Briefing paper to Nelson City Council Woodburner Working Party

Background to Health Effects and Airshed Definition

Purpose

To provide a brief background to the assessment of health related impacts of particulate air pollution (smoke) in Nelson and how Nelson airshed boundaries have been defined. For the details of health assessments the paper provided by Emily Wilton of Environet (attached) and the statement of the Public Health Service should be referred to.

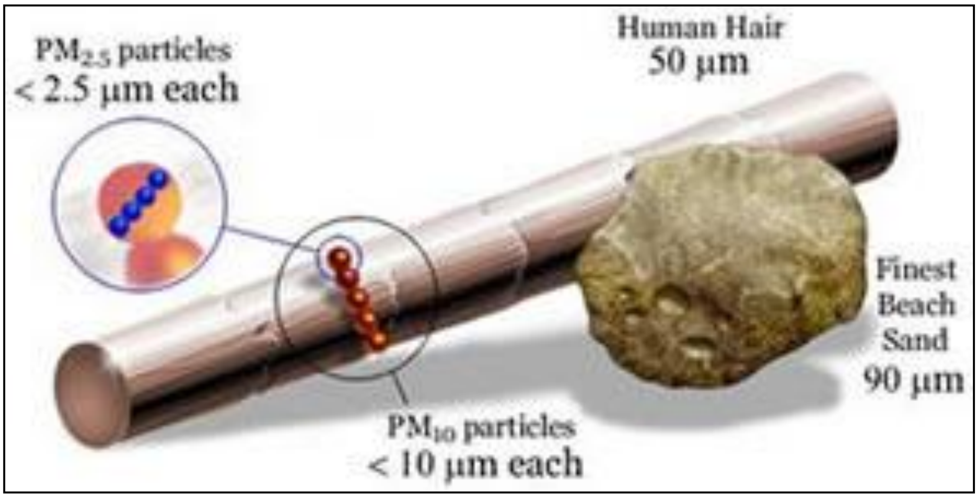
Background

During its meeting of August 21st 2014 members of the Woodburner Working Party asked for further information concerning health impacts and for clarification of the way in which the airshed boundaries were defined. This paper seeks to provide a brief overview regarding those matters.

Characteristics of Smoke

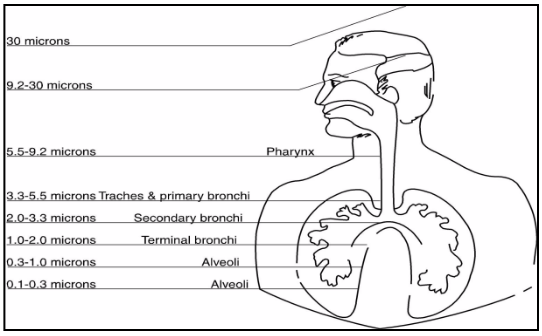
Smoke comprises a range of particle sizes and can come from a range of combustion sources including wood burners. In New Zealand the National Environmental Standard for particulate air pollution relates to particles smaller than ten microns (PM_{10}). Measured PM_{10} also includes all of the smaller particle sizes including $PM_{2.5}$ and PM_1 (which are regulated in some other parts of the world). Monitoring undertaken in Nelson Airshed A shows that during the mid winter period over 90% of the measured PM_{10} comprises of particles of 2.5 microns or smaller ($PM_{2.5}$).

The diagram below (from MfE) puts these particle sizes in context. A human hair is approximately 50 µm in diameter therefore it takes 5 PM_{10} particles in a line to span the width of a human hair or it takes 25 $PM_{2.5}$ particles.



Recognised Health Effects of PM_{10}

Small particles penetrate deep into the body generally through the lungs. An indication of the penetration of the different sized particles is given in the diagram below. As can be seen the smaller the particle size the deeper the penetration.



The health effects from exposure to PM_{10} include sickness and premature death. Sicknesses includes respiratory hospital admissions, emergency room visits for asthma, restricted activity days (when people just can't get on with their normal activities) and school absenteeism. Premature deaths are generally associated with heart and/or lung failure. The World Health Organisation considers that there is no safe level for PM_{10}.

Basis for Predicting Health effects in Nelson

Health effects directly associated with particulate air pollution are difficult to attribute causality to. Health effects analysis and prediction requires a large sample size and a long monitoring period. This ensures that short term trends and confounding factors do not skew the results giving false conclusions and that there is adequate statistical certainty in the sample size. Within a small urban area such as Nelson City there are simply not enough people to assess long term trends in human health impacts from elevated PM_{10} with any degree of confidence.

By comparison the American Cancer Society Study (Pope and colleagues1995) included 552,138 adult subjects in 154 US cities over a seven year period. The results of this study were challenged by members of Congress, industry and some members of the scientific community. The Health Effects Institute based at Harvard University completed a full review of the study's methodology, analysis and conclusions and concluded that the study was sound and the results substantially proven (in 2000).

This situation has been mirrored by New Zealand and Australian experience. In its report in 2010, a collaborative study which included Australian Universities and Australian and New Zealand Government Departments (Environment Protection and Heritage Council) made the following observation:

"A number of single city studies in Australia and New Zealand have examined the impact of air pollution on health outcomes, for example for Brisbane, Sydney, Melbourne, Christchurch and Perth. However such studies have been criticised for bias, and generally differ in the statistical approaches, making comparisons difficult. Further, results for cities with smaller populations tend to be very sensitive to the methodology used, and the estimates for the increases in mortality or morbidity that might arise with increases in air pollution have higher levels of uncertainty.........We recommend caution against using the results of single-city studies, whether individually or pooled, for impact assessment. Multi-city approaches, such as NMMAPS or APHENA, offer a now-feasible alternative that is less subject to publication bias."

HAPINZ Study

In 2003, the Ministry for the Environment, the Ministry of Transport and the Health Research Council of New Zealand (with in-kind support from the Ministry of Health and regional councils) commissioned the Health and Air Pollution in New Zealand (HAPINZ) study. That study was reported in 2007. This represented New Zealand's first study on the national health impacts of air pollution. It found that the primary health impact resulting from air pollution (in terms of social costs) is premature mortality in adults.

HAPINZ examined 67 urban areas and included 73 per cent of New Zealand's population. The HAPINZ study linked anthropogenic (human-caused) air pollution with approximately 1,100 premature deaths each year. The HAPINZ report was updated in 2012 including development of a predictive model which utilises monitored PM_{10} concentrations and population statistics to predict health related impacts.

The HAPINZ study reviewed the conclusions from national and international literature. It used a concentration response relationships based on New Zealand studies (Hales, Blakely, & Woodward, 2010). Its findings are consistent with the major international results. It was nationally and internationally peer reviewed. It represents the best data we have available for predicting heath effects from PM_{10}.pollution in Nelson.

A detailed analysis of health effects from air pollution in Nelson using the HAPINZ Predictive Model has prepared by Emily Wilton of Environet and is appended to this report. The HAPINZ assessment will be discussed in detail at the next Woodburner Working Party meeting.

Health Effects Cold Homes

While air pollution has proven adverse impacts on human health, so to have cold homes. A review of the health impacts of cold homes was undertaken for the Friends of the Earth by the Marmot Review Team, Department of Epidemiology & Public Health, University College, London in 2010 (The Marmot Review).

Key findings of that review are :

- Countries which have more energy efficient housing have lower Excess Winter Deaths (EWDs).
- There is a relationship between EWDs, low thermal efficiency of housing and low indoor temperature.
- EWDs are almost three times higher in the coldest quarter of housing than in the warmest quarter (21.5% of all EWDs are attributable to the coldest quarter of housing, because of it being colder than other housing).
- Around 40% of EWDs are attributable to cardiovascular diseases.
- Around 33% of EWDs are attributable to respiratory diseases.
- There is a strong relationship between cold temperatures and cardio-vascular and respiratory diseases.
- Children living in cold homes are more than twice as likely to suffer from a variety of respiratory problems than children living in warm homes.
- Mental health is negatively affected by fuel poverty and cold housing for any age group.
- More than 1 in 4 adolescents living in cold housing are at risk of multiple mental health problems compared to 1 in 20 adolescents who have always lived in warm housing.
- Cold housing increases the level of minor illnesses such as colds and flu and exacerbates existing conditions such as arthritis and rheumatism.

This work has been reconfirmed by a number of researchers in New Zealand (including the University of Otago) and underpins initiatives to improve indoor air temperatures undertaken by ECCA and by a number of public health organisations including some District Health Boards.

The Canterbury District Health Board in its statement of 2012 (Housing, Home Heating and Air Quality: A Public Health Perspective) recognised the dual needs to improve indoor air temperatures and reduce air pollution levels both for public health benefits. It went on to state its ongoing support for the Christchurch Air Plan (See Draft Position Statement attached).

Airshed Boundaries

Following the enactment of the National Environmental Standards for Air Quality (NES) the Ministry for the Environment set out to provide guidance on how airsheds could be defined. A team comprising expertise from NIWA, Endpoint, Environet (Emily Wilton), the University of Canterbury and Kingett Mitchell were commissioned to compile an information resource which was completed in early 2005.

That information resource underpins the definition of the Nelson Airsheds and some of its authors were engaged by Nelson City Council to assist with defining the Nelson airsheds.

A key element of the MfE advice was that airsheds defined under the NES are primarily a management tool and are not strictly a scientifically defined airshed. The recognition of airsheds as a management tool introduces a number of management related considerations. Matters considered during the Nelson airshed definition included:

1. There should not be more airsheds than are strictly need for management purposes. Each airshed has associated administrative and monitoring costs and the greater the number of airsheds the greater that cost. As a consequence it is desirable to "lump" some airsheds together where they have similar characteristics (such as Nelson Airshed C) rather than have multiple small airsheds.
2. Airsheds will vary in extent according to the type of discharge and the ambient meteorological conditions. Some discharges and events can impact multiple airsheds. For example the single largest exceedence of PM10 in Auckland relates to the Sydney bush fires.
3. Airsheds will often (but not always) include geophysical boundaries such as hills and valleys which tend to contain and direct the flow of air pollutions, particularly during cold air conditions where the air is sinking rather than rising. During cold winter nights in low wind conditions air tends to flow downhill much as a water does in a hydrological catchment and along valleys.
4. Airsheds need to take into account local weather patterns which may condense or disburse air pollutants. For example elevated pollution concentrations tend to occur during light south west winds and therefore an airshed may need to be elongate in the north east direction to include the impacted area.
5. Airsheds should take into account the location of different activities and exposures. Matters for consideration include the location of residential areas (people being exposed) and discharges such as industries and main roads
6. Airsheds should take into account existing boundaries. At the larger scale these include jurisdictional boundaries such as the NCC/TDC boundary and at a smaller scale census boundaries such as census area units and meshblock boundaries by which much of the available population and dwelling data is organised.

7. Airsheds should make sense on the ground. As far as possible they should follow physical boundaries such as roads or ridges and avoid cutting through land parcels so that people know what side of the line they are on.

Since the Nelson airshed were defined two additional studies have been completed which provide additional insight on how different areas respond to the discharge of air pollutants.

The first involved taking of air quality measurements from a moving vehicle over multiple nights. The pollution concentration plot from that work is shown below with high concentrations shown in red and low concentrations in blue. In the plot Airshed A is clearly visible by high concentrations as is Airshed B1 and B2.

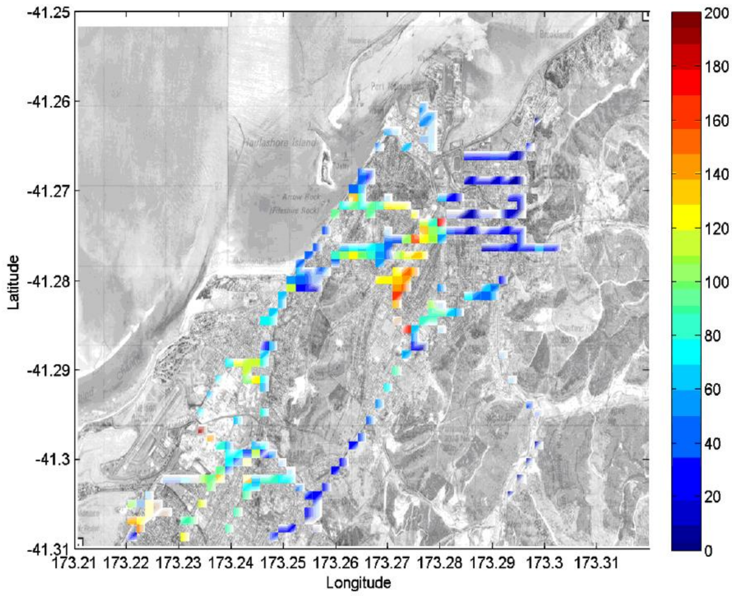


Figure 4-2 **(a) Nelson urban area - PM_{10} concentrations averaged over ~120m^2 grids, for all nights when the mobile system was active. Colour scale is PM_{10} concentration (μg/m^3). (b) PM_{10} concentrations with transparency mask applied to highlight areas that were measured more often.**

The second study involved the development of a computer based air quality model for the whole Nelson–Richmond urban area (a joint NCC/TDC project). The output from that model shows areas where breaches of the NES for PM_{10} are likely and unlikely to occur. They show relativity between location rather than objects. The plot below clearly distinguishes the Nelson Airshed A, B1 and B2 areas along with the Richmond Airshed. Outside these areas the model does not predict any breaches of the NES. The areas not predicted to have NES breaches include the Maitai Valley, Brook Valley, Wood and Atawhai areas which comprise Airshed C.

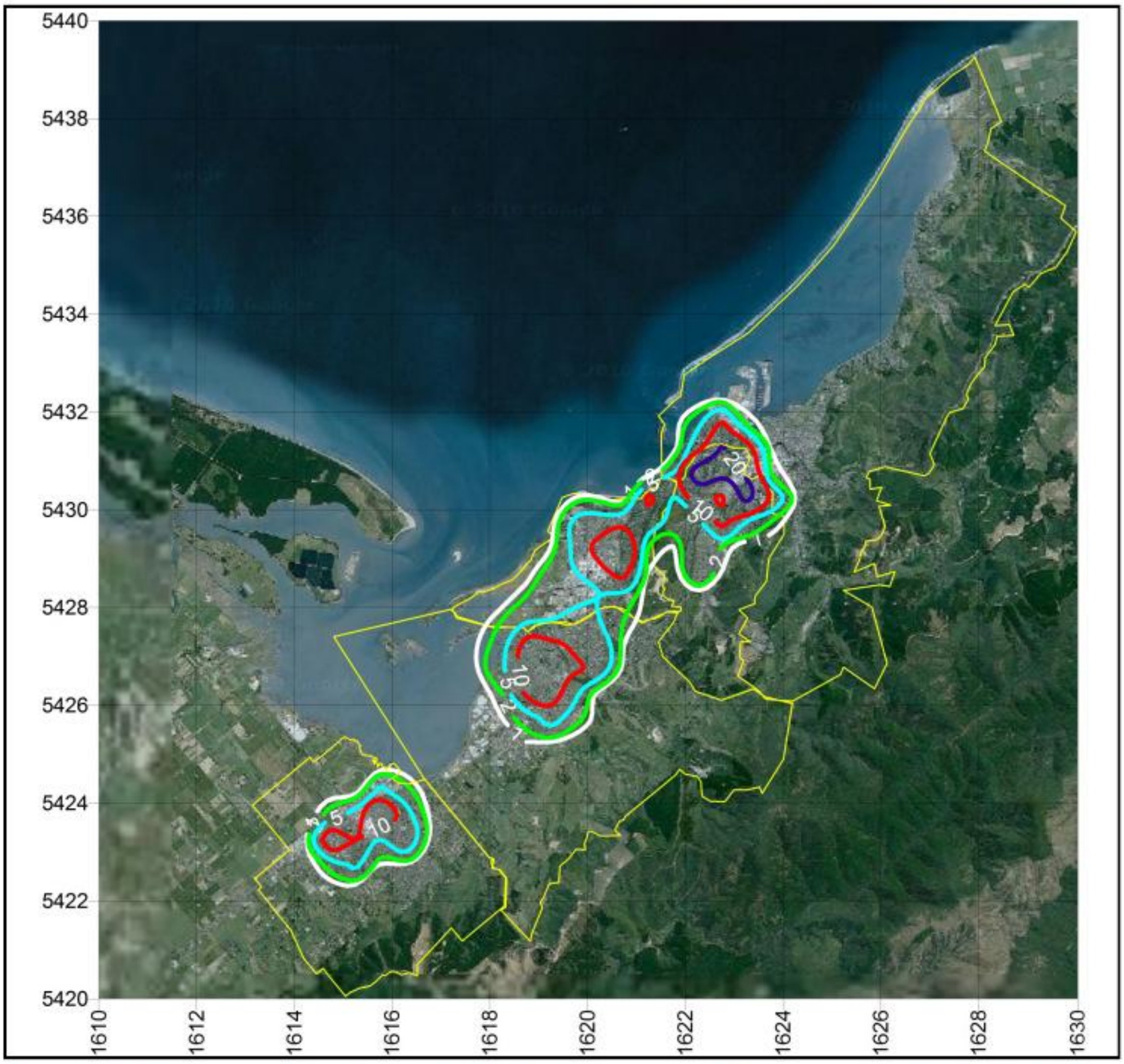


Figure 21: Modelled number of exceedences of the NES for 24-hour-average PM_{10} (concentration 50 $\mu g/m^3$) in 2008. Contours levels denote 1 (white), 2 (green), 5 (light blue), 10 (red) or 20 (dark blue) events.

The NES sets a standard for PM_{10} and at this stage there is no proposal to alter the standard. In many parts of the world including most of Europe and the United Sates, standards are also set for $PM_{2.5}$. $PM_{2.5}$ is much smaller than PM_{10} and penetrates deeper into the lungs. It is more strongly associated with adverse health effects than is PM_{10} and hence the overseas maximum allowable concentrations for $PM_{2.5}$ are much lower than for PM_{10}. In New Zealand the Ambient Air Quality Guidelines set a maximum guideline value of 25 µg/m^3 for $PM_{2.5}$. This level is very similar to the $PM_{2.5}$ standards set in Europe and the US.

Combustion sources such as woodfires and vehicles normally generate very fine particles in the $PM_{2.5}$ range. Nelson City Council has undertaken monitoring of $PM_{2.5}$ in Airshed A since 2008. During the winter period approximately 90% of the PM_{10} measured in Airshed A comprises of $PM_{2.5}$ particles or smaller (PM_1).

As a consequence when a winter measurement of 50 µg/m^3 of PM_{10} occurs (not a breach of the NES), the corresponding concentration of $PM_{2.5}$ is about 45 µg/m^3. That concentration is nearly twice the maximum permissible under the New Zealand Ambient Air Quality Guidelines or under European or US standards.

Putting this another way, during this year (2014) there have been 2 breaches of the NES for PM_{10} in Airshed A during the winter period. If these PM_{10} levels are converted to $PM_{2.5}$ levels by using the locally measured factor of 90% and compared against the New Zealand Ambient Air Quality Guidelines (or against overseas standards) there have been **60** breaches of the $PM_{2.5}$ guideline during the same winter period.

Whilst there is no immediate suggestion that New Zealand adopts a national environmental standard for $PM_{2.5}$ similar to our current Ambient Air Quality Guideline values (and overseas standards), if they were adopted then Nelson will have great difficulty meeting that standard. This is not a matter that is currently legislated and is therefore just one further risk for consideration if it is within the remit of the Working Party.

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Health and Air Pollution in Nelson – outputs from HAPINZ 2006 and evaluation of impact of changes from 2001 to 2013

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Introduction

In 2004 the Ministry for the Environment introduced National Environmental Standards for Air Quality (NESAQ) to improve the health of the New Zealand population by requiring minimum levels for air quality (Ministry for Environment, 2004). Standards were introduced for key air contaminants including a limit of 50 µg/m^3 (24-hour average) for PM_{10} which can be exceeded on only one occasion per year. Prior to the introduction of the NESAQ the limit for PM_{10} was breached in more than 30 urban areas of New Zealand including Nelson. In 2001 Nelson, prior to the introduction of the NES, exceeded 50 µg/m^3 on 81 days at the air quality monitoring site in the Nelson South/ Washington area. The annual average PM_{10} concentration for 2001 at this site was 42 µg/m^3.

Air pollution, in particular concentrations of PM_{10}, result in adverse health impacts. The nature of the impacts varies from relatively minor throat and eye irritations in relatively healthy people to more serious impacts such as chronic bronchitis, increase in asthma symptoms and aggravation of respiratory and cardiopulmonary illness in health compromised individuals. Indicators of particulate pollution related health impacts include hospital admissions for respiratory and cardiopulmonary disease and premature mortality.

The Health and Air Pollution in New Zealand (HAPINZ) 2012 quantified the health impacts of exposure to particulate pollution in New Zealand. That study found that the primary health impact resulting from air pollution (in terms of social costs) is premature mortality in adults. More than 2,300 New Zealanders were estimated to die prematurely each year due to exposure to PM_{10} pollution based on 2006 PM_{10} concentrations (Kuschel et al., 2012).

The HAPINZ study reviews concentration response relationships from the international literature including extensive cohort studies carried out in the United States (e.g., Pope III, 2002) and for a range of health endpoints. The concentration response relationships selected for all-cause mortality adults (ages 30 years and over), annual mean, all ethnicities of 7%, based on Hales, Blakely, & Woodward, (2010), is a locally derived relationship which is consistent with relationships based on international literature. The HAPINZ study included leading health and air pollution researchers in New Zealand and was internationally peer reviewed.

Air quality in Nelson has improved significantly since 2001. In 2013 there were nine exceedences of 50 µg/m3 at the Nelson South monitoring site and the annual average PM_{10} concentration was 18 µg/m^3. Improvements in PM_{10} concentrations in other areas of Nelson have also occurred. The health benefits associated with these improvements can be quantified for Nelson using the HAPINZ model developed by (Kuschel et al., 2012).

Objectives

The objective of this report is to provide estimates of health impacts within the Nelson population associated with exposure to concentrations of PM_{10} using the 2012 health and air pollution in New Zealand (HAPINZ) model (Kuschel et al., 2012). The model is used to estimate health impacts in Nelson for the following scenarios:

- Summary of the estimates presented in HAPINZ for 2006.
- An estimate of the likely impacts for 2001, prior to improvements in PM_{10} concentrations.
- An estimate of the health impacts for 2013 and a summary of the health benefits associated with improvements in PM_{10} concentrations from 2001 to 2013.

HAPINZ outputs for Nelson

Tables 2.1 to 2.3 show the estimated health impacts and associated costs for Nelson for the years 2001, 2006 and 2013 respectively. The estimates have been made using the HAPINZ model adjusted for PM_{10} concentrations using the following annual average concentrations:

2001 – Airshed A – 42 µg/m^3, Airshed B – 27 µg/m^3, Airshed C 19 µg/m^3

2006 HAPINZ model – Airshed A – 25 µg/m^3, Airshed B – 23 µg/m^3, Airshed C 16 µg/m^3

2013 – Airshed A – 18 µg/m^3, Airshed B – 22 µg/m^3, Airshed C 15 µg/m^3

The 2001 and 2013 annual average PM_{10} concentrations for Airshed C were estimated based on annual average concentrations for 2008/2009 adjusted for the changes in PM_{10} observed in Airshed B. Figure 2.1 shows these changes in annual average PM_{10} concentrations in Airsheds A, B and C from 2001 to 2013. Actual data for Airshed C will be available for 2014 and the analysis for this area can be updated if necessary.

The health estimates do not take into account population changes from 2001 to 2013 in Nelson. However these are relatively minor over this period and a better indication of health benefits is possible if population adjustments are not included.

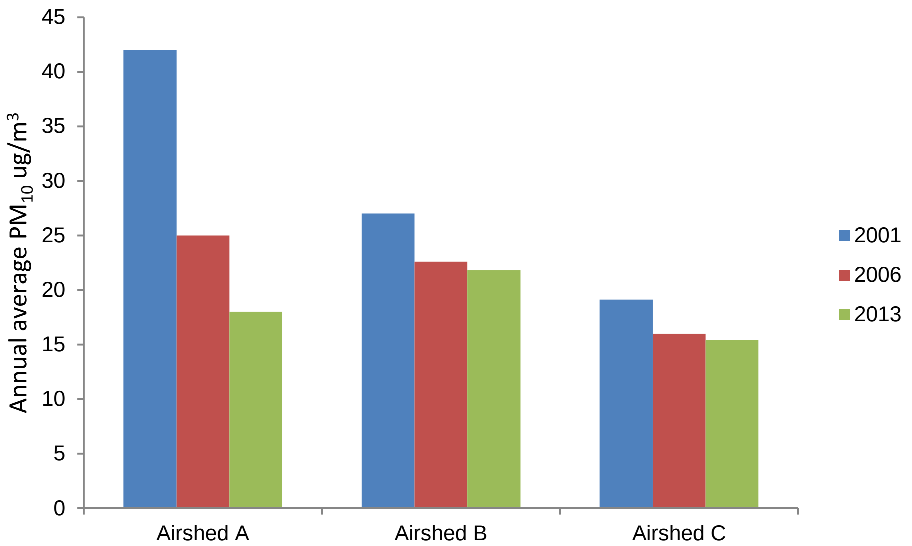

Figure 0-1: Annual average PM_{10} concentrations in Nelson

Table 0-1: HAPINZ model outputs for Nelson for 2001

	Total Nelson Health Effects (cases) 2001	Total Nelson Social cost 2001 ($million/annum)	Airshed A Health Effects (cases) 2001	Airshed A Social cost 2001 ($million/annum)	Airshed B Health Effects (cases) 2001	Airsehd B Social cost 2001 ($million/annum)	Airshed C Health Effects (cases) 2001	Airshed C Social cost 2001 ($million/annum)
Mortality Adults 30+ yrs	31	109	8	28.6	15	51.8	8	28.6
Mortality Adults Maori 30+ yrs	1	5	0	1.1	1	2.1	0	1.6
Mortality Babies 0-1 yrs	0	0	0.0	0.1	0.0	0.1	0.0	0.1
	0	0						
Cardiac Hospital Admissions: All ages	8	0	2.4	0.0	3.7	0.0	1.8	0.0
Respiratory Hospital Admissions: All ages	10	0	3.0	0.0	4.1	0.0	2.5	0.0
Respiratory Hospital Admissions: Children 1-4 yrs	4	0	1.2	0.0	1.2	0.0	1.1	0.0
Respiratory Hospital Admissions: Children 5-14 yrs	3	0	0.7	0.0	1.4	0.0	0.6	0.0
Restricted Activity Days	56,797	4	23,815	1.5	21,875	1.4	11,107	0.7
Total Cost		113		30.3		53.3		29.4

Table 0-2: HAPINZ model outputs for Nelson for 2006

	Total Nelson Health Effects (cases) 2006	Total Nelson Social cost 2006 ($million/annum)	Airshed A Health Effects (cases) 2006	Airshed A Social cost 2006 ($million/annum)	Airshed B Health Effects (cases) 2006	Airsehd B Social cost 2006 ($million/annum)	Airshed C Health Effects (cases) 2006	Airshed C Social cost 2006 ($million/annum)
Mortality Adults 30+ yrs	26	90.8	5	18.7	13	46.5	7	25.6
Mortality Adults Maori 30+ yrs	1	4.1	0	0.8	1	1.9	0	1.4
Mortality Babies 0-1 yrs	0.1	0.3	0.0	0.1	0.0	0.1	0.0	0.1
Cardiac Hospital Admissions: All	2.4	6.3	0.4	1.4	1.3	3.3	0.6	1.6

ages								
Respiratory Hospital Admissions: All ages	2.8	7.7	0.6	1.8	1.4	3.6	0.8	2.2
Respiratory Hospital Admissions: Children 1-4 yrs	1.0	2.8	0.2	0.7	0.4	1.1	0.3	1.0
Respiratory Hospital Admissions: Children 5-14 yrs	0.8	2.2	0.1	0.5	0.5	1.2	0.2	0.5
Restricted Activity Days	43,364	2.7	14,176	0.9	19,358	1.2	9,830	0.6
Total Cost		93.8		19.7		47.8		26.3

Table 0-3: HAPINZ model outputs for Nelson for 2013

	Total Nelson Health Effects (cases) 2013	Total Nelson Social cost 2013 ($million/annum)	Airshed A Health Effects (cases) 2013	Airshed A Social cost 2013 ($million/annum)	Airshed B Health Effects (cases) 2013	Airsehd B Social cost 2013 ($million/annum)	Airshed C Health Effects (cases) 2013	Airshed C Social cost 2013 ($million/annum)
Mortality Adults 30+ yrs	23	84	4	14	13	45	7	25
Mortality Adults Maori 30+ yrs	1	4	0	1	1	2	0	1
Mortality Babies 0-1 yrs	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0
Cardiac Hospital Admissions: All ages	6	0	1	0	3	0	2	0
Respiratory Hospital Admissions: All ages	7	0	1	0	3	0	2	0
Respiratory Hospital Admissions: Children 1-4 yrs	3	0	1	0	1	0	1	0
Respiratory Hospital Admissions: Children 5-14 yrs	2	0	0	0	1	0	1	0
	0	0	0	0	0	0	0	0
Restricted Activity Days	38,227	2	10,206	1	18,584	1	9,436	1
Total Cost		86.2		14.7		46.1		25.4

Health benefits of improving air quality in Nelson 2001-2013

Table 3.1 shows the estimated health benefits associated with improvements in air quality in Nelson from 2001 to 2013. This suggests a reduction in impact on mortality of around seven deaths per year and a total cost avoided of $27 million. The majority of the improvement occurs in Airshed A despite this area contributing only 26% of 2001 health impacts as a result of annual average concentrations of PM_{10} in this area having decreased by more than 50%. This disproportionate reduction across airsheds is illustrated in Figure 3.1 which shows the changes in estimated premature mortality occurring as a result of exposure to PM_{10} concentrations by airshed for 2001 and 2013.

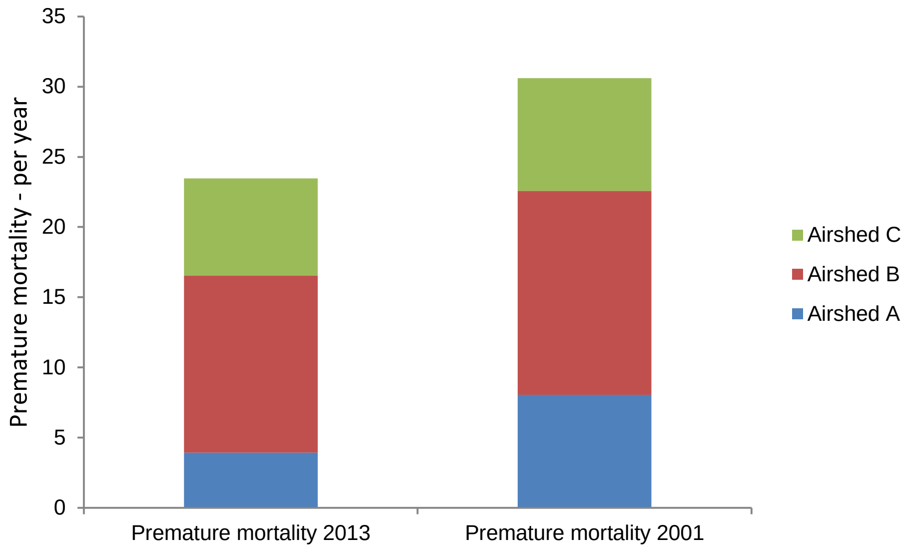

Figure 0-1: Estimates of premature mortality in Nelson

Table 0-1: Health benefits of improvements in air quality in Nelson 2001 - 2013

	Total Nelson Health Effects (cases)	Total Nelson Social cost ($million/annum)	Airshed A Health Effects (cases)	Airshed A Social cost ($million/annum)	Airshed B Health Effects (cases)	Airsehd B Social cost ($million/annum)	Airshed C Health Effects (cases)	Airshed C Social cost ($million/annum)
Mortality Adults 30+ yrs	7	25	4	15	2	7	1	4
Mortality Adults Maori 30+ yrs	0	1	0	0	0	0	0	0
Mortality Babies 0-1 yrs	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0
Cardiac Hospital Admissions: All ages	2	0	1	0	1	0	0	0
Respiratory Hospital Admissions: All ages	3	0	2	0	1	0	0	0
Respiratory Hospital Admissions: Children 1-4 yrs	1	0	1	0	0	0	0	0
Respiratory Hospital Admissions: Children 5-14 yrs	1	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0
Restricted Activity Days	18,571	1	13,609	1	3,291	0	1,671	0
Total Cost		27		16		7		4

Summary

Concentrations of PM_{10} have decreased significantly in Nelson particularly in Airshed A where the annual average PM_{10} concentration has reduced from 42 µg/m^3 in 2001 to around 18 µg/m^3 in 2013. Concentrations in other airsheds have reduced also but not to the same extent. Health benefits will occur as a result of improvements in air quality. The most significant measure in terms of costs avoided is premature mortality (ref). This analysis estimates that air pollution related premature mortality in Nelson has reduced from around 31 deaths per year in 2001 to around 26 in 2013, a total of seven premature deaths avoided per year. The majority of these occur as a result of improvements in PM_{10} concentrations in Airshed A. Total health benefits associated with this improvement in air quality are estimated at around $27 million per year.

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2.0 Draft Position Statement

CANTERBURY DHB DRAFT POSITION STATEMENT

Home Heating and Air Quality

1. The Canterbury District Health Board (CDHB) acknowledges that a warm home is vital for comfort and good health whilst also recognizing that many New Zealand homes tend to be cold with temperatures regularly falling below the World Health Organization's recommendations.
2. The CDHB acknowledges that the direct effects of cold homes on health include excess mortality from cardiovascular and respiratory disease amongst the elderly, increased respiratory problems in children, increased illnesses such as colds, influenza and mental health problems, and the exacerbation of existing conditions such as arthritis.
3. The CDHB recognises that home heating (temperature, humidity and ventilation), energy costs and fuel poverty are key housing issues with implications for health outcomes.
4. The CDHB wishes to emphasize the importance of home heating and energy efficiency, as a health protection measure, due to the significant public health impacts that result when dwellings do not provide a healthy environment for occupants.
5. The CDHB considers the human right to housing to be much more than simply a right to shelter but also the right to have somewhere to live that supports good health outcomes. The CDHB therefore acknowledges the inextricable link between the right to housing and the need for warm and dry, affordable, culturally appropriate and accessible housing that is part of a wider community with easy access to essential services within a healthy environment.
6. The CDHB understands that retrofitting New Zealand homes with insulation and clean heat options has been shown to increase indoor temperatures, decrease relative humidity, reduce energy use and improve the self-reported health of occupants, and consequently encourages actions to retrofit insulation and clean heat options for households.
7. The CDHB recognises that clean air is a requirement for health and wellbeing and that urban outdoor air pollution is the eighth most common risk factor for death in high income countries.
8 The CDHB acknowledges the considerable international evidence that air pollution causes excess morbidity and mortality particularly through increases in the incidence of respiratory and cardiovascular illness.
9. The CDHB acknowledges that whilst air quality has improved in recent years the most recent best estimate (2005) indicates that air pollution in Christchurch results in 158 premature deaths annually in those aged 30 years and over. The proportion of these deaths associated with smoke, caused by woodburners, was calculated as 78% or 124 of these deaths.
10. The CDHB remains committed to its support of the Christchurch Air Plan, recognising the long term health benefits to Christchurch citizens, whilst acknowledging the ongoing challenge of improving air quality in order to meet the National Environmental Standards for Air Quality by 2016 and 2020.
11. The CDHB recognises the impact of the recent earthquakes on those who have lost their favoured primary heating source, due to the loss of their home, particularly when that appliance cannot be replaced under the Christchurch Air Plan.
12. The CDHB wishes to highlight the risks of unflued gas heaters to human health, due to the high levels of moisture and harmful combustion products which are produced by

these appliances and the associated significant reduction in the quality of the indoor environment.

13. The CDHB acknowledges the risks that the affordability and fragility of our electricity system pose to the health of the most vulnerable community members and seeks to work with partner agencies to develop mitigation strategies.