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Jason Grieve
Brockman Resources
1/117 Stirling Highway
NEDLANDS WA 6009

Dear Jason,

MARILLANA IRON ORE PROJECT
NOISE TO FORTESCUE MARSH

As requested, Lloyd George Acoustics have undertaken some indicative calculations of noise emissions from the proposed iron ore mine to the Fortescue Marsh in order to consider the potential noise impacts on the wetlands fauna.

Note that only indicative calculations are considered warranted as the separation distance between the mine and wetlands is large – refer PER *Figures 5-3 & 5-4* attached. The distance between the northern most point of the mine area and southern most point of the wetlands is calculated to be approximately 12.5 kilometres.

Typical equipment (refer *Table 1*) have been incorporated into the noise modelling programme *SoundPLAN 6.5* with the equipment having sound power levels shown in *Table 2*. All noise sources have been positioned at 2 metres above existing ground level. For the mobile equipment in the pits, this is considered conservative, as for the most part they will be located within the pit.

Table 1 – Noise Sources Considered in Assessment

Equipment	No. in Model
Haultrucks	6
Loaders	2
FEL	1
Dozer	1
Grader	1
Drill Rig	1
Water Carts	1
Conveyor Drives (Cluster of 4)	12
Service Truck	1
Primary Crusher	1
Secondary Crusher	1
Tertiary Crusher	1
Vibrating Screens	10
Conveyors	7

Table 2 – Source Sound Power Levels, dB

SOURCE	OCTAVE BAND CENTRE FREQUENCY (Hz)								OVERALL, dB(A)
	31.5	63	125	250	500	1k	2k	4k	
Mine Area									
Haul Trucks	118	113	109	115	112	111	107	106	116
Loaders	123	130	133	127	123	119	118	110	126
Front-End Loader	113	112	113	110	108	105	100	94	110
Dozers	108	112	117	115	106	107	103	98	112
Graders	105	112	110	107	109	108	106	101	112
Drill Rigs	113	121	122	124	122	118	115	109	124
Water Carts	110	112	121	118	115	109	106	101	116
Conveyor Drives	93	95	97	99	99	99	101	94	105
Service Trucks	115	109	112	109	111	112	109	106	121
	109	108	119	118	115	110	109	102	
	103	105	110	110	115	110	109	100	
Processing Area									
Primary Crusher	117	117	114	122	122	118	116	109	128
	117	117	115	122	124	118	113	109	
	117	115	117	118	121	116	111	105	
Secondary Crusher	107	107	112	110	117	116	113	106	123
	107	111	113	112	116	115	111	103	
	105	111	114	114	115	114	108	100	
Tertiary Crusher	115	106	105	106	108	106	101	95	115
	111	106	108	109	112	108	98	93	
	108	105	106	104	105	101	96	93	
Vibrating Screens	108	112	103	102	104	103	105	108	117
	107	106	104	102	104	104	105	106	
	108	100	103	99	103	104	107	105	

Noise levels were predicted under light downwind conditions as specified in EPA *Guidance for the Assessment of Environmental Factors No.8 Environmental Noise draft*, and shown below in *Table 3*.

Table 3 –Modelling Meteorological Conditions

Parameter	Night (1900-0700)
Temperature (^{o}C)	15
Humidity (%)	50
Wind Speed (m/s)	3
Wind Direction	Source to Receiver
Pasquil Stability Factor	F

Three of the closest points on the south side of the wetlands were selected and noise levels were calculated to range 17 to 20 dB(A).

The calculated noise level is very low and likely to be below background noise levels in the area. Note that for humans, the allowable noise level during the most stringent night period is 35 dB(A), prescribed by the *Environmental Protection (Noise) Regulations 1997*.

Blasting may also occur at the mine and thus the noise from this activity to the wetlands has also been considered. The calculation of sound levels from blasting follows the procedures of Australian Standard 2187.2-2006 *Explosives – Storage and Use, Part 2: Use of Explosives*. This Standard provides equations for confined and unconfined blasts. It should be noted however that the accurate estimation of airblast levels is a complex task since the blasting process is highly non-linear and most rock types are highly variable.

Assuming a confined blast with a charge mass per delay of 3,300kg, the calculated noise level at 12.5km is expected to range 89 to 109 dB $L_{Linear\ peak}$.

Note that for humans, blasting during the day (Mondays to Saturdays) can be up to a level of 125dB $L_{Linear\ peak}$.

Very little research has been undertaken in Australia regarding the effects of noise on birds. Most studies are undertaken in Europe or America, with particular reference to military operations, and this may hold some relevance to Australia. The Australian Federal Government Department of Environment and Heritage reported the following:

Research into the effects of noise on animals is relatively scarce. The results obtained from the studies conducted are frequently contradictory or inconclusive. It does appear reasonably conclusive however, that as with humans, animal reactions to noise vary from species to species. Even species that seem perfectly adapted to human noise can show variation in their reactions.

It is known that a large number of animals have adapted to the presence of humans and the noise we generate. In fact, many animals live, apparently quite happily, in extremely noisy environments for example, rodents in factories, ships and subways, fish in waters with constant shipping activity and birds and mammals on and around airfields. Although there have been reports of panic and similar "startle" reactions in animals to both fixed and rotating wing aircraft activity, the difference between these reports and field observations around military and commercial airfields may be explained by the learning process and habituation of many animal populations.

Studies conducted on arctic wildlife suggest that the same animal population should be observed over an extended time period at the same location. Busnel (1978) believes that unusual noise, in combination with close proximity visual stimulation, is enough to disturb any animal, including man, and cause panic. He also points out that any sudden and unexpected intrusion, whether acoustic or another nature, can produce a startle or panic reaction. What is due specifically to noise alone is not always known.

Experimentation with the sonic boom, which is a purely acoustic stimulus (with no associated visual or odour stimuli), shows that the behaviour of domestic and also some traditionally shy wild species was unaffected as the result of repeated sonic booms (see Casaday & Lehmann, 1967, Welch, 1970). Bird scare guns are also an acoustic source producing similar results and farmers have reported birds actually perching on the guns after a couple of days operation.

The learning ability of many animal species is discussed by Busnel (1971). The animal's initial reaction to a new noise source is fright and avoidance but if other sensory systems are not stimulated (for instance optical or smell), the animal learns quite quickly to ignore the noise source, particularly when it exists in the presence of man.

For the predicted noise levels of up to 20 dB(A) for mining activities, it is considered there will be no impact as such a level of noise is likely to be masked by other background noise.

For the predicted blasting noise levels of $L_{Linear\ peak}$ 89 to 109 dB, there is unlikely to be any disturbance. In any case, birds are quick to adapt to a changing environment, particularly when other senses such as optical or smell are undisturbed and would be expected to resume normal activities in a short period of time.

From the analysis, it is considered that noise from the proposed mining operations at the Marillana Iron Ore Project are unlikely to have any acoustic impact at the Fortescue Marsh.

Regards,

Terry George