

**Inventory of
emissions to air in
Timaru and
Washdyke, 2005**

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Executive Summary

An assessment of emissions to air in Timaru and Washdyke was carried out in 2005 to determine the contribution of different source types to airshed contaminants. Air pollutants assessed were particulate matter less than ten, and less than two and a half microns in diameter (PM₁₀ and PM_{2.5}), carbon monoxide (CO), nitrogen oxides (NO_x), oxides of sulphur (SO_x) and benzene. For the first time, emissions are presented on a weekday, weekend day and hourly basis to provide data that may be more readily used for modelling purposes.

Environment Canterbury has monitored air quality in Timaru since 1997 and results show that the National Environmental Standard (NES) for PM₁₀ (50µgm⁻³, 24-hour average) has been exceeded between 35 and 53 times each winter. Previous inventories carried out in 1996 and 2001 found that domestic fires were the primary source of this contaminant in Timaru. The 2005 inventory illustrates that domestic home heating is the predominant wintertime source of not only PM₁₀ but also PM_{2.5}, CO and benzene. Source contributions to PM₁₀ emissions were 92% from home heating, 5% from industry and commerce and 3% from motor vehicles on weekdays and 96% from home heating on weekend days.

Due to the physical separation of Washdyke from Timaru and its mainly industrial nature, Washdyke emissions have been assessed and are presented independently.

Relative contributions to contaminant emissions determined by the inventory are summarised below:

Contaminant	Domestic home heating		Motor vehicles		Industrial and commercial activities		Total kg
	kg/day	%	kg/day	%	kg/day	%	
Timaru (weekdays)							
PM ₁₀	1366	92%	44	3%	80	5%	1490
PM _{2.5}	1311	95%	37	3%	37	3%	1385
CO	12818	73%	4672	27%	83	0%	17573
NO _x	133	16%	577	70%	113	14%	822
SO _x	46	10%	78	17%	331	73%	455
Benzene	134	75%	45	25%	0.02	0%	180
Timaru (weekend days)							
PM ₁₀	1580	96%	30	2%	32	2%	1641
PM _{2.5}	1518	97%	25	2%	16	1%	1559
CO	14927	83%	3135	17%	27	0%	18088
NO _x	152	27%	388	68%	33	6%	572
SO _x	51	19%	53	20%	160	61%	263
Benzene	157	81%	37	19%	0.01	0%	194
Washdyke (weekdays)							
PM ₁₀	57	17%	10	3%	273	80%	340
PM _{2.5}	55	23%	8	3%	179	74%	242
CO	564	27%	1072	52%	431	21%	2067
NO _x	4.8	1%	130	23%	427	76%	562
SO _x	1.3	0%	18	1%	1621	99%	1640
Benzene	6.0	37%	10	63%	0.07	0%	16
Washdyke (weekend days)							
PM ₁₀	57	18%	6.5	2%	254	80%	318
PM _{2.5}	55	24%	5.5	2%	167	73%	228
CO	562	34%	689	42%	408	25%	1659
NO _x	4.8	1%	84	18%	388	81%	477
SO _x	1.3	0%	11	1%	1480	99%	1492
Benzene	6.0	42%	8.0	57%	0.06	0%	14

In Timaru, household heating emissions have remained at approximately the same level in the last five years, with a continued reduction in the quantity of coal burnt but an increase in wood burning. For the first time, home heating emissions were determined for a weekend day and were found to be 16% above the weekday emissions for the contaminants of concern. On both weekdays and weekend days, the majority of PM₁₀ is produced in the 4pm to 10pm time period.

In Washdyke, industrial and commercial activities were responsible for the majority of emissions, including 80% of the PM₁₀, 76% of the NO_x, and 99% of the SO_x. These are mainly caused by combustion processes, with emissions being nearly constant throughout the 24-hour period.

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1 Introduction

Timaru has frequently experienced poor air quality during the winter months. The main cause for concern is the concentration of particulate matter less than 10 microns in size (PM₁₀) and it is this pollutant that has been the focus of air quality monitoring and investigation.

In 2004, the Resource Management (National Environmental Standards Relating to Certain Air Pollutants, Dioxins, and Other Toxics) Regulations were established pursuant to Section 43 of the Resource Management Act 1991. The Regulations introduced a set of National Environmental Standards (NES) for various pollutants including PM₁₀. This NES (50 micrograms per cubic metre expressed as a 24 hour mean) has been exceeded between 35 and 53 times each winter in Timaru, usually on cold, calm evenings. The NES for PM₁₀ allows for one annual exceedance and must be achieved by 2013. Non-compliance after 2013 will prevent consenting authorities from issuing any air discharge resource consents. To meet this target, management interventions may be required. Emission inventories are used to identify those sources that are the cause of the problem and thus determine which steps should be taken in an air quality management plan to reduce harmful emissions and to improve ambient air quality.

The main objective of an emission inventory is to list, by source, the mass of airborne contaminants discharged into the air within a defined area. They are used by regulatory authorities to identify air pollution problems, assess the effectiveness of air pollution policy, and provide data that may be used in airshed modelling.

The inventory identifies the major sources discharging contaminants to air, provides estimates of the quantities emitted and determines relative contributions to total emissions. For pollutants such as PM₁₀ major source categories include domestic home heating, motor vehicles, and industry. It also provides a baseline from which future improvements can be evaluated, updates source information and reassesses the relative source contributions to emissions. Previous inventories completed for Timaru in 1996 and 2001 (Fisher. *et al*, 1998; Wilton, 2001) identified domestic home heating as the predominant wintertime source of PM₁₀. Consultation with the community has recently finished in the Timaru area which will lead to the development of proposed strategies to reduce contaminant emissions from domestic home heating. Further planning and consultation will be needed before any strategies are adopted.

This report provides separate emission inventories for Timaru and Washdyke.

1.1 Study objectives

The 2005 Timaru emissions inventory aims to:

- provide information about the sources of air pollution in Timaru and Washdyke;
- establish the contribution to total emissions from the sources identified;
- determine trends in emissions where possible;
- compare the results with previous inventories; and
- provide data at better resolution for modelling purposes.

The information provided in the inventory may be used by air quality professionals and regulators to monitor effectiveness and appropriateness of future strategies which may be considered in order to meet the NES standards. It may also identify those areas or sources where additional action is required.

1.2 Study area

Timaru is located on the East Coast of the South Island about 160km south of Christchurch. The terrain comprises both low hills and flat areas, with the foothills of the Southern Alps lying further to the West. The area around Timaru consists of a set of small stream catchments that drain abruptly to the coast with ridges between these catchments acting as airshed boundaries (van Wasbeek, 2002).

Washdyke is an industrial area about five kilometres north of Timaru and separated from Timaru by a ridge with a maximum height of 57m. At the present time, Washdyke is included in the Timaru “airshed” for NES purposes. However, Washdyke may potentially be gazetted independently in future years and for this reason Washdyke is considered separately.

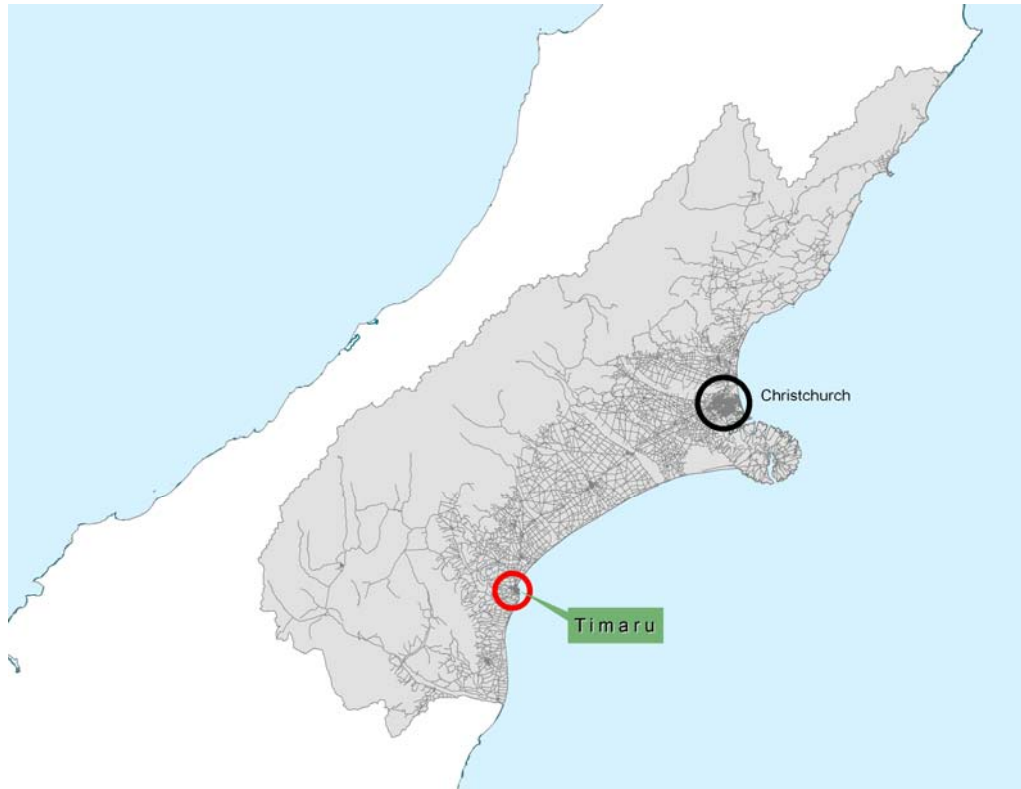


Figure 1.1 Geographical location of Timaru

1.3 Scope of the inventory

The 2005 inventory incorporates the following contaminants:

- particulate matter less than 10 microns in size (PM_{10});
- particulate matter less than 2.5 microns ($PM_{2.5}$) also known as fine particles;
- carbon monoxide (CO);
- oxides of nitrogen (NO_x);
- oxides of sulphur (SO_x); and
- benzene.

This list includes the same contaminants as those selected for study in the 1996 and 2001 Timaru emission inventories (Fisher *et al.*, 1998; Wilton, 2001), with the addition of $PM_{2.5}$. Although benzene has been included, the data needs to be used with caution as emission

factors for this contaminant are very limited. It is envisaged that the range of contaminants in future inventories may increase as reliable emission factors for other contaminants become available.

1.4 Sources

The contaminants considered here are discharged from a variety of sources and processes, including the anthropogenic combustion of fossil fuels and biomass, and from natural and industrial abrasion processes. Potential sources of these emissions include:

- domestic home heating;
- motor vehicles;
- industrial and commercial activities;
- railway locomotives;
- lawn mowers;
- fuel storage;
- rural fires/outdoor burning;
- resuspended road dust and wearing of brakes and tyres;
- off-road vehicles;
- wind-blown dust;
- landfills; and
- marine aerosol (sea salt).

PM₁₀ and PM_{2.5}, the contaminants of greatest concern in Timaru, are primarily produced by the combustion of fuel. Major sources contributing to these emissions include domestic home heating, motor vehicles and industrial and commercial activities. Consequently, these comprise the main source categories in the 2005 emission inventory.

Emissions from rail and lawn mowers have been quantified but are not included in the total emissions section owing to the higher level of uncertainty associated with these estimates. The remaining sources, although not quantified in the 2005 assessment, are important and discussed briefly in Section 4.2.4.

1.5 Temporal resolution

Degraded air quality occurs both in Timaru and Washdyke on a seasonal basis, with peak concentrations in the evenings of winter months. It was considered appropriate to adopt a similar "winter's day" approach as that implemented previously (Fisher *et al.*, 1998; Wilton, 2001) to ensure that comparisons with past inventories could be made.

Inventory data for residential emissions was split into weekday and weekend day use and then further split into four time periods:

- 6am – 10am (morning)
- 10am – 4pm (daytime)
- 4pm – 10pm (evening)
- 10pm – 6am (overnight)

Further analysis has allowed the estimation of hour by hour emissions. The process is outlined in Appendix A, and for the sake of brevity only PM₁₀ emissions are included.

1.6 Spatial resolution

The study areas selected for the 2005 inventory were similar to those used in the previous 2001 inventory (Wilton, 2001) to enable comparisons to be made and trends established.

The area of Timaru was broken down into the following combinations of suburbs:

- Gleniti including Glenwood;
- Highfield;
- Kensington including Timaru Gardens and Redruth;
- Maori Hill including Maori Park and Waimataitai;
- Marchwiell;
- Parkside;
- Seaview;
- Watlington;
- Washdyke; and
- West End including Fraser Park.

The inventory design was based upon suburbs rather than a grid pattern which gave the advantage of being able to incorporate other data (eg population statistics) which is only available on a suburb-wide basis.



Figure 1.2 2005 Timaru emission inventory study area

2 Methodology

The methods used in gathering and analysing data for this inventory are generally consistent with those recommended by the Ministry for the Environment's "Good practice guide for preparing emission inventories." (MfE, 2001).

2.1 Domestic home heating

2.1.1 Overview

Emissions from the home heating sector were estimated by applying emission factors to home heating activity data. Data collected included number, type and age of appliance and fuel use for all appliances except woodburners for which the figures reported in the Christchurch home heating diary (Lamb 2003) were assumed.

2.1.2 Method of data collection

Home heating activity data were primarily collected by household survey conducted by telephone. A representative sample of households was surveyed based on methodologies outlined in Lamb (2005). Table 2.1 details sample sizes selected for the various study areas and the associated error. A total of 1497 households were surveyed in the study area with an overall error estimate of 2.4%.

Table 2.1 Study area, sample size and related error

	Area in Hectares	Total number of households	Households surveyed	Sample error
Timaru -Total	2470	11415	1497	2.4
Timaru excluding Washdyke	1921	11028	1429	2.4
Gleniti/Glenwood	305	1557	255	5.6
Highfield	226	1458	200	6.4
Kensington & Redruth	313	753	105	8.9
Maori Hill/Waimataitai	159	1119	156	9.4
Marchwiell	218	1560	189	6.7
Parkside	158	1152	141	7.7
Seaview	289	1284	104	9.2
Washdyke	549	387	68	10.8
Watlington	120	918	129	8
West-End & Fraser Park	133	1227	150	7.5

Home heating methods were classified as electricity, open fires, woodburners installed pre-1994, woodburners installed from 1994 to 2000, woodburners installed from 2001 onwards, pellet fires, multi-fuel burners, gas burners and oil burners. Woodburner categories were determined by the emission factors available. An emissions study conducted recently in Tokoroa (Wilton and Smith, 2006) provided reliable emission factors for pre-1994 woodburners. Less reliable data were available for more modern woodburners and it was assumed that there had been some level of improvement over time in response to the influence of Christchurch rules on the broader Canterbury market. In addition to the survey, Timaru District Council (TDC) permit data and information from Solid Energy was used to estimate pellet burner installation numbers.

The questionnaire used to undertake the survey (Appendix B) focused on the forms of heating used in the main living area on a typical winter's weekday and on a weekend day. Respondents were asked to indicate the times of day heating appliances were used and to estimate the quantity of fuel consumed. When respondents were unable to provide the age of their appliance and/or the quantity of fuel used, substitute values were used based on the distribution

of the data collected. For the purpose of the emission calculations, a log of wood was assumed to have a mass of 1.9 kg and a bucket of coal 9 kg.

2.1.3 Emission Factors

Emission factors are representative values which provide a measurement of contaminant discharge for a specific type of activity and fuel consumption. Factors are expressed as the weight of pollutant divided by the unit weight, volume, distance or duration of the activity emitting the pollutant. The factors used in the study are summarised in Table 2.2 and their derivation discussed below.

Table 2.2 Domestic home heating emission factors

Appliance	PM ₁₀ g/kg	PM _{2.5} g/kg	CO g/kg	NO _x g/kg	SO _x g/kg	Benzene g/kg
Open fires						
Open fire (wood)	9	8	68	1.4	0.2	0.97
Open fire (coal)	21	20	70	4.1	5.1	0.00065
Woodburners						
Pre-1994 wood burner	11	10.7	110	1.0	0.2	0.97
1994-2000 wood burner	9	8.7	90	0.5	0.2	0.97
2001+ wood burner	6	5.8	60	0.5	0.2	0.97
Pellet burner	1.6	1.5	15	1.0	0.2	0.97
Multifuel Burners						
Multifuel burner (wood)	11	10.7	110	1.0	0.2	0.97
Multifuel burner (coal)	19	17	110	1.6	1.1	0.00065
Gas burner	0.03	0.03	0.02	1.5	8.25E-09	2.13E-03
Oil burner	0.3	0.2	0.5	2.0	4.0	2.16E-05

2.1.3.1 Emission factors for open fires

With the exception of benzene, the values for open fires are identical to those used in the 2002 Christchurch emissions inventory (Scott and Gunatilaka, 2004). The benzene value was derived from Wilton (2005).

2.1.3.2 Emission factors for pre-1994 woodburners and multifuel burners (wood)

In a study conducted in 2005/6 to determine PM₁₀ emission factors, twelve appliances installed prior to 1994 were tested. At least seven 24-hour samples were collected from each appliance. The mean result, when only the first 7 sampling days are used (some appliances were tested up to 11 days) was 11 g/kg measured on a wet wood mass basis.

The following assumptions were made when determining the emission factors for each category:

- all PM is PM₁₀ ;
- 97% of PM₁₀ is PM_{2.5};
- CO is proportional to PM₁₀ (Wilton 2005);
- NO_x and SO_x are the same as those indicated in for the mid-wood burner category in Scott and Gunatilaka (2004); and
- the benzene value is the same as Wilton (2005).

2.1.3.3 Emission factors for 1994-2000 woodburners

This category was selected to create a mid-category where some improvement in wood burner emissions had occurred due to the influence of wood burner emission limits in Christchurch. It is not based on real measurements but is simply the average of the pre-1994 category (real-data) and the lower value used to represent those installed from 2001.

Assumptions made are identical to those listed above.

2.1.3.4 Emission factors for 2001+ woodburners

These emission factors are the same as those used for the Canterbury towns emission inventory (McCauley and Scott 2006). The CO emission factor has been revised upwards reflecting the proportions in Wilton (2005).

2.1.3.5 Emission factors for other burners

In the case of gas-fired appliances the PM₁₀ and PM_{2.5} emission factors were adopted in response to emission test results noted in Scott (2005) and are identical to those used in McCauley and Scott (2006). For oil fired burners reference has been made to ARS (2002a,b,c and d)

2.1.4 Emission calculations and analysis

The activity data and emission factors were used to calculate emissions as indicated in Equation 2.1

<i>Equation 2.1</i>	$E = F \times EF/1000$
---------------------	------------------------

Where

E = contaminant emission (kg)

F = fuel used (kg)

EF= emission factor for a particular contaminant, activity and fuel (g/kg).

Timaru (excluding Washdyke) emissions for each contaminant are presented in Section 4.1 and for each source in Section 4.2, and for Washdyke, Sections 4.3 and 4.4.

2.2 Motor vehicles

Emissions from the motor vehicle sector were estimated using activity data in the form of vehicle kilometres travelled (VKT) for various congestion conditions or levels of service (LOS), and the application of emission factors to this data. The Timaru vehicle fleet profile was obtained from Ministry of Transport (MoT) registration data maintained by Environment Canterbury.

2.2.1 Method of data collection

VKT data were prepared by Gabites Porter using the latest version of the Timaru Transportation Model based on the TRACKS suite of programs. The entire Timaru urban area was included in the model and was divided into twelve suburban areas for the estimation of emissions. The total VKT within each area were calculated by the TRACKS model for each hour from 0000-2400. This allowed the distribution of emissions for both area and time of day to be calculated.

2.2.2 Level of service (LOS) and driving conditions

Prior to applying emission factors to the VKT data, LOS value or driving condition category was allocated to each VKT estimate. The driving condition categories were the same as those used in the Vehicle Fleet Emission Model (VFEM) developed by the MoT (1998a). The driving condition groupings were:

- *Free flow*: Little or no vehicle hindrance with warm running, LOS level A/B, volume/capacity <35%
- *Interrupted*: Moderate vehicle interaction with warm running, LOS level C/D, volume/capacity >35% and <70%
- *Congested*: Severe vehicle interaction with warm running, LOS level E/F, volume/capacity >70%

Data were assessed as 90% suburban (Su) and 10% central urban (CU). Account was also taken of cold start driving, which was assessed to be 30% of the total.

2.2.3 Emission factors

Emissions of total particulate matter (PM), NO_x and CO were calculated using the Ministry of Transport New Zealand Traffic Emission Rates model (NZ-TER) version 1.0 (MoT, 2000) using a base year of 2005. It was assumed that all particles emitted are in the PM₁₀ size fraction. Emissions of PM_{2.5} were calculated using proportions of the PM₁₀ values which were obtained from the Canadian Lower Fraser Valley emission inventory (GVRD, 2003). All emission factors used are detailed in Appendix C.

Non-tailpipe emissions, for example those of particles derived from brake and tyre wear, are not included in this inventory. Local emission factors of this type are not available, and if overseas factors were used, considerable uncertainty remains regarding the extent of re-suspension that may occur (Bluett et al, 2005).

As the SO_x emissions depend only on the sulphur content of the fuel and the quantity of fuel burnt, a fleet averaged value was used. Benzene emission factors were derived from the benzene weight fraction of the volatile organic compounds present in the exhaust gases. These weight fractions are sourced from Environment Australia (2000).

NZTER does not include emission factors for petrol – powered buses / heavy commercial vehicles, and so where present these vehicles were incorporated into the diesel fleet for emission calculation. (These categories are relatively small parts of the total fleet in Timaru).

Single vehicle emission rates were calculated for all vehicle types (for example, petrol car, diesel car, CNG car, etc) for each of the road type and level of service categories. It was assumed in all cases that 90% of vehicle activity took place in a suburban road environment, and 10% on a central urban road type. This split was made arbitrarily, based on an approximate estimate of the proportion of the roads that may lie within the business district (“urban”

environment) in Timaru. It was also assumed that 30% of all driving occurred under cold start conditions. This is based on the figure assumed by Wilton and Simpson (2001) for the Nelson city emission inventory, but the basis of this assumption is unknown. A more detailed discussion of the proportion of vehicles driven under cold start conditions appears in McCauley and Scott, 2006.

2.2.4 Emission calculations

Emission factors from NZ-TER were applied to the VKT data (classified by driving condition, road type and vehicle type) to calculate motor vehicle emissions in each of the study areas.

<i>Equation 2.2</i> $E = EF \times VKT/1000$
--

where:

E = contaminant emission (kg)

VKT = vehicle kilometres travelled (km)

EF = emission factor for each contaminant, under the corresponding LOS and road type (g/km).

2.3 Industrial and commercial

Activity data were collated on the basis of process, rather than by primary industrial type. This means that industrial premises operating different types of equipment, such as a foundry and an LPG-fired boiler will have emissions included under both the foundry and LPG fired boiler categories, rather than a universal “metal processing” category. Fugitive emissions from additional industrial sources on site such as stockpiles and unpaved areas, for example, are not included unless explicitly identified in an air discharge consent.

2.3.1 Method of data collection

Industrial and commercial premises that generated air discharges were identified using a combination of Environment Canterbury resource consent files and the use of telephone directories. Each identified business was mailed a survey form which specifically requested information regarding:

- type of activity;
- type of equipment/size/rating;
- type of control equipment;
- hours and days of operation;
- wintertime operating schedule;
- average monthly fuel use;
- processing rates; and
- measured emissions, (if known).

The survey enabled emissions to be calculated on an hour by hour basis on weekdays and weekend days. The survey form was sent out to 246 industrial and commercial facilities located in the area of study and a total of 133 surveys were satisfactorily completed and returned to Environment Canterbury (a response rate of 54%). Consent and compliance information contained in resource consent files held by Environment Canterbury was used to collect activity data for industries that did not respond to the survey. A copy of the survey is attached in Appendix D.

Data were collected for industrial and commercial activities on a monthly basis to establish temporal variations. Details provided in the survey regarding hours and days of operation allowed daily wintertime emissions to be assessed for weekdays, weekend days and at an hourly resolution. Emissions at other times of the year are not presented in this report.

2.3.2 Emission factors

The industrial emission factors used in this study are tabulated in Appendix E and were primarily derived from the United States Environment Protection Agency’s (USEPA) “AP-42”

compilation of emission factors (fifth edition), with additional data from Air Chief 12 (USEPA 2005). These factors have varying publication dates and are collectively referenced in this report according to the date of publication of the fifth edition as a whole, as USEPA (1995). Where factors could not be found in AP-42, they were sourced from Economopoulos (1993).

2.3.3 Emission calculation

Contaminant emissions were calculated by multiplying fuel used for each process by the corresponding emission factor. This is indicated below:

<i>Equation 2.3</i>	$E = F \times EF$
---------------------	-------------------

where:

E = contaminant emission (g)

F = fuel used in 24 hours (kg)

EF = emission factor for a particular contaminant, activity and fuel (g/kg)

2.4 Other sources

There are a number of other sources that discharge contaminants to air in Timaru. These include emissions from rail, lawn mowers, marine aerosol, rural burning and off-road motor vehicles. This report includes a basic assessment of emissions from rail and lawn mowers. The activity data used to calculate the estimates were dated or from other areas of New Zealand and as such these values were associated with high levels of uncertainty. Consequently, the estimates, which provide a broad indication of the magnitude of emissions from these sources, are not presented in the main emission summaries but separately in Section 4.2.4. The remaining sources (including marine aerosol, rural burning and off-road motor vehicles), while not quantified, are also discussed briefly. The magnitude of contributions from these sources is such that they are unlikely to have a substantial impact on the overall pattern of wintertime emissions.

2.4.1 Rail

The 2001 Timaru inventory used the MoT (1999) assessment of railway emissions which calculated the emissions per kilometre of track in accordance with train load and track gradient variation. In this inventory, the locomotive movements have been divided into main line operations and shunting.

2.4.2 Method of data collection

Data have been provided by Toll Holdings which have allowed shunting emissions to be calculated on the basis of average monthly fuel use, engine type and capacity, and main line emissions to be calculated using individual train movements including engine power, throttle settings, distance travelled and time taken to pass through Timaru and Washdyke.

2.4.3 Emission factors

Emission factors for PM₁₀, CO and NO_x were taken from MoT (1999) and those for SO_x are based upon mass balances with the fuel containing 0.05% by weight sulphur. These factors are summarised below. Note that emissions for main line services were estimated using the g/kWh emission factors and for shunting g/L factors were used.

Table 2.3 Rail emission factors

	g/kWh	g/litre
PM ₁₀	0.4	1.8
CO	1.7	7.0
NO _x	17.3	71.3
SO _x	0.2	0.8

2.4.4 Lawn mowing

To estimate emissions from lawn mowers in Timaru, activity data regarding the number of households using 2-stroke and 4-stroke lawn mowers and average mowing times were required. Emission factors were applied to this information to calculate emissions.

2.4.4.1 Data Collection

Lawn mower emissions were calculated using the methodology and assumptions described in the 2002 Christchurch inventory (Scott and Gunatilaka, 2004), in turn based on activity data and emission factors presented in the Wellington Regional Council 1998 emission inventory (PAE, 1998). The only "site-specific" data used for this analysis are the number of households in each of the towns. The calculation will therefore only provide an indicative result. The assumption that every household mows on the same weekend, using a motor mower, is also likely to be conservative, particularly given that the emissions are assumed to occur during the winter.

2.4.4.2 Emission factors

The emission factors used in this assessment were the same as those used by Environment Australia (1999), and are viewed as sufficient in the absence of local emission data. A conversion factor of 99.4% was applied to the total suspended particulate factors to calculate PM₁₀. Table 2.4 below outlines the emission factors applied to the data.

Table 2.4 Lawn mower emission factors

	2-stroke emission rate (g/hr)	4-stroke emission rate (g/hr)
PM ₁₀	7.8	0.5
CO	731	489
NO _x	1.5	4.9
SO _x	0.3	0.2

2.4.5 Emission calculation

Emissions were calculated using the following formula:

$$E = (TH \times \%2\text{-stroke} \times EF2\text{-stroke}) + (TH \times \%4\text{-stroke} \times EF4\text{-stroke})$$

Where:

- E = emission in grams per day
- TH = total hours mowing per weekend day;
- %2-stroke = the proportion of 2-stroke mowers
- EF2-stroke = the relevant 2-stroke emission factor
- %4-stroke = the proportion of 4-stroke mowers
- EF4-stroke = the relevant 4-stroke emission factor

2.5 Comparison of the 1996, 2001 and 2005 Timaru emission inventories

The 1996 ((Fisher *et al.*, 1998), 2001 (Wilton, 2001) and current Timaru emission inventory reports are not directly comparable in their published forms. This is due to differences in emission factors, fuel data and methodologies. The data have been recalculated (where possible) to enable comparisons and trends to be established from 1996 to 2005. The recalculated values, presented throughout this report, are referred to as back-cast estimates.

Industrial emissions for 2001 only have been recalculated as insufficient data exists for the recalculation of emissions with any degree of certainty for 1996. The methods used to collect

activity data between inventory years were substantially different and the emissions could not reliably be back-cast. Caution is advised when comparing industrial and commercial emissions from one year to the next for the following reasons:

- Total fuel use and calculated emissions are dependent on the number and type of industries included from one year to the next. In particular the 2005 inventory includes data from all known industrial facilities not just from those with resource consents. Correction has been made for facilities which existed in 2001 but were not included in the inventory and also for facilities which have ceased operations in the intervening period;
- Fuel use figures for the industrial sites not included in the original 2001 inventory are assumed to be the same as in the latest inventory. This may be unduly conservative as it makes no allowance for improvements in technology; and
- The quality of activity classification, and subsequent emission calculation, can vary depending on the data collection method used. Surveys can provide more direct information and allow more refined classification. This ensures that more appropriate emission factors are selected and can significantly change emissions calculated for that source from one inventory to the next.

While the emissions data for industrial emissions incorporates some uncertainties it can now be used for a general indication of the direction of trends since 2001.

Table 2.5 outlines key characteristics of the various inventories and identify the main differences. It also states how the back-cast estimates were calculated.

Table 2.5 Characteristics of the 1996, 2001 and 2005 Timaru emission inventories

Inventory Characteristics	1996	2001	2005	1996-2005 Comparison
Study area	Data collected in Washdyke, Northern Residential, Maori Park, Westend and Inner City, Highfield residential and Southern Residential.	Activity data were collected from Gleniti/Glenwood, Highfield, Kensington, Waimatitai/Maori Hill, Marchwiel, Parkside, Seaview, Washdyke, Watlington and Fraser Park	Activity data were collected from Gleniti/Glenwood, Highfield, Kensington and Redruth, Waimatitai/Maori Hill, Marchwiel, Parkside, Seaview, Washdyke, Watlington and West End/Fraser Park	Comparisons could be made directly with the 2001 and 2005 Inventories for all suburbs.
Domestic home heating	Telephone survey	Telephone survey	Telephone survey, home heating diary	Comparison can be made with the 1996, 2001 and 2005 weekday data.
Survey method and focus	Main living area Typical winter's day	Main living area Typical winter's day	Main living area Typical winter's weekday and weekend day	
Number of households surveyed and associated errors	504	1464 (2.4% error)	1497 (2.4% error)	
Burner categories	Pre-1989, 1989-1992 and 93+ wood burner categories were selected to coincide with changes in emission criteria rules. Included pot bellies, incinerators and enclosed coal burner category.	Burner categories were: Pre 1991, 1991-1996 and 1997 onwards Included a multi-fuel wood burner and multifuel coal burner categories. These included pot bellies and incinerators.	Burner categories were:>10 years old, 6-10 years old, 2-5 years and those installed 2004 onwards. The multi-fuel burner category includes the same types of burners as those in 2001.	Burner numbers for all three inventories were adjusted to Pre-1994, 1994-2000, and 2001 and later. Pot bellies, incinerators, enclosed coal burners and wood burners using coal in 1996 were added together to obtain numbers comparable to the 1999 and 2001 multi-fuel burner categories.
Fuel use calculation	Householders asked for fuel use by number of logs or buckets of coal used. Assumptions; wood log = 1.6kg, bucket of coal = 10kg	Householders asked for fuel use by number of logs or buckets of coal used. Assumptions; wood log = 1.4kg, bucket of coal = 10kg	Householders with woodburners are assumed to burn 2.4kg wood per hour. Householders with pellet fires assumed to burn 1.25kg pellets per hour. All other households using wood or coal asked for actual fuel use figures. Log wood =1.9kg, bucket of coal 9kg. Oil and gas users asked for annual fuel use which was divided by 183.	Comparison of emissions and fuel use can be made for open fires and multifuel burners after recalculation to account for log and bucket mass differences. No direct comparison can be made for woodburners as the methodology is different.

Table 2.5 Characteristics of the 1996, 2001 and 2005 Timaru emission inventories (continued).

Inventory Characteristics	1996	2001	2005	1996-2005 Comparison
Motor vehicles	VKT data from Environment Canterbury	NZTER emission rates, VKT using the TRACKS modelling system	NZTER emission rates, VKT using the TRACKS transport model	2001 and 2005 data are directly comparable.
Industry	Industry – Part A, B and C classifications under the Clean Air Act 1972. Scaled up estimates based upon Christchurch data.	Activity data were collected from resource consent files and through consultation with the holders of the resource consents.	Questionnaires were distributed to all known industrial facilities.. Resource consent files and previous inventory data were used to supplement this information.	2001 industry list has been extended to include all facilities operating that year. 2001 and 2005 emissions are directly comparable
Emission factors	Domestic heating, motor vehicles and industry – a variety of sources including the USEPA	Domestic heating emission factors were revised to take into account more recent and local emission data. Motor vehicle emission factors revised as part of the vehicle fleet emission control strategy. Industrial emission factors included more detailed data on emissions from different types of coal burners.	Domestic heating emission factors revised to take into account more recent and local emission data. Motor vehicle emission factors were different. This was due to the updated motor vehicle fleet. Industrial emission factors updated from USEPA-AP42 tenth edition. SOx emissions from generators < 450 kW now based on mass balance.	The emission factors revised in 2005 were applied to 1996 and 2001 data to re-estimate domestic heating emissions. Motor vehicle emission rates for 2001 taken from NZTER. 2001 vehicle fleet profile derived from Ecan motor vehicle database. 2001 and 2005 are directly comparable.
Conclusion	<p>Home heating - After backcasting 1996, 2001 and 2005, estimates are not directly comparable as woodburner methodology is different.</p> <p>Vehicles - After backcasting, 2001 and 2005 estimates are directly comparable.</p> <p>Industry - After backcasting, emissions can be used to provide emission trends.</p>			

3 Activity data

3.1 Domestic home heating

Domestic home heating emissions were dependent on household numbers, the types of home heating methods used, type and quantity of fuel used, and burner age. Table 3.1 outlines the number of households and the number of combustion appliances used in Timaru. Table 3.2 presents a breakdown of appliance numbers by suburb.

Table 3.1 Change in household numbers and appliances 1996-2005

Timaru (excluding Washdyke)	1996	2001	2005	% change	% change
				' 96 to 05	' 01 to 05
Household numbers	9408	10696	11028	17.2%	3.1%
Combustion appliances	7771	8677	8088	4.1%	-6.8%

Overall household numbers in Timaru increased by 17.2% from 1996 to 2005. Most of the growth occurred between 1996 and 2001 with a lesser increase evident between 2001 and 2005. Over the nine year period from 1996 the number of combustion appliances increased from 7771 to 8088, an increase of 4%.

3.1.1.1 Energy type

In 2005, the most popular form of heating in Timaru was electricity with 55% of households using this method. Fifty-three percent of households (5850) used wood as fuel in woodburners, multifuel burners and open fires, 16% used gas, 6% (612) used coal in open fires and multifuel burners and 2% used oil. In many instances, primary heating methods were supplemented by an additional form of heating. Gas and electricity, available as portable heaters, were the most likely forms of energy used to supplement other home heating appliances.

Table 3.2 Methods of domestic heating across all study areas in Timaru (excluding Washdyke)

	Timaru		Gleniti		Highfield		Kensington		Maori Hill		Marchwiell		Parkside		Seaview		Watlington		West End	
Sample (n)	1429		255		200		105		156		189		141		104		129		150	
Total households (population (N))	11028		1557		1458		753		1119		1560		1152		1284		918		1227	
Error level (%)	2.4		5.6		6.4		8.9		9.4		6.7		7.7		9.2		8		7.5	
Area (ha)	1921		305		226		313		159		218		158		289		120		133	
	Number of appliances	% of HH	Number of appliances	% of HH	Number of appliances	% of HH	Number of appliances	% of HH	Number of appliances	% of HH	Number of appliances	% of HH	Number of appliances	% of HH	Number of appliances	% of HH	Number of appliances	% of HH	Number of appliances	% of HH
Open fire	723	7%	43	3%	109	7%	29	4%	72	6%	124	8%	82	7%	123	10%	43	5%	98	8%
Open fire (wood)	632	6%	43	3%	87	6%	29	4%	50	4%	124	8%	74	6%	99	8%	36	4%	90	7%
Open fire (coal)	289	3%	0	0%	51	3%	7	1%	22	2%	66	4%	8	1%	74	6%	36	4%	25	2%
Total woodburners	4737	43%	641	41%	658	45%	409	54%	394	35%	599	38%	537	47%	484	38%	462	50%	554	45%
Pre-1994 woodburners	1929	17%	311	20%	298	20%	137	18%	177	16%	240	15%	178	15%	202	16%	162	18%	223	18%
1994-2000 woodburners	1599	14%	175	11%	231	16%	146	19%	98	9%	170	11%	239	21%	186	15%	144	16%	210	17%
2001+ woodburners	1209	11%	155	10%	128	9%	126	17%	120	11%	188	12%	120	10%	96	7%	156	17%	121	10%
Pellet burners	96	1%	13	1%	13	1%	8	1%	8	1%	12	1%	11	1%	10	1%	9	1%	11	1%
Multifuel burners (all types)	544	5%	67	4%	36	2%	72	10%	29	3%	107	7%	57	5%	62	5%	57	6%	57	5%
Multifuel burner (wood)	481	4%	49	3%	29	2%	65	9%	22	2%	99	6%	57	5%	62	5%	57	6%	41	3%
Multifuel burner (coal)	323	3%	31	2%	7	0%	50	7%	7	1%	50	3%	41	4%	62	5%	50	5%	25	2%
Total gas	1803	16%	226	15%	248	17%	151	20%	215	19%	297	19%	172	15%	136	11%	121	13%	237	19%
Flued gas	819	7%	146	9%	161	11%	50	7%	79	7%	107	7%	98	9%	37	3%	35	4%	106	9%
Unflued gas	1023	9%	85	5%	109	7%	107	14%	136	12%	190	12%	74	6%	99	8%	92	10%	131	11%
Oil burner	185	2%	18	1%	29	2%	14	2%	14	1%	25	2%	33	3%	37	3%	7	1%	8	1%
Electricity	6044	55%	898	58%	904	62%	330	44%	689	62%	858	55%	531	46%	741	58%	463	50%	630	51%

Notes

Gleniti includes Glenwood
 Kensington includes Timaru Gardens and Redruth
 Maori Hill includes Maori Park and Waimataitai suburbs
 Westend includes Fraser Park

3.1.1.2 Distribution of combustion appliances

Wood and gas burners were identified as the most common combustion appliances used in Timaru in 2005 (see Table 3.2). Woodburners were used in 4737 households (43%), gas appliances in 1803 households (16%), open fires in 723 households (7%), multifuel burners in 544 households (5%), oil 185 households (2%). Of the woodburners, 41% were older than 10 years, 34% were between 5 and 10 years old and 25% were less than 5 years old. Of the 544 households using multifuel burners, 481 burn wood and 323 burn coal. It is therefore clear that many households with multifuel burners use both wood and coal.

Table 3.3 Changes in domestic heating methods 1996 - 2005 (Timaru excluding Washdyke)

Timaru (excluding Washdyke)	1996	2001	2005	% change ' 96 to 05	% change ' 01 to 05
Open fire	917	991	723	-21%	-27%
Open fire (wood)	904	933	632	-30%	-32%
Open fire (coal)	516	371	289	-44%	-22%
Total woodburners	3452	4054	4737	37%	17%
Pre-1994 woodburners	2829	2115	1929	-32%	-9%
1994-2000 woodburners	623	1682	1599	156%	-5%
2001+ woodburners	0	258	1209		369%
Pellet burners¹	0	0	96		
Multifuel burners (all types)	901	1126	544	-40%	-52%
Multifuel burner (wood)	876	1125	481	-45%	-57%
Multifuel burner (coal)	781	529	323	-59%	-39%
Total gas	2252	2331	1803	-20%	-23%
Flued gas		498	819		64%
Unflued gas		1861	1023		-45%
Oil burner	249	175	185	-26%	6%
Electricity	6000	4853	6044	1%	25%

¹ Pellet burner numbers provided by Nature's Flame.

Since the 2001 inventory significant changes have taken place in the methods used for domestic home heating. These include:

- open fire numbers which declined by 27%;
- multifuel numbers which declined by 52%;
- gas burner numbers which declined by 23%; and
- woodburner numbers which increased by 17%.

3.1.1.3 Fuel quantities

Woodburners

In previous years, householders have been asked to estimate how many logs of wood they used on their woodburner. However as there were concerns about the reliability of the information collected, an alternative method for obtaining this information was adopted in 2005. The home heating diary study conducted in Christchurch in 2002 provided robust burning rate data for woodburners (2.4 kg h^{-1}). This information was then used, with the householder's estimation of the number of hours appliances were used, to more accurately calculate daily fuel use.

Pellet Burners

Fuel use for pellet fires was estimated using data provided by Solid Energy (*pers.comm.*, Pearce, S., Solid Energy Ltd). Weighted averages were calculated from average burn rates observed in the laboratory and assumed that a householder used the appliance on a high setting for 25% of the burn time, 45% on medium and 30% on low. This value (1.25 kg h^{-1}) was applied to hours of use data provided by the householder.

All other combustion

Burn rate data were not available for other appliance types and it was necessary to rely on householder estimates of fuel use. For wood and coal use on multifuel and open fires, the number of logs and /or the buckets of coal used on a single night were the basis of the calculation of fuel used. A log of wood was taken to be 1.9 kg and a bucket of coal, 9 kg. For gas and oil, the amount used over the heating season, taken to be 183 days, was used as the basis for calculation. Where the number of respondents using the specified heating method was less than 5% of the sample size an average fuel use figure was used. (An example is oil burning, where some suburbs had only one or two respondents using this heating method. In these cases a rate of fuel use figure based upon Timaru as a whole was used).

The recalculated fuel use data for 1996 and 2001 is shown in Table 3.4, and breakdown by hours of use and quantity of fuel used by suburb appears in Appendix F.

Table 3.4 Quantity of fuel consumed on an average winter's day (Timaru excluding Washdyke)

	1996 t/day	2001 t/day	2005 Weekdays t/day	2005 Weekend day(t/day)
Open fire (wood)	19.4	19.5	11.4	12.2
Open fire (coal)	4.7	2.8	2.3	2.4
Wood burners	67.9	78.0	116.7	138.6
Pre-1994 wood burner	55.6	41.6	46.0	55.8
1994-2000 wood burner	12.3	31.6	39.4	46.1
2001+ wood burner		4.9	31.3	36.8
Pellet burners	0.0	0.0	1.3	1.5
Multi-fuel burner (wood)	18.4	22.8	9.2	9.7
Multi-fuel burner (coal)	6.3	4.1	3.3	3.2
Gas burner	1.6	4.3	5.9	6.9
Oil burner	0.5	0.6	0.6	0.6
Total wood (t/day)	105.7	120.4	137.4	160.5
Total coal (t/day)	11.0	6.8	5.6	5.6

Note

The 1996 and 2001 results are backcast as described in Table 2.5, and therefore woodburner results are not directly comparable.

3.1.2 Domestic home heating (Washdyke)**3.1.2.1 Household numbers**

Household numbers in Washdyke increased from 324 in 2001 to 387 in 2005 (+19%).

3.1.2.2 Energy type

In 2005 the most popular form of heating was woodburners with 52% of households using this method. Fifty-one percent of households used electricity, 15% gas, 2% open fires, 3% multifuel burners and no households used oil. In many instances the primary heating method was supplemented by an additional form of heating.

Table 3.5 Methods of domestic heating in Washdyke 1996 - 2005

Washdyke Total households 387	1996	2001	2005		Change 1996 to 2001	Change since 2001
	Number of appliances	Number of appliances	Number of appliances	% of HH		
Open fire	23	21	6	2%	-9%	-71%
Open fire (wood)	23	21	6	2%	-9%	-71%
Open fire (coal)	9	0	0	0%	-100%	0%
Total woodburners	198	164	201	52%	-17%	23%
Pre-1994 woodburners	141	65	67	17%	-54%	4%
1994-2000 woodburners	35	86	81	21%	148%	-6%
2001+ woodburners	0	13	52	13%		314%
Pellet burners	0	0	4	1%		
Multifuel burners (all types)	23	34	11	3%	48%	-68%
Multifuel burner (wood)	23	34	11	3%	48%	-68%
Multifuel burner (coal)	23	13	11	3%	-43%	-15%
Total gas	45	88	57	15%	96%	-35%
Flued gas		8	11	3%		38%
Unflued gas		80	46	12%		-43%
Oil burner	0	0	0	0%	0%	0%
Electricity	149	88	199	51%	-41%	126%

Since the 2001 inventory, open fire use has declined significantly in Washdyke (a decrease of 71%) while woodburner numbers increased (+23%). Emissions from these burners were somewhat offset by a decrease in the number of older high emission wood burners. The use of electricity increased, whereas the number of households using gas decreased sharply.

3.1.2.3 Fuel quantities

Notes on the method of deriving fuel quantities used by each appliance type are provided in Section 3.1.1.3. The recalculated fuel use data for 1996 and 2005 are shown in Table 3.6. Where the number of respondents using open fires, multifuel burners or oil was less than the margin of error, then an average fuel use figure from the 'Timaru excluding Washdyke' section was used.

Table 3.6 Quantity of fuel consumed on an average winter's day (Washdyke)

Washdyke	1996 kg/day	2001 kg/day	2005 Weekdays kg/day	2005 Weekend day (kg/day)
Open fire (wood)	99	543	54	54
Open fire (coal)	27	0	0	0
Woodburners	756	2307	5867	5836
Pre-1994 woodburner	614	950	2343	2333
1994-2000 woodburner	142	1167	1999	2022
2001+ woodburner	0	190	1524	1481
Wood pellets	0	0	63	63
Multifuel burner (wood)	44	679	195	195
Multifuel burner (coal)	20	90	77	77
Gas burner	79	200	149	183
Oil burner	0	0	0	0
Total wood	899	3529	6116	6085
Total coal	47	90	77	77

3.2 Motor vehicles

3.2.1 Motor vehicle numbers

The numbers of motor vehicles registered in Timaru were extracted from the Environment Canterbury database of vehicle registrations and are presented in Table 3.7. The data provide a general overview of motor vehicle numbers in Timaru and were used to calculate emissions by vehicle type, based upon the estimate of VKT by consultants, Gabites Porter. This is a change in methodology to that used in the 2001 and 1996 inventories and allows the impact of different vehicle and fuel types on emissions to be evaluated.

Table 3.7 Motor vehicle numbers 2001 - 2005

Type	Number		Percentage change
	2001	2005	
Bus large CNG	2	0	
Bus large diesel	265	295	11.3%
Bus large LPG	0	0	
Bus medium CNG	0	0	
Bus medium diesel	259	99	-61.8%
Bus medium LPG	0	0	
Car CNG	0	0	
Car diesel	2681	3738	39.4%
Car LPG	11	3	-72.7%
Car petrol	25682	28331	10.3%
HCV large CNG	0	0	
HCV large diesel	606	825	36.1%
HCV large LPG	0	1	
HCV medium CNG	1	0	
HCV medium diesel	254	275	8.3%
HCV medium LPG	7	0	
HCV small CNG	1	0	
HCV small diesel	465	826	77.6%
HCV small LPG	11	4	-63.6%
LCV CNG	0	1	
LCV diesel	2332	3173	36.1%
LCV LPG	0	2	
LCV petrol	2787	2277	-18.3%
Motorcycle	1547	1700	9.9%
Total	36911	41550	12.6%

Explanation	
LCV's	Light commercial vehicles, weighing less than 3,500kg
HCV's small	Heavy commercial vehicles, weighing more than 3,500kg and less than 7,500kg
HCV's medium	Heavy commercial vehicles, weighing more than 7,500kg and less than 12,000kg
HCV's large	Heavy commercial vehicles, weighing more than 12000kg
Buses medium	A specialised sub-group of 'HCV's medium'
Buses large	A specialised sub-group of 'HCV's large'
CNG	Compressed Natural Gas fuelled (dedicated)
LPG	Liquefied Petroleum Gas fuelled (dedicated)

An increase in vehicle numbers is evident from 36911 in 2001 to 41550 in 2005 (+13%). There was an increase in numbers for all main vehicle types:

- Cars from 28374 in 2001 to 32072 in 2005 (+13%)
- LCV's from 5119 in 2001 to 5452 in 2005 (+7%), and
- Total HCV's from 1345 in 2001 to 1931 in 2005 (+44%)

Data were not available for 1996.

3.2.2 Fuel type

The proportion of diesel to petrol cars in the Timaru motor vehicle fleet has increased since the 2001 inventory. In 2001, 9.5% of cars were diesel powered and this had increased to 11.6% of cars in 2005. The number of diesel vehicles in the Timaru fleet increased, from 18.6% in to 22.2% in the same years, with a consequent reduction in the proportion of petrol vehicles, from 81.3% in 2001 to 77.8% in 2005.

Overall the number of diesel powered vehicles had increased by 35% and petrol vehicles by 8%.

Table 3.8 Vehicle numbers by fuel type

Fuel	Vehicle numbers		Percentage
	2001	2005	change
Diesel	6862	9231	35%
Petrol	30016	32308	8%
LPG	29	10	-66%
CNG	4	1	NS
Totals	36911	41550	13%

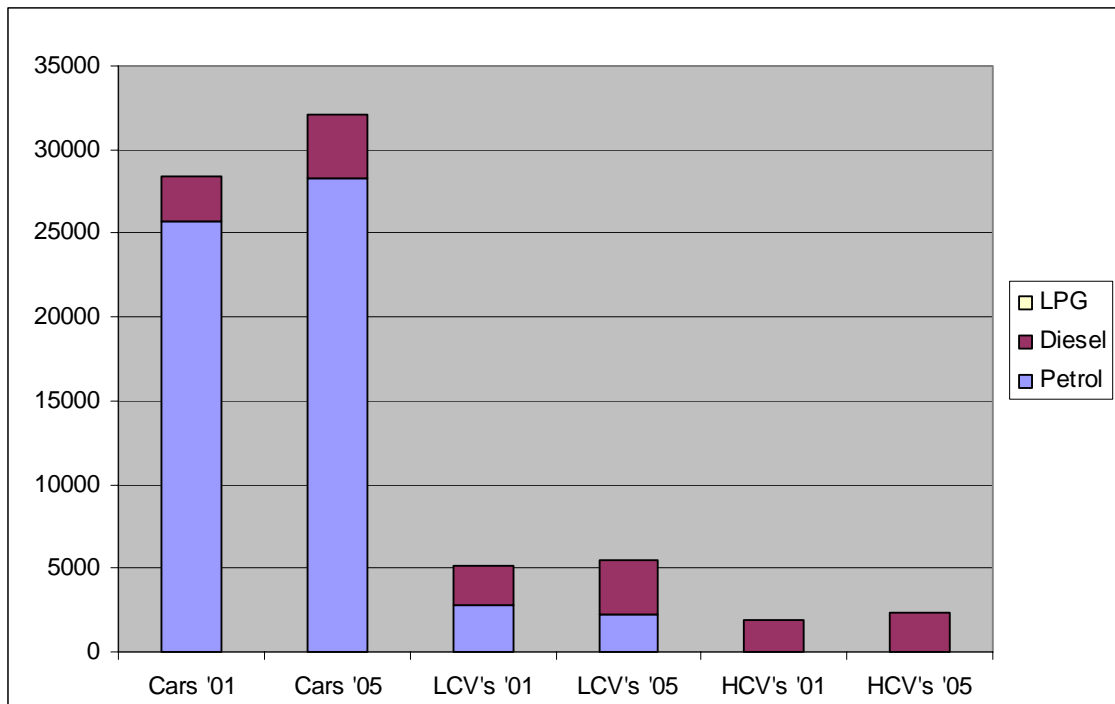


Figure 3.1 Main categories of vehicle by fuel type

3.2.3 Vehicle Kilometres Travelled (VKT)(Timaru excluding Washdyke)

Table 3.9 presents VKT for the different study areas. In 2005, total VKT on an average winter's weekday in Timaru (excluding Washdyke) was 346058 and on a weekend day were 232679. These figures show a reduced number of VKT on the previous inventory of 0.8%. The majority of 2005 VKT occurred under free-flow conditions (87%) with 13% under interrupted flow and none under congested flow. The total weekday VKT by congestion type for each year is shown in Table 3.10.

Table 3.9 Vehicle kilometres travelled (Timaru excluding Washdyke)

VKT travelled Suburb	Weekend day 2005	Weekday 2005	Weekday 2001	Change 2001-05
Gleniti/Glenwood	16549	25453	25967	-2.0%
Highfield	22774	33896	46832	-27.6%
Kensington & Redruth	15541	23566	18590	26.8%
Maori Hill/Waimataitai	54497	79670	74530	6.9%
Marchwiell	19262	30981	38199	-18.9%
Parkside	22746	33593	36683	-8.4%
Seaview	57675	82337	70836	16.2%
Watlington	7521	11956	11441	4.5%
West-End & Fraser Park	16114	24606	25664	-4.1%
Total	232679	346058	348742	-0.8%

Table 3.10 Total weekday VKT by congestion type (Timaru excluding Washdyke)

	2001 VKT		2005 VKT		Change in	
	LOS AB	LOS CD	LOS AB	LOS CD	LOS AB	LOS CD
Gleniti/Glenwood	25967	0	25028	425	-4%	
Highfield	46447	385	33209	687	-29%	79%
Kensington & Redruth	18590	0	23184	383	25%	
Maori Hill/Waimataitai	44199	30331	53057	26613	20%	-12%
Marchwiell	33323	4876	30981	0	-7%	-100%
Parkside	36683	0	32760	833	-11%	
Seaview	69139	1697	78798	3538	14%	108%
Watlington	11441	0	11956	0	4%	
West-End & Fraser Park	25664	0	24606	0	-4%	
Total	311453	37289	313579	32479	1%	-13%

3.2.4 Vehicle Kilometres Travelled (Washdyke)

Table 3.11 VKT in Washdyke

VKT's travelled Suburb	Weekend day 2005	Weekday 2005	Weekday 2001	Change 2001-05
Washdyke	49677	76924	93474	-17.7%

Table 3.12 Total weekday VKT by congestion type (Washdyke)

	2001 VKT		2005 VKT		Change in	
	LOS AB	LOS CD	LOS AB	LOS CD	LOS AB	LOS CD
Washdyke	72781	20693	54110	22814	-26%	10%

3.3 Industrial and commercial

Industrial and commercial emissions were dependent on the number and type of activities operating, type and quantity of fuel used, hours of operation and type of control equipment employed.

3.3.1 Activity type and quantity

The 246 industrial and commercial activities surveyed in the area of study included:

- abrasive blasting;
- foundries;
- seed cleaning/handling;
- operation of combustion equipment such as boilers, generators and incinerators;
- arc, tungsten inert gas (tig) and metal inert gas (mig) welding;
- quarrying and crushing plant; and
- asphalt production.

Industries such as adhesive coating, fibreglassing, powder coating, printing and spray painting were excluded unless they used combustion processes within their business. The activities of these companies, which mainly discharged volatile organic compounds, were not included as contaminants in the 2001 inventory and are not included in this inventory.

Table 3.13 Survey response analysis

	Timaru	Washdyke	Total
Surveyed	171	75	246
Received usable (including no emissions)	90	43	133
Received unusable (or not received)	81	32	113

Table 3.14 Number of sources, fuel and material use 2001 – 2005 (Timaru excluding Washdyke)

Timaru (excluding Washdyke) Discharge type	2001		2005		
	Number	Daily fuel/ material use (kg)	Number	Weekday fuel/ material use (kg)	Weekend day fuel/material use (kg)
Coal fired boilers	10	19000	10	19008	9166
Diesel fired boilers	9	1000	9	1005	0
Diesel generators	6	550	6	550	0
Light fuel oil burners	0	0	0	0	0
LPG boilers/heaters	5	140	5	142	77
Waste oil burners/heaters	3	80	3	83	0
Other combustion	0	0	0	0	0
Total combustion	33	20770	33	20788	9243
Abrasive blasting	2	1000	2	1000	0
Foundry	3	3150	2	2100	0
Feed processing	1	201000	1	201000	201000
Seed cleaning	0	0	0	0	0
Welding	8	22	9	25	0
Quarrying	0	0	0	0	0
Total processing	14	205172	14	204125	201000

Both the development of new industrial facilities and the expansion of existing ones have been slow in Timaru. Direct comparison with the 2001 inventory would suggest a large increase in activity but backcasting, which produces the data above, shows the true position. The backcasting process involved adding to the 2001 list of facilities so that it included all known industrial and commercial concerns operating at that time, (only consented activities were included in the original 2001 inventory), and basing their fuel use and contaminant emissions on like plants in other locations.

Table 3.15 Number of sources, fuel and material use, 2001 - 2005 (Washdyke)

Washdyke Discharge type	2001		2005		
	Number	Daily fuel/ material use (kg)	Number	Weekday fuel/ material use (kg)	Weekend day fuel/material use (kg)
Coal fired boilers	4	98000	5	112000	94000
Diesel fired boilers	5	155	5	155	0
Diesel generators	0	0	0	0	0
Light fuel oil burners	2	1600	2	1630	129
LPG boilers/heaters	7	4200	7	4210	130
Waste oil burners/heaters	1	30	1	30	0
Other combustion	0	0	0	0	0
Total combustion	19	103985	20	118025	94259
Abrasive blasting	2	1800	2	1800	0
Foundry	1	9000	1	9000	0
Feed processing	0	0	0	0	0
Seed cleaning	1	33000	1	33000	0
Welding	7	47	9	60	0
Quarrying	1	200000	1	200000	0
Total processing	12	243847	14	243860	0

3.4 Other sources

3.4.1 Rail

The new emission assessment assumed a fuel use of 7000 litres per month for shunting operations using DSC and DSG shunters which are less than 450 kW diesel electric locomotives. For the main trunk line an average of twelve trains a day using either DFT or DX locomotives with power ratings of 1800 kW or 2240 kW respectively was assumed. There are 29 DFT's and 46 DX's in service giving an average locomotive power of 2070 kW. Trains take 55 minutes to clear Washdyke (2.85 km) and Timaru (6.26 km) with throttle settings at 80% for 15 minutes, 50% for 15 minutes and 30% for 25 minutes (*pers.comm.*, Oldman, T. Toll Holdings).

4 Emission estimates

Emission inventories are used to determine source contributions to emissions. The calculated emission contributions are presented in this section by contaminant and source. Time of day data are included where available. These data are useful as input into box or dispersion models for predicting source contributions to predicted concentrations.

Data are also presented for previous inventories where possible (described as back-cast estimates). PM_{2.5} has been back-cast despite not being incorporated into the 2001 inventory of air emissions.

It should be noted that in all tables, sub totals have been rounded to the nearest integer and that totals are calculated on the unrounded figures. For this reason it may appear that published percentages do not always add to 100.0%

4.1 Emissions by contaminant (Timaru excluding Washdyke)

4.1.1 Particulate matter less than 10 microns (PM₁₀)

A total of 1.5 tonne of PM₁₀ was discharged on a winter's weekday in Timaru and 1.6 tonne on a weekend day. The domestic home heating sector generated the greatest quantity of PM₁₀ with a contribution of 1366 kg (92% of total weekday PM₁₀). Industrial and commercial sources contributed 80 kg (5%), followed by 44 kg (3%) from motor vehicles. Home heating still dominated on weekend days but discharged a slightly greater amount of PM₁₀ whereas motor vehicles and industry discharged less on the weekend.

Table 4.1 presents PM₁₀ emissions for a typical winter's weekday and weekend day, and Figure 4.1 illustrates the contribution of each source to total emissions.

Table 4.1 Daily emissions of PM₁₀ (Timaru excluding Washdyke)

Timaru (excluding Washdyke)	Weekdays				Total (kg)
	6am-10am	10am-4pm	4pm-10pm	10pm-6am	
Domestic heating	152.3	269.1	690.1	254.5	1366
Motor vehicles	8.3	19.5	14.9	1.4	44
Industry/commercial	23.4	27.0	13.1	16.1	80
Total (kg)	184	315	718	272	1490
	Weekend days				
Domestic heating	189.3	410.6	706.0	273.6	1580
Motor vehicles	3.3	15.6	9.1	1.6	30
Industry/commercial	5.3	8.0	8.0	10.7	32
Total (kg)	198	434	723	286	1641

4.1.1.1 PM₁₀ emission by time of day

On weekdays the highest rate of emission in Timaru occurred during the 4pm to 10pm time period. Ninety-six percent of average hourly emissions at that time came from domestic home heating, with motor vehicles and industry contributing 2% each. On weekend days the highest average hourly rate of emission occurred during the 4pm to 10pm time period with 97% coming from home heating.

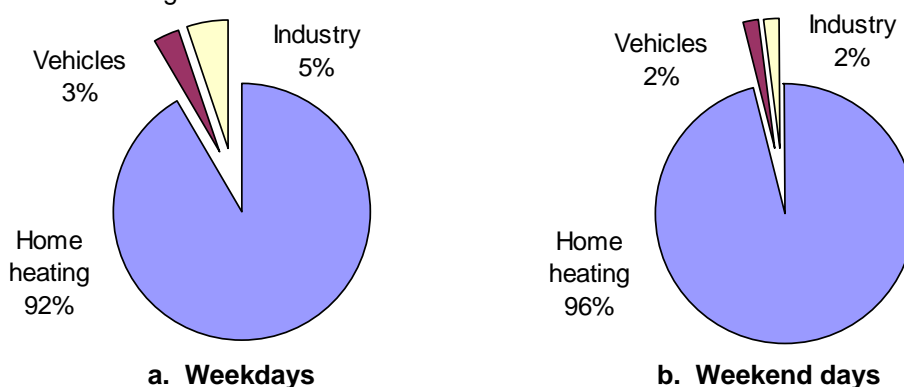


Figure 4.1 The contribution of major sources to total PM₁₀ emission in Timaru

The data were further analysed to allow hour by hour emissions to be calculated. During the home heating survey, participants indicated the number of hours fuel was burnt in each time segment. An assumption was then made regarding the exact time burning took place, based

upon the burning patterns specified in Appendix A. For motor vehicles, hourly data was extracted from the work done by Gabites Porter, and for industry the actual hours of activity were available from the survey.

The following graphs illustrate how the hour by hour emissions of PM₁₀ change over a 24-hour period. The hourly data for all suburbs on a weekday and weekend day are presented in Appendix A.

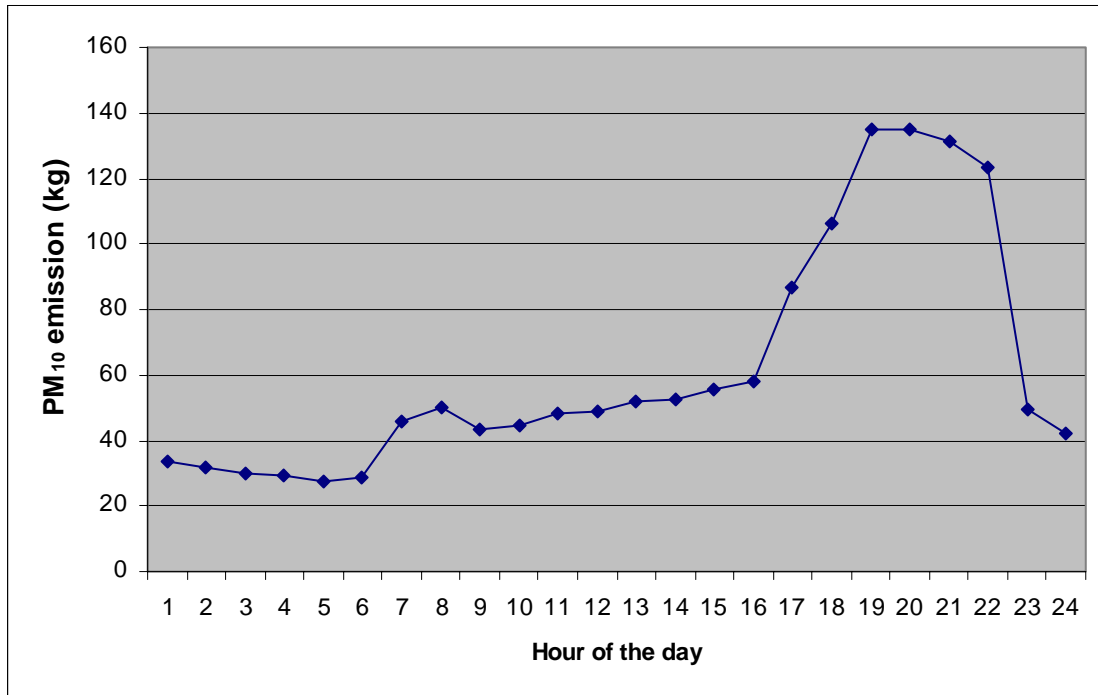


Figure 4.2 Weekday emission of PM₁₀ by time of day

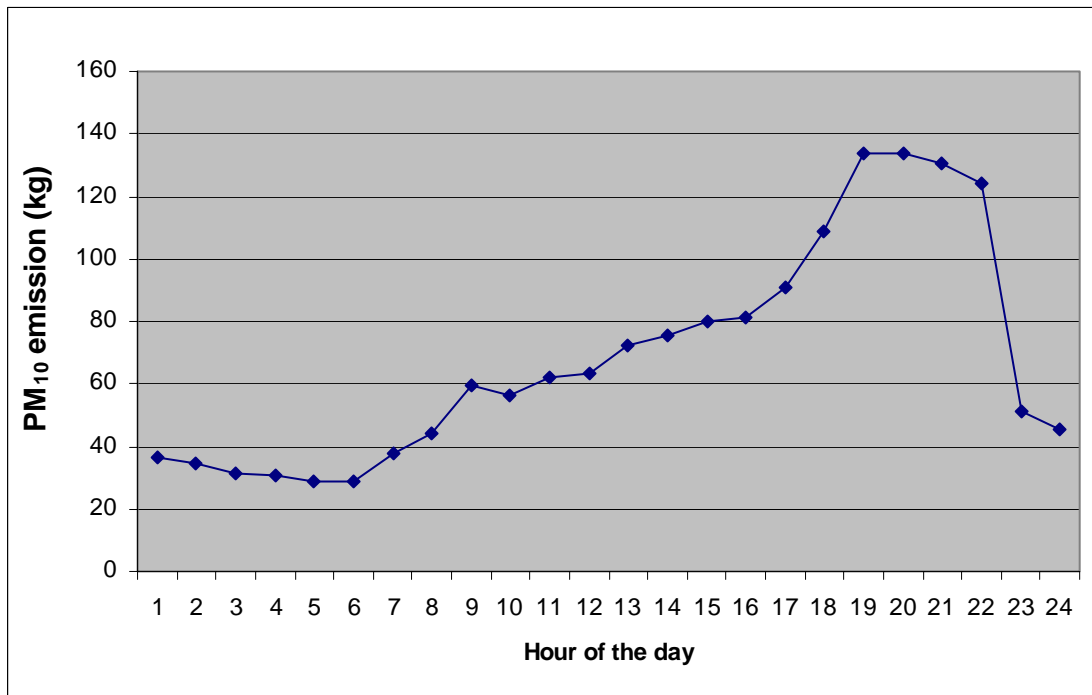


Figure 4.3 Weekend day emission of PM₁₀ by time of day

More detail on PM₁₀ emission by time and suburb is presented in Appendix G for home heating, Table 4.20 for motor vehicles and Tables 4.25 and 4.26 for commerce and industry. Further analysis and more detail on methodology to produce hour by hour emission of PM₁₀ is provided in Appendix A.

4.1.1.2 PM₁₀ emission trends

Weekday data have been used for the comparison of emissions in this section.

Industrial and motor vehicle activity data collected in 1996 and 2001 was explicitly for weekday activity, but for home heating it has been assumed that the data was valid for weekdays.

PM₁₀ emissions from home heating increased by 3.6% during the period 1996 – 2005, with a 2.4% increase in the last five years. While woodburner use increased over that time (+17%), the number of open fires and multifuel burners decreased, thus limiting the home heating emissions increase to 2.4%. Motor vehicle emissions decreased by 17% due to improvements in motor vehicle engine technology, and to a lesser extent, a reduction in VKT (see Table 3.9). Industrial and commercial emissions have shown a decrease of 5%, due mainly to the closure of a single large emitter in the Kensington suburb.

Table 4.2 Change in PM₁₀ emissions (Timaru excluding Washdyke)

Particulate matter less than 10 microns				
Timaru (excluding Washdyke)	Inventory year			Change %
	1996	2001	2005	
Domestic heating	1318	1333	1366	2.4%
Motor vehicles	NA	53	44	-16.6%
Industry	NA	84	80	-4.7%
Total (kg)		1470	1490	1.3%

4.1.2 Particulate matter less than 2.5 microns (PM_{2.5})

A total of 1.4 tonne of PM_{2.5} was discharged on a winter's weekday in Timaru and 1.6 tonne on a winter's weekend day. The domestic home heating sector generated the greatest quantity of PM_{2.5} with a contribution of 1311 kg of the 1385 kg total (95% of total PM_{2.5}) on a weekday and 1518 kg of the 1559 kg total (97%) on a weekend day. Motor vehicles contributed 37 kg on weekdays and 25 kg on weekend days which represented 3% and 2% of PM_{2.5} emissions respectively. Industrial and commercial sources contributed similar amounts of PM_{2.5} as motor vehicles on weekdays but were reduced to 1% on weekend days.

Table 4.3 Daily emission of PM_{2.5} (Timaru excluding Washdyke)

Timaru (excluding Washdyke)	Weekdays				
	6am-10am	10am-4pm	4pm-10pm	10pm-6am	Total (kg)
Domestic heating	146.4	258.1	662.1	244.6	1311
Motor vehicles	7.0	16.4	12.6	1.2	37
Industry/commercial	11.3	10.1	6.5	8.7	37
Total (kg)	165	285	681	255	1385
Weekend days					
Domestic heating	182.2	394.9	677.4	263.4	1518
Motor vehicles	2.8	13.2	7.7	1.3	25
Industry/commercial	2.7	4.0	4.0	5.4	16
Total (kg)	188	412	689	270	1559

4.1.2.1 PM_{2.5} emission by time of day

On an average hourly basis the highest rate of emission in Timaru occurred during the 4pm to 10pm time period. Ninety-seven percent of average hourly emissions at that time came from domestic home heating, with motor vehicles and industry contributing 2% and 1% respectively. On weekend days the highest average hourly rate of emission occurred during the 4pm to 10pm time period with 98% coming from home heating.

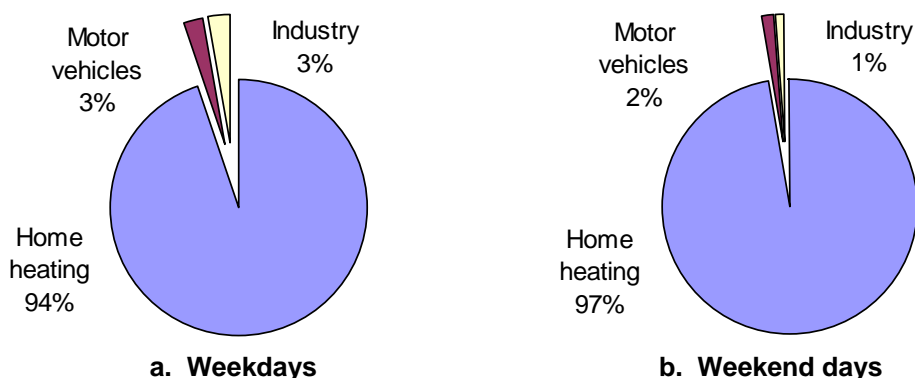


Figure 4.4 The contribution of major sources to total PM_{2.5} emissions in Timaru

More detail on emission of PM_{2.5} by time and suburb is presented in Appendix G for home heating, in Table 4.20 for vehicle emissions and Tables 4.25 and 4.26 for industrial and commercial sources.

4.1.2.2 PM_{2.5} emission trends

The trend for PM_{2.5} emission is similar to that mentioned for PM₁₀, with a 16% reduction of PM_{2.5} emission due to vehicles. Once again this is probably due to improving engine technology in later model vehicles.

Table 4.4 Change in PM_{2.5} emissions (Timaru excluding Washdyke)

Particulate matter less than 2.5 microns				
Timaru (excluding Washdyke)	Inventory year			Change %
	1996	2001	2005	
Domestic heating	1254	1273	1311	3.0%
Motor vehicles	NA	45	37	-16.4%
Industry	NA	37	37	0.0%
Total (kg)		1354	1385	2.3%

The change in home heating emission needs to be read in conjunction with the comment at the beginning of section 4.1.1.2.

4.1.3 Carbon monoxide (CO)

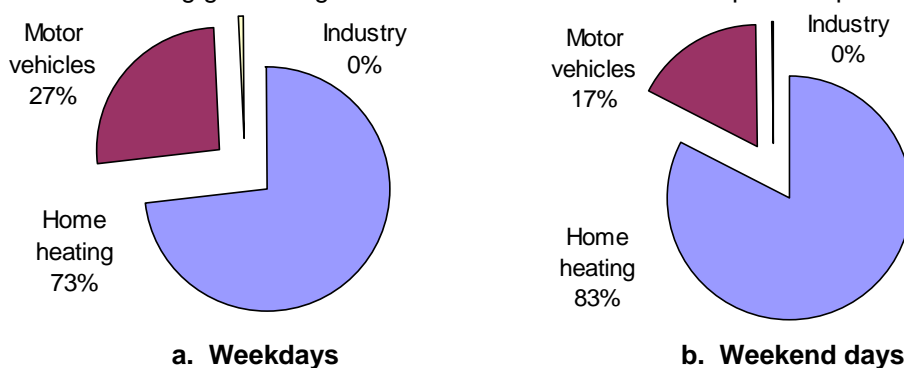
A total of 17.6 tonnes of CO are emitted on weekdays and 18 tonnes on weekend days. On weekdays home heating contributes 73% of CO emissions with motor vehicle emissions at about 27% and industry less than half of one percent of the total. On weekend days, home heating emissions rise to 83% and motor vehicle emissions fall to 17% of the total.

Table 4.5 Daily emissions of CO (Timaru excluding Washdyke)

Timaru (excluding Washdyke)	Weekdays				Total (kg)
	6am-10am	10am-4pm	4pm-10pm	10pm-6am	
Domestic heating	1452.9	2528.8	6441.0	2394.9	12818
Motor vehicles	881.0	2064.3	1576.3	149.9	4672
Industry/commercial	30.9	20.8	13.2	18.6	83
Total (kg)	2365	4614	8031	2563	17573
	Weekend days				
Domestic heating	1815.5	3907.7	6608.0	2595.6	14927
Motor vehicles	346.1	1659.1	964.5	164.9	3135
Industry/commercial	4.4	6.6	6.6	8.8	27
Total (kg)	2166	5573	7579	2769	18088

4.1.3.1 CO emission by time of day

On weekdays, the highest CO emission rate occurred between 4pm and 10pm. Eighty percent of average hourly emissions at that time came from domestic home heating, 20% from motor vehicles and a very small amount from industry. Very similar trends occur on weekend days with home heating generating 87% of the CO emissions in the 4pm to 10pm time period.

**Figure 4.5 The contribution of major sources of total CO emissions in Timaru**

More detail on emission CO by time and suburb is presented in Appendix G for home heating, in Table 4.20 for vehicle emissions and Tables 4.25 and 4.26 for industrial and commercial sources.

4.1.3.2 CO emission trends

There has been an overall decrease in the total emission of CO by 5%. Motor vehicle and industrial emissions decreased 26% and 14% respectively, while a 5% increase in home heating emissions has occurred. Motor vehicle emissions have decreased due to improvements in engine technology over time and an increasing proportion of diesel powered vehicles in the Timaru vehicle fleet. Industrial emissions have decreased due to the closure of a single large emitter in the Kensington suburb.

Table 4.6 Change in CO emissions (Timaru excluding Washdyke)

Timaru (excluding Washdyke)	CO emission weekdays (kg)			Change %
	1996	2001	2005	
Domestic heating	11589	12187	12818	5%
Motor vehicles	NA	6290	4672	-26%
Industry	NA	97	83	-14%
Total (kg)		18573	17573	-5%

4.1.4 Oxides of nitrogen (NO_x)

A total of 822 kg of NO_x are emitted on weekdays and 572 kg on weekend days. On weekdays, motor vehicles contribute the greatest amount with 70% coming from this source. Home heating contributes a further 16% and industry 14%. On weekend days much less of this contaminant is released into the airshed, with motor vehicles and industry emitting 189 kg and 80 kg less respectively, but home heating emitting 19 kg (+14%) more.

Table 4.7 Daily emission of NO_x (Timaru excluding Washdyke)

Timaru (excluding Washdyke)	Weekdays				Total (kg)
	6am-10am	10am-4pm	4pm-10pm	10pm-6am	
Domestic heating	14.9	25.4	68.8	23.4	133
Motor vehicles	109.0	255.0	194.6	18.7	577
Industry/commercial	48.4	30.4	14.2	19.6	113
Total (kg)	172	311	278	62	822
	Weekend days				
Domestic heating	18.1	38.8	69.5	25.6	152
Motor vehicles	42.9	205.0	119.4	20.6	388
Industry/commercial	5.4	8.1	8.1	10.8	33
Total (kg)	66	252	197	57	572

4.1.4.1 NO_x emission by time of day

Unlike the previously discussed contaminants, the peak emission takes place in the middle of the day when the motor vehicle activity is at its greatest. In the 10am to 4pm weekday time period, motor vehicles contribute 255 kg of the total emission of 311 kg or 82%. In the same time period home heating contributes 8% and industry 10%. NO_x emissions on weekend days were much lower between 6am and 10am due to lower vehicle activity in this time period.

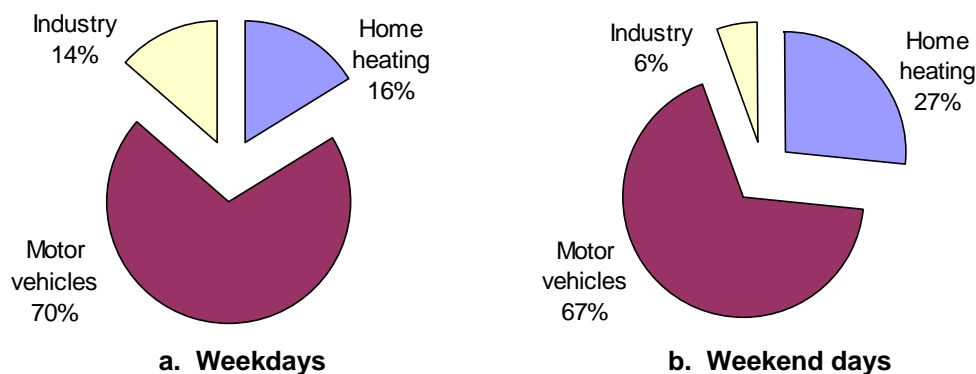


Figure 4.6 The contribution of major sources to total NO_x emissions in Timaru

More detail on emission of NO_x by time and suburb is presented in Appendix G for home heating, in Table 4.20 for vehicle emissions and Tables 4.25 and 4.26 for industrial and commercial sources.

4.1.4.2 NO_x emission trends

The general trend was a decrease in emissions of 6% which was due to a drop in both home heating and vehicle emissions (-2% and -12% respectively).

Table 4.8 Change in NO_x emissions (Timaru excluding Washdyke)

NO _x emissions (weekdays)				
Timaru (excluding Washdyke)	Inventory year			Change %
	1996	2001	2005	
Domestic heating	140	136	133	-2%
Motor vehicles	NA	654	577	-12%
Industry	NA	113	113	-0.2%
Total (kg)		902	822	-9%

4.1.5 Oxides of sulphur (SO_x)

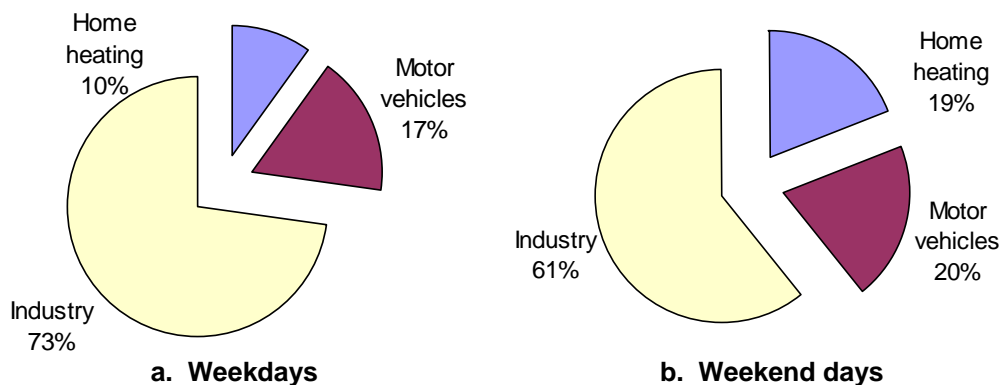
A total of 455 kg of SO_x is emitted on weekdays and 263 kg on weekend days. On weekdays, industry contributes 73% of emissions with home heating and vehicles contributing 10% and 17% respectively. On weekend days, industrial and commercial emissions of SO_x are much lower; vehicle emissions are reduced but home heating emissions rise.

Table 4.9 Daily emission of SO_x (Timaru excluding Washdyke)

Timaru (excluding Washdyke)	Weekdays				
	6am-10am	10am-4pm	4pm-10pm	10pm-6am	Total (kg)
Domestic heating	4.6	8.6	23.7	8.7	46
Motor vehicles	14.8	34.6	26.4	2.5	78
Industry/commercial	98.4	90.4	61.5	80.6	331
Total (kg)	118	134	112	92	455
Weekend days					
Domestic heating	5.6	12.4	23.5	9.1	51
Motor vehicles	5.8	27.8	16.2	2.8	53
Industry/commercial	26.7	40.0	40.0	53.3	160
Total (kg)	38	80	80	65	263

4.1.5.1 SO_x emission by time of day

On weekdays the highest SO_x emission occurred during the 6am to 10am time period. Eighty-three percent of average hourly emissions at that time came from industry, 13% from motor vehicles and 4% from domestic home heating. The trend is somewhat different on weekend days as industrial emissions are very much reduced. On these days, the peak occurs in the 10am to 4pm time period when motor vehicle use is at its greatest.

**Figure 4.7** The contribution of major sources to total SO_x emissions in Timaru

More detail on emission of SO_x by time and suburb is presented in Appendix G for home heating, in Table 4.20 for vehicle emissions and Tables 4.25 and 4.26 for industrial and commercial sources.

4.1.5.2 SO_x emission trends

The general trend was for almost no change in emissions in the last five years.

Table 4.10 Change in SO_x emissions (Timaru excluding Washdyke)

SO _x emissions (weekdays)				
Timaru (excluding Washdyke)	Inventory year			Change %
	1996	2001	2005	
Domestic heating	54	45	46	0.8%
Motor vehicles	NA	79	78	-0.9%
Industry	NA	331	331	0.0%
Total (kg)		455	455	-0.1%

4.1.6 Benzene

A total of 180 kg of benzene was emitted on weekdays and 194 kg on weekend days. On weekdays, home heating contributes 75% of emissions with vehicles contributing 25%. Industry emissions of benzene are very small. On weekend days vehicle emissions are reduced to 19% of the total but home heating emissions rise to 81%. Industry and commercial emissions remain at a very low level.

Table 4.11 Daily emission of benzene (Timaru excluding Washdyke)

Timaru (excluding Washdyke)	Weekdays				
	6am-10am	10am-4pm	4pm-10pm	10pm-6am	Total (kg)
Domestic heating	15.4	26.4	67.5	25.1	134
Motor vehicles	8.6	20.1	15.3	1.5	45
Industry/commercial	0.0	0.0	0.0	0.0	0
Total (kg)	24	46	83	27	180
Weekend days					
Domestic heating	19.4	41.1	69.3	27.3	157
Motor vehicles	4.1	19.7	11.5	2.0	37
Industry/commercial	0.0	0.0	0.0	0.0	0
Total (kg)	24	61	81	29	194

4.1.6.1 Benzene emission by time of day

On weekdays the highest benzene emission rate occurred during the 4pm to 10pm time period. Eighty-two percent of average hourly emissions at that time came from domestic home heating and 18% from vehicle emissions. Industrial emission of benzene was at a minimum at that time. On weekend days the maximum rate of emission is once again in the 4pm to 10pm time period with 86% of emissions coming from home heating.

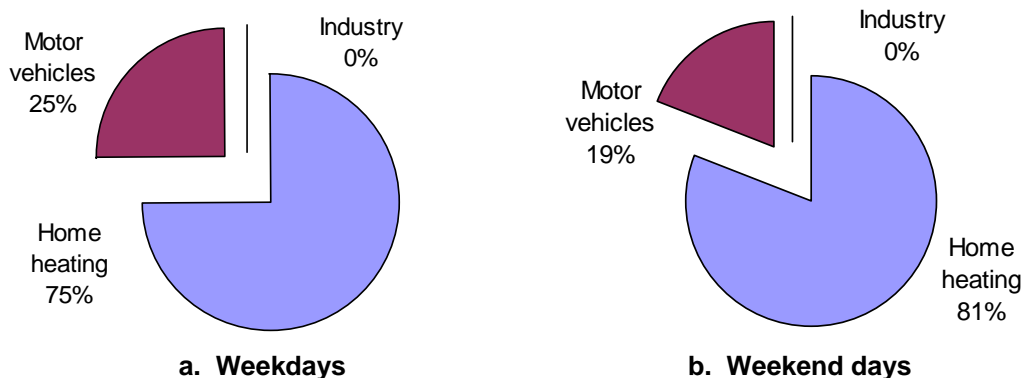


Figure 4.8 The significance of major sources to total benzene emission

More detail on emission of benzene by time and suburb is presented in Appendix G for home heating, in Table 4.20 for vehicle emissions and Tables 4.25 and 4.26 for industrial and commercial sources.

4.1.6.2 Benzene emission trends

The general trend was an increase in emissions of 2.5% which was due to a 15% increase in home heating, offset by a 23% drop in vehicle emissions.

Table 4.12 Change in benzene emissions (Timaru excluding Washdyke)

Benzene emissions (weekdays)				
Timaru (excluding Washdyke)	Inventory year			Change %
	1996	2001	2005	
Domestic heating	103	117	134	15%
Motor vehicles	NA	59	45	-23%
Industry	NA	0.019	0.019	0%
Total (kg)		175	180	2.5%

4.1.7 Summary

- Emissions of PM₁₀, PM_{2.5}, CO and benzene are dominated by home heating with a pronounced evening peak. Weekend day emissions of these contaminants are higher than the weekday emissions.
- Emissions of NO_x are dominated by those from motor vehicles with maximum discharges occurring in the 10am to 4pm time period. Weekend day emissions of NO_x are lower than weekday emissions.
- SO_x emissions are dominated by the industrial and commercial sector with peak discharges occurring within the 10am to 4pm time period. Weekend day emissions are lower than weekday emissions.

4.2 Emissions by source (Timaru excluding Washdyke)

The purpose of this section is to provide additional detail regarding the types of sources contributing to the emissions summarised in Section 4.1, thus enabling management measures to be focussed on the correct sector and appliance types. This is done by splitting various source categories, such as home heating emissions, into subgroups such as open fires, woodburners by age etc. In addition, backcasting of contaminant emission has been presented in order to identify trends within each source sector.

4.2.1 Emissions from domestic home heating

In 2005, the domestic home heating sector was the greatest source of PM₁₀ (92%) and PM_{2.5} emissions (95%) in Timaru on weekdays and 96% of PM₁₀ and 97% of PM_{2.5} on weekend days. It also contributed 73% and 83% (weekday/weekend day) of CO emissions, 16% and 27% (weekday/weekend day) of NO_x, 10% and 19% (weekday/weekend day) of SO_x and 75% and 81% (weekday/weekend day) of benzene emissions.

The tables in Appendices F and G provide details of 2005 emissions from home heating for the different study areas by appliance type, contaminant and time period. In Timaru, woodburners were the major source of PM₁₀ emissions from this sector, 77% on weekdays and 79% at weekends. Woodburners also contributed approximately 76% PM_{2.5}, 82% of the CO, 62% of the NO_x, 50% of the SO_x and 84% of the benzene emissions, generated by home heating.

Figure 4.9 gives the proportion of each contaminant to the total home heating emissions by fuel type. Wood burning was clearly the major source of all emissions and coal burning contributed significantly to domestic SO_x emissions. Gas emissions were negligible compared to wood and coal for most contaminants, with the exception of NO_x.

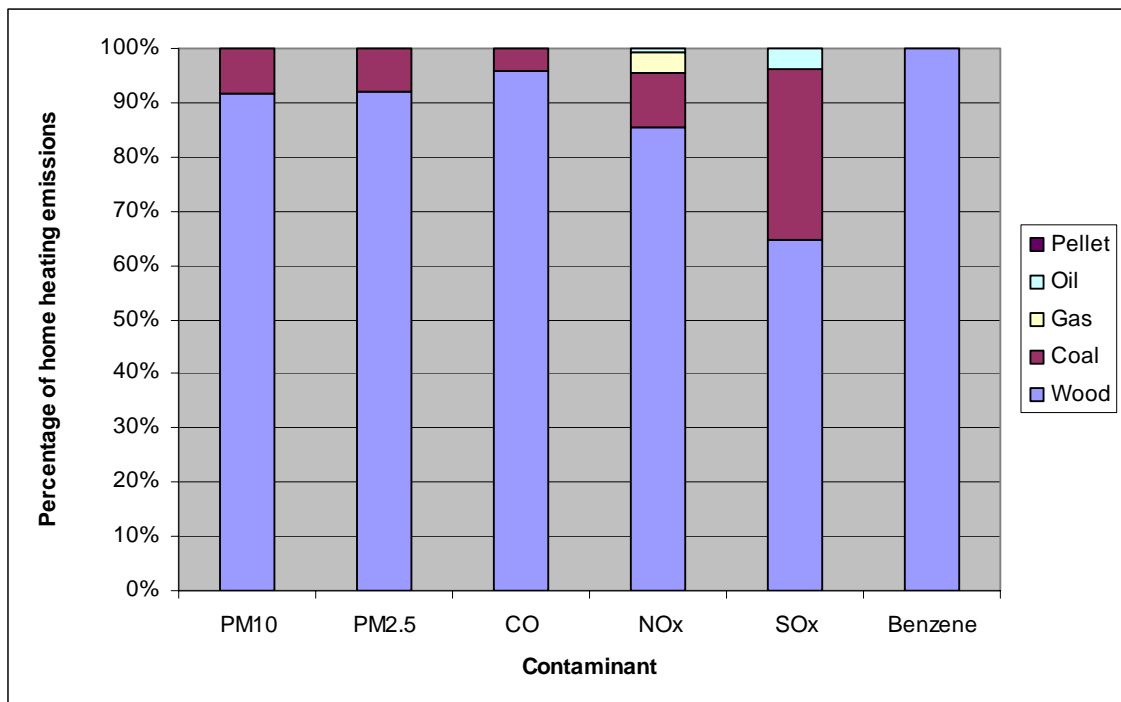


Figure 4.9 Contaminant by fuel type (weekdays)

Figure 4.10 illustrates the emission of contaminants emitted by one appliance when it is burning an average quantity of fuel for that appliance type.

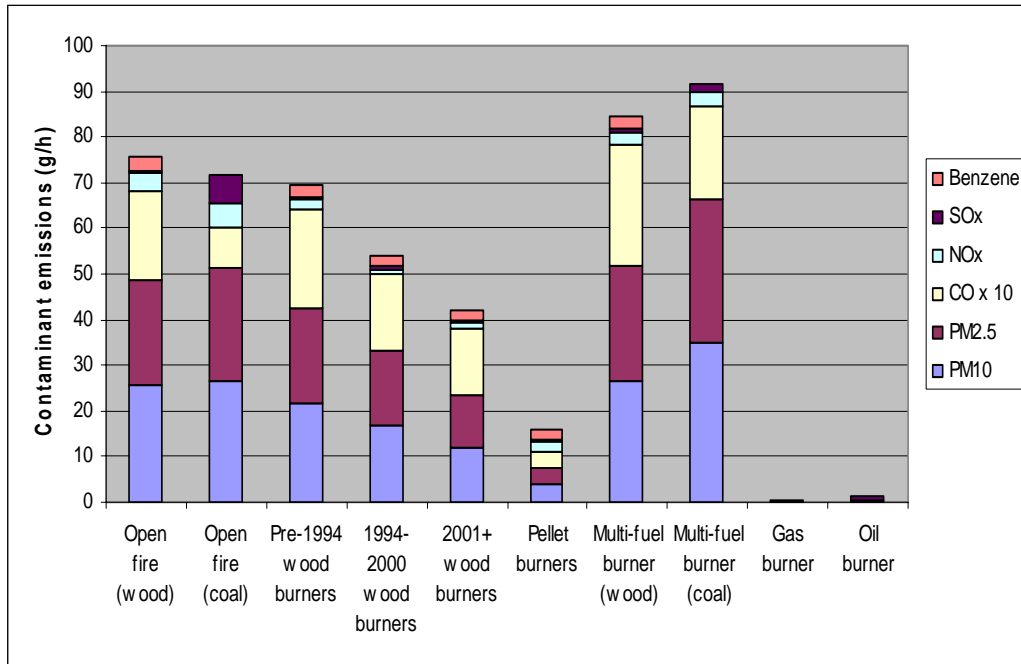


Figure 4.10 Appliance emissions per hour per appliance 2005 Emissions

Domestic home heating emissions varied over the period of a day with emissions for all contaminants increasing rapidly after 4pm to reach a maximum around 10pm.

Hourly emissions of PM₁₀ for each appliance type in each area of study are presented in Appendix A.

Table 4.13 Weekday emissions from home heating appliances by time period

Timaru (exc. Washdyke) Weekdays	PM ₁₀					PM _{2.5}				
	6am- 10am	10am- 4pm	4pm- 10pm	10pm- 6am	Total kg	6am- 10am	10am- 4pm	4pm- 10pm	10pm- 6am	Total kg
Open fire (wood)	10	20	59	14	103	9	18	52	12	91
Open fire (coal)	3	7	30	9	49	3	7	28	9	47
Pre-1994 woodburners	57	100	254	95	506	55	97	247	92	491
1994-2000 woodburners	41	67	179	68	355	40	65	173	66	344
2001+ wood burners	23	38	89	38	188	22	36	87	37	182
Pellet burners	0.2	0.4	1.0	0.4	2.0	0.2	0.4	0.9	0.4	1.9
Multifuel burner (wood)	12	22	51	17	102	12	21	49	16	99
Multifuel burner (coal)	6	16	27	13	62	5	14	24	12	55
Gas burner	0.03	0.02	0.11	0.02	0.18	0.03	0.02	0.11	0.02	0.18
Oil burner	0.03	0.04	0.07	0.04	0.18	0.02	0.03	0.05	0.03	0.12
Total (kg)	152	269	690	254	1366	146	258	662	245	1311

Timaru (exc. Washdyke) Weekdays	CO					NO _x				
	6am- 10am	10am- 4pm	4pm- 10pm	10pm- 6am	Total kg	6am- 10am	10am- 4pm	4pm- 10pm	10pm- 6am	Total kg
Open fire (wood)	78	150	443	104	775	2	3	9	2	16
Open fire (coal)	10	23	100	30	163	1	1	6	2	10
Pre-1994 woodburners	572	996	2544	949	5061	5	9	23	9	46
1994-2000 woodburners	408	672	1787	680	3547	2	4	10	4	20
2001+ wood burners	226	375	894	384	1879	2	3	7	3	16
Pellet burners	2.2	3.7	9.3	3.6	18.8	0.1	0.2	0.6	0.2	1.3
Multifuel burner (wood)	123	218	506	169	1016	1	2	5	2	9
Multifuel burner (coal)	34	90	158	76	358	0	1	2	1	5
Gas burner	0.02	0.02	0.07	0.01	0.12	1.5	1.2	5.3	0.8	8.8
Oil burner	0.04	0.06	0.11	0.07	0.29	0.2	0.3	0.5	0.3	1.2
Total (kg)	1453	2529	6441	2395	12818	15	25	69	23	133

Timaru (exc. Washdyke) Weekdays	SO _x					Benzene				
	6am- 10am	10am- 4pm	4pm- 10pm	10pm- 6am	Total kg	6am- 10am	10am- 4pm	4pm- 10pm	10pm- 6am	Total kg
Open fire (wood)	0.2	0.4	1.3	0.3	2.3	1.1	2.1	6.3	1.5	11
Open fire (coal)	0.7	1.7	7.3	2.2	11.9	0.0	0.0	0.0	0.0	0
Pre-1994 woodburners	1.0	1.8	4.6	1.7	9.2	5.0	8.8	22.4	8.4	45
1994-2000 woodburners	0.9	1.5	4.0	1.5	7.9	4.4	7.2	19.3	7.3	38
2001+ wood burners	0.8	1.3	3.0	1.3	6.3	3.6	6.1	14.5	6.2	30
Pellet burners	0.0	0.0	0.1	0.0	0.3	0.1	0.2	0.6	0.2	1.2
Multifuel burner (wood)	0.2	0.4	0.9	0.3	1.8	1.1	1.9	4.5	1.5	9
Multifuel burner (coal)	0.3	0.9	1.6	0.8	3.6	0.0	0.0	0.0	0.0	0
Gas burner	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.01
Oil burner	0.35	0.51	0.90	0.57	2.33	0.00	0.00	0.00	0.00	0.00
Total (kg)	5	9	24	9	46	15	26	68	25	134

Table 4.14 Weekend day emissions from home heating appliances by time period

Timaru (exc. Washdyke) Weekend day	PM ₁₀					PM _{2.5}				
	6am- 10am	10am- 4pm	4pm- 10pm	10pm- 6am	Total kg	6am- 10am	10am- 4pm	4pm- 10pm	10pm- 6am	Total kg
Open fire (wood)	11	24	59	15	110	10	21	52	13	97
Open fire (coal)	4	10	27	10	50	3	9	26	9	48
Pre-1994 woodburners	75	164	265	108	614	73	160	257	105	595
1994-2000 woodburners	52	104	184	75	415	50	101	178	73	402
2001+ wood burners	29	61	91	39	221	29	59	88	38	214
Pellet burners	0.3	0.6	1.0	0.4	2.4	0.3	0.6	1.0	0.4	2.2
Multifuel burner (wood)	12	29	50	16	106	11	28	49	15	103
Multifuel burner (coal)	5	19	27	10	62	5	17	24	9	55
Gas burner	0.03	0.04	0.11	0.02	0.21	0.03	0.04	0.11	0.02	0.21
Oil burner	0.03	0.05	0.07	0.05	0.18	0.02	0.03	0.04	0.03	0.12
Total (kg)	189	411	705	275	1580	182	396	676	264	1518

Timaru (exc. Washdyke) Weekend day	CO					NO _x				
	6am- 10am	10am- 4pm	4pm- 10pm	10pm- 6am	Total kg	6am- 10am	10am- 4pm	4pm- 10pm	10pm- 6am	Total kg
Open fire (wood)	86	183	445	115	829	2	4	9	2	17
Open fire (coal)	12	33	91	32	168	1	2	5	2	10
Pre-1994 woodburners	752	1645	2654	1084	6135	7	15	24	10	56
1994-2000 woodburners	519	1038	1837	753	4148	3	6	10	4	23
2001+ wood burners	294	607	912	393	2206	2	5	8	3	18
Pellet burners	2.8	5.9	9.6	4.0	22.4	0.2	0.4	0.6	0.3	1.5
Multifuel burner (wood)	116	287	500	158	1062	1	3	5	1	10
Multifuel burner (coal)	31	110	156	60	357	0	2	2	1	5
Gas burner	0.02	0.03	0.07	0.01	0.14	1.7	2.2	5.4	1.0	10.2
Oil burner	0.05	0.08	0.11	0.08	0.31	0.2	0.3	0.4	0.3	1.2
Total (kg)	1814	3908	6605	2599	14927	18	39	70	25	152

Timaru (exc. Washdyke) Weekend day	SO _x					Benzene				
	6am- 10am	10am- 4pm	4pm- 10pm	10pm- 6am	Total kg	6am- 10am	10am- 4pm	4pm- 10pm	10pm- 6am	Total kg
Open fire (wood)	0.3	0.5	1.3	0.3	2.4	1.2	2.6	6.4	1.6	12
Open fire (coal)	0.9	2.4	6.6	2.4	12.2	0.0	0.0	0.0	0.0	0
Pre-1994 woodburners	1.4	3.0	4.8	2.0	11.2	6.6	14.5	23.4	9.6	54
1994-2000 woodburners	1.2	2.3	4.1	1.7	9.2	5.6	11.2	19.8	8.1	45
2001+ wood burners	1.0	2.0	3.0	1.3	7.4	4.8	9.8	14.7	6.3	36
Pellet burners	0.0	0.1	0.1	0.1	0.3	0.2	0.4	0.6	0.3	1.4
Multifuel burner (wood)	0.2	0.5	0.9	0.3	1.9	1.0	2.5	4.4	1.4	9
Multifuel burner (coal)	0.3	1.1	1.6	0.6	3.6	0.0	0.0	0.0	0.0	0
Gas burner	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.01
Oil burner	0.38	0.61	0.87	0.60	2.45	0.00	0.00	0.00	0.00	0.00
Total (kg)	6	13	23	9	51	19	41	69	27	157

4.2.1.1 Backcast emissions for home heating appliances

Backcasting refers to calculating previous inventory data on the basis of current inventory assumptions (eg emission factors). This involves revisiting the original 1996 data and 2001 data and making changes as appropriate to provide an estimate of emissions in those years based upon current understanding. This is important for a valid assessment of changes in emissions over time.

Backcasting involved adjusting the 1996 and 2001 woodburner categories to match those used in the 2005 inventory. Woodburners using coal were grouped into the multifuel burner category along with incinerators, pot bellies etc. The fuel use data were then adjusted to account for the wood used by coal burning wood burners based on the proportion of wood/coal used by multifuel burners in the more recent inventories. The woodburner categories were then adjusted into the 2005 age groups. Fuel use was adjusted from the 1996 and 2001 log mass assumptions of 1.4 kg and 1.6 kg, respectively, to the 2005 figure of 1.9 kg, and a bucket of coal from 10 kg to the 2005 figure of 9 kg.

4.2.1.2 Change in emissions 1996-2005 (Timaru excluding Washdyke)

Table 4.15 presents the emission of contaminants for 1996, 2001 and 2005. PM₁₀ emissions from home heating increased by 3.7%, PM_{2.5} by 4.6%, CO by 10.6% and benzene by 31.2%, conversely, NO_x decreased by 5.4% and SO_x by 15.8%.

Notice should be taken of the 1996 – 2005 comparison characteristics as stated in Table 2.5. Also note that the percentage changes are between the 1996 and 2005 figures.

Table 4.15 Change in emissions from home heating appliances 1996 - 2005

	PM ₁₀ emission (kg)				PM _{2.5} emission (kg)				CO emission (kg)			
	1996	2001	2005	% change	1996	2001	2005	% change	1996	2001	2005	% change
Open fire (wood)	174	176	103	-41%	155	156	91	-41%	1317	1329	775	-41%
Open fire (coal)	98	59	49	-50%	93	56	47	-50%	327	195	163	-50%
Woodburners												
Pre-1994 woodburner	612	458	506	-17%	593	444	491	-17%	6115	4576	5061	-17%
1994-2000 woodburner	111	284	355	220%	108	275	344	220%	1110	2840	3547	220%
2001+ woodburner	0	29	188		0	28	182		0	293	1879	
Pellet burner	0	0	2.0		0	0	1.9		0	0	19	
Multifuel												
Multifuel burner (wood)	202	251	102	-50%	197	244	99	-50%	2024	2508	1016	-50%
Multifuel burner (coal)	120	77	62	-49%	108	69	55	-49%	696	446	358	-49%
Gas burner	0.05	0.1	0.2	262%	0.05	0.1	0.2	262%	0.03	0.1	0.1	262%
Oil burner	0.2	0.2	0.2	10%	0.1	0.1	0.1	10%	0.3	0.3	0.3	10%
Total	1318	1333	1366	3.7%	1254	1273	1311	4.6%	11589	12187	12818	10.6%

	NO _x emission (kg)				SO _x emission (kg)				Benzene (kg)			
	1996	2001	2005	% change	1996	2001	2005	% change	1996	2001	2005	% change
Open fire (wood)	27	27	16	-41%	4	4	2	-41%	19	19	11	-41%
Open fire (coal)	19	11	10	-50%	24	14	12	-50%	0	0	0	-50%
Woodburners												
Pre-1994 woodburner	56	42	46	-17%	11	8	9	-17%	54	40	45	-17%
1994-2000 woodburner	6	16	20	220%	2	6	8	220%	12	31	38	220%
2001+ woodburner	0	2.4	16		0	1.0	6.3		0	4.7	30.4	
Pellet burner	0	0	1.3		0	0	0.3		0	0	1.2	
Multifuel												
Multifuel burner (wood)	18	23	9	-50%	4	5	2	-50%	18	22	9	-50%
Multifuel burner (coal)	10	6	5	-49%	7	4	4	-49%	0	0	0	-49%
Gas burner	2.4	6.4	8.8	262%	0.0	0.0	0.0	0%	0.0	0.0	0.0	0%
Oil burner	1.1	1.2	1.2	10%	2.1	2.4	2.3	10%	0.0	0.0	0.0	10%
Total	140	136	133	-5.4%	54	45	46	-15.8%	103	117	134	31.2%

4.2.2 Emissions from motor vehicles

The motor vehicle emissions take into account variables such as vehicle and fuel type, driving condition and road type, cold start and warm engine driving. The emissions calculated were classified by contaminant type, vehicle type, fuel type, time of day and study area. Emission factors for all vehicle types, road types and driving conditions are given in Appendix C.

4.2.2.1 2005 Emissions (Timaru excluding Washdyke)

In 2005, the motor vehicle sector was the greatest source of NO_x (70% on weekdays and 68% on weekend days) and contributed 25% (19% on weekend days) of benzene emissions, 27% (17% on weekend days) of CO, 17% (20% on weekend days) of SO_x emissions and about 3% of PM₁₀ and PM_{2.5}. It is worth noting that the contaminant of concern in Timaru is PM₁₀ and that motor vehicles contribute very little towards the total of this contaminant (3% on weekdays and 2% weekend days).

Table 4.16 Weekday contaminant emission by vehicle type (Timaru excluding Washdyke)

Fleet profile			Weekdays							
Type	#	% of total	Contaminant emission (kg)							
			PM ₁₀	%	PM _{2.5}	%	CO	%	NO _x	%
Bus large CNG	0	0.00%	0.0	0.0%	0.0	0.0%	0	0.0%	0.0	0.0%
Bus large diesel	295	0.71%	2.8	6.4%	2.6	7.0%	7	0.1%	49.6	8.6%
Bus large LPG	0	0.00%	0.0	0.0%	0.0	0.0%	0	0.0%	0.0	0.0%
Bus medium CNG	0	0.00%	0.0	0.0%	0.0	0.0%	0	0.0%	0.0	0.0%
Bus medium diesel	99	0.24%	0.5	1.2%	0.5	1.3%	1	0.0%	8.0	1.4%
Bus medium LPG	0	0.00%	0.0	0.0%	0.0	0.0%	0	0.0%	0.0	0.0%
Car CNG	0	0.00%	0.0	0.0%	0.0	0.0%	0	0.0%	0.0	0.0%
Car diesel	3738	9.00%	10.0	22.8%	8.9	24.4%	46	1.0%	19.7	3.4%
Car LPG	3	0.01%	0.0	0.0%	0.0	0.0%	0	0.0%	0.0	0.0%
Car petrol	28331	68.19%	5.7	12.9%	3.3	7.7%	3740	80.1%	234.2	40.6%
HCV large CNG	0	0.00%	0.0	0.0%	0.0	0.0%	0	0.0%	0.0	0.0%
HCV large diesel	825	1.99%	7.8	17.8%	7.1	19.6%	20	0.4%	138.7	24.0%
HCV large LPG	1	0.00%	0.0	0.0%	0.0	0.0%	0	0.0%	0.1	0.0%
HCV medium CNG	0	0.00%	0.0	0.0%	0.0	0.0%	0	0.0%	0.0	0.0%
HCV medium diesel	275	0.66%	1.5	3.4%	1.4	3.7%	4	0.1%	27.3	4.7%
HCV medium LPG	0	0.00%	0.0	0.0%	0.0	0.0%	0	0.0%	0.0	0.0%
HCV small CNG	0	0.00%	0.0	0.0%	0.0	0.0%	0	0.0%	0.0	0.0%
HCV small diesel	826	1.99%	4.2	9.4%	3.8	10.4%	11	0.2%	56.3	9.7%
HCV small LPG	4	0.01%	0.0	0.0%	0.0	0.0%	0	0.0%	0.2	0.0%
LCV CNG	1	0.00%	0.0	0.0%	0.0	0.0%	0	0.0%	0.0	0.0%
LCV diesel	3173	7.64%	10.0	22.8%	8.8	24.0%	43	0.9%	17.1	3.0%
LCV LPG	2	0.00%	0.0	0.0%	0.0	0.0%	0	0.0%	0.0	0.0%
LCV petrol	2277	5.48%	0.5	1.2%	0.3	0.7%	417	8.9%	24.2	4.2%
Motorcycle	1700	4.09%	0.9	2.1%	0.5	1.2%	383	8.2%	1.7	0.3%
Total	41550	100.00%	44	100.0%	37	100.0%	4672	100.0%	577	100.0%

Diesel vehicles make up 22% of the Timaru vehicle fleet and emit 84% of the vehicle PM₁₀ and 89% of the vehicle PM_{2.5} emissions. Petrol vehicles emit by far the greatest proportion of CO. Vehicles powered by these engines make up 78% of the fleet and emit 97% of the vehicle CO emission.

Using the 2005 methodology it was not possible to quantify SO_x emissions by vehicle fuel use type. SO_x emission factors are fleet averaged, not split by vehicle type.

Table 4.17 Weekday vehicle emissions by fuel type (Timaru excluding Washdyke)

Timaru Vehicle Fleet			Weekday emissions (kg)									
Fuel	#	%	PM ₁₀	%	PM _{2.5}	%	CO	%	NO _x	%	Benzene	%
Diesel	9231	22.22%	36.9	83.8%	33.1	88.9%	131.1	2.8%	316.8	54.9%	0.4	0.99%
Petrol	32308	77.76%	7.1	16.2%	4.1	11.0%	4540	97.2%	260.1	45.1%	45.0	99.01%
LPG	10	0.02%	0.0	0.0%	0.0	0.0%	0.7	0.0%	0.4	0.1%	0.0	0.0%
CNG	1	0.00%	0.0	0.0%	0.0	0.0%	0.1	0.0%	0.0	0.0%	0.0	0.0%
Total	41550	100.0%	44.1	100.0%	37.2	100.0%	4672	100.0%	577	100.0%	45.5	100.0%

Weekend day emissions are about 33% less than weekday emissions due to a lower number of VKT travelled on those days.

Table 4.18 Weekend day contaminant emission by vehicle type

Fleet profile Type	Weekend day Contaminant emission (kg)							
	PM ₁₀	%	PM _{2.5}	%	CO	%	NO _x	%
Bus large CNG	0.0	0.0%	0.0	0.0%	0	0.0%	0.0	0.0%
Bus large diesel	1.9	6.4%	1.7	6.9%	5	0.1%	33.6	8.7%
Bus large LPG	0.0	0.0%	0.0	0.0%	0	0.0%	0.0	0.0%
Bus medium CNG	0.0	0.0%	0.0	0.0%	0	0.0%	0.0	0.0%
Bus medium diesel	0.4	1.2%	0.3	1.3%	1	0.0%	5.4	1.4%
Bus medium LPG	0.0	0.0%	0.0	0.0%	0	0.0%	0.0	0.0%
Car CNG	0.0	0.0%	0.0	0.0%	0	0.0%	0.0	0.0%
Car diesel	6.7	22.8%	6.0	24.0%	31	1.0%	13.4	3.4%
Car LPG	0.0	0.0%	0.0	0.0%	0	0.0%	0.0	0.0%
Car petrol	3.8	12.9%	2.2	8.8%	2509	80.1%	158.7	40.9%
HCV large CNG	0.0	0.0%	0.0	0.0%	0	0.0%	0.0	0.0%
HCV large diesel	5.3	17.8%	4.8	19.2%	13	0.4%	94.0	24.3%
HCV large LPG	0.0	0.0%	0.0	0.0%	0	0.0%	0.1	0.0%
HCV medium CNG	0.0	0.0%	0.0	0.0%	0	0.0%	0.0	0.0%
HCV medium diesel	1.0	3.4%	0.9	3.6%	3	0.1%	15.1	3.9%
HCV medium LPG	0.0	0.0%	0.0	0.0%	0	0.0%	0.0	0.0%
HCV small CNG	0.0	0.0%	0.0	0.0%	0	0.0%	0.0	0.0%
HCV small diesel	2.8	9.4%	2.5	10.1%	7	0.2%	38.1	9.8%
HCV small LPG	0.0	0.0%	0.0	0.0%	0	0.0%	0.1	0.0%
LCV CNG	0.0	0.0%	0.0	0.0%	0	0.0%	0.0	0.0%
LCV diesel	6.7	22.8%	5.9	23.8%	29	0.9%	11.6	3.0%
LCV LPG	0.0	0.0%	0.0	0.0%	0	0.0%	0.0	0.0%
LCV petrol	0.4	1.2%	0.2	0.8%	280	8.9%	16.4	4.2%
Motorcycle	0.6	2.1%	0.4	1.4%	257	8.2%	1.1	0.3%
Total	30	100.0%	25	100.0%	3135	100.0%	388	100.0%

Table 4.19 Weekend day vehicle emissions by fuel type

Fuel	Weekend day emissions (kg)									
	PM ₁₀	%	PM _{2.5}	%	CO	%	NO _x	%	Benzene	%
Diesel	24.8	83.8%	22.2	88.9%	88.1	2.8%	211.3	54.5%	0.4	1.0%
Petrol	4.8	16.2%	2.8	11.1%	3046.0	97.2%	176.3	45.5%	36.9	99.0%
LPG	0.0	0.0%	0.0	0.0%	0.4	0.0%	0.3	0.1%	0.0	0.0%
CNG	0.0	0.0%	0.0	0.0%	0.0	0.0%	0.0	0.0%	0.0	0.0%
Total	30	100.0%	25	100.0%	3135	100.0%	388	100.0%	37	100.0%

4.2.2.2 Emissions by time of day

Motor vehicle emissions varied over the period of a day with maximum emissions for all contaminants and areas occurring between 10am and 4pm (see Tables 4.20 and 4.21). On weekdays 19% of contaminants from motor vehicles are discharged between 6am and 10am, 44% between 10am and 4pm, 34% between 4pm and 10pm and 3% between 10pm and 6am. Detail on the discharge of PM₁₀ on an hourly basis by suburb is shown in Appendix A.

Table 4.20 Weekday vehicle emissions by suburb by time of day

Weekdays Suburb	PM ₁₀					PM _{2.5}					CO				
	6am- 10am	10am- 4pm	4pm- 10pm	10pm- 6am	PM ₁₀ (kg)	6am- 10am	10am- 4pm	4pm- 10pm	10pm- 6am	PM _{2.5} (kg)	6am- 10am	10am- 4pm	4pm- 10pm	10pm- 6am	CO (kg)
Gleniti/Glenwood	0.6	1.4	1.1	0.1	3.2	0.5	1.2	0.9	0.1	2.7	66	145	119	11	340
Highfield	0.8	1.9	1.5	0.1	4.3	0.7	1.6	1.2	0.1	3.6	83	200	156	15	454
Kensington & Redruth	0.5	1.3	1.1	0.1	3.0	0.4	1.1	0.9	0.1	2.5	55	136	114	10	315
Maori Hill/Waimataitai	2.0	4.7	3.4	0.3	10.4	1.7	4.0	2.9	0.3	8.8	211	498	362	35	1106
Marchwiell	0.8	1.6	1.4	0.1	3.9	0.7	1.3	1.2	0.1	3.3	85	169	147	12	414
Parkside	0.8	1.9	1.4	0.1	4.2	0.7	1.6	1.2	0.1	3.6	82	201	152	14	450
Seaview	1.9	4.8	3.4	0.4	10.4	1.6	4.0	2.8	0.3	8.8	205	507	355	37	1105
Watlington	0.3	0.6	0.5	0.0	1.5	0.2	0.5	0.5	0.0	1.3	30	66	58	5	160
West-End & Fraser Park	0.6	1.3	1.1	0.1	3.1	0.5	1.1	0.9	0.1	2.6	64	141	113	11	329
Total (kg)	8	19	15	1	44	7	16	13	1	37	881	2064	1576	151	4672

Weekdays Suburb	NO _x					SO _x					Benzene				
	6am- 10am	10am- 4pm	4pm- 10pm	10pm- 6am	NO _x (kg)	6am- 10am	10am- 4pm	4pm- 10pm	10pm- 6am	SO _x (kg)	6am- 10am	10am- 4pm	4pm- 10pm	10pm- 6am	Benzene (kg)
Gleniti/Glenwood	8.1	18.0	14.7	1.3	42.1	1.1	2.4	2.0	0.2	5.7	0.6	1.4	1.2	0.1	3.3
Highfield	10.3	24.7	19.2	1.8	56.1	1.4	3.3	2.6	0.2	7.6	0.8	2.0	1.5	0.1	4.4
Kensington & Redruth	6.8	16.9	14.1	1.2	39.0	0.9	2.3	1.9	0.2	5.3	0.5	1.3	1.1	0.1	3.1
Maori Hill/Waimataitai	26.0	61.6	44.7	4.4	136.6	3.5	8.4	6.1	0.6	18.5	2.0	4.8	3.5	0.3	10.6
Marchwiell	10.6	20.9	18.1	1.5	51.1	1.4	2.8	2.5	0.2	6.9	0.8	1.7	1.4	0.1	4.1
Parkside	10.1	24.9	18.8	1.8	55.6	1.4	3.4	2.6	0.2	7.5	0.8	2.0	1.5	0.1	4.4
Seaview	25.3	62.7	43.9	4.6	136.5	3.4	8.5	6.0	0.6	18.5	2.0	5.0	3.5	0.4	10.8
Watlington	3.8	8.2	7.2	0.6	19.7	0.5	1.1	1.0	0.1	2.7	0.3	0.6	0.6	0.0	1.6
West-End & Fraser Park	7.9	17.4	14.0	1.3	40.6	1.1	2.4	1.9	0.2	5.5	0.6	1.4	1.1	0.1	3.2
Total (kg)	109	255	195	19	577	15	35	26	3	78	9	20	15	1	45

Table 4.21 Weekend day vehicle emissions by suburb by time of day

Weekend day Suburb	PM ₁₀					PM _{2.5}					CO				
	6am-10am	10am-4pm	4pm-10pm	10pm-6am	PM ₁₀ (kg)	6am-10am	10am-4pm	4pm-10pm	10pm-6am	PM _{2.5} (kg)	6am-10am	10am-4pm	4pm-10pm	10pm-6am	CO (kg)
Gleniti/Glenwood	0.2	1.1	0.6	0.1	2.1	0.2	0.9	0.5	0.1	1.8	24.4	116	67.7	11.7	220.0
Highfield	0.3	1.5	0.9	0.2	2.9	0.3	1.3	0.7	0.1	2.4	33.6	160	93.2	16.1	302.8
Kensington & Redruth	0.2	1.0	0.6	0.1	2.0	0.2	0.9	0.5	0.1	1.7	22.9	109	63.6	10.9	206.6
Maori Hill/Waimataitai	0.8	3.8	2.2	0.4	7.1	0.7	3.2	1.8	0.3	6.0	83.1	405	233.7	38.8	760.6
Marchwiell	0.3	1.3	0.7	0.1	2.4	0.2	1.1	0.6	0.1	2.0	28.3	135	78.8	13.5	256.1
Parkside	0.3	1.5	0.9	0.1	2.9	0.3	1.3	0.7	0.1	2.4	33.4	161	93.5	15.8	304.2
Seaview	0.8	3.8	2.2	0.4	7.3	0.7	3.2	1.9	0.3	6.2	85.4	406	237.1	41.0	770.0
Watlington	0.1	0.5	0.3	0.1	0.9	0.1	0.4	0.2	0.0	0.8	11.1	53	30.8	5.3	100.0
West-End & Fraser Park	0.2	1.1	0.6	0.1	2.0	0.2	0.9	0.5	0.1	1.7	23.9	113	66.0	11.7	214.3
Total (kg)	3	16	9	2	30	3	13	8	1	25	346	1659	964	165	3135

Weekend day Suburb	NO _x					SO _x					Benzene				
	6am-10am	10am-4pm	4pm-10pm	10pm-6am	NO _x (kg)	6am-10am	10am-4pm	4pm-10pm	10pm-6am	SO _x (kg)	6am-10am	10am-4pm	4pm-10pm	10pm-6am	Benzene (kg)
Gleniti/Glenwood	3.0	14.5	8.4	1.5	27.4	0.4	2.0	1.1	0.2	3.7	0.3	1.4	0.8	0.1	2.6
Highfield	4.2	19.9	11.6	2.0	37.7	0.6	2.7	1.6	0.3	5.1	0.4	1.9	1.1	0.2	3.6
Kensington & Redruth	2.9	13.6	7.9	1.4	25.8	0.4	1.8	1.1	0.2	3.5	0.3	1.3	0.8	0.1	2.5
Maori Hill/Waimataitai	10.2	48.9	28.4	4.8	92.3	1.4	6.7	3.9	0.7	12.6	1.0	4.7	2.7	0.5	8.8
Marchwiell	3.5	16.9	9.8	1.7	31.9	0.5	2.3	1.3	0.2	4.3	0.3	1.6	0.9	0.2	3.1
Parkside	4.2	20.0	11.6	2.0	37.8	0.6	2.7	1.6	0.3	5.1	0.4	1.9	1.1	0.2	3.6
Seaview	10.6	50.5	29.5	5.1	95.7	1.4	6.8	4.0	0.7	13.0	1.0	4.9	2.8	0.5	9.2
Watlington	1.4	6.6	3.8	0.7	12.5	0.2	0.9	0.5	0.1	1.7	0.1	0.6	0.4	0.1	1.2
West-End & Fraser Park	3.0	14.0	8.2	1.5	26.7	0.4	1.9	1.1	0.2	3.6	0.3	1.4	0.8	0.1	2.6
Total (kg)	43	205	119	21	388	6	28	16	3	53	4	20	11	2	37

4.2.2.3 Backcasting vehicle emissions

No data existed for the 1996 vehicle fleet profile and VKT data were not available for weekends in 2001, therefore backcasting could only take place for weekdays in 2001. It involved the calculation of contaminant emissions using the 2001 single vehicle rate emission factors from the NZTER database and applying the same suburban/central urban proportions, (90% and 10% respectively) and cold start driving (30% of total) as was used in the 2005 inventory, to the original Gabites Porter 2001 VKT estimates.

Table 4.22 Change in emissions 2001 – 2005 by vehicle fuel type

Weekdays Fuel	2001	2005	Change %	2001	2005	Change %	2001	2005	Change %
	PM ₁₀ (kg)	PM ₁₀ (kg)		PM _{2.5} (kg)	PM _{2.5} (kg)		CO (kg)	CO (kg)	
Diesel	43.7	36.9	-15.6%	39.3	33.1	-15.7%	140.5	131.1	-6.7%
Petrol	9.1	7.1	-21.5%	5.2	4.1	-21.5%	6149.2	4540.4	-26.2%
LPG	0.0	0.0	NS	0.0	0.0	NS	2.0	0.7	NS
CNG	0.0	0.0	NS	0.0	0.0	NS	0.1	0.1	NS
Total (kg)	52.8	44.1	-16.5%	44.5	37.2	-16.3%	6289.7	4671.5	-14.6%

Weekdays Fuel	2001	2005	Change %	2001	2005	Change %	2001	2005	Change %
	NO _x (kg)	NO _x (kg)		SO _x (kg)	SO _x (kg)		B'zene (kg)	B'zene (kg)	
Diesel	313.0	316.8	1.2%	NA	NA	NA	0.5	0.4	NS
Petrol	341.1	260.1	-23.7%	NA	NA	NA	58.2	45.0	-22.7%
LPG	1.3	0.4	-72.1%	NA	NA	NA	0.0	0.0	NS
CNG	0.3	0.0	NS	NA	NA	NA	0.0	0.0	0.0%
Total (kg)	654.1	577.3	-11.7%	79.0	78.3	-0.9%	58.7	45.5	-5.5%

Vehicle emissions in all sectors were reduced with the single exception of NO_x emissions from diesel vehicles (up by 1.2%). This was related to an increase in diesel powered vehicle numbers of 35%. The reduction in remaining contaminant emissions is likely to be the result of improved engine technology with an updated fleet, rather than the small decrease in VKT.

Table 4.23 Change in emissions by suburb 2001 - 2005

Weekdays Suburb	2001	2005	Change %	2001	2005	Change %	2001	2005	Change %
	PM ₁₀ (kg)	PM ₁₀ (kg)		PM _{2.5} (kg)	PM _{2.5} (kg)		CO (kg)	CO (kg)	
Gleniti/Glenwood	3.9	3.2	-17.4%	3.3	2.7	-17.2%	459	339	-26.1%
Highfield	7.0	4.3	-39.0%	5.9	3.6	-38.9%	830	452	-45.5%
Kensington & Redruth	2.8	3.0	6.9%	2.3	2.5	7.1%	329	314	-4.5%
Maori Hill/Waimataitai	11.7	10.4	-10.6%	9.8	8.8	-10.4%	1416	1117	-21.1%
Marchwiell	5.8	3.9	-32.7%	4.9	3.3	-32.6%	691	412	-40.4%
Parkside	5.5	4.2	-22.7%	4.6	3.6	-22.5%	649	448	-30.9%
Seaview	10.6	10.4	-2.0%	9.0	8.8	-1.7%	1259	1102	-12.4%
Watlington	1.7	1.5	-12.1%	1.4	1.3	-11.9%	202	159	-21.5%
West-End & Fraser Park	3.8	3.1	-19.3%	3.2	2.6	-19.1%	454	327	-27.9%
Total (kg)	53	44	-17%	45	37	-16%	6290	4672	-26%

Table 4.23 continued

Weekdays Suburb	2001	2005	Change %	2001	2005	Change %	2001	2005	Change %
	NO _x (kg)	NO _x (kg)		SO _x (kg)	SO _x (kg)		B'zene (kg)	B'zene (kg)	
Gleniti/Glenwood	48.3	42.2	-12.6%	5.8	5.7	-1.8%	4.3	3.3	-23.3%
Highfield	87.2	56.3	-35.5%	10.5	7.6	-27.5%	7.8	4.4	-43.4%
Kensington & Redruth	34.6	39.1	13.0%	4.2	5.3	27.0%	3.1	3.1	-0.9%
Maori Hill/Waimataitai	142.7	135.1	-5.3%	17.4	18.5	6.1%	12.7	10.6	-16.9%
Marchwiell	71.7	51.3	-28.4%	8.7	6.9	-20.0%	6.4	4.1	-37.1%
Parkside	68.3	55.8	-18.3%	8.2	7.5	-8.2%	6.1	4.4	-28.4%
Seaview	132.1	136.9	3.6%	15.9	18.5	16.5%	11.9	10.8	-9.1%
Watlington	21.3	19.8	-7.0%	2.6	2.7	4.5%	1.9	1.6	-18.4%
West-End & Fraser Park	47.8	40.8	-14.6%	5.7	5.5	-4.1%	4.3	3.2	-25.1%
Total (kg)	654	577	-12%	79	78	-0.9%	59	45	-23%

4.2.3 Emissions from Industry and Commerce

4.2.3.1 2005 Emissions (Timaru excluding Washdyke)

In 2005 industrial and commercial activity was the greatest source of SO_x emissions (73% on weekdays, 61% on weekend days) in Timaru (excluding Washdyke). This sector also emitted 5% of PM₁₀ emissions, 3% of PM_{2.5}, 14% of NO_x and less than 1% of CO and benzene. On weekend days the percentages are reduced (see tables 3.1 to 3.18 for individual contaminants). Tables 3.37 and 3.38 present emission of contaminants by suburb and time period.

4.2.3.2 Contaminant emissions by commercial and industrial source type, 2005

It is clear from Table 4.24 that the burning of coal in boilers is the single largest emitter of all contaminants quantified.

Table 4.24 Contaminant emissions by commercial and business source (Timaru excluding Washdyke)

Timaru (exc. Washdyke) Weekdays	PM ₁₀ (kg)	PM _{2.5} (kg)	CO (kg)	NO _x (kg)	SO _x (kg)	Benzene (kg)
Coal fired boilers	51.2	35.4	75.1	77.6	327.2	0.012
Diesel fired boilers	0.1	0.1	0.5	2.1	0.9	0
Diesel generators	1.5	0.0	7.7	32.2	0.5	0.007
Light fuel oil burners	0	0	0	0	0	0
LPG boilers/heaters	0.0	0.0	0.1	0.5	0.0	0
Waste oil burners/heaters	0.5	0.0	0.0	0.2	2.3	0
Other combustion	0.0	0.0	0.0	0.0	0.0	0
Total combustion	53	36	83	113	331	0.019
Total processing	26.2	1.1	0	0	0	0
Total (kg)	80	37	83	113	331	0.019

Timaru (exc. Washdyke)	PM₁₀	PM_{2.5}	CO	NO_x	SO_x	Benzene
Weekend days	(kg)	(kg)	(kg)	(kg)	(kg)	(kg)
Coal fired boilers	21.5	16.1	26.5	32.2	160.0	0.006
Diesel fired boilers	0	0	0	0	0	0
Diesel generators	0	0	0	0	0	0
Light fuel oil burners	0	0	0	0	0	0
LPG boilers/heaters	0	0	0	0	0	0
Waste oil burners/heaters	0	0	0	0	0	0
Other combustion	0	0	0	0	0	0
Total combustion	21	16	27	33	160	0.006
Total processing	10.5	0	0	0	0	0
Total (kg)	32	16	27	33	160	0.006

Table 4.25 Weekday industrial and commercial emissions by time of day

Suburb Weekdays	PM ₁₀					PM _{2.5}				
	6am-10am	10am-4pm	4pm-10pm	10pm-6am	Total kg	6am-10am	10am-4pm	4pm-10pm	10pm-6am	Total kg
Gleniti/Glenwood	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Highfield	0.4	0.1	0.0	0.0	0.6	0.3	0.1	0.0	0.0	0.3
Kensington & Redruth	6.0	11.5	9.2	10.9	37.6	3.8	5.8	5.8	7.7	23.0
Maori Hill/Waimataitai	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Marchwiell	3.2	0.0	0.0	0.8	4.0	2.0	0.0	0.0	0.5	2.5
Parkside	2.0	0.3	0.3	0.8	3.4	1.1	0.2	0.2	0.5	2.0
Seaview	9.2	15.0	3.6	3.6	31.4	2.6	4.0	0.6	0.1	7.3
Watlington	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
West-End & Fraser Park	2.5	0.0	0.0	0.0	2.5	1.6	0.0	0.0	0.0	1.6
Total (kg)	23	27	13	16	80	11	10	7	9	37

Suburb Weekdays	CO					NO _x				
	6am-10am	10am-4pm	4pm-10pm	10pm-6am	Total kg	6am-10am	10am-4pm	4pm-10pm	10pm-6am	Total kg
Gleniti/Glenwood	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.1	0.1	0.3
Highfield	0.8	0.3	0.0	0.0	1.0	0.6	0.2	0.0	0.0	0.9
Kensington & Redruth	9.0	11.6	11.6	15.4	47.6	14.1	12.4	12.4	16.5	55.4
Maori Hill/Waimataitai	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Marchwiell	5.7	0.0	0.0	1.4	7.2	5.2	0.0	0.0	1.2	6.4
Parkside	3.8	0.6	0.6	1.4	6.4	5.7	0.8	0.5	1.2	8.2
Seaview	7.1	8.3	1.1	0.3	16.7	18.8	16.8	1.3	0.6	37.5
Watlington	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
West-End & Fraser Park	4.5	0.0	0.0	0.0	4.5	3.9	0.0	0.0	0.0	3.9
Total (kg)	31	21	13	19	83	48	30	14	20	113

Suburb Weekdays	SO _x					Benzene				
	6am-10am	10am-4pm	4pm-10pm	10pm-6am	Total kg	6am-10am	10am-4pm	4pm-10pm	10pm-6am	Total kg
Gleniti/Glenwood	0.0	0.0	0.0	0.0	0.0	0.0000	0.0000	0.0000	0.0000	0.0000
Highfield	2.1	0.7	0.0	0.0	2.8	0.0001	0.0000	0.0000	0.0000	0.0001
Kensington & Redruth	36.5	55.2	54.2	72.0	217.9	0.0025	0.0020	0.0020	0.0026	0.0091
Maori Hill/Waimataitai	0.0	0.0	0.0	0.0	0.0	0.0000	0.0000	0.0000	0.0000	0.0000
Marchwiell	16.1	0.0	0.0	4.0	20.1	0.0007	0.0000	0.0000	0.0002	0.0008
Parkside	9.1	2.0	1.5	4.0	16.6	0.0010	0.0001	0.0001	0.0002	0.0013
Seaview	21.9	32.5	5.8	0.6	60.8	0.0037	0.0033	0.0002	0.0000	0.0072
Watlington	0.0	0.0	0.0	0.0	0.0	0.0000	0.0000	0.0000	0.0000	0.0000
West-End & Fraser Park	12.7	0.0	0.0	0.0	12.7	0.0005	0.0000	0.0000	0.0000	0.0005
Total (kg)	98	90	62	81	331	0.0085	0.0054	0.0022	0.0030	0.0191

Table 4.26 Weekend day industrial and commercial emissions by time of day

Suburb Weekend day	PM ₁₀					PM _{2.5}				
	6am- 10am	10am- 4pm	4pm- 10pm	10pm- 6am	Total kg	6am- 10am	10am- 4pm	4pm- 10pm	10pm- 6am	Total kg
Gleniti/Glenwood	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Highfield	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Kensington & Redruth	3.4	5.1	5.1	6.8	20.3	2.6	3.8	3.8	5.1	15.4
Maori Hill/Waimataitai	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Marchwiell	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Parkside	0.2	0.3	0.3	0.4	1.2	0.1	0.2	0.2	0.2	0.7
Seaview	1.8	2.6	2.6	3.5	10.5	0.0	0.0	0.0	0.0	0.0
Watlington	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
West-End & Fraser Park	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total (kg)	5	8	8	11	32	3	4	4	5	16

Suburb Weekend day	CO					NO _x				
	6am- 10am	10am- 4pm	4pm- 10pm	10pm- 6am	Total kg	6am- 10am	10am- 4pm	4pm- 10pm	10pm- 6am	Total kg
Gleniti/Glenwood	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.1	0.1	0.3
Highfield	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Kensington & Redruth	4.1	6.1	6.1	8.1	24.3	5.1	7.6	7.6	10.1	30.4
Maori Hill/Waimataitai	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Marchwiell	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Parkside	0.4	0.5	0.5	0.7	2.2	0.3	0.5	0.5	0.6	1.9
Seaview	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Watlington	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
West-End & Fraser Park	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total (kg)	4	7	7	9	27	5	8	8	11	33

Suburb Weekend day	SO _x					Benzene				
	6am- 10am	10am- 4pm	4pm- 10pm	10pm- 6am	Total kg	6am- 10am	10am- 4pm	4pm- 10pm	10pm- 6am	Total kg
Gleniti/Glenwood	0.0	0.0	0.0	0.0	0.0	0.0000	0.0000	0.0000	0.0000	0.0000
Highfield	0.0	0.0	0.0	0.0	0.0	0.0000	0.0000	0.0000	0.0000	0.0000
Kensington & Redruth	25.7	38.5	38.5	51.3	154.0	0.0021	0.0013	0.0013	0.0018	0.0065
Maori Hill/Waimataitai	0.0	0.0	0.0	0.0	0.0	0.0000	0.0000	0.0000	0.0000	0.0000
Marchwiell	0.0	0.0	0.0	0.0	0.0	0.0000	0.0000	0.0000	0.0000	0.0000
Parkside	1.0	1.5	1.5	2.0	6.1	0.0000	0.0001	0.0001	0.0001	0.0003
Seaview	0.0	0.0	0.0	0.0	0.0	0.0000	0.0000	0.0000	0.0000	0.0000
Watlington	0.0	0.0	0.0	0.0	0.0	0.0000	0.0000	0.0000	0.0000	0.0000
West-End & Fraser Park	0.0	0.0	0.0	0.0	0.0	0.0000	0.0000	0.0000	0.0000	0.0000
Total (kg)	27	40	40	53	160	0.0021	0.0014	0.0014	0.0018	0.0067

Table 4.27 Change in industrial and commercial emissions 2001 - 2005

Weekdays Suburb	2001	2005	Change %	2001	2005	Change %	2001	2005	Change %
	PM ₁₀ (kg)	PM ₁₀ (kg)		PM _{2.5} (kg)	PM _{2.5} (kg)		CO (kg)	CO (kg)	
Gleniti/Glenwood	0.0	0.0	0.0%	0.0	0.0	0.0%	0.1	0.1	0.0%
Highfield	0.6	0.6	0.0%	0.3	0.3	0.0%	1.0	1.0	0.0%
Kensington & Redruth	41.5	37.6	-9.5%	23.0	23.0	-0.2%	61.2	47.6	-22.2%
Maori Hill/Waimataitai	0.0	0.0	0.0%	0.0	0.0	0.0%	0.0	0.0	0.0%
Marchwiell	4.0	4.0	0.0%	2.5	2.5	0.0%	7.2	7.2	0.0%
Parkside	3.4	3.4	0.0%	2.0	2.0	0.0%	6.4	6.4	0.0%
Seaview	31.4	31.4	0.0%	7.3	7.3	0.0%	16.7	16.7	0.0%
Watlington	0.0	0.0	0.0%	0.0	0.0	0.0%	0.0	0.0	0.0%
West-End & Fraser Park	2.5	2.5	0.0%	1.6	1.6	0.0%	4.5	4.5	0.0%
Total (kg)	84	80	-4.7%	37	37	-0.1%	97	83	-14.0%

Weekdays Suburb	2001	2005	Change %	2001	2005	Change %	2001	2005	Change %
	NO _x (kg)	NO _x (kg)		SO _x (kg)	SO _x (kg)		Benzene (kg)	Benzene (kg)	
Gleniti/Glenwood	0.3	0.3	0.0%	0	0	0.0%	0.000	0.000	0.0%
Highfield	0.9	0.9	0.0%	3	3	0.0%	0.000	0.000	0.0%
Kensington & Redruth	55.6	55.4	-0.5%	218	218	0.0%	0.009	0.009	0.0%
Maori Hill/Waimataitai	0.0	0.0	0.0%	0	0	0.0%	0.000	0.000	0.0%
Marchwiell	6.4	6.4	0.0%	20	20	0.0%	0.001	0.001	0.0%
Parkside	8.2	8.2	0.0%	17	17	0.0%	0.001	0.001	0.0%
Seaview	37.5	37.5	0.0%	61	61	0.0%	0.007	0.007	0.0%
Watlington	0.0	0.0	0.0%	0	0	0.0%	0.000	0.000	0.0%
West-End & Fraser Park	3.9	3.9	0.0%	13	13	0.0%	0.001	0.001	0.0%
Total (kg)	113	113	-0.2%	331	331	0.0%	0.019	0.019	0.0%

4.2.4 Other Sources

While other sources are generally unlikely to contribute significant amounts to contaminant emissions a rudimentary assessment of rail and lawnmowers is included separately from that of the major sources and not included in the main analysis. Other sources, including rural fires, resuspended road dust, off-road motor vehicles, marine combustion sources, landfills, marine aerosol and agricultural tilling were not quantified.

Outdoor burning within the urban areas of Timaru is prohibited at all times of the year by Timaru District Council by-laws. However, rural vegetative waste (from orchards, market gardens, vineyards, arable crops, nurseries and life style blocks) is likely to be burnt during the cooler months of the year in the area outside the city boundary and this may impact upon the air quality in Timaru.

4.2.4.1 Rail

The 2001 Timaru inventory estimated rail emissions using the methodology outlined in MoT, (1999) and produced values of 1.6 kg PM, 6.3 kg CO, and 61 kg of NO_x. For the 2005 inventory, actual fuel use data for shunting, and typical power notch settings on the DFT and DX class locomotives for the main line operation were used.

Table 4.28 Rail emissions in Timaru (excluding Washdyke)

Timaru rail emissions (kg per day)			
PM ₁₀	CO	NO _x	SO ₂
4	15	157	2

Table 4.28 indicates that the rail sector generated 4 kg/day of PM₁₀, 15 kg/day of CO, 157 kg/day of NO_x, and 1.8 kg/day of SO₂. Benzene emission was not included in this assessment due to the lack of reliable emission factors. These results suggest that rail emissions are unlikely to be a significant source of emissions when considered independently of other sources.

4.2.4.2 Lawn mowing

Lawn mowers, leaf blowers and chainsaws are other sources of emissions that are sometimes included in emission inventories. The contribution from these sources is typically minor and in the case of Timaru unlikely to be significant given the existing contribution from solid fuel burning for domestic heating. PM₁₀ emissions from lawn mowing were estimated to be between 2 and 7 kg per day by Wilton (2001) and are likely to be much the same in 2005. Although the number of households has increased by 3.5% in the four years since the last inventory, the actual grassed area is likely to have decreased and therefore this figure is regarded as conservative. Table 4.29 presents lawn mowing emissions calculated from the number of households and emission factors sourced from Environment Australia (1999).

Table 4.29 Emissions from lawn mowing in Timaru (excluding Washdyke)

Contaminant	Emission (kg/day)
PM ₁₀	2
CO	283
NO _x	2
SO ₂	6

4.3 Emissions by contaminant (Washdyke)

Washdyke lies 5 km to the north of the main residential suburbs of Timaru. It is separated from the city by a ridge which tends to keep emissions from the two areas separate and it therefore acts as a different airshed.

Many of the comments made in the previous sections regarding methodology, accuracy of estimation etc. also apply to the Washdyke inventory and, in the case of residential home heating, particular note should be made of the small sample size of surveyed households and related sample error (see Table 2.1).

4.3.1 Particulate matter less than 10 microns (PM₁₀)

A total of 340 kg of PM₁₀ was discharged on a winter's weekday in Washdyke and 318 kg on a weekend day. The industrial and commercial sector generated the greatest quantity of PM₁₀, with a contribution of 273 kg (80% of total PM₁₀) on weekdays. Home heating contributed 57 kg (17%), followed by 10 kg (3%) from motor vehicles. The pattern was very similar on weekend days with industry contributing 254 kg or 80% of the total PM₁₀ emissions.

Table 4.30 Daily emissions of PM₁₀ (Washdyke)

Washdyke	Weekdays				
	6am-10am	10am-4pm	4pm-10pm	10pm-6am	Total (kg)
Domestic heating	6.0	10.5	24.8	15.8	57
Motor vehicles	2.0	4.3	3.4	0.3	10
Industry/commercial	48.2	74.2	67.2	83.2	273
Total (kg)	56	89	95	99	340
	Weekend days				
Domestic heating	6.4	13.5	26.0	11.1	57
Motor vehicles	0.7	3.4	2.0	0.3	6
Industry/commercial	44.2	66.5	62.0	81.5	254
Total (kg)	51	83	90	93	318

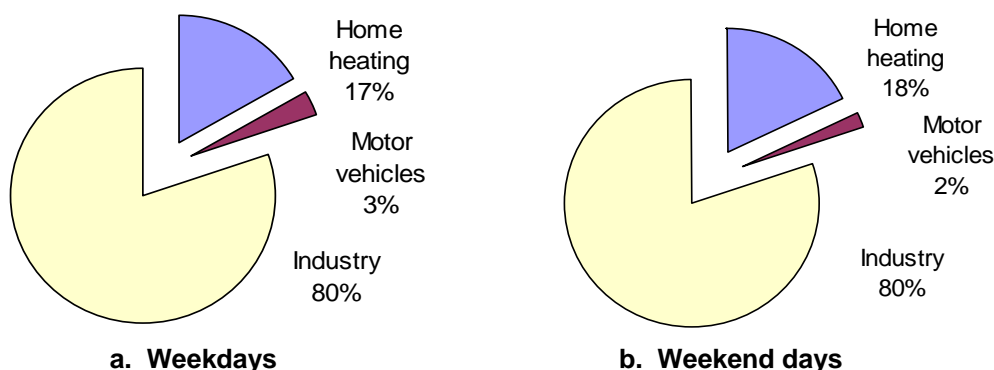


Figure 4.11 PM₁₀ emissions by source (Washdyke)

4.3.1.1 PM₁₀ emission by time of day

On weekdays, seventy percent of average hourly emissions at that time came from industrial sources, with home heating and motor vehicles contributing 26% and 4% respectively. On weekend days the highest average hourly rate of emission occurred during the 4pm to 10pm time period with 69% coming from industrial sources.

The data were further analysed to allow hour by hour emissions to be calculated. The process is explained, and results presented, in Appendix A.

4.3.1.2 PM₁₀ emission trends

Total PM₁₀ emissions increased by 6% in Washdyke since 2001 caused by an increase in emissions from home heating. This was probably related to the increase in the number of households in Washdyke from 324 to 387 (+19%)

Table 4.31 Change in PM₁₀ emissions (Washdyke)

Washdyke	Particulate matter less than 10 microns (kg)			Change %
	Inventory year			
	1996	2001	2005	
Domestic heating	10.4	36.2	57.1	58%
Motor vehicles	NA	14.3	10.0	-30%
Industry	NA	271.5	272.9	1%
Total (kg)		322	340	6%

Weekend use cannot be compared between years as data were not collected for such a comparison in 1996 and 2001.

4.3.2 Particulate matter less than 2.5 microns (PM_{2.5})

A total of 242 kg of PM_{2.5} was discharged on a winter's weekday in Washdyke and 228 kg on a weekend day. The industrial and commercial sector generated the greatest quantity of PM_{2.5}, with a contribution of 179 kg (74% of total PM_{2.5}). Home heating contributed 55 kg (23%), followed by 8.5 kg (3%) from motor vehicles. The pattern was very similar on weekend days, with industry contributing 167 kg or 73% of the total PM_{2.5} emissions.

Table 4.32 Daily emissions of PM_{2.5} (Washdyke)

Washdyke	Weekdays				Total (kg)
	6am-10am	10am-4pm	4pm-10pm	10pm-6am	
Domestic heating	5.8	10.2	24.0	15.3	55
Motor vehicles	1.7	3.6	2.9	0.3	8
Industry/commercial	31.1	47.8	44.8	55.0	179
Total (kg)	39	62	72	71	242
Weekend days					
Domestic heating	6.2	13.1	25.1	10.8	55
Motor vehicles	0.6	2.9	1.7	0.3	5
Industry/commercial	29.0	43.7	40.8	53.7	167
Total (kg)	36	60	68	65	228

4.3.2.1 PM_{2.5} emission by time of day

On weekdays the highest average hourly emission in Washdyke occurred during the 4pm to 10pm time period. Sixty three percent of average hourly emissions at that time came from industrial sources, with home heating and motor vehicles contributing 33% and 4% respectively. Very similar trends occurred on weekend days with 60% coming from industrial sources.

4.3.2.2 PM_{2.5} emission trends

PM_{2.5} emissions increased by 11% since 2001 due to a 60% increase in emissions from domestic home heating. Again it is likely that the increase in the number of households in Washdyke was the main reason for this increase.

Table 4.33 Change in PM_{2.5} emissions

Washdyke	Particulate matter less than 2.5 microns (kg)			
	Inventory year			Change %
	1996	2001	2005	
Domestic heating	9.9	35	55	59.8%
Motor vehicles	NA	12	8	-29.8%
Industry	NA	171	179	4.6%
Total (kg)		218	242	11.4%

4.3.3 Carbon monoxide (CO)

A total of 2067 kg of CO was discharged on a winter's weekday in Washdyke and 1659 kg on a weekend day. Motor vehicles generated the greatest quantity with a contribution of 1072 kg (52% of the total) on weekdays and 689 kg (42%) on weekend days. Home heating contributed 564 kg and 562 kg (weekday/weekend day), and industry emitted 431 kg and 408 kg on weekdays and weekend days respectively.

Table 4.34 Daily emission of CO (Washdyke)

Washdyke	Weekdays				
	6am-10am	10am-4pm	4pm-10pm	10pm-6am	Total (kg)
Domestic heating	59.5	105.2	244.1	154.9	564
Motor vehicles	218.4	456.2	365.1	32.4	1072
Industry/commercial	76.9	116.2	105.7	132.1	431
Total (kg)	355	678	715	319	2067
	Weekend days				
Domestic heating	63.1	134.9	254.7	109.3	562
Motor vehicles	75.3	367.0	211.7	35.2	689
Industry/commercial	71.2	107.0	99.1	130.2	408
Total (kg)	210	609	566	275	1659

4.3.3.1 CO emission by time of day

On weekdays, the highest CO emission occurred during the 4pm to 10pm time period. Fifty-one percent of the average hourly emissions at that time came from motor vehicles, 34% from domestic home heating, and 15% from industry. On weekend days, the highest rate of CO emissions was between 10am and 4pm. This was associated with a reduction in the use of motor vehicles in the 4pm to 10pm time period rather than an increase in any sector.

4.3.3.2 CO emission trends

The reduction in CO emissions is probably due to the reduced number of VKT (-17%) by vehicles powered by petrol engines.

Table 4.35 Change in CO emissions (Washdyke)

Washdyke	CO emission weekdays (kg)			
	Inventory year			Change %
	1996	2001	2005	
Domestic heating	96	342	564	65%
Motor vehicles	NA	1720	1072	-38%
Industry	NA	456	431	-5%
Total (kg)		2518	2067	-18%

4.3.4 Oxides of nitrogen (NO_x)

A total of 562 kg of NO_x was discharged on a winter's weekday in Washdyke and 477 kg on a weekend day. Industrial sources generated the greatest quantity with a contribution of 427 kg (76% of the total) on weekdays and 388 kg (81%) on weekend days. Motor vehicles contributed 130 kg and 84 kg (weekday/weekend day), and domestic home heating emitted 5 kg on all days.

Table 4.36 Daily emission of NO_x (Washdyke)

Washdyke	Weekdays				
	6am-10am	10am-4pm	4pm-10pm	10pm-6am	Total (kg)
Domestic heating	0.5	0.9	2.1	1.3	5
Motor vehicles	26.5	55.4	44.3	3.9	130
Industry/commercial	77.1	117.8	105.0	126.7	427
Total (kg)	104	174	151	132	562
Weekend days					
Domestic heating	0.6	1.1	2.2	0.9	5
Motor vehicles	9.2	44.5	25.8	4.4	84
Industry/commercial	67.7	102.2	94.4	124.1	388
Total (kg)	77	148	122	129	477

4.3.4.1 NO_x emission by time of day

The peak rate of emission takes place in the middle of the day when both motor vehicle and industrial activity is at its greatest. In the 10am to 4pm weekday time period industrial and commercial sources contribute 118 kg of the total emission of 174 kg or 68%. In the same time period motor vehicles contribute 32% and home heating less than 1%. Emissions of NO_x on weekend days were much lower between 6am and 10am due to lower vehicle and industrial activity in that time period.

4.3.4.2 NO_x emission trends

The reduction of 7% in NO_x emissions may be due a reduction in the number of VKT and improvements in engine technology.

Table 4.37 Change in NO_x emissions (Washdyke)

NO _x emissions (weekdays)				
Washdyke	Inventory year			Change %
	1996	2001	2005	
Domestic heating	1.1	3.5	4.8	36%
Motor vehicles	NA	177	130.1	-26%
Industry	NA	426	426.6	0%
Total (kg)		606	561	-7%

4.3.5 Oxides of sulphur (SO_x)

A total of 1640 kg of SO_x was discharged on a winter's weekday in Washdyke and 1492 kg on a weekend day. Industrial sources generated almost all of the SO_x with 99% of emissions being generated by this source.

Table 4.38 Daily emission of SO_x (Washdyke)

Washdyke	Weekdays				Total (kg)
	6am-10am	10am-4pm	4pm-10pm	10pm-6am	
Domestic heating	0.1	0.2	0.6	0.4	1
Motor vehicles	3.6	7.6	6.1	0.5	18
Industry/commercial	284.2	440.6	408.7	487.5	1621
Total (kg)	288	448	415	488	1640
	Weekend days				
Domestic heating	0.2	0.3	0.6	0.2	1
Motor vehicles	1.3	6.1	3.5	0.6	11
Industry/commercial	257.0	390.4	359.1	473.2	1480
Total (kg)	258	397	363	474	1492

4.3.5.1 SO_x emissions by time of day

On weekdays the peak rate of emission was in the 10am to 4pm time period with 98% of emissions during this time coming from industry. Weekend day emissions were only slightly lower as many of the large emitters were 24-hour, 7 day a week operations.

4.3.5.2 SO_x emission trends

Total SO_x emissions have increased by 8.5% since the last inventory due to a slight increase in economic activity. Domestic home heating emissions of this contaminant have increased considerably in percentage terms but the mass emission is still very low.

Table 4.39 Change in SO_x emissions (Washdyke)

Washdyke	SO _x emissions (weekdays)			Change %
	Inventory year			
	1998	2001	2005	
Domestic heating	0.3	0.8	1.3	63.5%
Motor vehicles	NA	21	18	-17.0%
Industry	NA	1491	1621	8.7%
Total (kg)		1513	1640	8.5%

4.3.6 Benzene

Benzene emissions are dominated by the vehicle and home heating sectors. On weekdays, vehicles emit 10.2 kg (63%) and domestic home heating 6.0 kg (37%), with industry contributing less than 1% of benzene emissions. On weekend days, vehicles emit 8.0 kg (57%), home heating 43% and industry again less than 1%.

Table 4.40 Daily emissions of benzene, 2005 Washdyke

Washdyke	Weekdays				Total (kg)
	6am-10am	10am-4pm	4pm-10pm	10pm-6am	
Domestic heating	0.6	1.2	2.6	1.5	6
Motor vehicles	2.1	4.3	3.5	0.3	10
Industry/commercial	0.0	0.0	0.0	0.0	0
Total (kg)	3	6	6	2	16
	Weekend days				
Domestic heating	0.7	1.5	2.7	1.0	6
Motor vehicles	0.9	4.3	2.5	0.4	8
Industry/commercial	0.0	0.0	0.0	0.0	0
Total (kg)	2	6	5	1	14

4.3.6.1 Benzene emission by time of day, 2005 Washdyke

On weekdays, the highest average hourly emission in Washdyke occurred during the 4pm to 10pm time period. Fifty-seven percent of average hourly emissions at that time came from motor vehicles with home heating and industrial sources contributing 43% and 0.2% respectively. On weekend days, the highest average hourly rate of emission occurred during the 10am to 4pm time period with 75% coming from motor vehicles.

4.3.6.2 Benzene emission trends

Since 2001, a 16% reduction in total benzene emissions has occurred in Washdyke. This is due to a reduced number of VKT and a probable improvement in engine technology. The increase in home heating emissions is explained earlier.

Table 4.41 Change in benzene emissions

Benzene emissions (weekdays)				
Washdyke	Inventory year			Change %
	1998	2001	2005	
Domestic heating	0.9	3.4	6.0	75%
Motor vehicles	NA	15.8	10.2	-35%
Industry	NA	0.07	0.07	4%
Total (kg)	0.9	19.3	16.3	-16%

4.4 Washdyke emissions by source

This section describes each source in detail and discusses how emissions from the various sectors have changed in recent years.

4.4.1 Washdyke domestic home heating

4.4.1.1 2005 Emissions

Domestic home heating was the source of 17% of PM₁₀ emissions on weekdays in 2005 and 23 % of PM_{2.5}. It also contributed 27% of CO emissions, 37% of benzene and less than 1% of NO_x and SO_x.

Table 4.42 provides details of 2005 emissions from home heating for Washdyke by appliance type and contaminant. In Washdyke, woodburners were the major source of emissions of PM₁₀ from this sector, with a contribution of 93% on both weekdays and weekends. Woodburners also contributed approximately 93% of PM_{2.5}, and 94% of the CO.

Table 4.42 Daily emission of contaminants from home heating in Washdyke 2005

Washdyke Weekdays	Hours used	Mass of fuel (kg)	PM ₁₀ (kg)	PM _{2.5} (kg)	CO (kg)	NO _x (kg)	SO ₂ (kg)	Benzene (kg)
Open fire								
Open fire (wood)	24	54	0.5	0.4	3.7	0.1	0.0	0.1
Open fire (coal)	0	0	0.0	0.0	0.0	0.0	0.0	0.0
Woodburners								
Pre-1994 woodburners	976	2343	25.8	25.0	257.8	2.3	0.5	2.3
1994-2000 woodburners	833	1999	18.0	17.5	180.0	1.0	0.4	1.9
2001+ woodburners	635	1524	9.1	8.9	91.4	0.8	0.3	1.5
Pellet burners	51	63	0.1	0.1	0.9	0.1	0.0	0.1
Multifuel burners (inc. potbellies and coal ranges)								
Multifuel burner (wood)	78	195	2.1	2.1	21.5	0.2	0.0	0.2
Multifuel burner (coal)	78	77	1.5	1.3	8.5	0.1	0.1	0.0
Gas burner	287	149	0.0	0.0	0.0	0.2	0.0	0.0
Oil burner	0	0	0.0	0.0	0.0	0.0	0.0	0.0
Total			57	55	564	5	1	6

Washdyke Weekend days	Hours used	Mass of fuel (kg)	PM ₁₀ (kg)	PM _{2.5} (kg)	CO (kg)	NO _x (kg)	SO ₂ (kg)	Benzene (kg)
Open fire								
Open fire (wood)	24	54	0.5	0.4	3.7	0.1	0.0	0.1
Open fire (coal)	0	0	0.0	0.0	0.0	0.0	0.0	0.0
Woodburners								
Pre-1994 woodburners	972	2333	25.7	24.9	256.6	2.3	0.5	2.3
1994-2000 woodburners	843	2022	18.2	17.7	182.0	1.0	0.4	2.0
2001+ woodburners	617	1481	8.9	8.6	88.9	0.7	0.3	1.4
Pellet burners	50	63	0.1	0.1	0.9	0.1	0.0	0.1
Multifuel burners (inc. potbellies and coal ranges)								
Multifuel burner (wood)	57	195	2.1	2.1	21.5	0.2	0.0	0.2
Multifuel burner (coal)	57	77	1.5	1.3	8.5	0.1	0.1	0.0
Gas burner	352	183	0.0	0.0	0.0	0.3	0.0	0.0
Oil burner	0	0	0.0	0.0	0.0	0.0	0.0	0.0
Total			57	55	562	5	1	6

Table 4.43 Washdyke weekday emissions from home heating appliances by time period

Washdyke Weekdays	PM ₁₀					PM _{2.5}				
	6am-10am	10am-4pm	4pm-10pm	10pm-6am	Total kg	6am-10am	10am-4pm	4pm-10pm	10pm-6am	Total kg
Open fire (wood)	0	0	0	0	0	0	0	0	0	0
Open fire (coal)	0	0	0	0	0	0	0	0	0	0
Pre-1994 woodburners	3	5	9	8	26	3	5	9	8	25
1994-2000 woodburners	1	3	9	4	18	1	3	9	4	17
2001+ woodburners	1	2	4	2	9	1	2	4	2	9
Pellet burners	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.1
Multifuel burner (wood)	0	0	1	1	2	0	0	1	1	2
Multifuel burner (coal)	0	0	1	1	1	0	0	1	1	1
Gas burner	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Oil burner	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total (kg)	6	11	25	16	57	6	10	24	15	55

Washdyke Weekdays	CO					NO _x				
	6am-10am	10am-4pm	4pm-10pm	10pm-6am	Total kg	6am-10am	10am-4pm	4pm-10pm	10pm-6am	Total kg
Open fire (wood)	0	0	4	0	4	0	0	0	0	0
Open fire (coal)	0	0	0	0	0	0	0	0	0	0
Pre-1994 woodburners	32	49	94	83	258	0	0	1	1	2
1994-2000 woodburners	15	32	93	40	180	0	0	1	0	1
2001+ woodburners	12	24	40	16	91	0	0	0	0	1
Pellet burners	0.1	0.2	0.4	0.2	0.9	0.0	0.0	0.0	0.0	0.1
Multifuel burner (wood)	1	0	9	12	21	0	0	0	0	0
Multifuel burner (coal)	0	0	4	5	8	0	0	0	0	0
Gas burner	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.1	0.0	0.2
Oil burner	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0
Total (kg)	59	105	244	155	564	1	1	2	1	5

Washdyke Weekdays	SO _x					Benzene				
	6am-10am	10am-4pm	4pm-10pm	10pm-6am	Total kg	6am-10am	10am-4pm	4pm-10pm	10pm-6am	Total kg
Open fire (wood)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0
Open fire (coal)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
Pre-1994 woodburners	0.1	0.1	0.2	0.2	0.5	0.3	0.4	0.8	0.7	2
1994-2000 woodburners	0.0	0.1	0.2	0.1	0.4	0.2	0.3	1.0	0.4	2
2001+ woodburners	0.0	0.1	0.1	0.1	0.3	0.2	0.4	0.6	0.3	1
Pellet burners	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Multifuel burner (wood)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0
Multifuel burner (coal)	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0
Gas burner	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Oil burner	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total (kg)	0	0	1	0	1	1	1	3	2	6

Table 4.44 Washdyke weekend day emissions from home heating appliances by time period

Washdyke Weekend days	PM ₁₀					PM _{2.5}				
	6am-10am	10am-4pm	4pm-10pm	10pm-6am	Total kg	6am-10am	10am-4pm	4pm-10pm	10pm-6am	Total kg
Open fire (wood)	0	0	0	0	0	0	0	0	0	0
Open fire (coal)	0	0	0	0	0	0	0	0	0	0
Pre-1994 woodburners	3	5	10	7	26	3	5	10	7	25
1994-2000 woodburners	1	5	9	2	18	1	5	9	2	18
2001+ woodburners	1	2	4	1	9	1	2	4	1	9
Pellet burners	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.1
Multifuel burner (wood)	0	0	1	1	2	0	0	1	1	2
Multifuel burner (coal)	0	0	1	0	1	0	0	1	0	1
Gas burner	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.01
Oil burner	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total (kg)	6	13	26	11	57	6	13	25	11	55

Washdyke Weekend days	CO					NO _x				
	6am-10am	10am-4pm	4pm-10pm	10pm-6am	Total kg	6am-10am	10am-4pm	4pm-10pm	10pm-6am	Total kg
Open fire (wood)	0	0	4	0	4	0	0	0	0	0
Open fire (coal)	0	0	0	0	0	0	0	0	0	0
Pre-1994 woodburners	31	55	99	71	257	0	0	1	1	2
1994-2000 woodburners	14	55	92	21	182	0	0	1	0	1
2001+ woodburners	14	25	42	8	89	0	0	0	0	1
Pellet burners	0.1	0.2	0.4	0.2	0.9	0.0	0.0	0.0	0.0	0.1
Multifuel burner (wood)	2	0	12	7	21	0	0	0	0	0
Multifuel burner (coal)	1	0	5	3	8	0	0	0	0	0
Gas burner	0.00	0.00	0.00	0.00	0.00	0.0	0.1	0.2	0.0	0.3
Oil burner	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0
Total (kg)	63	135	255	109	562	1	1	2	1	5

Washdyke Weekend days	SO _x					Benzene				
	6am-10am	10am-4pm	4pm-10pm	10pm-6am	Total kg	6am-10am	10am-4pm	4pm-10pm	10pm-6am	Total kg
Open fire (wood)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0
Open fire (coal)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
Pre-1994 woodburners	0.1	0.1	0.2	0.1	0.5	0.3	0.5	0.9	0.6	2
1994-2000 woodburners	0.0	0.1	0.2	0.0	0.4	0.2	0.6	1.0	0.2	2
2001+ woodburners	0.0	0.1	0.1	0.0	0.3	0.2	0.4	0.7	0.1	1
Pellet burners	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Multifuel burner (wood)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0
Multifuel burner (coal)	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0
Gas burner	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Oil burner	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total (kg)	0	0	1	0	1	1	1	3	1	6

4.4.2 Washdyke motor vehicle emissions

Motor vehicle emissions are dependent on vehicle numbers, age and type of vehicle, fuel type and consumption, road type and congestion conditions.

4.4.2.1 Vehicle emissions in Washdyke

Table 4.45 Weekday vehicle emissions in Washdyke

Washdyke		Weekdays							
Type	% of total	Contaminant emission (kg/day)							
		PM ₁₀		PM _{2.5}		CO		NO _x	
			%		%		%		%
Bus large CNG	0.00%	0.00	0.0%	0.00	0.0%	0.0	0.0%	0.0	0.0%
Bus large diesel	0.71%	0.63	6.3%	0.57	6.8%	1.6	0.1%	11.2	8.6%
Bus large LPG	0.00%	0.00	0.0%	0.00	0.0%	0.0	0.0%	0.0	0.0%
Bus medium CNG	0.00%	0.00	0.0%	0.00	0.0%	0.0	0.0%	0.0	0.0%
Bus medium diesel	0.24%	0.12	1.2%	0.11	1.3%	0.3	0.0%	1.8	1.4%
Bus medium LPG	0.00%	0.00	0.0%	0.00	0.0%	0.0	0.0%	0.0	0.0%
Car CNG	0.00%	0.00	0.0%	0.00	0.0%	0.0	0.0%	0.0	0.0%
Car diesel	9.00%	2.30	23.0%	2.05	24.2%	10.3	1.0%	4.5	3.4%
Car LPG	0.01%	0.00	0.0%	0.00	0.0%	0.1	0.0%	0.0	0.0%
Car petrol	68.19%	1.27	12.7%	0.74	8.7%	858.7	80.1%	53.4	41.1%
HCV large CNG	0.00%	0.00	0.0%	0.00	0.0%	0.0	0.0%	0.0	0.0%
HCV large diesel	1.99%	1.77	17.6%	1.61	19.0%	4.4	0.4%	31.3	24.1%
HCV large LPG	0.00%	0.00	0.0%	0.00	0.0%	0.0	0.0%	0.0	0.0%
HCV medium CNG	0.00%	0.00	0.0%	0.00	0.0%	0.0	0.0%	0.0	0.0%
HCV medium diesel	0.66%	0.34	3.4%	0.31	3.6%	0.8	0.1%	5.1	3.9%
HCV medium LPG	0.00%	0.00	0.0%	0.00	0.0%	0.0	0.0%	0.0	0.0%
HCV small CNG	0.00%	0.00	0.0%	0.00	0.0%	0.0	0.0%	0.0	0.0%
HCV small diesel	1.99%	0.96	9.5%	0.87	10.3%	2.5	0.2%	13.0	10.0%
HCV small LPG	0.01%	0.00	0.0%	0.00	0.0%	0.0	0.0%	0.0	0.0%
LCV CNG	0.00%	0.00	0.0%	0.00	0.0%	0.0	0.0%	0.0	0.0%
LCV diesel	7.64%	2.30	23.0%	2.03	23.9%	9.6	0.9%	3.9	3.0%
LCV LPG	0.00%	0.00	0.0%	0.00	0.0%	0.1	0.0%	0.0	0.0%
LCV petrol	5.48%	0.12	1.2%	0.07	0.8%	95.7	8.9%	5.5	4.2%
Motorcycle	4.09%	0.21	2.1%	0.12	1.4%	87.9	8.2%	0.4	0.3%
Total	100.00%	10.0	100.0%	8.5	100.0%	1072	100.0%	130	100.0%

Table 4.46 Washdyke weekday vehicle emissions by fuel type

Washdyke vehicles		Weekday emissions (kg/day)							
Fuel	%	PM ₁₀		PM _{2.5}		CO		NO _x	
			%		%		%		%
Diesel	22.22%	8.42	84.0%	7.6	89.1%	30	2.8%	71	54.4%
Petrol	77.76%	1.60	16.0%	0.9	10.9%	1042	97.2%	59	45.5%
LPG	0.02%	0.00	0.0%	0.0	0.0%	0.1	0.0%	0	0.1%
CNG	0.00%	0.00	0.0%	0.0	0.0%	0.0	0.0%	0	0.0%
Total	100.00%	10.0	100.0%	8.5	100.0%	1072	100.0%	130	100.0%

Table 4.47 Weekend day vehicle emissions in Washdyke

Washdyke		Weekend day							
Type	% of total	Contaminant emission (kg/day)							
		PM ₁₀	%	PM _{2.5}	%	CO	%	NO _x	%
Bus large CNG	0.00%	0.00	0.0%	0.00	0.0%	0.0	0.0%	0.0	0.0%
Bus large diesel	0.71%	0.41	6.4%	0.37	6.9%	1.0	0.1%	7.3	8.7%
Bus large LPG	0.00%	0.00	0.0%	0.00	0.0%	0.0	0.0%	0.0	0.0%
Bus medium CNG	0.00%	0.00	0.0%	0.00	0.0%	0.0	0.0%	0.0	0.0%
Bus medium diesel	0.24%	0.08	1.2%	0.07	1.3%	0.2	0.0%	1.2	1.4%
Bus medium LPG	0.00%	0.00	0.0%	0.00	0.0%	0.0	0.0%	0.0	0.0%
Car CNG	0.00%	0.00	0.0%	0.00	0.0%	0.0	0.0%	0.0	0.0%
Car diesel	9.00%	1.47	22.8%	1.31	24.0%	6.7	1.0%	2.9	3.5%
Car LPG	0.01%	0.00	0.0%	0.00	0.0%	0.0	0.0%	0.0	0.0%
Car petrol	68.19%	0.83	12.8%	0.48	8.8%	552.5	80.2%	34.0	40.5%
HCV large CNG	0.00%	0.00	0.0%	0.00	0.0%	0.0	0.0%	0.0	0.0%
HCV large diesel	1.99%	1.15	17.8%	1.05	19.2%	2.9	0.4%	20.5	24.4%
HCV large LPG	0.00%	0.00	0.0%	0.00	0.0%	0.0	0.0%	0.0	0.0%
HCV medium CNG	0.00%	0.00	0.0%	0.00	0.0%	0.0	0.0%	0.0	0.0%
HCV medium diesel	0.66%	0.22	3.4%	0.20	3.6%	0.5	0.1%	3.3	3.9%
HCV medium LPG	0.00%	0.00	0.0%	0.00	0.0%	0.0	0.0%	0.0	0.0%
HCV small CNG	0.00%	0.00	0.0%	0.00	0.0%	0.0	0.0%	0.0	0.0%
HCV small diesel	1.99%	0.61	9.4%	0.55	10.2%	1.6	0.2%	8.3	9.9%
HCV small LPG	0.01%	0.00	0.0%	0.00	0.0%	0.0	0.0%	0.0	0.0%
LCV CNG	0.00%	0.00	0.0%	0.00	0.0%	0.0	0.0%	0.0	0.0%
LCV diesel	7.64%	1.47	22.8%	1.30	23.8%	6.2	0.9%	2.5	3.0%
LCV LPG	0.00%	0.00	0.0%	0.00	0.0%	0.0	0.0%	0.0	0.0%
LCV petrol	5.48%	0.08	1.2%	0.04	0.8%	61.1	8.9%	3.6	4.3%
Motorcycle	4.09%	0.14	2.1%	0.08	1.4%	56.1	8.1%	0.2	0.3%
Total	100.00%	6.5	100.0%	5.5	100.0%	689	100.0%	84	100.0%

Table 4.48 Washdyke weekend day vehicle emissions by fuel type

Washdyke vehicles		Weekday emissions (kg/day)							
Fuel	%	PM ₁₀	%	PM _{2.5}	%	CO	%	NO _x	%
Diesel	22.22%	5.4	83.8%	4.8	89.0%	19	2.8%	46.0	54.8%
Petrol	77.76%	1.0	16.2%	0.6	11.0%	670	97.2%	37.8	45.1%
LPG	0.02%	0.0	0.0%	0.0	0.0%	0.1	0.0%	0.1	0.1%
CNG	0.00%	0.0	0.0%	0.0	0.0%	0.0	0.0%	0.0	0.0%
Total	100.00%	6.5	100.0%	5.5	100.0%	689	100.0%	83.9	100.0%

4.4.2.2 Vehicle emissions by time period

Hourly emissions of PM₁₀ from motor vehicles are tabulated in Appendix A

Table 4.49 Vehicle emissions in Washdyke by time period

Weekday vehicle emissions in Washdyke										
PM ₁₀ (kg/day)					PM _{2.5} (kg/day)					
6am-10am	10am-4pm	4pm-10pm	10pm-6am	Total	6am-10am	10am-4pm	4pm-10pm	10pm-6am	Total	
2.0	4.3	3.4	0.3	10.0	1.7	3.6	2.9	0.3	8.5	
CO (kg/day)					NO _x (kg/day)					
6am-10am	10am-4pm	4pm-10pm	10pm-6am	Total	6am-10am	10am-4pm	4pm-10pm	10pm-6am	Total	
218	456	365	32	1072	26.5	55.4	44.3	3.9	130.1	
SO _x (kg/day)					Benzene (kg/day)					
6am-10am	10am-4pm	4pm-10pm	10pm-6am	Total	6am-10am	10am-4pm	4pm-10pm	10pm-6am	Total	
3.6	7.6	6.1	0.5	17.8	2.1	4.3	3.5	0.3	10.2	

Weekend day vehicle emissions in Washdyke										
PM ₁₀ (kg/day)					PM _{2.5} (kg/day)					
6am-10am	10am-4pm	4pm-10pm	10pm-6am	Total	6am-10am	10am-4pm	4pm-10pm	10pm-6am	Total	
0.7	3.4	2.0	0.3	6.5	0.6	2.9	1.7	0.3	5.5	
CO (kg/day)					NO _x (kg/day)					
6am-10am	10am-4pm	4pm-10pm	10pm-6am	Total	6am-10am	10am-4pm	4pm-10pm	10pm-6am	Total	
75	367	212	35	689	9.2	44.5	25.8	4.4	83.9	
SO _x (kg/day)					Benzene (kg/day)					
6am-10am	10am-4pm	4pm-10pm	10pm-6am	Total	6am-10am	10am-4pm	4pm-10pm	10pm-6am	Total	
1.3	6.1	3.5	0.6	11.5	0.9	4.3	2.5	0.4	8.0	

Table 4.50 Change in vehicle emissions 2001 - 2005

Washdyke Weekdays Fuel	2001	2005	Change	2001	2005	Change	2001	2005	Change
	PM ₁₀ (kg/day)	PM ₁₀ (kg/day)		%	PM _{2.5} (kg/day)		PM _{2.5} (kg/day)	%	
Diesel	11.8	8.4	-29%	10.7	7.6	-29%	39	29.6	-23%
Petrol	2.5	1.6	-35%	1.4	0.9	-35%	1490	1042.4	-30%
LPG	0.0	0.0	NS	0.0	0.0	NS	1	0.1	NS
CNG	0.0	0.0	NS	0.0	0.0	NS	0	0.0	NS
Total (kg)	14.3	10.0	-30%	12.1	8.5	-30%	1529	1072.1	-30%

Washdyke Weekdays Fuel	2001	2005	Change	2001	2005	Change	2001	2005	Change
	NO _x (kg/day)	NO _x (kg/day)		%	SO _x (kg/day)		SO _x (kg/day)	%	
Diesel	84.0	70.8	-16%	NA	NA	NA	0.1	0.1	1%
Petrol	92.1	59.3	-36%	NA	NA	NA	15.7	10.1	-21%
LPG	0.4	0.1	-75%	NA	NA	NA	0.0	0.0	NS
CNG	0.1	0.0	NS	NA	NA	NA	0.0	0.0	0%
Total (kg)	176.6	130.2	-26%		18		15.8	10.2	-21%

Vehicle emissions are lower for all contaminants in 2005 than in 2001, by twenty percent or more. Once again, this may be due to better engine technology and a reduced number of VKT.

Washdyke industrial and commercial emissions

4.4.2.3 2005 Emissions

In Washdyke, industrial and commercial activities were the greatest source of PM₁₀, PM_{2.5}, CO, NO_x and SO_x with 80%, 74%, 21%, 76% and 99% of the totals respectively. Benzene emissions were less than 1% of the total. Weekend day emissions were not significantly different as many of the large industries in Washdyke operate 24 hours a day, seven days a week.

Table 4.51 Industrial and commercial emissions by time of day (Washdyke)

Washdyke emissions					Total kg/day
Weekdays	6am-10am	10am-4pm	4pm-10pm	10pm-6am	
PM ₁₀	48	74	67	83	273
PM _{2.5}	31	48	45	55	179
CO	77	116	106	132	431
NO _x	77	118	105	127	427
SO _x	284	441	409	488	1621
Benzene	0.015	0.021	0.015	0.019	0.07
Weekend days	6am-10am	10am-4pm	4pm-10pm	10pm-6am	kg/day
PM ₁₀	44	66	62	82	254
PM _{2.5}	29	44	41	54	167
CO	71	107	99	130	408
NO _x	68	102	94	124	388
SO _x	257	390	359	473	1480
Benzene	0.01	0.01	0.01	0.02	0.06

Table 4.52 Contaminant emissions by commercial and industrial source (Washdyke)

Washdyke	PM ₁₀	PM _{2.5}	CO	NO _x	SO _x	Benzene
Weekdays	(kg)	(kg)	(kg)	(kg)	(kg)	(kg)
Coal fired boilers	267	179	424	407	1617	0.06
Diesel fired boilers	0.0	0.0	0.1	0.4	0.2	0.00
Diesel generators	0.0	0.0	0.0	0.0	0.0	0.00
Light fuel oil burners	1.0	0.0	1.2	5.0	3.0	0.00
LPG boilers/heaters	0.4	0.0	3.0	12.7	0.0	0.00
Waste oil burners/heaters	0.0	0.0	0.0	0.0	0.7	0.00
Other combustion	0.0	0.0	0.0	0.0	0.0	0.00
Total combustion	269	179	428	425	1620.8	0.06
Total processing	4.0	0.1	3.0	1.3	0.3	0.01
Total (kg)	272.9	179	431	427	1621	0.07
Weekend days						
Coal fired boilers	254	167	407	387	1466	0.06
Diesel fired boilers	0.0	0.0	0.0	0.0	0.0	0.00
Diesel generators	0.0	0.0	0.0	0.0	0.0	0.00
Light fuel oil burners	0.3	0.0	0.3	1.3	13.3	0.00
LPG boilers/heaters	0.0	0.0	0.1	0.3	0.0	0.00
Waste oil burners/heaters	0.0	0.0	0.0	0.0	0.0	0.00
Other combustion	0.0	0.0	0.0	0.0	0.0	0.00
Total combustion	254.2	167.1	407.6	388.3	1480	0.06
Total processing	0.0	0.0	0.0	0.0	0.0	0.00
Total (kg)	254.2	167.1	407.6	388.3	1480	0.06

4.4.2.4 Backcasting industrial emissions

Very little economic development has taken place in Washdyke since the 2001 inventory. SO_x emissions were higher as a result of increased coal combustion. This was due to an increase in the number of facilities using coal boilers rather than a move from other fuels to coal burning.

Table 4.53 Change in industrial emissions 2001 - 2005

	2001	2005	Change (%)
PM₁₀	272	273	0.5%
PM_{2.5}	171	179	4.6%
CO	456	431	-5.4%
NO_x	426	427	0.1%
SO_x	1491	1621	8.7%
Benzene	0.067	0.070	4.0%

4.4.3 Other Sources

Table 4.54 Washdyke rail emissions

Washdyke rail emissions (kg per day)			
PM ₁₀	CO	NO _x	SO _x
2	6	64	1

Table 4.55 Washdyke lawn mowing emissions

Contaminant	Emission (kg/day)
PM ₁₀	0.1
CO	41
NO _x	0.1
SO ₂	0.0

4.5 Total emissions to the gazetted Timaru airshed

At the present time, the gazetted Timaru airshed includes all of the Timaru urban area including Washdyke. As mentioned earlier, Washdyke may potentially be gazetted independently in future years and this is the reasoning behind the presentation of separate emission tables in most chapters. For ease of comparison with previous inventories, Table 4.56 is presented which details emissions of contaminants to air in the Timaru airshed (including Washdyke).

Table 4.56 Total emissions to the gazetted Timaru airshed

Contaminant	Domestic Home Heating		Motor Vehicles		Industrial and Commercial Activities		Total kg/day
	kg/day	%	kg/day	%	kg/day	%	
Timaru airshed including Washdyke (weekdays)							
PM ₁₀	1423	78%	54	3%	352	19%	1830
PM _{2.5}	1367	84%	46	3%	215	13%	1628
CO	13381	68%	5744	29%	514	3%	19639
NO _x	137	10%	707	51%	539	39%	1384
SO _x	47	2%	96	5%	1952	93%	2095
Benzene	140	72%	56	28%	0.09	0%	196
Timaru airshed including Washdyke (weekend days)							
PM ₁₀	1636	84%	36	2%	286	15%	1959
PM _{2.5}	1573	88%	30	2%	183	10%	1787
CO	15489	78%	3824	19%	434	2%	19747
NO _x	157	15%	472	45%	421	40%	1049
SO _x	52	3%	64	4%	1640	93%	1756
Benzene	163	78%	45	22%	0.06	0%	208

5 Sources of uncertainty

Uncertainty in these emission estimates relates to three main areas:

1. omission or inclusion of sources in the inventory;
2. the gathering of activity data; and
3. the use of emission factors.

5.1 Omission or inclusion of sources

The principal error that can arise is that of omitted sources leading to an under-estimation of total emissions and - more importantly - consequent error in allocating the proportion of emissions to the sources that have been included. It is also possible for double counting to occur, with consequent over-estimation, although this is less likely.

Sources can be intentionally omitted from an emission inventory for a number of reasons, the most significant being a lack of relevant emission factors, emission factor uncertainty and/or difficulty in quantifying activity rates. In this case, such sources include:

- dust emissions from paved and unpaved roadways, for which emission factors are known to be highly uncertain;
- the pneumatic transfer of wood waste which requires volumetric flow data not generally known by survey respondents;
- natural sources, the most common of which is sea salt;
- industrial sources lacking emission factors (for example powder coating);
- non-tailpipe vehicle emissions; and
- the formation of secondary particles during atmospheric chemical processes.

Naturally, sources can also be unintentionally omitted. None became apparent during the preparation of this inventory. However, some industries either did not return survey forms or returned responses that were incomplete. A justified estimate was made based on the information available from similar industries or further data gleaned from consent files.

5.2 The gathering of activity data

The activity data gathered by survey (home heating and industrial emissions) are subject to uncertainty in three main areas:

- the surveys themselves, which are tradeoffs between gathering accurate data and not requiring so much time that respondents do not participate. Such an approach leads mainly to poor temporal resolution, particularly in the case of industrial emissions where monthly material use rates are requested.
- the assessments made by respondents (for example fuel use rates, log sizes, raw material use rates, mass or volume of material through an industrial process, and many others). It is possible that such errors will be less in the case of home heating surveys - conducted verbally - than in the case of the industrial responses which are provided in writing and obviously - in some cases - completed in a hurry.
- the rate of return. In the case of industry this was less than 100% and a comment on this is provided above. Home heating surveys were conducted until required sample sizes were met, and they are considered to be representative.

Vehicle activity data (the derivation of VKT) are based primarily traffic on modelling by consultants and calibrated by count data where these are available. This relationship is relatively strong, however, the estimates are subject to some uncertainty.

5.3 The use of emission factors

Emission factors are well-known sources of uncertainty, principally because they use information from a relatively small number of test results to characterise the typical emissions from a large and varied group of “real world” appliances or processes. In the case of industrial emission factors, experience indicates that this tends to be in the direction of conservatism, such that emission calculations frequently err toward over-estimation. However, this is not always the case and the extent is very difficult to quantify. The USEPA “AP-42” data used in this study are generally well supported by descriptive background documents and all have an estimate of uncertainty (emission factor rating). Alternative emission estimates are generally not easy to use, an example being stack test data for particulate matter discharged from a boiler. In such a case, the data reflect only one or a few operating conditions – which may or may not be typical - and can be difficult to tie in with the fuel use rates stated in a survey response.

The NZ-TER vehicle emission estimates used in this study are not well documented other than by way of a description of the testing programme from which they were derived (MoT, 1998). Limited independent validation studies have been undertaken (e.g. Bluett and Fisher, 2005), but it is fair for the moment to assume that these factors are subject to unquantified error. However, they are locally-derived factors and discarding them in favour of overseas data would require robust justification and is not considered appropriate in this case.

5.4 Emission calculation

In general, emission calculation can be treated as the step where errors and uncertainties from other sources are combined, rather than an inherent source of new ones. Uncertainty can arise as a result of calculation errors, but this is a matter of work quality. All calculations have been double- or triple-checked.

6 Conclusion

The 2005 emission inventory provides an overview of sources contributing to wintertime emissions in Timaru and, separately, Washdyke.

Since 1996, there have been three inventories in these study areas and all three indicate that the major source of PM₁₀ (the contaminant of concern) was domestic home heating (92% on weekdays and 96% on weekend days) in Timaru and industry (80% both days) in Washdyke.

In Timaru, domestic home heating also contributed to 73% of the CO and 75% of the benzene emissions with motor vehicles contributing 70% of the NO_x.

In Washdyke, industry produces 99% of the SO_x, 76% of the NO_x, and motor vehicles account for about half of the CO released into the air.

The only sector with significant changes is that of motor vehicles, where a combination of fewer VKT and better engine technology has produced lower emissions in all study areas.

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Appendix A: Hour by hour emissions of PM₁₀ in each suburb

Appendix A Hour by hour emissions in all suburbs

Methodology

For home heating, surveyed households were asked for the number of hours that they used their heating appliance within four time bins. These were:

- from 6am to 10am;
- from 10am to 4pm;
- from 4pm to 10pm; and
- from 10pm to 6am.

Assumptions were then made as to the actual hours they were using their appliance. These assumptions are in Chart 1 and 2. It can be seen that the burning pattern is different on weekend days to weekdays. For example where a household burnt wood or coal for three hours between 6am and 10am and four hours between 4pm and 10pm on a weekday, it was assumed that the appliance was used from 7am to 10am and 6pm to 10pm (ie the shaded regions).

For motor vehicle use, Gabites Porter provided VKT's on an hourly basis.

For industry, the surveys sent to every known facility asked for the actual times that processing was taking place and combustion appliances were operating.

Chart 1 Weekday home heating burning template

All Suburbs	Burn time (hr)	Hour of the day																							
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
0600-1000	1																								
	2																								
	3																								
	4																								
10.00-1600	1																								
	2																								
	3																								
	4																								
	5																								
	6																								
1600-22.00	1																								
	2																								
	3																								
	4																								
	5																								
	6																								
2200-0600	1																								
	2																								
	3																								
	4																								
	5																								
	6																								
	7																								
	8																								

Chart 2 Weekend day home heating template

All Suburbs	Burn time (hr)	Hour of the day																							
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Weekends 0600-1000	1																								
	2																								
	3																								
	4																								
10.00-1600	1																								
	2																								
	3																								
	4																								
	5																								
	6																								
1600-22.00	1																								
	2																								
	3																								
	4																								
	5																								
	6																								
2200-0600	1																								
	2																								
	3																								
	4																								
	5																								
	6																								
	7																								
	8																								

**Appendix A Hourly emission of PM₁₀ by source type and suburb
Gleniti and Glenwood**

Gleniti & Glenwood Weekdays	Emission of PM ₁₀ each hour of the day in Gleniti suburb (kg)									
	1	2	3	4	5	6	7	8	9	10
Home heating										
Open fire (wood)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0905	0.0905	0.0452	0.0452
Open fire (coal)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Pre-1994 woodburners	1.8979	1.8979	1.4655	1.4655	1.3213	1.3213	2.3303	2.6186	2.1862	2.1862
1994-2000 woodburners	0.7137	0.7137	0.6827	0.6827	0.6724	0.6724	1.0914	1.0183	0.6720	0.6720
2001+ woodburners	0.6335	0.6335	0.6360	0.6360	0.6369	0.6369	0.7383	0.7991	0.6733	0.6733
Pellet burners	0.0062	0.0062	0.0054	0.0054	0.0052	0.0052	0.0079	0.0083	0.0066	0.0066
Multifuel burner (wood)	0.1773	0.1773	0.1773	0.1773	0.1773	0.1773	0.5911	0.4729	0.4729	0.4729
Multifuel burner (coal)	0.3048	0.3048	0.3048	0.3048	0.3048	0.3048	0.0000	0.0000	0.0000	0.0000
Gas burner	0.0004	0.0004	0.0002	0.0002	0.0001	0.0001	0.0007	0.0008	0.0005	0.0005
Oil burner	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0009	0.0009	0.0009	0.0009
Sub-total	3.73	3.73	3.27	3.27	3.12	3.12	4.85	5.01	4.06	4.06
Motor Vehicles	0.0075	0.0046	0.0047	0.0040	0.0059	0.0149	0.0440	0.1099	0.2566	0.2163
Industrial and commercial										
Coal fired boilers	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Other combustion	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004
Processing	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Sub-total	0.01	0.01	0.01	0.00	0.01	0.02	0.04	0.11	0.26	0.22
Total	3.74	3.74	3.28	3.28	3.12	3.13	4.90	5.12	4.31	4.27

Gleniti & Glenwood Weekend days	Emission of PM ₁₀ each hour of the day in Gleniti suburb (kg)									
	1	2	3	4	5	6	7	8	9	10
Home heating										
Open fire (wood)	0.0531	0.0531	0.0531	0.0531	0.0000	0.0000	0.0531	0.0531	0.1062	0.1062
Open fire (coal)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Pre-1994 woodburners	2.3303	2.3303	1.8979	1.8979	1.7538	1.7538	2.3544	2.6426	3.0751	3.0751
1994-2000 woodburners	0.9345	0.9334	0.9028	0.9028	0.8926	0.8926	0.9673	1.1457	1.7768	1.6507
2001+ woodburners	0.7583	0.6744	0.6767	0.6767	0.6775	0.6775	0.7374	0.7998	0.9898	0.9891
Pellet burners	0.0076	0.0074	0.0066	0.0066	0.0064	0.0064	0.0077	0.0086	0.0111	0.0108
Multifuel burner (wood)	0.1371	0.1371	0.1371	0.1371	0.1371	0.1371	0.3655	0.3655	0.5483	0.3655
Multifuel burner (coal)	0.2280	0.2280	0.2280	0.2280	0.2280	0.2280	0.0000	0.0000	0.0000	0.0000
Gas burner	0.0005	0.0005	0.0003	0.0003	0.0002	0.0002	0.0003	0.0006	0.0011	0.0009
Oil burner	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0009	0.0009	0.0009	0.0009
Sub-total	4.45	4.36	3.90	3.90	3.70	3.70	4.49	5.02	6.51	6.20
Motor Vehicles	0.0149	0.0120	0.0059	0.0061	0.0059	0.0080	0.0217	0.0317	0.0608	0.1167
Industrial and commercial										
Coal fired boilers	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Other combustion	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004
Processing	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Sub-total	0.02	0.01	0.01	0.01	0.01	0.01	0.02	0.03	0.06	0.12
Total	4.47	4.38	3.91	3.91	3.70	3.70	4.51	5.05	6.57	6.32

Emission of PM ₁₀ each hour of the day in Gleniti suburb (kg)														
11	12	13	14	15	16	17	18	19	20	21	22	23	24	
	0.0452	0.0452	0.0452	0.0452	0.0452	0.0452	0.0905	0.1357	0.2262	0.2262	0.2262	0.2262	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	2.0420	2.0420	2.3303	2.3303	2.7628	3.0510	4.2522	4.4204	7.9039	7.9039	7.7598	7.4715	2.7628	2.4745
	1.0921	1.0921	1.2384	1.3967	1.4593	1.4794	2.2018	2.7224	3.6057	3.7315	3.5308	3.2970	0.9328	0.7869
	0.7399	0.7399	0.7391	0.8028	0.8639	0.8625	1.1224	1.4596	2.2015	2.2022	2.0761	1.8249	0.6929	0.6934
	0.0074	0.0074	0.0081	0.0086	0.0096	0.0101	0.0141	0.0163	0.0256	0.0258	0.0249	0.0232	0.0081	0.0074
	0.2027	0.2027	0.2027	0.2027	0.2027	0.2027	0.7290	1.0836	1.3201	1.3201	1.3201	1.3201	0.1773	0.1773
	0.4644	0.4644	0.4644	0.4644	0.4644	0.4644	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.3048	0.3048
	0.0004	0.0004	0.0005	0.0005	0.0005	0.0005	0.0006	0.0007	0.0015	0.0016	0.0013	0.0010	0.0005	0.0005
	0.0013	0.0013	0.0013	0.0013	0.0013	0.0013	0.0013	0.0013	0.0013	0.0013	0.0013	0.0013	0.0004	0.0004
	4.60	4.60	5.03	5.25	5.81	6.12	8.41	9.84	15.29	15.41	14.94	14.17	4.88	4.45
	0.1847	0.2030	0.2537	0.2406	0.2287	0.2573	0.3568	0.3478	0.1492	0.1142	0.0797	0.0601	0.0335	0.0202
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.19	0.20	0.25	0.24	0.23	0.26	0.36	0.35	0.15	0.11	0.08	0.06	0.03	0.02
	4.78	4.80	5.28	5.49	6.04	6.37	8.77	10.19	15.44	15.53	15.02	14.23	4.91	4.47

Emission of PM ₁₀ each hour of the day in Gleniti suburb (kg)														
11	12	13	14	15	16	17	18	19	20	21	22	23	24	
	0.1062	0.1062	0.1062	0.1593	0.1593	0.1593	0.1062	0.2125	0.3718	0.3718	0.3718	0.3718	0.0531	0.0531
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	3.3634	3.3634	3.9399	3.9399	5.1171	5.2613	5.1411	6.3183	8.2162	8.2162	8.2162	7.9279	3.0510	2.9069
	1.6607	1.6607	1.9864	2.2093	2.3240	2.3665	2.4245	2.9814	3.5951	3.7209	3.5302	3.3179	1.2690	1.0076
	1.0087	1.0087	1.1543	1.3442	1.4016	1.4640	1.3497	1.5356	2.1370	2.1377	2.0110	1.8018	0.8193	0.8183
	0.0113	0.0113	0.0133	0.0143	0.0165	0.0170	0.0166	0.0200	0.0259	0.0261	0.0254	0.0239	0.0096	0.0088
	0.2361	0.2361	0.2361	0.2361	0.2361	0.2361	0.6549	0.9290	1.0204	1.0204	1.0204	1.0204	0.1371	0.1371
	0.3927	0.3927	0.3927	0.3927	0.3927	0.3927	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.2280	0.2280
	0.0007	0.0007	0.0008	0.0008	0.0009	0.0009	0.0007	0.0008	0.0016	0.0017	0.0014	0.0011	0.0005	0.0005
	0.0013	0.0013	0.0013	0.0013	0.0013	0.0013	0.0013	0.0013	0.0013	0.0013	0.0013	0.0013	0.0004	0.0004
	6.78	6.78	7.83	8.30	9.65	9.90	9.70	12.00	15.37	15.50	15.18	14.47	5.57	5.16
	0.1777	0.2075	0.1922	0.1711	0.1819	0.1688	0.1714	0.1452	0.1230	0.0905	0.0631	0.0494	0.0343	0.0229
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.18	0.21	0.19	0.17	0.18	0.17	0.17	0.15	0.12	0.09	0.06	0.05	0.03	0.02
	6.96	6.99	8.02	8.47	9.83	10.07	9.87	12.14	15.49	15.59	15.24	14.52	5.60	5.18

**Appendix A Hourly emission of PM₁₀ by source type and suburb
Highfield**

Highfield Weekdays	Emission of PM ₁₀ each hour of the day in Highfield suburb (kg)									
	1	2	3	4	5	6	7	8	9	10
Home heating										
Open fire (wood)	0.3274	0.3274	0.2232	0.2232	0.2232	0.2232	0.5757	0.5757	0.5757	0.5757
Open fire (coal)	0.5893	0.5893	0.4018	0.4018	0.4018	0.4018	0.0000	0.0000	0.0000	0.0000
Pre-1994 woodburners	1.7538	1.7538	1.7538	1.7538	1.5856	1.5856	2.2823	2.2823	1.7538	1.7538
1994-2000 woodburners	1.0076	1.0076	1.0076	1.0076	0.9151	0.9151	1.0446	1.1928	0.9657	0.9657
2001+ woodburners	0.6290	0.6290	0.6290	0.6290	0.4720	0.4720	0.6265	0.7251	0.6428	0.6428
Pellet burners	0.0065	0.0065	0.0065	0.0065	0.0056	0.0056	0.0074	0.0079	0.0064	0.0064
Multifuel burner (wood)	0.1535	0.1535	0.1535	0.1535	0.1535	0.1535	0.2504	0.1708	0.1708	0.1708
Multifuel burner (coal)	0.0478	0.0478	0.0478	0.0478	0.0478	0.0478	0.0532	0.0363	0.0363	0.0363
Gas burner	0.0002	0.0002	0.0002	0.0002	0.0000	0.0000	0.0028	0.0018	0.0012	0.0012
Oil burner	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Sub-total	4.52	4.52	4.22	4.22	3.80	3.80	4.84	4.99	4.15	4.15
Motor Vehicles	0.0103	0.0065	0.0069	0.0056	0.0084	0.0210	0.0610	0.1504	0.3171	0.2773
Industrial and commercial										
Coal fired boilers	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1411	0.1411	0.1411
Other combustion	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Processing	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Sub-total	0.01	0.01	0.01	0.01	0.01	0.02	0.06	0.29	0.46	0.42
Total	4.53	4.52	4.23	4.23	3.81	3.83	4.90	5.28	4.61	4.57

Highfield Weekend days	Emission of PM ₁₀ each hour of the day in Highfield suburb (kg)									
	1	2	3	4	5	6	7	8	9	10
Home heating										
Open fire (wood)	0.5431	0.5431	0.4375	0.4375	0.2263	0.2263	0.5837	0.5837	0.5837	0.5837
Open fire (coal)	0.8000	0.8000	0.6445	0.6445	0.3333	0.3333	0.0000	0.0000	0.0000	0.0000
Pre-1994 woodburners	1.9219	1.7538	1.7538	1.7538	1.5856	1.5856	1.9219	1.9219	3.1471	3.1471
1994-2000 woodburners	1.0205	1.0086	1.0076	1.0076	0.9582	0.9582	1.0570	1.2846	1.9135	1.7664
2001+ woodburners	0.7262	0.7271	0.6290	0.6290	0.5562	0.5562	0.7019	0.8606	1.0145	1.0138
Pellet burners	0.0070	0.0068	0.0065	0.0065	0.0059	0.0059	0.0070	0.0079	0.0115	0.0112
Multifuel burner (wood)	0.1403	0.1403	0.1403	0.1403	0.1403	0.1403	0.1561	0.1561	0.3018	0.2289
Multifuel burner (coal)	0.0437	0.0437	0.0437	0.0437	0.0437	0.0437	0.0331	0.0331	0.0641	0.0486
Gas burner	0.0005	0.0005	0.0005	0.0005	0.0002	0.0002	0.0015	0.0018	0.0033	0.0020
Oil burner	0.0005	0.0005	0.0005	0.0005	0.0000	0.0000	0.0005	0.0005	0.0005	0.0005
Sub-total	5.20	5.02	4.66	4.66	3.85	3.85	4.46	4.85	7.04	6.80
Motor Vehicles	0.0210	0.0169	0.0079	0.0087	0.0079	0.0109	0.0300	0.0441	0.0835	0.1597
Industrial and commercial										
Coal fired boilers	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Other combustion	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Processing	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Sub-total	0.02	0.02	0.01	0.01	0.01	0.01	0.03	0.04	0.08	0.16
Total	5.22	5.04	4.67	4.67	3.86	3.86	4.49	4.89	7.12	6.96

Emission of PM ₁₀ each hour of the day in Highfield suburb (kg)														
11	12	13	14	15	16	17	18	19	20	21	22	23	24	
	0.5757	0.5757	0.5757	0.5757	0.3925	0.5757	0.8610	1.1143	1.6039	1.6039	1.6039	1.4857	0.5506	0.3274
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.1237	1.4542	2.0931	2.0931	2.0931	1.9389	0.9910	0.5893
	1.9219	1.9219	2.4504	2.6186	2.9790	2.9790	3.8438	5.7658	7.3513	7.3513	7.3513	6.8228	2.4745	2.1141
	1.0194	1.0194	1.0563	1.0680	1.2397	1.3865	2.7777	3.6795	4.9382	4.9382	4.9003	4.5486	1.8159	1.1811
	0.6282	0.6282	0.6257	0.6249	0.6242	0.6251	1.0883	1.5973	1.8402	1.8402	1.7668	1.7675	0.7269	0.7260
	0.0068	0.0068	0.0077	0.0079	0.0088	0.0091	0.0145	0.0207	0.0262	0.0262	0.0260	0.0245	0.0094	0.0077
	0.1708	0.1708	0.2504	0.2504	0.2504	0.3301	0.3506	0.4352	0.4352	0.4352	0.4352	0.4352	0.1535	0.1535
	0.0363	0.0363	0.0532	0.0532	0.0532	0.0701	0.0565	0.0701	0.0701	0.0701	0.0701	0.0701	0.0478	0.0478
	0.0000	0.0000	0.0002	0.0002	0.0005	0.0007	0.0012	0.0022	0.0058	0.0060	0.0048	0.0038	0.0002	0.0002
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0005	0.0011	0.0016	0.0022	0.0022	0.0022	0.0016	0.0011	0.0000
	4.36	4.36	5.02	5.20	5.55	5.98	10.12	14.14	18.37	18.37	18.25	17.10	6.77	5.15
	0.2551	0.2798	0.3488	0.3315	0.3156	0.3539	0.4525	0.4441	0.2073	0.1564	0.1096	0.0822	0.0463	0.0281
	0.1411	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.40	0.28	0.35	0.33	0.32	0.35	0.45	0.44	0.21	0.16	0.11	0.08	0.05	0.03
	4.76	4.64	5.37	5.53	5.86	6.33	10.57	14.59	18.57	18.52	18.36	17.18	6.82	5.18

Emission of PM ₁₀ each hour of the day in Highfield suburb (kg)														
11	12	13	14	15	16	17	18	19	20	21	22	23	24	
	0.6442	0.6442	0.7996	0.7996	0.7996	0.9551	0.6343	1.0220	1.7796	1.7796	1.6563	1.5329	0.5431	0.5431
	0.2432	0.2432	0.3019	0.3019	0.3019	0.3606	0.6229	1.0036	1.7476	1.7476	1.6265	1.5054	0.8000	0.8000
	2.6186	2.7868	4.5405	4.9009	4.9009	4.9009	4.5646	5.9580	7.8799	7.8799	7.7117	7.3513	2.6186	2.6186
	1.7973	1.9939	2.3003	2.3252	2.3252	2.5102	3.3673	4.1122	4.9339	4.9363	4.7776	4.6057	1.8258	1.2164
	0.9711	1.0446	1.1111	1.1096	1.1096	1.1838	1.3461	1.5144	1.6254	1.7649	1.7649	1.7656	0.7264	0.7235
	0.0103	0.0112	0.0147	0.0153	0.0153	0.0159	0.0175	0.0215	0.0264	0.0269	0.0263	0.0254	0.0097	0.0085
	0.2289	0.2289	0.3018	0.3018	0.3018	0.3018	0.3205	0.3978	0.3978	0.3978	0.3978	0.3978	0.1403	0.1403
	0.0486	0.0486	0.0641	0.0641	0.0641	0.0641	0.0516	0.0641	0.0641	0.0641	0.0641	0.0641	0.0437	0.0437
	0.0005	0.0005	0.0015	0.0015	0.0020	0.0023	0.0025	0.0028	0.0065	0.0065	0.0053	0.0043	0.0005	0.0005
	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0011	0.0011	0.0016	0.0016	0.0016	0.0011	0.0010	0.0005
	6.56	7.00	9.44	9.82	9.82	10.30	10.93	14.10	18.46	18.61	18.03	17.25	6.71	6.10
	0.2454	0.2852	0.2642	0.2361	0.2500	0.2312	0.2364	0.1985	0.1688	0.1240	0.0858	0.0680	0.0476	0.0318
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.25	0.29	0.26	0.24	0.25	0.23	0.24	0.20	0.17	0.12	0.09	0.07	0.05	0.03
	6.81	7.29	9.70	10.06	10.07	10.53	11.16	14.30	18.63	18.73	18.12	17.32	6.76	6.13

**Appendix A Hourly emission of PM₁₀ by source type and suburb
Kensington**

Kensington Weekdays	Emission of PM ₁₀ each hour of the day in Kensington suburb (kg)									
	1	2	3	4	5	6	7	8	9	10
Home heating										
Open fire (wood)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Open fire (coal)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Pre-1994 woodburners	0.8649	0.6967	0.6967	0.6967	0.6967	0.6967	1.2012	1.3694	1.2012	1.2012
1994-2000 woodburners	0.8976	0.7376	0.7376	0.7376	0.7376	0.7376	0.9588	0.9708	0.5898	0.5898
2001+ woodburners	0.6511	0.5532	0.5532	0.5532	0.5532	0.5532	0.7231	0.7221	0.5741	0.5741
Pellet burners	0.0049	0.0041	0.0041	0.0041	0.0041	0.0041	0.0058	0.0061	0.0047	0.0047
Multifuel burner (wood)	0.1431	0.1431	0.1431	0.1431	0.1431	0.1431	0.4333	0.4333	0.3287	0.3287
Multifuel burner (coal)	0.1984	0.1984	0.1984	0.1984	0.1984	0.1984	0.2901	0.2901	0.2201	0.2201
Gas burner	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0007	0.0005	0.0003	0.0003
Oil burner	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0010	0.0010	0.0005	0.0005
Sub-total	2.76	2.33	2.33	2.33	2.33	2.33	3.61	3.79	2.92	2.92
Motor Vehicles	0.0065	0.0041	0.0044	0.0038	0.0054	0.0143	0.0413	0.1030	0.2062	0.1728
Industrial and commercial										
Coal fired boilers	1.3613	1.3613	1.3613	1.3613	1.3613	1.3613	1.3613	1.3613	1.3613	1.3613
Other combustion	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0584	0.4678
Processing	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0179	0.0179
Sub-total	1.37	1.37	1.37	1.37	1.37	1.38	1.40	1.46	1.64	2.02
Total	4.13	3.70	3.70	3.70	3.70	3.71	5.02	5.26	4.56	4.94

Kensington Weekend days	Emission of PM ₁₀ each hour of the day in Kensington suburb (kg)									
	1	2	3	4	5	6	7	8	9	10
Home heating										
Open fire (wood)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Open fire (coal)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Pre-1994 woodburners	1.0330	1.0330	1.0330	1.0330	1.0330	1.0330	1.5616	1.7297	1.7297	1.7297
1994-2000 woodburners	1.1370	0.9889	0.9509	0.8435	0.9509	0.9509	0.8435	0.8556	1.1872	1.2619
2001+ woodburners	0.8089	0.7101	0.5379	0.3273	0.5379	0.5379	0.8292	0.8281	0.9033	1.0510
Pellet burners	0.0061	0.0055	0.0050	0.0042	0.0050	0.0050	0.0064	0.0067	0.0076	0.0081
Multifuel burner (wood)	0.1861	0.1861	0.1861	0.1861	0.1861	0.1861	0.2452	0.2452	0.3233	0.2452
Multifuel burner (coal)	0.2097	0.2097	0.2097	0.2097	0.2097	0.2097	0.1591	0.1591	0.2097	0.1591
Gas burner	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001	0.0002	0.0004	0.0003
Oil burner	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0010	0.0010
Sub-total	3.38	3.13	2.92	2.60	2.92	2.92	3.65	3.83	4.36	4.46
Motor Vehicles	0.0143	0.0114	0.0052	0.0055	0.0052	0.0070	0.0200	0.0299	0.0567	0.1093
Industrial and commercial										
Coal fired boilers	0.8442	0.8442	0.8442	0.8442	0.8442	0.8442	0.8442	0.8442	0.8442	0.8442
Other combustion	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Processing	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Sub-total	0.86	0.86	0.85	0.85	0.85	0.85	0.86	0.87	0.90	0.95
Total	4.24	3.99	3.77	3.45	3.77	3.77	4.51	4.70	5.26	5.41

Emission of PM ₁₀ each hour of the day in Kensington suburb (kg)														
11	12	13	14	15	16	17	18	19	20	21	22	23	24	
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.4532	0.5974	0.5974	0.5974	0.5974	0.5974	0.1790	0.1790
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0885	0.1167	0.1167	0.1167	0.1167	0.1167	0.0000	0.0000
	1.0330	1.2012	1.5375	1.5375	1.8739	1.8739	2.0661	2.5946	3.2913	3.2913	3.2913	3.1231	1.3694	1.2012
	0.7622	0.7742	0.7982	0.7982	0.9700	0.9700	1.8971	2.3849	2.9518	2.9518	2.8044	2.4977	1.1181	1.1063
	0.6496	0.6487	0.6467	0.6467	0.7437	0.7437	1.1495	1.5519	1.7956	1.7956	1.7951	1.7950	0.7227	0.7235
	0.0049	0.0052	0.0058	0.0058	0.0069	0.0069	0.0102	0.0131	0.0160	0.0160	0.0157	0.0148	0.0064	0.0061
	0.1839	0.1839	0.1839	0.1839	0.2759	0.2759	0.4097	0.5086	0.8053	0.8053	0.7064	0.6075	0.2146	0.2146
	0.1623	0.1623	0.1623	0.1623	0.2435	0.2435	0.3110	0.3860	0.6112	0.6112	0.5361	0.4611	0.2976	0.2976
	0.0002	0.0002	0.0003	0.0004	0.0004	0.0004	0.0005	0.0008	0.0016	0.0017	0.0016	0.0014	0.0002	0.0002
	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0010	0.0010	0.0010	0.0010	0.0010	0.0005	0.0005
	2.80	2.98	3.34	3.34	4.11	4.11	6.39	8.15	10.19	10.19	9.87	9.22	3.91	3.73
	0.1735	0.1905	0.2383	0.2261	0.2151	0.2417	0.3441	0.3379	0.1400	0.1069	0.0747	0.0560	0.0314	0.0189
	1.3613	1.3613	1.3613	1.3613	1.3613	1.3613	1.3613	1.3613	1.3613	1.3613	1.3613	1.3613	1.3613	1.3613
	0.0584	0.0584	0.0584	0.0584	0.0584	0.0584	0.0584	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.9784	0.9784	0.9784	0.0225	0.0179	0.0179	0.9620	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	2.57	2.59	2.64	1.67	1.65	1.68	2.73	1.70	1.50	1.47	1.44	1.42	1.39	1.38
	5.37	5.56	5.97	5.00	5.77	5.79	9.11	9.85	11.69	11.66	11.30	10.63	5.30	5.11

Emission of PM ₁₀ each hour of the day in Kensington suburb (kg)														
11	12	13	14	15	16	17	18	19	20	21	22	23	24	
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.3617	0.5426	0.7234	0.7234	0.7234	0.7234	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0640	0.0960	0.1280	0.1280	0.1280	0.1280	0.0000	0.0000
	1.5616	1.5616	2.0901	2.2583	2.7628	2.9309	2.5946	3.1231	3.4595	3.4595	3.4595	3.4595	1.5375	1.3694
	1.2125	1.2125	1.2510	1.2638	1.4844	1.4964	2.3039	2.6451	3.1111	3.1111	2.9636	2.6688	1.3202	1.3083
	0.9781	0.9781	1.0734	1.1706	1.2422	1.2412	1.2954	1.7955	1.7952	1.7952	1.7947	1.7937	0.8066	0.8075
	0.0076	0.0076	0.0087	0.0093	0.0107	0.0110	0.0122	0.0151	0.0165	0.0165	0.0162	0.0157	0.0072	0.0070
	0.2156	0.2156	0.2156	0.2156	0.2843	0.2843	0.3213	0.5651	0.7978	0.7978	0.7203	0.6427	0.2452	0.2452
	0.1844	0.1844	0.1844	0.1844	0.2431	0.2431	0.2114	0.3717	0.5248	0.5248	0.4738	0.4227	0.2764	0.2764
	0.0001	0.0001	0.0002	0.0003	0.0003	0.0003	0.0002	0.0003	0.0006	0.0007	0.0006	0.0006	0.0001	0.0001
	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0010	0.0010	0.0010	0.0010	0.0010	0.0005	0.0005
	4.16	4.16	4.82	5.10	6.03	6.21	7.17	9.16	10.56	10.56	10.28	9.86	4.19	4.01
	0.1668	0.1951	0.1804	0.1607	0.1706	0.1582	0.1611	0.1360	0.1155	0.0850	0.0583	0.0463	0.0321	0.0212
	0.8442	0.8442	0.8442	0.8442	0.8442	0.8442	0.8442	0.8442	0.8442	0.8442	0.8442	0.8442	0.8442	0.8442
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	1.01	1.04	1.02	1.00	1.01	1.00	1.01	0.98	0.96	0.93	0.90	0.89	0.88	0.87
	5.17	5.20	5.85	6.11	7.04	7.21	8.17	10.14	11.52	11.49	11.18	10.75	5.07	4.88

**Appendix A Hourly emission of PM₁₀ by source type and suburb
Maori Hill**

Maori Hill Weekdays	Emission of PM ₁₀ each hour of the day in Maori Hill suburb (kg)									
	1	2	3	4	5	6	7	8	9	10
Home heating										
Open fire (wood)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1543	0.4628	0.3085	0.3085
Open fire (coal)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Pre-1994 woodburners	1.3694	1.3694	1.2012	1.2012	1.2012	1.2012	2.0661	2.4024	2.4024	2.4024
1994-2000 woodburners	0.3940	0.3172	0.3057	0.3057	0.3057	0.3057	0.7823	0.6974	0.5099	0.5099
2001+ woodburners	0.2884	0.1421	0.1427	0.1427	0.1427	0.1427	0.5666	0.6372	0.3671	0.3671
Pellet burners	0.0037	0.0032	0.0029	0.0029	0.0029	0.0029	0.0064	0.0069	0.0058	0.0058
Multifuel burner (wood)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Multifuel burner (coal)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Gas burner	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0013	0.0009	0.0004	0.0004
Oil burner	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0010	0.0010	0.0010	0.0010
Sub-total	2.06	1.83	1.65	1.65	1.65	1.65	3.58	4.21	3.60	3.60
Motor Vehicles	0.0244	0.0159	0.0167	0.0142	0.0200	0.0507	0.1463	0.3606	0.8063	0.6754
Industrial and commercial										
Coal fired boilers	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Other combustion	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Processing	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Sub-total	0.02	0.02	0.02	0.01	0.02	0.05	0.15	0.36	0.81	0.68
Total	2.08	1.85	1.67	1.67	1.67	1.70	3.72	4.57	4.40	4.27

Maori Hill Weekend days	Emission of PM ₁₀ each hour of the day in Maori Hill suburb (kg)									
	1	2	3	4	5	6	7	8	9	10
Home heating										
Open fire (wood)	0.0703	0.0703	0.0000	0.0000	0.0000	0.0000	0.1405	0.2810	0.5620	0.5620
Open fire (coal)	0.0454	0.0454	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Pre-1994 woodburners	1.3694	1.3694	1.2012	1.2012	1.2012	1.2012	2.2342	2.7628	3.0991	2.9309
1994-2000 woodburners	0.4372	0.3614	0.3497	0.3497	0.3497	0.3497	0.4982	0.5734	0.9685	0.7727
2001+ woodburners	0.3724	0.2255	0.2263	0.2263	0.2263	0.2263	0.3680	0.4387	0.7819	0.7078
Pellet burners	0.0041	0.0035	0.0032	0.0032	0.0032	0.0032	0.0055	0.0067	0.0090	0.0081
Multifuel burner (wood)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Multifuel burner (coal)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Gas burner	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0005	0.0007	0.0015	0.0009
Oil burner	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0010	0.0010	0.0010	0.0010
Sub-total	2.30	2.08	1.78	1.78	1.78	1.78	3.25	4.06	5.42	4.98
Motor Vehicles	0.0507	0.0405	0.0191	0.0210	0.0191	0.0261	0.0716	0.1057	0.2001	0.3821
Industrial and commercial										
Coal fired boilers	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Other combustion	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Processing	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Sub-total	0.05	0.04	0.02	0.02	0.02	0.03	0.07	0.11	0.20	0.38
Total	2.35	2.12	1.80	1.80	1.80	1.81	3.32	4.17	5.62	5.37

Emission of PM ₁₀ each hour of the day in Maori Hill suburb (kg)														
11	12	13	14	15	16	17	18	19	20	21	22	23	24	
	0.3085	0.3085	0.3085	0.3085	0.3085	0.3085	0.2221	0.4442	0.7774	0.7774	0.7774	0.6664	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0827	0.1655	0.2895	0.2895	0.2895	0.2482	0.0000	0.0000
	2.2342	2.2342	2.4024	2.5706	2.5706	2.5706	3.4354	3.7718	4.2763	4.2763	4.2763	3.9399	1.3694	1.3694
	0.7391	0.7391	0.9734	0.9851	1.0230	1.0230	1.6039	1.6665	2.0422	2.0422	2.0422	1.9433	0.5783	0.3940
	0.4190	0.4190	0.5661	0.5653	0.6388	0.6388	1.0919	1.2617	1.6390	1.6390	1.6390	1.4933	0.3630	0.2884
	0.0061	0.0061	0.0072	0.0075	0.0078	0.0078	0.0116	0.0127	0.0153	0.0153	0.0153	0.0142	0.0043	0.0037
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.5549	0.7314	0.7314	0.7314	0.7314	0.1164	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.3536	0.4661	0.4661	0.4661	0.4661	0.2330	0.0000
	0.0003	0.0003	0.0006	0.0007	0.0012	0.0012	0.0006	0.0019	0.0032	0.0040	0.0032	0.0026	0.0006	0.0003
	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0005	0.0005
	3.71	3.71	4.26	4.44	4.55	4.55	6.45	8.23	10.24	10.24	10.24	9.51	2.67	2.06
	0.6162	0.6982	0.8700	0.8268	0.7869	0.8828	1.0080	0.9905	0.4924	0.3745	0.2622	0.1970	0.1114	0.0674
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0014	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.62	0.70	0.87	0.83	0.79	0.88	1.01	0.99	0.49	0.37	0.26	0.20	0.11	0.07
	4.33	4.41	5.13	5.27	5.34	5.43	7.46	9.22	10.73	10.62	10.50	9.70	2.78	2.12

Emission of PM ₁₀ each hour of the day in Maori Hill suburb (kg)														
11	12	13	14	15	16	17	18	19	20	21	22	23	24	
	0.2132	0.2132	0.3198	0.4264	0.4264	0.4264	0.1952	0.5018	1.1012	1.1012	1.1012	0.9061	0.1405	0.0703
	0.0438	0.0438	0.0657	0.0876	0.0876	0.0876	0.0554	0.1426	0.3129	0.3129	0.3129	0.2574	0.0907	0.0454
	2.9309	2.9309	3.0991	3.6276	3.6276	3.6276	3.4354	3.9640	4.6607	4.6607	4.6607	4.1321	1.5375	1.3694
	0.8660	0.8660	1.2463	1.2833	1.3590	1.3967	1.6051	1.6424	2.0695	2.0695	2.0695	1.9569	0.5970	0.4372
	0.6739	0.6739	0.8224	0.8198	0.9669	1.0405	1.1898	1.1870	1.6369	1.6369	1.6369	1.4923	0.4705	0.3724
	0.0082	0.0082	0.0096	0.0105	0.0111	0.0113	0.0119	0.0128	0.0160	0.0160	0.0160	0.0145	0.0049	0.0041
	0.0773	0.0773	0.0773	0.0773	0.0773	0.0773	0.3688	0.3688	0.4861	0.4861	0.4861	0.4861	0.0000	0.0000
	0.1439	0.1439	0.1439	0.1439	0.1439	0.1439	0.2183	0.2183	0.2878	0.2878	0.2878	0.2878	0.0000	0.0000
	0.0005	0.0006	0.0006	0.0013	0.0016	0.0018	0.0007	0.0021	0.0032	0.0038	0.0032	0.0026	0.0006	0.0004
	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0005	0.0005
	4.96	4.96	5.79	6.48	6.70	6.81	7.08	8.04	10.58	10.58	10.58	9.54	2.84	2.30
	0.5874	0.7137	0.6500	0.5653	0.6006	0.5546	0.5666	0.4761	0.4041	0.2976	0.2060	0.1629	0.1138	0.0759
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.59	0.71	0.65	0.57	0.60	0.55	0.57	0.48	0.40	0.30	0.21	0.16	0.11	0.08
	5.55	5.67	6.44	7.04	7.30	7.37	7.65	8.52	10.98	10.87	10.78	9.70	2.96	2.38

**Appendix A Hourly emission of PM₁₀ by source type and suburb
Marchwiell**

Marchwiell Weekdays	Emission of PM ₁₀ each hour of the day in Marchwiell suburb (kg)									
	1	2	3	4	5	6	7	8	9	10
Home heating										
Open fire (wood)	0.3086	0.3086	0.3086	0.3086	0.3086	0.3086	0.4156	0.5486	0.4156	0.4156
Open fire (coal)	0.1754	0.1754	0.1754	0.1754	0.1754	0.1754	0.2935	0.3874	0.2935	0.2935
Pre-1994 woodburners	1.2012	1.2012	1.2012	1.2012	1.2012	1.2012	1.5856	1.7778	1.5856	1.5856
1994-2000 woodburners	1.2949	1.2949	1.0834	1.0404	1.0404	1.0404	1.2451	1.2587	1.0747	1.0747
2001+ woodburners	0.5837	0.5837	0.4990	0.4148	0.4148	0.4148	0.8728	0.8718	0.6337	0.6337
Pellet burners	0.0060	0.0060	0.0054	0.0051	0.0051	0.0051	0.0074	0.0077	0.0064	0.0064
Multifuel burner (wood)	0.8315	0.8315	0.8315	0.6957	0.6957	0.6957	1.1199	0.7917	0.7917	0.7917
Multifuel burner (coal)	0.5752	0.5752	0.5752	0.4813	0.4813	0.4813	0.5269	0.3724	0.3724	0.3724
Gas burner	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0017	0.0014	0.0004	0.0004
Oil burner	0.0006	0.0006	0.0006	0.0006	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Sub-total	4.98	4.98	4.68	4.32	4.32	4.32	6.07	6.02	5.17	5.17
Motor Vehicles	0.0082	0.0052	0.0055	0.0042	0.0070	0.0177	0.0515	0.1267	0.3483	0.2895
Industrial and commercial										
Coal fired boilers	0.0000	0.0000	0.0000	0.0000	0.0000	0.7997	0.7997	0.7997	0.7997	0.7997
Other combustion	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0031	0.0031	0.0043	0.0043
Processing	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Sub-total	0.01	0.01	0.01	0.00	0.01	0.82	0.85	0.93	1.15	1.09
Total	4.99	4.98	4.69	4.33	4.33	5.14	6.92	6.95	6.33	6.27

Marchwiell Weekend days	Emission of PM ₁₀ each hour of the day in Marchwiell suburb (kg)									
	1	2	3	4	5	6	7	8	9	10
Home heating										
Open fire (wood)	0.3138	0.3138	0.3138	0.3138	0.3138	0.3138	0.4615	0.6091	0.7568	0.7568
Open fire (coal)	0.1744	0.1744	0.1744	0.1744	0.1744	0.1744	0.2565	0.3386	0.4207	0.4207
Pre-1994 woodburners	1.5856	1.5856	1.5856	1.5856	1.3934	1.3934	1.5856	1.7778	2.3784	2.1862
1994-2000 woodburners	1.4073	1.3644	1.1530	1.1099	1.0535	1.0535	1.3297	1.3433	1.5978	1.5842
2001+ woodburners	0.7505	0.6663	0.5815	0.4973	0.4140	0.4140	0.9292	0.9282	1.1222	1.1233
Pellet burners	0.0073	0.0070	0.0064	0.0060	0.0054	0.0054	0.0077	0.0080	0.0100	0.0097
Multifuel burner (wood)	0.5359	0.5359	0.5359	0.5359	0.5359	0.5359	0.6098	0.6098	0.7576	0.7576
Multifuel burner (coal)	0.2303	0.2303	0.2303	0.2303	0.2303	0.2303	0.1782	0.1782	0.2214	0.2214
Gas burner	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0003	0.0006	0.0023	0.0018
Oil burner	0.0006	0.0006	0.0006	0.0006	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Sub-total	5.01	4.88	4.58	4.45	4.12	4.12	5.36	5.79	7.27	7.06
Motor Vehicles	0.0177	0.0137	0.0066	0.0072	0.0066	0.0093	0.0244	0.0372	0.0703	0.1343
Industrial and commercial										
Coal fired boilers	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Other combustion	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Processing	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Sub-total	0.02	0.01	0.01	0.01	0.01	0.01	0.02	0.04	0.07	0.13
Total	5.02	4.89	4.59	4.46	4.13	4.13	5.38	5.83	7.34	7.20

Emission of PM ₁₀ each hour of the day in Marchwiell suburb (kg)														
11	12	13	14	15	16	17	18	19	20	21	22	23	24	
	0.7442	0.7442	0.7442	0.7442	0.7442	0.7442	1.5828	1.9070	2.3838	2.3838	2.0596	2.0596	0.7624	0.7624
	0.4230	0.4230	0.4230	0.4230	0.4230	0.4230	0.7853	0.9461	1.1826	1.1826	1.0218	1.0218	0.4333	0.4333
	1.9940	1.9940	1.9940	1.9940	1.9940	2.1862	2.9790	4.3724	5.7898	5.7898	5.7898	5.3814	1.6096	1.2012
	1.1913	1.1913	1.1913	1.2340	1.2347	1.2912	2.3529	3.4923	3.6356	3.6356	3.6356	3.5639	1.6204	1.5065
	1.0386	1.0386	1.0386	1.1230	1.2354	1.3186	2.1677	2.6233	2.6998	2.6998	2.6998	2.6177	0.8352	0.6684
	0.0084	0.0084	0.0084	0.0087	0.0090	0.0097	0.0154	0.0211	0.0238	0.0238	0.0238	0.0228	0.0080	0.0067
	0.6009	0.6009	0.6009	0.6009	0.7466	0.7466	0.7721	0.9227	1.7136	1.7136	1.3935	1.2429	0.8315	0.8315
	0.3409	0.3409	0.3409	0.3409	0.4236	0.4236	0.3947	0.4717	0.8760	0.8760	0.7123	0.6353	0.5752	0.5752
	0.0003	0.0003	0.0003	0.0006	0.0007	0.0007	0.0009	0.0018	0.0040	0.0042	0.0031	0.0025	0.0006	0.0004
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0013	0.0013	0.0019	0.0019	0.0013	0.0013	0.0012	0.0012
	6.34	6.34	6.34	6.47	6.81	7.14	11.05	14.76	18.31	18.31	17.34	16.55	6.68	5.99
	0.2136	0.2346	0.2956	0.2801	0.2659	0.3001	0.4531	0.4454	0.1725	0.1311	0.0926	0.0692	0.0388	0.0233
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0015	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.22	0.23	0.30	0.28	0.27	0.30	0.45	0.45	0.17	0.13	0.09	0.07	0.04	0.02
	6.56	6.58	6.64	6.75	7.08	7.44	11.51	15.20	18.48	18.44	17.43	16.62	6.72	6.01

Emission of PM ₁₀ each hour of the day in Marchwiell suburb (kg)														
11	12	13	14	15	16	17	18	19	20	21	22	23	24	
	0.5907	0.5907	0.5907	0.5907	0.8950	0.8950	1.6095	1.7647	2.4240	2.4240	2.0943	2.0943	0.7753	0.7753
	0.3554	0.3554	0.3554	0.3554	0.5385	0.5385	0.7809	0.8562	1.1761	1.1761	1.0162	1.0162	0.4309	0.4309
	2.9790	2.9790	2.9790	2.9790	2.9790	3.1712	4.1562	4.9489	6.3423	6.3423	6.3423	5.7417	1.7778	1.5856
	1.7553	1.7553	1.8458	1.8884	1.8884	1.9023	2.5628	3.4895	3.6791	3.6791	3.6791	3.6366	1.6749	1.6187
	1.6491	1.6491	1.8285	1.9130	1.9130	1.9118	2.0770	2.4234	2.5952	2.5952	2.5952	2.5984	0.9188	0.8353
	0.0128	0.0128	0.0134	0.0138	0.0138	0.0141	0.0174	0.0214	0.0244	0.0244	0.0244	0.0234	0.0086	0.0080
	1.0108	1.0108	1.1502	1.1502	1.1502	1.1502	1.1894	1.3335	1.6219	1.6219	1.6219	1.4777	0.6658	0.6658
	0.3563	0.3563	0.4054	0.4054	0.4054	0.4054	0.3778	0.4236	0.5151	0.5151	0.5151	0.4693	0.2862	0.2862
	0.0006	0.0006	0.0007	0.0008	0.0011	0.0011	0.0013	0.0018	0.0038	0.0039	0.0031	0.0025	0.0004	0.0003
	0.0006	0.0006	0.0006	0.0006	0.0012	0.0012	0.0013	0.0013	0.0019	0.0019	0.0013	0.0013	0.0012	0.0012
	8.71	8.71	9.17	9.30	9.79	9.99	12.77	15.26	18.38	18.38	17.89	17.06	6.54	6.21
	0.2056	0.2406	0.2225	0.1983	0.2106	0.1949	0.1986	0.1673	0.1417	0.1040	0.0726	0.0573	0.0401	0.0265
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.21	0.24	0.22	0.20	0.21	0.19	0.20	0.17	0.14	0.10	0.07	0.06	0.04	0.03
	8.92	8.95	9.39	9.50	10.00	10.19	12.97	15.43	18.53	18.49	17.97	17.12	6.58	6.23

**Appendix A Hourly emission of PM₁₀ by source type and suburb
Parkside**

Parkside Weekdays	Emission of PM ₁₀ each hour of the day in Parkside suburb (kg)									
	1	2	3	4	5	6	7	8	9	10
Home heating										
Open fire (wood)	0.1798	0.1798	0.1798	0.1798	0.1798	0.1798	0.3985	0.3985	0.1992	0.1992
Open fire (coal)	0.0067	0.0067	0.0067	0.0067	0.0067	0.0067	0.0000	0.0000	0.0000	0.0000
Pre-1994 woodburners	1.5616	1.3694	0.9850	0.9850	0.7928	0.7928	0.9850	1.1772	1.1772	1.1772
1994-2000 woodburners	1.1876	1.0881	1.0619	1.0619	1.0059	1.0059	1.6159	1.8407	1.4598	1.4598
2001+ woodburners	0.5292	0.3618	0.3631	0.3631	0.2796	0.2796	0.3465	0.4305	0.3458	0.3458
Pellet burners	0.0062	0.0053	0.0046	0.0046	0.0040	0.0040	0.0056	0.0066	0.0056	0.0056
Multifuel burner (wood)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.4850	0.4850	0.4850	0.4850
Multifuel burner (coal)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.3641	0.3641	0.3641	0.3641
Gas burner	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0012	0.0010	0.0005	0.0005
Oil burner	0.0018	0.0018	0.0012	0.0012	0.0012	0.0012	0.0019	0.0019	0.0019	0.0019
Sub-total	3.47	3.01	2.60	2.60	2.27	2.27	4.20	4.71	4.04	4.04
Motor Vehicles	0.0097	0.0064	0.0067	0.0056	0.0078	0.0205	0.0596	0.1471	0.3072	0.2620
Industrial and commercial										
Coal fired boilers	0.0506	0.0506	0.0506	0.0506	0.0506	0.4440	0.4440	0.4440	0.4440	0.4440
Other combustion	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0037	0.2038
Processing	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Sub-total	0.06	0.06	0.06	0.06	0.06	0.46	0.50	0.59	0.75	0.91
Total	3.53	3.07	2.66	2.66	2.33	2.73	4.71	5.30	4.79	4.95

Parkside Weekend days	Emission of PM ₁₀ each hour of the day in Parkside suburb (kg)									
	1	2	3	4	5	6	7	8	9	10
Home heating										
Open fire (wood)	0.1351	0.1351	0.1351	0.1351	0.1351	0.1351	0.1497	0.1497	0.4491	0.2994
Open fire (coal)	0.0067	0.0067	0.0067	0.0067	0.0067	0.0067	0.0000	0.0000	0.0000	0.0000
Pre-1994 woodburners	1.7538	1.5616	1.1772	1.1772	1.1772	1.1772	1.1772	1.3694	1.9459	1.7538
1994-2000 woodburners	1.1630	1.1498	1.1235	1.1235	1.1235	1.1235	1.3360	1.5608	2.2964	2.1145
2001+ woodburners	0.4549	0.4556	0.4571	0.4571	0.4571	0.4571	0.6541	0.7379	0.7372	0.7376
Pellet burners	0.0063	0.0060	0.0053	0.0053	0.0053	0.0053	0.0063	0.0072	0.0096	0.0089
Multifuel burner (wood)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.2524	0.5770	1.1540	0.5770
Multifuel burner (coal)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1656	0.3785	0.7569	0.3785
Gas burner	0.0005	0.0005	0.0003	0.0003	0.0003	0.0003	0.0005	0.0007	0.0017	0.0014
Oil burner	0.0018	0.0018	0.0012	0.0012	0.0012	0.0012	0.0019	0.0019	0.0019	0.0019
Sub-total	3.52	3.32	2.91	2.91	2.91	2.91	3.74	4.78	7.35	5.87
Motor Vehicles	0.0205	0.0164	0.0075	0.0082	0.0075	0.0103	0.0288	0.0430	0.0818	0.1553
Industrial and commercial										
Coal fired boilers	0.0506	0.0506	0.0506	0.0506	0.0506	0.0506	0.0506	0.0506	0.0506	0.0506
Other combustion	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Processing	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Sub-total	0.07	0.07	0.06	0.06	0.06	0.06	0.08	0.09	0.13	0.21
Total	3.59	3.38	2.96	2.97	2.96	2.97	3.82	4.88	7.49	6.08

Emission of PM ₁₀ each hour of the day in Parkside suburb (kg)														
	11	12	13	14	15	16	17	18	19	20	21	22	23	24
	0.3985	0.3985	0.3985	0.3985	0.3985	0.3985	1.4414	1.4414	1.6188	1.7962	1.6188	1.4414	0.3596	0.3596
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0609	0.0609	0.0684	0.0759	0.0684	0.0609	0.0133	0.0133
	0.9850	0.9850	1.1772	1.3694	1.3694	1.3694	3.1471	3.5315	4.7087	4.7087	4.5165	4.5165	2.1381	1.7538
	1.2780	1.2780	1.2910	1.4726	1.5158	1.5158	3.3785	4.3556	5.1192	5.1192	4.9374	4.7256	1.4820	1.4124
	0.3460	0.3460	0.3455	0.3452	0.4293	0.4293	1.1242	1.2930	1.6373	1.6373	1.6376	1.5531	0.6957	0.6131
	0.0050	0.0050	0.0053	0.0060	0.0063	0.0063	0.0146	0.0176	0.0219	0.0219	0.0212	0.0206	0.0082	0.0072
	0.4850	0.4850	0.4850	0.4850	0.4850	0.7276	0.7427	0.9804	1.4557	1.4557	1.4557	1.4557	0.0000	0.0000
	0.3641	0.3641	0.3641	0.3641	0.3641	0.5462	0.5868	0.7745	1.1500	1.1500	1.1500	1.1500	0.0000	0.0000
	0.0002	0.0002	0.0002	0.0002	0.0005	0.0005	0.0012	0.0015	0.0031	0.0031	0.0026	0.0021	0.0010	0.0005
	0.0019	0.0019	0.0019	0.0019	0.0019	0.0019	0.0019	0.0019	0.0025	0.0025	0.0025	0.0025	0.0018	0.0018
	3.86	3.86	4.07	4.44	4.57	5.00	10.50	12.46	15.79	15.97	15.41	14.93	4.70	4.16
	0.2563	0.2803	0.3515	0.3338	0.3157	0.3579	0.4369	0.4282	0.1988	0.1528	0.1075	0.0804	0.0453	0.0273
	0.0506	0.0506	0.0506	0.0506	0.0506	0.0506	0.0506	0.0506	0.0506	0.0506	0.0506	0.0506	0.0506	0.0506
	0.0037	0.0037	0.0037	0.0037	0.0037	0.0037	0.0029	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.31	0.33	0.41	0.39	0.37	0.41	0.49	0.48	0.25	0.20	0.16	0.13	0.10	0.08
	4.17	4.20	4.47	4.83	4.94	5.41	10.99	12.94	16.03	16.17	15.57	15.06	4.80	4.24

Emission of PM ₁₀ each hour of the day in Parkside suburb (kg)														
	11	12	13	14	15	16	17	18	19	20	21	22	23	24
	0.6175	0.6175	0.6175	0.6175	0.6175	0.6175	1.0976	1.0976	1.3678	1.5029	1.3678	1.2327	0.4053	0.4053
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0546	0.0546	0.0680	0.0748	0.0680	0.0613	0.0202	0.0202
	1.9700	1.9700	2.5706	2.7628	3.1471	3.1471	3.5315	3.7237	4.5165	4.5165	4.3243	4.3243	2.1381	1.9459
	1.9040	1.9040	2.1152	2.4655	2.5350	2.5350	3.6581	4.4104	5.0145	5.0145	4.8327	4.6640	1.4442	1.3878
	0.8869	0.8869	0.9970	0.9972	1.0798	1.0798	1.1654	1.2504	1.4452	1.4452	1.4454	1.4451	0.6221	0.5388
	0.0093	0.0093	0.0109	0.0119	0.0129	0.0129	0.0159	0.0179	0.0208	0.0208	0.0202	0.0198	0.0079	0.0072
	0.9015	0.9015	1.1900	1.1900	1.1900	1.1900	1.3119	1.3119	1.5678	1.5678	1.5678	1.5678	0.2142	0.2142
	0.5913	0.5913	0.7806	0.7806	0.7806	0.7806	1.1952	1.1952	1.4284	1.4284	1.4284	1.4284	0.2898	0.2898
	0.0007	0.0007	0.0009	0.0009	0.0014	0.0015	0.0017	0.0019	0.0031	0.0031	0.0026	0.0024	0.0014	0.0008
	0.0019	0.0019	0.0019	0.0019	0.0019	0.0019	0.0019	0.0019	0.0025	0.0025	0.0025	0.0025	0.0018	0.0018
	6.88	6.88	8.28	8.83	9.37	9.37	12.03	13.07	15.43	15.58	15.06	14.75	5.14	4.81
	0.2461	0.2865	0.2653	0.2375	0.2524	0.2252	0.2369	0.1938	0.1646	0.1216	0.0840	0.0666	0.0462	0.0306
	0.0506	0.0506	0.0506	0.0506	0.0506	0.0506	0.0506	0.0506	0.0506	0.0506	0.0506	0.0506	0.0506	0.0506
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.30	0.34	0.32	0.29	0.30	0.28	0.29	0.24	0.22	0.17	0.13	0.12	0.10	0.08
	7.18	7.22	8.60	9.12	9.67	9.64	12.32	13.31	15.65	15.75	15.19	14.87	5.24	4.89

**Appendix A Hourly emission of PM₁₀ by source type and suburb
Seaview**

Seaview Weekdays	Emission of PM ₁₀ each hour of the day in Seaview suburb (kg)									
	1	2	3	4	5	6	7	8	9	10
Home heating										
Open fire (wood)	0.1280	0.1280	0.1280	0.1280	0.1280	0.1280	0.5225	0.3945	0.2666	0.2666
Open fire (coal)	0.1416	0.1416	0.1416	0.1416	0.1416	0.1416	0.5782	0.4366	0.2950	0.2950
Pre-1994 woodburners	0.8889	0.8889	0.8889	0.8889	0.6006	0.6006	1.2012	1.4895	0.8889	0.8889
1994-2000 woodburners	1.2942	1.2942	1.2942	1.2942	1.0209	1.0209	1.3158	1.8628	1.8222	1.8222
2001+ woodburners	0.5570	0.5570	0.5570	0.5570	0.5578	0.5578	0.5557	0.5557	0.5577	0.5577
Pellet burners	0.0055	0.0055	0.0055	0.0055	0.0045	0.0045	0.0060	0.0075	0.0065	0.0065
Multifuel burner (wood)	0.3518	0.3518	0.3518	0.3518	0.3518	0.3518	0.7328	0.7328	0.0000	0.0000
Multifuel burner (coal)	0.1860	0.1860	0.1860	0.1860	0.1860	0.1860	0.3875	0.3875	0.0000	0.0000
Gas burner	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0010	0.0009	0.0005	0.0005
Oil burner	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0018	0.0018	0.0009	0.0009
Sub-total	3.55	3.55	3.55	3.55	2.99	2.99	5.30	5.87	3.84	3.84
Motor Vehicles	0.0255	0.0167	0.0174	0.0148	0.0210	0.0531	0.1550	0.3855	0.7673	0.6339
Industrial and commercial										
Coal fired boilers	0.0000	0.0000	0.0000	0.0000	0.0000	0.0868	0.7343	0.7343	0.7343	0.7343
Other combustion	0.0035	0.0035	0.0035	0.0035	0.0035	0.0035	0.0000	0.0289	0.0435	0.6770
Processing	0.4391	0.4391	0.4391	0.4391	0.4391	0.4391	0.4391	1.6966	1.7008	1.7008
Sub-total	0.47	0.46	0.46	0.46	0.46	0.58	1.33	2.85	3.25	3.75
Total	4.02	4.01	4.01	4.01	3.46	3.57	6.63	8.71	7.08	7.58

Seaview Weekend days	Emission of PM ₁₀ each hour of the day in Seaview suburb (kg)									
	1	2	3	4	5	6	7	8	9	10
Home heating										
Open fire (wood)	0.1251	0.1251	0.1251	0.1251	0.1251	0.1251	0.3858	0.3858	0.6465	0.3858
Open fire (coal)	0.1227	0.1227	0.1227	0.1227	0.1227	0.1227	0.3783	0.3783	0.6339	0.3783
Pre-1994 woodburners	1.4895	1.4895	0.8889	0.8889	0.6006	0.6006	1.4895	2.0901	2.6907	2.6907
1994-2000 woodburners	1.5239	1.5239	1.4834	1.4834	1.2104	1.2104	1.5450	2.1148	2.1552	2.1552
2001+ woodburners	0.4289	0.4289	0.4309	0.4309	0.4315	0.4315	0.4290	0.5963	0.5944	0.5944
Pellet burners	0.0065	0.0065	0.0055	0.0055	0.0045	0.0045	0.0065	0.0090	0.0100	0.0100
Multifuel burner (wood)	0.3518	0.3518	0.3518	0.3518	0.3518	0.3518	0.0000	0.0000	0.7328	0.7328
Multifuel burner (coal)	0.1860	0.1860	0.1860	0.1860	0.1860	0.1860	0.0000	0.0000	0.3875	0.3875
Gas burner	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0005	0.0005	0.0012	0.0009
Oil burner	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0018	0.0018
Sub-total	4.24	4.24	3.60	3.60	3.03	3.03	4.24	5.58	7.85	7.34
Motor Vehicles	0.0531	0.0422	0.0202	0.0219	0.0202	0.0273	0.0752	0.1113	0.2129	0.4100
Industrial and commercial										
Coal fired boilers	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Other combustion	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Processing	0.4391	0.4391	0.4391	0.4391	0.4391	0.4391	0.4391	0.4391	0.4391	0.4391
Sub-total	0.49	0.48	0.46	0.46	0.46	0.47	0.51	0.55	0.65	0.85
Total	4.73	4.72	4.05	4.06	3.49	3.50	4.75	6.13	8.51	8.19

Emission of PM ₁₀ each hour of the day in Seaview suburb (kg)														
11	12	13	14	15	16	17	18	19	20	21	22	23	24	
	0.5225	0.5225	0.5225	0.5225	0.5225	0.5225	0.9031	1.0496	1.3425	1.3425	1.1960	0.9031	0.3945	0.3945
	0.5782	0.5782	0.5782	0.5782	0.5782	0.5782	0.7470	0.8681	1.1104	1.1104	0.9893	0.7470	0.4366	0.4366
	1.4895	1.4895	1.4895	1.4895	1.7778	1.7778	4.1562	4.4444	5.0450	5.0450	5.0450	5.0450	1.4655	1.1772
	1.6741	1.6741	1.7384	1.7384	2.0113	2.2645	2.9605	2.9801	4.0005	4.0005	4.0005	3.6828	1.7167	1.6315
	0.6815	0.6815	0.8080	0.8080	0.8074	0.8079	0.9794	0.9784	1.3673	1.3673	1.3673	1.2405	0.9766	0.6828
	0.0075	0.0075	0.0080	0.0080	0.0090	0.0094	0.0150	0.0155	0.0195	0.0195	0.0195	0.0185	0.0084	0.0069
	1.0846	1.0846	1.0846	1.0846	1.0846	1.0846	1.0846	1.4363	1.7881	1.7881	1.7881	1.7881	0.7035	0.7035
	0.5735	0.5735	0.5735	0.5735	0.5735	0.5735	0.5735	0.7595	0.9455	0.9455	0.9455	0.9455	0.3720	0.3720
	0.0007	0.0007	0.0007	0.0007	0.0007	0.0007	0.0009	0.0010	0.0014	0.0014	0.0010	0.0010	0.0003	0.0003
	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0027	0.0027	0.0018	0.0018	0.0018	0.0009
	6.61	6.61	6.80	6.80	7.37	7.62	11.42	12.53	15.62	15.62	15.35	14.37	6.08	5.41
	0.6429	0.7075	0.8857	0.8390	0.7987	0.8979	0.9597	0.9413	0.5235	0.4002	0.2796	0.2093	0.1178	0.0709
	0.7343	0.7343	0.7343	0.7343	0.7343	0.7343	0.7343	0.0868	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0400	0.0392	0.0300	0.0300	0.0299	0.0299	0.0007	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0035
	1.7812	1.7812	1.7008	1.7008	1.7008	1.7008	0.5209	0.5195	0.4391	0.4391	0.4391	0.4391	0.4391	0.4391
	3.20	3.26	3.35	3.30	3.26	3.36	2.22	1.55	0.96	0.84	0.72	0.65	0.56	0.51
	9.81	9.88	10.16	10.11	10.63	10.98	13.64	14.08	16.59	16.46	16.07	15.02	6.63	5.92

Emission of PM ₁₀ each hour of the day in Seaview suburb (kg)														
11	12	13	14	15	16	17	18	19	20	21	22	23	24	
	0.5109	0.5109	0.6361	0.6361	0.6361	0.6361	1.0323	1.0323	1.0323	1.0323	1.0323	1.0323	0.3858	0.3858
	0.5010	0.5010	0.6237	0.6237	0.6237	0.6237	1.0122	1.0122	1.0122	1.0122	1.0122	1.0122	0.3783	0.3783
	2.9550	3.2432	3.5315	3.5315	3.8198	3.8198	3.8438	4.4444	4.4444	4.4444	4.4444	4.4444	2.0661	1.7778
	2.2173	2.2368	2.3215	2.5741	2.5937	2.8464	3.1924	3.2330	3.9388	3.9388	3.9388	3.6212	1.9472	1.6082
	0.7334	0.7324	0.8573	0.8582	0.8572	0.8581	0.9952	0.9933	1.3833	1.3833	1.3833	1.2565	0.8481	0.5541
	0.0110	0.0115	0.0124	0.0129	0.0134	0.0139	0.0150	0.0160	0.0185	0.0185	0.0185	0.0175	0.0094	0.0075
	1.0846	1.0846	1.0846	1.0846	1.0846	1.0846	1.0846	1.4363	1.7881	1.7881	1.7881	1.7881	0.7035	0.7035
	0.5735	0.5735	0.5735	0.5735	0.5735	0.5735	0.5735	0.7595	0.9455	0.9455	0.9455	0.9455	0.3720	0.3720
	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0010	0.0013	0.0013	0.0012	0.0012	0.0002	0.0002
	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0027	0.0027	0.0018	0.0018	0.0018	0.0009
	8.59	8.90	9.64	9.90	10.20	10.46	11.75	12.93	14.57	14.57	14.57	14.12	6.71	5.79
	0.6174	0.7260	0.6709	0.5954	0.6331	0.5926	0.5978	0.5105	0.4326	0.3171	0.2188	0.1726	0.1204	0.0793
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.4391	0.4391	0.4391	0.4391	0.4391	0.4391	0.4391	0.4391	0.4391	0.4391	0.4391	0.4391	0.4391	0.4391
	1.06	1.17	1.11	1.03	1.07	1.03	1.04	0.95	0.87	0.76	0.66	0.61	0.56	0.52
	9.64	10.06	10.75	10.93	11.28	11.49	12.79	13.88	15.44	15.32	15.22	14.73	7.27	6.31

**Appendix A Hourly emission of PM₁₀ by source type and suburb
Watlington**

Watlington Weekdays	Emission of PM ₁₀ each hour of the day in Watlington suburb (kg)									
	1	2	3	4	5	6	7	8	9	10
Home heating										
Open fire (wood)	0.1113	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Open fire (coal)	0.0882	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Pre-1994 woodburners	1.0330	1.0330	0.8649	0.8649	0.8649	0.8649	1.5135	1.3453	0.8408	0.8408
1994-2000 woodburners	0.7457	0.7457	0.6964	0.6964	0.5491	0.5491	1.2598	1.4704	0.9541	0.9541
2001+ woodburners	0.5478	0.5478	0.4749	0.4749	0.4743	0.4743	0.7189	0.8677	0.6970	0.6970
Pellet burners	0.0046	0.0046	0.0041	0.0041	0.0038	0.0038	0.0068	0.0074	0.0051	0.0051
Multifuel burner (wood)	0.2867	0.2867	0.2867	0.2867	0.1434	0.1434	0.1254	0.1254	0.1254	0.1254
Multifuel burner (coal)	0.2053	0.2053	0.2053	0.2053	0.1027	0.1027	0.1198	0.1198	0.1198	0.1198
Gas burner	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0009	0.0005	0.0000	0.0000
Oil burner	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0005	0.0000	0.0000	0.0000
Sub-total	3.02	2.82	2.53	2.53	2.14	2.14	3.75	3.94	2.74	2.74
Motor Vehicles	0.0032	0.0021	0.0021	0.0017	0.0026	0.0070	0.0201	0.0494	0.1205	0.1006
Industrial and commercial										
Coal fired boilers	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Other combustion	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0022
Processing	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Sub-total	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.05	0.12	0.10
Total	3.03	2.83	2.53	2.53	2.14	2.14	3.77	3.99	2.86	2.85

Watlington Weekend days	Emission of PM ₁₀ each hour of the day in Watlington suburb (kg)									
	1	2	3	4	5	6	7	8	9	10
Home heating										
Open fire (wood)	0.1153	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Open fire (coal)	0.0923	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Pre-1994 woodburners	1.0330	1.0330	0.8649	0.8649	0.8649	0.8649	1.0330	1.2012	1.8739	1.7057
1994-2000 woodburners	0.7403	0.7403	0.6910	0.6910	0.5063	0.5063	0.7830	0.9797	1.5831	1.5705
2001+ woodburners	0.5372	0.5372	0.4643	0.4643	0.3899	0.3899	0.6216	0.6951	1.1110	1.0136
Pellet burners	0.0046	0.0046	0.0040	0.0040	0.0034	0.0034	0.0049	0.0058	0.0092	0.0086
Multifuel burner (wood)	0.3733	0.3733	0.2488	0.2488	0.2488	0.2488	0.2212	0.2212	0.2212	0.2212
Multifuel burner (coal)	0.2547	0.2547	0.1698	0.1698	0.1698	0.1698	0.1940	0.1940	0.1940	0.1940
Gas burner	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0009	0.0005
Oil burner	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Sub-total	3.15	2.94	2.44	2.44	2.18	2.18	2.86	3.30	4.99	4.71
Motor Vehicles	0.0070	0.0053	0.0025	0.0027	0.0025	0.0034	0.0097	0.0143	0.0274	0.0528
Industrial and commercial										
Coal fired boilers	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Other combustion	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Processing	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Sub-total	0.01	0.01	0.00	0.00	0.00	0.00	0.01	0.01	0.03	0.05
Total	3.16	2.95	2.45	2.45	2.19	2.19	2.87	3.31	5.02	4.77

Emission of PM ₁₀ each hour of the day in Watlington suburb (kg)														
11	12	13	14	15	16	17	18	19	20	21	22	23	24	
	0.0000	0.0000	0.0000	0.0000	0.1113	0.1113	0.2227	0.4454	0.6681	0.6681	0.6681	0.5567	0.2227	0.1113
	0.0000	0.0000	0.0000	0.0000	0.0882	0.0882	0.1764	0.3528	0.5292	0.5292	0.5292	0.4410	0.1764	0.0882
	1.3694	1.3694	1.3694	1.7057	1.8739	1.8739	2.4024	3.6036	3.7718	3.7718	3.7718	3.7718	1.8739	1.3694
	1.3809	1.3809	1.4183	1.5892	1.6759	1.6768	1.7896	2.0244	3.0626	3.0626	3.0626	3.0252	1.3250	1.0670
	0.6463	0.6463	0.7200	0.7190	0.8657	0.9639	1.2070	1.4957	2.2215	2.2215	2.2215	2.1477	1.0855	0.9402
	0.0066	0.0066	0.0069	0.0078	0.0086	0.0089	0.0107	0.0138	0.0181	0.0181	0.0181	0.0179	0.0086	0.0069
	0.1254	0.1254	0.1254	0.1254	0.1254	0.1254	0.4009	0.6682	1.0691	1.0691	1.0691	0.9355	0.5017	0.3763
	0.1198	0.1198	0.1198	0.1198	0.1198	0.1198	0.3358	0.5597	0.8956	0.8956	0.8956	0.7836	0.4791	0.3594
	0.0002	0.0002	0.0002	0.0002	0.0005	0.0005	0.0006	0.0009	0.0014	0.0016	0.0013	0.0012	0.0002	0.0002
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	3.65	3.65	3.76	4.27	4.87	4.97	6.55	9.16	12.24	12.24	12.24	11.68	5.67	4.32
	0.0839	0.0920	0.1153	0.1095	0.1040	0.1172	0.1817	0.1784	0.0673	0.0517	0.0360	0.0270	0.0152	0.0093
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.08	0.09	0.12	0.11	0.10	0.12	0.18	0.18	0.07	0.05	0.04	0.03	0.02	0.01
	3.73	3.74	3.88	4.38	4.97	5.09	6.73	9.34	12.30	12.29	12.27	11.71	5.69	4.33

Emission of PM ₁₀ each hour of the day in Watlington suburb (kg)														
11	12	13	14	15	16	17	18	19	20	21	22	23	24	
	0.0000	0.1153	0.1153	0.1153	0.1153	0.1153	0.1153	0.5767	0.6921	0.6921	0.6921	0.5767	0.2307	0.1153
	0.0000	0.0923	0.0923	0.0923	0.0923	0.0923	0.0923	0.4614	0.5537	0.5537	0.5537	0.4614	0.1846	0.0923
	1.8739	1.8739	1.8739	2.2102	2.3784	2.3784	2.2342	3.2673	3.7718	3.7718	3.7718	3.6036	2.0420	1.3694
	1.5667	1.5667	1.6048	1.8508	2.0848	2.0848	1.8958	2.0443	3.0680	3.0680	3.0680	3.0187	1.2943	1.0617
	1.0372	1.0372	1.2094	1.3557	1.5030	1.5030	1.5524	1.6942	2.2461	2.2461	2.2461	2.1732	1.0002	0.9296
	0.0089	0.0089	0.0095	0.0109	0.0120	0.0120	0.0116	0.0139	0.0182	0.0182	0.0182	0.0177	0.0085	0.0068
	0.2212	0.2212	0.2212	0.2212	0.2212	0.2212	0.3535	0.5892	0.9426	0.9426	0.9426	0.8248	0.6221	0.4977
	0.1940	0.1940	0.1940	0.1940	0.1940	0.1940	0.2720	0.4534	0.7254	0.7254	0.7254	0.6347	0.4245	0.3396
	0.0003	0.0003	0.0003	0.0003	0.0007	0.0007	0.0006	0.0009	0.0013	0.0015	0.0012	0.0012	0.0002	0.0002
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	4.90	5.11	5.32	6.05	6.60	6.60	6.53	9.10	12.02	12.02	12.02	11.31	5.81	4.41
	0.0806	0.0942	0.0872	0.0777	0.0825	0.0762	0.0778	0.0655	0.0556	0.0409	0.0282	0.0223	0.0155	0.0103
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.08	0.09	0.09	0.08	0.08	0.08	0.08	0.07	0.06	0.04	0.03	0.02	0.02	0.01
	4.98	5.20	5.41	6.13	6.68	6.68	6.61	9.17	12.07	12.06	12.05	11.33	5.82	4.42

**Appendix A Hourly emission of PM₁₀ by source type and suburb
West End**

West End Weekdays	Emission of PM ₁₀ each hour of the day in West End suburb (kg)									
	1	2	3	4	5	6	7	8	9	10
Home heating										
Open fire (wood)	0.3601	0.3601	0.3601	0.3601	0.3601	0.3601	0.6187	0.6187	0.4304	0.4304
Open fire (coal)	0.0582	0.0582	0.0582	0.0582	0.0582	0.0582	0.0000	0.0000	0.0000	0.0000
Pre-1994 woodburners	1.5616	1.3694	1.1772	1.1772	0.9850	0.9850	1.5616	1.5616	1.1772	1.1772
1994-2000 woodburners	0.8550	0.8417	0.8283	0.8283	0.8150	0.8150	1.2789	1.2789	1.2520	1.2520
2001+ woodburners	0.4265	0.4273	0.4282	0.4282	0.4290	0.4290	0.7082	0.7082	0.7100	0.7100
Pellet burners	0.0053	0.0050	0.0047	0.0047	0.0043	0.0043	0.0069	0.0069	0.0063	0.0063
Multifuel burner (wood)	0.1452	0.0000	0.0000	0.0000	0.0000	0.0000	0.2556	0.1278	0.1278	0.1278
Multifuel burner (coal)	0.0526	0.0000	0.0000	0.0000	0.0000	0.0000	0.1445	0.0723	0.0723	0.0723
Gas burner	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0012	0.0010	0.0006	0.0006
Oil burner	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006
Sub-total	3.47	3.06	2.86	2.86	2.65	2.65	4.58	4.38	3.78	3.78
Motor Vehicles	0.0069	0.0043	0.0044	0.0037	0.0058	0.0146	0.0439	0.1101	0.2518	0.1999
Industrial and commercial										
Coal fired boilers	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.6363	0.6363	0.6363	0.6363
Other combustion	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Processing	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Sub-total	0.01	0.00	0.00	0.00	0.01	0.01	0.68	0.75	0.89	0.84
Total	3.47	3.07	2.86	2.86	2.66	2.67	5.26	5.12	4.67	4.61

West End Weekend days	Emission of PM ₁₀ each hour of the day in West End suburb (kg)									
	1	2	3	4	5	6	7	8	9	10
Home heating										
Open fire (wood)	0.3564	0.3564	0.3564	0.3564	0.3564	0.3564	0.3226	0.3226	0.6453	0.4840
Open fire (coal)	0.0443	0.0443	0.0443	0.0443	0.0443	0.0443	0.0658	0.0658	0.1315	0.0986
Pre-1994 woodburners	1.3694	1.3694	1.1772	1.1772	1.1772	1.1772	1.5616	1.7538	1.9459	1.9459
1994-2000 woodburners	1.0531	1.0531	0.9536	0.9536	0.9536	0.9536	1.5384	1.7632	2.1139	1.9452
2001+ woodburners	0.5121	0.5121	0.3446	0.3446	0.3446	0.3446	0.8879	0.9718	0.9718	0.9713
Pellet burners	0.0056	0.0056	0.0047	0.0047	0.0047	0.0047	0.0079	0.0089	0.0099	0.0096
Multifuel burner (wood)	0.2216	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1108	0.2216	0.1108
Multifuel burner (coal)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1194	0.2388	0.1194
Gas burner	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0005	0.0010	0.0014	0.0011
Oil burner	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006
Sub-total	3.56	3.34	2.88	2.88	2.88	2.88	4.39	5.12	6.28	5.69
Motor Vehicles	0.0146	0.0116	0.0053	0.0059	0.0053	0.0075	0.0210	0.0317	0.0610	0.1169
Industrial and commercial										
Coal fired boilers	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Other combustion	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Processing	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Sub-total	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.03	0.06	0.12
Total	3.58	3.35	2.89	2.89	2.89	2.89	4.41	5.15	6.34	5.80

Emission of PM ₁₀ each hour of the day in West End suburb (kg)														
11	12	13	14	15	16	17	18	19	20	21	22	23	24	
	0.7144	0.7144	0.7144	0.7144	0.7144	0.7144	1.3683	1.5367	1.8735	1.8735	1.8735	1.8735	0.9003	0.7202
	0.1434	0.1434	0.1434	0.1434	0.1434	0.1434	0.3148	0.3535	0.4310	0.4310	0.4310	0.4310	0.1455	0.1164
	1.1772	1.1772	1.3694	1.3694	1.3694	1.5616	2.9550	4.1321	5.6937	5.6937	5.6937	5.3093	2.3544	2.1622
	0.9549	0.9979	1.0542	1.0542	1.0542	1.0676	1.5870	2.7414	4.4596	4.4596	4.4596	3.6951	1.2909	1.1095
	0.4566	0.5409	0.6242	0.6242	0.6242	0.6233	0.7867	0.8706	1.3000	1.3000	1.3000	1.2151	0.6205	0.6205
	0.0050	0.0053	0.0060	0.0060	0.0060	0.0063	0.0099	0.0142	0.0212	0.0212	0.0212	0.0189	0.0079	0.0073
	0.5990	0.5990	0.5990	0.5990	0.5990	0.5990	0.3721	0.3721	0.7293	0.8484	0.6102	0.4912	0.4356	0.1452
	0.4335	0.4335	0.4335	0.4335	0.4335	0.4335	0.2566	0.2566	0.5029	0.5850	0.4208	0.3387	0.1577	0.0526
	0.0004	0.0004	0.0004	0.0004	0.0004	0.0007	0.0007	0.0011	0.0025	0.0025	0.0019	0.0015	0.0005	0.0003
	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006
	4.49	4.61	4.95	4.95	4.95	5.15	7.65	10.28	15.01	15.22	14.81	13.37	5.91	4.93
	0.1791	0.1971	0.2456	0.2334	0.2221	0.2503	0.3331	0.3266	0.1447	0.1145	0.0802	0.0599	0.0335	0.0199
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.18	0.20	0.25	0.23	0.22	0.25	0.33	0.33	0.14	0.11	0.08	0.06	0.03	0.02
	4.66	4.81	5.19	5.18	5.17	5.40	7.98	10.61	15.16	15.33	14.89	13.43	5.95	4.95

Emission of PM ₁₀ each hour of the day in West End suburb (kg)														
11	12	13	14	15	16	17	18	19	20	21	22	23	24	
	0.7850	0.7850	0.7850	0.7850	0.7850	0.7850	1.1874	1.7082	1.8748	1.8748	1.8748	1.8748	0.9132	0.9132
	0.1951	0.1951	0.1951	0.1951	0.1951	0.1951	0.2101	0.3022	0.3317	0.3317	0.3317	0.3317	0.1135	0.1135
	2.1622	2.3544	2.5465	2.5465	2.5465	2.5465	3.7237	4.3243	5.5015	5.5015	5.3093	5.3093	2.5706	1.9700
	1.7827	1.8390	2.1093	2.4464	2.6150	2.6150	2.3372	3.2860	4.4514	4.4514	4.4383	3.8686	1.5057	1.1287
	0.6231	0.7065	1.0987	1.0997	1.1002	1.1002	1.0242	1.2209	1.6501	1.6501	1.6508	1.5650	0.3593	0.3598
	0.0086	0.0092	0.0112	0.0118	0.0122	0.0122	0.0132	0.0166	0.0219	0.0219	0.0215	0.0202	0.0079	0.0063
	0.4570	0.4570	0.4570	0.4570	0.4570	0.4570	0.3939	0.5200	0.6461	0.7721	0.6461	0.5200	0.2216	0.2216
	0.4925	0.4925	0.4925	0.4925	0.4925	0.4925	0.3217	0.4246	0.5275	0.6304	0.5275	0.4246	0.0000	0.0000
	0.0003	0.0003	0.0005	0.0007	0.0011	0.0011	0.0009	0.0010	0.0026	0.0026	0.0021	0.0015	0.0004	0.0004
	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006
	6.51	6.84	7.70	8.04	8.21	8.21	9.21	11.80	15.01	15.24	14.80	13.92	5.69	4.71
	0.1719	0.2034	0.1880	0.1661	0.1779	0.1677	0.1665	0.1449	0.1236	0.0909	0.0627	0.0492	0.0343	0.0222
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.17	0.20	0.19	0.17	0.18	0.17	0.17	0.14	0.12	0.09	0.06	0.05	0.03	0.02
	6.68	7.04	7.88	8.20	8.38	8.37	9.38	11.95	15.13	15.33	14.87	13.97	5.73	4.74

Appendix A Hourly emission of PM₁₀ by source type and suburb Washdyke

Washdyke Weekdays	Emission of PM ₁₀ each hour of the day in Washdyke (kg)									
	1	2	3	4	5	6	7	8	9	10
Home heating										
Open fire (wood)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Open fire (coal)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Pre-1994 woodburners	1.1051	1.1051	0.9610	0.9610	0.9610	0.9610	0.8168	0.9610	0.6967	0.6967
1994-2000 woodburners	0.5268	0.5268	0.5154	0.5154	0.3564	0.3564	0.3816	0.3919	0.3409	0.3409
2001+ woodburners	0.2593	0.2593	0.1763	0.1763	0.1130	0.1130	0.3300	0.3292	0.2674	0.2674
Pellet burners	0.0035	0.0035	0.0030	0.0030	0.0025	0.0025	0.0030	0.0032	0.0025	0.0025
Multifuel burner (wood)	0.1650	0.1650	0.1650	0.1650	0.0825	0.0825	0.0825	0.0000	0.0000	0.0000
Multifuel burner (coal)	0.1125	0.1125	0.1125	0.1125	0.0563	0.0563	0.0563	0.0000	0.0000	0.0000
Gas burner	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0004	0.0003	0.0001	0.0001
Oil burner	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Sub-total	2.17	2.17	1.93	1.93	1.57	1.57	1.67	1.69	1.31	1.31
Motor Vehicles	0.0222	0.0143	0.0152	0.0134	0.0181	0.0455	0.1333	0.3294	0.8694	0.7116
Industrial and commercial										
Coal fired boilers	10.191	10.191	10.191	10.191	10.994	10.994	11.044	11.848	11.848	11.848
Other combustion	0.0000	0.0000	0.0000	0.0000	0.0000	0.0412	0.0760	0.0760	0.3753	0.3776
Processing	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0171	0.0584	0.3362	0.3371
Sub-total	10.21	10.21	10.21	10.20	11.01	11.08	11.27	12.31	13.43	13.27
Total	12.39	12.38	12.14	12.14	12.58	12.65	12.94	14.00	14.74	14.58

Washdyke Weekend days	Emission of PM ₁₀ each hour of the day in Washdyke (kg)									
	1	2	3	4	5	6	7	8	9	10
Home heating										
Open fire (wood)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Open fire (coal)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Pre-1994 woodburners	0.9610	0.9610	0.8168	0.8168	0.8168	0.8168	0.6727	0.8168	0.8168	0.8168
1994-2000 woodburners	0.2267	0.2267	0.2140	0.2140	0.1782	0.1782	0.2663	0.2768	0.4347	0.4347
2001+ woodburners	0.1430	0.1430	0.0608	0.0608	0.0000	0.0000	0.3302	0.3293	0.3934	0.3934
Pellet burners	0.0023	0.0023	0.0019	0.0019	0.0016	0.0016	0.0025	0.0028	0.0032	0.0032
Multifuel burner (wood)	0.1129	0.1129	0.1129	0.1129	0.0000	0.0000	0.0000	0.0000	0.1129	0.1129
Multifuel burner (coal)	0.0770	0.0770	0.0770	0.0770	0.0000	0.0000	0.0000	0.0000	0.0770	0.0770
Gas burner	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0005	0.0003
Oil burner	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Sub-total	1.52	1.52	1.28	1.28	1.00	1.00	1.27	1.43	1.84	1.84
Motor Vehicles	0.0455	0.0363	0.0172	0.0186	0.0172	0.0239	0.0652	0.0958	0.1824	0.3498
Industrial and commercial										
Coal fired boilers	10.191	10.191	10.191	10.191	10.191	10.191	11.044	11.044	11.044	11.044
Other combustion	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0319	0.0334
Processing	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Sub-total	10.24	10.23	10.21	10.21	10.21	10.21	11.11	11.14	11.26	11.43
Total	11.76	11.75	11.49	11.49	11.20	11.21	12.38	12.57	13.10	13.27

Emission of PM ₁₀ each hour of the day in Washdyke (kg)														
11	12	13	14	15	16	17	18	19	20	21	22	23	24	
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1215	0.1215	0.1215	0.1215	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.6727	0.6727	0.8168	0.8168	0.9610	0.9610	1.1051	1.3694	1.7778	1.7778	1.7778	1.6336	1.1051	1.1051
	0.4975	0.4975	0.5076	0.5718	0.5821	0.5821	0.8504	1.5120	1.7578	1.7578	1.7578	1.6888	0.6528	0.5268
	0.3314	0.3314	0.3306	0.4571	0.4563	0.4563	0.5092	0.5730	0.7507	0.7507	0.7507	0.6354	0.2600	0.2593
	0.0030	0.0030	0.0032	0.0037	0.0039	0.0039	0.0048	0.0067	0.0083	0.0083	0.0083	0.0076	0.0037	0.0035
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1513	0.1513	0.1513	0.1513	0.1513	0.1513	0.1650	0.1650
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1032	0.1032	0.1032	0.1032	0.1032	0.1032	0.1125	0.1125
	0.0001	0.0001	0.0001	0.0001	0.0002	0.0002	0.0003	0.0005	0.0005	0.0005	0.0005	0.0005	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	1.50	1.50	1.66	1.85	2.00	2.00	2.72	3.84	4.67	4.67	4.67	4.22	2.30	2.17
	0.5553	0.6133	0.7899	0.7505	0.7142	0.8016	1.0746	1.0555	0.4482	0.3425	0.2398	0.1792	0.1009	0.0603
	11.848	11.848	11.848	11.848	11.848	11.848	11.848	10.994	10.994	10.994	10.994	10.994	10.191	10.191
	0.3763	0.3733	0.1116	0.1116	0.1116	0.1112	0.0771	0.0749	0.0412	0.0412	0.0412	0.0412	0.0000	0.0000
	0.3292	0.3292	0.3262	0.3262	0.3262	0.3262	0.1049	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	13.11	13.16	13.08	13.04	13.00	13.09	13.10	12.12	11.48	11.38	11.27	11.21	10.29	10.25
	14.61	14.67	14.73	14.89	15.00	15.09	15.83	15.96	16.15	16.05	15.95	15.43	12.59	12.42

Emission of PM ₁₀ each hour of the day in Washdyke (kg)														
11	12	13	14	15	16	17	18	19	20	21	22	23	24	
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1215	0.1215	0.1215	0.1215	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.8168	0.8168	0.9610	0.9610	0.9610	0.9610	1.3694	1.5135	1.8018	1.8018	1.8018	1.6577	0.9610	0.9610
	0.8656	0.8656	0.9078	0.9399	0.9399	0.9721	1.1537	1.4487	1.6594	1.6594	1.6594	1.6173	0.5107	0.3520
	0.3318	0.3318	0.3944	0.4576	0.4576	0.5208	0.5720	0.6353	0.7608	0.7608	0.7608	0.6982	0.2076	0.1441
	0.0039	0.0039	0.0044	0.0046	0.0046	0.0049	0.0060	0.0070	0.0082	0.0082	0.0082	0.0077	0.0031	0.0026
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.2070	0.2070	0.2070	0.2070	0.2070	0.2070	0.1129	0.1129
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1412	0.1412	0.1412	0.1412	0.1412	0.1412	0.0770	0.0770
	0.0002	0.0002	0.0002	0.0002	0.0003	0.0003	0.0004	0.0006	0.0006	0.0006	0.0006	0.0006	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	2.02	2.02	2.27	2.36	2.36	2.46	3.45	4.07	4.70	4.70	4.70	4.33	1.87	1.65
	0.5338	0.6272	0.5807	0.5147	0.5461	0.5061	0.5151	0.4355	0.3700	0.2714	0.1880	0.1486	0.1028	0.0685
	11.044	11.044	11.044	11.044	11.044	11.044	11.044	10.191	10.191	10.191	10.191	10.191	10.191	10.191
	0.0334	0.0334	0.0334	0.0334	0.0334	0.0334	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	11.61	11.70	11.66	11.59	11.62	11.58	11.56	10.63	10.56	10.46	10.38	10.34	10.29	10.26
	13.63	13.72	13.93	13.96	13.99	14.04	15.01	14.70	15.26	15.16	15.08	14.67	12.17	11.91

**Appendix A Hourly emission of PM₁₀ by source type and suburb
Timaru excluding Washdyke**

Timaru (excluding Washdyke) Weekdays	Emission of PM ₁₀ each hour of the day in Timaru (ex. Washdyke) (kg)									
	1	2	3	4	5	6	7	8	9	10
Home heating										
Open fire (wood)	1.42	1.30	1.20	1.20	1.20	1.20	2.78	3.09	2.24	2.24
Open fire (coal)	1.06	0.97	0.78	0.78	0.78	0.78	0.87	0.82	0.59	0.59
Pre-1994 woodburners	12.13	11.58	10.23	10.23	9.25	9.25	14.73	16.02	13.21	13.21
1994-2000 woodburners	8.39	8.04	7.70	7.65	7.06	7.06	10.59	11.59	9.30	9.30
2001+ woodburners	4.85	4.44	4.28	4.20	3.96	3.96	5.86	6.32	5.20	5.20
Pellet burners	0.05	0.05	0.04	0.04	0.04	0.04	0.06	0.07	0.05	0.05
Multifuel burner (wood)	2.09	1.94	1.94	1.81	1.66	1.66	3.99	3.34	2.50	2.50
Multifuel burner (coal)	1.57	1.52	1.52	1.42	1.32	1.32	1.89	1.64	1.18	1.18
Gas burner	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00
Oil burner	0.01	0.01	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01
Sub-total	31.56	29.84	27.71	27.35	25.29	25.29	40.78	42.91	34.30	34.30
Motor Vehicles	0.10	0.07	0.07	0.06	0.08	0.21	0.62	1.54	3.38	2.83
Industrial and commercial										
Coal fired boilers	1.41	1.41	1.41	1.41	1.41	2.69	3.98	4.12	4.12	4.12
Other combustion	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.11	1.36
Processing	0.44	0.44	0.44	0.44	0.44	0.44	0.44	1.70	1.72	1.72
Sub-total	1.96	1.92	1.92	1.91	1.94	3.35	5.04	7.39	9.33	10.02
Total	33.51	31.77	29.63	29.26	27.22	28.63	45.82	50.30	43.62	44.31

Timaru (excluding Washdyke) Weekend days	Emission of PM ₁₀ each hour of the day in Timaru (ex Washdyke) (kg)									
	1	2	3	4	5	6	7	8	9	10
Home heating										
Open fire (wood)	1.71	1.60	1.42	1.42	1.16	1.16	2.10	2.39	3.75	3.18
Open fire (coal)	1.29	1.19	0.99	0.99	0.68	0.68	0.70	0.78	1.19	0.90
Pre-1994 woodburners	13.89	13.53	11.58	11.58	10.79	10.79	14.92	17.25	21.89	21.17
1994-2000 woodburners	9.42	9.12	8.62	8.46	8.00	8.00	9.90	11.62	15.59	14.82
2001+ woodburners	5.35	4.94	4.35	4.05	4.04	4.04	6.16	6.86	8.23	8.20
Pellet burners	0.06	0.05	0.05	0.05	0.04	0.04	0.06	0.07	0.09	0.09
Multifuel burner (wood)	1.95	1.72	1.60	1.60	1.60	1.60	1.85	2.29	4.26	3.24
Multifuel burner (coal)	1.15	1.15	1.07	1.07	1.07	1.07	0.73	1.06	2.07	1.51
Gas burner	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01
Oil burner	0.01	0.01	0.01	0.01	0.00	0.00	0.01	0.01	0.01	0.01
Sub-total	34.81	33.31	29.68	29.23	27.38	27.38	36.42	42.32	57.08	53.11
Motor Vehicles	0.21	0.17	0.08	0.09	0.08	0.11	0.30	0.45	0.85	1.64
Industrial and commercial										
Coal fired boilers	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89
Other combustion	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Processing	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44
Sub-total	1.55	1.50	1.41	1.42	1.41	1.44	1.64	1.78	2.19	2.97
Total	36.36	34.82	31.09	30.65	28.79	28.82	38.06	44.11	59.27	56.09

Emission of PM ₁₀ each hour of the day in Timaru (excluding Washdyke) (kg)														
11	12	13	14	15	16	17	18	19	20	21	22	23	24	
	3.31	3.31	3.31	3.31	3.24	3.42	7.15	8.67	11.09	11.27	10.62	9.81	3.37	2.85
	1.14	1.14	1.14	1.14	1.23	1.23	3.38	4.32	5.82	5.83	5.54	5.01	2.20	1.68
	14.25	14.41	16.12	16.98	18.57	19.24	29.24	36.64	47.83	47.83	47.50	45.38	17.42	14.82
	10.09	10.15	10.76	11.34	12.18	12.67	20.55	26.05	33.82	33.94	33.37	30.98	11.88	10.20
	5.61	5.69	6.11	6.26	6.83	7.01	10.72	13.13	16.70	16.70	16.50	15.65	6.72	5.96
	0.06	0.06	0.06	0.07	0.07	0.07	0.12	0.14	0.19	0.19	0.19	0.18	0.07	0.06
	3.45	3.45	3.53	3.53	3.77	4.09	4.86	6.96	10.05	10.17	9.51	9.01	3.13	2.60
	2.49	2.49	2.51	2.51	2.68	2.87	2.51	3.63	5.52	5.60	5.20	4.85	2.47	2.01
	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.02	0.03	0.02	0.02	0.00	0.00
	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
	40.41	40.72	43.56	45.15	48.59	50.64	78.54	99.56	131.05	131.57	128.46	120.89	47.26	40.19
	2.61	2.88	3.60	3.42	3.25	3.66	4.53	4.44	2.10	1.60	1.12	0.84	0.47	0.29
	2.29	2.15	2.15	2.15	2.15	2.15	2.15	1.50	1.41	1.41	1.41	1.41	1.41	1.41
	0.10	0.10	0.09	0.09	0.09	0.09	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2.76	2.76	2.68	1.72	1.72	1.72	1.48	0.52	0.44	0.44	0.44	0.44	0.44	0.44
	7.76	7.89	8.52	7.38	7.21	7.62	8.22	6.46	3.95	3.45	2.97	2.69	2.32	2.14
	48.17	48.61	52.09	52.54	55.80	58.25	86.75	106.02	135.00	135.02	131.43	123.58	49.59	42.33

Emission of PM ₁₀ each hour of the day in Timaru (excluding Washdyke) (kg)														
11	12	13	14	15	16	17	18	19	20	21	22	23	24	
	3.47	3.58	3.97	4.13	4.43	4.59	6.34	8.46	11.37	11.50	10.91	10.35	3.45	3.26
	1.34	1.43	1.63	1.66	1.84	1.90	2.89	3.93	5.33	5.34	5.05	4.77	2.02	1.88
	22.41	23.06	27.17	28.76	31.28	31.78	33.23	40.07	48.79	48.79	48.24	46.29	19.34	16.91
	14.76	15.04	16.78	18.31	19.21	19.75	23.35	27.84	33.86	33.99	33.30	31.36	12.88	10.77
	8.56	8.72	10.15	10.67	11.17	11.38	12.00	13.61	16.51	16.65	16.53	15.89	6.57	5.94
	0.09	0.09	0.10	0.11	0.12	0.12	0.13	0.16	0.19	0.19	0.19	0.18	0.07	0.06
	4.43	4.43	4.93	4.93	5.00	5.00	6.00	7.45	9.27	9.39	9.19	8.73	2.95	2.83
	2.98	2.98	3.23	3.23	3.29	3.29	3.22	3.91	5.02	5.12	4.97	4.68	1.92	1.84
	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.03	0.02	0.02	0.00	0.00
	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
	58.05	59.34	67.99	71.81	76.36	77.84	87.17	105.46	130.38	131.02	128.41	122.27	49.21	43.50
	2.50	2.95	2.72	2.41	2.56	2.37	2.41	2.04	1.73	1.27	0.88	0.69	0.48	0.32
	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44
	3.83	4.29	4.05	3.74	3.89	3.70	3.75	3.37	3.06	2.61	2.21	2.03	1.82	1.66
	61.89	63.63	72.05	75.55	80.26	81.54	90.92	108.83	133.44	133.62	130.62	124.30	51.03	45.16

Appendix B: Home heating survey form

Timaru Home Heating Questionnaire

Good morning / afternoon/evening my name is _____ and I am calling on behalf of Environment Canterbury.

May I please speak to an adult in your household who knows about your home heating. We are currently undertaking a survey in your area on methods of home heating. We wish to know what you use **to heat your main living areas on a typically cold Winter's day, and night. ie A COLD WINTERS DAY OR NIGHT!**

TICK THOSE WHICH APPLY & RECORD THE APPROPRIATE NUMBERS eg HOURS ETC AS APPROPRIATE.

1. SUBURB _____

2. (a) Do you use an open fire (includes a visor fireplace) AT ANY TIME in your MAIN living areas on a TYPICALLY COLD Winter's day or night? YES [] NO [] *If NO GO TO Question 3*

(b) Do you use it	WEEKDAYS	WEEKENDS
i. Morning (6am - 10 am)	YES [] HRS ____	YES [] HRS ____
ii. Day time (10am - 4pm)	YES [] HRS ____	YES [] HRS ____
iii. Evening (4pm - 10pm)	YES [] HRS ____	YES [] HRS ____
iv. Night (10pm - 6am)	YES [] HRS ____	YES [] HRS ____

(c) Do you use wood on your open fire? YES [] NO [] *If NO GO TO Part (e)*

(d) How much wood do you use per day? (*ask them how many logs they use on a typically cold Winters day or night?*) WEEKDAYS ____ WEEKENDS ____

(e) Do you use coal on your open fire? YES [] NO [] *If NO GO TO Question 3.*

(f) How much coal do you use per day? (*ask them how many buckets of coal they use on a typically cold Winters day or night?*) WEEKDAYS ____ WEEKENDS ____

3. (a) Do you use any type of electrical heating in your MAIN living areas on a TYPICALLY COLD Winter's day or night? YES (1) [] NO (0) [] *If NO GO TO Question 4.*

(b) Do you use it	WEEKDAYS	WEEKENDS
i. Morning (6am - 10 am)	YES [] HRS ____	YES [] HRS ____
ii. Day time (10am - 4pm)	YES [] HRS ____	YES [] HRS ____
iii. Evening (4pm - 10pm)	YES [] HRS ____	YES [] HRS ____
iv. Night (10pm - 6am)	YES [] HRS ____	YES [] HRS ____

4. (a) Do you use any type of gas heating in your MAIN living areas on a TYPICALLY COLD Winter's day or night? YES (1) [] NO (0) [] *If NO GO TO Question 5 OVER PAGE.*

(b) Is it flued or unflued gas heating? FLUED (1) [] UNFLUED (2) [] BOTH (3) []

(c) Do you use it	WEEKDAYS	WEEKENDS
i. Morning (6am - 10 am)	YES [] HRS ____	YES [] HRS ____
ii. Day time (10am - 4pm)	YES [] HRS ____	YES [] HRS ____
iii. Evening (4pm - 10pm)	YES [] HRS ____	YES [] HRS ____
iv. Night (10pm - 6am)	YES [] HRS ____	YES [] HRS ____

(d) How much gas do you use ? (*ask them for the size of the gas bottles(s) and how often they would refill*)

them -(sizes are 2kg, 2.5kg, 3kg, 4.5kg, 9kg, 18kg, 20kg, 45kg, 90kg)

Size#1 _____ Freq#1 _____

Size#2 _____

Freq#2 _____

5. (a) Do you use a log burner? (*This is not a multi fuel burner ie does not burn coal*) in your **MAIN living area on a TYPICALLY COLD Winter's day or night.** YES [] NO [] *If NO GO TO Question 6.*

(b) How old is your log burner? **TICK** 10 yrs+ [] 6 - 10 yrs old [] 2 - 5 yrs [] 2004 + []

(c) Do you use it	WEEKDAYS	WEEKENDS
i. Morning (6am - 10 am)	YES [] HRS ____	YES [] HRS ____
ii. Day time (10am - 4pm)	YES [] HRS ____	YES [] HRS ____
iii. Evening (4pm - 10pm)	YES [] HRS ____	YES [] HRS ____
iv. Night (10pm - 6am)	YES [] HRS ____	YES [] HRS ____

6. (a) Do you use a burner which burns coal as well as wood - ie a multi fuel burner (*This includes incinerators, pot belly stoves, McKay space heaters etc.*) in your **MAIN living area on a TYPICALLY COLD Winter's day or night?** YES [] NO [] *If NO GO TO Question 7*

(b) How old is your burner? 10 yrs+[] 6 - 10 yrs old [] 2 - 5 yrs [] 2004 + []

(c) Do you use it	WEEKDAYS	WEEKENDS
i. Mornings (6am - 10 am)	YES [] HRS ____	YES [] HRS ____
ii. Day time (10am - 4pm)	YES [] HRS ____	YES [] HRS ____
iii. Evening (4pm - 10pm)	YES [] HRS ____	YES [] HRS ____
iv. Night (10pm - 6am)	YES [] HRS ____	YES [] HRS ____

(d) Do you use wood on your multi fuel burner? YES [] NO [] *If NO GO TO Part (f)*

(e) How much wood do you use per day? (*ask them how many logs they use on a TYPICALLY COLD Winters day or night*) WEEKDAYS ____ WEEKENDS ____

(f) Do you use coal on your multi fuel burner? YES [] NO [] *If NO GO TO Question 7.*

(g) How much coal do you use per day? (*how many buckets of coal used on a TYPICALLY COLD Winters day or night*) WEEK DAYS ____ WEEKEND DAYS ____

7. (a) Do you use an oil fired heating system in your **MAIN living area on a TYPICALLY COLD Winter's day or night?** YES [] NO [] *If NO GO TO END.*

(b) Do you use it	WEEKDAYS	WEEKENDS
i. Mornings (6am - 10 am)	YES [] HRS ____	YES [] HRS ____
ii. Day time (10am - 4pm)	YES [] HRS ____	YES [] HRS ____
iii. Evening (4pm - 10pm)	YES [] HRS ____	YES [] HRS ____
iv. Night (10pm - 6am)	YES [] HRS ____	YES [] HRS ____

(c) How much oil do you use? _____

END –

THANK YOU VERY MUCH FOR YOUR HELP WITH THIS SURVEY.

Appendix C: Vehicle emission factors used in this study

	Suburban, LOS A,B				Suburban, LOS C,D				Central urban, LOS A,B			
	CO	NO _x	PM	Benzene	CO	NO _x	PM	Benzene	CO	NO _x	PM	Benzene
Motorcycle	11.09	0.11	0.0319	0.090804	17.1	0.12	0.0359	0.103306	12.82	0.11	0.0347	0.0987
Car petrol	6.5	0.93	0.0115	0.090146	10.03	1.03	0.0129	0.102648	7.51	0.89	0.0125	0.098042
Car diesel	1.03	0.52	0.2212	0.003232	1.18	0.55	0.2895	0.004242	1.03	0.47	0.2949	0.003232
Car CNG	2.15	0.62	0.0077	0	3.31	0.69	0.0087	0	2.48	0.6	0.0084	0
Car LPG	4.88	0.93	0.0086	1.292E-05	7.52	1.03	0.0097	1.471E-05	5.64	0.89	0.0094	1.405E-05
LCV petrol	8.93	1.21	0.0139	0.119098	13.75	1.24	0.0156	0.135548	10.27	1.27	0.0149	0.132258
LCV diesel	1.13	0.52	0.2634	0.003434	1.28	0.55	0.3427	0.004444	1.13	0.6	0.3293	0.003434
LCV CNG	2.95	0.81	0.0093	0	4.54	0.83	0.0104	0	3.39	0.85	0.01	0
LCV LPG	6.7	1.21	0.0104	1.707E-05	10.32	1.24	0.0117	1.943E-05	7.7	1.27	0.0112	1.895E-05
HCV small diesel	1.3	7.03	0.4883	0.007575	1.7	8.77	0.6397	0.011312	1.77	8.19	0.5694	0.008787
HCV medium diesel	1.41	8.9	0.5596	0.009292	1.65	9.89	0.6529	0.012423	1.65	8.9	0.5596	0.009292
HCV large diesel	2.53	18.85	1.0057	0.017675	2.73	19.35	1.0839	0.021715	3.21	20.47	1.0922	0.01919
HCV small CNG	0.91	3.51	0.0098	0	1.19	4.38	0.0128	0	1.24	4.1	0.0114	0
HCV medium CNG	0.99	4.45	0.0112	0	1.15	4.95	0.0131	0	1.15	4.45	0.0112	0
HCV large CNG	1.77	9.43	0.0201	0	1.91	9.67	0.0217	0	2.25	10.24	0.0218	0
HCV small LPG	1.3	5.27	0.0244	7.073E-06	1.7	6.57	0.032	1.056E-05	1.77	6.14	0.0285	8.204E-06
HCV medium LPG	1.41	6.68	0.028	8.676E-06	1.65	7.42	0.0326	1.16E-05	1.65	6.68	0.028	8.676E-06
HCV large LPG	3.53	14.14	0.0503	1.65E-05	2.73	14.51	0.0542	2.027E-05	3.21	15.35	0.0546	1.792E-05
Bus medium diesel	1.41	8.9	0.5596	0.009292	1.65	9.89	0.6529	0.012423	1.65	8.9	0.5596	0.009292
Bus large diesel	2.53	18.85	1.0057	0.017675	2.73	19.35	1.0839	0.021715	3.21	20.47	1.0922	0.01919
Bus medium CNG	0.99	4.45	0.0112	0	1.15	4.95	0.0131	0	1.15	4.45	0.0112	0
Bus large CNG	1.77	9.43	0.0201	0	1.91	9.67	0.0217	0	2.25	10.24	0.0218	0
Bus medium LPG	1.41	6.68	0.028	8.676E-06	1.65	7.42	0.0326	1.16E-05	1.65	6.68	0.028	8.676E-06
Bus large LPG	2.53	14.14	0.0503	1.65E-05	2.73	14.51	0.0542	2.027E-05	3.21	15.35	0.0546	1.792E-05

	Central urban, LOS C,D				Suburban, Cold start				Central urban, Cold start			
	CO	NO _x	PM	Benzene	CO	NO _x	PM	Benzene	CO	NO _x	PM	Benzene
Motorcycle	21.44	0.15	0.0483	0.13818	60.57	0.14	0.147	0.459942	79.53	0.13	0.1371	0.421778
Car petrol	12.57	1.2	0.0174	0.137522	35.51	1.16	0.0529	0.45731	46.63	1.07	0.0493	0.419146
Car diesel	1.23	0.72	0.4033	0.004444	2.46	0.9	0.5067	0.006767	2.58	1.06	0.7058	0.00707
Car CNG	4.15	0.8	0.0116	0	11.72	0.78	0.0354	0	15.39	0.72	0.0331	0
Car LPG	9.43	1.2	0.013	1.971E-05	26.63	1.16	0.0397	6.554E-05	34.97	1.07	0.037	6.007E-05
LCV petrol	17.5	1.58	0.0212	0.186872	49.68	1.45	0.059	0.54285	63.45	1.38	0.0548	0.51982
LCV diesel	1.36	0.93	0.4541	0.004747	2.69	0.89	0.5997	0.006767	2.86	1.36	0.7947	0.007171
LCV CNG	5.78	1.06	0.0142	0	16.39	0.97	0.0395	0	20.94	0.92	0.0367	0
LCV LPG	13.13	1.58	0.0159	2.678E-05	37.26	1.45	0.0443	7.78E-05	47.59	1.38	0.0411	7.45E-05
HCV small diesel	2.09	10.48	0.7711	0.011918	2.08	10.23	0.7996	0.01414	2.56	12.33	1.0031	0.014847
HCV medium diesel	1.92	11.21	0.7461	0.012423	1.99	11.54	0.8161	0.015554	2.32	13.19	0.9886	0.015554
HCV large diesel	3.7	25.48	1.4395	0.02525	3.24	22.57	1.3548	0.027169	4.4	29.98	1.9857	0.031613
HCV small CNG	1.47	5.24	0.0154	0	1.45	5.11	0.016	0	1.79	6.16	0.0201	0
HCV medium CNG	1.35	5.6	0.0149	0	1.39	5.77	0.0163	0	1.63	6.59	0.0198	0
HCV large CNG	2.59	12.74	0.0288	0	2.27	11.29	0.0271	0	3.08	14.99	0.0392	0
HCV small LPG	2.09	7.86	0.0386	1.113E-05	2.08	7.67	0.04	1.32E-05	2.56	9.25	0.0502	1.386E-05
HCV medium LPG	1.92	8.41	0.0373	1.16E-05	1.99	18.65	0.0408	1.452E-05	2.32	9.89	0.0494	1.452E-05
HCV large LPG	3.7	19.11	0.072	2.358E-05	3.24	16.93	0.0677	2.537E-05	4.4	22.49	0.0979	2.952E-05
Bus medium diesel	1.92	11.21	0.7461	0.012423	1.99	11.54	0.8161	0.015554	2.32	13.19	0.9886	0.015554
Bus large diesel	3.7	25.48	1.4395	0.02525	3.24	22.57	1.3548	0.027169	4.4	29.98	1.9587	0.031613
Bus medium CNG	1.35	5.6	0.0148	0	1.39	5.77	0.0163	0	1.63	6.59	0.0198	0
Bus large CNG	2.59	12.74	0.0288	0	2.27	11.29	0.0271	0	3.08	14.99	0.0392	0
Bus medium LPG	1.92	8.41	0.0373	1.16E-05	1.99	8.65	0.0408	1.452E-05	2.32	9.89	0.0494	1.452E-05
Bus large LPG	3.7	19.11	0.072	2.358E-05	3.24	16.93	0.0677	2.537E-05	4.4	22.49	0.0979	2.952E-05

PM _{2.5} multipliers			
Motorcycle	56%	HCV small CNG	100%
Car petrol	58%	HCV medium CNG	100%
Car diesel	89%	HCV large CNG	100%
Car CNG	100%	HCV small LPG	100%
Car LPG	100%	HCV medium LPG	100%
LCV petrol	57%	HCV large LPG	100%
LCV diesel	88%	Bus medium diesel	91%
LCV CNG	100%	Bus large diesel	91%
LCV LPG	100%	Bus medium CNG	100%
HCV small diesel	91%	Bus large CNG	100%
HCV medium diesel	91%	Bus medium LPG	100%
HCV large diesel	91%	Bus large LPG	100%

SO _x Fleet average	Su A,B	Su C,D	CU A,B	CU C,D
g/VKT	0.22	0.24	0.26	0.32

Emissions from the industrial and commercial sector were estimated by applying emission factors to point source-based activity data. The 2005 assessment includes all known industrial and commercial facilities with significant emissions in the Timaru and Washdyke areas. PM₁₀, PM_{2.5}, CO, NO_x, SO_x emissions were assessed, as was benzene. Other volatile organic compounds were excluded.

Appendix D: Industrial emissions survey form

Industry Questionnaire
Timaru Emissions Inventory 2005
 Please complete and return by 18 November 2005

Company or organisation name

Resource consent number(s) if applicable

Street address

Postal address

Name of person completing questionnaire

Position

Contact telephone number

PLEASE RING (03) 371 7196 IF YOU NEED HELP WITH, OR WOULD LIKE TO DISCUSS THIS QUESTIONNAIRE.

1. What type of activity is undertaken at your site?
2. Is the activity mobile and if so, how often is it undertaken within Timaru?
3. Please indicate whether the following equipment or activities are used or undertaken by the business:

- | | | | |
|--|---|--|--|
| <input type="checkbox"/> Abrasive blasting | <input type="checkbox"/> Animal feed manufacture | <input type="checkbox"/> Asphalt manufacture | <input type="checkbox"/> Coal/wood - fired boiler/heater |
| <input type="checkbox"/> Concrete production | <input type="checkbox"/> Electric arc welding | <input type="checkbox"/> Flour/grain milling | <input type="checkbox"/> Foundry |
| <input type="checkbox"/> Incinerator | <input type="checkbox"/> Liquid fuel - driven generator | <input type="checkbox"/> Liquid fuel - fired boiler/heater | <input type="checkbox"/> Quarrying |
| <input type="checkbox"/> LPG -fired boiler/heater | <input type="checkbox"/> Meat smoking | <input type="checkbox"/> Powder coating | |
| <input type="checkbox"/> Seed cleaning/handling | <input type="checkbox"/> Wood waste disposal (cyclone) | | |
| <input type="checkbox"/> Other (please specify)..... | | | |

4. If you use a solid fuel, liquid fuel or gas fired heating appliance or generator (other than small, portable, non-flued appliances), please fill out the following details (the first, shaded row is provided as an example):

Type of appliance ¹	Rating (kW)	Fuel Type	Type of emission control equipment	Operating Schedule and Fuel Use											
				June		July		August		Sep-Nov		Dec-Feb		Mar-May	
				Hours and days of operation	Average monthly fuel use ²	Hours and days of operation	Average monthly fuel use ²	Hours and days of operation	Average monthly fuel use ²	Hours and days of operation	Total fuel used in period ²	Hours and days of operation	Total fuel used in period ²	Hours and days of operation	Total fuel used in period ²
FOR EXAMPLE: Vekos coal boiler	450 kW	coal	baghouse filter	Mon –Fri 08.00-12.00 Sat- 08.00-10.00	30 tonnes	Mon –Fri 08.00-12.00	25 tonnes	Mon –Fri 08.00-12.00	25 tonnes	Mon –Fri 08.00-12.00	80 tonnes	Mon –Fri 08.00-12.00	80 tonnes	Mon –Fri 08.00-12.00	80 tonnes
Please state any variation to the rate of operation of the appliance here: (for example: Boiler is run at 75% (08.00 - 10.00) and at 20% (10.00 - 12.00))															
Any other comments?:															

¹ In column 1, please indicate brand/type of boiler e.g.- for coal boilers - chain grate, vekos, underfeed stoker, low ram etc

² Use either kg, tonnes or litres as units and indicate which one is used.

5. For other discharge sources please fill out the following details (the first, shaded row is provided as an example):

PLEASE REFER TO ATTACHMENT 1 IF UNSURE OF DATA REQUIRED:

Discharge type	Rate of operation ¹	Material used	Type of control equipment	Wintertime operating schedule and material used						Sep-Nov		Dec-Feb		Mar-May	
				June		July		August		Hours and days of operation	Material Use ²	Hours and days of operation	Material Used ²	Hours and days of operation	Material Used ²
				Hours and days of operation	Average monthly material use ¹	Hours and days of operation	Average monthly material use ¹	Hours and days of operation	Average monthly material use ¹						
FOR EXAMPLE: Abrasive Blasting	120 kg/hr	Garnet	Filtration system	Mon – Fri 08.00 - 12.00 Sat 08.00 - 10.00	30 tonnes	Mon – Fri 08.00 - 12.00	25 tonnes	Mon -Fri 08.00 - 12.00	25 tonnes	Mon –Fri 08.00-12.00	80 tonnes	Mon –Fri 08.00-12.00	80 tonnes	Mon –Fri 08.00-12.00	80 tonnes
Please state any variation to the rate or nature of operation here: <i>(for example: glass used instead of garnet 10% of the time)</i>															
Any other comments?:															

¹ Use either kg/hour, tonnes/hour or litres/hour as units and indicate which one is used

²Total amount of material used over the entire time period

1. If the emissions from any processes or equipment have been measured please outline these below and attach emission test data if available.

Discharge Type	Compounds Measured	Discharge Rate	Tested By

For Office Use Only

Name

File number

Resource consent number(s)

Data entered

Attachment 1: Types of activity data required for different industries

Discharge type	Type of activity data required	Other data required
<i>Abrasive blasting</i>	<i>Quantity of abrasive material used</i>	<i>Type of material eg, sand, garnet or metal</i>
<i>Aggregate handling and storage piles</i>	<i>Tonnes of material transferred</i>	<i>Type of material</i>
<i>Asphalt plants</i>	<i>Tonnes of product produced; Amount of fuel used by burner</i>	<i>Process type eg, batch mix or drum mix, type of control equipment eg, venturi scrubber</i>
<i>Coal – fired boiler</i>	<i>Tonnes of coal burnt</i>	<i>Type of boiler eg, chain grate, vekos, underfeed stoker etc; Rating of boiler (kilowatts, BTU, etc)</i>
<i>Concrete Batching</i>	<i>Tonnes of concrete produced</i>	<i>Type of control equipment (eg baghouse filters)</i>
<i>Diesel – fired boiler</i>	<i>Litres or tonnes of diesel burnt</i>	<i>Rating of boiler (kilowatts, BTU, etc)</i>
<i>Diesel – driven generator</i>	<i>Litres or tonnes of diesel burnt</i>	<i>Type of use – load shedding, or emergency only? Rating of generator (kilowatts, kVA, BTU, etc)</i>
<i>Electric Arc Welding</i>	<i>Kilograms of rod used</i>	<i>Type of rod used (mig/CE, etc), type of control equipment</i>
<i>Flour Milling</i>	<i>Tonnes of flour produced</i>	<i>Type of control equipment (eg baghouse filter)</i>
<i>Foundry</i>	<i>Amount of metal melted, amount of fuel used</i>	<i>Type of metal, type of furnace, type of control equipment (eg, baghouse filter)</i>
<i>Incinerators</i>	<i>Type and Amount of material burnt</i>	<i>Type of control equipment</i>
<i>Light fuel oil (LFO) – fired boilers</i>	<i>Litres or tonnes of LFO burnt</i>	<i>Rating of boiler (kilowatts, BTU, etc)</i>
<i>LPG – fired boilers</i>	<i>Tonnes of LPG burnt</i>	<i>Rating of boiler (kilowatts, BTU, etc)</i>
<i>Meat smoking</i>	<i>Amount of wood used</i>	<i>Batch or continuous process, control equipment eg, wet scrubber and de-mister</i>
<i>Pneumatic conveying of wood waste</i>	<i>Hours conveying occurs and quantity (m³) of material conveyed</i>	<i>Type and number of machines, type of wood or wood product</i>
<i>Powder coating and other metal coating methods</i>	<i>Area coated and type of coating products used</i>	<i>Types of objects being coated, control equipment</i>
<i>Quarrying</i>	<i>Tonnes of material processed</i>	<i>Type of material eg, coal, lime etc, control equipment or measures (eg water sprays)</i>
<i>Seed cleaning and handling</i>	<i>Tonnes of seed cleaned/ handled</i>	<i>Type of control equipment</i>
<i>Waste oil – fired burners</i>	<i>Litres or tonnes of waste oil burnt</i>	<i>Ash and sulphur content of fuel</i>
<i>Wood - fired burners</i>	<i>Type and tonnage of wood burnt</i>	<i>Type of control equipment, moisture content</i>

Appendix E: Industrial emission factors used in this study

Discharge types	Unit	PM ₁₀	Rating ¹	PM _{2.5}	Rating	NO _x	Rating	SO _x	Rating	CO	Rating	Benzene	Rating
Abrasive blasting sand uncontrolled	g/kg blast medium	13	E	1.3	E								
Abrasive blasting garnet fabric filter	g/kg blast medium	0.69	E										
Animal feed processing	g/kg	0.051	N/A										
Asphalt plant oil-fired drum mix venturi scrubber	g/kg product	0.023	A			0.028	E	0.0055	C	0.044	B		
Coal-fired boiler. Underfeed- no control	g/kg fuel	3.1	E	1.9	E	4.75	B	15.5	B	5.5	E	0.0007	E
Coal-fired boiler Underfeed stoker with cyclones	g/kg fuel	3.1	E	1.9	C	4.75	A	15.5	A	5.5	E	0.0007	E
Coal-fired boiler Overfeed stoker with cyclones	g/kg fuel	2.5	E	1.9	E	3.75	C	19	B	3	E	0.0007	E
Diesel-fired boiler/heater	g/l fuel	0.13	D	0.1	D	2.4	A	1.37	A	0.6	D	3E-05	D
Diesel driven generator < 450kW	g/l fuel	4.75	D			67.7	D	0.83	A	14.6	D	0.014	E
Diesel driven generator > 450kW	g/l fuel	0.88	B			49.1	B	0.83	A	13.06	C	0.011	C
Electric arc welding mig	g/kg rod	9.2	N/A										
Electric arc welding covered electrode	g/kg rod	20.17	N/A										
Grey iron furnace cupola with top	k/kg material	4	N/A										
Light fuel oil boiler/heater	g/l fuel	0.462	B			2.4	B	24	B	0.6	B		
Iron electric arc furnace uncontrolled	kg/tn product	12.63	N/A										
Liquefied petroleum gas-fired boiler/heater	g/kg fuel	0.11	E	0.11 ²	E	3.345	E			0.8	E		
Quarrying tertiary crushing	kg/tn product	0.001	N/A	0.0002	N/A								
Seed cleaning/handling uncontrolled	kg/tn product	0.013	N/A	0.004	N/A								
Waste oil-fired boiler/heater Space heater atomizing	g/kg fuel	7.7	E			1.92	D	25.68	D	0.25	D		
Waste oil-fired boiler/heater Space heater vaporising	g/kg fuel	0.336	E			1.32	D	24	D	0.2	D		

1: AP-42 emission factors are rated in reliability from E to A, with A being the most reliable. The factors found in Econompoulos (1993) are not rated. In some cases a single process emission factor has been calculated from a number of sub-process factors with different ratings. In these cases no single rating is assigned.

2: LPG PM_{2.5}, 100% of PM₁₀ assumed.

Abrasive blasting sand uncontrolled	AP-42 Chapter 13.2.6
Abrasive blasting garnet fabric filter	AP-42 Chapter 13.2.6
Animal feed processing	AP-42 Chapter 9.4
Asphalt plant oil-fired drum mix venturi scrubber	Economopoulos Section 354
Coal-fired boiler. Underfeed- no control	AP-42 Chapter 1.1
Coal-fired boiler Underfeed stoker with cyclones	AP-42 Chapter 1.1
Coal-fired boiler Overfeed stoker with cyclones	AP-42 Chapter 1.1
Diesel-fired boiler/heater	AP-42 Chapter 1.3
Diesel driven generator < 450kW	AP-42 Chapter 3.3
Diesel driven generator > 450kW	AP-42 Chapter 3.3
Electric arc welding mig	AP-42 Chapter 12.19
Electric arc welding covered electrode	AP-42 Chapter 12.19
Grey iron furnace cupola with top	Economopoulos Section 371
Light fuel oil boiler/heater	AP-42 Chapter 1.3
Iron electric arc furnace uncontrolled	Economopoulos Section 371
Liquefied petroleum gas-fired boiler/heater	AP-42 Chapter 1.5
Quarrying tertiary crushing	AP-42 Chapter 11.19.2
Seed cleaning/handling uncontrolled	Source unknown - figure used is from previous inventories
Waste oil-fired boiler/heater Space heater atomizing	AP-42 Chapter 1.11
Waste oil-fired boiler/heater Space heater vaporising	AP-42 Chapter 1.11

Appendix F: Emission of contaminants by home heating appliance type in each study area

Appendix F Emission of contaminants by home heating appliances by suburb

Gleniti & Glenwood Weekdays	Hours used	Mass of fuel (kg)	PM ₁₀ (kg)	PM _{2.5} (kg)	CO (kg)	NO _x (kg)	SO ₂ (kg)	Benzene (kg)
Open fire								
Open fire (wood)	222	186	1.7	1.5	12.6	0.3	0.0	0.2
Open fire (coal)	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Woodburners								
Pre-1994 woodburners	2962	7109	78.2	75.9	782.0	7.1	1.4	6.9
1994-2000 woodburners	1674	4018	36.2	35.1	361.6	2.0	0.8	3.9
2001+ woodburners	1647	3953	23.7	23.0	237.2	2.0	0.8	3.8
Pellet burners	130	162	0.3	0.2	2.4	0.2	0.0	0.2
Multifuel burners (inc. potbellies and coal ranges)								
Multifuel burner (wood)	596	1067	11.7	11.4	117.4	1.1	0.2	1.0
Multifuel burner (coal)	154	275	5.2	4.7	30.3	0.4	0.3	0.0
Gas burner	1479	483	0.0	0.0	0.0	0.7	0.0	0.0
Oil burner	312	78	0.0	0.0	0.0	0.2	0.3	0.0
Total			157	152	1543	14	4	16

Gleniti & Glenwood Weekend days	Hours used	Mass of fuel (kg)	PM ₁₀ (kg)	PM _{2.5} (kg)	CO (kg)	NO _x (kg)	SO ₂ (kg)	Benzene (kg)
Open fire								
Open fire (wood)	366	360	3.2	2.9	24.5	0.5	0.1	0.3
Open fire (coal)	0	0	0.0	0.0	0.0	0.0	0.0	0.0
Woodburners								
Pre-1994 woodburners	3716	8917	98.1	95.1	980.9	8.9	1.8	8.6
1994-2000 woodburners	2086	5006	45.1	43.7	450.5	2.5	1.0	4.9
2001+ woodburners	1920	4608	27.6	26.8	276.5	2.3	0.9	4.5
Pellet burners	160	199	0.3	0.3	3.0	0.2	0.0	0.2
Multifuel burners (inc. potbellies and coal ranges)								
Multifuel burner (wood)	645	893	9.8	9.6	98.2	0.9	0.2	0.9
Multifuel burner (coal)	165	220	4.2	3.7	24.2	0.4	0.2	0.0
Gas burner	1861	608	0.0	0.0	0.0	0.9	0.0	0.0
Oil burner	312	78	0.0	0.0	0.0	0.2	0.3	0.0
Total			188	182	1858	17	5	19

Appendix F Emission of contaminants by home heating appliances by suburb (cont.)

Highfield Weekdays	Hours used	Mass of fuel (kg)	PM ₁₀ (kg)	PM _{2.5} (kg)	CO (kg)	NO _x (kg)	SO ₂ (kg)	Benzene (kg)
Open fire								
Open fire (wood)	622	1808	16.3	14.5	122.9	2.5	0.4	1.8
Open fire (coal)	244	722.0	15.2	14.4	50.5	3.0	3.7	0.0
Woodburners								
Pre-1994 woodburners	2887	6928	76.2	73.9	762.0	6.9	1.4	6.7
1994-2000 woodburners	2111	5066	45.6	44.2	456.0	2.5	1.0	4.9
2001+ woodburners	1473	3535	21.2	20.6	212.1	1.8	0.7	3.4
Pellet burners	134	167	0.3	0.3	2.5	0.2	0.0	0.2
Multifuel burners (inc. potbellies and coal ranges)								
Multifuel burner (wood)	396	540	5.9	5.8	59.4	0.5	0.1	0.5
Multifuel burner (coal)	125	66	1.3	1.1	7.3	0.1	0.1	0.0
Gas burner	984	1135	0.0	0.0	0.0	1.7	0.0	0.0
Oil burner	168	42	0.0	0.0	0.0	0.1	0.2	0.0
Total			182	175	1673	19	8	18

Highfield Weekends	Hours used	Mass of fuel (kg)	PM ₁₀ (kg)	PM _{2.5} (kg)	CO (kg)	NO _x (kg)	SO ₂ (kg)	Benzene (kg)
Open fire								
Open fire (wood)	712	2098	18.9	16.8	142.7	2.9	0.4	2.0
Open fire (coal)	294	722	15.2	14.4	50.5	3.0	3.7	0.0
Woodburners								
Pre-1994 woodburners	3474	8339	91.7	89.0	917.2	8.3	1.7	8.1
1994-2000 woodburners	2547	6112	55.0	53.4	550.1	3.1	1.2	5.9
2001+ woodburners	1748	4196	25.2	24.4	251.8	2.1	0.8	4.1
Pellet burners	161	201	0.3	0.3	3.0	0.2	0.0	0.2
Multifuel burners (inc. potbellies and coal ranges)								
Multifuel burner (wood)	433	540	5.9	5.8	59.4	0.5	0.1	0.5
Multifuel burner (coal)	137	66	1.3	1.1	7.3	0.1	0.1	0.0
Gas burner	1396	1610	0.0	0.0	0.0	2.4	0.0	0.0
Oil burner	230	57	0.0	0.0	0.0	0.1	0.2	0.0
Total			214	205	1982	23	8	21

Appendix F Emission of contaminants by home heating appliances by suburb (cont.)

Kensington Weekdays	Hours used	Mass of fuel (kg)	PM ₁₀ (kg)	PM _{2.5} (kg)	CO (kg)	NO _x (kg)	SO ₂ (kg)	Benzene (kg)
Open fire								
Open fire (wood)	149	422	3.8	3.4	28.7	0.6	0.1	0.4
Open fire (coal)	32	32.0	0.7	0.6	2.2	0.1	0.2	0.0
Woodburners								
Pre-1994 woodburners	1462	3510	38.6	37.4	386.1	3.5	0.7	3.4
1994-2000 woodburners	1411	3387	30.5	29.6	304.8	1.7	0.7	3.3
2001+ woodburners	1487	3570	21.4	20.8	214.2	1.8	0.7	3.5
Pellet burners	90	113	0.2	0.2	1.7	0.1	0.0	0.1
Multifuel burners (inc. potbellies and coal ranges)								
Multifuel burner (wood)	302	722	7.9	7.7	79.4	0.7	0.1	0.7
Multifuel burner (coal)	296	361	6.9	6.1	39.7	0.6	0.4	0.0
Gas burner	794	399	0.0	0.0	0.0	0.6	0.0	0.0
Oil burner	217	54	0.0	0.0	0.0	0.1	0.2	0.0
Total			110	106	1057	10	3	11

Kensington Weekends	Hours used	Mass of fuel (kg)	PM ₁₀ (kg)	PM _{2.5} (kg)	CO (kg)	NO _x (kg)	SO ₂ (kg)	Benzene (kg)
Open fire								
Open fire (wood)	118	422	3.8	3.4	28.7	0.6	0.1	0.4
Open fire (coal)	29	32	0.7	0.6	2.2	0.1	0.2	0.0
Woodburners								
Pre-1994 woodburners	1840	4416	48.6	47.1	485.8	4.4	0.9	4.3
1994-2000 woodburners	1728	4147	37.3	36.2	373.2	2.1	0.8	4.0
2001+ woodburners	1781	4273	25.6	24.9	256.4	2.1	0.9	4.1
Pellet burners	111	138	0.2	0.2	2.1	0.1	0.0	0.1
Multifuel burners (inc. potbellies and coal ranges)								
Multifuel burner (wood)	405	722	7.9	7.7	79.4	0.7	0.1	0.7
Multifuel burner (coal)	373	329	6.3	5.6	36.2	0.5	0.4	0.0
Gas burner	724	187	0.0	0.0	0.0	0.3	0.0	0.0
Oil burner	217	54	0.0	0.0	0.0	0.1	0.2	0.0
Total			130	126	1264	11	4	14

Appendix F Emission of contaminants by home heating appliances by suburb (cont.)

Maori Hill Weekdays	Hours used	Mass of fuel (kg)	PM ₁₀ (kg)	PM _{2.5} (kg)	CO (kg)	NO _x (kg)	SO ₂ (kg)	Benzene (kg)
Open fire								
Open fire (wood)	306	750	6.8	6.0	51.0	1.1	0.2	0.7
Open fire (coal)	65	65.0	1.4	1.3	4.6	0.3	0.3	0.0
Woodburners								
Pre-1994 woodburners	2201	5283	58.1	56.4	581.1	5.3	1.1	5.1
1994-2000 woodburners	1029	2470	22.2	21.6	222.3	1.2	0.5	2.4
2001+ woodburners	1083	2600	15.6	15.1	156.0	1.3	0.5	2.5
Pellet burners	89	111	0.2	0.2	1.7	0.1	0.0	0.1
Multifuel burners (inc. potbellies and coal ranges)								
Multifuel burner (wood)	108	327	3.6	3.5	36.0	0.3	0.1	0.3
Multifuel burner (coal)	37	129	2.5	2.2	14.2	0.2	0.1	0.0
Gas burner	1243	850	0.0	0.0	0.0	1.3	0.0	0.0
Oil burner	280	70	0.0	0.0	0.0	0.1	0.3	0.0
Total			110	106	1067	11	3	11

Maori Hill Weekends	Hours used	Mass of fuel (kg)	PM ₁₀ (kg)	PM _{2.5} (kg)	CO (kg)	NO _x (kg)	SO ₂ (kg)	Benzene (kg)
Open fire								
Open fire (wood)	440	981	8.8	7.8	66.7	1.4	0.2	1.0
Open fire (coal)	157	97	2.0	1.9	6.8	0.4	0.5	0.0
Woodburners								
Pre-1994 woodburners	2532	6076	66.8	64.8	668.3	6.1	1.2	5.9
1994-2000 woodburners	1133	2719	24.5	23.7	244.7	1.4	0.5	2.6
2001+ woodburners	1279	3070	18.4	17.9	184.2	1.5	0.6	3.0
Pellet burners	102	128	0.2	0.2	1.9	0.1	0.0	0.1
Multifuel burners (inc. potbellies and coal ranges)								
Multifuel burner (wood)	142	286	3.1	3.1	31.5	0.3	0.1	0.3
Multifuel burner (coal)	60	129	2.5	2.2	14.2	0.2	0.1	0.0
Gas burner	1379	943	0.0	0.0	0.0	1.4	0.0	0.0
Oil burner	280	70	0.0	0.0	0.0	0.1	0.3	0.0
Total			126	122	1218	13	4	13

Appendix F Emission of contaminants by home heating appliances by suburb (cont.)

Marchwiell Weekdays	Hours used	Mass of fuel (kg)	PM₁₀ (kg)	PM_{2.5} (kg)	CO (kg)	NO_x (kg)	SO₂ (kg)	Benzene (kg)
Open fire								
Open fire (wood)	753	2446	22.0	19.6	166.3	3.4	0.5	2.4
Open fire (coal)	436	565.0	11.9	11.3	39.6	2.3	2.9	0.0
Woodburners								
Pre-1994 woodburners	2228	5346	58.8	57.0	588.1	5.3	1.1	5.2
1994-2000 woodburners	1955	4692	42.2	41.0	422.2	2.3	0.9	4.6
2001+ woodburners	2064	4955	29.7	28.8	297.3	2.5	1.0	4.8
Pellet burners	129	161	0.3	0.2	2.4	0.2	0.0	0.2
Multifuel burners (inc. potbellies and coal ranges)								
Multifuel burner (wood)	783	1945	21.4	20.8	214.0	1.9	0.4	1.9
Multifuel burner (coal)	392	639	12.1	10.9	70.3	1.0	0.7	0.0
Gas burner	1476	840	0.0	0.0	0.0	1.3	0.0	0.0
Oil burner	182	45	0.0	0.0	0.0	0.1	0.2	0.0
Total			198	190	1800	20	8	19

Marchwiell Weekends	Hours used	Mass of fuel (kg)	PM₁₀ (kg)	PM_{2.5} (kg)	CO (kg)	NO_x (kg)	SO₂ (kg)	Benzene (kg)
Open fire								
Open fire (wood)	760	2509	22.6	20.1	170.6	3.5	0.5	2.4
Open fire (coal)	438	565	11.9	11.3	39.6	2.3	2.9	0.0
Woodburners								
Pre-1994 woodburners	2741	6578	72.4	70.2	723.6	6.6	1.3	6.4
1994-2000 woodburners	2225	5339	48.1	46.6	480.5	2.7	1.1	5.2
2001+ woodburners	2426	5822	34.9	33.9	349.3	2.9	1.2	5.6
Pellet burners	153	191	0.3	0.3	2.9	0.2	0.0	0.2
Multifuel burners (inc. potbellies and coal ranges)								
Multifuel burner (wood)	871	2070	22.8	22.1	227.7	2.1	0.4	2.0
Multifuel burner (coal)	429	416	7.9	7.1	45.8	0.7	0.5	0.0
Gas burner	1630	928	0.0	0.0	0.0	1.4	0.0	0.0
Oil burner	246	61	0.0	0.0	0.0	0.1	0.2	0.0
Total			221	212	2040	22	8	22

Appendix F Emission of contaminants by home heating appliances by suburb (cont.)

Parkside Weekdays	Hours used	Mass of fuel (kg)	PM₁₀ (kg)	PM_{2.5} (kg)	CO (kg)	NO_x (kg)	SO_x (kg)	Benzene (kg)
Open fire								
Open fire (wood)	592	1638	14.7	13.1	111.4	2.3	0.3	1.6
Open fire (coal)	54	22.0	0.5	0.4	1.5	0.1	0.1	0.0
Woodburners								
Pre-1994 woodburners	1791	4298	47.3	45.9	472.8	4.3	0.9	4.2
1994-2000 woodburners	2392	5741	51.7	50.1	516.7	2.9	1.1	5.6
2001+ woodburners	1117	2680	16.1	15.6	160.8	1.3	0.5	2.6
Pellet burners	110	137	0.2	0.2	2.1	0.1	0.0	0.1
Multifuel burners (inc. potbellies and coal ranges)								
Multifuel burner (wood)	254	1149	12.6	12.3	126.4	1.1	0.2	1.1
Multifuel burner (coal)	168	515	9.8	8.8	56.7	0.8	0.6	0.0
Gas burner	1003	700	0.0	0.0	0.0	1.0	0.0	0.0
Oil burner	592	147	0.0	0.0	0.1	0.3	0.6	0.0
Total			153	146	1448	14	4	15

Parkside Weekends	Hours used	Mass of fuel (kg)	PM₁₀ (kg)	PM_{2.5} (kg)	CO (kg)	NO_x (kg)	SO₂ (kg)	Benzene (kg)
Open fire								
Open fire (wood)	750	1560	14.0	12.5	106.1	2.2	0.3	1.5
Open fire (coal)	54	22	0.5	0.4	1.5	0.1	0.1	0.0
Woodburners								
Pre-1994 woodburners	2230	5351	58.9	57.1	588.6	5.4	1.1	5.2
1994-2000 woodburners	2685	6444	58.0	56.3	580.0	3.2	1.3	6.3
2001+ woodburners	1451	3482	20.9	20.3	208.9	1.7	0.7	3.4
Pellet burners	132	164	0.3	0.2	2.5	0.2	0.0	0.2
Multifuel burners (inc. potbellies and coal ranges)								
Multifuel burner (wood)	345	1677	18.4	17.9	184.5	1.7	0.3	1.6
Multifuel burner (coal)	202	772	14.7	13.1	84.9	1.2	0.8	0.0
Gas burner	1417	989	0.0	0.0	0.0	1.5	0.0	0.0
Oil burner	592	147	0.0	0.0	0.1	0.3	0.6	0.0
Total			186	178	1757	17	5	18

Appendix F Emission of contaminants by home heating appliances by suburb (cont.)

Seaview Weekdays	Hours used	Mass of fuel (kg)	PM ₁₀ (kg)	PM _{2.5} (kg)	CO (kg)	NO _x (kg)	SO ₂ (kg)	Benzene (kg)
Open fire								
Open fire (wood)	604	1431	12.9	11.4	97.3	2.0	0.3	1.4
Open fire (coal)	524	589.0	12.4	11.8	41.2	2.4	3.0	0.0
Woodburners								
Pre-1994 woodburners	1900	4560	50.2	48.7	501.6	4.6	0.9	4.4
1994-2000 woodburners	2320	5568	50.1	48.6	501.2	2.8	1.1	5.4
2001+ woodburners	1328	3187	19.1	18.6	191.2	1.6	0.6	3.1
Pellet burners	115	143	0.2	0.2	2.2	0.1	0.0	0.1
Multifuel burners (inc. potbellies and coal ranges)								
Multifuel burner (wood)	361	1924	21.2	20.6	211.6	1.9	0.4	1.9
Multifuel burner (coal)	361	589	11.2	10.0	64.8	0.9	0.6	0.0
Gas burner	1106	508	0.0	0.0	0.0	0.8	0.0	0.0
Oil burner	396	98	0.0	0.0	0.0	0.2	0.4	0.0
Total			177	170	1611	17	7	16

Seaview Weekends	Hours used	Mass of fuel (kg)	PM ₁₀ (kg)	PM _{2.5} (kg)	CO (kg)	NO _x (kg)	SO ₂ (kg)	Benzene (kg)
Open fire								
Open fire (wood)	628	1454	13.1	11.6	98.9	2.0	0.3	1.4
Open fire (coal)	628	611	12.8	12.2	42.8	2.5	3.1	0.0
Woodburners								
Pre-1994 woodburners	2490	5975	65.7	63.8	657.3	6.0	1.2	5.8
1994-2000 woodburners	2621	6290	56.6	54.9	566.1	3.1	1.3	6.1
2001+ woodburners	1284	3082	18.5	17.9	184.9	1.5	0.6	3.0
Pellet burners	132	165	0.3	0.2	2.5	0.2	0.0	0.2
Multifuel burners (inc. potbellies and coal ranges)								
Multifuel burner (wood)	361	1924	21.2	20.6	211.6	1.9	0.4	1.9
Multifuel burner (coal)	361	589	11.2	10.0	64.8	0.9	0.6	0.0
Gas burner	1195	549	0.0	0.0	0.0	0.8	0.0	0.0
Oil burner	396	98	0.0	0.0	0.0	0.2	0.4	0.0
Total			199	191	1829	19	8	18

Appendix F Emission of contaminants by home heating appliances by suburb (cont.)

Washdyke Weekdays	Hours used	Mass of fuel (kg)	PM ₁₀ (kg)	PM _{2.5} (kg)	CO (kg)	NO _x (kg)	SO ₂ (kg)	Benzene (kg)
Open fire								
Open fire (wood)	24	54	0.5	0.4	3.7	0.1	0.0	0.1
Open fire (coal)	0	0	0.0	0.0	0.0	0.0	0.0	0.0
Woodburners								
Pre-1994 woodburners	976	2343	25.8	25.0	257.8	2.3	0.5	2.3
1994-2000 woodburners	833	1999	18.0	17.5	180.0	1.0	0.4	1.9
2001+ woodburners	635	1524	9.1	8.9	91.4	0.8	0.3	1.5
Pellet burners	51	63	0.1	0.1	0.9	0.1	0.0	0.1
Multifuel burners (inc. potbellies and coal ranges)								
Multifuel burner (wood)	78	195	2.1	2.1	21.5	0.2	0.0	0.2
Multifuel burner (coal)	78	77	1.5	1.3	8.5	0.1	0.1	0.0
Gas burner	287	149	0.0	0.0	0.0	0.2	0.0	0.0
Oil burner	0	0	0.0	0.0	0.0	0.0	0.0	0.0
Total			57	55	564	5	1	6

Washdyke Weekend days	Hours used	Mass of fuel (kg)	PM ₁₀ (kg)	PM _{2.5} (kg)	CO (kg)	NO _x (kg)	SO ₂ (kg)	Benzene (kg)
Open fire								
Open fire (wood)	24	54	0.5	0.4	3.7	0.1	0.0	0.1
Open fire (coal)	0	0	0.0	0.0	0.0	0.0	0.0	0.0
Woodburners								
Pre-1994 woodburners	972	2333	25.7	24.9	256.6	2.3	0.5	2.3
1994-2000 woodburners	843	2022	18.2	17.7	182.0	1.0	0.4	2.0
2001+ woodburners	617	1481	8.9	8.6	88.9	0.7	0.3	1.4
Pellet burners	50	63	0.1	0.1	0.9	0.1	0.0	0.1
Multifuel burners (inc. potbellies and coal ranges)								
Multifuel burner (wood)	57	195	2.1	2.1	21.5	0.2	0.0	0.2
Multifuel burner (coal)	57	77	1.5	1.3	8.5	0.1	0.1	0.0
Gas burner	352	183	0.0	0.0	0.0	0.3	0.0	0.0
Oil burner	0	0	0.0	0.0	0.0	0.0	0.0	0.0
Total			57	55	562	5	1	6

Appendix F Emission of contaminants by home heating appliances by suburb (cont.)

Watlington Weekdays	Hours used	Mass of fuel (kg)	PM ₁₀ (kg)	PM _{2.5} (kg)	CO (kg)	NO _x (kg)	SO ₂ (kg)	Benzene (kg)
Open fire								
Open fire (wood)	123	433	3.9	3.5	29.4	0.6	0.1	0.4
Open fire (coal)	123	147.0	3.1	2.9	10.3	0.6	0.7	0.0
Woodburners								
Pre-1994 woodburners	1665	3997	44.0	42.6	439.6	4.0	0.8	3.9
1994-2000 woodburners	1674	4018	36.2	35.1	361.6	2.0	0.8	3.9
2001+ woodburners	1672	4013	24.1	23.4	240.8	2.0	0.8	3.9
Pellet burners	104	129	0.2	0.2	1.9	0.1	0.0	0.1
Multifuel burners (inc. potbellies and coal ranges)								
Multifuel burner (wood)	245	798	8.8	8.5	87.8	0.8	0.2	0.8
Multifuel burner (coal)	217	391	7.4	6.6	43.0	0.6	0.4	0.0
Gas burner	708	356	0.0	0.0	0.0	0.5	0.0	0.0
Oil burner	7	2	0.0	0.0	0.0	0.0	0.0	0.0
Total			128	123	1214	11	4	13

Watlington Weekends	Hours used	Mass of fuel (kg)	PM ₁₀ (kg)	PM _{2.5} (kg)	CO (kg)	NO _x (kg)	SO ₂ (kg)	Benzene (kg)
Open fire								
Open fire (wood)	133	487	4.4	3.9	33.1	0.7	0.1	0.5
Open fire (coal)	133	167	3.5	3.3	11.7	0.7	0.9	0.0
Woodburners								
Pre-1994 woodburners	1809	4342	47.8	46.3	477.6	4.3	0.9	4.2
1994-2000 woodburners	1762	4230	38.1	36.9	380.7	2.1	0.8	4.1
2001+ woodburners	1942	4660	28.0	27.1	279.6	2.3	0.9	4.5
Pellet burners	114	142	0.2	0.2	2.1	0.1	0.0	0.1
Multifuel burners (inc. potbellies and coal ranges)								
Multifuel burner (wood)	306	879	9.7	9.4	96.7	0.9	0.2	0.9
Multifuel burner (coal)	268	391	7.4	6.6	43.0	0.6	0.4	0.0
Gas burner	743	374	0.0	0.0	0.0	0.6	0.0	0.0
Oil burner	0	0	0.0	0.0	0.0	0.0	0.0	0.0
Total			139	134	1325	12	4	14

Appendix F Emission of contaminants by home heating appliances by suburb (cont.)

West End Weekdays	Hours used	Mass of fuel (kg)	PM ₁₀ (kg)	PM _{2.5} (kg)	CO (kg)	NO _x (kg)	SO ₂ (kg)	Benzene (kg)
Open fire								
Open fire (wood)	765	2285	20.6	18.3	155.4	3.2	0.5	2.2
Open fire (coal)	173	184.0	3.9	3.7	12.9	0.8	0.9	0.0
Woodburners								
Pre-1994 woodburners	2074	4977	54.8	53.1	547.5	5.0	1.0	4.8
1994-2000 woodburners	1853	4448	40.0	38.8	400.3	2.2	0.9	4.3
2001+ woodburners	1174	2819	16.9	16.4	169.1	1.4	0.6	2.7
Pellet burners	105	132	0.2	0.2	2.0	0.1	0.0	0.1
Multifuel burners (inc. potbellies and coal ranges)								
Multifuel burner (wood)	350	762	8.4	8.2	83.8	0.8	0.2	0.7
Multifuel burner (coal)	206	294	5.6	5.0	32.3	0.5	0.3	0.0
Gas burner	1413	616	0.0	0.0	0.0	0.9	0.0	0.0
Oil burner	192	48	0.0	0.0	0.0	0.1	0.2	0.0
Total			150	144	1403	15	5	15

West End Weekends	Hours used	Mass of fuel (kg)	PM ₁₀ (kg)	PM _{2.5} (kg)	CO (kg)	NO _x (kg)	SO ₂ (kg)	Benzene (kg)
Open fire								
Open fire (wood)	783	2316	20.8	18.5	157.5	3.2	0.5	2.2
Open fire (coal)	228	184	3.9	3.7	12.9	0.8	0.9	0.0
Woodburners								
Pre-1994 woodburners	2408	5779	63.6	61.7	635.7	5.8	1.2	5.6
1994-2000 woodburners	2415	5795	52.2	50.6	521.6	2.9	1.2	5.6
2001+ woodburners	1487	3569	21.4	20.8	214.1	1.8	0.7	3.5
Pellet burners	130	163	0.3	0.2	2.4	0.2	0.0	0.2
Multifuel burners (inc. potbellies and coal ranges)								
Multifuel burner (wood)	265	668	7.3	7.1	73.5	0.7	0.1	0.6
Multifuel burner (coal)	211	331	6.3	5.6	36.4	0.5	0.4	0.0
Gas burner	1582	690	0.0	0.0	0.0	1.0	0.0	0.0
Oil burner	192	48	0.0	0.0	0.0	0.1	0.2	0.0
Total			176	168	1654	17	5	18

Appendix G: Emission of contaminants from home heating appliances by time period in each study area

Appendix G Emission of contaminants from home heating appliances by time period in each study area. Gleniti and Glenwood

Gleniti & Glenwood Weekdays	PM ₁₀					PM _{2.5}				
	6am-10am	10am-4pm	4pm-10pm	10pm-6am	Total kg	6am-10am	10am-4pm	4pm-10pm	10pm-6am	Total kg
Open fire (wood)	0	0	1	0	2	0	0	1	0	1
Open fire (coal)	0	0	0	0	0	0	0	0	0	0
Pre-1994 woodburners	9	15	40	15	78	9	14	39	14	76
1994-2000 woodburners	3	8	19	6	36	3	8	19	6	35
2001+ woodburners	3	5	11	5	24	3	5	11	5	23
Pellet burners	0.0	0.1	0.1	0.0	0	0.0	0.0	0.1	0.0	0
Multifuel burner (wood)	2	1	7	1	12	2	1	7	1	11
Multifuel burner (coal)	0	3	0	2	5	0	2	0	2	5
Gas burner	0.00	0.00	0.01	0.00	0	0.00	0.00	0.01	0.00	0
Oil burner	0.00	0.01	0.01	0.00	0	0.00	0.01	0.01	0.00	0
Total (kg)	18	31	78	30	157	17	30	76	29	152

Gleniti & Glenwood Weekdays	CO					NO _x				
	6am-10am	10am-4pm	4pm-10pm	10pm-6am	Total kg	6am-10am	10am-4pm	4pm-10pm	10pm-6am	Total kg
Open fire (wood)	2	2	9	0	13	0	0	0	0	0
Open fire (coal)	0	0	0	0	0	0	0	0	0	0
Pre-1994 woodburners	93	146	397	146	782	1	1	4	1	7
1994-2000 woodburners	35	78	191	59	362	0	0	1	0	2
2001+ woodburners	29	47	109	52	237	0	0	1	0	2
Pellet burners	0.3	0.5	1.2	0.5	2	0.0	0.0	0.1	0.0	0
Multifuel burner (wood)	20	12	71	14	117	0	0	1	0	1
Multifuel burner (coal)	0	16	0	14	30	0	0	0	0	0
Gas burner	0.00	0.00	0.00	0.00	0	0.1	0.1	0.3	0.1	1
Oil burner	0.01	0.01	0.01	0.01	0	0.0	0.1	0.1	0.0	0
Total (kg)	179	301	778	285	1543	2	3	7	3	14

Gleniti & Glenwood Weekdays	SO _x					Benzene				
	6am-10am	10am-4pm	4pm-10pm	10pm-6am	Total kg	6am-10am	10am-4pm	4pm-10pm	10pm-6am	Total kg
Open fire (wood)	0.0	0.0	0.0	0.0	0	0.0	0.0	0.1	0.0	0
Open fire (coal)	0.0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0
Pre-1994 woodburners	0.2	0.3	0.7	0.3	1	0.8	1.3	3.5	1.3	7
1994-2000 woodburners	0.1	0.2	0.4	0.1	1	0.4	0.8	2.1	0.6	4
2001+ woodburners	0.1	0.2	0.4	0.2	1	0.5	0.8	1.8	0.8	4
Pellet burners	0.0	0.0	0.0	0.0	0	0.0	0.0	0.1	0.0	0
Multifuel burner (wood)	0.0	0.0	0.1	0.0	0	0.2	0.1	0.6	0.1	1
Multifuel burner (coal)	0.0	0.2	0.0	0.1	0	0.0	0.0	0.0	0.0	0
Gas burner	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0
Oil burner	0.05	0.11	0.11	0.05	0	0.00	0.00	0.00	0.00	0
Total (kg)	0	1	2	1	4	2	3	8	3	16

Appendix G Emission of contaminants from home heating appliances by time period in each study area. Gleniti and Glenwood

Gleniti & Glenwood Weekend day	PM ₁₀					PM _{2.5}				
	6am- 10am	10am- 4pm	4pm- 10pm	10pm- 6am	Total kg	6am- 10am	10am- 4pm	4pm- 10pm	10pm- 6am	Total kg
Open fire (wood)	0	1	2	0	3	0	1	2	0	3
Open fire (coal)	0	0	0	0	0	0	0	0	0	0
Pre-1994 woodburners	11	25	44	18	98	11	24	43	17	95
1994-2000 woodburners	6	12	20	8	45	5	12	19	8	44
2001+ woodburners	4	7	11	6	28	3	7	11	6	27
Pellet burners	0.0	0.1	0.1	0.1	0	0.0	0.1	0.1	0.1	0
Multifuel burner (wood)	2	1	6	1	10	2	1	6	1	10
Multifuel burner (coal)	0	2	0	2	4	0	2	0	2	4
Gas burner	0.00	0.00	0.01	0.00	0	0.00	0.00	0.01	0.00	0
Oil burner	0.00	0.01	0.01	0.00	0	0.00	0.01	0.01	0.00	0
Total (kg)	22	49	82	35	188	22	48	80	34	182

Gleniti & Glenwood Weekend day	CO					NO _x				
	6am- 10am	10am- 4pm	4pm- 10pm	10pm- 6am	Total kg	6am- 10am	10am- 4pm	4pm- 10pm	10pm- 6am	Total kg
Open fire (wood)	2	6	14	2	24	0	0	0	0	1
Open fire (coal)	0	0	0	0	0	0	0	0	0	0
Pre-1994 woodburners	111	250	440	179	981	1	2	4	2	9
1994-2000 woodburners	55	122	196	77	451	0	1	1	0	3
2001+ woodburners	35	74	110	58	276	0	1	1	0	2
Pellet burners	0.4	0.8	1.3	0.6	3	0.0	0.1	0.1	0.0	0
Multifuel burner (wood)	16	14	57	11	98	0	0	1	0	1
Multifuel burner (coal)	0	14	0	11	24	0	0	0	0	0
Gas burner	0.00	0.00	0.00	0.00	0	0.1	0.2	0.4	0.2	1
Oil burner	0.01	0.01	0.01	0.01	0	0.0	0.1	0.1	0.0	0
Total (kg)	221	480	817	339	1858	2	4	7	3	17

Gleniti & Glenwood Weekend day	SO _x					Benzene				
	6am- 10am	10am- 4pm	4pm- 10pm	10pm- 6am	Total kg	6am- 10am	10am- 4pm	4pm- 10pm	10pm- 6am	Total kg
Open fire (wood)	0.0	0.0	0.0	0.0	0	0.0	0.1	0.2	0.0	0
Open fire (coal)	0.0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0
Pre-1994 woodburners	0.2	0.5	0.8	0.3	2	1.0	2.2	3.9	1.6	9
1994-2000 woodburners	0.1	0.3	0.4	0.2	1	0.6	1.3	2.1	0.8	5
2001+ woodburners	0.1	0.2	0.4	0.2	1	0.6	1.2	1.8	0.9	4
Pellet burners	0.0	0.0	0.0	0.0	0	0.0	0.1	0.1	0.0	0
Multifuel burner (wood)	0.0	0.0	0.1	0.0	0	0.1	0.1	0.5	0.1	1
Multifuel burner (coal)	0.0	0.1	0.0	0.1	0	0.0	0.0	0.0	0.0	0
Gas burner	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0
Oil burner	0.05	0.11	0.11	0.05	0	0.00	0.00	0.00	0.00	0
Total (kg)	1	1	2	1	5	2	5	9	4	19

Appendix G Emission of contaminants from home heating appliances by time period in each study area. Highfield

Highfield Weekdays	PM ₁₀					PM _{2.5}				
	6am-10am	10am-4pm	4pm-10pm	10pm-6am	Total kg	6am-10am	10am-4pm	4pm-10pm	10pm-6am	Total kg
Open fire (wood)	2	3	8	2	16	2	3	7	2	14
Open fire (coal)	0	0	11	4	15	0	0	10	4	14
Pre-1994 woodburners	8	15	38	15	76	8	14	37	14	74
1994-2000 woodburners	4	7	26	9	46	4	7	25	9	44
2001+ woodburners	3	4	10	5	21	3	4	10	5	21
Pellet burners	0.0	0.0	0.1	0.1	0	0.0	0.0	0.1	0.1	0
Multifuel burner (wood)	1	1	3	1	6	1	1	2	1	6
Multifuel burner (coal)	0	0	0	0	1	0	0	0	0	1
Gas burner	0.01	0.00	0.02	0.00	0	0.01	0.00	0.02	0.00	0
Oil burner	0.00	0.00	0.01	0.00	0	0.00	0.00	0.01	0.00	0
Total (kg)	18	30	96	37	182	17	29	93	36	175

Highfield Weekdays	CO					NO _x				
	6am-10am	10am-4pm	4pm-10pm	10pm-6am	Total kg	6am-10am	10am-4pm	4pm-10pm	10pm-6am	Total kg
Open fire (wood)	17	25	63	18	123	0	1	1	0	3
Open fire (coal)	0	0	36	15	51	0	0	2	1	3
Pre-1994 woodburners	81	149	385	148	762	1	1	3	1	7
1994-2000 woodburners	42	68	258	89	456	0	0	1	0	3
2001+ woodburners	26	38	99	49	212	0	0	1	0	2
Pellet burners	0.3	0.4	1.3	0.5	3	0.0	0.0	0.1	0.0	0
Multifuel burner (wood)	8	14	25	12	59	0	0	0	0	1
Multifuel burner (coal)	1	2	2	2	7	0	0	0	0	0
Gas burner	0.00	0.00	0.02	0.00	0	0.4	0.1	1.2	0.1	2
Oil burner	0.00	0.00	0.02	0.00	0	0.0	0.0	0.1	0.0	0
Total (kg)	175	295	869	333	1673	2	3	11	4	19

Highfield Weekdays	SO _x					Benzene				
	6am-10am	10am-4pm	4pm-10pm	10pm-6am	Total kg	6am-10am	10am-4pm	4pm-10pm	10pm-6am	Total kg
Open fire (wood)	0.1	0.1	0.2	0.1	0	0.2	0.4	0.9	0.3	2
Open fire (coal)	0.0	0.0	2.6	1.1	4	0.0	0.0	0.0	0.0	0
Pre-1994 woodburners	0.1	0.3	0.7	0.3	1	0.7	1.3	3.4	1.3	7
1994-2000 woodburners	0.1	0.2	0.6	0.2	1	0.4	0.7	2.8	1.0	5
2001+ woodburners	0.1	0.1	0.3	0.2	1	0.4	0.6	1.6	0.8	3
Pellet burners	0.0	0.0	0.0	0.0	0	0.0	0.0	0.1	0.0	0
Multifuel burner (wood)	0.0	0.0	0.0	0.0	0	0.1	0.1	0.2	0.1	1
Multifuel burner (coal)	0.0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0
Gas burner	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0
Oil burner	0.00	0.01	0.15	0.01	0	0.00	0.00	0.00	0.00	0
Total (kg)	0	1	5	2	8	2	3	9	3	18

Appendix G Emission of contaminants from home heating appliances by time period in each study area. Highfield

Highfield Weekend day	PM ₁₀					PM _{2.5}				
	6am- 10am	10am- 4pm	4pm- 10pm	10pm- 6am	Total kg	6am- 10am	10am- 4pm	4pm- 10pm	10pm- 6am	Total kg
Open fire (wood)	2	5	8	4	19	2	4	7	3	17
Open fire (coal)	0	2	8	5	15	0	2	8	5	14
Pre-1994 woodburners	10	25	41	16	92	10	24	40	15	89
1994-2000 woodburners	6	13	27	9	55	6	13	26	9	53
2001+ woodburners	4	7	10	5	25	3	6	9	5	24
Pellet burners	0.0	0.1	0.1	0.1	0	0.0	0.1	0.1	0.1	0
Multifuel burner (wood)	1	2	2	1	6	1	2	2	1	6
Multifuel burner (coal)	0	0	0	0	1	0	0	0	0	1
Gas burner	0.01	0.01	0.03	0.00	0	0.01	0.01	0.03	0.00	0
Oil burner	0.00	0.00	0.01	0.00	0	0.00	0.00	0.01	0.00	0
Total (kg)	23	53	97	40	214	22	51	94	38	205

Highfield Weekend day	CO					NO _x				
	6am- 10am	10am- 4pm	4pm- 10pm	10pm- 6am	Total kg	6am- 10am	10am- 4pm	4pm- 10pm	10pm- 6am	Total kg
Open fire (wood)	18	35	64	26	143	0	1	1	1	3
Open fire (coal)	0	6	28	17	51	0	0	2	1	3
Pre-1994 woodburners	101	246	413	156	917	1	2	4	1	8
1994-2000 woodburners	60	133	267	90	550	0	1	1	1	3
2001+ woodburners	36	65	98	53	252	0	1	1	0	2
Pellet burners	0.4	0.8	1.3	0.5	3	0.0	0.1	0.1	0.0	0
Multifuel burner (wood)	8	17	23	11	59	0	0	0	0	1
Multifuel burner (coal)	1	2	2	2	7	0	0	0	0	0
Gas burner	0.01	0.01	0.02	0.00	0	0.4	0.4	1.4	0.2	2
Oil burner	0.00	0.01	0.01	0.01	0	0.0	0.0	0.1	0.0	0
Total (kg)	225	505	896	356	1982	2	5	11	4	23

Highfield Weekend day	SO _x					Benzene				
	6am- 10am	10am- 4pm	4pm- 10pm	10pm- 6am	Total kg	6am- 10am	10am- 4pm	4pm- 10pm	10pm- 6am	Total kg
Open fire (wood)	0.1	0.1	0.2	0.1	0	0.3	0.5	0.9	0.4	2
Open fire (coal)	0.0	0.4	2.0	1.3	4	0.0	0.0	0.0	0.0	0
Pre-1994 woodburners	0.2	0.4	0.8	0.3	2	0.9	2.2	3.6	1.4	8
1994-2000 woodburners	0.1	0.3	0.6	0.2	1	0.6	1.4	2.9	1.0	6
2001+ woodburners	0.1	0.2	0.3	0.2	1	0.6	1.1	1.6	0.9	4
Pellet burners	0.0	0.0	0.0	0.0	0	0.0	0.1	0.1	0.0	0
Multifuel burner (wood)	0.0	0.0	0.0	0.0	0	0.1	0.1	0.2	0.1	1
Multifuel burner (coal)	0.0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0
Gas burner	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0
Oil burner	0.03	0.04	0.11	0.05	0	0.00	0.00	0.00	0.00	0
Total (kg)	1	2	4	2	8	2	5	9	4	21

Appendix G Emission of contaminants from home heating appliances by time period in each study area. Kensington

Kensington Weekdays	PM ₁₀					PM _{2.5}				
	6am-10am	10am-4pm	4pm-10pm	10pm-6am	Total kg	6am-10am	10am-4pm	4pm-10pm	10pm-6am	Total kg
Open fire (wood)	0	0	3	0	4	0	0	3	0	3
Open fire (coal)	0	0	1	0	1	0	0	1	0	1
Pre-1994 woodburners	5	9	18	7	39	5	9	17	7	37
1994-2000 woodburners	3	5	15	7	30	3	5	15	7	30
2001+ woodburners	3	4	10	5	21	3	4	10	5	21
Pellet burners	0.0	0.0	0.1	0.0	0	0.0	0.0	0.1	0.0	0
Multifuel burner (wood)	2	1	4	1	8	1	1	4	1	8
Multifuel burner (coal)	1	1	3	2	7	1	1	3	2	6
Gas burner	0.00	0.00	0.01	0.00	0	0.00	0.00	0.01	0.00	0
Oil burner	0.00	0.00	0.01	0.00	0	0.00	0.00	0.00	0.00	0
Total (kg)	13	21	54	22	110	13	20	52	21	106

Kensington Weekdays	CO					NO _x				
	6am-10am	10am-4pm	4pm-10pm	10pm-6am	Total kg	6am-10am	10am-4pm	4pm-10pm	10pm-6am	Total kg
Open fire (wood)	0	0	26	3	29	0	0	1	0	1
Open fire (coal)	0	0	2	0	2	0	0	0	0	0
Pre-1994 woodburners	50	91	177	69	386	0	1	2	1	4
1994-2000 woodburners	31	51	155	68	305	0	0	1	0	2
2001+ woodburners	26	41	99	49	214	0	0	1	0	2
Pellet burners	0.2	0.3	0.8	0.4	2	0.0	0.0	0.1	0.0	0
Multifuel burner (wood)	15	13	38	13	79	0	0	0	0	1
Multifuel burner (coal)	6	7	17	10	40	0	0	0	0	1
Gas burner	0.00	0.00	0.01	0.00	0	0.1	0.1	0.4	0.0	1
Oil burner	0.01	0.01	0.01	0.01	0	0.0	0.0	0.0	0.0	0
Total (kg)	128	202	515	212	1057	1	2	5	2	10

Kensington Weekdays	SO _x					Benzene				
	6am-10am	10am-4pm	4pm-10pm	10pm-6am	Total kg	6am-10am	10am-4pm	4pm-10pm	10pm-6am	Total kg
Open fire (wood)	0.0	0.0	0.1	0.0	0	0.0	0.0	0.4	0.0	0
Open fire (coal)	0.0	0.0	0.2	0.0	0	0.0	0.0	0.0	0.0	0
Pre-1994 woodburners	0.1	0.2	0.3	0.1	1	0.4	0.8	1.6	0.6	3
1994-2000 woodburners	0.1	0.1	0.3	0.2	1	0.3	0.5	1.7	0.7	3
2001+ woodburners	0.1	0.1	0.3	0.2	1	0.4	0.7	1.6	0.8	3
Pellet burners	0.0	0.0	0.0	0.0	0	0.0	0.0	0.1	0.0	0
Multifuel burner (wood)	0.0	0.0	0.1	0.0	0	0.1	0.1	0.3	0.1	1
Multifuel burner (coal)	0.1	0.1	0.2	0.1	0	0.0	0.0	0.0	0.0	0
Gas burner	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0
Oil burner	0.04	0.04	0.08	0.06	0	0.00	0.00	0.00	0.00	0
Total (kg)	0	1	2	1	3	1	2	6	2	11

Appendix G Emission of contaminants from home heating appliances by time period in each study area. Kensington

Kensington Weekend day	PM ₁₀					PM _{2.5}				
	6am- 10am	10am- 4pm	4pm- 10pm	10pm- 6am	Total kg	6am- 10am	10am- 4pm	4pm- 10pm	10pm- 6am	Total kg
Open fire (wood)	0	0	4	0	4	0	0	3	0	3
Open fire (coal)	0	0	1	0	1	0	0	1	0	1
Pre-1994 woodburners	7	13	20	9	49	7	13	19	9	47
1994-2000 woodburners	4	8	17	8	37	4	8	16	8	36
2001+ woodburners	4	7	10	5	26	4	6	10	5	25
Pellet burners	0.0	0.1	0.1	0.0	0	0.0	0.1	0.1	0.0	0
Multifuel burner (wood)	1	1	4	2	8	1	1	4	2	8
Multifuel burner (coal)	1	1	3	2	6	1	1	2	2	6
Gas burner	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0
Oil burner	0.00	0.00	0.01	0.00	0	0.00	0.00	0.00	0.00	0
Total (kg)	16	30	58	26	130	16	29	55	25	126

Kensington Weekend day	CO					NO _x				
	6am- 10am	10am- 4pm	4pm- 10pm	10pm- 6am	Total kg	6am- 10am	10am- 4pm	4pm- 10pm	10pm- 6am	Total kg
Open fire (wood)	0	0	29	0	29	0	0	1	0	1
Open fire (coal)	0	0	2	0	2	0	0	0	0	0
Pre-1994 woodburners	68	132	196	91	486	1	1	2	1	4
1994-2000 woodburners	41	79	168	85	373	0	0	1	0	2
2001+ woodburners	36	67	103	51	256	0	1	1	0	2
Pellet burners	0.3	0.5	0.9	0.4	2	0.0	0.0	0.1	0.0	0
Multifuel burner (wood)	11	14	38	16	79	0	0	0	0	1
Multifuel burner (coal)	4	7	15	10	36	0	0	0	0	1
Gas burner	0.00	0.00	0.00	0.00	0	0.0	0.1	0.1	0.0	0
Oil burner	0.01	0.01	0.01	0.01	0	0.0	0.0	0.0	0.0	0
Total (kg)	160	300	551	253	1264	1	3	5	2	11

Kensington Weekend day	SO _x					Benzene				
	6am- 10am	10am- 4pm	4pm- 10pm	10pm- 6am	Total kg	6am- 10am	10am- 4pm	4pm- 10pm	10pm- 6am	Total kg
Open fire (wood)	0.0	0.0	0.1	0.0	0	0.0	0.0	0.4	0.0	0
Open fire (coal)	0.0	0.0	0.2	0.0	0	0.0	0.0	0.0	0.0	0
Pre-1994 woodburners	0.1	0.2	0.4	0.2	1	0.6	1.2	1.7	0.8	4
1994-2000 woodburners	0.1	0.2	0.4	0.2	1	0.4	0.9	1.8	0.9	4
2001+ woodburners	0.1	0.2	0.3	0.2	1	0.6	1.1	1.7	0.8	4
Pellet burners	0.0	0.0	0.0	0.0	0	0.0	0.0	0.1	0.0	0
Multifuel burner (wood)	0.0	0.0	0.1	0.0	0	0.1	0.1	0.3	0.1	1
Multifuel burner (coal)	0.0	0.1	0.1	0.1	0	0.0	0.0	0.0	0.0	0
Gas burner	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0
Oil burner	0.04	0.04	0.08	0.06	0	0.00	0.00	0.00	0.00	0
Total (kg)	0	1	2	1	4	2	3	6	3	14

Appendix G Emission of contaminants from home heating appliances by time period in each study area. Maori Hill

Maori Hill Weekdays	PM ₁₀					PM _{2.5}				
	6am-10am	10am-4pm	4pm-10pm	10pm-6am	Total kg	6am-10am	10am-4pm	4pm-10pm	10pm-6am	Total kg
Open fire (wood)	1	2	4	0	7	1	2	3	0	6
Open fire (coal)	0	0	1	0	1	0	0	1	0	1
Pre-1994 woodburners	9	15	24	10	58	9	14	23	10	56
1994-2000 woodburners	2	5	11	3	22	2	5	11	3	22
2001+ woodburners	2	3	9	2	16	2	3	9	2	15
Pellet burners	0.0	0.0	0.1	0.0	0	0.0	0.0	0.1	0.0	0
Multifuel burner (wood)	0	0	3	0	4	0	0	3	0	3
Multifuel burner (coal)	0	0	2	0	2	0	0	2	0	2
Gas burner	0.00	0.00	0.02	0.00	0	0.00	0.00	0.02	0.00	0
Oil burner	0.00	0.01	0.01	0.00	0	0.00	0.00	0.00	0.00	0
Total (kg)	15	25	55	15	110	14	24	53	15	106

Maori Hill Weekdays	CO					NO _x				
	6am-10am	10am-4pm	4pm-10pm	10pm-6am	Total kg	6am-10am	10am-4pm	4pm-10pm	10pm-6am	Total kg
Open fire (wood)	9	14	28	0	51	0	0	1	0	1
Open fire (coal)	0	0	5	0	5	0	0	0	0	0
Pre-1994 woodburners	93	146	240	103	581	1	1	2	1	5
1994-2000 woodburners	25	55	113	29	222	0	0	1	0	1
2001+ woodburners	19	32	88	17	156	0	0	1	0	1
Pellet burners	0.2	0.4	0.8	0.2	2	0.0	0.0	0.1	0.0	0
Multifuel burner (wood)	0	0	35	1	36	0	0	0	0	0
Multifuel burner (coal)	0	0	13	1	14	0	0	0	0	0
Gas burner	0.00	0.00	0.01	0.00	0	0.2	0.2	0.8	0.1	1
Oil burner	0.01	0.01	0.01	0.01	0	0.0	0.0	0.0	0.0	0
Total (kg)	147	248	522	151	1067	2	2	6	1	11

Maori Hill Weekdays	SO _x					Benzene				
	6am-10am	10am-4pm	4pm-10pm	10pm-6am	Total kg	6am-10am	10am-4pm	4pm-10pm	10pm-6am	Total kg
Open fire (wood)	0.0	0.0	0.1	0.0	0	0.1	0.2	0.4	0.0	1
Open fire (coal)	0.0	0.0	0.3	0.0	0	0.0	0.0	0.0	0.0	0
Pre-1994 woodburners	0.2	0.3	0.4	0.2	1	0.8	1.3	2.1	0.9	5
1994-2000 woodburners	0.1	0.1	0.3	0.1	0	0.3	0.6	1.2	0.3	2
2001+ woodburners	0.1	0.1	0.3	0.1	1	0.3	0.5	1.4	0.3	3
Pellet burners	0.0	0.0	0.0	0.0	0	0.0	0.0	0.1	0.0	0
Multifuel burner (wood)	0.0	0.0	0.1	0.0	0	0.0	0.0	0.3	0.0	0
Multifuel burner (coal)	0.0	0.0	0.1	0.0	0	0.0	0.0	0.0	0.0	0
Gas burner	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0
Oil burner	0.06	0.08	0.08	0.06	0	0.00	0.00	0.00	0.00	0
Total (kg)	0	1	2	0	3	2	3	6	2	11

Appendix G Emission of contaminants from home heating appliances by time period in each study area (cont).Maori Hill

Maori Hill Weekend day	PM ₁₀					PM _{2.5}				
	6am- 10am	10am- 4pm	4pm- 10pm	10pm- 6am	Total kg	6am- 10am	10am- 4pm	4pm- 10pm	10pm- 6am	Total kg
Open fire (wood)	2	2	5	0	9	1	2	4	0	8
Open fire (coal)	0	0	1	0	2	0	0	1	0	2
Pre-1994 woodburners	11	20	26	10	67	11	19	25	10	65
1994-2000 woodburners	3	7	11	3	24	3	7	11	3	24
2001+ woodburners	2	5	9	2	18	2	5	9	2	18
Pellet burners	0.0	0.1	0.1	0.0	0	0.0	0.1	0.1	0.0	0
Multifuel burner (wood)	0	0	3	0	3	0	0	3	0	3
Multifuel burner (coal)	0	1	2	0	2	0	1	1	0	2
Gas burner	0.00	0.01	0.02	0.00	0	0.00	0.01	0.02	0.00	0
Oil burner	0.00	0.01	0.01	0.00	0	0.00	0.00	0.00	0.00	0
Total (kg)	18	36	56	17	126	17	34	54	16	122

Maori Hill Weekend day	CO					NO _x				
	6am- 10am	10am- 4pm	4pm- 10pm	10pm- 6am	Total kg	6am- 10am	10am- 4pm	4pm- 10pm	10pm- 6am	Total kg
Open fire (wood)	12	15	37	3	67	0	0	1	0	1
Open fire (coal)	0	1	5	1	7	0	0	0	0	0
Pre-1994 woodburners	110	198	255	105	668	1	2	2	1	6
1994-2000 woodburners	28	70	114	32	245	0	0	1	0	1
2001+ woodburners	23	50	88	23	184	0	0	1	0	2
Pellet burners	0.3	0.6	0.8	0.3	2	0.0	0.0	0.1	0.0	0
Multifuel burner (wood)	0	5	27	0	31	0	0	0	0	0
Multifuel burner (coal)	0	5	9	0	14	0	0	0	0	0
Gas burner	0.00	0.00	0.01	0.00	0	0.2	0.3	0.8	0.1	1
Oil burner	0.01	0.01	0.01	0.01	0	0.0	0.0	0.0	0.0	0
Total (kg)	173	345	536	164	1218	2	4	6	2	13

Maori Hill Weekend day	SO _x					Benzene				
	6am- 10am	10am- 4pm	4pm- 10pm	10pm- 6am	Total kg	6am- 10am	10am- 4pm	4pm- 10pm	10pm- 6am	Total kg
Open fire (wood)	0.0	0.0	0.1	0.0	0	0.2	0.2	0.5	0.0	1
Open fire (coal)	0.0	0.1	0.3	0.1	0	0.0	0.0	0.0	0.0	0
Pre-1994 woodburners	0.2	0.4	0.5	0.2	1	1.0	1.7	2.2	0.9	6
1994-2000 woodburners	0.1	0.2	0.3	0.1	1	0.3	0.8	1.2	0.3	3
2001+ woodburners	0.1	0.2	0.3	0.1	1	0.4	0.8	1.4	0.4	3
Pellet burners	0.0	0.0	0.0	0.0	0	0.0	0.0	0.1	0.0	0
Multifuel burner (wood)	0.0	0.0	0.0	0.0	0	0.0	0.0	0.2	0.0	0
Multifuel burner (coal)	0.0	0.0	0.1	0.0	0	0.0	0.0	0.0	0.0	0
Gas burner	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0
Oil burner	0.06	0.08	0.08	0.06	0	0.00	0.00	0.00	0.00	0
Total (kg)	0	1	2	0	4	2	4	6	2	13

Appendix G Emission of contaminants from home heating appliances by time period in each study area Marchwiell

Marchwiell Weekdays	PM ₁₀					PM _{2.5}				
	6am-10am	10am-4pm	4pm-10pm	10pm-6am	Total kg	6am-10am	10am-4pm	4pm-10pm	10pm-6am	Total kg
Open fire (wood)	2	4	12	3	22	2	4	11	3	20
Open fire (coal)	1	3	6	2	12	1	2	6	2	11
Pre-1994 woodburners	7	12	30	10	59	6	12	29	10	57
1994-2000 woodburners	5	7	20	10	42	5	7	20	10	41
2001+ woodburners	3	7	16	4	30	3	7	15	4	29
Pellet burners	0.0	0.1	0.1	0.0	0	0.0	0.0	0.1	0.0	0
Multifuel burner (wood)	3	4	8	6	21	3	4	8	6	21
Multifuel burner (coal)	2	2	4	4	12	1	2	4	4	11
Gas burner	0.00	0.00	0.02	0.00	0	0.00	0.00	0.02	0.00	0
Oil burner	0.00	0.00	0.01	0.00	0	0.00	0.00	0.01	0.00	0
Total (kg)	22	39	96	40	198	21	38	92	38	190

Marchwiell Weekdays	CO					NO _x				
	6am-10am	10am-4pm	4pm-10pm	10pm-6am	Total kg	6am-10am	10am-4pm	4pm-10pm	10pm-6am	Total kg
Open fire (wood)	14	34	94	26	166	0	1	2	1	3
Open fire (coal)	4	8	20	6	40	0	0	1	0	2
Pre-1994 woodburners	65	122	301	100	588	1	1	3	1	5
1994-2000 woodburners	47	73	203	99	422	0	0	1	1	2
2001+ woodburners	30	68	155	44	297	0	1	1	0	2
Pellet burners	0.3	0.5	1.2	0.4	2	0.0	0.0	0.1	0.0	0
Multifuel burner (wood)	35	39	78	62	214	0	0	1	1	2
Multifuel burner (coal)	10	13	23	25	70	0	0	0	0	1
Gas burner	0.00	0.00	0.01	0.00	0	0.2	0.1	0.8	0.1	1
Oil burner	0.00	0.00	0.01	0.01	0	0.0	0.0	0.1	0.0	0
Total (kg)	205	357	875	363	1800	2	4	10	4	20

Marchwiell Weekdays	SO _x					Benzene				
	6am-10am	10am-4pm	4pm-10pm	10pm-6am	Total kg	6am-10am	10am-4pm	4pm-10pm	10pm-6am	Total kg
Open fire (wood)	0.0	0.1	0.3	0.1	0	0.2	0.5	1.3	0.4	2
Open fire (coal)	0.3	0.6	1.5	0.5	3	0.0	0.0	0.0	0.0	0
Pre-1994 woodburners	0.1	0.2	0.5	0.2	1	0.6	1.1	2.7	0.9	5
1994-2000 woodburners	0.1	0.2	0.5	0.2	1	0.5	0.8	2.2	1.1	5
2001+ woodburners	0.1	0.2	0.5	0.1	1	0.5	1.1	2.5	0.7	5
Pellet burners	0.0	0.0	0.0	0.0	0	0.0	0.0	0.1	0.0	0
Multifuel burner (wood)	0.1	0.1	0.1	0.1	0	0.3	0.3	0.7	0.6	2
Multifuel burner (coal)	0.1	0.1	0.2	0.3	1	0.0	0.0	0.0	0.0	0
Gas burner	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0
Oil burner	0.00	0.00	0.12	0.06	0	0.00	0.00	0.00	0.00	0
Total (kg)	1	2	4	2	8	2	4	9	4	19

Appendix G Emission of contaminants from home heating appliances by time period in each study area. Marchwiell

Marchwiell Weekend day	PM ₁₀					PM _{2.5}				
	6am- 10am	10am- 4pm	4pm- 10pm	10pm- 6am	Total kg	6am- 10am	10am- 4pm	4pm- 10pm	10pm- 6am	Total kg
Open fire (wood)	3	4	12	3	23	2	4	11	3	20
Open fire (coal)	1	2	6	2	12	1	2	6	2	11
Pre-1994 woodburners	8	18	34	12	72	8	18	33	12	70
1994-2000 woodburners	6	11	21	10	48	6	11	20	10	47
2001+ woodburners	4	11	15	5	35	4	11	14	5	34
Pellet burners	0.0	0.1	0.1	0.1	0	0.0	0.1	0.1	0.1	0
Multifuel burner (wood)	3	7	9	5	23	3	6	9	4	22
Multifuel burner (coal)	1	2	3	2	8	1	2	3	2	7
Gas burner	0.00	0.00	0.02	0.00	0	0.00	0.00	0.02	0.00	0
Oil burner	0.00	0.00	0.01	0.00	0	0.00	0.00	0.01	0.00	0
Total (kg)	25	56	100	40	221	24	53	95	38	212

Marchwiell Weekend day	CO					NO _x				
	6am- 10am	10am- 4pm	4pm- 10pm	10pm- 6am	Total kg	6am- 10am	10am- 4pm	4pm- 10pm	10pm- 6am	Total kg
Open fire (wood)	20	31	94	26	171	0	1	2	1	4
Open fire (coal)	5	8	20	6	40	0	0	1	0	2
Pre-1994 woodburners	79	181	339	125	724	1	2	3	1	7
1994-2000 woodburners	59	110	207	104	481	0	1	1	1	3
2001+ woodburners	41	109	149	51	349	0	1	1	0	3
Pellet burners	0.3	0.8	1.3	0.5	3	0.0	0.1	0.1	0.0	0
Multifuel burner (wood)	27	66	89	45	228	0	1	1	0	2
Multifuel burner (coal)	5	14	16	11	46	0	0	0	0	1
Gas burner	0.00	0.00	0.01	0.00	0	0.2	0.2	0.8	0.1	1
Oil burner	0.00	0.01	0.01	0.01	0	0.0	0.0	0.1	0.0	0
Total (kg)	235	520	915	370	2040	3	5	11	4	22

Marchwiell Weekend day	SO _x					Benzene				
	6am- 10am	10am- 4pm	4pm- 10pm	10pm- 6am	Total kg	6am- 10am	10am- 4pm	4pm- 10pm	10pm- 6am	Total kg
Open fire (wood)	0.1	0.1	0.3	0.1	1	0.3	0.4	1.3	0.4	2
Open fire (coal)	0.3	0.6	1.5	0.5	3	0.0	0.0	0.0	0.0	0
Pre-1994 woodburners	0.1	0.3	0.6	0.2	1	0.7	1.6	3.0	1.1	6
1994-2000 woodburners	0.1	0.2	0.5	0.2	1	0.6	1.2	2.2	1.1	5
2001+ woodburners	0.1	0.4	0.5	0.2	1	0.7	1.8	2.4	0.8	6
Pellet burners	0.0	0.0	0.0	0.0	0	0.0	0.0	0.1	0.0	0
Multifuel burner (wood)	0.0	0.1	0.2	0.1	0	0.2	0.6	0.8	0.4	2
Multifuel burner (coal)	0.0	0.1	0.2	0.1	0	0.0	0.0	0.0	0.0	0
Gas burner	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0
Oil burner	0.00	0.06	0.12	0.06	0	0.00	0.00	0.00	0.00	0
Total (kg)	1	2	4	1	8	3	6	10	4	22

Appendix G Emission of contaminants from home heating appliances by time period in each study area. Parkside

Parkside Weekdays	PM ₁₀					PM _{2.5}				
	6am-10am	10am-4pm	4pm-10pm	10pm-6am	Total kg	6am-10am	10am-4pm	4pm-10pm	10pm-6am	Total kg
Open fire (wood)	1	2	9	2	15	1	2	8	2	13
Open fire (coal)	0	0	0	0	0	0	0	0	0	0
Pre-1994 woodburners	5	7	25	10	47	4	7	24	10	46
1994-2000 woodburners	6	8	28	9	52	6	8	27	9	50
2001+ woodburners	1	2	9	3	16	1	2	9	3	16
Pellet burners	0.0	0.0	0.1	0.0	0	0.0	0.0	0.1	0.0	0
Multifuel burner (wood)	2	3	8	0	13	2	3	7	0	12
Multifuel burner (coal)	1	2	6	0	10	1	2	5	0	9
Gas burner	0.00	0.00	0.01	0.00	0	0.00	0.00	0.01	0.00	0
Oil burner	0.01	0.01	0.01	0.01	0	0.00	0.01	0.01	0.01	0
Total (kg)	17	26	85	25	153	16	25	81	24	146

Parkside Weekdays	CO					NO _x				
	6am-10am	10am-4pm	4pm-10pm	10pm-6am	Total kg	6am-10am	10am-4pm	4pm-10pm	10pm-6am	Total kg
Open fire (wood)	9	18	71	14	111	0	0	1	0	2
Open fire (coal)	0	0	1	0	2	0	0	0	0	0
Pre-1994 woodburners	45	73	251	104	473	0	1	2	1	4
1994-2000 woodburners	64	84	276	93	517	0	0	2	1	3
2001+ woodburners	15	22	89	35	161	0	0	1	0	1
Pellet burners	0.2	0.3	1.1	0.4	2	0.0	0.0	0.1	0.0	0
Multifuel burner (wood)	19	32	75	0	126	0	0	1	0	1
Multifuel burner (coal)	8	14	35	0	57	0	0	1	0	1
Gas burner	0.00	0.00	0.01	0.00	0	0.2	0.1	0.7	0.1	1
Oil burner	0.01	0.02	0.02	0.02	0	0.0	0.1	0.1	0.1	0
Total (kg)	161	242	800	246	1448	2	2	8	2	14

Parkside Weekdays	SO _x					Benzene				
	6am-10am	10am-4pm	4pm-10pm	10pm-6am	Total kg	6am-10am	10am-4pm	4pm-10pm	10pm-6am	Total kg
Open fire (wood)	0.0	0.1	0.2	0.0	0	0.1	0.3	1.0	0.2	2
Open fire (coal)	0.0	0.0	0.1	0.0	0	0.0	0.0	0.0	0.0	0
Pre-1994 woodburners	0.1	0.1	0.5	0.2	1	0.4	0.6	2.2	0.9	4
1994-2000 woodburners	0.1	0.2	0.6	0.2	1	0.7	0.9	3.0	1.0	6
2001+ woodburners	0.0	0.1	0.3	0.1	1	0.2	0.4	1.4	0.6	3
Pellet burners	0.0	0.0	0.0	0.0	0	0.0	0.0	0.1	0.0	0
Multifuel burner (wood)	0.0	0.1	0.1	0.0	0	0.2	0.3	0.7	0.0	1
Multifuel burner (coal)	0.1	0.1	0.3	0.0	1	0.0	0.0	0.0	0.0	0
Gas burner	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0
Oil burner	0.10	0.15	0.18	0.16	1	0.00	0.00	0.00	0.00	0
Total (kg)	1	1	2	1	4	2	2	8	3	15

Appendix G Emission of contaminants from home heating appliances by time period in each study area. Parkside

Parkside Weekend days	PM ₁₀					PM _{2.5}				
	6am- 10am	10am- 4pm	4pm- 10pm	10pm- 6am	Total kg	6am- 10am	10am- 4pm	4pm- 10pm	10pm- 6am	Total kg
Open fire (wood)	1	4	8	2	14	1	3	7	1	12
Open fire (coal)	0	0	0	0	0	0	0	0	0	0
Pre-1994 woodburners	6	16	25	12	59	6	15	24	12	57
1994-2000 woodburners	7	13	28	10	58	7	13	27	9	56
2001+ woodburners	3	6	8	4	21	3	6	8	4	20
Pellet burners	0.0	0.1	0.1	0.0	0	0.0	0.1	0.1	0.0	0
Multifuel burner (wood)	3	7	9	0	18	2	6	9	0	18
Multifuel burner (coal)	2	4	8	1	15	2	4	7	1	13
Gas burner	0.00	0.01	0.01	0.00	0	0.00	0.01	0.01	0.00	0
Oil burner	0.01	0.01	0.01	0.01	0	0.00	0.01	0.01	0.01	0
Total (kg)	22	50	86	28	186	21	48	82	27	178

Parkside Weekend days	CO					NO _x				
	6am- 10am	10am- 4pm	4pm- 10pm	10pm- 6am	Total kg	6am- 10am	10am- 4pm	4pm- 10pm	10pm- 6am	Total kg
Open fire (wood)	8	28	58	12	106	0	1	1	0	2
Open fire (coal)	0	0	1	0	2	0	0	0	0	0
Pre-1994 woodburners	62	156	249	121	589	1	1	2	1	5
1994-2000 woodburners	73	135	276	96	580	0	1	2	1	3
2001+ woodburners	29	59	82	39	209	0	0	1	0	2
Pellet burners	0.3	0.6	1.1	0.5	2	0.0	0.0	0.1	0.0	0
Multifuel burner (wood)	26	66	89	4	184	0	1	1	0	2
Multifuel burner (coal)	10	25	47	3	85	0	0	1	0	1
Gas burner	0.00	0.00	0.01	0.00	0	0.2	0.3	0.7	0.2	1
Oil burner	0.01	0.02	0.02	0.02	0	0.0	0.1	0.1	0.1	0
Total (kg)	208	469	803	277	1757	2	5	8	3	17

Parkside Weekend days	SO _x					Benzene				
	6am- 10am	10am- 4pm	4pm- 10pm	10pm- 6am	Total kg	6am- 10am	10am- 4pm	4pm- 10pm	10pm- 6am	Total kg
Open fire (wood)	0.0	0.1	0.2	0.0	0	0.1	0.4	0.8	0.2	2
Open fire (coal)	0.0	0.0	0.1	0.0	0	0.0	0.0	0.0	0.0	0
Pre-1994 woodburners	0.1	0.3	0.5	0.2	1	0.6	1.4	2.2	1.1	5
1994-2000 woodburners	0.2	0.3	0.6	0.2	1	0.8	1.5	3.0	1.0	6
2001+ woodburners	0.1	0.2	0.3	0.1	1	0.5	1.0	1.3	0.6	3
Pellet burners	0.0	0.0	0.0	0.0	0	0.0	0.0	0.1	0.0	0
Multifuel burner (wood)	0.0	0.1	0.2	0.0	0	0.2	0.6	0.8	0.0	2
Multifuel burner (coal)	0.1	0.2	0.5	0.0	1	0.0	0.0	0.0	0.0	0
Gas burner	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0
Oil burner	0.10	0.15	0.18	0.16	1	0.00	0.00	0.00	0.00	0
Total (kg)	1	1	2	1	5	2	5	8	3	18

Appendix G Emission of contaminants from home heating appliances by time period in each study area. Seaview

Seaview Weekdays	PM ₁₀					PM _{2.5}				
	6am-10am	10am-4pm	4pm-10pm	10pm-6am	Total kg	6am-10am	10am-4pm	4pm-10pm	10pm-6am	Total kg
Open fire (wood)	1	3	7	2	13	1	3	6	1	11
Open fire (coal)	2	3	6	2	12	2	3	5	2	12
Pre-1994 woodburners	4	10	29	7	50	4	9	28	7	49
1994-2000 woodburners	7	11	22	11	50	7	11	21	10	49
2001+ woodburners	2	5	7	5	19	2	4	7	5	19
Pellet burners	0.0	0.0	0.1	0.0	0	0.0	0.0	0.1	0.0	0
Multifuel burner (wood)	1	7	10	4	21	1	6	9	3	21
Multifuel burner (coal)	1	3	5	2	11	1	3	5	2	10
Gas burner	0.00	0.00	0.01	0.00	0	0.00	0.00	0.01	0.00	0
Oil burner	0.01	0.01	0.01	0.01	0	0.00	0.00	0.01	0.01	0
Total (kg)	19	42	85	32	177	18	40	81	30	170

Seaview Weekdays	CO					NO _x				
	6am-10am	10am-4pm	4pm-10pm	10pm-6am	Total kg	6am-10am	10am-4pm	4pm-10pm	10pm-6am	Total kg
Open fire (wood)	11	24	51	12	97	0	0	1	0	2
Open fire (coal)	5	12	19	6	41	0	1	1	0	2
Pre-1994 woodburners	45	95	288	74	502	0	1	3	1	5
1994-2000 woodburners	68	111	216	106	501	0	1	1	1	3
2001+ woodburners	22	46	73	50	191	0	0	1	0	2
Pellet burners	0.2	0.5	1.0	0.4	2	0.0	0.0	0.1	0.0	0
Multifuel burner (wood)	15	65	97	35	212	0	1	1	0	2
Multifuel burner (coal)	4	20	30	11	65	0	0	0	0	1
Gas burner	0.00	0.00	0.00	0.00	0	0.1	0.2	0.3	0.1	1
Oil burner	0.01	0.01	0.02	0.01	0	0.0	0.0	0.1	0.1	0
Total (kg)	171	373	774	294	1611	2	4	8	3	17

Seaview Weekdays	SO _x					Benzene				
	6am-10am	10am-4pm	4pm-10pm	10pm-6am	Total kg	6am-10am	10am-4pm	4pm-10pm	10pm-6am	Total kg
Open fire (wood)	0.0	0.1	0.1	0.0	0	0.2	0.3	0.7	0.2	1
Open fire (coal)	0.4	0.8	1.4	0.4	3	0.0	0.0	0.0	0.0	0
Pre-1994 woodburners	0.1	0.2	0.5	0.1	1	0.4	0.8	2.5	0.7	4
1994-2000 woodburners	0.2	0.2	0.5	0.2	1	0.7	1.2	2.3	1.1	5
2001+ woodburners	0.1	0.2	0.2	0.2	1	0.4	0.7	1.2	0.8	3
Pellet burners	0.0	0.0	0.0	0.0	0	0.0	0.0	0.1	0.0	0
Multifuel burner (wood)	0.0	0.1	0.2	0.1	0	0.1	0.6	0.9	0.3	2
Multifuel burner (coal)	0.0	0.2	0.3	0.1	1	0.0	0.0	0.0	0.0	0
Gas burner	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0
Oil burner	0.07	0.07	0.14	0.11	0	0.00	0.00	0.00	0.00	0
Total (kg)	1	2	3	1	7	2	4	8	3	16

Appendix G Emission of contaminants from home heating appliances by time period in each study area. Seaview

Seaview Weekend days	PM ₁₀					PM _{2.5}				
	6am- 10am	10am- 4pm	4pm- 10pm	10pm- 6am	Total kg	6am- 10am	10am- 4pm	4pm- 10pm	10pm- 6am	Total kg
Open fire (wood)	2	4	6	2	13	2	3	6	1	12
Open fire (coal)	2	3	6	1	13	2	3	6	1	12
Pre-1994 woodburners	9	21	26	10	66	9	20	25	10	64
1994-2000 woodburners	8	15	22	12	57	8	14	21	12	55
2001+ woodburners	2	5	7	4	18	2	5	7	4	18
Pellet burners	0.0	0.1	0.1	0.0	0	0.0	0.1	0.1	0.0	0
Multifuel burner (wood)	1	7	10	4	21	1	6	9	3	21
Multifuel burner (coal)	1	3	5	2	11	1	3	5	2	10
Gas burner	0.00	0.01	0.01	0.00	0	0.00	0.01	0.01	0.00	0
Oil burner	0.01	0.01	0.01	0.01	0	0.00	0.00	0.01	0.01	0
Total (kg)	25	58	83	34	199	24	55	79	33	191

Seaview Weekend days	CO					NO _x				
	6am- 10am	10am- 4pm	4pm- 10pm	10pm- 6am	Total kg	6am- 10am	10am- 4pm	4pm- 10pm	10pm- 6am	Total kg
Open fire (wood)	14	27	47	12	99	0	1	1	0	2
Open fire (coal)	6	12	20	5	43	0	1	1	0	3
Pre-1994 woodburners	90	209	261	98	657	1	2	2	1	6
1994-2000 woodburners	80	148	219	120	566	0	1	1	1	3
2001+ woodburners	22	49	74	40	185	0	0	1	0	2
Pellet burners	0.3	0.7	1.0	0.5	2	0.0	0.0	0.1	0.0	0
Multifuel burner (wood)	15	65	97	35	212	0	1	1	0	2
Multifuel burner (coal)	4	20	30	11	65	0	0	0	0	1
Gas burner	0.00	0.00	0.00	0.00	0	0.2	0.3	0.3	0.1	1
Oil burner	0.01	0.01	0.02	0.01	0	0.0	0.0	0.1	0.1	0
Total (kg)	230	530	748	321	1829	2	6	8	3	19

Seaview Weekend days	SO _x					Benzene				
	6am- 10am	10am- 4pm	4pm- 10pm	10pm- 6am	Total kg	6am- 10am	10am- 4pm	4pm- 10pm	10pm- 6am	Total kg
Open fire (wood)	0.0	0.1	0.1	0.0	0	0.2	0.4	0.7	0.2	1
Open fire (coal)	0.4	0.8	1.5	0.4	3	0.0	0.0	0.0	0.0	0
Pre-1994 woodburners	0.2	0.4	0.5	0.2	1	0.8	1.8	2.3	0.9	6
1994-2000 woodburners	0.2	0.3	0.5	0.3	1	0.9	1.6	2.4	1.3	6
2001+ woodburners	0.1	0.2	0.2	0.1	1	0.4	0.8	1.2	0.6	3
Pellet burners	0.0	0.0	0.0	0.0	0	0.0	0.0	0.1	0.0	0
Multifuel burner (wood)	0.0	0.1	0.2	0.1	0	0.1	0.6	0.9	0.3	2
Multifuel burner (coal)	0.0	0.2	0.3	0.1	1	0.0	0.0	0.0	0.0	0
Gas burner	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0
Oil burner	0.07	0.07	0.14	0.11	0	0.00	0.00	0.00	0.00	0
Total (kg)	1	2	3	1	8	2	5	7	3	18

Appendix G Emission of contaminants from home heating appliances by time period in each study area. Watlington

Watlington Weekdays	PM ₁₀					PM _{2.5}				
	6am-10am	10am-4pm	4pm-10pm	10pm-6am	Total kg	6am-10am	10am-4pm	4pm-10pm	10pm-6am	Total kg
Open fire (wood)	0	0	3	0	4	0	0	3	0	3
Open fire (coal)	0	0	3	0	3	0	0	2	0	3
Pre-1994 woodburners	5	10	21	9	44	4	9	20	9	43
1994-2000 woodburners	5	9	16	6	36	4	9	16	6	35
2001+ woodburners	3	5	12	5	24	3	4	11	5	23
Pellet burners	0.0	0.0	0.1	0.0	0	0.0	0.0	0.1	0.0	0
Multifuel burner (wood)	1	1	5	2	9	0	1	5	2	9
Multifuel burner (coal)	0	1	4	2	7	0	1	4	2	7
Gas burner	0.00	0.00	0.01	0.00	0	0.00	0.00	0.01	0.00	0
Oil burner	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0
Total (kg)	13	25	64	25	128	13	24	62	24	123

Watlington Weekdays	CO					NO _x				
	6am-10am	10am-4pm	4pm-10pm	10pm-6am	Total kg	6am-10am	10am-4pm	4pm-10pm	10pm-6am	Total kg
Open fire (wood)	0	2	24	3	29	0	0	1	0	1
Open fire (coal)	0	1	9	1	10	0	0	0	0	1
Pre-1994 woodburners	45	96	211	88	440	0	1	2	1	4
1994-2000 woodburners	46	91	160	64	362	0	1	1	0	2
2001+ woodburners	30	46	115	50	241	0	0	1	0	2
Pellet burners	0.2	0.4	0.9	0.4	2	0.0	0.0	0.1	0.0	0
Multifuel burner (wood)	5	8	52	23	88	0	0	0	0	1
Multifuel burner (coal)	3	4	25	11	43	0	0	0	0	1
Gas burner	0.00	0.00	0.00	0.00	0	0.1	0.1	0.3	0.0	1
Oil burner	0.00	0.00	0.00	0.00	0	0.0	0.0	0.0	0.0	0
Total (kg)	130	247	598	240	1214	1	2	6	2	11

Watlington Weekdays	SO _x					Benzene				
	6am-10am	10am-4pm	4pm-10pm	10pm-6am	Total kg	6am-10am	10am-4pm	4pm-10pm	10pm-6am	Total kg
Open fire (wood)	0.0	0.0	0.1	0.0	0	0.0	0.0	0.3	0.0	0
Open fire (coal)	0.0	0.0	0.6	0.1	1	0.0	0.0	0.0	0.0	0
Pre-1994 woodburners	0.1	0.2	0.4	0.2	1	0.4	0.8	1.9	0.8	4
1994-2000 woodburners	0.1	0.2	0.4	0.1	1	0.5	1.0	1.7	0.7	4
2001+ woodburners	0.1	0.2	0.4	0.2	1	0.5	0.7	1.9	0.8	4
Pellet burners	0.0	0.0	0.0	0.0	0	0.0	0.0	0.1	0.0	0
Multifuel burner (wood)	0.0	0.0	0.1	0.0	0	0.0	0.1	0.5	0.2	1
Multifuel burner (coal)	0.0	0.0	0.3	0.1	0	0.0	0.0	0.0	0.0	0
Gas burner	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0
Oil burner	0.01	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0
Total (kg)	0	1	2	1	4	1	3	6	3	13

Appendix G Emission of contaminants from home heating appliances by time period in each study area. Watlington

Watlington Weekend days	PM ₁₀					PM _{2.5}				
	6am- 10am	10am- 4pm	4pm- 10pm	10pm- 6am	Total kg	6am- 10am	10am- 4pm	4pm- 10pm	10pm- 6am	Total kg
Open fire (wood)	0	1	3	0	4	0	1	3	0	4
Open fire (coal)	0	0	3	0	4	0	0	3	0	3
Pre-1994 woodburners	6	13	20	9	48	6	12	20	9	46
1994-2000 woodburners	5	11	16	6	38	5	10	16	6	37
2001+ woodburners	3	8	12	5	28	3	7	12	5	27
Pellet burners	0.0	0.1	0.1	0.0	0	0.0	0.1	0.1	0.0	0
Multifuel burner (wood)	1	1	5	3	10	1	1	4	3	9
Multifuel burner (coal)	1	1	4	2	7	1	1	3	2	7
Gas burner	0.00	0.00	0.01	0.00	0	0.00	0.00	0.01	0.00	0
Oil burner	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0
Total (kg)	16	35	63	26	139	15	33	61	25	134

Watlington Weekend days	CO					NO _x				
	6am- 10am	10am- 4pm	4pm- 10pm	10pm- 6am	Total kg	6am- 10am	10am- 4pm	4pm- 10pm	10pm- 6am	Total kg
Open fire (wood)	0	4	25	3	33	0	0	1	0	1
Open fire (coal)	0	2	9	1	12	0	0	1	0	1
Pre-1994 woodburners	58	126	204	89	478	1	1	2	1	4
1994-2000 woodburners	49	108	162	62	381	0	1	1	0	2
2001+ woodburners	34	76	122	47	280	0	1	1	0	2
Pellet burners	0.3	0.6	0.9	0.4	2	0.0	0.0	0.1	0.0	0
Multifuel burner (wood)	9	13	46	29	97	0	0	0	0	1
Multifuel burner (coal)	4	7	20	11	43	0	0	0	0	1
Gas burner	0.00	0.00	0.00	0.00	0	0.1	0.1	0.3	0.0	1
Oil burner	0.00	0.00	0.00	0.00	0	0.0	0.0	0.0	0.0	0
Total (kg)	155	336	589	244	1325	1	3	6	2	12

Watlington Weekend days	SO _x					Benzene				
	6am- 10am	10am- 4pm	4pm- 10pm	10pm- 6am	Total kg	6am- 10am	10am- 4pm	4pm- 10pm	10pm- 6am	Total kg
Open fire (wood)	0.0	0.0	0.1	0.0	0	0.0	0.1	0.4	0.0	0
Open fire (coal)	0.0	0.1	0.6	0.1	1	0.0	0.0	0.0	0.0	0
Pre-1994 woodburners	0.1	0.2	0.4	0.2	1	0.5	1.1	1.8	0.8	4
1994-2000 woodburners	0.1	0.2	0.4	0.1	1	0.5	1.2	1.7	0.7	4
2001+ woodburners	0.1	0.3	0.4	0.2	1	0.6	1.2	2.0	0.8	5
Pellet burners	0.0	0.0	0.0	0.0	0	0.0	0.0	0.1	0.0	0
Multifuel burner (wood)	0.0	0.0	0.1	0.1	0	0.1	0.1	0.4	0.3	1
Multifuel burner (coal)	0.0	0.1	0.2	0.1	0	0.0	0.0	0.0	0.0	0
Gas burner	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0
Oil burner	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0
Total (kg)	0	1	2	1	4	2	4	6	3	14

Appendix G Emission of contaminants from home heating appliances by time period in each study area. West End

West End Weekdays	PM ₁₀					PM _{2.5}				
	6am-10am	10am-4pm	4pm-10pm	10pm-6am	Total kg	6am-10am	10am-4pm	4pm-10pm	10pm-6am	Total kg
Open fire (wood)	2	4	10	4	21	2	4	9	3	18
Open fire (coal)	0	1	2	1	4	0	1	2	1	4
Pre-1994 woodburners	5	8	29	12	55	5	8	29	11	53
1994-2000 woodburners	5	6	21	7	40	5	6	21	7	39
2001+ woodburners	3	3	7	4	17	3	3	7	4	16
Pellet burners	0.0	0.0	0.1	0.0	0	0.0	0.0	0.1	0.0	0
Multifuel burner (wood)	1	4	3	1	8	1	3	3	1	8
Multifuel burner (coal)	0	3	2	0	6	0	2	2	0	5
Gas burner	0.00	0.00	0.01	0.00	0	0.00	0.00	0.01	0.00	0
Oil burner	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0
Total (kg)	17	29	76	28	150	16	28	73	27	144

West End Weekdays	CO					NO _x				
	6am-10am	10am-4pm	4pm-10pm	10pm-6am	Total kg	6am-10am	10am-4pm	4pm-10pm	10pm-6am	Total kg
Open fire (wood)	16	32	79	29	155	0	1	2	1	3
Open fire (coal)	0	3	8	2	13	0	0	0	0	1
Pre-1994 woodburners	55	80	295	118	548	0	1	3	1	5
1994-2000 woodburners	51	62	214	74	400	0	0	1	0	2
2001+ woodburners	28	35	68	38	169	0	0	1	0	1
Pellet burners	0.2	0.3	1.0	0.4	2	0.0	0.0	0.1	0.0	0
Multifuel burner (wood)	6	36	34	7	84	0	0	0	0	1
Multifuel burner (coal)	2	15	14	2	32	0	0	0	0	0
Gas burner	0.00	0.00	0.01	0.00	0	0.2	0.1	0.5	0.1	1
Oil burner	0.00	0.01	0.01	0.01	0	0.0	0.0	0.0	0.0	0
Total (kg)	158	264	712	269	1403	2	3	8	3	15

West End Weekdays	SO _x					Benzene				
	6am-10am	10am-4pm	4pm-10pm	10pm-6am	Total kg	6am-10am	10am-4pm	4pm-10pm	10pm-6am	Total kg
Open fire (wood)	0.0	0.1	0.2	0.1	0	0.2	0.5	1.1	0.4	2
Open fire (coal)	0.0	0.2	0.6	0.1	1	0.0	0.0	0.0	0.0	0
Pre-1994 woodburners	0.1	0.1	0.5	0.2	1	0.5	0.7	2.6	1.0	5
1994-2000 woodburners	0.1	0.1	0.5	0.2	1	0.5	0.7	2.3	0.8	4
2001+ woodburners	0.1	0.1	0.2	0.1	1	0.5	0.6	1.1	0.6	3
Pellet burners	0.0	0.0	0.0	0.0	0	0.0	0.0	0.1	0.0	0
Multifuel burner (wood)	0.0	0.1	0.1	0.0	0	0.1	0.3	0.3	0.1	1
Multifuel burner (coal)	0.0	0.2	0.1	0.0	0	0.0	0.0	0.0	0.0	0
Gas burner	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0
Oil burner	0.03	0.05	0.05	0.06	0	0.00	0.00	0.00	0.00	0
Total (kg)	0	1	2	1	5	2	3	7	3	15

Appendix G Emission of contaminants from home heating appliances by time period in each study area. West End

West End Weekend days	PM ₁₀					PM _{2.5}				
	6am- 10am	10am- 4pm	4pm- 10pm	10pm- 6am	Total kg	6am- 10am	10am- 4pm	4pm- 10pm	10pm- 6am	Total kg
Open fire (wood)	2	5	10	4	21	2	4	9	4	19
Open fire (coal)	0	1	2	0	4	0	1	2	0	4
Pre-1994 woodburners	7	15	30	12	64	7	14	29	12	62
1994-2000 woodburners	7	13	23	9	52	7	13	22	8	51
2001+ woodburners	4	6	9	3	21	4	6	8	3	21
Pellet burners	0.0	0.1	0.1	0.0	0	0.0	0.1	0.1	0.0	0
Multifuel burner (wood)	0	3	3	1	7	0	3	3	1	7
Multifuel burner (coal)	0	3	3	0	6	0	3	3	0	6
Gas burner	0.00	0.00	0.01	0.00	0	0.00	0.00	0.01	0.00	0
Oil burner	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0
Total (kg)	21	45	80	29	176	21	44	76	28	168

West End Weekend days	CO					NO _x				
	6am- 10am	10am- 4pm	4pm- 10pm	10pm- 6am	Total kg	6am- 10am	10am- 4pm	4pm- 10pm	10pm- 6am	Total kg
Open fire (wood)	13	36	79	30	157	0	1	2	1	3
Open fire (coal)	1	4	6	2	13	0	0	0	0	1
Pre-1994 woodburners	72	147	297	120	636	1	1	3	1	6
1994-2000 woodburners	74	134	228	86	522	0	1	1	0	3
2001+ woodburners	38	57	88	31	214	0	0	1	0	2
Pellet burners	0.3	0.6	1.1	0.4	2	0.0	0.0	0.1	0.0	0
Multifuel burner (wood)	4	27	35	7	73	0	0	0	0	1
Multifuel burner (coal)	3	17	17	0	36	0	0	0	0	1
Gas burner	0.00	0.00	0.01	0.00	0	0.2	0.2	0.5	0.1	1
Oil burner	0.00	0.01	0.01	0.01	0	0.0	0.0	0.0	0.0	0
Total (kg)	206	423	750	275	1654	2	4	8	3	17

West End Weekend days	SO _x					Benzene				
	6am- 10am	10am- 4pm	4pm- 10pm	10pm- 6am	Total kg	6am- 10am	10am- 4pm	4pm- 10pm	10pm- 6am	Total kg
Open fire (wood)	0.0	0.1	0.2	0.1	0	0.2	0.5	1.1	0.4	2
Open fire (coal)	0.1	0.3	0.4	0.1	1	0.0	0.0	0.0	0.0	0
Pre-1994 woodburners	0.1	0.3	0.5	0.2	1	0.6	1.3	2.6	1.1	6
1994-2000 woodburners	0.2	0.3	0.5	0.2	1	0.8	1.4	2.5	0.9	6
2001+ woodburners	0.1	0.2	0.3	0.1	1	0.6	0.9	1.4	0.5	3
Pellet burners	0.0	0.0	0.0	0.0	0	0.0	0.0	0.1	0.0	0
Multifuel burner (wood)	0.0	0.0	0.1	0.0	0	0.0	0.2	0.3	0.1	1
Multifuel burner (coal)	0.0	0.2	0.2	0.0	0	0.0	0.0	0.0	0.0	0
Gas burner	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0
Oil burner	0.03	0.05	0.05	0.06	0	0.00	0.00	0.00	0.00	0
Total (kg)	1	1	2	1	5	2	4	8	3	18

Appendix G Emission of contaminants from home heating appliances by time period in each study area. Timaru excluding Washdyke

Timaru (exc. Washdyke) Weekdays	PM ₁₀					PM _{2.5}				
	6am- 10am	10am- 4pm	4pm- 10pm	10pm- 6am	Total kg	6am- 10am	10am- 4pm	4pm- 10pm	10pm- 6am	Total kg
Open fire (wood)	10	20	59	14	103	9	18	52	12	91
Open fire (coal)	3	7	30	9	49	3	7	28	9	47
Pre-1994 woodburners	57	100	254	95	506	55	97	247	92	491
1994-2000 woodburners	41	67	179	68	355	40	65	173	66	344
2001+ woodburners	23	38	89	38	188	22	36	87	37	182
Pellet burners	0.2	0.4	1.0	0.4	2.0	0.2	0.4	0.9	0.4	1.9
Multifuel burner (wood)	12	22	51	17	102	12	21	49	16	99
Multifuel burner (coal)	6	16	27	13	62	5	14	24	12	55
Gas burner	0.03	0.02	0.11	0.02	0.18	0.03	0.02	0.11	0.02	0.18
Oil burner	0.03	0.04	0.07	0.04	0.18	0.02	0.03	0.05	0.03	0.12
Total (kg)	152	269	690	254	1366	146	258	662	245	1311

Timaru (exc. Washdyke) Weekdays	CO					NO _x				
	6am- 10am	10am- 4pm	4pm- 10pm	10pm- 6am	Total kg	6am- 10am	10am- 4pm	4pm- 10pm	10pm- 6am	Total kg
Open fire (wood)	78	150	443	104	775	2	3	9	2	16
Open fire (coal)	10	23	100	30	163	1	1	6	2	10
Pre-1994 woodburners	572	996	2544	949	5061	5	9	23	9	46
1994-2000 woodburners	408	672	1787	680	3547	2	4	10	4	20
2001+ woodburners	226	375	894	384	1879	2	3	7	3	16
Pellet burners	2.2	3.7	9.3	3.6	18.8	0.1	0.2	0.6	0.2	1.3
Multifuel burner (wood)	123	218	506	169	1016	1	2	5	2	9
Multifuel burner (coal)	34	90	158	76	358	0	1	2	1	5
Gas burner	0.02	0.02	0.07	0.01	0.12	1.5	1.2	5.3	0.8	8.8
Oil burner	0.04	0.06	0.11	0.07	0.29	0.2	0.3	0.5	0.3	1.2
Total (kg)	1453	2529	6441	2395	12818	15	25	69	23	133

Timaru (exc. Washdyke) Weekdays	SO _x					Benzene				
	6am- 10am	10am- 4pm	4pm- 10pm	10pm- 6am	Total kg	6am- 10am	10am- 4pm	4pm- 10pm	10pm- 6am	Total kg
Open fire (wood)	0.2	0.4	1.3	0.3	2.3	1.1	2.1	6.3	1.5	11
Open fire (coal)	0.7	1.7	7.3	2.2	11.9	0.0	0.0	0.0	0.0	0
Pre-1994 woodburners	1.0	1.8	4.6	1.7	9.2	5.0	8.8	22.4	8.4	45
1994-2000 woodburners	0.9	1.5	4.0	1.5	7.9	4.4	7.2	19.3	7.3	38
2001+ woodburners	0.8	1.3	3.0	1.3	6.3	3.6	6.1	14.5	6.2	30
Pellet burners	0.0	0.0	0.1	0.0	0.3	0.1	0.2	0.6	0.2	1.2
Multifuel burner (wood)	0.2	0.4	0.9	0.3	1.8	1.1	1.9	4.5	1.5	9
Multifuel burner (coal)	0.3	0.9	1.6	0.8	3.6	0.0	0.0	0.0	0.0	0
Gas burner	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.01
Oil burner	0.35	0.51	0.90	0.57	2.33	0.00	0.00	0.00	0.00	0.00
Total (kg)	5	9	24	9	46	15	26	68	25	134

Appendix G Emission of contaminants from home heating appliances by time period in each study area. Timaru excluding Washdyke

Timaru (exc. Washdyke) Weekend day	PM ₁₀					PM _{2.5}				
	6am-10am	10am-4pm	4pm-10pm	10pm-6am	Total kg	6am-10am	10am-4pm	4pm-10pm	10pm-6am	Total kg
Open fire (wood)	11	24	59	15	110	10	21	52	13	97
Open fire (coal)	4	10	27	10	50	3	9	26	9	48
Pre-1994 woodburners	75	164	265	108	614	73	160	257	105	595
1994-2000 woodburners	52	104	184	75	415	50	101	178	73	402
2001+ woodburners	29	61	91	39	221	29	59	88	38	214
Pellet burners	0.3	0.6	1.0	0.4	2.4	0.3	0.6	1.0	0.4	2.2
Multifuel burner (wood)	12	29	50	16	106	11	28	49	15	103
Multifuel burner (coal)	5	19	27	10	62	5	17	24	9	55
Gas burner	0.03	0.04	0.11	0.02	0.21	0.03	0.04	0.11	0.02	0.21
Oil burner	0.03	0.05	0.07	0.05	0.18	0.02	0.03	0.04	0.03	0.12
Total (kg)	189	411	705	275	1580	182	396	676	264	1518

Timaru (exc. Washdyke) Weekend day	CO					NO _x				
	6am-10am	10am-4pm	4pm-10pm	10pm-6am	Total kg	6am-10am	10am-4pm	4pm-10pm	10pm-6am	Total kg
Open fire (wood)	86	183	445	115	829	2	4	9	2	17
Open fire (coal)	12	33	91	32	168	1	2	5	2	10
Pre-1994 woodburners	752	1645	2654	1084	6135	7	15	24	10	56
1994-2000 woodburners	519	1038	1837	753	4148	3	6	10	4	23
2001+ woodburners	294	607	912	393	2206	2	5	8	3	18
Pellet burners	2.8	5.9	9.6	4.0	22.4	0.2	0.4	0.6	0.3	1.5
Multifuel burner (wood)	116	287	500	158	1062	1	3	5	1	10
Multifuel burner (coal)	31	110	156	60	357	0	2	2	1	5
Gas burner	0.02	0.03	0.07	0.01	0.14	1.7	2.2	5.4	1.0	10.2
Oil burner	0.05	0.08	0.11	0.08	0.31	0.2	0.3	0.4	0.3	1.2
Total (kg)	1814	3908	6605	2599	14927	18	39	70	25	152

Timaru (exc. Washdyke) Weekend day	SO _x					Benzene				
	6am-10am	10am-4pm	4pm-10pm	10pm-6am	Total kg	6am-10am	10am-4pm	4pm-10pm	10pm-6am	Total kg
Open fire (wood)	0.3	0.5	1.3	0.3	2.4	1.2	2.6	6.4	1.6	12
Open fire (coal)	0.9	2.4	6.6	2.4	12.2	0.0	0.0	0.0	0.0	0
Pre-1994 woodburners	1.4	3.0	4.8	2.0	11.2	6.6	14.5	23.4	9.6	54
1994-2000 woodburners	1.2	2.3	4.1	1.7	9.2	5.6	11.2	19.8	8.1	45
2001+ woodburners	1.0	2.0	3.0	1.3	7.4	4.8	9.8	14.7	6.3	36
Pellet burners	0.0	0.1	0.1	0.1	0.3	0.2	0.4	0.6	0.3	1.4
Multifuel burner (wood)	0.2	0.5	0.9	0.3	1.9	1.0	2.5	4.4	1.4	9
Multifuel burner (coal)	0.3	1.1	1.6	0.6	3.6	0.0	0.0	0.0	0.0	0
Gas burner	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.01
Oil burner	0.38	0.61	0.87	0.60	2.45	0.00	0.00	0.00	0.00	0.00
Total (kg)	6	13	23	9	51	19	41	69	27	157



Christchurch

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Timaru

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