APPENDIX I

Analysis by Philip Best of the MCQ Monitoring Data from the western end of Sussex Street (2001-2017), outside 58 Richer Street (2001-2017) and 159 Mt Coot-tha Road (2011-2017) (selected screenshots only to summarise. The entire spread-sheet is available on application).

Glossary of Terms

BCC	Brisbane City Council
MCQ	BCC Owned and Operated Mount Coot-tha Quarry
DEHP	QG Department of Environment & Heritage Protection
DNRM	QG Department of Natural Resources & Mines
DILGP	QG Department of Infrastructure, Local Government & Planning
ERA-16	DEHP Extractive & Screening Activities Regulations
mm/sec ppv	Unit of Blast Vibration Peak Particle Velocity measured in Millimetres per second. Similarly, DEHP ERA-16 (2013-2017) and ANZEC (1990) define 5mm/sec as the target maximum, with occasional "mistake" values permitted, but never above 10mm/sec.
KRA-42	Qld DILGP defines this Key Resource Area for MCQ
KRA-42-RPA	MCQ Key Resource Area - Resource Processing Area. Defined area of land where blasting, processing, storage and despatch is permitted.
KRA-42-Separation Zone *(All Educational Structures banned).*	Outside the RPA there is a separation zone defined where no public or private buildings and habitation are permitted. Specifically, no educational structures are permitted. The presence of these structures traditionally defines a smaller or more remote RPA zone. 500metres is regarded as the very minimum RPA distance and a 1,000 metre zone is traditionally required.
OMCR	Old Mt Coot-tha Road including the Community Title Estate plus the Pre-1911 historic site (no. 25, possibly a Cobb& Co changing facility prior to 1900).
159MCR	The MCQ Blast Monitoring Location setup above the designated 159 Mt Coot-tha Rd address, 1 metre to the North of the bitumen and near the concealed driveway for 3 Sir Samuel Griffith Drive (3SSGD). This being the closest KRA-41-RPA point to the BCC approved residential homes, some of which were established around 2000 and later.
End-Sussex	Monitoring point established near the end of Sussex Street
58-Richer	Monitoring point established near 58 Richer St and sometimes at other Richer St addresses
3SSGD	The Private Residence at 3 Sir Samuel Griffith Drv. L2RP51294

1.0 It is a matter of record that MCQ went through a period of more frequent and intense blasting which was linked to its increased output to supply the ICB project between 1997 and 2001. During this period, the MCQ blast vibration levels in adjacent homes were considered by Local Residents to be very high.
This episode may occur again if MCQ gravel is used for new major civil projects.

Year	*Output in Tonnes*
1985	**250,000 approx.**
1997	**369,495**
1998	**408,144**
1999	**473,544**
2000	**601,038**
2001	**743,838**
2002	**750,518**
2003 - 2017	**BCC refused our RTI data request.**

Table 1 Comparative Annual MCQ Output Tonnages – *as advised by Cr Judy Magub 3/4/2003*

2.0 The RTI blast monitoring data obtained from both DEHP and BCC demonstrate that, up until November 2011, MCQ chose to locate and carry out blast vibration monitoring at two relatively distant locations (see **Figure 1 & Table 2** comparison below). In the absence of monitoring at noise sensitive use locations much closer to the quarry, it seems that the results of MCQ monitoring seriously underestimated the strength encountered by Local Residents.

It is known that vibration monitoring was done at the MCQ weighbridge, however these data were not provided to us as part of the BCC RTI request.

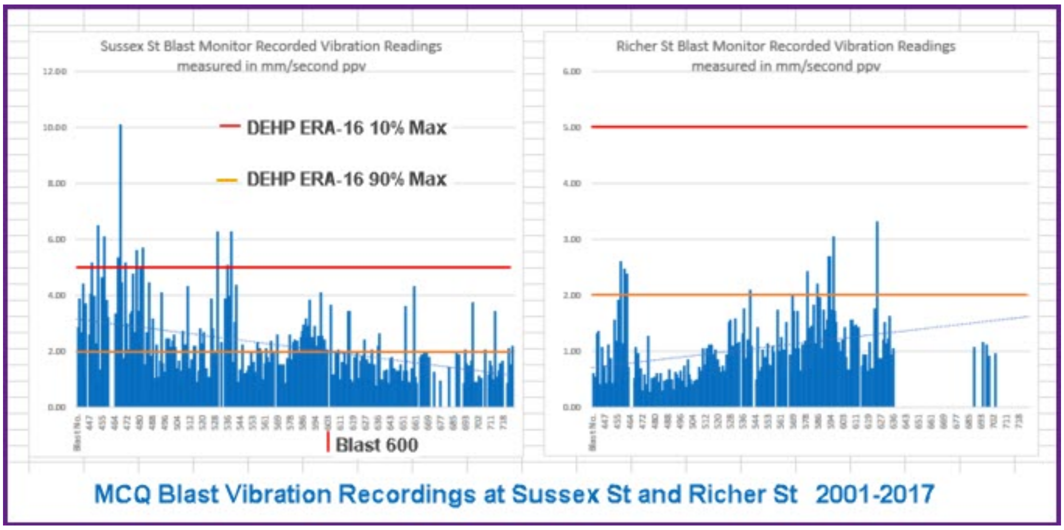
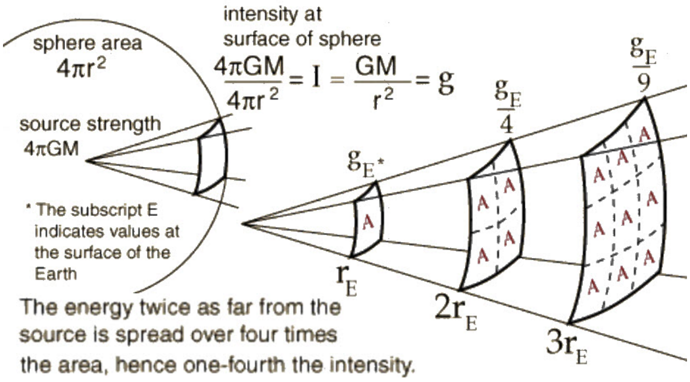


Figure 1 MCQ Blast Vibration monitoring 2001-2017 at End-Sussex & 58-Richer

3.0 As predicted by solid angle theory, and similar to our averaged values, the 15/10/2002 blast which was measured above 10mm/sec at the End-Sussex monitoring point may have been stronger than 30mm/sec at 159MCR.



Monitoring Location Distances	*End-Sussex*	*58-Richer*	*159MCR*
Distance to MCQ KRA-42 RPA:	602 metres	324 metres	53 metres

MCQ Blast Numbers (estimated from RTI Data)				
Blast Range	*Date Range*	*End-Sussex*	*58-Richer*	*159MCR*
440 - 599	2001 to Sept-2011	140	138	2 *(from blast 593)*
600 - 725	Nov-2011 to March -2017	99	43	120

Table 2 A summary comparison of distance to the quarry RPA, the periods of monitoring and the number of measurements taken by MCQ at each of the three monitoring locations.

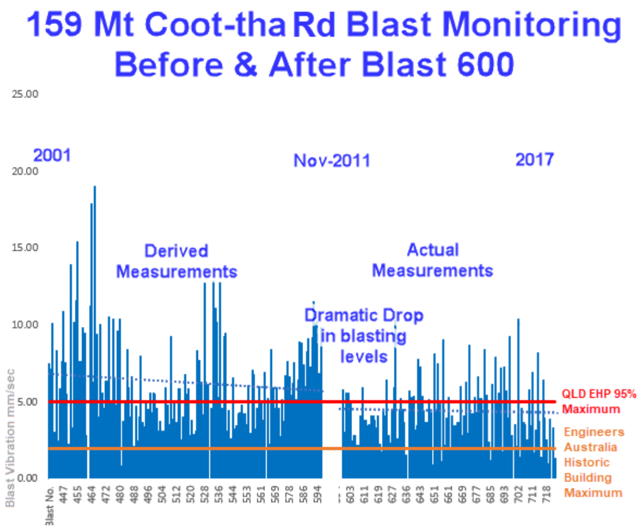
4.0 DEHP currently specifies the exact locations where blast monitoring is to be carried out in their EPPR mining license conditions. However, his was not done for MCQ and as a result, the choice of MCQ blast vibration monitoring locations was much further away than would reasonably be expected and the logic for location choice has never been explained.

5.0 Full Blast Vibration Footprint Reporting

In 2011 the Local Residents prevailed upon MCQ to monitor near the closest homes on OMCR and 3SSGD.

Hence in November 2011, a monitor was created at 159MCR on blast 593, (regular blast monitoring began here at Blast 600).

The accompanying chart (using both 'derived' and actual blast levels, see below for explanation) seems to indicate a sudden drop in the operational blast strength, from that time forward to the present.



Thus, the Local Residents consider that it was not until after November 2011 that MCQ began to fully report its accurate blast vibration footprint.

Key	Red Value - Exceedence			
Blast Number	Blast Date	Monitoring Location	Peak Vibration (mm/sec) Limit: 10mm/sec	Air Overpressure (dB) Limit: 125dB
592	25-A	treet	[illegible]	104.2
592	25-A	Stree		5
593	02-S	treet		8
593	02-S	Stree		8
594	22-Nov-11	Richer Street	2.680	111.8
594	22-Nov-11	Phil Best	**11.500**	115.0
594	22-Nov-11	Sussex Street	2.900	116.6
596	15-Dec-11	Ric	1.730	105.5
596	15-Dec-11	Su	2.190	111.5
597	01-Feb-12	Ri	3.030	108.0
597	01-Feb-12	Su	2.550	113.5
599	16-Feb-12	Ri	1.710	114.0
599	16-Feb-12	Sus	0	0
598	09-Mar-12	Richer St	1.510	112.8
598	09-Mar-12	Phil Best	3.060	115.4
598	09-Mar-12	Sussex Street	4.120	106.5

BCC RTI Data as provided, includes Sequence Errors.

First ever monitoring done at 159MCR, to measure blast vib near the closest properties and only 53metres from KRA-42-RPA.

Start Date for Mt Coot-tha Road Blast Vibration Monitoring was due to our persistence.

The monitoring point was initially given my name because it was a special request. However this 159MCR location soon became permanent.

Table 3 Screenshot of MCQ Blast Vibration Monitoring Results BCC RTI Data

6.0 The absence of monitoring data at the closest sensitive-use areas before blast 600 is believed to be significant, due to the apparent sudden change in blasting levels from that time forward.

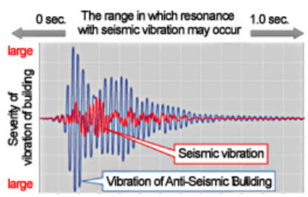
Subsequent to blast 600, MCQ also continued to monitor at the End-Sussex and 58-Richer locations, and these measurements thus provided simultaneous comparisons with those at the new 159MCR monitoring point. (**see Table 4 screenshot of data spread-sheet**).

This spreadsheet compares monitoring, between blasts 600 and 725, of the more distant locations against the residences closest to the quarry. It is concluded that the MCQ Blast Vibration levels, presumably reported annually to the DEHP, are likely to have underestimated the blast strength at the closest residences, by a factor of 3 times, during the decades before November 2011.

7.0 In November 2016, DEHP advised "Consideration for the cumulative number of blasts and also that multi-level residential structures may experience higher vibrations on the upper levels are considered worthwhile". This was in the context of what BCC DA-West had approved to be built in this (hilly) area, which has a high proportion of high-set, multi-level and pole-type homes.

Hence it is clear that:

- The effects of all blast vibrations may be cumulative.
- Sympathetic building vibrations are amplified with height.
- Vibrations cause movement in building footings, which can then be transmitted vertically.



8.0 Following this DEHP feedback, it was resolved to use the existing End-Sussex and 58-Richer monitoring data prior to blast 600, as a basis to estimate the equivalent-but-missing 159MCR values, and hence indicate the possible cumulative effect on nearby homes.

We used a simple averaging method. (We obtained verbal advice from a qualified statistician but did not obtain a written report.)

We wish to confirm that we are not statisticians and the derived data reported here should only be considered as a reasonable approximation.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	**BCC RTI Supplied MCQ Blast Vibration Data**										Site Abbreviations: SST = Sussex St, RST = Richer St,				
2	**Version 3 Display of MCR & Stuartholme Blast Vibrations**										MCR = 159 Mt Coot-tha Rd, STHOME=Stuartholme Steps				
3	*Averages Based Derived Values = blue.*						*Chart Data*	*Chart Data*			*Chart Data*				
4	Date	SST	RST	MCR	MCR/SST	MCR/RST	MCR All Data	MCR-InHouse	STHOME	MCR/STHOME	STHOME All Data	STHOME Internal	Blast No.	Notes and Charts	
266	1/09/2016			2.57			2.57	3.33			0.69	0.90	707		
267	7/09/2016	1.16		5.80	5.01		5.80	7.54			1.57	2.04	709		
268	22/09/2016	1.65		3.42	2.07		3.42	4.44			0.92	1.20	711		
269	29/09/2016	1.46		6.91	4.73		6.91	8.99			1.87	2.43	708		
270	6/10/2016	1.01		1.69	1.67		1.69	2.20			0.46	0.59	710		
271	20/10/2016	3.44		3.17			3.17	4.12			0.86	1.12	712		
272	27/10/2016	1.06		8.18	7.73		8.18	10.64			2.21	2.88	713		
273	24/11/2016	1.29		3.75	2.91		3.75	4.88			1.02	1.32	714		
274	8/12/2016	1.55		1.37	0.89		1.37	1.78			0.37	0.48	716		
275	25/01/2017	1.21		6.40	5.30		6.40	8.31			1.73	2.25	717		
276	9/02/2017	1.66		3.97	2.39		3.97	5.16			1.07	1.40	718		
277	16/02/2017			2.56			2.56	3.32			0.69	0.90	715		
278	23/02/2017			0.96			0.96	1.24			0.26	0.34	719		
279	2/03/2017	0.87		3.90	4.47		3.90	5.07			1.05	1.37	721		
280	9/03/2017	2.10					7.03	9.14			1.90	2.47	722		
281	17/03/2017	1.51		3.33	2.21		3.33	4.33			0.90	1.17	723		
282	23/03/2017	2.17		1.31			1.31	1.70			0.35	0.46	725		
283															
284	Total Sum	532.23	188.19	535.45	301.50	159.68	1509.19	1961.95	6.74	1.08	408.23	530.70			
285															
286	Data Counts	240.00	182.00	121.00	90.00	40.00	278.00	278.00	4.00	4.00	278.00	278.00	278		
287	< Blast 600	140.00	138.00	1.00											
288	Blast 600+	99.00	43.00	120.00	89.00	39.00	127.00	127.00	4.00	4.00	127.00	127.00	277		
289															
290	Average	2.22	1.03	4.43	**3.35**	**3.99**	5.43	7.06	1.69	**0.27**	1.47	1.91			
291	Median			**4.07**	**2.82**	**3.65**	4.92	6.40	1.63	0.27	1.33	1.73			
292	StDeviation			**2.13**	**1.93**	**1.87**	2.90	3.77							
293	Count > 5mm/sec			**44.00**			**138.00**	**186.00**							
294	Count > 10mm/sec			**3.00**			**23.00**	**50.00**							
295	**The Method and Process used here was considered by a Statstical Consultant (PowerStats).**														
296	**The advice was that whist our simple process was correct, we should also calculate the Median values (which we did).**														
297	**However this does not change the instance of misrepresented blast vibration footprint data, as the result of the deliberate choice of more distant monitoring locations before Nov-2011.**														

MCQ Blast Vibrations Spreadsheet Screen-Shot 2001-2017

Table 4 Screenshot of our MCQ Blast Vibration Monitoring spreadsheet Totals Area. (Copy of our full spread-sheet is available on request.)

9.0 Our intention was **to create a simple set of 'derived' 159MCR values before blast 600, as a means to understand the possible historical impact of blasting on our homes.**
We used the ratio of averaged measurements for the three monitoring locations from blast 600 onwards to create a transform factor. We used Excel to calculate both the AverageA and Median values.

While the median value is more useful for non-bell-curve data spreads, we chose to use the Excel AverageA function result as this specifically ignores blank values caused by transducer failures or unmonitored blasts.

The RTI data from BCC and EHP was thus copied into the spreadsheet.

- On occasions there were the odd one or two special request monitoring values for other locations which we ignored because they did not indicate any kind of trend.
- We also found a few readings for Mt Coot-tha Rd, but because the street number or cemetery location was unknown, they were also ignored.
- Several times we found that the data had not been written down correctly, with many sequence errors. However, the actually value assignments appeared to be valid.
- At times the blast noise value seemed to be inconsistent with the blast vibration (possibly due to a copying error) and hence we did not consider the blast sonic boom "overpressure" noise levels.
- We were also conscious that the less-consistent tent-peg transducer monitoring method was specified by the quarry manager to be used instead of the best-practice concrete block transducer mounting method. (The tent peg or soil spike transducer mounting is specifically NOT recommended in AS2187 Appendix J).

We calculated the AverageA results, plus the 159MCR/End-Sussex and 159MCR/58-Richer monitoring average.

- There was significant variation between the three monitoring points.
- However, upon investigating solid angle theory, it appears that these kinds of reduced and attenuated values are only to be expected with more distant monitoring points.

10.0 In order to create some derived values for the period up until blast 600, the only method available to us was to utilise the pre-blast-600 averages for End-Sussex and 58-Richer values.

- This 'derived values' approximation is aided by the coordinate locations being approximately West and North of the MCQ, which to some extent compensates for blast source geographic point location and blasted rock seam ducting variations.
- Further consideration of descriptive statistics such as median values and variance measures are not considered to provide any useful information, since it is the largest values and highest blast strengths that are of most concern to Local Residents.
- <u>Where one of the monitoring sites was used, our only available method of estimation</u> was to multiply that value by the relevant 159MCR averaged ratio.

Example of the algorithm used is:

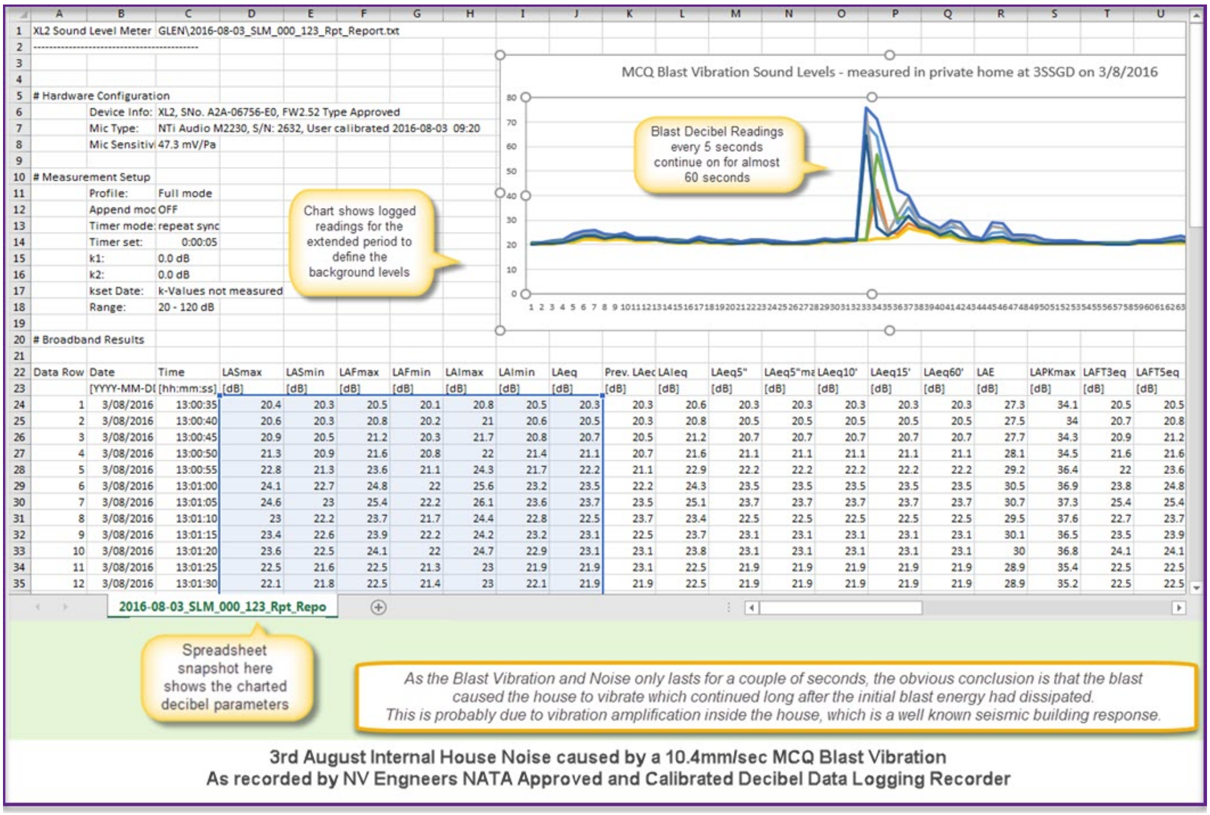
Both End-Sussex & 58-Richer monitored	Derived 159MCR Value = (Sussex * 3.35 + Richer *3.99) / 2
Blast 457, Sussex = 6.1, Richer=2.59	Derived 159MCR = 15.39mm/sec
Blast 468, Sussex = 10.11, Richer = 1.06	Derived 159MCR = 19.05mm/sec

Table 5 Examples of the calculation of 'derived values' for unmeasured blast strength at 159MCR using the average of blast data ratios.

While our pre-blast-600 algorithm could be developed further, the 159MCR/End-Sussex plus the 159MCR/58-Richer average and median ratios stand together as good indicators that there were inadequacies in the blast footprint reporting system for many years, up until 2011.
The local residents who are subject to the highest blast levels are those closest the KRA-42-RPA, (including the Historic at 25 OMCR building), whose persistent efforts have resulted in improvements to the blast vibration footprint report.

11.0 Subsequent to the DEHP information, the local residents decided to investigate the vibration amplification concept, as applied to multi-level and pole homes, of which there are several within 300m of MCQ.
Vibration amplification is a commonly-occurring seismic symptom that is known to cause building damage and its consideration is the basis of earthquake-proof building design.

12.0 On 3rd August 2016 we hired a NATA approved and calibrated Decibel Data Logger from NV Engineers (based in Camp Hill, Brisbane). They pre-set all the parameters.
Our instructions were to place the data logger inside the house, press the start button and leave the premises. No person or animal was allowed to remain in or near the premises.
After we returned home, the data logger was immediately returned back to Camp Hill office, for analysis.


XL2 Sound Level Meter GLEN\2016-08-03_SLM_000_123_Rpt_Report.txt
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Hardware Configuration
Device Info: XL2, SNo. A2A-06756-E0, FW2.52 Type Approved
Mic Type: NTi Audio M2230, S/N: 2632, User calibrated 2016-08-03 09:20
Mic Sensitivi 47.3 mV/Pa

Measurement Setup
Profile: Full mode
Append moc OFF
Timer mode: repeat sync
Timer set: 0:00:05
k1: 0.0 dB
k2: 0.0 dB
kset Date: k-Values not measured
Range: 20 - 120 dB

Broadband Results

Data Row	Date	Time	LASmax	LASmin	LAFmax	LAFmin	LAImax	LAImin	LAeq	Prev. LAec	LAIeq	LAeq5"	LAeq5"ma	LAeq10'	LAeq15'	LAeq60'	LAE	LAPKmax	LAFT3eq	LAFT5eq
	[YYYY-MM-DI	[hh:mm:ss]	[dB]	[dB]	[dB]	[dB]	[dB]	[dB]	[dB]	[dB]	[dB]	[dB]	[dB]	[dB]	[dB]	[dB]	[dB]	[dB]	[dB]	[dB]
1	3/08/2016	13:00:35	20.4	20.3	20.5	20.1	20.8	20.5	20.3	20.3	20.6	20.3	20.3	20.3	20.3	20.3	27.3	34.1	20.5	20.5
2	3/08/2016	13:00:40	20.6	20.3	20.8	20.2	21	20.6	20.5	20.3	20.8	20.5	20.5	20.5	20.5	20.5	27.5	34	20.7	20.8
3	3/08/2016	13:00:45	20.9	20.5	21.2	20.3	21.7	20.8	20.7	20.5	21.2	20.7	20.7	20.7	20.7	20.7	27.7	34.3	20.9	21.2
4	3/08/2016	13:00:50	21.3	20.9	21.6	20.8	22	21.4	21.1	20.7	21.6	21.1	21.1	21.1	21.1	21.1	28.1	34.5	21.6	21.6
5	3/08/2016	13:00:55	22.8	21.3	23.6	21.1	24.3	21.7	22.2	21.1	22.9	22.2	22.2	22.2	22.2	22.2	29.2	36.4	22	23.6
6	3/08/2016	13:01:00	24.1	22.7	24.8	22	25.6	23.2	23.5	22.2	24.3	23.5	23.5	23.5	23.5	23.5	30.5	36.9	23.8	24.8
7	3/08/2016	13:01:05	24.6	23	25.4	22.2	26.1	23.6	23.7	23.5	25.1	23.7	23.7	23.7	23.7	23.7	30.7	37.3	25.4	25.4
8	3/08/2016	13:01:10	23	22.2	23.7	21.7	24.4	22.8	22.5	23.7	23.4	22.5	22.5	22.5	22.5	22.5	29.5	37.6	22.7	23.7
9	3/08/2016	13:01:15	23.4	22.6	23.9	22.2	24.2	23.2	23.1	22.5	23.7	23.1	23.1	23.1	23.1	23.1	30.1	36.5	23.5	23.9
10	3/08/2016	13:01:20	23.6	22.5	24.1	22	24.7	22.9	23.1	23.1	23.8	23.1	23.1	23.1	23.1	23.1	30	36.8	24.1	24.1
11	3/08/2016	13:01:25	22.5	21.6	22.5	21.3	23	21.9	21.9	23.1	22.5	21.9	21.9	21.9	21.9	21.9	28.9	35.4	22.5	22.5
12	3/08/2016	13:01:30	22.1	21.8	22.5	21.4	23	22.1	21.9	21.9	22.5	21.9	21.9	21.9	21.9	21.9	28.9	35.2	22.5	22.5

2016-08-03_SLM_000_123_Rpt_Repo

Table 6 Blast Vibration Decibel Recording inside 3SSGD on 3rd August 2016

On the following day, the data were checked by an RPEQ NV Engineer and emailed to us. This provided **an indication that vibration amplification had occurred**. The ground-measured blast vibrations only last for approximately one second, while the NV Engineers data indicated that the house continued to vibrate for a considerably longer period.

Even though the MCQ EPPR blasting license defines monitoring at any noise sensitive place, no vibration monitoring has ever been done inside a private house, to the best of our knowledge. Hence BCC management would not have any indications of what vibration amplification or resulting damage may be caused, inside nearby homes. This decibel recording remains the only current indication of internal home vibration response to the quarry blast.

We are also advised that the Initial Energy Source of home damage may be liable for all consequential vibrations and damages as the blast impacts are cumulative.

Based on the recorded internal home decibel data, we estimated a 30% vibration internal-home increase (x1.3) could be applied, especially for the stronger blasts. This factor is consistent with the 10-year qualitative experience of being inside our house when the stronger blasts occur. We then applied this factor across all measurements.

13.0 The application of this formula results in a proportional increase in received blast strength inside our house.

Expected Derived & Internal High-Set/Tall House Vibrations based on 159MCR values:
Blast 457 = 20mm/sec
Blast 468 = 25mm/sec

Some of the older houses in nearby locations have timber stumps which have suffered from decades of strong blasting vibrations.

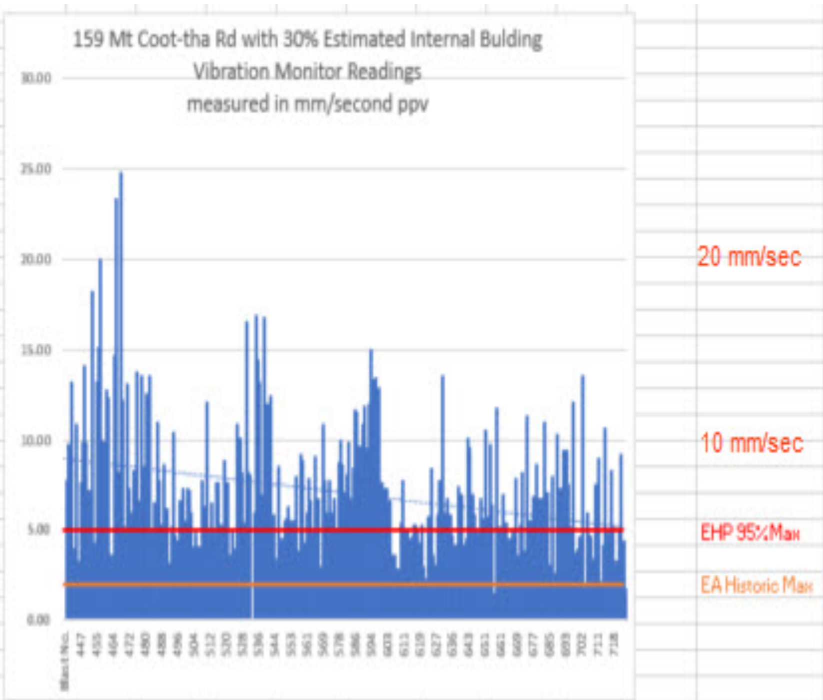

Table 7 159MCR Estimated Internal House Blast Vibration levels

14.0 **Botanical Gardens**: While this report is not primarily about non-residential areas, we feel that some consideration for the Botanical Gardens is warranted, because of their significance with both local residents and the broader community. The Botanic Gardens have an Iconic Profile and 700,000 Tourists visit, every year. This number is expected to increase in future, with significant increases associated with infrastructure improvements including expected the second Brisbane Airport runway and the new cruise ship terminal, by the end of 2020.

A view of the BCC CityMap2014 map contour lines indicate that KRA-42-RPA is immediately adjacent to the gardens, plus the quarry face is approximately 50 metres from the common RPA/Gardens Border Line. As the actual blasting point moved around inside the KRA-41-RPA, it is likely to have come within 100 metres of the community centre, 200 metres of the Planetarium and 350metres of the Terrarium.

However, because there was no Gardens Monitoring Locations or results supplied with our blast vibration RTI data, we conclude that No Blast Vibration or Blast Noise Monitoring has been carried out in the Gardens Area.
The Botanic Gardens Educational and Equipment areas including the Meeting Room, Planetarium and Terrarium, as well as a large percentage of the gardens themselves, all lie within the mapped KRA-42-Separation area.
We conclude that botanic gardens and associated tourist activities are incompatible with and hampered by any industrial or intrusive facility.

15.0 **Summary**
This report highlights the need for a balanced approach by MCQ management due to their impacts on the local residents. The life of any quarry depends on public support and there is widespread ratepayer support for integration of the quarry area into the botanic gardens.

16.0 **Further Notes and Other Related Data.**
Terabyte Mechanical Data Storage:
Requiring specific consideration is the issue of mechanical disk data storage, of which the volumes, storage capabilities and importance have increased dramatically in the past 10 years, whilst the form-factor or physical size has had to remain the same.
This results in magnetised tracks becoming ultra-thin with almost no separation. (These tracks on multiple disk surfaces are called “Cylinders”).
The ability of the mechanical head to correctly read each cylinder data is prevented during a loud noise, which causes a re-read or latency error.
During a write process, if the head alignment is disturbed, adjacent tracks may get overwritten. Mechanical vibration is thus likely to cause damage to important and mission critical data.
The large amount of data stored can only be backed up onto a similar Terabyte hard drive.

Recorded Blast Vibration Example:

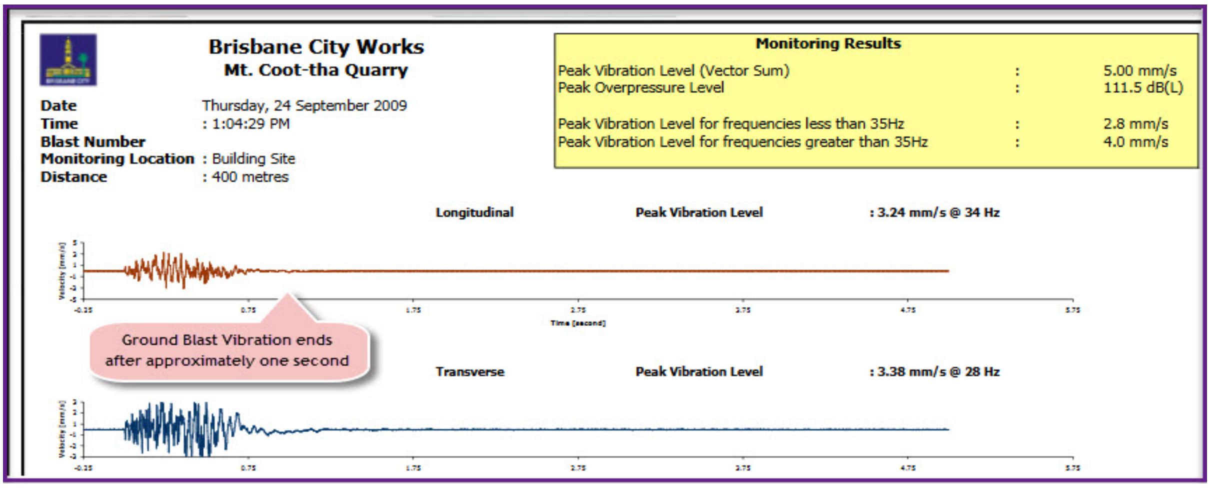

Table 9 Blast Vibration Monitor Example

This shows that the **disruptive blast vibration period lasts for approximately one second**. Hence it is highly significant that the NV Engineers 3rd August 2016 data for their Decibel Data Logger (shown earlier) shows **Loud Internal House noise for more than 30 seconds**.

Instantel Minimate Blast Monitor:

This is one of the most commonly used blast monitors. The User Guide states: The ground coupling must be **as secure as possible** and the **transducer must be level**.

However, when using a "soil spike" tent peg arrangement, with no soil density or aeration specification, good coupling and consistent results can be difficult to achieve every time.

Thank you for reading this document,
Philip Best.
https://au.linkedin.com/in/philbest