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23th December 2016

The Secretary
NSW Department of Planning & Environment
GPO Box 39
SYDNEY NSW 2001
ATTENTION: LAUREN EVANS

Dear Lauren,

Re: CLEARY BROS. ALBION PARK QUARRY – STAGES 5 & 6 MODIFICATION
LEC CONSENT NO. 10639 OF 2005 MOD 3
SUPPLEMENTARY RESPONSE TO MATTERS RAISED IN SUBMISSIONS

I refer to the NSW Department of Planning & Environment (DPE) correspondence dated 13th October 2016 and associated Agency/public submissions, requesting the preparation and submission of a supplementary report responding to the matters raised in relation to the Environmental Assessment provided for the above-mentioned Modification 3. These submissions have been reviewed by representatives of Cleary Bros (the proponent) and their consultants, with the following responses provided for the DPE's consideration in this instance.

DPE Correspondence dated 13th October 2016 (Attachment A)

1. **Air Quality**

The proponent has reviewed the submitted Air Quality Assessment prepared by SLR and acknowledges there is a typographical error in the heading of Table 9. In this regard, the Air Quality Assessment has now been amended such that the heading of Table 13 now reads: *"Incremental and Cumulative Annual Average TSP Concentrations at Surrounding Receptors"*, and the

updated report is attached as *Appendix 1* of this supplementary response.

2. Noise and Blasting

a. The DPE submission raised concerns over the analysis of noise impacts on sensitive receivers in the area, principally that only "The Hill" residence is explicitly identified in the text of the Noise and Blasting Assessment prepared by SLR. In the Noise and Blasting Assessment, "The Cottage" residence is incorrectly referred to as "The Hill" residence. This typographical error has now been corrected in the updated Noise and Blasting Assessment, attached as *Appendix 2* of this supplementary response.

"The Cottage" is the closest residence to the project site, located at approximately 385 metres from its closest point, to the nearest point of the extraction zone. As per standard industry practice and in line with previous assessments prepared, this nearest residence has been selected for assessing the impact of noise on the residences to the east of the quarry extension, all of which benefit from the affective noise mitigating measures created by the existing acoustic bund. Modelling of the noise contribution from the operation justify this approach, with all sensitive receptors below the 35dBA noise contour level, as depicted in Appendix C of the Noise and Blasting Assessment (again refer *Appendix 2* of this supplementary response).

Furthermore, the focus of this assessment has been to validate the predictions of the original approved Environmental Impact Statement (EIS) by Perram & Partners, following the collection of additional noise monitoring data through the earlier stages of quarry development. This assessment concluded that the measured noise levels were consistent (within 1 dBA) of the original predicted noise levels and, as such, no further investigation was required. This is supported by the absence of any complaints attributable to noise from the general quarry operations since the commencement of the quarry extension.

b. The DPE submission raised concerns that the noise level contour plan in Appendix C of the Noise and Blasting Assessment by SLR was not clear, with poor contrast between the different contours. This plan has now been amended to improve the contrast and is included in updated report attached as *Appendix 2* of this supplementary response.

c. The DPE submission requested further information regarding the predicted levels of airblast overpressure and vibration related to blasting activities, particularly the levels predicted by the Environmental Assessment (EA). The EA predicted levels for airblast overpressure and ground vibration of 112.3 dBLinear and 2.72 mm/s respectively. These levels were included in the EA for the previous Modification 2 application for the Albion Park Quarry (as approved), and represented the maximum measured levels from quarry operations since the commencement of the quarry extension up to the publication of the assessment. A further review of data since the time of this previous assessment calculates the 95th percentile values (consistent with licence and consent conditions) for airblast overpressure and ground vibration (Peak Vector Sum) to be 110.3 dBLinear and 2.48 mm/s respectively, while maximum values are 115.6 dB and 3.43 mm/s respectively. It is considered this now extensive record reinforces the effectiveness of the current site laws and blasting practices in achieving the objective limits related to blasting, and complying with all aspects of the environmental protection licence and development consent for the project. Further information relating to the management of blasting for the project can be found in the updated Noise and Blasting Assessment, attached as *Appendix 2* of this supplementary response

d. The DPE submission suggested discrepancies in the distance of blasting from the property boundary, with blasting described as being around 30 metres from the property boundary in Section 9.6.1 of the Noise and Blasting Assessment by SLR, whilst Section 9.8 describes control measures to be implemented to mitigate potential impacts

from flyrock when blasting within 20 metres of the property boundary. It must be acknowledged that the proponent is committed to maximising the recovery of the finite hard rock resource within the approved lease area, whilst at the same time ensuring the safety of people and stock, as well as minimising disruption of blasting activities on neighbouring properties. For this purpose, the proponent wishes to clarify that blasting may be undertaken to within 20 metres of the property boundary in Stage 5 of the project, with the additional controls (as described in the Noise and Blasting Assessment attached as *Appendix 2* of this supplementary response) to be implemented when blasting is to occur in close proximity to the property boundary. Further to this, the proponent's blasting contractor has since inspected all areas in close proximity to the property boundary, confirming that through techniques (such as decking, alignment, reducing bench heights, and where the blast design requires using additional cover material or the use of non-explosive rock breaking techniques), flyrock can be prevented from travelling not more than 10 metres behind the blast towards the property boundary. These techniques will adversely impact the productivity of extraction of the blue metal resource in close proximity to the boundary for the proponent, but will maximise resource recovery and ensure the responsible utilisation of the State's extractive resources, as supported by the Department of Industry – Resources and Energy in their submission to this Modification 3 (dated 12th October 2016). Accordingly, the Noise and Blasting Assessment, included as *Appendix 2* of this supplementary response, has been amended to remove any such inconsistencies now.

In addition to the above commentary provided on noise and blasting matters, I refer you to the 'Response to Comments' advice also provided by SLR, which is attached as *Appendix 5* of this supplementary response for DPE's consideration.

3. Agricultural Impacts

The DPE submission requested further assessment of the potential impacts on existing agricultural activities in the area, particularly in relation to the neighbouring dairy farm. Appendix S of the originally approved EIS for the Quarry Extension comprised a report by agricultural specialists Cowman Stoddart, into the effects of the project on the continuing operation of this neighbouring dairy farm. This report included discussions with the landholder of the neighbouring "Figtree Hill" property regarding their concerns of the potential impacts of the project on the continuing dairying enterprise. Five key concerns were raised at the time in relation to this matter, which were assessed by the consultant accordingly. These included potential links between blasting activities and abortions in cattle; impact of dust fallout on pasture productivity or cattle health; concerns around increased vehicular traffic along the public road Dunster's Lane related to vehicles accessing the quarry via this route; the loss of grazing land; and the potential for ingress into the neighbouring property due to landslips and erosion. To assist in providing the DPE with further analysis into the potential impacts of the project on existing agricultural activities, the proponent has undertaken a review of the original Cowman Stoddart assessment to assess the validity of the findings in this report, based on several years of site operation. This review follows the structure of the original assessment by examining each potential impact in turn as follows:-

a) *Abortion of Cattle*

A link was suggested between blasting activities and the abortion of cattle, with abortions identified following some blasts conducted by the quarries in the area. The consultant identified that the rate of abortions (at less than 5%) was within the natural limit accepted by veterinarians, and appeared not to have been a notable concern given no further veterinary advice had been sought. The rate of abortions has not since been raised as a cause for concern by neighbouring dairy properties, either directly or through the Community Consultative Committee (CCC) in place for the Albion Park Quarry operations. As such, the conclusions in the original assessment remain relative and

appropriate.

b) *Dust*

It was suggested that dust fallout onto pastures may affect pasture productivity or cattle health. The original approved EIS demonstrated through literature review of previous scientific studies that mine dust contributions of up to 8 g/m^2/month cause no impact on pasture productivity and/or milk production levels. Monitoring of dust deposition rates at fixed gauges surrounding the quarry and processing areas have shown average deposition rates of between 1.6 and 3.7 g/m^2/month, being within the accepted limit of 4g/m^2/month and well below the level identified above (at which no discernible impact on agricultural production was detected). Therefore, the determinations of the original assessment relating to dust impact on agricultural production remain valid.

c) *Public Road*

Concern was raised that quarry vehicles may increasingly use Dunster's Lane to access the quarry, thereby potentially affecting livestock. The Development Consent requires all access to the quarry excavation to be via the East-West Link, with Dunster's Lane able to be used to access the quarry in an emergency. The conditions of consent in relation to Site Access have been complied with since Consent approval. The proponent has constructed a haul road and formalised the right of way between the Quarry Extension and the East West Link, with no changes to this arrangement to be made while continuing quarry operations into Stages 5 and 6. As no vehicles are accessing the quarry excavation via Dunster's Lane, there will continue to be no impact on agricultural production from this activity.

d) *Loss of Grazing Land*

Concerns were raised around the loss of dry cattle grazing land in the original submission. No changes to land tenure are proposed as part of the progression into Stage 5 and 6 and, as such, the conclusions contained within the originally approved EIS study remain valid.

e) *Landslip on Quarry Boundary*

Concerns were raised around the possibility of landslips and erosion along the crest of the highwall of the quarry, leading to intrusions into neighbouring properties and the potential loss of fences. An acoustic and visual buffer is now in place between the quarry expansion and the surrounding (non-project related) agricultural activities, which serves to provide a physical buffer of at least 10 metres from the proposed highwall crest to the property boundary. This stable buffer has been successful in preventing any incursions to date, and will remain as an effective buffer as the quarry proceeds into Stage 5 and 6, especially when considering the inherent geotechnical strength of the hard rock resource.

The above further examination into the impacts of the first four stages of quarrying activities have demonstrated that the Cowman Stoddart conclusions of the original assessment into the impacts of the project on neighbouring dairying properties remain relative and valid. Therefore, it is confirmed that the quarrying operations can coexist with agricultural activities on the neighbouring properties.

4. Aboriginal Heritage

The DPE submission identified that the original investigations into indigenous heritage in the area were undertaken between 1998 and 2001 and, as such, a suggested further desktop review is warranted. The most recent study undertaken by Mary Dallas Consulting Archaeologists in 2001 concluded that the project is unlikely to have a significant impact on Aboriginal archaeology and/or cultural heritage. This conclusion was based on previous studies in the region, the topography of the area, nature of the soils within the project site, and the previous agricultural activities. Surface disturbance of Stages 1 to 4 of the project have not identified any items of indigenous cultural heritage to date, consistent with the findings of this study.

Notwithstanding this, as requested a search of the Aboriginal Heritage

Information Management System (AHIMS) was conducted on the 25th November 2016 on Lot 1 of Deposited Plan 858245 (on which Stages 5 and 6 are located) to identify whether any new records of indigenous cultural heritage are associated with the project site. This search identified no aboriginal sites or aboriginal places associated with the subject land parcel. A copy of this report is included as *Appendix 3* of this supplementary response. Based on the findings of this search, past investigations into indigenous heritage on the project site, as well as the results of surface preparation works in Stage 1 to 4 of the project, no further investigations are deemed warranted.

Further to this, in terms of overall Heritage Management, it must be acknowledged that specific actions to be taken in the event aboriginal relics are ever encountered during quarrying activities are already addressed in the Quarry Environmental Management Plan (QEMP) for the project site.

5. Agency and public submission

The request to consider and respond to all agency and public submissions is noted, and provided below for the DPE's consideration.

Department of Industry – Resources and Energy (DRE) correspondence dated 12th October 2016

The comments related to the responsible utilisation of the State's extractive resources are noted.

Department of Primary Industries – Water (DPI Water) correspondence dated 12th October 2016 (Attachment A)

Water supplies and quarry dam

The DPI Water raised concerns with the size of the existing dam on Lot 23 of Deposited Plan 1039967, suggesting its current capacity of 24ML exceeded the harvestable right of the property of 18.56ML. It must be noted that this

dam falls outside of the scope of the current development, however, water from this dam is utilised for dust suppression purposes on the project. Nevertheless, the proponent has (since the previous comments provided from DPI Water in relation to the approved Modification 2 of 10639/2005), reduced the overall capacity of the quarry dam to comply with the harvestable right under the *Water Management Act 2000*.

To this end, a new 150mm pipe has been installed adjacent to the spillway of the dam, with the invert 600mm below the overflow height of the previous weir structure. This has effectively reduced the maximum volume of water that can be stored in the dam by 6ML (down to a total of 18ML), aligning with the entitlement for harvestable rights. As such, a Water Access Licence and Water Entitlement is not required to comply with the *Water Management Act 2000*.

Annual Reporting

The DPI Water referred to the Integrated Water Management Strategy (IWMS) described under Condition 32 of Schedule 4 of the Development Consent, which requires an IWMS (where required) to include consideration of legislative requirements. However, Condition 27(e) of the Development Consent only requires the inclusion of the abovementioned IWMS where the Water Balance shows a potential demand for water above that which can be collected from rainfall. Appendix G of the QEMP contains the Water Balance assessment, which includes an examination of the self-sufficiency of the project with regards to water. This Water Balance has determined that during Stages 5 and 6 of the quarry extension, the project would be self-sufficient with regards to water and, as such, an IWMS (as described in Schedule 4 Condition 32 of the Consent) is not required.

Furthermore, the DPI Water suggested that the IWMS should be included within the Annual Review of the Water Management Plan. The Water Management Plan is required to be reviewed on an annual basis as per Schedule 4 Condition 32 of the Development Consent, however, as an IWMS is not a required sub-plan of the Water Management Plan, it does not (and

cannot) form part of this review. Nevertheless, the annual review of the Water Management Plan is included in the Annual Review prepared under Schedule 6 Condition 2 of the Development Consent. These Annual Reviews are, and will continue to be, available to the DPI Water to access on the proponent's website, as required by Schedule 6 Condition 9 of the Development Consent.

The DPI Water also raised a separate matter of the potential for groundwater interception as quarrying proceeds into Stages 5 and 6. As described in the Annual Reviews for the project to date, groundwater interception in the earlier stages of the quarry development has been minimal, with the massive basalt structure containing little free water. Quarrying is restricted to this hard rock resource overlying the porous sandstone aquifer. Water levels recorded in the groundwater monitoring bores, combined with the observable minimal accumulation of water in the Quarry Extension sump (which is discharged to the creek as required), suggest that there has been negligible interception of groundwater by the Quarry Extension to date. Nevertheless, the QEMP describes methods to transfer any groundwater that may accumulate in the quarry extension in the future, including through groundwater injection. This matter will continue to be reported in subsequent Annual Reviews for the Quarry Extension and, thus, will be continue to be available to the DPI Water.

Environmental Protection Authority (EPA) correspondence dated 13th October 2016 (Attachment A)

In considering the matters raised by EPA in their correspondence referred above, it is noted that the proponent met with representatives of the EPA on the 18th November 2016 to review the relative items contained within their submission, as well as discuss potential methods to address the EPA's queries. In this regard, the following is noted:-

EPA Regulation

The provisions of the POEO Act 1997 are noted in respect of the quarry operations and this proposed Modification 3.

Air Quality

The EPA's comments regarding the likely impacts on air quality at all residential receptors are noted.

Particulate Monitoring

The EPA's submission proposes a modernisation of the air quality monitoring network at the project site, from a single high volume air sampler (HVAS) and four dust depositional gauges, to a monitoring network based on real-time particulate monitoring. Furthermore, this direction is based on a change from a reactive management approach, where changes are made in response to measurements that may have been sampled over a month ago, to one where the site is able to respond almost immediately to elevated emissions. The EPA has expressed a desire to move from a regulatory environment for the local quarries based on absolute compliance with pre-determined criteria, to one based on adaptive management of relative levels of measured pollutants. This scenario would utilise a Trigger Action Response Plan (TARP) type approach to review and progressively alter operations if required to address elevated PM_{10} concentrations based on site-specific criteria as will be described in an updated Air Quality Management Plan.

In this regard, the proponent accepts the intent of the EPA is to improve air quality monitoring, and replace the existing HVAS and depositional gauge network, with a 'still to be determined' number of real time PM_{10} monitors (currently proposed by the proponent as two monitors), sited so as to assess any impact on the closest sensitive receptors to the Quarry Extension. The proponent envisages this can be achieved following further discussion with the DPE and the EPA, in order to ensure a consistent and appropriate approach regarding this matter. These monitors will be sited with the aim of

measuring particulate matter concentrations of the airshed adjacent to the closest sensitive receptors to the quarry processing and extraction areas, taking into consideration the dominant wind patterns of the Region. Based on discussions with other sites/projects that have implemented similar systems in the past, it is expected that the revised TARP's (and possibly the location of the new monitoring stations) will need to evolve over time due to the inherent attributes unique to any site.

The proponent supports the recommendations of the EPA to change from a reactive approach to the proactive approach supported by a real-time monitoring system. The proponent suggests the following changes to be made to the Development Consent (in association with the necessary aligned changes to the Air Quality Management Plan and Environmental Protection Licence), to support the modernisation of the approach to air quality management:

- *Update Schedule 4 Condition 15 (Impact Assessment Criteria) as follows:*
    - *Replace "so that particulate matter emissions generated by the development do not exceed the criteria in Table 5 at any sensitive receiver or residence on privately-owned land" with "on the site"; and*
    - *Delete Table 5 and all associated notes.*

- *Update Schedule 4 Condition 16 (Operating Conditions) as follows:*
    - *Delete the following text from Item (c): "(see Note d to Table 5 above)"; and*
    - *In Item (d), replace "compliance with the relevant air quality conditions in this consent" with "the requirements of the Air Quality Management Plan".*

- *Update Schedule 4 Condition 17 (Air Quality Management Plan) to achieve the following aims:*
    - *Update the Air Quality Management Plan in consultation with the EPA, and submit to the Secretary for approval within 6 months of the approval of Modification 3;*
    - *Replace part (b) with the following:*

        - *Describe the measures that would be implemented to minimise the adverse impacts of the project on local air quality;*
    - *Delete part (d) to incorporate into an updated part (e)*
    - *Replace part (e) to require an air quality monitoring program that:*
        - *Is capable of measuring in real-time the relative concentrations of particulate matter (PM_{10}) at the locations identified in the Plan;*
        - *Includes a Trigger Action Response Plan (TARP) which describes actions to be taken when specific trigger levels are exceeded.*
        - *Evaluates and reports on the adequacy of the air quality management system.*

The proponent accepts that further discussion with the EPA and DPE may be required to ensure a sensible and modern approach to air quality management can be realised.

Noise

The EPA raised concerns around the methodology used to guide noise monitoring and assessments on the project, more particularly the meteorological conditions under which the noise limits apply. The existing Automatic Weather Station (AWS) at the site is located adjacent to the project-related "Belmont" residence, situated in the southeast corner of the approved extraction area and has a 10 m mast. In terms of noise compliance, data from this AWS is only relied upon annually for the period of noise logging (generally 7 to 10 days) in order to determine the prevailing weather conditions. For the annual noise compliance assessment, two near-field monitoring locations (adjacent to the Processing Plant and in the Quarry Extension area) are incorporated into the existing quarry noise model, which was developed in 2002 and used to prepare the Noise and Blasting Impact Assessment for the quarry. These two locations are used as reference points enabling a comparison to be made between the predicted noise levels at the two reference locations, and the noise levels modelled at the most affected sensitive receptors. This relationship is subsequently used to calculate the daily fluctuating quarry noise contributions at the respective sensitive

receptors.

The noise limits of the Development Consent apply under calm conditions only (ie wind speeds up to 0.5 m/s at 10 m height). Accordingly, the analysis of the noise logger results together with the modelling results also enables the contribution of the Albion Park Quarry to be calculated for calm (ie. no wind) conditions. This is the noise compliance assessment procedure developed with and endorsed by the DPE back in 2009, and has been used annually since that time. Subsequent to the commencement of activities in the quarry extension area, no community complaints have been received in relation to general operational noise.

On the basis of the above, it is not considered necessary nor warranted to modify the Consent in relation to the weather conditions under which the noise limits apply (Schedule 4, Condition 4, Note 5 of the Consent). In addition to the above commentary provided on noise matters, I refer you to the 'Response to Comments' advice also provided by SLR, which is attached as *Appendix 5* of this supplementary response for DPE's consideration.

Water Discharges

The EPA requested that the DPE include as a condition of consent a review of the Water Management Plan. However, this request is not considered to be necessary, as Schedule 6 Condition 3 of the Development Consent will require a review of all plans associated with the consent (including the Water Management Plan).

Furthermore, the EPA suggested that the project may be contributing to the presence of various metals and metalloids in the watercourses downstream of the project. In regards to this suggestion, we refer the EPA to the full content of the 2013 Water Management Plan Review, as well as other studies that are publicly available and related to the project (namely the original EIS and various Annual Reviews). In addition, it is considered that the extensive water quality monitoring programme in place since 2008 must be acknowledged.

In this regard, the original EIS assessed the predicted impact of the project (Stages 1 to 6) on the surface water quality of the watercourses surrounding and downstream of the project site. This included an assessment of pre-quarrying water quality of the small ephemeral watercourses draining the site. This pre-impact assessment showed copper, lead and zinc were detectable in these watercourses, evidence of natural leaching from the volcanic facies. Regular monitoring of the water quality in these watercourses since quarry establishment has provided an extensive insight into the impact of quarrying operations on these streams. The 2013 Water Management Plan Review included an analysis of these results, with chromium, lead and zinc not detectable in any samples since quarry establishment, while arsenic was detectable at very low levels (less than the ANZECC 95% guideline) in a single drought-affected sampling event. It is clear from these results that quarrying activities are having no observable adverse impact on the water quality of these streams.

Furthermore, it is understood that recent sampling of the water collected in the sump of the quarry extension measured concentrations of all metals and metalloids at concentrations below standard laboratory detection limits for trace metals, with the exception of copper. As described above, copper was identified in water samples prior to quarrying as a naturally occurring trace metal in the volcanic facies of the area, and the concentration measured in the quarry sump was significantly less than that recorded in all pre-quarrying sampling. In reviewing the 2013 Water Management Plan Review and the original EIS, which assessed potential impacts on surface water quality for all stages of extraction, it is considered that the EPA can be confident that no further assessment or investigation regarding this matter is warranted.

The EPA also requested that a review of the Water Management Plan include consideration of the NSW Water Quality Objectives (WQO). The WQO were introduced in 2006 to provide assistance in assessing and managing the likely impacts of activities on surface and groundwater resources. The Water Management Plan for the project identified the WQO applicable to the project, namely the rainforest ecosystems downstream of the site. Similarly,

this plan identified potential impacts that the project may have on these ecosystems. To mitigate these potential impacts, limits on pH and suspended solids were applied to any water discharges from the quarry extension at the time, with TSS since modernised to turbidity based on a site specific correlation. These limits align with or offer greater protection than those described in the WQO, and proves that the project is meeting the identified WQO prior to discharge from the quarry extension. This is further supported by the regular ecological assessments undertaken on the riparian corridor of the watercourses, with no degradation in ecosystem health identified since the establishment of the quarry extension.

As the WQO are already adequately addressed and managed in the Water Management Plan, no further assessment of the impacts of the project on the WQO is deemed necessary.

Stormwater Treatment

The EPA have requested the DPE consider adding as a condition of consent a review of the Water Management Plan, in this case to minimise pollutant discharges when discharging captured stormwater. As described earlier, this request is not considered necessary as Schedule 6 Condition 3 of the Development Consent will require a review of all plans associated with the consent, including the Water Management Plan. Nevertheless, the proponent accepts that there may be opportunities to improve current discharge arrangements to reduce potential sediment loads. As such, the proponent will, as part of the review of the Water Management Plan required by Schedule 6 Condition 3 of the Development Consent, examine current stormwater discharge practices to assess whether any improvements can be made, as suggested in the EPA submission.

Office of Environment and Heritage (OEH) correspondence dated 11th October 2016

The comments related to the existing avoidance, mitigation, and revegetation measures of the project are noted.

Figtree Hill Pty Ltd (Figtree Hill) correspondences

The submissions by Figtree Hill contained a number of dot points, each of which are addressed separately in turn as follows:-

Approved Dwelling

The submission claimed that the Noise and Blasting Assessment did not take into account the approved dwelling on land owned by Figtree Hill. As above described in the response to the DPE submission, the Noise and Blasting Assessment examined the potential impact on the most affected sensitive receivers to each of the key operational areas of the project. The approved dwelling is approximately 560 metres from the nearest part of the extraction area, while "The Cottage", at which point these impacts were modelled, is approximately 385 metres away. Modelling of predicted noise impacts from the operation justify this approach, with all sensitive receptors below the 35 dBA noise contour level as depicted in Appendix C of the Noise and Blasting Assessment.

Distances to residences

The proponent acknowledges that there are some discrepancies in the distances quoted in the Executive Summary and the Noise and Blasting Assessment. Some of this discrepancy can be attributed to the differing distances between the total project footprint (including noise and visual bund) and the actual excavation boundary from these residences. The Noise and Blasting Assessment has been reviewed for accuracy, and is included as *Appendix 2* of this supplementary response.

Blast Management Plan

The submission claims that there has been no consultation with Figtree Hill regarding the Blast Management Plan. The proponent has previously provided the owners of Figtree Hill with the Blast Management Plan and the Noise and Blasting Assessment for their review, and raised this Modification 3

with the Figtree Hill representative at CCC meetings before lodgement with DPE.

The submission states that there is no reference in the Blast Management Plan to the approved dwelling. The Development Consent prescribes limits for airblast overpressure and ground vibration from blasting at any residence on privately owned land. The Blast Management Plan states that the permanent blast monitor will be located at the closest affected residence to blasting (The Cottage). By ensuring airblast overpressure and ground vibration levels remain within the acceptable limits at this location, it can be assumed that compliance will be achieved at locations further from the project site within a similar geological and geographical setting, including the suggested approved dwelling.

The proponent acknowledges that the persons on Figtree Hill land have been requested to relocate further from the common property boundary on two occasions in the past while blasting activities have taken place. The proponent refers to the Statement of Evidence – Noise and Blasting provided to the NSW LEC in October 2005, describing maximum flyrock travel based on the extensive experience of the blasting contractors. This submission is included as *Appendix 4* of this supplementary response for consideration, and states that flyrock will travel no more than 10 metres behind the face of the blast (ie. in the direction of Figtree Hill land), when the applicable controls as described in the submission are implemented. Furthermore, the proponent's blasting contractor undertook an inspection on 24th November 2016 of all areas in close proximity to the Figtree Hill land boundary where blasts will be required in the future, and has confirmed based on past blasting performance on the site and the current controls implemented to minimise flyrock, that no personnel or cattle will be required to relocate back from the property boundary when undertaking future blasts on the project from now on.

Heritage

The proponent has previously attempted to undertake dilapidation studies of the residences on the Figtree Hill property in accordance with Schedule 4

Condition 51, however, have not received any nominations from the owners for appropriate personnel to undertake this review as required by the Condition. Furthermore, the proponent has provided a nomination of a suitably qualified person to Figtree Hill for their consideration, however, this request was declined.

The proponent welcomes the opportunity expressed by Figtree Hill to undertake these surveys. The Figtree Hill submission also requested changes to the wording of this condition (Sch 6 Cond 51a) to expand the dilapidation surveys from the residences only, to include all other buildings on the Figtree Hill land. This would include a dilapidation survey of the operational dairy building and yards and relevant associated farm buildings. The proponent supports this proposal, but only on the condition acceptable access is provided by the owners of Figtree Hill to undertake this survey. As such, the proponent proposes the following updated commentary to replace condition 51(a): *"a program for baseline dilapidation surveys of residences on the 'Belmont' property and of existing residences and other existing buildings on the Figtree Hill land, subject to reasonable access being granted by the respective landowners, to the engaged consultant(s) to undertake the surveys".*

I trust this supplementary response (and associated attachments) satisfactorily addresses the Agency and public submissions and our discussions to date and, should you wish to discuss any matters further and/or require any additional information, please contact me on (02) 4229 5555.

Yours faithfully,
MARTIN MORRIS & JONES PTY LTD

LUKE ROLLINSON BUrbRegPlan DipArchTech MPIA
DIRECTOR - TOWN PLANNER

APPENDIX 1:

“Air Quality Impact Assessment (Rev 1)” prepared by SLR

global environmental solutions

Albion Park Quarry

Proposed Expansion

Air Quality Impact Assessment

Report Number 610.04156

9 December 2016

Cleary Bros (Bombo) Pty Ltd

39 Five Islands Road

Port Kembla NSW 2505

Version: Revision 1

Albion Park Quarry

Proposed Expansion

Air Quality Impact Assessment

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Executive Summary

SLR Consulting Pty Ltd has been commissioned by Cleary Bros (Bombo) Pty Ltd to conduct an Air Quality Impact Assessment of the expansion of the Albion Park Quarry. The Quarry is currently extracting 900,000 tonnes per annum of hard rock from Stage 2 and 4 of the operations. This assessment addresses the potential impacts to air quality from extracting 900,000 tpa of hard rock from Stage 5 and 6 of the operations. SLR has historically conducted air quality impact assessments for this quarry.

Atmospheric dispersion modelling was carried out to determine the potential impacts to air quality of extractive activities for the Albion Park Quarry. The potential emission-generating activities for the both the stages of operation have been identified and potential emissions from these activities were estimated based on available information and emission factors from the literature.

The existing air quality environment was quantified through a combination of monitoring data from both the Albion Park Quarry and a regional station maintained by the NSW Office of Environment and Heritage. Data from the on-site meteorological station were used to represent the local atmospheric dispersion conditions.

Dispersion modelling of the emissions to predict maximum off-site pollutant concentrations indicates that the proposed operational activities would comply with all relevant ambient air quality criteria at all representative surrounding sensitive receptors, even when existing background pollutant levels are considered.

Based on the modelling approach, it is concluded that dust and particulate matter impacts during the annual extraction of 900,000 tpa of hard rock during Stage 5 and 6 at the Albion Park Quarry would not cause exceedances of the relevant air quality criteria.

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APPENDICES

1 INTRODUCTION

Cleary Bros (Bombo) Pty Ltd (Bombo) are seeking approval to extend their quarry operations to include additional reserves to the Albion Park Quarry's east (the Project site). Operations in the current stages 1, 2, 3 and 4 of the quarry's operations will continue to operate as necessary to commence benching into the additional reserves of Stage 5 & 6. There will be no increase in the annual extraction rate of 900,000 tonnes per annum (tpa).

SLR Consulting Pty Ltd (SLR Consulting) has had a long history performing air quality impact assessments for the operations at Albion Park Quarry.

In 2002, SLR Consulting (formerly Heggies Pty Ltd) was commissioned to prepare an air quality impact assessment for a previous increase in extraction rate at the site (Report 10-1676-R1, dated 23 October 2002) as part of the Environmental Impact Assessment. As part of that assessment, atmospheric dispersion modelling was performed based on an extraction rate of 400,000 tpa. The results of the dispersion modelling indicated that all relevant air quality assessment goals would be complied with for the life of the operation. Approval for the increase in the extraction rate at the Project site, with a maximum annual extraction limit of 400,000 tpa, was granted in February 2006.

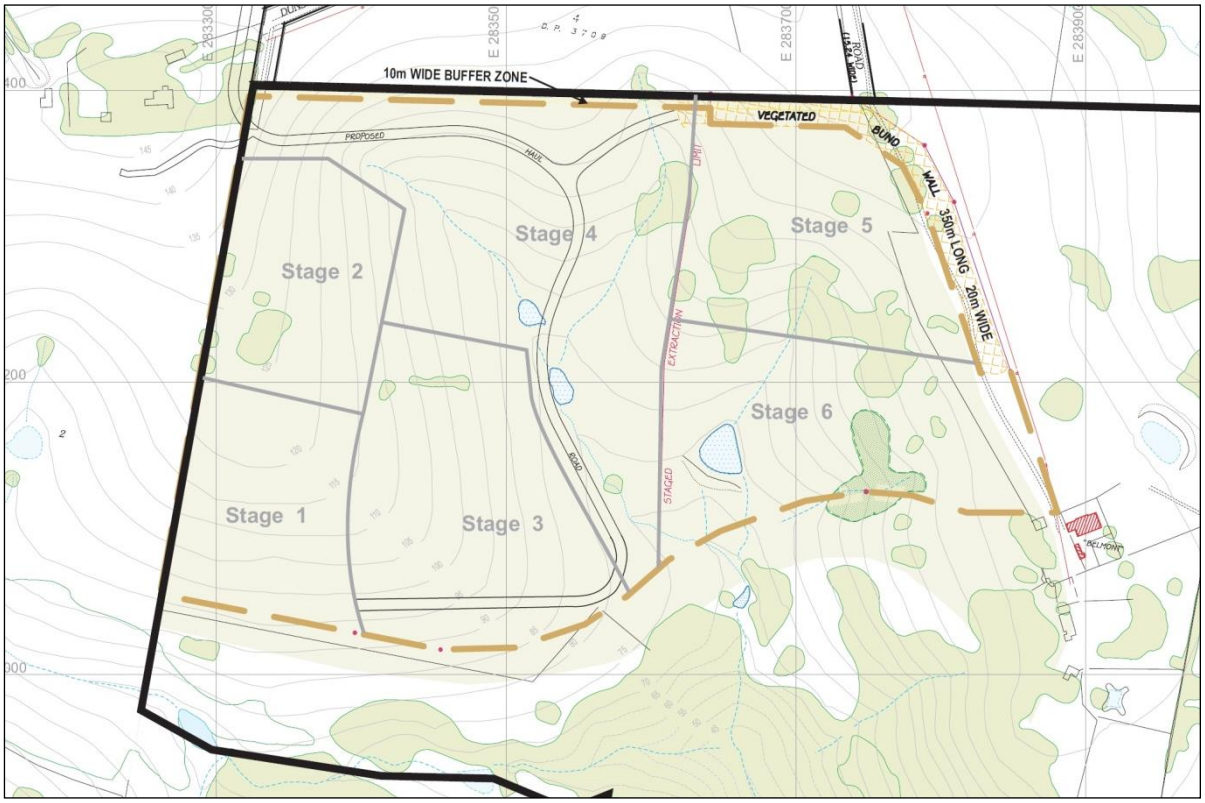
In 2004, SLR Consulting was commissioned to conduct an additional dispersion modelling investigation (Report 10-1676-R2, dated 31 May 2004) to determine the air quality impact of increasing the extraction rate of the quarry operation to 500,000 tpa. The results of the dispersion modelling indicated that, while maximum off-site incremental concentrations were predicted to increase, all relevant air quality assessment goals would be complied with if the annual extraction increased to 500,000 tpa.

In 2008, SLR Consulting was again commissioned to conduct additional atmospheric dispersion modelling (Report 10-7319-R1, dated 29 October 2008) for another increase in the extraction rate at the Albion Park hard rock quarry, to determine the level of air quality impact associated with increasing the extraction rate to 800,000 tpa. Using resources not available at the time of the previous two assessments, including site-specific meteorological and air quality monitoring data, the results of the dispersion modelling study indicated that all relevant air quality assessment goals would be complied with for the life of the operation.

SLR Consulting was commissioned in 2012 to conduct additional atmospheric dispersion modelling (Report 610.14029-R1, dated 20 November 2012) for another increase in the annual extraction rate to 900,000 tpa at the Albion Park hard rock quarry. The predicted incremental and cumulative impact at the surrounding sensitive receptors complied with the relevant guidelines.

Figure 1 illustrates the proposed layout of the six-stage 30-year operation of the Albion Park Quarry.

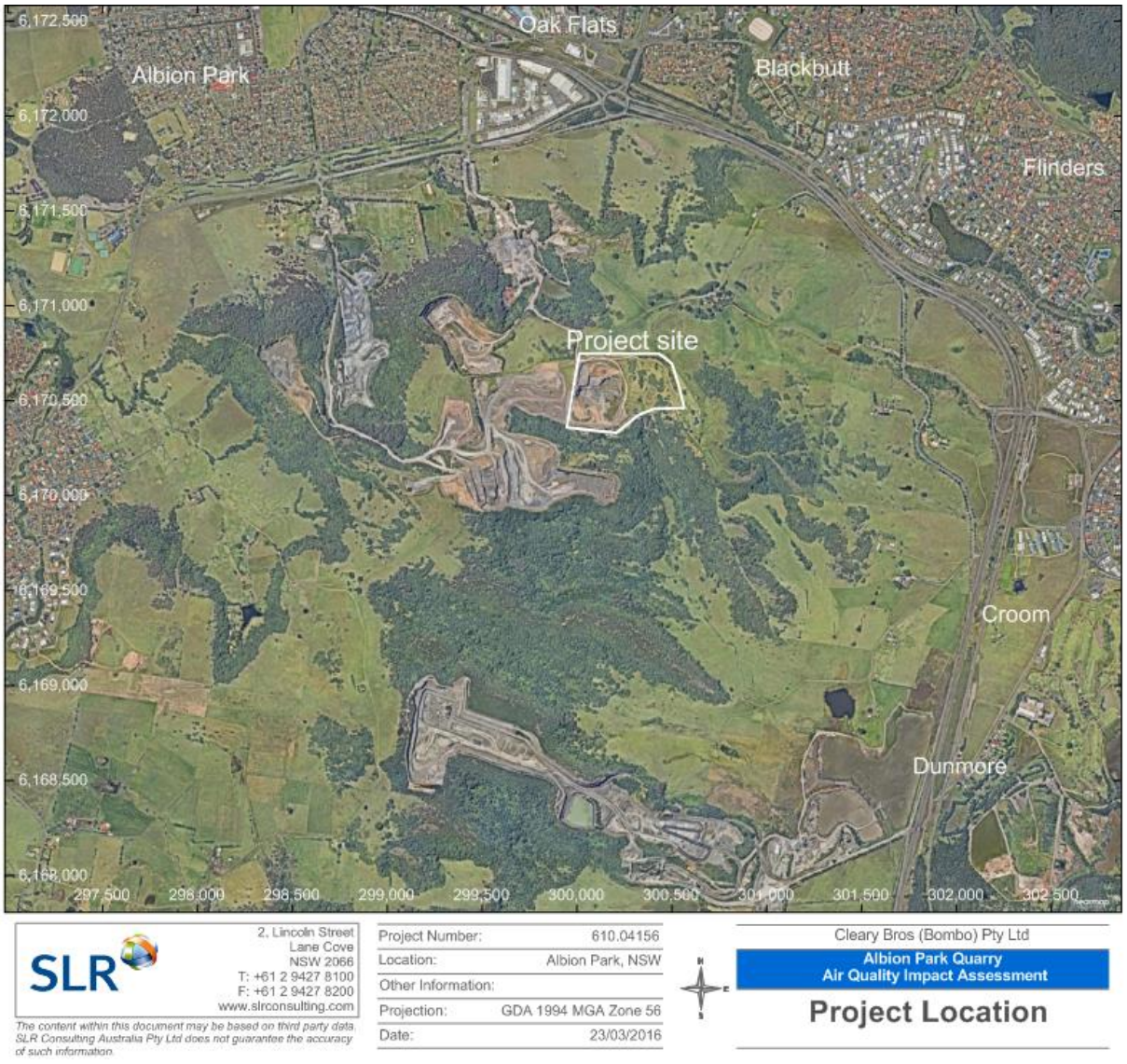
Figure 1 Layout of Albion Park Quarry Proposed Expansion



2 PROJECT SETTING

The Albion Park Quarry (the Project Site) is situated approximately 20 km south-southwest of the central business district of Wollongong on the New South Wales south coast. **Figure 2** illustrates the regional setting of the Project Site.

Figure 2 Local Setting of the Project Site



2.1 Sensitive Receptors

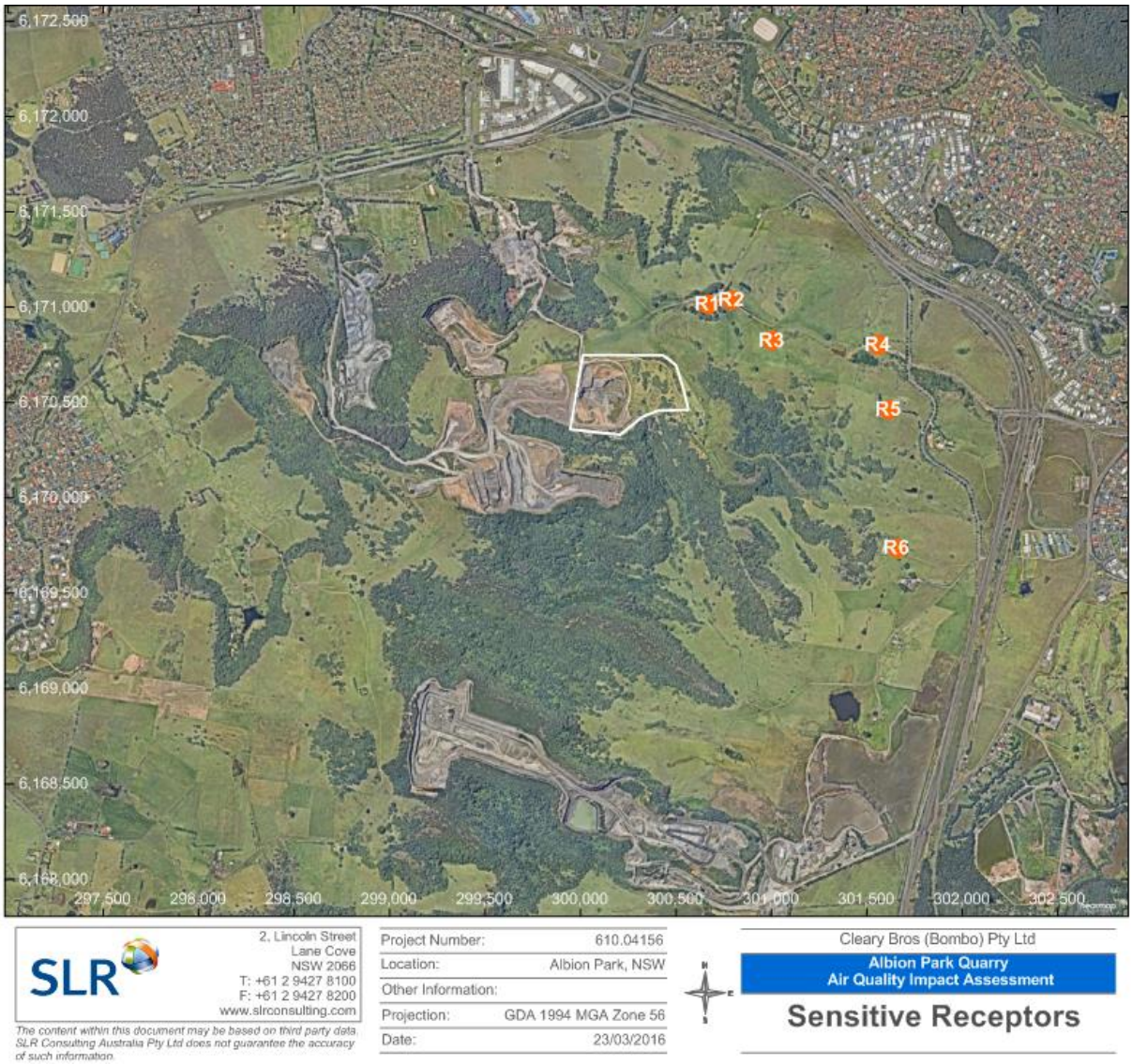
A number of non-project related residential dwellings are situated in the area surrounding the Project Site. The nearest dwellings were identified as sensitive receptor locations to be taken into account during the assessment of potential air quality impacts due to the expanded operations.

A list of existing sensitive receptor points (R1 to R6) identified in the immediate vicinity of the Project Site is provided in **Table 1**, along with the respective distances of each of these receptor points to the site boundary. **Figure 3** illustrates the location of the surrounding receptors in relation to the Project Site.

Table 1 Surrounding Sensitive Receptor Locations

Receptor ID	Receptor Name	Location (m, UTM)		Distance (m) / Direction from Site Boundary	Elevation (m, AHD)
		Easting	Northing		
R1	The Cottage	300,669	6,171,018	330 / NE	140
R2	The Hill	300,794	6,171,040	440 / NE	140
R3	Approved Property	301,005	6,170,825	520 / ENE	110
R4	St Ives Farm	301,560	6,170,804	1020 / E	60
R5	Deer Farm	301,616	6,170,465	970 / E	70
R6	Kurrawong	301,659	6,169,740	1180 / SE	50

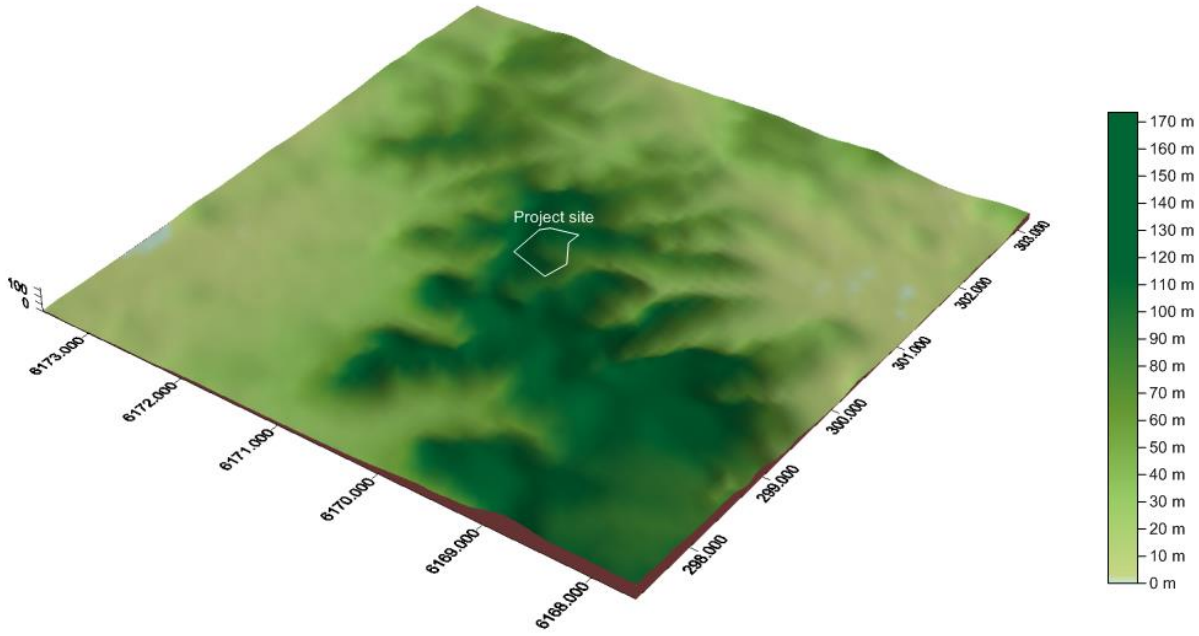
Figure 3 Sensitive Receptor Locations



2.2 Surrounding Topography

A three dimensional representation of the topographical features in the region surrounding the Project Site is presented in **Figure 4**.

Figure 4 Local Topography Surrounding the Project Site



3 AIR QUALITY CRITERIA

3.1 Pollutants of Interest

As previously stated, SLR Consulting have been commissioned to conduct a number of air quality impact assessments for the Project Site for lower annual extraction rates; specifically 400,000 tpa, 500,000 tpa, 800,000 tpa, and 900,000 tpa.

The results of these assessments indicated that the key pollutants for determining compliance with relevant air quality criteria were suspended particulate matter and fugitive dust deposition. While emissions of pollutants associated with the combustion of diesel fuel, including nitrogen dioxide, sulphur dioxide, carbon monoxide, and air toxics, will be generated by the current and proposed operations at the Project Site, these emissions are unlikely to compromise air quality goals at the closest receptors, given the nature and scale of the operation.

3.2 Particulate Matter (as TSP, PM_{10} and $PM_{2.5}$)

Airborne contaminants that can be inhaled directly into the lungs can be classified on the basis of their physical properties as gases, vapours or particulate matter. In common usage, the terms “dust” and “particulates” are often used interchangeably. The term “particulate matter” refers to a category of airborne particles, typically less than 50 microns (µm) in diameter and ranging down to 0.1 µm and is termed Total Suspended Particulate (TSP). The annual goal for TSP recommended by the NSW Environment Protection Authority (EPA) is 90 micrograms per cubic metre of air (µg/m^3) (NHMRC, 1996).

The TSP goal was developed before the more recent results of epidemiological studies which suggested a relationship between health impacts and exposure to concentrations of finer particulate matter.

Emissions of particulate matter less than 10 µm and 2.5 µm in diameter (referred to as PM_{10} and $PM_{2.5}$ respectively) are considered important pollutants due to their ability to penetrate into the respiratory system. In the case of the $PM_{2.5}$ category, recent health research has shown that this penetration can occur deep into the lungs. Potential adverse health impacts associated with exposure to PM_{10} and $PM_{2.5}$ include increased mortality from cardiovascular and respiratory diseases, chronic obstructive pulmonary disease and heart disease, and reduced lung capacity in asthmatic children.

The NSW EPA PM_{10} assessment goals set out in the *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (NSW OEH, 2005) are as follows:

- a 24-hour maximum of 50 µg/m^3; and
- an annual average of 30 µg/m^3.

The Approved Methods do not set any assessment goals for $PM_{2.5}$. In December 2000, the National Environment Protection Council (NEPC) initiated a review to determine whether a national ambient air quality criterion for $PM_{2.5}$ was required in Australia, and the feasibility of developing such a criterion. The review found that:

- there are health effects associated with these fine particles;
- the health effects observed overseas are supported by Australian studies; and
- fine particle standards have been set in Canada and the USA, and an interim criterion is proposed for New Zealand.

The review concluded that there was sufficient community concern regarding $PM_{2.5}$ to consider it an entity separate from PM_{10}.

As such, in July 2003, a variation to the Ambient Air Quality NEPM was made to extend its coverage to $PM_{2.5}$, setting the following Interim Advisory Reporting Standards for $PM_{2.5}$ (NEPC, 2003):

- a 24-hour average concentration of 25 µg/m^3; and
- an annual average concentration of 8 µg/m^3.

It is noted that the NEPM Advisory Reporting Standards relating to $PM_{2.5}$ particles are reporting guidelines only at the present time and not intended to represent air quality criteria.

The National Clean Air Agreement (NCAA) was endorsed by Commonwealth, state and territory Environment Ministers on 15 December 2015. Ministers agreed to strengthen national ambient air quality reporting standards for airborne fine particles as follows:

For PM_{10}:

- a 24-hour average concentration of 50 µg/m^3 (unchanged from the Approved Methods); and
- an annual average of 25 µg/m^3 (compared to a value of 30 µg/m^3 in the Approved Methods).

For $PM_{2.5}$:

- a 24-hour average concentration of 25 µg/m^3; and
- an annual average concentration of 8 µg/m^3.

All jurisdictions have agreed to implement strengthened standards for particles, as well as move to even tighter standards for annual average and 24-hour $PM_{2.5}$ in 2025. As these standards have not yet been adopted by NSW EPA, this assessment is based on the current assessment goals set out in the Approved Methods and the NEPM.

A summary of the particulate guidelines is shown in **Table 2**.

Table 2 EPA Criteria for Particulates

Pollutant	Averaging Time	Criteria
TSP	Annual	90 µg/m^3
PM_{10}	24 Hours Annual	50 µg/m^3 30 µg/m^3
$PM_{2.5}$	24 Hours Annual	25 µg/m^3 (interim advisory reporting standard only) 8 µg/m^3 (interim advisory reporting standard only)

Source: (NSW OEH, 2005), (NEPC, 2003)

3.3 Nuisance Impacts of Fugitive Emissions

The criteria for PM_{10} and $PM_{2.5}$ are primarily concerned with the health impacts of exposure to suspended particulate matter. Nuisance impacts need also to be considered, mainly in relation to the larger size fractions of dust. In NSW, accepted practice regarding the nuisance impact of dust is that dust-related nuisance can be expected to impact on residential areas when annual average dust deposition levels exceed 4 g/m^2/month.

Table 3 presents the impact assessment goals for dust deposition, showing the maximum increase in dust deposition levels over the ambient (background) level which would be acceptable to avoid dust nuisance.

Table 3 Goals for Allowable Dust Deposition

Averaging Period	Maximum Increase in Deposited Dust Level	Maximum Total Deposited Dust Level
Annual	2 g/m^2/month	4 g/m^2/month

Source: (NSW OEH, 2005).

3.4 Project Air Quality Goals

In view of the foregoing, the air quality goals adopted for this assessment, which conform to current air quality criteria, are summarised in **Table 4**.

Table 4 Adopted Project Air Quality Goals

Pollutant	Averaging Period	Concentration
TSP	Annual	90 µg/m^3
PM_{10}	24 Hours Annual	50 µg/m^3 30 µg/m^3
$PM_{2.5}$	24 Hours Annual	25 µg/m^3 (interim advisory reporting standard only) 8 µg/m^3 (interim advisory reporting standard only)
Dust Deposition (Project only)	Annual	2 g/m^2/month
Dust Deposition (Cumulative)	Annual	4 g/m^2/month

4 EXISTING AIR QUALITY

4.1 Air Quality Monitoring Locations

Recent air quality monitoring data for PM_{10} and dust deposition from the Project site, or in close proximity to the Project site, provide an indication of the existing air quality environment. The locations of the monitoring sites from which data was sourced for use in this report, are presented in **Figure 5**. It is noted that this monitoring data would include a contribution from the operations at the Project site, and when combined with the incremental modelling for the Project site, is effectively double counting emissions from the Project site. Appropriate background concentrations have been selected with this in mind.

4.2 Background Dust Deposition

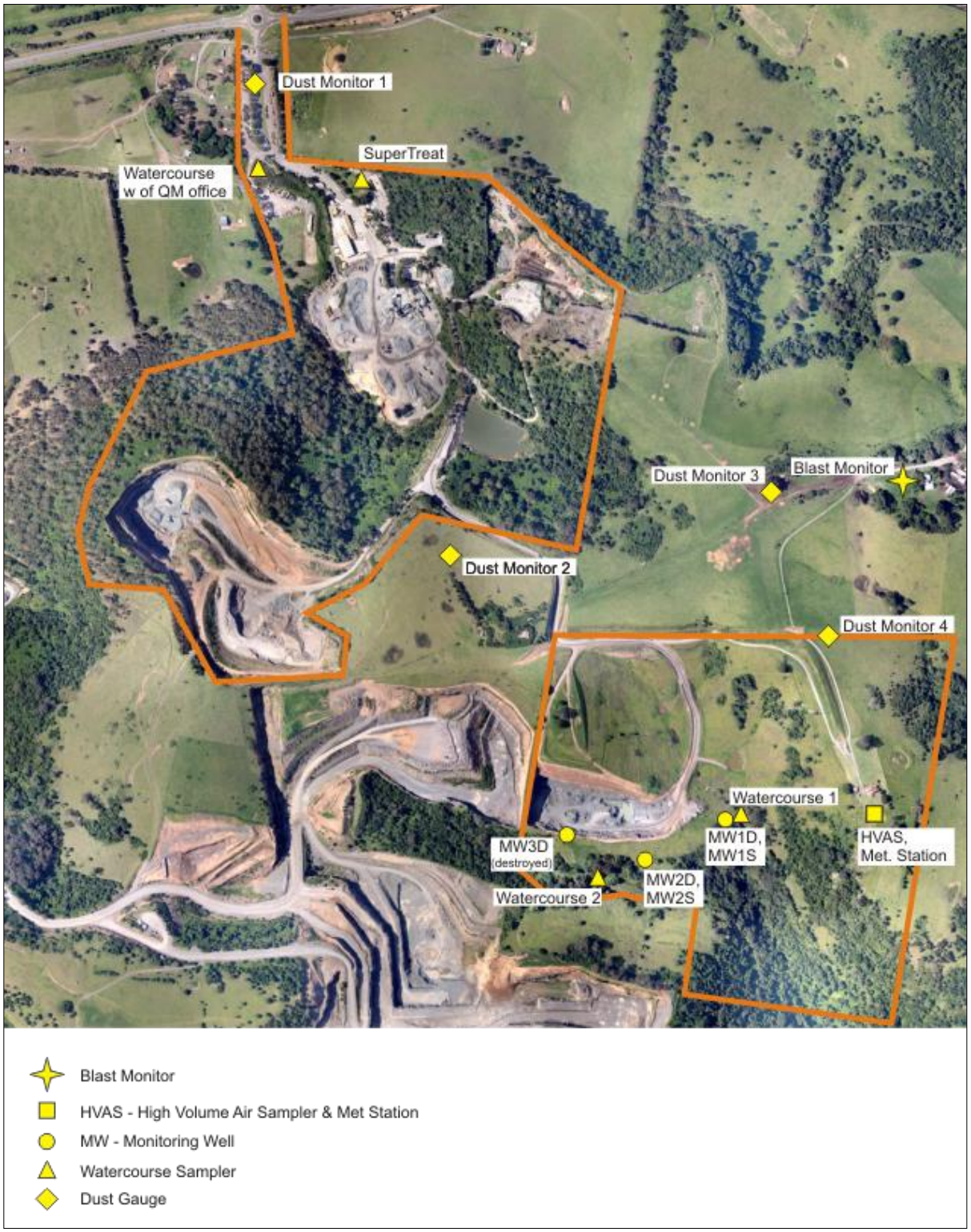
Dust deposition monitoring has been conducted at four locations in the area surrounding the Project Site for a number of years. Annual average dust deposition data for the period between January 2010 and December 2015 are presented in **Table 5**. The locations of the dust monitors are illustrated in **Figure 5**.

Table 5 Annual Average Dust Deposition Monitoring Data – 2010 to 2015

ID	Average Total Insoluble Solids (g/m^2/month)					
	2010	**2011**	**2012**	**2013**	**2014**	**2015**
Dust Monitor 1	2.8	2.7	4.4	4.5	3.1	3.0
Dust Monitor 2	2.7	2.5	1.6	2.7	2.6	2.1
Dust Monitor 3	2.0	1.6	1.6	0.7	0.9	1.1
Dust Monitor 4	1.8	1.7	2.2	1.5	1.6	2.2
Average	**2.3**	**2.1**	**2.4**	**2.4**	**2.1**	**2.1**
Maximum	**2.8**	**2.7**	**4.4**	**4.5**	**3.1**	**3.0**

Based on the data presented in **Table 5**, a conservatively high background dust deposition rate at the Project Site of 2.4 g/m^2/month (expressed as an annual average) has been assumed for assessment purposes. This value corresponds to the worst case annual average deposition rate recorded across all four monitoring sites (ie 2012 and 2013) over the period reviewed.

Figure 5 Air Quality Monitoring Locations – Albion Park Quarry



4.3 Suspended Particulate Matter (PM_{10})

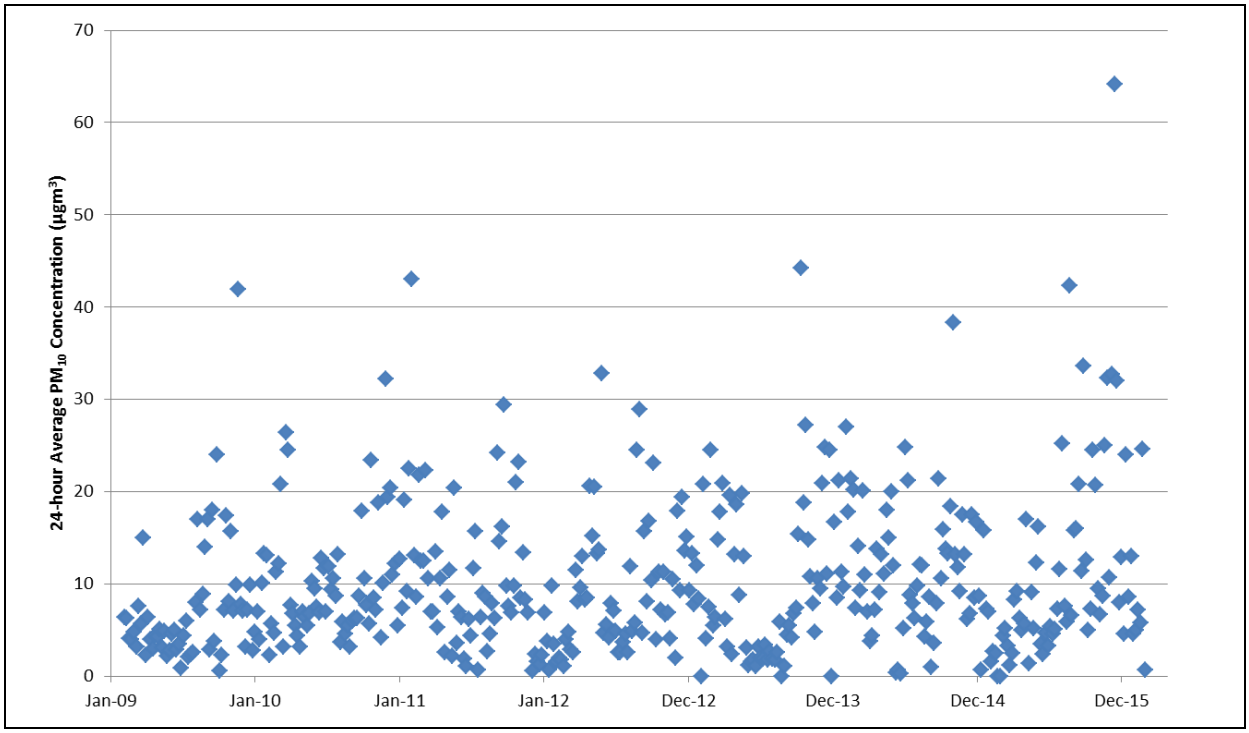
PM_{10} monitoring is conducted immediately east of the Project Site at the *Belmont* property, indicated on **Figure 5** using a High Volume Air Sampler (HVAS) fitted with a size-selective sampling head. The HVAS is used to collect 24-hour average PM_{10} samples in accordance with the standard one-in-six day sampling routine. A summary of the 24-hour PM_{10} concentrations recorded at the Project Site in 2010 to 2015 are presented in **Table 6** and **Figure 6**.

Table 6 24-Hour Average PM_{10} Concentrations – January 2010 to December 2015

	24-hour Average PM_{10} ($\mu g/m^3$)			Sampling Method	Number of Samples	Monitoring Location
	Average	Minimum	Maximum			
2010	9.9	2.3	32.2	HVAS	61	Project site
2011*	10.6	0.6	43.0	HVAS	60	Project site
2012	9.3	0.7	32.8	HVAS	61	Project site
2013	10.0	0	44.2	HVAS	58	Project site
2014	12.2	0.3	38.3	HVAS	61	Project site
2015	11.9	0.7	64.2	HVAS	59	Project site

Note An extremely high 24-hour average PM_{10} concentration of 207 µg/m³ was recorded on 28th November 2011. The occurrence of such high concentrations is very uncharacteristic of this area and therefore this record was considered as contaminated and has not been considered in the cumulative impact assessment presented in this report.

Figure 6 24-Hour Average PM_{10} Concentrations Recorded at the Project Site



It is noted that continuous PM_{10} monitoring data from the Albion Park South monitoring station (located approximately 3 km west of the Project Site), is available to use as daily varying background data. A brief summary of this background dataset, which was based on 24-hour average concentrations recorded during the 2015 calendar year (i.e. concurrent with the meteorological dataset used), are presented in **Table 7**.

It can be observed from **Table 6** and **Table 7** that average PM_{10} concentrations recorded at the project site in recent years are lower than the concentrations measured in 2015 by the air quality monitoring station (AQMS) located at Albion Park South. Therefore use of this 2015 monitoring data as background data would be expected to provide a conservative estimate of current ambient background PM_{10} levels in the Project area. This means that the impacts predicted in this study for the proposed operations should provide a conservative worst-case estimate of the actual cumulative concentrations that would be expected to occur.

Table 7 24-Hour Average PM_{10} Concentrations (2015) – Albion Park South

Year	24-hour Average PM_{10} ($\mu g/m^3$)			Sampling Method	Number of Samples	Monitoring Location
	Average	Minimum	Maximum			
2015	14.0	2.8	41.2	TEOM	347	Albion Park

4.4 Suspended Particulate Matter ($PM_{2.5}$)

Continuous $PM_{2.5}$ monitoring data is also available to use as daily varying background data from the Albion Park South monitoring station. A brief summary of this background dataset, which was based on 24-hour average concentrations recorded during the 2015 calendar year (i.e. concurrent with the meteorological dataset used), are presented in **Table 8**.

Table 8 24-Hour Average $PM_{2.5}$ Concentrations (2015) – Albion Park South

Year	24-hour Average $PM_{2.5}$ ($\mu g/m^3$)			Sampling Method	Number of Samples	Monitoring Location
	Average	Minimum	Maximum			
2015	6.4	0.6	21.1	TEOM	286	Albion Park

4.5 Total Suspended Particulate Matter

Concentrations of TSP are not measured at Albion Park South. As PM_{10} represents a fraction of the broader particulate concentration, relationships between TSP and PM_{10} as measured at four sites in the Newcastle area between 2000 and 2011 (NSW OEH, 2012) and in the Illawarra region between 1996 and 2004 have been examined and are presented in **Appendix A**. This analysis indicates that the annual average TSP concentration is approximately 2.4 times the annual average PM_{10} concentration (ie PM_{10} represents 41% of total TSP). This multiplier has been applied to the annual average PM_{10} concentration measured at Albion Park South in 2015 to estimate the annual average TSP concentration at this location.

Although many of the TSP/PM_{10} data have been measured in areas in which the sources of particulate matter may not be identical to those surrounding the Development site, the broad relationship is considered to be appropriate for use within this assessment. It is noted that the conclusions of this assessment as they relate to the annual average TSP concentration are not dependent on highly accurate calculation of the existing background TSP concentration experienced in the area.

4.6 Background Air Quality Levels Assumed for Assessment Purposes

For the purposes of assessing the potential cumulative air quality impacts from the Project, an estimation of background air quality levels is required. The site-specific background air quality levels adopted for this assessment are summarised in **Table 9**.

Table 9 Ambient Air Quality Environment for Assessment Purposes

Air Quality Parameter	Averaging Period	Assumed Background Ambient Level	Data Source
TSP	Annual	34.2 µg/m^3	Estimated based on a PM_{10}:TSP ratio of 0.41:1
PM_{10}	24-Hour	41.2 µg/m^3	Albion Park South – highest measured concentration
	Annual	14.0 µg/m^3	Albion Park South
$PM_{2.5}$	24-Hour	21.1 µg/m^3	Albion Park South – highest measured concentration
	Annual	6.4 µg/m^3	Albion Park South
Dust Deposition	Annual	2.4 g/m^2/month	Bombo

5 ASSESSMENT OF POTENTIAL IMPACTS

Emissions from proposed quarrying operations associated with Stage 5 & 6 at the Project site identified as having the potential to impact upon the nearby residences have been modelled using the US EPA's CALPUFF (Version 6.267) modelling system as described below.

5.1 Dispersion Modelling Methodology

For this assessment, dispersion modelling was conducted using the US EPA's CALPUFF (Scire, Strimaitis, & Yamartino, 2000) modelling system.

CALPUFF is a transport and dispersion model that ejects "puffs" of material emitted from modelled sources, simulating dispersion and transformation processes along the way. In doing so it typically uses the fields generated by a meteorological pre-processor CALMET, discussed further in **Section 5.1.1.2**. Temporal and spatial variations in the meteorological fields selected are explicitly incorporated in the resulting distribution of puffs throughout a simulation period.

The primary output files from CALPUFF contain hourly concentrations or deposition values evaluated at selected receptor locations. The CALPOST post-processor is then used to process these files, producing tabulations that summarise results of the simulation for user-selected averaging periods.

5.1.1 Meteorological Modelling

Meteorological mechanisms govern the dispersion, transformation and eventual removal of pollutants from the atmosphere. The extent to which pollution will accumulate or disperse in the atmosphere is dependent on the degree of thermal and mechanical turbulence within the earth's boundary layer. Dispersion comprises vertical and horizontal components of motion. The stability of the atmosphere and the depth of the surface-mixing layer define the vertical component. The horizontal dispersion of pollution in the boundary layer is primarily a function of the wind field. The wind speed determines both the distance of downwind transport and the rate of dilution as a result of plume 'stretching'. The generation of mechanical turbulence is similarly a function of the wind speed, in combination with the surface roughness. The wind direction, and the variability in wind direction, determines the general path pollutants will follow, and the extent of crosswind spreading.

Pollution concentration levels therefore fluctuate in response to changes in atmospheric stability, to concurrent variations in the mixing depth, and to shifts in the wind field (Oke 1998).

To adequately characterise the dispersion meteorology of the study site, information is needed on the prevailing wind regime, mixing height and atmospheric stability and other parameters such as ambient temperature, rainfall and relative humidity.

Meteorological data collected over the period 2010-2015 at the nearest BOM station (Albion Park [station number 068241]) were analysed to select a representative year for dispersion modelling. The analysis showed that data collected during the 2015 calendar year are in reasonably good agreement with long term averages compared to other years and was therefore selected for use in this assessment.

5.1.1.1 TAPM

In order to calculate all required meteorological parameters required by the dispersion modelling process, meteorological modelling using The Air Pollution Model (TAPM, v 4.0.4) has been performed. TAPM, developed by the Commonwealth Scientific and Industrial Research Organisation (CSIRO) is a prognostic model which may be used to predict three-dimensional meteorological data and air pollution concentrations.

The TAPM model predicts wind speed and direction, temperature, pressure, water vapour, cloud, rain water and turbulence. The program allows the user to generate synthetic observations by referencing databases (covering terrain, vegetation and soil type, sea surface temperature and synoptic scale meteorological analyses) which are subsequently used in the model input to generate site-specific hourly meteorological observations at user-defined levels within the atmosphere.

TAPM may also assimilate actual local wind observations so that they can optionally be included in a model solution. However, given that TAPM is known to under-predict calm wind conditions, the wind speed and direction observations obtained from the nearest BoM stations have also been used in the subsequent CALMET component of the modelling as described in **Section 5.1.1.2** below.

Table 10 Meteorological Parameters used for this Study (TAPM v 4.0.4)

Modelling Period	1 January 2015 to 31 December 2015
Centre of analysis	300,251 mE 6,170,554 mN (UTM Coordinates)
Number of grid points	30 × 30 × 25
Number of grids (spacing)	3 (30 km, 10 km, 6 km)
Data assimilation	Onsite meteorological data Albion Park AWS (Station # 68241)
Terrain	AUSLIG 9 second DEM

The three dimensional upper air data from TAPM output was used as input for the diagnostic meteorological model (CALMET).

5.1.1.2 CALMET

In the simplest terms, CALMET is a meteorological model that develops wind and temperature fields on a three-dimensional gridded modelling domain. Associated two-dimensional fields such as mixing height, surface characteristics, and dispersion properties are also included in the file produced by CALMET. The interpolated wind field is then modified within the model to account for the influences of topography, as well as differential heating and surface roughness associated with different land uses across the modelling domain. These modifications are applied to the winds at each grid point to develop a final wind field. The final wind field thus reflects the influences of local topography and current land uses.

CALMET modelling was conducted using the 'with Obs' CALMET approach. TAPM-generated upper air data and available surface weather observations in the area were used to refine the wind field predetermined by TAPM data. Hourly surface meteorological data from the nearest BoM stations were incorporated in the CALMET modelling. A horizontal grid spacing of 100 m was used to adequately represent the important local terrain features and land use. **Table 11** details the parameters used in the meteorological modelling.

Table 11 CALMET Configuration Used for this Study

Modelling Period	1 January 2015 to 31 December 2015
Centre of analysis	300,251 mE 6,170,554 mN (UTM Coordinates)
Meteorological grid domain (Meteorological grid resolution)	170 km x 170 km (3.4 km) 50 km x 50 km (1 km) 15 km x 15 km (0.3 km) 6 km x 6 km (0.1 km)
Vertical Resolution (Cell Heights)	10 (0 m, 20 m, 40 m, 80 m, 160 m, 320 m, 640 m, 1200 m, 2000 m, 3000 m, 4000 m)
Data Assimilation	Onsite meteorological data Albion Park AWS (Station # 68241) Sydney Airport AWS (Station # 66037)

A summary of the key features of the site-representative meteorological file derived for use in the modelling study using the above methodology is provided in **Appendix B**.

5.2 Emission Estimation Methodology

Two emission inventories have been compiled for this assessment:

- Stage 5 operations – 900,000 tpa; and
- Stage 6 operations – 900,000 tpa.

The emission inventories take into consideration the movement of mobile plant and equipment during operation at the current extraction rates and incorporate the following activities:

- Extraction operations, including drilling and blasting, bulldozer and excavator;
- Overburden removal, including use of scraper and excavator;
- Stockpiling of overburden material, including wind-generated erosion;
- Stockpile management;
- Grader operation;
- Movement of haul trucks about the Project Site; and
- Unloading of extracted materials at the existing operations to the north.

Potential particulate emissions from the operations have been estimated based on the emission factors presented in the *Emission Estimation Technique Manual for Mining* (hereafter, "EETMM")*, Version 3.1* (DSEWPC, 2012). In some instances, the moisture content of materials at the Project Site is not adequately reflected within the default emission factors contained in the EETMM or the equations given in Table 1 of the EETMM document. USEPA AP-42 documentation was therefore used to derive representative emission factors in these instances (USEPA, 1998).

Potential particulate emissions from both the Stage 5 & 6 operations were estimated based on the latest EETMM and AP42 documents in order to provide comparable emission inventories for the two scenarios. Details of the emission factor/equations used in estimating the potential emissions are provided below.

5.2.1 Bulldozer

$$EF = k \times \frac{s^a}{M^b} \text{ kg/h}$$

where k=2.6, a=1.2, b=1.3 for TSP and k=0.34, a=1.5, b=1.4 for PM_{10}, $PM_{2.5}$ = EF_{TSP} x 0.105; s = silt content and M = moisture content.
Source: EETMM and AP42

5.2.2 Miscellaneous Handling (Excavators, loading/unloading of material)

$$EF = k \times 0.0016 \times \left(\frac{U}{2.2}\right)^{1.3} \left(\frac{M}{2}\right)^{-1.4} \text{ kg/t}$$

where k=0.74 for TSP and 0.35 for PM_{10}, 0.053 for $PM_{2.5}$, U = mean wind speed and M = moisture content.
Source: EETMM and AP42

5.2.3 Scraper Operation

$$EF = k \times 10^{-6} \times s^{1.3} W^{2.4} \text{ kg/VKT}$$

where k=9.6 for TSP and 1.32 for PM_{10}, $PM_{2.5}$ = EF_{TSP} x 0.0468, s = silt content and W = vehicle gross mass
Note: VKT = Vehicle Kilometres Travelled.
Source: EETMM

5.2.4 Grader Operation

$$EF_{TSP} = 0.0034 \times S^{2.5} \text{ kg/VKT}$$

$$EF_{PM10} = 0.00336 \times S^{2.0} \text{ kg/VKT}$$

where S = average vehicle speed, $PM_{2.5}$ = EF_{TSP} x 0.031
Note: VKT = Vehicle Kilometres Travelled
Source: AP42

5.2.5 Blasting

$$EF = 0.00022 \times A^{1.5} \text{ kg/blast}$$

where A = Blast area (m²),PM_{10} is 52% of TSP.
Source: EETMM

5.2.6 Stockpile Wind Erosion

EF = 0.4 kg/ha/hr for TSP

EF = 0.2 kg/ha/hr for PM_{10} and $PM_{2.5}$
Source: EETMM

5.2.7 Haul Truck Wheel Dust

$$EF = k \times \left(\frac{s}{12}\right)^{0.7} \times \left(\frac{W}{3}\right)^{0.45} \times \left(\frac{0.4536}{1.6093}\right) \text{kg/VKT}$$

where k=4.9 for TSP, 1.5 for PM_{10}, 0.15 for $PM_{2.5}$, s = silt content and W = vehicle gross mass
Note: VKT = Vehicle Kilometres Travelled.
Source: USEPA AP-42

5.3 Estimated Emissions

Table 12 presents a comparison of the assumed operating parameters and total estimated potential TSP and PM_{10} emission rates for the Stage 5 & 6 operating scenarios. Detailed calculations for estimating the emissions are presented in **Appendix C**.

SLR has been advised that currently the scraper operates approximately once a week. Information provided for current operations indicates that the haul roads are usually graded once a week.

Table 12 Operating Parameters and Estimated Emission Rate

Activity	Unit	Stage 5	Stage 6
Extraction rate	tpa	900,000	900,000
Hours of operation	per annum	2,888	2,888
Disturbed area	ha	2.6	2.9
Number of blasts[1]	per annum	26	26
Number of Drill holes	per annum	1,766	1,766
Hauling	VKT/hr	12.0	11.0
Grading	km/week	3.9	3.6
Scraper	VKT/annum	573	573
$PM_{2.5}$ emission rate	**kg/annum**	**4,292**	**4,189**
PM_{10} emission rate	**kg/annum**	**28,970**	**27,983**
TSP emission rate	**kg/annum**	**55,060**	**52,546**

Notes:

1. There will be approximately 26 blasts per annum however, the emissions from one blast per day has been modelled to capture the worst 24-hour average (ie the maximum ground level concentration).

5.4 Predicted Impacts

5.4.1 Total Suspended Particulate Matter (TSP)

Potential TSP emissions from Stages 5 & 6 of the quarry operations have been estimated based on the current NPI and AP42 documents. Annual average incremental and cumulative TSP concentrations predicted at the nearest sensitive receptors for Stage 5 & 6 operations are presented in **Table 13**, with contour plots of the incremental impacts presented in **Figure 7** and **Figure 8** respectively.

The modelling results indicate that the extraction of hard rock from Stages 5 & 6 is unlikely to result in exceedances of the criterion for annual average TSP concentrations at any of the surrounding sensitive residences.

Table 13 Incremental and Cumulative Annual Average TSP Concentrations at Surrounding Receptors

Receptor	Background	Incremental Impact (µg/m^3)		Cumulative Impact (µg/m^3)	
		Stage 5	Stage 6	Stage 5	Stage 6
R1	34.2	1.7	1.7	35.9	35.9
R2	34.2	1.2	1.2	35.4	35.4
R3	34.2	1.0	1.0	35.2	35.2
R4	34.2	0.3	0.3	34.5	34.5
R5	34.2	0.3	0.3	34.5	34.5
R6	34.2	0.1	0.1	34.3	34.3
Criterion				**90**	**90**

Figure 7 Stage 5 Predicted Annual Average Incremental TSP Concentrations

Figure 8 Stage 6 Predicted Annual Average Incremental TSP Concentrations

5.4.2 Suspended Particulate Matter (PM_{10})

Table 14 presents incremental and cumulative annual average PM_{10} concentrations predicted at each receptor listed in **Section 2.1**. The incremental and cumulative annual average PM_{10} concentrations predicted at each sensitive receptor are well below the relevant guideline, indicating that the proposed operations are unlikely to cause any exceedances of the guideline at these locations.

It can also be observed that the predicted incremental annual average PM_{10} concentrations at all receptors are minor (<5%) compared to the relevant ambient air quality guideline. The proposed operational activities are unlikely to cause any additional exceedances above background air quality concentrations of the PM_{10} criterion at the sensitive receptor locations.

Contour plots of the predicted annual average incremental PM_{10} concentrations are presented in **Figure 9** and **Figure 10** for Stage 5 & 6 operations.

Table 14 Incremental and Cumulative Annual Average PM_{10} Concentrations at Surrounding Receptors

Receptor	Background	Incremental Impact (µg/m^3)		Cumulative Impact (µg/m^3)	
		Stage 5	Stage 6	Stage 5	Stage 6
R1	14.0	1.0	0.8	15.0	14.8
R2	14.0	0.7	0.6	14.7	14.6
R3	14.0	0.6	0.5	14.6	14.5
R4	14.0	0.2	0.2	14.2	14.2
R5	14.0	0.2	0.2	14.2	14.2
R6	14.0	0.1	0.1	14.1	14.1
Criterion				**30**	**30**

The maximum 24-hour average incremental PM_{10} concentrations predicted at sensitive receptors for Stage 5 & 6 operations are presented in **Table 15**, with contour plots of the incremental impacts presented in **Figure 11** and **Figure 12** respectively.

Table 15 Incremental Maximum 24-Hour Average PM_{10} Concentrations at Surrounding Receptors

Receptor	Incremental Impact (µg/m^3)	
	Stage 5	Stage 6
R1	7.1	7.1
R2	4.8	4.8
R3	5.4	5.4
R4	1.6	1.6
R5	1.3	1.3
R6	1.0	1.0

Based on the results presented in **Table 15**, Residence R1 was identified as being the potentially worst impacted sensitive receptor. To analyse the cumulative 24-hour average PM_{10} impacts predicted by the modelling in more detail, a contemporaneous analysis was conducted as required by the Approved Methods for this receptor (R1) and is presented in **Table 16** for Stage 5 and **Table 17** for Stage 6.

The data presented in **Table 16** shows that, during Stage 5, the days predicting the highest impacts occur when the contribution from background air quality sources is high. The modelling results show that the cumulative 24-hour average PM_{10} concentrations for Stage 5 are predicted to be below the relevant criterion.

Table 16 Stage 5 - Summary of Contemporaneous Impact and Background at Receptor R1

Maximum Predicted 24-Hour Average PM_{10} Concentrations (µg/m³)							
High Background Days				High Increment Days			
Date	**Background**	**Increment**	**Total**	**Date**	**Background**	**Increment**	**Total**
26/11/2015	41.2	0.7	41.9	30/06/2015	10.0	7.1	17.1
05/05/2015	38.6	0.0	38.6	20/06/2015	8.7	6.0	14.7
20/12/2015	38.6	0.0	38.6	18/06/2015	5.0	5.8	10.8
16/10/2015	38.0	0.0	38.0	10/08/2015	13.4	5.5	18.9
06/05/2015	37.8	1.0	38.8	01/07/2015	8.6	5.1	13.7
22/08/2015	33.9	0.0	33.9	18/07/2015	7.8	5.1	12.9
19/11/2015	33.6	0.1	33.7	24/09/2015	8.4	4.9	13.3
19/12/2015	33.0	0.0	33.0	19/06/2015	4.2	4.9	9.1
21/08/2015	32.5	0.3	32.8	19/07/2015	6.7	4.8	11.5
07/10/2015	31.1	0.2	31.3	16/07/2015	4.6	4.7	9.3
Criterion			**50**				**50**

The data presented in **Table 16** shows that, during Stage 6, the days predicting the highest impacts occur when the contribution from background air quality sources is high. The modelling results show that the cumulative 24-hour average PM_{10} concentrations for Stage 6 are predicted to be below the relevant criterion.

Table 17 Stage 6 – Summary of Contemporaneous Impact and Background at Receptor R1

Maximum Predicted 24-Hour Average PM_{10} Concentrations (µg/m³)							
High Background Days				High Increment Days			
Date	**Background**	**Increment**	**Total**	**Date**	**Background**	**Increment**	**Total**
26/11/2015	41.2	0.6	41.8	01/07/2015	8.6	4.4	13.0
05/05/2015	38.6	<0.1	<38.7	19/07/2015	6.7	4.1	10.8
20/12/2015	38.6	<0.1	<38.7	24/03/2015	9.2	4.0	13.2
16/10/2015	38.0	<0.1	38.1	30/06/2015	10.0	4.0	14.0
06/05/2015	37.8	0.7	38.5	18/06/2015	5.0	3.9	8.9
22/08/2015	33.9	<0.1	<34.0	24/09/2015	8.4	3.8	12.2
19/11/2015	33.6	0.1	33.7	02/05/2015	9.6	3.8	13.4
19/12/2015	33.0	<0.1	<33.1	20/06/2015	8.7	3.7	12.4
21/08/2015	32.5	0.3	32.8	10/08/2015	13.4	3.5	16.9
07/10/2015	31.1	0.2	31.3	03/07/2015	10.0	3.3	13.3
Criterion			**50**				**50**

It is therefore concluded that extraction of hard rock during Stages 5 & 6 is unlikely to cause any additional exceedances of the 24-hour average PM_{10} guideline at the surrounding sensitive receptors.

Figure 9 Stage 5 Predicted Annual Average Incremental PM_{10} Concentration

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Date:	24/03/2016

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Albion Park Quarry - Stage 5
Air Quality Impact Assessment

Incremental Impact

Pollutant	PM_{10}	Averaging Period	Annual	Unit	µg/m³

Figure 10 Stage 6 Predicted Annual Average Incremental PM_{10} Concentrations

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Air Quality Impact Assessment

Incremental Impact

Pollutant	PM_{10}	Averaging Period	Annual	Unit	µg/m³

Figure 11 Stage 5 Predicted Maximum 24-Hour Average Incremental PM_{10} Concentrations

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Air Quality Impact Assessment

Incremental Impact

Pollutant	PM_{10}	Averaging Period	24-Hour	Unit	µg/m³

Figure 12 Stage 6 Predicted Maximum 24-Hour Average Incremental PM_{10} Concentrations

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Air Quality Impact Assessment

Incremental Impact

Pollutant	PM_{10}	Averaging Period	24-Hour	Unit	µg/m³

5.4.3 Suspended Particulate Matter ($PM_{2.5}$)

Table 18 and **Table 19** show the predicted incremental and cumulative impacts for annual and the predicted incremental 24-hour average $PM_{2.5}$ concentrations at each receptor, respectively. The maximum 24-hour and annual average incremental $PM_{2.5}$ concentration contour plots for both Stage 5 and 6 are presented in **Figure 13** to **Figure 16**.

The predicted incremental 24-hour and annual average $PM_{2.5}$ concentrations at all receptors are minor (<10% and <5% respectively) compared to the relevant ambient air quality guideline. Considering the relatively small predicted incremental contribution, it can be concluded that the proposed operational activities are unlikely to cause any additional exceedances above background air quality concentrations of the 24-hour or annual average $PM_{2.5}$ criteria at sensitive receptor locations.

Table 18 Incremental and Cumulative Annual Average $PM_{2.5}$ Concentrations at Surrounding Receptors

Receptor	Background	Incremental Impact (µg/m^3)		Cumulative Impact (µg/m^3)	
		Stage 5	Stage 6	Stage 5	Stage 6
R1	6.4	0.2	0.2	6.6	6.6
R2	6.4	0.1	0.1	6.5	6.5
R3	6.4	0.1	0.1	6.5	6.5
R4	6.4	<0.1	<0.1	<6.5	<6.5
R5	6.4	<0.1	<0.1	<6.5	<6.5
R6	6.4	<0.1	<0.1	<6.5	<6.5
Criterion				**8**	**8**

Table 19 Incremental Maximum 24-Hour average $PM_{2.5}$ Concentrations at Surrounding Receptors

Receptor	Incremental Impact (µg/m^3)	
	Stage 5	Stage 6
R1	1.6	1.6
R2	1.1	1.1
R3	1.1	1.1
R4	0.3	0.3
R5	0.2	0.2
R6	0.2	0.2

Based on the results presented in **Table 19**, Residence R1 was identified as being the potentially worst impacted sensitive receptor. To analyse the cumulative 24-hour average $PM_{2.5}$ impacts predicted by the modelling in more detail, a contemporaneous analysis was conducted as required by the Approved Methods for this receptor (R1) and is presented in **Table 20** for Stage 5 and **Table 21** for Stage 6.

The data presented in **Table 20** shows that, during Stage 5, the days predicting the highest impacts occur when the contribution from background air quality sources is high. The modelling results show that the cumulative 24-hour average $PM_{2.5}$ concentrations for Stage 5 are predicted to be below the relevant criterion.

Table 20 Stage 5 - Summary of Contemporaneous Impact and Background at Receptor R1

Maximum Predicted 24-Hour Average $PM_{2.5}$ Concentrations (µg/m³)							
High Background Days				High Increment Days			
Date	**Background**	**Increment**	**Total**	**Date**	**Background**	**Increment**	**Total**
21/08/2015	21.1	<0.1	<21.2	30/06/2015	6.0	1.6	7.6
22/08/2015	18.5	<0.1	<18.6	10/08/2015	6.5	1.2	7.7
19/12/2015	16.9	<0.1	<17.0	20/06/2015	-	1.1	1.1
20/12/2015	16.9	<0.1	<17.0	18/06/2015	2.1	1.1	3.2
16/10/2015	16.2	<0.1	<16.3	01/07/2015	5.2	1.0	6.2
25/11/2015	15.3	<0.1	<15.4	19/07/2015	3.1	0.9	4.0
20/11/2015	15.1	0.1	15.2	18/07/2015	3.5	0.9	4.4
11/12/2015	15.1	0.1	15.2	02/06/2015	4.5	0.9	5.4
29/11/2015	14.7	<0.1	<14.8	16/07/2015	3.7	0.9	4.6
11/10/2015	14.4	<0.1	<14.5	19/06/2015	-	0.9	0.9
Criterion			**25**				**25**

The data presented in **Table 21** shows that, during Stage 6, the days predicting the highest impacts occur when the contribution from background air quality sources is high. The modelling results show that the cumulative 24-hour average $PM_{2.5}$ concentrations for Stage 6 are predicted to be below the relevant criterion.

Table 21 Stage 6 - Summary of Contemporaneous Impact and Background at Receptor R1

Maximum Predicted 24-Hour Average $PM_{2.5}$ Concentrations (µg/m³)							
High Background Days				High Increment Days			
Date	**Background**	**Increment**	**Total**	**Date**	**Background**	**Increment**	**Total**
21/08/2015	21.1	<0.1	<21.2	01/07/2015	5.2	0.9	6.1
22/08/2015	18.5	<0.1	<18.6	24/03/2015	3.5	0.9	4.4
19/12/2015	16.9	<0.1	<17.0	30/06/2015	6.0	0.8	6.8
20/12/2015	16.9	<0.1	<17.0	19/07/2015	3.1	0.8	3.9
16/10/2015	16.2	<0.1	<16.3	02/05/2015	4.1	0.8	4.9
25/11/2015	15.3	<0.1	<15.4	18/06/2015	2.1	0.8	2.9
20/11/2015	15.1	0.1	15.2	10/08/2015	6.5	0.7	7.2
11/12/2015	15.1	0.1	15.2	03/07/2015	5.9	0.7	6.6
29/11/2015	14.7	<0.1	<14.8	20/06/2015	-	0.7	0.7
11/10/2015	14.4	<0.1	<14.5	24/09/2015	4.1	0.7	4.8
Criterion			**25**				**25**

It is therefore concluded that extraction of hard rock during Stages 5 & 6 is unlikely to cause any additional exceedances of the 24-hour average $PM_{2.5}$ guideline at the surrounding sensitive receptors.

Figure 13 Stage 5 Predicted Annual Average Incremental $PM_{2.5}$ Concentrations

Figure 14 Stage 6 Predicted Annual Average Incremental $PM_{2.5}$ Concentrations

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Albion Park Quarry - Stage 6
Air Quality Impact Assessment

Incremental Impact

Pollutant	$PM_{2.5}$	Averaging Period	Annual	Unit	µg/m³

Figure 15 Stage 5 Predicted Maximum 24-Hour Average Incremental $PM_{2.5}$ Concentrations

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Albion Park Quarry - Stage 5
Air Quality Impact Assessment

Incremental Impact

Pollutant	$PM_{2.5}$	Averaging Period	24-Hour	Unit	µg/m³

Figure 16 Stage 6 Predicted Maximum 24-Hour Average Incremental $PM_{2.5}$ Concentrations

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Air Quality Impact Assessment

Incremental Impact

Pollutant	$PM_{2.5}$	Averaging Period	24-Hour	Unit	µg/m³

5.4.4 Dust Deposition

Annual average dust deposition rates (in g/m²/month) at the surrounding sensitive receptors due to the proposed quarry operations during Stage 5 & 6 have been predicted based on the TSP emission rates presented in **Table 12**.

Estimated annual average incremental and cumulative dust deposition levels at each receptor for the proposed operation are summarised in **Table 22** and the incremental impacts are presented as contour plots in **Figure 17** and **Figure 18**. It can be observed that the proposed operation is unlikely to exceed the nuisance criteria for incremental or cumulative dust deposition levels at any of the identified surrounding sensitive receptor locations.

Table 22 Incremental and Cumulative Annual Average Dust Deposition at Nearest Receptors

Receptor	Background* (g/m²/month)	Incremental Impact (g/m²/month)		Cumulative (g/m²/month)	
		Stage 5	Stage 6	Stage 5	Stage 6
R1	2.4	<0.1	<0.1	<2.5	<2.5
R2	2.4	<0.1	<0.1	<2.5	<2.5
R3	2.4	<0.1	<0.1	<2.5	<2.5
R4	2.4	<0.1	<0.1	<2.5	<2.5
R5	2.4	<0.1	<0.1	<2.5	<2.5
R6	2.4	<0.1	<0.1	<2.5	<2.5
Criterion		**2.0**	**2.0**	**4.0**	**4.0**

Note: *****The background value is based on data from the site monitoring program and therefore includes the impact from current operations.

Figure 17 Stage 5 Predicted Annual Average Incremental (Project only) Dust Deposition

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Albion Park Quarry - Stage 5
Air Quality Impact Assessment

Incremental Impact

Pollutant	Dust Deposition	Averaging Period	Annual	Unit	g/m²/month

Figure 18 Stage 6 Predicted Annual Average Incremental (Project only) Dust Deposition

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Albion Park Quarry - Stage 6
Air Quality Impact Assessment

Incremental Impact

Pollutant	Dust Deposition	Averaging Period	Annual	Unit	g/m²/month

6 CONCLUSION

The Albion Park Quarry is currently extracting 900,000 tpa of hard rock from Stage 4 of the operations. This assessment addresses the potential impacts to air quality from extracting 900,000 tpa of hard rock from Stage 5 and 6 of the operations. SLR has historically conducted air quality impact assessments for this quarry.

Atmospheric dispersion modelling was carried out to determine the potential impacts to air quality of extractive activities for the Project. The potential emission-generating activities for the both stages of operation have been identified and potential emissions from these activities were estimated based on available information and emission factors from the literature.

The existing air quality environment was quantified through a combination of monitoring data from both the Project Site and a regional station maintained by the NSW Office of Environment and Heritage. Data from the on-site meteorological station were used to represent the local atmospheric dispersion conditions.

Dispersion modelling of the emissions to predict maximum off-site pollutant concentrations indicates that the proposed operational activities would comply with all relevant ambient air quality criteria at all representative surrounding sensitive receptors, even when existing background pollutant levels are considered.

Based on the modelling approach, it is concluded that dust and particulate matter impacts during the annual extraction of 900,000 tpa of hard rock during Stage 5 and 6 at the Albion Park Quarry would not cause exceedances of the relevant air quality criteria.

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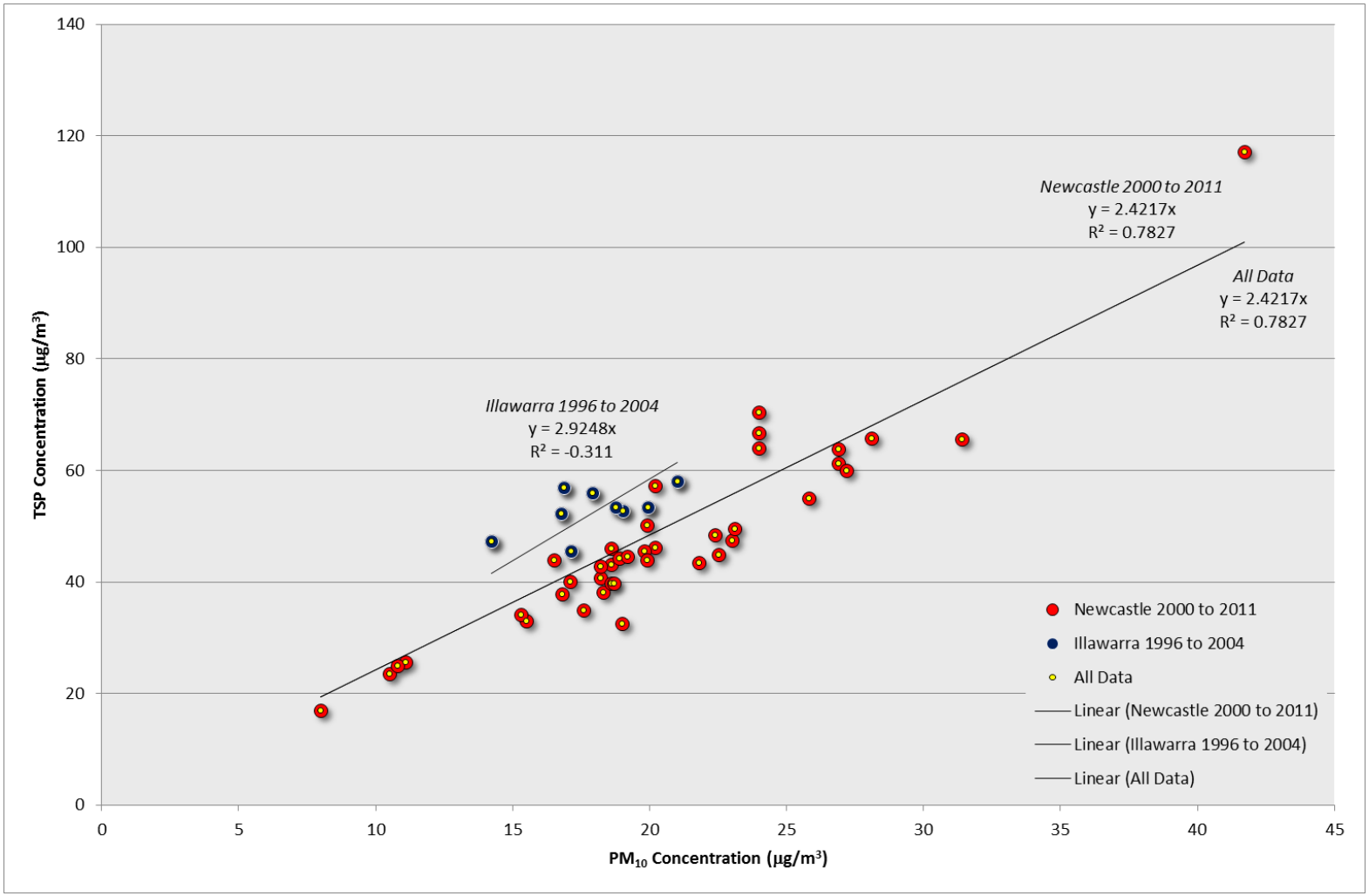
Figure A-1 Analysis of PM_{10} and TSP HVAS Data, Newcastle Region (2000 to 2011) and Illawarra Region (1996 to 2004)



Newcastle: Mayfield, Steel River Estate, Stockton, Fern Bay and Fullerton Road, Stockton. Illawarra: Albion Park, Kembla Grange, Warrawong, Wollongong, Port Kembla.

METEOROLOGICAL DATA USED IN MODELLING

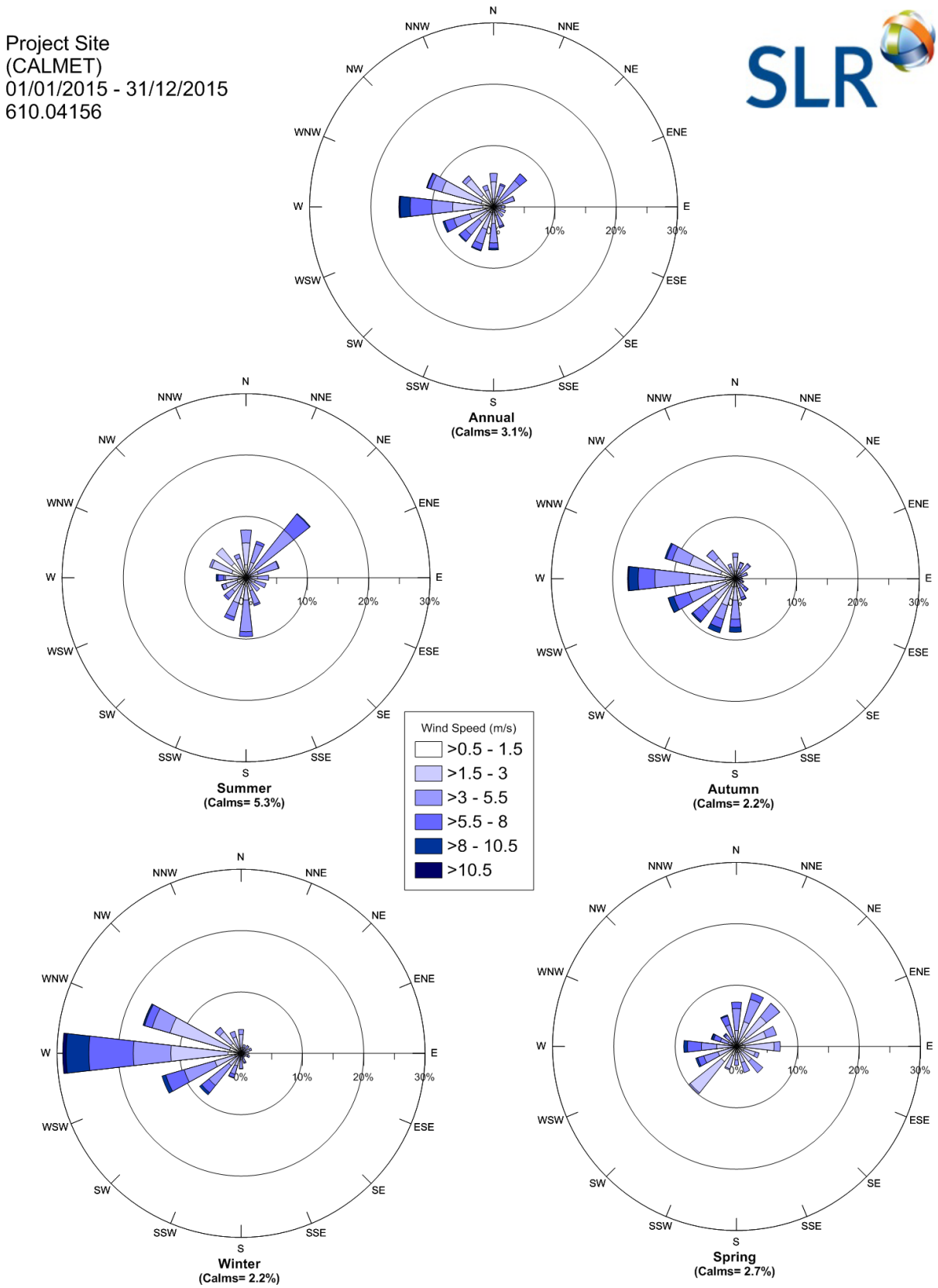
Wind Speed and Direction

A summary of the annual wind behaviour predicted by CALMET at the Development site is presented as wind roses in **Figure B-1**. **Figure** indicates that winds experienced at the site are predominantly moderate (between 1.5 m/s and 5.5 m/s) with a large percentage of the strong winds (>10.5 m/s) originating from the west. Calm wind conditions (wind speed less than 0.5 m/s) were predicted to occur approximately 3.1% of the time throughout the modelling period.

The seasonal wind roses indicate that typically:

- In summer, winds are moderate to strong predominantly from the northeast.
- In autumn, winds are moderate to strong predominantly from the western quadrant with also a significant contribution of moderate to strong winds from the southwest quadrant.
- In winter, predominant wind directions are from the west and wind speeds are considered to be moderate to strong.
- In spring, moderate winds occur from the northeasterly quadrant with winds from the southwest also dominant.

Figure B-1 Predicted Seasonal Wind Roses for the Project Site (CALMET predictions, 2015)



Atmospheric Stability

Atmospheric stability refers to the tendency of the atmosphere to resist or enhance vertical motion. The Pasquill-Turner assignment scheme identifies six Stability Classes, A to F, to categorize the degree of atmospheric stability as follows:

- A = Extremely unstable conditions
- B = Moderately unstable conditions
- C = Slightly unstable conditions
- D = Neutral conditions
- E = Slightly stable conditions
- F = Moderately stable conditions

The meteorological conditions defining each Pasquill stability class are shown in **Table B-1**.

Table B-1 Meteorological Conditions Defining Pasquill Stability Classes (Source: Pasquill, 1961)

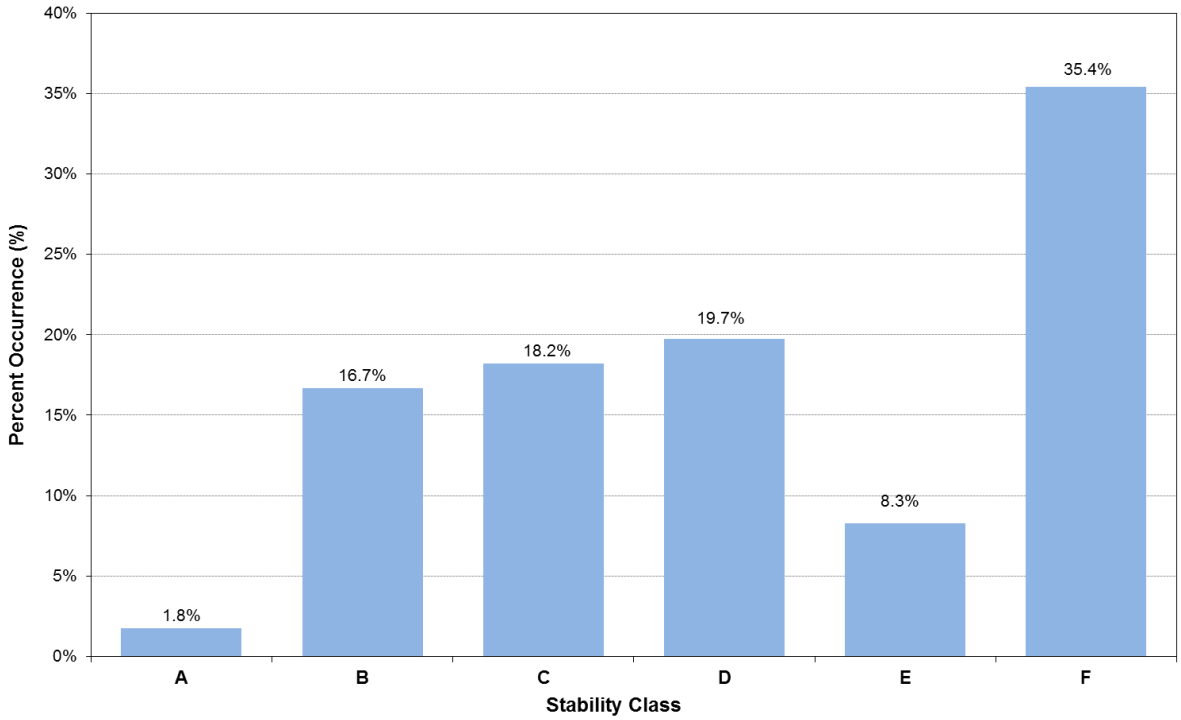
Surface wind speed (m/s)	Daytime insolation			Night-time conditions	
	Strong	Moderate	Slight	Thin overcast or > 4/8 low cloud	<= 4/8 cloudiness
< 2	A	A - B	B	E	F
2 - 3	A - B	B	C	E	F
3 - 5	B	B - C	C	D	E
5 - 6	C	C - D	D	D	D
> 6	C	D	D	D	D

Notes:

1. Strong insolation corresponds to sunny midday in midsummer in England; slight insolation to similar conditions in midwinter.
2. Night refers to the period from 1 hour before sunset to 1 hour after sunrise.
3. The neutral category D should also be used, regardless of wind speed, for overcast conditions during day or night and for any sky conditions during the hour preceding or following night as defined above.

The frequency of each stability class predicted by CALMET during the modelling period, extracted at the centre of the Project Site, is presented in **Figure B-2**. The results indicate a high frequency of conditions typical to Stability Class F. Stability Class F is indicative of stable night time conditions, which will inhibit pollutant dispersion resulting in higher pollutant concentrations.

Figure B-2 Predicted Stability Class Frequencies at the Development Site (CALMET predictions, 2015)

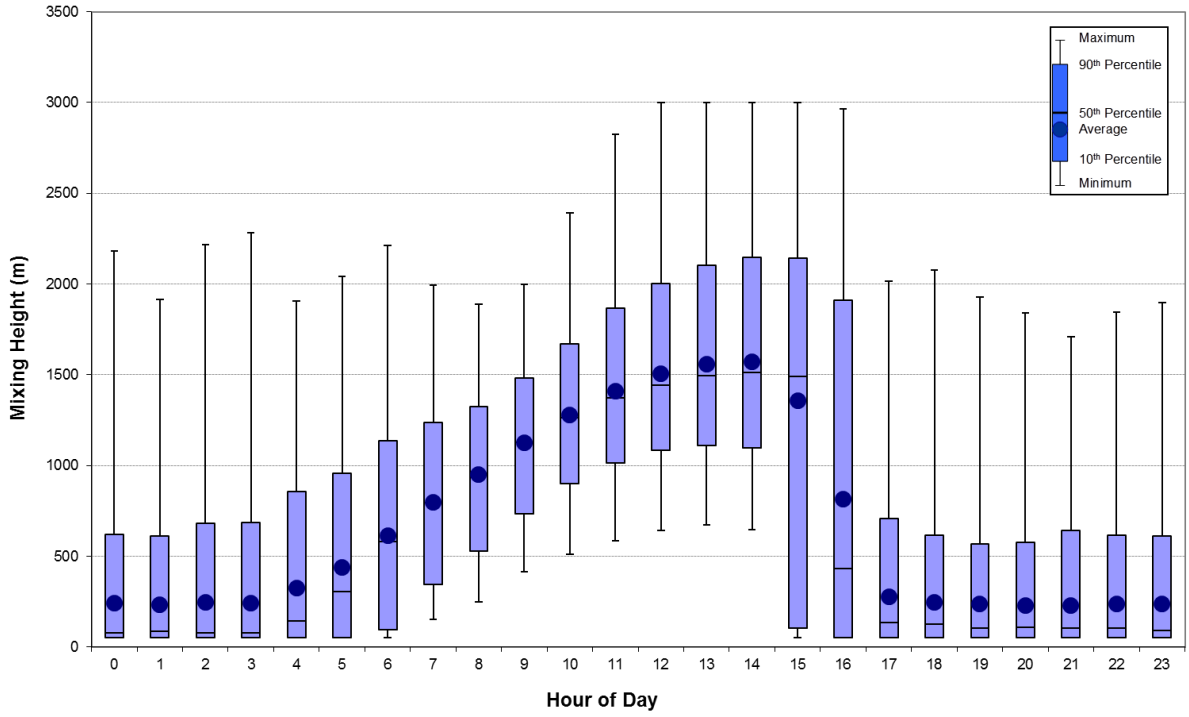


Mixing Heights

Diurnal variations in maximum and average mixing heights predicted by CALMET at the Development site during the 2015 modelling period are illustrated in **Figure B-3**.

As would be expected, an increase in mixing height during the morning is apparent, arising due to the onset of vertical mixing following sunrise. Maximum mixing heights occur in the mid to late afternoon, due to the dissipation of ground based temperature inversions and growth of the convective mixing layer.

Figure B-3 Predicted Mixing Heights at the Project Site (CALMET predictions, 2015)



Temperature

The modelled temperature variations as predicted at the Development site during 2015 are illustrated in **Figure B-4**. The maximum temperature (31.6°C) was predicted on 20 November and the minimum temperature (5.1°C) was predicted on 4 August.

Figure B-4 Predicted Temperatures at the Project Site (CALMET predictions, 2015)

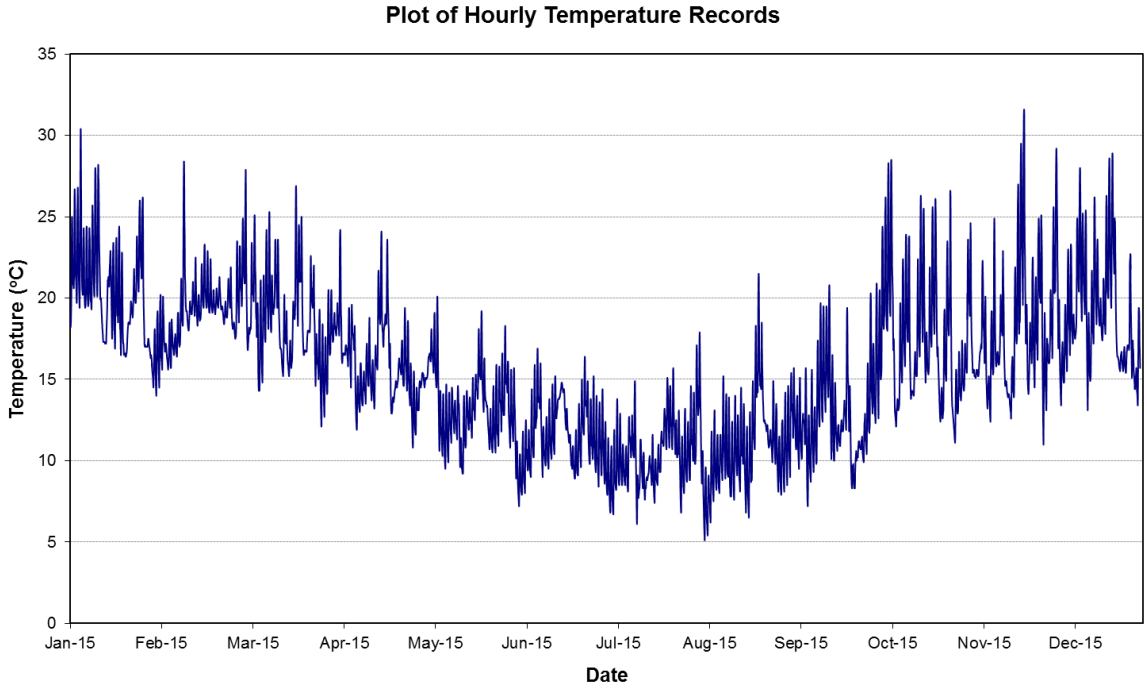


Table C-1 Stage 5 Emission Inventory

Activity	Control Factors	TSP emission (kg/y)	PM_{10} emission (kg/y)	$PM_{2.5}$ emission (kg/y)	Intensity	Units	TSP emission factor	PM_{10} emission factor	$PM_{2.5}$ emission factor	Units
Bulldozer	2	8,150	3,593	1,626	1,650	hours/year	9.9	2.3	1.0	kg/h
Excavator - Rock	2	502	451	68	900,000	tonnes/year	0.0011	0.0005	0.00008	kg/t
Excavator - OB	2	13	12	2	49,196	tonnes/year	0.0005	0.0003	0.00004	kg/t
Air - Track Drill	2	521	515	46	1,766	holes/year	0.59	0.3068	0.0276	kg/hole
Scrapers	2	3,441	473	161	573	VKT	6.008	0.8261	0.2812	kg/VKT
Grader	1,2	26	16	2	195	Km	1.08	0.34	0.03	kg/VKT
Blasting	2	13	13	1	26	blasts/year	1.0	0.5	0.03	kg/blast
Wheel Dust (Empty)	1,2	15,123	7,757	776	34,768	VKT	3.480	0.939	0.094	kg/VKT
Wheel Dust (Full)	1,2	22,285	11,431	1,143	34,768	VKT	5.128	1.384	0.138	kg/VKT
Trucks dumping Rock	2	502	451	68	900,000	tonnes/year	0.0011	0.0005	0.00008	kg/t
Dumping overburden	2	13	12	2	49,196	tonnes/year	0.0005	0.0003	0.00004	kg/t
Wind Erosion	2	4,471	4,248	398	2.6	ha	0.40	0.20	0.02	kg/ha/hour
Total		**55,060**	**28,970**	**4,292**						

Notes:

1. Control factors:
    1. Haul road water spraying = 75% reduction
    2. Pit Retention: TSP = 50% reduction; PM_{10} = 5% reduction

Table C-2 Stage 6 Emission Inventory

Activity	Control Factors	TSP emission (kg/y)	PM_{10} emission (kg/y)	$PM_{2.5}$ emission (kg/y)	Intensity	Units	TSP emission factor	PM_{10} emission factor	$PM_{2.5}$ emission factor	Units
Bulldozer	2	8,150	3,593	1,626	1,650	hours/year	9.9	2.3	1.0	kg/h
Excavator - Rock	2	502	451	68	900,000	tonnes/year	0.0011	0.0005	0.00008	kg/t
Excavator - OB	2	13	12	2	49,196	tonnes/year	0.0005	0.0003	0.00004	kg/t
Air - Track Drill	2	521	515	46	1,766	holes/year	0.59	0.3068	0.0276	kg/hole
Scrapers	2	3,441	473	161	573	VKT	6.008	0.8261	0.2812	kg/VKT
Grader	1,2	24	14	1	180	km	1.08	0.34	0.03	kg/VKT
Blasting	2	13	13	1	26	blasts/year	1.0	0.5	0.03	kg/blast
Wheel Dust (Empty)	1,2	13,826	7,092	709	31,788	VKT	3.480	0.939	0.094	kg/VKT
Wheel Dust (Full)	1,2	20,375	10,451	1,045	31,788	VKT	5.128	1.384	0.138	kg/VKT
Trucks dumping Rock	2	502	451	68	900,000	tonnes/year	0.0011	0.0005	0.00008	kg/t
Dumping overburden	2	13	12	2	49,196	tonnes/year	0.0005	0.0003	0.00004	kg/t
Wind Erosion	2	5,165	4,907	459	2.9	ha	0.40	0.20	0.02	kg/ha/hour
Total		**52,546**	**27,983**	**4,189**						

Notes:

2. Control factors:
    1. Haul road water spraying = 75% reduction
    2. Pit Retention: TSP = 50% reduction; PM_{10} = 5% reduction

APPENDIX 2:

“Noise and Blasting Assessment (Version v3.0)” prepared by SLR

global environmental solutions

Albion Park Quarry Extension - Stages 5 and 6

Noise and Blasting Assessment

Report Number 610.04156-R06

15 December 2016

Cleary Bros (Bombo) Pty Ltd

39 Five Island Road

PORT KEMBLA NSW 2505

Version: v3.0

Albion Park Quarry Extension - Stages 5 and 6

Noise and Blasting Assessment

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DOCUMENT CONTROL

Reference	Date	Prepared	Checked	Authorised
610.04156-R06-v3.0	15 December 2016	Dick Godson	Mark Blake	Dick Godson

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APPENDICES

1 INTRODUCTION

The Minister for Infrastructure and Planning (now, Department of Planning and Environment, DPE) has conditionally approved the extension of the Cleary Bros (Bombo) Pty Ltd (Cleary Bros) Albion Park Quarry extension and the development of the quarry haul road in 2004.

Further to this approval being issued, a third party appeal was lodged by Figtree Hill Pty Limited against Cleary Bros (Bombo) Pty Limited and the Minister for Planning. Following the Land and Environment Court Proceedings No. 10639 of 2005, amended Consent Conditions (Consent) were issued.

The Consent Conditions for the hard rock quarry haul road on Lot 2 DP858245, Dunsters Lane, Croome relate to Development Application No. 467-11-2003 (Haul Road DA). The Consent Conditions for the extension of the hard rock quarry on Lot 1 DP858245 and Lot 23 DP1939967, Dunsters Lane, Croome relate to DA 466-11-2003 (Quarry Extension DA).

Initially, SLR Consulting Australia Pty Ltd (SLR - then Heggies Australia Pty Ltd) was requested to provide a Blast Management Plan (BMP) and Noise Monitoring Programme (NMP) relating to the assessment and monitoring requirements in order to ensure environmental compliance in regard to the blasting and noise aspects of the operations.

The SLR report dated 10 February 2006 contained the NMP for the Albion Park Quarry extension and detailed monitoring locations and intervals, methods of monitoring noise emissions and associated weather as well as the correct compliance checking procedures/corrective action and subsequent reporting in accordance with the (then) Department of Infrastructure, Planning and Natural Resources (DIPNR) and the Department of Environment and Conservation (DEC) requirements.

The original Noise Monitoring Programme was prepared in accordance with Conditions 7, Schedule 4 of the 2006 Consent Conditions for the quarry extension.

In 2015 a Modified Development Consent (2015 Consent) was issued for the extension to the hard rock quarry and is attached as **Appendix A**.

Subsequently, a Noise Management Plan (NMP) was prepared in accordance with Condition 14, Schedule 4 of the 2015 Quarry Extension DA Consent which states that:

> *"Noise Management Plan*
>
> *8. The Applicant shall prepare and implement a Noise Management Plan for the development to the satisfaction of the Secretary. This plan must:*
>
> *a) be prepared in consultation with the EPA, and submitted to the secretary for approval by 30 September 2015;*
>
> *b) describe the measures that would be implemented to ensure compliance with the relevance noise criteria and operating conditions in this consent;*
>
> *c) describe the proposed noise management system on site; and*
>
> *d) include a monitoring program that:*
> - *uses attended monitoring to evaluate the compliance of the development against the noise criteria in this consent;*
> - *evaluates and reports on the effectiveness of the noise management system and the best practice noise management measures; and*
> - *defines what constitutes a noise incident, and includes a protocol for identifying and notifying the Department and relevant stakeholders of any noise incidents."*

Similarly, a Revised Blast Management Plan (RBMP) was prepared in accordance with Condition 14 of the 2015 Consent which states that:

"Blast Management Plan

14. Prior to the commencement of operations in each stage of the development after Stage 1, the Applicant shall prepare, and subsequently implement, a Blast Management Plan for the development in consultation with the landowner(s) of The Fig Tree Hill Land, the EPA and to the satisfaction of the Secretary. This plan must:

a) include a summary of monitoring results for the previous quarry stage;

b) describe the objectives for noise and blasting for that stage;

c) describe the proposed blasting design for that stage, and demonstrate that the design will meet the blast criteria listed in Tables 3 and 4;

d) include a monitoring program for evaluating and reporting on the performance of the development, including:
- *compliance with the blasting criteria in this consent; and*
- *minimising the fume emissions from the site;*

e) describe the measures that would be implemented to:
- *ensure compliance with the blasting criteria and operating conditions of this consent; and*
- *mitigate, remediate or compensate for any blasting impacts of the development on The Fig Tree Hill Land or the use of that land.*

Note: The plan shall be generally in accordance with the draft Blast Management Plan titled 'Albion Park Quarry Extension, Noise Monitoring Program/Blast Management Plan' dated 10 February 2006 and prepared by Heggies Australia Pty Ltd."

The EPA's response to a review of the NMP (dated 30 October 2015) and the BMP (dated 18 November 2015) is attached as **Appendix B**.

As Stage 2 and Stage 4 of the subject quarry extension are being excavated concurrently, the next stage of excavation is Stage 5 concurrently with Stage 6.

In relation to Stages 5 and 6 of the subject Quarry Extension, Condition 6, Schedule 3 of the 2015 Consent states that:

"Staged Development"

…….

"6. Under section 80(5) of the Act, Stages 5 and 6 must been the subject of another development consent.

A consent granted in accordance with condition 6 does not require a further development application under section 78A of the Act. However, in seeking consent for Stages 5 and 6, the Applicant shall submit a report to the Minister that has been prepared in consultation with the CCC, the landowner(s) of The Fig Tree Hill Land, and relevant government authorities. The report shall be consistent with the original development application (DA 466-11-2003) and shall include:
a) details of the proposed quarrying operations for Stages 5 and 6;
b) results of consultation conducted during preparation of the report;
c) assessment of the environmental, social, agricultural and economic impacts of Stages 5 and 6, based on the environmental performance of Stages 1 to 4 and consultation referred to in subclause (b) above;
d) assessment of the consistency of Stages 5 and 6 with relevant environmental planning instruments and strategies; and
e) justification for the extraction of Stages 5 and 6.

Notes: Within 4 weeks of receiving this report, the Minister will endeavour to:
- *make the report public;*
- *seek independent expert advice on the report if deemed to be warranted;*

- *seek advice from relevant government authorities on the report;*
- *determine the proposal; and*
- *make this determination public."*

Following a meeting between the Proponent and DPE representatives, the Proponent was advised, in relation to the assessment for Stages 5 and 6 of the Quarry Extension called up in Condition 6 above, that:

> *"This assessment should focus on changed impacts associated with Stages 5 & 6 and does not need to address already approved operations. The Environmental Assessment must provide an assessment of the environmental performance of the quarry to date and, where possible, use this information to calibrate the prediction of impacts for Stages 5 & 6."*

This assessment has consequently been prepared on that basis.

2 PROJECT NOISE EMISSION LIMITS

2.1 Noise

Condition 4, Schedule 4 of the 2015 Consent states that:

> *"The Applicant shall ensure that noise generated by the development does not exceed the criteria specified in Table 1.*

Receiver Locations	***Noise Limits dB(A) $L_{Aeq(15minute)}$***		
	Stages 1-2	*Stages 3-4*	*Stages 5-6*
'The Hill' residence (Dunster premises)	*35*	*38*	*35*
'The Cottage' residence (Dunster premises)	*35*	*38*	*35*
Approved rural workers dwelling (Dunster premises)	*35*	*38*	*35*
Greenmeadows Residential Estate	*41*	*41*	*41*

Table 1:Noise Criteria for the Development

Notes:

1. *Staging as depicted in Figure 3.5 of the EIS prepared by Perram and Partners, dated October 2003.*
2. *Receiver locations nominated in Table 5.12 of the report prepared by Richard Heggie and Associates Report No. 30-1079R1 titled 'Noise and Blasting Impact Assessment - Cleary Bros Albion Park Quarry' (13 December 2002). At the time of the DA the above were the nearest affected residences.*
3. *The receiver locations and noise limits in the above table may be varied in the instance that negotiated agreements are entered into by the licensee and affected residents/occupiers or if existing agreements become void, or the nearest receiver location changes due to urban encroachment. These limits may be subject to change with an EPL variation.*
4. *Noise from the premises is to be measured at the most affected point within the residential boundary, or at the most affected point within 30 metres of the dwelling where the dwelling is more than 30 metres from the boundary, to determine compliance with the noise level limits in Table 1. Where it can be demonstrated that direct measurement of noise from the premises is impractical, the EPA may accept alternative means of determining compliance. See Chapter 11 of the NSW Industrial Noise Policy. The modification factors presented in Section 4 of the NSW Industrial Noise Policy shall also be applied to the measured noise level where applicable.*
5. *The noise emission limits in Table 1 apply under meteorological conditions of:*
   - *Wind speeds up to 0.5m/s in any direction at 10 metres above ground level; or*
   - *Temperature gradient (environmental lapse rate) conditions of less than or equal to 0°C/100m (lapse)."*

2.2 Operating Hours

Conditions 5 and 6, Schedule 4 of the 2015 Consent state that:

"5. The Applicant shall comply with the operating hours in Table 2.

Activity	***Days of the Week***	***Time***
Drilling, rock breaking, loading and haulage of materials from quarry to processing plant, processing and stockpiling, overburden stripping and other stage preparatory works, all site construction activities, rehabilitation works, general plant and maintenance. Processing, crushing and screening and product transfer to stockpiles	*Monday - Friday*	*7.00 am - 5.30 pm*
	Saturday	*7.00 am - 1.00 pm*

Table 2: Operating Hours for the Development

6. The following activities may be carried out at the premises outside the hours specified in Table 2:
- *a) the delivery of materials as requested by Police or other authorities for safety reasons;*
- *b) emergency work to avoid the loss of lives, property and/or to prevent environmental harm;*
- *c) workshop activities and other maintenance work inaudible at the nearest affected receiver."*

3 QUARRY ENVIRONMENTAL MANAGEMENT PLAN

The criteria and procedures in the current Quarry Environmental Management Plan (QEMP) for Albion Park Quarry which relate to noise are as follows. However, the QEMP will be revised and updated in accordance with this Noise Management Plan.

"5.5 NOISE LIMITS

5.5.1 Performance Objective

Source - *Quarry development consent: schedule 4, conditions 4, 8 and 9; Access road consent: conditions 16, 17 and 18. (identical)*

Requirement - *Operational noise generated by the development must not exceed criteria specified in Table 5.1 under conditions of wind speeds (10 metres above ground) of up to 0.5 metres per second and under temperature gradients of to 0°C per 100 metres (Condition 4).*

Verification - *Noise measurement to be undertaken at the most affected point on the receptor boundary or within 30 metres of the dwelling where the dwelling is more than 30 metres from the boundary. Measurements to be undertaken by a qualified person within eight weeks of commencing extraction and annually thereafter. Results to be submitted to DECC and the Director-General within three months (Condition 8). Noise monitoring procedures are included in the noise monitoring plan and summarised in section 7 of this QEMP.*

Notification - *Within seven days of detecting an exceedance of a noise limit in Table 5.1, the exceedance is to be reported to DECC, the Director-General and the owner of the property. (refer to Condition 9 for details).*

Table 5.1 NOISE LIMITS

Receiver Locations	***Noise Limits $L_{Aeq(15minute)}$***		
	Stages 1-2	***Stages 3-4***	***Stages 5-6***
"The Hill" residence (Dunster premises)	*35*	*38*	*35*
"The Cottage" residence (Dunster premises)	*35*	*38*	*35*
Approved rural worker's dwelling (Dunster premises)	*35*	*38*	*35*
Greenmeadows residential estate	*41*	*41*	*41*

7.3 NOISE MONITORING

7.3.1 Source

Noise monitoring requirements are detailed in the Noise Monitoring Programme/Blast Management Plan (Heggies Australia 2006) and summarised below.

7.3.2 Location

Noise monitoring locations are as follows:

Location Type	***Monitoring***
Reference location	*"Belmont" (Cody Residence)*
Residential Assessment Location	*"The Cottage" (Dunster Residence)*
Residential Assessment Location	*Greenmeadows Residential Estate*

Operator attended monitoring and unattended noise logging shall be carried at all of the above locations, except as detailed in 7.3.3 below.

7.3.3 Frequency

Operator attended monitoring is to be undertaken on one day per calendar quarter for the first 12 months after commencement of works and then at yearly intervals and at the commencement of any significant operational event.

Unattended noise logging is to be carried out for a minimum period of seven days on a quarterly basis for the first 12 months after commencement of works and then at yearly intervals.

The Greenmeadows estate is affected by noise from the processing plant which is unlikely to change unless the plant is altered. Once compliance has been established, further quarterly noise monitoring at this location is not required, although annual monitoring will continue.

7.3.4 Method

Operator attended monitoring shall quantify and characterise the maximum (L_{Amax}) and the average ($L_{Aeq(15minute)}$) intrusive noise from quarrying over a 15 minute measuring period.

Unattended continuous noise logging shall be conducted to quantify overall ambient noise amenity levels resulting from quarrying and processing emissions and other environmental noise sources.

Measurements will be taken with acoustic instrumentation carrying current NATA or manufacturer calibration certificates. Instrument calibration will be checked before and after each measurement survey.

All noise measurements will be accompanied by qualitative and quantitative measurements of prevailing local weather conditions. The operator shall record any significant quarry generated noise sources and obtain the operating logs for quarry plant and equipment during the measurement period.

7.3.5 Performance Targets

Performance targets are summarised in section 5.5 of this QEMP.

7.3.6 Assessment

Operator attended residential measurements are designed to confirm that noise generated by the development does not exceed the noise limits specified in the development consent (see section 5.5 of this QEMP).

Unattended noise logger data shall be correlated with weather data and quarry operating conditions, with data from periods of unstable weather deleted. The results shall be presented graphically.

7.3.7 Reporting and Review

The results of noise monitoring are to be included in the Annual Environmental Management Report.

In the event of any exceedance of relevant criteria, the matter will immediately be brought to the attention of the Quarry Production Manager, who will report the exceedance as required in section 7.7 of this QEMP."

4 NOISE MONITORING PROGRAM STAGES 5 AND 6

4.1 Historic Noise Compliance Monitoring

Subsequent to the submission of the January 2009 to March 2009 noise compliance report to the Department of Planning and Infrastructure (DoPI, now DPE), concerns were expressed by the DPE in relation to the lack of supporting evidence to justify the reported findings of compliance with the noise limits for the Albion Park Quarry.

Accordingly, SLR prepared a noise monitoring methodology in order to accommodate the requirements of the DPE. This methodology differs from the Noise Monitoring Programme developed in 2006 for the Albion Park Quarry. The subsequent reporting procedures are considered sufficient to meet the requirements of the 2015 Consent in relation to Stages 5 and 6 and are presented in **Section 4.2**.

4.2 General Requirements

The noise measurement procedures employed throughout the monitoring programme are in accordance with the requirements of AS 1055 1997 "*Acoustics - Description and Measurement of Environmental Noise*" and the NSW EPA's Industrial Noise Policy (INP).

In response to the DPE's request for supporting evidence to justify compliance with the noise limits for the Albion Park Quarry, two unattended continuous noise loggers are installed at strategic positions within the quarry in order to capture the contributions from the Albion Park Quarry. One logger are installed in the Processing Plant Area near the crusher and the other logger is installed in the Quarry Extension Area for a minimum period of 7 days, depending upon the weather conditions.

However, the weather conditions has a minimal effect on the measured noise level at the two unattended monitoring locations (Processing Plant and Quarry Extension Areas) because of the close proximity of the noise loggers to the Albion Park Quarry operations.

The median value of the L_{A1} and L_{A10} quarry operations noise levels is used to quantify the "maximum" and "average maximum" noise levels respectively at the nominated assessment locations. The L_{Aeq} is the equivalent continuous noise level which is equal in energy to the fluctuating level over the 15 minute interval.

In order to derive the statistical noise levels, the data is processed for the 0700 hours to 1800 hours daytime period. The calculated statistical ambient noise levels at each monitoring location will subsequently be determined.

4.2.1 Noise Impact Assessment Procedures

The two unattended monitoring locations have been incorporated into the existing quarry noise model, which was developed in 2002 and used to prepare the Noise and Blasting Impact Assessment for the quarry. These two locations are used as reference points enabling a comparison to be made between the predicted noise levels at the two reference locations and the noise levels modelled at the residences under varying weather conditions. This "relationship" is subsequently used to calculate the daily fluctuating quarry noise contributions at the respective residences.

The 2015 Consent noise limits apply under calm conditions only (ie wind speeds up to 0.5 m/s at 10 m height). Accordingly, the analysis of the noise logger results together with the modelling results during Stages 5 and 6 enables the contribution of the Albion Park Quarry to be calculated for calm (ie no wind) conditions to check compliance with the Consent noise limits.

4.3 Operator Attended Noise Surveys

Operator attended noise measurements and recordings are also be conducted, where prevailing weather conditions are favourable, in order to quantify the intrusive noise emissions from the quarrying, processing and transportation operations as well as the overall level of ambient noise in order to complement the unattended noise survey analysis.

The operator quantifies and characterises the maximum (L_{Amax}) and the average ($L_{Aeq(15minute)}$) intrusive noise level from quarrying and processing operations over a 15 minute measurement period. In addition, the operator quantifies and characterises the overall levels of ambient noise (ie L_{Amax}, L_{A1}, L_{A10}, L_{A50}, L_{A90}, L_{A99}, L_{Amin}) over the 15 minute measurement interval.

4.4 Monitoring Locations and Intervals

Operator-attended noise measurements during Stages 5 and 6 will be carried out at the three (3) key monitoring locations identified in Table 1 of the 2015 Consent at yearly intervals as well as at the commencement of any significant operational event. Operator-attended noise measurements will be carried out during the operating hours presented in Table 2 of the 2015 Consent.

5 INSTRUMENTATION AND MEASUREMENT PARAMETERS

5.1 Operator-Attended Surveys and Unattended Logging

All acoustic instrumentation employed throughout the Stages 5 and 6 monitoring programme will be designed to comply with the requirements of AS 1259.2-1990, "*Sound Level Meters*" and will carry current NATA or manufacturer calibration certificates.

All instrumentation will be programmed to record continuously statistical noise level indices in 15 minute intervals which may include the L_{Amax}, L_{A1}, L_{A5}, L_{A10}, L_{A50}, L_{A90}, L_{A99}, L_{Amin} and the L_{Aeq}.

Instrument calibration will be checked before and after each measurement survey, with the variation in calibrated levels not to exceed ±0.5 dBA.

5.2 Weather Monitoring Instrumentation

All noise measurements will be accompanied by both qualitative description (including cloud cover) and quantitative measurements of prevailing local weather conditions throughout the survey period.

Meteorological measurements will be guided by the requirements of AS 2923-1987 "*Ambient Air-Guide for Measurements of Horizontal Wind for Air Quality Applications*". An automatic weather station on the quarry site has been programmed to continuously record the meteorological parameters as shown in **Table 1**.

Table 1 Meteorological Measurement Parameters

Measured Parameter	Unit	Sample Interval
Mean wind speed	km/hr (or m/s)	15 minute
Mean wind direction	Degrees	15 minute
Sigma-theta	-	15 minute
Aggregate rainfall	mm	15 minute
Mean air temperature	°C	15 minute
Mean relative humidity	%RH	15 minute

5.3 Plant and Equipment Observations and Log

During the Stages 5 and 6 attended noise measurements, the operator will record any significant quarry generated noise sources (ie haul trucks, dozer, etc). In addition, the operator will obtain copies of the relevant fixed plant and mobile quarrying equipment operating shift logs during the period of the unattended noise logger surveys.

6 DOCUMENTING, REPORTING AND CORRECTIVE ACTION

6.1 Operator Attended Noise Surveys

The measured $L_{Aeq(15minute)}$ noise level contributions from Stages 5 and 6 quarrying, processing and transporting operations as well as the overall ambient noise levels together with the weather and quarrying operating conditions will be documented on an annual basis.

The measured contributed noise emissions from quarrying, processing and transporting operations will be evaluated and assessed with the noise emission criteria presented in Table 1 of the 2015 Consent.

6.2 Unattended Continuous Noise Logging

The unattended ambient noise logger data from each key monitoring location, together with the weather and quarrying operating conditions, will be presented graphically on a daily basis together with the corresponding noise levels modelled at the residences.

Prior to further analysis and where appropriate, the ambient noise level data from each monitoring location which correlate with periods of unstable weather (ie rainfall greater than 0.5 mm or wind speed greater than 18 km/h) will be discarded.

6.3 Reporting

All Stages 5 and 6 quarry operational noise monitoring results will be documented and reported on an annual basis in accordance with the 2015 Consent requirements, as is currently the case.

6.4 Excessive Noise Emissions and Corrective Action

In addition to the routine requirements of the noise monitoring programme, should the occupant of any dwelling raise concerns about the levels of noise associated with the normal quarry operations, then the emission level and its source will be promptly investigated.

In the event of an exceedance of the relevant criteria (a "noise incident"), the Albion Park Quarry Environmental Engineer will be promptly informed of the location and the margin of exceedance. The noise, weather and plant operating results will be documented and forwarded to the Environmental Engineer.

Further, in the event that a noise incident is identified, the relevant Government Department and affected stakeholders will be notified immediately.

The following corrective action will be implemented in order to restore compliance with the appropriate criteria.

Potential noise mitigation measures include the use of Best Achievable Technology together with Best Environmental Management Practices.

In general terms, Best Achievable Technology will include the following engineering based treatments:

- **Source Mitigation**, including variation to the operating method or design and the modification or replacement of plant and equipment.
- **Propagation Path Mitigation**, including the use of barriers (or isolation) in close proximity to the source of emission or at the receiver.
- **Receiver Mitigation**, including permanent treatment of a dwelling to the satisfaction of the occupant.

Best Environmental Management Practices will include the following procedures:

- Siting high noise generating plant and equipment at remote locations.
- Scheduling high noise generating operations to occur during late morning and afternoon only.
- Monitoring, reporting and community liaison programmes.

6.5 Historic Noise Emission Performance

Based on the procedures and requirements of the Noise Compliance Surveys outlined in **Sections 4.1** to **4.4**, presented below in **Table 2** are the noise impact assessment results together with the noise limits for the years 2012 to 2015.

Table 2 Calculated Noise Contribution of the Albion Park Quarry for No Wind (Calm) L_{Aeq} (dBA)

Monitoring Location	Stages 3 and 4				Noise Limits
	2012	2013	2014	2015	Stage 3 and 4
The Cottage	37	36	38	32	38
The Hill	35	35	37	31	38
GR Estate	36	36	36	36	41

The historic noise survey results presented in **Table 2** indicate that the calculated Albion Park Quarry noise levels complied with the 2015 Consent under the nominated meteorological conditions.

7 STAGES 5 AND 6 NOISE ASSESSMENT

In order to predict the Stages 5 and 6 quarry operational noise levels, the approach developed for the annual noise compliance measurements has been adopted, as outlined in **Sections 4.2**, **4.3** and **4.4**, and compared to the noise predictions presented in the original EIS.

The mobile equipment modelled in the EIS for Stages 5 and 6 as well as the mobile equipment proposed to be used during the Stages 5 and 6 operations are presented in **Table 3**.

Table 3 Quarry Extension Area (Stages 5 and 6 Extraction Areas Operations) Equipment Fleet

Equipment Type	EIS Fleet	Currently Proposed Fleet
Excavator + hammer CAT 330L	1	1
Excavator Hitachi 1200	1	1
Excavator CAT 345	1	1
Dump trucks (50t) – CAT 773B, CAT 777 and CAT 773E	5	6
Scrapers CAT 637	1	2
Water truck	1	1
Dozer CAT D8	1	1
FEL CAT 992C	1	1
Pump	-	1
Drill	1	1

Comparison of the 2012 to 2015 emission performance noise levels at The Cottage residence during Stages 3 and 4 (as presented in **Table 2**) with the noise level predictions presented in Table 7.1.1 of the original Noise and Blasting Impact Assessment for the quarry extension EIS indicates that the quarry operational noise levels are 0 dBA to 6 dBA lower than the predicted EIS level.

Given the similarity of the equipment fleets used for the EIS assessment, those used in Stages 3 and 4 and those proposed for the Stages 5 and 6 operations (refer to **Table 3**), it is anticipated that the Stages 5 and 6 operational noise level at "The Cottage" residence would be between 1 dBA and 7 dBA lower than that predicted in the EIS.

The predicted Stages 5 and 6 operational noise level at The Cottage residence in the EIS (incorrectly labelled as the Hill) is 34 dBA $L_{Aeq(15minute)}$. It is therefore anticipated, based on the results in **Table 2**, that the actual quarry noise level contribution at The Cottage will be between 28 dBA $L_{Aeq(15minute)}$ and 34 dBA $L_{Aeq(15minute)}$ and that the corresponding actual noise level contribution at The Hill will be between 27 dBA $L_{Aeq(15minute)}$ and 33 dBA $L_{Aeq(15minute)}$, thereby complying with the 2015 Consent Stages 5 and 6 noise criterion at The Cottage and The Hill of 35 dBA $L_{Aeq(15minute)}$.

The operational noise level contours for Stages 5 and 6 of the quarry extension are presented in **Appendix C**.

8 PROJECT BLAST EMISSION LIMITS

8.1 Blasting

Condition 10 and 11, Schedule 4 of the 2015 Quarry Extension DA Consent state that:

"Airblast Overpressure Criteria

10. The Applicant shall ensure that the airblast overpressure level from blasting at the development does not exceed the criteria in Table 3 at any point that is located at least 3.5 m from any residence or other sensitive receiver on privately owned land.

Airblast overpressure Level [dB(Lin Peak)]	***Allowable Exceedance***
115	*5% of the total number of blasts over any 12 month reporting period*
120	*0%*

Table 3: Airblast Overpressure Limits

Ground Vibration Criteria

11. The Applicant shall ensure that the peak particle velocity from blasting at the development does not exceed the criteria in Table 4 at any point that is located at least 3.5 m from any residence or other sensitive receiver on privately owned land.

Peak particle velocity (mm/s)	***Allowable exceedance***
5	*5% of the total number of blasts over any 12 month reporting period*
10	*0%*

Table 4: Ground Vibration Limit

8.2 Operating Hours

Condition 5, Schedule 4 of the 2015 Quarry Extension DA Consent state that:

"The Applicant shall comply with the operating hours in Table 2.

Activity	***Days of the Week***	***Time***
Drilling, rock breaking, loading and haulage of materials from quarry to processing plant, processing and stockpiling, overburden stripping and other stage preparatory works, all site construction activities, rehabilitation works, general plant and maintenance. Processing, crushing and screening and product transfer to stockpiles	*Monday - Friday* *Saturday*	*7.00 am - 5.30 pm* *7.00 am - 1.00 pm*

Table 2: Operating Hours of the Development

Condition 12, Schedule 4 of the 2015 Quarry Extension DA Consent goes on to state:

"Blasting Restrictions

12. Blasting operations on the premises may only take place:

a. between 9.00am and 5.00pm Monday to Friday inclusive:

b. are limited to 1 blast each day; and
c. at such other times as may be approved by the EPA."

9 BLAST HISTORY/MANAGEMENT PLAN

9.1 Overview

A detailed review of the historic blast designs and corresponding blast emissions (ground vibration and airblast) monitoring data, as presented in **Table 4**, was conducted by SLR for blasting in Stages 1 to 4 of the quarry extension in order to complement the findings presented in SLR Report 610.04156-R3 Revision 4 *"Albion Park Quarry Extension Revised Blast Management Plan"* (RBMP). The findings of the updated review form the basis of this assessment.

Table 4 Historic Blast Emissions Levels

Date	Blast ID Number	Ground Vibration PPV (mm/s)	Airblast (dB Linear Peak)
11-Mar-16	06/16	0.59	109.9
08-Mar-16	05/16	1.39	104.2
01-Mar-16	04/16	1.24	101.9
12-Feb-16	03/16	1.20	101.9
05-Feb-16	02/16	1.49	107.5
12-Jan-16	01/16	1.92	105.8
09-Dec-15	14/15	2.07	103.4
02-Nov-15	13/15	2.61	104.6
12-Oct-15	12/15	1.24	107.0
06-Aug-15	11/15	1.45	102.7
30-Jul-15	09/15	1.30	108.8
30-Jun-15	08/15	2.61	102.0
17-Jun-15	07/15	1.11	108.9
25-May-15	06/16	2.35	105.9
07-May-15	05/15	0.96	113.4
10-Apr-15	04/15	1.78	108.6
18-Mar-15	03/15	3.43	100.3
12-Mar-15	02/15	2.61	107.3
19-Jan-15	01/15	2.12	106.9
08-Dec-14	16/14	1.51	101.9
04-Nov-14	15/14	1.08	104.2
23-Sep-14	14/14	0.79	101.0
09-Sep-14	13/14	0.85	101.0
05-Aug-14	12/14	1.17	105.5
16-Jul-14	11/14	1.23	108.1
23-Jul-14	10/14	2.84	104.2
04-Jun-14	09/14	0.72	101.0
06-May-14	08/14	1.30	104.9
15-Apr-14	07/14	0.81	105.1
08-Apr-14	06/14	1.91	99.6
04-Apr-14	05/14	0.62	107.0
12-Mar-14	04/14	1.46	112.2
05-Mar-14	03/14	1.83	98.8

Date	Blast ID Number	Ground Vibration PPV (mm/s)	Airblast (dB Linear Peak)
12-Feb-14	02/14	1.09	102.8
30-Jan-14	01/14	0.79	97.5
19-Dec-13	26/13	1.15	92.6
09-Dec-13	25/13	0.35	100.0
19-Nov-13	24/13	2.67	107.0
01-Nov-13	22/13	1.29	108.0
11-Oct-13	23/13	1.18	100.7
04-Sep-13	21/13	2.17	101.8
20-Aug-13	20/13	1.61	101.8
16-Aug-13	19/13	1.08	100.7
05-Aug-13	18/13	1.16	106.8
15-Jul-13	17/13	1.21	103.5
25-Jun-13	16/13	1.46	109.1
05-Jun-13	15/13	1.18	105.6
27-May-13	14/13	0.91	101.8
16-May-13	13/13	0.88	-
29-Apr-13	12/13	1.29	100.3
18-Apr-13	11/13	1.21	101.9
11-Apr-13	10/13	1.21	103.3
04-Apr-13	09/13	2.13	105.0
25-Mar-13	08/13	1.92	99.4
06-Mar-13	06/13	1.76	99.9
27-Feb-13	05/13	0.94	100.5
20-Feb-13	04/13	1.48	100
19-Dec-12	24/12	1.11	95.9
05-Dec-12	23/12	1.95	114.0
27-Nov-12	21/12	1.35	101.0
16-Oct-12	16/12	2.17	97.5
13-Sep-12	14/12	2.48	105.5
09-Aug-12	11/12 & 12/12	0.84	108.0
02-Jul-12	10/12	0.69	107.0
01-May-12	8/12	0.71	101.0
03-Apr-12	6 & 7/12	0.99	100.0
29-Feb-12	4/12	0.58	95.9
23-Feb-12	3/12	0.86	94.0
02-Feb-12	2/12	1.58	110.0
19-Jan-12	1/12	1.59	101.0
15-Dec-11	18 & 19/11	1.24	107.0
14-Nov-11	15/11	0.82	94.0
28-Oct-11	14/11	0.61	102.8
10-Oct-11	13/11	1.24	101.9
21-Sep-11	12/11	0.84	108.0

Date	Blast ID Number	Ground Vibration PPV (mm/s)	Airblast (dB Linear Peak)
06-Sep-11	11/11	0.74	104.2
22-Aug-11	10/11	0.51	106.0
25-Jul-11	9/11	0.87	102.8
24-Aug-11	8/11	0.74	109.0
16-Jun-11	7/11	0.73	106.0
30-May-11	6/11	0.58	103.5
08-Apr-11	5/11	1.04	104.9
08-Mar-11	3 & 4/11	0.67	106.0
22-Feb-11	2/11	0.80	108.8
03-Feb-11	1/11	0.78	103.5
20-Dec-10	31/10	0.74	112.3
03-Dec-10	30/10	1.10	101.0
26-Nov-10	29/10	0.45	104.9
08-Nov-10	28/10	0.78	97.5
29-Oct-10	26/10 & 27/10	0.88	104.2
15-Oct-10	25/10	Below threshold level	Below threshold level
27-Sep-10	24/10	0.48	98.8
17-Sep-10	22/10 & 23/10	0.52	110.6
11-Aug-10	21/10	0.29	104.9
27-Jul-10	20/10	0.77	104.9
19-Jul-10	19/10	1.62	109.2
09-Jul-10	18/10	0.86	103.5
28-Jun-10	17/10	1.16	98.8
17-Jun-10	15/10 & 16/10	0.67	102.8
08-Jun-10	14/10	0.75	104.2
31-May-10	13/10	0.60	88.0
24-May-10	11/10 & 12/10	0.79	101.0
18-May-10	10/10	0.69	106.0
10-May-10	09/10	Below threshold level	Below threshold level
03-May-10	08/10	0.32	95.7
23-Apr-10	07/10	Below threshold level	Below threshold level
13-Apr-10	06/10	1.07	97.5
22-Mar-10	04/10 & 05/10	1.06	109.5
15-Mar-10	03/10	1.32	104.2
19-Feb-10	02/10	2.65	101.9
21-Jan-10	01/10	Below threshold level	Below threshold level
22-Dec-09	48/09	0.94	95.9
08-Dec-09	47/09	2.05	80.7
26-Nov-09	45/09	Below threshold level	Below threshold level
26-Nov-09	46/09	Below threshold level	Below threshold level
16-Nov-09	44/09	0.91	111.8
27-Oct-09	43/09	1.39	105.5

Date	Blast ID Number	Ground Vibration PPV (mm/s)	Airblast (dB Linear Peak)
16-Oct-09	42/09	0.93	107.5
02-Oct-09	41/09	2.72	80.7
25-Sep-09	40/09	1.87	80.7
17-Sep-09	39/09	1.46	99.9
07-Sep-09	38/09	1.18	102.0
21-Aug-09	37/09	0.75	108.8
07-Aug-09	36/09	0.38	100.0
03-Aug-09	35/09	0.64	100.0
22-Jul-09	34/09	0.58	94.0
17-Jul-09	33/09	0.32	108.4
03-Jul-09	32/09	0.65	109.5

Note: Additional blast emissions monitoring results to those presented in **Table 4** have been recorded in order to increase the accuracy of the blast emissions (ground vibration and airblast) prediction site laws. The additional data collected to prepare the site laws does not contain any exceedances of the 2015 Consent blast emissions criteria at the closest residence.

9.2 Supplementary Considerations for Vibration and Airblast Criteria

In order to address Condition 13a) of the 2015 Consent, the vibration and airblast site laws are able to be used to take account of the likely impact at the adjacent Fig Tree Hill Land southern boundary, in order to protect the health of people and/or cattle.

9.3 Vibration

The ground vibration site law has been developed in such a way that it can be used to assist in designing the blasts so that the peak particle component velocity levels for blasting at the development do not exceed 200 mm/s at any point on the southern boundary of the Fig Tree Hill Land. This ground vibration criterion is based on the approved SLR NMP/BMP dated 10 February 2006 (refer to the note in the 2015 Consent, Schedule 4, Condition 14).

9.3.1 Airblast

The airblast site law has been developed in such a way that it can be used to assist in designing the blasts so that the airblast levels for blasting at the development do not exceed 135 dBLinear at any point on the southern boundary of the Fig Tree Hill Land. This airblast criterion was agreed at the Joint Conference of the respective parties which was convened as part of Appeal No 10839 of 2005 in the Land and Environment Court of NSW.

9.4 General Blast Management

The following blast design parameters will be implemented for all blasts:

- Direction of detonator initiation is away from the closest residence, where possible.
- All blast faces to face generally away from the closest residence where possible.
- Use of solid decking in the blastholes, where required (solid decking is an inert material used in deck charging, usually stemming material).
- Two (or more) columns of explosives of approximately equal length per blasthole, where decked holes are required.

- Two (or more) detonators per blasthole, where decked blastholes are required.
- Use of 89 mm diameter blastholes, unless otherwise authorised.
- Stemming depth 3.0 m (nominal).
- Subdrill of 1.0 m (nominal) for both production and overburden blasts.
- Bench height up to 14 m, unless blastholes are decked.
- Front row burden 4.0 m (nominal).
- Subsequent burden 2.5 m (nominal)
- Spacing 3.5 m (nominal).

9.5 Predicted Blast Emission Levels

Blast emission data from every blast will be used (via the blast emissions site laws developed from the results of the quarry extension blast monitoring to date) to refine subsequent blast designs in order to control blast emission (ground vibration and airblast) levels, particularly for later blasting when operating closer to residences.

The ground vibration and airblast criteria nominated in the 2015 Consent cater for the inherent variation in emission levels from a given blast design by allowing a five percent exceedance of a general criterion up to a (never to be exceeded) maximum. Correspondingly, the "5% exceedance" prediction formulae were generated in the blast emissions site laws. All subsequent blast emissions will be predicted using the then current continually refined site laws.

9.6 Managing Airblast

The Maximum Instantaneous Charge (MIC-kg) of blasts in Stages 5 and 6 will not exceed the mass of explosives given by the then current airblast site law. The following formula is based on the current 5% exceedance airblast site law:

$$MIC\ (kg) = [(Distance\ to\ nearest\ Receiver\ (m)) / 124.6]^3$$

9.6.1 Mitigation of Airblast

Blast design procedures will be implemented with the objectives of maintaining the levels of airblast at the closest residences below 115 dB Linear, in accordance with the 2015 Consent, and protecting people and/or cattle at the Fig Tree Land southern boundary. The 2015 Consent also states that the blast emissions criteria at the closest residence may be exceeded for up to 5% of the total number of blasts over a period of 12 months but there can be no exceedances of 120 dBLinear.

By incorporating deck charging (a method of loading blastholes in which the explosive charges in the same blasthole are separated by an inert material) of (at least) the front row of blastholes in each blast (for benches greater than 14 m high) and initiating the blast in the direction away from the closest receiver location, emissions from blasting in the proposed extension, using an MIC in accordance with the then current airblast site law established for the quarry, will result in compliance with the general 2015 Consent condition of 115 dB Linear airblast.

In relation to the protection of people potentially located on the Fig Tree Land southern boundary during blasting, as an example, for an MIC of 50 kg, the current 5% exceedance site law predicts that an airblast level of 135 dB Linear would occur at a distance of approximately 50 m from the blast. As a precaution, when blasting within about 50 m of the property boundary, the MIC for each blast may need to be restricted to below 10 kg. However, this would be based on the then current airblast site law for the quarry extension.

Based on the current airblast site law, conventional blasting during Stages 5 and 6 of the quarry operation will occur up to approximately 50 m of the Fig Tree Hill southern boundary. This buffer will be reviewed in response to future near-field blast emission monitoring, which may increase or decrease the required offset to achieve the nominated blast emission criteria and safety limits. Non-explosive rock fracturing techniques may be used to allow extraction of the hard rock resource in closer proximity to the Fig Tree Hill boundary, if the then current site laws restrict explosive blasting techniques.

9.7 Managing Vibration

The MIC (kg) of blasts in the Stages 5 and 6 area of the quarry extension will not exceed the mass of explosives given by the then current ground vibration site law. The following formula is based on the current 5% exceedances site law:

$$\text{MIC (kg)} = (\text{Distance to nearest Receiver (m)})^2 / 2{,}389$$

Blast design procedures will be implemented with the primary objective of maintaining the levels of ground vibration at the closest residences below 5 mm/s, in accordance with the 2015 Consent . The 2015 Consent also states that the blast emissions criteria may be exceeded for up to 5% of the total number of blasts over a period of 12 months.

By incorporating, where required, deck charging of the blastholes in each blast and generally initiating the blast in the direction away from the closest receiver location, it is predicted that emissions from blasting in the proposed extension, using an MIC in accordance with the then current ground vibration site law established for the quarry, will result in compliance with the general consent condition of 5 mm/s ground vibration.

The impacts of vibration from quarry blasting at the closest residential receivers and close to the Fig Tree Hill Land southern boundary will be mitigated in line with the reduction of the MIC associated with the control of airblast levels, based on the then current vibration site law for the quarry extension.

9.8 Managing Flyrock

There are generally two main areas within the blast from which flyrock has the potential to be produced. These are at the blasthole collar (where the stemming length has not been optimised and the explosive column is too close to the upper surface of the rock mass creating crater effects - rifling) and at the face of the blast (where there could be less than optimum burden on a blasthole whereby the explosives gases are able to vent to atmosphere - blowouts, producing flyrock).

For the subject blasting, the front row blastholes will be “Boretraked” in order to identify any areas of less than optimum burden in order that, if required, inert material (rather than explosives) can be placed at this location in the blasthole. Consequently, in relation to flyrock ejection, the latter situation will not occur.

In terms of collar ejection, the minimum stemming length of 3.0 m is considered adequate for the blasthole lengths and has been selected in order to totally contain the explosives and separate them from the collar of the blasthole.

As well, aggregate will be used as the stemming material (not drill dust) again in order to contain the explosives within the blasthole (aggregate is used as stemming material as it “locks” at the collar of the blasthole upon initiation of the blast enabling the explosives gases to be used in fracturing and moving the rock instead of being ejected from the blasthole (“rifling”)).

The blast design procedures for blasting near the Fig Tree Hill Land southern boundary will be determined via reference to the then current blast emissions site laws (refer to **Section 9.5**). As stated, the site specific quarry extension site laws (for ground vibration and airblast) will be regularly updated and subsequently used to design the next blast. Consequently, the allowable MICs to comply with the nominated ground vibration and airblast safety limits at the Fig Tree Hill Land southern boundary will progressively reduce, thereby further reducing the likelihood of flyrock.

9.9 External Blast Design Review

Prediction of ground vibration and airblast will be conducted prior to each blast by the acoustical consultant in order to determine the impact at the critical receiver locations. The ground vibration and airblast site laws will be updated on a regular basis to reflect the blast results obtained.

9.10 Meteorological Considerations

Meteorological data will be made available to, and evaluated by, the blasting contractor prior to blasting, as close as practical to the time of blasting. The expected weather conditions and their effect on the airblast (and dust) generated by the blasting will be considered and blast plans and/or timing altered if necessary. Meteorological conditions that will be considered are:

- Prevailing winds including their direction and velocity.
- Temperature inversions.
- Time of day.
- Seasonal effects on weather patterns.
- Cloud cover.

Blasting will be avoided, where possible, under the following meteorological conditions:

- When winds are blowing from the blast site to the nearest receiver at a strength likely to enhance blast emissions impacts.
- Where there is heavy low level cloud.
- Where a temperature inversion is indicated.

9.11 Notifying Landowners or Occupiers of Blast Events

When blasting within 100 m of the Fig Tree Hill Land southern boundary, the owners of the Fig Tree Hill Land will be notified at least the day prior to blasting of the proposed date and expected time of firing with a follow-up phone call on the morning of the blast confirming the time of firing.

Cleary Bros will also notify Holcim of the proposed blast at a minimum of one day prior to the blast. If, when notifying Holcim, it is found that they have a blast is planned for the same day, measures will be taken to ensure the blasts are adequately separated in time.

10 BLAST MONITORING PROGRAMME

10.1 Blast Monitoring Plan Requirements

Condition 14, Schedule 4 of the 2015 Quarry Extension DA Consent states that:

> *"Blast Management Plan*
>
> *14. Prior to the commencement of operations in each stage of the development after Stage 1, the Applicant shall prepare, and subsequently implement, a Blast Management Plan for the development in consultation with the landowner(s) of The Fig Tree Hill Land, the EPA and to the satisfaction of the Secretary. This plan must: ……..*
>
> *d) include a monitoring program for evaluating and reporting on the performance of the development, including:*
> - *compliance with the blasting criteria in this consent;*
> - *minimising the fume emission from the site; …..."*

10.2 General Procedure

The Programme of Monitoring will be developed with reference to the procedures described in AS 2187.2-1993, "*Explosives - Storage, Transport and Use*" and with reference to the ANZECC's "*Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration*", September 1990.

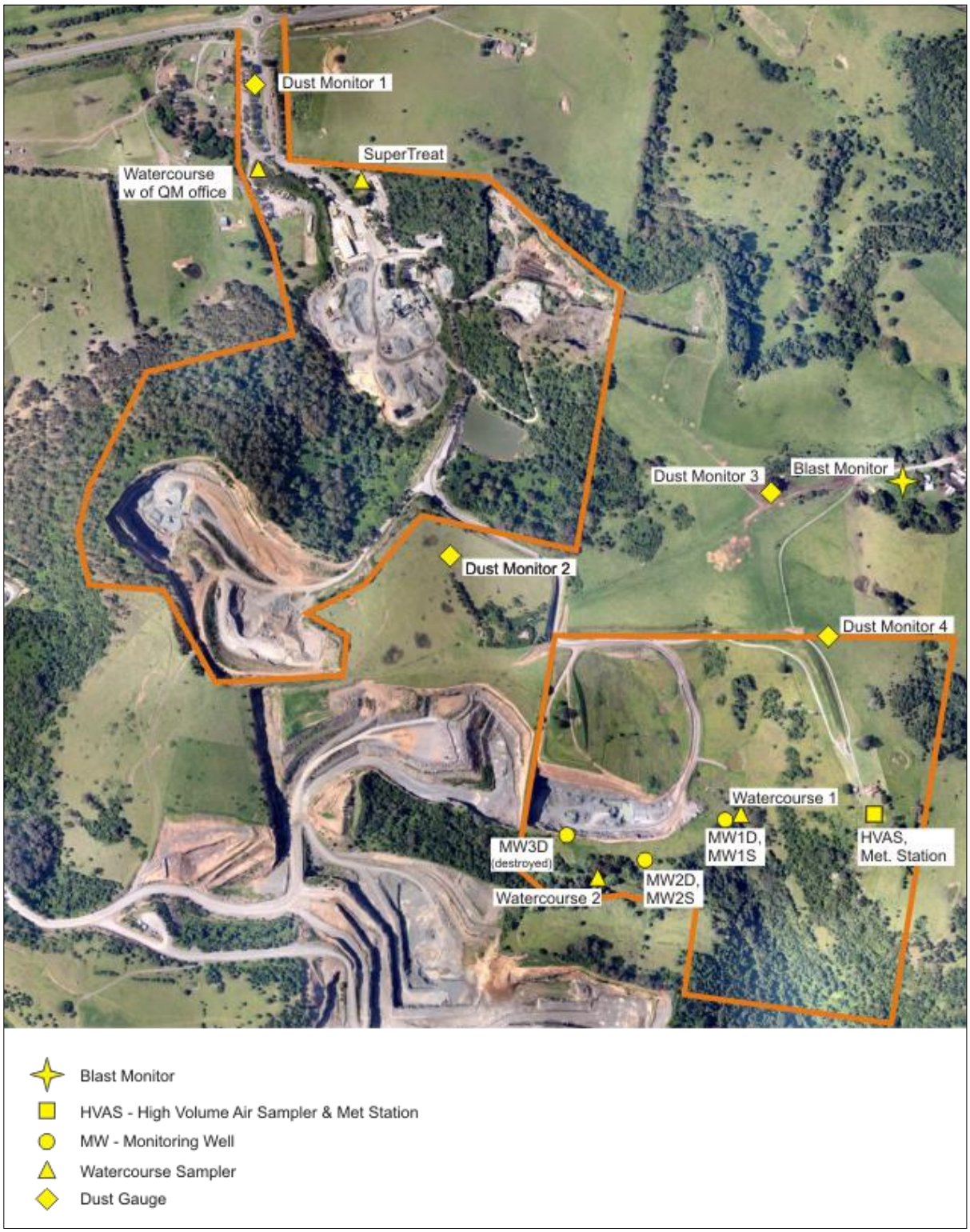
The blast emissions will be quantified for all blast events conducted at the project site.

In the event that the quarry's blast monitoring equipment is unavailable for service, due to installation or calibration requirement throughout the monitoring programme, then blast emissions will be monitored by alternative calibrated instrumentation.

10.3 Monitoring Locations

A permanent blast monitor emissions (airblast and vibration) has been located at the closest inhabited residence to the quarry's excavation boundary, namely the Dunster's ("The Cottage") residence. The blast monitor location is shown in **Figure 1**.

Figure 1 Blast Monitoring Location



A portable blast emissions monitor (to measure airblast and vibration) will be positioned at the nearest potentially affected residences (or other blast emissions sensitive receivers other than the Dunster's residence) to the blasting operations, if required as a response to community feedback or concerns.

10.4 Instrumentation Requirements

10.4.1 Blast Emission Monitors

Blast monitoring instrumentation will be employed to meet the following primary specifications presented in **Table 5**. The instrumentation will be installed, operated and maintained by suitably qualified or trained personnel. The instruments will be externally calibrated at regular intervals throughout the life of the project.

Table 5 Blast Monitor Specifications

Specification	Seismic	Airblast
Resolution	0.016 mm/s	0.1 dB
Range	0.1 mm/s to 254 mm/s	88 dB to 148 dB
Accuracy	3% at 15 Hz	0.2 dB at 30 Hz
Sample Rate	Minimum 1024 samples per second per channel	
Frequency Response	2 Hz to 250 Hz (3 dB points)	
Communications Link	Keyboard and Modem	
Recording Mode	Full Waveform Recording and archiving	

10.4.2 Permanent Monitor Installation

The Dunster's blast monitor will continue to be permanently installed prior to blasting operations, probably with a remote modem communication link.

10.4.3 Portable Monitor Installation

The portable blast monitor(s) will be operated manually for each blast requiring the additional monitoring.

Vibration velocity geophones will be coupled to the ground via a "star stake" or concrete plinth embedded in the consolidated surface approximately 25 m from the subject building or structure, with the microphone positioned in the free-field.

10.4.4 Weather Monitoring Equipment

An automatic anemometer and wind vane station will be located in the vicinity of the quarry and will be considered representative of wind propagation conditions in relation to blast emissions throughout the blast monitoring programme.

The automatic station will be programmed, as a minimum, to continuously record the meteorological parameters as shown in **Table 1** (**Section 5.2**).

11 BLAST DESIGN RECORDS AND PREDICTED EMISSION LEVELS

Blast design records will be maintained for individual blast events. The purpose of the records is to assist in the design and optimisation of future events, planning and control of blasting emissions and to provide a traceable system of documentation in case of accident or complaint.

The blasting contractor will provide a description of blast parameters prior to each blast event and include the location co-ordinates (East, North, RL) of the blast site (or the distance from the blast site to the blast monitor(s)) and the maximum explosive mass (MIC) to be detonated in any 8 ms interval.

Section 9.5 and **Section 9.7** present MIC limiting equations based on the current blast emission site laws for ground vibration and airblast from the results of blasting in Stages 1 to 4 of the quarry extension. These site laws, in the standard form, are presented below. The site law graphs are presented in **Appendices D1** and **D2**.

The 1% and 5% site laws for ground vibration and airblast are:

Ground Vibration

PVS (1%) = 715 $(SD_1)^{-1.19}$
PVS (5%) = 507 $(SD_1)^{-1.19}$

Airblast

SPL (1%) = 176.7 – 27.9 log (SD_2)
SPL (5%) = 173.5 - 27.9 log (SD_2)

where PVS (1% and 5%) and SPL (1% and 5%) are the levels of ground vibration (Peak Vector Sum - mm/s) and peak airblast (dB Linear) respectively, above which 1% and 5% respectively of the total population (of data points) will lie, assuming that the population has the same statistical distribution as the underlying measured sample.

SD1 and SD2 are the ground vibration and airblast Scaled Distances, where:

$$SD1 = Distance / MIC^{1/2} \quad (m.kg^{-0.5})$$

and,

$$SD2 = Distance / MIC^{1/3} \quad (m.kg^{-0.33})$$

The distances of blasting in Stages 5 and 6 from the Dunster Residence ("The Cottage") range from 710 m (far point of Stage 5) to 385 m (near point of Stage 5). Based on the 5% exceedance blast emission site laws presented above, the allowable MICs for compliance with the blast emission levels in the 2015 Consent range from 29 kg at 385 m offset to 183 kg at 710 m offset, in both cases controlled by airblast (rather than ground vibration).

The Quarry Foreman (or the Blasting Contractor) will verify and approve the proposed blast design with respect to potential blast emissions based initially on the current 5% exceedance predictive site laws for ground vibration and airblast.

In order to maximise the benefits of the blast monitoring process, the significant design parameters, emission levels and meteorological data will be collated and maintained by the quarry in a Blast Design Record for each blast event. Cleary Bros Albion Park Quarry Work Instruction No WIAPQ/05 will be used for this purpose.

12 BLAST FUME EMISSIONS

12.1 Mitigation of Fume Emissions

Mitigation measures for fume control during blasting include:

- Fine material collected during drilling must not be used for blast stemming.
- All blastholes would be adequately stemmed with aggregate.
- Blasting to only occur between the hours 9.00 am and 5.00 pm, Monday to Friday, or as otherwise approved by the EPA as per the EPL conditions.
- In excessive wind events (ie prolonged visual dust in a particular area or following receipt of dust monitoring results in exceedance of the dust criteria), temporary halting of blasting activities and resuming when weather conditions have improved following appropriate assessment of weather conditions.

A professional contractor is hired to survey the blast area, create a Blasting Plan and to conduct the blast. Blasting should only occur following appropriate assessment of weather conditions by the Cleary Bros Environment Coordinator (or equivalent role) and the professional and suitably qualified Drill and Blast Superintendent to ensure that wind speed and direction will not result in excess fume (or dust) emissions from the site in the direction of the sensitive receptor locations. This measure will be effective in controlling off-site impacts due to fumes released during blasting operations.

Additionally, the design for each blast will aim to maximise the blast efficiency and minimise the emission of fumes (as well as dust and odour) in order to ensure compliance with site specific blasting criteria.

Fumes can be generated by the mechanisms as outlined in **Table 6** (also refer to the Air Quality Management Plan). Potential indicative control measures are also presented in **Table 6**. It is noted that wet product is used in both wet and dry blastholes to minimise blast fume generation.

Table 6 Possible Causes and Controls for Blast Fume Generation

Possible Cause	Potential Control Measures
Explosive Formulation	
Explosive incorrectly formulated or not manufactured to specifications	• Track explosive mix back with supplier • Perform visual check at discharge point • Use supplier who operates under an externally accredited quality system
Improper mixing of raw materials / incorrect metering	• Perform visual check at discharge point • Ensure Mobile Manufacturing Unit (MMU) calibrated every 6 months
Blast design	
Inappropriate priming and/or placement	• Follow manufacturer's recommendations on placement on initiating explosives

Adapted from BHP Billiton Mt Arthur Blast Management Plan (MAC-ENC-MTP-015).

Blasting should only occur following an appropriate assessment of weather conditions by the Environment Coordinator and the Drill and Blast Superintendent (or equivalent roles) to ensure that wind speed and direction will not result in excess fume (or dust) emissions from the site in the direction of sensitive receptor locations. This measure will be effective at controlling off-site impacts due to fumes released during blasting operations.

Additionally, the design for each blast will aim to maximise the blast efficiency and minimise the emission of fumes (as well as dust and odour) in order to ensure compliance with site specific blasting conditions.

The blasting schedule will also be made available to the public via the Quarry website.

12.2 Monitoring Programme for Fume Emissions

The fume emissions will be monitored by a visual assessment being conducted by Cleary Bros Quarry Production foreman or his delegate immediately after the blast.

A visual rating of blast fume emissions is approximate at best, but gives some indication of the severity of the event, so is worth recording.

The following factors (taken from the Code of Good Practice: Prevention and Management of Blast Generated NO_x Gases in Surface Blasting issued by the Australia Explosives Industry and Safety Group Inc.) should be considered for inclusion in a post-blast report:

- Date and time of blast

- Presence of noticeable post-blast NOx gases
- Post-blast NOx gas rating, eg 0-5 (refer **Appendix E**)
- Extent of post-blast NOx gas event, eg A, B or C (refer **Appendix E**)
- Duration of any post-blast NOx gas event (measure of time to disperse)
- Direction of movement of any post-blast NOx plume
- Movement of any post-blast NOx gas plume relative to the established exclusion zone and any establishment management zone (ie maintained within, exceeded)
- Climate conditions, including temperature, humidity, wind speed and direction, cloud cover, rain
- Results/readings of any NOx monitoring equipment employed for the blast

Video results of blast where relevant

2015 CONDITIONS OF CONSENT FOR THE HARD ROCK QUARRY

EPA RESPONSE TO A REVIEW OF THE NOISE MANAGEMENT PLAN

Dick Godson

From: Matthew Fuller <Matthew.Fuller@epa.nsw.gov.au>
Sent: Thursday, 24 September 2015 6:15 PM
To: Helen Nicolaidis
Subject: CB Blast Management Plan and Noise Management Plan

Hi Helen,

Although the EPA do not generally review and approve site specific Management Plans, I do not see any major deficiencies with the above plans.

If you have any concerns regarding the acequacy of either of these plans Cleary Bros could have them reviewed by a suitably qualified consultant.

Regards
Matt Fuller
Regional Operations Officer| **NSW Environment Protection Authority** |
☎: (02) 42244100 | Mobile ☎: 0409 524 540 | 🖷: (02) 42244110 |🖱:Matthew.Fuller@epa.nsw.gov.au

STAGES 5 AND 6 NOISE LEVEL CONTOURS

75 mm ON ORIGINAL

REV.	DATE	AMENDMENT / ISSUE DESCRIPTION	PREPARED	CHECKED
0	18/03/16		YL	MB

0 80 160
Scale = 1:80

Legend

- 25 dBA Noise Contour
- 30 dBA Noise Contour
- 35 dBA Noise Contour
- 40 dBA Noise Contour
- 45 dBA Noise Contour
- 50 dBA Noise Contour
- Quarry Boundary

SLR Consulting Australia Pty Ltd
2 Lincoln Street
Lane Cove NSW 2066 Australia
PO Box 176 Lane Cove NSW 1595
Email address sydney@heggies.com.au
Telephone 02 9427 8100. Facsimilie 02 9427 8200

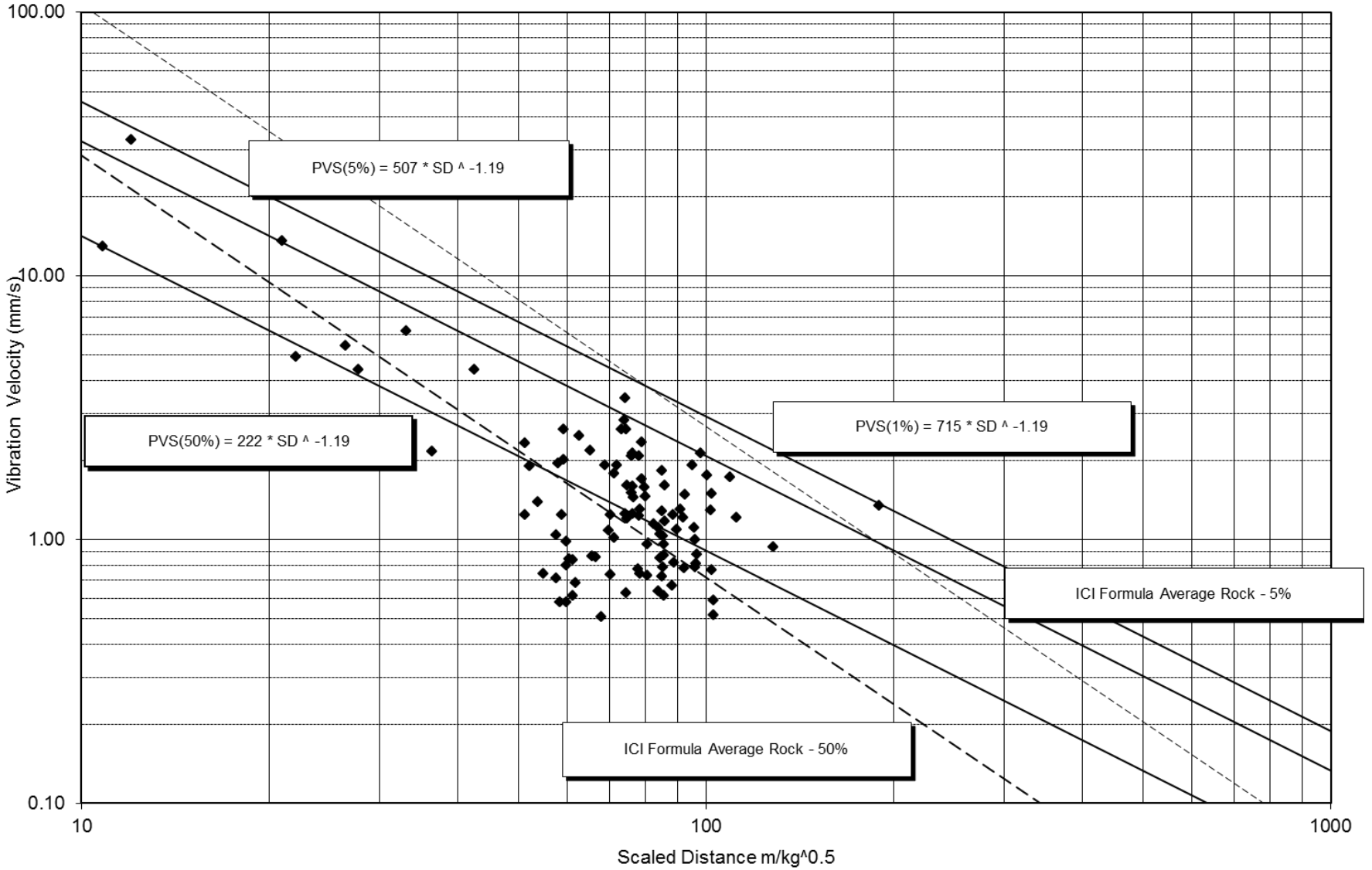
Albion Park Quarry
Up to Year 30 Quarry Plan

FILE NAME

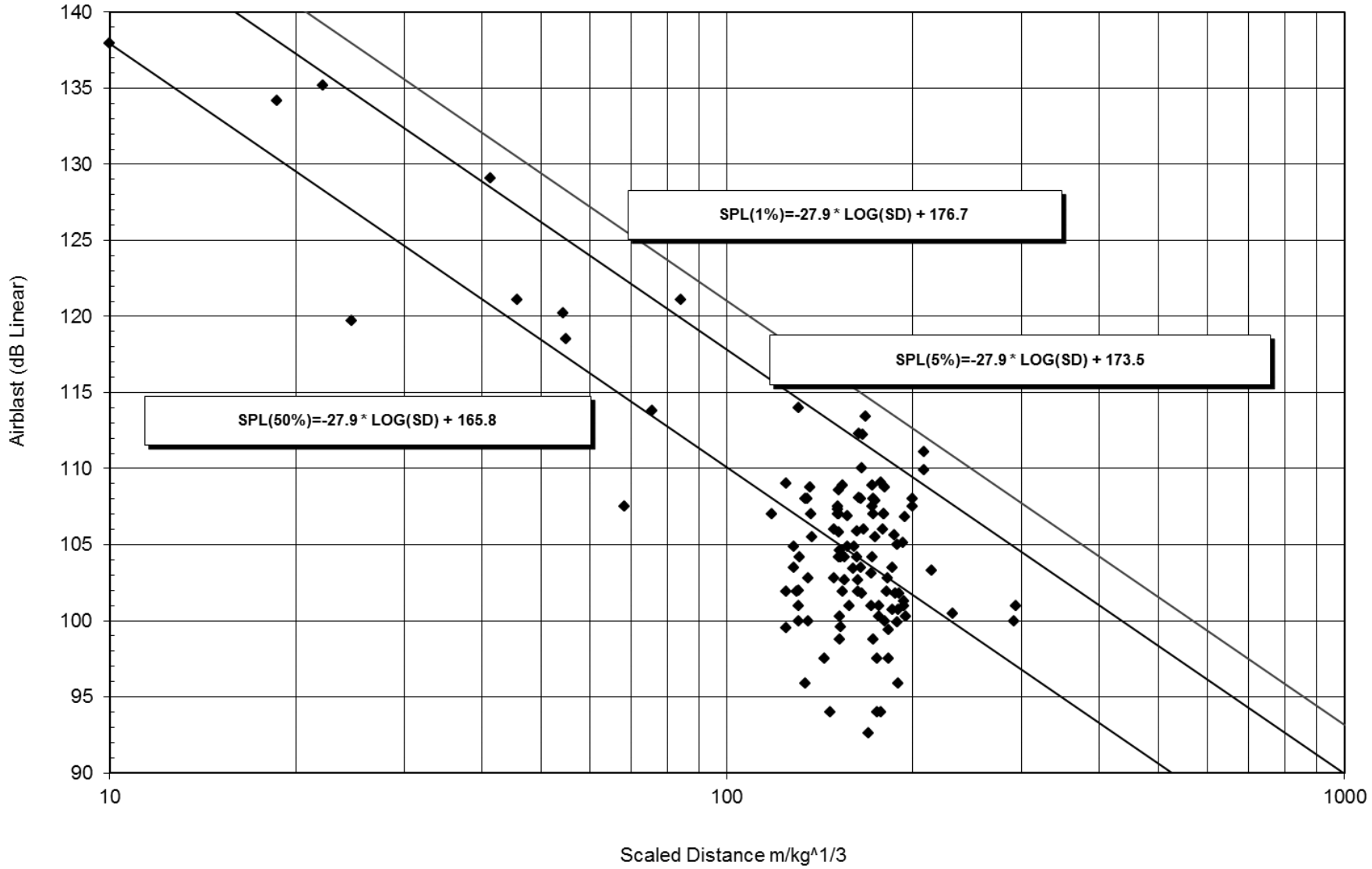
DRAWING No. 30-1097

REVISION 0

PVS GROUND VIBRATION VELOCITY SITE LAW - 106 DATA POINTS



PEAK LINEAR AIRBLAST SITE LAW - 116 DATA POINTS



VISUAL NOX FUME RATING SCALE AND FIELD COLOUR CHART

APPENDIX 3:

"AHIMS Search Result - Lot 1 DP 858245"

AHIMS Web Services (AWS)
Search Result

Purchase Order/Reference : CLeary Bros 2

Client Service ID : 255865

Martin Morris & Jones Pty Limited

Date: 25 November 2016

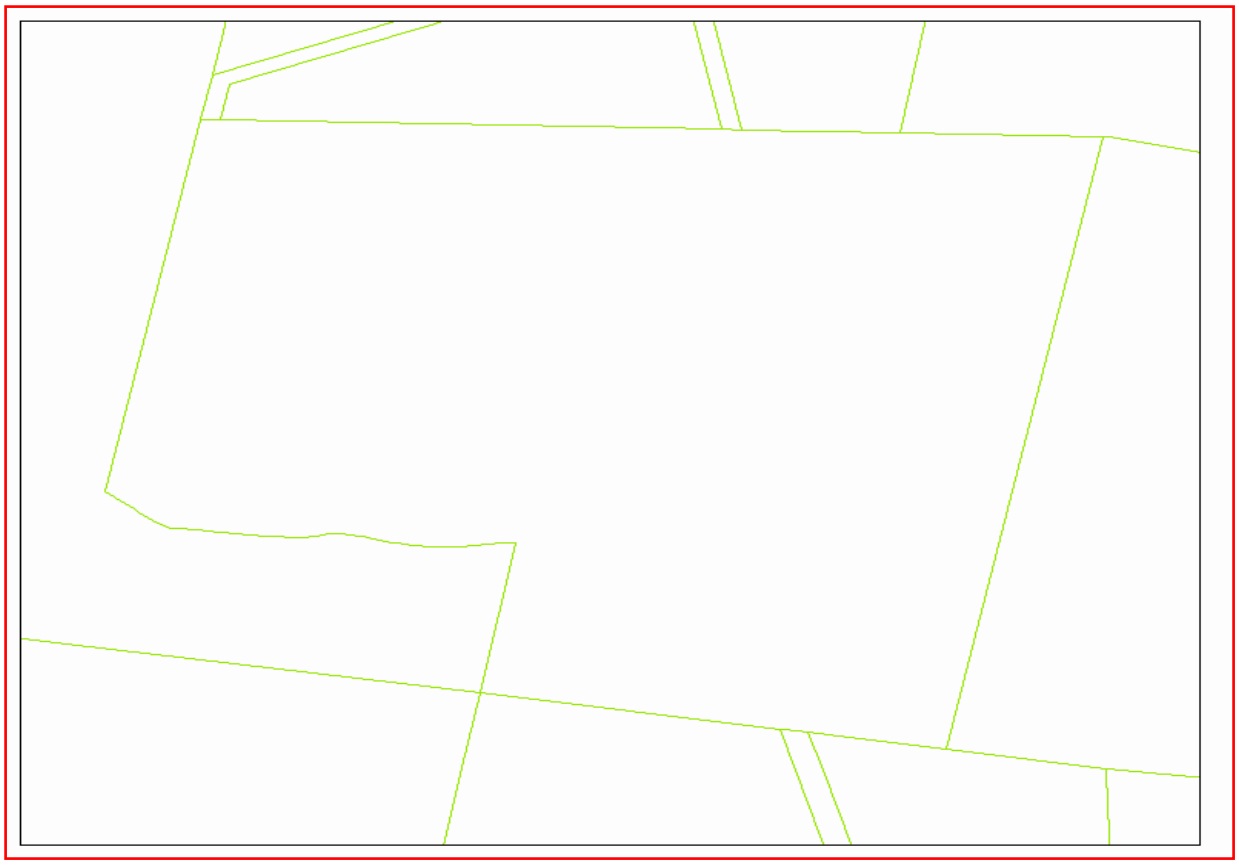
Attention: Luke Rollinson

Email: luke.rollinson@mmj.com.au

Dear Sir or Madam:

AHIMS Web Service search for the following area at Lot : 1, DP:DP858245 with a Buffer of 50 meters, conducted by Luke Rollinson on 25 November 2016.

The context area of your search is shown in the map below. Please note that the map does not accurately display the exact boundaries of the search as defined in the paragraph above. The map is to be used for general reference purposes only.



A search of the Office of the Environment and Heritage AHIMS Web Services (Aboriginal Heritage Information Management System) has shown that:

0	Aboriginal sites are recorded in or near the above location.
0	Aboriginal places have been declared in or near the above location. *

If your search shows Aboriginal sites or places what should you do?

- You must do an extensive search if AHIMS has shown that there are Aboriginal sites or places recorded in the search area.
- If you are checking AHIMS as a part of your due diligence, refer to the next steps of the Due Diligence Code of practice.
- You can get further information about Aboriginal places by looking at the gazettal notice that declared it. Aboriginal places gazetted after 2001 are available on the NSW Government Gazette (http://www.nsw.gov.au/gazette) website. Gazettal notices published prior to 2001 can be obtained from Office of Environment and Heritage's Aboriginal Heritage Information Unit upon request

Important information about your AHIMS search

- The information derived from the AHIMS search is only to be used for the purpose for which it was requested. It is not be made available to the public.
- AHIMS records information about Aboriginal sites that have been provided to Office of Environment and Heritage and Aboriginal places that have been declared by the Minister;
- Information recorded on AHIMS may vary in its accuracy and may not be up to date .Location details are recorded as grid references and it is important to note that there may be errors or omissions in these recordings,
- Some parts of New South Wales have not been investigated in detail and there may be fewer records of Aboriginal sites in those areas. These areas may contain Aboriginal sites which are not recorded on AHIMS.
- Aboriginal objects are protected under the National Parks and Wildlife Act 1974 even if they are not recorded as a site on AHIMS.
- This search can form part of your due diligence and remains valid for 12 months.

3 Marist Place, Parramatta NSW 2150
Locked Bag 5020 Parramatta NSW 2220
Tel: (02) 9585 6380 Fax: (02) 9873 8599

ABN 30 841 387 271
Email: ahims@environment.nsw.gov.au
Web: www.environment.nsw.gov.au

APPENDIX 4:

"Statement of Evidence – Noise and Blasting provided to NSW LEC (October 2005)"

REPORT 10-4250-S1

Draft 4

Land and Environment Court NSW

Cleary Bros (Bombo) Pty Limited and The Minister for Infrastructure and Planning

ats

Figtree Hill Pty Limited

Proceedings No 10639 of 2005
Statement of Evidence - Noise and Blasting

Dick Godson

17 October 2005 ~~**August 2005**~~

PREPARED FOR

Sparke Helmore Lawyers
Level 30
2 Park Street
SYDNEY NSW 2000

2 ISSUES AND RESPONSES

2.1 Flyrock

Item 2b. of the Amended Statement of Issues dated 24 August 2005 states (in relation to flyrock) that:

> *"The consent authority does not have the power to determine the application as the Environmental Impact Statement that accompanies the development application DA 466-11-2003 prepared by Perram Partners dated October 2003 ("the EIS") is inadequate."*
>
> *"The EIS fails to assess the effect of fly rock on adjoining land, including the Fig Tree Hill Land."*

Items 3a., 3c. and 3i.(ii) of the Amended Statement of Issues dated 24 August 2005 state that:

> *"3 In the alternative, if the Court does have power to grant development consent for the use of the premises for the designated development, namely the extension of the hard rock quarry, the development application should be refused for the following reasons:*
>
> *a. The location of the extension to the hard rock quarry is not suitable for the proposed use having regard to the reliance on the Fig Tree Hill land as a buffer of the effects of..... ...fly rock from the quarry."*
>
> *"c. The potential for fly rock to escape on to the Fig Tree Hill land poses a serious risk to the safety of farm personnel and cattle."*
>
> *"i.(ii)There is no assessment of fly rock from the quarry or how any fly rock generated by the approved activities would be managed."*

Response

In anticipation of operating the proposed quarry extension, extensive blast emissions (vibration, airblast and flyrock) investigations were conducted.

The purpose of these investigations was to optimise the proposed future blast designs in order to minimise the potential impacts of blast emissions.

The investigations included monitoring vibration and airblast for various blast designs at offset distances similar to those of the closest residential receiver locations to the nearpoint of the proposed quarry extension. They also included an analysis of the video recordings of the blasts.

In order to determine the effects on vibration, airblast and flyrock of the blast face orientation (as well as the direction of initiation of the delay detonators), measurements were conducted at a range of offset distances to the front, back and sides of the blasts. The results of these investigations were presented in Heggies Report 10-1594-R1 Revision 0 dated 16 November 2001 ("Heggies Report 1").

The overall findings of the blast emissions investigations were that flyrock was not a significant issue with the trialled blasting practices and that all blast emissions impacts (particularly flyrock and airblast) were minimised in the direction behind the blast.

Consequently, the quarry extension has been designed so that the blast faces (and therefore the direction of movement of the rock) are in the direction away from the closest potentially affected residential receivers (refer to Figures 3.6 to 3.11 in the EIS).

Having established that flyrock was not an issue with the optimised blast designs and blasting practices, an assessment of flyrock for inclusion in the EIS was not considered necessary.

Furthermore, there are generally two main areas within the blast from which flyrock has the potential to be produced. These are at the blasthole collar (where the stemming length has not been optimised and the explosive column is too close to the upper surface of the rock mass creating crater effects - rifling) and at the face of the blast (where there could be less than optimum burden on a blasthole whereby the explosives gases are able to vent to atmosphere - blowouts, producing flyrock).

For the subject blasting, the front-row blastholes will be "Boretraked" in order to identify any areas of less than optimum burden in order that, if required, inert material (rather than explosives) can be placed at this location in the blasthole. Consequently, the latter situation in relation to flyrock ejection would not occur.

In terms of collar ejection, the proposed stemming length of ~~1.5~~2.2 m is considered optimum for the proposed blasthole lengths and has been selected in order to totally contain the explosives and separate them from the collar of the blasthole.

Further, aggregate (probably 14 mm) will be used as the stemming material (not drill dust) again in order to contain the explosives within the blasthole.

Drilling Services Pty Ltd has advised Heggies that, based upon their experience in quarries and road construction projects, they are able to confidently state that blasted rock will fall within a blast envelope with dimensions:

50 m in front of the face
20 m on either side of the face, and
10 m behind the face

and that such dimensions are consistent with industry best practice and are readily achievable.

As an additional mitigation measure Cleary Bros propose to leave a 1 m layer of overburden in place on top of each shot when blasting within 10 m of the Fig Tree Hill land boundary. This layer of overburden is intended to act much the same way as a blast mat and will significantly reduce the likelihood of flyrock generation in the region of the blast hole collar.

Refer to Section 6.2 (Managing Flyrock) of the Noise Monitoring Programme/Blast management Plan, Heggies Australia Report 10-4156-R2 Revision 0 of 5 October 2005 ("Heggies Report 2").

The closest that the (rear wall) of the blasting will come to the property boundary (and not until the end of Stage 5) is approximately 10 m down the northern site boundary and 20 m (controlled by noise mitigation bund) in the north-eastern section of the site.

2.2 Noise

Items 2e., 3d., 3f., 3i.(iv) and (v) of the Amended Statement of Issues dated 24 August 2005 state (in relation to noise) that:

> *"2 The consent authority does not have the power to determine the application as the Environmental Impact Statement that accompanies the development application DA 466-11-2003 prepared by Perram Partners dated October 2003 (the "EIS") is inadequate."*

APPENDIX 5:

“Response to Comments” prepared by SLR

16 December 2016

610.04156.00600-L01-v1.0 Response to Comments 20161213.docx

Cleary Bros (Bombo) Pty Ltd
39 Five Islands Road
PORT KEMBLA NSW 2505

Attention: Helen Nicolaidis / Mark Hammond

Dear Helen / Mark

Response to Comments
Noise and Blasting Assessment
Albion Park Quarry Extension - Stages 5 and 6

1 Introduction

Further to the submission of the Environmental Assessment (EA) for the subject Stages 5 and 6 of the Albion Park Quarry Extension (which contained the Noise and Blasting Assessment/Management Plans (dated 4 April 2016 prepared by SLR), a number of comments were received.

This report is the response to the comments raised by Figtree Hill, the NSW Department of Planning and Environment (DPE) and the NSW Environment Protection Authority (EPA).

2 Response to Comments

2.1 Response to Figtree Hill Comments

2.1.1 Comment

It [the EA] does not take into account the approved dwelling on the land owned by Figtree Hill Pty Ltd in relation to noise and blast monitoring management plan. Also, the management plan falls to take into account what will happen should this dwelling be built. The approved site is approximately 430 metres from the nearest part of the proposed extraction boundary.

Response

Condition 4, Noise Limits of Schedule 4 in the 2015 Condition of Consent for the Hard Rock Quarry (the 2015 Consent, also reproduced in Section 2.1 of the Noise and Blasting Assessment dated 15 December 2016 (NBA) contains the noise limits for the "*Approved rural workers dwelling (Dunster premises)"*. The noise limits for the approved dwelling are the same as those for "The Cottage" residence and "The Hill" residence.

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(PO Box 176 Lane Cove NSW 1595 Australia) T: +61 2 9427 8100 F: +61 2 9427 8200
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ABN 29 001 584 612

As The Cottage and The Hill are closer to the near-point of the quarry extraction boundary in Stages 5 and 6 (at 385 m and 480 m respectively) than the approved dwelling, compliance with the noise limits at The Hill would also result in compliance with the noise limits at the approved dwelling (refer to **Appendix C**, Stages 5 and 6 Noise Contours in the NBA) on which The Cottage, The Hill and the approved dwelling are shown).

Accordingly, Section 7 of the NBA states that:

> "*The predicted Stages 5 and 6 operational noise level at The Cottage residence in the EIS (incorrectly labelled as the Hill) is 34 dBA $L_{Aeq(15minute)}$. It is therefore anticipated, based on the results in Table 2, that the actual quarry noise level contribution at The Cottage will be between 28 dBA $L_{Aeq(15minute)}$ and 34 dBA $L_{Aeq(15minute)}$ and that the corresponding actual noise level contribution at The Hill will be between 27 dBA $L_{Aeq(15minute)}$ and 33 dBA $L_{Aeq(15minute)}$, thereby complying with the 2015 Consent Stages 5 and 6 noise criterion at The Cottage and The Hill of 35 dBA $L_{Aeq(15minute)}$.*
>
> *The operational noise level contours for Stages 5 and 6 of the quarry extension are presented in **Appendix C**."*

In relation to blasting, Conditions 10 and 11 of the 2015 Consent present limits for airblast overpressure and ground vibration from blasting respectively which apply "*at any residences or sensitive receiver on privately-owned land."*

When constructed, the quarry blasts will be designed for compliance with the nominated limits at the rural workers dwelling, as is currently the practice for compliance with the nominated 2015 Consent blast emissions criteria at The Cottage (the closest residence to the present quarry blasting).

2.1.2 Comment

"There are discrepancies in the distances quoted of residence from the nearest part of the proposed extraction areas: Executive Summary (2.2.5 Surrounding Lane Use) quotes 375 m for the "Cottage" and 460 metres for "The Hill". The SLR Report (11. Blast Design Records and Prediction Emission Levels) quotes 420 m for "The Hill" and no reference to the "Cottage".

Response

This issue has been addressed in the NBA.

As stated in the Section 2.1.1 response above, The Cottage, The Hill and the approved dwelling are situated 385 m, 480 m and 560 m from the near-point of the Stage 5 and 6 quarry extraction boundary (refer to **Appendix C** of the NBA).

2.1.3 Comment

Schedule 4 Condition 14 – Blast Management Plan

The SLR Report purports to be a Blast Management Plan however there are the following deficiencies in the document:

a) There has been no consultation with Figtree Hill Pty Ltd by SLR.

b) There is no reference to the approved dwelling which retains its currency.

c) There is no reference to the problems concerning the exclusion of people and stock from the buffer zone, even though these issues were noted in Minutes of CCC Meetings 8/7/15 and 9/12/15, Appendix 5. We note two separate occasions when property owners were directed out of areas on Figtree Hill land and a public road to a distance of 400 metres. According to Cleary Bros advice per Minutes of CCC Meeting 9/12/15, the blasting contractors required this as a safety precaution for people and stock.

d) There is also no reference to contingent actions taken in the event the owners of Figtree Hill Pty Ltd do not comply with the above requests to vacate that "buffer/exclusion zone" extending over their land.

e) There is no reference to any restriction of entitlement of the owner or occupier of the Figtree Hill land regarding the use of their property during the course of running commercial operations – land use related to dairying is long established and predates quarry uses nearby.

Condition 14(e):

"Describe the measures that would be implemented to:

- Mitigate, remediate or compensate for any blasting impacts of the development on the Figtree Hill land or use of that land."

*Whilst we acknowledge there are procedures proposed to **mitigate** the impacts (management of flyrock, and notification of landowners of blast events), the other issues of remediation or compensation have not been addressed.*

Response

a) As Cleary Bros are the "owners" of the NBA, the process is, as it has been historically, for Cleary Bros to forward the NBA to Figtree Hill Pty Ltd for comment once completed, as they have done on this occasion.

b) Please refer to the Responses in Sections 2.1.1 and 2.1.2 above.

c) In relation to the protection of stock and people, Sections 9.3, 9.3.1 and 9.8 (last paragraph) of the NBA state the following:

> *"**9.3 Vibration***
>
> *The ground vibration site law has been developed in such a way that it can be used to assist in designing the blasts so that the peak particle component velocity levels for blasting at the development do not exceed 200 mm/s at any point on the southern boundary of the Fig Tree Hill Land. This ground vibration criterion is based on the approved SLR NMP/BMP dated 10 February 2006 (refer to the note in the 2015 Consent, Schedule 4, Condition 14).*
>
> ***9.3.1 Airblast***
>
> *The airblast site law has been developed in such a way that it can be used to assist in designing the blasts so that the airblast levels for blasting at the development do not exceed 135dB Linear at any point on the southern boundary of the Fig Tree Hill Land. This airblast criterion was agreed at the Joint Conference of the respective parties which was convened as part of Appeal No 10839 of 2005 in the Land and Environment Court of NSW."*
>
> ***9.8 Managing Flyrock***
>
> "*The blast design procedures for blasting near the Fig Tree Hill Land southern boundary will be determined via reference to the then current blast emissions site laws (refer to **Section 9.5**). As stated, the site specific quarry extension site laws (for ground vibration and airblast) will be regularly updated and subsequently used to design the next blast. Consequently, the allowable MICs to comply with the nominated ground vibration and airblast safety limits at the Fig Tree Hill Land southern boundary will progressively reduce, thereby further reducing the likelihood of flyrock*."

d) I would assume that Cleary Bros only obligations in this regard are to comply with the 200 mm/s ground vibration and 135 dBLinear airblast overpressure safety limits via the implementation of best management practice to protect the safety of people and livestock in the surrounding area (refer to Schedule3, Condition 13. a) of the 2015 Consent).

Also, as stated in Section 9.8, Managing Flyrock, of the NBA, "*The blast design procedures for blasting near the Fig Tree Hill Land southern boundary will be determined via reference to the then current blast emissions site laws (refer to **Section 9.5**). As stated, the site specific quarry extension site laws (for ground vibration and airblast) will be regularly updated and subsequently used to design the next blast. Consequently, the allowable MICs to comply with the nominated ground vibration and airblast safety limits at the Fig Tree Hill Land southern boundary will progressively reduce, thereby further reducing the likelihood of flyrock*."

e) Please refer to the Response in Section 2.1.3 c) above.

By adopting the procedures nominated it is anticipated that blasting/rock excavation can be conducted in Stages 5 and 6 of the quarry extension without having to implement any further measures to mitigate, remediate or compensate for any blasting/rock excavation on The Fig Tree Hill Land or the use of that land.

2.2 Department of Planning and Environment

2.2.1 Comments

2. Noise and Blasting

DPE considers that the submitted Noise and Blasting Assessment lacks sufficient detail, and contains some apparent inconsistencies. The Department requests further information or clarification with respect to the following matters:

a. The noise assessment in Section 7 relates to "The Hill" only, and provides no analysis with respect to the remaining three receivers identified in Table 1 of the consent The Department notes that this issue has also been raised in the submissions.

b. The noise level contour plan in Appendix C does not indicate receiver locations. The three green-coloured contour lines (representing the 35, 40 and 45 dBA contours) are also difficult to differentiate.

c. Table 5.1 of the EA estimates the airblast overpressure level and peak particle velocity for blasting activities during Stages 5 and 6 at 112.3 dB and 2.72 mm/s, respectively. However, the basis for these predictions Is unclear, as they are not repeated In the Noise and Blasting Assessment.

d. There are inconsistencies within the Noise and Blasting Assessment/Management Plans regarding blasting setbacks from the Fig Tree Hill property. Section 9.6.1 stales that during Stages 5 and 6, 'blasting at the closest point will occur 30 m from the Fig Tree Hill Land southern boundary.' However, Section 9.8 outlines proposed flyrock mitigation measures for blasting within 20 metres of this same boundary.

Response

'a. Refer to the Response in Section 2.1.1 above.

Also, Section 4 of the NBA presents information on the Noise Compliance Monitoring for Stages 3 and 4 of the quarry which has been conducted annually over the past four years (2012 to 2015). Table 2 in Section 6.5 of the NBA, Historic Noise Compliance Survey Results, presents the quarry Stages 3 and 4 noise contribution at The Hill, The Cottage and at the Greenmeadow Residential Estate for those past four years.

As well, the operational noise level contours for Stages 5 and 6 of the quarry extension are presented in Appendix C of the NBA.

b. The contour diagram in Appendix C of the NBA has been re-drafted with the respective noise sensitive receivers labelled and the contours re-coloured in order to make them easier to read.

c. SLR was not privy to the origin of these vibration and airblast predictions. However, it is now understood that the predicted levels for the airblast overpressure and ground vibration of 112.3 dB Linear and 2.72 mm/s respectively were included by Cleary Bros in the EA for the previous Modification 2 of the Albion Park Quarry and represented the maximum measured blast emission levels from the Albion Park Quarry operations since the commencement of the quarry extension up to the publication of the EA.

d. These inconsistencies have been rectified in the NBA. The relevant sections of Section 9.6.1 of the NBA now reads:

> "*In relation to the protection of people potentially located on the Fig Tree Land southern boundary during blasting, as an example, for an MIC of 50 kg, the current 5% exceedance site law predicts that an airblast level of 135 dB Linear would occur at a distance of approximately 50 m from the blast. As a precaution, when blasting within about 50 m of the property boundary, the MIC for each blast may need to be restricted to below 10 kg. However, this would be based on the then current airblast site law for the quarry extension.*
>
> *Based on the current airblast site law, conventional blasting during Stages 5 and 6 of the quarry operation will occur up to approximately 50 m of the Fig Tree Hill southern boundary. This buffer will be reviewed in response to future near-field blast emission monitoring, which may increase or decrease the required offset to achieve the nominated blast emission criteria and safety limits. Non-explosive rock fracturing techniques may be used to allow extraction of the hard rock resource in closer proximity to the Fig Tree Hill boundary, if the then current site laws restrict explosive blasting techniques."*

And the relevant section of Section 9.8 of the NBA dated 12 December now reads:

> "*The blast design procedures for blasting near the Fig Tree Hill Land southern boundary will be determined via reference to the then current blast emissions site laws (refer* ***Section 9.5****). As stated, the site specific quarry extension site laws (for ground vibration and airblast) will be regularly updated and subsequently used to design the next blast. Consequently, the allowable MICs to comply with the nominated ground vibration and airblast safety limits at the Fig Tree Hill Land southern boundary will progressively reduce, thereby further reducing the likelihood of flyrock."*

2.3 Response to EPA Comments

NOISE

Following an assessment of the Noise and Blasting Assessment/Management Plan in the EA, the EPA advises that the assessment was undertaken generally in compliance with accepted guidelines and shows that the proposal meets impact assessment criteria and is unlikely to result in a deterioration in environmental performance. The EPA supports the limits and conditions in the 2015 Consent (Schedule 4 Condition 4), including the ongoing monitoring and reporting requirements. The EA provides information which indicates there will be no unacceptable noise impacts from the proposed quarrying in Stages 5 and 6. This has been partly demonstrated through compliance in meeting the noise requirements/conditions through Stages 3 and 4.

Schedule 4 Condition 4 (Note 5.) of the consent states:

The noise emission limits in Table 1 apply under meteorological conditions of:

- *Wind speed up to 0.5mls in any direction at 10 metre8 above ground level; or*
- *Temperature gradient (environmental lapse rate) conditions of Jess than or equal to 0 degrees C/100m (lapse).*

As this environmental lapse rate (0 degrees C/1OOm • which lies within Stability Category E) requires a 60m minimum height tower to obtain acceptable accuracy for continuous establishing of the lapse rate, the EPA recommends that the Consent be modified to specify that the limits apply under A, B, C and D Stability Categories, which can be measured with a standard 10m tower.

Response

The existing Automatic Weather Station (AWS) at the quarry is located adjacent to the Cleary Bros owned "Belmont" residence situated in the southeastern corner of the approved extraction area and has a 10 m tower.

In terms of noise compliance, data from this AWS is only relied upon annually for the period of noise logging during the noise compliance assessments (generally 7 to 10 days) in order to determine the prevailing weather conditions.

For the annual noise compliance assessment, two near-field monitoring locations (one adjacent to the Processing Plan and the other adjacent to the Quarry Extension Area) are incorporated into the existing quarry noise model. This model was developed in 2002 and used to prepare the Noise and Blasting Impact Assessment for the quarry as part of the EIS. The two monitoring locations are used as reference points enabling a comparison to be made between the predicted noise levels at the two reference locations and the noise levels modelled at the residences. This "relationship" is subsequently used to calculate the daily fluctuating quarry noise contributions at the respective residences.

As discussed, the 2015 Consent noise limits apply under calm conditions only (ie wind speeds up to 0.5 m/s at 10 m height). Accordingly, the analysis of the noise logger results together with the modelling results also enables the contribution of the Albion Park Quarry to be calculated for calm (ie no wind) conditions for the noise compliance assessments.

This is the noise compliance assessment procedure developed with and endorsed by the DPE in 2009 and has been used annually since that time.

On the basis of the above, it is not considered necessary to modify the 2015 Consent in relation to the weather conditions under which the Noise Limits apply (Schedule 4, Condition 4, Note 5 of the 2015 Consent).

I trust the above satisfies your immediate requirements. Should you have any queries or require further information please contact me.

Yours sincerely

DICK GODSON
Technical Director

Checked/
Authorised by: MB