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CCA and Formaldehyde Monitoring at Railway Crescent, Masterton

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1. Introduction

A targeted air quality monitoring programme was undertaken at Railway Crescent, Masterton during the winter of 2004.

The monitoring programme was initiated in response to local residents concerns regarding emissions from a neighbouring timber mill and timber treatment facility. Due to a lack of New Zealand specific air quality monitoring data in regard to the actual downwind environmental effects due to emissions from such activities, Greater Wellington carried out a three month screening survey to determine whether there was any potential for offsite environmental effects including potential effects on public health.

Ambient air quality monitoring for total suspended particulate matter (TSP) and formaldehyde was undertaken from May to September 2004. The purpose of the monitoring was to quantify atmospheric loadings of TSP and determine the concentrations of copper, chromium and arsenic (CCA) species associated with the particulate matter. Ambient air was also sampled to determine the concentrations of gaseous formaldehyde and other aldehyde species associated with the kiln drying of timber and re-drying of CCA treated timber.

2. Monitoring programme

2.1 Air pollutants discharged from timber milling, timber treatment, and kiln drying processes

There are a number of discharges to air associated with timber milling, treatment of timber, and kiln drying of timber.

2.1.1 Timber milling

Timber milling processes discharge sawdust particles which are generally extracted by pneumatic conveyance to a cyclone dust collection system. Cyclone collectors are not 100% efficient and therefore some of the finer particles are discharged from the exhaust gas outlet.

2.1.2 Timber treatment

Timber treatment by copper chrome arsenic (CCA) wood preservatives is conducted under pressure in a sealed chamber and there is little or no discharge to air during this process, however, removing the treated timber and transfer around the yard area can lead to some preservative dripping on to the ground. There it can be adsorbed onto dust particles, become airborne by wind or vehicle movements and thereby transferred offsite.

2.1.3 Kiln drying of timber

Kiln drying of untreated timber releases steam and a range of volatile organic compounds (VOCs), primarily in the form of low molecular weight aldehydes and terpenes. Formaldehyde and acetaldehyde dominate the emission of aldehyde compounds. Kiln drying of CCA treated timber releases similar VOCs as well as copper, chromium and arsenic compounds (Mc Donald et al, Forest Research Institute (FRI) Report '*Air and Condensate Emissions from Lumber Drying. Part IV.*' Multi-Client Drying Research Project Report No. 2 June 1998). Kiln drying of timber involves a cycle of steam heating and forced ventilation. Releases to atmosphere are via stub vents on the kiln roof controlled by software designed to optimise product quality. The FRI report does not indicate the physical form that CCA compounds are released in, but indicates that the chemicals are likely to be steam stripped during the drying process and discharged through the vents.

For the purposes of this report it is assumed that the CCA components are steam stripped during the kiln drying process by solvation in the steam water droplets and retain the same oxidation state and form that they were as the timber treatment solution i.e. as various Cu II, Cr VI and As V salts (from Material Safety Data Sheet for Tanilith C Oxide produced by Koppers Arch Wood Protection (NZ) Ltd). On discharge to atmosphere through the kiln vents it is likely that the steam droplets would evaporate leaving the CCA species as fine particulate matter that are either dispersed as is, agglomerate to form larger particles, or are adsorbed onto particles already present in the atmosphere. It is considered likely that a combination of all three mechanisms is involved in the fate of CCA discharges from the kiln.

2.2 Ambient monitoring programme design

The chemical and physical form of the discharges from the timber milling, timber treatment facility and kiln drying processes were considered when designing the monitoring programme. Based on the emissions outlined in Section 2.1, the monitoring programme was designed to include analysis of air particulate matter for chemical species associated with the preservative treatment of timber, namely that of copper, chromium and arsenic. Additionally, monitoring for volatile organic species discharged from kiln emissions was also monitored with formaldehyde chosen as the indicator species.

2.2.1 Sampling for total suspended particulate matter and CCA

There are a variety of methods for sampling air particulate matter, for the purposes of this study sampling for total suspended particulate matter (TSP) was the most appropriate to cover the range of particle sizes discharged from the activities carried out at the timber mill. The TSP sampling method used is a USEPA Federal Reference Method (40 CFR Part 50, Appendix B *Reference Method for the Determination of Suspended Particulate Matter in the Atmosphere (High-Volume Method)*) and the sampler and sampling methodology was set up and carried out accordingly. Essentially, ambient air was sampled through an 8"x10" individually numbered glass fibre filter at a rate of 70 m^3/hr. Analysis of CCA content was by ICP-MS. Filters were supplied and analysed by Environmental Laboratory Services Ltd.

2.2.2 Sampling for formaldehyde and other aldehydes

Formaldehyde and other aldehydes were sampled using a sorbent tube packed with 2,4-dinitrophenylhydrazine. (USEPA Compendium Method TO-11A *Determination of Formaldehyde in Ambient Air Using Adsorbent Cartridge followed by High Performance liquid Chromatography (HPLC).* Sampling rate was approximately 1500 ml/min using an SKC Airchek 2000 automated sampler. Sorbent tubes were supplied and analysed by Allan Aspell and Associates Ltd.

2.2.3 Sampling site description and location

The samplers were set up in the front yard of a residential property on Railway Crescent, Masterton. The monitoring site was approximately 100 metres to the southeast of the timber mill's wood drying kilns. Figure 1 shows an aerial photograph of the monitoring site and Figure 2 shows the site location to the north of Masterton town centre.

Figure 1: Aerial view of monitoring site (★)

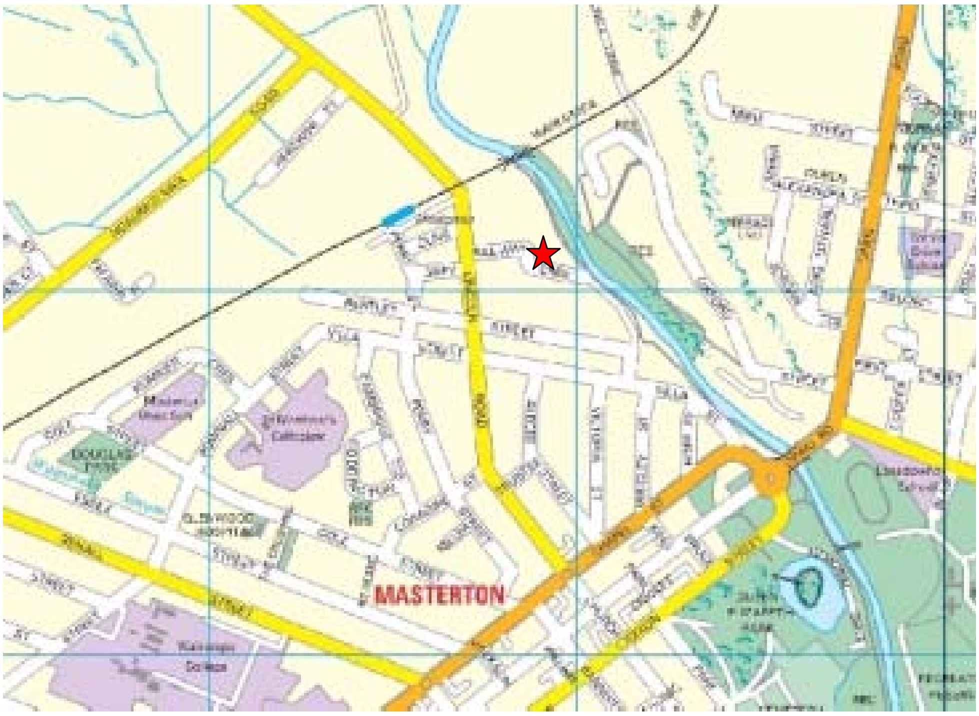


Figure 2: Location map of monitoring site (★)

2.3 Monitoring period and sampling frequency

The monitoring site was established in May 2004 and sampling began on 26 May 2004 and ran to the end of September 2004. The monitoring programme was set up as a one-day-in-three (i.e. 24 hours out of every 72) sampling frequency. Samples were collected from midday to midday to coincide with the monitoring regime at the Greater Wellington ambient air quality monitoring station at Wairarapa College, Masterton. The concurrent sampling enabled the

Wairarapa College site to be used as a background reference for the results obtained at Railway Crescent.

2.4 Quality assurance

Both sets of sampling equipment were calibrated on a monthly basis. Air flow through the high-volume sampler was calibrated using a critical orifice manometer and the AirChek 2000 VOC sampler was calibrated using a Gillian ‘Gillibrator’ bubble flow meter. All data presented in this report has been corrected for blank subtraction.

3. Monitoring Results

3.1 TSP and CCA results

A total of 33 TSP samples were collected during the monitoring period. The results for the TSP and CCA analysis are given in Table 1 and depicted graphically in Figure 3.

Table 1: TSP and CCA analysis results

Filter Paper Number	Date on (12:00)	Date Off (12:00)	TSP (g/m^3)	Arsenic (g/m^3)	Chromium (g/m^3)	Copper (g/m^3)
7515300	27/05/2004 12:00	28/05/2004 12:00	18.27	0.004	0.000	0.002
7515299	30/05/2004 12:00	31/05/2004 12:00	26.73	0.012	0.000	0.003
7515268	02/06/2004 12:00	03/06/2004 12:00	30.83	0.004	0.000	0.003
7515269	08/06/2004 12:00	09/06/2004 12:00	34.17	0.009	0.000	0.003
7515270	11/06/2004 12:00	12/06/2004 12:00	32.98	0.013	0.000	0.002
7515271	14/06/2004 12:00	15/06/2004 12:00	29.46	0.011	0.002	0.007
7515272	20/06/2004 12:00	21/06/2004 12:00	13.75	0.008	0.000	0.002
7515273	23/06/2004 12:00	24/06/2004 12:00	37.74	0.013	0.000	0.004
7515274	26/06/2004 12:00	27/06/2004 12:00	10.42	0.001	0.000	0.001
7515298	02/07/2004 12:00	03/07/2004 12:00	28.45	0.007	0.000	0.002
7515275	07/07/2004 12:00	08/07/2004 12:00	31.49	0.026	0.000	0.004
7515276	11/07/2004 12:00	12/07/2004 12:00	33.57	0.017	0.000	0.003
7515277	14/07/2004 12:00	15/07/2004 12:00	37.44	0.047	0.007	0.011
7515278	17/07/2004 12:00	18/07/2004 12:00	24.23	0.002	0.000	0.001
7515279	20/07/2004 12:00	21/07/2004 12:00	38.99	0.009	0.000	0.004
7515280	23/07/2004 12:00	24/07/2004 12:00	38.57	0.015	0.000	0.001
7515281	29/07/2004 12:00	30/07/2004 12:00	28.63	0.005	0.000	0.002
7515282	04/08/2004 12:00	05/08/2004 12:00	19.82	0.005	0.000	0.002
7515283	07/08/2004 12:00	08/08/2004 12:00	27.02	0.011	0.000	0.001
7515284	10/08/2004 12:00	11/08/2004 12:00	34.88	0.007	0.002	0.007
7515285	13/08/2004 12:00	14/08/2004 12:00	29.88	0.002	0.000	0.002
7515286	16/08/2004 12:00	17/08/2004 12:00	31.13	0.003	0.000	0.001
7515297	22/08/2004 12:00	23/08/2004 12:00	26.49	0.001	0.000	0.002
7515287	25/08/2004 12:00	26/08/2004 12:00	24.58	0.003	0.000	0.001
7515296	28/08/2004 12:00	29/08/2004 12:00	19.17	0.010	0.000	0.002
7515288	31/08/2004 12:00	01/09/2004 12:00	23.81	0.006	0.000	0.002
7515295	03/09/2004 12:00	04/09/2004 12:00	22.98	0.006	0.000	0.001
7515294	06/09/2004 12:00	07/09/2004 12:00	28.87	0.006	0.000	0.002
7515293	09/09/2004 12:00	10/09/2004 12:00	51.90	0.010	0.000	0.004
7515292	12/09/2004 12:00	13/09/2004 12:00	33.63	0.006	0.001	0.005
7515291	15/09/2004 12:00	16/09/2004 12:00	19.82	0.005	0.002	0.004
7515290	18/09/2004 12:00	19/09/2004 12:00	23.51	0.016	0.000	0.002
7515289	21/09/2004 12:00	22/09/2004 12:00	30.09	0.010	0.010	0.009
		Max	**51.9**	**0.047**	**0.010**	**0.011**
		Min	**10.4**	**0.001**	**0.00**	**0.001**
		Average	**28.6**	**0.009**	**0.001**	**0.003**

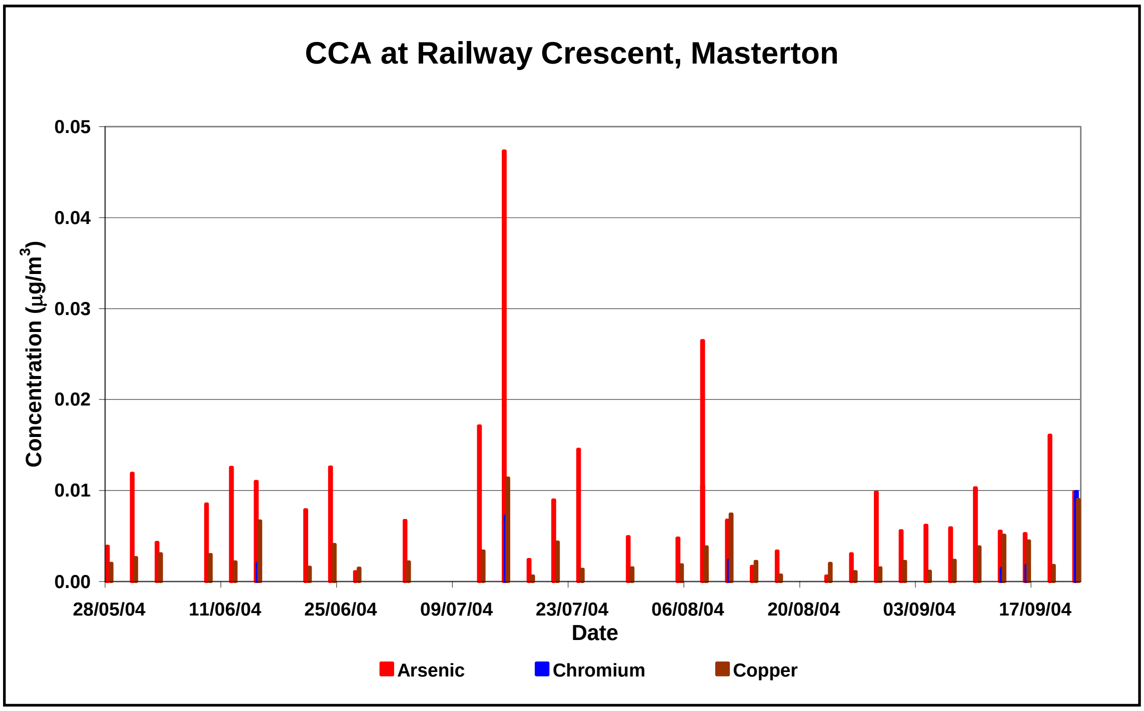


Figure 3: CCA concentrations at Railway Crescent, Masterton

3.1.1 Background CCA concentrations

Concurrent to the monitoring carried out at the Railway Crescent site, GW was also monitoring elemental concentrations of various species present in PM_{10} at the Wairarapa College ambient air quality monitoring station using a GENT sampler and analysis by proton induced x-ray emission. For the purposes of this study the analytical methods were considered comparable. The maximum/minimum/mean concentrations (36 samples) of CCA metals measured in this manner are presented in Table 2.

Table 2: Background CCA concentrations in Masterton from Wairarapa College site

	PM_{10} (g/m^3)	Arsenic (g/m^3)	Chromium (g/m^3)	Copper (g/m^3)
Max	53.2	0.045	0.018	0.023
Min	6.7	0.00	0.004	0.00
Average	22.0	0.012	0.010	0.008

The background CCA concentrations are depicted graphically in Figure 4.

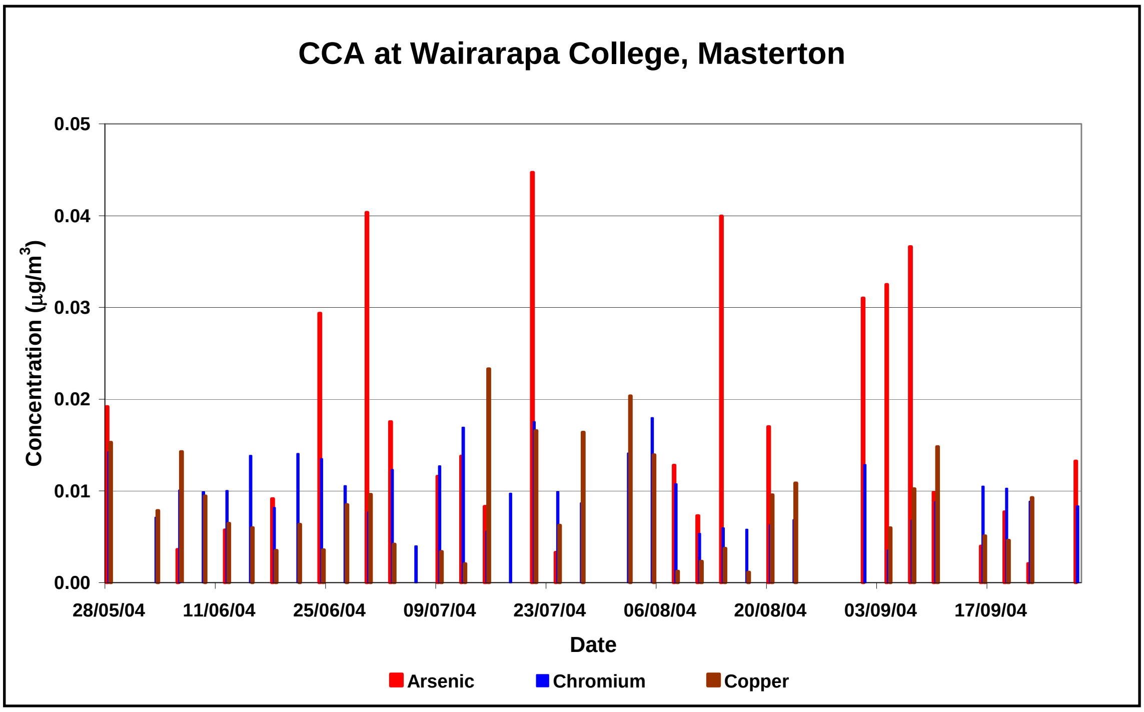


Figure 4: Background CCA concentrations at Wairarapa College, Masterton

3.2 Aldehydes results

A total of 39 VOC samples were collected during the monitoring period. The results for the VOC analysis are given in Table 3 and depicted graphically in Figure 5.

Table 3: Concentration of aldehydes at Railway Crescent, Masterton

Tube number	Start	Stop	Formaldehyde µg/m³	Acetaldehyde µg/m³	Acrolein µg/m³
0767902224	27/05/2004 12:00	28/05/2004 12:00	2.20	0.54	0.40
0767902032	30/05/2004 12:00	31/05/2004 12:00	3.14	0.81	0.85
0767902222	02/06/2004 12:00	03/06/2004 12:00	2.73	0.63	0.67
0767902223	05/06/2004 12:00	06/06/2004 12:00	2.82	0.85	0.85
0767902216	08/06/2004 12:00	09/06/2004 12:00	3.05	0.99	0.85
0767902036	11/06/2004 12:00	12/06/2004 12:00	3.09	0.76	0.85
0767902218	14/06/2004 12:00	15/06/2004 12:00	3.27	0.99	0.85
0767902034	17/06/2004 12:00	18/06/2004 12:00	0.37	<0.25	<0.25
0767902031	20/06/2004 12:00	21/06/2004 12:00	0.39	<0.25	<0.25
0767902225	23/06/2004 12:00	24/06/2004 12:00	0.17	<0.25	<0.25
0767902221	26/06/2004 12:00	27/06/2004 12:00	0.34	<0.25	<0.25
0767902217	29/06/2004 12:00	30/06/2004 12:00	0.28	<0.25	<0.25
0767902219	02/07/2004 12:00	03/07/2004 12:00	0.20	<0.25	<0.25
0767902220	05/07/2004 12:00	06/07/2004 12:00	0.28	<0.25	<0.25
0840302570	07/07/2004 12:00	08/07/2004 12:00	2.55	0.58	0.45
0767902033	11/07/2004 12:00	12/07/2004 12:00	2.60	0.76	0.81
0840302573	14/07/2004 12:00	15/07/2004 12:00	2.66	0.55	0.55
0767902029	17/07/2004 12:00	18/07/2004 12:00	3.05	0.83	0.89
0840302572	20/07/2004 12:00	21/07/2004 12:00	3.32	0.94	1.00

Tube number	Start	Stop	Formaldehyde µg/m³	Acetaldehyde µg/m³	Acrolein µg/m³
0767902038	23/07/2004 12:00	24/07/2004 12:00	3.71	1.22	1.16
0840302571	26/07/2004 12:00	27/07/2004 12:00	1.33	0.39	0.50
0840302577	29/07/2004 12:00	30/07/2004 12:00	2.22	0.66	0.72
0767902307	01/08/2004 12:00	02/08/2004 12:00	2.44	0.83	0.89
0840302574	04/08/2004 12:00	05/08/2004 12:00	1.22	0.39	0.50
0840302578	07/08/2004 12:00	08/08/2004 12:00	0.72	<0.25	<0.25
0840302569	10/08/2004 12:00	11/08/2004 12:00	0.38	<0.25	<0.25
0840302575	13/08/2004 12:00	14/08/2004 12:00	0.39	<0.25	<0.25
0840302466	16/08/2004 12:00	17/08/2004 12:00	0.38	<0.25	<0.25
0840302488	22/08/2004 12:00	23/08/2004 12:00	0.39	<0.25	<0.25
0840302487	25/08/2004 12:00	26/08/2004 12:00	0.29	<0.25	<0.25
0840302484	28/08/2004 12:00	29/08/2004 12:00	0.30	<0.25	<0.25
NN1	03/09/2004 12:00	04/09/2004 12:00	4.49	1.11	1.11
NN2	06/09/2004 12:00	07/09/2004 12:00	1.72	0.28	0.33
0840302482	09/09/2004 12:00	10/09/2004 12:00	1.44	<0.25	<0.25
0840302481	12/09/2004 12:00	13/09/2004 12:00	1.99	<0.25	<0.25
0840302479	15/09/2004 12:00	16/09/2004 12:00	1.55	<0.25	<0.25
0840302483	18/09/2004 12:00	19/09/2004 12:00	1.66	<0.25	<0.25
0840302480	21/09/2004 12:00	22/09/2004 12:00	2.10	0.28	0.66
0840302485	24/09/2004 12:00	25/09/2004 12:00	2.27	<0.25	<0.25
		Max	**4.5**	**1.2**	**1.2**
		Min	**0.17**	**<0.25**	**<0.25**
		Average	**1.7**	**0.72**	**0.75**

Figure 5 shows the results graphically.

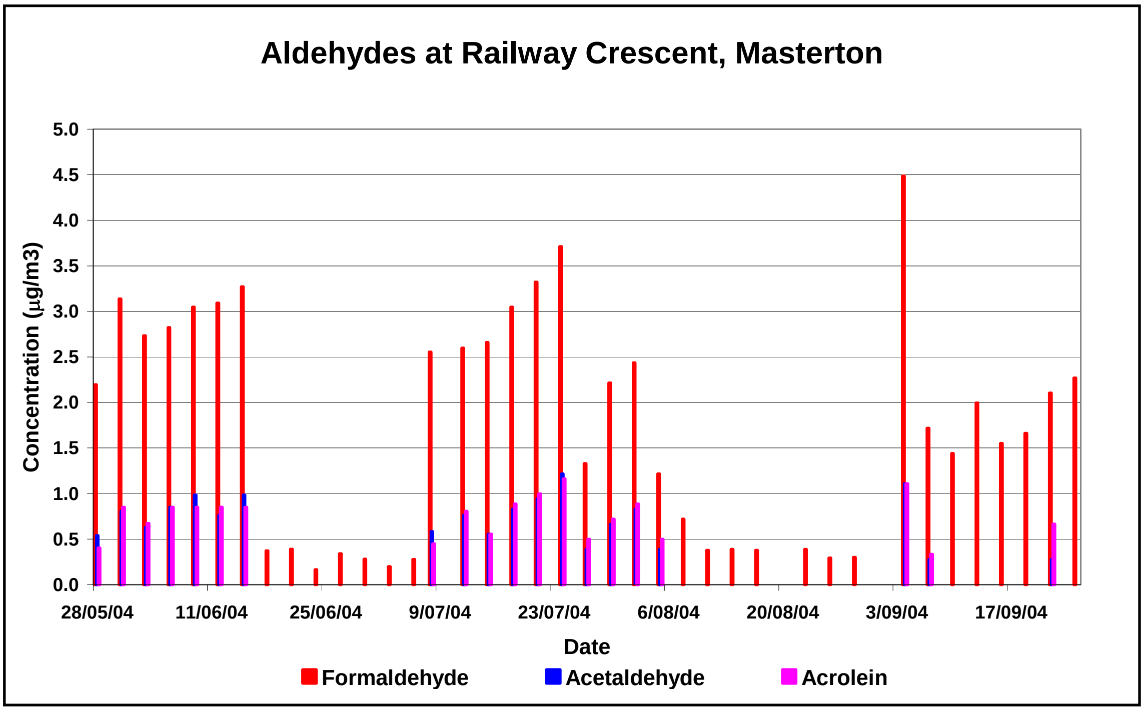


Figure 5: Aldehyde concentrations at Railway Crescent, Masterton

Due to cost constraints no background VOC sampling was undertaken during this study.

4. Discussion

4.1 TSP and CCA

The analysis of TSP samples for CCA show that detectable levels of these elements were present in the air at the Railway Crescent site. However, comparison with concentrations at the Wairarapa College background air quality monitoring site show that levels of CCA at Railway Crescent are similar to CCA concentrations likely to be found elsewhere in the Masterton airshed.

Several of the TSP filters from Railway Crescent were selected for further analysis by scanning electron microscopy (SEM) to examine the morphology, composition and size distribution of the particles collected. In particular, a filter with the highest concentrations of CCA (collected on 14/15 July 2004) was examined in detail. The analysis showed that most of the particles present were likely to have originated from combustion sources or soil. At the resolution available using SEM in the energy-dispersive spectroscopy mode, no individual particles were found to be predominantly composed of CCA.

Of the filters examined by SEM only one was found to have CCA containing particles (sample collected 21/22 September 2004). These particles were relatively large (20-30 μm long), predominantly composed of carbon and had the organic appearance of wood fibres. Figure 6 is a SEM image of one of the particles identified as containing CCA.

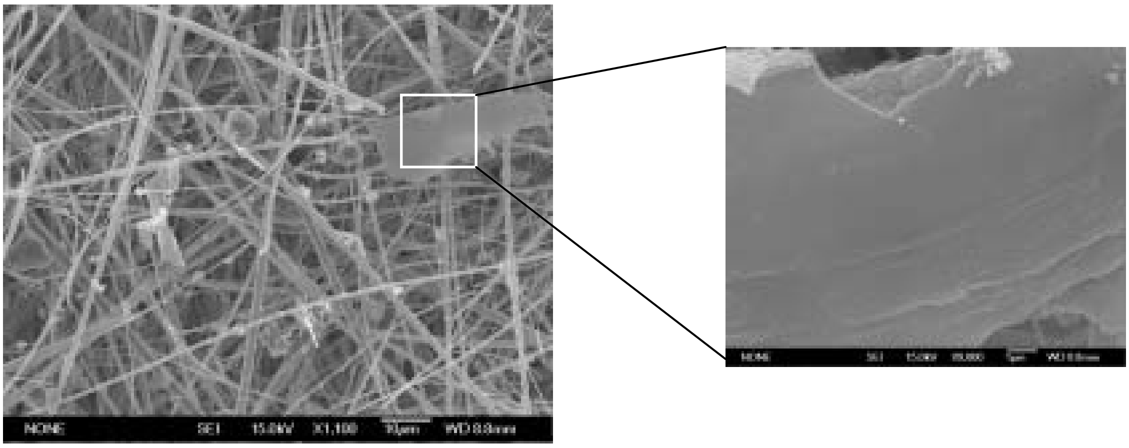


Figure 6: SEM image of glass fibre filter showing CCA containing wood fibre

There are a number of sources that such CCA containing wood particles may originate from. It is understood that some re-milling of CCA treated timber is carried out at the neighbouring timber mill and that some fine wood particles containing CCA are likely to be discharged from the cyclone dust collectors (as discussed in Section 2.1.1). During a site visit to the timber mill on 17 February 2005 visible amounts of fine sawdust were observed being discharged from the cyclones and hopper system conveying the sawdust to the back of a truck used to cart the waste away. Other sources of CCA treated wood fibres are also possible including the building supplies depot next door to the timber mill and even down to domestic activities such as fence or deck building. However, given the scale of operations at the mill and the height of the discharge from the cyclone dust collection system, this is likely to be the dominant source of wood fibre emissions in the area.

4.1.1 Comparison of CCA concentrations and Health Guidelines

The form of arsenic and chromium used in timber treatment preparations are known to be toxic to humans above certain concentrations, while the toxicity of copper is only apparent at much higher concentrations. The New Zealand Ambient Air Quality Guidelines (Ministry for the Environment, May 2002) contain guidelines for both inorganic arsenic (0.0055 $\mu g/m^3$) and chromium VI (0.0011 $\mu g/m^3$) as annual averages. There is no ambient guideline for copper. The guideline values are the minimum requirements that outdoor air quality should meet in order to protect human health and the environment.

As the monitoring programme was only undertaken for three months, the results are not directly comparable to an annual average, however, for the purposes of this study it is considered sufficient to indicate whether there is cause for concern regarding ambient concentrations of chromium or arsenic.

Table 4 shows the monitoring results from Railway Crescent and Wairarapa College alongside the relevant ambient air quality guideline. The annual average can be converted to a three-month average by using a conservative power law relationship as recommended by Chiodo and Rolfe (Chiodo J., Rolfe K. 2000. *Health Effects of Eleven Hazardous Air Contaminants and Recommended Evaluation Criteria*. Air quality Technical Report 13 Prepared for the Ministry for the Environment.) The annual guidelines for chromium and arsenic have been converted to three-month averages for comparative purposes in Table 4.

Table 4: Monitoring results from Railway Crescent compared to ambient guidelines

	Railway Crescent (3-month average)	**Wairarapa College (3-month average)**	**Ambient Guideline (annual average)**	**Ambient Guideline (converted to 3 month average)**
Chromium (g/m^3)	0.001	0.010	0.0011 (Cr VI)	0.0015 (Cr VI)
Arsenic (g/m^3)	0.009	0.012	0.0055 (inorganic As)	0.0073 (inorganic As)

Care must be taken when comparing the results from the two monitoring sites to the ambient guidelines as the monitoring results represent **all** forms of chromium and arsenic not just the most toxic species represented by the guidelines. As noted in the Ambient Air Quality Guidelines, for chromium metal and Cr III compounds, concentrations 100 times larger than those for Cr VI are more appropriate as a guideline level.

Comparison of the monitoring results from Railway Crescent with the ambient guidelines as shown in Table 4 show that chromium concentrations at that location do not appear to be of particular concern with regard to human health. As mentioned above, this is a particularly conservative comparison given that the measured chromium concentrations represent all oxidation states and not just chromium (VI).

Arsenic concentrations at Railway Crescent would appear slightly elevated when compared to the guideline value, but the background concentrations as measured at the Wairarapa College monitoring site are higher still. Research carried out at the Wairarapa College monitoring site suggests that these elevated arsenic concentrations may be associated with fine particles discharged from domestic fires (P. K. Davy et al *Elemental Analysis and Source Apportionment of Ambient Particulate Matter at Masterton, New Zealand*. International Journal of PIXE in press).

4.2 Formaldehyde and other aldehydes

The sampling results for aldehydes (11 analytes altogether) at Railway Crescent show that only formaldehyde, acetaldehyde and acrolein were present at detectable concentrations. Concentrations of all three aldehydes were correlated indicating that they were likely to be from the same source. Table 5 shows the results of the correlation analysis.

Table 5: Correlation matrix for aldehyde samples

	Formaldehyde	Acetaldehyde	Acrolein
Formaldehyde	1		
Acetaldehyde	**0.90**		
Acrolein	**0.90**	**0.96**	1

4.2.1 Comparison of aldehyde concentrations with ambient guidelines

The Ambient Air Quality Guidelines 2002 contain guidelines for maximum concentrations of acetaldehyde and formaldehyde designed to protect human health, though there is no guideline for acrolein. The guideline for acetaldehyde is an annual average and the guideline for formaldehyde is given as a 30-minute average, whereas the sampling period at Railway Crescent was 24-hours.

Table 6 shows the monitoring results from Railway Crescent alongside the relevant ambient air quality guideline. The relevant averages have been converted for comparative purposes using the conservative power law relationship as recommended by Chiodo and Rolfe (Chiodo J., Rolfe K. 2000. *Health Effects of Eleven Hazardous Air Contaminants and Recommended Evaluation Criteria*. Air quality Technical Report 13 Prepared for the Ministry for the Environment.).

There is no New Zealand guideline concentration for acrolein, therefore several overseas databases have been reviewed for appropriate guidelines for the protection of human health; these include the USEPA Integrated Risk Information System (IRIS), the Texas Commission on Environmental Quality – Effects Screening Levels (TCEQ-ESL's) and the World Health Organisation Ambient Air Quality Guidelines (WHO). The guidelines for acrolein derived from the above sources are also presented in Table 6.

Table 6: Monitoring results of aldehydes at Railway Crescent compared to ambient guidelines

	Railway Crescent (3-month average)	Ambient Guideline	Ambient Guideline (converted to appropriate average)
Formaldehyde (g/m^3)	1.7 4.5 (max 24-hour result)	100 (30-minute average)	18 (3-month average) 46 (24-hour average)
Acetaldehyde (g/m^3)	0.75 1.2 (max 24-hour result)	30 (annual average) 9.0 (IRIS 24-hour average)	40 (3-month average)
Acrolein (g/m^3)	0.72 1.2 (max 24-hour result)	2.3 (TCEQ-ESL 1-hour average) 0.02 (IRIS 24-hour average)	0.3 (3-month average)

Comparison of the aldehyde monitoring results from Railway Crescent with the ambient guidelines as shown in Table 6 show that formaldehyde and acetaldehyde concentrations at that location do not appear to be of particular concern with regard to potential effects on human health, as their measured concentrations were well below the guideline values.

Acrolein concentrations at Railway Crescent would appear to be elevated when compared to the guideline values. Analysis of the monitoring results alongside meteorological data from the ambient air quality monitoring station at Wairarapa College indicates that the highest concentrations of acrolein (and the other aldehydes) occurred during winds from the south-westerly quarter (wind roses for selected sampling days are contained in Appendix 1). This would suggest that emissions from the timber mill drying kilns are not contributing to the elevated acrolein concentrations at Railway Crescent. The most likely source of this pollutant is domestic fires as acrolein (along with formaldehyde and acetaldehyde) is known to be discharged from burning wood.

5. Conclusions

Ambient air quality monitoring for CCA and aldehydes was undertaken at Railway Crescent, Masterton from May to September 2004. The monitoring results show that CCA concentrations at Railway Crescent are similar to those measured at Greater Wellington's background ambient air quality monitoring site at Wairarapa College. Ambient concentrations of chromium at Railway Crescent were found to be below air quality guidelines for the protection of human health. Arsenic concentrations were found to be slightly elevated compared to the relevant guidelines for both the Railway Crescent and Wairarapa College sites. Research work on fine particle samples from the Wairarapa College site suggests that the arsenic may be associated with emissions from domestic fires. The comparison of the monitoring results for chromium and arsenic with the New Zealand ambient air quality guidelines for Cr VI and As-inorganic is considered conservative as the monitoring results include all forms of the contaminants (Chromium: Cr VI, Cr III, Cr metal; Arsenic: arsine, inorganic) which have higher guideline values (by an order of magnitude) than Cr VI or As-inorganic.

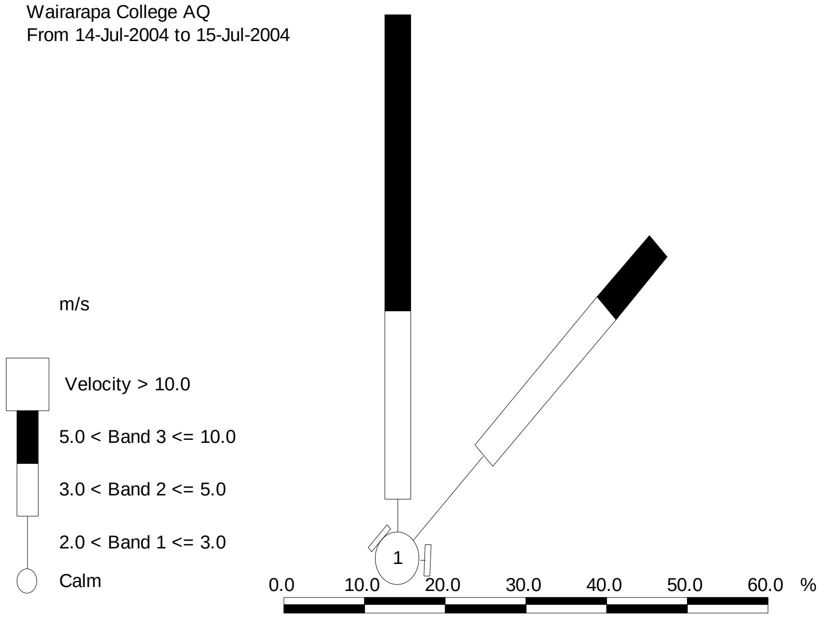
The results from the aldehydes monitoring show that only formaldehyde, acetaldehyde and acrolein were present at detectable concentrations. Formaldehyde and acetaldehyde levels were found to be well below New Zealand ambient air quality guidelines for the protection of human health. Acrolein concentrations at Railway Crescent were found to exceed USEPA guidelines (there is no relevant New Zealand guideline for acrolein). Analysis of the sampling results alongside meteorological data shows that peak acrolein concentrations occurred during south-westerly winds indicating that emissions from the timber mill are unlikely to be the source. Acrolein emissions (also formaldehyde and acetaldehyde) are known to be associated with wood combustion such as domestic fires.

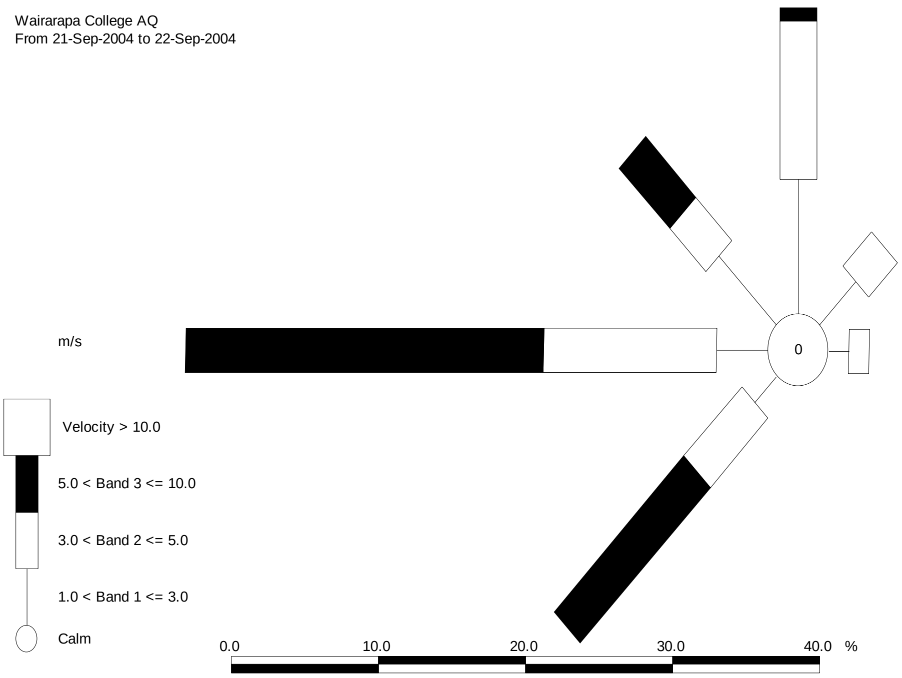
A site visit to the timber mill showed that there is the potential for nuisance dust emissions at times from the site, mainly from the unsealed yard and poorly maintained/designed air pollution control equipment for the pneumatic conveyancing and collection of sawdust generated from milling activities. One of the TSP samples collected at Railway Crescent showed evidence of wood fibre-like particles that may have originated from emissions at the timber mill. The timber mill operators should ensure that their activities on site are well controlled as part of best-practice environmental management.

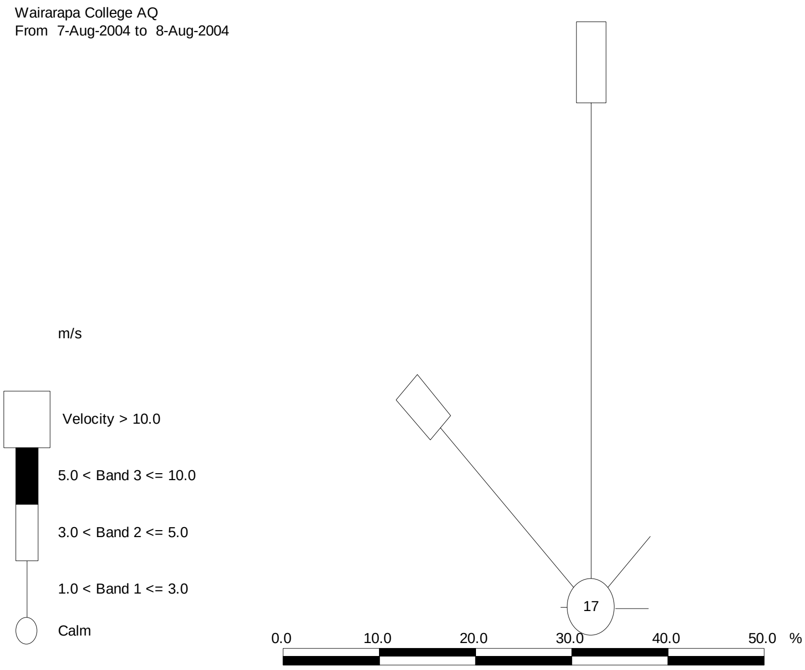
The total suspended particulate CCA and aldehydes monitoring results at Railway Crescent indicate that there is no measurable effect of emissions from the kiln drying operation on concentrations of those pollutants at the Railway Crescent site. In fact, comparison of the monitoring results obtained at Railway Crescent with results obtained at the Greater Wellington ambient air quality monitoring station at Wairarapa College suggest that emissions from domestic fires are likely to be the main source of air pollutants at Railway Crescent during winter.

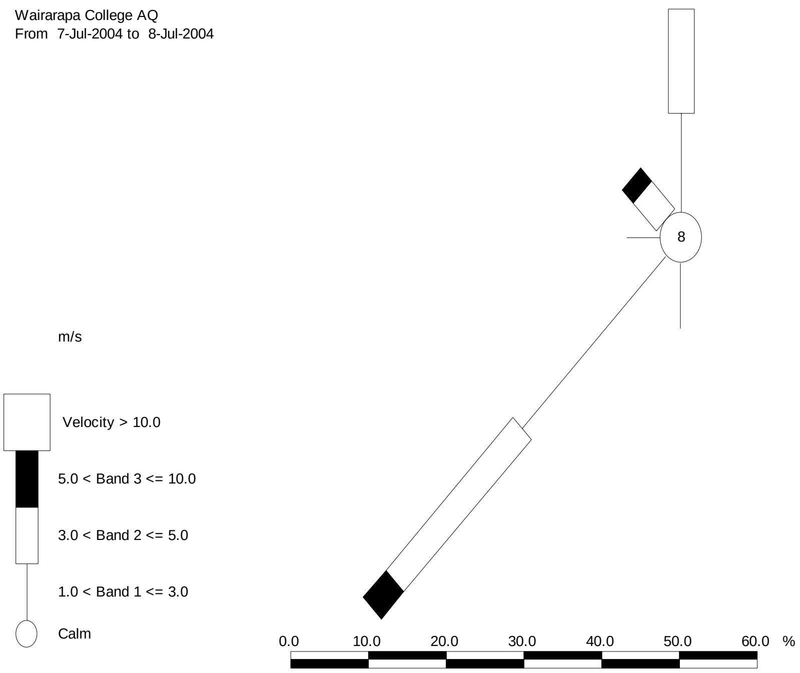
Appendix 1

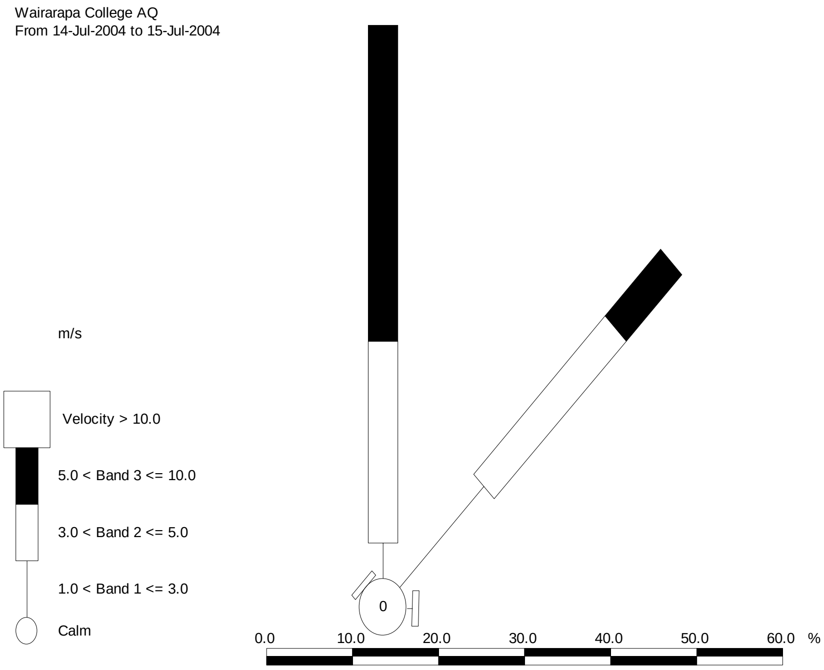
Wind roses for selected sampling periods

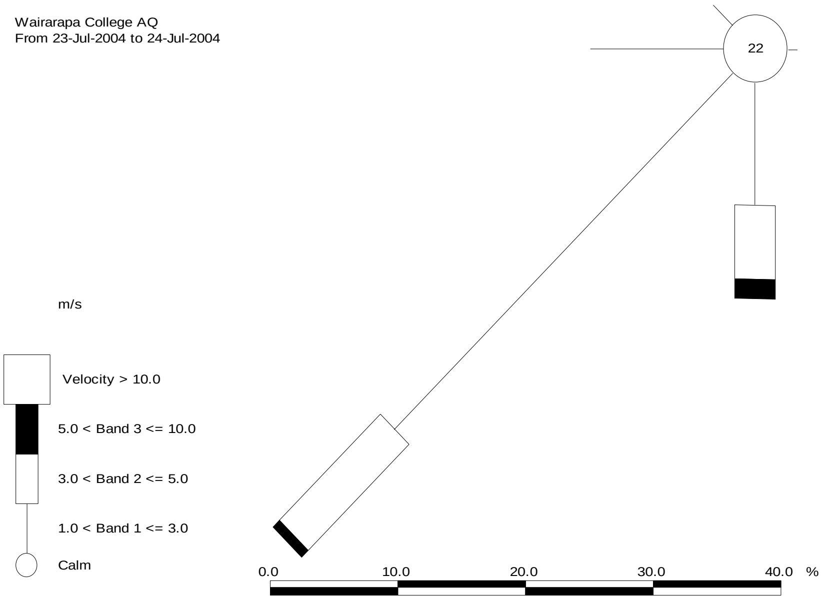

Wairarapa College AQ
From 14-Jul-2004 to 15-Jul-2004
m/s
Velocity > 10.0
5.0 < Band 3 <= 10.0
3.0 < Band 2 <= 5.0
2.0 < Band 1 <= 3.0
Calm
1
0.0
10.0
20.0
30.0
40.0
50.0
60.0
%

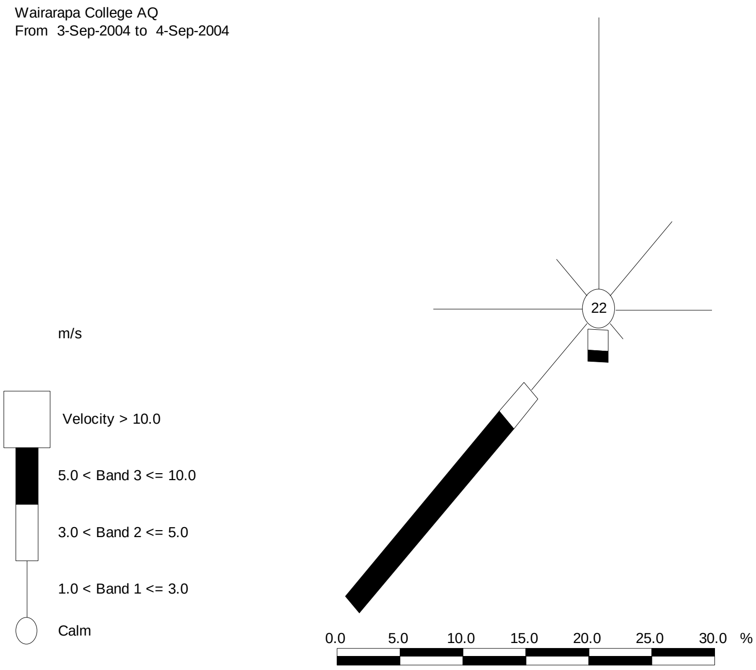

Wairarapa College AQ
From 21-Sep-2004 to 22-Sep-2004
m/s
Velocity > 10.0
5.0 < Band 3 <= 10.0
3.0 < Band 2 <= 5.0
1.0 < Band 1 <= 3.0
Calm
0
0.0
10.0
20.0
30.0
40.0
%

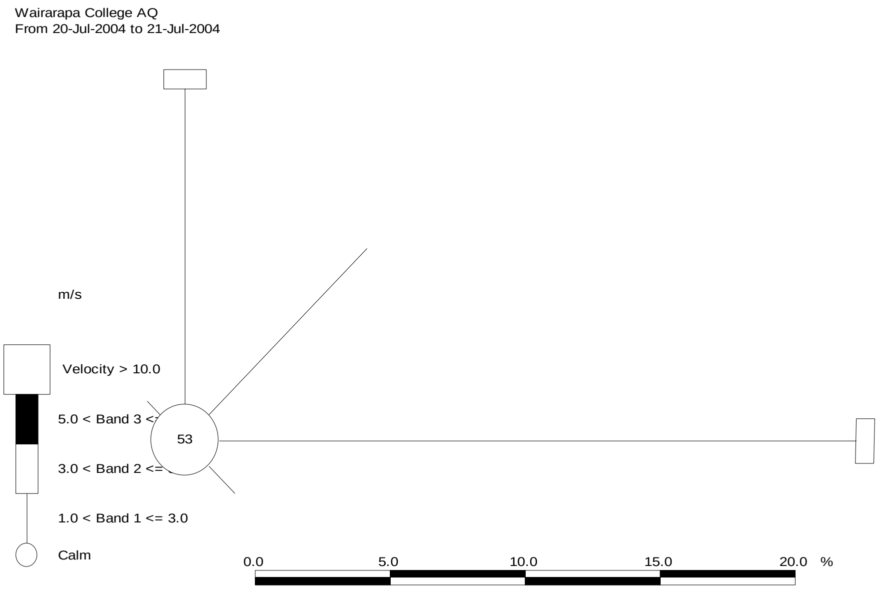

Wairarapa College AQ
From 7-Aug-2004 to 8-Aug-2004
m/s
Velocity > 10.0
5.0 < Band 3 <= 10.0
3.0 < Band 2 <= 5.0
1.0 < Band 1 <= 3.0
Calm
17
0.0
10.0
20.0
30.0
40.0
50.0
%

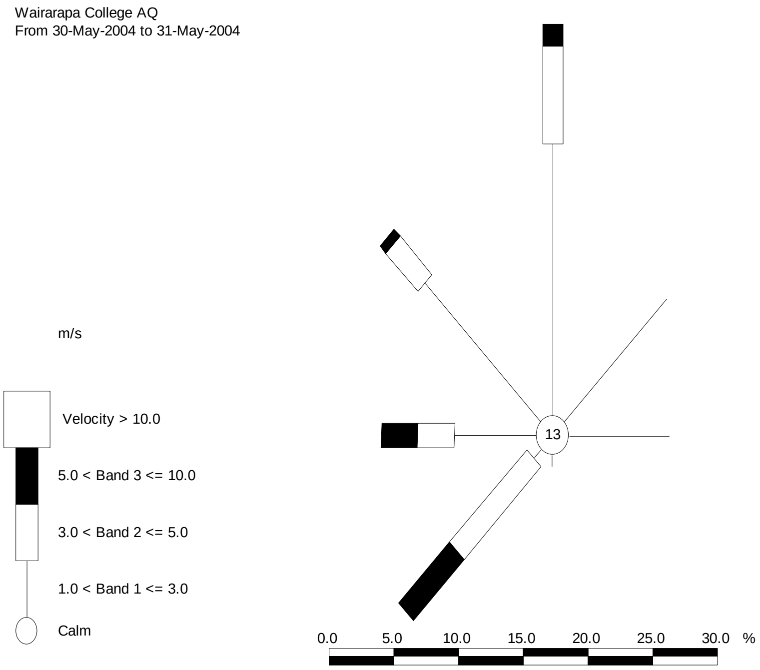

Wairarapa College AQ
From 7-Jul-2004 to 8-Jul-2004
m/s
Velocity > 10.0
5.0 < Band 3 <= 10.0
3.0 < Band 2 <= 5.0
1.0 < Band 1 <= 3.0
Calm
8
0.0
10.0
20.0
30.0
40.0
50.0
60.0
%


Wairarapa College AQ
From 14-Jul-2004 to 15-Jul-2004
m/s
Velocity > 10.0
5.0 < Band 3 <= 10.0
3.0 < Band 2 <= 5.0
1.0 < Band 1 <= 3.0
Calm
0
0.0
10.0
20.0
30.0
40.0
50.0
60.0
%


Wairarapa College AQ
From 23-Jul-2004 to 24-Jul-2004
22
m/s
Velocity > 10.0
5.0 < Band 3 <= 10.0
3.0 < Band 2 <= 5.0
1.0 < Band 1 <= 3.0
Calm
0.0
10.0
20.0
30.0
40.0
%


Wairarapa College AQ
From 3-Sep-2004 to 4-Sep-2004
m/s
Velocity > 10.0
5.0 < Band 3 <= 10.0
3.0 < Band 2 <= 5.0
1.0 < Band 1 <= 3.0
Calm
22
0.0 5.0 10.0 15.0 20.0 25.0 30.0 %


Wairarapa College AQ
From 20-Jul-2004 to 21-Jul-2004
m/s
Velocity > 10.0
1.0 < Band 1 <= 3.0
Calm
53
0.0 5.0 10.0 15.0 20.0 %


Wairarapa College AQ
From 30-May-2004 to 31-May-2004
m/s
Velocity > 10.0
5.0 < Band 3 <= 10.0
3.0 < Band 2 <= 5.0
1.0 < Band 1 <= 3.0
Calm
13
0.0
5.0
10.0
15.0
20.0
25.0
30.0
%