

**HAZELWOOD MINE FIRE INQUIRY**  
**PUBLIC HEARINGS 1 – 3 SEPTEMBER 2015: TERM OF REFERENCE 6**  
**SUBMISSIONS ON BEHALF OF GDF SUEZ AUSTRALIAN ENERGY**

**SUMMARY OF GDFSAE SUBMISSIONS**

1. The Board has been asked to inquire into and report on Term of Reference 6 (**TOR6**), namely:  

‘whether the Hazelwood Coal Mine Fire contributed to an increase in deaths, having regard to any relevant evidence for the period 2009 to 2014.’
2. Term of Reference 6 involves the consideration of two key questions:
  - a. was there an increase in deaths in the Latrobe Valley? (**Question One**); and
  - b. did the Mine Fire contribute to any such increase in deaths? (**Question Two**).
3. GDFSAE submits that the Board is not in a position to make any findings that there was an increase in deaths, or that the Mine Fire contributed to an increase in deaths (if there was such an increase), on the basis of the evidence which has been adduced before it.
4. This is for a number of reasons:
  - a. first, the evidence essentially comprises statistical analysis of crude high level mortality data from various postcodes in the Latrobe Valley which is open to a number of different and opposing interpretations, is subject to substantial natural variation given the small population size in question, and which in any event by its nature falls well short of the standard of evidence which is required to form a view as to whether in fact there was an increase in deaths in the Latrobe Valley, and whether in fact the Mine Fire contributed to an increase in deaths (if there was any such increase);
  - b. second, at its highest, the statistical evidence which has been presented to the Board comprises speculation which is heavily qualified, and even then amounts only to "moderate"/ "some"/ "not strong"/ "weak" *statistical* evidence of there being any increase in deaths. Such evidence is incapable of supporting any conclusions of fact; and
  - c. third, the manner in which the statistical analysis has been presented before the Board has inhibited a properly informed testing of it, further undermining the weight that can be placed on it.

## DETAILED SUBMISSIONS

### Question One: was there an increase in deaths in the Latrobe Valley?

#### *Conclusions drawn by certain experts on the basis of statistical modelling*

5. On the basis of the various statistical analyses of RBDM data before the Board, it is not possible to conclude that there was an increase in the rate of deaths in the Latrobe Valley either:
  - a. over the period of the Mine Fire (9 February 2014 to 25 March 2014); or
  - b. over the extended period that has been analysed (February to June 2014).
6. In his evidence to the Board, Professor Armstrong was asked by Mr Rozen to provide a response to the following question: 'is there a straightforward answer you can give to the question the board has to grapple with and that is did the mine fire in 2014, February to March, contribute to an increase in deaths in the Latrobe Valley?'
7. Professor Armstrong's response was provided in two parts, including, first, in relation to the whether any additional deaths had occurred in the Latrobe Valley. In response to this question, his response was as follows: 'I think we have as described moderate evidence for an increase in deaths during that period so anything I say about the cause of it has to take into account the fact that the evidence for the increase itself is not strong.'<sup>1</sup>
8. Professor Armstrong's comments on the question as to whether there had been an increase in the rate of deaths in the Latrobe Valley, were substantially endorsed by Professor Gordon, Associate Professor Barnett and Dr Flander, subject to (inter alia) the following additional comments being made by Dr Flander:
  - a. 'this kind of an experiment by its nature looks at all the possible data that we can use and tries to make an estimate. We recommend much further enquiry including the longitudinal study I believe has already been initiated headed up by Monash University';<sup>2</sup> and
  - b. 'we make our best estimate and we use different methods and we have different judgments and assumptions, and in the case of the small numbers we're dealing with here we all have been taught well that we do not want to conclude there is an effect if there is none, nor do we want to miss an effect if there is one.'<sup>3</sup>

#### *Limitations in the modeling undertaken*

9. There are significant limitations and anomalies in the statistical modeling that has been undertaken. As a consequence, any attempts to draw conclusions from the data relied upon, and the modelling undertaken, are likely to be fraught with uncertainty, inconclusive and unreliable. Key limitations and anomalies include the following:
  - a. *The statistics do not identify the actual place of residence at the time of death or in the period of the Mine Fire.* From the data analysed it is not possible to ascertain whether the deceased resided at the location identified as their usual place of residence at the time of their death or for any significant period before that and specifically during the duration of the Mine Fire. The mortality statistics are derived from the death registration statement, which is completed by funeral directors from information obtained by family members of the deceased.<sup>4</sup> RBDM has no way of knowing how accurate the address given by next of kin in the death registration statement, the information as to residential address being taken at 'face value' by RBDM and they

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<sup>1</sup> Professor Armstrong T518.14-18

<sup>2</sup> Dr Flander T527.23-27

<sup>3</sup> Dr Flander T527.28-31 - T528.1-4

<sup>4</sup> Sims T282.26-31 - T283.1-7

assume it is correct.<sup>5</sup> RBDM does not know whether the deceased lived at the address given in the death registration statement for the last 2 weeks before their death or the last 20 years<sup>6</sup> or indeed at all. RBDM obtains data relating to the place of death of the deceased. However, the data supplied to the Board did not include this information in relation to all deaths. Postcode of the “place of death” is not a mandatory field of information which is required to be supplied by medical practitioners certifying a death.<sup>7</sup>

- b. *It is not known whether or not those who died were actually resident in the postcode at any relevant time, that is at the time of the Mine Fire so as to ascertain their level of exposure and any protective measures that may have been undertaken by them.*<sup>8</sup> Without this information there is no way of knowing about the levels of exposure of the deceased to the Mine Fire.<sup>9</sup> Whether a deceased was residing in the postcode indicated in the RBDM statistics is particularly relevant to understanding any causal relationship and would improve the quality of the data.<sup>10</sup> In the majority of the registrations extracted in Annexure 1 to the Statement of Ms Sims the field “place of death” has not been completed.<sup>11</sup> It is therefore not possible to know from the statistics provided when the deceased was last at the address identified as their usual place of address,<sup>12</sup> that is, whether they in fact had any exposure to the effects of the Mine Fire at all.
- c. *The postcodes analysed cover an area which exceeds the modeled extent of smoke associated with the Mine Fire.* Indeed in the case of one of the postcodes, it extends some 70km to the north of the Mine<sup>13</sup> which is far beyond any area impacted by smoke from the Mine Fire. The statistical analyses do not take account of the levels of exposure of the deceased having regard to factors such as wind direction and varying concentrations of pollutants within the area of study. The CSIRO modelling (attached to Professor Abramson’s statement) expresses exposure to smoke of locations outside Morwell as a proportion of the Morwell exposure and indicates that the smoke was blown in a predominately east-west direction in the Latrobe Valley. That is, there are large areas of at least three of the postcodes which were analysed that were not exposed to significant levels of smoke associated with the Mine Fire at all, particularly to the north and south of Morwell. However, the statistical analyses have included deaths outside the areas which the CSIRO have modelled to have had exposure to effects from the Mine Fire.
- d. *There is no medical basis for extending the period of analysis beyond 5 days after the Mine Fire was brought under control.* The analyses of Associate Professor Barnett and Professor Gordon extended the period of analysis to encompass the period of May/June 2014. Professor Gordon contended that there was a ‘logical possibility’ that acute effects could have a lingering effect,<sup>14</sup> and that it was reasonable to believe that any effect of the Mine Fire on mortality ‘may have continued for some time after the fire was declared safe on 25 March 2014’.<sup>15</sup> The longer periods analysed by Professor Gordon had the lowest P-values (the P-values decreased for Feb-May 2014 (0.026) and for Feb-June 2014 (0.014)), and he commented that these extended periods beyond the

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<sup>5</sup> Sims T293.8-15

<sup>6</sup> Sims T283.8-18

<sup>7</sup> Sims T285.6-16

<sup>8</sup> Dr Flander T526.19-22

<sup>9</sup> Dr Flander T530.13-16

<sup>10</sup> Associate Professor Barnett T563.17-26

<sup>11</sup> Statement of Dawn Sims, Exhibit 2, WIT.0002.001.0001 at .0003 para [34(c)]; Sims T293.16-23 and T296.4-17

<sup>12</sup> Sims T297.3-7

<sup>13</sup> See the plan which depicts the postcodes assessed, Exhibit 1A, SUBM.0001.002.0070

<sup>14</sup> Professor Gordon T476.1-10; Report of Professor Gordon ‘*Commentary on the Hazelwood mine fire and possible contribution to deaths*’, 11 August 2015, Exhibit 29, EXP.0003.001.0001 at .003 [14]

<sup>15</sup> Report of Professor Gordon ‘*Commentary on the Hazelwood mine fire and possible contribution to deaths*’, 11 August 2015, Exhibit 29, EXP.0003.001.0001 at .003 [14]

actual time of the fire result in the excess deaths being observed to be ‘statistically significant at conventional levels’.<sup>16</sup> However, Professor Gordon is not medically qualified to determine the period in which any exposure to elevated concentrations of particulate matter may lead to an increased risk or morbidity or mortality, and would defer to others on medical questions.<sup>17</sup> There is no evidence that would validate extending the period of analysis beyond 5 days after the Mine Fire was brought under control (i.e. 30 March 2014). Dr Armstrong acknowledges that deaths prompted by a sharp increase in PM<sub>2.5</sub> may happen after a period of delay but states that the available evidence suggests that this period is from *one to five days* and cites a study by Brook and others regarding particulate matter in support of the selection of this period.<sup>18</sup> The material cited by Dr Armstrong was produced by Associate Professor Barnett and provided to the parties on 7 September 2015. The Brook study concludes that:

“The overall evidence from time-series analyses conducted worldwide since publication of the first AHA statement confirms the existence of a small, yet consistent association between increased mortality and short-term elevations in PM<sub>10</sub> and PM<sub>2.5</sub> approximately equal to a 0.4% to 1.0% increase in daily mortality (and cardiovascular death specifically) due to a 10ug/m<sup>3</sup> elevation in PM<sub>2.5</sub> during the preceding 1 to 5 days.”<sup>19</sup>

There is therefore no scientific or medical basis for extending the period of analysis beyond 5 days and certainly no basis for extending it by a period of months. However, it is only when the period of analysis is extended to May or June 2014 that results which are statistically significant at conventional levels are derived from the modelling.

- e. *The analysis does not adequately take into account the effect of extended periods of high temperature.* Temperature is an important covariant in explaining mortality at the time of the Mine Fire. The modeling conducted has taken account of monthly *averages* in temperature as opposed to *peak* temperatures. The maximum temperatures of 40+ degrees on consecutive days which were a feature of February 2009 and January and February 2014 have not been taken into account in the modeling. The January and February 2014 heatwave may have affected vulnerable people in the Latrobe Valley who later died during the period of the Mine Fire. However, the small number of deaths in the affected postcodes restricts the analysis to temperatures on the date of death. It is not possible to analyse each death in association with temperatures on the day, week or month before that death.<sup>20</sup> It is extreme fluctuations in temperature and their duration, rather than monthly averages that impact on mortality<sup>21</sup> and the impact of fluctuations in temperature and extended periods of high temperatures on mortality have not been assessed.
- f. *The limited sample size of the data.* All of the reports prepared by the experts (necessarily) suffer from the same weakness, namely the limited population and the corresponding limited size of the data set capable of being assessed. This is a fact that cannot be overcome. Splitting all causes mortality into further sub-categories (e.g. cardiovascular and respiratory) makes the data sets being assessed even smaller with the consequence that the confidence intervals for these reduced data sets substantially increase thus increasing the uncertainty of any conclusions. The effect of a reduced data

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<sup>16</sup> Report of Professor Gordon ‘*Commentary on the Hazelwood mine fire and possible contribution to deaths*’, 11 August 2015, Exhibit 29, EXP.0003.001.0001 at .0009 [40]

<sup>17</sup> Professor Gordon T 590.23-26

<sup>18</sup> Report of Professor Armstrong, Exhibit 28, EXP.0003.001.0001 at .0012

<sup>19</sup> Brook R & Ors, ‘*Particulate Matter Air Pollution and Cardiovascular disease - An update to the scientific statement from the American Heart Association*’, Circulation June 1, 2010

<sup>20</sup> Report of Dr Flander & Ors ‘*Age standardised mortality and cause of death in the Latrobe Valley at the time of (and five years prior to) the Hazelwood coalmine fire in Morwell, Victoria*’, Exhibit 23, EXP.0004.003.0001 at .0017

<sup>21</sup> Dr Flander, ‘*Review of “Analysis of death data during the Morwell mine fire”, A Barnett (2014) and “An updated analysis of death data during the Morwell mine fire”, A. Barnett (2015)*’, 28 April 2015, Exhibit 22, EXP.0004.002.0001 at .0003

set is demonstrated by Professor Armstrong's Table 2. That table indicates that for deaths of all causes in the period 2009-2013 in comparison to 2014, that the 95% confidence interval for the rate ratio of 0.90 is 0.80 to 1.00. When the data set for the same period is divided into deaths from respiratory causes and deaths from cardiovascular causes, the 95% confidence interval for the rate ratios are much wider with a range from 0.88 to 1.66 and 0.61 to 1.04.<sup>22</sup> There is an increasing risk of unreliability of the results as subsets of data are analysed. As the sample of data are divided into smaller subsets the chance of aberrant results, that differ from the overall result, increase. Once multiple hypotheses are tested there is an increased risk of one or more being statistically significant by chance when there is not real effect, so each new test becomes a little weaker than it would be if only a single hypothesis were being tested.<sup>23</sup> By corollary, as the sample sizes increase even a slightly smaller ratio will become more statistically significant.<sup>24</sup> The magnitude of effects can be influenced by the number of observations which are being considered. In this case there are a low number of observations. As a result, there is considerable difficulty in choosing between various explanations, simply because the variation around the point estimates is so broad and the confidence intervals are large.<sup>25</sup> At **Annexure 1** to this submission, is a summary of the confidence intervals and P-values associated with the statistical analyses underlying certain of the key opinions expressed in the joint report of Professor Armstrong, Professor Gordon, Dr Flander and Associate Professor Barnett dated 31 August 2015 (**Joint Report**). As is clear from the table at Annexure 1, the majority of the results are not statistically significant at conventional levels.

- g. *The data set is relatively 'crude' because it is monthly and 'all deaths' data.*<sup>26</sup> There is no set amount of information required to be disclosed by medical practitioners other than at least one cause of death.<sup>27</sup> The outcome of the analysis depends on the quality of the data as well as starting assumptions and the type of analysis used. However, it is the quality of the data that is crucial.<sup>28</sup> A more accurate analysis could be provided by using more accurate data, namely using daily rather than monthly death statistics, knowing the actual cause of death and the age of the deceased.<sup>29</sup> There are some deaths which ought to be easily discarded from the analysis due to the disclosed cause of death (for example death by gunshot or road trauma). Excluding deaths that were not possibly related to the Mine Fire would improve the quality of the data.<sup>30</sup> Deaths from a special cause, particularly one at a particular time point do not reflect the natural variation in death rates which is of interest as a background comparison to analysing any possible Mine Fire effect.<sup>31</sup>
- h. *Deaths prior to the fire in February have been taken into account.* The data set relied upon in the analyses is for the entire month of February. Deaths which occurred prior the fire should be excluded from the data and this would improve the quality of the data.<sup>32</sup>

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<sup>22</sup> Report of Professor Armstrong, Exhibit 28, EXP.0002.001.0001 at .0009, Table 3

<sup>23</sup> Professor Armstrong T575.8-16

<sup>24</sup> Professor Gordon T480.9-19

<sup>25</sup> Dr Flander T482.12-31-483.1

<sup>26</sup> Dr Flander T563.1-4

<sup>27</sup> Sims T293.24-31

<sup>28</sup> Dr Flander T533.24-29

<sup>29</sup> Working Paper of Associate Professor Barnett, 'An updated analysis of death data during the Morwell mine fire', December 2014, Exhibit 27, EXP.0005.002.0001 at .0009

<sup>30</sup> Associate Professor Barnett T563.10-16; Report of Professor Gordon 'Commentary on the Hazelwood mine fire and possible contribution to deaths', 11 August 2015, Exhibit 29, EXP.0003.001.0001 at .0008 [35]

<sup>31</sup> Report of Professor Gordon 'Commentary on the Hazelwood mine fire and possible contribution to deaths', 11 August 2015, Exhibit 29, EXP.0003.001.0001 at .0007 [33]

<sup>32</sup> Dr Flander T562.31-26; Associate Professor Barnett 565.5-9; Report of Professor Gordon 'Commentary on the Hazelwood mine fire and possible contribution to deaths', 11 August 2015, Exhibit 29, EXP.0003.001.0001 at .0008 [37]

- i. *We do not have randomisation to protect the quality of the data.* The more times an association is tested the less weight that can be put on the association. Once multiple analyses are conducted of data there can be a concern that the tester is influenced by what they have seen in the data and it is more likely that selections can be made so that data appears positive in relation to the hypothesis when in fact the observations may be just chance occurrences.<sup>33</sup> Every time a 'pass is made through data' this can alter the 'architecture of the data' such as the variables in the analysis slightly different results can occur<sup>34</sup> which detracts from the reliability of the analysis and reduce overall confidence in the results.<sup>35</sup>
- j. *There is difficulty separating out smoke from the Mine Fire from smoke from bushfires generally in the Latrobe Valley during the same period.* The effect of bushfires in 2009 and 2014 is a 'confounding element' in the analysis.<sup>36</sup> This is acknowledged in the Joint Report, paragraph 2.1 which states that Professors Armstrong and Gordon and Dr Flander agreed: 'mortality from all causes in February and March and February to June 2014 was closer to that in the corresponding periods of 2009 than in those of 2009-2013. This observation may suggest that bushfires, which occurred in Latrobe Valley in February in both 2014 and 2009, contributed to the probable increase in mortality from all causes in 2014.'<sup>37</sup>

**Question Two: did the Mine Fire contribute to any such increase in deaths?**

10. The second of the two key questions for the Board arising from TOR6, is did the Mine Fire contribute to any such increase in deaths?

***Role of statistical analysis***

11. The second question cannot be determined on the basis of statistical analysis of the limited and crude data which is presently available. The mere demonstration of a temporal association between increased mortality in February to March 2014 and the Mine Fire does not establish an underlying causal relationship between those two events.
12. The statistical analyses presented to the Board were directed to identifying the presence or absence of effects, and then to evaluate the strength of those effects. In doing so, the approach has not been directed to undertaking a causal experiment. As Dr Flander noted the experts 'were very careful throughout to not make statements that pointed to causing this or causing that, or not causing this or not causing that'<sup>38</sup> but were considering probable or predictive hypotheses. The analyses do not provide conclusive evidence of any particular effect, given the very wide confidence intervals around the observations, and the lack of useful denominators to compare health events in the postcodes analysed. The uncertainties in the analysis include the statistically very small population size under review, the absence of information about the underlying age, sex distribution and population movements over time within the postcodes analysed<sup>39</sup> and pre-existing medical conditions.
13. The second step, or point of analysis, is to prove the correlation is causal. This secondary enquiry requires an investigation of the dose/response relationship so as to identify levels of

<sup>33</sup> Professor Armstrong T490.28-31-491.1-17 and T491.19-31-492.1-6; Professor Gordon T492.8-9

<sup>34</sup> Dr Flander T490.17-31

<sup>35</sup> Dr Flander T499.3-6. See also Professor Armstrong at T518.20-31-T519.1-12

<sup>36</sup> Professor Armstrong T495.27-31-T496.1-8

<sup>37</sup> *Joint expert report of Professors Armstrong and Gordon, Associate Professor Barnett and Dr Flander* dated 31 August 2015, Exhibit 30, EXP.0008.001.0001; Report of Professor Armstrong 'Expert assessment and advice regarding mortality information as it relates to the Hazelwood Mine Fire Inquiry Terms of Reference - Final Report', August 2015, Exhibit 28, EXP.0002.001.0001 at .0009 -.0010 [5]

<sup>38</sup> Dr Flander T440.7-20

<sup>39</sup> Dr Flander, 'Review of Births Deaths & Marriages Victoria (BDMV) mortality data for the Latrobe Valley and the time of the Hazelwood coal mine fire in Morwell', Exhibit 21, EXP.0004.001.0001 at .0002

exposure. An analysis to ascertain if there was a discernible and credible increase in deaths in populations exposed to the Mine Fire has not been undertaken. As Professor Mc Neil highlighted in his report,<sup>40</sup> typically a study of the effects of an environmental event would look at death or illness rates amongst the *known exposed population*. In this instance, vastly inferior surrogate measures such as reference to postcodes of usual residence, have been adopted. These surrogate measures may not correlate well with actual exposures. Clearly a surrogate study of death rates runs the real risk of including deaths from those not known to be exposed and indeed of excluding those who experienced exposure but do not reside in the area studied. For this reason, a surrogate analysis of the sort undertaken here is an inherently inferior form of analysis and should be treated with considerable care.

#### ***Anomalies in the data and the statistical analyses undertaken of the data***

14. *There are significant anomalies and counter-intuitive elements in the data and the statistical analyses thereof.* The fact of these anomalies underscores the inability to draw any conclusions as to a causal hypothesis based on the existing data. For example:

- a. *The observed mortality figures for Morwell do not support the hypothesis of a link between the Mine Fire and increased mortality.* Paragraph 2.5 of the Joint Report refers to observations that Barnett ‘also observed a *lack of increase* in mortality in Morwell during February and March 2014 relative to that over the whole of the period 2004-2014.’ (Note that the relevance of analyses over this extended period is questionable, given that TOR6 refers specifically on 2009-2014). A clearer characterisation of the statistics would perhaps have been that the figures in fact show a *decrease* in mortality in the relevant period. Irrespective of the manner in which the observation has been recorded, since Morwell was the most exposed of the populations to emissions from the Mine Fire, the comparative lack of greater mortality in Morwell in 2014 than in 2009-2013 is inconsistent with the proposition that emissions from the Mine Fire caused an increase in mortality in Latrobe Valley.<sup>41</sup>
- b. The attempt to dismiss the decreased mortality rates in Morwell as being referable to relocations from Morwell, natural variation, or otherwise justifiable on the basis of ‘equivalent’ PM<sub>2.5</sub> concentrations in Morwell East and Traralgon, is wholly unsatisfactory and hollow.

In a number of documents VOTV have provided to the Board there has been a comment about people leaving Morwell or being evacuated from Morwell<sup>42</sup> with it being suggested that 60% of residents of Morwell evacuated, although it is unclear when, and how, many residents evacuated and the duration of their absence. Mr Ipsen of VOTV was unable to provide insight into how many people left Morwell: ‘not really, there was a figure bandied around of about 60 per cent but I’m not sure that is an actual figure, my guess is it’s probably may be ten, 15 or something.’<sup>43</sup> It is also not possible to gain any clarity about the extent of relocation of residents by reference to the number of people who accessed respite and relocation allowances administered by the Department of Human Services, as it is unknown whether the recipients of those payments in fact utilised the funds for the purpose of relocating from Morwell during the Mine Fire.<sup>44</sup> As Professor Armstrong noted, there was not ‘much evidence around’<sup>45</sup> and no one had been able to provide him with any data that would substantiate the

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<sup>40</sup> Report of Professor John McNeil, dated 28 August 2015, Exhibit 11 at page 1

<sup>41</sup> Professor Armstrong T585.1-4; Report of Professor Armstrong, Exhibit 28 EXP.0002.001.0001 at .0025 [4].

<sup>42</sup> See for example the submission by VOTV SUBM.0001.001.0001 at .0006

<sup>43</sup> Mr Ipsen T278.26-31 and T279.1-2

<sup>44</sup> Dr Lester T431.24-31-T432.1-25

<sup>45</sup> Professor Armstrong T522.6-15

number of persons who relocated from Morwell, and to make allowance for this factor would 'fall into the realm of speculation'.<sup>46</sup>

Professor Gordon's comments in his evidence to the Board regarding PM<sub>2.5</sub> concentrations in Traralgon and Morwell East during the period of the Mine fire, were not covered in his report, were not substantiated by specific references to available data sets, and in any event are inconsistent with the *Hazelwood Mine Fire Inquiry Report 2014*, regarding available data concerning PM<sub>2.5</sub> concentrations in Traralgon. At p.267 of the *Hazelwood Mine Fire Inquiry Report 2014*, it is noted that the EPA air monitoring station in Traralgon did not monitor PM<sub>2.5</sub> concentrations during the Hazelwood Mine Fire. However, the PM<sub>2.5</sub> readings ascribed to Traralgon in Figure 4.27 of the *Hazelwood Mine Fire Inquiry Report 2014* are indicative/ projected values only. Further, it is notable from DHHS.1001.001.0931 that the PM<sub>2.5</sub> readings recorded in Morwell East were generally higher than the (predicted) values for Traralgon, although there were some similarities on days with lower readings (see particularly DHHS.1001.001.0931 at VAED adm by pcode 1jan-30jun).

Further, Professor Gordon in his evidence sought to discount this factor on the basis of 'natural variation' due to the small population involved – yet such natural variation applies equally to many of the modelling results relied upon by Professor Armstrong, Professor Gordon, Dr Flander and Associate Professor Barnett.

- c. *The deaths from respiratory causes were greater in 2009-2013 than in 2014.* This contradicts the hypothesis that you would expect to see more respiratory mortality in the period of the Mine Fire than afterwards.<sup>47</sup> It would also be expected that respiratory and cardiovascular emergency admissions would increase in association with the Mine Fire. However, the statistical analysis reveals considerable uncertainty regarding the increased probability of respiratory and cardiovascular emergency admissions. The analysis reveals that it is uncertain, and that there may have been no increase, and could in fact have been a decrease. There was a 1 in 4 prospect that the results were a chance variation.<sup>48</sup>
- d. *There was no evidence that deaths from all causes or from cardiovascular disease alone during the period of the Mine Fire were more frequent on days with higher PM<sub>2.5</sub> levels than on days with lower PM<sub>2.5</sub> levels.*<sup>49</sup>
- e. *There is no evidence of any dose-response relationship between the deceased and the Mine Fire.* There is considerable uncertainty about the actual exposure of the deceased to the Mine Fire.<sup>50</sup> In order to establish a causal connection between the Mine Fire and any increased mortality it is necessary to review all of the available medical data regarding cause of death for individual deaths. At an absolute minimum, this will require a review of the actual cause of death, the state of health of the deceased and confirmation of their whereabouts during the period of the Mine Fire so that a dose-response relationship can be assessed.

### **Evidence of Professor Armstrong**

15. Professor Armstrong's report to the Board did not reach any conclusions in relation to Question Two.

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<sup>46</sup> Professor Armstrong T601.7-27

<sup>47</sup> Professor Armstrong T574.20-31-T575.1-4

<sup>48</sup> Professor Armstrong T588.18-31

<sup>49</sup> Joint expert report of Professors Armstrong and Gordon, Associate Professor Barnett and Dr Flander dated 31 August 2015, Exhibit 30, EXP.0008.001.0001 at .0002 [2.3]

<sup>50</sup> Professor Gordon T524.12-18

16. In his evidence before the Board, Professor Armstrong's answer on the second day of his evidence to the direct question from Counsel Assisting as to any link between the Mine Fire and increased mortality was heavily qualified. Professor Armstrong emphasised that the evidence for an increase in deaths was only 'moderate' and anything about cause of the increase had to take into account the fact that the evidence for the increase itself was not strong.<sup>51</sup> With that significant caveat, Professor Armstrong's evidence was that the 'most likely' explanation of the various explanations that 'one can put forward'<sup>52</sup> was that an increase, if one occurred, was due to the increase in particulate pollution of the air during that period of time, most likely due to the Mine Fire, but 'possibly added to by the bushfires that occurred at the same time'.<sup>53</sup> That is, at its highest, the evidence is subject to the significant doubt as to whether there was any increase in deaths at all, and even if there was, the causal link to the Mine Fire was put only as the most likely of the four possible explanations to which the experts confined themselves to<sup>54</sup>, and even then the supposed link to the Mine Fire was undermined by the impact of the bushfires that occurred at the same time.
17. Insofar as Professor Armstrong proffered his opinion on Question Two in his evidence to the Board, in addition to being subject to the matters referred to above, it was expressed to be based upon the following two matters:
- a. the relationship between particulate pollution and the risk of death in the Latrobe Valley as observed by Dr Flander and her colleagues; and
  - b. a large body of evidence (i.e. general academic literature) which indicates that short term increases in particulate matter are associated with short-term increases in death.
18. As regards Professor Armstrong's reliance on the first matter (namely, Dr Flander's study), it is notable that the results of Professor Armstrong's own particular study regarding the link between PM<sub>2.5</sub> concentrations and mortality data ran counter to it. Further, it is a perverse outcome for Professor Armstrong to rely on Dr Flander's study to form his affirmative view on Question Two, in circumstances where Dr Flander (who presumably was better aware of the limitations of her own study) was herself not prepared to form a concluded view.
19. In relation to the 'large body of evidence' referred to by Professor Armstrong, it is notable that:
- a. Professor Armstrong acknowledged that 'the evidence in *these circumstances* (i.e. the evidence concerning the effects of the Mine Fire) is not strong';<sup>55</sup>
  - b. the 'large body of evidence' is not outlined in his report in any detail and thus, has not been appropriately reviewed and tested by the Board, or by parties with leave to appear before the Board (and the same applies to the reports referred to for the first time by Associate Professor Barnett in evidence to the Board on 3 September 2015);<sup>56</sup>
  - c. Professor Abramson, who conducted the most detailed review of the available medical literature:
    - i. gave evidence that in the most reliable study that he could identify (of Associate Professor Morgan of the University of Sydney), *no* association was found between high particulate matter from a bushfire, and mortality;

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<sup>51</sup> Professor Armstrong T518.14-18 and T519.1-12

<sup>52</sup> Professor Armstrong T518.20-22

<sup>53</sup> Professor Armstrong T518.20-26

<sup>54</sup> Bushfires, fine particulate air pollution, carbon monoxide air pollution, and high temperatures: see Professor Armstrong T505-22-29

<sup>55</sup> Professor Armstrong T518.14-18

<sup>56</sup> Associate Professor Barnett T525.3-21. Certain reports have been disclosed by Associate Professor Barnett since the time of his evidence. None of the reports appear to support a proposition that exposure to a short - medium term (45 day) pollution event would be expected to lead to additional deaths in the medium term (i.e. in the case of the Mine Fire, in the period to May or June 2014)

- ii. indicated that where you observe increased morbidity from an environmental health event, you would not necessarily expect to see increased mortality – as this is a function of how extreme the exposure is, and the health of the underlying population that have been exposed to it; and
- iii. in a Rapid Health Assessment conducted for DHHS, which was informed by the results of the literature review, Professor Abramson and his colleagues including Head of School Professor John McNeil concluded that *no* additional deaths were likely to occur over a 6 week period as a consequence of pollution from the Mine Fire.

20. As Professor Armstrong noted during the course of his evidence, statistical information provides an answer to the question whether or not there is an increase in mortality and can also address what environmental exposures may have led to any observed increase in mortality. However, ‘there will always be additional considerations to take into account in interpreting that statistical information in terms of a potential cause and effect relationship.’<sup>57</sup>

### ***Evidence of Dr Flander***

21. The evidence and analysis of Dr Flander on the second question is the preferable evidence before the Board. That evidence is that it is not possible to conclude that the *mortality* observed is due to any single cause, or whether it has occurred by chance alone. An analysis of the cause of deaths for the period would be required to explore common risk factors. However there is no information on the underlying age/sex distribution of the localities assessed, or of any recent demographic changes in these communities, both of which are trends that could underlie the mortality observed in 2014.<sup>58</sup> If there were complete information on each death we would ‘be able to tell a lot more of this story.’<sup>59</sup>
22. As Dr Flander stated in her evidence to the Board, there is a concept in observations and evidence around epidemiology which speaks to the ‘under determination of observations and evidence’ and that is the case here. There are simply not sufficiently reliable and robust observations to enable the Board to choose between alternative explanations or alternative hypotheses as to a causal relationship in this case.
23. Put another way, the data is undetermined with the result it is not possible to exclude a given hypothesis.<sup>60</sup> Results in the case of small sample sizes are prone to misinterpretation leading to the conclusion of an effect where there is none, or the conclusion of no effect where there is one. In this case there are not enough observations to choose between competing hypotheses as to cause.<sup>61</sup> The analysis, which compares data for regions across years is limited with respect to individual circumstances and is ‘one of the weakest methods for assigning cause of deaths.’<sup>62</sup> Therefore, even if deaths were higher in 2014 than in some preceding years, any such increase (if it occurred) cannot be attributed to the Mine Fire because there was an insufficient number of deaths, and lack of personal level data and circumstances of deaths. This means that ‘we are not able to rule in or rule out evidence for excess regional deaths because of the coal fire’.<sup>63</sup>

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<sup>57</sup> Professor Armstrong T506.3-12

<sup>58</sup> Dr Flander, ‘*Review of Births Deaths & Marriages Victoria (BDMV) mortality data for the Latrobe Valley and the time of the Hazelwood coal mine fire in Morwell*’, Exhibit 21, EXP.0004.001.0001 at .0003

<sup>59</sup> Dr Flander T531.1-7

<sup>60</sup> Dr Flander T532.1-15

<sup>61</sup> Dr Flander T533.1-10

<sup>62</sup> Report of Dr Flander & Ors ‘*Age standardized mortality and cause of death in the Latrobe Valley at the time of (and five years prior to) the Hazelwood coalmine fire in Morwell, Victoria*’, Exhibit 23, EXP.0004.003.0001 at .0018

<sup>63</sup> Report of Dr Flander & Ors ‘*Age standardised mortality and cause of death in the Latrobe Valley at the time of (and five years prior to) the Hazelwood coalmine fire in Morwell, Victoria*’, Exhibit 23, EXP.0004.003.0001 at .0018

24. Dr Flander was also concerned to ensure that caution was exercised in the drawing of any conclusions from the limited statistical analysis. The statistical evidence reveals that there is an association between air quality  $\geq 50\mu\text{g}/\text{m}^3$   $\text{PM}_{10}$  is associated with mortality through the entire 2009-2014 study period and not just during the period of the Mine Fire. The small number of deaths restricts the analysis to air quality measures on the date of death and it is not possible to analyse each death in association with air quality on the day, week or month before that death. Further, smoke exposure was variable throughout the Latrobe Valley and there may be associated differences in regional mortality that cannot be captured in the analysis.<sup>64</sup> The scarce data underlying the analyses prevent 'the confident conclusion that the period of the fire is associated with statistically significant increased mortality in the Latrobe Valley postcodes.'<sup>65</sup> The analyses are also limited by their neglect of a fuller explanation of the results.

#### ***Evidence of Professor Abramson and the literature reviews***

25. Professor Abramson was acknowledged as the leading authority on the epidemiological assessment of mortality and morbidity as a result of the Mine Fire.<sup>66</sup> His evidence should be given considerable weight by the Board in its analysis.
26. Professor Abramson undertook a comprehensive literature review. There is a dearth of literature and studies regarding the effects on morbidity and mortality of fire events on communities. In particular, despite research internationally, the health impacts of a comparable event to the Mine Fire has not been the subject of study by researchers. However, from the available literature, and in particular the study conducted by Professor Morgan of the effects of smoke from bushfires on communities in Sydney which found no association between mortality and bushfires,<sup>67</sup> Professor Abramson formed the opinion that it would be unlikely for there to be an increase in mortality without a detectable increase in morbidity.<sup>68</sup> The Morgan study found that there was a discernable effect on respiratory admissions, but no effect on cardiovascular admissions.<sup>69</sup> It was Professor Abramson's evidence that where there has been an increase in mortality due to environmental smoke it would be expected to see an antecedent increase in morbidity. As a corollary where there is increased morbidity it is not necessarily expected to see increased mortality.<sup>70</sup> From this evidence, it can be seen that there are significant dangers in seeking to draw conclusions from a limited statistical analysis of the Mine Fire, particularly where those conclusions contrast with the conclusions reached in studies conducted to identify effects from particulate pollution.

#### **Further submissions in relation to the evidence**

27. It is plain from the email correspondence between Associate Professor Barnett, the ABC, representatives of VOTV, Friends of the Earth and Environmental Justice Victoria that he assumed a role which is inconsistent with the role as an independent expert. Associate Professor Barnett:

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<sup>64</sup> Report of Dr Flander & Ors 'Age standardised mortality and cause of death in the Latrobe Valley at the time of (and five years prior to) the Hazelwood coalmine fire in Morwell, Victoria', Exhibit 23, EXP.0004.003.0001 at .0017

<sup>65</sup> Dr Flander, *Review of 'Analysis of death data during the Morwell mine fire', A Barnett (2014) and 'An updated analysis of death data during the Morwell mine fire', A. Barnett (2015)*, 28 April 2015, Exhibit 22, EXP.0004.002.0001 at .0005

<sup>66</sup> Professor Armstrong T599.24-31

<sup>67</sup> Professor Abramson T368.5-11

<sup>68</sup> Professor Abramson T362.18-31-T363.1-16; Statement of Professor Abramson, Exhibit 6, WIT.0003.001.0004 at [32]

<sup>69</sup> Professor Abramson T370.17-29; Professor Abramson & Ors, '*Updated Literature Review on Mortality and Morbidity associated with environmental smoke events*', 5 May 2014, Annexure 2 to the Statement of Professor Abramson, Exhibit 6, WIT.0003.001.0007 at page 14 WIT.0003.001.0021

<sup>70</sup> Professor Abramson T371.22-31-T372.1-3

- a. was retained by the ABC presumably as a result of his media profile and prior interviews with the ABC<sup>71</sup> and obtained the data he used in his analysis from the ABC via VOTV;
  - b. settled press releases prepared by Environmental Justice Victoria<sup>72</sup> and was comfortable with being involved in the media release on behalf of VOTV;<sup>73</sup>
  - c. was not paid for his work for VOTV and undertook the work as ‘a labour of love’;<sup>74</sup>
  - d. provided advice to VOTV as to how to ‘pick out the results for the three postcodes’ being the three postcodes which recorded an increase in deaths<sup>75</sup> being well aware that the VOTV had a clear position which was that there had been adverse mortality effect as a result of the fire;<sup>76</sup>
  - e. sought advice on the results that VOTV *expected* to see prior to undertaking modelling of the data – in circumstances where Professor Armstrong, in his evidence, made it clear that ‘the more you're influenced by what you have seen in the data about the questions you pose to the data, the more likely it is you start to select things that look as if they might be positive and you will sure find lots of positive things if you do it that way when in fact most of them probably are just chance occurrences’;<sup>77</sup>
  - f. provided ‘strategic advice’ to VOTV whom he knew were advocating a particular position as to increased mortality associated with the Mine Fire as to when to release his analysis to obtain maximum exposure in the media and endorsed the VOTV’s decision to release it to coincide with the anniversary of the Mine Fire (‘Great idea to use the anniversary’);<sup>78</sup>
  - g. identified in email correspondence deficiencies in the data and analysis (namely the small size of the data sample) being a matter which conspicuously was not identified in his reports. That is, his reports were designed to have the “maximum impact” by not expressly covering limitations and uncertainties; and
  - h. commented to VOTV, presumably in an effort to overcome the problems identified as to the data set not identifying the expected increase in deaths: ‘one way to bolster the arguments is to cite the very many larger studies that have consistently shown an increased risk of death after exposure to pollution.’<sup>79</sup>
28. The foregoing matters demonstrate, when considered objectively, that Associate Professor Barnett allowed himself to be used as a part of a campaign by VOTV.
29. GDFSAE has no objection to VOTV retaining an expert for its own purposes. However, in GDFSAE’s submission, Associate Professor Barnett should not be regarded as if he were an independent expert, and should not have participated in the panel of experts and joint report process. Considerable caution should be exercised in reliance upon his evidence where it is either the basis for others or where it is inconsistent with others, since he failed to keep himself at arm’s length from those whose cause he clearly associated with.
30. Professor Gordon is also associated with VOTV.

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<sup>71</sup> T541.31

<sup>72</sup> Email from A. Barnett to C. Coote of Environmental Justice Victoria, copied to W. Farmer, R. Ipsen of VOTV and N. Rivers of Environmental Justice Victoria dated 5 February 2015 17:11:22, Exhibit 31

<sup>73</sup> T544.22-31

<sup>74</sup> T542.6-13

<sup>75</sup> Email from AP Barnett to W. Farmer and R. Ipsen dated 1 February 2015 23:10:34, Exhibit 31; Associate Professor Barnett T549.6-30

<sup>76</sup> T548.7-11

<sup>77</sup> T491.28-31-T492.1-3

<sup>78</sup> Email from AP Barnett to W. Farmer dated 22 January 2015 at 10.43, Exhibit 31; Associate Professor Barnett T 547.21-31 and T548.1-6

<sup>79</sup> Email from Associate Professor Barnett to Ms Farmer of VOTV and representatives of Environmental Justice Victoria dated 5 February 2015 9.52am, Exhibit 31

## **Joint Report**

31. As noted above, as demonstrated in **Annexure 1** to this submission, a number of the key opinions expressed by Professor Armstrong, Professor Gordon, Dr Flander and Associate Professor Barnett in their Joint Report are supported by the results of statistical analyses within their individual reports, which are not statistically significant at conventional levels.
32. Further issues associated with the Joint Report include that the Joint Report appears to have been written with some unspoken presumption in favour of a finding of increase in mortality due to the fire. Hence 'some' data (suggestive of an increase) replaces 'weak data' (suggestive of the opposite), and 'lack of increase' is preferred to 'decrease'. An added note to 2.5 asserts '...a large increase in mortality in Morwell cannot be ruled out'. The equally available opposite conclusion (given the 95% Confidence Interval in Professor Armstrong's Report of 0.51 – 1.26) is omitted and only emerged in cross-examination. It should be noted that the majority of the 95% CI is less than 1, which is consistent with a reduction of mortality in Morwell, which is what was observed. This consistent pattern of language tends to promote an affirmative finding and is of concern if the Joint Report is to be treated as a balanced canvassing of all the options actually available given the data.

## **Challenges associated with participation in the Inquiry**

33. As noted by GDFSAE in its opening submissions, GDFSAE sought leave to participate in the Inquiry in recognition of the importance of the matters to be considered by the Board, and is grateful to have been granted leave.
34. Whilst GDFSAE has been legally represented at the public hearings before the Board, and has had the opportunity to put questions to the witnesses before the Board, GDFSAE notes that there have been challenges associated with its participation in this Inquiry process, and in particular, in its interrogation of the expert material due to the significantly compressed timelines for the consideration of material served upon it.
35. In particular, the timing of the provision of expert material has compromised GDFSAE's ability to analyse the material. GDFSAE submits that this has had the consequence that the evidence has not been *tested* by any party disposed to do so to a degree that is desirable, and the Board should bear this in mind in placing reliance upon on it. As regards the issue of the timing of the expert reports and material tendered to the Board it is notable that:
  - a. GDFSAE received copies of the relevant expert reports and other relevant materials only a short time before the commencement of the Hearings, for example:
    - i. on 25 August 2015, being 4 business days prior to the commencement of the hearing before the Board on 1 September 2015, a large tranche of material included expert reports prepared by Professor Armstrong (dated 1 August 2015), statement of Ms Cristine dated 18 August 2015; report of Dr Gordon dated 11 August 2015, reports prepared by Dr Flander (dated September 2014, April and June 2015), reports of Associate Professor Barnett dated September 2014 and December 2014 and statement of Dr Lester dated 24 August 2015. The reports and material served were voluminous and raised numerous factual issues as well as complex statistical and epidemiological issues;
    - ii. on 28 August 2015, further expert reports from Dr Burdon and Dr Lorimer were served with the parties being advised it was intended that the reports be tendered in evidence without the experts being called or the evidence tested;

- iii. on 28 August 2015 (at 6.38pm) a further tranche of material forming part of the hearing book was served comprising some 84 documents including detailed statistics forming the material considered by various experts and draft reports;
      - iv. on Saturday 29 August 2015 (at 2.30pm), a statement of Ms Sims and numerous annexures including statistical material were served via email;
    - b. GDFSAE was only notified that an expert conference between Professor Armstrong, Dr Flander, Professor Gordon and Associate Professor Barnett was to be conducted 3 business days before the commencement of the Hearing. Further, the conference was characterised as being concerned with statistical analysis only;
    - c. the Joint Report of Professor Armstrong, Dr Flander, Professor Gordon and Associate Professor Barnett was served on 31 August 2015, in effect half a business day prior to the commencement of the Hearings; and
    - d. additional reports and analyses were provided throughout the course of the hearing on 1-3 September 2015.
36. The late provision of the expert material is particularly problematic in circumstances where the subject matter of the reports is technical, and where the reports themselves disclosed the existence of certain data sets (e.g. of Latrobe Valley hospital admission rates, and of individual *causes* of death), which were previously unknown to GDFSAE and which had been the subject of analysis by certain of the experts over a period of several months). The underlying data in large part was not disclosed together with the reports, and in any event, could not have been fully analysed by GDFSAE in the short time available.
37. Added difficulties associated with the Inquiry process include:
- a. evidence of the individual experts on Question 2 only emerging at the end of their oral evidence to the Board on the morning of Thursday 3 September 2015 (and in response to a direct question from Counsel Assisting), they having declined to express views on such issues in either individual expert reports, or the joint expert report, or during their evidence on Wednesday 2 September 2015;
  - b. oral evidence on matters going well beyond the scope of opinions provided in written reports; and
  - c. ad hoc evidence, including untested and potentially unsound modelling and analysis, including:
    - i. additional modelling undertaken by Professor Gordon at the request of Mr Rozen, in which 11 deaths were removed from the 2009 RBDM postcode mortality data for Churchill, on account of 11 reported deaths within Churchill directly connected with the 2009 Black Saturday bushfires. A review of the Royal Commission report into the Black Saturday fires in Churchill indicates that 6 of the 11 persons that died in Churchill were likely to have been residents, and 5 visitors or family members residing outside of Churchill.<sup>80</sup> The deaths of the latter group of persons may not have been included in the RBDM mortality data for Churchill. This is consistent with the evidence of Dr Flander, who noted that the RBDM data only recorded 6 deaths for Churchill associated with the Black Saturday bushfires. This issue again underlines the crude nature of the RBDM mortality data analysed in the evidence before the Board; and

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<sup>80</sup> 2009 Victorian Bushfires Royal Commission, Final Report, Volume 1: The Fires and the Fire-Related Deaths, Chapter 17: The Churchill Fire

- ii. over reliance on small data sets – as demonstrated by Professor Armstrong’s oral evidence regarding possible explanations as to why there has been a ‘dramatic’ reduction in the rate of cancer patient hospital admissions in the Latrobe Valley during the period of the Mine Fire. The raw data (as summarised Professor Armstrong’s report at Table 5) suggests that in real terms, there were 3 fewer admissions in the period of February and March 2014, compared to 2013 (16 admissions, compared to 19).
38. Inevitably these factors limited GDFSAE and other parties from interrogating the evidence on a fully informed basis.

#### **Submissions on the Board’s conclusions on TOR 6**

39. On the limited available evidence, the Board cannot conclude that there was an increase in deaths in the Latrobe Valley and that an increase (if there was one) was contributed to by the Mine Fire.
40. For the reasons outlined in this submission, statistical analyses of crude data sets which are subject to numerous limitations, qualifications and shortcomings (including in large part failing to meet conventional levels of statistical significance) and which are characterized by descriptions such as moderate”, “weak” and “not strong” and “some” cannot enable any such findings.
41. The Board can only consider Question Two if Question One is answered in the affirmative, however - there is no satisfactory evidence before the Board that enables any such conclusion.
42. Absent complete information on the location of the deceased prior to death, specifically where they were in the days leading up to and on the day of death, absent complete information on their exposure, where they were and what kinds of exposure to degraded air quality or excess temperature, absent that kind of information, no reliable conclusion can be drawn. At the least, a longitudinal study is a better model<sup>81</sup> when seeking to understand any causal link between any increased mortality and exposure to the Mine Fire.
43. The Study will facilitate individual analysis which is in stark contrast to the ‘essentially ecological’ approach by referencing data related to postcodes. The key advantage of an individual analysis is that it will allow adjustments to be made for individual ‘confounders’, such as sex, age, socioeconomic status, smoking and occupational exposures.<sup>82</sup> Confounders are variables which are associated with the exposure of interest but can also cause the outcome in its own right.<sup>83</sup> In particular the Study will consider the effect of smoking as a confounder which must be allowed for in order to detect any effects of the Mine Fire.<sup>84</sup> The Study will also analyse exposure data and has commissioned the CSIRO to undertake further modeling. The location of people during the fire relative to concentrations of PM<sub>2.5</sub> will allow researchers to obtain individual exposure estimates. The individual analysis is therefore likely to provide a more comprehensive and reliable answer to the key questions posed to the Board particularly because the Study will give consideration to the effect of ‘confounders’ and the degree of exposure of subjects to the effects of the Mine Fire and other variables.
44. It is inconsistent with the status attributed to the findings of a Board of Inquiry that its conclusions depend significantly upon crude data, marginal and therefore equivocal statistics, or speculative opinions.

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<sup>81</sup> Dr Flander T529.2026

<sup>82</sup> Statement of Professor Abramson, Exhibit 6, WIT.0003.001.0004 at [22]

<sup>83</sup> Professor Abramson T344.26-31-T3451-10

<sup>84</sup> Statement of Professor Abramson, Exhibit 6, WIT.0003.001.0004 at [24]

45. GDFSAE further submits that the Board should proceed with the utmost caution in reporting on TOR6 given the seriousness of the matters in question and:
- (a) the potential for any comments or observations made in the Board's report to be taken out of context and for members of the community to be misled; and
  - (b) the potential for any views expressed by this Board to be inconsistent with later findings in the qualitatively superior Health Study, potentially undermining community confidence in it.

Dated: 9 September 2015

**ANTHONY NEAL QC  
MARITA FOLEY  
KING & WOOD MALLESONS**

**ANNEXURE 1 – COMMENTS IN JOINT EXPERT REPORT – SOURCES AND ASSOCIATED CONFIDENCE INTERVALS / P-VALUES**

<b>COMMENT IN JOINT EXPERT REPORT</b>	<b>PRINCIPAL SOURCE OF COMMENT</b>	<b>CONFIDENCE INTERVALS</b>	<b>P-VALUE</b>
<p>1.1 There is moderate evidence for a higher mortality from all causes and from cardiovascular disease in Latrobe Valley in Feb-Jun 2014 than in the same period during 2009-13.</p>	<p>Professor Armstrong's Report Page 8, Table 2<sup>85</sup></p>	<i>Deaths from <b>all causes</b> 2009-13 compared to 2014</i>	
		Feb-Jun 2009-13: 95%CI <b>0.80-1.00</b>	Feb-Jun 2009-13: <b>0.04</b>
		Feb-Mar 2009-13: 95%CI <b>0.68-1.02</b>	Feb-Mar 2009-13: <b>0.08</b>
		<i>Deaths from <b>respiratory causes</b> in 2009-13 compared to 2014</i>	
		Feb-Jun 2009-13: 95%CI <b>0.88-1.66</b>	Feb-Jun 2009-13: <b>0.25</b>
		Feb-Mar 2009-13: 95%CI <b>0.77-2.23</b>	Feb-Mar 2009-13: <b>0.31</b>
<p>2.1 Mortality from all causes in February and March and February to June 2014 was closer to that in the corresponding periods of 2009 than in those of 2009-13. This observation may suggest that bushfires, which occurred in the Latrobe Valley in February in both 2014 and 2009, contributed to the probable increase in mortality from all causes in 2014. This was not evident for deaths from cardiovascular disease.</p>	<p>Professor Armstrong's Report Page 9, Table 3<sup>86</sup></p>	<i>Deaths from <b>all causes</b> in 2009 and in 2009-13 compared to 2014</i>	
		Feb-Jun 2009: 95%CI <b>0.81-1.06</b>	Feb-Jun 2009: <b>0.30</b>
		Feb-Jun 2009-13: 95%CI <b>0.80-1.00</b>	Feb-Jun 2009-13: <b>0.04</b>
		Feb-Mar 2009: 95%CI <b>0.79-1.28</b>	Feb-Mar 2009: <b>0.91</b>
		Feb-Mar 2009-13: 95%CI <b>0.68-1.02</b>	Feb-Mar 2009-13: <b>0.08</b>
		<i>Deaths from <b>respiratory causes</b> in 2009 and in 2009-13 compared to 2014</i>	
Feb-Jun 2009: 95%CI <b>0.61-1.47</b>	Feb-Jun 2009: <b>0.82</b>		
Feb-Jun 2009-13: 95%CI <b>0.88-1.66</b>	Feb-Jun 2009-13: <b>0.25</b>		
Feb-Mar 2009: 95%CI <b>0.54-2.17</b>	Feb-Mar 2009: <b>0.81</b>		

<sup>85</sup> T 572.9-15

<sup>86</sup> T 580.23-31, T 581.1

COMMENT IN JOINT EXPERT REPORT	PRINCIPAL SOURCE OF COMMENT	CONFIDENCE INTERVALS	P-VALUE
		Feb-Mar 2009-13: 95%CI <b>0.77-2.23</b>	Feb-Mar 2009-13: <b>0.31</b>
		Deaths from <b>cardiovascular causes</b> in 2009 and in 2009-13 compared to 2014	
		Feb-Jun 2009: 95%CI <b>0.49-1.00</b>	Feb-Jun 2009: <b>0.06</b>
		Feb-Jun 2009-13: 95%CI <b>0.61-1.04</b>	Feb-Jun 2009-13: <b>0.10</b>
		Feb-Mar 2009: 95%CI <b>0.34-0.99</b>	Feb-Mar 2009: <b>0.05</b>
		Feb-Mar 2009-13: 95%CI <b>0.42-0.97</b>	Feb-Mar 2009-13: <b>0.04</b>
2.4 Crude mortality data suggest that mortality from all causes in Morwell in February and March and February to June 2014 was little if at all greater than that in the corresponding periods of 2009-13. In Churchill, Moe and Traralgon, however, crude mortality in these periods was greater than in 2009-12. Since Morwell was the most exposed of these populations to emissions from the mine fire, the comparative lack of greater mortality in Morwell in 2014 than 2009-13 is inconsistent with the mine fire being the cause of greater mortality in the Latrobe Valley.	Professor Armstrong's Report Pages 5-6, Table 1 and Conclusion <sup>87</sup>	<b>Morwell</b>	
		Feb-Mar: 95%CI <b>0.51-1.26</b>	Feb-Mar: <b>0.34</b>
		Feb-Jun: 95%CI <b>0.81-1.35</b>	Feb-Jun: <b>0.72</b>
		<b>Churchill, Moe and Traralgon</b>	
		Feb-Mar: 95%CI <b>1.07-1.71</b>	Feb-Mar: <b>0.01</b>
		Feb-Jun: 95%CI <b>1.02-1.45</b>	Feb-Jun: <b>0.008</b>
3.1 Emergency hospital admissions for all conditions in the Latrobe Valley during the period of the mine fire in 2014 were more frequent than they were for the same period in 2013. Hospital admission rates for respiratory and cardiovascular disease, considered individually, were also greater in 2014 than in 2013, though the statistical evidence for these increases was weaker.	Professor Armstrong's Report Page 21, Tables 5 and 6 <sup>88</sup>	Rates of <b>emergency admissions to hospital</b> in Latrobe Valley in 2014 compared to 2013 for the period 9 Feb-25 Mar <b>by condition</b>	
		Cardiovascular: 95%CI <b>0.90-1.48</b>	Cardiovascular: <b>0.26</b>
		Respiratory: 95%CI <b>0.98-1.75</b>	Respiratory: <b>0.07</b>
		Cancers: 95%CI <b>0.43-1.64</b>	Cancers: <b>0.61</b>
		All other conditions: 95%CI <b>1.04-1.28</b>	All other conditions: <b>0.006</b>
		All conditions: 95%CI <b>1.06-1.27</b>	All conditions: <b>0.001</b>

<sup>87</sup> T 570.25, T 571.19-28

<sup>88</sup> T 587.20-31, T 588.1-2, T 589.1-8

COMMENT IN JOINT EXPERT REPORT	PRINCIPAL SOURCE OF COMMENT	CONFIDENCE INTERVALS	P-VALUE
		Rates of <i>emergency admissions to hospital</i> in Latrobe Valley in 2014 compared to 2013 for the period 9 Feb-25 Mar <i>by age</i>	
		0-4 years: 95%CI <b>0.78-1.72</b> 5-14 years: 95%CI <b>0.63-1.51</b> 15-24 years: 95%CI <b>0.75-1.41</b> 25-39 years: 95%CI <b>1.27-2.13</b> 40-64 years: 95%CI <b>0.88-1.21</b> 65-74 years: 95%CI <b>1.08-1.75</b> 75+ years: 95%CI <b>0.93-1.32</b>	0-4 year: <b>0.48</b> 5-14 years: <b>0.91</b> 15-24 years: <b>0.87</b> 25-39 years: <b>&lt;0.001</b> 40-64 years: <b>0.71</b> 65-74 years: <b>0.009</b> 75+ years: <b>0.26</b>