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Executive summary

Diesel and petrol vehicles are an important part of the public and private transportation sector but are also one of the largest contributors to environmental pollution worldwide. Vehicle emissions have significant effects on health and the environment, including the development of cancer; cardiovascular and respiratory health effects; pollution of air, water, and soil; reduced visibility; and global climate change. The public health implications and costs of these air pollutants are large. In an analysis by the Bureau of Transport and Regional Economics, Canberra, it was estimated that the health cost of road traffic air pollution to the Australian community was AUD$3308 million in 2000 (BTRE, 2005).

As part of the Department of Environment and Conservation's *CleanRun*'s environmental verification component, the following project examined the variability in ambient particle concentrations measured as total suspended particles (TSP) at two air monitoring sites along a major traffic corridor in the Perth metropolitan area. The elemental constituents of the sampled TSP were also analysed for each of the air samples. In addition to the sampling of TSP, polycyclic aromatic hydrocarbons (PAHs) in association with traffic-related particles were investigated at a third air monitoring site. Sample collection was performed at the three air monitoring sites from May 2007 to May 2008. A total of 59 samples were collected at each of the TSP monitoring sites, Brentwood and Melville, and 60 samples at the PAH air monitoring site in East Fremantle.

The principal objectives of the project were:

- To gather data on the concentration of traffic-related particles and PAHs along a major traffic corridor;
- To gather data on the elemental constituents, including metals, of traffic-related particles in the designated study area; and
- To identify the variability in the concentrations of these air pollutants in the designated study area.

The 24-hour TSP concentrations at the Melville air monitoring site ranged from 15.7 $\mu g/m^3$ to 86.4$\mu g/m^3$, while at the Brentwood air monitoring site, 24-hour TSP concentrations ranged from 14.1 $\mu g/m^3$ to 124.6 $\mu g/m^3$. The annual mean 24-hour TSP concentrations for Melville and Brentwood were 38.6 $\mu g/m^3$ and 34.1 $\mu g/m^3$, respectively. Differences in 24-hour TSP concentrations between these two air monitoring sites approached statistical significance.

The highest 24-hour TSP concentration recorded was 124.6 $\mu g/m^3$ at Brentwood in November 2007. This was the only measurement recorded at either of the two sites that was above the Kwinana EPP Area C Standard of 90 $\mu g/m^3$, but still below the Kwinana EPP Area C Limit of 150 $\mu g/m^3$. The second highest measurement recorded was 86.4 $\mu g/m^3$ at Melville in February 2008.

Seasonal differences were investigated in relation to the TSP concentrations.

Seasons were defined as summer (November to April) and winter (May to October). For both air monitoring sites, the lowest monthly mean 24-hour TSP concentrations were during the winter months of June, July and August. The summer mean 24-hour TSP concentrations for Melville and Brentwood were 46.3 $\mu g/m^3$ and 43.1 $\mu g/m^3$, respectively. The winter mean 24-hour TSP concentrations for Melville and Brentwood were 30.2 $\mu g/m^3$ and 24.5 $\mu g/m^3$, respectively. These seasonal differences in 24-hour TSP concentrations were highly statistically significant for both air monitoring sites.

Of the 30 chemical species included in the elemental analysis of the TSP samples, 13 elements (As, Be, Cd, Cr, Co, Ga, Mo, Ni, Se, Ag, Tl, Th, and V) were below the Limit of Reporting in all of the TSP samples. Of the remaining 17 elements identified, seven (Al, Ca, Fe, Mg, K, Na, and S) had mean annual concentrations above 0.1 $\mu g/m^3$. A statistically significant difference was observed between the Melville and Brentwood air monitoring sites for only three of the elements—namely, Ba, Cu and Zn. TSP samples from the Brentwood air monitoring site had marginally higher concentrations of Ba and Cu than those from the Melville air monitoring site. Concentrations of Zn were marginally higher in the Melville TSP samples than in the Brentwood TSP samples. The concentrations of these elements (Ba, Cu and Zn) were low for both air monitoring sites, with values below 0.04 $\mu g/m^3$.

The highest annual mean PAH concentrations were found for the PAHs that occur as gases in the air samples. Phenanthrene had the highest annual mean of 3.33 ng/m^3 and was the only PAH with an annual mean above 1 ng/m^3. The highest 24-hour concentration was recorded for phenanthrene (9.07 ng/m^3) and the second highest 24-hour concentration was recorded for acenaphthylene (5.84 ng/m^3). Five other PAHs recorded highest 24-hour concentrations above 1 ng/m^3—namely, naphthalene (3.59 ng/m^3), fluorene (2.63 ng/m^3), anthracene (1.78 ng/m^3), fluoranthene (2.59 ng/m^3) and pyrene (2.53 ng/m^3). The annual mean concentration for BaP (0.08 ng/m^3) did not exceed the annual average goals for the UK (0.25 ng/m^3) or the European Commission (1.0 ng/m^3).

The results from this study were similar to those obtained during the Perth Haze Study (1994-1995). The Perth Haze Study found the highest 24-hour concentrations above 0.1 $\mu g/m^3$ for Al, Si, Ca, Fe, Cu, Zn and Pb, with the highest ambient concentration (3.59 $\mu g/m^3$) recorded being for K. Most of the elements in the study showed strong seasonal cycles, with combustion sources contributing most strongly in the months of May to October. Similar to the Perth Haze Study, this study found Al, Ca, Fe, and K with the highest 24-hour concentrations above 0.1 $\mu g/m^3$. However, Mg, Mn, Na, and S were also found to have the highest 24-hour concentrations above 0.1 $\mu g/m^3$ in this study. This difference may be due to the differences in sampling regime. The Perth Haze Study focussed on fine particulate matter, while this study also sampled the coarse fraction of particulate matter, which includes metals such as Ca, Al, Mg, and Mn.

There have been a number of studies in Australia that have measured PAH concentrations in ambient air, however no standard or systematic measurement methods were used in these studies. It is therefore difficult to make direct comparisons between the results of these studies. The average 24-hour PAH concentrations for Perth were generally lower than those observed in these Australian studies (Environment Australia, 2002a).

Studies have shown that Cu and Zn originate from anthropogenic sources, including motor vehicle components and industrial activities (Weckwerth 2001; Cadle et al, 1999). It has been suggested that low Cu/Zn ratios in TSP are source indicators for petrol and diesel vehicles (Lim et al, 2005). In this study of TSP, the mean Cu/Zn ratio for the Melville air monitoring site was 0.31 and 0.53 for the Brentwood air monitoring site. These Cu/Zn ratios suggest that the motor vehicle emissions may be a major contributor of TSP in these areas. Similarly, the coronene to BaP ratios suggest that vehicle emissions are the primary source of the PAHs measured in this study. To add support to this finding, the highest 24-hour PAH concentrations measured were for phenanthrene—another source indicator for vehicle emissions.

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Abbreviations

Acronym	Explanation
ANOVA	Analysis of variance
BTRE	Bureau of Transport and Regional Economics
CBD	Central Business District
COPD	Chronic obstructive pulmonary disease
DEP	Department of Environmental Protection
DNIPHE	Dutch National Institute of Public Health and the Environment
DoE	Department of Environment
EPP	Environmental Protection Policy
ICP/AES	Inductively coupled plasma/atomic emission spectroscopy
ICP/MS	Inductively coupled plasma/mass spectrometry
MPC	Maximum permissible concentration
NEPM	National Environment Protection Measure
ng/m^3	Nanograms per cubic metre
NOx	Nitrogen oxides
PAH	Polycyclic aromatic hydrocarbons
PM	Particulate matter
ppb	Parts per billion
ppm	Parts per million
TSP	Total suspended particulate
T-Test	Student's t-test
$\mu g/m^3$	Micrograms per cubic metre
UK	United Kingdom
VOC	Volatile organic compounds

Abbreviations of chemical species

Acronym	Chemical species
Ag	Silver
Al	Aluminium
As	Arsenic
B	Boron
Ba	Barium
Be	Beryllium
Ca	Calcium
Cd	Cadmium
Co	Cobalt
Cr	Chromium
Cu	Copper
Fe	Iron
Ga	Gallium
K	Potassium
Mg	Magnesium
Mn	Manganese
Mo	Molybdenum
Na	Sodium
Ni	Nickel
P	Phosphorus
Pb	Lead
S	Sulphur
Sb	Antimony
Se	Selenium
Sn	Tin
Sr	Strontium
Th	Thorium
Tl	Thallium
V	Vanadium
Zn	Zinc

Abbreviations of polycyclic aromatic hydrocarbons

Acronym	Polycyclic aromatic hydrocarbon
ACE	Acenaphthene
ACY	Acenaphthylene
ANT	Anthracene
BaA	Benz(a)anthracene
BaP	Benzo(a)pyrene
BbF	Benzo(b)fluoranthene
BeP	Benzo(e)pyrene
BghiP	Benzo(g,h,i)perylene
BkF	Benzo(k)fluoranthene
CHR	Chrysene
COR	Coronene
DBA	Dibenz(a,h)anthracene
FL	Fluoranthene
FLU	Fluorene
IND	Indeno(1,2,3-cd)pyrene
NAP	Naphthalene
PER	Perylene
PHE	Phenanthrene
PYR	Pyrene

1 Introduction

The transportation sector is a major source of air pollution in most urban areas. Emission estimates from the *Perth Airshed Emissions Inventory Update 1998-1999* (DEP, 2002) indicated that motor vehicles are the largest single source of smog precursors (volatile organic compounds (VOCs) and oxides of nitrogen (NO_x)) in the Perth airshed and contribute significantly to photochemical smog and emissions of other air pollutants, including particles.

Diesel and petrol vehicles are an important part of the public and private transportation sector but are also one of the largest contributors to environmental pollution worldwide. Vehicle emissions have significant effects on health and the environment, including the development of cancer; cardiovascular and respiratory health effects; pollution of air, water, and soil; reduced visibility; and global climate change. With large increases expected in petrol and diesel vehicle fleet numbers and vehicle kilometres travelled, motor vehicles will remain a major contributor to increasing global emissions air pollutants.

The public health implications and costs of these air pollutants are large. The Bureau of Transport and Regional Economics, Canberra, estimated that the health cost of road traffic air pollution to the Australian community was AUD$3308 million in 2000 (BTRE, 2005). In Perth, significant associations have been found between daily changes in particle and ozone concentrations and hospitalisations for asthma, chronic obstructive pulmonary disease (COPD), pneumonia and respiratory disease (DoE 2003).

The National Environment Protection (Diesel Vehicles Emissions) Measure (Diesel NEPM) forms part of an integrated suite of approaches to manage emissions from diesel vehicles in Australia. The goal of the Diesel NEPM is to reduce exhaust emissions from diesel vehicles. As part of the implementation of the Diesel NEPM, Western Australia's Department of Environment and Conservation (DEC) introduced the *CleanRun* program, one component of which is environmental verification. Environmental verification involves obtaining baseline measurements of Ambient Air NEPM pollutants and diesel-specific air pollutants from transport-related emissions. This baseline data will be used to determine the impacts of diesel vehicles on airsheds at the local level (microairsheds) as well as the effectiveness of the Diesel NEPM and future emission reduction programs.

As part of *CleanRun*'s environmental verification component, this project examined the variability in ambient particle concentrations measured as total suspended particles (TSP) along a major traffic corridor in the Perth metropolitan area. The elemental constituents of the TSP were also analysed for each of the air samples. In addition to the sampling of TSP, polycyclic aromatic hydrocarbons (PAHs) in association with traffic-related particles were investigated.

2 Scope of project

The aim of the project was to determine the contribution of traffic-related particles and PAHs to small-scale airsheds (microairsheds) at the local level, with specific reference to traffic corridors.

The principal objectives of this project were:

- To gather data on the concentration of traffic-related particles and PAHs along a major traffic corridor;
- To gather data on the elemental constituents, including metals, of traffic-related particles in the designated study area; and
- To identify the variability in the concentrations of these air pollutants in the designated study area.

3 Methodology

Airborne particles are commonly classified by their size in terms of their aerodynamic diameter. For the purposes of this study, Total Suspended Particles (TSP) were collected and analysed. TSP was chosen so as to collect sufficient particulate matter for the chemical analyses. TSP are particles of an equivalent aerodynamic diameter of 50 $\mu g/m^3$ or less.

3.1 Air monitoring sites

Air samples were collected from three sites. TSP were sampled at two sites (Brentwood and Melville) located along a major transport route (Leach Highway). The Brentwood air monitoring site was located near the entry to Kwinana Freeway, a major freeway linking Perth's southern suburbs to the Central Business District. The Melville air monitoring site was located at a senior high school that was adjacent to a residential area. Polycyclic aromatic hydrocarbons (PAHs) were sampled at a site located near the junction of two major traffic routes, Canning Highway and Stirling Highway, in East Fremantle.

3.2 Air monitoring procedure and chemical analyses

High-volume air samplers (HiVol-3000, Ecotech) equipped with tissue quartz filters (Pallflex Membrane Filter, Tissue Quartz 2500QAT-UP, 8x10 inch) were used to collect TSP in compliance with Australian/New Zealand Standard 3580.10.1: 2003 (Methods for Sampling and Analysis of Ambient Air). A modified high-volume air sampler (HiVol-3000, Ecotech) equipped with a PUF (polyurethane foam) and quartz filter (Pallflex Membrane Filter, Tissue Quartz 2500QAT-UP, 102 mm diameter) was used to collect PAHs. The high-volume samplers were operated for 24 hours on a rotational 6-day cycle. Blank field samples were included to verify the integrity of the sampling protocol. This methodology follows the configuration for PAH sampling as recommended by Environment Australia (now known as Department of Environment, Water, Heritage and the Arts) (Environment Australia, 2002a).

TSP samples were analysed using inductively coupled plasma atomic emission spectroscopy (ICP/AES) and inductively coupled plasma/mass spectrometry (ICP/MS) as per US EPA IO-3.4 and IO-3.5 (Chemical Species Analysis of Filter-Collected Suspended Particulate Matter), respectively. The elemental analysis included the fractionation of 30 elements—namely, Aluminium (Al), Antimony (Sb), Arsenic (As), Barium (Ba), Beryllium (Be), Boron (B), Calcium (Ca), Cadmium (Cd), Chromium (Cr), Cobalt (Co), Copper (Cu), Iron (Fe), Gallium (Ga), Lead (Pb), Magnesium (Mg), Manganese (Mn), Molybdenum (Mo), Potassium (K), Phosphorus (P), Nickel (Ni), Selenium (Se), Sodium (Na), Silver (Ag), Strontium (Sr), Sulfur (S), Thallium (Tl), Tin (Sn), Thorium (Th), Vanadium (V), and Zinc (Zn).

The PAH extraction and analysis was performed as per US EPA TO-13A (Determination of PAHs in Ambient Air Using Gas Chromatography/Mass Spectrometry (GC/MS)). For the purposes of this study, the US EPA TO-13A method was modified so that the PUF (polyurethane foam) and filter paper were analysed separately for each sample. The chemical analysis included the following 19 PAHs; Naphthalene (NAP), Acenaphthylene (ACY), Acenaphthene (ACE), Fluorene (FLU), Phenanthrene (PHE), Anthracene (ANT), Fluoranthene (FL), Pyrene (PYR), Benz(a)anthracene (BaA), Chrysene (CHR), Benzo(b)fluoranthene (BbF), Benzo(k)fluoranthene (BkF), Benzo(e)pyrene (BeP), Benzo(a)pyrene (BaP), Perylene (PER), Indeno(1,2,3-cd)pyrene (IND), Dibenz(a,h)anthracene (DBA), Benzo(g,h,i)perylene (BghiP), and Coronene (COR).

3.3 Statistical analyses

Descriptive statistics were used to compare TSP, elemental particle and PAH concentrations between the air monitoring sites and historical data. The air pollutant concentration data were log-transformed for the statistical analyses. Differences between air monitoring sites were examined using T-Tests and ANOVAs. Analyses were performed using the statistical software package R Version 2.8.0 (The R Foundation for Statistical Computing 2008). For statistical purposes, when an element was not detected above the Limit of Detection were assigned a default value of one-half of the Limit of Reporting. Elements that were below the Limit of Detection for all of the samples were not included in the statistical analyses.

No National Environment Protection Measure (NEPM) has yet been established for Total Suspended Particles (TSP). For comparative purposes, the Kwinana EPP Area C Standard of 90 $\mu g/m^3$ (24-hour average) and Limit of 150 $\mu g/m^3$ (24-hour average) were used in this report.

There are no ambient air quality standards for PAHs in Australia. Australia has a monitoring investigative level for benzo-a-pyrene (BaP), a marker for PAHs, of 0.3 ng/m^3 as an annual average. The purpose of the monitoring investigative level is to facilitate the development of a BaP standard in Australia through data collection. The UK has implemented a national air quality objective for BaP of 0.25 ng/m^3 as an annual average that is to be achieved by 2010. The European Directive target value for BaP is 1.0 ng/m^3. The Dutch National Institute for Public Health and the Environment (DNIPHE) has set Maximum Permissible Concentrations (MPCs), or risk limits, for toxic compounds. DNIPHE's MPC for BaP in ambient air is 1.0 ng/m^3.

4 Results

Sample collection was performed at the three air monitoring sites from May 2007 to May 2008. A total of 59 samples were collected at each of the TSP monitoring sites, Brentwood and Melville, and 60 samples at the PAH air monitoring site.

4.1 Total suspended particles

See following data 4.1.1 to 4.1.5.

4.1.1 Total suspended particles (TSP) concentrations

The annual mean 24-hour TSP concentrations for Melville and Brentwood were 38.6 μg/m^3 and 34.1 μg/m^3, respectively. The 24-hour TSP concentrations at the Melville air monitoring site ranged from 15.7 μg/m^3 to 86.4μg/m^3, while at the Brentwood air monitoring site, 24-hour TSP concentrations ranged from 14.1 μg/m^3 to 124.6 μg/m^3. Differences in 24-hour TSP concentrations between these two air monitoring sites approached statistically significance (p=0.07).

The monthly mean 24-hour TSP concentrations for Melville ranged from 24.0 μg/m^3 (June 2007) to 55.8 μg/m^3 (February 2008) (Figure 1; Appendix 1: Table 1.1). A similar range of concentrations were observed at the Brentwood air monitoring site, with monthly mean 24-hour TSP concentrations ranging from 19.8 μg/m^3 (June 2007) to 63.7 μg/m^3 (November 2007). The monthly mean 24-hour TSP concentrations were consistently higher at the Melville air monitoring site in comparison to the Brentwood air monitoring site, except for the months of November and December 2007.

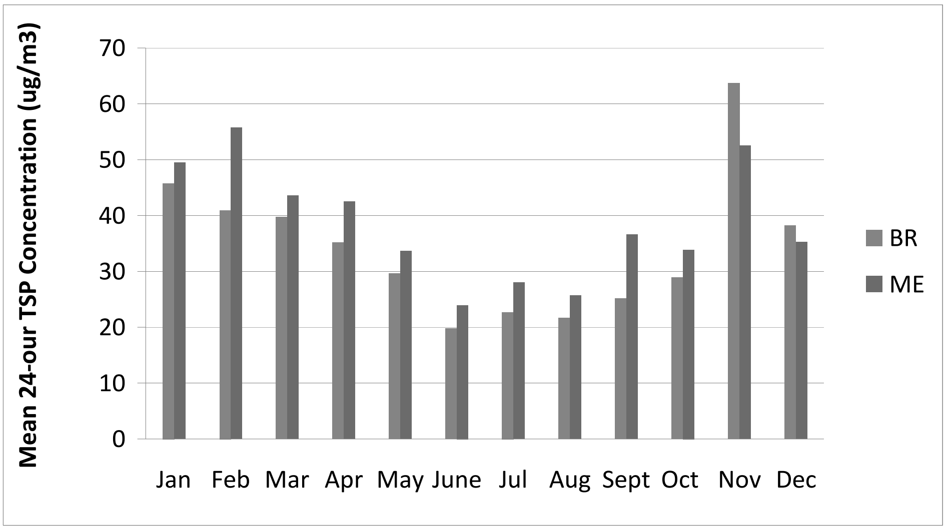

Figure 1. Mean 24-hour TSP concentrations (μg/m^3) for each month at Brentwood (BR) and Melville (ME).

The highest 24-hour TSP concentration recorded was 124.6 μg/m^3

(November 2007) at Brentwood (Figure 2). This was the only measurement recorded at either of the two sites that was above the Kwinana EPP Area C Standard of 90 μg/m^3, but still below the Kwinana EPP Area C Limit of 150 μg/m^3. The second highest measurement recorded was 86.4 μg/m^3 (February 2008) at Melville.

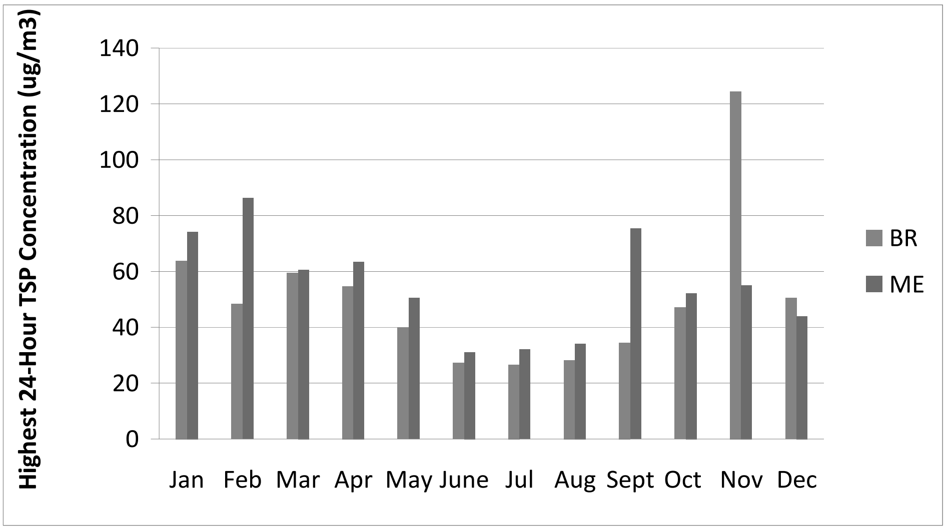

Figure 2. Highest 24-hour TSP concentrations (μg/m^3) for each month at Brentwood (BR) and Melville (ME).

Seasonal differences were investigated for each of the two air monitoring sites. Summer was defined as November to April and winter was defined as May to October. For both air monitoring sites, the lowest monthly mean 24-hour TSP concentrations were during the winter months of June, July and August. The summer mean 24-hour TSP concentrations for Melville and Brentwood were 46.3 μg/m^3 and 43.1 μg/m^3, respectively. The winter mean 24-hour TSP concentrations for Melville and Brentwood were 30.2 μg/m^3 and 24.5 μg/m^3, respectively. These seasonal differences in 24-hour TSP concentrations were highly statistically significant (p=0.0001) for both air monitoring sites.

The mean 24-hour TSP concentrations by day-of-week for Melville ranged from 24.6 μg/m^3 (Sunday) to 46.6 μg/m^3 (Thursday) (Figure 3; Appendix 1: Table 1.2). A similar range of concentrations were observed at the Brentwood air monitoring site, with mean 24-hour TSP concentrations ranging from 21.4 μg/m^3 (Sunday) to 41.0 μg/m^3 (Tuesday). The day-of-week mean 24-hour TSP concentrations were consistently higher at the Melville air monitoring site in comparison to the Brentwood air monitoring site for all of the days of the week, except Tuesday.

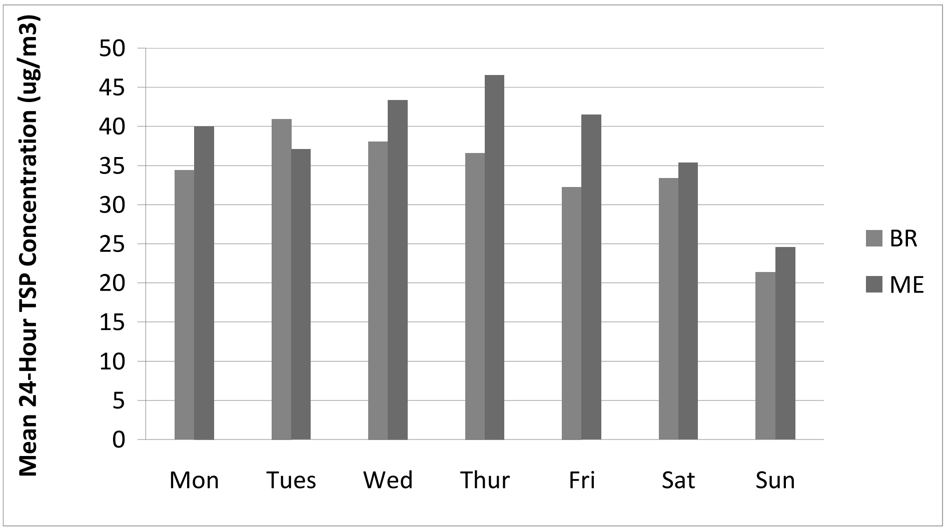

Figure 3. Mean 24-hour TSP concentrations (μg/m³) by day-of-the-week at Brentwood (BR) and Melville (ME).

4.1.2 Comparison of total suspended particles (TSP) concentrations to other sites in Perth

There have been a total of five stations in the Perth metropolitan region which have monitored ambient TSP concentrations during the period from 1992 to 2008 (Appendix 1: Table 1.3). Of these sites, Queens Buildings was the only site monitoring TSP for more than two years.

The annual mean 24-hour TSP concentrations at Queens Buildings during the period from 2000 to 2005 were higher than any of the annual mean 24-hour TSP concentrations observed for Melville, Brentwood, Caversham or Midvale Primary School during 2007/2008 (Figure 4). The Queens Buildings site was located in a heavily trafficked area of the Central Business District (CBD) of Perth. Historically, this site recorded the highest concentrations of vehicle-related air pollutants (e.g. NOx and CO).

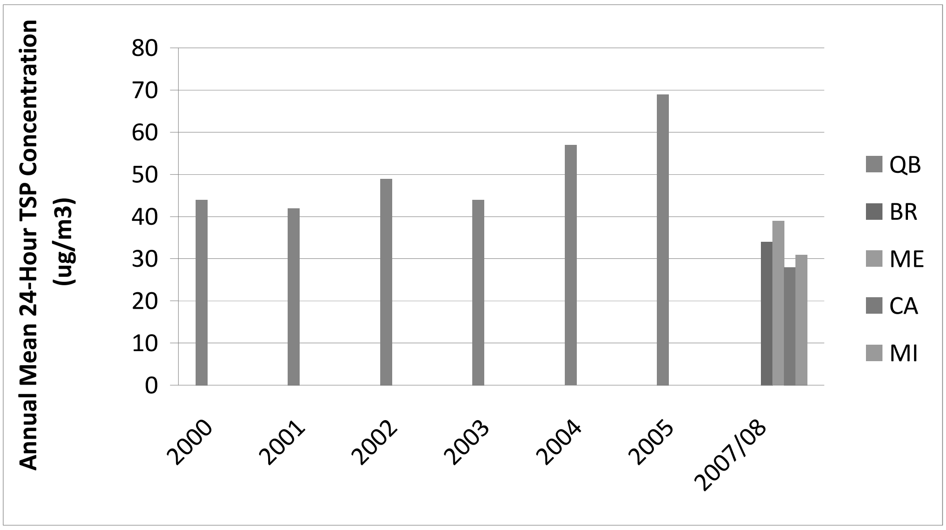

Figure 4. Annual mean 24-hour TSP concentrations (μg/m³) at Caversham (CA), Queens Buildings (QB), Midvale Primary School (MI), Melville (ME), and Brentwood (BR).

The Melville and Brentwood air monitoring sites had higher mean 24-hour TSP concentrations than Caversham for each month of the study period (Figure 5). The highest 24-hour TSP concentrations for the Melville site were also higher than those for Caversham during that period (Figure 6). Except for the months of February, June, September and December, Brentwood also had higher highest 24-hour TSP concentrations than Caversham.

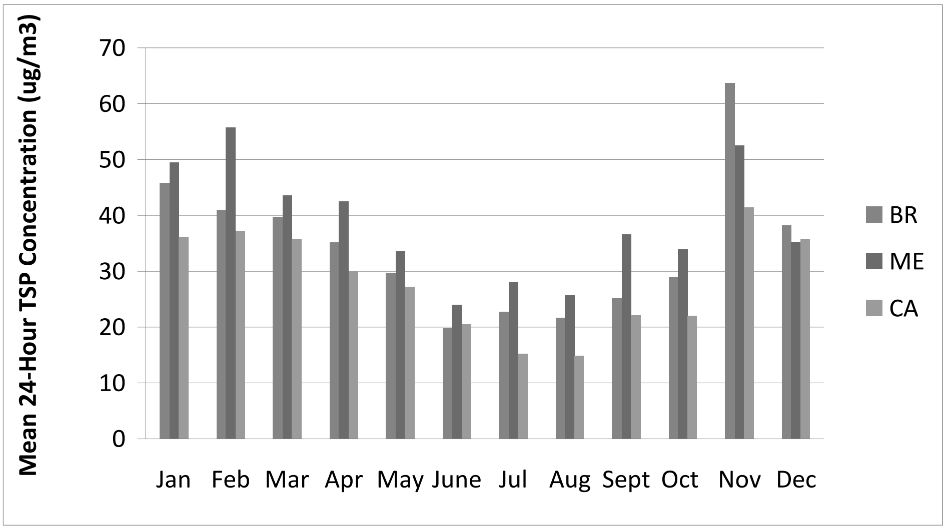

Figure 5. Mean 24-hour TSP concentrations ($\mu g/m^3$) for each month at Caversham (CA), Melville (ME) and Brentwood (BR).

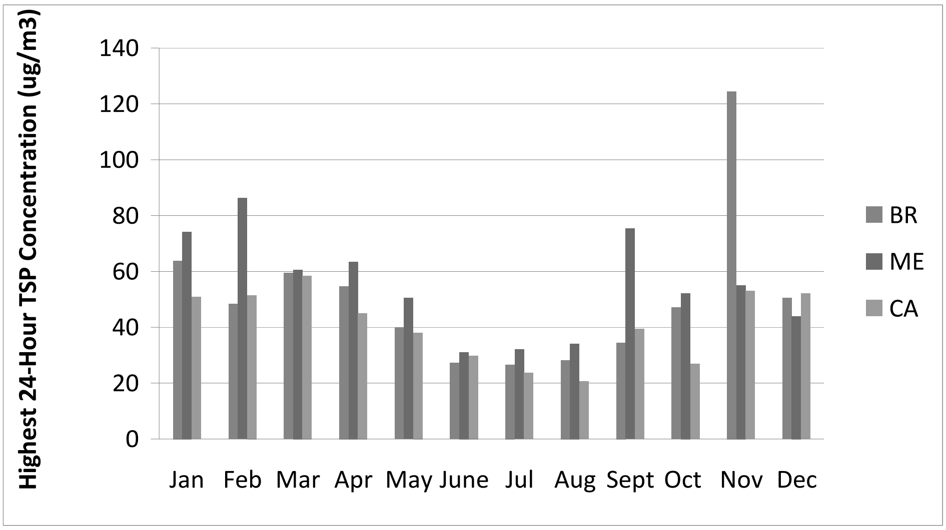

Figure 6. Highest 24-hour TSP concentrations ($\mu g/m^3$) for each month at Caversham (CA), Melville (ME) and Brentwood (BR).

4.1.3 Elemental concentrations in TSP

Of the 30 chemical species included in the elemental analysis, 13 elements (As, Be, Cd, Cr, Co, Ga, Mo, Ni, Se, Ag, Tl, Th, and V) were below the Limit of Reporting (LoR) in all of the TSP samples.[1]

Only eight chemical species (Al, Ca, Fe, Mg, Mn, K, Na and S) recorded highest 24-hour concentrations above 0.1 $\mu g/m^3$ (Appendix 1: Table 1.4). The highest 24-hour concentrations were recorded for Ca, Fe, Mg, Na and S. There were no exceedences of the annual standards (World Health Organisation (WHO) or Texas Commission on Environmental Quality (TCEQ)) for any of the elements at either of the two air monitoring sites.

Of the 8 chemical species identified, Al, Ca, Fe, Mg, K, Na, and S had mean annual concentrations above 0.1 $\mu g/m^3$ (Figure 7; Appendix 1: Table 1.5). A statistically significant difference was observed between the Melville and Brentwood air monitoring sites for only three of the chemical species—namely, Ba (p=0.007), Cu (p=0.005) and Zn (p=0.04). TSP samples from the Brentwood air monitoring site had marginally higher concentrations of Ba and Cu than those from the Melville air monitoring site. Concentrations of Zn were marginally higher in the Melville TSP samples than in the Brentwood TSP samples. The concentrations of these elements (Ba, Cu and Zn) were low for both air monitoring sites, with values below 0.04 $\mu g/m^3$.

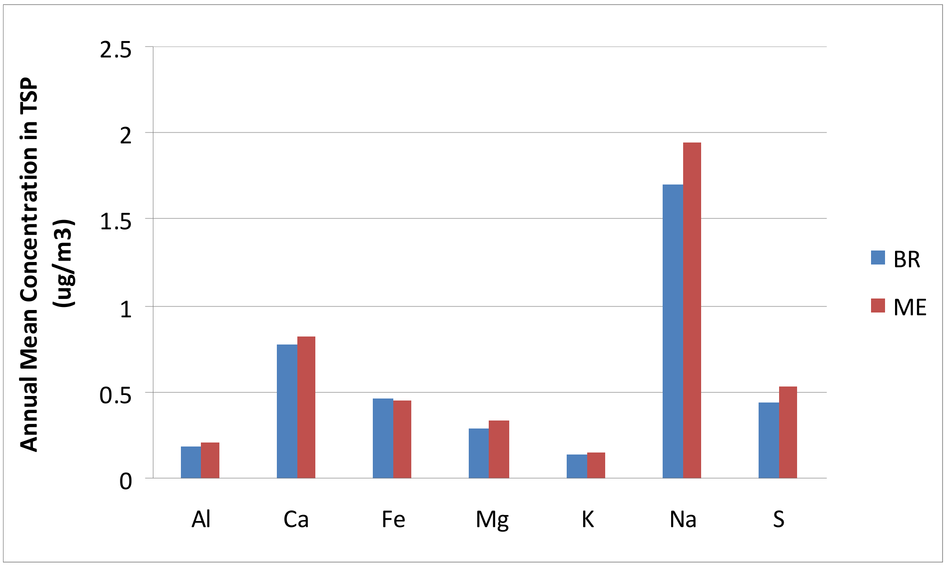

Figure 7. Annual mean concentrations ($\mu g/m^3$) for selected chemical species in TSP at Melville (ME) and Brentwood (BR).

The monthly mean concentrations for each of the chemical species in TSP samples from the Brentwood and Melville air monitoring sites are illustrated in Figures 8a and 8b (Appendix 1: Tables 1.6a, 1.6b, 1.7a and 1.7b). Seasonal

[1] Limit of Reporting (LoR) is the lowest detectable concentration of a substance that can be reliably reported, using a specific laboratory method and instrument. The value is calculated from the instrument detection limits and with appropriate scale-up factors applied. The scale-up factors are affected by the analytical procedures and methods and size of the sample.

differences were observed for 11 of the 17 chemical species identified at the Brentwood air monitoring site and 12 of the 17 chemical species identified at the Melville air monitoring site. These differences were highly statistically significant (p=0.0001) for the majority of the chemical species. Only three of the chemical species were just within statistically significance (p=0.04)—Ba (at Brentwood), K (at Melville) and Zn (at Melville). No seasonal differences were observed for Sb, Cu, Mg, Mn, and Sn in TSP samples at either of the two air monitoring sites. No seasonal differences were observed for B at the Brentwood air monitoring site, but seasonal differences in B were observed at the Melville air monitoring site.

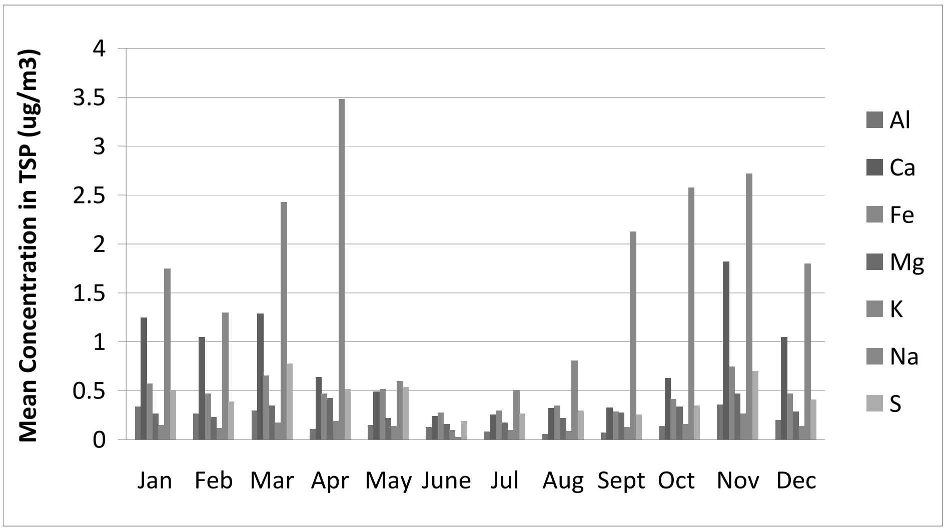

Figure 8a. Mean concentrations (μg/m^3) by month for selected chemical species in TSP at Brentwood (BR).

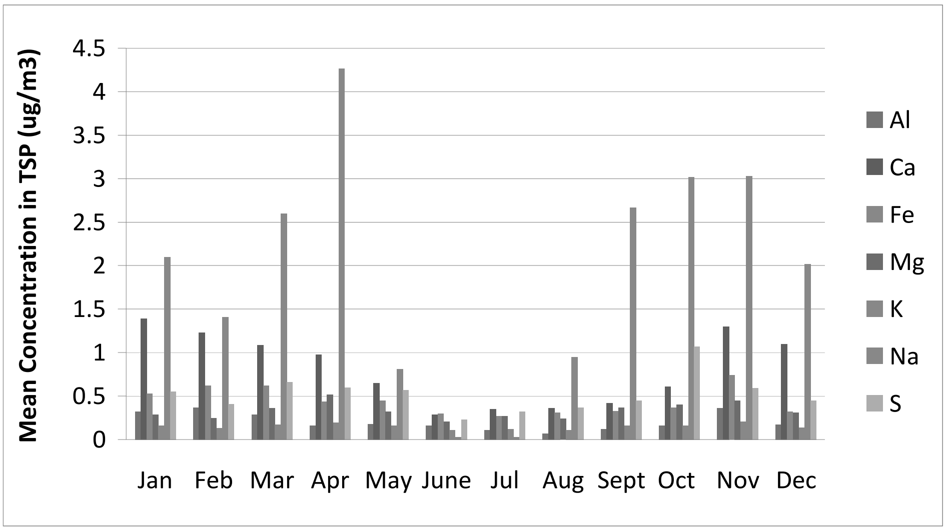

Figure 8b. Mean concentrations (μg/m^3) by month for selected chemical species in TSP at Melville (ME).

The elemental concentrations in TSP by day-of-week for the Brentwood and Melville air monitoring sites are illustrated in Figures 9a and 9b (Appendix 1: Tables 1.8 and 1.9). The lowest mean concentrations at both air monitoring sites were observed for Sunday. For Al and Ca, concentrations were half of those observed during the rest of week. The day-of-week mean chemical species concentrations were consistently higher at the Melville air monitoring site in comparison to the Brentwood air monitoring site for all of the days of the week, except Tuesday.

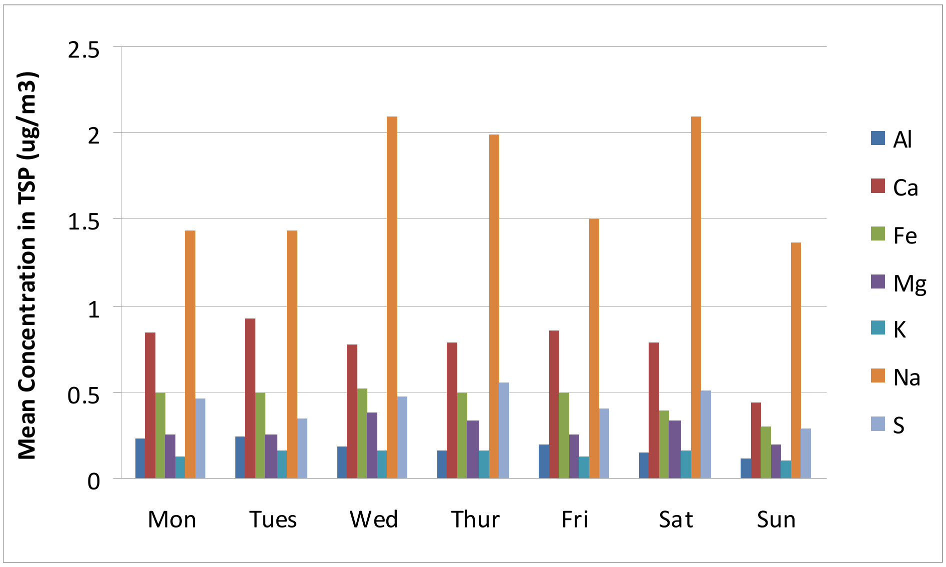

Figure 9a. Mean concentrations (μg/m^3) by day-of-week for selected chemical species in TSP at Brentwood (BR).

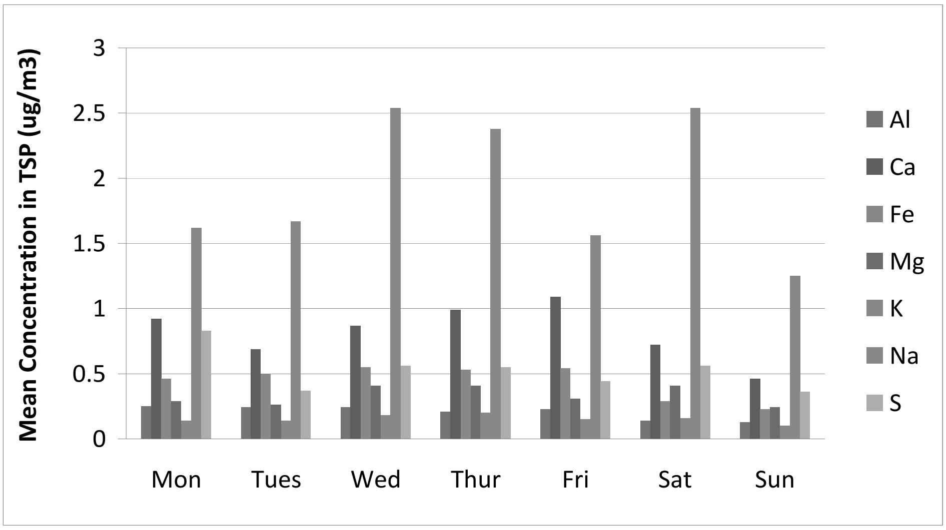

Figure 9b. Mean concentrations (μg/m^3) by day-of-week for selected chemical species in TSP at Melville (ME).

4.1.4 Elemental concentrations in comparison to other sites

The Midvale Primary School and Caversham air monitoring sites showed a similar pattern in chemical species, with the greatest annual mean concentrations being observed for the Melville and Brentwood air monitoring sites (Figure 10). Melville and Brentwood showed higher annual mean concentrations for Ca, Mg, Na, and S than the Midvale Primary School and Caversham sites. Similar values for the annual mean concentrations for Fe, K and Zn were observed for all the sites. The annual mean concentrations for Al were higher for Midvale Primary School and Caversham air monitoring sites than for the Melville and Brentwood air monitoring sites.

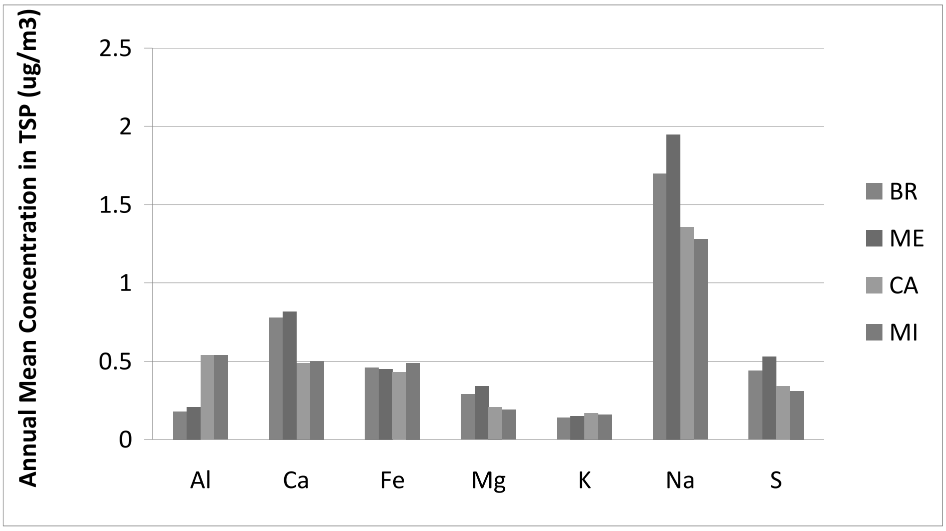

Figure 10. Annual mean concentrations (μg/m^3) for selected chemical species in TSP at Melville (ME), Brentwood (BR), Caversham (CA) and Midvale Primary School (MI).

The Duncraig and Queens Buildings air monitoring sites also showed a similar pattern in chemical species, with the greatest annual mean concentrations observed for the Melville and Brentwood air monitoring sites (Figure 11). Queens Buildings showed higher annual mean concentrations for Al, Ca, and Fe sites than did the Melville and Brentwood air monitoring sites. Similar values for the annual mean concentrations for Mg, K, Na, S and Zn were observed for Duncraig, Queens Buildings, Melville and Brentwood.

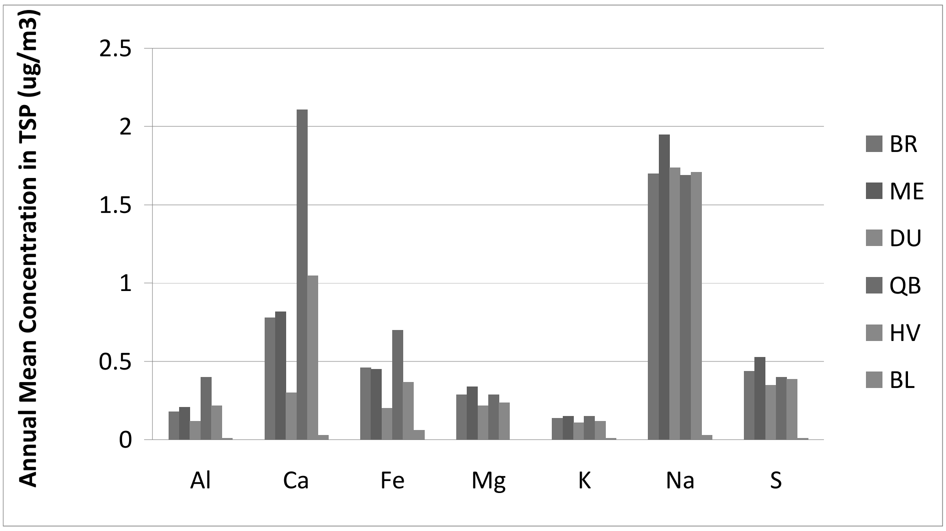

Figure 11. Annual mean concentrations (μg/m^3) for selected chemical species in TSP at Melville (ME), Brentwood (BR), Duncraig (DU), Queens Buildings (QB), Hope Valley (HV) and Bibra Lake (BL).

4.1.5 Elemental concentrations in Perth in comparison to other studies

There have been a number of Australian studies that have investigated metals in the composition of particulate matter, including the Melbourne Aerosol Study, the Perth Haze Study, the Australian Fine Particle Study (Melbourne, Sydney, Brisbane, Adelaide, Launceston, and Canberra), the Aerosol Sampling Program (Sydney, Wollongong, and Newcastle), the Charles Point Coarse and Fine Particle Study (Northern Territory), and the Queensland study (Environment Australia, 2002b). The majority of these studies were on PM10 and PM2.5. No standard or systematic measurement methods were used in these studies, so direct comparison of results is difficult. In general, the Perth air monitoring sites showed higher Al, Ca and Fe than other Australian cities (Figure 12).

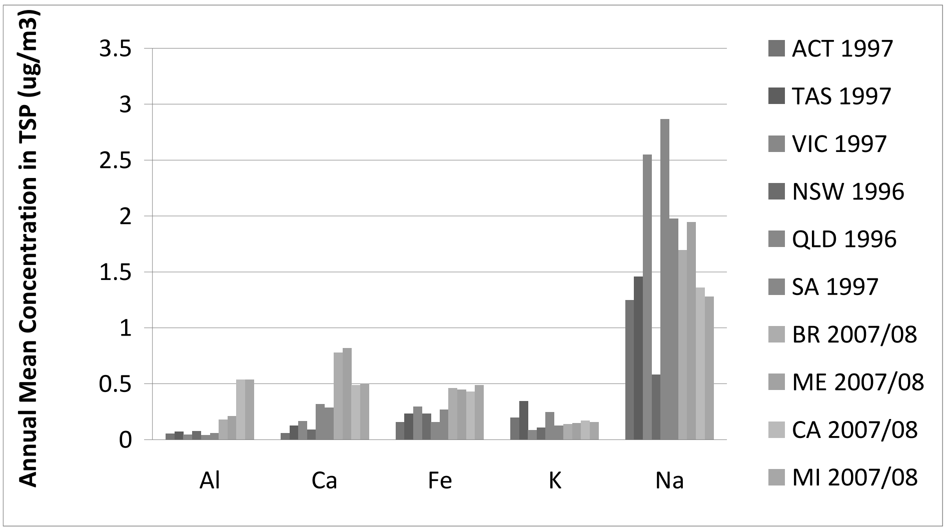

Figure 12. Annual mean concentrations (μg/m^3) for selected chemical species in TSP in Australia.

The results from this study were similar to those obtained during the Perth Haze Study (1994-1995). In the Perth Haze Study, fine particulate matter rather than TSP was collected using specially constructed high-volume samplers at three sites (Caversham, Duncraig, and Swanbourne).The Perth Haze Study found the highest 24-hour concentrations above 0.1 μg/m^3 for Al, Si, Ca, Fe, Cu, Zn and Pb, with the highest ambient concentration (3.59 μg/m^3) recorded being for K. Most of the chemical species in the study showed strong seasonal cycles, with combustion sources contributing most strongly in winter and spring.

Similar to the Perth Haze Study, this study found Al, Ca, Fe, and K with the highest 24-hour concentrations above 0.1 μg/m^3. However, Mg, Mn, Na, and S were also found to have the highest 24-hour concentrations above 0.1 μg/m^3 in this study. This difference may be due to the differences in sampling regime. The Perth Haze Study focussed on fine particulate matter, while this study also sampled the coarse fraction of particulate matter, which includes metals such as Ca, Al, Mg, and Mn.

A Brisbane study that characterised the elemental composition of TSP at a site (ANZ Stadium) similar to Melville reported mean 24-hour concentrations significantly higher for Al (1.14 μg/m^3) and Pb (0.14 μg/m^3) (Lim et al., 2005).

However, the mean 24-hour concentration at the ANZ Stadium for Fe (0.46 μg/m^3) was similar to that of Melville (0.45 μg/m^3) and Brentwood (0.46 μg/m^3). The mean 24-hour concentration for Mg at the ANZ Stadium (0.05 μg/m^3) was significantly lower than that of Melville (0.34 μg/m^3) and Brentwood (0.29 μg/m^3).

4.2 Polycyclic aromatic hydrocarbons (PAHs)

See data 4.2.1 to 4.2.2.

4.2.1 PAH concentrations

The highest annual mean concentrations were found for PAHs that occur as gases (Appendix 2: Table 2.1). PHE had the highest annual mean of 3.33 ng/m^3 and was the only PAH with an annual mean above 1 ng/m^3 (Figure 13). The highest 24-hour concentration was recorded for PHE (9.07 ng/m^3) and the second highest 24-hour concentration was recorded for ACY (5.84 ng/m^3). Five other PAHs recorded highest 24-hour concentrations above 1 ng/m^3—namely, NAP (3.59 ng/m^3), FLU (2.63 ng/m^3), ANT (1.78 ng/m^3), FL (2.59 ng/m^3) and PYR (2.53 ng/m^3). BaP, a commonly used marker for PAHs, had an annual average of 0.08 ng/m^3, which is below the annual average goals for the UK or the European Commission.

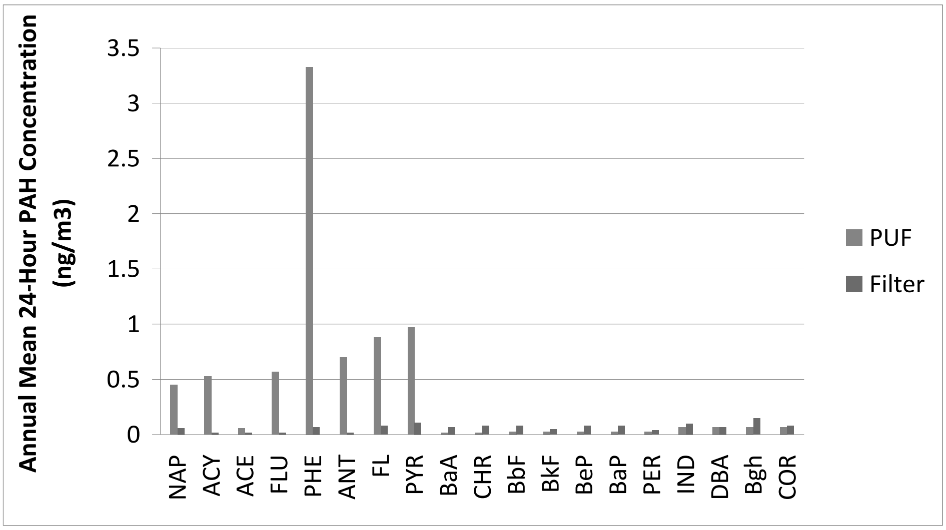

Figure 13. Annual mean concentrations (ng/m^3) for each PAH captured on the PUF and filter portions of the air sample.

Of the 11 PAHs found as particles (BaA, CHR, BbF, BkF, BeP, BaP, PER, IND, DBA, BghiP and COR), the highest annual mean was found for BghiP (0.15 ng/m^3). The second highest annual mean for this group of PAHs was for IND (0.10 ng/m^3). The highest 24-hour concentration recorded for this group of PAHs was for BaP (0.62 ng/m^3) and the second highest 24-hour concentration recorded for this group was for BghiP (0.55 ng/m^3) (Figure 14).

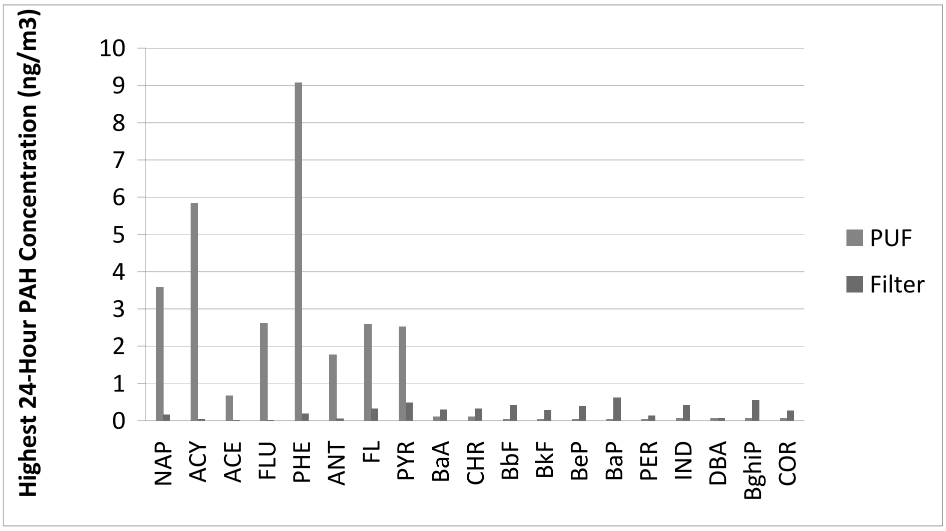

Figure 14. Highest 24-hour concentrations (ng/m^3) for each PAH captured on the PUF and filter portions of the air sample.

The mean 24-hour concentrations for each of the PAHs for each month for the PUF and filter portions of the air samples are illustrated in Figures 15 and 16, respectively (Appendix 2: Tables 2.2a, 2.2b, 2.3a and 2.3b). Statistically significant seasonal differences were observed for 13 of the 19 PAHs, with PAH concentrations being higher in the winter than in the summer. Two PAHs approached statistical significance—FLU ($p=0.07$) and FL ($p=0.06$). No statistically significant seasonal differences were found for PHE, ANT, PER and COR.

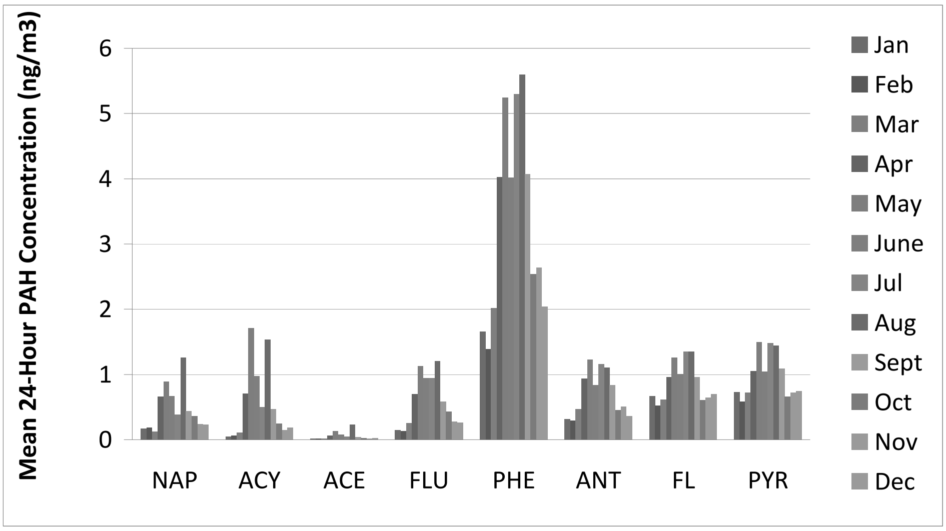

Figure 15. The mean concentrations (ng/m^3) by month for predominant PAHs captured on the PUF portion of the air sample.

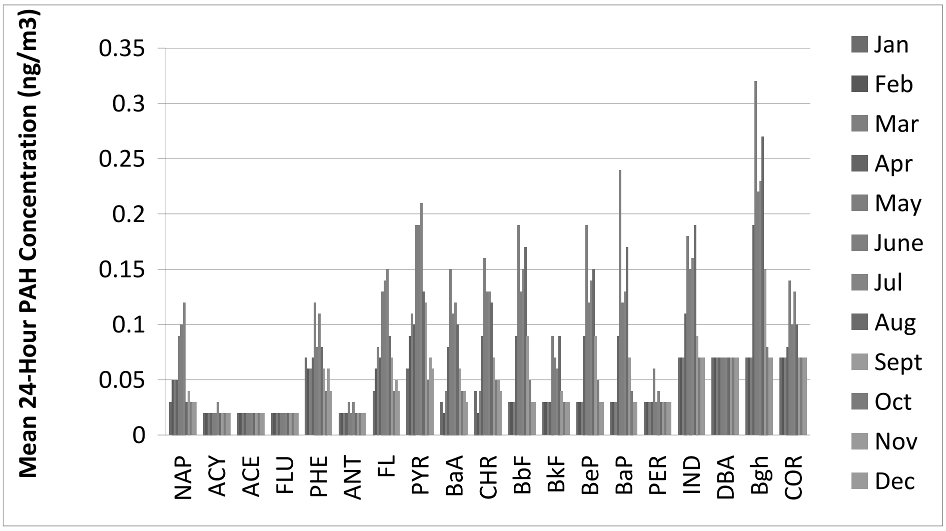

Figure 16. The mean concentrations (ng/m^3) by month for each PAH captured on the filter portion of the air sample.

The highest 24-hour concentrations for each of the PAHs for each month for the PUF and filter portions of the air samples are illustrated in Figure 17. The highest 24-hour PAH concentrations were recorded in the winter, with August recording the highest concentrations for NAP and PHE for the PUF portion of the air samples and May for BaA, Chrysene, BeP, BaP, and BghiP for the filter portion of the air samples.

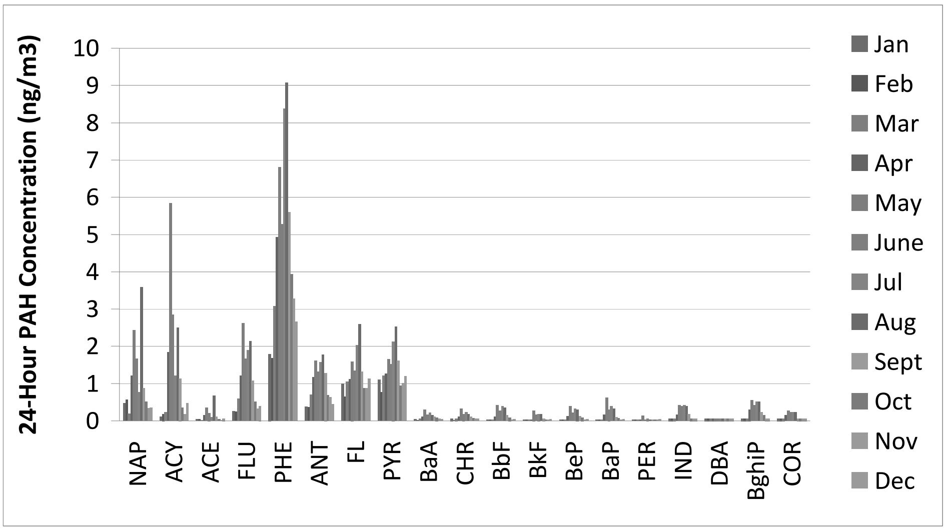

Figure 17. The highest 24-hour concentrations (ng/m^3) by month for each PAH captured on the PUF and filter portions of the air sample.

The mean 24-hour PAH concentrations by day-of-week are illustrated in Figures 18 and 19 (Appendix 2: Tables 2.4 and 2.5). For the PAHs that occur as gases (NAP, ACY, ACE, FLU, PHE, ANT, FL, and PYR), there was no consistent day-of-the-week pattern observed for the group as a whole. The lowest mean PAH concentrations for NAP, ACY, ACE, and FLU were for Monday, while the lowest mean PAH concentrations for PHE and PYR were for Sunday. The lowest mean PAH concentrations for ANT and FL were for Tuesday.

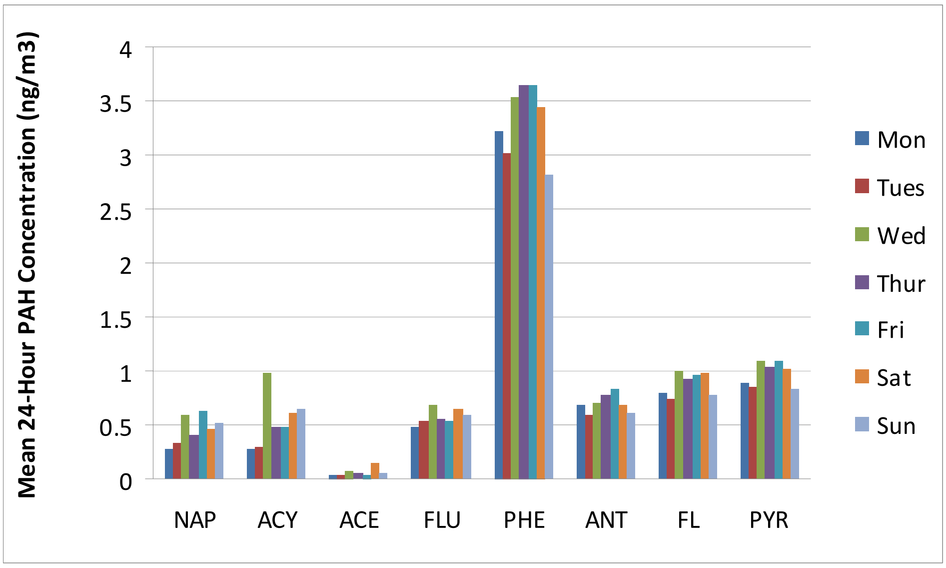

Figure 18. The mean concentrations (ng/m^3) by day-of-week for selected PAHs captured on the PUF portion of the air sample.

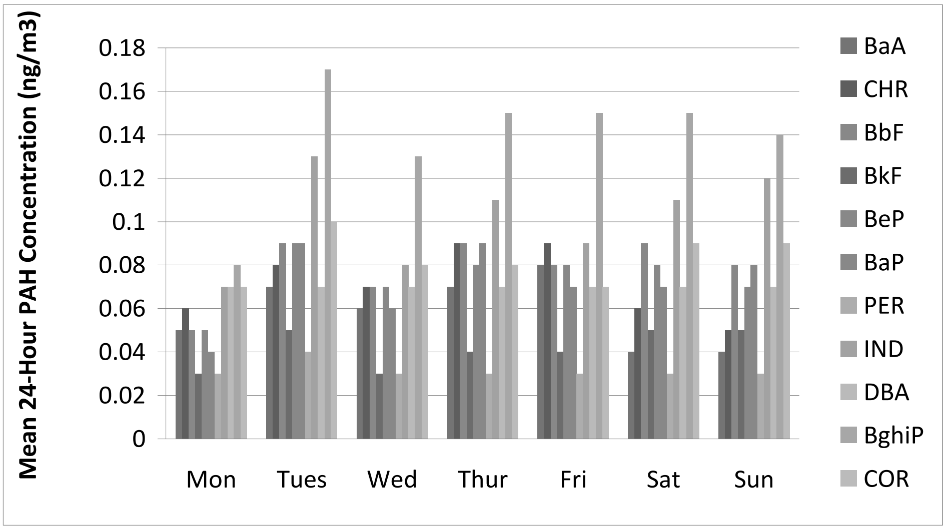

Figure 19. The mean concentrations (ng/m^3) by day-of-week for selected PAHs captured on the filter portion of the air sample.

For these gaseous phase PAHs, the highest 24-hour PAH concentrations were observed on Saturday for ACE, PHE, ANT, FL, and PYR. For ACY and FLU, the highest PAH concentrations were observed on Wednesday and for NAP, on Friday. The highest 24-hour concentrations on the PUF portion of the air sample were recorded for PHE (Figure 20).

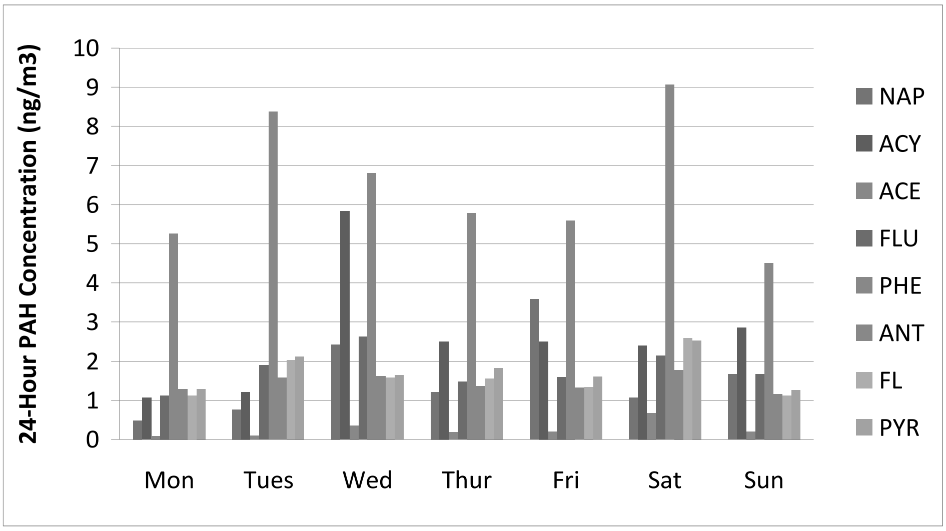

Figure 20. The highest 24-hour concentrations (ng/m^3) by day-of-week for selected PAHs captured on the PUF portion of the air sample.

For the PAHs found as particles (BaA, CHR, BbF, BkF, BeP, BaP, PER, IND, DBA, BghiP and COR), the lowest mean PAH concentrations were for Monday and the highest 24-hour PAH concentrations were observed for Tuesday. The highest 24-hour concentrations on the filter portion of the air sample were recorded for BghiP (Figure 21).

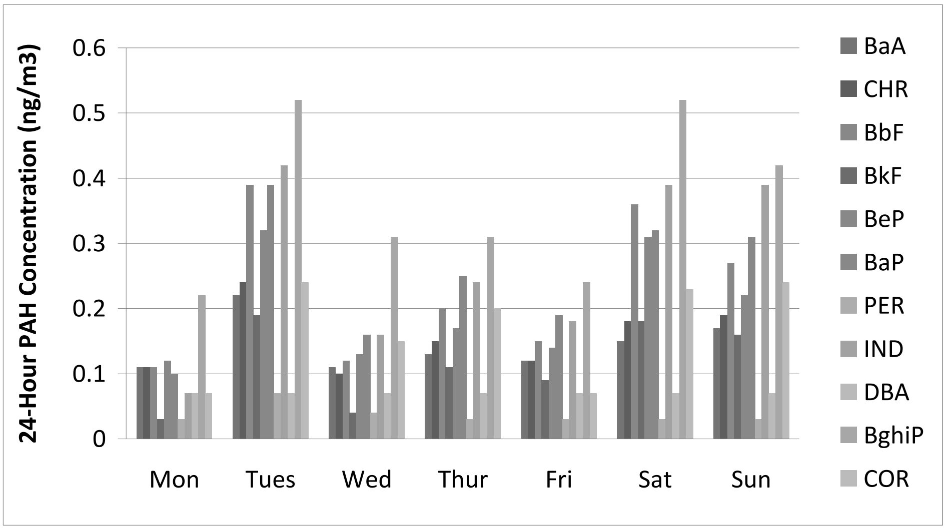

Figure 21. The highest 24-hour concentrations (ng/m^3) by day-of-week for selected PAHs captured on the filter portion of the air sample.

4.2.2 PAH Concentrations in Perth in Comparison to Other Cities

There have been a number of studies in Australia that have measured PAH concentrations in ambient air, including Brisbane (1994/1995), Perth (1994/1995), Darwin (1994 -1997), Canberra (1996/1997), Launceston (1991 -1993), Melbourne (1990/1991), and NSW (1997-2001) (Environment Australia, 2002a). As no standard or systematic measurement methods were used in these studies, it is difficult to make direct comparisons between the results of these studies. The most studied PAHs in these Australian studies were BaA, BaP, BbF, BghiP, BkF, CHR, DBA, FL, PHE, and PYR

(Environment Australia, 2002a). The average 24-hour PAH concentrations for Perth were generally lower than those observed in these Australian studies, with the exception of PHE (Figure 22).

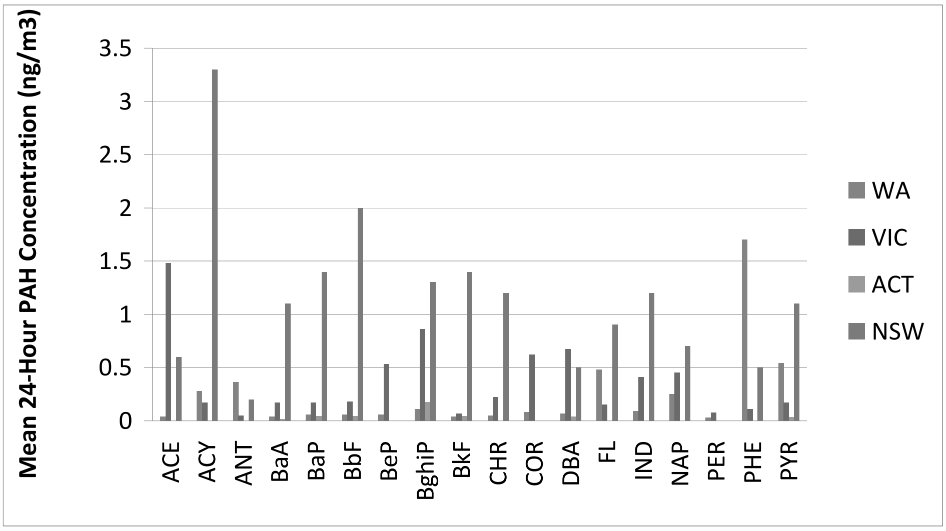

Figure 22. Average 24-hour concentrations for ambient PAHs measured in Australia

In the NSW study, 11 PAHs (BaA, CHR, BbF, BkF, BeP, BaP, PER, IND, DBA, BghiP and COR) were measured at 22 sites between August 1997 and February 2001. Five of these air monitoring sites were located in the Great Dividing Range where the altitude is higher, where winter conditions are cooler. The mean total PAHs (24-hour averages) ranged from 0.92 ng/m^3 (Nowra) to 23.8 ng/m^3 (Lithgow) in the winter and from 0.28 ng/m^3 (Armidale) to 0.82 ng/m^3 (Tumut) in the summer. For the Sydney sites, the mean total PAHs (24-hour averages) ranged from 1.56 (Richmond) to 7.35 (Earlwood) in the winter and from 0.22 (Richmond) to 0.97 (Earlwood) in the summer.

In comparison, the mean total PAHs (24-hour averages) for these same 11 PAHs in Perth was 1.18 ng/m^3 in winter (highest 24-hour of 3.79 ng/m^3) and 0.58 ng/m^3 (highest 24-hour of 1.37 ng/m^3) in summer. These concentrations were comparable to those observed for the Sydney sites of Richmond in the winter and Blacktown in the summer.

The PAH concentrations in Australian cities are similar to those reported in the international literature (Environment Australia, 2002a). The seasonal effect that has been observed across Australia, with winter PAH concentrations being significantly higher has also been reported in overseas studies.

5 Conclusions

5.1 Total suspended particles (TSP) concentrations

Total Suspended Particles (TSP) consist of particles with aerodynamic diameters up to and above 50 μm. The composition of TSP is diverse as it includes fine particulate matter (aerodynamic diameters less than or equal to 2.5 μm) that is emitted from fossil fuel combustion, vehicle emissions and wood burning as well as coarse particles (aerodynamic diameters between 2.5 μm and 10 μm) that arise from road and fugitive dust, tyre wear, sea spray, and a number of biological sources (e.g. pollens, fungal spores).

Through chemical analyses of the TSP sampled, it is possible to determine the potential sources of the particulate matter. Elements such as Al, Ca, Fe, K, Na, Pb, Si, and Zn. have been found to be associated with motor vehicle emissions. This study found Al, Ca, Fe, K, and Na as well as Mg, Mn, and S with highest 24-hour concentrations above 0.1 $\mu g/m^3$. However, the concentrations of most of these metals were found to be lower than those reported in the Perth Haze Study. The metals Mg and Mn were found in higher concentrations than in the Perth Haze Study, but this may be due the sampling regime used. The metals Mg and Mn are found in the coarse fraction of particulate matter and coarse particles were not sampled in the Perth Haze Study.

Studies have shown that Cu and Zn originate from anthropogenic sources, including motor vehicle components and industrial activities (Weckwerth 2001; Cadle et al, 1999). It has been suggested that low Cu/Zn ratios (e.g. 0.04-0.51) in TSP are source indicators for petrol and diesel vehicles, while high Cu/Zn ratios (0.76-1.61) indicate industrial activities (Lim et al, 2005).

In this study of TSP, the mean Cu/Zn ratio for the Melville air monitoring site was 0.31 and for Brentwood, 0.53. The range of the Cu/Zn ratio for the Melville site was 0.09 to 0.80. Similarly, the Cu/Zn ratio for the Brentwood site was 0.23 to 0.86. These Cu/Zn ratios suggest that the motor vehicle emissions may be a major contributor of TSP in these areas.

5.2 Polycyclic aromatic hydrocarbons (PAHs)

BghiP, COR and PHE are known PAH source indicators for motor vehicle emissions. By comparing ratios between pairs of frequently found PAHs characteristic of different sources, it is possible to distinguish between mobile and stationary sources. Stationary source combustion emissions from the use of coal, oil and wood tend to be low in COR relative to benzo(a)pyrene (BaP). Mobile source combustion emissions from diesel and petroleum use are high in BghiP and COR relative to BaP.

In this Perth study of PAHs, the COR to BaP ratio ranged from 0.25 to 1.65, with a mean ratio of 0.74, and the BghiP to BaP ratio ranged from 0.89 to 6.3, with a mean ratio of 2.39. These ratios suggest that vehicle emissions are the primary source of the PAHs measured in this study. To add support to this finding, the highest 24-hour PAH concentrations measured were for PHE—another source indicator for vehicle emissions.

The mean 24-hour concentrations for PHE ranged from 2.81 ng/m^3 (Sunday) to 3.65 ng/m^3 (Thursday and Friday), thereby demonstrating a similar day-of-the-week as was seen with the TSP data. This day-of-the-week effect is supported by the findings of a recent review of the Perth vehicle emissions inventory (Rostampour and Rye, in press). This review found that Sunday had the lowest estimated vehicle emissions regardless of road type (Figure 23). These findings would suggest that air quality policies that focus on reducing vehicle use may substantially improve air quality in areas heavily impacted by vehicular emissions.

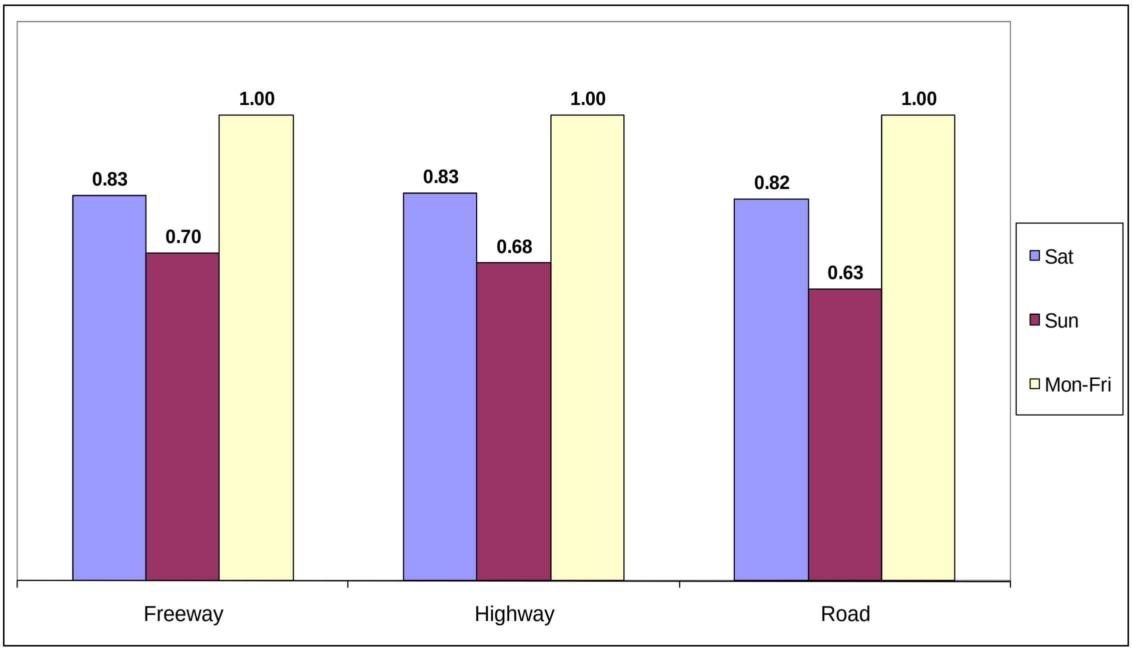

Figure 23. Weekday and weekend traffic factors for different road types in Perth.

5.3 Further work

Source apportionment is integral to the development of ambient air quality management strategies. When used in isolation, source identification based on the comparison of ratios of the concentrations of metals and PAHs is subject to a great degree of uncertainty. As no meteorological data was available for the air monitoring sites in this study, further investigation is required, including multivariate data analysis as well as air quality modelling of estimated vehicle emissions so as to better ascertain the contribution of motor vehicle emissions to the Perth airshed.

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APPENDICES

APPENDIX 1: Total suspended particles

APPENDIX 2: Polycyclic aromatic hydrocarbons

APPENDIX 1: Total suspended particles

Table 1.1 Average 24-hour TSP concentrations (μg/m^3) by month at Melville and Brentwood air monitoring sites

	Number of Samples	**Melville** Mean (Range) μg/m^3	**Brentwood** Mean (Range) μg/m^3
January	6	49.6 (31.1, 74.2)	45.8 (33.1, 63.9)
February	4	55.8 (31.5, 86.4)	41.0 (24.1, 48.4)
March	6	43.6 (27.7, 60.7)	39.8 (30.3, 59.5)
April	5	42.6 (21.9, 63.5)	35.2 (19.4, 54.8)
May	4	33.7 (22.4, 50.6)	29.7 (21.0, 40.0)
June	5	24.0 (15.7, 31.1)	19.8 (15.3, 27.3)
July	5	28.0 (24.3, 32.2)	22.7 (17.9, 26.7)
August	5	25.7 (17.3, 34.2)	21.7 (14.1, 28.3)
September	5	36.7 (19.4, 75.4)	25.2 (17.7, 34.5)
October	5	33.9 (18.4, 52.3)	28.9 (14.1, 47.2)
November	5 (Melville) 4 (Brentwood)	52.6 (48.7, 55.1)	63.7 (23.8, 124.6)
December	4 (Melville) 5 (Brentwood)	35.3 (28.4, 44.0)	38.2 (25.6, 50.6)

Table 1.2 Average 24-hour TSP concentrations (μg/m^3) by day-of-week at Melville and Brentwood air monitoring sites

	Number of Samples	**Melville** Mean (Range) μg/m^3	**Brentwood** Mean (Range) μg/m^3
Monday	9	40.0 (22.0, 86.4)	34.4 (20.3, 60.5)
Tuesday	9	37.1 (17.3, 52.6)	41.0 (14.1, 124.6)
Wednesday	9 (Melville) 8 (Brentwood)	43.4 (23.5, 63.5)	38.1 (17.7, 54.8)
Thursday	9	46.6 (31.5, 75.4)	36.6 (25.9, 59.5)
Friday	7 (Melville) 8 (Brentwood)	41.5 (19.4, 74.2)	32.3 (16.4, 63.9)
Saturday	8	35.4 (24.7, 44.0)	33.4 (25.2, 50.6)
Sunday	8	24.6 (15.7, 31.5)	21.4 (14.1, 33.1)

Table 1.3 Comparison to Perth air monitoring network sites: Annual average 24-hour TSP concentrations (µg/m^3)

	Murray Street Mean (Range) µg/m^3	**Caversham** Mean (Range) µg/m^3	**Kenwick** Mean (Range) µg/m^3	**Queens Buildings** Mean (Range) µg/m^3	**Melville SHS** Mean (Range) µg/m^3	**Brentwood** Mean (Range) µg/m^3	**Midvale PS** Mean (Range) µg/m^3
1992	67(27.5, 626.5)			51 (24.5, 91.5)			
1993				52 (21.5, 95.5)			
1994		49.5 (9.5, 110.5)	56 (17.5, 170.5)	58 (25.5, 108.5)			
1995		39 (7.5, 80.5)	41 (8.5, 96.5)	52 (18.5, 82.5)			
1996				47 (13.5, 94.5)			
1997				41 (17.5, 88.5)			
1998				44 (18.5, 117.5)			
1999				42 (17.5, 70)			
2000				44 (20, 100)			
2001				42 (15, 86)			
2002				49 (20, 85)			
2003				44 (15, 94)			
2004				57 (24, 129)			
2005				69 (23, 154)			
2006							
2007							
2007/08		28 (7, 58.5)			39 (16, 86)	34 (14.1, 125)	31 (10, 70)

Table 1.4 Comparison to 2005/2006 Study: Annual highest 24-hour elemental concentrations (µg/m³) in TSP

	Melville (n=59) Max (µg/m³)	**Brentwood** (n=59) Max (µg/m³)	**Duncraig** (n=62) Max (µg/m³)	**Queens Buildings** (n=61) Max (µg/m³)	**Hope Valley** (n=62) Max (µg/m³)	**Bibra Lake** (n=18) Max (µg/m³)	**Caversham** (n=) Max (µg/m³)	**Midvale PS** (n=) Max (µg/m³)
Al	0.52	0.51	0.46	1.07	0.76	0.02	2.06	1.59
Sb	0.02	0.04	NA	NA	NA	NA	0.01	0.02
Ba	0.03	0.06	0.02	0.04	0.01	0.00	0.01	0.04
B	0.02	0.07	0.03	0.05	0.04	0.02	1.18	0.01
Ca	3.29	3.45	0.89	8.05	6.10	0.08	1.44	2.01
Cu	0.03	0.04	0.01	0.03	0.04	0.00	0.01	0.01
Fe	1.03	0.98	0.78	1.48	3.25	0.17	1.10	1.08
Pb	0.05	0.03	0.01	0.02	0.01	0.00	0.02	0.01
Mg	1.12	0.91	0.92	0.86	0.92	0.02	0.78	0.85
Mn	0.19	0.13	0.00	0.02	0.02	0.00	0.02	0.02
K	0.39	0.54	0.35	0.32	0.30	0.03	0.38	0.33
P	0.07	0.12	0.05	0.05	0.15	0.00	0.05	0.05
Na	9.68	7.91	7.88	6.25	7.26	0.11	6.15	6.28
Sr	0.02	0.02	NA	NA	NA	NA	NA	NA
S	3.67	1.71	3.15	0.88	1.25	0.03	1.21	1.01
Sn	0.02	0.03	NA	NA	NA	NA	0.75	0.01
Zn	0.08	0.07	0.07	0.10	0.07	0.00	0.07	0.12

Table 1.5 Comparison to 2005/2006 Study: Annual average elemental concentrations (µg/m^3) in TSP

	Melville Mean (µg/m^3)	Brentwood Mean (µg/m^3)	Duncraig Mean (µg/m^3)	Queens Buildings Mean (µg/m^3)	Hope Valley Mean (µg/m^3)	Bibra Lake Mean (µg/m^3)	Caversham Mean (µg/m^3)	Midvale PS Mean (µg/m^3)
Al	0.21	0.18	0.12	0.40	0.22	0.01	0.54	0.54
Sb	0.01	0.01	NA	NA	NA	NA	0.00	0.00
Ba	0.02	0.02	0.01	0.02	0.00	0.00	0.01	0.01
B	0.02	0.02	0.00	0.01	0.00	0.00	0.03	0.00
Ca	0.82	0.78	0.30	2.11	1.05	0.03	0.49	0.50
Cu	0.01	0.02	0.00	0.01	0.01	0.00	0.01	0.01
Fe	0.45	0.46	0.20	0.70	0.37	0.06	0.43	0.49
Pb	0.01	0.01	0.00	0.01	0.00	0.00	0.00	0.01
Mg	0.34	0.29	0.22	0.29	0.24	0.00	0.21	0.19
Mn	0.01	0.01	0.00	0.01	0.01	0.00	0.01	0.01
K	0.15	0.14	0.11	0.15	0.12	0.01	0.17	0.16
P	0.02	0.02	0.01	0.02	0.03	0.00	0.02	0.02
Na	1.95	1.70	1.74	1.69	1.71	0.03	1.36	1.28
Sr	0.01	0.01	NA	NA	NA	NA	NA	NA
S	0.53	0.44	0.35	0.40	0.39	0.01	0.34	0.31
Sn	0.01	0.01	NA	NA	NA	NA	0.02	0.00
Zn	0.04	0.03	0.02	0.05	0.02	0.00	0.03	0.03

Table 1.6a Average elemental concentrations (μg/m^3) in TSP for Brentwood by month (January to June)

	January Mean (Range) μg/m^3	**February** Mean (Range) μg/m^3	**March** Mean (Range) μg/m^3	**April** Mean (Range) μg/m^3	**May** Mean (Range) μg/m^3	**June** Mean (Range) μg/m^3
Al	0.34 (0.23, **0.51**)	0.27 (0.25, 0.29)	0.30 (0.19, 0.43)	0.11 (0.03, 0.17)	0.15 (0.08, 0.28)	0.13 (0.03, 0.24)
Sb	0.01 (0.01, 0.01)	0.01 (0.01, 0.01)	0.01 (0.01, 0.01)	0.01 (0.01, 0.01)	0.01 (0.01, 0.02)	0.01 (0.01, 0.01)
Ba	0.02 (0.01, 0.03)	0.03 (0.01, 0.06)	0.02 (0.01, 0.04)	0.03 (0.01, 0.04)	0.03 (0.01, 0.04)	0.02 (0.01, 0.03)
B	0.02 (0.02, 0.02)	0.02 (0.02, 0.02)	0.02 (0.02, 0.02)	0.02 (0.02, 0.02)	0.02 (0.02, 0.02)	0.02 (0.02, 0.02)
Ca	1.25 (0.69, 2.34)	1.05 (0.52, 1.94)	1.29 (0.50, 1.83)	0.64 (0.67, 0.80)	0.49 (0.33, 0.87)	0.24 (0.18, 0.30)
Cu	0.02 (0.01, 0.03)	0.01 (0.01, 0.02)	0.02 (0.01, 0.03)	0.02 (0.01, 0.03)	**0.03** (0.01, 0.03)	0.01 (0.01, 0.02)
Fe	0.57 (0.39, 0.93)	0.47 (0.43, 0.54)	0.66 (0.46, **0.98**)	0.47 (0.21, 0.62)	0.52 (0.20, 0.82)	0.28 (0.14, 0.47)
Pb	0.00 (0.00, 0.01)	0.00 (0.00, 0.00)	0.01 (0.00, 0.01)	0.01 (0.00, 0.01)	0.02 (0.01, 0.03)	0.01 (0.00, 0.01)
Mg	0.27 (0.02, 0.49)	0.23 (0.19, 0.23)	0.35 (0.18, 0.73)	0.43 (0.19, **0.91**)	0.22 (0.16, 0.37)	0.16 (0.05, 0.35)
Mn	0.01 (0.01, 0.01)	0.01 (0.01, 0.01)	0.01 (0.01, 0.01)	0.01 (0.01, 0.01)	0.01 (0.01, 0.01)	0.01 (0.01, 0.01)
K	0.15 (0.10, 0.21)	0.12 (0.10, 0.14)	0.18 (0.11, 0.29)	0.19 (0.10, 0.32)	0.14 (0.11, 0.18)	0.10 (0.06, 0.15)
P	0.04 (0.01, 0.11)	0.01 (0.01, 0.01)	0.03 (0.01, 0.06)	0.01 (0.01, 0.01)	0.01 (0.01, 0.01)	0.01 (0.01, 0.01)
Na	1.75 (0.74, 3.20)	1.30 (1.17, 1.53)	2.43 (0.92, 6.16)	**3.48** (1.59, **7.91**)	0.60 (0.03, 1.30)	0.03 (0.03, 0.03)
Sr	0.01 (0.00, 0.01)	0.00 (0.00, 0.00)	0.01 (0.00, 0.01)	0.01 (0.00, 0.02)	0.00 (0.00, 0.00)	0.00 (0.00, 0.00)
S	0.51 (0.28, 0.82)	0.39 (0.31, 0.46)	0.78 (0.22, **1.71**)	0.52 (0.34, 0.85)	0.54 (0.31, 1.09)	0.19 (0.08, 0.29)
Sn	0.01 (0.01, 0.01)	0.01 (0.01, 0.01)	0.01 (0.01, 0.02)	0.01 (0.01, 0.01)	0.01 (0.01, 0.01)	0.01 (0.01, 0.01)
Zn	0.03 (0.02, 0.05)	0.03 (0.02, 0.04)	0.04 (0.03, 0.07)	0.04 (0.02, 0.05)	0.04 (0.02, 0.06)	0.02 (0.01, 0.04)

Table 1.6b Average elemental concentrations (µg/m^3) in TSP for Brentwood by month (July to December)

	July Mean (Range) µg/m^3	**August** Mean (Range) µg/m^3	**September** Mean (Range) µg/m^3	**October** Mean (Range) µg/m^3	**November** Mean (Range) µg/m^3	**December** Mean (Range) µg/m^3
Al	0.08 (0.03,0.14)	0.06 (0.03, 0.15)	0.07 (0.03, 0.11)	0.14 (0.08, 0.24)	**0.36** (0.17, 0.48)	0.20 (0.11, 0.30)
Sb	0.01 (0.01, 0.01)	0.01 (0.01, 0.01)	0.01 (0.01, 0.01)	0.01 (0.01, 0.01)	0.01 (0.01, 0.01)	0.01 (0.01, 0.01)
Ba	0.02 (0.00, 0.03)	0.02 (0.01, **0.05**)	0.02 (0.01, 0.03)	0.02 (0.01, 0.03)	**0.03** (0.02, 0.03)	0.02 (0.02, 0.03)
B	**0.03** (0.02**, 0.07**)	0.02 (0.02, 0.02)	0.02 (0.02, 0.02)	0.02 (0.02, 0.02)	0.02 (0.02, 0.02)	0.02 (0.02, 0.02)
Ca	0.26 (0.15, 0.33)	0.32 (0.20, 0.46)	0.33 (0.25, 0.36)	0.63 (0.42, 0.86)	**1.82** (0.56, **3.45**)	1.05 (0.51, 2.11)
Cu	0.01 (0.00, 0.02)	0.02 (0.00, **0.04**)	0.01 (0.00, 0.02)	0.02 (0.01, 0.02)	0.02 (0.01, 0.02)	0.02 (0.01, 0.02)
Fe	0.30 (0.03, 0.56)	0.35 (0.11, 0.71)	0.29 (0.20, 0.38)	0.42 (0.22, 0.57)	**0.75** (0.42, 0.93)	0.47 (0.30, 0.56)
Pb	0.01 (0.00, 0.02)	0.01 (0.00, 0.03)	0.01 (0.01, 0.02)	0.01 (0.01, 0.02)	0.02 (0.01, 0.03)	0.00 (0.00, 0.00)
Mg	0.18 (0.07, 0.28)	0.22 (0.10, 0.44)	0.28 (0.14, 0.55)	0.34 (0.15, 0.56)	**0.47** (0.17, 0.84)	0.29 (0.20, 0.52)
Mn	0.03 (0.01, 0.03)	0.01 (0.01, 0.01)	0.01 (0.01, 0.01)	0.01 (0.01, 0.01)	0.01 (0.01, 0.01)	0.01 (0.01, 0.01)
K	0.10 (0.07, 0.15)	0.09 (0.01, 0.14)	0.13 (0.08, 0.19)	0.16 (0.08, 0.24)	**0.27** (0.14, **0.54**)	0.14 (0.10, 0.22)
P	0.01 (0.01, 0.01)	0.01 (0.01, 0.01)	0.01 (0.01, 0.01)	0.01 (0.01, 0.01)	**0.05** (0.01, **0.12**)	0.01 (0.01, 0.01)
Na	0.51 (0.03, 2.32)	0.81 (0.03, 1.90)	2.13 (1.05, 4.39)	2.58 (1.04, 4.33)	2.72 (1.04, 4.32)	1.80 (0.90, 3.07)
Sr	0.00 (0.00, 0.00)	0.00 (0.00, 0.00)	0.00 (0.00, 0.00)	0.01 (0.00 0.01)	0.01 (0.00 0.02)	0.00 (0.00, .01)
S	0.27 (0.22, 0.31)	0.30 (0.27, 0.34)	0.26 (0.06, 0.39)	0.35 (0.01, 0.57)	0.70 (0.19, 0.89)	0.41 (0.33, 0.54)
Sn	0.01 (0.01, 0.03)	0.01 (0.01, 0.01)	0.01 (0.01, 0.01)	0.01 (0.01, 0.01)	0.01 (0.01, 0.01)	0.01 (0.01, 0.02)
Zn	0.03 (0.01, 0.06)	0.02 (0.01, 0.04)	0.02 (0.01, 0.03)	0.03 (0.02, 0.05)	**0.05** (0.03, **0.06**)	0.03 (0.02, 0.04)

Table 1.7a Average elemental concentrations (μg/m^3) in TSP for Melville by month (January to June)

	January Mean (Range) μg/m^3	**February** Mean (Range) μg/m^3	**March** Mean (Range) μg/m^3	**April** Mean (Range) μg/m^3	**May** Mean (Range) μg/m^3	**June** Mean (Range) μg/m^3
Al	0.32 (0.21, **0.52**)	**0.37** (0.26, 0.50)	0.29 (0.18, 0.44)	0.16 (0.07, 0.20)	0.18 (0.09, 0.33)	0.16 (0.03, 0.33)
Sb	0.01 (0.01, 0.01)	0.01 (0.01, 0.01)	0.01 (0.01, 0.01)	0.01 (0.01, 0.01)	0.01 (0.01, 0.01)	0.01 (0.01, 0.01)
Ba	0.02 (0.01, 0.03)	0.02 (0.01, 0.02)	0.02 (0.02, 0.03)	0.02 (0.01, 0.03)	0.02 (0.01, 0.03)	0.01 (0.01, 0.02)
B	0.02 (0.02, 0.02)	0.02 (0.02, 0.02)	0.02 (0.02, 0.02)	0.02 (0.02, 0.02)	0.02 (0.02, 0.02)	0.02 (0.02, 0.02)
Ca	**1.39** (0.76, **3.29**)	1.23 (0.52, 2.43)	1.09 (0.54, 1.57)	0.98 (0.23, 1.46)	0.65 (0.40, 1.08)	0.29 (0.22, 0.38)
Cu	0.01 (0.01, 0.02)	0.01 (0.01, 0.02)	0.02 (0.01, 0.02)	0.01 (0.01, 0.02)	0.02 (0.01, 0.03)	0.01 (0.01, 0.01)
Fe	0.53 (0.28, 0.93)	0.62 (0.41, 0.84)	0.62 (0.36, 0.85)	0.44 (0.18, 0.58)	0.45 (0.20, 0.83)	0.30 (0.13, 0.50)
Pb	0.00 (0.00, 0.01)	0.00 (0.00, 0.01)	0.00 (0.00, 0.01)	0.01 (0.00, 0.01)	0.02 (0.00, 0.04)	0.02 (0.00, 0.05)
Mg	0.29 (0.02, 0.51)	0.25 (0.19, 0.33)	0.36 (0.17, 0.80)	0.52 (0.21, **1.12**)	0.32 (0.21, 0.59)	0.21 (0.07, 0.49)
Mn	0.01 (0.01, 0.01)	0.01 (0.01, 0.01)	0.01 (0.01, 0.01)	0.01 (0.01, 0.01)	0.01 (0.01, 0.01)	0.01 (0.01, 0.01)
K	0.16 (0.10, 0.23)	0.13 (0.10, 0.14)	0.17 (0.09, 0.29)	0.20 (0.08, **0.39**)	0.16 (0.10, 0.22)	0.11 (0.07, 0.18)
P	0.04 (0.01, 0.07)	0.01 (0.01, 0.01)	0.02 (0.01, 0.05)	0.03 (0.01, 0.06)	0.02 (0.01, 0.04)	0.01 (0.01, 0.01)
Na	2.10 (0.88, 3.47)	1.41 (1.17, 1.88)	2.60 (0.87, 6.86)	**4.27** (1.81, **9.68**)	0.81 (0.03, 1.97)	0.03 (0.03, 0.03)
Sr	0.01 (0.00, 0.02)	0.00 (0.00, 0.01)	0.01 (0.00, 0.01)	0.01 (0.00, 0.01)	0.00 (0.00, 0.01)	0.00 (0.00, 0.01)
S	0.55 (0.32, 0.95)	0.41 (0.34, 0.48)	0.66 (0.20, 1.25)	0.60 (0.37, 0.99)	0.57 (0.34, 1.04)	0.23 (0.10, 0.36)
Sn	0.01 (0.01, 0.02)	0.01 (0.01, 0.01)	0.01 (0.01, 0.01)	0.01 (0.01, 0.02)	0.01 (0.01, 0.01)	0.01 (0.01, 0.01)
Zn	0.04 (0.02, 0.06)	0.04 (0.02, 0.05)	**0.05** (0.02, **0.08**)	**0.05** (0.03, 0.06)	0.04 (0.02, 0.06)	0.03 (0.02, 0.05)

Table 1.7b Average elemental concentrations (μg/m^3) in TSP for Melville by month (July to December)

	July Mean (Range) μg/m^3	**August** Mean (Range) μg/m^3	**September** Mean (Range) μg/m^3	**October** Mean (Range) μg/m^3	**November** Mean (Range) μg/m^3	**December** Mean (Range) μg/m^3
Al	0.11 (0.03, 0.22)	0.07 (0.03, 0.19)	0.12 (0.07, 0.27)	0.16 (0.09, 0.26)	0.36 (0.24, 0.49)	0.17 (0.13, 0.20)
Sb	0.01 (0.01, 0.01)	0.01 (0.01, 0.02)	0.01 (0.01, 0.01)	0.01 (0.01, 0.01)	0.01 (0.01, 0.02)	0.01 (0.01, 0.01)
Ba	0.01 (0.00, 0.02)	0.01 (0.00, 0.03)	0.01 (0.01, 0.02)	0.02 (0.01, 0.02)	0.02 (0.02, 0.02)	0.02 (0.01, 0.02)
B	0.02 (0.02, 0.02)	0.02 (0.02, 0.02)	0.02 (0.02, 0.02)	0.02 (0.02, 0.02)	0.02 (0.02, 0.02)	0.02 (0.02, 0.02)
Ca	0.35 (0.18, 0.58)	0.36 (0.16, 0.77)	0.42 (0.32, 0.74)	0.61 (0.42, 0.93)	1.30 (1.00, 1.68)	1.10 (0.86, 1.53)
Cu	0.01 (0.00, 0.02)	0.01 (0.00, 0.03)	0.01 (0.00, 0.02)	0.01 (0.01, 0.02)	0.01 (0.01, 0.02)	0.01 (0.01, 0.01)
Fe	0.27 (0.04, 0.51)	0.31 (0.11, 0.58)	0.33 (0.16, 0.78)	0.37 (0.17, 0.52)	**0.74** (0.53, **1.03**)	0.32 (0.23, 0.36)
Pb	0.01 (0.00, 0.02)	0.02 (0.01, 0.03)	0.01 (0.01, 0.03)	0.01 (0.01, 0.03)	0.02 (0.01, 0.02)	0.00 (0.00, 0.01)
Mg	0.27 (0.10, 0.45)	0.24 (0.18, 0.28)	0.37 (0.18, 0.72)	0.40 (0.21, 0.66)	**0.45** (0.22, 0.62)	0.31 (0.17, 0.55)
Mn	0.05 (0.01, 0.19)	0.01 (0.01, 0.01)	0.01 (0.01, 0.01)	0.01 (0.01, 0.01)	0.01 (0.01, 0.02)	0.01 (0.01, 0.01)
K	0.12 (0.08, 0.16)	0.11 (0.10, 0.13)	0.16 (0.08, 0.29)	0.16 (0.10, 0.24)	**0.21** (0.18, 0.23)	0.14 (0.10, 0.22)
P	0.01 (0.01, 0.01)	0.01 (0.01, 0.01)	0.02 (0.01, 0.04)	0.01 (0.01, 0.01)	0.04 (0.01, 0.07)	0.01 (0.01, 0.01)
Na	0.03 (0.03, 0.03)	0.95 (0.03, 2.24)	2.67 (1.39, 5.47)	3.02 (1.51, 5.05)	3.03 (1.11, 4.67)	2.02 (0.84, 3.42)
Sr	0.00 (0.00, 0.00)	0.00 (0.00, 0.00)	0.00 (0.00, 0.01)	0.01 (0.00, 0.01)	0.01 (0.01, 0.01)	0.01 (0.01, 0.01)
S	0.32 (0.27, 0.43)	0.37 (0.25, 0.51)	0.45 (0.22, 0.72)	**1.07** (0.29, **3.67**)	0.59 (0.23, 1.03)	0.45 (0.28, 0.57)
Sn	0.01 (0.01, 0.02)	0.01 (0.01, 0.01)	0.01 (0.01, 0.02)	0.01 (0.01, 0.01)	0.01 (0.01, 0.02)	0.01 (0.01, 0.01)
Zn	0.03 (0.01, 0.06)	0.03 (0.01, 0.06)	0.03 (0.02, 0.06)	0.03 (0.02, 0.05)	0.04 (0.04, 0.05)	0.03 (0.02, 0.04)

Table 1.8 Average elemental concentrations (µg/m^3) in TSP for Brentwood by day-of-the-week

	Monday Mean (Range) µg/m^3	**Tuesday** Mean (Range) µg/m^3	**Wednesday** Mean (Range) µg/m^3	**Thursday** Mean (Range) µg/m^3	**Friday** Mean (Range) µg/m^3	**Saturday** Mean (Range) µg/m^3	**Sunday** Mean (Range) µg/m^3
Al	0.23 (0.03, 0.46)	0.24 (0.03, 0.48)	0.19 (0.03, 0.43)	0.16 (0.07, 0.31)	0.20 (0.03, **0.51**)	0.15 (0.03, 0.26)	0.12 (0.03, 0.29)
Sb	0.01 (0.01, 0.01)	0.01 (0.01, 0.01)	0.01 (0.01, 0.01)	0.01 (0.01, **0.04**)	0.01 (0.01, 0.01)	0.01 (0.01, 0.01)	0.01 (0.01, 0.01)
Ba	0.03 (0.00, **0.06**)	0.03 (0.00, 0.06)	0.03 (0.01, 0.04)	0.03 (0.01, 0.05)	0.02 (0.01, 0.04)	0.02 (0.01, 0.03)	0.02 (0.00, 0.03)
B	0.02 (0.02, **0.07**)	0.02 (0.02, 0.02)	0.02 (0.02, 0.02)	0.02 (0.02, 0.02)	0.02 (0.02, 0.02)	0.02 (0.02, 0.02)	0.02 (0.02, 0.02)
Ca	0.84 (0.15, 1.94)	0.93 (0.20, **3.45**)	0.77 (0.31, 1.83)	0.79 (0.30, 1.79)	0.86 (0.30, 2.34)	0.79 (0.28, 2.11)	0.44 (0.18, 1.10)
Cu	0.02 (0.00, 0.03)	0.01 (0.00, 0.03)	0.02 (0.00, 0.03)	0.02 (0.01, **0.04**)	0.02 (0.00, 0.03)	0.01 (0.01, 0.02)	0.01 (0.00, 0.02)
Fe	0.50 (0.03, 0.89)	0.50 (0.11, 0.93)	0.52 (0.18, 0.97)	0.50 (0.20, 0.75)	0.50 (0.14, **0.98**)	0.39 (0.20, 0.55)	0.30 (0.09, 0.43)
Pb	0.01 (0.00, 0.02)	0.01 (0.00, **0.03**)	0.01 (0.00, **0.03**)	0.01 (0.00, 0.02)	0.01 (0.00, 0.02)	0.01 (0.00, **0.03**)	0.01 (0.00, 0.01)
Mg	0.25 (0.10, 0.49)	0.26 (0.05, 0.84)	0.38 (0.16, **0.91**)	0.33 (0.02, 0.73)	0.26 (0.14, 0.40)	0.34 (0.10, 0.55)	0.20 (0.08, 0.28)
Mn	0.01 (0.01, 0.01)	0.02 (0.01, **0.13**)	0.01 (0.01, 0.01)	0.01 (0.01, 0.01)	0.01 (0.01, 0.01)	0.01 (0.01, 0.01)	0.01 (0.01, 0.01)
K	0.13 (0.07, 0.21)	0.16 (0.06, **0.54**)	0.16 (0.08, 0.32)	0.16 (0.10, 0.29)	0.13 (0.01, 0.21)	0.16 (0.10, 0.24)	0.10 (0.07, 0.13)
P	0.02 (0.01, 0.06)	0.03 (0.01, **0.12**)	0.02 (0.01, 0.06)	0.01 (0.01, 0.01)	0.03 (0.01, 0.07)	0.01 (0.01, 0.01)	0.02 (0.01, 0.11)
Na	1.43 (0.03, 3.20)	1.43 (0.03, 4.32)	2.10 (0.03, **7.91**)	1.99 (0.03, 6.16)	1.51 (0.03, 2.68)	2.10 (0.03, 4.39)	1.36 (0.03, 2.32)
Sr	0.01 (0.00, 0.01)	0.01 (0.00, **0.02**)	0.01 (0.00, 0.01)	0.01 (0.00, **0.02**)	0.00 (0.00, 0.01)	0.01 (0.00, 0.01)	0.00 (0.00, 0.01)
S	0.46 (0.28, 0.89)	0.35 (0.08, 0.84)	0.48 (0.28, 0.85)	0.56 (0.22, 1.09)	0.41 (0.19, 0.84)	0.51 (0.06, **1.71**)	0.29 (0.01, 0.44)
Sn	0.01 (0.01, 0.01)	0.01 (0.01, 0.01)	0.01 (0.01, 0.01)	0.01 (0.01, 0.01)	0.01 (0.01, 0.02)	0.01 (0.01, 0.01)	0.01 (0.01, **0.03**)
Zn	0.03 (0.01, 0.05)	0.03 (0.01, 0.06)	0.04 (0.01, **0.07**)	0.04 (0.02, 0.06)	0.03 (0.01, 0.06)	0.03 (0.02, 0.04)	0.02 (0.01, 0.03)

Table 1.9 Average elemental concentrations (μg/m^3) in TSP for Melville by day-of-the-week

	Monday Mean (Range) μg/m^3	**Tuesday** Mean (Range) μg/m^3	**Wednesday** Mean (Range) μg/m^3	**Thursday** Mean (Range) μg/m^3	**Friday** Mean (Range) μg/m^3	**Saturday** Mean (Range) μg/m^3	**Sunday** Mean (Range) μg/m^3
Al	0.25 (0.03, 0.50)	0.24 (0.03, 0.33)	0.24 (0.03, 0.49)	0.21 (0.11, 0.33)	0.23 (0.03, **0.52**)	0.14 (0.03, 0.27)	0.13 (0.03, 0.26)
Sb	0.01 (0.01, 0.01)	0.01 (0.01, 0.01)	0.01 (0.01, **0.02**)	0.01 (0.01, 0.01)	0.01 (0.01, 0.01)	0.01 (0.01, 0.01)	0.01 (0.01, 0.01)
Ba	0.02 (0.01, 0.02)	0.02 (0.00, **0.03**)	0.02 (0.00, **0.03**)	0.02 (0.01, **0.03**)	0.02 (0.00, **0.03**)	0.01 (0.01, 0.02)	0.01 (0.00, 0.01)
B	0.02 (0.02, **0.02**)	0.02 (0.02, **0.02**)	0.02 (0.02, **0.02**)	0.02 (0.02, **0.02**)	0.02 (0.02, **0.02**)	0.02 (0.02, **0.02**)	0.02 (0.02, **0.02**)
Ca	0.92 (0.18, 2.43)	0.69 (0.26, 1.08)	0.87 (0.29, 1.44)	0.99 (0.36, 1.57)	1.09 (0.22, **3.29**)	0.72 (0.16, 1.53)	0.46 (0.23, 0.87)
Cu	0.01 (0.00, 0.02)	0.01 (0.00, **0.03**)	0.01 (0.00, 0.02)	0.02 (0.00, 0.02)	0.01 (0.00, **0.03**)	0.01 (0.00, 0.01)	0.01 (0.00, 0.01)
Fe	0.46 (0.04, 0.84)	0.50 (0.11, 0.83)	0.55 (0.15, **1.03**)	0.53 (0.20, 0.78)	0.54 (0.13, 0.93)	0.29 (0.16, 0.44)	0.23 (0.06, 0.41)
Pb	0.01 (0.00, **0.05**)	0.01 (0.00, 0.02)	0.01 (0.00, 0.04)	0.01 (0.00, 0.03)	0.01 (0.00, 0.03)	0.01 (0.00, 0.02)	0.01 (0.00, 0.01)
Mg	0.29 (0.12, 0.49)	0.26 (0.07, 0.62)	0.41 (0.12, 0.66)	0.41 (0.02, **0.80**)	0.31 (0.18, 0.51)	0.41 (0.16, 0.72)	0.24 (0.08, 0.45)
Mn	0.01 (0.01, 0.01)	0.03 (0.01, **0.19**)	0.01 (0.01, 0.01)	0.01 (0.01, 0.01)	0.01 (0.01, 0.02)	0.01 (0.01, 0.01)	0.01 (0.01, 0.01)
K	0.14 (0.09, 0.21)	0.14 (0.07, 0.23)	0.18 (0.08, **0.39**)	0.20 (0.12, 0.29)	0.15 (0.08, 0.23)	0.16 (0.09, 0.22)	0.10 (0.07, 0.16)
P	0.01 (0.01, 0.04)	0.02 (0.01, **0.07**)	0.02 (0.01, 0.06)	0.03 (0.01, 0.06)	0.03 (0.01, **0.07**)	0.01 (0.01, 0.01)	0.02 (0.01, **0.07**)
Na	1.62 (0.03, 3.47)	1.67 (0.03, 4.67)	2.54 (0.03, **9.68**)	2.38 (0.03, 6.86)	1.56 (0.03, 2.86)	2.54 (0.03, 5.47)	1.25 (0.03, 2.15)
Sr	0.01 (0.00, 0.01)	0.01 (0.00, 0.01)	0.01 (0.00, 0.01)	0.01 (0.00, 0.01)	0.01 (0.00**, 0.02**)	0.01 (0.00, 0.01)	0.00 (0.00, 0.01)
S	0.83 (0.30, **3.67**)	0.37 (0.10, 0.56)	0.56 (0.28, 1.03)	0.55 (0.23, 1.04)	0.44 (0.22, 0.95)	0.56 (0.25, 1.25)	0.36 (0.12, 0.48)
Sn	0.01 (0.01, 0.01)	0.01 (0.01, **0.02**)	0.01 (0.01, **0.02**)	0.01 (0.01, **0.02**)	0.01 (0.01, 0.01)	0.01 (0.01, 0.01)	0.01 (0.01, 0.01)
Zn	0.03 (0.01, 0.05)	0.04 (0.01, 0.06)	0.04 (0.02, 0.06)	0.05 (0.02, 0.07)	0.05 (0.02, **0.08**)	0.03 (0.02, 0.04)	0.02 (0.02, 0.05)

APPENDIX 2: Polycyclic aromatic hydrocarbons

Table 2.1 Annual average 24-hour PAH concentrations (ng/m^3)

	PUF + Filter Mean (Range) ng/m^3	**Filter Mean (Range)** ng/m^3	**PUF Mean (Range)** ng/m^3
NAP	0.25 (0.03, 3.59)	0.06 (0.03, 0.16)	0.45 (0.03, **3.59**)
ACY	0.28 (0.02, 5.84)	0.02 (0.02, 0.05)	0.53 (0.02, **5.84**)
ACE	0.04 (0.02, 0.68)	0.02 (0.02, 0.02)	0.06 (0.02, 0.68)
FLU	0.30 (0.02, 2.63)	0.02 (0.02, 0.02)	0.57 (0.02, **2.63**)
PHE	**1.70** (0.02, **9.07**)	0.07 (0.02, 0.20)	**3.33** (**0.19**, **9.07**)
ANT	0.36 (0.02, 1.78)	0.02 (0.02, 0.06)	0.70 (0.02, **1.78**)
FL	0.48 (0.02, 2.59)	0.08 (0.02, 0.33)	0.88 (0.02, **2.59**)
PYR	0.54 (0.02, 2.53)	0.11 (0.02, 0.49)	0.97 (0.02, **2.53**)
BaA	0.04 (0.02, 0.30)	0.07 (0.02, 0.30)	0.02 (0.02, 0.11)
CHR	0.05 (0.02, 0.32)	0.08 (0.02, 0.32)	0.02 (0.02, 0.12)
BbF	0.06 (0.03, 0.42)	0.08 (0.03, 0.42)	0.03 (0.03, 0.04)
BkF	0.04 (0.03, 0.28)	0.05 (0.03, 0.28)	0.03 (0.03, 0.04)
BeP	0.06 (0.03, 0.39)	0.08 (0.03, 0.39)	0.03 (0.03, 0.04)
BaP	0.06 (0.03, 0.62)	0.08 (0.03, 0.62)	0.03 (0.03, 0.04)
PER	0.03 (0.03, 0.14)	0.04 (0.03, 0.14)	0.03 (0.03, 0.04)
IND	0.09 (0.06, 0.42)	0.10 (0.07, 0.42)	0.07 (0.06, 0.07)
DBA	0.07 (0.06, 0.07)	0.07 (0.06, 0.07)	0.07 (0.06, 0.07)
BghiP	0.11 (0.06, 0.55)	0.15 (0.07, 0.55)	0.07 (0.06, 0.07)
COR	0.08 (0.06, 0.27)	0.08 (0.06, 0.27)	0.07 (0.06, 0.07)

Table 2.2a Average concentrations (ng/m^3) of PAHs from filter sample by month

	Jan Mean (Range) ng/m^3	Feb Mean (Range) ng/m^3	Mar Mean (Range) ng/m^3	Apr Mean (Range) ng/m^3	May Mean (Range) ng/m^3	Jun Mean (Range) ng/m^3
NAP	0.03 (0.03, 0.03)	0.05 (0.03, 0.09)	0.05 (0.03, 0.07)	0.05 (0.03, 0.09)	0.09 (0.09, 0.11)	0.10 (0.03, 0.13)
ACY	0.02 (0.02, 0.02)	0.02 (0.02, 0.02)	0.02 (0.02, 0.02)	0.02 (0.02, 0.02)	0.02 (0.02, 0.04)	0.02 (0.02, 0.02)
ACE	0.02 (0.02, 0.02)	0.02 (0.02, 0.02)	0.02 (0.02, 0.02)	0.02 (0.02, 0.02)	0.02 (0.02, 0.02)	0.02 (0.02, 0.02)
FLU	0.02 (0.02, 0.02)	0.02 (0.02, 0.02)	0.02 (0.02, 0.02)	0.02 (0.02, 0.02)	0.02 (0.02, 0.02)	0.02 (0.02, 0.02)
PHE	0.07 (0.02, 0.20)	0.06 (0.02, 0.12)	0.06 (0.02, 0.09)	0.07 (0.02, 0.11)	0.12 (0.06, 0.16)	0.08 (0.03, 0.12)
ANT	0.02 (0.02, 0.02)	0.02 (0.02, 0.02)	0.02 (0.02, 0.02)	0.02 (0.02, 0.02)	0.03 (0.02, 0.06)	0.02 (0.02, 0.03)
FL	0.04 (0.02, 0.08)	0.06 (0.02, 0.12)	0.08 (0.02, 0.17)	0.07 (0.02, 0.13)	0.13 (0.08, 0.21)	0.14 (0.02, 0.21)
PYR	0.06 (0.02, 0.11)	0.09 (0.02, 0.17)	0.11 (0.02, 0.23)	0.10 (0.02, 0.17)	0.19 (0.12, 0.28)	0.19 (0.04, 0.29)
BaA	0.03 (0.02, 0.05)	0.02 (0.02, 0.02)	0.04 (0.02, 0.06)	0.08 (0.02, 0.12)	0.15 (0.10, 0.30)	0.11 (0.05, 0.17)
CHR	0.04 (0.02, 0.07)	0.02 (0.02, 0.02)	0.04 (0.02, 0.07)	0.09 (0.04, 0.12)	0.16 (0.10, 0.32)	0.13 (0.08, 0.19)
BbF	0.03 (0.03, 0.03)	0.03 (0.03, 0.03)	0.03 (0.03, 0.03)	0.09 (0.03, 0.12)	0.19 (0.10, 0.42)	0.13 (0.03, 0.27)
BkF	0.03 (0.03, 0.03)	0.03 (0.03, 0.03)	0.03 (0.03, 0.03)	0.03 (0.03, 0.03)	0.09 (0.03, 0.28)	0.07 (0.03, 0.16)
BeP	0.03 (0.03, 0.03)	0.03 (0.03, 0.03)	0.03 (0.03, 0.03)	0.09 (0.03, 0.13)	0.19 (0.11, 0.39)	0.12 (0.07, 0.22)
BaP	0.03 (0.03, 0.03)	0.03 (0.03, 0.03)	0.03 (0.03, 0.03)	0.09 (0.03, 0.16)	0.24 (0.09, 0.62)	0.12 (0.03, 0.31)
PER	0.03 (0.03, 0.03)	0.03 (0.03, 0.03)	0.03 (0.03, 0.03)	0.03 (0.03, 0.03)	0.06 (0.03, 0.14)	0.03 (0.03, 0.03)
IND	0.07 (0.07, 0.07)	0.07 (0.07, 0.07)	0.07 (0.07, 0.07)	0.11 (0.07, 0.16)	0.18 (0.07, 0.42)	0.15 (0.07, 0.39)
DBA	0.07 (0.07, 0.07)	0.07 (0.07, 0.07)	0.07 (0.07, 0.07)	0.07 (0.07, 0.07)	0.07 (0.06, 0.07)	0.07 (0.06, 0.07)
BghiP	0.07 (0.07, 0.07)	0.07 (0.07, 0.07)	0.07 (0.07, 0.07)	0.19 (0.07, 0.31)	0.32 (0.19, 0.55)	0.22 (0.07, 0.42)
COR	0.07 (0.07, 0.07)	0.07 (0.07, 0.07)	0.07 (0.07, 0.07)	0.08 (0.07, 0.15)	0.14 (0.07, 0.27)	0.10 (0.06, 0.24)

Table 2.2b Average concentrations (ng/m^3) of PAHs from filter sample by month

	Jul Mean (Range) ng/m^3	Aug Mean (Range) ng/m^3	Sept Mean (Range) ng/m^3	Oct Mean (Range) ng/m^3	Nov Mean (Range) ng/m^3	Dec Mean (Range) ng/m^3
NAP	0.12 (0.09, 0.16)	0.03 (0.03, 0.07)	0.04 (0.03, 0.09)	0.03 (0.03, 0.03)	0.03 (0.03, 0.03)	0.03 (0.03, 0.04)
ACY	0.03 (0.03, 0.05)	0.02 (0.02, 0.02)	0.02 (0.02, 0.02)	0.02 (0.02, 0.02)	0.02 (0.02, 0.02)	0.02 (0.02, 0.02)
ACE	0.02 (0.02, 0.02)	0.02 (0.02, 0.02)	0.02 (0.02, 0.02)	0.02 (0.02, 0.02)	0.02 (0.02, 0.02)	0.02 (0.02, 0.02)
FLU	0.02 (0.02, 0.02)	0.02 (0.02, 0.02)	0.02 (0.02, 0.02)	0.02 (0.02, 0.02)	0.02 (0.02, 0.02)	0.02 (0.02, 0.02)
PHE	0.11 (0.02, 0.20)	0.08 (0.07, 0.09)	0.06 (0.02, 0.11)	0.04 (0.02, 0.08)	0.06 (0.04, 0.07)	0.04 (0.02, 0.07)
ANT	0.03 (0.02, 0.05)	0.02 (0.02, 0.02)	0.02 (0.02, 0.02)	0.02 (0.02, 0.02)	0.02 (0.02, 0.02)	0.02 (0.02, 0.02)
FL	0.15 (0.02, 0.33)	0.09 (0.07, 0.15)	0.07 (0.02, 0.19)	0.04 (0.02, 0.10)	0.05 (0.02, 0.11)	0.04 (0.02, 0.10)
PYR	0.21 90.02, 0.49)	0.13 (0.11, 0.16)	0.12 (0.04, 0.29)	0.05 (0.02, 0.13)	0.07 (0.04, 0.15)	0.06 (0.02, 0.15)
BaA	0.12 (0.04, 0.22)	0.10 (0.06, 0.15)	0.06 (0.02, 0.11)	0.04 (0.02, 0.09)	0.04 (0.02, 0.06)	0.03 (0.02, 0.05)
CHR	0.13 (0.05, 0.24)	0.12 (0.07, 0.18)	0.07 (0.04, 0.11)	0.05 (0.02, 0.08)	0.05 (0.02, 0.06)	0.04 (0.02, 0.06)
BbF	0.15 (0.03, 0.39)	0.17 (0.03, 0.36)	0.09 (0.03, 0.15)	0.05 (0.03, 0.09)	0.03 (0.03, 0.03)	0.03 (0.03, 0.04)
BkF	0.06 (0.03, 0.19)	0.09 (0.03, 0.18)	0.04 (0.03, 0.07)	0.03 (0.03, 0.03)	0.03 (0.03, 0.03)	0.03 (0.03, 0.04)
BeP	0.14 (0.03, 0.32)	0.15 (0.07, 0.31)	0.09 (0.03, 0.13)	0.05 (0.03, 0.09)	0.03 (0.03, 0.03)	0.03 (0.03, 0.04)
BaP	0.13 (0.03, 0.39)	0.17 (0.03, 0.32)	0.07 (0.03, 0.10)	0.04 (0.03, 0.08)	0.03 (0.03, 0.03)	0.03 (0.03, 0.04)
PER	0.04 (0.03, 0.07)	0.03 (0.03, 0.03)	0.03 (0.03, 0.03)	0.03 (0.03, 0.03)	0.03 (0.03, 0.03)	0.03 (0.03, 0.04)
IND	0.16 (0.07, 0.42)	0.19 (0.07, 0.39)	0.09 (0.07, 0.18)	0.07 (0.07, 0.07)	0.07 (0.07, 0.07)	0.07 (0.07, 0.07)
DBA	0.07 (0.06, 0.07)	0.07 (0.06, 0.07)	0.07 (0.06, 0.07)	0.07 (0.07, 0.07)	0.07 (0.07, 0.07)	0.07 (0.07, 0.07)
BghiP	0.23 (0.07, 0.52)	0.27 (0.14, 0.52)	0.15 (0.07, 0.24)	0.08 (0.07, 0.15)	0.07 (0.07, 0.07)	0.07 (0.07, 0.07)
COR	0.13 (0.07, 0.24)	0.10 (0.06, 0.23)	0.07 (0.06, 0.07)	0.07 (0.07, 0.07)	0.07 (0.07, 0.07)	0.07 (0.07, 0.07)

Table 2.3a Average concentrations (ng/m^3) of PAHs from PUF sample by month

	Jan Mean (Range) ng/m^3	**Feb** Mean (Range) ng/m^3	**Mar** Mean (Range) ng/m^3	**Apr** Mean (Range) ng/m^3	**May** Mean (Range) ng/m^3	**Jun** Mean (Range) ng/m^3
NAP	0.17 (0.08, 0.48)	0.19 (0.03, 0.57)	0.12 (0.07, 0.20)	0.66 (0.36, 1.22)	0.89 (0.16, 2.43)	0.67 (0.24, 1.67)
ACY	0.05 (0.02, 0.12)	0.07 (0.02, 0.19)	0.11 (0.02, 0.24)	0.71 (0.33, 1.85)	1.71 (0.16, 5.84)	0.98 (0.21, 2.86)
ACE	0.02 (0.02, 0.05)	0.02 (0.02, 0.04)	0.02 (0.02, 0.02)	0.07 (0.02, 0.15)	0.13 (0.02, 0.36)	0.08 (0.02, 0.21)
FLU	0.15 (0.08, 0.26)	0.13 (0.06, 0.25)	0.26 (0.02, 0.60)	0.70 (0.40, 1.22)	1.13 (0.43, 2.63)	0.95 (0.59, 1.67)
PHE	1.66 (1.24, 1.80)	1.39 (1.08, 1.68)	2.02 (0.19, 3.08)	4.03 (3.30, 4.93)	5.25 (3.97, 6.81)	4.02 (2.51, 5.28)
ANT	0.32 (0.19, 0.38)	0.29 (0.22, 0.37)	0.47 (0.02, 0.71)	0.94 (0.66, 1.18)	1.23 (0.92, 1.62)	0.84 (0.55, 1.32)
FL	0.67 (0.48, 1.00)	0.52 (0.44, 0.66)	0.62 (0.02, 1.05)	0.96 (0.79, 1.12)	1.26 (1.09, 1.59)	1.01 (0.55, 1.35)
PYR	0.73 (0.48, 1.11)	0.59 (0.50, 0.77)	0.72 (0.02, 1.22)	1.05 (0.92, 1.27)	1.50 (1.29, 1.65)	1.04 (0.55, 1.52)
BaA	0.02 (0.02, 0.02)	0.02 (0.02, 0.02)	0.02 (0.02, 0.02)	0.02 (0.02, 0.02)	0.02 (0.02, 0.02)	0.02 (0.02, 0.02)
CHR	0.02 (0.02, 0.02)	0.02 (0.02, 0.02)	0.02 (0.02, 0.02)	0.02 (0.02, 0.02)	0.02 (0.02, 0.02)	0.02 (0.02, 0.02)
BbF	0.03 (0.03, 0.03)	0.03 (0.03, 0.03)	0.03 (0.03, 0.03)	0.03 (0.03, 0.03)	0.03 (0.03, 0.03)	0.03 (0.03, 0.03)
BkF	0.03 (0.03, 0.03)	0.03 (0.03, 0.03)	0.03 (0.03, 0.03)	0.03 (0.03, 0.03)	0.03 (0.03, 0.03)	0.03 (0.03, 0.03)
BeP	0.03 (0.03, 0.03)	0.03 (0.03, 0.03)	0.03 (0.03, 0.03)	0.03 (0.03, 0.03)	0.03 (0.03, 0.03)	0.03 (0.03, 0.03)
BaP	0.03 (0.03, 0.03)	0.03 (0.03, 0.03)	0.03 (0.03, 0.03)	0.03 (0.03, 0.03)	0.03 (0.03, 0.03)	0.03 (0.03, 0.03)
PER	0.03 (0.03, 0.03)	0.03 (0.03, 0.03)	0.03 (0.03, 0.03)	0.03 (0.03, 0.03)	0.03 (0.03, 0.03)	0.03 (0.03, 0.03)
IND	0.07 (0.07, 0.07)	0.07 (0.07, 0.07)	0.07 (0.07, 0.07)	0.07 (0.07, 0.07)	0.07 (0.07, 0.07)	0.07 (0.07, 0.07)
DBA	0.07 (0.07, 0.07)	0.07 (0.07, 0.07)	0.07 (0.07, 0.07)	0.07 (0.07, 0.07)	0.07 (0.07, 0.07)	0.07 (0.07, 0.07)
BghiP	0.07 (0.07, 0.07)	0.07 (0.07, 0.07)	0.07 (0.07, 0.07)	0.07 (0.07, 0.07)	0.07 (0.07, 0.07)	0.07 (0.07, 0.07)
COR	0.07 (0.07, 0.07)	0.07 (0.07, 0.07)	0.07 (0.07, 0.07)	0.07 (0.07, 0.07)	0.07 (0.07, 0.07)	0.07 (0.07, 0.07)

Table 2.3b Average concentrations (ng/m^3) of PAHs from PUF sample by month

	Jul Mean (Range) ng/m^3	Aug Mean (Range) ng/m^3	Sept Mean (Range) ng/m^3	Oct Mean (Range) ng/m^3	Nov Mean (Range) ng/m^3	Dec Mean (Range) ng/m^3
NAP	0.39 (0.15, 0.77)	1.26 (0.19, 3.59)	0.44 (0.18, 0.88)	0.36 (0.14, 0.52)	0.24 (0.17, 0.34)	0.23 (0.14, 0.35)
ACY	0.50 (0.25, 1.22)	1.54 (0.13, 2.51)	0.47 (0.20, 1.14)	0.25 (0.19, 0.36)	0.15 (0.13, 0.18)	0.19 (0.08, 0.47)
ACE	0.05 (0.02, 0.10)	0.23 (0.02, 0.68)	0.04 (0.02, 0.11)	0.03 (0.02, 0.05)	0.02 (0.02, 0.02)	0.03 (0.02, 0.07)
FLU	0.95 (0.56, 1.90)	1.21 (0.31, 2.14)	0.59 (0.43, 1.07)	0.43 (0.36, 0.52)	0.28 (0.23, 0.32)	0.27 (0.21, 0.40)
PHE	5.30 (3.07, 8.38)	5.60 (3.95, 9.07)	4.07 (2.27, 5.60)	2.54 (1.89, 3.93)	2.64 (2.32, 3.28)	2.04 (1.34, 2.66)
ANT	1.16 (0.78, 1.58)	1.11 (0.89, 1.78)	0.84 (0.53, 1.29)	0.46 (0.36, 0.69)	0.51 (0.36, 0.64)	0.36 (0.18, 0.44)
FL	1.35 (0.93, 2.03)	1.35 (0.95, 2.59)	0.96 (0.62, 1.32)	0.61 (0.52, 0.88)	0.65 (0.46, 0.88)	0.70 (0.47, 1.13)
PYR	1.48 (1.09, 2.13)	1.44 (1.04, 2.53)	1.09 (0.72, 1.61)	0.66 (0.52, 0.95)	0.72 (0.46, 1.01)	0.75 (0.54, 1.20)
BaA	0.02 (0.02, 0.04)	0.04 (0.02, 0.11)	0.02 (0.02, 0.05)	0.02 (0.02, 0.02)	0.02 (0.02, 0.02)	0.02 (0.02, 0.02)
CHR	0.02 (0.02, 0.05)	0.04 (0.02, 0.12)	0.03 (0.02, 0.07)	0.02 (0.02, 0.02)	0.02 (0.02, 0.04)	0.02 (0.02, 0.02)
BbF	0.03 (0.03, 0.03)	0.03 (0.03, 0.03)	0.03 (0.03, 0.03)	0.03 (0.03, 0.03)	0.03 (0.03, 0.03)	0.03 (0.03, 0.04)
BkF	0.03 (0.03, 0.03)	0.03 (0.03, 0.03)	0.03 (0.03, 0.03)	0.03 (0.03, 0.03)	0.03 (0.03, 0.03)	0.03 (0.03, 0.03)
BeP	0.03 (0.03, 0.03)	0.03 (0.03, 0.03)	0.03 (0.03, 0.03)	0.03 (0.03, 0.03)	0.03 (0.03, 0.03)	0.03 (0.03, 0.03)
BaP	0.03 (0.03, 0.03)	0.03 (0.03, 0.03)	0.03 (0.03, 0.03)	0.03 (0.03, 0.03)	0.03 (0.03, 0.03)	0.03 (0.03, 0.03)
PER	0.03 (0.03, 0.03)	0.03 (0.03, 0.03)	0.03 (0.03, 0.03)	0.03 (0.03, 0.03)	0.03 (0.03, 0.03)	0.03 (0.03, 0.03)
IND	0.07 (0.06, 0.07)	0.07 (0.06, 0.07)	0.07 (0.06, 0.07)	0.07 (0.07, 0.07)	0.07 (0.07, 0.07)	0.07 (0.07, 0.07)
DBA	0.07 (0.06, 0.07)	0.07 (0.06, 0.07)	0.07 (0.06, 0.07)	0.07 (0.07, 0.07)	0.07 (0.07, 0.07)	0.07 (0.07, 0.07)
BghiP	0.07 (0.06, 0.07)	0.07 (0.06, 0.07)	0.07 (0.06, 0.07)	0.07 (0.07, 0.07)	0.07 (0.07, 0.07)	0.07 (0.07, 0.07)
COR	0.07 (0.06, 0.07)	0.07 (0.06, 0.07)	0.07 (0.06, 0.07)	0.07 (0.07, 0.07)	0.07 (0.07, 0.07)	0.07 (0.07, 0.07)

Table 2.4 Average concentrations (ng/m^3) of PAHs from filter sample by day-of-the-week

	Monday Mean (Range) ng/m^3	**Tuesday** Mean (Range) ng/m^3	**Wednesday** Mean (Range) ng/m^3	**Thursday** Mean (Range) ng/m^3	**Friday** Mean (Range) ng/m^3	**Saturday** Mean (Range) ng/m^3	**Sunday** Mean (Range) ng/m^3
NAP	0.06 (0.03, 0.15)	0.06 (0.03, 0.16)	0.06 (0.03, 0.13)	0.05 (0.03, 0.09)	0.05 (0.03, 0.13)	0.04 (0.03, 0.07)	0.04 (0.03, 0.09)
ACY	0.02 (0.02, 0.03)	0.02 (0.02, 0.05)	0.02 (0.02, 0.02)	0.02 (0.02, 0.02)	0.02 (0.02, 0.02)	0.02 (0.02, 0.02)	0.02 (0.02, 0.02)
ACE	0.02 (0.02, 0.02)	0.02 (0.02, 0.02)	0.02 (0.02, 0.02)	0.02 (0.02, 0.02)	0.02 (0.02, 0.02)	0.02 (0.02, 0.02)	0.02 (0.02, 0.02)
FLU	0.02 (0.02, 0.02)	0.02 (0.02, 0.02)	0.02 (0.02, 0.02)	0.02 (0.02, 0.02)	0.02 (0.02, 0.02)	0.02 (0.02, 0.02)	0.02 (0.02, 0.02)
PHE	0.07 (0.02, 0.16)	0.10 (0.04, **0.20**)	0.08 (0.04, 0.12)	0.07 (0.04, 0.11)	0.08 (0.07, 0.12)	0.03 (0.02, 0.08)	0.02 (0.02, 0.05)
ANT	0.02 (0.02, 0.04)	0.02 (0.02, 0.05)	0.02 (0.02, 0.02)	0.02 (0.02, 0.02)	0.02 (0.02, 0.03)	0.02 (0.02, 0.02)	0.02 (0.02, 0.02)
FL	0.10 (0.02, **0.33**)	0.09 (0.02, **0.22**)	0.08 (0.02, 0.12)	0.07 (0.02, 0.13)	0.10 (0.07, 0.19)	0.04 (0.02, 0.15)	0.03 (0.02, 0.13)
PYR	0.14 (0.02, **0.49**)	0.14 (0.04, **0.29**)	0.12 (0.02, 0.17)	0.10 (0.04, 0.17)	0.15 (0.08, **0.29**)	0.05 (0.02, 0.16)	0.04 (0.02, 0.15)
BaA	0.05 (0.02, 0.11)	0.07 (0.02, **0.22**)	0.06 (0.02, 0.11)	0.07 (0.02, 0.13)	0.08 (0.04, 0.12)	0.04 (0.02, 0.15)	0.04 (0.02, 0.17)
CHR	0.06 (0.02, 0.11)	0.08 (0.02, **0.24**)	0.07 (0.02, 0.10)	0.09 (0.04, 0.15)	0.09 (0.04, 0.12)	0.06 (0.02, 0.18)	0.05 (0.02, 0.19)
BbF	0.05 (0.03, 0.11)	0.09 (0.03, **0.39**)	0.07 (0.03, 0.12)	0.09 (0.03, **0.20**)	0.08 (0.03, 0.15)	0.09 (0.03, **0.36**)	0.08 (0.03, **0.27**)
BkF	0.03 (0.03, 0.03)	0.05 (0.03, 0.19)	0.03 (0.03, 0.04)	0.04 (0.03, 0.11)	0.04 (0.03, 0.09)	0.05 (0.03, 0.18)	0.05 (0.03, 0.16)
BeP	0.05 (0.03, 0.12)	0.09 (0.03, **0.32**)	0.07 (0.03, 0.13)	0.08 (0.03, 0.17)	0.08 (0.03, 0.14)	0.08 (0.03, **0.31**)	0.07 (0.03, **0.22**)
BaP	0.04 (0.03, 0.10)	0.09 (0.03, **0.39**)	0.06 (0.03, 0.16)	0.09 (0.03, **0.25**)	0.07 (0.03, 0.19)	0.07 (0.03, **0.32**)	0.08 (0.03, **0.31**)
PER	0.03 (0.03, 0.03)	0.04 (0.03, 0.07)	0.03 (0.03, 0.04)	0.03 (0.03, 0.03)	0.03 (0.03, 0.03)	0.03 (0.03, 0.03)	0.03 (0.03, 0.03)
IND	0.07 (0.07, 0.07)	0.13 (0.07, **0.42**)	0.08 (0.07, 0.16)	0.11 (0.07, **0.24**)	0.09 (0.07, 0.18)	0.11 (0.07, **0.39**)	0.12 (0.07, **0.39**)
DBA	0.07 (0.07, 0.07)	0.07 (0.06, 0.07)	0.07 (0.07, 0.07)	0.07 (0.06, 0.07)	0.07 (0.07, 0.07)	0.07 (0.06, 0.07)	0.07 (0.06, 0.07)
BghiP	0.08 (0.07, **0.22**)	0.17 (0.07, **0.52**)	0.13 (0.07, **0.31**)	0.15 (0.07, **0.31**)	0.15 (0.07, **0.24**)	0.15 (0.07, **0.52**)	0.14 (0.07, **0.42**)
COR	0.07 (0.07, 0.07)	0.10 (0.07, **0.24**)	0.08 (0.07, 0.15)	0.08 (0.06, 0.20)	0.07 (0.07, 0.07)	0.09 (0.07, **0.23**)	0.09 (0.06, **0.24**)

Table 2.5 Average concentrations (ng/m^3) of PAHs from PUF sample by day-of-the-week

	Monday Mean (Range) ng/m^3	**Tuesday** Mean (Range) ng/m^3	**Wednesday** Mean (Range) ng/m^3	**Thursday** Mean (Range) ng/m^3	**Friday** Mean (Range) ng/m^3	**Saturday** Mean (Range) ng/m^3	**Sunday** Mean (Range) ng/m^3
NAP	0.28 (0.11, 0.49)	0.33 (0.03, 0.77)	0.60 (0.03, **2.43**)	0.40 (0.08, **1.22**)	0.63 (0.09, **3.59**)	0.47 (0.07, **1.07**)	0.52 (0.14, **1.67**)
ACY	0.28 (0.05, **1.07**)	0.30 (0.02, **1.22**)	0.99 (0.02, **5.84**)	0.49 (0.05, **2.51**)	0.48 (0.04, **2.51**)	0.61 (0.05, **2.40**)	0.65 (0.04, **2.86**)
ACE	0.04 (0.02, 0.09)	0.04 (0.02, 0.10)	0.07 (0.02, 0.36)	0.05 (0.02, 0.19)	0.04 (0.02, 0.21)	0.14 (0.02, 0.68)	0.06 (0.02, 0.21)
FLU	0.48 (0.15, **1.13**)	0.54 (0.02, **1.90**)	0.69 (0.07, **2.63**)	0.56 (0.17, **1.48**)	0.53 (0.13, **1.60**)	0.65 (0.11, **2.14**)	0.60 (0.15, **1.67**)
PHE	**3.22 (1.68, 5.27)**	**3.02** (0.19, **8.38**)	**3.54 (1.29, 6.81)**	**3.65 (1.80, 5.79)**	**3.65 (1.73, 5.60)**	**3.44 (1.49, 9.07)**	**2.81 (1.48, 4.51)**
ANT	0.68 (0.28, **1.29**)	0.59 (0.02, **1.58**)	0.71 (0.18, **1.62**)	0.78 (0.34, **1.37**)	0.83 (0.36, **1.32**)	0.69 (0.34, **1.78**)	0.61 (0.30, **1.17**)
FL	0.80 (0.44, **1.12**)	0.74 (0.02, **2.03**)	**1.00** (0.66, **1.59**)	0.93 (0.51, **1.57**)	0.96 (0.46, **1.35**)	0.98 (0.54, **2.59**)	0.78 (0.47, **1.13**)
PYR	0.88 (0.50, **1.29**)	0.86 (0.02, **2.13**)	**1.10** (0.93, **1.65**)	**1.04** (0.58, **1.83**)	**1.09** (0.46, **1.61**)	**1.02** (0.61, **2.53**)	0.83 (0.51, **1.27**)
BaA	0.02 (0.02, 0.02)	0.02 (0.02, 0.04)	0.02 (0.02, 0.02)	0.02 (0.02, 0.02)	0.02 (0.02, 0.04)	0.03 (0.02, 0.11)	0.02 (0.02, 0.05)
CHR	0.02 (0.02, 0.04)	0.02 (0.02, 0.05)	0.02 (0.02, 0.04)	0.02 (0.02, 0.04)	0.02 (0.02, 0.02)	0.04 (0.02, 0.12)	0.02 (0.02, 0.07)
BbF	0.03 (0.03, 0.03)	0.03 (0.03, 0.03)	0.03 (0.03, 0.04)	0.03 (0.03, 0.03)	0.03 (0.03, 0.03)	0.03 (0.03, 0.03)	0.03 (0.03, 0.03)
BkF	0.03 (0.03, 0.03)	0.03 (0.03, 0.03)	0.03 (0.03, 0.04)	0.03 (0.03, 0.03)	0.03 (0.03, 0.03)	0.03 (0.03, 0.03)	0.03 (0.03, 0.03)
BeP	0.03 (0.03, 0.03)	0.03 (0.03, 0.03)	0.03 (0.03, 0.04)	0.03 (0.03, 0.03)	0.03 (0.03, 0.03)	0.03 (0.03, 0.03)	0.03 (0.03, 0.03)
BaP	0.03 (0.03, 0.03)	0.03 (0.03, 0.03)	0.03 (0.03, 0.04)	0.03 (0.03, 0.03)	0.03 (0.03, 0.03)	0.03 (0.03, 0.03)	0.03 (0.03, 0.03)
PER	0.03 (0.03, 0.03)	0.03 (0.03, 0.03)	0.03 (0.03, 0.04)	0.03 (0.03, 0.03)	0.03 (0.03, 0.03)	0.03 (0.03, 0.03)	0.03 (0.03, 0.03)
IND	0.07 (0.06, 0.07)	0.07 (0.06, 0.07)	0.07 (0.06, 0.07)	0.07 (0.06, 0.07)	0.07 (0.07, 0.07)	0.07 (0.06, 0.07)	0.07 (0.06, 0.07)
DBA	0.07 (0.06, 0.07)	0.07 (0.06, 0.07)	0.07 (0.06, 0.07)	0.07 (0.06, 0.07)	0.07 (0.07, 0.07)	0.07 (0.06, 0.07)	0.07 (0.06, 0.07)
BghiP	0.07 (0.06, 0.07)	0.07 (0.06, 0.07)	0.07 (0.06, 0.07)	0.07 (0.06, 0.07)	0.07 (0.07, 0.07)	0.07 (0.06, 0.07)	0.07 (0.06, 0.07)
COR	0.07 (0.06, 0.07)	0.07 (0.06, 0.07)	0.07 (0.06, 0.07)	0.07 (0.06, 0.07)	0.07 (0.07, 0.07)	0.07 (0.06, 0.07)	0.07 (0.06, 0.07)