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# Evaluation of air quality monitoring sites for Blenheim and Picton



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## EXECUTIVE SUMMARY

This report evaluates the requirements for air quality monitoring sites in Blenheim and evaluates the need for further monitoring of PM<sub>10</sub> in Picton.

Air quality monitoring of PM<sub>10</sub> concentrations has been carried out in Blenheim since 2000 when a site was established at Middle Renwick Road (MRR). The monitoring method at this site has been gravimetric high volume sampling since monitoring commenced. A second monitoring site was established in Redwoodtown in 2004. A continuous beta attenuation monitor (BAM) was installed at this site in 2005 to provide PM<sub>10</sub> concentrations compliant with National Environmental Standards (NES) for air quality.

Monitoring of PM<sub>10</sub> in Redwoodtown currently fulfils the Marlborough District Councils requirements for monitoring of PM<sub>10</sub> under the NES. These requirements specify a continuous record of 24-hour average PM<sub>10</sub> concentrations using an approved method in non-complying airsheds, in an area within the airshed where concentrations are highest, and that monitoring must continue until such time as the airshed becomes compliant and for at least five years after. The current location of this site is appropriate. Co-location monitoring of PM<sub>10</sub> using the high volume sample should continue at this site until September 2014.

The MRR site is not required under the NES and typically one air quality monitoring site would be sufficient in an area the size of Blenheim. Concentrations of PM<sub>10</sub> at MRR in 2013 were approximately half those of Redwoodtown. The value of this site is in the historical nature of the data as records are available from 2000. Trends in concentrations at this site differ to Redwoodtown and provide insight which may be of value for air quality management purposes. It is recommended that monitoring continue at this site for a further 1-3 years using the current method (gravimetric high volume sampling) and sample frequency but that consideration be given to disestablishing this site after this period.

Air quality monitoring has been carried out in Picton during 2008 and 2009 and previously in 2000 and 2003.. The maximum measured PM<sub>10</sub> concentrations was 53 µg/m<sup>3</sup>. Although the NES threshold of 50 µg/m<sup>3</sup> was exceeded no NES breach occurred as this was the only concentration measured above 50 µg/m<sup>3</sup>. As monitoring was only carried out every third day a breach of the NES may have occurred during 2008. In addition it is unlikely that the monitoring site captured the worst of the PM<sub>10</sub> concentrations in Picton. Because of this, it is recommended that further monitoring be carried out in Picton and that a location in the vicinity Waikawa Road down the southern/ Picton end be sourced. Continuous monitoring is the preferred approach for this site (e.g., a BAM) and would also be of value if additional investigate monitoring of PM<sub>10</sub> is to be carried out in other more remote areas of Marlborough.

Recommendations from this report are:

- Continue to monitor PM<sub>10</sub> concentrations at Redwoodtown using a BAM.
- Establish a new monitoring site in Picton in the southern Waikawa Road area.
- Obtain a continuous monitor to measure PM<sub>10</sub> concentrations in Picton.
- Continue to monitor PM<sub>10</sub> at Middle Renwick Road for a further 1-3 years.

# 1 INTRODUCTION

## 1.1 Objective

The objective of this report is to evaluate the requirements for air quality monitoring sites in Blenheim and the need for further monitoring of PM<sub>10</sub> in Picton.

## 1.2 Background

Air quality monitoring has been carried at Middle Renwick Road (MRR) in Blenheim since 2000 and at Redwoodtown since 2004. The MRR site uses a high volume sampler which requires filter changing one day in three. It is a labour intensive method of monitoring PM<sub>10</sub> and therefore has a high cost in terms of staff time. An evaluation of the benefits of this site is required to determine if there is sufficient value in the data to justify the ongoing investment of these resources.

The Redwoodtown site was established in 2004 and is the NES compliant air quality monitoring site for Blenheim. Ongoing monitoring of PM<sub>10</sub> is required in any non-complying airshed and must continue for five years after achieving compliance. The NES requires monitoring in the location in the airshed where air quality is worst or experiences the greatest number of exceedences of the NES limit value of 50 µg/m<sup>3</sup> (24-hour average). The NES for PM<sub>10</sub> allows one exceedence of 50 µg/m<sup>3</sup> (24-hour average) per year. The monitoring method at the Redwoodtown air quality monitoring site is compliant with the requirements of the NES. Evaluation is required to determine if this is likely to represent the worst case location for PM<sub>10</sub> concentrations in Blenheim.

Investigative monitoring of PM<sub>10</sub> in Picton has been carried out during 2000, 2003 and more recently during 2008 and 2009. Results suggest that Picton is compliant with the NES. However, conclusions are based on limited monitoring and there is uncertainty as to whether the current monitoring site is likely to represent worst case concentrations. Evaluation of existing monitoring data and other investigations are required to determine if more monitoring is necessary.

## 2 BLENHEIM – MIDDLE RENWICK ROAD

### 2.1 Purpose

The purpose of the Middle Renwick Road air quality monitoring site is to provide historical PM<sub>10</sub> data for Blenheim. The data also provides an alternative PM<sub>10</sub> measurement for Blenheim which has been used to provide exposure information for health impacts assessments, for example in the HAPINZ model (Kuschel et al., 2012).

### 2.2 Location

The Middle Renwick Road monitoring site is located at 106 Middle Renwick Road. The site meets the residential peak classification as per the Ministry for the Environment's Good Practice Guide for Air Quality Monitoring and Data Management (Ministry for the Environment, 2009). The peak aspect relates to motor vehicle emissions as the monitor is located within four metres of the roadside. Prior to 2008 the Middle Renwick Road monitoring site was located at the same site but at a distance of more than 10 metres back from either road. Between 2008 and 2010 the site was located at the Bowling Club, a back section at 136 Middle Renwick Road at a distance of more than 20 metres from the road.

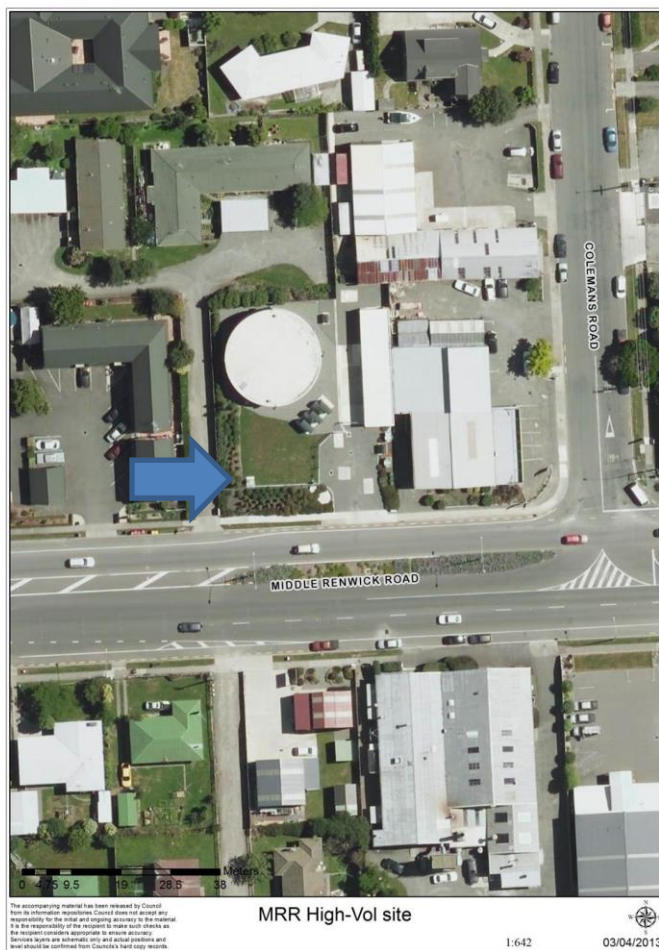


Figure 2-1: Location of the Middle Renwick Road air quality monitoring site

## 2.3 Assessment

Figure 2.2 shows PM<sub>10</sub> concentrations measured at MRR relative to the Ministry for the Environment air quality indicator categories. Results indicate an increase in the proportion of PM<sub>10</sub> concentrations that meet the “good” air quality category and a reduction in the proportion in other categories. Annual average PM<sub>10</sub> concentrations at this site also are indicative of improving PM<sub>10</sub> concentrations (Figure 2.3). These indicators of trends are not observed at Redwoodtown and provide additional insight into air quality in Blenheim.

The monitoring site is unlikely to be representative of average exposure to particulate concentrations in Blenheim as it is located near to the roadway. Some of the surrounding area is subject to high PM<sub>10</sub> emission densities but with a predominant westerly airflow, the area is unlikely to be downwind of significant PM<sub>10</sub> from domestic home heating. The value of the site is in the historical nature of the data and in the differences in trends to those observed at Redwoodtown. The influence of slight changes in site location on monitoring data are unclear.

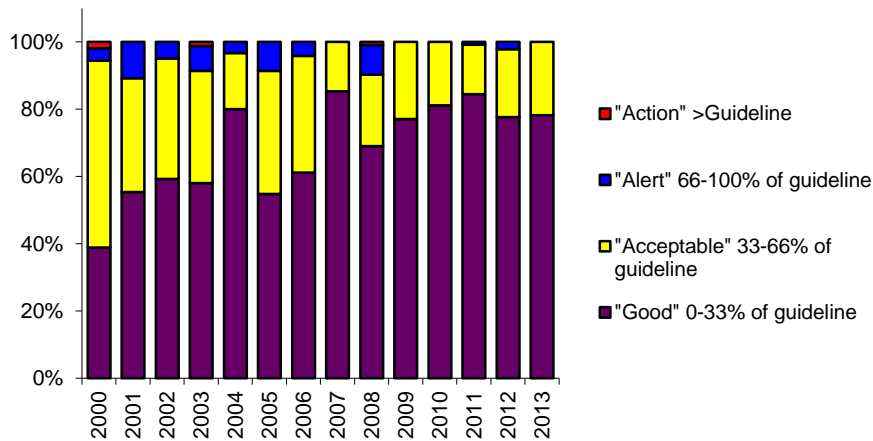


Figure 2-2: Trends in concentrations of PM<sub>10</sub> expressed relative to MfE air quality indicator categories. (arrows illustrate different locations of the monitoring site)

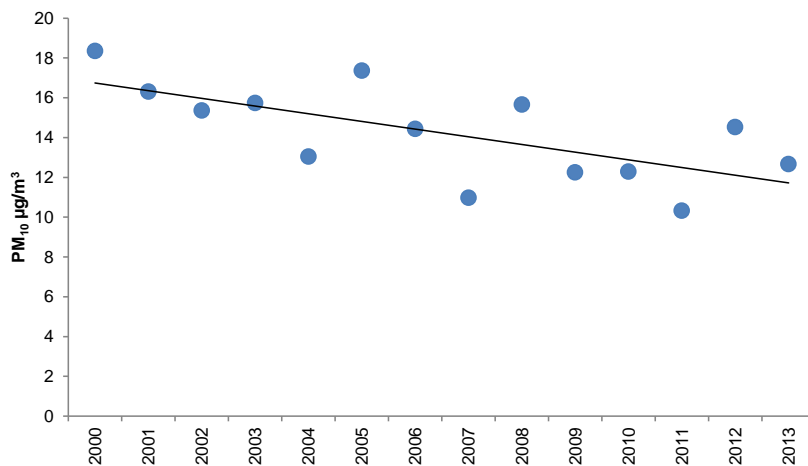


Figure 2-3: Annual average PM<sub>10</sub> measured at Middle Renwick Road from 2000 – 2013

### 2.3.1 Emission density data

Figure 2.4 shows the distribution in PM<sub>10</sub> emissions from wood burning across the Blenheim airshed. The MRR site has a high emission density area to the north west.

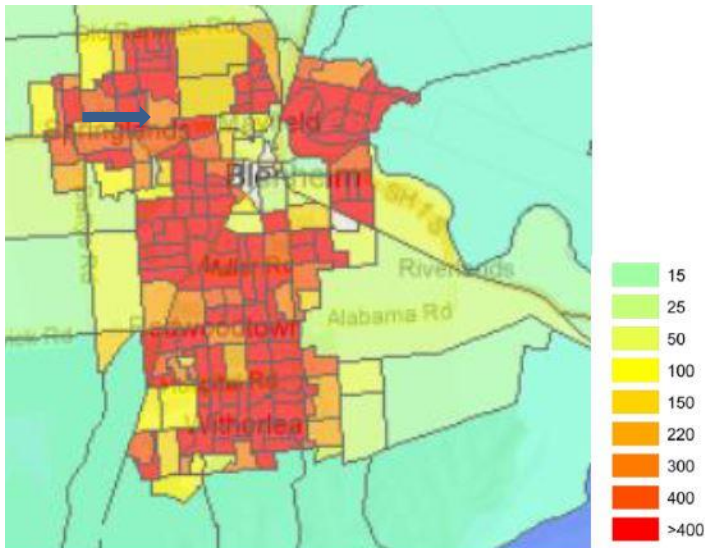


Figure 2-4: PM<sub>10</sub> emission densities g/ha for different meshblock areas in Blenheim (arrow depicts the location of the MRR monitoring site).

### 2.3.2 Mobile monitoring data

The spatial distribution of particulate across Blenheim was evaluated through mobile monitoring carried out by NIWA during 2012 (Somervell, Longley, & Olivares, 2013). Figure 2.4 shows the median black carbon concentrations for the monitored route for two days during late August 2012. Results suggest concentrations are highest in the inner Blenheim area and decrease on the outskirts of Blenheim. The MMR area showed concentrations lower than the Redwoodtown area but higher than the outer areas of Blenheim.

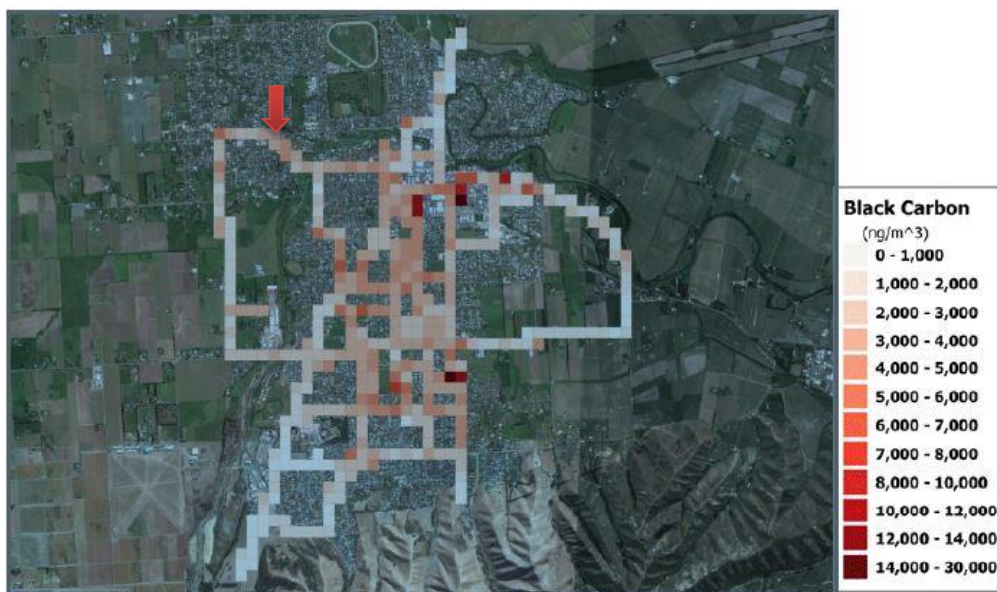


Figure 2-5: Median black carbon concentrations from mobile monitoring campaign (from Somervell, Longley, & Olivares, (2013) with arrow depicting location of Middle Renwick Road monitoring site



## 2.4 Summary

The location of the monitoring site in Middle Renwick Road has limited value in terms of its representation of air quality in Blenheim. It is neither a worst case nor an average location for representing PM<sub>10</sub> exposure. It provides an indication of trends in emissions with time and is likely to reflect a greater motor vehicle contribution than Redwoodtown.

Currently, the value for this site lies in the extent of historical data available and the differences in trends to those observed at Redwoodtown. It is possible that the value of having this historical data will diminish as the record from Redwoodtown extends. During the current stage of intensive evaluation of air quality data for information that may be of value for air quality management continued monitoring at this site is recommended. It is likely that information from this site will be of value for a further 1-3 years but the longevity of the site may require reassessment at that point in time.

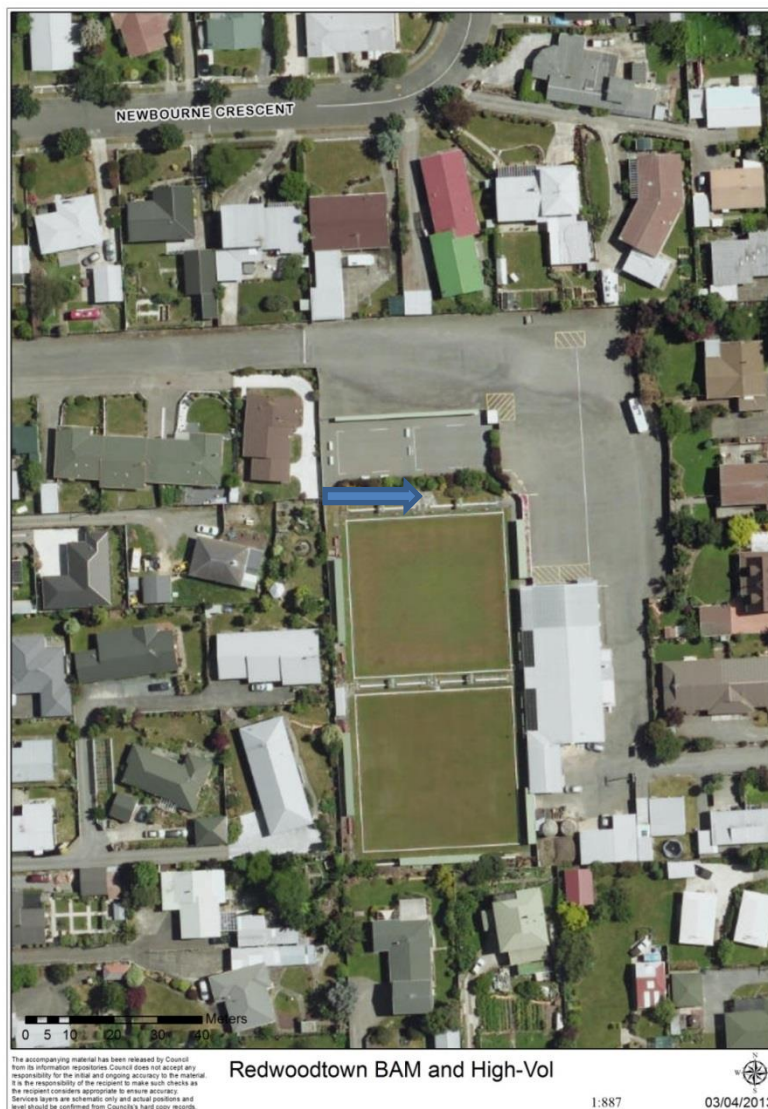
### 3 BLENHEIM REDWOODTOWN

#### 3.1 Purpose

The purpose of the Redwoodtown air quality monitoring site is to measure compliance with the National Environmental Standards (NES) for PM<sub>10</sub>.

#### 3.2 Location

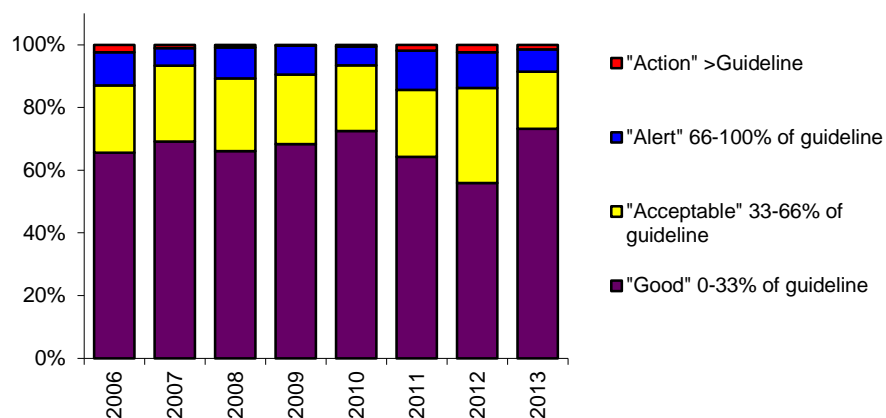
The Redwoodtown air quality monitoring site is located at the Redwoodtown Bowling Club (Figure 3.1).



**Figure 3.1: Redwoodtown – Bowling Club air quality monitoring site (note: blue arrow depicts monitoring site).**

### 3.3 Assessment

Monitoring at Redwoodtown has been carried out using a beta attenuation monitor (BAM) since 2006. A comparison of PM<sub>10</sub> concentrations to Ministry for the Environment (MfE) air quality indicator categories since 2006 is shown in Figure 3.2. Results show a decrease in the proportion of data in the “action” category from 2008 to 2010 following by an increase from 2011 to 2013.



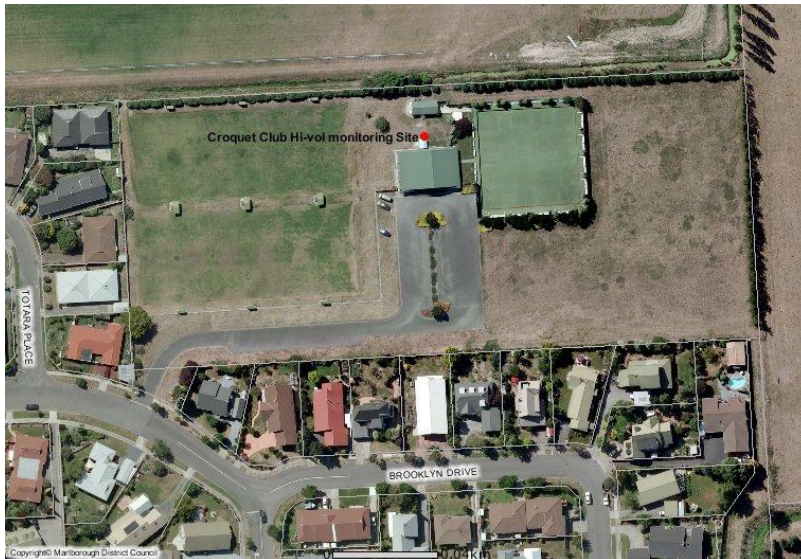
**Figure 3.2: Comparison of PM<sub>10</sub> concentrations measured in Redwoodtown to MfE air quality indicator categories.**

The main considerations with the Redwoodtown air quality monitoring site are whether the site is compliant with the monitoring requirements specified in the NES and whether the site is representative of worst case PM<sub>10</sub> concentrations in Blenheim.

The BAM method is a compliant method under the NES although it is not the reference method (gravimetric high volume sampling). Monitoring must be carried out on a daily basis to provide a full record of 24-hour average concentrations which must be measured from midnight to midnight. The BAM provides PM<sub>10</sub> concentrations on an hourly (or 10 minute basis) allowing 24-hour averages from midnight to midnight to be calculated. Investigative monitoring is carried out to evaluate the relationship between the BAM and gravimetric high volume sampling. A comparison of the relationship between concentrations over a 1-2 year period is typically required to establish a correlation. Colocation monitoring with the new BAM commenced in January 2013. It is recommended that this continue until September 2014 to give two winters worth of comparisons between the methods.

The representativeness of the monitoring site is difficult to evaluate with a high degree of certainty as monitoring in a number of locations is resource intensive.

Some investigative monitoring to determine the worst case location has been carried out in Blenheim. In 2004 a monitoring site was established in at a residential location in Brooklyn Street. This site recorded higher PM<sub>10</sub> concentrations than those measured at Redwoodtown but questions were raised as to the validity of the data owing to the proximity of the site to localised sources (neighbouring chimneys). To check the appropriateness of the location of the Redwoodtown Bowling Club site in terms of worst case concentrations, a second site in Redwoodtown was established in 2007 to evaluate PM<sub>10</sub> concentrations in the vicinity of the 2004 Brooklyn Street site and compare them to those measured at the Bowling Club. The site was at the Croquet Club (Figure 3.2).



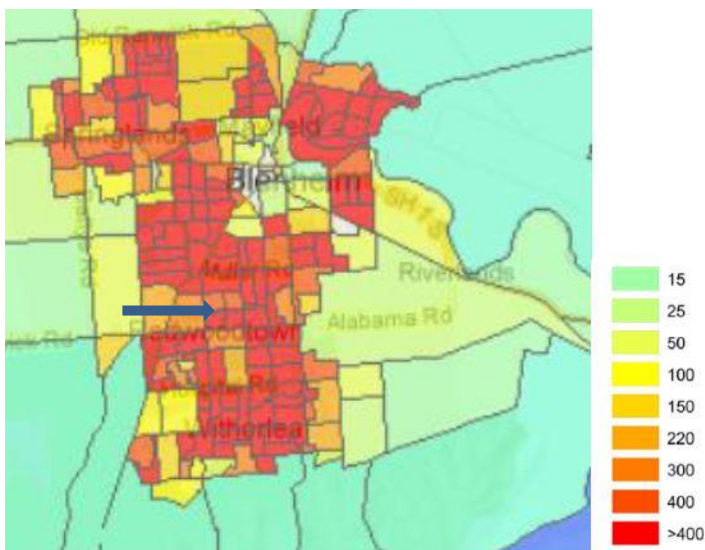
**Figure 3.3: Redwoodtown – Croquet Club air quality monitoring site.**

Results indicated PM<sub>10</sub> concentrations were higher at the Bowling Club site and the Croquet Club monitoring was discontinued.

Air quality monitoring reports indicate that the predominant wind direction on days when PM<sub>10</sub> concentrations in excess of 50 µg/m<sup>3</sup> are recorded is nor-westerly (Wilton & Baynes, 2009) or south westerly (Wilton, 2014). It is likely that the worst case PM<sub>10</sub> concentrations would be measured at a monitoring site located downwind of sources of PM<sub>10</sub>.

### 3.3.1 Emission density data

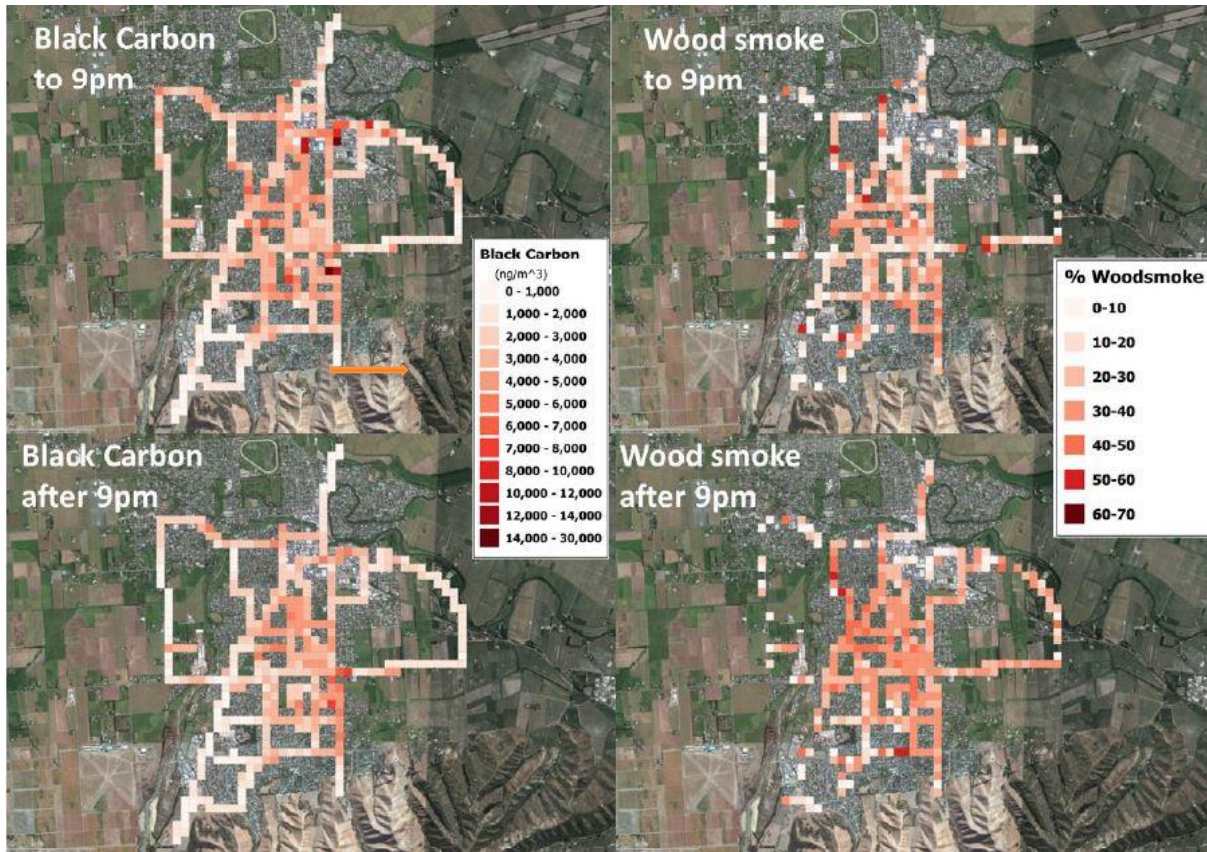
Figure 3.3 shows the emissions density of PM<sub>10</sub> from domestic home heating across the Blenheim airshed (output from ESESM model). Results suggest many areas of Blenheim experience high density emissions from wood burning. The Redwoodtown area is suitably located amidst an area of high density emissions and downwind (from north west winds) of further higher density emission areas.



**Figure 3-4: PM<sub>10</sub> emission densities g/ha for different meshblock areas in Blenheim (red depicts high emission density areas).**

### 3.3.2 Mobile monitoring data

Mobile monitoring of black carbon (an indicator of PM<sub>10</sub>) was carried out in Blenheim on two days during August 2012. The spatial distribution in black carbon concentrations and the proportion of carbon that is wood smoke is shown in Figure 3.4. This shows a number of small hotspots sporadic in their distribution across Blenheim. Although the Redwoodtown area is not particularly elevated in this illustration, the sample days were not high pollution days (daily PM<sub>10</sub> concentrations < 25 µg/m<sup>3</sup>).



**Figure 3-5: Black carbon concentrations and proportion of black carbon that is wood smoke from mobile monitoring campaign (from Somervell, Longley, & Olivares, 2013).**

### 3.4 Summary

The key requirements of the Redwoodtown monitoring site are that it is compliant with the monitoring requirements of the NES and that it represents the worst case PM<sub>10</sub> concentrations for Blenheim.

The BAM method is a compliant method under the NES and 24-hour averages from midnight to midnight are calculated as required.

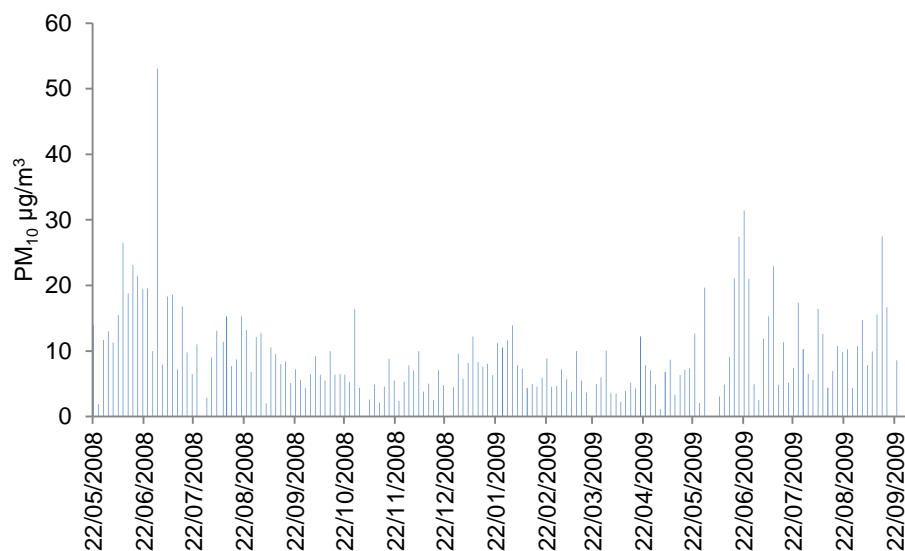
An evaluation of emissions data and meteorological conditions on high pollution nights would support the location of the worst case monitoring site being around the Redwoodtown area. This was unable to be confirmed using mobile monitoring owing to the sample days not being representative of high pollution days.

## 4 PICTON

### 4.1 Background

Air quality monitoring for PM<sub>10</sub> has been carried out in Picton during 2000, 2003 and more recently in 2008 and 2009. Concentrations measured during this time are shown in Figure 4.1. The monitoring method was a gravimetric high volume sampler. Measurements were taken for a 24-hour period from midnight to midnight based on a one day in three sampling regime. Picton is not a gazetted airshed under the NES as historical data has shown PM<sub>10</sub> concentrations have not breached the 50 µg/m<sup>3</sup> limit.

The maximum daily PM<sub>10</sub> concentration measured at the Picton monitoring site was 53 µg/m<sup>3</sup>. Although the NES threshold of 50 µg/m<sup>3</sup> was exceeded no NES breach occurred as this was the only concentration above 50 µg/m<sup>3</sup>. As monitoring was only carried out every third day a breach of the NES may have occurred during 2008.



**Figure 4-1: Daily PM<sub>10</sub> concentrations measured in Picton during 2008 and 2009**

### 4.2 Location

The location of the earlier monitoring was in Picton at the Fire Station (2000) and at 25 Oxford Street (2003). The maximum measured concentration was 43 µg/m<sup>3</sup>. In 2008 and 2009 the monitoring site was located on the west side of Lincoln Street (Figure 4.2). The monitor is located close to the hill area which is devoid of housing. The main airflows down the Waikawa Road area are illustrated in Somervell, Longley, & Gustavo, (2013). Figure 4.3 from Somervell et al., (2013) provides an illustration of the potential drainage flows down the Waikawa Road towards Picton although also drainage flows towards Waikawa are also possible. In both instances the drainage flow occurs down the road rather than across towards the hill area. A location towards the western hill side of the road is therefore unlikely to represent maximum PM<sub>10</sub> concentrations.



Figure 4-2: Location of the air quality monitoring site in Picton



Figure 4-3: Typical wind flows in Picton on days when the wind is calm (from Somervell, Longley, & Gustavo, (2013)

#### 4.2.1 Emission density data

Figure 4.4 shows the relative emission density of PM<sub>10</sub> from domestic home heating across Picton. The main areas where emissions occur are south of central Picton and the Waikawa road area between Picton and Waikawa.

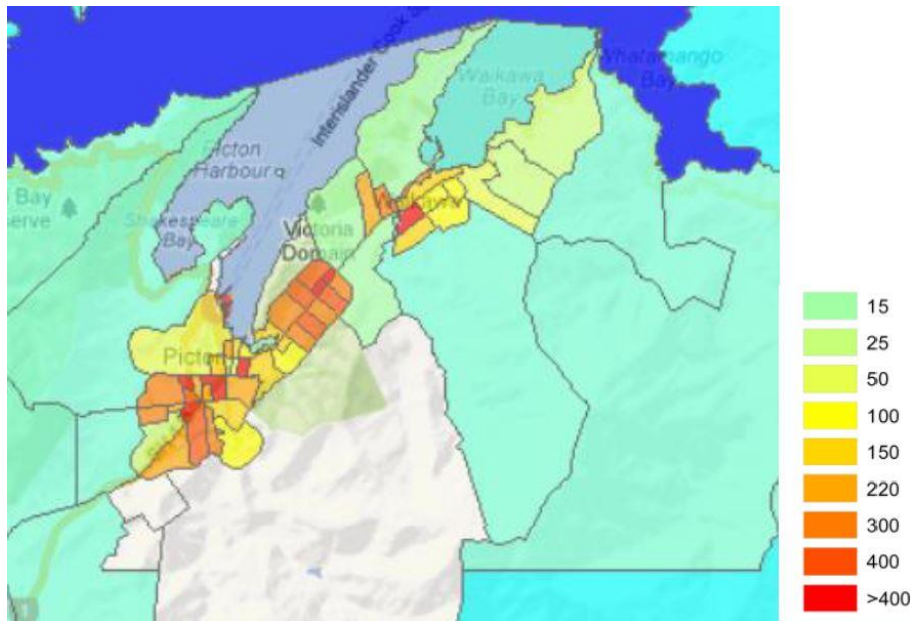


Figure 4-4: Density of PM<sub>10</sub> emissions from wood burning (g/ha) in Picton

#### 4.2.2 Mobile monitoring data

Mobile monitoring of PM<sub>10</sub> concentrations on a small number of days during August 2012 was carried out by Somervell, Longley, & Gustavo, (2013). Median black carbon (used as an indicator of PM<sub>10</sub> concentrations) measured across Picton is shown in Figure 4.5. This indicates highest levels were observed in the southern Waikawa road area.

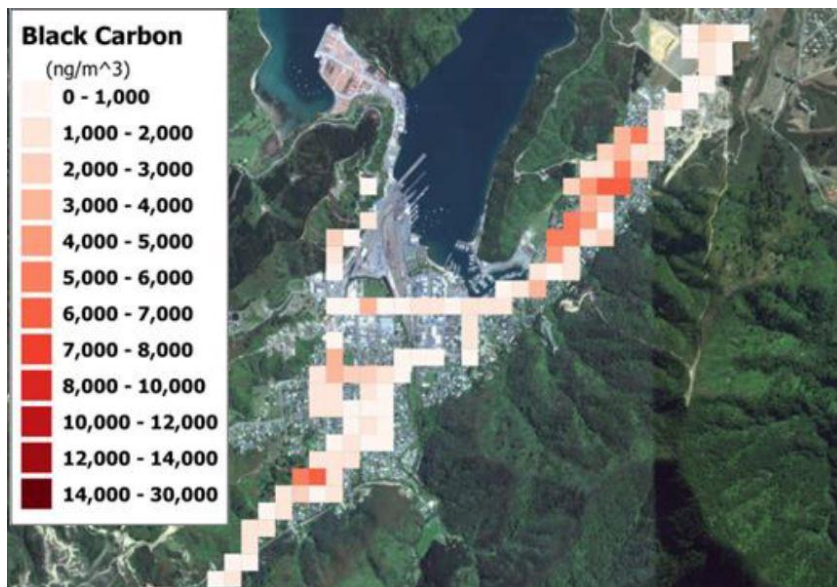


Figure 4-5: Median black carbon concentrations across Picton (from Somervell, Longley, & Gustavo, (2013))



### 4.3 Purpose of future monitoring

Air quality monitoring for PM<sub>10</sub> has been carried out in Picton historically to evaluate the likelihood of compliance with the NESAQ for PM<sub>10</sub>.

Future monitoring is justified in Picton because:

- Monitoring is limited to two years of intermittent sampling (one day in three) and one exceedence of 50 µg/m<sup>3</sup> was measured during this time.
- The location of the historical monitoring site is unlikely to be downwind of significant emissions sources.

The purpose of future monitoring would be ongoing investigative monitoring to evaluate likely compliance with the NES for PM<sub>10</sub>.

### 4.4 Recommended monitoring method and location.

#### 4.4.1 Method

The recommended monitoring method is a continuous PM<sub>10</sub> monitoring method such as a BAM. The reason for this is that detecting non-compliance is difficult when the number of exceedences are low and an intermittent method such as a high volume sampler is used. If this is not feasible the existing high volume sampling method could be used with an increased sampling frequency (one day in two) during the months May to August. The latter option does not require the purchase of new equipment but is not ideal in that it is resource intensive and may miss exceedence days.

#### 4.4.2 Location

The evaluation above suggest that the southern Waikawa road area is likely to be the worst case in terms of PM<sub>10</sub> concentrations in Picton. The NES requires that monitoring be carried out in the worst case location. Finding a suitable location for a monitoring site in the southern Waikawa Road area is particularly difficult. The area where concentrations are most elevated based on the mobile monitoring and meteorological data evaluation is a block either side of Waikawa Road around the Sussex Street area.

From the satellite image (Figure 4.6) there are no ideal land masses for the monitoring site around the southern Waikawa Road area. The only potential location that may be suitable is the marina entrance area opposite the Top Ten holiday park near Surrey Street.



**Figure 4-6: Satellite image of the southern Waikawa road area depicting few plots of bare land suitable for an air quality monitoring site in the vicinity of Waikawa Road.**

The other area that provides appropriate green spaces for a monitor is around the Queen Charlotte College area or the Marae. Both areas provide better opportunities for the siting of air quality monitoring equipment, which can be problematic owing to issues of access to power and vandalism. However, mobile monitoring data indicates lower concentrations around these areas on the days when the sampling was undertaken. These sites would pick up elevated  $PM_{10}$  concentrations under the “reverse flow” winds described above. However, the drainage flow towards Picton appears the predominant wind direction under still conditions the preferred location would be opposite the Top Ten Holiday Park.

## 5 CONCLUSIONS

The main air quality monitoring site in Blenheim is at Redwoodtown. Ongoing monitoring at this site is a requirement under the NES. The existing BAM method is appropriate and the location is likely to be representative of worst case PM<sub>10</sub> concentrations in Blenheim as required by the NES. Co-location monitoring of PM<sub>10</sub> using a high volume sampler at this site should be continued until September 2014.

A second monitoring site in Blenheim located at Middle Renwick Road provides a more historical record of PM<sub>10</sub> concentrations. The data may also be of value in tracking changes in concentrations in a different location in Blenheim over the next few years as measures are implemented to reduce PM<sub>10</sub> from domestic home heating. The ongoing value of this site is likely to be limited once a longer record of data is available from Redwoodtown and once NES compliance is attained. It is recommended that the site continue for further 3-5 years (depending on NES attainment).

Concentrations of PM<sub>10</sub> have been measured in Picton in 2008 and 2009. One exceedence of 50 µg/m<sup>3</sup> was recorded during 2008. However, sampling was only carried out one day in three and the monitoring site is unlikely to have captured the highest concentrations. It is possible that Picton does breach the NES for PM<sub>10</sub> and further monitoring is recommended. If possible this should be carried out using a continuous PM<sub>10</sub> monitoring method such as a BAM. If this is not feasible the existing high volume sampling method could be used with an increased sampling frequency to one day in two during the months May to August.

The main limitation with air quality monitoring in Picton is the establishment of a monitoring suitably located monitoring site. Mobile monitoring data suggest that the best location for a site would be around the southern end of the Waikawa Road. Evaluation of satellite images of this area indicates almost no areas ideal for air quality monitoring sites. One potential area is around the marina entrance opposite the Top Ten Holiday Park. Further investigations in the potential for establishing a monitoring site in this area is recommended.

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