



GLOUCESTER RESOURCES LTD

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Part 2C: Peer Review of the Air Quality and Health Risk Assessment and the Social Impact and Noise Assessments

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CONTENTS

	Page
1. INSTRUCTIONS	5
2. BACKGROUND	6
3. AIR QUALITY AND HEALTH RISK ASSESSMENT	8
4. HEALTH RISK ASSESSMENT	9
5. SOCIAL IMPACT ASSESSMENT	11
6. NOISE, VIBRATION AND BLASTING ASSESSMENT	11
7. CONCLUSIONS.....	12

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**AMENDED ROCKY HILL COAL PROJECT
GLOUCESTER RESOURCES LIMITED**

**PEER REVIEW OF THE AIR QUALITY AND HEALTH RISK ASSESSMENT AND
THE SOCIAL IMPACT AND NOISE ASSESSMENTS**

**PREPARED BY
ASSOCIATE PROFESSOR DAVID MCKENZIE**

1. INSTRUCTIONS

- 1.2 This report has been prepared on behalf of RW Corkery & Co. Pty Ltd to form part of an Environmental Impact Statement for the above project.
- 1.3 This report has been prepared having regard to Division 2 of Part 31 of the Uniform Civil Procedure Rules 2005 and the Expert Witness Code of Conduct in Schedule 7 of the Uniform Civil Procedure Rules 2005. I have read these provisions and agree to be bound by them.
- 1.4 In preparing this report, I have reviewed the following material:
 - (a) *EIS Executive Summary - RWC;*
 - (b) *Extracts from the Air Quality Assessment – Pacific Environment Limited;*
 - (c) *Health Risk Assessment – Pacific Environmental Limited;*
 - (d) *Extracts from the Social Impact Assessment - Key Insights;*
 - (e) *Noise, vibration and blasting assessment – SLR Consulting Australia Pty Ltd.*
- 1.5 I have been instructed to review the above documents and provide a peer review of the assessments with particular emphasis on any health-related issues for the residents of Gloucester with respect to open cut coal mining and the air quality projections contained in the Air Quality Assessment for the amended Rocky Hill Coal Project.
- 1.6 I am a Respiratory Physician with 30 years clinical experience and considerable expertise in occupational lung disorders and airborne pollution. I am the Medical Director of the Program of Medicine and Integrated Care at the Prince of Wales Hospital, South Eastern Sydney Local Health District. I am also in private practice at the Prince of Wales Private Hospital and it is in the latter capacity that I have prepared this report.

2. BACKGROUND

- 2.1. Inhalation of suspended particulate matter is a natural phenomenon that has occurred throughout evolution. The healthy lung can remove most forms of foreign matter using the mucus lining the airways and special scavenger cells (macrophages) in the air sacs (alveoli). The potential for inhaled particulates to cause harm depends on the chemical and physical nature of the particles, the concentration of the particles in the air, the percentage of particulate matter which is in the respirable size range of $<10\mu\text{m}$ in diameter (i.e. small enough to be inhaled into the lung, also known as PM_{10}) and the individual susceptibility of the person inhaling the dust. Many scientific studies are now concentrating on the smaller or fine particles ($\text{PM}_{2.5}$) which are inhaled as far as the alveoli in the lungs.
- 2.2. Most dust that we inhale is harmless and sometimes referred to as "nuisance" dust. Asbestos fibres and very fine particles of crystalline silica, on the other hand, may produce severe fibrotic reactions in the lungs. Silica is contained in quartz, sand and many rocks such as granite. The percentage of free silica in coal and the overburden (material above or around the coal seam) varies substantially from site to site but is usually a relatively small fraction. Atmospheric levels of silica have been measured in the vicinity of two mines in the Hunter Valley and the worst case values ($0.5 - 1.8 \mu\text{g}/\text{m}^3$) were well below the environmental standard for an annual average ($3.0 \mu\text{g}/\text{m}^3$, ACARP Study, C18026, June 2012). Dust we inhale also contains numerous other substances usually in very small quantities. In heavily populated urban areas, the air contains particles from the exhaust systems of vehicles, especially diesel trucks and buses and other processes which combust hydrocarbon fuels such as power stations, heavy industries, jet aeroplanes etc. In rural communities, the dust may contain particles from wood fire smoke and dust released from ploughing and the harvesting or processing of various grains such as wheat. There are also small concentrations of pollens and spores of fungi. In coastal areas, sea salt comprises a significant fraction of the particulate matter (PM).
- 2.3. The PM_{10} fraction of airborne dust will therefore vary in composition from place to place depending on the types of industry and the density of vehicular traffic. It also varies with the temperature, humidity, weather (including rain, wind speed and direction), and the time of year. The composition of fine airborne particles collected in an urban area would be different from the particles collected in a rural area because of the relative contribution of exhaust fumes. Motor vehicles are the major source of air pollution in urban areas, contributing to the photochemical smog or haze seen on still days. The urban pollutants most strongly associated with adverse outcomes are "black smoke" or "elemental carbon" which are products of combustion and most strongly associated with diesel traffic. However, air quality in Australian cities is better than in most other cities of similar size in Europe and the US, particularly in relation to the levels of $\text{PM}_{2.5}$.

- 2.4. Suspended particulates (PM₁₀ and PM_{2.5}) in a purely rural setting are different from urban pollution and are less likely to adversely affect health because of a smaller fraction of products of combustion, especially vehicle exhaust fumes which are prominent in the petrochemical smog of cities. In rural areas, the bulk of airborne particulates are likely to be dust released from farming operations or road works and would include mineral dust, grain dust, pollens and, in winter, smoke from wood fires. It would vary with season, the type of farming and any other variable such as an open cut coal mine, coal fired power station or smelter in the district. In other words, the percentage of PM_{2.5} within the PM₁₀ range is lower in rural samples than in urban samples. Air quality criteria for PM₁₀ (and PM_{2.5}) have been established for urban areas and applied to rural settings. Using the urban criteria for rural areas is regarded as conservative.
- 2.5. Long-term exposure to excess levels of urban pollution is thought to induce oxidative stress, inflammation, progression of atherosclerosis and, possibly, altered autonomic function of the heart. Very high concentrations of airborne urban pollution are associated with increased cardiovascular and respiratory disease (including exacerbations of asthma) and increased mortality on high pollution days. A small proportion of the population is at risk of adverse outcome from short- and long-term exposure to pollution - that is the elderly, those with cardiopulmonary disease, infants and asthmatics. Most studies conclude that, although a susceptible individual's risk when exposed to air pollution is small, the large populations exposed in cities result in a significant burden of illness and mortality.
- 2.6. High levels of particulates occur with high winds in dry seasons and bush fires. When bushfires occur around Sydney, PM₁₀ levels can rise to 100-500 µg/m³ (i.e. up to 10 times the 24 hr criterion). There is weak evidence for increased admissions to hospital for respiratory complaints during bush fires around Australian cities. In contrast to the effects of urban pollution, there was no increase in cardiovascular admissions or in mortality. During the infamous East Coast dust storm of 23 September 2009, 24 hour PM₁₀ levels in Sydney reached 11,000 µg/m³ and PM_{2.5} reached 1,600 µg/m³ (80 times the NEPM standard). Emergency services reported an increase in complaints of breathing difficulties. Children, elderly and those with heart and lung conditions were advised to remain indoors. There was no significant increase in cardiovascular visits to emergency departments or hospital admissions for any reason. Paradoxically, there was a 5% decrease in the risk of admission to hospital for respiratory illness.
- 2.7. Noise intensity decreases with distance from the source according to the inverse square law under ideal conditions. If the sound intensity 100 m away from the source is x, it will be x/4 at 200 m and so on. The pressure wave on the other hand decreases in a power function such that it is halved every time the distance is doubled. The decibel scale which is logarithmic is used to measure noise intensity. Painful noise (e.g. a rock concert or jack hammer) is around 120 dB(A) but levels over 80 dB(A) may damage the inner ear if exposure is prolonged. The likelihood of

damage to hearing is a product of intensity and duration of the noise as well as the frequency composition of the sound. A quiet room would be between 30 and 40 dB(A). Noise intensity diminishes by 6 dB with every doubling of distance from the source. Therefore, if the worker was exposed to noise of 85 dB(A) at a distance of 1 m then the noise intensity at 1 km would be 25 dB(A) outdoors and 18 dB(A) indoors (with windows open). At 4 km, the noise level would be 13 and 6 dB(A) respectively and so on. These values are substantially less than the noise in a quiet room and therefore very unlikely to cause any health impacts. These calculations assume ideal conditions and do not take into account variations in atmospheric conditions, wind, reflection, etc. so the actual transmission could be greater or less.

- 2.8. In NSW, night-time traffic noise outside residences should be below 55 dB(A) as an average but transient peaks of 65-70 dB(A) may occur (e.g. trucks, motor bikes and sports cars). The noise inside is around 10 dB(A) less than outside. Residences near train lines may be exposed to peaks of 80 dB(A) at night. Aircraft produce noise levels typically in the range of 70-85 dB(A) depending on distance from the airport. The health effects of lower noise intensities are mostly believed to relate to sleep disturbance.

3. AIR QUALITY AND HEALTH RISK ASSESSMENT

The air quality and health risk assessment by Pacific Environment Limited includes an introduction explaining the possible emissions from an open cut coal mine. It is argued that emissions from combustion engines including carbon monoxide, sulphur dioxide and diesel fumes would be relatively low given the number of mining machines and the large area of the mine together with the fact that these emissions disperse rapidly and widely. The main focus of the report is on total suspended particulate matter (TSP), particulate matter with an equivalent aerodynamic diameter of 10 μm or less, particulate matter with an equivalent aerodynamic diameter of 2.5 μm or less and deposited dust emissions. The relevant air quality impact assessment criteria and advisory reporting standards for these particles are listed in detail.

Air-quality monitoring of deposited dust, PM_{10} and $\text{PM}_{2.5}$ has been ongoing since July 2010 at a number of places around the site. Meteorological data has also been collected from a weather station within the Mine Area specifically installed for this project. All these observations and measurements appear to have been conducted with appropriate methodology and the results are presented clearly.

Data for dust deposition indicates relatively low levels at all sites tested with an average across all sites of $1\text{g}/\text{m}^2/\text{month}$. The annual average PM_{10} data for the area ranged between $7\text{--}15\ \mu\text{g}/\text{m}^3$ with an average of $9\ \mu\text{g}/\text{m}^3$. Concentrations were slightly higher at the monitor closer to Jacks Road and the township of Gloucester which suggested a possible influence from nearby traffic. These values are well below the relevant standard which is $30\ \mu\text{g}/\text{m}^3$. Annual average $\text{PM}_{2.5}$ concentrations ranged from $3\text{--}7\ \mu\text{g}/\text{m}^3$, with an average concentration of $4.6\ \mu\text{g}/\text{m}^3$ which is well below the standard of $8\ \mu\text{g}/\text{m}^3$.

The highest 24-hour PM₁₀ concentrations for all sites ranged between 18 and 52 µg/m³. Only two exceedances of the 50 µg/m³ standard occurred over the 6 year monitoring period. One of these was possibly related to burning off nearby. There were six and seven occasions when the 24-hour PM_{2.5} concentration at the North and South TEOM sites respectively exceeded the advisory reporting standard of 25 µg/m³.

The report also summarised data for air-quality monitoring at the nearby Stratford Mining Complex. Over a ten-year period, the average dust deposition across all sites was 1.0 g/m²/month. The annual average PM₁₀ concentration across all sites was 11 µg/m³. These are both well within the standard.

Predictions based on dispersion modelling were made for four operational stages of the amended Project up to Year 10 (considered to be the worst periods for potential dust emissions) for concentrations of PM₁₀ and PM_{2.5}. Firstly, the dust emissions for the amended Project were modelled at 159 privately-owned residences and receivers and contour plots drawn around the Site. Then the cumulative concentrations incorporating the background concentration plus any contribution from surrounding mining operations were modelled. The results indicated that no privately-owned residences are predicted to experience exceedances of the project-related 24-hour average PM₁₀ levels above the criterion of 50 µg/m³ during each year of the amended Project. No privately-owned residences/receivers were predicted to experience exceedances of annual average PM₁₀, TSP or dust deposition above the assessment criteria. No residences/receivers were predicted to experience project-related PM_{2.5} concentrations above the 24 hr and annual assessment criteria.

In my opinion, the methodology used in this air quality assessment has been appropriate and applied in a conservative manner. The predictions have assumed a worst-case scenario, and actual emissions are likely to be less than modelled. I agree with the argument that diesel emissions will have a negligible impact on air quality at any privately-owned residence.

4. HEALTH RISK ASSESSMENT

The health assessment prepared by Pacific Environment Limited has used the modelling data from the air quality assessment to derive predicted increases in PM₁₀ and PM_{2.5} concentrations. These values were then examined in relation to the medical literature from epidemiological studies that have calculated the risks to health from urban pollution. The authors assert that the health risk assessment is conservative for several reasons. Firstly, the modelling data for dust emissions was designed to incorporate worst-case scenarios. Second, the environmental standards have been set conservatively with safety margins built-in to protect the most vulnerable individuals including the sick and elderly and infants. Third, the health risk assessment calculated the long-term risks based on exposure at the predicted levels for 24 hours per day for each day of the year for greater than 30 years whereas the life of the mine is estimated to be around 20 years. I agree with the assertion that the modelling has used conservative assumptions and that possible effects are likely to be less than calculated here (discussed further below).

The authors point out that there is relatively little Australian data on health effects from pollution and particulate matter. They also point out that there is little, if any, data on the risks associated with particulate matter in rural communities. They provide a brief review of some of the literature which has examined the short-term and long-term effects of PM on a variety of health outcomes. The review is not exhaustive and is not critical but I agree with the general line that has been taken and the conclusions. Data from several different studies were used to provide estimates of risks of death or hospitalisation associated with a $10 \mu\text{g}/\text{m}^3$ increase in PM_{10} and $\text{PM}_{2.5}$. These values were then adjusted for the predicted incremental increases in PM_{10} and $\text{PM}_{2.5}$ as a result of the amended Rocky Hill Coal Project based on the air quality assessment. Based on these calculations, it was estimated that the annual mortality per 100,000 would increase by 0.02 to 0.31 for different residences/receivers (from the 2010 base of 353 deaths; i.e. less than 1 extra death/ 100,000 population). The risk from short-term exceedances is even lower and would require a population of many millions to see a single death. The authors also calculated the increased risks of other outcomes such as increased admissions to hospital for various respiratory and cardiac conditions and these were generally less than 0.1 per 100,000 population.

The authors discuss these calculations in the context of the assumptions that were used and concluded that these estimates of risk are exaggerated. The modelling data from the air quality assessment gives levels in the open air which are likely to be higher than those in doors. It would also be reasonable to argue that the PM emissions from the mining operation would be less toxic than the petrochemical smog of urban pollution.

Therefore, the authors conclude that the risk to health from the amended Project is within the NEPM guidelines which state that an additional risk of one per 100,000 for adverse health outcomes is sufficiently small to be acceptable. I agree with this conclusion.

Pacific Environment Limited also calculated the health risks due to NO_2 . The air quality assessment predictions of NO_2 levels from blast emissions at the worst affected residence are well below the ambient air NEPM of $246 \mu\text{g}/\text{m}^3$ (one hour). Because blasting will occur only intermittently, the chronic levels of NO_2 will be well below the NEPM of $61.5 \mu\text{g}/\text{m}^3$ (annual). Therefore, it was concluded that health risks from NO_2 would be very unlikely. I agree that there would be minimal risk from NO_2 emissions for the residents in the vicinity of the site. Sulphur dioxide, carbon monoxide and diesel emissions will also be relatively small and disperse rapidly.

5. SOCIAL IMPACT ASSESSMENT

The Social Impact Assessment prepared by Key Insights Pty Ltd includes a survey of residents and interviews with key service providers. It provides a comprehensive analysis of potential benefits and risks to the community with emphasis on the potential loss of amenity to residents. I am not an expert in this field but I could find no obvious errors or omissions in this assessment which seems objective and sympathetic to the concerns of the community and service providers.

The conclusions are relevant and indicate that, by and large, the township's infrastructure would cope with the predicted increase in population with the possible exception of the ambulance service which is stretched at present. There were some concerns about the availability and affordability of housing and rental accommodation while others were concerned that property values near the mine would fall. Residents were concerned about potential health effects, noise and increased traffic and the uncertainty of change. Potential remedies to address some of these concerns were discussed and it was felt that uncertainty about the process and effects of the mine were creating anxiety which would likely ameliorate once a decision was made.

Overall, I felt the report was balanced and agree with the findings.

6. NOISE, VIBRATION AND BLASTING ASSESSMENT

The Noise, Vibration and Blasting Assessment described the results of noise monitoring at a number of residences/receivers in the vicinity of the Project between July 2010 and July 2012. The results show that most of the surrounding area had generally low noise levels except for those residences/receivers near roads which had elevated levels due to traffic noise. Noise modelling was then undertaken to predict the total noise at each residence/receiver in the vicinity at a number of key stages in the construction and operation of the amended Project. These periods for modelling noise levels were chosen because they represent distinct stages of the amended Project and included the period likely to have maximum noise impacts. The modelling considered noise emissions during calm and southerly wind conditions during the day and evening. The wind condition considered a feature of the area in accordance with the Industrial Noise Policy. Several potential sources of noise in the 2013 Project are not included in the amended Project so noise issues are of less concern.

The results indicated that the construction noise management level would be exceeded at a number of residences/receivers for approximately one week during the road upgrading works on Jacks Road and for approximately one month during the construction of the Mine Area access road and entrance. Mining operations will be limited to day and evening. Three privately-owned residences are predicted to have exceedances mainly between Year 4 and Year 7 of 1 - 2 dB(A) with one of them experiencing up to 40 dB(A) in the evenings.

Predictions for blasting indicate that during the early stages of the amended Project, all blasts would produce pressure waves and ground vibration within criterion levels at all privately-owned residences/receivers. This would continue in the later stages of the

amended Project, as blasting approaches the closest point to surrounding residences. The effects of blasting would be monitored and changes to the design and charge quantities of blasts would ensure that pressure waves and ground vibration criteria are not exceeded.

The assessment also listed a number of noise mitigation and abatement strategies that would be likely to reduce the noise experienced at the surrounding residences/receivers to levels below those in the predictions which do not take into account such strategies.

In my opinion the methodologies used in the noise and vibration predictions are appropriate and designed to be conservative. In other words, the actual noise levels experienced are more likely to be below the predicted levels than above them. The predicted levels of noise are generally low and well below those commonly experienced by residents in urban areas.

The noise levels predicted to occur at sensitive residences/receivers in the vicinity of the Mine Area are well below those that have been reported in the medical literature to be associated with potential health risks.

A large body of medical literature indicates that cardiovascular effects have not been demonstrated with noise levels below 55 - 60 dB(A) and cognitive impairment in children has not been demonstrated with noise levels below 50 dB(A). Significant sleep disturbance was not considered to occur at levels below 45 dB(A). Many studies have shown that sleep disturbances secondary to noise habituate over time. None of the surrounding residences/receivers are predicted to have noise levels above this range in the evenings. This is relevant for children and shift workers who may be sleeping in the evening or day. Moreover the amended Project will have no activity occurring overnight. Therefore the impact on sleep for most residents should be negligible.

7. CONCLUSIONS

After review of the dispersion modelling data for PM₁₀ and PM_{2.5} dust levels, I conclude that PM_{2.5} levels would be at acceptable levels in the districts and residential areas within the vicinity of the Rocky Hill Mine Area throughout the life of the mine even if the PM values exceeded the criteria at some residences/receivers from time to time. Fumes and gases from diesel exhausts and blasting disperse more rapidly in the atmosphere than particulate matter. These would not exceed criteria levels.

The calculations in the Health Risk Assessment are based on conservative assumptions and interpretation of the worst case scenario in the modelling data. I conclude that the potential risk to health is very small and within acceptable levels.

The noise levels predicted for residences/receivers in the vicinity of the Mine Area are below those that have been reported in the medical literature to produce adverse health effects. There should be no clinically significant impact on sleep quality or quantity, particularly given there will be no activity occurring overnight.