

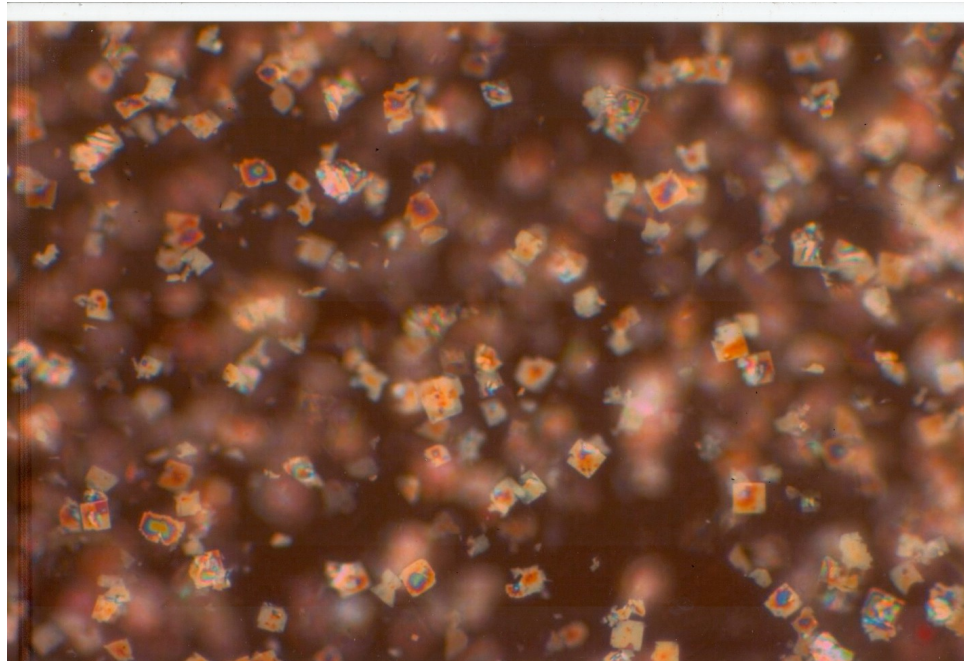
SUMMARY OF EVIDENCE

IN THE MATTER OF Application CRC 181274

DATE OF HEARING 3 to the 6th of April 2018

Kelvin Duncan, PhD

4 April 2017

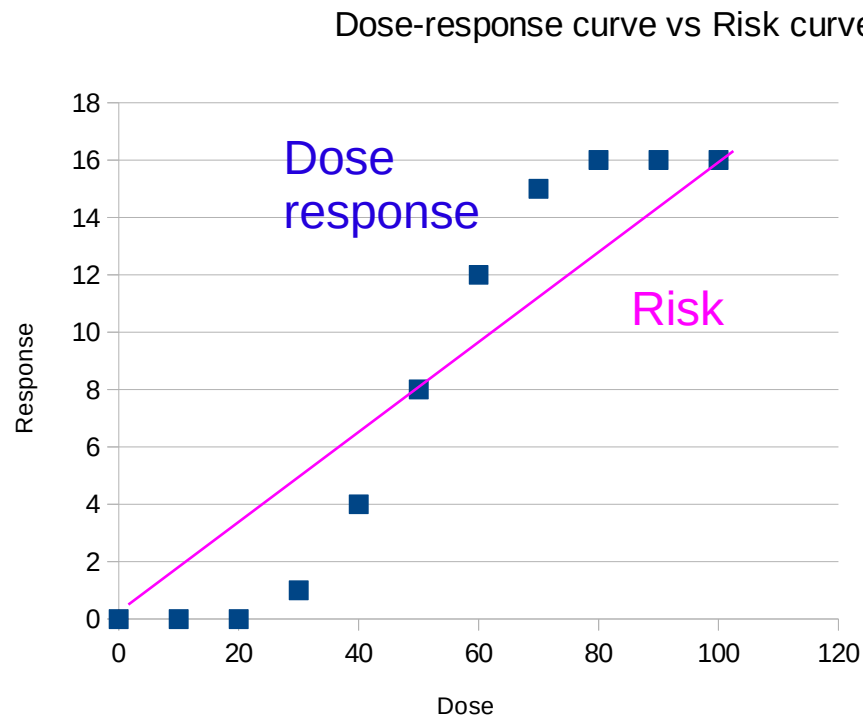


IS THERE A RISK?

- Mr Chapman refers to a Court judgement that “there is no place mere perceptions of risk which are not shown to be well founded.” This is an old judgement (2000) where there was an appeal against a proposed geothermal power station near Taupo. The adverse effects were held to be not well enough substantiated to prevent the consent being granted. The objectors failed.
- But the effects in the present case **are well founded**, as evidenced by the following (amongst others):
 - Medical evidence provided by the residents' medical advisers
 - The dust nuisance photos
 - The results from the earlier investigations
 - The veterinarian reports on animal health
 - The microbiological reports on the effects of dust on the mycorrhizas of Truffles.
- This judgement, if applied to the present case, does not concur with the RMA's requirement in S5 (b) to “Safeguard the life-supporting capacity of air, water, soil, and ecosystems...”
Thus the RMA covers more than “demonstrated effects.” It is also in breach if applied to the present hearing, of the Precautionary Principle as discussed in my evidence.
- I do not see the relevance of Mr Chapman's point either in subject matter or in law.
- We can conclude there are emissions from the Yaldhurst quarries that are causing actual harm. The present application, if granted, will result in further harm.

RISK OR DOSE

- Should we use the term risk or not? I believe not. Risks are used by engineers in such matters as the risk of landslides etc.
- Medical scientists use a different concept – dose, usually expressed as a dose response curve. Internationally, the law is informed by dose response curves constructed from evidence, not risk given by opinion.



PELS

- Mr Chapman is misleading in his Paragraph 52. We do not know what the annual dose is that the residents suffer, but other jurisdictions give hourly, 8- hourly, 24 hourly (NOT 9 hour) and annual PELs. These limits cannot be exceeded. All the reports done by others show exceedances occur at Yaldhurst as I discuss in my evidence. But to repeat: the Australian national standard as decided in December 2015 are $8\mu\text{g}/\text{m}^3$ for annual average, and $25\mu\text{g}/\text{m}^3$ for 24-hour PM_{2.5}. These are shortly to be reduced even further (to 7 and 20 respectively). And it is simply not true that long-termed averages longer than one year are likely to be lower than the annual average. I have never seen any reports using averages longer than annual.
- The evidence I have presented is taken directly and accurately from international official and scientific sources. I have not relied on any of my own investigations other than the photomicrographs which are self evidently true. I ask the Commissioners to look at the evidence I present which is accurate and unemotional. Do not be swayed by attempts to discredit me. It is the evidence that is important. My comments on how well the quarries conform to international standards of best practice are warranted and reflect my concern for the residents' welfare. But that is a matter of opinion; the evidence is not, no matter how much Mr Chapman tries to weaken it.
- Mr Chilton's defensive opinions are noted, but he does not rely on the evidence already available. His position is untenable as he cannot explain why the residents are suffering medical conditions typical of breathing RCS.
- Mr Chapman should read my evidence more carefully. I have relied on completed studies and far less on interim results, contrary to what he asserts.

EXPERT?

- My background and expertise has been called into question. I have three degrees (B.A., B.Sc. (Hons First Class), and PhD) and a few Diplomas (Statistics, Post grad Chemistry), I have studied the “hard” sciences of Chemistry, Mathematics, Physics, Biochemistry, Chemistry, Physiology, and Zoology. I am not a social scientist/geographer. I have conducted research in ecology and general biology and have published papers in these fields. I also have patents or papers in chemical process technology, antifungal compounds, antibiotics, conservation management (patch theory, risks from human activities to sensitive ecosystems, management of aquatic pests by natural means) and the application of Stoke's Law to aerosols (“dust”).
- Mr Chapman also considers that my evidence, which consists of reports of overseas studies and regulations and not of my own work, is undermined by partisanship. If he wishes he can separate my reports on the science and law from my comments on the New Zealand situation. Then he would see that the evidence I present stands irrefutably on its own. He should recognise that I am a scientist dedicated to what the evidence tells us. I serve the truth, not clients.

LAW

- My suggestion that the Crimes Act may apply has been reviewed by lawyers, including a QC. They consider there is a case that could be made.
- I also refer in my evidence to the concept of the Precautionary Principle, which is a part of the RMA Amendment Act 2017. So Mr Chapman's assertion that mere perceptions of risk has no place in Courts is not current law and it has no weight or applicability at this hearing.

THE MEANING OF WORDS

Mr Chapman accuses me of emotionalism. But words such as "unconscionable" are descriptive, with a meaning of "having no conscience", or "not right" or "not reasonable" (OED). This perfectly describes both Mr Chapman's statements and those of his employers, the quarries, as they know of the dangers of respirable crystalline silica. It is not an emotional word. (I forgot to mention earlier that I have also studied semantics and logic.)

SOURCES OF GRAVEL

- The quarry companies claim that costs will increase if they are forced to quarry further away. This is true, but by how much? Transport is only one component of any company's cost structure. And what price human health and lives? Economics does not give justification for harming innocent victims.
- International reviews state that the great majority of gravel worldwide is obtained from beaches or rivers. Not in Canterbury, however, although these sources are readily available locally. Instead we mine high value, rural residential land that has high amenity and aesthetic value, and which endangers the health of residents.
- An abundant and renewable source of gravel is in the Waimakariri River bed and banks.
- The industry claim that this source is unsuitable as it doesn't have fines. This claim is false.
- The industry should be required to extract its gravel from this source which will harm nobody. But it should be done under the guidance of properly qualified hydrologists and ecologists to ensure no environmental damage is done through ignorance.

CORRECTIONS OF FACTS IN MS SIMPSON'S AND MR PENE'S REPORT

Please refer to the numbered sections in their report.

- S 3.3 Other jurisdictions require no dust be emitted over the quarry's boundaries. It is not satisfactory to assume that the residents are present in their houses at all times – they may be conducting outside activities. 100m to the nearest point of the residents' houses is not good practice. 500m is better.
- S 5.10. This is simply wrong. The Victorian EPA (and others) requires a 500m setback if RCS is present, even where there is no blasting. And the Vic EPA have confirmed that a belt and braces approach is taken. 500M is allowed provided that there is no dust or there is an annual average of whole dust less than 8 micro g/m³ (Agreed Statement of the Meeting of Environmental Ministers 15th Dec 2015.)
- S 5.60 PM₁₀ is not a surrogate for anything. It has harmful health and other effects of its own right, although these are not as serious as those caused by the PM_{2.5} RCS fraction.
- S 5.63 Makes no mention of the ChemSafety Report of 1-25 August 2017 which found that 4 of the seven “valid” results showed exposures above the critical limit, nor the K2 Report of 8th November 2016 which found 30% RCS in dust in resident's homes. Under my supervision the residents also had dust analysed and they, too, found 30% RCS content. These values are virtually the same as the quarry dust sampled at the quarry face. This level is extremely high by international standards. The ECAN investigation dated June 2016 did not find significant RCS content, but this was probably because they sampled the PM₁₀ fraction. Such large particles are unlikely to contain fly silica crystals. The PM_{2.5} fraction containing RCS would pass straight through their filters.
- S 5.66. This is plainly wrong. There is a wealth of studies, information and regulations about non-occupational diseases caused by PM₁₀ and PM 2.5 and RCS. These have been published in the years following about 2001.

Corrections continued

The reliance on monitor AQS3 by Ms Simpson is not justified as this unit was removed for a lengthy period when the southerlies were blowing because “it was reading too high.” When reinstalled during a period when the southerlies were not blowing it still read higher than indicated by Ms Simpson in her evidence. The correct values are given in my full evidence. The monitor, of course, should have been cross-calibrated with at least one other unit before withdrawal from service and any conclusions drawn.

- S 6.1 (a) Bunds are deprecated by many authorities because they cause fine particles to be swept up higher in the air stream due to aerodynamic turbulence, and hence travel even further than they otherwise would have done.
- S 6.1 (c). Currently, the monitor on site of one of the quarries is covered. This is bad practice.
- S 6.3. This is not in accord with current good practice overseas. Dust fences, not bunds, sealed haulage tracks, covered trucks, sealed ground surfaces except for the smallest possible working surface, continual and effective watering of dust-emitting surfaces, and covered reserves of top soil backfill, safe disposal of silica-containing fines are all recommended.

Corrections continued

S 7.1 There is general agreement that a PEL for RCS of less $3\mu\text{g}/\text{m}^3$ is the safe level as multiple research investigations conclude that samples under this level will cause no or a very small chance of deleterious health effects; above it there is. The $3\mu\text{g}/\text{m}^3$ point represents a significant upward increase in the gradient of the appropriate dose-response curve. That's why it was chosen.

S 7.3 Animals differ in their physiological responses compared to humans. Eg, chocolate kills dogs, but it doesn't hurt us. There are over 200 significant differences in the metabolism of mice and people. It is unknown what the effect of chronic exposure to RCS has on animals – it would be dangerous to suppose that it is identical to the effects on humans.

Comments on Mr Chilton's Rebuttal

This was lodged after the due date for discovery, so should be dismissed. If it is not, I make the following comments in order to be helpful to the hearing.

S5. I do consider the mitigation efforts. They are similar to the current methods in the existing quarries that are demonstrably ineffective judging by the sampling conducted in the residents' homes and on their persons. The monitoring and enforcement efforts by ECAN have not corrected these ineffective mitigation methods. So, one is left with little faith that the current extension application will be managed, monitored and enforced any better than in the past. In any case, it is the health effects that are of paramount importance.

S6. Mr Chilton should have drawers full of suitable references of the international literature. I quote honestly and accurately from existing sources and can provide references for him if he desires. This one is from the prestigious JAMA 2016, E69-E74. Wikipedia is a comprehensive source. Bridge (2009) in *Air Quality and Climate Change vol 43[1] pp 17-23* also gives quantitative assessments. There are many other papers but I am sure they are known to all air quality experts.

Comments on Mr Chilton's Rebuttal continued

S 8. I didn't highlight any particular activity, but included them all if reported in the Source I used. I know that this proposed extension will not contain a crusher, But material will be transported to an uncovered crusher that will crush material and which does emit dust. In any case the other activities to be conducted on site will raise dust.

S 9.2 In my opinion the errors in the K2 Report do not affect the confirmation of the presence of significant quantities of RCS. The determination of the amounts of RCS were not conducted by K2, but by a fully accredited laboratory.

The analysis of bulk samples of dust from surfaces is likely to result in an under-representation of the proportion of RCS in the sample, as the fine particles are more difficult to collect and RCS has the property of sticking like glue to surfaces through electrostatic attraction. So Mr Chilton's conclusions are not warranted.

The collection by deposition is a standard collection method and only differs in its operation from filtration or even cyclonic sampling by its slow speed.

Comments on Mr Chilton's Rebuttal

S 10. These authors comment on airborne particles in PM2.5, and PM2.5 is one of the measures being assessed at Yaldhurst. RCS is a component of the PM2.5 measured, so the effects at Yaldhurst are likely to be more severe than reported by Dominici et al.

Mr Chilton should examine the section he reproduced that is not underlined by him in the official statement entitled *Adverse effects of crystalline silica exposure* adopted by The American Thoracic Society (*Am J Resp Crit Care Med Vol 155. pp 761-765.*) It says “that chronic simple silicosis has been described after environmental exposure.... This is an old paper and a more modern report is given by Bhajia's paper on *Non-occupational exposure to dust*, in *I J Occup Environ Med. 2012, 16(3): 95-100.* This does deal with respirable crystalline silica. There are many others.

My apologies for assuming that fellow experts would be familiar with the very many papers on this important and crucial topic.

S 21. Wind is not so important for fine particles which “hang in the air” rather than depositing quickly. I pointed out that the Australian authorities recommend that PM2.5 be treated as a gas rather than as a particulate aerosol.

S 13. My purpose was to indicate that other jurisdictions treat this matter (non-occupational exposure) very seriously and that our regulations seem inadequate by comparison. That is why I rely on the RMA and the RMA Amendment Act 2017.

Comments on Mr Chilton's Rebuttal

S 14. The world is moving to this requirement, that there be no noxious matter discharged beyond the property boundary. Even our RMA requires no discharge of such material.

Even more significant is the RMA Amendment Act 2017 which incorporates the Precautionary Principle. Some experts may think that significant amounts of a known carcinogen in the aerosol flowing over residents' houses is a “less than minor nuisance”, but this is a conclusion that is surely hard to maintain given the evidence of 30% respirable crystalline silica in the dust in the houses neighbouring the quarries and in the air they breathe.

Mr Chilton considers the mitigation measures he proposes will be effective. I find this difficult to accept given that

- they haven't worked before
- they are not in step with the far more stringent requirements in other jurisdictions, including Tasman
- and the onus is on the Applicants and their experts to satisfy the Precautionary Principle and explain the medical problems being shown by the residents.

S 16. Silica is silica no matter whereabouts in the world it occurs. If Victoria (and other places) require stricter mitigation then we should take note. We are not more resistant to dust induced diseases than are Australians.

Comments on Mr Chilton's Rebuttal

S 17. Mr Chilton is, of course, entitled to his opinion, but the AQI is used widely around the world for all sorts of valid purposes. It is even available as an phone app for personal use. See the Iowa Dept. of Natural Resources for a good explanation and instructions on how to use it for personal monitoring of the air pollution a person may be experiencing. Particles are one of the five classes of pollutants incorporated in the calculations, and “are one of the worst threats to human health in this country” (the USA). The other pollutants are ground-level ozone, carbon monoxide, sulfur (sic) dioxide, and nitrogen dioxide.

It is a fact that the AQI is showing its age since the absence of VOCs is notable. These are now claimed to be responsible at least in large part for the astronomical rise in heart conditions since before the industrial age when it was a rare disease, to its present position as the number one killer of both men and women. VOCs are also major drivers of climate change.

It is estimated by Lim et al, 2012, in *The Lancet* that the number of deaths globally due to PM2.5 in 2010 was 3.22 million. High RCS PM2.5 is reported to have much higher mortality rates, so the personal use of AQI is probably a wise move.

S 10. I reported on **both** the PM10 and the PM2.5 measurements. They were not my measurements (although my measurements do show similar results) so I am glad that Mr Chilton agrees they are unhealthy. The periods over which they were measured is given as around 480 minutes, that is 8 hours. So the values represent an 8-hour average. No other information was reported.

- These values are well above the 3 $\mu\text{g}/\text{m}^3$ RSC PEL (or adjusted 10 $\mu\text{g}/\text{m}^3$ for whole dust). They are also unhealthy to hazardous according to the AQI.
- In Mr Chilton's conclusion the states that “in my opinion Dr Duncan's evidence highlights what the effects of RCS can be....”

This means that in Mr Chilton's opinion I have satisfied the test of the RMA Amendment Act's Precautionary Principle by demonstrating the potential for harm. This is a breach of the Act so must result in refusal of the consent.

- But it is difficult to see how Mr Chilton can say this is only a potential in the light of the solid evidence I and others have presented regarding the presence of RCS, the amount of RCS experienced by the residents which is well above he permitted PEL, and the medical evidence of actual and serious harm presented by the residents' medical experts.

SUMMARY

- Best to extract from the Waimakariri River bed or banks as harm is resulting from quarrying at Yaldhurst.
- If allowed, Indian or Australian or Tasman District rules should be imposed as these are much more in harmony with the RMA and its amending act. Setbacks should be at least 500m as per the Victorian EPA. Effective dust mitigation should be imposed and the quarries required to use international and New Zealand (eg Tasman) best practice employing a belt and braces approach with the aim of having no dangerous dust beyond the quarry boundary.
- Enforcement should be more relevant, competent and effective. Independent audits (by the EPA?) should be conducted on enforcement and mitigation practices, and enforcement staff trained appropriately.
- Breaches should be punished appropriately – they may qualify as assault or even manslaughter so should be treated most seriously. After all, the quarries at Yaldhurst are discharging a known carcinogen into the air which travels far further than does visible dust.

SUMMARY CONTINUED

- This application will add to an already intolerable situation regarding PM10 and PM2.5 emissions. It may well be the straw that breaks the silicosis camel's back. The risk is too great since the dose response curve effects will be shifted to the rapidly increasing part of the curve, thus probably causing much more damage to residents and others nearby than is the case at present.
- Much more attention should be placed on the existing and future health effects of discharging noxious and dangerous (to health) material into the air. The risks are too great. The guidelines considered by other experts appearing for the company do not consider the dangerous PM2.5 component, which is far less affected by wind than is the visible component since it can hang in the air as a large cloud even in still conditions.