REVIEW
AIR QUALITY IMPACT ASSESSMENT
MT OWEN CONTINUED OPERATIONS PROJECT

NSW Department of Planning & Environment

29 April 2016

Job Number 15090470

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Peer Review
Air Quality Impact Assessment
Mt Owen Continued Operations Project

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DOCUMENT CONTROL

Report Version	Date	Prepared by	Reviewed by
DRAFT - 001	30/10/2015	A Todoroski / P Henschke	A Todoroski
FINAL - 001	30/10/2015	A Todoroski	
DRAFT - 002	20/11/2015	A Todoroski	
DRAFT - 003	23/03/2016	A Todoroski / P Henschke	
DRAFT - 004	24/03/2016	A Todoroski	
FINAL - 002	31/03/2016	A Todoroski	
FINAL - 003	29/03/2016	A Todoroski	

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

SUMMARY

This report outlines, in blue text the final review of an air quality assessment for the continued operation of the Mount Owen Project. The text in light brown outlines clarifications and requests for additional information in relation to the earlier, initial review shown in black text.

Issues in the air assessment that warrant attention were identified in the review. At the outset it was also reasonable to conclude that the Project would be generally sound, and unlikely to be a significant risk to the environment. This could be determined by simply considering that the Project would utilise essentially the same equipment to extract the same or lesser quantities of coal. The Project would move to the southeast, and given the prevailing winds, there would only be a significant risk of increased impacts at only a few receptors to the southeast.

The review is thus primarily concerned with determining whether the predicted dust levels at the south eastern receptors are sufficiently reliable.

The proponent provided its responses and data in regard to the issues identified. The majority of the proponent's responses were accepted by the review. Several issues were not adequately addressed, however the proponent provided data that allowed these issues to be examined independently by the review. The examination is described in this report, and found that:

1. Skew in the measured weather data occurs at one of the two weather stations, but the modelled meteorological data, used in the assessment to predict dust levels matches the valid measured data and is likely to be representative of the actual weather conditions at the southeast receptors;
2. The background levels used in the assessment are based on monitoring data away from the site which does not accord with the EPA Approved Methods. Three different values are used at various times by the proponent and none could be derived from the actual data by the review. The review applied the proponent's assumptions regarding the absence of the mining effects in its "background" data and found a potential underestimation of up to approximately 3.1 $\mu g/m^3$ in the predicted annual average PM_{10} levels could occur due to the selected "background" value.
3. The review identified scope for underestimation arising from the apportionment of dust from the various mine dust sources, and that relative to the measured dust levels, significantly higher dust levels originate from the northeast contrary to the predictions.

The review also identified that the modelling results did not reasonably align with the observed dust levels, for example the modelling indicates less dust from the northwest, and more from other directions than measured. To consider what effect these issues may have on the predicted dust levels, the review considered three scenarios to test the potential upper bound of any underestimation in the predicted level of impact that may be possible. The scenarios included; (1) adding $3.1\mu g/m^3$ to consider underestimation in background dust levels; (2) adding half as much again to the predicted Project dust levels; and, (3) doubling the predicted Project dust levels and halving those from other mine sources. It is not considered plausible for higher impacts to occur than those tested in the three scenarios.

The re-evaluated results showed that Receptors 114 and 116 would potentially experience annual average PM_{10} impacts. Accordingly, recommendations were made to afford these receptors acquisition rights on the basis of potential annual average PM_{10} impacts, for the Project to operate a weather station near the southeast receptors, and a predictive system to manage potential dust effects in that area.

1 INTRODUCTION

Todoroski Air Sciences has been engaged by the NSW Department of Planning & Environment (DP&E) to provide an independent peer review of air quality matters associated with the proposed Mt Owen Continued Operations Project (the Project).

1. This review has considered the following documents pertaining to the air quality assessment for the Project:

2. *Mt Owen Continued Operations Project - Environmental Impact Statement (EIS)*, prepared by Umwelt and dated January 2015 - sections relevant to the air quality evaluation;

3. *Appendix 6 of the EIS – Air Quality Impact Assessment*, prepared by Pacific Environment Limited and dated October 2014 (referred to as The AQIA in the remainder of this review report);

4. Mt Owen Continued Operations Project – Response to Submissions - Report A: NSW Agency and Community Submissions, prepared by Umwelt and dated June 2015 – sections relevant to the air quality evaluation; and

5. Comments raised in submissions by key regulatory agencies regarding the air quality aspects of the Project and/or the adequacy of the above documents.

The report considers matters clarified with the proponent, their consultant and the DP&E at a meeting on 10 November 2015. The changes to the report that arose from the clarification are shown in light brown text for ease of reference to the previous report.

This report also considers further information and data discussed with the proponent, their consultant and the DP&E at a meeting on 7 March 2016. The information was made available via download link on 10 March 2016. Additional information was also provided in a letter dated 18 April 2016. The changes to the report that arise from consideration of further information from the proponent, and an analysis of data provided by the proponent, are shown in blue text for ease of reference to the previous draft of this report.

The report considered further information from the proponent including;

1. "Analysis of Data Requested by Peer Reviewer for the Mount Owen Continued Operations Project", dated 3 March 2016.

2. "Responses to Peer Review Report Mount Owen Continued Operations Project" dated 14 December 2015.

3. Some electronic data provided by the proponent for our analysis.

4. Letter from Umwelt to Department of Planning dated 18 April 2016.

2 SCOPE OF THE REVIEW

As outlined in the Scope of Works for the peer review, the review aims to:

1. consider the adequacy and accuracy of the air quality modelling and methodology undertaken for the proposal, including consideration of relevant guidelines, suitability of the model used, and the reasonableness of the inputs used in the model;

2. identify any significant gaps or inconsistencies in the assessment of air quality impacts, the reliability of the predictions, and provide advice to the Department regarding the likely Project impacts based on the information in the assessment documentation;

3. review the Project against best practice dust mitigation, management and monitoring, including best practice measures associated with:

    - haul roads;
    - materials handling;
    - blasting;
    - real-time dust management; and
    - minimising surface disturbance;

4. consider and recommend any additional measures to further minimise and mitigate any identified impacts, particularly on receivers to the south and east of the Project; and

5. advise whether the air quality modelling is adequate to inform the Department's assessment of the likely impacts associated with the Project (SSD 5850).

3 PROJECT REVIEW

3.1 Overview

The Project proposes to extend the duration of the current mining activity by continuing mining in the Mt Owen North Pit in a generally southerly direction. There would also be mining in the northernmost and southernmost areas of the Ravensworth East operations area which is to the west of the Mt Owen North Pit.

There would not be any increase in the approved rates of ROM coal extracted, however it is not clear if there would be any significant change to the amount of overburden handled. This is a relevant issue and should be clarified. (Note that data provided in Table 8.10 of the AQIA indicate approximately 38% and 25% more PM_{10} is generated in Years 1 and 5 relative to 2011/12, but no tangible difference in Year 10, which is the critical year for impact due to proximity to receptors.) Essentially if there is no increase in the total quantity of ROM and overburden being handled, the only scope for increased impacts relative to the current operations would arise from the activities moving closer to receptors, or into a location that is closer to being directly upwind of a receptor along the predominant wind axis.

Years 1, 5 and 10 have been selected for the modelling. Year 10 represents activity at a relatively high rate that is closer to residences that Years 1 and 5. It is not clear from the AQIA if Years 11 onwards would be closer to residences, and if this may have an effect. It would be appropriate to clarify whether the focus of activity in the future years may be substantially closer to receptors, or perhaps in a location

that is more directly upwind. This should confirm the position of the activity in years 11 onwards when considering how the reduced activity rate may affect net potential impacts at receptors.

Given that Years 11 onwards have significantly lower rates of material handling than in Year 10 (refer to Figure 2.2 of AQIA), and there does not appear to be a great deal of available area between the Year 10 pit extent and the mine lease boundary in the direction of the receptors, it is likely that the maximum potential impacts have been reasonably encompassed in the Year 10 assessment results.

Whilst this should be confirmed (for example by confirming if Year 14, which has approx. 70% of the material handling rate relative to Year 10 and may have potential to lead to greater impacts than in Year 10 due to the focus of the activity in Year 14), no large effect on the results is expected to arise due to the years selected.

The key remaining aspects of the Project that may lead to the applicable criteria being met or exceeded at a receptor, and that are considered in this review include:

1. Calculated emission rates;
2. Technical accuracy of the modelling in the AQIA;
    a. meteorological aspects;
    b. air dispersion aspects;
    c. validation/ calibration; and,
3. Summation of cumulative effects with future other projects and background dust levels.

In this review we have endeavoured to identify the key factors which may affect the predicted impacts of the Project as shown in the AQIA, and to examine what this may mean in regard to any actual impacts (with potential to exceed criteria) that may arise due to the Project.

The Project proposes to continue mining operations into a new area, and as such the receptors located to the southeast of this area are most at risk of additional dust effects. This arises due to the prevailing northwest and southeast winds that occur in the Hunter Valley. (Note that there are no receptors to the northwest within the likely potential reach of effect of the proposed active mining areas.)

The focus of the review then is to ensure that the areas with the greatest potential for any significant impact are accurately assessed. We have endeavoured to outline the key factors that may significantly affect the predicted impacts of the Project as shown in the AQIA, and to examine these in regard to any actual impacts (with potential to exceed criteria) that may arise due to the Project.

Minor issues with only an insignificant influence on the likely Project impacts have either not been reported in this review, or are stated to be minor issues.

Where it is not clear whether an issue may be significant or not, clarification may be requested.

This review is limited to a review of the proponent's reports and the modelling results published therein, and does not extend to an examination of the electronic modelling input files or model settings.

When referring to "the assessment" in this peer review, this may also be a reference to the air quality impact assessment (AQIA) for the Project in the EIS, or the supplementary responses to submissions regarding air quality related matters, or all of these.

3.2 NSW EPA submissions

This review agrees with the issues raised by NSW EPA, apart from two issues where it is not considered that the EPA submission is robust or clear. These issues are outlined below.

1. The NSW EPA raises the issue that the assessment may underestimate diesel particulate emissions by applying a control factor of 85% to the emissions from haul roads.

Whilst some site specific control factors established through recent NSW EPA Pollution Reduction Programs (PRP's) were based on data measured very close to the moving wheels of a light vehicle and therefore did not consider diesel particulate emissions from haul trucks, it is important to appreciate that it does not follow that due to this there is any underestimation in the assessment's evaluation of diesel particulate. This is because the equations that underpin the emission factors used in the AQIA are based on US EPA measured emissions which do include diesel particulate (and likely more diesel exhaust particulate than from a modern truck as equations were developed on the basis of emissions from trucks measured in the 1970's and 1980's.)

The haul road dust control levels at a number of comparable mines were assessed by the reviewer using the same (at the wheel) approach as above but also through methods that directly measured all particles generated by haul trucks, including diesel emissions. These studies found that even lower emissions (than those derived using US EPA emission factor equations) would arise at higher road surface moisture levels (perhaps in some part due to cleaner engine technology in modern trucks as raised in the proponent's response to submissions, but more so due to the non-linear nature of the relationship between the dust generation from haul roads and moisture levels).

These studies were reported to the NSW EPA and confirmed that a (total, including diesel particulate emissions) control factor of 85% can be maintained. In this regard, the EPA submission does not appear supported by complete consideration of the evidence.

No further response in this regard is required.

2. The EPA also states that the response to submissions did not include a complete contemporaneous assessment of 24-hour PM_{10} impacts as it did not consider all days of the year.

It is agreed that the proponent's response to submissions does not present a complete contemporaneous assessment, but not that all days of the year need be presented to make the assessment complete.

The proponent's assessment should extend the number of days presented in the tables (note that there are two Table 4.2's in the response to submissions) until there is no scope for other days that are not presented to be an exceedance day. This can be done simply by ensuring that the sum of the lowest ranked background level and the lowest ranked incremental level does not exceed the criteria at any receptor assessed.

This issue has the potential to lead to property acquisition rights being applicable at a receptor. However it is a minor matter to extend the tables and to thus confirm whether there may be additional impact days or not.

It is noted by the proponent that some additional days of 24-hour average impact may be shown in the extended tables, and that the extended tables would be presented.

The appropriate tabled data necessary to satisfy this issue was provided by the proponent. The tables identified some additional days of impact (not shown in the original truncated tables). This does not alter the outcomes of the assessment as the properties with additional days of impact now evident in the tables were already shown to have significant impacts above the criterion.

3.3 Director-General Requirements

The assessment appears to address the Director General Requirements (DGRs), with the exception of the requirements for a quantitative assessment of the dust generated from coal transport which have been addressed qualitatively.

It is noted that there would be minimal construction involved in the extension of an existing mine, and as there is also no increase in coal production there would be no change in coal transport to that already approved.

Therefore even though technically only a qualitative assessment is provided for some aspects, it is considered that the assessment generally addresses the intended requirements of the DGR's in its scope of work. This is considered to be a minor issue. No further response in this regard is required.

3.4 Model selection and approach

To assess the potential air quality impacts associated with the operation, the proponent utilised the CALPUFF model to conduct air dispersion modelling. Meteorological data were sourced from various sites surrounding the facility and incorporated into the air dispersion model using a combination of the TAPM and CALMET meteorological models.

Given the relatively varied terrain in the vicinity of the Project site that would affect the wind patterns spatially to some extent, the CALPUFF modelling suite would be an appropriate choice for this location.

When operated correctly, the model is capable of dealing with the complex wind flows and air dispersion conditions. The CALPUFF modelling suite however is not foolproof and only minor adjustments or errors in the input settings can cause large effects in the results.

It is noted that some of the key model settings are set out in the AQIA. Whilst the model settings provided appear to be appropriate, the model has many dozens of other settings that may affect the results, and it is not generally practical to list all of these settings in a written report. Thus without access to the electronic modelling files used for the modelling, it is not possible to conclusively identify any potential issues in the modelling setup.

Some additional information (data and modelling outputs) is requested to assist in the review. This is outlined in other sections.

Additional data and information was provided by the proponent and is considered in more detail below.

3.5 Meteorological (and dust conditions) in selected modelling year

The modelling for the Project was based on meteorological data for the 1 September 2011 to 31 August 2012 period. The AQIA states "*on the basis of the percentage of calms, the completeness of the data and the predominant wind direction, 2011/2012 was chosen as a suitable and representative modelling year*".

Analysis of the selected modelling year against long-term climate trends and an analysis of wind direction conditions may be beneficial to justify the year selected for use in the model.

It is acknowledged that at present the Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales (**DEC, 2005**) only requires consideration of the representativeness of the prevailing meteorological data when selecting the year for modelling. However contemporary practice is to also consider ambient dust levels when selecting the year to model (and in some cases modelling many years).

In this regard, the analysis does not provide sufficient justification to confirm that the selected modelling year is representative of typical conditions.

For example,

1. Section 5.1.1 of the AQIA presents wind roses for all years compared to the selected modelling years from the two Mt Owen operated weather stations (SX8 and SX13). From this it can be seen that in comparison to all other years; station SX8 is skewed further in an anti-clockwise direction, and both the SX8 and SX13 stations reported fewer periods of summer winds from the northwest; and,

2. Figure 5.5 of the AQIA (see **Figure 10** below) shows that the selected year corresponds to relatively low dust levels.

To clarify the skew for weather station SX8: the data presented in Section 5.1.1 of the AQIA shows that the wind rose for the modelling period selected has some skew relative to the wind rose for all of the data (including the period selected). For example Figure 5.3 of the AQIA shows that annually, predominantly SE winds (period selected) occur relative to E winds (all data), and there is very little NNW and N winds in the period selected. The skew is more significant when examining the summer and winter period.

It is also noted that a spatially and temporally varying meteorological file is used in the assessment. This file is derived using meteorological modelling methods, and may reflect the local winds that are likely to occur.

The issues raised in the review regarding the weather data are illustrated in the **Figure 1** and **Figure 2** below:

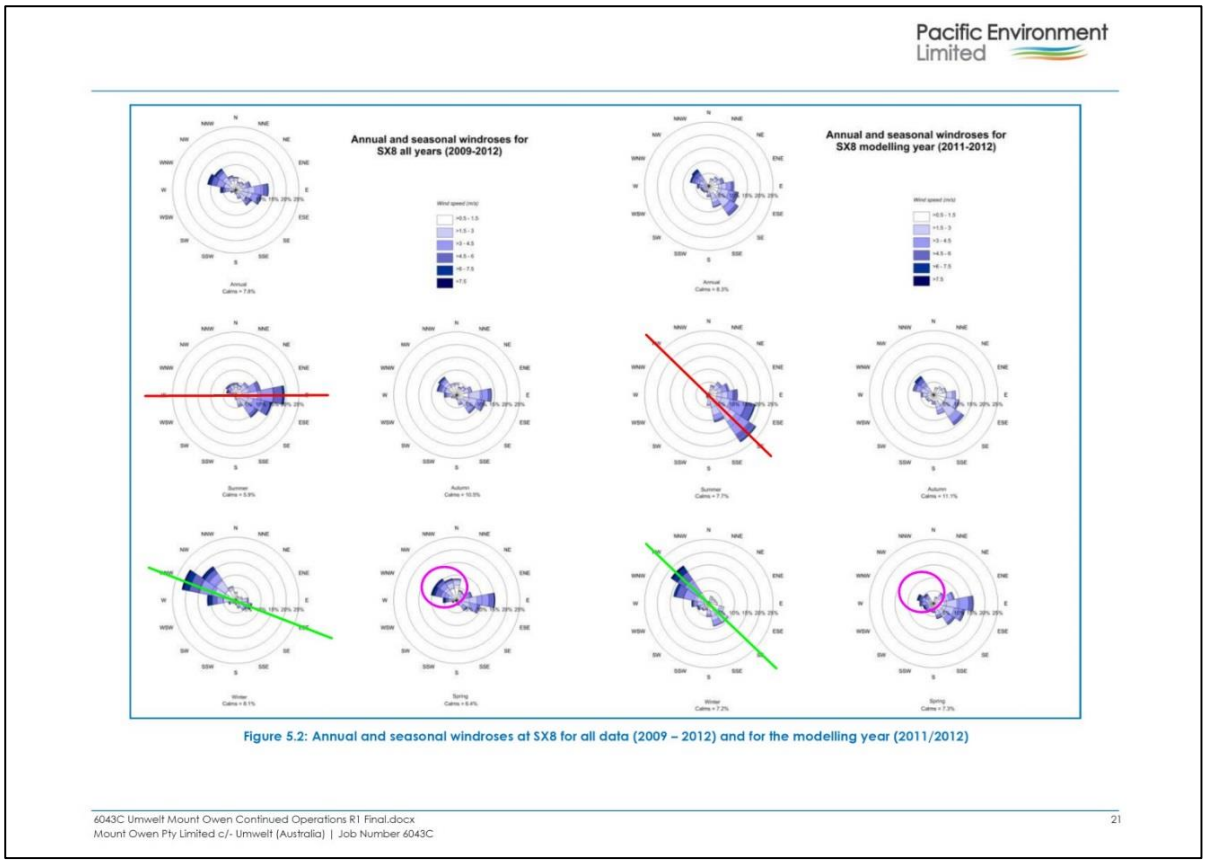

Figure 1: Skew and NW winds between modelling data (right) and all data (left) for SX8

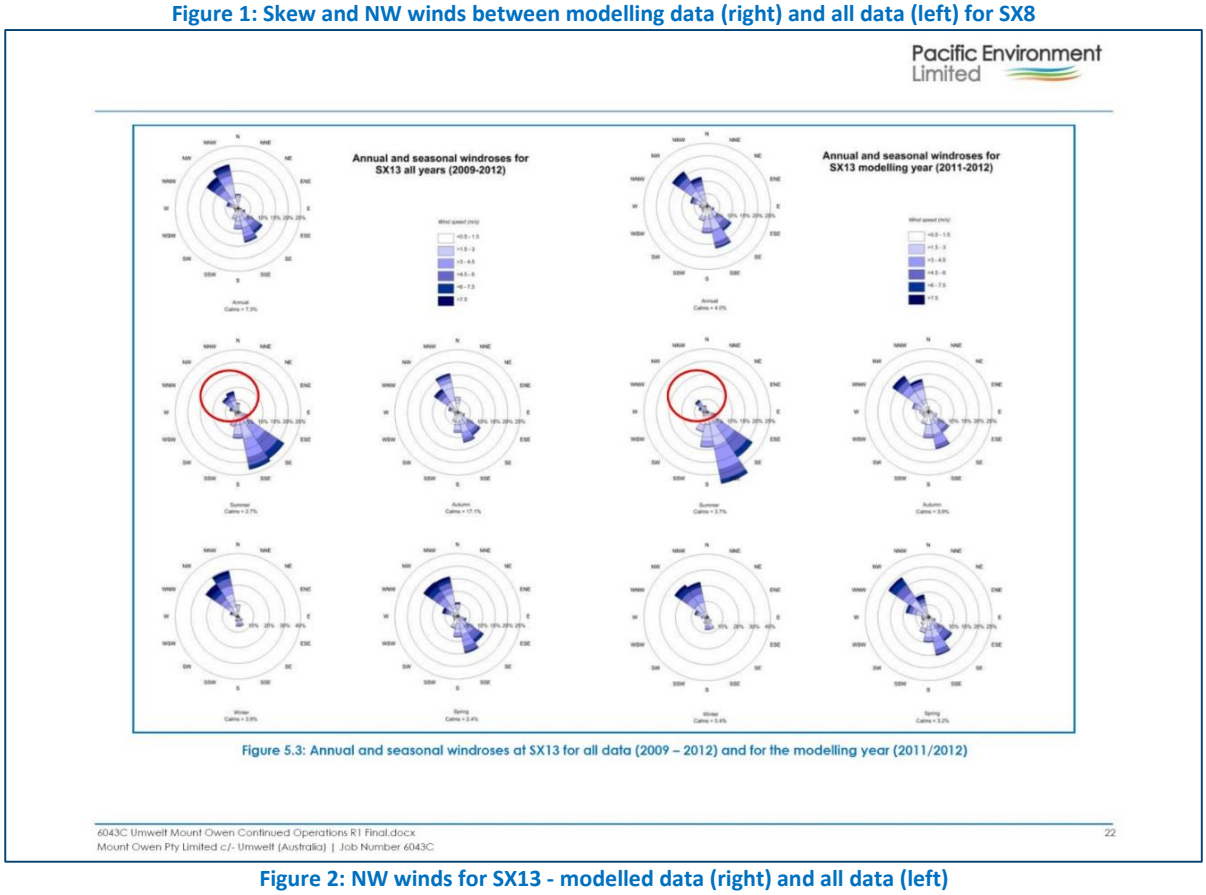

Figure 2: NW winds for SX13 - modelled data (right) and all data (left)

These issues have the potential to underestimate the frequency of potential impacts to the east-southeast of the Project, towards the area most sensitive to potential impacts from the Project (due to the apparent bias in the selected meteorological data relative to the typical conditions) and also the scale of potential impacts (due to low dust levels in the modelled year).

Further analysis of the monitoring data should be performed to clarify the significance of this issue in so far as it may affect the scale and frequency of impacts.

It is noted that the assessment does not use the local data for assessing annual average background dust levels. However the local data is used directly in the 24-hour PM_{10} and $PM_{2.5}$ assessment, and to scale modelling results.

Presently (without any further analysis to the contrary), it can be reasonably assumed that some underestimation of impacts will occur due to the use of data selected from a year with relatively low dust levels, but this underestimation would be limited to the differences in the selected year and the dust levels that typically arise. This matter can be put into perspective by considering that in future the actual dust levels will also vary up and down, as is normal between any given year, and the selected background level used in the assessment may be higher or lower than that in any future given year.

So it is generally a matter of ensuring that there is no significant bias in the selection of the background data that are used in the assessment. Generally, to ensure there is no bias leading to underestimation of impacts in the assessment, it is better to select a year with somewhat higher data than may be typical.

A similar situation arises in regard to the selected meteorological data, except that the actual impacts relate to air dispersion, (which is a function of wind speed, direction frequency etc.), and is not directly proportional to impacts as is the case for background levels.

As it is important to ensure that the prevailing meteorological data are represented in the model, it is requested that the proponent provide an extract of the actual meteorological file used in the assessment at a location to the SE of the mine, i.e. in the area with most potential for impacts to arise.

A comparison between the actual meteorological data used in the assessment and the weather data measured nearby should be made in order to evaluate whether the selected modelling year is representative of the available measured data at the key assessment locality to the SE of the Project. As the proponent did not adequately respond to this suggestion, the comparison was made independently (see below).

To be clear, further information and analysis is requested to clarify the potential effect on the predicted annual average and 24-hour average results due the meteorological data used in the modelling and also the baseline dust levels in the year selected for modelling. (Note that further comments on the dust monitoring data are provided below.)

The proponent has provided its detailed analysis of this issue. The proponent's response dated 14 December 2015 in this regard does not adequately respond to the issues raised regarding the period modelled, and instead focusses on peripheral matters, calendar year analysis or an illustrative example raised in discussions.

Figure 3 provides a graphical summary taken from the proponent's later 3 March 2016 analysis. This shows that the modelled year is generally similar to the other years, apart from having above average south easterly winds (140 to 200 degrees) and below average north winds (340 to 360 degrees).

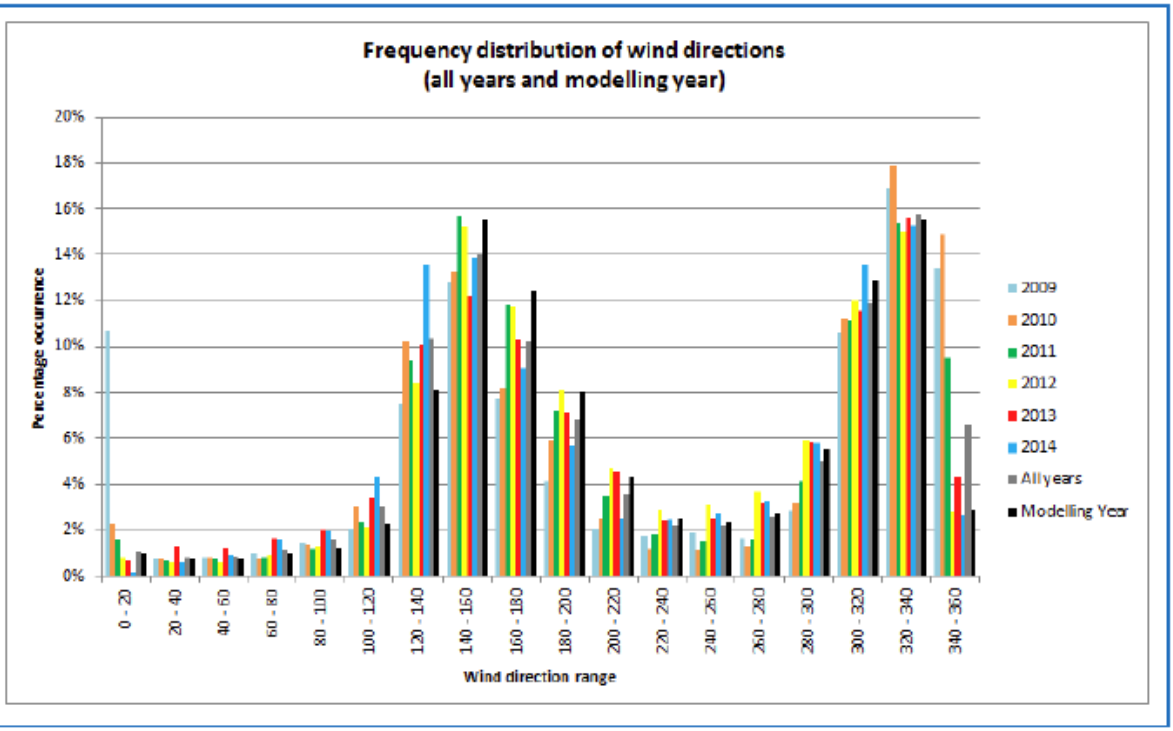

Figure 2: Frequency distribution of wind direction for individual years

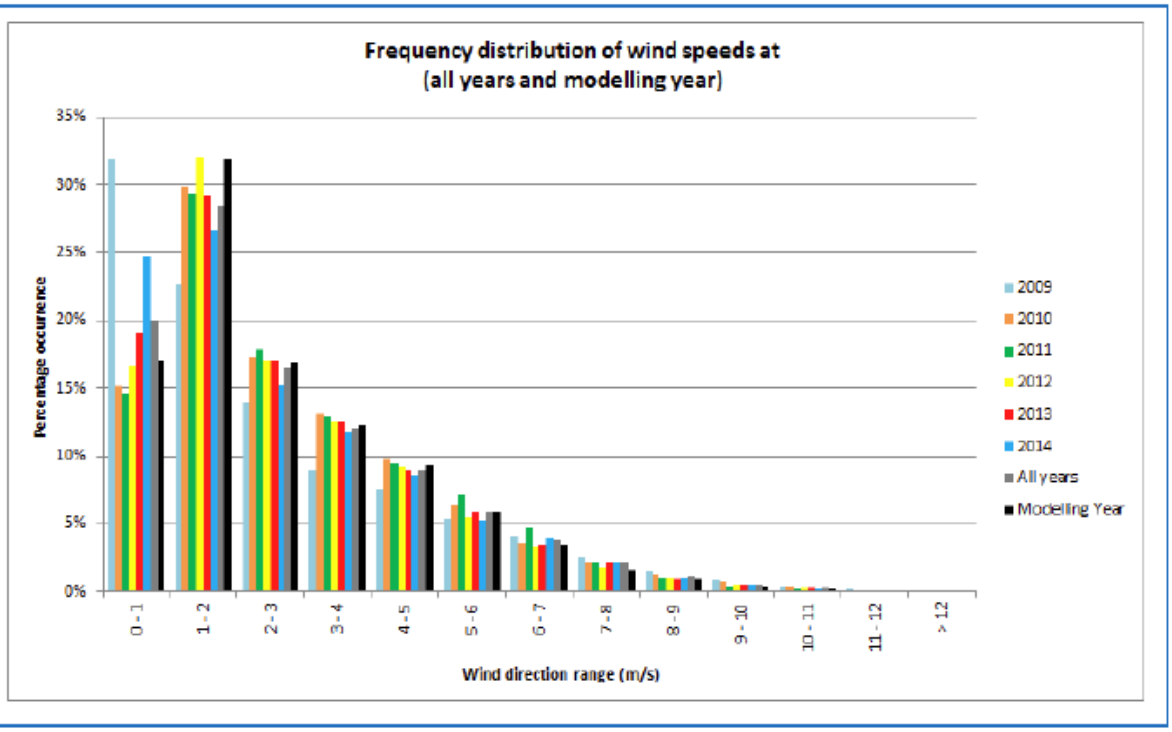

Figure 3: Frequency distribution of wind speed for individual years

Figure 3: Proponent's analysis of potential skew in wind direction and wind speed in the modelling data

In its analysis, the proponent compares its selected modelling data with all of the data, finds that its selected data lies within the minimum and maximum of the data, and uses this as the basis for concluding that its selected data are representative of the prevailing wind directions and speeds.

However, the proponent's analysis overlooks the fact that it is impossible for any subset of data to lie outside of the minimum and maximum range of the full data set, and therefore the analysis cannot prove (or disprove) that the data are representative of the prevailing conditions.

In light of this the review examined the measured weather data to consider whether the data input to the modelling lies within the 95th percentile confidence interval of the full data set (i.e. to test whether the data contains outlier data in the very high and low +/- 2.5 percentile edge of the data range). The data were also analysed to make a relative comparison between all years of data (similar to the proponent's analysis, but for comparison with other stations also). Some clearly erroneous data at the start of 2009 were removed from the analysis.

Figure 4 shows that the selected year has data at the edge of the (wide) confidence interval for south easterly winds and outside of the confidence interval range for north winds (350 to 10 degrees).

An important finding is that although winds from the northeastern quadrant occur less than on average, and are outside the relatively wide 95th percentile confidence interval in some cases, the more frequent, (and important in regard to the most potentially impacted receptors), north westerly winds (310 to 330 degrees) lie within the 95th percentile confidence interval, with 300 to 400 hours of such data.

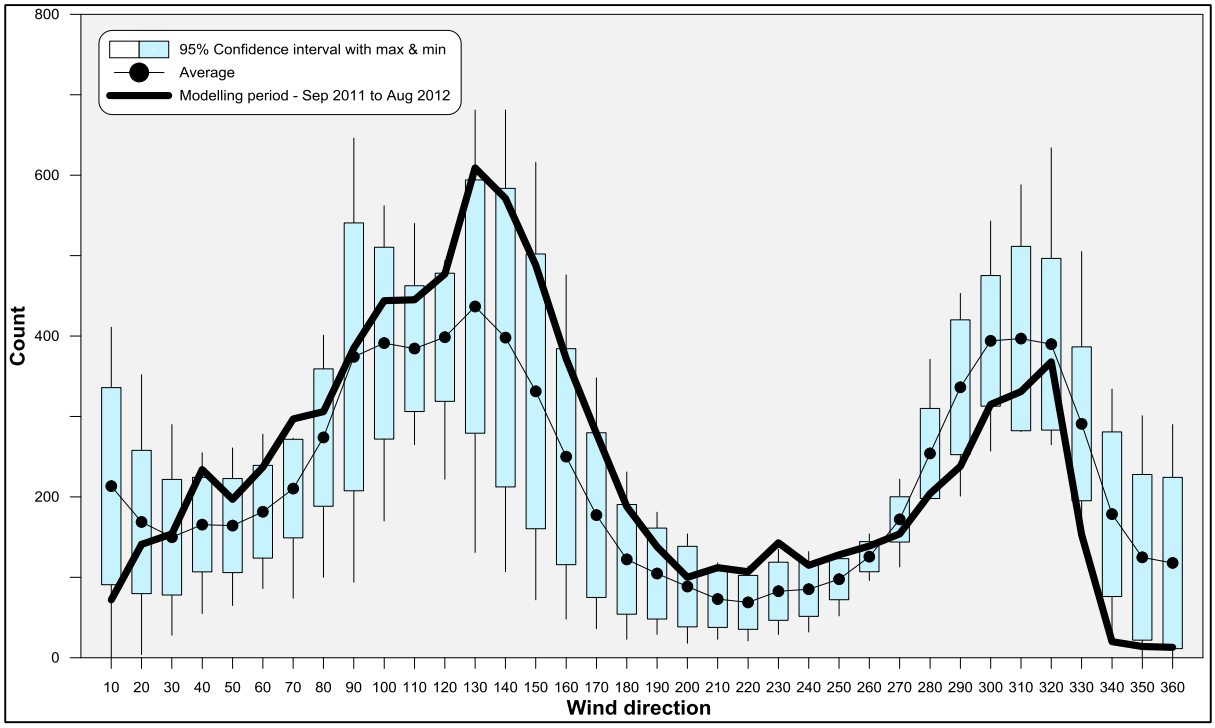

Figure 4: Comparison of modelled data with the average and 95th percentile confidence interval of all data – SX8

Figure 5 shows that all of the years of data at station SX8 show an unusually large spread of wind directions relative to the average, and that there may be quality issues with the data.

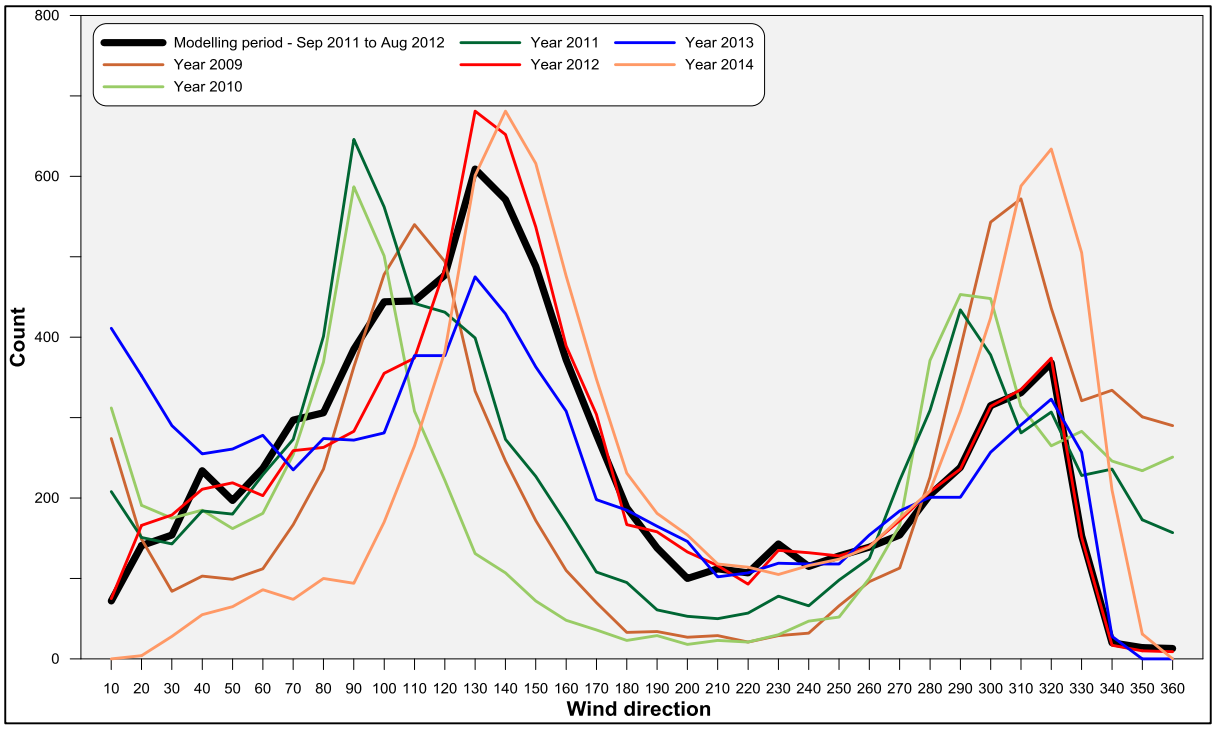

Figure 5: Comparison of modelled year with each available calendar year – SX8

The unusually wide range in the data at station SX8 is evident in comparison with the equivalent data for station SX13 for the same period, as presented in **Figure 6**. The figure shows a much smaller range in the 95th percentile confidence interval, approximately twice as much data in the northwest segment (700 to 800 hours), and much less variation in wind direction between years.

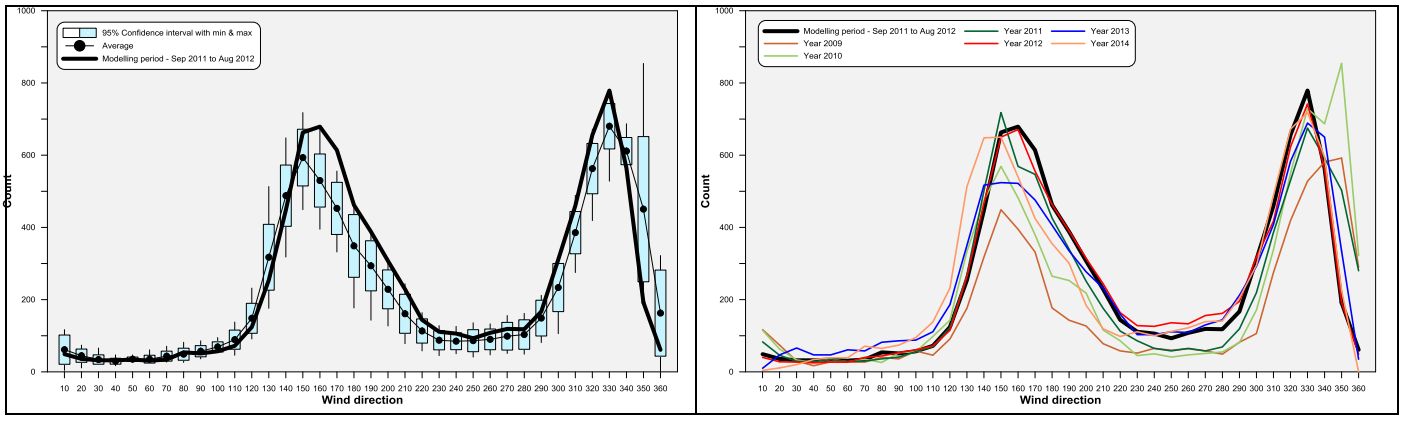

Figure 6: Data comparison – SX13

The indication is that there are problems with the available data from station SX8. The trends in the data indicate the possibility that there has been an abnormal shift in the wind direction sensor alignment, possibly a change in the instrument or some other issue such as interference from vegetation or wear in the instrument. The issue is especially evident for south easterly winds.

This issue is examined in **Figure 7**.

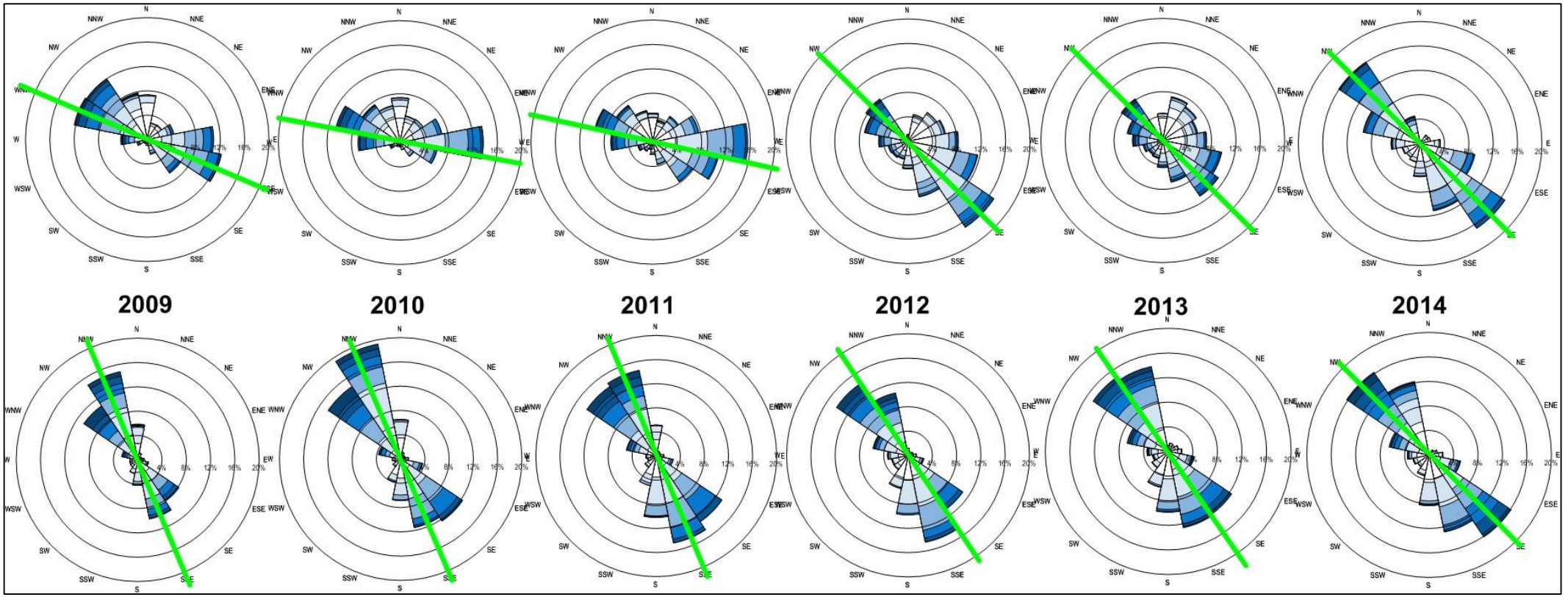

Figure 7: Comparison of annual wind roses for SX8 (top row) and SX13 (bottom row)

The data in **Figure 7** show that there is a significant change in the wind directions being recorded at station SX8 between 2011 and 2012 (the chosen modelling period) and a narrower range of wind direction for the dominant winds in 2014.

In contrast, the station SX13 data show relatively consistent results in all years that are similar to the station SX8 data in 2014.

However, as stated in the previous review, the data used in the actual dust modelling varies across the modelling domain and is generated by a combined TAPM/ CALMET meteorological model. Although the meteorological model uses weather data from stations SX8 and SX13 as inputs, it will adjust the data at locations away from the station to factor in the effects of the actual local terrain features and land use.

These output meteorological data are used directly in the modelling of dust impacts and are examined in **Figure 8**. The figure shows that at the receptors of most interest, the data generally lies between the measured SX8 and SX13 station's data, and most importantly, for the critical north westerly winds the modelled data are closer to the SX13 station's data set, and include a reasonably representative fraction and spread of north westerly wind conditions.

Other relevant aspects to note are that the data used in the modelling include winds from the north-northeast (e.g. from 20 degrees) which are not present in either the station SX8 or SX13 data. The full independent analysis (not shown) reveals that these are generally low speed winds in a narrow range of direction, and are potentially due to katabatic wind flows down the general alignment of the creek valley near the receptors of most interest. This indicates that the meteorological model is potentially responding to the local terrain, and the data therefore are likely to be reasonably representative of the actual weather conditions near these receptors.

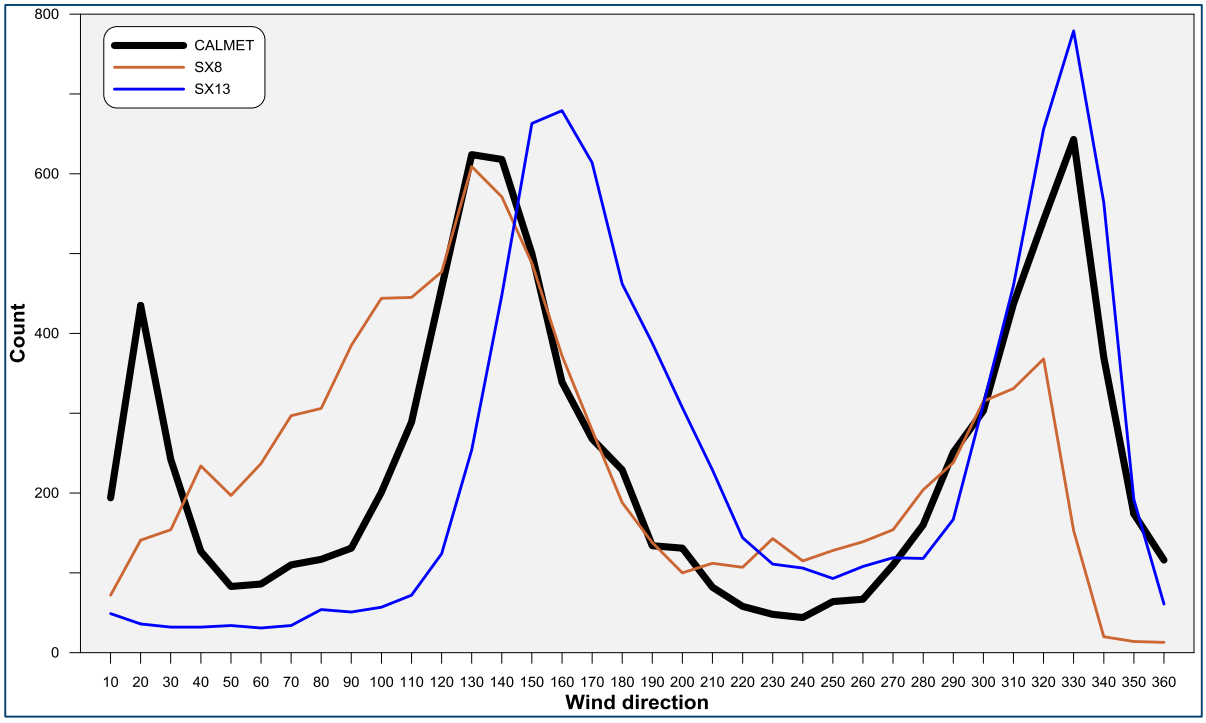

Figure 8: Comparison of SX8, SX13 and modelling data near the likely most affected receptors to the southeast of the Project - period of modelling 2011-12

In summary, it is clear that there is an issue with the data quality for the station SX8 data (generally) and specifically in the chosen modelling period.

The key finding however is that despite the issues in the measured weather data, the generated meteorological data used in the modelling of dust impacts near the most likely affected receptors to the south east reasonably reflect the wind conditions which may be expected to occur at that location.

The review thus accepts that the meteorological component of the modelling is adequate at the receptors of key interest.

3.5.1 Existing air quality and calculation of background levels in the modelling assessment

Background air quality in the area surrounding the Project would be influenced by emissions from coal mining operations and emissions from anthropogenic sources including agricultural activities, wood heaters, motor vehicle exhaust and other industrial sources. Natural sources of emissions, include sea salt and particles originating from the natural land and vegetation, dust storms and bushfires.

The assessment for the Project provides background emissions data from monitoring stations operated as part of the Mt Owen air quality monitoring network and the Upper Hunter Air Quality Monitoring Network (UHAQMN).

Corresponding monitoring data analysis of the running annual average PM_{10} (see **Figure 10**) indicates that the chosen year for modelling typically contains generally low dust levels relative to the other years available. The blue shaded box indicates the selected modelling period which is 1 September 2011 to 31 August 2012.

Two monitors in particular do not appear to provide accurate results, these are the PM10-1 (located to the northwest of the Project) and SX14 (located to the south of the Project in Camberwell) monitors. Monitor PM10-1 appears to move from having some of the highest to some of the lowest levels for the period reviewed. Monitor SX14 appears to operate incorrectly as it records even lower and higher levels than PM10-1, and reports unrealistically low levels in Camberwell. It is unlikely that the data from this monitor is valid during the selected modelling period, given that it shows a downward trend without the seasonal variability apparent in all of the other monitors.

However, given the prevailing winds, Camberwell is unlikely to be significantly influenced by the proposed new mining areas. Therefore this may not be a significant issue in regard to impacts at receptors, provided that the data from PM10-1 and SX14 are not used in the assessment.

To clarify if this is an issue, it is requested that all data that does not conform to the applicable monitoring standards (e.g. without adequate QA checks, calibration, servicing etc.) or appears to be erroneous be removed from the analysis. This is primarily of interest in regard to the "calibration grid" and 24-hour PM_{10} assessment.

The proponent has provided an analysis of its "calibration grid", and shows that it is not significantly affected in the area of most interest (to the southeast of the mine) when potentially anomalous data are removed.

The effect of the anomalous data (SX14) on the 24 hour PM_{10} assessment is directly assessed by the proponent by revising the 24-hour average PM_{10} impact assessment results. This re-analysis is per the NSW EPA Approved Methods, and uses the likely valid local monitoring data. The key observation is

that although more impact days are now counted, this does not affect any new receptors and does not change the conclusions.

The proponent has conducted a generally conservative assessment of potential 24-hour PM_{10} impacts, the approach follows recognised methods, uses the actual measured local data in the calculations and is considered to be conservative as there appears to be some double counting of emissions. It is noted that the modelling period selected does correspond with a period of low annual average levels, and may not have as many levels above the criterion in the existing data set. However, the key factor in the 24-hour PM_{10} assessment is the prevalence of data close to but below the criterion level, that may be tipped over the criterion level by the additional effects of the proposal. In this regard, there is some double counting of the mine contribution in the background data and in the predictions, and the pollution roses (see below) indicate that the period chosen does contain significant high dust levels from the direction of the Project. The findings of the contemporaneous 24-hour average PM_{10} assessment are therefore accepted by the review.

The proponent uses pollution roses to analyse all data in its 3 March 2016 analysis. The proponent uses these plots to correctly conclude that at the receptors of most interest, winds from the northwest, that predominantly arise in the cooler periods, are associated with high background dust levels.

These plots clearly show that the choice of meteorological data (SX8 or SX13) has a significant bearing on the results (e.g. seen by comparing the proponent's Figure 4 with Figure 5 in its March analysis, as presented in **Figure 9**).

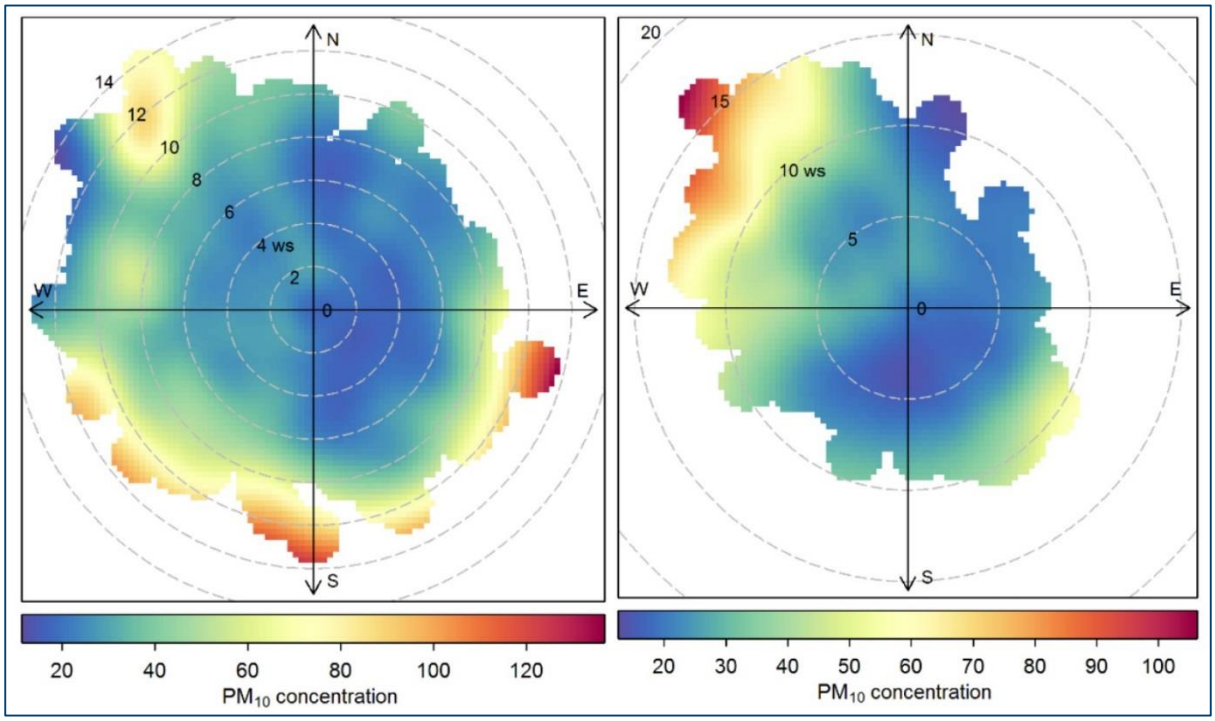

Figure 9: Pollution rose for SX9 PM_{10} monitoring data using SX8 weather (left per proponent's Figure 4) and SX13 weather (right, per proponent's Figure 5)

The plots derived using the problematic SX8 weather station data (e.g. left side of **Figure 9**) are not accepted as valid by the review, but the plots based on station SX13 data (e.g. right side of **Figure 9**)

are considered to be reliable, especially when considering the generally good agreement between the locally modelled weather data and the SX13 weather data (see **Figure 8**).

Overall, notwithstanding the use of problematic station SX8 data to generate some of the pollution roses, these aspects of the proponent's analysis and responses are generally good, they aim to address the issue raised and are accepted by the review.

The proponent however does not adequately respond to the issue of whether the background dust levels chosen for the review are representative of the actual case, given that the modelling period corresponds with low levels of measured dust in the ambient air (e.g. see **Figure 10**).

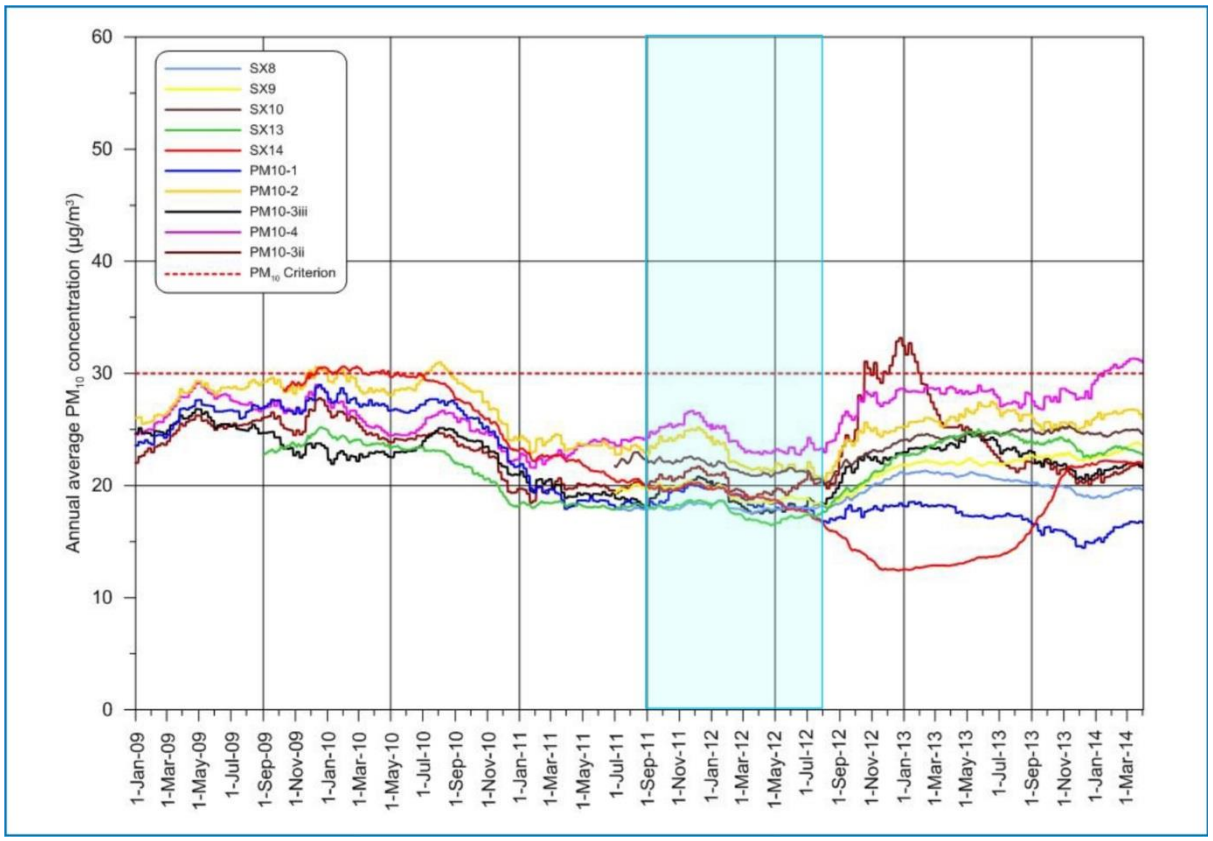

Figure 10: Running annual average PM_{10} concentrations at Mt Owen Monitoring Sites (Fig 5.5 of AQIA)

3.5.2 Setting annual average background levels

The Upper Hunter Air Quality Monitoring Network (UHAQMN) stations at Wybong, Jerrys Plains and Merriwa are used to estimate background PM_{10} air quality levels in the AQIA, and the Camberwell station is used to estimate background $PM_{2.5}$ levels.

The median values at these sites have been used in order to *"provide an indication of average conditions in the absence of outliers in the data caused by significant event such as bushfires and dust storms."* However paragraph 3 on Page 32 states that the median value was used because it "*reduces the influence of significant weather events (which are essentially unpredictable into the future) and thus provides a more representative background value."*

Whilst it is recognised that spurious high data may have an effect on annual average dust levels, in the reviewer's experience this is less than the bias caused by using the median value. Thus the adopted

approach may potentially be reasonable, but it may also bias the results and produce lower annual average cumulative results.

At any rate, the adopted approach does not appear to be in accordance with the NSW EPA Approved Methods as it does not use annual average data.

Paragraph two on page 32 of the assessment begins by stating that the Wybong, Merriwa and Jerry's Plains sites are *"representative of the existing* [PM_{10}] *background levels without the influence of mining",* but then states that the sites are influenced by "finer particles" from mining, including by recirculation, and that the Jerry's Plains site is less influenced by mining that the Merriwa and Wybong sites.

It may be that this paragraph is implying that these sites are affected by $PM_{2.5}$ from mining, but not PM_{10}. However, this does not appear to be correct and there is no evidence provided in the assessment to support the inference (if it is referring to $PM_{2.5}$ from mining).

On the other hand, if the paragraph is referring to PM_{10}, it contradicts the first part of the paragraph, and should be explained.

A different method is used for the statistical analysis, making it impossible to compare the modelled results with the statistically derived results. In the statistical method, monitoring data near to the receptors is used directly.

The proponent has clarified that it uses the annual average and annual median data from OEH monitoring stations well away from the Project location when assessing annual average PM_{10} dust levels, and that this is detailed in the proponent's response to submissions report.

Relative to using median values, the use of the average level will increase the background dust level applied in the assessment.

As the criteria apply to annual average levels, the use of the annual average background level is supported by the review.

However the approach of using data from further afield than the background level measured closest to the most potentially affected receptors is not supported by the review.

The adopted approach is considered to be incongruous with the NSW EPA's Approved Methods, which state*: "The background concentrations of air pollutants are ideally obtained from ambient monitoring data collected at the proposed site. As this is extremely rare, data is typically obtained from a monitoring site as close as possible to the proposed location where the sources of air pollution resemble the existing sources at the proposed site."* The Approved Methods also define background levels as *"existing concentrations of pollutants in the ambient air".*

The adopted approach has applied an alternative definition of the background level to that in the EPA Approved Methods, i.e. the levels used in the assessment are not like those near the proposed location of the Project, and are selected to exclude the effects of existing sources of dust near the proposed site such as mining activities.

The rationale provided for this is that this prevents double counting of mining emissions in the background data and in the predicted data. The review agrees that there should not be such double counting of mining emissions, however it is pointed out that there is no need to double count mining emissions when following the EPA approach.

It is noted that the local background data, as defined per the EPA Methods appear to be used in the assessment to conduct the 24-hour PM_{10} and $PM_{2.5}$ assessment, and that this is incongruous with the rationale set out in the AQIA for using the distant OEH data to conduct the annual average PM_{10} assessment.

No analysis is presented in the AQIA or response to submissions that clearly demonstrates that the adopted approach is at least equivalent to the Approved Methods approach. The indication is that there is some small double counting in the approach anyway, (e.g. paragraph two on page 32), and inaccuracy (over or under estimation) in the background level near the Project site will inherently occur due to the use of background levels from a different locality.

Overall the approach for assessing annual average PM_{10} impacts would inherently produce less accurate and less reliable results than the approach outlined in the NSW EPA Approved Methods.

Therefore it is requested that the annual average PM_{10} results be reprocessed using the actual (annual average) background data near the Project location, per the EPA methods.

The proponent re-analysed the dust monitoring data and excluded potentially anomalous data (e.g. SX14 data), and also re-analysed the 24-hour PM_{10} impacts by excluding such data. The proponent removed the applied calibration factor and re-assessed the predicted annual average dust results at the most likely affected locations to the southeast of the Project.

The proponent's re-analysed results show no exceedances of annual average PM_{10} levels, however when the proponent's data were checked, an exceedance of annual average levels at receptor R116 in Year 1 is identified. As the difference between the values is small, it appears that this may be due to rounding of the number.

These aspects of the proponent's response clearly aim to address the issues raised, are generally good, and are accepted by the review.

However, the proponent did not adequately respond to the issue of low dust levels in the period selected for the modelling, or examine how its chosen modelling period and background dust level may affect the predicted results. The proponent reiterated its philosophical discussion regarding the merits of its chosen approach for setting annual average background levels which involves re-defining background dust levels and using data from elsewhere. The proponent's approach is not per the NSW EPA Approved Methods.

In this regard, the proponent incorrectly asserts that the Approved Methods outline alternative approaches, and also states that *"the approach used in the AQIA has undergone scrutiny by the NSW EPA and they have concluded that the methodology has been satisfactorily addressed in our RTS report and retains an appropriate degree of conservativeness."* The review has no reason to doubt that the EPA may have concluded so, but this does not answer the issue raised in the review at to whether the period of

data (with low dust levels) used in the assessment will reasonably represent the dust levels in the area of most concern.

The review thus examined the apparently low levels of dust in the data year selected for the assessment.

On an annual average basis, the review found that in most locations in the Hunter Valley, the period selected for the modelling recorded ambient dust levels that are lower than is typical. This can be seen in **Table 1**, which shows the levels in the period selected are 6% to 41% lower than the average calendar year levels (excluding 2009 which was affected by major dust storms).

Table 1: Summary of measured annual average PM_{10} levels (µg/m³)

Year	Singleton	Camberwell	Wybong	Jerrys Plains	Merriwa	SX9 PM10	SX10 PM10
2009						34	36.2
2010						19.6	23.4
2011	19.8					20.1	21.1
2012	22.5	26.5	15.4	10.9	14.3	22.1	22.8
2013	23.4	27.9	15.6	18.6	14.9	22.7	25.3
2014	20.8	24.4	16.7	18	15	20.4	22.6
Modelling period Sept 2011 - Aug 2012	**20.3**	**23.2**	**13.2**	**9.3**	**10.6**	**19.1**	**20.1**
Modelling period % below average (excluding 2009)	**6%**	**12%**	**17%**	**41%**	**28%**	**9%**	**13%**

The period chosen for modelling has 9% to 13% lower than average measured levels of dust, and these levels are 0.5 to 5.2 µg/m³ lower than in any other calendar year in the vicinity of the receptors of interest to the south east (except 2009, which is affected by dust storms).

The average measured level at Wybong, Jerry's Plains and Merriwa in all calendar years is 15.5 µg/m³, whereas the average measured level in the modelling period is 4.5 µg/m³ lower at 11.0 µg/m3 (note that a level of 14.9 µg/m³ was used in the assessment). Similarly the average level at SX9 and SX10 in all calendar years is 2.6 to 3.5 µg/m³ higher than that in the modelling period, or in other words the period used for the modelling has background dust levels that are 3.1µg/m³ lower on average.

In its December 2015 response to this issue the proponent uses an annual average PM_{10} background level of 14.9 µg/m³ when it re-analyses the modelling results at a selected number of receptor locations. This re-analysis focuses on the receptors of most interest to the southeast of the Project. The re-analysis also removed the calibration factor and found that no impacts are likely to occur at these receptors in any year, however there appears to be an exceedance at Receptor R116 in Year 1.

It is not clear how the revised new background annual average PM_{10} level was derived. In its December 2015 response , the proponent only states that the new background dust level was estimated "*using the three OEH monitors that are further removed from the influence of mining activity*", and that it "*is the mean rather than the median used in the original AQIA*".

The review was unable to use the actual monitoring data to derive a "background" level of 14.9 µg/m³.

It is noted that the measured data from SX9 and SX10 for 2011-2012 do not agree with the data in the spreadsheets provided for the review (shown in the table above). For example 18.7 µg/m^3 in the response to submissions vs. 19.1 µg/m^3; and, 21.5 µg/m^3 in the response to submissions vs. 20.1 µg/m^3).

However, regardless of how the proponent has set or calculated the now applied background level of 14.9µg/m^3, the following observations can be made:

1. The value used is generally less than the data measured in any calendar year at Wybong, Jerry's Plains and Merriwa, except for Jerry's Plains and Merriwa in 2011, and it is equal to the Merriwa data in 2012. This indicates that the chosen level of 14.9µg/m^3 may generally underestimate the background dust levels in the nominated locations further removed from mining activity;

2. The value used is significantly less than any of the background levels measured at SX9 and SX10 in any calendar year and in the modelling period. Whilst the level chosen therefore does not represent the background levels near the location of interest, it is noted that the proponent is not attempting to do this, but instead aims to use this value to estimate the "background" level in the absence of mining activity. In this regard, the estimated level would allow for some mining contributions.

Per the proponent's assumption that other data *("from the three OEH monitors that are further removed from the influence of mining activity")* can be used to represent the "background" level in this locality, the difference between the measured background levels at Wybong, Jerry's Plains and Merriwa (the three OEH monitors further removed from the influence of mining) and the levels measured concurrently at SX9 and SX10 should give an indication of the influence of mining activity near the receptors of most interest. The differences can be construed to represent the contribution from mining activities. In the modelling period these differences range from 5.9 to 9.8 µg/m^3 at SX9 and 6.9 to 10.8 µg/m^3 at SX10, (and in any available calendar year from 2.4 to 11.2 µg/m^3 at SX9 and 4.6 to 11.9 µg/m^3 at SX10).

If these values are added to the proponent's selected "background" level of 14.9 µg/m^3, the background levels near mining in the area of interest would be approximately 17.3 to 26.8 µg/m^3. These levels are 3.1 µg/m^3 less than the lowest measured levels of 20.4 µg/m^3 in any calendar year, and 1.5 µg/m^3 above the maximum measured background level of 25.3 µg/m^3.

This indicates that if the proponent's assumptions are to be accepted, then on balance it is more likely for there to be an underestimation than overestimation in the total predicted levels when the measured data across the three available calendar years are considered.

With this in mind, the reviewer is inclined to estimate that the cumulative results may under predict impacts due to the Project by up to approximately 3.1 µg/m^3.

3.5.2.1 TSP levels

The approach uses the ratio of TSP to PM_{10} at four monitors located in the vicinity of the Project and then scales up the PM_{10} background level based on data from elsewhere to establish the background TSP level.

The method adopted in the AQIA to set the background levels appears to be based on selecting data from afar that was considered to be unaffected by mining dust (although this is not clear). Thus to use the TSP to PM_{10} ratio from the local site to adjust data that would be affected by mining dust does not appear to be logical.

The reviewer is not aware of any situation of any exceedance of TSP levels due to mining at locations where the PM_{10} criteria or $PM_{2.5}$ advisory reporting levels are not exceeded. In this case, as PM_{10} and $PM_{2.5}$ are more closely related to health impacts and are a more limiting criteria that needs to be met, the issue with TSP background estimation is not significant, and no further comment is provided.

No further response in this regard is required.

3.5.2.2 PM_{10} levels

Based on our analysis of the UHAQMN data available on the NSW EPA website, we calculate the median PM_{10} value for Jerrys Plains during 2012 as 9.5 µg/m^3 and not 6.5µg/m^3 as stated in Table 5.6 of the AQIA. As this site appears to be used for the setting of background dust levels, this may have an effect on the Project findings.

Further analysis of the median values in Table 5.6 of the AQIA indicates that the median PM_{10} value for the Wybong, Jerrys Plains and Merriwa sites during 2012 is 11.4µg/m^3 not 13.2µg/m^3 as stated.

How the median value of 13.2µg/m^3 used for the background value of PM_{10} has been calculated should be clarified.

As noted above, annual average levels have been used in the assessment described in the response to submissions, and it has been requested that the results be re-processed using the local background data. This would effectively deal with any issue identified in this section.

The proponent has now adopted annual average (rather than median levels) but did not provide an adequate response to the request to reprocess the predicted annual average PM_{10} results using local background levels per the EPA Approved Methods in order to assess the potential impacts from the Project.

The proponent's re-analysis of annual average impacts at the receptors of interest uses a third, newly revised background level of 14.9 µg/m^3 *"which is the mean rather than the median used in the original AQIA"*

This issue is discussed in detail above at **Section 3.5.2**.

As outlined at **Section 3.5.1**, the proponent has revised its 24-hour PM_{10} impact assessment per the EPA Approved Methods, the proponent's assessment is considered to be conservative and the results of the 24-hour PM_{10} impact assessment are accepted by the review.

3.5.2.3 $PM_{2.5}$ levels

It is noted that the assessment only considered OEH data from Singleton, Camberwell and Muswellbrook, despite other $PM_{2.5}$ data measured by Glencore potentially being available.

The reviewer agrees that using data from Singleton and Muswellbrook would be overly conservative and not representative of the area of most interest, but considers that adoption of a median $PM_{2.5}$ value of 7.1µg/m^3 from the Camberwell monitoring data is also conservative, and it is noted than in the Response to Submissions a lower value is selected on the basis of the $PM_{2.5}$ to PM_{10} ratios at the OEH monitoring sites.

Whilst the adopted approach would be reasonable for town sources, the ratios of measured $PM_{2.5}$ to PM_{10} at the ten other known monitoring locations in the Hunter Valley show lower background levels of $PM_{2.5}$ than applied in the assessment.

This indicates that the assessment may potentially overestimate the cumulative $PM_{2.5}$ levels.

No further response in this regard is required.

3.5.3 Summary of annual average background level selection

The assessment does not appear to consider actual annual average background levels per the EPA Approved Methods, and instead uses median values from sites where dust levels are low. The response to submissions uses annual average background levels, but like the median value, the data are from a distant location.

This approach would introduce bias and error in estimating the likely cumulative impacts.

It is also unclear why the background levels from locations nearest the receptors were not used, as this would be expected to better represent the conditions during the time of the modelling, at the locations of most potential impact.

It would also be appropriate to use the same background data for the assessment of modelled impacts (based on median data from afar) and the statistically derived impacts (based on local data).

There is likely to be a significant underestimation of the statistically derived dust impacts at Receptor 127c (Camberwell Village) which arises from the use of background data that appear to be invalid.

There should be further justification regarding the approach selected to calculate annual average background PM_{10} and $PM_{2.5}$ levels, including:

- a clear justification for not following the Approved Methods, (for example by providing a quantitative evaluation of whether the bias introduced by using a median value is significant relative to the Approved Methods approach); No further response in this regard is required.
- whether the period selected contains representative data;
- whether the levels are representative of those in the key area of interest; (e.g. by reprocessing the results using the local background monitoring data) and,
- whether the SX14 data used to statistically derive impacts at Camberwell Village are valid, and if not what underestimation in the impacts at this location may have occurred as a result. No further response in this regard is required. The proponent has now excluded the anomalous data from its assessment.

The review considers that, if the proponent's assumptions regarding background levels are adopted, the background level selected by the proponent for the chosen modelling period has on balance, after comparison with all available calendar years of data, more potential to underestimate than overestimate total annual average dust impacts at the receptors of most concern to the southeast of the Project. The scale of the potential underestimation, is calculated to be 3.1 µg/m^3, per the proponent's assumptions.

3.6 Emissions

A summary of modelled annual emission rates for the Project is presented in Table 8.10 of the AQIA. The table indicates that for the modelled scenarios, emissions would increase by approx. 22% in Year 1 and 5 compared to the estimated 2011/2012 period and would decrease by approx. 7% in Year 10 when activity is closer to the sensitive receptor locations.

In terms of PM_{10} emissions the table indicates approximately 38% and 25% more emissions in Year 1 and 5, relative to year 2011/12, and no tangible difference in Year 10

The assessment notes that the PM_{10} emissions estimated for the 2012 operations are significantly lower than those for 2010 estimated as part of the Dust Stop PRP. The levels appear to be close to half the 2010 Dust Stop PRP values. The main reason given is the use of a higher haul road control factor and lower measured haul road silt, but the inclusion of other hauling from Glendell operations and a different mine plan year would contribute to the difference.

The silt content measurements for the site specific PRP were excluded because a laser diffraction analysis method was used instead of the Approved Method which is a dry sieving method.

The assessment relies on site specific measurements of silt content and moisture in establishing its emissions rate and distribution between the various activities proposed.

However, the assessment does not appear to evaluate whether the sampled results for silt and moisture levels are representative of the actual conditions that may arise across the site and over time. For example, a few samples totalling a few kilograms may not reliably represent the many billions of kilograms of material being handled across several square kilometres, over many years.

This has the potential to skew the emissions inventory leading to inaccurate modelling results.

Figure 11 shows a breakdown of the dust sources for the Project as assessed in Year 1. The figure indicates that the quantity of emissions in the inventory for some of the key sources of dust from the Project appear to be significantly different to what is likely to occur in practice.

For example in Year 1, Overburden Activity accounts for only 4% of the total emissions and Coal Activity, including dozers on coal, makes up 40% of total emissions. Relative to most other mines of a similar nature, these key sources of dust emissions from the Project appear to be many times too low and too high respectively.

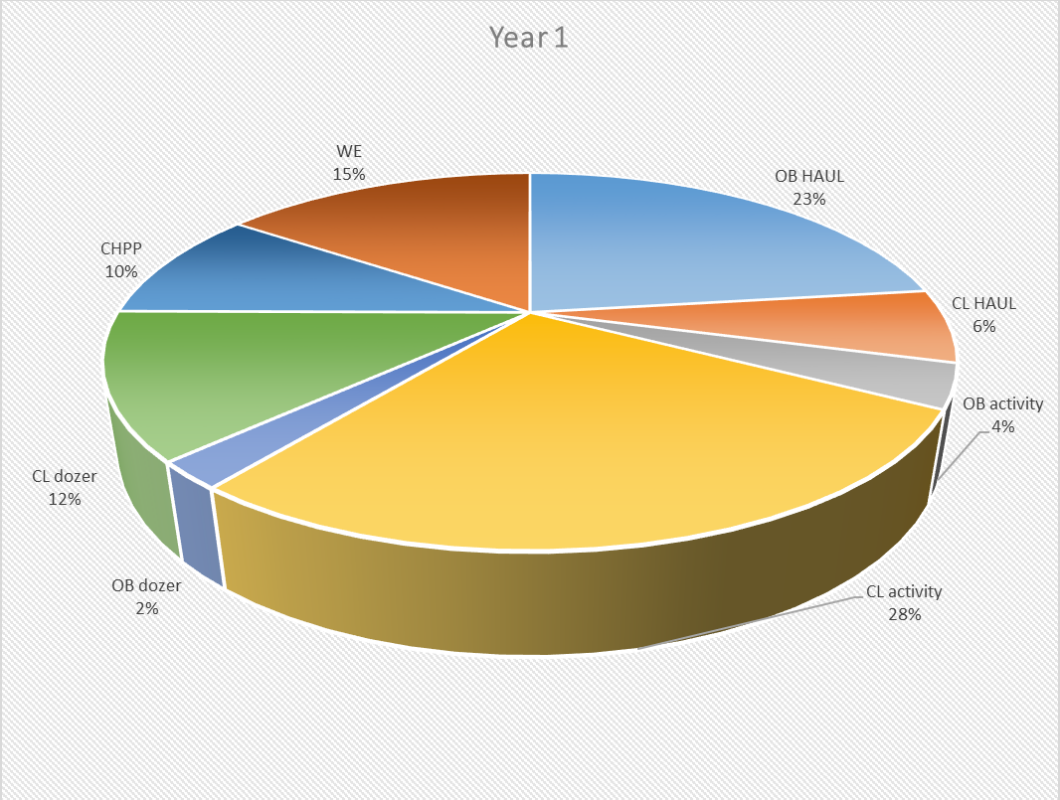

Figure 11: Distribution of modelled emissions, Project Year 1.

As emissions from overburden tend to occur in the more elevated areas of the mine with more scope to be carried off by the wind than coal activities which tend to occur at the base of the pit, and at stockpiles generally located further from receptors, this may skew the modelling results and may lead to an underestimation of the potential impacts.

This issue warrants clarification and quantification to ensure that the modelling of impacts at the most likely affected locations is reliably accurate.

A breakdown of the summation of the proponent's data in each "slice" of the pie chart above has been provided by the reviewer and it is understood that the Department has supplied this information to the proponent. The general trend in the above pie chart, (i.e. unusually low net dust from overburden activity, and unusually high net dust from coal handling activity) is evident in all years for the Project alone and for the Project with associated coal handling activities.

It is understood that the proponent will review whether the data applied in the inventory are representative of likely actual silt and moisture levels, and examine what effect this may have on the representation of the site dust sources (their relative fraction) in the emissions inventory, and net total emissions, and hence predicted impacts from the Project arising from the emissions.

The response and analysis provided by the proponent in this regard misconstrues the substantive issue which is whether the data applied in the calculations are reliable and whether the resulting calculated breakdown (relative proportions) of emissions from various activities is reasonably representative of what may occur in practice. The response provided instead focusses on the specifics of just one example raised at the 10 November meeting that was simply used to illustrate the substantive issue.

The review accepts that this mine may differ relative to other mines due to the deep pit and long coal hauls, and that this would result in lower than typical emissions from activities such as dozers on overburden, and higher than typical emissions from coal hauling. However, the emissions from overburden handling (loading and unloading) activity would still occur and appear to be implausibly low relative to the other sources, similarly the coal handling emissions are unusually high.

The review considers that the response provided does not adequately address the issue and that the breakdown (relative proportions) of source emissions appears to be unrealistic.

The review thus examined the net total emissions of dust from the Project and considers these likely to be representative of the net total emissions of a mine of this scale.

The review also notes that for PM_{10}, only a small (approx. 5%) factor has been shown in research studies to apply to pit retention of the emissions, and in any case the model as set up would not generate different wind induced emissions at the various source locations in the modelling domain.

The potential under-representation of the quantity of dust from the overburden handling areas is tempered by a relatively large wind erosion fraction arising from these areas.

However, the potentially over-represented proportion of emissions from the coal stockpile areas and under-represented proportion of emissions from overburden handling are considered likely to add some significant bias in the predicted impacts from the Project due to the position of these sources nearer or closer to receptors.

3.6.1 Train dust emissions

No quantitative assessment is provided.

Comments on wind tunnel tests for various coal types are provided, however no numerical values are given. An estimate of the emissions is made using a wind erosion factor, and the emissions are found to be less than 0.03% of the total annual emissions from the mine.

Reference is also made to studies which find dust emissions from trains to be low.

As far as the reviewer is aware, there is no significant issue with actual coal emissions from loaded coal wagons, rather the emissions that do occur are due to locomotives and re-entrained dust from the rail line, an issue that affects all diesel train activity in a similar manner.

This is consistent with the information presented in the AQIA.

Therefore the lack of a quantitative assessment of impacts is not seen as a significant issue, with perhaps the exception of receptors located very near (a few tens of metres) from the rail line.

No further response in this regard is required.

3.6.2 Blasting

The assessment applies an emission rate for NO_2 emissions from blasting at approximately 1,200g/s for a 10-minute period per blast (comprised of 12 sources).

This emission rate would overestimate the maximum measured emission rates from blasts which tend to be several times lower, indicating that there may be a problem with the emission calculation equation being applied.

Each blast appears to be represented in significant detail by considering it to be comprised of 12 sources.

No further response in this regard is required.

3.6.3 Emissions from other mines

It is noted that emissions from other mines are based on PRP data rather than the (potentially) binding rates set out in the EIS's for these mines. However, the emission rates for the Project are not based on the PRP estimates.

The assessment omits modelling other mines in future years as these other mines do not have approval to operate beyond certain dates.

However this is not the case for Liddell which has submitted an application for further modification.

It is also not clear why Rix's Creek is excluded from the modelling in future years, given that some 4 to 8 months prior to the first draft of the AQIA, Rix's Creek's PEA was public (21 November 2013) and DGR's were issued (March 2014) for the Rix's Creek continuation project, which would operate until 2038.

The Year 10 modelling land use data includes Rix's Creek (see Figure 6.3 of AQIA) even though it was apparently not modelled. Year 1 and 5 also include Ashton NEOC (see Figure 6.2 of AQIA) even though the site was rehabilitated several years ago. However this is only a minor technical modelling issue and unlikely to significantly affect results.

Emission estimates for the Integra OC and UG in Table 8.14 of the AQIA show a sudden reduction in Year 10 compared to the estimates for Year 1 and 5. The footnote for the values indicate it is considered to be a conservative estimate as it is now under care and maintenance. However a mine in care and maintenance may re-start in future, making it perhaps more likely that its emissions would occur later than was originally planned.

It is considered reasonable that the assessment should include the approved operations and also known operations with high potential to be operating in future.

It is noted that potentially this may not be a significant issue near the most impacted receptors near the Proposal (especially as the closer Integra Operations are included albeit at a reduced level in 2010) but clarification is warranted to determine the extent of any potential underestimation arising from the exclusion of the other operations.

The proponent clarified that at the time of preparation of the AQIA (and the modelling) there were data available to reasonably include the proposed Liddell operations, but not the proposed Rix's Creek operations. Therefore no further justification in this regard is necessary.

It is requested to provide some qualitative comment on the potential significance of the proposed Rix's Creek activities at the critical locations to the SE of the Project.

The requested qualitative comment has been provided. The proponent considers that there is little cumulative interaction between the Project and the Rix's Creek project. The review agrees with this and notes that the observation is consistent with the pollution roses provided by the proponent.

3.7 Approach to predictions and analysis of impacts

3.7.1 Dust assessment

The response to submissions shows that lower background levels have been used in the assessment to avoid double counting of mine emissions, which is appropriate (i.e. to avoid double counting of emissions). The selected levels appear to be a generally reasonable representation of the typical underlying background levels and potentially lower levels may be reasonable to have been used also.

However, as suggested earlier, there is concern with the factoring approach applied where the predicted impacts from other mines are scaled down by up to five fold according to the ratio of the total predicted level and the measured level in 2011/12.

Given the low and potentially invalid data recorded at SX14 in Camberwell, this may be part of the problem in the model accuracy.

The issue of potential problems in the model set up, the scaling approach and background data warrant closer attention and quantification to confirm that reliable results are being produced at the most impacted downwind locations near to the Project.

When examining the results in the appendices of the AQIA in more detail, it appears that there may be errors in the results. Whilst these may be simple typographical or transcription errors, they may also arise due to the approach adopted for the annual average assessment.

In light of this, and the overall issues identified in the review, the following data are requested to assist in the review:

- Ambient air quality monitoring data from SX10 and PM10-2 stations (1-hourly format, for the modelled 2011 to 2012 period);
- Meteorological data from SX8 and SX13 weather stations and an extracted CALMET file for a location to the SE of the Project (1-hourly format, for the modelled 2011 to 2012 period); and,

The time series modelling results for PM_{10} concentrations (1-hourly format) at the following receptor locations:

  - Receptor 38;
  - Receptor 41;
  - Receptor 114;
  - Receptor 127c; and
  - Receptor 133.

The time series data should be provided electronically for each modelled year (i.e. 2011/12, Year 1, Year 5 and Year 10), and as a separate time series modelling result for the Project alone (i.e. Mt Owen) and for each of the other individual mines. It is understood that there may not be separate data for each individual other mine, but if possible this should be provided.

It is requested that the most current data be provided, (e.g. to reflect any revised modelling in light of the other analyses made in response to the issues raised).

These data were provided and have been applied in this review to assess the Project.

It is noted that the DGR's require an appropriate probabilistic approach to be used. The method used in the AQIA is unreliable as it predicts impacts greater than the NSW EPA maximum background plus the maximum increment screening method. Thus the assessment in this regard in the AQIA is of no tangible value.

Other, simpler statistical methods can calculate the maximum likely upper bound of the potential impact more reasonably and perhaps more complicated methods could be applied to give a realistic assessment of likely impacts.

It does not appear to be necessary to use such methods in this case, as the Project is for an established operation where there is ample monitoring data available.

It is therefore suggested that the DGR request to use an appropriate probabilistic method may perhaps be warranted in cases where there would not be adequate data to characterise the ambient environment, but not in other situations. No response from the proponent in regard to a probabilistic assessment is required.

It is noted that the probabilistic (Monte Carlo) assessment of 24-hour average PM_{10} impacts provided for the Project shows that significant impacts would arise at some receptors. The review does not consider the approach to be reliable as it incorrectly assumes that mining dust and background levels are independent at any location. The review does not recommend that the probabilistically derived results be used to assess potential impacts.

3.7.2 Nitrogen Dioxide

It should be noted that maximum NO_2 impacts tend to occur some distance away from the release point due to chemical reactions in the air which convert some of the released NOx to NO_2 over time frames of minutes to hours.

3.7.2.1 Nitrogen Dioxide assessment – operational activities

The assessment considers potential Nitrogen Dioxide (NO_2) impacts from operational plant.

The Ozone Limiting Method (OLM) has been used with data from the NSW OEH Monitoring site at Wallsend which is approximately 75 kilometres away. As it is unlikely that there would be any relationship between the ozone levels at Wallsend and NO_2 levels in the locality, it is unclear why the approach has been used. It is also not outlined just how the "unity" emission rates per plant item are represented in the model *"and then post-processed and scaled using the actual emission rates for each pollutant"*.

The AQIA has predicted that NO_2 impacts would arise at two mine owned receptors, and no suggestions for mitigating the impacts are provided.

However, given that the maximum measured NO_2 levels in the upper Hunter Valley are well below the criteria, and that the Project would essentially continue using a relatively similar set of plant items to

conduct similar activities, it is not plausible for what would be a relatively small change (if any) in NOx emissions from only one mine, to lead to any significant cumulative NO_2 impacts.

Thus the issue is not considered significant. No further response in this regard is required.

3.7.2.2 Nitrogen Dioxide assessment - Blasting

The emission rate used in the assessment would overestimate the maximum measured emission rates from blasts by several times, indicating that there may be a problem with the emission calculation equation being applied.

Whilst a several fold overestimation in the blast emissions would overstate impacts significantly, there are two other concerning aspects to the assessment methodology that also warrant clarification and quantification;

There are inhabited residences in a wide range of directions from the mine that may potentially be affected by blasting, however the assessment only considers a few receptors which are clustered together in a narrow arc to the southeast of the proposal.

This has a high potential to significantly misrepresent the likelihood of the blast impacts that are presented in the assessment;

No assessment between 7 am and 9 am is provided, which is a time that significant blasting impacts may arise off-site if not properly managed.

This has the potential to significantly underestimate the maximum impacts and also the likelihood of blast impacts.

NO_2 impacts from blasting are possible when there are unforeseeable complications with a blast. However this is the case for any blast at any mine in the Hunter Valley, and there is no specific or unusual circumstance in this situation that would alter this.

Blasting effects are generally well managed by scheduling activities to times when there is a low risk of impact, often when winds blow away from receptors.

It is normal for air dispersion modelling to predict that blasting under unfavourable conditions may impact receptors.

As would be expected, this is the case for this Project, however the assessment leads to some uncertainty as there are influences that both over and underestimate potential effects.

Generally more detail on how blasts would be managed might have been provided, however, blast management is a well-established practice in the Hunter Valley and this is not seen as a significant issue for this Project provided that the normal best practice measures for blast management are adopted.

In this regard it is requested that the proponent consider all potentially inhabited residences in developing its blast management strategy. A commitment to this effect would be a sufficient response, and it is expected that this commitment would entail the evaluation of potential blast impacts at a larger number of receptors prior to finalising the blast management strategy.

It should be noted that many of the details in a blast management plan may need revision from time to time, for example as the position of blasting activities relative to receptors changes over time. Thus the blast management strategy details such as wind angles and speeds etc. should not be rigidly fixed (e.g. in licence or consent conditions).

The proponent has provided appropriate commitments in this regard and points out that it did examine potential blast impact at all hours.

3.8 Overall modelling accuracy

The AQIA evaluates the model by comparing annual average PM_{10} levels for the mine operations and background levels with those measured in the same year.

The results are presented in Table 8.17 of the AQIA, which is shown below. The results show that modelled results, with the addition of a background level of 13.2 $\mu g/m^3$ of annual average PM_{10} are all well above the measured levels.

It is normal, and expected that NSW EPA approved regulatory models do not under predict impacts, but generally for annual average values the modelling results would typically lie within approx. 100% to 150% of the actual levels, a ratio of 1.0 to 0.66. Accurate modelling results are often within 110% of the measured levels, a ratio 0.91.

It is not generally reasonable to expect the model to be particularly accurate a long way away from the focus area, in locations where the Project being assessment may not have any tangible impact.

Table 2: Proponent's Table 8.17

Table 8.17: Comparison of measured and modelled annual average PM_{10} concentrations for 2011/2012

Monitoring Site	Measured	Model + Background	Ratio of measured to modelled
PM10-1	17.2	26.1	0.7
PM10-2	23.1	27.2	0.8
PM10-3iii	20.3	28.1	0.7
PM10-4	25.5	79.6	0.3
PM10-3ii	22.6	51.8	0.4
SX8	18.4	46.4	0.4
SX9	18.7	50.7	0.4
SX10	21.5	27.2	0.8
SX13	19.0	92.8	0.2
SX14	15.6	75.0	0.2
Maison Dieu (UHAQMN)	23.2	83.5	0.3
Camberwell (UHAQMN)	22.6	76.4	0.3
Singleton NW (UHAQMN)	23.1	48.4	0.5

The results in **Table 2** show that large over predictions arise in the AQIA modelling, up to five times higher near monitors SX13 and SX14, but that there is reasonable model performance at monitors PM10-1, PM10-2, PM10-3iii and SX10.

Generally simplistic and conservative Gaussian plume models tend to perform better on an annual average estimation basis, and it is noted that the AQIA acknowledges the large variability in model performance and to deal with this the AQIA applies an adjustment "grid" to correct the modelled results to equal that at the measurement locations.

This approach potentially removes all of the stated conservatism in the modelling, as the corrected results, which form the basis of the final assessment of impacts would be closely matched with the measured levels in 2011-2012.

However the AQIA does not consider two important issues:

1. Whether the large variation in modelling performance may be related to the quality of the measured data; or,

2. Whether scaling down of the predicted impacts (by a fixed fraction) by up to five fold is valid in the future case for future predictions.

The review previously noted that monitors PM10-1 and SX14 do not appear to have reported valid data, and the results at these locations are therefore dubious.

It is noted that some of the best and worst agreements between the modelled results and the measured levels occur at sites where the measured data do not appear to be valid, and it is concerning that this apparent error in the measurement data has been carried into the modelling in the form of a correction grid. This would make the model results equal the likely invalid measured levels, and this error is also projected to the future results.

This warrants correction as it would affect the modelled predictions.

At the most likely impacted private receptors (e.g. 114 and 116), the modelled results appear to be within the 0.5 to 0.6 ratio for the grid, thus the predicted future levels would be scaled down to levels that are half to 60% of that predicted.

It would appear that this correction would be applied to all future modelled years, however this does not consider that in future all of the mines would have moved and the impacts would be re-distributed (higher or lower). For the Project, the impacts are likely to increase in the future as the mine moves closer to receptors, but these impacts (and those from other mines) would be scaled down by up to half to 60% using a correction factor based on model performance for a scenario when the mine impacts were lower.

The method for correcting modelling inaccuracy using a fixed fraction, (calculated for the extent of over prediction in 2011-12 data, using what appears to be invalid monitoring data in some locations) is unlikely to improve model performance, and is not considered to be a reasonable means of improving the model performance.

The future impacts from the Project would be higher than in 2011-2012, and there is no reasonable basis to assume that because the current predictions (summed with background data) are higher by some percentage that all future predictions summed with the same background level will also be proportionally higher by the same fraction at the same location. (The proponent has now clarified that only the modelled other mines are scaled down in the future scenarios.)

It appears that the method for correcting the model variability is an additional biasing factor that affects the future modelling predictions, which whilst making the future predictions significantly lower, is unlikely to make them accurate.

Given the predicted results, using dust emission rates that are half of what might ordinarily be used, are higher than would be expected there is a concern that there may be something incorrect in the modelling. The scale of the model overestimation in parts of the modelling domain is also unusually large (approx. five-fold) but is also outside of the norms for reasonable modelling accuracy at the locations of most potential impact, and this issue is therefore a key concern.

Overall, the scale of the discrepancy between the measured data and the predicted results is large enough to suggest that there may be problems with the technical model set up, the approach to cumulative assessment or the monitoring data, all of which warrant examination and correction to ensure that the performance of the model in the areas that may be significantly influenced by the Project are reliable. (This issue primarily affects annual average PM_{10}.)

It is anticipated that these issues would be clarified after review of the monitoring and modelled time-series data requested above.

The data requested were made available on 10 March 2016.

4 DISCUSSION AND CONCLUSIONS

Various aspects of the assessment that warrant attention are raised in the review and the NSW EPA submissions.

Despite these concerns, it is however reasonable to conclude that the Project is generally sound, and is unlikely to be a significant risk to the environment. This can be determined by simply considering that the Project would utilise essentially the same equipment to extract the same or lesser quantities of coal. Although it is not clear if more overburden may be moved, the emission estimates for the various modelling scenarios indicate that dust emission levels in the most critical Year 10 scenario are similar to existing levels or lower. Therefore, the key risk associated with the Project is its potential to increase the dust levels at the receptors it would move closer to.

There are perhaps two privately owned receptors (R114 and R116) that, due to their location relative to the proposed mine progression, are likely to experience an increase in dust impacts with potential to tip the dust levels into the unacceptable range.

(It is re-iterated that whilst there are technical issues identified in the assessment, there is no inherent scope for what is proposed to have a widespread and significant impact on the environment, and only some localised effects would be possible.)

The critical issue for the assessment therefore is to accurately define where the relative change in the impact that may arise would occur, and also to accurately define the zone of impact.

Air dispersion modelling is especially suitable for this purpose, and is the best tool for making such an assessment.

The assessment in the AQIA focusses on predicting the zone of impact but is not convincing in this regard due to uncertainty in the assumptions used, for example there are assumptions that would underestimate or overestimate potential impacts by a significant amount.

Also there is no relative comparison between the current and future "line" of impact, which is a relatively neat way of overcoming minor uncertainty in the assumptions (provided the same assumptions are used in both cases and the zone of impact is reasonably commensurate with the measured levels).

Until the issues with the AQIA are clarified, it is not reasonable to draw any firm conclusions in regard to the actual acceptability of impacts at any specific receptor, but as noted at the outset, the nature of any impact only has potential to affect a small number of receptors to a small degree and overall the Project has merit.

The above review does not contain an exhaustive list of the issues identified, and it is possible that new issues may arise once further clarification is provided.

Additional information has been provided to address many of the technical issues raised in the review. Data were also provided so that the issues could be independently analysed.

This additional information and analysis of the data focussed on the cluster of receptors to the southeast of the Project, as described above. These are the only locations where the Project will progressively move closer to and thus where its impacts would increase over time. Receptors further north or south of this cluster of privately owned receptors would not experience sufficient prevailing winds from the direction of the mine to cause long term or lasting impacts, and therefore would not have significant scope for any major effects.

Generally, the information now provided by the proponent addresses the majority of the issues raised.

The proponent did not adequately address several issues, however it provided raw data which allowed the review to conduct its own analysis and assessment. These issues were:

1. Whether the skew in the measured weather data would affect the modelling results.
2. Whether the period chosen for modelling, which corresponds with low levels of annual average PM_{10} measured at the SX9 and SX10 monitors in the vicinity of the southeast receptors of most interest would affect the conclusions reached in regard to impacted receptors.
3. Whether the modelling assumptions in general but specifically those relating to annual average background PM_{10} would affect the results (and hence conclusions).
4. Whether the potential bias in the emissions from the various dust sources are reliable and whether this may have an effect on the modelled outcomes.

4.1 Skew in weather data

The issue raised regarding the skew in the measured weather data becomes clear when the analysis requested by the review was conducted. This is detailed in **Section 3.5** and identifies the skew in the weather data.

The proponent's analysis of this issue is considered to be inadequate. The proponent considered whether the weather data were within the minimum and maximum of the data set, (which by definition it must be) and used this as the basis to conclude that the data were representative of the prevailing conditions.

The proponent did not adequately examine the issue, and hence did not clearly determine whether or not the issue affected the results of the air assessment. The proponent appears to have focussed on an example raised in discussions about the weather data, and does not adequately address the key substantive issue in this regard.

The review made written requests for specific analyses to be done, such as those conducted by the review and presented in **Figure 1**, **Figure 2** and **Figure 4** to **Figure 8**. The figures show that there is a problem with the data measured at station SX8, but that the data measured at SX13 do not appear to have any significant issues. The SX8 and SX13 weather data are used as input to the meteorological model.

In **Figure 8**, the review examined whether the modelled data (black line) was reasonably representative of the actual conditions which may occur near the cluster of receptors to the southeast of the Project. The figure shows that the data used in the actual modelling reflect the data at station SX13 (containing

valid data). The figure also indicates that the modelled data also include low wind speed flows down along the valley at this location, as would be expected in reality.

It was thus concluded that although there are problems with the input meteorological data from SX8, this would not appear to have caused any significant effect on the modelling in the vicinity of the receptors to the southeast. Thus the meteorological aspect of the modelling was considered to be adequate in the vicinity of the receptors of key interest.

It is also observed that the problematic station SX8 appears to be producing sensible data in 2014, thus no further recommendations are made to examine possible issues with the SX8 station.

4.2 Low background levels in the period chosen for modelling and modelling assumptions, including "background" dust levels

The proponent did not adequately respond to the issue of low background dust levels. The issue is detailed in **Section 3.5.2**. The data show that the annual average PM_{10} levels measured in the period chosen for the assessment are below the levels measured in any calendar year, and when plotted, correspond with a period of some of the lowest levels measured in the area.

The background levels in the period modelled are lower than is typical and hence are not representative of the likely conditions that may occur in the vicinity of the south east receptors. This means that there would be an underestimation in the predicted off site dust levels.

The second issue arises in regard to the actual "background" level"[1] used by the proponent in its assessment of annual average PM_{10} levels.

The proponent used a median level (in the AQIA), then mean values (in the initial revised response) and in the final response used a different mean level, all derived on the basis of data from OEH stations away from major mining activity. None of the "background" levels calculated by the proponent could be reproduced by the review using the data provided by the proponent.

It is not known how the background levels used in the assessment were derived. The proponent did not explain the apparent discrepancy between its derived background levels and the measured data. The review thus considers that it is likely that there may be an error in the proponent's calculations in this regard.

This poses an issue for the review in regard to evaluating the likely cumulative annual average PM_{10} impacts of the Project. An analysis was conducted by the review as outlined in **Section 3.5.2**. The review concluded that on balance, it is likely that an underestimation in the (most recent) "background" levels applied by the proponent of 3.1 $\mu g/m^3$ may arise.

[1] It needs to be noted that the proponent used its own definition of the "background" level for assessing annual average PM_{10}, and using data from elsewhere. This was done because the proponent was attempting to avoid double counting of the existing mining emissions in the background data and in the predicted modelling values. However following the EPA Approved Methods would not introduce double counting.

4.3 Bias in the apportionment of emissions from the various dust sources

This issue relates to the unusually low fraction of the total emissions that were calculated by the proponent to originate from overburden activities, and the high fraction from coal activities.

Various data inputs, including the silt and moisture levels of materials are used in emission factor equations to calculate the emissions from a range of mine dust sources. The review questioned whether these data inputs were representative of the entire site, and used an example to illustrate that the data may not be representative. The example pointed out that the moisture level in the overburden reduced after handling (the reverse would be expected).

The proponent's response examines the example, rather than providing an adequate response to the issue raised. It applied one of the potentially unrepresentative values for the overburden moisture levels to all of the overburden and as this did not change the emission source apportionment greatly, concluded there was no issue.

The proponent did not adequately respond to the issue that its overburden handling emissions total 4% of the mine emissions or that it's coal handling emissions total 40% of the mine emissions and are thus unlikely to represent the actual case reasonably.

The proponent's response in this regard is inadequate. The review concluded that there is bias in the apportionment of the emissions, and this will bias the potential impact predicted from the site to some degree.

The effect would likely lead to under prediction of the Project dust levels at the receptors to the southeast. This is because, although the net total emissions appear to be reasonable, the emissions from activities closest to the receptors appear to be too low and those from activities further away appear to be too high.

The issue of bias in the apportionment of dust sources in the modelling may be a factor affecting the apparent inaccuracy in the modelling. At the receptors of key interest to the south east of the Project, the predicted Year 1 results do not accord with the measured data, and show lower effects than would be likely to arise from the northwest and higher effects from other directions than occur in the measured data.

This issue poses problems for the review in determining the likely off site dust levels due to the Project.

4.4 Effects of the issues on the predicted results (modelling inaccuracy)

The issues with potential for underestimating the Project impacts were not considered to be significant for 24-hour average PM_{10}. The review examined the predicted 24-hour average levels and found very large over estimations on many days. Therefore on a short term basis, there does not appear to be scope to underestimate the highest 24-hour dust levels due to the Project at the receptors of most concern.

On an annual average basis, the review found scope for underestimation in the Project PM_{10} dust levels at receptors to the southeast. The predicted dust levels due to the Project were not available for the review for the baseline model year (2011-2012), but were provided for Years 1, 5 and 10.

Based on the total of all mine predictions available for the baseline year and the Project alone predictions for Year 1, it can be reasonably estimated that the Project contribution to annual average PM_{10} levels near receptors to the southeast in the baseline year may be approximately 7.5 to 5 $\mu g/m^3$ at SX10 and SX9 respectively (note that the Year 1 levels are 8.5 to 5.7 $\mu g/m^3$).

Thus the modelling results suggest that other mines would contribute between approximately 5.7 and >30 $\mu g/m^3$ in the baseline year at SX10 and SX9 respectively (as the proponent's modelled total contribution from all mines is 13.2 and 36.7 $\mu g/m^3$ at SX10 and SX9 respectively).

This indicates that relative to the Project, the proponent predicted that other mines would have a similar, or much larger contribution to the measured dust levels in the baseline year. This is also the case in Year 1 as can be seen from the proponent's December 2015 response which shows bar graphs of the various predicted levels. The proponent's figures show that the contribution to dust levels at receptors to the southeast from mine sources to the northwest is similar or smaller than that from mine sources to the southeast or other directions.

However the proponent's predictions are in conflict with the actual situation in the baseline year. The measured background data near the private receptors of interest to the southeast of the Project are shown in the proponent's pollution roses (refer to the right side of **Figure 9**), and show that the key impacting dust sources are from the northwest, and significantly less from all other directions.

The proponent did not provide pollution roses for the baseline year (chosen modelling period). This is provided by the review in **Figure 12**.

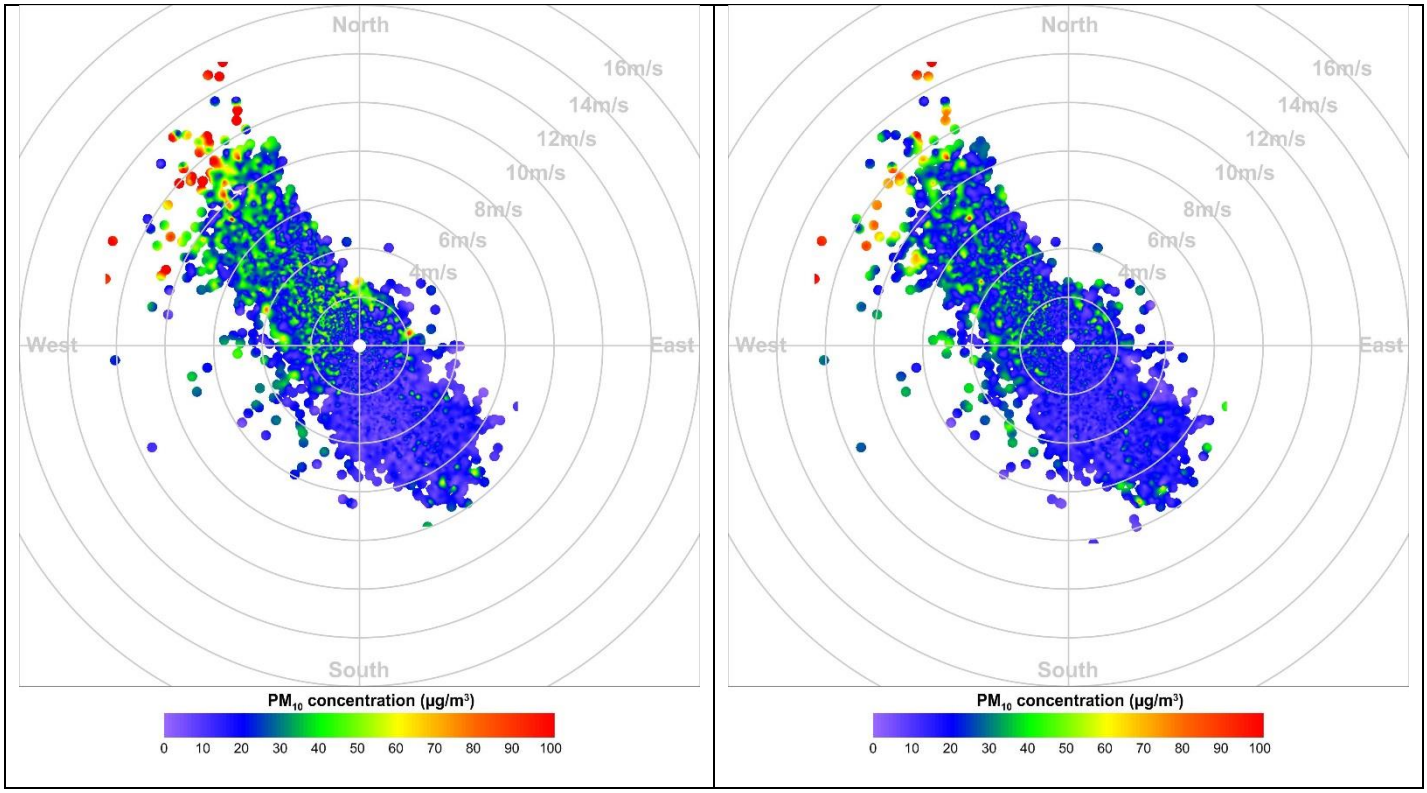

Figure 12: Pollution roses for period modelled for SX10 (left) and SX9 (right) dust levels using SX13 weather data

The pollution roses for the modelling period, and also the measured data at SX9 and SX10 show that the dust levels from the northwest quadrant are close to double (approximately 160% to 220%) those from the southeast quadrant on an annual average basis. As a large part of this would be from mining dust, the proponent's predictions in regard to the scale of the contributions from the various sources to dust levels appear to be in conflict with the actual situation.

The data indicate that there is likely to be an underestimation in the mine dust levels from the northwest and overestimation in those from other directions, estimated to be between 50% to 100%, based on the pollution rose data and assuming that not all of the measured difference is due to mining activities. [2]

This observation is further supported by considering that the proponent's maximum predicted levels at the southeast receptors in Year 1 are as low as approx. 23 µg/m^3 (uncalibrated results using the higher 14.9 µg/m^3 background levels) and that the levels measured in the recent past (when impacts should be less) in that area have been above 25 µg/m^3.

The issues raised in regard to unlikely apportionment of dust contributions from the various sources on the site would also have some effect on these predictions.

The modelling approach is therefore not considered to be reliable in regard to the total predicted annual average PM_{10} level and also the attribution of the sources contributing to the annual average PM_{10} impacts.

In light of this, and the other issues identified above, the review developed three scenarios to determine the maximum potential effect these issues may have on the conclusions of the assessment.

4.5 Factoring in the potential effect of the various issues on the predicted dust levels

The review examined the likely upper range of effects on annual average PM_{10} resulting from the identified issues. This was done by considering three possible scenarios affecting the predicted results at the receptors of most interest to the southeast of the Project.

The scenarios are considered to represent the upper bounds of any potential underestimation in the predicted levels at the receptors to the southeast. The scenarios considered were as follows;

1. Add 3.1 µg/m^3 to the predicted annual average PM_{10} levels (the uncalibrated levels using a background level of 14.9 µg/m^3). This was done to consider potential underestimation in the background levels used in the assessment.

[2] It is noted that in its March analysis, the proponent outlines that modelling will over predict impacts under low wind speed conditions more so than under high wind conditions. This is correct, but it is also relevant to observe that the proponent's wind roses use a coarse resolution (or some form of averaging) and hence do not clearly show the short term dust levels that actually occur. By reference to **Figure 12** it is apparent that relatively elevated short term dust levels do occur under low wind speeds, and these elevated levels arise during winds from the northwest.

2. Add 50% to the annual average PM_{10} predicted Project contribution, this was done to consider the apparent underestimation in potential impacts from the Project, evident by examining the pollution roses and by comparing the modelled and measured results.

3. Add 100% to (double) the annual average PM_{10} Project contribution and halve the contribution from other mines. This was done to consider the issues at scenario 2, but also to cumulatively consider that the other mining sources appear to be overestimated in the modelling.

When these three adjustments to the predicted results are made, private receptors R114 and R116 would experience annual average PM_{10} impacts, as shown in bold red font in **Table 3.**

It is noted that whilst exact data are not available for private receptor R4, examination of the proponent's December 2015 response indicates that minor potential impacts may occur at R4 in Year 1 and Year 5, but not in Year 10.

The proponent has calculated that if 3.1µg/m^3 is added to the predictions the scale of the potential exceedance would be exactly 0.1 and 0.2µg/m^3 in Years 1 and 5 respectively. The proponent also notes that predictive dust management would reduce emissions and this was not considered in the review.

The review agrees that reductions arising from the operation of a sophisticated predictive dust management system are unlikely to be reflected in the monitoring data used to form the basis of the review estimations. The review also agrees that minor improvements of 0.1 to 0.2 µg/m^3 could be reasonably achieved with the use of a sophisticated predictive system and the improvements in mining activities that typically ensue from the use of such systems. It is also noted that as the mine moves closer to the receptors of concern to the southeast, and its incremental dust impacts increase, the benefit from a predictive system would also increase, albeit remaining relatively small on an annual average basis. Hence it is considered that with such a system in place, such potentially minor impacts at R4 could be reasonably controlled.

Table 3: Summary of results

Receptor ID	Year 1 scenarios			Year 5 scenarios			Year 10 scenarios		
	1	2	3	1	2	3	1	2	3
R19	26.1	24.1	23.3	24.9	23.1	23.2	22.0	19.6	20.0
R23	27.8	26.2	25.3	27.1	26.0	26.6	23.0	21.0	21.6
R112	29.3	27.9	26.7	28.5	27.8	28.3	24.5	23.1	24.2
R114	**32.3**	**31.1**	28.6	**31.8**	**32.0**	**32.6**	28.7	29.2	**31.9**
R116	**33.6**	**32.2**	28.8	**32.1**	**31.9**	**31.5**	28.8	29.2	**31.6**

As the three scenarios represent reasonable upper bounds of potential impact, it is not considered likely for the impacts that may arise from the Project to be greater than shown in the three scenarios considered.

5 RECOMMENDATIONS

As many of the issues raised appear to be relatively simple matters of clarification and quantification, it is recommended that the proponent address the issues.

The key objective of addressing the issues raised is to ensure that the AQIA is able to reasonably establish whether all receptors that should be afforded acquisition rights have been identified (or not). It is believed that this issue may affect only a few receptors that are relatively close to the applicable criteria (i.e. to the SE of the Project).

To achieve this, the core recommendations are to:

1. Address the various issues raised in this assessment and the NSW EPA submission;

2. Provide plots showing the predicted zone of impact for annual average PM_{10} and $PM_{2.5}$ for the existing operation (i.e. in the modelled meteorological year). The purpose is to demonstrate that the existing predicted levels align reasonably with the actual measured levels). Plots should also be provided for incremental 24-hour PM_{10} and $PM_{2.5}$. The results should be for the model used in the AQIA to predict the future impacts. Please note that only the latest results should be provided (the original AQIA results would not be necessary if there has been any update).

3. Revise the modelling to ensure that reasonably reliable alignment is achieved between the actual and the predicted dust levels for the existing case;

4. On the same plots in point 2, overlay the maximum:

    a. approved levels of impacts from the previous EIS study, demonstrating the difference in the results arising due to the model used in the AQIA, relative to the approved extent of impacts;

    b. future predicted levels, demonstrating the extent of any increase in impacts due to the Project (relative to the existing case and the approved case);

5. Revise the AQIA, as necessary to reflect the above. Please note that only the latest results should be provided (the original AQIA results would not be necessary if there has been any update).

The focus should be on understanding how the dust levels from the Project may affect the areas to the southeast where the greatest potential for any adverse impact may arise.

It is considered that if this is done reasonably it would allow the PAC to make a reasonable and robust assessment of the Project in regards to the acceptability (or not) of any specific impacts at each receptor.

The review examined the proponent's responses and data that arise from the review and concludes that due to the modelling period chosen, the adopted assessment approach and other issues, there is potential for the proponent's predictions to underestimate annual average PM_{10} impacts.

The review thus examined the likely upper range of effects on annual average PM_{10} resulting from this issue by considering three possible scenarios affecting the predicted results at the southeast receptors. The scenarios considered to test the upper bounds of potential impacts were as follows.

1. Add 3.1 µg/m^3 to the predicted annual average PM_{10} levels (the uncalibrated levels using a background level of 14.9 µg/m^3). This was done to consider potential underestimation in the background levels used in the assessment.

2. Add 50% to the annual average PM_{10} predicted Project contribution, this was done to consider the apparent underestimation in potential impacts from the Project, evident by examining the pollution roses and by comparing the modelled and measured results.

3. Double the annual average PM_{10} Project contribution and halve the contribution from other mines. This was done to consider the issues at scenario 2, but also to cumulatively consider that the other mining sources appear to be overestimated in the modelling.

When this was done, it identified that private receptors R114 and R116 would experience potential annual average PM_{10} impacts.

Thus, on the basis of the review and the information available, the following recommendation is made:

That the air quality assessment, additional information and data provided by the proponent and considered in this review is now sufficiently adequate to determine the potential impacts of the Project, and that if the Project is approved, it be subject to the addition of three conditions relating to air quality. These conditions arise from the additional information provided to the review, and are as follows:

1. That a 10m high weather station be installed in the general vicinity of the cluster of private receptors to the southeast of the Project. This would be a location approximately between or at either of dust monitoring stations SX9 and SX10. The purpose of this condition is to assist the mine to best manage any potential impacts that may arise to the southeast;

2. That receptors R114 and R116 be afforded acquisition rights on the basis of likely annual average PM_{10} impacts in all years; and,

3. That an accurate predictive dust management system be operated to minimise the potential dust impacts of the Project, with focus on the receptors to the southeast of the Project.

To be clear, the impacts presented by the proponent do not include annual average impacts at R114 and R116 as determined by this review. These additional impacts should be added to any conditions that would normally be derived by the Department in its review of the proponent's assessment. In this regard the assessment and information provided by the proponent can be used to develop any other relevant air quality conditions.

6 REFERENCES

NSW DEC (2005)
"Approved Methods for the Modelling and Assessment of Air Pollutants in NSW", August 2005