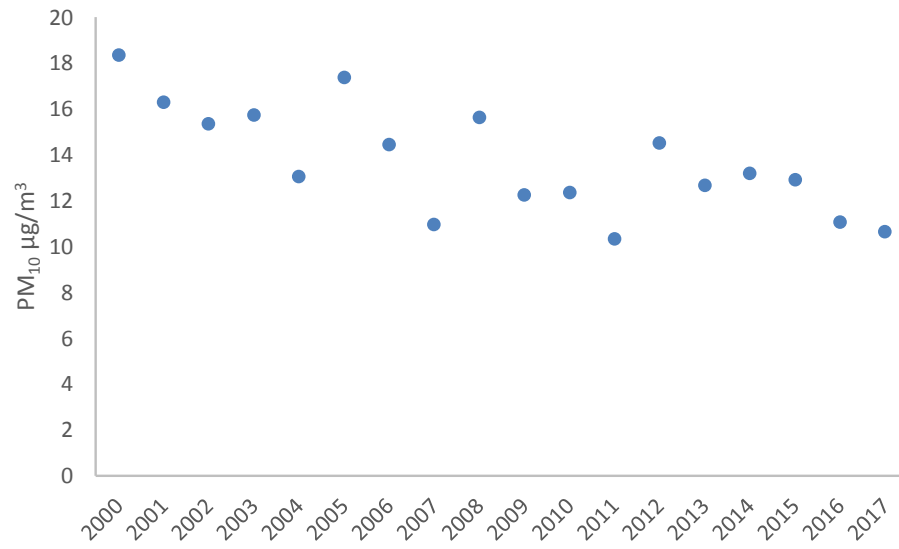


Figure 3.6: Annual average PM<sub>10</sub> concentration from 2000 to 2017 at the MRR site.

**Table 3.1: Summary of PM<sub>10</sub> concentrations measured at the MRR monitoring site from 2000 to 2017.**

|  | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
|--|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| "Good" 0-33% of guideline  | 39%  | 55%  | 59%  | 58%  | 80%  | 55%  | 61%  | 85%  | 69%  | 77%  | 81%  | 84%  | 78%  | 76%  | 73%  | 82%  | 82%  | 84%  |
| "Acceptable" 33-66% of guideline   | 56%  | 34%  | 36%  | 33%  | 17%  | 37%  | 35%  | 15%  | 21%  | 23%  | 19%  | 15%  | 20%  | 21%  | 26%  | 17%  | 18%  | 16%  |
| "Alert" 66-100% of guideline   | 4%   | 11%  | 5%   | 7%   | 3%   | 9%   | 4%   | 0%   | 8%   | 0%   | 0%   | 1%   | 2%   | 0%   | 1%   | 1%   | 0%   | 0%   |
| "Action" >Guideline  | 2%   | 0%   | 0%   | 1%   | 0%   | 0%   | 0%   | 0%   | 1%   | 0%   | 0%   | 0%   | 0%   | 1%   | 0%   | 0%   | 0%   | 0%   |
| Percentage of valid data   | 15%  | 20%  | 22%  | 22%  | 16%  | 25%  | 33%  | 32%  | 31%  | 32%  | 29%  | 32%  | 26%  | 32%  | 30%  | 28%  | 27%  | 27%  |
| Annual average ( $\mu\text{g m}^{-3}$ )                                    | 18   | 16   | 15   | 16   | 13   | 17   | 14   | 11   | 16   | 12   | 12   | 10   | 15   | 13   | 13   | 13   | 11   | 11   |
| Measured PM <sub>10</sub> concentrations above 50 $\mu\text{g m}^{-3}$     | 1    | -    | -    | 1    | -    | -    |      |      | 1    |      |      |      |      |      | 0    | 0    | 0    | 0    |
| Extrapolated PM <sub>10</sub> concentrations above 50 $\mu\text{g m}^{-3}$ |      |      |      |      |      |      |      |      | 3    |      |      |      |      |      | 0    | 0    | 0    | 0    |
| 99.7 %ile concentration ( $\mu\text{g m}^{-3}$ )                           | 53   | 46   | 40   | 67   | 46   | 47   | 42   | 27   | 48   | 31   | 32   | 34   | 38   | 28   | 38   | 33   | 28   | 26   |
| Annual maximum ( $\mu\text{g m}^{-3}$ )                                    | 56   | 48   | 41   | 75   | 49   | 49   | 45   | 28   | 51   | 32   | 32   | 35   | 40   | 28   | 42   | 33   | 29   | 26   |
| Number of records  | 54   | 74   | 81   | 81   | 60   | 93   | 121  | 116  | 113  | 118  | 106  | 116  | 97   | 115  | 111  | 101  | 98   | 98   |

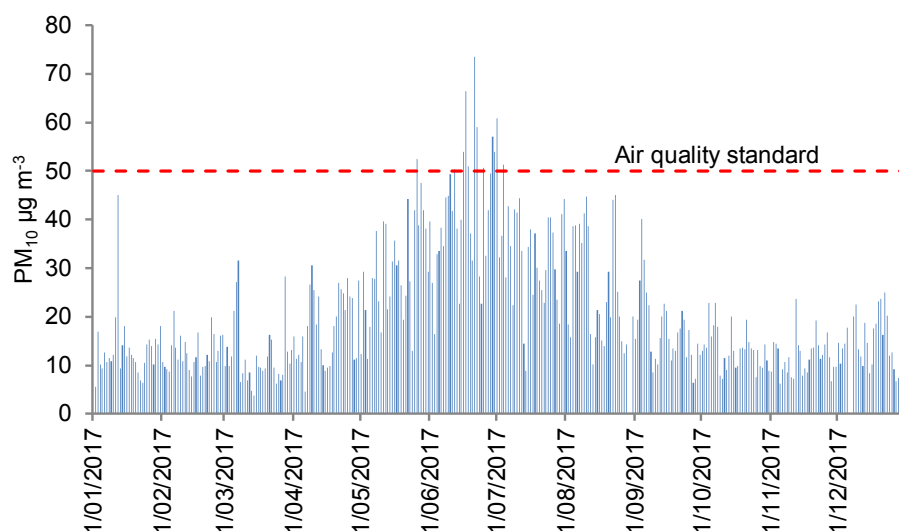


## 3.2. Particulate concentrations at Redwoodtown – Bowling Club

### 3.2.1. PM<sub>10</sub>

During 2017 there were 11 exceedences of 50  $\mu\text{g}/\text{m}^3$  at the Redwoodtown air quality monitoring site (Figure 3.7). The NES allows one exceedence of 50  $\mu\text{g}/\text{m}^3$  per year before a breach occurs. Thus the NES was breached on 10 occasions at Redwoodtown during 2017. This is the greatest number of breaches of the NES for Blenheim since the standard became effective in 2005. Prior to this, the maximum exceedences for a year was seven (2012).

Despite the greater number of exceedences the maximum PM<sub>10</sub> concentration for 2017 was not higher than all previous years at 74  $\mu\text{g}/\text{m}^3$  (20 June). The second highest PM<sub>10</sub> concentration was 66  $\mu\text{g}/\text{m}^3$  and was measured on 16 June. Previous recent maximum concentrations at Redwoodtown have ranged from 59 - 82  $\mu\text{g}/\text{m}^3$ .



**Figure 3.7: 24-hour average PM<sub>10</sub> concentrations measured at the Redwoodtown – Bowling Club site during 2017.**

Daily PM<sub>10</sub> concentrations measured from 2006 to 2017 relative to the MfE air quality indicator categories (shown in Table 1.3) are illustrated in Figure 3.8. Similarly, monthly variations in the distribution of PM<sub>10</sub> concentrations for 2017 are shown in Figure 3.9. The distribution of PM<sub>10</sub> concentrations by season are similar to other years with the winter months showing the greatest proportion of days in the “acceptable”, “alert” and “action” categories and fewer days in the “good” category. However, the distribution of the June data, with 73% of the days with PM<sub>10</sub> concentrations above 33  $\mu\text{g}/\text{m}^3$  is higher than typical.

Figure 3.10 compares the number of days when the NES was exceeded in 2017 to previous years along with the maximum concentration and the second highest concentration. It is important to note, that comparisons between years does not take into account year to year variations in the impact of meteorology. This issue is examined further in section 4 of this report.

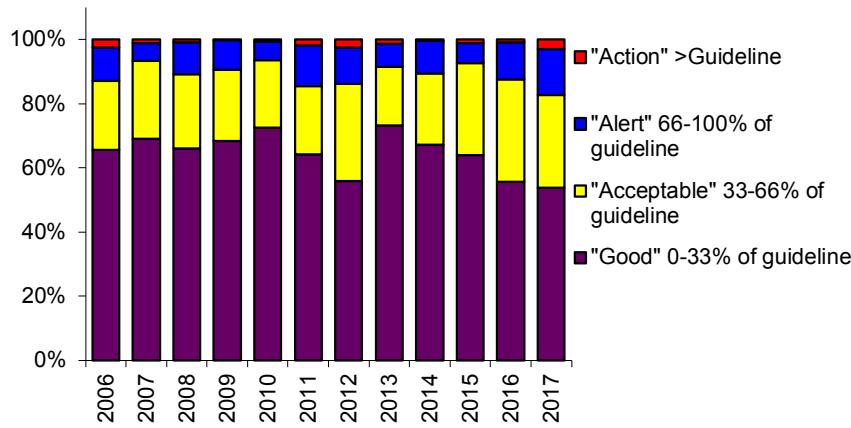


Figure 3.8: Comparison of PM<sub>10</sub> concentrations measured at Redwoodtown – Bowling Club site during 2006 to 2017 to air quality indicator categories.

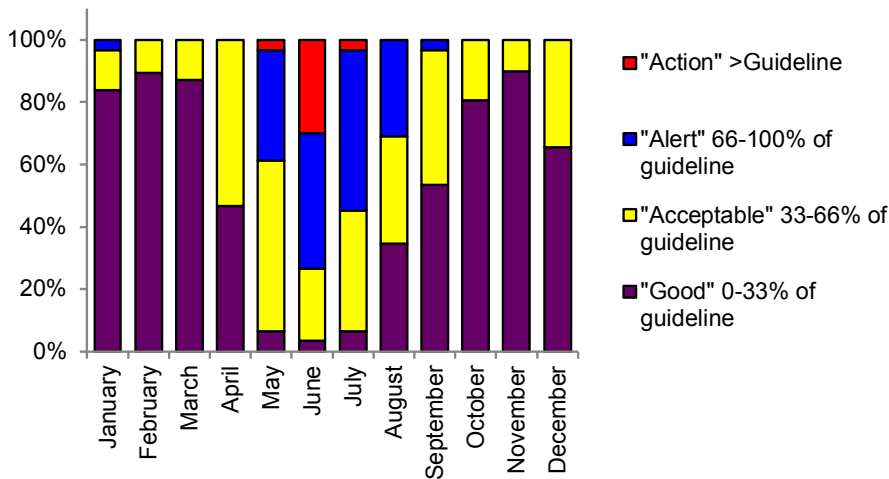


Figure 3.9: Comparison of daily PM<sub>10</sub> concentrations each month during 2017 to air quality indicator categories.

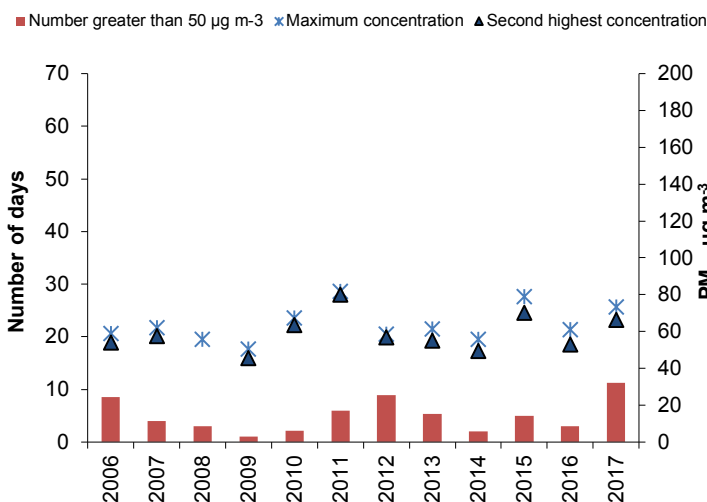


Figure 3.10: Number of days when 50 µg m<sup>-3</sup> was exceeded, the maximum concentration and the second highest concentration from 2006 to 2017.

The annual average PM<sub>10</sub> concentration for 2016 was 20 µg m<sup>-3</sup>. This is slightly above the normal range for this monitoring site (14-19 µg/m<sup>3</sup>). The Ministry for the Environment specifies an annual average guideline for PM<sub>10</sub> of 20 µg m<sup>-3</sup>. The NES does not currently include an annual average concentration for PM<sub>10</sub>.

Summary statistics for PM<sub>10</sub> monitoring results from the Redwoodtown Bowling Club site from 2002 to 2017 are provided in Table 3.2. Data from 2016 has been adjusted for gravimetric equivalency. From 2005 monitoring was conducted from January to December and in 2004 air quality monitoring took place at a site in Brooklyn Street.

**Table 3.2: Summary of PM<sub>10</sub> concentrations measured at Redwoodtown – Bowling Club site from 2002-2016.**

|  | 2002   | 2003   | 2004   | 2005   | 2006* | 2007* | 2008* | 2009* | 2010* | 2011* | 2012*      | 2013* | 2014*      | 2015*      | 2016** | 2017** |
|--|--------|--------|--------|--------|-------|-------|-------|-------|-------|-------|------------|-------|------------|------------|--------|--------|
| Monitoring method  | Hi-vol | Hi-vol | Hi-vol | Hi-vol | BAM   | BAM   | BAM   | BAM   | BAM   | BAM   | BAM/Hi-vol | BAM   | BAM/Hi-vol | BAM/Hi-vol | BAM    | BAM    |
| "Good" 0-33% of guideline  | 18%    | 22%    | 46%    | 63%    | 66%   | 69%   | 66%   | 68%   | 72%   | 64%   | 56%        | 72%   | 67%        | 64%        | 56%    | 54%    |
| "Acceptable" 33-66% of guideline   | 62%    | 30%    | 22%    | 17%    | 21%   | 24%   | 23%   | 22%   | 21%   | 21%   | 31%        | 18%   | 22%        | 29%        | 32%    | 29%    |
| "Alert" 66-100% of guideline   | 10%    | 26%    | 20%    | 17%    | 10%   | 6%    | 10%   | 9%    | 6%    | 13%   | 11%        | 7%    | 10%        | 6%         | 12%    | 14%    |
| "Action" >Guideline  | 10%    | 22%    | 12%    | 3%     | 3%    | 1%    | 1%    | 0%    | 1%    | 2%    | 2%         | 1%    | 0%         | 1%         | 1%     | 3%     |
| Percentage of valid data   | 14%    | 7%     | 22%    | 32%    | 68%   | 99%   | 99%   | 98%   | 96%   | 87%   | 91%        | 98%   | 70%        | 91%        | 95%    | 99%    |
| Annual average ( $\mu\text{g m}^{-3}$ )                                    | -      | -      | 22     | 18     | 17    | 15    | 17    | 15    | 14    | 16    | 19         | 14    | 16         | 17         | 18     | 20     |
| Measured PM <sub>10</sub> concentrations above 50 $\mu\text{g m}^{-3}$     | 5      | 6      | 10     | 3      | 6     | 5     | 3     | 1     | 2     | 6     | 8          | 5     | 1          | 4          | 3      | 11     |
| Extrapolated PM <sub>10</sub> concentrations above 50 $\mu\text{g m}^{-3}$ | 16     | 34     | 31     | 9      | 10    | 4     | 3     | 1     | 2     | 6     | 9          | 5     | 2          | 5          | 3      | 11     |
| Second highest PM <sub>10</sub> concentration ( $\mu\text{g m}^{-3}$ )     |        |        |        |        | 54    | 58    | 56    | 46    | 64    | 80    | 57         | 55    | 51         | 70         | 53     | 66     |
| Annual maximum ( $\mu\text{g m}^{-3}$ )                                    | 58     | 60     | 81     | 58     | 59    | 62    | 56    | 46    | 67    | 82    | 59         | 61    | 56         | 79         | 61     | 74     |
| Number of records  | 50     | 27     | 82     | 115    | 247   | 360   | 363   | 357   | 352   | 319   | 331        | 351   | 254        | 331        | 346    | 361    |

\*not adjusted for gravimetric equivalency

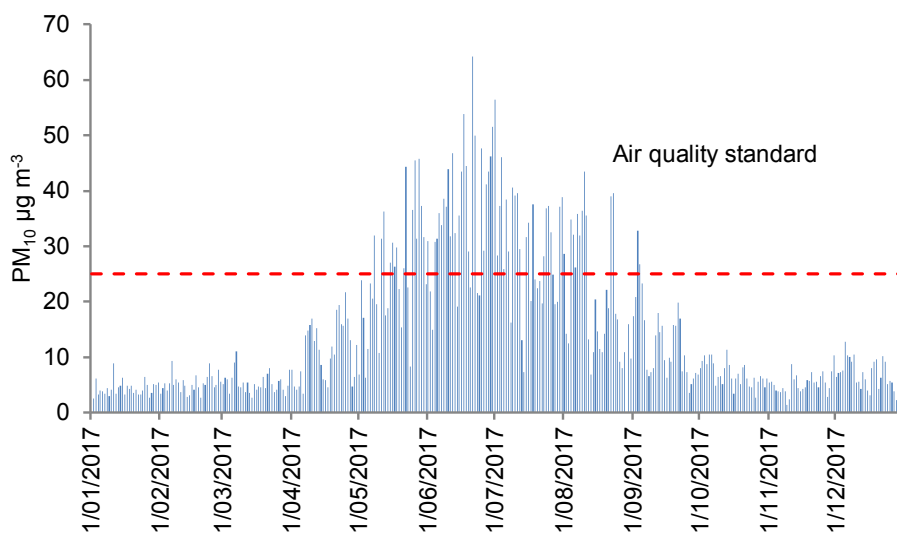
\*\*adjusted for gravimetric equivalency

### 3.2.2. PM<sub>2.5</sub>

While there is currently no NES for PM<sub>2.5</sub> it is generally accepted as the main air quality indicator for particulate in terms of health impacts. Most significant in terms of impacts on health is the annual average. The current WHO annual average PM<sub>2.5</sub> guideline is 10 µg/m<sup>3</sup>. However, a 2013 review of WHO guidelines noted that recent long-term studies show associations between PM<sub>2.5</sub> and mortality levels at concentrations well below the current annual WHO air quality guideline level for PM<sub>2.5</sub> (10 µg/m<sup>3</sup>) and recommended a review of that value. During 2017 an annual average PM<sub>2.5</sub> concentration of 14 µg/m<sup>3</sup> was measured at Redwoodtown.

Shorter term exposures are also of concern from a health viewpoint. During 2017 there were 72 exceedences of the 24-hour average reporting guideline for PM<sub>2.5</sub> of 25µg/m<sup>3</sup> at the Redwoodtown air quality monitoring site (Figure 3.11).

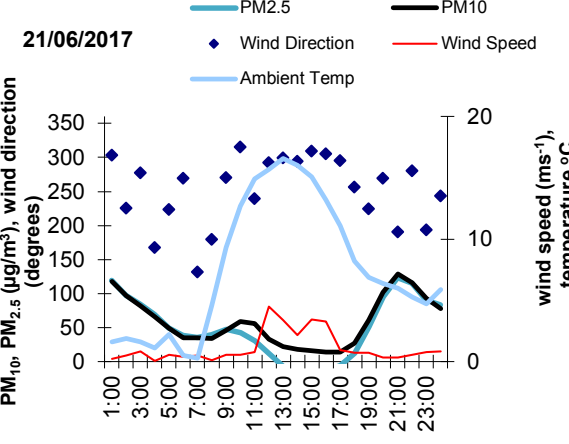
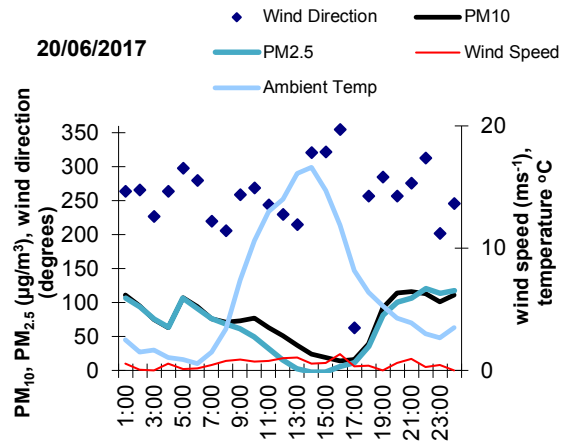
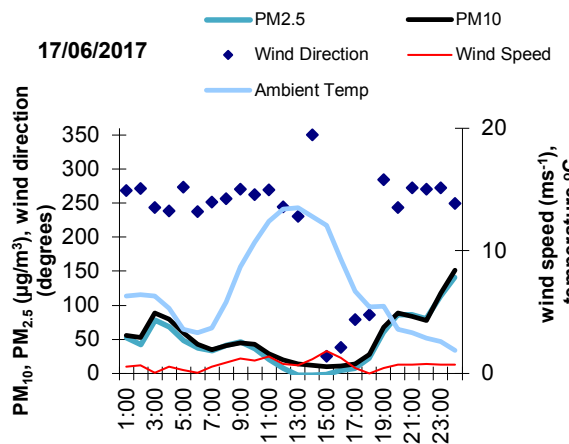
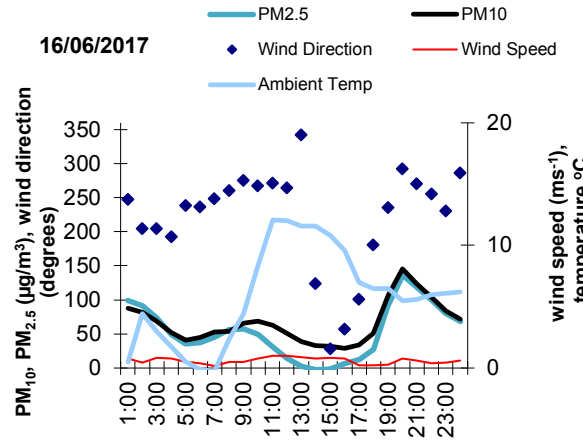
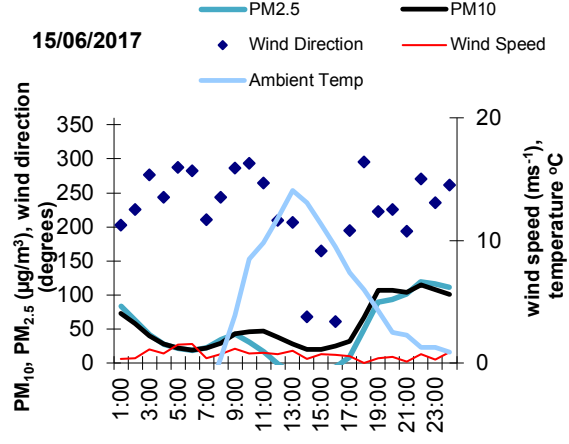
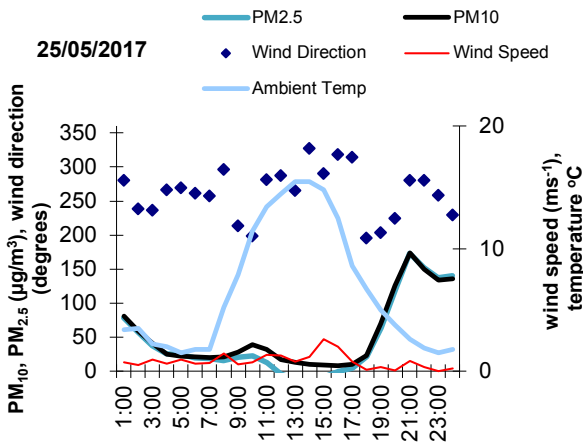
Air quality monitoring of PM<sub>2.5</sub> during 2017 suggests PM<sub>2.5</sub> concentrations may be a bigger concern for the town than the previous indicator, PM<sub>10</sub>.



**Figure 3.11: 24-hour average PM<sub>2.5</sub> concentrations measured at the Redwoodtown – Bowling Club site during 2017.**

### 3.3. Particulate concentrations and meteorology in Blenheim

Daily variations in PM<sub>10</sub> and PM<sub>2.5</sub> concentrations and meteorological conditions on days during 2017 when the 24-hour average PM<sub>10</sub> concentrations exceeded 50 µg m<sup>-3</sup> at the Redwoodtown air quality monitoring site are shown in Figure 3.12. Data are consistent with historical high pollution days with peak PM<sub>10</sub> concentrations occurring during the evening and a typically smaller peak occurring mid morning. The concentrations of PM<sub>10</sub> and PM<sub>2.5</sub> are very similar during the evening, overnight and morning periods but differ during the daytime when PM<sub>10</sub> concentrations are typically much higher than PM<sub>2.5</sub>. The key meteorological conditions associated with the elevated concentrations are low wind speeds and south-westerly wind direction.



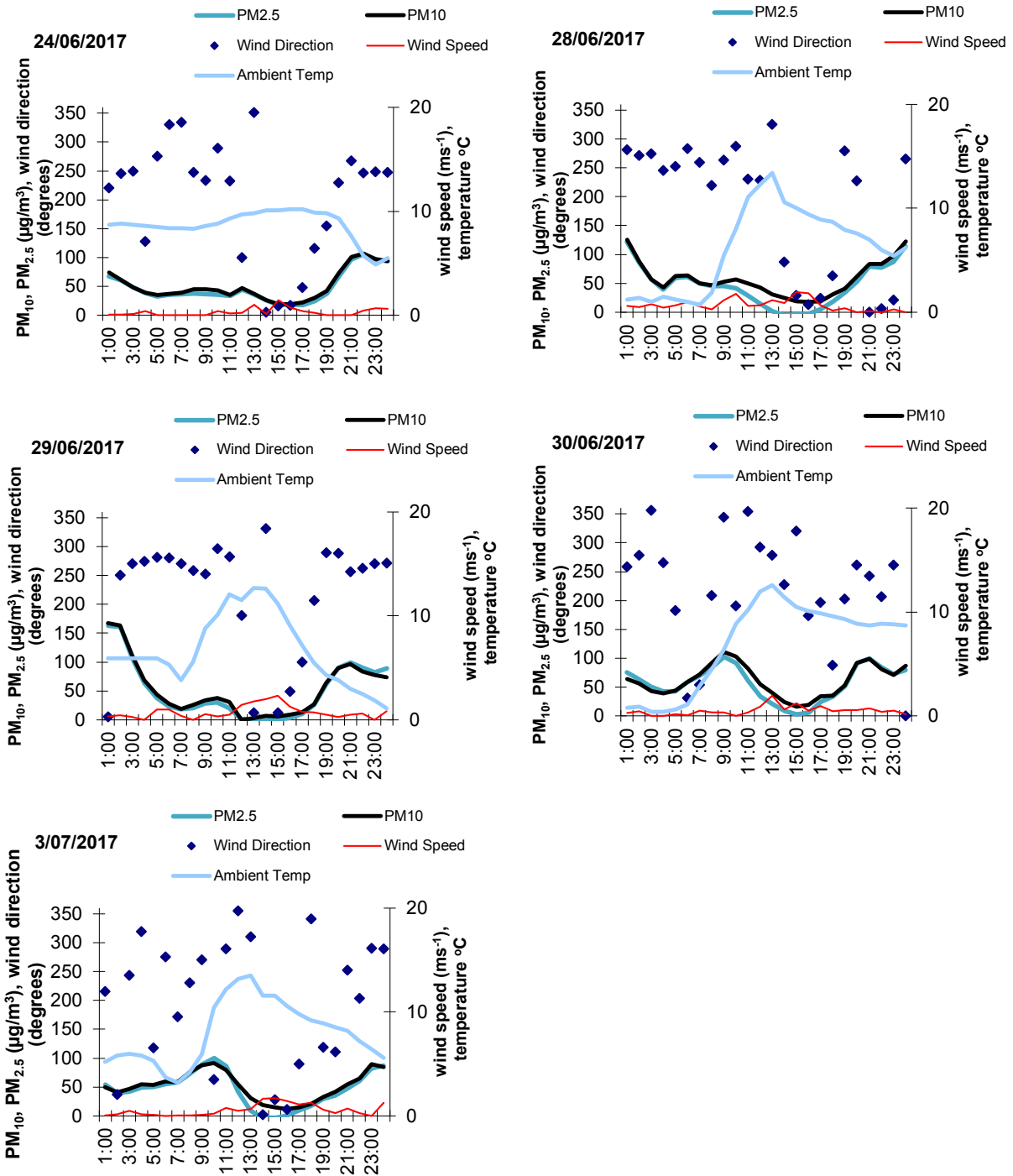


Figure 3.12: Hourly average PM<sub>10</sub>, PM<sub>2.5</sub>, wind direction and temperature on days when PM<sub>10</sub> concentrations exceeded 50 µg m<sup>-3</sup> (24 hour average) at Redwoodtown.

## 4. Trends in PM<sub>10</sub> concentrations in Blenheim

To quantify the impact of meteorological conditions and therefore further assess the likelihood of changes in PM<sub>10</sub> concentrations since 2005, a trends assessment was updated in 2012 (Wilton, 2012). The objective of that work was to identify meteorological conditions giving rise to concentrations of PM<sub>10</sub> in excess of the NES and to provide a tool for comparing year to year PM<sub>10</sub> concentrations whilst minimising the impact of variability in meteorological conditions. The trends assessment provided a tool for updating the trends analysis with time. Figure 4.1 shows trends in PM<sub>10</sub> concentrations updated with the 2017 PM<sub>10</sub> data adjusted for the impact of meteorological conditions.

Results for 2017 indicate an increase in average concentrations, the 75<sup>th</sup> percentile concentrations being similar to the worst-case years (2006,2012,2013) and 90<sup>th</sup> percentile concentrations similar to the post 2009 data. The data is not indicative of an overall improvement or degradation in PM<sub>10</sub> concentrations in Blenheim. No trend is evident.

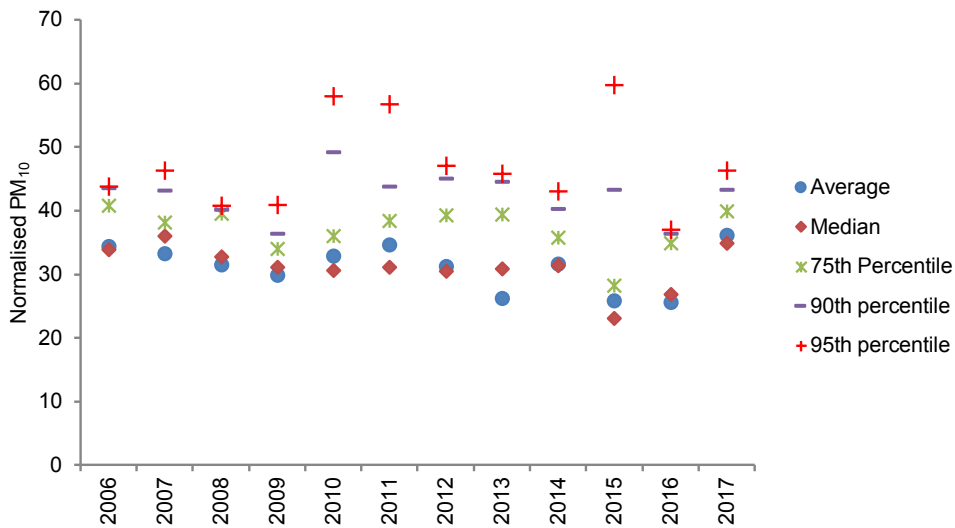


Figure 4.1: Trends in PM<sub>10</sub> concentrations after adjusting for meteorological conditions.



## 5. Summary

In 2017 there was a record number of breaches of the NES for PM<sub>10</sub> at Redwoodtown with 11 recorded exceedences of 50 µg/m<sup>3</sup> and 10 breaches of the NES for PM<sub>10</sub>. The highest concentration was measured on 20 June and reached 74 µg/m<sup>3</sup> (24-hour average). This is higher than for most years but slightly lower than the 2015 maximum concentration of 79 µg/m<sup>3</sup>. The annual average concentrations for Redwoodtown for 2017 was 19 µg/m<sup>3</sup> and is the higher annual average concentration measured at the site since continuous monitoring commenced in 2005.

Concentrations of PM<sub>10</sub> were also measured at the historical Middle Renwick Road monitoring site. There have been no exceedences of 50 µg/m<sup>3</sup> for PM<sub>10</sub> at this site since 2008. The maximum daily PM<sub>10</sub> concentration for 2017 was 26 µg/m<sup>3</sup>. An evaluation of annual average concentrations measured at this site since 2000 has previously indicated a downward trend in concentrations. The trend appears to have tapered since 2009. Concentrations at this site are less than half those measured at Redwoodtown on average.

The NES for PM<sub>10</sub> was reviewed by the Ministry for the Environment in 2011. A new date of September 2016 was given for compliance with 50 µg m<sup>-3</sup> (24-hour average, one allowable exceedence) for areas with fewer than 10 breaches. Blenheim was required to meet this target date which effectively meant Blenheim was unable to breach the NES for PM<sub>10</sub> from winter 2017.

Management measures to reduce PM<sub>10</sub> concentrations to meet the NES have been included in the in the Proposed Marlborough Environment Plan (notified June 2016). Measures are based on a 2012 assessment which predicted concentrations would reduce from 2012 – 2017 in the absence of regulation. Potential reasons for the reductions not occurring include higher than anticipated emissions from newer burners and underestimated population increase in the airshed area from 2006-2013. Given the absence of a downward trend from 2012-2017 it would seem unlikely that the management options specified in the notified air plan would be effective in reducing PM<sub>10</sub> concentrations to meet the NES.

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