PACIFIC HIGHWAY UPGRADE
OXLEY HIGHWAY TO KEMPSEY
NOISE & VIBRATION WORKING PAPER

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9 BLASTING VIBRATION AND OVERPRESSURE ASSESSMENT

Blasting operations generate both vibration and overpressure. Vibration is transmitted through the ground to the surrounding area but is generally attenuated to below residential criteria. Overpressure, which is similar to noise except that it normally includes some very low frequencies just below the audible range, is propagated through the air and may be attenuated less effectively with distance, depending upon the atmospheric conditions prevailing.

Both ground borne vibration and airborne overpressure may cause damage to buildings at relatively high levels in addition to causing potential annoyance to affected residential areas.

9.1 Assessment criteria

For the assessment of annoyance due to blasting, the NSW Department of Environment Climate Change and Water (DECCW) adopts guidelines produced by the Australian and New Zealand Environment and Conservation Council (ANZECC). The fundamental criteria are that at any residence or other sensitive location:

- The maximum peak particle ground velocity (PPV) should not exceed 5 mm/sec for more than 5% of blasts in any year, and should not exceed 10 mm/sec for any blast.
- The maximum overpressure due to blasting should not exceed 115 dB re 10^{-5} PA for more than 5% of blasts in any year, and should not exceed 120 dB for any blast.

9.2 Prediction of blasting overpressure and vibration levels

Airblast overpressure and ground vibration levels from blasting are related to the “scaled distance” from the blast, which is defined as:

Scaled distance = $D/W^{(1/3)}$ for airblast overpressure.
Scaled distance = $D/W^{(1/2)}$ for ground vibration.

Where D is the distance from the blast in metres and W is the maximum instantaneous charge of explosive, in kg Ammonium Nitrate Fuel Oil (ANFO) equivalent.

Standard predictive curves relating scaled distance to overpressure and ground vibration levels have been derived from measurements conducted at numerous sites. Wilkinson Murray has developed predictive algorithms for calculation of blast overpressure and vibration based on measurement of multiple mining blasts. For this assessment, blast measurements performed at the Bayswater No. 3 Mine between 1996 and 1999 were used in predictions. Ground vibration data for 193 blasts, and overpressure data for 171 blasts, were available for analysis.

Figure 9-1 shows the best-fit line and 95% confidence limit derived from the measured vibration levels. The figure also indicates the predicted vibration level using the method outlined in Australian Standard *AS2187.2-1993: Explosives – Storage, Transport and Use* for both normal and hard rock.

Figure 9-2 shows measured airblast overpressure values. As for most blast measurement data, overpressure levels show much higher variability than vibration levels due to prevailing atmospheric conditions.

Figure 9-1 Measured peak particle ground velocity & scaled distance

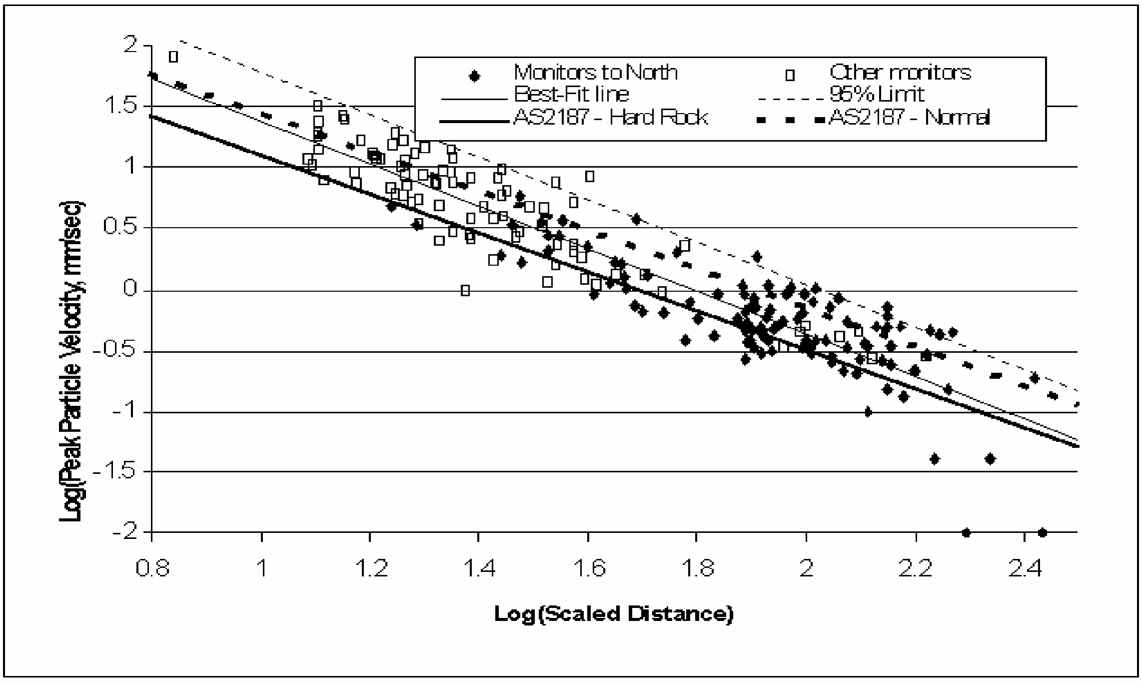
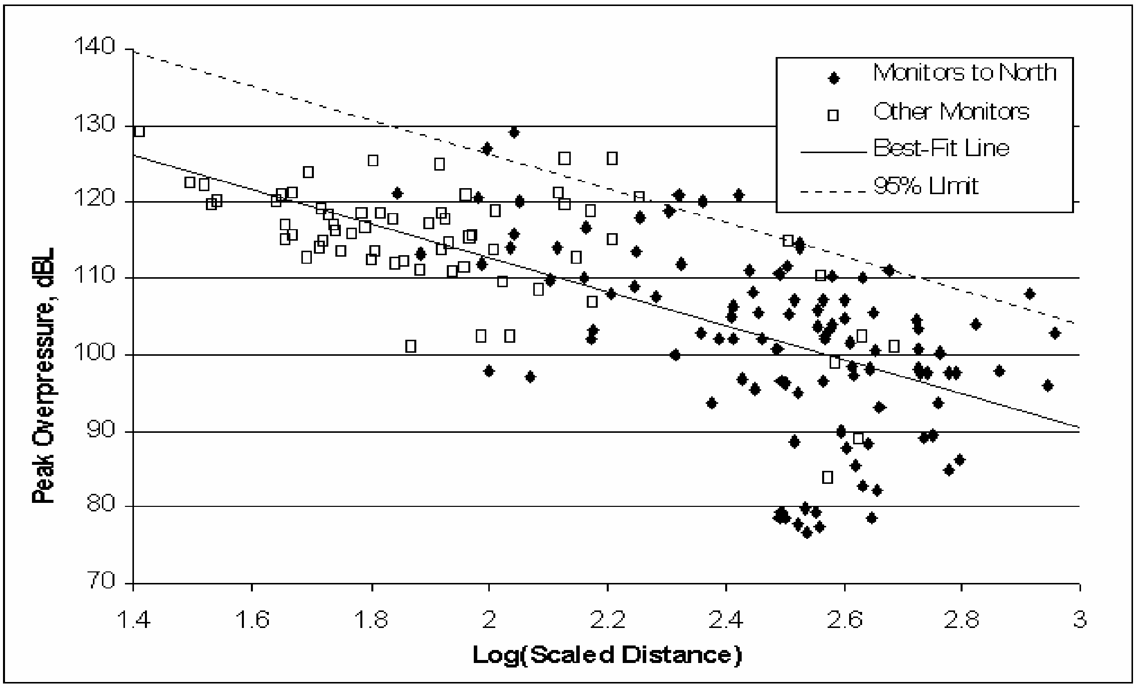


Figure 9-2 Measured blast overpressure & scaled distance



9.3 Predicted maximum instantaneous charges to meet residential overpressure & vibration criteria

The maximum instantaneous charges at which vibration and overpressure levels meet the Australian and New Zealand Environment and Conservation Council (ANZECC) guidelines can be calculated using the closest distance to any residential dwelling and predictive equations derived from Figure 9-1 and Figure 9-2.

Blasting could be required at a number of locations, primarily through the Cooperabung Hill and Maria River State Forest. The construction techniques would be determined during the detailed design phase and following further detailed geotechnical investigations.

Table 9-1 summarises the predicted results for the allowable maximum instantaneous charge to meet the overpressure ANZECC guidelines at the closest residence to each blast site. The predictions assume no shielding from local topography.

Table 9-1 Allowable MICs to meet overpressure goals

Blast site (approximate station)	Approximate distance to closest residence (m) *	Maximum instantaneous charge (kg)
3100	295	0.8
17450	160	0.1
17900	75	n/a
18400	250	0.5
20700	210	0.3
21000	170	0.2
21400	480	3.5
21600	420	2.3
22000	400	2
22600	720	11.8
33700	1000	31.7
34300	1590	127.4
35200	1190	53.4
35900	570	5.9
37200	80	n/a

* Note: Distance to closest residence is measured from the closest point of the upgraded highway alignment within the blast site to the residence in question

Table 9-1 indicates that ANZECC overpressure guidelines are achievable only at the furthest residences (blast sites at stations 22600, 33700, 34300 and 35200). Alternative methods of rock removal could be required at the other potential blast sites.

Table 9-2 summarises the predicted results for the allowable maximum instantaneous charge to meet the ground vibration ANZECC guidelines at the closest residential dwelling to each blast site.

Table 9-2 Allowable maximum instantaneous charge to meet ground vibration goals

Blast site (approximate station)	Approximate distance to closest residence (m) *	Maximum instantaneous charge (kg)
3100	295	26.8
17450	160	7.9
17900	75	1.7
18400	250	19.2
20700	210	13.6
21000	170	8.9
21400	480	70.9
21600	420	54.3
22000	400	49.2
22600	720	159.6
33700	1000	307.8
34300	1590	778.1
35200	1190	435.9
35900	570	100
37200	80	2

* Note: Distance to closest residence is measured from the closest point of the upgraded highway alignment within the blast site to the residence in question

Table 9-2 indicates that ANZECC ground vibration guidelines are achievable only at all but the closest residences (blast sites at stations 17450, 17900, 21000 and 37200). Alternative methods of rock removal could be required at these potential blast sites.

In order to meet the ANZECC overpressure guidelines, it is anticipated that only the most remote sites (stations 22600, 33700, 34300 and 35200) could be economically viable for blasting. In order to meet the guidelines control measures on blasting would need to be implemented. Necessary best-practice measures would include:

- Strict control of stemming for blast holes.
- Ensuring adequate timing sequences for all blasts.
- Restriction of blasting under adverse weather conditions.

Development of these procedures would require ongoing refinement of blast design in conjunction with monitoring. Construction techniques would be determined during the detailed design phase and following further detailed geotechnical investigations. The construction noise and vibration management plan would need to include a blasting management plan to provide for appropriate management of blast overpressure and ground vibration impacts.