MARLBOROUGH DISTRICT COUNCIL

# Annual Air Quality Monitoring Report – Blenheim 2018

Technical Report No: 19-002
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# Executive Summary

The main air pollutant of concern in urban areas of New Zealand is particulate. The main measures of particulate are $PM_{10}$ (particles less than 10 microns in diameter) and $PM_{2.5}$ (particles less than 2.5 microns in diameter). Both size fractions were measured at the Redwoodtown monitoring site during 2018. $PM_{10}$ monitoring has also been carried out at the historical monitoring site in Middle Renwick Road (MRR). The main source of particulate in Blenheim during the winter is solid fuel burning for domestic home heating.

Monitoring data for $PM_{10}$ were compared to the National Environmental Standard for Air Quality (NES) of 50 µg $m^{-3}$ (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 $PM_{10}$ breached the NES on seven occasions in Redwoodtown with six exceedences of 50 µg $m^{-3}$ (the NES allows for one exceedance per year). Blenheim was required to comply with the NES for $PM_{10}$ by winter 2017. The maximum measured concentration during 2018 was 61 µg $m^{-3}$. The annual average $PM_{10}$ concentrations was 19 µg/$m^3$.

Concentrations of $PM_{2.5}$ exceeded 25 µg/$m^3$ (24-hour average reporting guideline and WHO guideline) on 61 occasions. The annual average $PM_{2.5}$ concentration was 10 µg/$m^3$. This compares with the current WHO guideline for $PM_{2.5}$ of 10 µg/$m^3$.

The maximum $PM_{10}$ concentration measured at the MRR site was 26 µg $m^{-3}$ for 2018. The annual average concentration for this site was estimated to be 10 µg/$m^3$ for 2018 and compares with 11 in 2016- 2017 and 13 µg/$m^3$ for 2013-2015. An evaluation of trends at the MRR site suggests a decrease in annual average $PM_{10}$ concentrations at this site between 2000 and 2008 but no further reductions are evident since 2009.

Management measures to reduce $PM_{10}$ 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 $PM_{10}$ 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 $PM_{10}$, 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 $PM_{10}$ is set at 50 µg $m^{-3}$ 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 $PM_{2.5}$ size fraction and annual average concentrations. A likely implication is the need for $PM_{2.5}$ monitoring either in addition to or instead of $PM_{10}$ monitoring. The implications for the current $PM_{10}$ requirements are unclear at this stage.

This report summarises concentrations of $PM_{10}$ that were measured at two sites in Blenheim during 2018. The main site for reporting $PM_{10}$ 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 $PM_{10}$ at the MRR monitoring site, intermittent monitoring of $PM_{10}$ at the Redwoodtown Bowling Club site, survey $PM_{10}$ monitoring in Renwick during 2000 and 2002, monitoring for $PM_{10}$ in Picton during 2008 and 2009, visibility surveys and passive sampling for nitrogen oxides and sulphur oxides. From 2007 to early 2008, $PM_{10}$ 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 $PM_{10}$ 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 $PM_{10}$ 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 ($PM_{10}$ ) | 50 µg m-3 | 24-hour | 1 |
| Nitrogen dioxide | 200 µg m-3 | 1-hour | 9 |
| Sulphur dioxide | 350 µg m-3 | 1-hour | 9 |
| Sulphur dioxide | 570 µg m-3 | 1-hour | 0 |
| Ozone | 150 µg m-3 | 1-hour | 0 |

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

| Contaminant | 2002 guideline values | |
|---|---|---|
| | Concentration | Averaging Period |
| Carbon monoxide | 30 mg m-3<br>10 mg m-3 | 1-hour<br>8-hour |
| Particles ($PM_{10}$ ) | 50 µg m-3<br>20 µg m-3 | 24-hour<br>Annual |
| Nitrogen dioxide | 200 µg m-3<br>100 µg m-3 | 1-hour<br>24-hour |
| Sulphur dioxide [b] | 350 µg m-3<br>120 µg m-3 | 1-hour<br>24-hour |
| Ozone | 150 µg m-3<br>100 µg m-3 | 1-hour<br>8-hour |
| Hydrogen sulphide [c] | 7 µg m-3 | 1-hour |
| Lead d | 0.2 µg m-3<br>(lead content of PM10 ) | 3-month moving,<br>calculated monthly |
| Benzene (year 2002)<br>Benzene (year 2010) | 10 µg m-3<br>3.6 µg m-3 | Annual<br>Annual |
| 1,3-Butadiene | 2.4 µg m-3 | Annual |
| Formaldehyde | 100 µg m-3 | 30-minutes |
| Acetaldehyde | 30 µg m-3 | Annual |
| Benzo(a)pyrene | 0.0003 µg m-3 | Annual |
| Mercury (inorganic) [d]<br>Mercury (organic) | 0.33 µg m-3<br>0.13 µg m-3 | Annual<br>Annual |
| Chromium VI [d]<br>Chromium metal and chromium III | 0.0011 µg m-3<br>0.11 µg m-3 | Annual<br>Annual |
| Arsenic (inorganic) [d]<br>Arsine | 0.0055 µg m-3<br>0.055 µg m-3 | Annual<br>Annual |

Notes for Table 1.2:

[a] All values apply to the gas measured at standard conditions of temperature (0° C) and pressure (1 atmosphere).
[b] The sulphur dioxide guideline values do not apply to sulphur acid mist.
[c] The hydrogen sulphide value is based on odour nuisance and may be unsuitable for use in geothermal areas.
[d] The guideline values for metals are for inhalation exposure only; they do not include exposure from other routes such as ingestion. These other routes should be considered in assessments where appropriate.

**Table 1.3: Environmental Performance Indicator categories for air quality (MfE, 2002)**

| Category | Value relative to guideline | Comment |
|---|---|---|
| Excellent | Less than 10% of the guideline | Of little concern: if maximum values are less than a tenth of the guideline, average values are likely to be much less |
| Good | Between 10% and 33% of the guideline | Peak measurements in this range are unlikely to affect air quality |
| Acceptable | Between 33% and 66% of the guideline | A broad category, where maximum values might be of concern in some sensitive locations but generally they are at a level which does not warrant urgent action |
| Alert | Between 66% and 100% of the guideline | This is a warning level, which can lead to 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 $PM_{10}$ and other contaminant emissions (Wilton, 2017). The results of the inventory indicated that domestic home heating was the main source of $PM_{10}$ emissions, contributing to around 90% of the daily wintertime $PM_{10}$. Motor vehicles contributed to 1% of $PM_{10}$ 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 2018 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 $PM_{10}$ and $PM_{2.5}$ as well as a high-volume sampler measuring $PM_{10}$. The purpose of the high-volume sampler was to determine the relationship of the samplers to the high-volume reference method.

At the MMR 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 MMR 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 Environments 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 $PM_{10}$ 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 $PM_{10}$ and $PM_{10}$ concentrations measured at the Bowling Club. This was considered important because $PM_{10}$ concentrations of the magnitude measured during 2004 at Brooklyn Street had not been measured at the Bowling Club and because the reductions required in $PM_{10}$ 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 $PM_{10}$ 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: $PM_{10}$ 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 $PM_{10}$ 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 | $PM_{10}$ |
| 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: $PM_{10}$ 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 $PM_{10}$ 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 | $PM_{10}$ |
| 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 $PM_{10}$ 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 $PM_{10}$ 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 (± 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. $PM_{10}$ concentrations at the MRR site

Figure 3.1 shows daily average $PM_{10}$ concentrations measured at the MRR site during 2018. The maximum measured 24-hour average $PM_{10}$ concentration was 26 µg $m^{-3}$ and was measured on 2 July 2018. The corresponding concentration at Redwoodtown was 53 µg $m^{-3}$.

Figure 3.2 shows a reasonable correlation between gravimetric $PM_{10}$ concentrations measured at MRR during 2018 with those in Redwoodtown with the latter measuring less than half of the concentrations at Redwoodtown. The correlation is similar to that observed for other years.

Concentrations of $PM_{10}$ at MRR have exceeded 50 µg $m^{-3}$ on only a few years. In 2008 the maximum concentration recorded was 51 µg $m^{-3}$. The only other years that concentrations above 50 µg $m^{-3}$ have been recorded at this site are 2000 (56 µg $m^{-3}$), 2003 (75 µg $m^{-3}$) and 2008 (51µg $m^{-3}$).

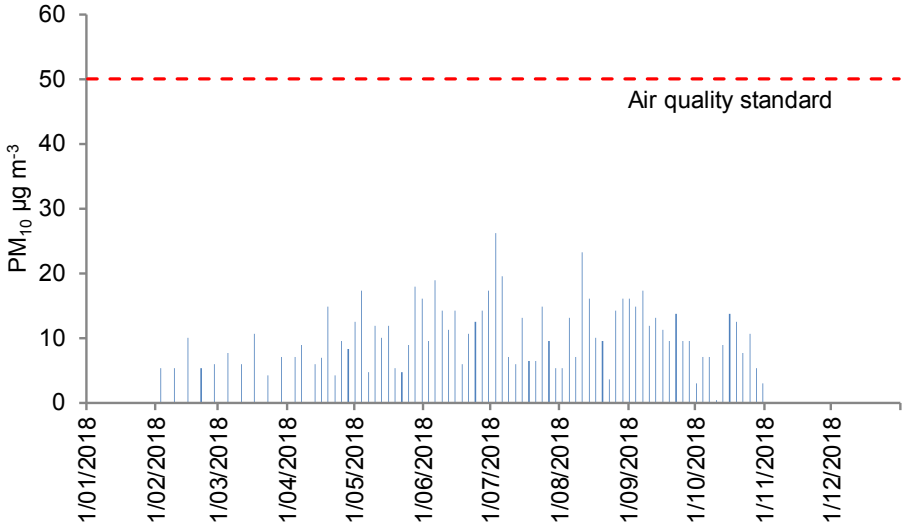


**Figure 3.1: Daily winter $PM_{10}$ concentrations measured at the MRR site during 2018.**

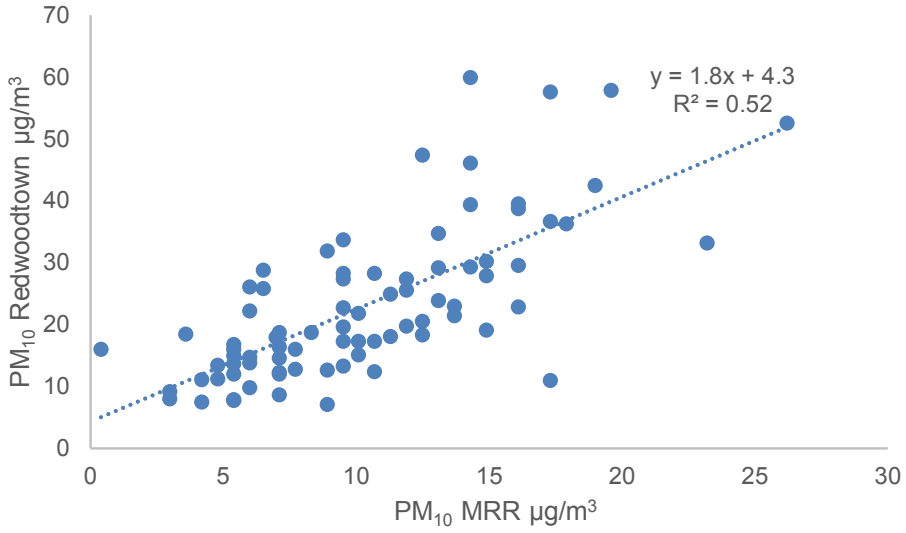


**Figure 3.2: Relations between daily winter $PM_{10}$ concentrations at the MRR site and at Redwoodtown during 2018.**

Figure 3.3 shows changes in $PM_{10}$ concentrations relative to MfE air quality indicator categories (shown in Table 1.3) at the MRR site from 2000 to 2018. Data indicate improving $PM_{10}$ concentrations at the MRR monitoring site between 2000 and 2011 with no further improvement evident after this time. Data for 2018 are similar to those for 2015-2017 with less than 20% of the concentrations above 16.5 µg/m$^3$ (33% of the NES).

Monthly variations in $PM_{10}$ concentrations compared to air quality indicators for 2018 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 2018 and for previous years.

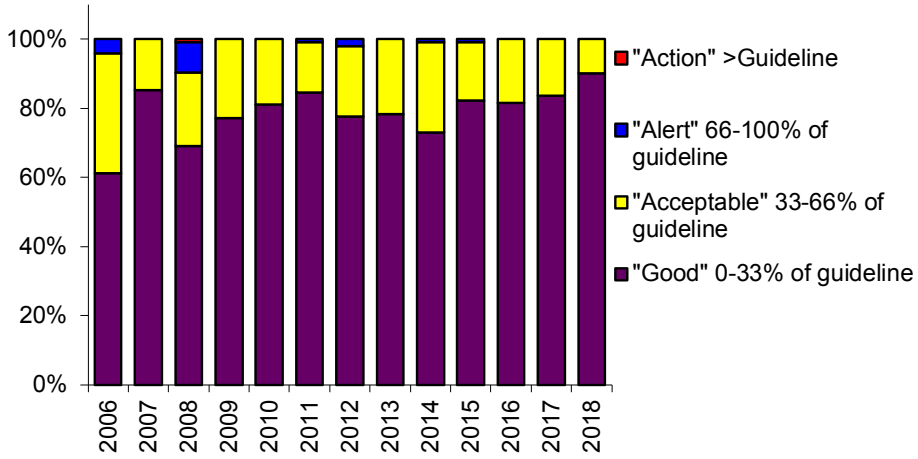


**Figure 3.3: Comparison of $PM_{10}$ concentrations measured at the MRR site from 2000 to 2018 to air quality indicator categories.**

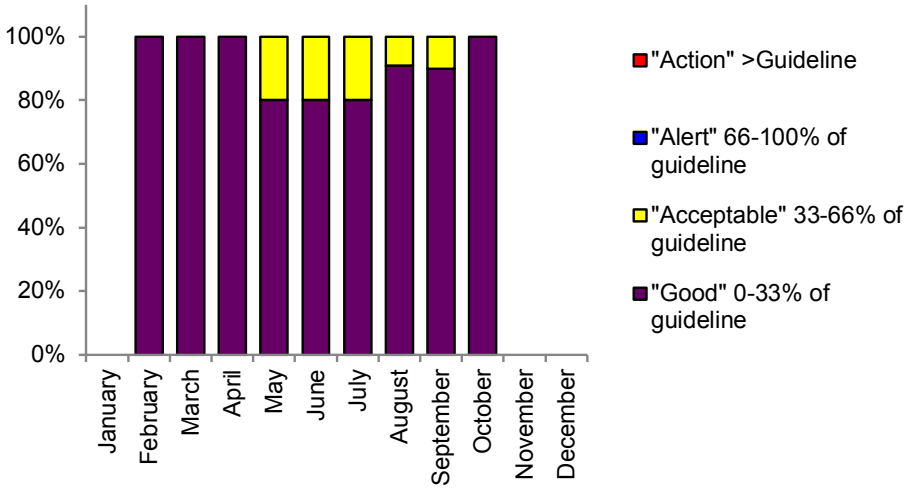


**Figure 3.4: Comparison of daily $PM_{10}$ concentrations each month during 2018 to air quality indicator categories at the MRR site.**

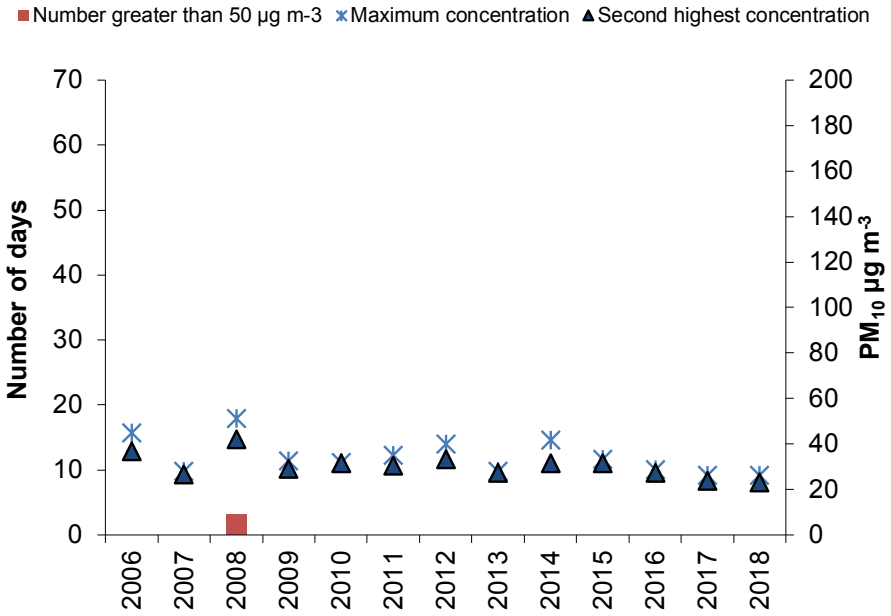


**Figure 3.5: Number of days when the NES was exceeded, the maximum concentration and the second highest concentration from 2006 to 2017 at the MRR site.**

The estimated annual average $PM_{10}$ concentration for the MRR site for 2018 is 9.7 µg $m^{-3}$, compared with around 13 µg/$m^3$ for 2013-2015. Figure 3.6 shows a downward trend in annual average $PM_{10}$ concentrations at MRR since 2000. Trends between 2000 and 2008 dominate this with data suggesting negligible changes in annual average $PM_{10}$ since 2009. The Ministry for the Environments annual average $PM_{10}$ guideline is 20 µg $m^{-3}$. There is currently no NES for annual average $PM_{10}$ concentrations.

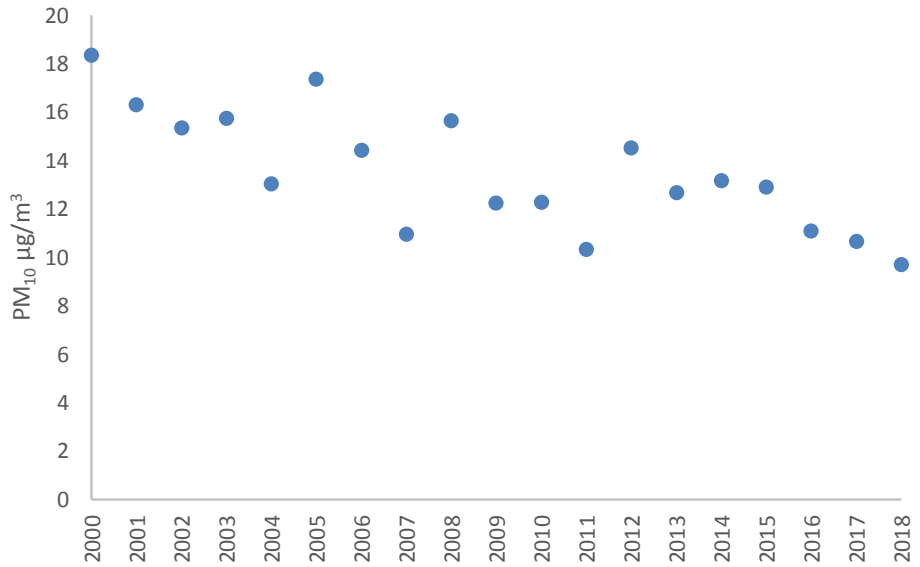


**Figure 3.6: Annual average $PM_{10}$ concentration from 2000 to 2018 at the MRR site.**

**Table 3.1: Summary of $PM_{10}$ 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 | 2018 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| "Good" 0-33% of guideline | 39% | 55% | 59% | 58% | 80% | 55% | 61% | 85% | 69% | 77% | 81% | 84% | 78% | 76% | 73% | 82% | 82% | 84% | 90% |
| "Acceptable" 33-66% of guideline | 56% | 34% | 36% | 33% | 17% | 37% | 35% | 15% | 21% | 23% | 19% | 15% | 20% | 21% | 26% | 17% | 18% | 16% | 10% |
| "Alert" 66-100% of guideline | 4% | 11% | 5% | 7% | 3% | 9% | 4% | 0% | 8% | 0% | 0% | 1% | 2% | 0% | 1% | 1% | 0% | 0% | 0% |
| "Action" >Guideline | 2% | 0% | 0% | 1% | 0% | 0% | 0% | 0% | 1% | 0% | 0% | 0% | 0% | 1% | 0% | 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% | 22% |
| Annual average ($\mu g\ m^{-3}$) | 18 | 16 | 15 | 16 | 13 | 17 | 14 | 11 | 16 | 12 | 12 | 10 | 15 | 13 | 13 | 13 | 11 | 11 | 9.7 |
| Measured $PM_{10}$ concentrations above 50 $\mu g\ m^{-3}$ | 1 | - | - | 1 | - | - | | | 1 | | | | | | 0 | 0 | 0 | 0 | 0 |
| Extrapolated $PM_{10}$ concentrations above 50 $\mu g\ m^{-3}$ | | | | | | | | | 3 | | | | | | 0 | 0 | 0 | 0 | 0 |
| 99.7 %ile concentration ($\mu g\ m^{-3}$) | 53 | 46 | 40 | 67 | 46 | 47 | 42 | 27 | 48 | 31 | 32 | 34 | 38 | 28 | 38 | 33 | 28 | 26 | 25 |
| Annual maximum ($\mu g\ m^{-3}$) | 56 | 48 | 41 | 75 | 49 | 49 | 45 | 28 | 51 | 32 | 32 | 35 | 40 | 28 | 42 | 33 | 29 | 26 | 26 |
| Number of records | 54 | 74 | 81 | 81 | 60 | 93 | 121 | 116 | 113 | 118 | 106 | 116 | 97 | 115 | 111 | 101 | 98 | 98 | 80 |

## 3.2. Particulate concentrations at Redwoodtown – Bowling Club

### 3.2.1. $PM_{10}$

During 2018 there were seven exceedences of 50 µg/$m^3$ at the Redwoodtown air quality monitoring site (Figure 3.7). The NES allows one exceedence of 50 µg $m^{-3}$ per year before a breach occurs. Thus, the NES was breached on six occasions at Redwoodtown during 2018. This represents the third greatest number of breaches of the NES for Blenheim since the standard was effective.

The maximum $PM_{10}$ concentration for 2018 was 61 µg/$m^3$ (7 June) and was followed by the next highest reading of 60 µg/$m^3$ on the 8 June. Previous recent maximum concentrations at Redwoodtown have ranged from 59 - 82 µg $m^{-3}$.

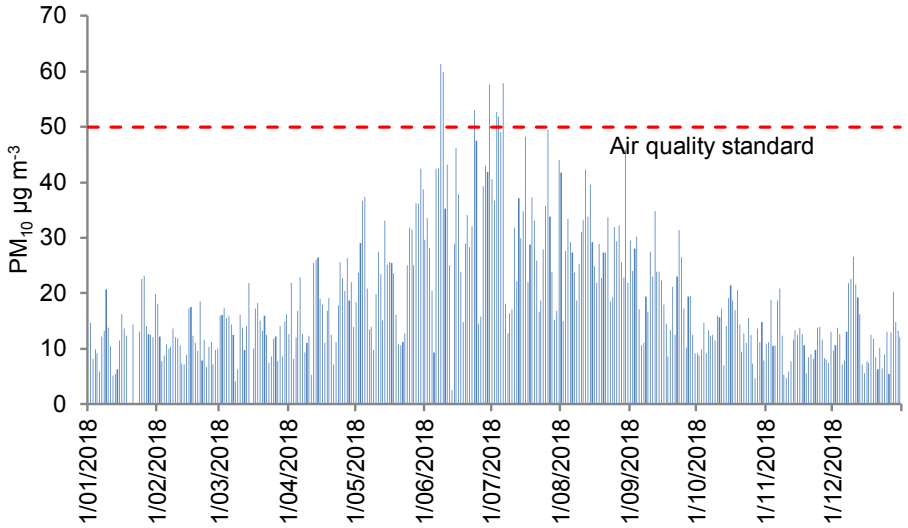


**Figure 3.7: 24-hour average $PM_{10}$ concentrations measured at the Redwoodtown - Bowling Club site during 2018.**

Daily $PM_{10}$ concentrations measured from 2006 to 2018 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 $PM_{10}$ concentrations for 2018 are shown in Figure 3.9. The distribution of $PM_{10}$ 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.

Figure 3.10 compares the number of days when the NES was exceeded in 2018 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.

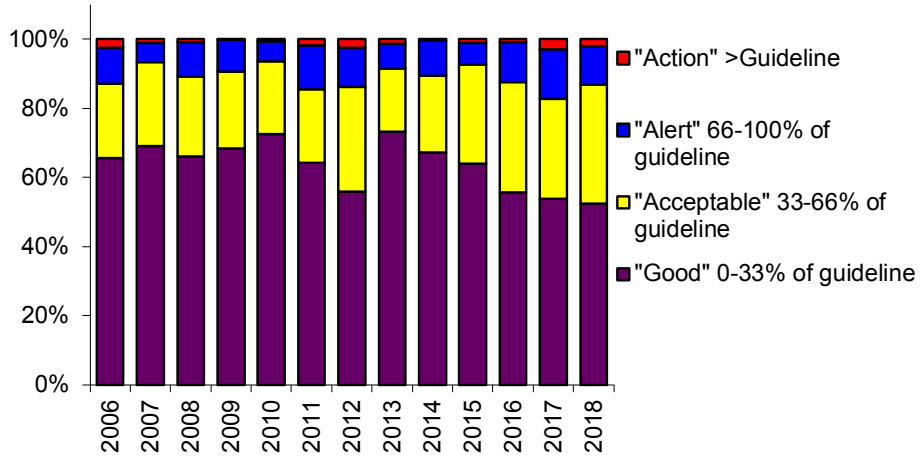


**Figure 3.8: Comparison of $PM_{10}$ concentrations measured at Redwoodtown - Bowling Club site during 2006 to 2018 to air quality indicator categories.**

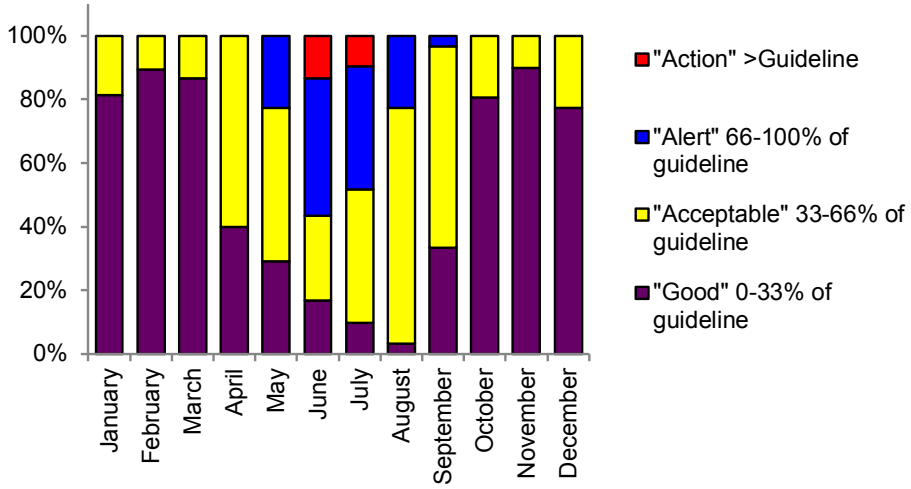


**Figure 3.9: Comparison of daily $PM_{10}$ concentrations each month during 2018 to air quality indicator categories.**

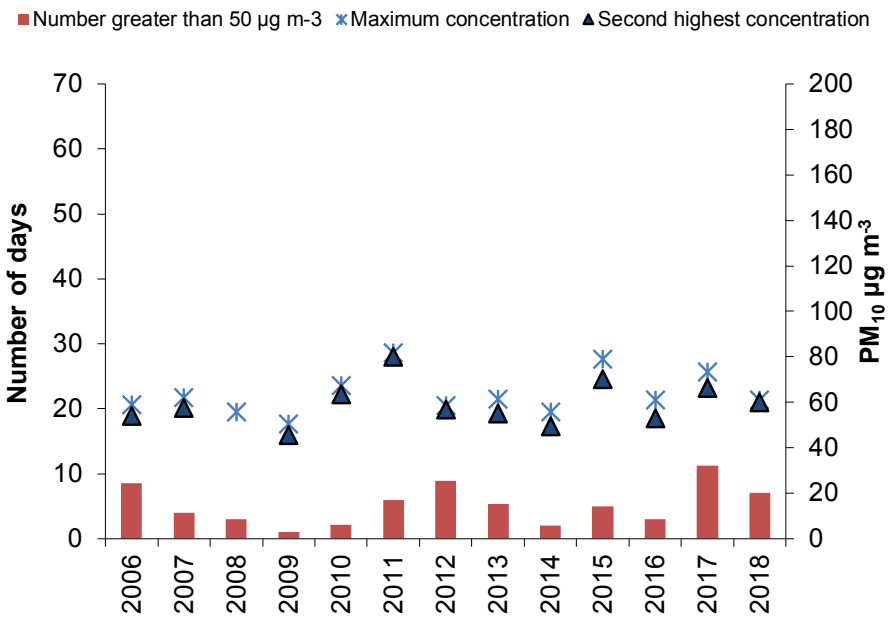


**Figure 3.10: Number of days when 50 µg $m^{-3}$ was exceeded, the maximum concentration and the second highest concentration from 2006 to 2018.**

The annual average $PM_{10}$ concentration for 2018 was 19 µg $m^{-3}$. This is at the upper end of the normal range for this monitoring site (14-19 µg/$m^3$). The Ministry for the Environment specifies an annual average guideline for $PM_{10}$ of 20 µg $m^{-3}$. The NES does not currently include an annual average concentration for $PM_{10}$.

Summary statistics for $PM_{10}$ 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 $PM_{10}$ concentrations measured at Redwoodtown – Bowling Club site from 2002-2018**

| | 2002 | 2003 | 2004 | 2005 | 2006* | 2007* | 2008* | 2009* | 2010* | 2011* | 2012* | 2013* | 2014* | 2015* | 2016** | 2017** | 2018 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 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 | BAM |
| "Good" 0-33% of guideline | 18% | 22% | 46% | 63% | 66% | 69% | 66% | 68% | 72% | 64% | 56% | 72% | 67% | 64% | 56% | 54% | 53% |
| "Acceptable" 33-66% of guideline | 62% | 30% | 22% | 17% | 21% | 24% | 23% | 22% | 21% | 21% | 31% | 18% | 22% | 29% | 32% | 29% | 34% |
| "Alert" 66-100% of guideline | 10% | 26% | 20% | 17% | 10% | 6% | 10% | 9% | 6% | 13% | 11% | 7% | 10% | 6% | 12% | 14% | 11% |
| “Action” >Guideline | 10% | 22% | 12% | 3% | 3% | 1% | 1% | 0% | 1% | 2% | 2% | 1% | 0% | 1% | 1% | 3% | 2% |
| Percentage of valid data | 14% | 7% | 22% | 32% | 68% | 99% | 99% | 98% | 96% | 87% | 91% | 98% | 70% | 91% | 95% | 99% | 99% |
| Annual average (µg $m^{-3}$) | - | - | 22 | 18 | 17 | 15 | 17 | 15 | 14 | 16 | 19 | 14 | 16 | 17 | 18 | 20 | 19 |
| Measured $PM_{10}$ concentrations above 50 µg $m^{-3}$ | 5 | 6 | 10 | 3 | 6 | 5 | 3 | 1 | 2 | 6 | 8 | 5 | 1 | 4 | 3 | 11 | 7 |
| Extrapolated $PM_{10}$ concentrations above 50 µg $m^{-3}$ | 16 | 34 | 31 | 9 | 10 | 4 | 3 | 1 | 2 | 6 | 9 | 5 | 2 | 5 | 3 | 11 | 7 |
| Second highest $PM_{10}$ concentration (µg $m^{-3}$) | | | | | 54 | 58 | 56 | 46 | 64 | 80 | 57 | 55 | 51 | 70 | 53 | 66 | 60 |
| Annual maximum (µg $m^{-3}$) | 58 | 60 | 81 | 58 | 59 | 62 | 56 | 46 | 67 | 82 | 59 | 61 | 56 | 79 | 61 | 74 | 61 |
| Number of records | 50 | 27 | 82 | 115 | 247 | 360 | 363 | 357 | 352 | 319 | 331 | 351 | 254 | 331 | 346 | 361 | 360 |

*not adjusted for gravimetric equivalency

**adjusted for gravimetric equivalency

### 3.2.2. $PM_{2.5}$

While there is currently no NES for $PM_{2.5}$ 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 exposure. The current WHO annual average $PM_{2.5}$ guideline is 10 µg/m$^3$. However, a 2013 review of WHO guidelines noted that recent long-term studies show associations between $PM_{2.5}$ and mortality levels at concentrations well below the current annual WHO air quality guideline level for $PM_{2.5}$ (10 µg/m$^3$) and recommended a review of that value. During 2018 an annual average $PM_{2.5}$ concentration of 13 µg/m$^3$ was measured at Redwoodtown and compares with an annual average concentration of 14 µg/m$^3$ for 2017.

Shorter term exposures are also of concern from a health viewpoint. During 2018 there were 61 exceedences of the 24-hour average reporting guideline for $PM_{2.5}$ of 25µg/m$^3$ at the Redwoodtown air quality monitoring site (Figure 3.11).

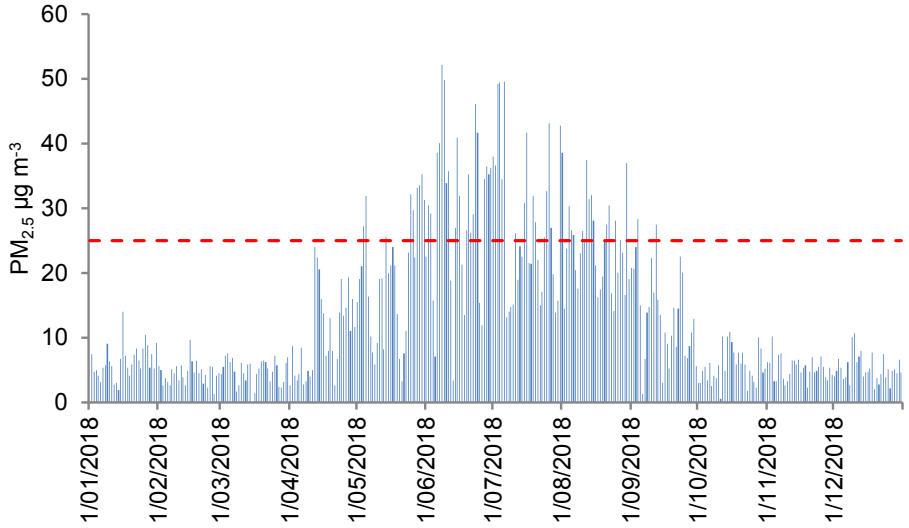


**Figure 3.11: 24-hour average $PM_{2.5}$ concentrations measured at the Redwoodtown – Bowling Club site during 2018.**

## 3.3. Particulate concentrations and meteorology in Blenheim

Daily variations in $PM_{10}$ and $PM_{2.5}$ concentrations and meteorological conditions on days during 2018 when the 24-hour average $PM_{10}$ concentrations exceeded 50 µg m$^{-3}$ at the Redwoodtown air quality monitoring site are shown in Figure 3.12. Data are consistent with historical high pollution days with peak $PM_{10}$ concentrations occurring during the evening and typically a smaller peak occurring mid-morning. The concentrations of $PM_{10}$ and $PM_{2.5}$ are very similar on most days The exception is 29 June when higher $PM_{10}$ concentrations were observed during the daytime and $PM_{2.5}$ concentrations remained low. During this time, it is likely that a source of coarse ($PM_{10}$-$PM_{2.5}$) particulate (e.g., dust) contributed to the $PM_{10}$ exceedence. The key meteorological conditions associated with the elevated concentrations on high pollution days are low wind speeds and south-westerly wind direction.

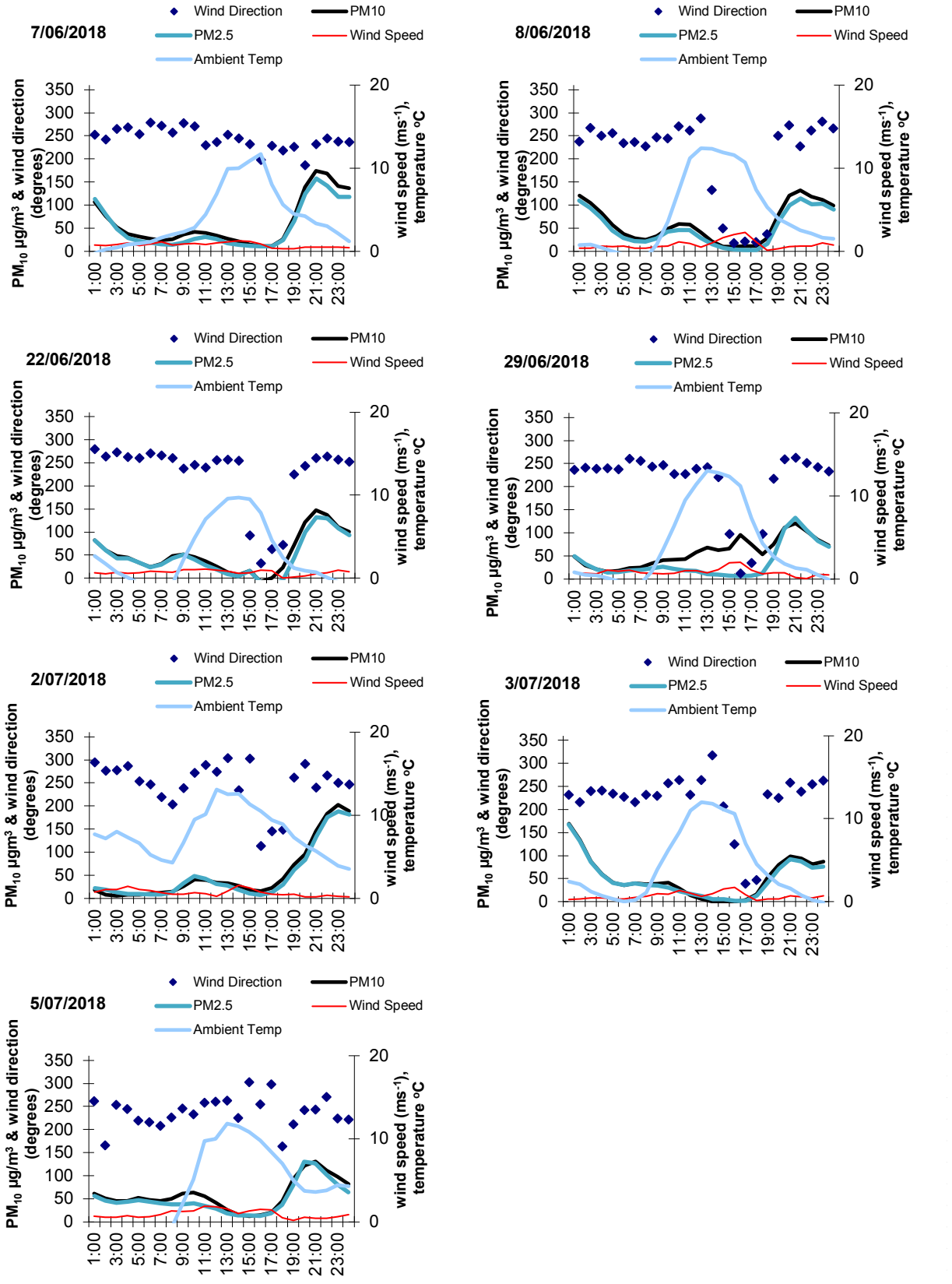


**Figure 3.12: Hourly average $PM_{10}$, $PM_{2.5}$, wind direction and temperature on days when $PM_{10}$ concentrations exceeded 50 µg $m^{-3}$ (24 hour average) at Redwoodtown.**

# 4. Trends in $PM_{10}$ concentrations in Blenheim

To quantify the impact of meteorological conditions and therefore further assess the likelihood of changes in $PM_{10}$ 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 $PM_{10}$ in excess of the NES and to provide a tool for comparing year to year $PM_{10}$ 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 $PM_{10}$ concentrations updated with the 2018 $PM_{10}$ data adjusted for the impact of meteorological conditions.

Results for 2018 support the 2017 conclusions that there have been no improvements in $PM_{10}$ concentrations in Blenheim over the monitoring period. The 75$^{th}$ percentile concentrations were consistent with the worst-case years (2006,2012,2013 and 2017) and 90$^{th}$ percentile concentrations were the second highest recorded. The data is not indicative of an overall improvement or degradation in $PM_{10}$ concentrations in Blenheim. No trend is evident.

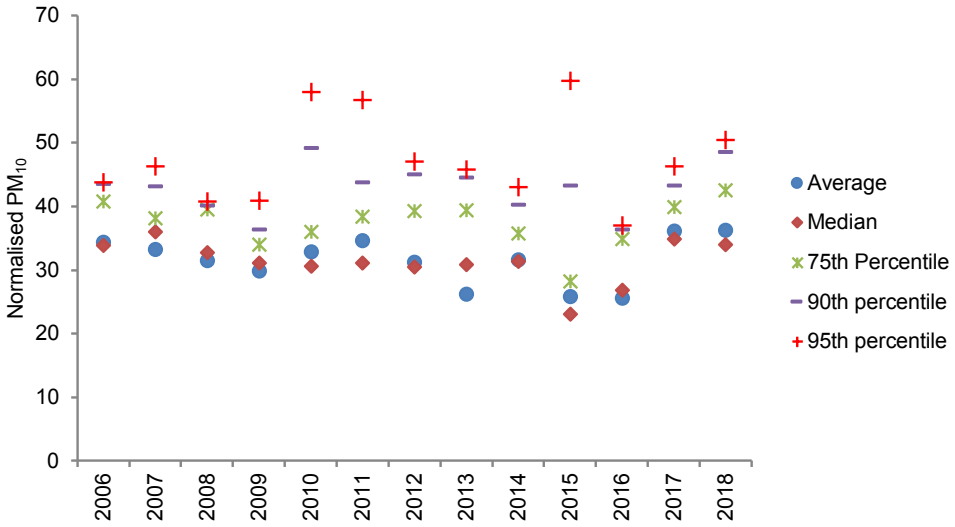


**Figure 4.1: Trends in $PM_{10}$ concentrations after adjusting for meteorological conditions**

# 5. Summary

There were six breaches of the NES for $PM_{10}$ at Redwoodtown during 2018 with seven recorded exceedences of 50 $\mu g/m^3$. This is less than the 2017 frequency of exceedance and the third highest number since 2005 when the NES became effective. The highest concentration 61 $\mu g/m^3$ (24-hour average) and is lower than the 2015 value of 79 $\mu g/m^3$. The annual average concentrations for Redwoodtown for 2018 was 19 $\mu g/m^3$ and is the highest equal (with 2017) annual average concentration measured at the site since continuous monitoring commenced in 2005.

The historical Middle Renwick Road monitoring site has recorded no exceedences of 50 $\mu g/m^3$ for $PM_{10}$ since 2008. The highest concentration measured during 2018 was 26 $\mu g/m^3$. 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 $PM_{10}$ was reviewed by the Ministry for the Environment in 2011. A new date of September 2016 was given for compliance with 50 $\mu g\ m^{-3}$ (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 $PM_{10}$ from winter 2017.

Management measures to reduce $PM_{10}$ 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 – 2018 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 2012-2018 it would seem unlikely that the management options specified in the notified air plan would be effective in reducing $PM_{10}$ concentrations to meet the NES.

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