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5.7. Climate and Air Quality

The air quality impacts assessed in this section include particulates (i.e dust) that may have a direct impact on human or environmental health.

A detailed air quality assessment has been prepared by SKM and is included in **Appendix E.** The results of the air quality assessment are summarised below.

5.7.1. Existing Conditions

Climate

The impact that dust from the ongoing operation at Burringbar Quarry and proposed expansion would have on the surrounding area is dependent on the climate and dispersion meteorology. The climatology and dispersion meteorology of the area is strongly influenced by latitude, topography and elevation.

The climatic environment at the site has been described using historical meteorological data recorded by the Australian Bureau of Meteorology at Murwillumbah (Bray Park) which is approximately 12 km to the north east of the site quarry at an elevation of 18 metres.

Temperature, Rainfall and Humidity

In general, Burringbar experiences mild climatic conditions, due to its coastal location in far north New South Wales, characterised by warm moist summers and dryer winters. The warmest month of the year is January, which experiences a mean daily maximum temperature of 29.6°C and a mean daily minimum temperature of 19.6°C. July is the coolest month experiencing mean daily maximum and minimum temperatures of 20.9°C and 8.5°C respectively.

The warmer months of the year, particularly February and March, are usually the wettest time of the year, with February receiving the highest monthly mean rainfall of 234 mm. The driest month is September receiving a mean monthly rainfall of approximately 39 mm. The mean annual rainfall is 1584 mm occurring over an average of 150 rain days throughout the year.

Relative humidity peaks in February, March, April and May and typically declines towards the minimum in September and October. The annual range in 9am relative humidity is between 84% in February to 66% in September and October.

Wind speed and direction

Surface wind observations at 9.00 am between November and March illustrate a dominance of wind from the south (25% of the time). From April through to September, winds are generally from the west (28% of the time) and the north west (33% of the time). Typically, wind direction changes at 3.00 pm and is predominantly from the north east through to the south during September through to April, from the south during May and June and from the south and west during July and August.

Modelled results show the strongest wind which generally occurs at Burringbar is 9m/s, although the average wind speed is 4m/s. The wind most commonly blows from the east, 23% of the time, while the least common wind direction is southerly occurring 7% of the time. Seasonally, summer experiences the highest average wind speed at slightly over 4 m/s, while autumn provides the lowest average wind speed, at just under 4 m/s, demonstrating minimal variation in wind intensity by season.

Summer wind directions tend to come from the north west and the east, while during Autumn, the wind primarily blows from the east to south east, swinging to the north west in winter. By contrast, spring produces diffuse wind conditions, with contributions from most directions.

Atmospheric Stability Class

Atmospheric stability class is used to categorise the rate at which a plume would disperse. The Pasquill-Gifford stability class assignment scheme uses six stability classes from A through to F. Class A refers to unstable conditions where pollutants spread rapidly throughout the mixed layer. Class F refers to stable conditions where plume spreading is slow and dispersion is poor. The most common stability class at Burringbar is class D, which occurs 34% of the time. By contrast, class A (unstable) occurs only 3% of the time.

Air Quality

There are currently no DECC ambient air quality monitoring sites located in close proximity to Burringbar Quarry.

Tweed Quarry, located at Terranora, is considered to be a representative location for the purposes of establishing background levels of ambient particulate matter and deposited dust at Burringbar. Tweed Quarry is located approximately 20 km north of Burringbar and similar quarry operations are undertaken at the site. Insoluble dust deposition and 24 hour PM_{10} data were monitored at Terranora. Data from the Terranora monitoring location was utilised and presented by *Holmes Air Sciences (2005)* for an air quality study for the Tweed Quarry expansion. **Table 5-15** shows summary data for depositional dust. In recent years (since 2001) the dust deposition levels at all off site receivers were lower than the DEC guideline of 4 g/m^2/month.

- **Table 5-15 Terranora Dust Deposition Data**

Annual Average Insoluble Solids Dust Deposition Rate									
Units g/m²/month									
	Off site				On Site				
Year	D1	D2	D3	D4	D33	D34	D35	D36	D37
1994					8.6	10.0	4.5	8.6	4.1
1995					10.8	11.6	3.3	3.2	3.0
1996	3.1	2.2	1.3		12.3	20.8	5.5	6.0	2.2
1997	1.8	1.1	1.6		9.5	10.9	3.8	3.8	7.1
1998	3.5	1.6	3.1		13.1	8.0	15.0	4.3	4.0
1999	2.0	1.1	1.2		10.7	4.9	7.6	3.2	2.2
2000	2.3	1.1	1.5	0.7	8.9	4.5	3.5	2.9	1.6
2001	2.6	1.3	1.0	0.6	6.0	2.9	2.8	2.3	2.5
2002	1.2	1.2	0.8	0.8	2.5	1.9	2.0	1.2	1.4
2003	1.2	1.3	1.9	0.9	1.0	0.7	0.9	0.6	0.5
2004	1.7	1.9	1.6	0.9	2.0	2.1	1.3	0.6	1.2
Avg Total Period	**2.16**	**1.42**	**1.56**	**0.78**	**7.76**	**7.12**	**4.56**	**3.34**	**2.71**
Avg 2001 – 2004	**1.67**	**1.42**	**1.32**	**0.80**	**2.87**	**1.90**	**1.75**	**1.17**	**1.4**

- *Adapted from Holmes (2005)*

The maximum recorded value for 24 hour PM_{10} glc between 19th August 2003 and 3rd May 2004 was 47 $\mu g/m^3$. The average value for the same monitoring period was 18 $\mu g/m^3$ (*Holmes, 2005*). Annual average Total Suspended Particulate Matter (TSP) and PM_{10} concentrations can be estimated from dust deposition data. Holmes (2005) estimated annual average TSP to be of the order of 45$\mu g/m^3$.

5.7.2. Air Quality Criteria

The DECC regulates air quality in NSW, and sets objectives, criteria and assessment methods, where applicable. The publication relevant to this project is the DECC publication - *Approved Methods and Guidance for the Modelling of Air Pollutants in New South Wales (2005).* This document specifies modelling methods, as well as sets goals and criteria for air quality.

DECC notes the National Health and Medical Research Council (NHMRC) and National Environment Protection Council (NEPC) Guidelines and World Health Organisation (WHO) long-term goals in this document.

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Methods for establishing project specific criteria to take into account existing background concentrations when assessing potential impact are also specified. The site specific criteria for PM_{10}, TSP and dust deposition are outlined below.

PM_{10}

The air quality criteria for dust concentration are listed in **Table 5-16**.

- **Table 5-16 NSW DECC Particulate Criteria**

Pollutant	Averaging Period	Goal
Total Suspended Particulates (TSP)	Annual	90μg/m³
Particulate Matter < 10 μm	24 hours	50 μg/m³
Particulate Matter < 10 μm	Annual	30 μg/m³

The NSW DECC goal for annual average PM_{10} is 30 $\mu g/m^3$. The existing annual average PM_{10} concentration is 18 $\mu g/m^3$. Therefore the site specific criteria for annual average PM_{10} is 12 $\mu g/m^3$ (ie 30 $\mu g/m^3$ – 18 $\mu g/m^3$ = 12 $\mu g/m^3$).

The DECC criteria for 24 hour PM10 is 50$\mu g/m^3$. This assessment considers the total DEC criteria as project criteria.

Total Suspended Particulate Matter

Annual Total Suspended Particulate Matter (TSP), as indicated in **Section 0** was calculated to be 45 $\mu g/m^3$. The DECC criterion for TSP is 90 $\mu g/m^3$, therefore the site specific criteria would be 45 $\mu g/m^3$ (ie 90 $\mu g/m^3$ – 45 $\mu g/m^3$ = 45 $\mu g/m^3$).

Dust Deposition

Depositing dust, if present at sufficiently high levels, can reduce the amenity of an area. In NSW the DECC set limits on acceptable dust deposition levels. **Table 5-17** shows the maximum acceptable increase in dust deposition over the existing dust levels.

- **Table 5-17 NSW DECC Criteria for Dust Fallout**

Existing dust fallout level (g/m^2/month)	Maximum acceptable increase over existing fallout levels (g/m^2/month)
	Residential
2	2
3	1
4	0

The maximum acceptable increase in the mean annual dust deposition rate is 2 g/m^2/month in those areas where the existing dust fallout rate does not exceed 2 g/m^2/month. The quarry extraction operations should not exceed an annual mean deposition rate of 4 g/m^2/month (for total solids). This level should not be exceeded outside the site boundary as a result of all activities at the site.

A background deposition level of 2 g/m^2/month is a reasonable assumption in a semi rural area. This assumption is validated for Burringbar Quarry by the annual depositional values presented in **Table 5-15** for Terranora Quarry. Under this assumption the site specific criteria is 2 g/m^2/month (ie 4 g/m^2/month – 2 g/m^2/month = 2 g/m^2/month).

5.7.3. Impact Assessment

An assessment of the quarry expansion on air quality was carried out. There would be very little construction activity associated with the proposed expansion due to the nature of quarrying, so all impacts assessed are related to operational impacts.

Air Emissions Sources

The main threat to air quality caused by quarry activities would be from the emission of particulates. Particulates may be emitted whenever bulk material is disturbed. Specific quarry activities that have the ability to contribute to particulate emissions are:

- Excavation of top soil base material;
- Bulldozing;
- Grading;
- Bulk material transfer, loading and dumping with a front end loader;
- Blasting;
- Material crushing and screening;
- Wheel generated dust; and
- Wind generated dust from exposed surfaces.

Methodology

The AUSPLUME (version 6) dispersion model was used to predict the dispersion of PM_{10}, TSP and dust deposition, along with site representative meteorological data, within an approximate 3 km x 3 km receptor grid surrounding the site. The receptor spacing within the grid was 100 m. The predicted ground level dust concentration and deposition rates were compared with the criteria listed in **Table 5-16** and **Table 5-17** to determine the level of impact at nearby sensitive receiver locations.

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TAPM (version 3) was used to create site representative meteorological data, and used as an input for AUSPLUME. The lack of available meteorological data, at an appropriate quality for dispersion modelling meant that a synthetic meteorological file for Burringbar Quarry had to be created.

Emission factors were used to estimate the rate at which dust is emitted from each of the air emission sources during the quarry works at the site.

Model Assumptions and Emission Factors

Quarry machinery generate dust during operating hours, while wind erosion is a potential source 24-hours a day. For modelling purposes, it was assumed that base material extraction and processing would occur for small portion of the year. To extract 30 000 tonnes annually, it was assumed that the quarry would operate for 2-3 months, for up to eight hours per day. Wind emission was assumed to occur all year. Transportation of stockpiled material off site would occur episodically. It was assumed that up to 8 x 12.5 t and 4 x 30 t trucks would be loaded at the site each hour, a total of 80 per day.

All emission factors used in this study were sourced from the either the National Pollutant Inventory Emission Estimation Technique Manual for Mining (Environment Australia, 1999) or the USEPA AP-42 document (USEPA, 1995).

Modelling Results

Modelling showed that extraction and crushing activities are not likely to cause exceedences of project specific criteria for annual average PM_{10} or TSP GLC's.

Dust Deposition

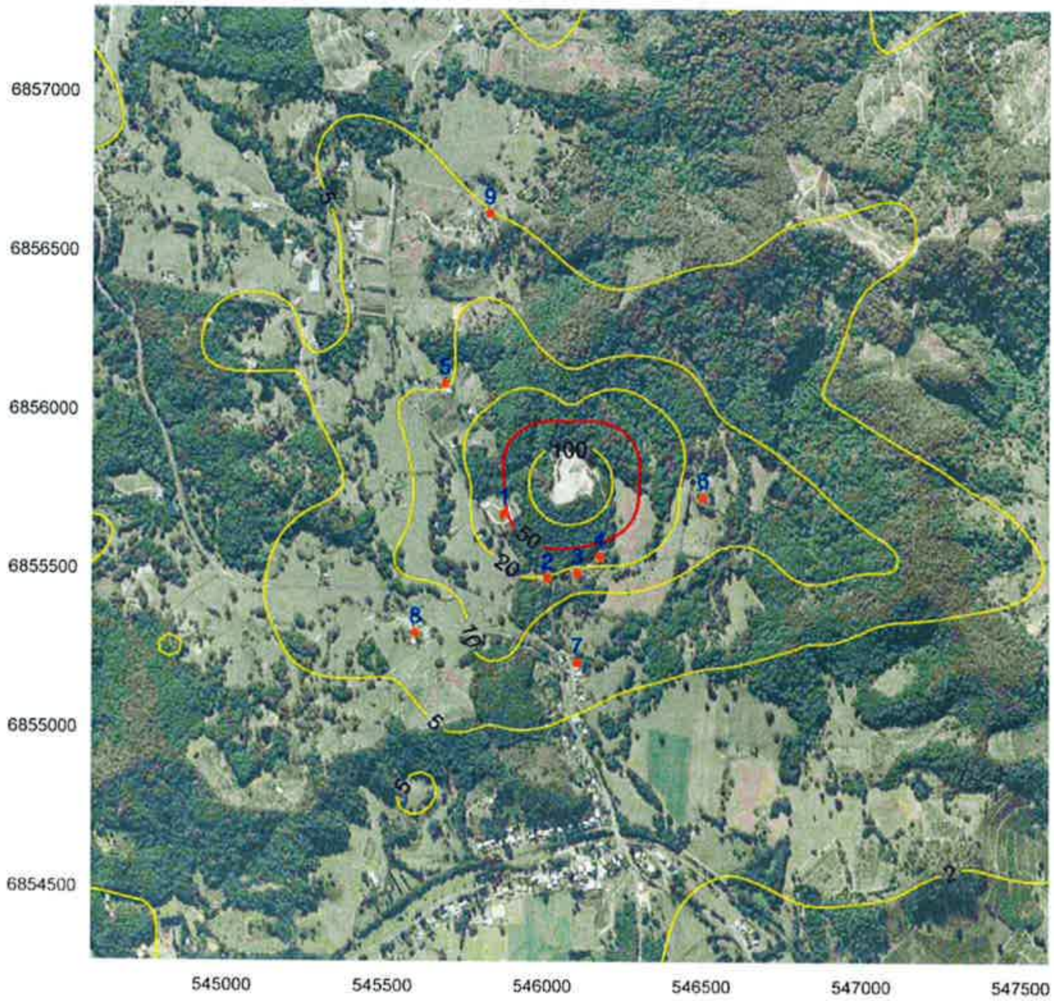
Monthly dust deposition rates were predicted on the basis of year-round quarry operations. Given that quarry operations are expected to occur episodically throughout the year, for an estimated total of just 2 - 3 months, these results were reduced by approximately 80% (2 months in 12) compared to those for year-round operations. Based on this adjustment, all predicted dust deposition rates (maximum of 1 g/m^2/month after modification) should meet the project criterion of 2 g/m^2/month.

24 hour PM_{10} Results

24 hour PM_{10} GLCs were predicted exclusive and inclusive of blasting. **Figure 5-6** shows model results for 24 hour PM_{10} without considering blasting. Results show that when blasting is not considered, there is no exceedance of the DEC criterion (50 $\mu g/m^3$), with the maximum modelled GLC of 44 $\mu g/m^3$ at Receiver 1.

Figure 5-7 shows predicted concentrations for 24 hour PM_{10} including blasting, which indicate that the 50 $\mu g/m^3$ criterion may be slightly exceeded at Receiver 1 with a value of 68 $\mu g/m^3$. Modelling therefore shows that blasting contributes substantially to the 24 hour GLC and any exceedance of the assessment criterion. Blasting is only expected to occur 1 to 2 times each year.

- **Figure 5-6: 24 hour PM10 Contours – Excluding Blasting**



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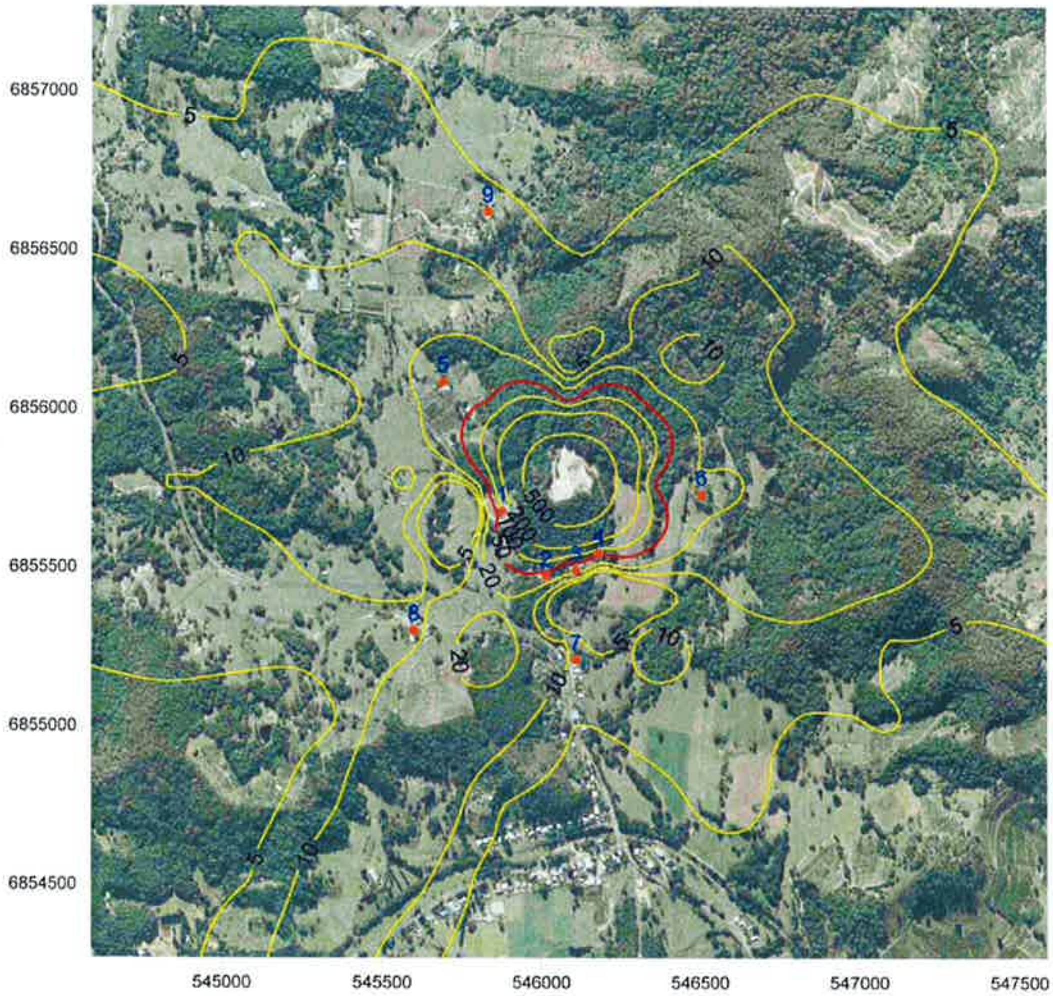
- **Figure 5-7: 24 hour PM_{10} Contours – Including Blasting ($\mu g/m^3$)**



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Annual PM_{10} Results

All predicted concentration increases were estimated to be below project criteria (12 μg/m^3), with a maximum increase predicted at an identified receiver of 4 μg/m^3. Predicted concentration contours are presented in the figures in **Appendix E.**

- **Table 5-18 Summary of Results**

Pollutant	Project Criteria	Dispersion Modelling Results / Compliance
PM_{10} (max 24-hr)	50 μg/m^3	Exceedence at sensitive receiver 1 (68 μg/m^3)
PM_{10} (annual)	12 μg/m^3	No exceedence at the nearest sensitive receiver (<4 μg/m^3)
TSP (annual)	45 μg/m^3	No exceedence at the nearest sensitive receiver (<14 μg/m^3)
Dust Deposition	2 g/m^2/month	No Exceedence at the nearest sensitive receiver (1g/m^2/month)

Conclusions

Given the episodic nature of the operations, modelling showed that extraction and crushing activities are not likely to cause exceedances of project specific criteria for annual average PM_{10} and TSP GLCs or dust deposition (refer **Section 0**).

In addition, 24-hour GLCs are not likely to exceed assessment criteria provided blasting does not occur. When blasting is undertaken, the 24-hour criterion may be exceeded, however this would only occur 1 or 2 times each year and would be within the DECC requirement of a maximum of 5 exceedances per year.

It is unlikely that the quarry operations would cause significant adverse impacts at nearby sensitive receivers. Mitigation measures would be implemented to maintain the potential impacts at a practical minimum.

5.7.4. Mitigation Measures

The principal means of reducing dust emissions from dust sources at the quarry is to increase the moisture content of the trafficked areas via watering or the use of chemical wetting agents. Therefore, the following control techniques would be implemented to control dust emissions:

- Watering of all road and exposed surfaces when the quarry is operational, in particular during dry and windy conditions;
- Sealing egress and ingress points to the site;
- Prompt clean up of any spills of quarried material on trafficked areas; and
- Maximum vehicle speed of 10 km/hr.

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All complaints in relation to quarry dust would be recorded and investigations commenced immediately (or as soon as practical) after receipt of the complaint.

In addition to this, management measures to reduce the impact on sensitive receivers, particularly during blasting, would include:

- Notification of all sensitive receivers before blasting episodes;
- Plan for blasting to take place under favourable meteorological conditions, to facilitate dispersion away for receivers (e.g. during a southerly wind); and
- Ceasing work on the quarry face in high wind or unfavourable wind conditions.