Submission to the
Senate of the Commonwealth of Australia

Standing Committee on Community Affairs
References Committee

Inquiry into the impacts on health of air quality in Australia

By
Mark Curran

representing and on behalf of

Residents Against Polluting Stacks Inc. (RAPS)

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Introduction

RAPS (Residents Against Polluting Stacks Inc) was founded in 1997, following and in response to the changes announced to the plans for the M5 East motorway and tunnel which removed the three ventilation stacks located on the hills above the proposed tunnel and replaced them with a single ventilation stack in the valley near Turrella railway station.

Then and now, the objectives of this organization are:

(a) To seek the installation and operation of air pollution treatment systems in the M5 East tunnel, and any other effective methods of reducing the impact of air pollution and stacks on the local area

(b) To seek fair and equitable infrastructure planning and pollution assessment processes and regulations.

(c) To support ecological sustainability in all projects affecting the local area.

(d) To share information, and offer advice and assistance to individuals and groups with similar objectives.

(e) To disseminate information to the public on issues related to urban air pollution and planning.

Background

During the 16 years the RAPS organization has been in existence we have experienced the actual operation of what were well intentioned regulatory attempts aiming to preserve the health and amenity of those either using the tunnel or living around the stack and, from our experiences, have formed opinions about the appropriateness and adequacy of existing environmental controls and standards.

In addition, we have accumulated significant amounts of information and experience about issues related to health impacts in a tunnel environment and also those affecting communities living around the tunnel, where they are exposed to pollution from multiple sources.

It must be of significance that the tunnel has never achieved what might be called quiet acceptance, either by its users or by those who live close to it, and it remains a constant source of irritation and real concern to commuters, professional drivers and those who live close to its stack or to its two portals.

No matter how effective the tunnel may be as a piece of infrastructure it is constantly and justifiably criticised in the press.

Numerous reports and studies have been commissioned by the NSW Government in attempts to allay these fears but these have tended to increase the concerns and provide further justification for them.

There have been studies into the effects of portal emissions, of apparent exceedences of air quality limits caused by the stack and three Parliamentary inquiries, all of which have led to the uncovering new and greater problems.

In many cases, these problems were only identified by the release of confidential records of Government departments supplied under the motions of the NSW Legislative Council.

Largely as a result of concerns expressed by local residents, the NSW Department of Health has conducted three studies relating to health impacts in the area immediately around the tunnel and one on in-tunnel exposure to pollutants and the likely health impacts resulting from this.

It therefore seems both useful and appropriate that we should share this experience and knowledge with your inquiry.

Mark Curran
President RAPS
c/o PO Box 270
Earlwood. 2206

Private Address:
38 Hocking Av., Earlwood. NSW 2206
markcurran@optusnet.com.au
0295588863 mob0411152960

Section 1: Local incidence of lung cancer levels above the national average.

Issue: In mid 2012, The NSW Department of Health announced the discovery of a disproportionate number of lung cancer cases in the area immediately surrounding the M5 East stack. No adequate explanation was provided but stack emissions were largely excluded as a potential cause of the cases observed.

Relevant terms of reference:

(a) Particulate matter, its sources and effects and

(b) those populations most at risk and the causes that put those populations at risk.

Background.

In October 2010, members of RAPS approached Dr Stephen Conaty, Sydney South West Area Health Service, with concerns expressed by members of the local community about what appeared to be a disproportionately high level of cancers in the area around the M5 stack.

In response, the health service undertook to examine the available mortality data for the appropriate areas, based on post codes. This initial study raised sufficient concern to prompt them to extend the study and to examine the available data more closely.

Eventually they came to the conclusion that there was, indeed, a disproportionate number of lung cancers in the areas around the M5 stack but that it was unlikely that these were caused by the stack as they largely predated the construction of the motorway.

The results of these investigations, titled "A review of cancer registry data in response to concerns about a possible excess of cancer associated with emissions from the M5 East tunnel", was released in July 2012 and is available at http://www.health.nsw.gov.au/pubs/2012/m5_east_tunnel.html.

A summary of the issues, from a community point of view, is attached.[i]

One of the most significant issues which arose was the fact that the standardised lung cancer rates especially for males showed a statistically significant increase before the stack opened, contrary to the state wide trend, although the study does not attempt to explain how or why this increase occurred.

Observation

It is our opinion, based on spatial and temporal considerations and on recent developments in medical science relating to the harm caused by fine particulate matter, that this significant increase is likely to be related to the massive increases of particulate and other emissions which resulted in the rapid development of Port Botany and growth of Sydney Airport.

The development of the airport involved the relocation of the international terminal to the North West corner of the airport immediately up wind of the Wolli Creek valley. The international terminal was opened in 1970 and was significantly expanded in 1992.

Both Port Botany and the redeveloped Sydney Airport are significant as generators of truck traffic and are significant sources of diesel particulate pollution as a result of their essential activities.

Jet and turbine engines generate large quantities of fine particles and the vast majority of these particles are less then 1 micron in diameter. They also generate significant amounts of nitrogen dioxide.[1]

Maximum emissions occur during takeoff but significant additional emissions can be generated during run-up and engine maintenance.

Because of a lack of available electrical power at many of the gates at Sydney Airport, waiting planes must be powered up either by the use of on-board power or more frequently by the use of mobile diesel generators and air conditioning units. In addition, we are informed that much of this ground equipment, which includes the massive tugs used to move aircraft, is old and poorly maintained.

[1] Black et al. Lung Deposition of Jet engine Exhaust Particulate Matter (2010) http://www.trbav030.org/pdf2010/Black_paper.pdf

As this equipment is not used on the open road, there appears to be no effective regulation of these emissions.

The significance and extent of ports as a pollution source has been largely ignored in publicly available pollution inventories, however their potential extent has recently been highlighted by the massive efforts made in California to clean up the ports of both Los Angeles and San Francisco (Oakland).

Our enquiries lead us to believe that, not only is Port Botany a massive and growing source of particulate pollution but also that much of the diesel powered equipment used at Port Botany is old, poorly maintained and basically unregulated in relation to emissions, as it is permanently located within the port confines.

To this must be added the emissions from ships, both in motion and while running generators to provide power while they are in dock. These emissions are from fuels often high in sulphur.

Scope for action:

1. Adequate monitoring capable of measuring and analysing the nature and extent of emissions from both the airport and the port is required. This should include the numbers and size distribution of particulate emissions as weight based methods (eg PM10,PM2.5) are inadequate and inappropriate for the task.

2. Emission regulations, at least equivalent to those applying the road vehicles, should be applied to all mobile and stationary diesel sources.

3. The possibility of mandating the use of electric or CNG engines wherever possible in the airport or Port Botany should be examined.

4. Ensure that Departments of Health and Environment are directly involved in the planning of major projects with the ability to impose appropriate conditions on the design and operational phases of a development, including the ability to require the limitation of pollution at source.

5. Departments of Planning should, after being advised by appropriate Health and Environment authorities, have the power to mandate changes to the design and operation of existing facilities should unforseen adverse impacts on health and amenity emerge after the commencement of operation of a project or facility.

[i] Lung Cancer cluster around the M5 stack

In July 2010, RAPS became aware of concerns that there seemed to be an increase in the numbers of cancers (and other illness) in residents around the stack.

The number of these reports led us to approach the Sydney South West Area Health Service to ask them to investigate these concerns. To their credit, they undertook to do so, surveying the data available relating to illnesses which are reported centrally, such as cancer.

In December 2011, they informed us of their concerns relating to an apparent increase in lung cancer in the areas surrounding the stack. They told us that they were proceeding to access some more detailed data sets to try and clarify what was actually happening.

The results of these investigations, titled "A review of cancer registry data in response to concerns about a possible excess of cancer associated with emissions from the M5 East tunnel", were discussed with us and released to the public on Monday 21st July.

The study looked at data of reported cancers during the 6 years before and after the stack opened (up till 2008) in an area centred on the stack and predicted by CSIRO modelling to receive significant fallout from the stack.

It found that there had been a statistically significant increase in lung cancer in both males and females following the stack opening. This increase was not seen in the areas immediately outside the study area.

The authors concluded that this increase was unlikely to be caused by the stack *per se,* as lung cancer takes a significant period to develop and the stack opened in late 2001.

We have no problem with the finding about the stack, however there is a massive elephant in the room which is not addressed.

The study shows that across the state, between 1981 and 2007, lung cancer rates for males have decreased by about 35%, however there has been a steady increase in lung cancer rates in females over the period.

In the study area, centred on Turrella but including areas of Sydenham, Hurlstone Park, Canterbury, Earlwood, Bardwell Park and Arncliffe, male lung cancer rates parallel the state trend at first but after about 1995 there is a clear point of inflection and male lung

cancer rates start to increase. There is a clear change from a negative rate to a positive rate which then accelerates (slightly) after 2001 when the stack opens. By 2007 the rates are close to those found in the 1980s. The situation in females is less clear.

As a community organization our main concern is obviously about our environment and its impact on us. Something must be causing this. It appears likely to us that there has been a significant deterioration in our air quality which dates to around the early '90s (given the cancer lead times).

This possibility is not even commented on and is certainly not addressed or highlighted in the report – surely a case of not seeing the wood for the trees!! When pressed for an explanation one expert (Professor Bruce Armstrong,) gave the suggestion that the increase in lung cancer might have been due to changes in smoking habits, although the study produced no data to support the contention. Logically, the change would have to have happened in Earlwood, Turrella, Arncliffe and Bardwell Park but NOT in Rockdale, Bexley, Marrickville and Campsie and Belmore!

In our view, strongly expressed to the study authors, is that the conclusions of the study do not address the most salient part of the data, the unexplained increase in male cancer rates around 1995. To us the most likely explanation is the rapid increase of diesel emissions resulting from the rapid development of both the airport and Port Botany prior to that time.

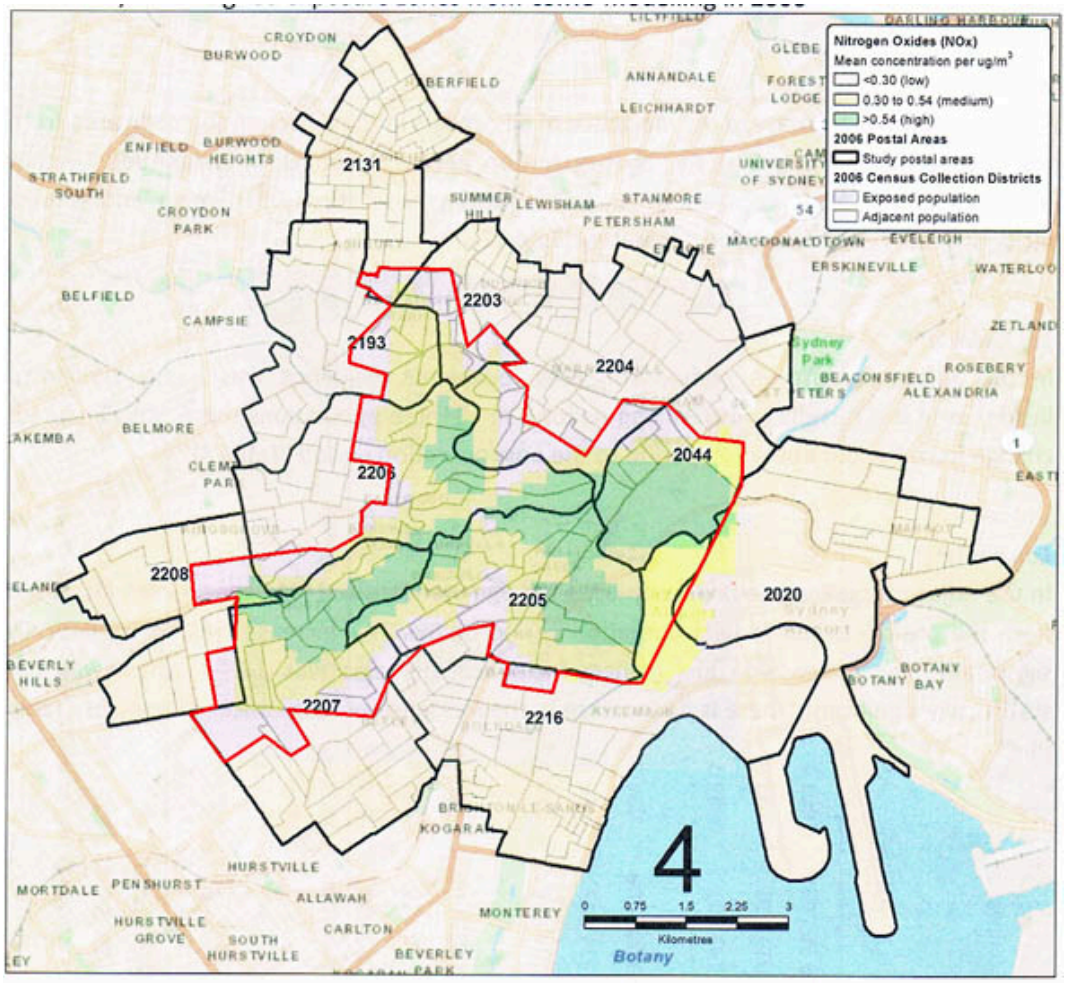
Diesel emissions are now accepted as a class 1 carcinogen (a substance known to cause cancer in humans). Specifically, it causes lung cancer.

According to the American cancer Society "*Health concerns about diesel exhaust relate not only to cancer, but also to other health problems such as lung (respiratory) and heart diseases."*

Our concern is that the stack, as the major point source of diesel particulate, is and, unless filtered, will continue adversely impacting locally and will add to an already deteriorating environment, but that impact of this will not show up for several years. The impact is, of course, lung cancer and likely death a relatively short time after , not an experiment of which I want to be a part!

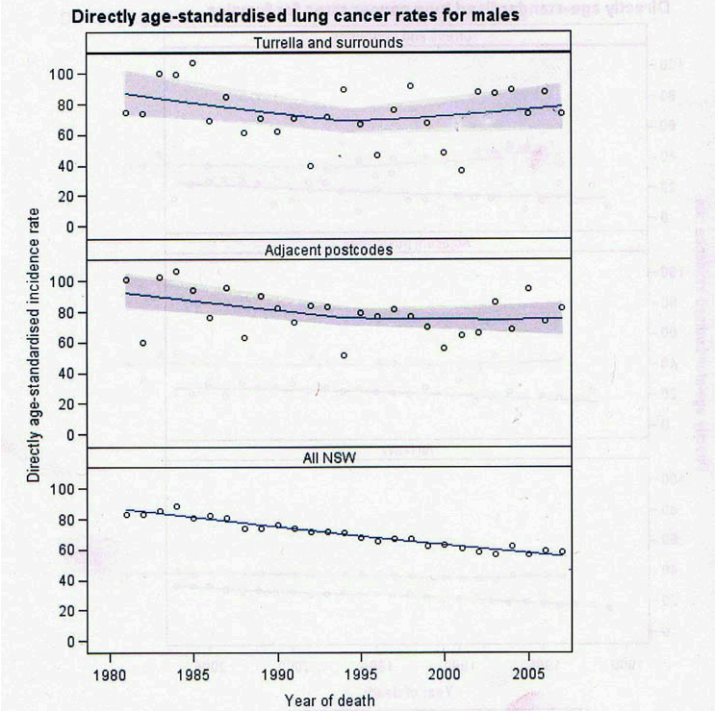
The report is available at : http://www.health.nsw.gov.au/pubs/2012/m5_east_tunnel.html.

Mark Curran President RAPS



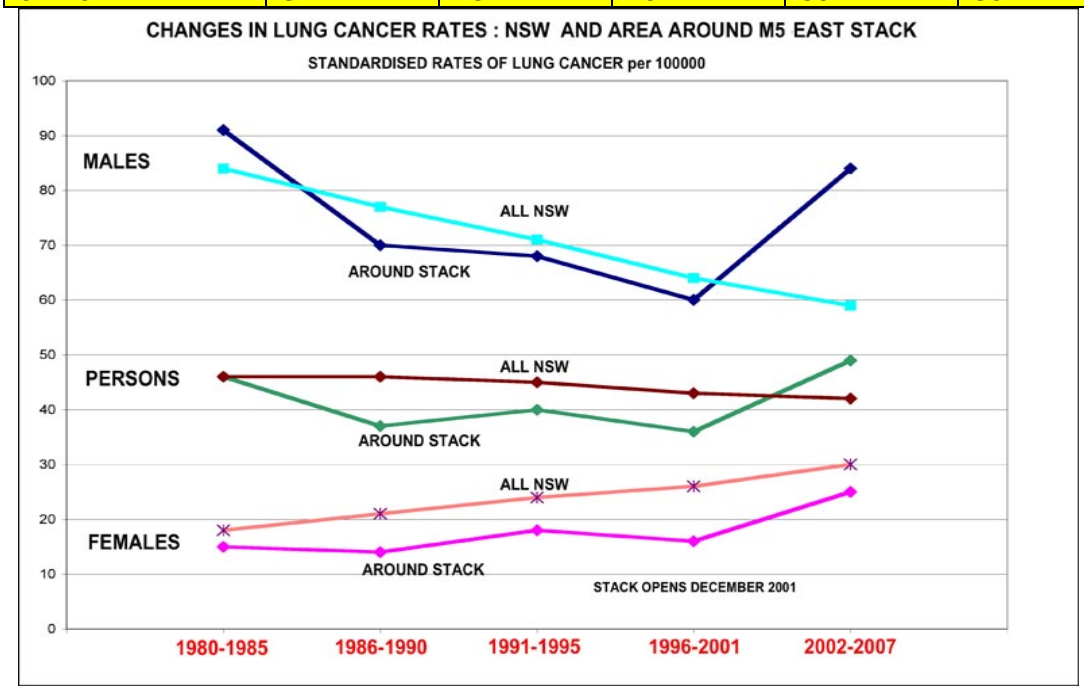
Figures from the report "A review of cancer registry data in response to concerns about a possible excess of cancer associated with emissions from the M5 East tunnel" issued by NSW Health July 2012. The red outlines the study area.

Figure 1: Lung cancer directly standardised rates for males only, for Turrella and surrounds, adjacent postcodes and all NSW, 1981-2007



Age standardised rates of lung cancer
Turrella and surrounds and NSW

	Turrella and surrounds			Whole state		
	Males	Females	Persons	Males	Females	Persons
81 - 85	91	15	46	84	18	46
86 - 90	70	14	37	77	21	46
91 - 95	68	18	40	71	24	45
96 - 01	60	16	36	64	26	43
M5 East motorway and stack opens in December 2001						
02 - 07	84	25	49	59	30	42



Section 2: Issues with emissions in and around road tunnels

Issue: Although monitoring of pollutant levels tends to concentrate on ambient air quality, in fact large parts of the actual exposure of people occurs in areas and under conditions which are specifically not covered by ambient air quality monitoring or guidelines. Exposures to excessively high levels of pollutants occur can occur in car parks, within the central business districts, on roads or especially inside road tunnels

Relevant terms of reference:

(a) Particulate matter, its sources and effects and

(c) The standards, monitoring and regulation of air quality at all levels of government.

Background

Our experience with the M5East tunnel shows that there appears to be a disconnect between the language used by regulators (such as Planning Departments) and the language as understood by engineers.

In relation to conditions outside the tunnel, it was clear to us that a requirement in the Conditions of Approval *"in any event, the air emissions must not result in the following ambient air quality emerging goals being exceeded at ground level: N02 - One hour average of 256 mg/m3 (0.125 ppm), PM10 - 24 hour average of 50 mg/m3"* , was interpreted during design as a bench mark up to which it was permissible to pollute.

Clearly, this was not the intention of the regulators, however the lack of a catch-all phrase such as *'all practical measures must be taken to minimize the impact of tunnel emissions on both residential and industrial areas'*, meant that this became the only guideline for the design of the tunnel exhaust and dispersal system.

Similarly the only condition which related to conditions inside the tunnel was that *"The tunnel ventilation system(s) must be designed and operated so that the World Health Organisation (WHO) 15-minute carbon monoxide (CO) goal of 87 ppm is not exceeded under any conditions."*

Although this was consistent with general practice at that time (as defined by the World Road Authority – PIARC) it did not take into account the fact that carbon monoxide emissions were falling rapidly due to the introduction of catalytic converters and this the PROPORTION of particulate matter in tunnel atmospheres was rising.

In the past, the high levels of carbon monoxide emissions had meant that any ventilation system which could maintain appropriate carbon monoxide levels would automatically be able to provide acceptable levels of particulate matter (then thought of in terms of visibility) and nitrogen dioxide

Observation

It seemed to us that the relevant regulators (both Planning and Environment) were attempting to achieve what was presumably their aim – to achieve safe and acceptable conditions in and around the tunnel – without ever specifically stating this as an over-riding condition which had to be met under all conditions.

The issue of air quality in and around road tunnels was exhaustively examined by the National Health and Medical Research Council in 2007-2008 and the results were published in its final report "Air Quality in and Around Traffic Tunnels" 2008 (Ian Longley and Francesca Kelly) [i]

This report represents what must be close to the current state of knowledge.

In relation to in-tunnel exposure the following recommendations were made:

8.2.6 Recommendations

We recommend development of a health-based exposure limit for NO2 and PM as a precautionary interim measure appropriate to both average and above average tunnel transit times in order to capture normal and congested conditions.

This process should consider interactions with co-exposure to other tunnel pollutants.

Particulate matter levels should be monitored with a view to reduction, as current levels of PM in some tunnels in Australia are in excess of 1000 .g m–3 which is clearly dangerous to health.

In order for progress to be made in developing a more definitive NO2 and PM limit we recommend the following:

• The health effects of exposure to tunnel air and its components at the relevant timescales (minutes) need to be determined from experimental studies. The relative importance of different indicators of in-tunnel air quality (eg NO2, particulates) in predicting pathophysiological or health effects should be explored. If possible, such studies should include sensitive individuals (eg those with asthma), and be extended to cover repeated exposure (eg to mimic exposure of taxi drivers repeatedly using tunnels). In-tunnel exposures should be compared to nontunnel exposures.

• A practical and reliable method for monitoring NO2 concentrations in road tunnels needs to be developed. Development should be supported by studies using accurate measurement techniques and world's best practice to measure in-tunnel concentrations of NO and components of PM in Australian tunnels, updating and extending the studies already conducted. These should cover the widest possible range of traffic densities, HDV use, and congested conditions, and be subject to peer review and publication in the open academic literature. Such studies would validate in-service vehicle emission factors.

• A practical method needs to be developed for predicting tunnel users' exposure to NO2. Development should be supported by a comprehensive study of AERs in Australian vehicles in the context of vehicle ventilation, driver behaviour and pollutant retention after tunnel transits.

In relation to air quality external to tunnels but potentially affected by them it was recommended:

8.3.7 Recommendations
In terms of existing or conventional techniques for assessing external air quality we make the following recommendations:
• Environmental impact assessment should include induced emission changes arising from changes to surface traffic as well as emissions from the tunnel itself.
• Air quality monitoring is an essential component of environmental management of a road tunnel in the early stages after opening (perhaps the first two years). However, beyond that period, monitoring is less important, although it could become important if emission from the tunnel rises significantly. Monitoring data should be used to verify and improve dispersion modelling so that modelling can become the principle means of environmental management if or when monitoring is removed.
• Monitors should be sited, where possible and practical, in locations relevant for exposure, representing a relatively high predicted ground-level impact, high frequency of plume impact and low average spatial concentration gradients (in terms of both tunnel and background contributions), as predicted by dispersion modelling and ideally verified by passive sampling campaigns.
• At least two monitors are preferred to increase the likelihood that at least one is upwind of the tunnel emission point source(s). This allows determination of 'background' air quality and the composition of the air entering a tunnel.
• We are not convinced that long-term monitoring of PM 10 is useful for the purposes of managing the impact on a community of a road tunnel alone, as opposed to the road network in general. CO and NOx are more robust indicators of effects on traffic impacts. The one hour NO2 WHO guideline, used in conjunction with WHO annual guidelines for PM2.5 and NO2 should provide adequate protection of health until scientific developments allow the development of a more robust standard for road traffic emissions that includes the effects of pollutant interaction.
• Further study should investigate the impacts of tunnels on the indoor air quality of residences near portals or stacks. This should include study of the health effects resulting from any increased exposure to pollutants.

To the best of our knowledge, none of these recommendations have been actively promoted.

Scope for action

Generally , to put into action the recommendations of the NH&MRC report, especially those relating to:

1. interim precautionary exposure limits for tunnels based on human health requirements

2. promoting actions to reduce the quantum of exposure to particulate matter inside existing tunnels

3. promoting research to enable the development of evidence based standards for road, road tunnel and other peak exposure situations for particulate matter and nitrogen dioxide both separately and in combination.

[i] "Air Quality in and Around Traffic Tunnels" 2008 (Ian Longley and Francesca Kelly)
http://www.nhmrc.gov.au/publications/synopses/_files/eh42.pdf

Section 3. Ambient monitoring of particulate matter

Issue. In the monitoring and regulation of particulate matter, there appears to be a logical disconnect between what is monitored (PM10, PM2.5) and what is now known about the actual causal agents involved in the ill effects of particulate matter (mainly ultra-fine and nano particles)

Relevant terms of reference:

(c) The standards, monitoring and regulation of air quality at all levels of government.

Background.

The first systematic measurements of particulate matter were based on light absorption (visibility) . This monitoring was replaced by various weight based methods (the high volume sampler and the TEOM instrument).

This equipment gave the possibility of differentiating to some extent between different sizes of particles by the use of different sampling heads.

Most of the sampling which has been done worldwide is for PM10, specifically the weight of all particles with an 'aerodynamic' diameter of less than 10 microns (millionths of a meter) contained in one cubic metre of air.

The Australian standard is 50 $\mu g/m^3$, averaged over a 24 hour period. Currently there is no standard for PM 2.5.

PARTICLE size	PM10	PM 2.5	PM1.0	PM0.1	PM0.01
Compare with	grapefruit	golf ball	cherry	wheat seed	sand grain
Same size as	Yeast cell	Bacteria		Mumps virus	ribosome
Number for equal mass	1	64	1000	1000,000	1,000,000,000
Surface area for equal mass	1	4	10	100	1000
Classification	Coarse		Fine	Nano particle	
Source	Mainly from mechanical processes		From combustion and vehicle exhaust		

It is fair to suggest that what has been sampled and regulated in the past in not what was most appropriate, in the sense of what was most likely to be the cause of harm, but what it was possible to monitor with a degree of reliability.

The fact that most of the medical evidence about the impacts of particulate matter reference PM10 measures results not from its appropriateness as a potentially causative agent but because of the widespread availability of records and the hope that the measure provides, at least, a surrogate for the causative agents.

The medical scientists producing the papers are not air quality experts or particle physicists and were probably largely unaware of the inadequacy of the measure, at least in the early parts of the development of the evidence.

The majority of the hundreds of studies which implicate particulate matter (usually designated as PM10) with adverse health outcomes are based on epidemiology and argue from the observed correlation between PM10 exposure, usually gleaned from ambient air monitoring.

It is axiomatic in science that correlation does not establish causation. At the very best "PM10" is an entity which contains or is correlated with the actual causal agents.

Observation

The designation "PM10" refers only to the maximum size of the particles in a specific sample, not to average size , the size distribution, the source or the chemical composition of the particles in question.

As particles become smaller and smaller, for an equal mass of particles, the surface area exposed becomes greater and greater.

Almost all vehicle exhaust particles by both number and weight fall into accumulation and nuclei mode and are less than 1 micron in diameter. Most are the size of a virus or less.

Health impacts are thought to be best correlated to the surface area of particles - the area available to carry toxins into the lungs.

For this reason PM10 is not a suitable measure for the impact of vehicle emissions as in a strongly traffic influenced environment they make up only 3% by weight of the measurement but would provide in excess of 95% of the surface area. [i]

PM 2.5 measurements give more information about vehicle emissions but are still dominated by non vehicle factors in all locations and in suburban background, the location of most monitoring stations, 99% of the measurement is of coarse mode, non vehicle particles[ii]

PM1 would be an appropriate and easily understandable measure, useful to assess health impacts of both vehicle emissions and products of combustion, especially if presented along with the more established PM10 measure.

Change in the composition of particulate matter

Of significant concern is the fact that the nature and composition of ambient particulate matter may be changing as a result of changes in diesel emissions.

What is not realised is that over the last 20 years there has been a progressive change on the composition of particles as a result of the EURO design rules for diesel engines. Although absolute emissions levels , measured in gravimetric terms, have decreased by 80% or more , in all probability, particle numbers have increased.[iii]

The actions taken to achieve the desired decrease in the weight of emissions have resulted, in many cases, in a significant increase in the number of particles, accompanied by a decrease in size. Now, almost all particles emitted from diesel engines will be less than 1 micron (PM1) with a median size between 0.15 and 0.18 μm [iv], falling exactly into the size range now known to be the most harmful.

As a result, on an equal weight (PM10) or visibility basis, particulate matter now contains a significantly higher proportion of ultra fine and 'nano' particles and has become significantly more harmful in urban areas,.

If visibility is used as the basis measurement to regulate the in-tunnel conditions, as suggested by PAIRC, then the 'established' measures will inevitably result in an increasing exposure to ultra-fine and 'nano' particles and greater potential for harm.

The same consideration also applies to emissions from tunnels, especially where dispersion is less than perfect or where significant use is made of portal emissions for routine tunnel ventilation. Although the quantum of particulate matter emitted from the tunnel may have decreased, when visibility criteria are used for control it is inevitable that the potential for harm posed by the emissions is increased.

Scope for action

1. Rather than proceed with the planned introduction of PM2.5, introduce routine monitoring of PM1, especially in urban areas or in areas prone to pollution by wood smoke .

2. Establish systematic detailed monitoring of particulate matter to detect changes in composition and particle size distribution to inform both the effectiveness of vehicle emission controls and the likely impacts on community health.

3. Where a requirement to meet ambient air quality goals is part of the conditions of approval for a project or where such goals are referenced as part of such a condition or where the numerical value of such a goal is referenced in a condition, it should be mandatory that these requirements are updated whenever changes are made to air quality goals.

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[i] Morawska,L.,& Thomas,S. (2000) Modality of Ambient Particle Distributions as a Basis for Developing Air Quality Regulations. *Proc. 15th Clean Air & Environment Conference Sydney.2000*

[ii] ibid

[iii] Particulate Emissions from Vehicles by Peter Eastwood (2008) John Wiley& Sons. Sec 11.2 'Smaller particles in larger numbers; or larger particles in smaller numbers'. Pp393-396.

[iv] Kittelson,D B, Watts, Jr.W. F (1998) Review of Diesel Particulate Matter Sampling Methods. Supplemental Report # 2 EPA Grant Review Of Diesel Particulate Matter. http://www.me.umn.edu/centers/cdr/reports/EPAreport2.pdf