AIR MONITORING AT NUNAWADING – OCTOBER 2003 TO FEBRUARY 2004

Publication 948

May 2004

SUMMARY

Air quality was monitored in Nunawading at a site exposed to peak motor vehicle emissions during the period September 2003 to February 2004.

During the period monitored, the *State Environment Protection Policy (Air Quality Management)* (SEPP(AQM)) intervention levels for particles (PM10), fine particles (PM2.5), nitrogen dioxide (NO_2) and carbon monoxide (CO) were not exceeded on any day. Levels of CO and NO_2 were slightly higher than those measured at Richmond and Alphington most likely due to the close proximity of the Nunawading site to heavy traffic.

Levels of the air toxic compounds benzene, toluene, xylenes, and poly aromatic hydrocarbons (PAHs) were found to be low during the study period and *Draft National Environment Protection (Air Toxics) Measure* (Air Toxics NEPM) investigation levels were not exceeded.

OBJECTIVES

The objectives of this study were to:

- Assess the level of motor vehicle derived air pollutants at a heavily trafficked intersection that might represent worst-case exposure for people living or working in a similar location.
- Determine if the concentration of pollutants at a heavily trafficked intersection site are significantly different from levels in typical residential areas of Melbourne measured at EPA air monitoring stations.

BACKGROUND

The main sources of air pollutants in Melbourne are emissions from motor vehicles (EPA, 1997). Other contributors to air pollution include domestic wood heating in the cooler months and industry. At other times natural events such as wild fires and dust storms can impact on local and regional air quality.

EPA has conducted air monitoring for the common air pollutants in Melbourne over many years and results indicate that Melbourne has generally good air quality (EPA, 2003).

The common air pollutants emitted by motor vehicles are particles (PM_{10} and $PM_{2.5}$), nitrogen dioxide (NO_2), and carbon monoxide (CO). The $PM_{2.5}$ particle fraction is of special interest due to the potential for fine particles to penetrate deep into the human respiratory system and cause long-term health problems.

Motor vehicles also emit volatile organic compounds (VOC), and semi-volatile organic compounds. These include the air toxic compounds also referred to as hazardous air pollutants, such as benzene, toluene, xylene and poly aromatic hydrocarbons (PAH). Air toxic compounds in ambient air are usually present in very low concentrations compared with the common motor vehicle derived air pollutants such as NO_X (oxides of nitrogen) and CO. Air toxics have

been less studied than other common air pollutants and their harmful affects at typical ambient exposure levels are less well established (Environment Australia (2002)).

METHODOLOGY

A monitoring site close to a major intersection was selected adjacent to the intersection of Springvale and Whitehorse Roads Nunawading (Figure 1). Molab was sited 6m from Springvale Road and 50-60m from Whitehorse Road. This site was chosen because it is considered to be typical of a worst-case congested intersection with residential properties in close proximity to the road (Molab was positioned at a distance similar to the nearest residential property). VicRoads traffic counting statistics estimate that an average of 250,000 vehicles per day pass through this intersection, approximately 5 per cent being trucks (VicRoads, 2004). This included vehicles in both north-south and east-west directions.

It is important to note that this study was largely conducted during summer months and measured pollution levels are not necessarily a reflection of air quality throughout an entire year. During autumn-winter months weather conditions are more stable and less likely to disperse pollutants, potentially leading to higher levels. Other sources of pollutants such as domestic heating also may impact on local air quality during cooler winter months.

For the Nunawading air monitoring study, EPA Victoria's mobile air monitoring laboratory (Molab) was used to monitor particles as PM_{10} and $PM_{2.5}$[1], NO_2, CO, VOCs and PAHs. NO_2, and CO were measured using continuous instrumental gas analysers. PM_{10} was measured by two techniques: manual daily collection of particles onto a pre-weighed filter over 24-hour periods followed by analysis in the laboratory; and a continuous instrumental technique (TEOM[2] PM_{10}). $PM_{2.5}$ was measured using a manual method similar to that used for PM_{10}. The manual particle methods were used for comparison with air quality objectives whereas the continuous method for PM_{10} was used for comparison of PM_{10} levels with EPA's fixed site monitoring stations located in the Melbourne residential areas of Alphington and Richmond.

VOC samples were collected once every three days and PAH samples were collected once every six days. This is in accordance with the minimum sampling requirements of the Draft Air Toxics NEPM. VOCs were measured by collecting 24-hour average samples using stainless steel fused-silica coated canisters. Analysis was performed by the analytical technique of gas chromatography/mass spectrometry (GC/MS). Air toxic compounds were then quantified by comparison with concentrations of known standards.

PAHs were sampled for 24-hours with a PUF sampler (polyurethane foam plug with paper filter) designed to trap semi-volatile organic compounds such as PAHs. Analyses of collected 24-hour average samples were performed by GC/MS. PAHs were

[1] Particle matter with aerodynamic diameter of less than 10 micrometres and less than 2.5 micrometres, respectively.

[2] Tapered element oscillating microbalance

quantified by comparison with a certified PAH standard mixture containing PAHs commonly found in motor vehicle emissions.

The local air quality at the Nunawading site was compared against the intervention levels specified in the *State Environment Protection Policy (Ambient Air Quality)* (SEPP (AQM)). Intervention levels are used to assess whether there are local air pollution problems that might represent unacceptable risk to a local community. They have been set at about 20 per cent above the relevant ambient air quality objective specified in the SEPP (AQM) 1999. An individual's risk from a given pollutant will depend on a number of factors including their susceptibility (for example, health, age) and exposure (for example, the time they spend at home and in their back yards). Intervention levels are trigger levels which if exceeded initiate further investigation.

Similarly air toxics were compared against the Draft Air Toxics NEPM investigation levels. Investigation levels are similar to SEPP intervention levels.

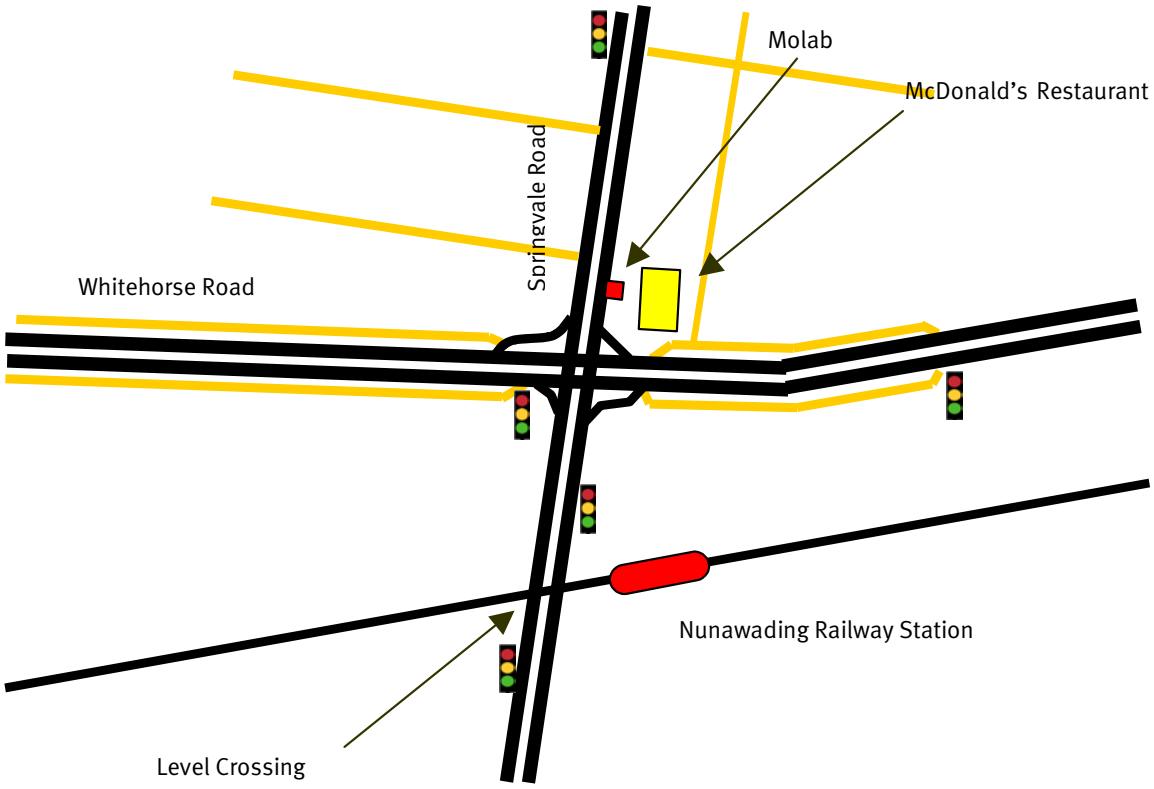

Figure 1: Location of Molab in Nunawading

RESULTS AND DISCUSSION

Particles (PM_{10})

The 24-hour average PM_{10} particle concentrations for the Nunawading site ranged from 9µg/m³ to 44µg/m³ (Figure 2) during the study period. There were no exceedences of the 24-hour SEPP (AQM) intervention level of 60µg/m³.

A comparison of daily TEOM PM_{10} data from the EPA air monitoring stations in Richmond and Alphington with the Nunawading site (Figure 3) indicates that PM_{10} levels for the two sites were similar during the monitored period.

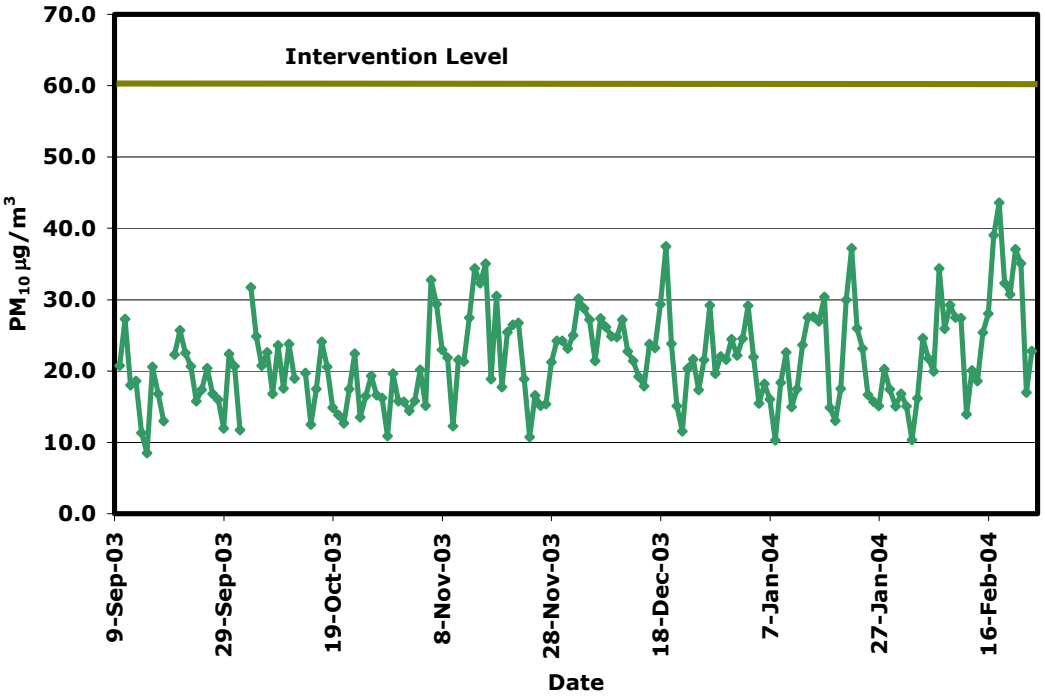

Figure 2: Daily average PM_{10} concentrations at the Nunawading monitoring site

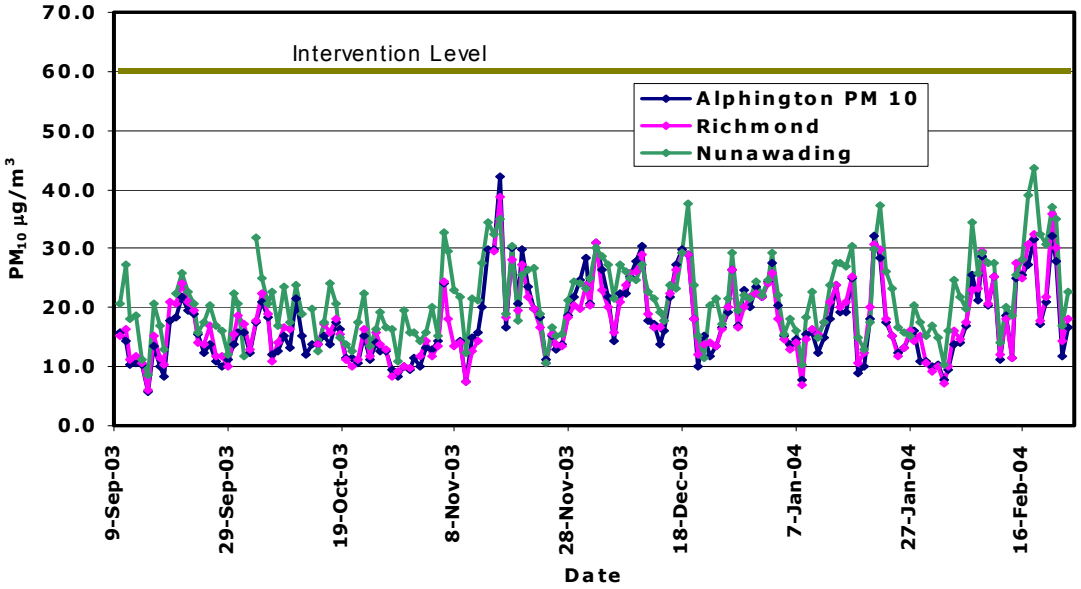

Figure 3: Daily average PM_{10} (TEOM) Nunawading Richmond and Alphington

Fine particles ($PM_{2.5}$)

The 24-hour average $PM_{2.5}$ particle concentrations for the Nunawading site ranged from 4µg/m³ to 20µg/m³ (Figure 4) during the study period. There were no exceedences of the 24-hour SEPP (AQM) intervention level of 36µg/m³.

The contribution of $PM_{2.5}$ to the particle concentration measured as PM_{10} is shown in Figure 5. The graph indicates that $PM_{2.5}$ accounts for on average 45 per cent ranging from 22 to 71 per cent of the PM_{10}. The $PM_{2.5}$ fraction follows the same trend as the PM_{10} fraction indicating a common source of particles.

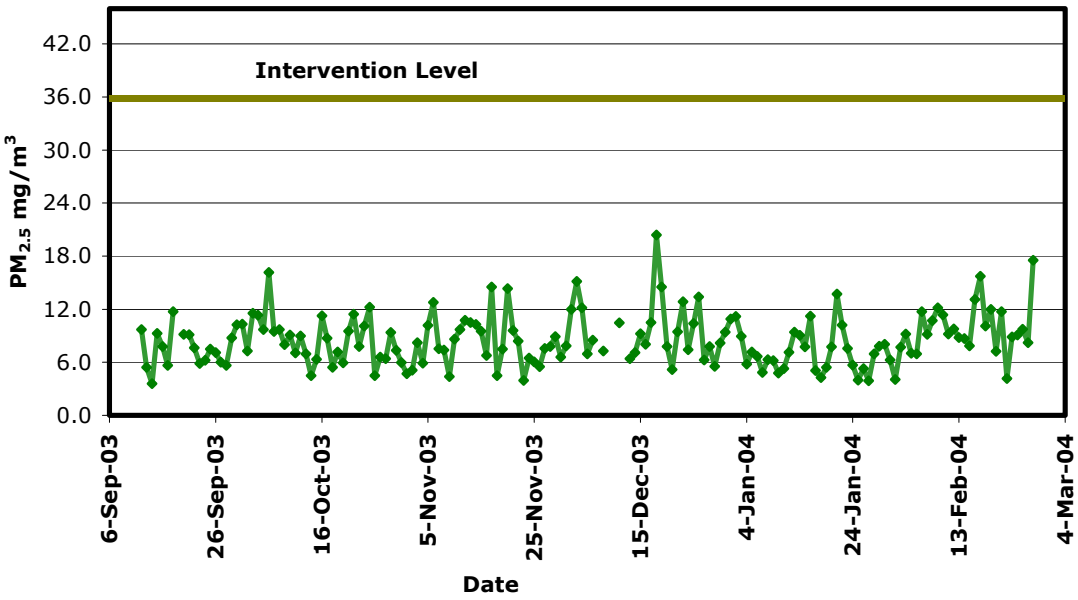

Figure 4: Daily average $PM_{2.5}$ concentrations at the Nunawading monitoring site.

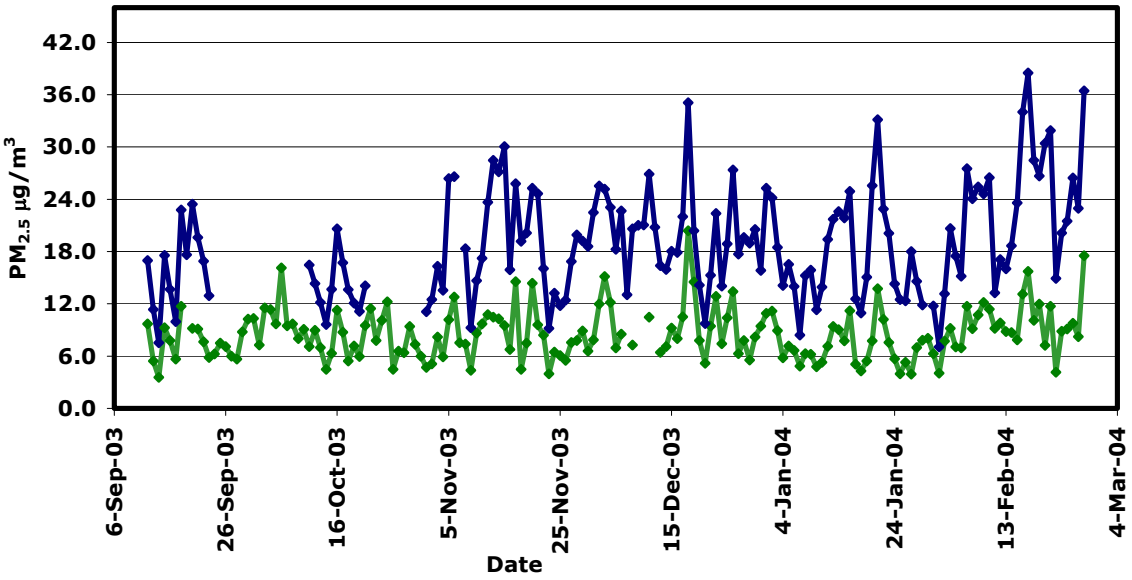

Figure 5: Daily average PM_{10} and $PM_{2.5}$ at the Nunawading monitoring site.

Nitrogen dioxide

Daily maximum hourly average concentrations for NO_2 are shown in Figure 6. The highest hourly NO_2 concentration measured was 55ppb. This is comparable to the maximum hourly value of 46ppb at the Alphington monitoring site and 48ppb at the Richmond monitoring site. These values are well below the SEPP (AQM) intervention level of 140ppb.

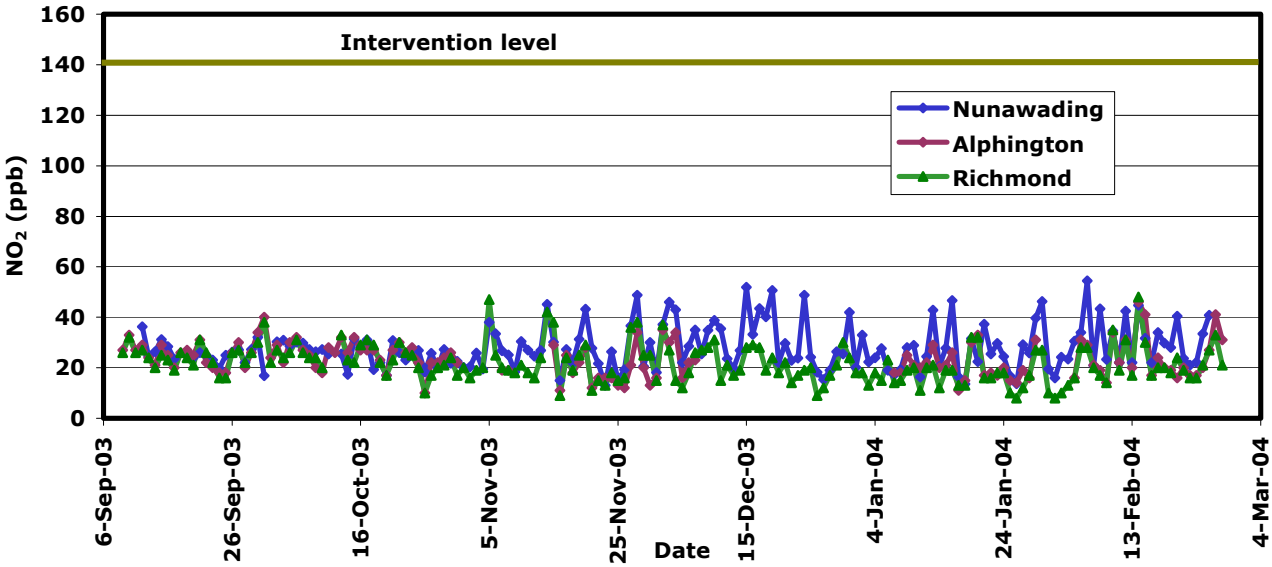

Figure 6: Maximum hourly average NO_2 concentrations at the Nunawading monitoring site.

Carbon monoxide

Daily maximum hourly average concentrations for CO for the Nunawading site are shown in Figure 7. The highest one-hour average CO concentration was 4.6ppm. This compares with a maximum hourly value of 2.7ppm at the Richmond monitoring site and 2.0ppm at the Alphington monitoring site. The higher CO concentrations at the Nunawading site can be attributed to the proximity of the site to heavy traffic. These values are lower than the SEPP (AQM) intervention level for CO of 29ppm for a one-hour averaging period.

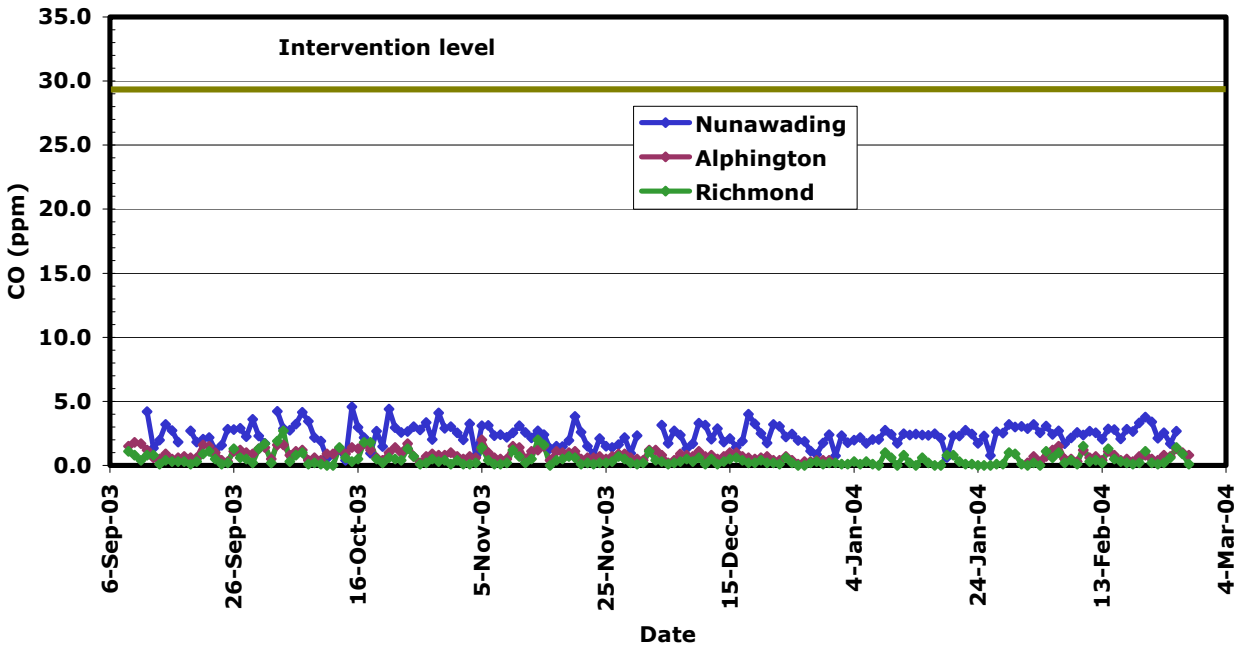

Figure 7: Maximum hourly average CO concentrations at the Nunawading monitoring site.

Volatile Organic Compounds (VOCs)

Maximum, minimum and average VOC concentrations measured during the study are shown in Table 1 with the Draft Air Toxics NEPM investigation levels. Graphical representations of the data are shown in Figure 8. For the duration of the study VOC concentrations were well below investigation levels (Air Toxics NEPM). VOC levels measured at Nunawading are similar to levels measured in a 1996 study adjacent to the Westgate Freeway, Millers Road Altona. (Westgate Freeway, 1996 – 1997) also presented in Table 1.

Table 1: Maximum, Minimum and Average 24-hour Concentrations (in ppb) of VOCs Compared with draft National Guidelines [Air Toxics NEPM].

VOC	Max	Min	Ave	Westgate Study Averages	Investigation. Level [Air Toxics NEPM]
1,3-butadiene	0.7	‹0.2	0.2	ND	NA
benzene	3.2	0.6	1.7	1.7	3 [1]
toluene	6.6	1.0	3.1	4.4	1000 [2]
ethylbenzene	0.8	‹0.2	0.4	0.4	NA
p-xylene	1.4	‹0.2	0.6	1.3	250 [2]
m-xylene	1.9	‹0.2	0.7	ND	
o-xylene	1.5	‹0.2	0.5	0.4	

Note: VOC concentrations should be taken as indicative only.
‹ 0.2 indicates concentration was below detection limit.
ND not determined
[1] Annual average [Air Toxics NEPM]
[2] 24-hour average [Air Toxics NEPM]

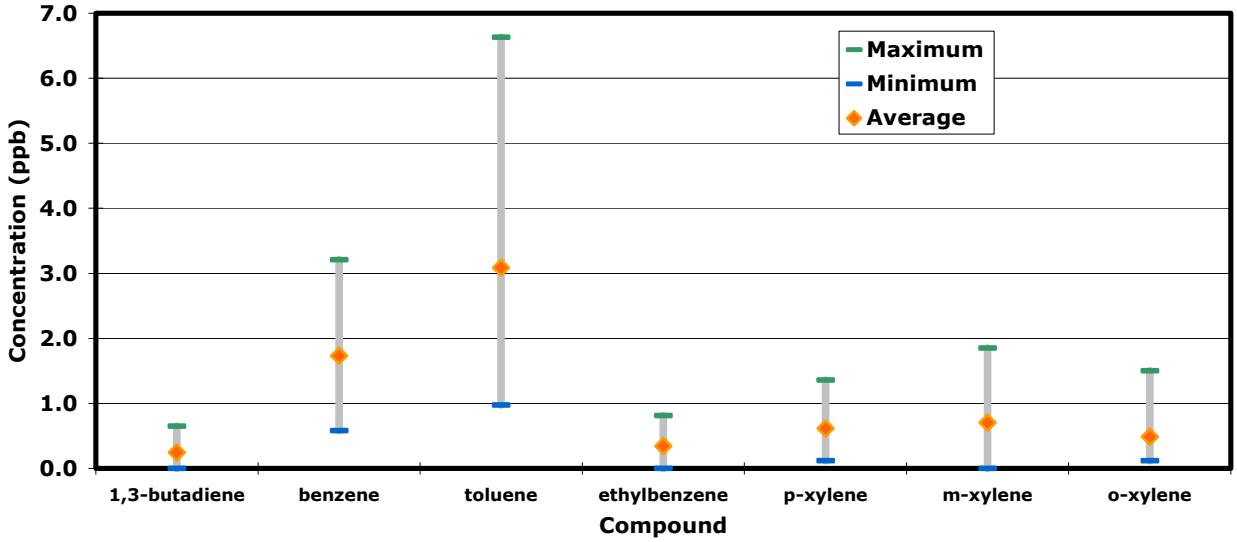

Figure 8: Daily average VOC concentrations at the Nunawading monitoring site.

Poly Aromatic Hydrocarbons

Maximum, minimum and average PAH concentrations (in nanograms per cubic metre, ng/m^3) measured during the study are shown in Figure 9[3]. The most abundant PAH was phenanthrene, followed by naphthalene. The investigation level for PAHs is based on benzo(a)pyrene as a marker for PAHs [Air Toxics NEPM]. The investigation level of 0.3ng/m^3 is based on an annual average. Benzo(a)pyrene is chosen as a PAH marker due to it being a potential human carcinogen. The maximum daily average concentration of benzo(a)pyrene measured was 0.6ng/m^3, a comparable annual average would be expected to be much lower than this level. The average benzo(a)pyrene during the five month monitoring period was 0.1ng/m^3.

[3] For samples analysed between 4 October and 17 November 2003 low levels of target compounds were detected in laboratory blanks that may indicate sample contamination.

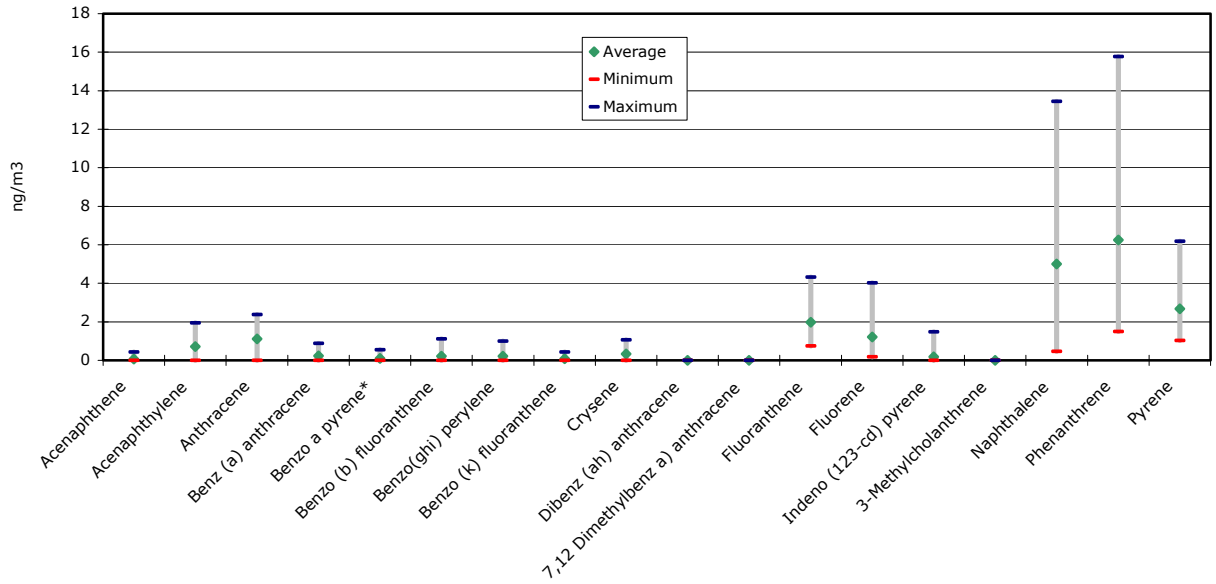

Figure 9: Daily average PAH concentrations at the Nunawading monitoring site.

PAH data were also compared with data from PAH monitoring results from Yarraville [Figure 10]. Results from Nunawading show lower PAH levels than Yarraville and higher PAH levels than Corio. The higher PAH levels at Yarraville are most likely related to the higher proportion of diesel vehicles at this site.

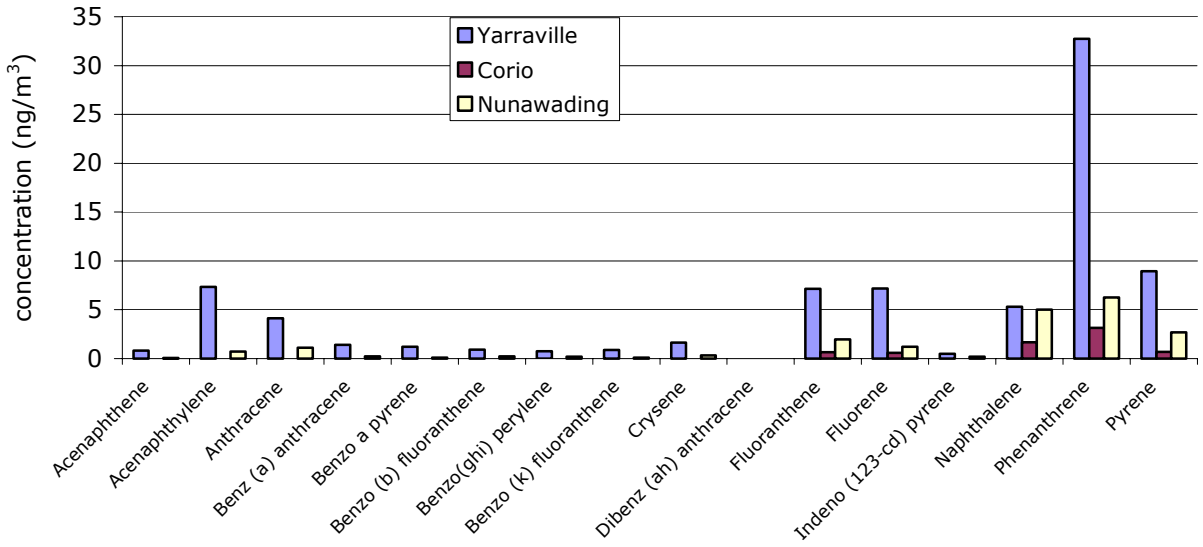

Figure 10: Daily average PAH concentrations at Nunawading, Corio and Yarraville

CONCLUSIONS

- Air quality was monitored near a heavily trafficked Nunawading intersection during the period September 2003 to February 2004. The results of this study are consistent with other roadside monitoring undertaken across various parts of the metropolitan area which indicate that within a very short distance from roads, ambient air quality objectives are generally met.
- For the study period, particles (measured as PM_{10} and $PM_{2.5}$), nitrogen dioxide (NO_2), and carbon monoxide (CO) were below intervention levels set in the *State Environment Protection Policy (Air Quality Management)* and do not represent concern at the concentrations measured.
- Volatile organic compounds (VOCs) and poly aromatic hydrocarbons (PAHs) levels were well below investigation levels as set in the *Draft National Environment Protection (Air Toxics) Measure* and do not constitute a significant health risk at the levels measured.
- NO_2, CO and particle levels were only slightly higher than levels measured at EPA fixed site monitoring stations in residential areas of Alphington and Richmond.
- VOC levels were generally low and were similar to levels measured in a previous study adjacent to the Westgate Freeway, Millers Road Altona (Westgate Freeway, 1996 – 1997).
- PAH levels were comparable to a similar roadside study, Princess Highway Corio (Corio 2002 – 2003). PAH levels for the current study were also much lower than those determined at a site in Yarraville, which had a high proportion of diesel vehicles.

REFERENCES

Draft National Environment Protection (Air Toxics) Measure EPHSC17/15 November 2003

Environment Australia (2002) *A Status Report to the Community: Living Cities-Air Toxics Program*.

EPA 1997, *Air Quality Management Plan Taking Stock*, EPA Publication 535 (National Pollution Inventory URL address www.npi.gov.au)

EPA 2003, *Victoria's Air Quality 2002*, EPA publication 910

Freeway Air Quality Study 1996, Westgate Freeway Altona

State Environment Protection Policy (Air Quality Management) 2001, Government of Victoria.

State Environment Protection Policy (Ambient Air Quality) 1999, Government of Victoria.

VicRoads 2003, Information Services Department Hourly Traffic Volumes February 8 2003, July 17 2003, Hourly Traffic Volumes data provided by VicRoads