greater WELLINGTON
REGIONAL COUNCIL

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Sources of air pollution in Wainuiomata

1. Purpose

To present the findings of an air quality investigation into the sources of particulate pollution in Wainuiomata, Lower Hutt.

2. Background

Wainuiomata experiences occasional winter-time episodes of elevated PM_{10} (airborne dust smaller than 10 microns in diameter) due to poor dispersion of domestic heating emissions. An emissions inventory conducted in 2006 found that over a third of households use wood to heat their homes in winter. Emissions from domestic home heating are predicted to decrease as householders replace woodburners at the end of their working life with cleaner burning models authorised by the National Environmental Standard for Air Quality (NES-AQ).

Regular PM_{10} monitoring tells us nothing about the sources of air pollution. In areas where air quality is degraded it is vital that we understand the relative contributions of each particular source to inform our regional air quality management plan and to effectively target any emissions reduction initiatives to improve air quality. Of considerable interest is the contribution of natural sources, such as sea-salt, to measured concentrations of PM_{10}. The natural component of PM_{10} cannot be controlled and must be factored into any air quality management strategy.

To provide robust and scientifically defensible information on the relative sources of air pollution in Wainuiomata a source apportionment study was carried out in collaboration with GNS Science. Similar studies were completed for Upper Hutt (2000 to 2002), Masterton (2002 to 2004) and Seaview (2005 to 2007). Samples of PM_{10} were collected as two size fractions – fine particulate matter ($PM_{2.5}$) and coarse particulate matter ($PM_{2.5-10}$) – from September 2006 to September 2008 at the air quality monitoring station in Moonhan Road,

Wainuiomata. Elemental fingerprints of the air particulate samples were determined at the ion beam analysis (IBA) facility at GNS Science. Using statistical techniques and mathematical models the sources of particulate matter measured in air were identified from the elemental fingerprints of each air particulate sample.

3. Key findings

3.1 Sources of fine particulate matter ($PM_{2.5}$)

$PM_{2.5}$ (airborne particles smaller than 2.5 microns in diameter) is produced by combustion and contains inorganic ions, carbon, organic aerosols and metals. In Wainuiomata, the major sources of $PM_{2.5}$ were found to be emissions from domestic fires and vehicles, and secondary sulphate from sources outside the airshed. $PM_{2.5}$ causes the most harm to people's health because smaller particles can penetrate deeper into the lungs. During the study the World Health Guideline for $PM_{2.5}$ was exceeded five times.

3.2 Sources of coarse particulate ($PM_{2.5-10}$)

Coarse particles ranging in size between 2.5 microns and 10 microns ($PM_{2.5-10}$) are formed by mechanical processes such as crushing of rocks and soils during earthworks or quarrying, or arise naturally from sea spray and wind-blown soils. In Wainuiomata, the principal source of coarse particulate is sea-salt, followed by road dust and soil. Road dust, produced as vehicles drive over the road surface, contains copper and zinc from wear of vehicle brake components and tyres.

3.3 Sources of PM_{10}

The fine particulate and coarse particulate source apportionment results were pooled to estimate the relative contribution of each source to total ambient PM_{10} concentrations. The NES-AQ focuses on PM_{10} and therefore we are primarily interested in identifying the principal source contributor when PM_{10} concentrations are above the 'alert' category (more than 66 percent of the threshold allowed by the NES-AQ).

For much of the year natural sources make up most of the PM_{10} in Wainuiomata's air. However, $PM_{2.5}$ produced by domestic fires makes up most of the PM_{10} measured on high pollution days in winter. Meteorology also plays an important role in pollution episodes. PM_{10} concentrations are more likely to be high on days where the average temperature is less than $10^{o}C$ and the average wind speed is less than 2 m/s.

Figure 1 shows the relative source contributions to the concentrations of fine and coarse particulate for days when PM_{10} concentrations were elevated.

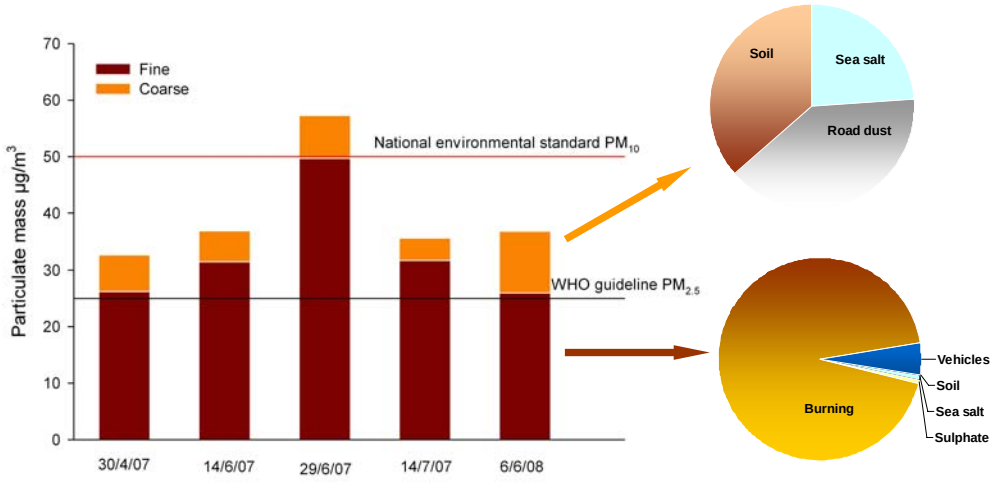

Figure 1: Relative source contributions to PM_{10} concentrations on winter days in Wainuiomata when pollution levels were elevated

3.4 Toxic compounds found in wood smoke

Domestic fires were found to be a source of arsenic in air, most likely arising from the burning of timber treated with copper-chrome-arsenic preservative. During winter, on average, organic carbon made up about 20 per cent of the PM_{10} measured. Most of this organic carbon arose from wood smoke that was found to contain toxic compounds such as polycyclic aromatic hydrocarbons (PAHs) at levels that may exceed health guidelines. A resource-intensive monitoring campaign would need to be undertaken in future years to confirm whether or not the predicted reduction in PM_{10} emissions is sufficient to reduce concentrations of other toxic pollutants to acceptable levels.

4. Conclusion

While the Wainuiomata airshed does not currently breach the NES, this study not only confirms that domestic fires are the primary source of PM_{10} but also shows that fires are the source of contaminants of health concern such as fine particles ($PM_{2.5}$), arsenic and PAHs. This information needs to be taken into account in managing this airshed.

5. Communication

The findings of this study were reported in the *Annual air quality monitoring report for the Wellington region, 2008* and the *Air quality 2008/09* report card. Both of these documents are available on our website.

6. Recommendations

That the Committee:

1. ***Receives** the report.*

2. ***Notes** the content of the report.*

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