MARLBOROUGH DISTRICT COUNCIL

Ambient Air Quality Monitoring Annual Report 2002

Prepared for
Marlborough District Council

By
Laboratory Services - Air Quality Group

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Ambient Air Quality Monitoring
Annual Report 2002

A report for
Marlborough District Council
Seymour Square
Blenheim

Ph 03 578 5249
Contact: Lynda Neame

4 July 2003

Watercare Services Ltd
52 Aintree Avenue
Airport Oaks
PO Box 107 028
Airport Oaks
AUCKLAND

Ph 09 255 1188
Fax 09 255 1530

[ ] [ ]

Judy Warren
Author

Rob Hannaby
Peer Reviewer

TABLE OF CONTENTS

Page

TABLES

Page

FIGURES

Page

APPENDICES

1 INTRODUCTION

The Marlborough District Council (MDC) undertakes ambient air quality monitoring within the Marlborough district. Currently, the MDC monitors visibility at one site in the district, and monitors inhalable particulate on a year-round basis at one site in Blenheim. In addition, the MDC monitored inhalable particulate at Renwick and Redwoodtown, Blenheim, for a four month period in the winter of 2002. A year-round site monitoring PM_{10} was established in Picton in October 2002.

Furthermore, commencing in July 2002, MDC have undertaken passive nitrogen dioxide (NO_2) and sulphur dioxide (SO_2) monitoring at five sites in the district.

Monitoring of visibility commenced in July 1999 at four sites in the Marlborough District. At three of these sites, monitoring was discontinued after one year. At the fourth site (Woodbourne), monitoring has continued from 1999 up until the present date. Results from 1999 to 2001 were previously reported in the Ambient Air Quality Monitoring Annual Report 2001. This report presents results from Woodbourne, with historic data included for comparison.

Particulate concentrations are reported to MDC by Watercare on a monthly basis. Passive NO_2 and SO_2 results are reported to MDC on a quarterly basis. This report contains an annual summary of particulate results and passive NO_2 and SO_2 results for monitoring undertaken in 2002.

2 PARAMETERS MONITORED

2.1 Visibility

Visibility is a measure of the degree to which the atmosphere is transparent. Visibility degradation is caused by haze, which obscures the clarity, colour and form of what is seen through the atmosphere.

The amount of cloud cover, and angle of sun, can also affect visibility. Low cloud and rain can obscure visibility, and therefore weather conditions at the time of observation are recorded. Furthermore, it is desirable to have recordings of visibility made at similar times of the day to minimise variability due to sun angle.

Visibility can be used as an indicator of general air quality. The main factors which affect visibility include particulate matter and nitrogen dioxide (NO_2). Other air pollutants such as other nitrogen oxides (NO_2, NO, N_2O, and other nitrogen oxides collectively referred to as NO_x), sulphur dioxide (SO_2), ozone (O_3) and volatile organic compounds (VOC) can also affect visibility through secondary particle formation. Fine particles ($PM_{2.5}$) are the most significant contributors to reduced visibility.

Sources of contaminants that cause reduced visibility include natural processes (windblown dust, coastal processes, volcanic eruptions), industrial discharges (SO_2 and NO_x), agricultural discharges such as dust from cultivation and smoke from rural burn-offs, and domestic sources, including home heating and outdoor burning, and vehicles. Visibility may also be enhanced or reduced by weather conditions. Warm dry conditions may favour secondary particle formation, whereas rain can wash particles out of the atmosphere.

Figure 1: Agricultural Burnoff, Marlborough District

2.2 Inhalable Particulate (PM_{10})

Particulate matter refers to numerous substances that exist in the atmosphere. It is a somewhat complex category, encompassing a wide range of chemically and physically diverse substances. Particulate matter includes all solid and aerosol matter that exists in ambient conditions.

Particulate matter has been divided into several categories, based upon the potential health or environmental effect. Total suspended particulate (TSP) consists of all particles which range in size from 20 μm diameter downwards. Particles larger than 20 μm are too large to remain airborne for extended periods, and thus are categorised as deposited particulate.

TSP is sufficiently small to be inhaled, however, the larger particles (10 – 20 μm) are readily filtered out in the nasal cavity. Therefore, it is not considered to be the main cause of concern with respect to health effects. TSP has a nuisance or annoyance effect, degrading the aesthetic quality of the ambient air.

Particles with a diameter of 10 μm or less (PM_{10}) can be inhaled into the respiratory system. The main effect of inhalable particulate is on human health. Major health effects are increased mortality, aggravation of existing respiratory disease, increased hospital admissions, and increased lost days (lost work days, school days, and increase in restricted activity days).

Current research is recognising the division of particulate into finer fractions, including PM_5 and $PM_{2.5}$, which may penetrate beyond the bronchial tubes and deep into the aveoli. These fractions are commonly referred to as fine particulate.

2.3 Sulphur Dioxide

Sulphur dioxide is an acidic gas with a pungent odour, which is mainly produced by the burning of fossil fuels. The gas is quite corrosive and can cause damage to building and other materials. It can also have significant effects on human health.

Sulphur dioxide can also have significant effects on the human respiratory system. Inhalation of high ambient concentrations of sulphur dioxide can cause stimulation of the nerves in the air passages, resulting in a reflex cough, irritation and chest tightness. It can also cause narrowing of the air passages, particularly in people suffering from asthma and chronic lung disease. These people frequently have narrowed airways, and any further restriction will have a disproportionately large effect, compared to people with uncompromised respiratory systems.

2.4 Nitrogen Dioxide

Nitrogen oxides incorporates several species that exist in the atmosphere, which are collectively referred to as NO_x. The two main oxides are nitrogen dioxide (NO_2), which is of concern due to its potential to cause health effects, and the monoxide form nitric oxide (NO), which is less toxic but may oxidise to NO_2 in the atmosphere. NO_2 contributes to susceptibility to respiratory infections.

Nitrogen oxides are formed in most combustion processes by oxidation of the nitrogen present in the atmosphere. Nitric oxide is the predominant primary product but this can then be oxidised to nitrogen dioxide in ambient air. As with carbon monoxide, motor vehicles are the major source of the NO_x in most parts of the country, although power stations and other large combustion units may be significant localised sources as well.

The main health effects of the oxides of nitrogen are due to NO_2, which is a respiratory irritant. Nitric oxide is believed to be quite harmless at the levels normally encountered in urban air.

NO_x is also an important air pollutant because of its role in photochemical smog. NO_2 is a reddish brown gas, and has synergistic effects with other pollutants such as SO_2 and particulate.

3 AIR QUALITY GUIDELINES

3.1 New Zealand Ambient Air Quality Guidelines

The Ministry for the Environment (MfE) published the first set of ambient air quality guidelines (AAQG) in 1994. These guidelines have now been replaced by reviewed guidelines (May 2002). The guidelines are set to protect human health.

Visibility is an indicator of air pollution i.e. it can be used to indicate the presence of air pollutants which may have an adverse effect on health. As it is only an indicator criteria, it does not have a guideline value.

Inhalable particulate has recognised direct effects on human health. The guideline values for inhalable particulate are given in Table 1.

Sulphur dioxide and nitrogen dioxide also have a recognised effect on human health. There are AAQG for 1 hour and 24 hour averaging periods. Passive monitoring, which measures ambient concentrations over a one month averaging period, cannot be directly compared to MfE guidelines, but nevertheless provide an indication of the potential for a problem to exist. Passive sampling results can be compared to UK guidelines for annual averages. Passive samplers can also provide a comparison between different locations within a region.

Table 1: Ambient Air Quality Guidelines

Contaminant	Guideline source	AAQG	Averaging Period	Purpose
Inhalable particulate (PM_{10})	NZ MfE 2002	20 $\mu g/m^3$	Annual	Chronic health effects
	NZ MfE 2002	50 $\mu g/m^3$	24 hour average	Acute health effects
Fine particulate ($PM_{2.5}$)	NZ MfE 2002	25 $\mu g/m^3$	24 hours	Monitoring guideline
Sulphur dioxide	NZ MfE 2002	120 $\mu g/m^3$	24 hour average	Health effects
	NZ MfE 2002	350 $\mu g/m^3$	1 hour average	Health effects
	UK AQM 2002	20 $\mu g/m^3$	Annual average	Ecosystem
Nitrogen dioxide	NZ MfE 2002	100 $\mu g/m^3$	24 hour average	Health effects
	NZ MfE 2002	200 $\mu g/m^3$	1 hour average	Health effects
	UK AQM 2002	40 $\mu g/m^3$	Annual average	Health effects

3.2 New Zealand Environmental Performance Indicators

The MfE notes that AAQG should not be seen as a limit to pollute up to, but rather should be considered as minimum requirements for air quality. The Resource Management Act (1991) requires the quality of the environment to be maintained or enhanced. In order to provide guidance on when enhancement should be required, the MfE has provided Environmental Performance Indicators (EPI), as set out in Table 2. These indicators can act as both indicators of poor air quality, and goals which policy can work towards achieving.

Table 2: Environmental Performance Indicators for Air

Category	Maximum Measured Value	Comment
Action	Exceeds guideline	Completely unacceptable by national and international standards
Alert	Between 66 % and 100 % of the guideline	Warning level, which can lead to guidelines being exceeded if trends are not curbed
Acceptable	Between 33 % and 66 % of the guideline	A broad category, where maximum values might be of concern in some sensitive locations, but are generally at a level which does not warrant dramatic action
Good	Between 10 % and 33 % of the guideline	Peak measurements in this range are unlikely to affect air quality
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
Not Assessed		Insufficient monitoring data to assess this category

4 MONITORING SITES

4.1 Visibility

There are four sites that were used by MDC for visibility monitoring. They are:

- Elisha Drive, Blenheim
- MDC Office Roof, Seymour Square, Blenheim
- Scotland Street, Picton
- Woodbourne Airport, Woodbourne

Monitoring of visibility at all sites was suspended in 2002, with the exception of the Woodbourne site.

4.2 Inhalable Particulate

The permanent PM_{10} monitoring site is located at 106 Middle Renwick Road, Blenheim. This site has been operating since February 2000. In 2001 it was also utilised for monitoring of short-term (4 – 5 hour) PM_{10} concentrations by co-locating a second HiVol sampler.

The Redwoodtown site was located at 65A Weld Street, Blenheim. Monitoring was undertaken between May and September 2002. This site was previously monitored from September 2001 to December 2001.

The Renwick site was located at 19 Uxbridge St. Monitoring was undertaken between May and August 2002. This site had not previously been utilised for air quality monitoring.

A new Picton site was established on Oxford Street. Monitoring commenced on 13 October 2002. This site has not previously been used for air quality monitoring.

A SUMMARY description of each site, as provided by MDC, is included in Table 3.

4.3 Passive SO_2 and NO_2

There are five sites used for passive SO_2 and NO_2 monitoring. Both SO_2 and NO_2 is monitored at each site. The sites are:

- Picton
- Bowling Club
- Riverlands
- State Highway 1
- State Highway 6

Monitoring commenced at all sites in June 2002.

A detailed description of each site, as provided by MDC, is included in Table 3.

	Site Area	Where	Purpose	Details	X-coord	Y-coord	Parameter	Old Site ID	New Site ID
Visibility	**Blenheim**	Elisha Drive, Blenheim	Survey site to monitor visibility	Elevated site , residential over town.	2590680	5962532	Visibility	**M1**	
	Blenheim	MDC Beehive Building, Seymour Square	Survey site to monitor visibility	On building over town.	2589688	5965710	Visibility	**M2**	
	Woodbourne	Air Traffic Control Tower	Permanent site to monitor visibility	Airport control tower.	2582409	5965467	Visibility	**M3**	
	Picton	39 Scotland Street, Picton	Survey site to monitor visibility	Elevated site , residential over town.	2593658	5989592	Visibility	**M4**	
PM10	**Picton**	25 Oxford Street	Survey site to monitor PM10	Enclosed site.	2593855	5989623	PM10	None	
	Picton	Fire Station, High Street	Survey site to monitor PM10	Enclosed site.	2594244	5990065	PM10	**1**	
	Blenheim	SH6 - 106 Middle Renwick Road	Permanent site to monitor PM10	Enclosed site.	2588212	5966047	PM10	**2**	
	Blenheim	Blenheim Bowling Club, 65A Weld Street, Redwoodtown	Survey site to monitor PM10	Enclosed site.	2589778	5964037	PM10	**3**	
	Renwick	19 Uxbridge Street, Renwick	Survey site to monitor PM10	Enclosed site.	2578968	5966149	PM10	None	
SO2 and NO2	**Blenheim**	SH1 - 34 Main Street	Survey site to monitor SO2 and NO2	Roadside.	2590343	5965502	SO2 and NO2	None	
	Blenheim	Blenheim Bowling Club, 65A Weld Street, Redwoodtown	Survey site to monitor SO2 and NO2	Enclosed site.	2589760	5964034	SO2 and NO2	**3**	
	Blenheim	Manchester Street, Riverlands Industrial	Survey site to monitor SO2 and NO2	Roadside.	2594114	5963633	SO2 and NO2	None	
	Blenheim	SH6 - 136 Middle Renwick Road	Survey site to monitor SO2 and NO2	Roadside.	2588029	5966019	SO2 and NO2	None	
	Picton	68 Broadway, Picton	Survey site to monitor SO2 and NO2	Roadside.	2593966	5989950	SO2 and NO2	None	

Table 3: MDC Site Description Summary

5 METHODS

5.1 Quality Assurance

All sampling is undertaken by the Marlborough District Council. Sampling operation includes maintenance of the site and calibration of monitoring equipment, and changeover of passive samplers on a monthly basis. Analysis of filters and provision of quality assured data is undertaken by Watercare.

Watercare Services Ltd holds IANZ accreditation for the operation of its laboratory, including analysis of HiVol PM_{10}. The Watercare Services Ltd Air Quality Department has been recommended for IANZ accreditation for its air quality sampling, including HiVol PM_{10} sampling.

5.2 Visibility Monitoring

Visibility monitoring in MDC was undertaken using manual observations of visibility. No instruments were used for recording visibility. Visibility monitoring was undertaken in accordance with the process determined for MDC, and detailed in the ESR report “Visibility observers guide: human judgement of visible air quality” (ESR July 1999). Monitoring required observation of visibility three times per week (Monday, Wednesday and Friday), at each of four sites. Multiple parameters were recorded, including weather conditions, sky colour, presence of haze, smoke, or dust, and farthest distance visible.

On-going monitoring at Woodbourne uses the same methodology as was employed in the project commencing 1999.

The visibility program design is in general accordance with the Ministry for the Environment’s (MfE) “Good practice guide for monitoring and management of visibility in New Zealand” (MfE 2001).

5.3 Inhalable Particulate Monitoring

Particulate is collected by drawing air through a filter using a standard high volume (HiVol) air sampler (Figure 3). The inlet on the sampler has a cut-off of 10 microns (PM_{10}), which is the limit for total inhalable particulates. The method for the high volume sampling is Air Quality Test Method T104, which is based on USEPA cfr40.

Sampling is usually undertaken for a 24 hour period. Sampling occurs once per three days in the winter period when particulate concentrations are potentially higher (1 in 3 day regime), but extends to once per six days throughout the rest of the year. In 2002, a 1 in 3 day regime was undertaken between 01 May and 1 September.

5.4 Passive SO_2 and NO_2 Monitoring

Passive samplers were supplied by Watercare, with analysis subcontracted to ELS. Samplers were prepared and constructed in accordance with methods developed by CSIRO, as reported in Ayers *et al* 1998. Briefly, glass fibre filters are impregnated with sodium hydroxide and sodium iodide. The filters are installed in a plastic casing, with a stainless steel mesh on one end to allow exposure to ambient air. Atmospheric NO_2 reacts with sodium iodide to form nitrite, which is extracted and analysed by UV Visible spectrophotometic method.

Samplers were exposed for periods of approximately one month. Laboratory blanks and spikes were prepared and analysed with each batch. Samplers were housed under an inverted Frisbee.

Figure 2: HiVol PM_{10} Sampler

6 VISIBILITY STUDY – RESULTS AND DISCUSSION

6.1 Visibility Monitoring Summary

Monitoring commenced at Woodbourne in 1999, and was undertaken throughout 2002. From 1 August 2000, monitoring at Woodbourne was undertaken twice each observation day, once in the morning and once in the afternoon. Woodbourne results have been split into 12 month periods, following a calendar year. The 2001 reporting divided the year of monitoring commencing on 1 August of each year.

The number of observations, and time of day when observations were made, are given in Table 3.

Table 4: Visibility Monitoring Summary

Site	Number of Observations	Observation Times	Exceptions to Observation Times
Woodbourne commenced 1999	74	8am to 9am	1
Woodbourne commenced 2000	213	8am to 9am 4pm	1
Woodbourne commenced 2001	312	8am to 9am 5pm to 5.45pm	1
Woodbourne commenced 2002	305	8am to 9am 4pm to 5.45pm	2

6.2 Visibility and Presence of Haze

Aside from weather conditions, it is the presence of haze in the atmosphere that can most severely affect visibility. Haze may be caused by natural processes or human activity. It may also be exacerbated by atmospheric conditions, in particular by temperature inversions trapping particulate within a limited atmospheric depth.

Table 4 shows the percentage of observations when haze, dust, or smoke was recorded, for each site. Haze, smoke and dust recordings are taken directly from the field observations. These define "haze" as a brown sky colour. "Smoke" refers to either an individual plume e.g. agricultural fire, or a collection of sources e.g. households. "Dust" is non-smoke plume.

Haze occurred at Woodbourne on 8 % of the observation days. This is less than previous years (Table 4). Dust occurrence was low (0.2 %), as per previous years.

Table 5: Occurrence of haze, smoke and dust

Site	Number of Observations	Haze as % of Total Observations	Smoke as % of Total Observations	Dust as % of Total Observations
Woodbourne Commenced 1999	158	29.7%	29.7%	1.4%
Woodbourne Commenced 2000	213	17.8%	22.1%	3.8%
Woodbourne Commenced 2001	312	9.3%	23.1%	2.9%
Woodbourne Commenced 2002	305	10.8 %	17.7 %	0.3 %

Error! Reference source not found. shows the overall breakdown of days when haze was recorded. Haze occurred concurrently with smoke or inversions on 72% of recorded days. This is higher than previous years. Inversions were concurrent with haze events for a 36 % of the time. This suggests that inversions do contribute significantly to formation of haze, a pattern not noted in earlier years. It is also noted that in 2002, morning observation times were all around 8am, before an overnight inversion degraded. In previous years, some observations occurred late in the morning, by which time a temperature inversion from the previous night may have degraded.

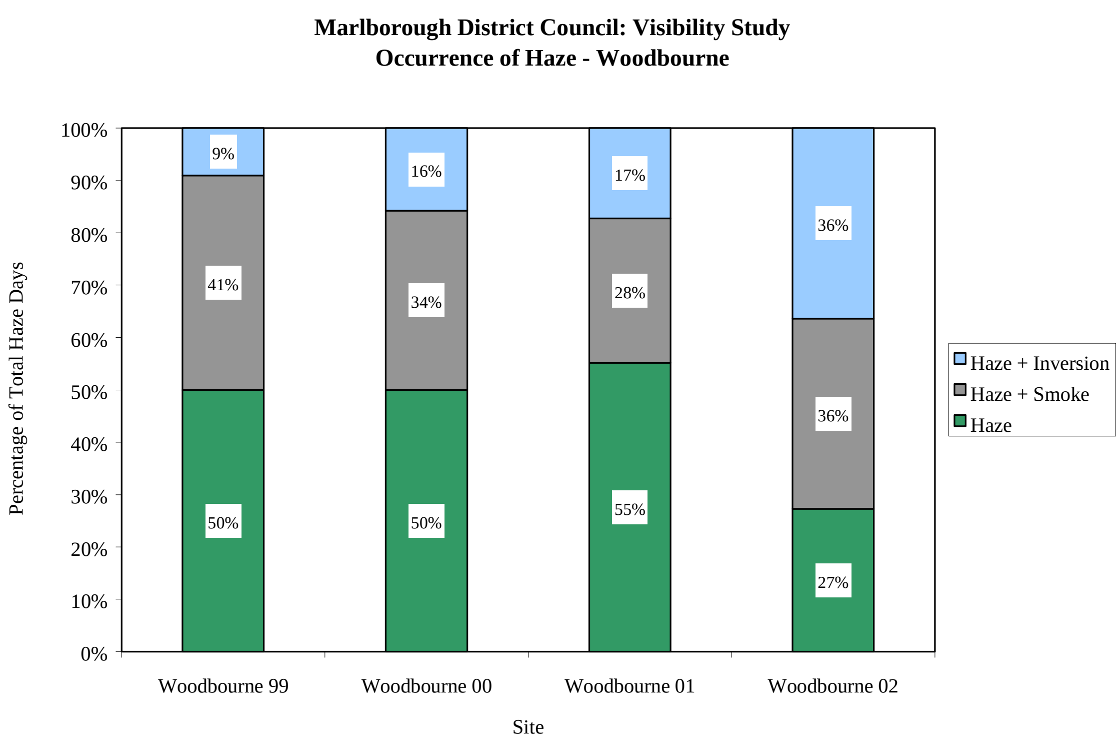

Figure 3: Occurrence of Haze at Woodbourne

Over the four years of monitoring at Woodbourne, a higher percentage of haze was recorded in the first year of observation (27% of total observations)(Table 4).

The percentage of observations when smoke was recorded at Woodbourne was low in 2001 and 2002 compared to previous years (Table 5). The occurrence of haze combined with smoke events was higher than other years (Figure 3). Dust events were low across all years (Table 4).

The occurrence of haze showed a slight seasonal trend (Figure 4). At Woodbourne, haze occurred throughout the year, but was slightly more frequent in March and April, and again in August and October. This may be due to agricultural practices influencing visibility in this rural location.

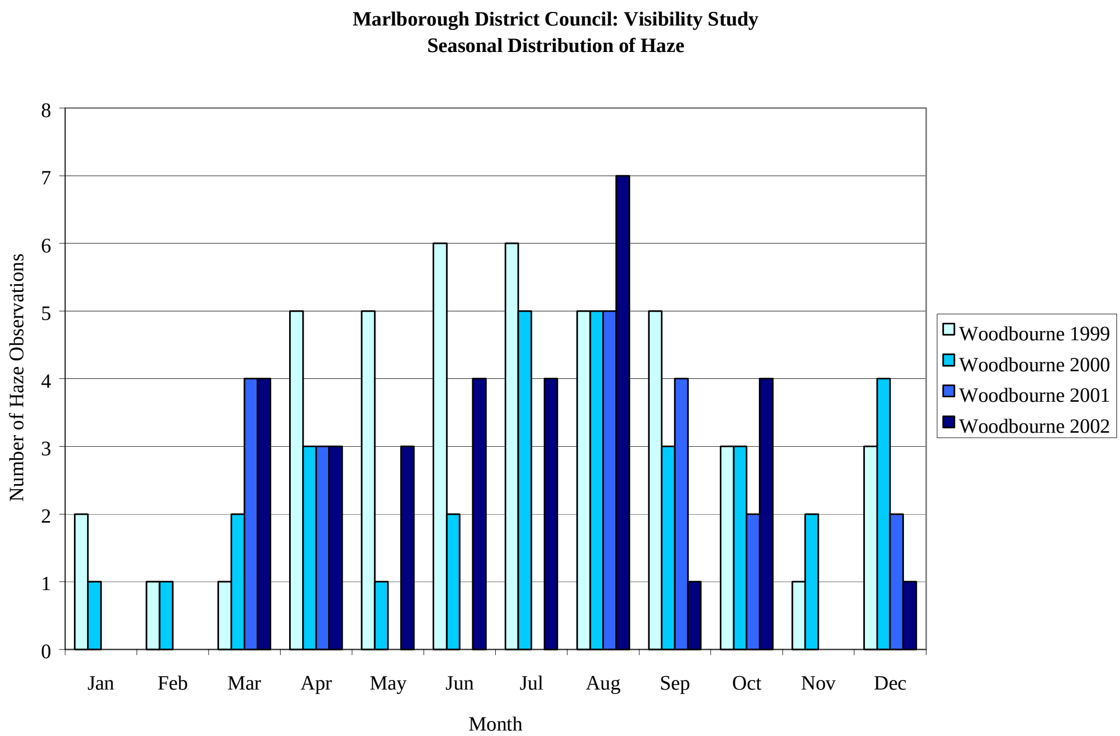

Figure 4: Seasonal Distribution of Haze at Woodbourne

6.3 Overall Clarity Rating for Marlborough District

The overall visual clarity is represented by the distance through the atmosphere over which landmarks and features can be readily observed. It is represented by the ease with which the chosen target landmark for each site is observed, and by the farthest distance (farthest landmark) that can be viewed on an observation day. Visibility observations undertaken by MDC have included the clarity of the target outline, whether the target colour can be determined, and an estimate of farthest distance viewed. These combine to give an indication of the overall visual clarity.

The clarity with which the target could be viewed at each site is shown in Figure 6. Figure 6 shows that for the majority of the time, the target could be seen with excellent clarity, or only slight haziness.

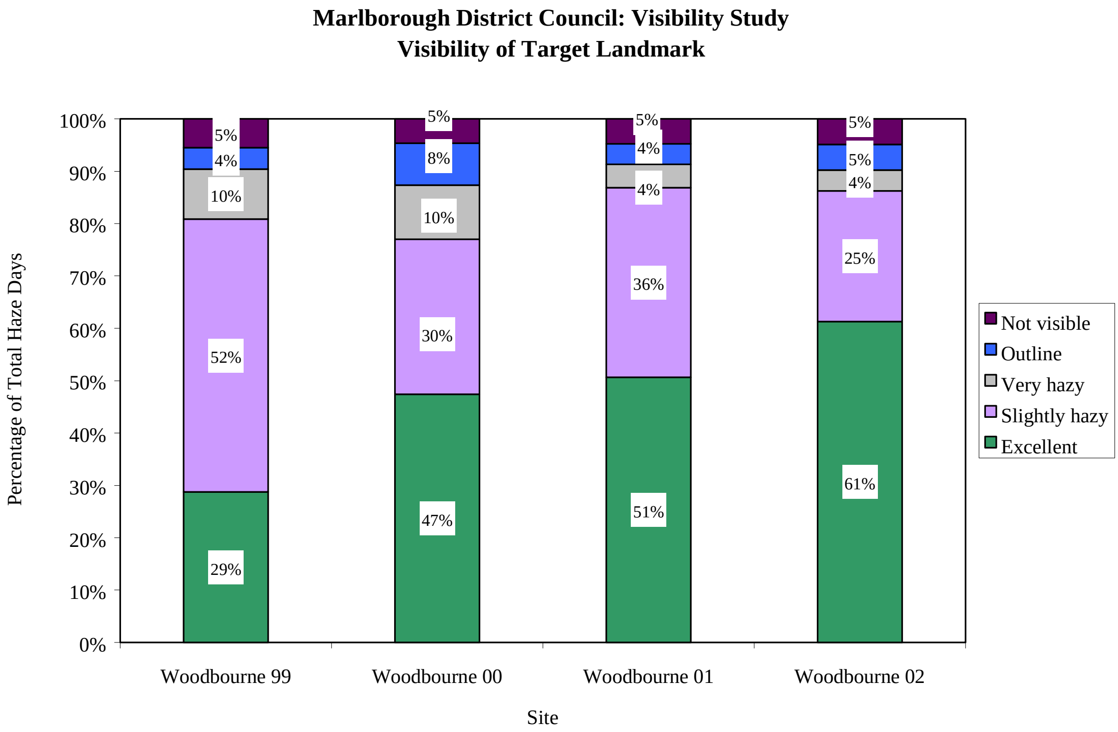

Figure 5: Visibility of Target Landmark

The maximum distance viewed each observation day was also recorded. The maximum distance provides an indication of the transparency of the atmosphere. Results are presented in Table 6.

Table 6: Visual Range – Farthest Distance

Site	0-2 km	2-10 km	11-25 km	26-50 km	51-69 km	70+ km
Woodbourne 1999	1%	9%	22%	32%	11%	24%
Woodbourne 2000	0%	4%	24%	29%	11%	31%
Woodbourne 2001	1%	2%	8%	38%	20%	31%
Woodbourne 2002	1%	3%	6%	36%	8%	46%

In the third and fourth year of observations, Woodbourne reported more high visibility range (>70 km) events than in previous years. This does not appear to be due to different observers.

6.4 Overall Visibility

The overall visibility gives an indication of how good visibility is on each day. Visibility observations undertaken by MDC included an assessment of the overall visibility on each observation day. The overall visibility rating is presented in Figure 6.

Figure 6 shows that in 2002, overall visibility was average or above average for 80% of the time. There is insufficient information from other regions to compare this to national averages.

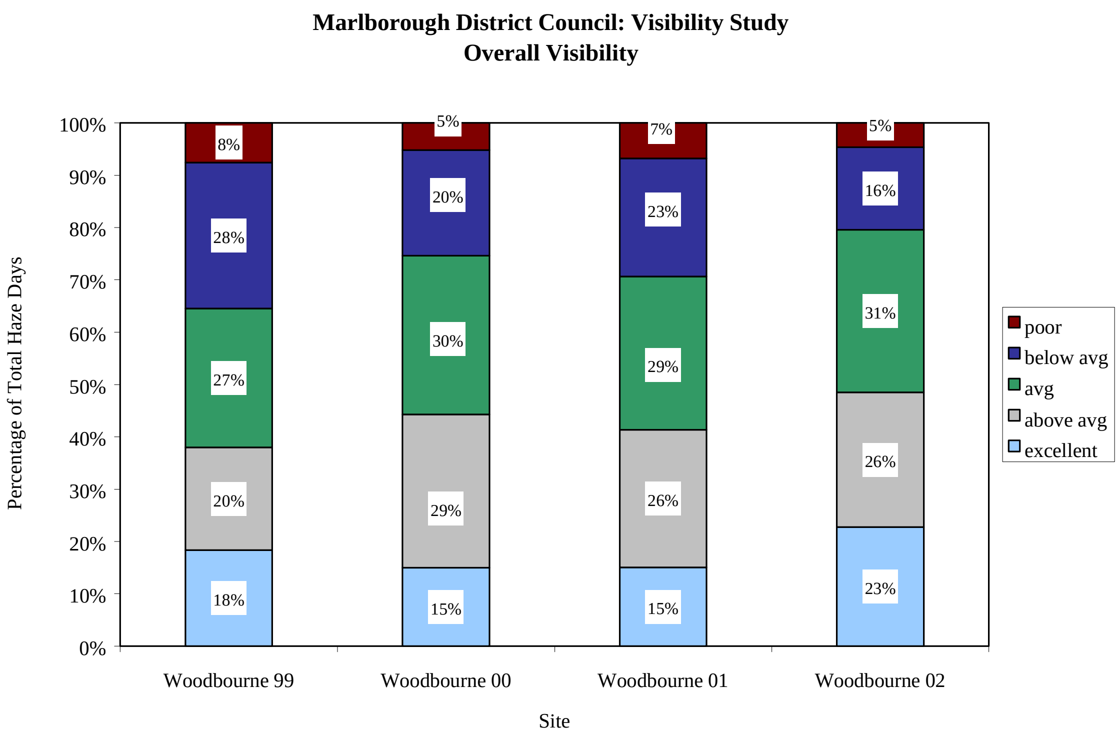

Figure 6: General Visibility Rating

7 INHALABLE PARTICULATE – RESULTS AND DISCUSSION

7.1 Ambient Particulate in Marlborough

Site performance in 2002 was very good. At three of the four sites valid results were obtained for all scheduled sampling days, resulting in 100% valid data. One sample was missed at Renwick, resulting in 97% valid data.

The air quality measured at each site, relative to AAQG, was determined by calculating the Environmental Performance Indicator (EPI) for three sites. At Picton, sampling commenced in October 2002, missing the winter monitoring period. This resulted in a very good EPI for Picton, which is unlikely to reflect the actual situation at this site, and therefore it has not been included in EPI reporting for 2002. The other site EPI's are shown graphically in Figure 7.

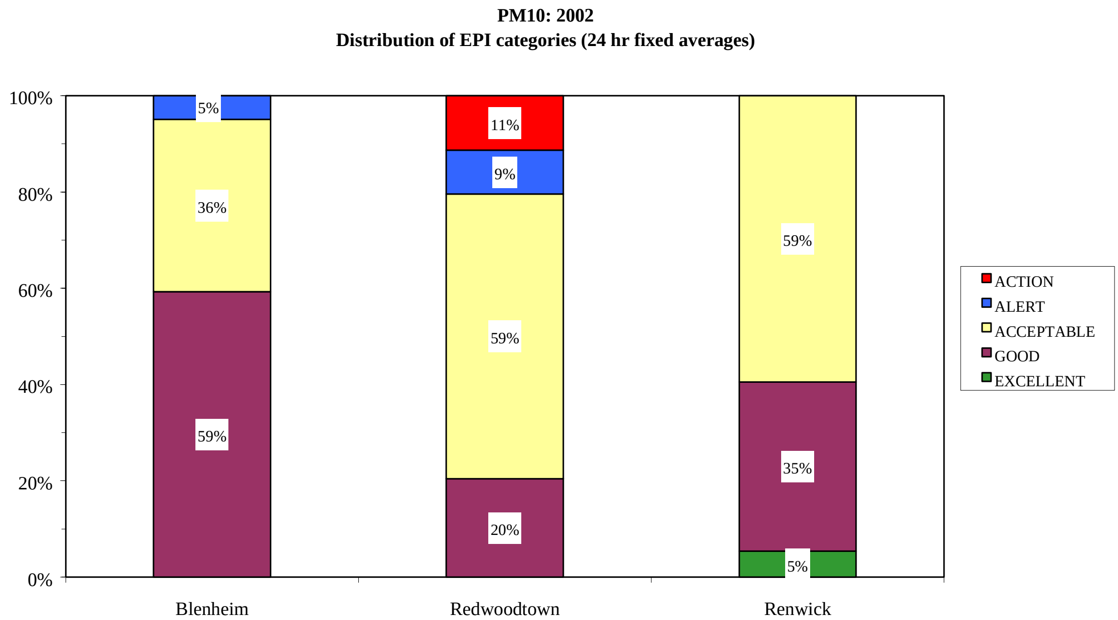

Figure 7: Comparison of PM_{10} to EPI

At the Blenheim site, there were no exceedances in 2002. Air quality was in the "alert" category for 5% of the time, in the "acceptable" category for 36% of the time, and in the "good" category for 59% of the time (refer to Table 2 for explanation of categories). Air quality was not "excellent" at Blenheim in 2002 with respect to PM_{10}. This is similar to 2001 results.

At Redwoodtown, air quality appeared to be worse than in Blenheim. Guidelines were exceeded on 5 monitored days, resulting in 11% of days in "action" category, 9% "alert", 59% "acceptable", 20% "good", and 0% "excellent". The EPI at this site is much worse than in 2001, but this can largely be attributed to the timing of monitoring. In 2001, this site was monitored in the spring and summer (September to December), which missed the wintertime peaks. In 2002, this site was monitored from May to September, with exceedances occurring between May and August.

At Renwick, air quality was better than the other two sites in 2002. Air quality did not reach the "action" or "alert" category. Air quality was in the "acceptable" category for 60% of the time, and in the "good" category for 35% of the time, and in the "excellent" category for 5% of the time (refer to Table 2 for explanation of categories).

The regular occurrences of "alert" categories in 2000, 2001 and 2002, and the occurrence of "action" category (guidelines have been exceeded) at Redwoodtown, indicate the need to improve air quality in Blenheim with respect to PM_{10}.

PM_{10} concentrations are shown in Figure 8 (Blenheim), Figure 9 (Redwoodtown), Figure 10 (Renwick), and Figure 11 (Picton – Oxford St). Summary statistics are presented in Table 7. Note that the Picton site was not established until October, and therefore the results do not include the winter period when ambient particulate concentrations are highest.

Table 7: PM_{10} Summary Statistics 2002

Site	No. of Samples	Maximum (µg/m^3)	Minimum (µg/m^3)	Average (µg/m^3)	No. of Exceedances of AAQG*
Blenheim	81	40.8	5.2	16.6	Nil
Redwoodtown	44	58.0	7.6	26.8	5
Renwick	35	29.5	7.0	16.8	Nil
Picton	14	11.0	1.6	6.7	Nil

* Exceedance of 50 µg/m^3, 2002 AAQG

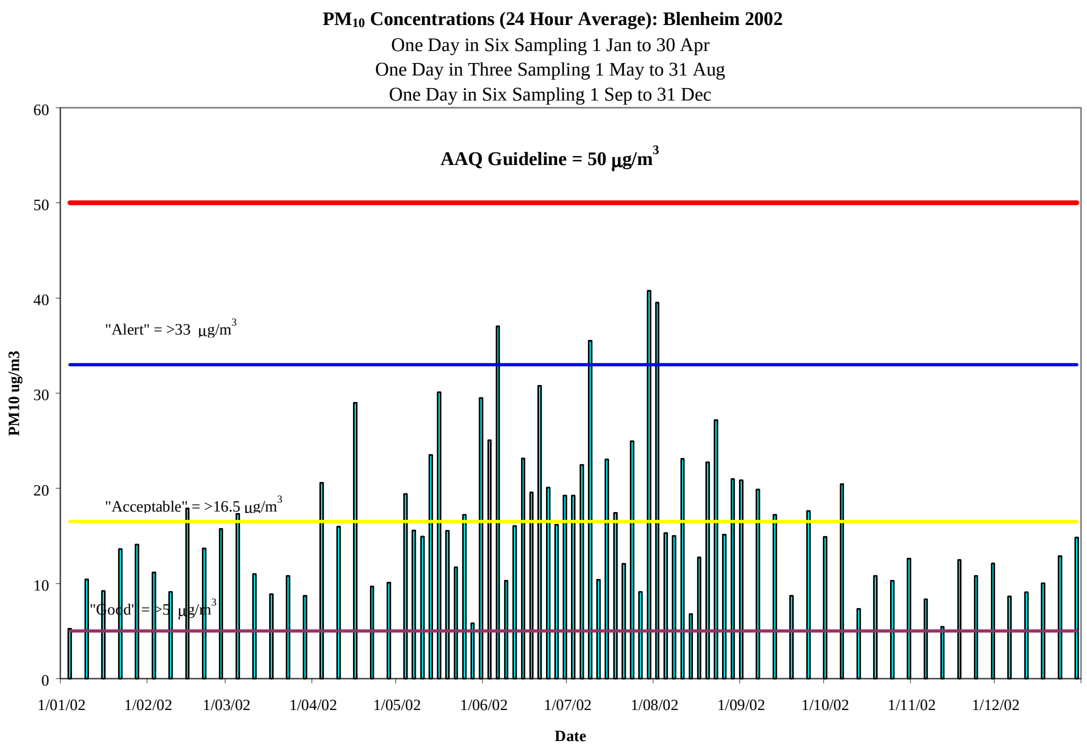

Figure 8: **PM_{10} concentrations (24 hr avg) at Blenheim**

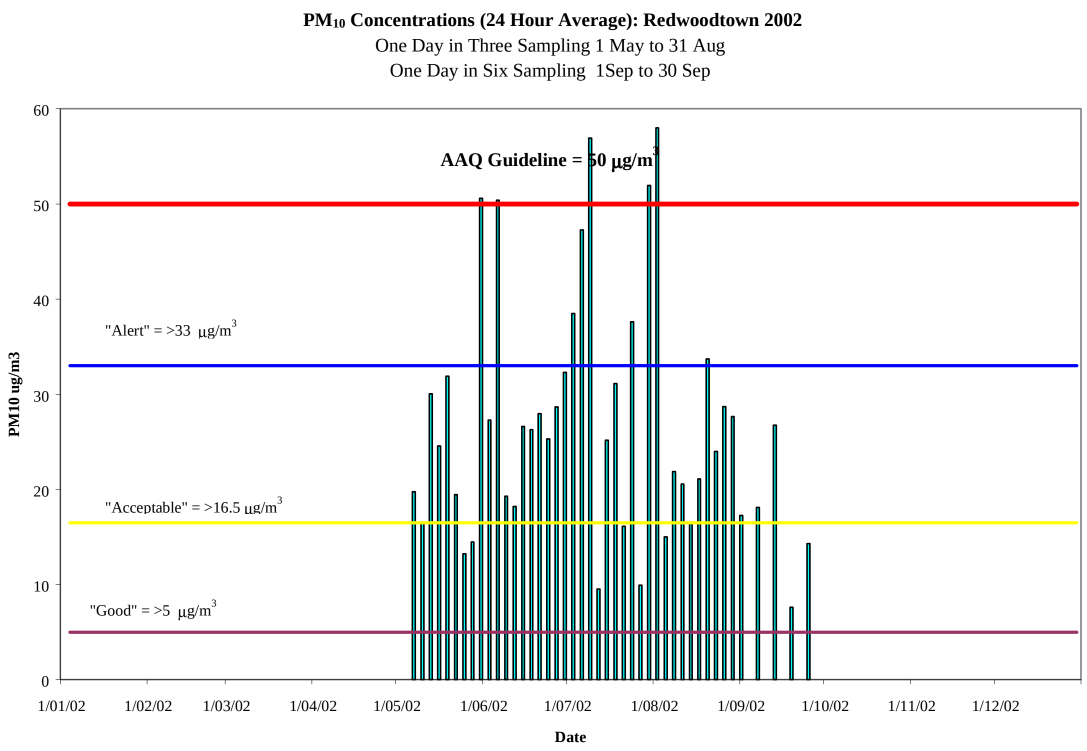

Figure 9: **PM_{10} concentrations (24 hr avg) at Redwoodtown**

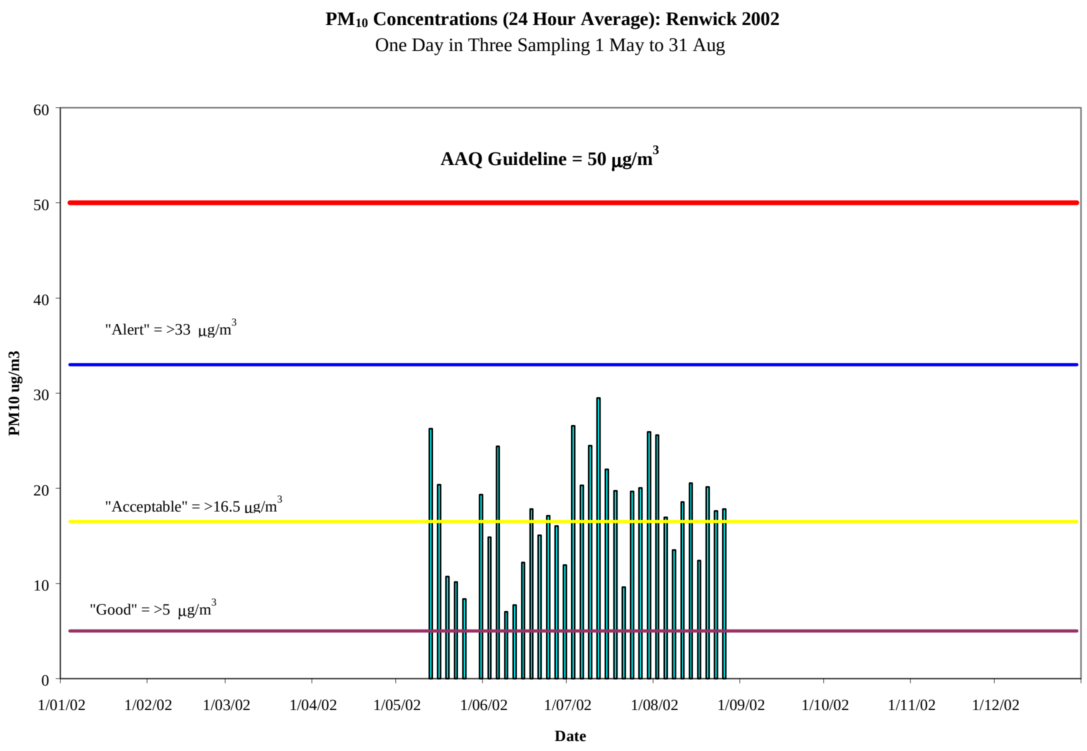

Figure 10: PM_{10} concentrations (24 hr avg) at Renwick

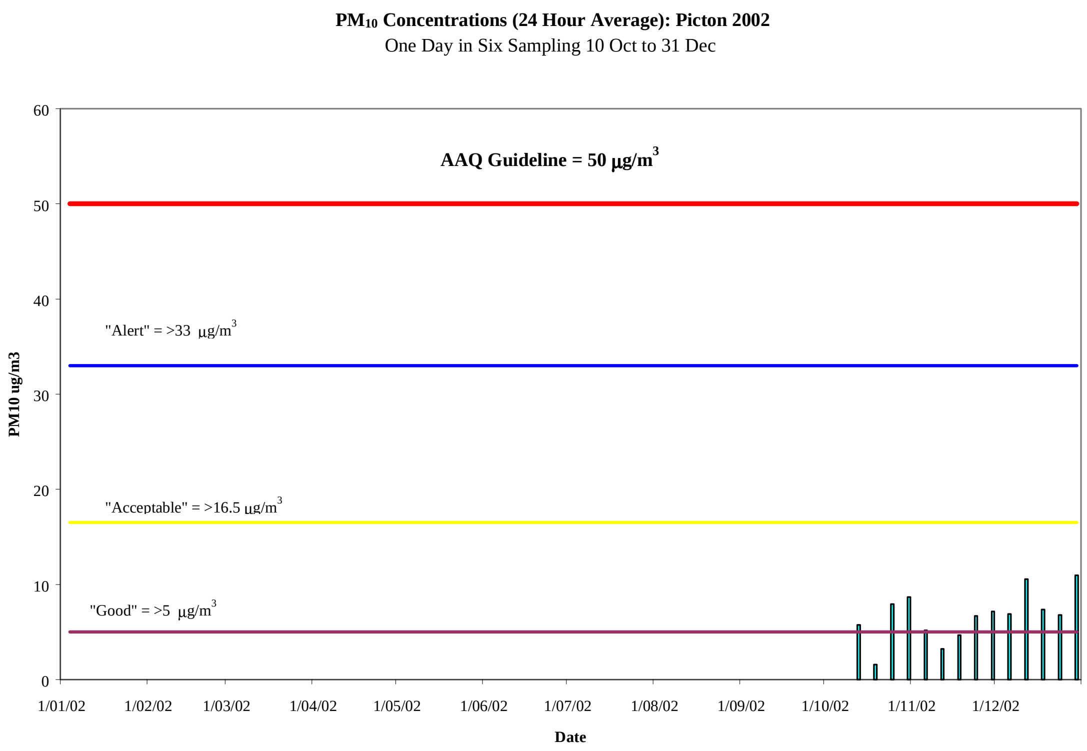

Figure 11: PM_{10} concentrations (24 hr avg) at Picton

7.2 Exceedances of Ambient Air Quality Guidelines for PM_{10}

The MfE AAQG of 50 µg/m^3 was exceeded at Redwoodtown on five monitored days in 2002. In addition, the EPI category of "alert", i.e. ambient PM_{10} concentrations greater than 33 µg/m^3, was reached on four days at Blenheim and four days at Redwoodtown. The effect of meteorology on ambient PM_{10} was evaluated.

Meteorological data from the Landcare Research Station is purchased from NIWA by MDC. The data obtained is wind speed, wind direction, rainfall and temperature (temperature commencing July 2002).

The exceedance dates, ambient PM_{10} concentrations, and meteorological data is summarised in Table 8 below. Hourly wind speed and temperature results are shown graphically in Appendix B.

Table 8: PM_{10} Exceedances and Meteorological Data

Date	Blenheim PM_{10} (µg/m^3)	Redwoodtown PM_{10} (µg/m^3)	Rainfall (mm)	Average Temp (°C)	Average Wind Speed (m/s)	Wind direction (degrees)
31/05/02	29.5	50.6	0	-	4.5	245-281
6/06/02	37.0	50.4	0	-	9.1	208-285
3/07/02	19.2	38.5	0	7.6	5.0	225-288
6/07/02	22.5	47.3	0	7.3	3.6	215-279
9/07/02	35.5	56.9	0	6.4	5.7	218-265
24/07/02	25.0	37.6	0	9.8	5.1	230-326
30/07/02	40.8	51.9	0	5.3	5.0	206-270
2/08/02	39.5	58.0	0	5.6	5.1	245-70
20/08/02	22.7	33.7	0	9.3	3.9	217-37

Ambient PM_{10} concentrations were exceeded on days that typically had cool nights (0.4 – 6 °C) (refer Appendix B), and low wind speeds (average less than 5 m/s in most cases). This is expected where domestic heating is the major source of particulate – cool nights encourage heating use, and low wind speeds reduce dispersion. Furthermore, wind direction was typically from the south west to west quarter (225 to 270 degrees). On some days, the wind changed to an easterly direction during the day, but night time was predominantly from the south west to west.

The effect of meteorology on overall particulate concentrations was further evidenced by high values often being reported at both sites. For example, when an exceedance of the AAQG occurred at Redwoodtown, this often coincided with concentrations at Blenheim above 33 µg/m^3 ("alert" EPI category).

8 COMPARISON OF PARTICULATE AND VISIBILITY DATA, 2002

In 2002, there were five exceedances of the PM_{10} AAQG at Redwoodtown, and a total of nine days when the MfE EPI "alert" category was reached (Table 8) . Over this period, visibility monitoring was undertaken at Woodbourne. The visibility conditions on high particulate days are summarised in Table 9.

Table 9: Comparison of PM_{10} to Atmospheric Visibility

Date	Blenheim PM_{10} ($\mu g/m^3$)	Redwoodtown PM_{10} ($\mu g/m^3$)	Haze	Inversion	General Visibility Rating
31/05/02	29.5	50.6	No	No	Excellent
6/06/02	37.0	50.4	NR	NR	NR
3/07/02	19.2	38.5	Yes	No	Average
6/07/02	22.5	47.3	NR	NR	NR
9/07/02	35.5	56.9	NR	NR	NR
24/07/02	25.0	37.6	No	No	Below average
30/07/02	40.8	51.9	NR	NR	NR
2/08/02	39.5	58.0	No	No	Average
20/08/02	22.7	33.7	NR	NR	NR

NR No Recording of visibility on this day

This comparison is limited because of the physical separation between the visibility and PM_{10} monitoring locations. Nevertheless, it does provide some information.

In earlier years, high particulate coincided with haze and / or inversion conditions. In 2002, this was not the case. Visibility is an indirect measurement of air quality, and does not provide a good indicator of concentrations of specific pollutants. In 2002, the relationship between visibility and PM_{10} was poor.

The weather conditions during high particulate events are indicative of calm, clear weather, with poor potential to disperse contaminants. These conditions can be expected to occur on several occasions every winter, and a corresponding high particulate concentration can likewise be expected every winter.

9 PASSIVE NO_2 AND SO_2 – RESULTS AND DISCUSSION

9.1 Passive NO_2 and SO_2 Results - Marlborough

Sampling for SO_2 and NO_2 commenced in July 2002. Data was obtained for all sites except Riverlands and State Highway 6 in December, when samplers were vandalised.

Samplers are prepared in batches, and blank and spiked samples are analysed concurrently as part of analytical quality assurance (QA). For the August to November batch, the QA samples were not within the expected range of results. Spike concentrations varied significantly. The laboratory was unable to determine the reason for this variability. Results have been reported, but are unable to be fully validated.

Results of passive monitoring in 2002 is shown in Figure 12 (passive NO_2) and Figure 13 (passive SO_2). All results show a distinct seasonal trend, with concentrations being higher in winter. This trend is more marked with NO_2 than with SO_2. Secondly, the results show a trend between sites, with higher concentrations in the vicinity of the SH1 and SH6 sites. The difference between sites was more pronounced for SO_2 than for NO_2. This is attributed to the contribution from diesel-powered vehicles on these major roads.

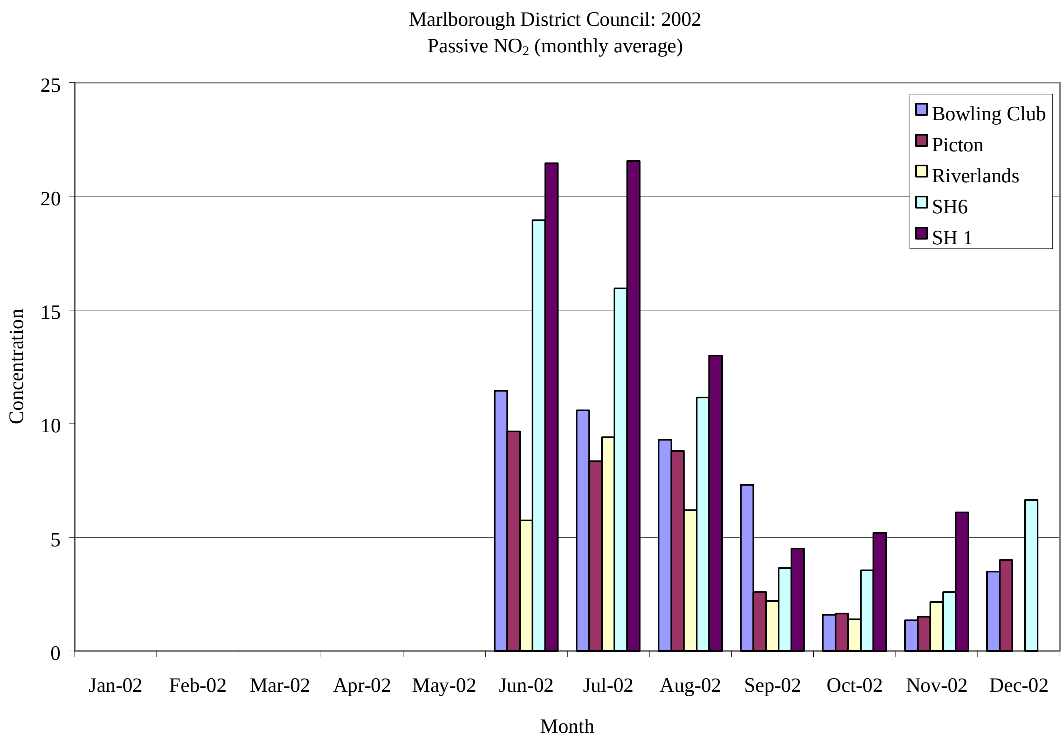

Figure 12: Passive NO_2 Results (monthly avg)

The results from MDC are all less than the UK annual guidelines of 40 $\mu g/m^3$ for NO_2 and 20 $\mu g/m^3$ for SO_2 (Table 1).

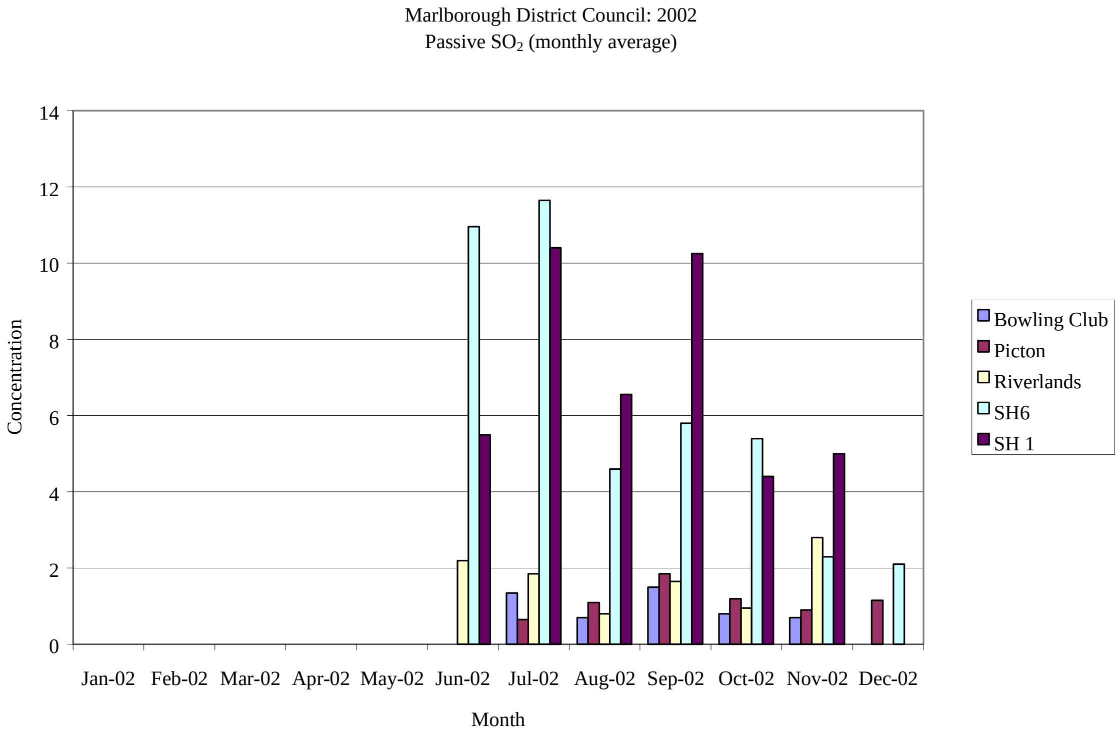

Figure 13: Passive SO_2 Results (monthly avg)

9.2 Comparison of Passive NO_2 and SO_2 to Otago

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As passive SO_2 and NO_2 monitoring has only recently commenced in Marlborough, there is no historic data to determine relative performance from. However, Otago Regional Council (ORC) use the same methodology for monitoring in Dunedin. In the year 2002, passive NO_2 concentrations ranged between 7.3 to 20.4 $\mu g/m^3$ at Albany St (central Dunedin, and 6.2 to 13.9 $\mu g/m^3$ at North East Valley. Peak concentrations are similar to those at the MDC SH1 site.

Passive SO_2 measurements in Albany St ranged from 9.2 to 25.7 $\mu g/m^3$, and in North East Valley ranged from 1.2 to 8.7 $\mu g/m^3$. Peak concentrations in Marlborough are less than highest values in Dunedin, but the magnitude is similar.

10 CONCLUSIONS AND RECOMMENDATIONS

10.1 Visibility

In 2002, the visibility from Woodbourne was very good. There was little haze, compared to previous years, and the overall clarity was average to above average for 80% of the time.

The rural location of the Woodbourne site is expected to contribute to the good visibility at this site.

10.2 Inhalable Particulate

Particulate results showed a strong seasonal trend, with higher concentrations in winter. Sampling on a 1 day in 3 regime over the winter provides a much improved data set over the 1 in 6 day regime undertaken throughout the rest of the year. It is recommended that 1 in 3 day monitoring is undertaken every winter.

The highest particulate results were obtained at Redwoodtown. Results from the Blenheim permanent sites were similar to 2001. The Renwick site had the lowest particulate results, and the EPI category for this site remained “acceptable” throughout the monitored period.

Meteorological records affected particulate concentrations, with high particulate results coinciding with cool evenings and low wind speeds.

The relationship between high particulate and visibility records at Woodbourne was poor in 2002.

10.3 Passive NO_2 and SO_2

The passive monitoring results show a seasonal trend, with concentrations being higher in winter. All results were less than the UK annual average. The NO_2 peak concentrations were similar to North East Valley, Dunedin. The SO_2 concentrations were less than either Dunedin sites, but were of a similar order of magniture.

The passive monitoring results have provided an indication of the relative contamination of different sites monitored by MDC. It is recommended that passive monitoring is continued.