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Gerry McInally
A/g Secretary
PO Box 6100
Parliament House, Canberra ACT 2600

Re: Inquiry into the impacts on health of air quality in Australia

Dear Gerry

Thank you for the invitation to provide a submission to the Senate inquiry into the impacts on health of air quality in Australia. We appreciate being a part of the improvement in Australia's legislative framework for this important issue.

A written submission is provided below. After you have reviewed the information we have provided, I would welcome the opportunity to provide evidence at the public hearings related to this inquiry.

Yours sincerely

Dr Fred Turatti PhD, MBA
Principal Environment Adviser

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EXECUTIVE SUMMARY

Rio Tinto operates more than 30 sites in five States and the Northern Territory, and is a major stakeholder in Australia's economy.

Emissions of particulate matter from our facilities are primarily due to disturbance of the earth's crust (crustal emissions) from operating equipment, vehicle movement, transfer of material, windblown erosion or blasting. However, the majority of regulatory monitoring occurs in urban areas, where emissions are dominated by combustion sources such as vehicles and power generation. Monitoring at these urban locations also forms the basis of the majority of health-based literature and subsequent policy development in this country and overseas.

Both long-term and short-term exposure to high concentrations of particulate matter can lead to undesirable health impacts. Over time it has become apparent that exposure to the smaller size fractions of particulate matter ($PM_{2.5}$)[i] presents a higher risk to human health than exposure to larger size fractions (PM_{10} and TSP)[ii]. This trend towards focusing on smaller size fractions has been reflected in the evolution of the Australian policy framework.

Most epidemiological studies have been conducted in major cities where the composition of particulate matter is primarily $PM_{2.5}$ from combustion sources. PM_{10} is still considered to be associated with health impacts separate to those of $PM_{2.5;}$ and there is now a limited, but increasing, body of literature considering the differences in health impacts between crustal and urban particulate matter emissions.

In summary, the available literature indicates that crustal emissions are associated with different, and likely lesser, health impacts than those from urban sources. It might therefore be assumed that appropriate target values for ambient particulate matter concentrations in areas dominated by crustal particulate matter emissions could justifiably be higher than those in urban areas. However, despite emerging findings suggesting support for this proposition, the current state of knowledge in this area remains limited, particularly in Australia. A significantly better understanding of health impacts associated with crustal emissions is required before appropriate target values can be rigorously determined for areas dominated by crustal particulate matter emissions. Nevertheless, air quality standards have continued to evolve over decades simply because uncertainty continues to exist whilst the evidence unfolds, and for practical reasons, standards must be set despite the prevailing uncertainty.

Air quality is regulated in Australia through a variety of Federal, State and Local government mechanisms. At the Federal level, management of air quality is primarily driven via National Environmental Protection Measures (NEPMs), which are broad framework-setting statutory

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i PM2.5 is particulate matter with an aerodynamic diameter of less than or equal to 2.5 µm.

ii PM10 is particulate matter with an aerodynamic diameter of less than or equal to 10 µm. TSP is total suspended particulate matter.

instruments defined in the *National Environment Protection Council Act 1994*. NEPMs are intended to describe agreed national objectives for protecting or managing particular aspects of the environment. Monitoring locations (as prescribed by the AAQ NEPM) are required to be representative of exposure to the 'general population' and not dominated by individual sources.

Australia's *National Environmental Protection (Ambient Air Quality) Measure* (AAQ NEPM) values are at (for PM_{10}) or below (for $PM_{2.5}$) the bottom of the range (i.e. most stringent) of guideline values selected in other jurisdictions, even though overseas studies are yet to be convincingly supported by Australian literature. Furthermore, the AAQ NEPM 'advisory standard' of 8 $\mu g/m^3$ for $PM_{2.5}$ is below the point at which the experts lose confidence in the data indicating health impacts (10-11 $\mu g/m^3$). It appears that the National Environment Protection Council equated a low value with 'best practice' by 'benchmarking' against the lowest values present in other jurisdictions, such as the World Health Organization (WHO), an approach contrary to the WHO's own advice.[iii]

In Australia, AAQ NEPM values ('advisory standards' or otherwise) are often used, if somewhat inconsistently, as the basis for the regulation of industry by State or local government. This occurs equally in rural and remote areas, where many Rio Tinto sites are located, as it does in urban areas. It is therefore important to recognise that when these levels are subsequently adopted in the regulation of air quality at a State and local government level, industrial facilities in all regions are subject to the same benchmark, even though a reduction in concentration in rural and remote areas would likely lead to insignificant improvements in health outcomes in absolute terms.

The model of 'exposure reduction' has been based upon the assumption that no safe lower concentration threshold exists for particulate matter, and any reduction in concentration would lead to public health benefits. This model has understandably been designed in the context of reducing ambient concentrations in densely populated urban areas. Even in this context, the key literature underpinning the setting of guideline values internationally identifies a threshold below which data become unreliable for use in a policy setting framework (because effects cannot be clearly distinguished). That point of unreliability, particularly for $PM_{2.5}$, is well above the criterion that is ultimately being used to regulate many of Rio Tinto's sites in rural and remote areas.

Many decision makers use the AAQ NEPM standard as a decision point on acceptability of a development proposal. If approval is granted, environmental licences may contain conditions requiring the meeting of AAQ NEPM standards at the site boundary or at the nearest sensitive

iii WHO (2006) Air Quality Guidelines – Global Update 2005, World Health Organization, Geneva, Switzerland.

receptor. Environmental licences often also contain requirements to implement costly monitoring of ambient air quality. If a company is shown not to comply with licence conditions, in many cases, legal action can be taken.

The AAQ NEPM standards were created to support the management of air quality in urban areas, a context that is very different to many of the locations where Rio Tinto operates. Nevertheless, in the absence of other guidance, many jurisdictions are applying AAQ NEPM standards as local airshed limits, even in rural areas where very little exposure occurs and where the characteristics of airborne particulate matter differ markedly from those in urban areas.

Considering the information presented in this submission, and our long history as an important stakeholder in Australia's economy, Rio Tinto makes the following recommendations with respect to management of air quality in Australia:

- Australia should adopt target levels that reflect the latest science on health impacts relevant to the particular context in which those targets are intended to apply. The levels adopted in jurisdictions outside Australia should not be used in the decision-making process for setting Australian values, without a clear recognition of the importance of context. To date, target values adopted by State and local governments in regulating air quality, by and large, do not reflect the relevance of context.
- Australia should implement a regulatory framework that focuses on achieving target values in urban areas as the highest priority, consistent with the exposure-based design of the AAQ NEPM.
- The use of AAQ NEPM standards as boundary/licence conditions should not be continued. This practice is not consistent with the clearly stated purpose of the AAQ NEPM.
- Facilities demonstrating good practice management or small increases above background levels should be allowed to operate.
- Where regional air quality issues exist, all sources of emissions (industrial, community) should be required to contribute equitably to improvements in air quality. In other words, the approval of better controlled operations should not be unduly impeded by the existence of operations that are not currently regulated or as effective in controlling emissions.
- A comprehensive study on the health impacts of crustal emissions in Australia is needed to form a better basis for standard-setting in communities subject to these types of emissions.
- A formal mechanism should be available for industries to demonstrate that their operations are consistent with appropriate health outcomes, even if their operations are inconsistent with target values designed on the basis of achieving health

outcomes in larger urban areas. Facilities that cause little or no exposure to the population (i.e. in remote areas) should not be required to meet the same standards designed for urban areas. We recognise while making this recommendation that environmental regulation is not the only constraint on particulate matter emissions, for example: occupational health and safety, as well as issues of equipment maintenance and safety, are also potential constraints that should be considered.

- An improved regulatory framework that allows for development in areas with high natural background concentrations (e.g. windblown crustal dust or sea salt) of particulate matter is required.

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1 RIO TINTO'S AUSTRALIAN OPERATIONS

Rio Tinto is a global leader in finding, mining and processing mineral resources. We directly employ over 20,000 people in Australia, producing iron ore, coal, bauxite, alumina, aluminium, uranium, copper, gold, diamonds and salt from more than 30 sites in Australia.

Our Australian assets include:

- Seven coal mines – four in Queensland and three in New South Wales.
- Fourteen iron ore mines in various part of Western Australia, supported by three shipping terminals and the largest privately owned railway in Australia.
- Two bauxite mines (in the Northern Territory and Queensland).
- Two alumina refineries (in the Northern Territory and Queensland).
- Three aluminium smelters (Queensland, Tasmania and New South Wales).
- A uranium mine in the Northern Territory.
- A copper/gold mine in New South Wales and diamond mine in Western Australia.
- Three salt operating sites in Western Australia.

Rio Tinto contributes considerably to the Australian economy each year, through the employment, supplier contracts, investments and profits our business generates. In 2011 alone, we paid close to $6.9 billion in taxes in Australia.

Since the year 2000, we have invested more than A$40 billion in Australia through capital expenditure and acquisitions. Despite ongoing volatility in the global economy, we continue to invest in long term projects. As of February 2012, around A$22 billion of Rio Tinto projects were either under construction or approved to go ahead.

These projects provide a much-needed boost to regional employment and generate demand for services and materials from local and national suppliers. We directly employ more than 20,000 people across Australia, and many more contractors. We are proud to be the largest private sector employer of Indigenous Australians, who now make up nine per cent of our workforce.

We operate in five States as well as the Northern Territory and are subject to the laws of many different local government authorities. Our facilities are often located in remote or rural areas, in regions with significant natural sources of background particulate matter emissions.

Emissions of particulate matter from our facilities are primarily due to disturbance of the earth's crust (crustal emissions) from:

- Operating equipment such as bulldozers, haul trucks, graders, scrapers, draglines and front-end loaders.
- Vehicles travelling on paved and unpaved roads.

- Movement and loading/unloading of material using equipment such as conveyers, stockers and reclaimers.
- Erosion from stockpiles and open areas due to wind.
- Blasting.

The National Pollutant Inventory (NPI) data for 2010-11 (Figure 1) show that iron ore mines and coal mines contribute 81% of Rio Tinto's PM_{10} emissions in Australia.

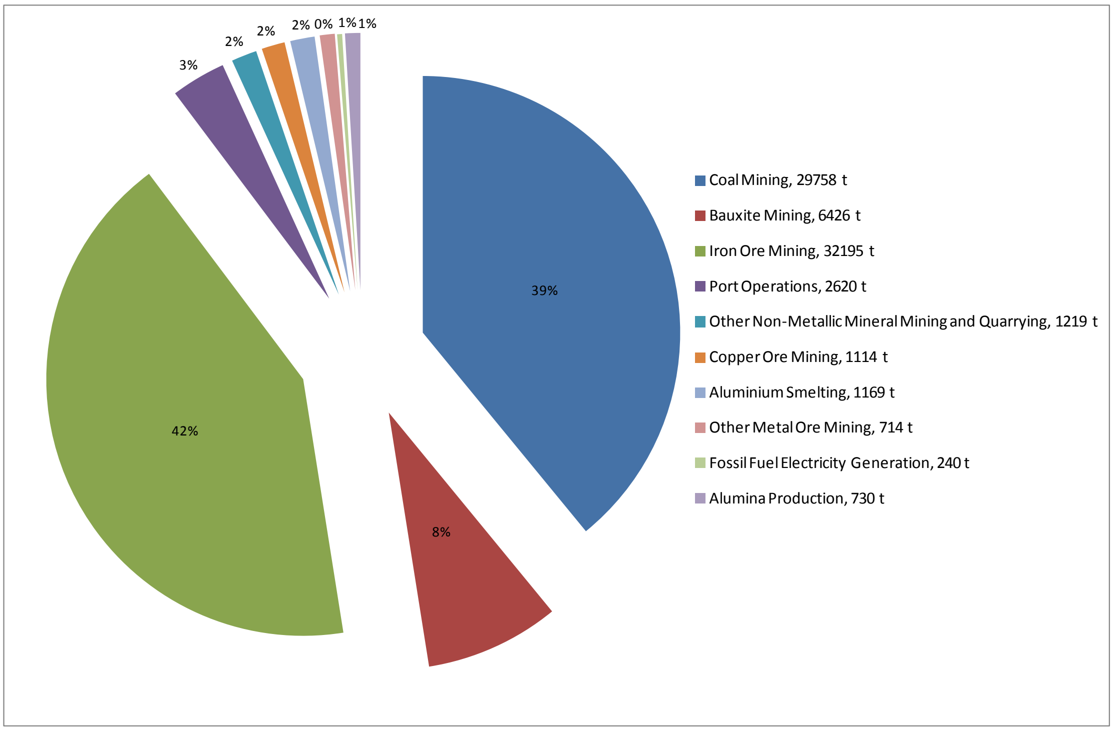

Figure 1: Particulate Matter Emissions from Rio Tinto Sites[iv]

A breakdown of emissions reported at our largest coal mine (Figure 2) and iron ore mine (Figure 3) is provided below. These data show that only 1% of PM_{10} emissions at Hunter Valley Operations (coal mining) and 1% of PM_{10} emissions at Mt Tom Price (iron ore mining) are combustion related, with open areas contributing the majority of the emissions at each facility.

iv DSEWPC (2012) 2010/2011 data within Australia - Particulate Matter 10.0 um from All Sources, Australian Government – Department of Sustainability, Environment, Water, Population and Communities. Accessed 13/03/13: http://www.npi.gov.au/npidata/action/load/emission-by-facility-result/criteria/year/2011/destination/ALL/substance/70/source-type/ALL/subthreshold-data/Yes/substance-name/Particulate%2BMatter%2B10.0%2Bum

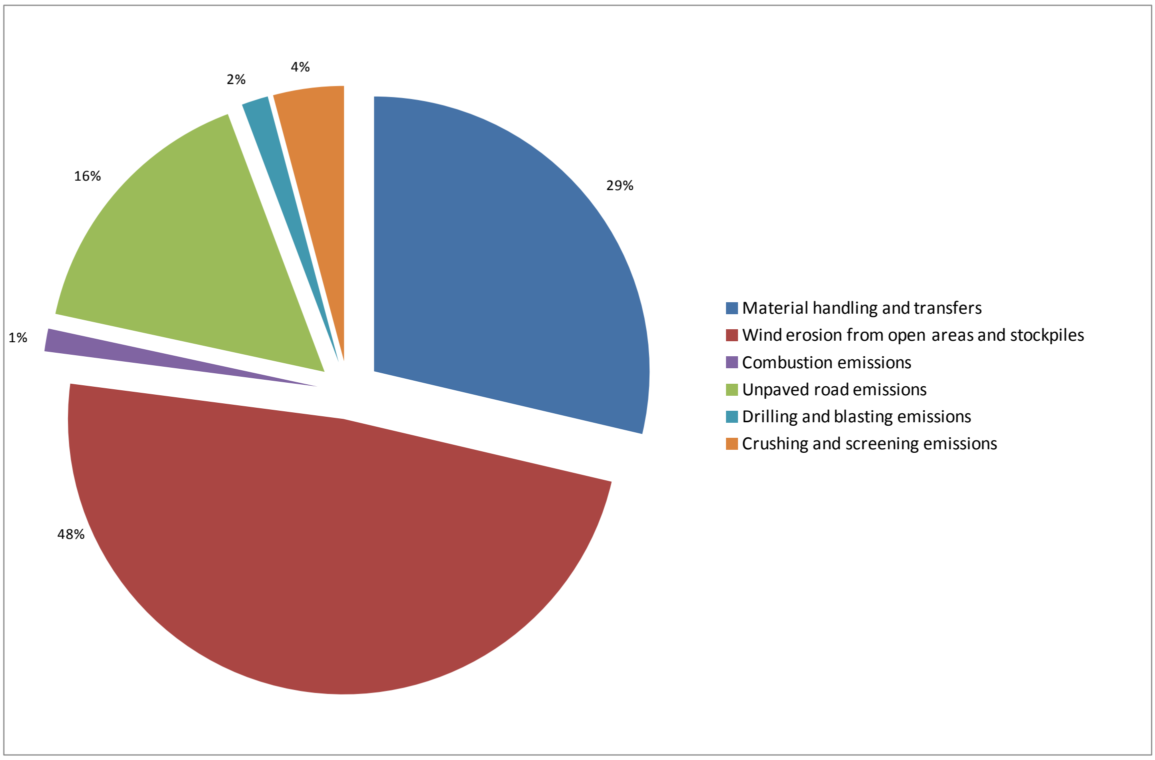

Figure 2: Contribution to total PM_{10} emissions at Hunter Valley Operations (coal mining)

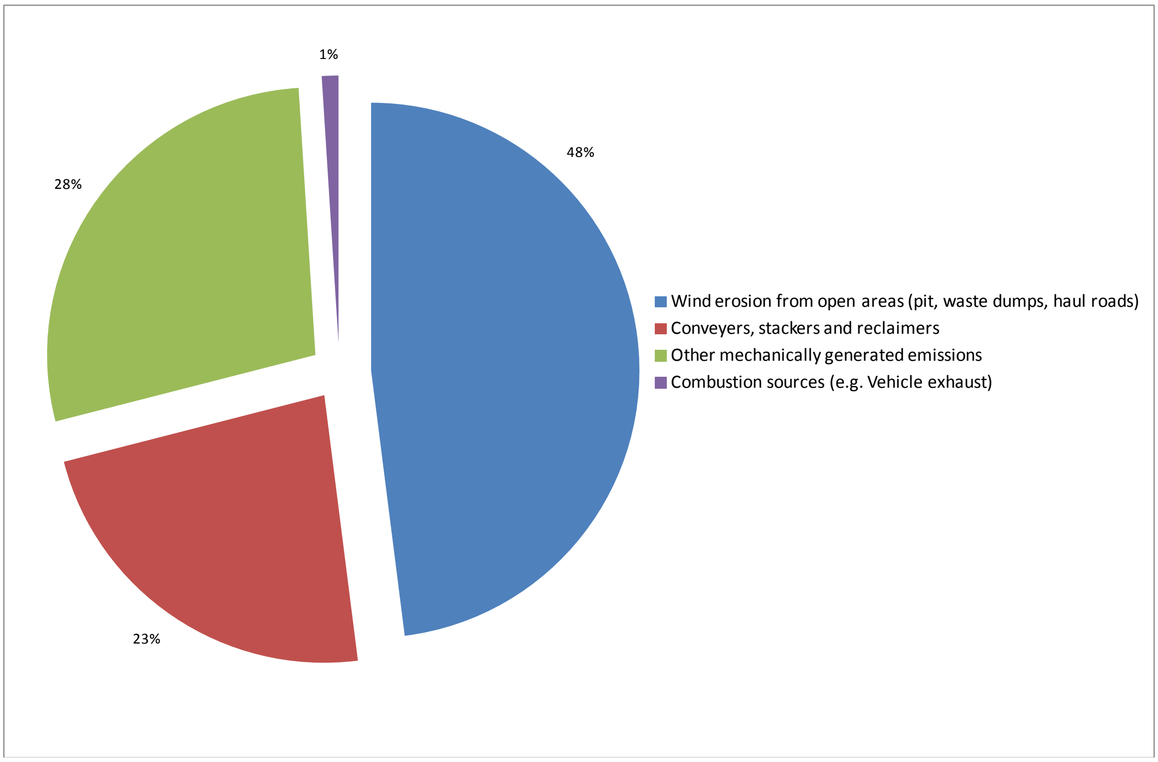

Figure 3: Contribution to total PM_{10} emissions at Mt Tom Price Operations (iron ore mining)

When considering this information, it is important to recognise that the majority of regulatory monitoring occurs in urban areas, where emissions are dominated by combustion sources such as vehicles and power generation. For example:

- in southeast Queensland, 79% of emissions of PM_{10} are due to motor vehicles, other mobile sources, bushfires/burning or other area-based sources[v]
- in Sydney, 30% of PM_{10} emissions are due to industrial sources, with the remainder due to biogenic-geogenic, commercial, domestic-commercial or mobile sources.[vi]

Monitoring at these urban locations then underpins the majority of health-based literature and subsequent policy development, which are both discussed in detail below.

2 HEALTH IMPACTS OF PARTICULATE MATTER

Both long-term and short-term exposure to high concentrations of particulate matter can lead to undesirable health impacts. These undesirable effects are predominantly related to the respiratory and cardiovascular systems. All members of the population can be affected, but susceptibility to exposure may vary with health or age.[vii]

Over time it has become apparent that exposure to the smaller size fractions of particulate matter ($PM_{2.5}$)[viii] presents a higher risk to human health than exposure to larger size fractions (PM_{10} and TSP)[ix]. For example, in the US, TSP has not been part of the National Ambient Air Quality Standards (NAAQS) since 1987 and PM_{10} is now primarily used as an indicator for the management for thoracic particulate matter ($PM_{10-2.5}$) in urban areas[x]. However, the health risk evidence available at this stage remains only 'suggestive' of a causal relationship between exposure to $PM_{10-2.5}$ and mortality, cardiovascular effects and respiratory effects, with many limitations on the available data. The World Health Organization (WHO), in its most recent risk assessment (used as the basis for setting air quality guidelines) also used $PM_{2.5}$ as the primary indicator of health impacts.[xi]

The *Integrated Science Assessment*, used to inform the most recent review of the NAAQS, supported this trend by concluding[xii] that there was:

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v EPA (2004) Air emissions inventory – South-east Queensland region, Queensland Government, Environmental Protection Agency, Brisbane.

vi NSW EPA (2012) Air Emissions Inventory for the Greater Metropolitan Region in New South Wales – 2008 calendar year – Consolidated natural and human-made emissions: Results – Technical report No. 1, State of NSW and the Environment Protection Authority, Sydney.

vii WHO (2006) WHO Air quality guidelines for particulate matter, ozone, nitrogen dioxide and sulfur dioxide – Global update 2005 – Summary of risk assessment, World Health Organization, Geneva, Switzerland.

viii $PM_{2.5}$ is particulate matter with an aerodynamic diameter of less than or equal to 2.5 µm.

ix PM_{10} is particulate matter with an aerodynamic diameter of less than or equal to 10 µm. TSP is total suspended particulate matter.

x Federal Register, Vol. 78, No. 10 January 15, 2013 – Part II – Environmental Protection Agency – 40 CFR Parts 50,51,52 et al. National Ambient Air Quality Standards for Particulate Matter; Final Rule.

xi WHO (2006) WHO Air quality guidelines for particulate matter, ozone, nitrogen dioxide and sulfur dioxide – Global update 2005 – Summary of risk assessment, World Health Organization, Geneva, Switzerland.

xii USEPA (2009) Integrated science assessment for particulate matter, National Center for Environmental Assessment-RTP Division, Office of Research and Development, United States Environmental Protection Agency, Research Triangle Park, NC, USA.

- a causal relationship[xiii] between long- and short-term $PM_{2.5}$ exposures, and mortality and cardiovascular effects
- a likely causal relationship[xiv] between long- and short-term $PM_{2.5}$ exposures and respiratory effects
- although more limited, evidence suggestive of a causal relationship[xv] between long- and short-term $PM_{2.5}$ exposures, and developmental, reproductive and carcinogenic effects.

The WHO's recent *Review of evidence on health aspects of air pollution* also referred to additional studies linking long-term exposure to $PM_{2.5}$ to atherosclerosis,[xvi] adverse birth outcomes and childhood respiratory disease.[xvii]

This trend towards focusing on smaller size fractions of particulate matter has been reflected in the Australian policy framework. In the *Review of the National Environment Protection (Ambient Air Quality) Measure* (AAQ NEPM) conducted in 2010, the National Environment Protection Council (NEPC) indicated that PM_{10} is an important indicator for $PM_{2.5}$ impacts, as $PM_{2.5}$ monitoring data alone are too limited. This is despite that fact that '$PM_{2.5}$ may be even more important with respect to adverse health impacts'.[xviii]

A summary of key aspects of relevant health literature is provided in Table 1 together with a summary of the outcomes with respect to the setting of guideline or target values in a number of jurisdictions, including Australia.

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xiii The pollutant has been shown to result in health effects in studies in which chance, bias, and confounding could be ruled out with reasonable confidence.

xiv The pollutant has been shown to result in health effects in studies in which chance and bias can be ruled out with reasonable confidence but potential issues remain.

xv Evidence is suggestive of a causal relationship with relevant pollutant exposures, but is limited because change, bias and confounding cannot be ruled out.

xvi When fat, cholesterol, and other substances build up in the walls of arteries and form hard structures called plaques. From NCBI (2012) A.D.A.M. Medical Encyclopedia, U.S. National Library of Medicine, Accessed 11/02/13. http://www.ncbi.nlm.nih.gov/pubmedhealth/PMH0001224/

xvii WHO (2013) Review of evidence on health aspects of air pollution - REVIHAAP – First results, World Health Organization, Copenhagen, Denmark.

xviii NEPC (2010) Review of the National Environment Protection (Ambient Air Quality) Measure – Discussion Paper - Air Quality Standards – July 2010, National Environmental Protection Council, Adelaide.

Table 1: Summary of Findings and Subsequent Adopted Levels

Jurisdiction	Key Findings	Level Adopted[xix,xx,xxi,xxii]
USA	- For $PM_{2.5}$, below an annual average of approximately 12 µg/m^3 there is appreciably less confidence in the associations observed in epidemiological studies.[xxiii] - 11 µg/m^3 is below the range of the lowest long-term mean $PM_{2.5}$ concentration reported in all multi-city long- and short-term exposure studies that provides evidence of positive and statistically significant associations with health effects classified as having evidence of a causal or likely causal relationship.[xxiv] - The evidence associated with PM_{10} has not changed significantly since a 1982 study in London concluded that a 24 hour average PM_{10} concentration of 150 µg/m^3 was an appropriate lower bound (including appropriate margin of safety) for protection of human health.[xxv] - PM_{10} is primarily an indicator for the management of thoracic particulate matter ($PM_{10-2.5}$) in urban areas. However, the health risk evidence available at this stage remains only 'suggestive' of a causal relationship between exposure to $PM_{10-2.5}$ and mortality, cardiovascular effects and respiratory effects, with many limitations in the data available.[xxvi]	**$PM_{2.5}$** 24 hour, 98th percentile concentration of 35 µg/m^3, not to be exceeded more than once per year on average over a three year period. Annual concentration of 12 µg/m^3. Annual arithmetic mean, averaged over three years. **PM_{10}** 24 hour concentration of 150 µg/m^3, not to be exceeded more than once per year on average over a three year period.
WHO[xxvii]	- Below an annual average of 13 µg/m^3 for $PM_{2.5}$, the confidence bounds significantly widen. - Health effects can are statistically significant in a range of 11-15 µg/m^3.	**$PM_{2.5}$** A 24 hour concentration of 25 µg/m^3 and annual concentration of 10

xix USEPA (2013) Federal Register, Vol. 78, No. 10 January 15, 2013 – Part II – Environmental Protection Agency – 40 CFR Parts 50,51,52 et al. National Ambient Air Quality Standards for Particulate Matter; Final Rule, United States Environmental Protection Agency, Research Triangle Park, NC, USA. Accessed: 11/02/2013. http://www.gpo.gov/fdsys/pkg/FR-2013-01-15/pdf/2012-30946.pdf

xx WHO (2006) WHO Air quality guidelines for particulate matter, ozone, nitrogen dioxide and sulfur dioxide – Global update 2005 – Summary of risk assessment, World Health Organization, Geneva, Switzerland.

xxi Directive 2008/50/EC of the European Parliament and of the Council of 21 May 2008 on ambient air quality and cleaner air for Europe, Official Journal of the European Union, L 152/1, 11.6.2008.

xxii National Environment Protection (Ambient Air Quality) Measure.

xxiii USEPA (2011) Policy Assessment for the Review of the Particulate Matter National Ambient Air Quality Standards, United States Environmental Protection Agency, Office of Air Quality Planning and Standards, Health and Environmental Impacts Division, Research Triangle Park, NC, USA.

xxiv USEPA (2011) Policy Assessment for the Review of the Particulate Matter National Ambient Air Quality Standards, United States Environmental Protection Agency, Office of Air Quality Planning and Standards, Health and Environmental Impacts Division, Research Triangle Park, NC, USA.

xxv USEPA (2013) Federal Register, Vol. 78, No. 10 January 15, 2013 – Part II – Environmental Protection Agency – 40 CFR Parts 50,51,52 et al. National Ambient Air Quality Standards for Particulate Matter; Final Rule, United States Environmental Protection Agency, Research Triangle Park, NC, USA. Accessed: 11/02/2013. http://www.gpo.gov/fdsys/pkg/FR-2013-01-15/pdf/2012-30946.pdf

xxvi USEPA (2013) Federal Register, Vol. 78, No. 10 January 15, 2013 – Part II – Environmental Protection Agency – 40 CFR Parts 50,51,52 et al. National Ambient Air Quality Standards for Particulate Matter; Final Rule, United States Environmental Protection Agency, Research Triangle Park, NC, USA. Accessed: 11/02/2013. http://www.gpo.gov/fdsys/pkg/FR-2013-01-15/pdf/2012-30946.pdf

xxvii WHO (2006) WHO Air quality guidelines for particulate matter, ozone, nitrogen dioxide and sulfur dioxide – Global update 2005 – Summary of risk assessment, World Health Organization, Geneva, Switzerland.

Jurisdiction	Key Findings	Level Adopted[xix,xx,xxi,xxii]
	- 10 µg/m^3 is considered to be below the annual mean for most likely effects and the lower end of the range over which significant effects were observed in the background studies. - PM_{10} is used as a proxy for $PM_{2.5}$ using a ratio of $PM_{2.5}$ to PM_{10} of 0.5, which is typical of developing country urban areas.	µg/m^3. **PM_{10}** 24 hour concentration of 50 µg/m^3, and an annual concentration of 20 µg/m^3.
EU	- Limit and target values determined via a cost-benefit analysis for Europe[xxviii], based on WHO literature regarding health impacts[xxix].	**$PM_{2.5}$** An annual 'target value' of 25 µg/m^3. **PM_{10}** 24 hour concentration of 50 µg/m^3 (allowing 35 exceedances per year), and an annual concentration of 40 µg/m^3.
Australian[xxx] AAQ NEPM	- A study based on monitoring in four cities compared the number of health outcomes avoided between three levels of $PM_{2.5}$ concentration (Annual average of 5, 8, and 10 µg/m^3). - Most cities already meet an annual $PM_{2.5}$ level of 10 µg/m^3. Therefore, in order to avoid a significant number of adverse health outcomes, reductions below that level are needed. - Using estimates from a study in Sydney that estimated the number of PM_{10} related deaths at current levels, the potential number of avoided deaths across Australia associated with a reduction in PM_{10} level was calculated. - On this basis, it was assumed that 600 premature deaths per year would be avoided by reducing PM_{10} concentrations in Australian cities to 50 µg/m^3. - The AAQ NEPM value for PM_{10} was based on the lowest deemed feasible in Australia, at the same time benchmarking against the lowest values present in other jurisdictions.	**$PM_{2.5}$** A 24 hour concentration of 25 µg/m^3 and annual standard of 8 µg/m^3, categorized as an 'advisory reporting standard'. **PM_{10}** 24 hour concentration of 50 µg/m^3, not to be exceeded more than five days per year, to allow for extreme events such as bushfires.

xxviii AEA Technology Environment (2005) Methodology for carrying out cost-benefit analysis for CAFE: Volume 2: Health Impact Assessment, Didcot, Oxon, United Kingdom.

xxix WHO (2006) WHO Air quality guidelines for particulate matter, ozone, nitrogen dioxide and sulfur dioxide – Global update 2005 – Summary of risk assessment, World Health Organization, Geneva, Switzerland.

xxx NEPC (2002) Impact statement for PM2.5 Variation – Setting a PM2.5 standard in Australia, National Environmental Protection Council, Adelaide.

Table 1 shows that Australia's AAQ NEPM values are at (for PM_{10}) or below (for $PM_{2.5}$) the bottom of the range of guideline values selected in other jurisdictions.

It is also important to note that overseas studies are yet to be convincingly supported by Australian literature. For example, the *Australian child health and air pollution study* 'did not find any adverse effects of PM on lung function in single pollution models',[xxxi] and the *Expansion of the multi-city mortality and morbidity study* could not conclusively separate effects of particulate matter from those of other pollutants.[xxxii] These studies were used as a basis for the latest review of the AAQ NEPM and were intended to provide a comprehensive state of the knowledge on health impacts of a variety of pollutants, including particulate matter. The causes of these inconsistencies are not yet clear but could be due to a different mix of emission sources and/or characteristics of particulate matter in Australian cities, compared to those overseas.

Furthermore, the 'advisory standard' of 8 µg/m^3 for $PM_{2.5}$ is below the point at which the experts lose confidence in the data indicating health impacts. From the *Revised Impact Statement* prepared for the AAQ NEPM in 1998, it appears that the National Environment Protection Council equated a low value with 'best practice' by 'benchmarking' against the lowest values present in other jurisdictions, such as the World Health Organization.[xxxiii] This approach is contrary to the WHO's own advice, which states that:[xxxiv]

> "*it is not intended or suggested that they [the Guidelines] simply be adopted as standards. In addition to the pathophysiological basis for the adverse effects that may be associated with exposure to air pollution, these factors include current exposure levels and risk perceptions of a given population, and, of equal importance, the specific social, economic and cultural conditions encountered in a given location. Provisions designed to protect vulnerable groups, such as young children or the elderly, can also influence the stringency of air quality standards. In addition, the standard-setting procedure may be influenced by the feasibility and costs of implementing and enforcing the standards. These considerations may lead to a standard above or below the respective recommended guideline value.*"

Importantly, in Australia, AAQ NEPM values ('advisory standards' or otherwise) are often used as the basis for the regulation of industry by State or local government (see Section 3).

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xxxi COAG (2012) Australian child health and air pollution study, COAG Standing Council on Environment and Water, Canberra, Australia.

xxxii EPHC (2010) Expansion of the multi-city mortality and morbidity study, Environment Protection Heritage Council, Adelaide.

xxxiii NEPC (1998) National Environment Protection (Ambient Air Quality) Measure – Revised Impact Statement, National Environmental Protection Council, Adelaide.

xxxiv WHO (2006) Air Quality Guidelines – Global Update 2005, World Health Organization, Geneva, Switzerland.

This occurs equally in rural and remote areas, where many Rio Tinto Sites are located, as it does in urban areas.

To be able to observe the impacts associated with changing concentrations, epidemiological studies need, by definition, to be located in areas with relatively high populations dominated by urban sources of emissions such as vehicles.

The following examples illustrate this dependency:

- In Australia, the decision to adopt a current advisory standard for $PM_{2.5}$ (8 µg/m3) was largely based upon monitoring at 13 locations in four cities over a three year period. These locations were primarily urban, with only two being described as 'semi-rural'. That study estimated the number of health outcomes avoided in urban centres at different levels of $PM_{2.5}$ concentration (5, 8, and 10 $\mu g/m^3$).[xxxv] The level of 8 $\mu g/m^3$ was selected as an 'advisory' standard as it represented an improvement in air quality across most urban centres, thereby delivering significant improvement in health outcomes in those locations.
- One of the key studies used to inform the NAAQS in the US was based on data from US counties with populations greater than or equal to 200,000.[xxxvi] The other key study also excluded data from locations where populations were 'low'.[xxxvii]

It is therefore important to recognise that when these levels are subsequently adopted in the regulation of air quality at a State and local government level, industrial facilities in all regions are subject to the same benchmark, even though a reduction in concentration in rural and remote areas would likely lead to insignificant improvements in health outcomes in absolute terms.

The model of exposure reduction has been based upon the assumption that no safe lower concentration threshold exists for particulate matter, and any reduction in concentration would lead to public health benefits. This model has understandably been designed in the context of reducing ambient concentrations in densely populated urban areas. Even in this context, the key literature underpinning the setting of guideline values in other parts of the world identifies a threshold below which data become unreliable for use in a policy setting framework because effects cannot be clearly distinguished (10-11 $\mu g/m^3$ for $PM_{2.5}$). That point of unreliability is well above the criterion that is ultimately being used to regulate many of Rio Tinto's sites in rural and remote areas.

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xxxv NEPC (2002) Impact statement for $PM_{2.5}$ Variation – Setting a $PM_{2.5}$ standard in Australia, National Environmental Protection Council, Adelaide.

xxxvi Bell, M., Ebisu, K., Peng, R., Walker, J., Samet, J., Zeger, S. & Dominici, F. (2008) Seasonal and regional short-term effects of fine particles on hospital admissions in 202 US Counties, 1999-2005, American Journal of Epidemiology, 2008, December 1; 168(11):1301-1310.

xxxvii Zanobetti, A. & Schwartz, J. (2009) 'The effect of fine and coarse particulate air pollution on mortality: A national analysis', Environmental Health Perspectives, 2009, June; 117(6):898-903.

2.1 The differences in health impacts between urban and crustal emissions

Most epidemiological studies have been conducted in major cities where the composition of the particulate matter is primarily $PM_{2.5}$ from combustion sources. PM_{10} is still considered to be associated with health impacts separate to those of $PM_{2.5}$ but there is now a limited, but increasing, body of literature considering the differences in health impacts between crustal and urban particulate matter emissions.

Initially, limited evidence from studies on dust storms indicated that PM_{10} from those sources is much less toxic than PM_{10} associated with combustion sources.[xxxviii] The US Clean Air Scientific Advisory Committee Panel for particulate matter noted that $PM_{10-2.5}$ in urban or industrial areas is likely to be enriched by anthropogenic pollutants that tend to be inherently more toxic than the windblown crustal material, which typically dominates $PM_{10-2.5}$ in rural areas[xxxix]. The US Environmental Protection Agency has also stated that the evidence of harm from urban-type particulate matter is stronger than for other types.[xl]

A further study then also concluded that aspects of particulate matter other than mass alone determined toxicity, namely the mass of sulfates and nitrates (at above ambient levels) in the particulate matter.[xli] Other experiments suggest that the effects of particulate matter are probably mediated by organic chemicals that are adsorbed on to the surfaces of the particulate matter, rather than being due to the core of the material itself.[xlii]

The WHO's recent *Review of evidence on health aspects of air pollution* noted that recent data had strengthened the earlier finding that 'while there was little indication that any one property of particulate matter was responsible for the adverse health effects, toxicological studies suggested that fossil fuel and biomass combustion processes may be a significant contributor to adverse health outcomes.' [xliii]

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xxxviii WHO (2000) Air Quality Guidelines for Europe – Second Edition, World Health Organization – Regional Office for Europe, Copenhagen.

xxxix US EPA (2005) Clean Air Scientific Advisory Committee (CASAC) Particulate Matter (PM) Review Panel's Peer Review of the Agency's Review of the National Ambient Air Quality Standards for Particulate Matter: Policy Assessment of Scientific and Technical Information (Second Draft PM Staff Paper, January 2005); and Particulate Matter Health Risk Assessment for Selected Urban Areas: Second Draft Report (Second Draft PM Risk Assessment, January 2005), Letter from Dr. Rogene Henderson (Chair, Clean Air Scientific Advisory Committee) to Honorable Stephen L. Johnson (Administrator, US EPA), EPA-SAB-CASAC-05-007.

xl USEPA (2004) Air Quality Criteria for Particulate Matter – Volume II of II, US Environmental Protection Agency, National Center for Environmental Assessment-RTP Office, Office of Research and Development, U.S. Environmental Protection Agency, Research Triangle Park, NC, USA.

xli WHO (2006) Air Quality Guidelines – Global Update 2005, World Health Organization, Geneva, Switzerland.

xlii WHO (2006) Air Quality Guidelines – Global Update 2005, World Health Organization, Geneva, Switzerland.

xliii WHO (2013) Review of evidence on health aspects of air pollution - REVIHAAP – First results, World Health Organization, Copenhagen, Denmark.

The scarcity of data relating specifically to the effects of crustal emissions has been recognised in some parts of Australia. For example, The Department of Health in Western Australia commissioned a study, completed in 2007, that concluded that in Port Hedland, where particulate matter emissions are dominated by iron ore rich soils, health impacts are unlikely to be as severe as in other regions with higher contributions due to urban emissions. An interim ambient 24 hour air quality standard of 70 µg/m^3 for $PM_{10\text{-}2.5}$ was subsequently recommended (i.e a higher value than the current AAQ NEPM value). That conclusion was primarily based on extrapolating data from other regions with approximately similar pollutant mixes to Port Hedland. However, the study recommended strongly that further monitoring and evaluation of health impacts occur in the area.[xliv] The ambient monitoring that will support a future assessment of health impacts is ongoing.

In summary, the available literature indicates that crustal emissions are associated with different, and likely lesser, health impacts than those from urban sources. It might therefore be assumed that appropriate target values for ambient particulate matter concentrations in areas dominated by crustal particulate matter emissions could justifiably be higher than those in urban areas. However, despite emerging findings suggesting support for this proposition, the current state of knowledge in this area remains limited, particularly in Australia. A significantly better understanding of health impacts associated with crustal emissions is required before appropriate target values can be rigorously determined for areas dominated by crustal particulate matter emissions. Nevertheless, air quality standards have continued to evolve over decades simply because uncertainty continues to exist while the evidence unfolds, while for practical reasons standards must be set despite the uncertainty.

3 THE AUSTRALIAN REGULATORY FRAMEWORK FOR AIR QUALITY MANAGEMENT

Air quality is regulated in Australia through a variety of Federal, State and local government mechanisms. At the Federal level, management of air quality is primarily driven via National Environmental Protection Measures (NEPMs), which are broad framework-setting statutory instruments defined in the *National Environment Protection Council Act 1994*. NEPMs are intended to describe agreed national objectives for protecting or managing particular aspects of the environment. When the *National Environment Protection (Ambient Air Quality) Measure* (AAQ NEPM) was made in 1998 it articulated the desire to achieve ‘ambient air quality that allows for the adequate protection of human health and well-being’.[xlv]

The AAQ NEPM establishes air quality standards and a monitoring and reporting protocol for the pollutants covered. The implementation of the AAQ NEPM is the responsibility of individual States and Territories. To meet the requirements of the AAQ NEPM, States and Territories are required to monitor and report on air quality in comparison with nominated

xliv LIWA & IOM (2007) Literature Review and Report on Potential Health Impacts of Exposure to Crustal Material in Port Hedland, Lung Institute of Western Australia Inc. & Institute of Occupational Medicine for the Department of Health, Perth.

xlv National Environment Protection (Ambient Air Quality) Measure (Cth) target values for a number of pollutants, including particulate matter. Monitoring locations are required to be representative of exposure to the 'general population' and not dominated by individual sources. Consequently, the AAQ NEPM standards (see Table 1) should be developed based on information pertaining to the general population.[xlvi]

AAQ NEPM standards are required to be achieved within ten years of the commencement (i.e. 2008 for PM_{10}). The method(s) of achieving the standard, or actions to be taken if the standard is not met, is at the discretion of State and Territory jurisdictions. The *National Environmental Protection Council Act 1994* also requires consideration of regional differences in the development of a NEPM, which includes the setting of standards.[xlvii]

The most recent review of the AAQ NEPM standard found:[xlviii]

- The evidence does not lead to the use of any specific indicator beyond either PM_{10} or $PM_{2.5}$.
- There are no data available at this time on ambient levels of $PM_{10-2.5}$ that could be utilised to guide the development of a standard for that fraction of particulate matter.
- Measures additional to upper limit standards are suggested. An exposure reduction framework appears to be implicitly recommended.

States and Territories regulate air quality issues at Rio Tinto's operations through a range of tools that are described in Table 2.

xlvi National Environment Protection (Ambient Air Quality) Measure (Cth)
xlvii National Environmental Protection Council Act 1994
xlviii NEPC (2010) Reveiw of the National Environment Protection (Ambient Air Quality) Measure – Discussion Paper – Air Quality Standards, National Environment Protection Council, Adelaide.

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Table 2: Tools used by States, Territories and local governments to manage air quality

Tools	Description	Examples
Statutory and non-statutory policies	Documents that establish processes, standards and environmental performance measures for generators of emissions to comply with, to meet requirements of legal instruments. Policies define the uses and environmental values to be protected and the environmental quality standards needed to protect these beneficial uses. They are enforced indirectly via notices, and via licence and works approval conditions	The *Environmental Protection (Air) Policy 2008* in Queensland establishes the framework for managing emissions to ensure compliance with the *Environmental Protection Act 1994* (Qld). *State Environment Protection Policy (Air Quality Management)* in Victoria is a statutory policy that establishes the legal framework for managing emissions to the air environment.
Guidance documents	Non-legal documents that provide general guidance about certain aspects of the policies or regulations to assist in the implementation of the policy or regulation. They have no legal basis.	The *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales*[xlix] prescribe methodologies for assessment and ambient air quality standards. South Australian *Guidelines for Separation Distances.*[l]
Environmental licences	A document that contains a set of conditions that a specific facility or business must comply with	Environment Protection Licence and Project Approval issued in New South Wales Development Approval issued in Queensland EPA Works Approval and Licence issued in Victoria
Pollution abatement/infringement notices	A notice that is issued to secure compliance with the general environmental duty, environmental licence conditions or laws/regulations of a specific jurisdiction or provisions of an Environment Protection Act.	An Environmental Protection Order can be issued under Queensland legislation. Abatement Notices can be issued in Victoria if the process or activity has caused pollution or does not comply with standards or regulations.

xlix DEC NSW (2005) Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales, Department of Environment and Conservation, Sydney.

l SA EPA(2007) Guidelines for Separation Distances – December 2007, Environment Protection Authority, Adelaide.

In practice, many of the tools identified in Table 2 are influenced, if inconsistently, by AAQ NEPM standards. Considering the lifecycle of a typical Rio Tinto project:

- State laws or regulations may or may not contain AAQ NEPM standard values as objectives to be met. If not referring to AAQ NEPM standards, legislation may contain reference to target values that are higher or lower than those standards (see Table 3). If referred to in the legislation, industry may be explicitly or implicitly required to meet the AAQ NEPM standard values for new developments.
- The terms of reference for the air quality impact assessments (required by planning legislation for new projects) often (but not always) make reference to compliance with AAQ NEPM standards. Assessments are typically required to assess 'cumulative' impacts. That is, the impacts of the facility plus background concentrations should be within AAQ NEPM standard levels at the facility boundary or at the nearest 'sensitive receptor' (typically the nearest residence).
- Guidance documents for how to conduct air quality impact assessments make reference to standards equivalent to the AAQ NEPM. For example, in New South Wales under the *Protection of the Environment Operations Act 1997* (NSW), modelling of industrial emissions is required for licence applications. The *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales*[li] sets the AAQ NEPM standard for PM_{10} as an assessment criterion at the nearest sensitive receptor, but it is often applied at the boundary. In Western Australia and Queensland a similar approach is used.
- Many decision makers use the AAQ NEPM standard as a decision point on acceptability of a development proposal. If approval is granted, environmental licences may contain conditions requiring the meeting of AAQ NEPM standards at the site boundary or at the nearest sensitive receptor. Environmental licences often also contain requirements to implement costly monitoring of ambient air quality. If a company is shown not to comply with licence conditions, in many cases, legal action can be taken.

li DEC NSW (2005) Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales, Department of Environment and Conservation, Sydney.

Table 3: Ambient Air Quality Criteria by Jurisdiction

Jurisdiction	PM Criterion		Units	Averaging Period	Exceedance Days	Reference
AAQ NEPM	PM_{10}	50	µg/m^3	24-hours	5 days each year	*National Environment Protection (Ambient Air Quality) Measure*
	$PM_{2.5}$	25	µg/m^3	24-hours		
		8	µg/m^3	1-year		
Queensland	TSP	90	µg/m^3	1-year	-	*Environmental Protection (Air) Policy 2008*
	PM_{10}	50	µg/m^3	24-hours	5 days each year	
	$PM_{2.5}$	25	µg/m^3	24-hours	-	
		8	µg/m^3	1-year	-	
New South Wales	TSP	90	µg/m^3	1-year		*Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales*[lii]
	PM_{10}	50	µg/m^3	24-hours		
	PM_{10}	30	µg/m^3	1-year		
Victoria	PM_{10}	50	µg/m^3	24-hours	5 days a year	*State Environment Protection Policy (Ambient Air Quality)*
Tasmania	TSP	150	µg/m^3	24-hours		*Environment Protection Policy (Air Quality) 2004*
South Australia	The AAQ NEPM criteria are typically applied, although there is no formal recognition of those standards in South Australia regulatory instruments.					
Western Australia	Adopt AAQ NEPM standards in the interim with Western Australian guidelines currently under development.					
Northern Territory	The AAQ NEPM criteria are typically applied, although there is no formal recognition of those standards in Northern Territory regulatory instruments.					
Australian Capital Territory	The AAQ NEPM criteria are typically applied, although there is no formal recognition of those standards in South Australia regulatory instruments.					

lii DEC NSW (2005) Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales, Department of Environment and Conservation, Sydney.

Some new approaches for regulation of air quality at a State level are however emerging. In Victoria, a *Protocol for Environmental Management (PEM) State Environment Protection Policy (Air Quality Management) for Mining and Extractive Industries* was jointly developed by several Government agencies (including EPA, DPI and DoH) together with the Minerals Council of Australia. The PEM is a statutory document that establishes the process for conducting air quality assessments for the mining and extractive industries, taking into account the nature of these industries. The PEM allows for different levels of assessment depending on the scale and location of the proposal. Small facilities or those in remote areas do not require air quality assessments, but are required to apply best practice management. Where assessment is required, the PEM clarifies the requirements of the *State Environment Protection Policy (Air Quality Management) 2001* (Vic) for the mining sector and establishes assessment criteria for both PM_{10} and $PM_{2.5}$ (24 hour average of 60 µg/m^3 and 36 µg/m^3 respectively) that apply at the nearest sensitive receptor. However, the air quality assessment must identify the contribution of the incremental contribution of the facility separately, which is used as valuable context in the approval process. Sites in large urban areas or close to residential areas are required to undertake real-time monitoring of PM_{10} and $PM_{2.5}$ at sensitive locations (such as residences). This monitoring should is required to be linked to a reactive management strategy that would allow changes to the operations on the site to be made if particulate matter concentrations reach levels over a short timeframe that may lead to the 24-hour health-based values being exceeded.[liii]

3.1 Limitations to the current framework

It is clear that there is no consistency in how air quality is regulated in Australia. AAQ NEPM standards are currently being used in a variety of locations and contexts, inconsistent with the intention of that framework, which was designed as a tool to assist in the management of air quality in urban areas.

The inconsistent application of ambient air quality standards has led to an uneven playing field for industry. The application of AAQ NEPM standards at the facility boundary or nearest sensitive receptor, where it occurs, is a clear contravention of the intention of the measure. This is particularly problematic for the resources sector, which is required to operate where the resource is located.

When standards are typically applied as a limit for an airshed, new developments, even if demonstrating best practice or insignificant contributions to existing levels, may be refused a licence to operate, uneccesarily restricting economic growth in that region. Alternatively, new developments may be required to apply costly mitigiation measures, even if their contribution to total emissions is small. This could even be the case if the elevated background levels were due to non-industrial souces, such as windblown dust, sea spray or bushfires. In rural

liii EPA Victoria (2007) Protocol for Environmental Management (PEM) State Environment Protection Policy (Air Quality Management) for Mining and Extractive Industries, EPA Victoria, Melbourne.

and remote areas, where little or no exposure to emissions occurs, industry may be subject to the same benchmark for performance as industry in densely populated urban areas, even though few or no people might be impacted.

There is also very little recognition in the current framework of the differences in types of particulate matter in different jurisdictions, and there is currently very little credible information in Australia that can be used to support the application of AAQ NEPM values outside of urban areas.

In Australian urban centres the ratio of $PM_{2.5}$ to PM_{10} is between 30 to 50%, which is considerably less than in the US and Europe. Some populated centres, such as Port Hedland (described earlier), are subject to a very different mix of particulate matter than the urban centres that form the basis of the AAQ NEPM standards. Sea salt can, for example, be a significant contributor to recorded particulate matter emissions. ANSTO presented contributions of sea salt to $PM_{2.5}$ concentrations ranging between 7% (as far away from the coast as the Hunter Valley) and 43% in Tasmania.[liv] In recognition of this issue, The Netherlands allows for the removal for the contribution of sea salt from reported particulate matter concentrations, a methodology that could have applicability in large parts of Australia.

4 CONCLUSIONS AND RECOMMENDATIONS

The information presented in this submission indicates that air quality is managed inconsistently throughout Australia. The AAQ NEPM standards, which form the basis for much of the regulation for air quality in this country, were created to support the management of air quality in urban areas, a context that is very different to many of the locations where Rio Tinto operates. Nevertheless, in the absence of other guidance, many jurisdictions are applying AAQ NEPM standards as local airshed limits, even in rural areas where very little exposure occurs and where the characteristics of airborne particulate matter differ markedly from that in urban areas.

The AAQ NEPM standards themselves are not strongly supported by the work on health impacts done overseas or in Australia. The standards adopted in Australia appear to have been taken as the lower (most stringent) end of the range of standards developed in other jurisdictions, inconsistent with the advice provided by the WHO on standard setting.

An exposure reduction framework, while applicable in urban areas with high levels of exposure, may not be applicable in rural areas with different compositions of particulate matter. A small but growing body of evidence indicates that particulate matter of crustal origin is probably of lesser concern to human health than the dominant types of particulate matter found in urban regions.

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liv ANSTO (2008) Fine Particle Aerosol Sampling Newsletter, Number 38, July 2008, Australian Nuclear Science and Technology Organisation, Lucas Heights, Australia.

Considering the information presented in this submission, and our long history as an important stakeholder in Australia's economy, Rio Tinto makes the following recommendations with respect to management of air quality in Australia:

- Australia should adopt target levels that reflect the latest science on health impacts relevant to the particular context in which those targets are intended to apply. The levels adopted in jurisdictions outside Australia should not be used in the decision-making process for setting Australian values, without a clear recognition of the importance of context. To date, target values adopted by State and local governments in regulating air quality, by and large, do not reflect the relevance of context.
- Australia should implement a regulatory framework that focuses on achieving target values in urban areas as the highest priority, consistent with the exposure-based design of the AAQ NEPM.
- The use of AAQ NEPM standards as boundary/licence conditions should not be continued. This practice is not consistent with the clearly stated purpose of the AAQ NEPM.
- Facilities demonstrating good practice management or small increases above background levels should be allowed to operate.
- Where regional air quality issues exist, all sources of emissions (industrial, community) should be required to contribute equitably to improvements in air quality. In other words, the approval of better controlled operations should not be unduly impeded by the existence of operations that are not as effective in controlling emissions.
- A comprehensive study on the health impacts of crustal emissions in Australia is needed to form a better basis for standard setting in communities subject to these types of emissions.
- A formal mechanism should be available for industries to demonstrate that their operations are consistent with appropriate health outcomes, even if their operations are inconsistent with target values designed on the basis of achieving health outcomes in larger urban areas. Facilities that cause little or no exposure to the population (i.e. in remote areas) should not be required to meet the same standards designed for urban areas. We recognise while making this recommendation that environmental regulation is not the only constraint on particulate matter emissions, for example: occupational health and safety, as well as issues of equipment maintenance and safety, are also potential constraints that should be considered.
- An improved regulatory framework that allows for development in areas with high natural background concentrations (e.g. windblown crustal dust or sea salt) of particulate matter is required.