

Before Independent Commissioners Appointed by the Canterbury Regional Council and Selwyn District Council

In the matter of The Resource Management Act 1991

And

In the matter of Applications by **Fulton Hogan Limited** for all resource consents necessary to establish, operate, maintain and close an aggregate quarry (**Roydon Quarry**) between Curraghs, Dawsons, Maddisons and Jones Roads, Templeton

SUPPLEMENTARY EVIDENCE OF AUDREY WAGENAAR ON BEHALF OF FULTON HOGAN LIMITED

RESPONSE TO PANEL REQUEST FOR ELABORATION

DATED: 29 JANUARY 2020

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Introduction

1. My full name is Audrey Kathleen Wagenaar. I am an Associate and a Senior Environmental Scientist at Golder Associates Ltd.
2. I have previously provided a written brief of evidence, two briefs of rebuttal evidence and supplementary evidence in response to panel request for elaboration in relation to the Roydon Quarry Proposal. My primary evidence is dated 23 September 2019. I confirm my qualifications and experience as set out in paragraphs 5 to 15 of that evidence.
3. I also confirm I have read and agree to comply with those parts of the Environment Court Practice Note that bear on my role as an expert witness, in accordance with paragraph 7 of my primary evidence.

Scope

4. This supplementary evidence responds to the request made by the Commissioners in their 13th Minute.
5. In particular, I have been asked to provide commentary on the evidence presented from medical professionals about the long term or cumulative adverse human health effects of small particulates and RCS that might foreseeably be emitted from the proposed quarry.
6. The primary evidence provided by a medical professional is that of Dr. Robert Seddon-Smith. For ease of reference, the main points in which Dr. Seddon-Smith provides commentary on my evidence, are written in italics below.
7. *"Have you died from drinking water? - out take"*

"I am put in mind at this point of the fluoride in water debate. Those who oppose fluoridation point out that as little as 1mg of fluoride can kill a healthy adult. They miss the point that the dose makes the toxin."

"The evidence of Audrey Wagenaar uses this appropriately in one context — we know from studies that very high doses of RCS cause cancer and that modest doses over the long-term cause pneumosilicosis and cancer, but of course the dose determines the toxin. They lead the reader to believe that very small doses of the toxin will cause no harm and in the context of fluoride this appears reasonable. Unlike fluoride, however, the toxin is not cleared

from the body, or if it is, it is cleared in a very harmful way. This is seen in mine workers and industrial exposures, with those having higher level exposures and those having longer exposures being at higher risk. The idea or concept that the deposition of even a small amount of RCS in the lungs is in some way acceptable is not based in science, but in presumption, and is not supported by evidence. A bit like the concept that we each contain a few molecules of Caesar's last breath, the small exposure is harmless hypothesis is very powerful and based in experience, but when it comes to micro particles, however, the physiology and the evidence tends to suggest that these particles accumulate in lung tissue and produce a cumulative effect over time. Even Wagenaar admits in their evidence that there is no evidence of a dose below which exposure is not harmful."

- 7.1 I agree with Dr. Seddon-Smith that dose is an important concept in toxicology and the dose of a substance to which a person is exposed to will determine whether or not there is a toxic effect (e.g. the dose response will determine the potential for an adverse health effect).
- 7.2 I do, however, disagree with his statement *"that even a small amount of RCS in the lungs is in some way acceptable is not based on science, but in presumption and is not supported by evidence."*
- 7.3 Several reputable international regulatory agencies (e.g. California Environmental Protection Agency and the Texas Commission on Environmental Quality) have developed air quality criteria for RCS (detailed derivations are provided in Sections 29 through and 34 of my primary evidence dated 23 September 2019). These international government agencies have derived an annual average air quality criteria for RCS on the basis of a non-carcinogenic endpoint (in that there is a threshold that must first be reached in order for a toxicological effect to occur) and are considered to be a "safe level" (without adverse health effects based on a chronic exposure) to which people can be exposed to. The annual average criterion is based on protection against silicosis derived from chronic exposure. Silicosis, which is considered an essential precursor, may lead to cancer. As a result, the annual average criterion protective of silicosis (e.g. preventing silicosis) is also considered by regulatory agencies to be protective of carcinogenic effects.
- 7.4 The air quality criteria developed by these regulatory agencies are based on robust technical studies and have considered the dose-response effect, in

that concentrations below a specific threshold are eliminated by the body and are not cumulative. The primary study for which the chronic air quality criteria for RCS is based on identified both a no-observed adverse effects level and a lowest observed adverse effects level in a large cohort of workers who were exposed to RCS, on average, for a period of 24 years. Additional adjustments and uncertainty factors are incorporated to derive an air quality criterion that is protective of the general population. Air quality criteria set by international regulatory agencies are specifically set so that cumulative effects will not occur over time.

7.5 I believe that Dr. Seddon-Smith has confused my statements on RCS and particulate matter when he indicates that “*Even Wagenaar admits in their evidence that there is no evidence of a dose below which exposure is not harmful*” I have not made such a statement in my evidence related to RCS. With respect to particulate matter I have indicated the following:

- (a) The World Health Organization (WHO) states that for airborne particulate matter a threshold concentration below which no adverse effects are expected is not likely to exist (WHO 2006).¹ Particulate matter is considered to be a stressor that can cause negative health outcomes at any exposure level and therefore lacks a threshold that can be used to set a guideline (WHO 2006).
- (b) The WHO (2006) therefore suggests that a guideline for particulate matter should be set based on achieving the lowest particulate matter concentration possible, given the local context and priorities of the region.
- (c) Therefore, for particulate matter, the guideline values are concentrations that correspond to a tolerable or acceptable level of risk (e.g. the guideline is set at the lowest particulate matter concentration possible considering typical local background levels) and rather than a negligible risk that would be fully protective of human health (WHO 2006).
- (d) The WHO (2006) chronic (e.g. long term or annual) air quality guidelines are based on a PM2.5 concentration that is just below the lower level of the range at which significant effects on survival were

¹ World Health Organization (WHO). 2006. WHO Air Quality Guidelines for Particulate Matter, Ozone, Nitrogen Dioxide and Sulfur Dioxide, Global update 2005, Summary of risk assessment. WHO, Geneva, Switzerland.

observed in several large international studies on cardiovascular and respiratory effects.

- (e) WHO (2006) indicated that “Although adverse effects on health cannot be entirely ruled out below these levels, the annual average WHO air quality guideline value represents that concentration of PM_{2.5} that has not only been shown to be achievable in large urban areas in highly developed countries, but also the attainment of which is expected to significantly reduce the health risks.”
 - (f) A factor representing the ratio of PM_{2.5}/PM₁₀ in air in developed and developing countries is used to convert the PM_{2.5} air quality guideline to a PM₁₀ guideline.
 - (g) New Zealand (2016)² has adopted the WHO (2006) annual air quality criteria for PM₁₀ and specifically recommends the use of the other WHO (2006) air quality criteria for PM_{2.5} and PM₁₀ in the absence of a New Zealand guideline.
8. *“The determination of a safe level of exposure is therefore not based in science as admitted by the key witness for the Applicant in their primary evidence.”*
- 8.1 This statement is not an accurate portrayal of my evidence. Please refer to item 7 for a detailed discussion as to why this statement is incorrect.
9. *“Lacking evidence for the safe level of exposure to RCS, the Applicant turns to air quality standards, and helpfully lists many which I do not dispute and will not re-iterate here.”*
- 9.1 Please refer to item 7 regarding the alleged lack of evidence for a safe level of exposure.
10. *“The problem is that they are the wrong standards to apply. They are generally either standards which apply to the air quality expected for exposure of workers who are aware of the risk, compensated for the risk and equipped to manage the risk, or more general standards for particulate matter which apply to the expected range of activities in cities.”*
- 10.1 It is my expert opinion that the air quality standards provided in my evidence are indeed the correct standards to apply. While some of the air quality

² Ministry for the Environment. 2016. *Good Practice Guide for Assessing Discharges to Air from Industry*. Wellington: Ministry for the Environment.

standards are based on epidemiological studies of workers because these are the most robust data sets available and which is not uncommon in the derivation of air quality criteria or toxicological reference doses, these criteria have been derived for the protection of the general public and include additional uncertainty factors to account for non-occupational exposure. None of the air quality standards provided in my evidence are occupational standards as I agree that these are not suitable for protection of the general population. The “*general standards for the particulate matter*” are air quality criteria derived by the World Health Organization and have been adopted by New Zealand (2016), so I am unclear as to why Dr. Seddon-Smith feels that these standards are the “*wrong standards to apply*”. Dr. Seddon-Smith does not provide suggestions for alternate guidelines, standards or criteria but seems to imply that any exposure to RCS is unacceptable, despite earlier supporting the fundamental toxicological principle of dose-response in that the “*dose makes the toxin*”.

11. “*They are not really intended to be used to assess the quality of air effluent from a quarry nor are they appropriate for this purpose.*”

11.1 I am unclear as to why Dr. Seddon-Smith feels that the air quality criteria derived by the World Health Organization or the California Environmental Protection Agency are not intended to be used to assess air quality from a quarry or why they are appropriate for this purpose. It has been my professional experience that these air quality criteria are used internationally in many different applications ranging from protection populations living in close proximity to a variety of industrial developments including mines and quarries to the assessment of background air quality in an airshed. New Zealand (2016)³ air quality guidance indicates that in the absence of the New Zealand air quality criteria that the WHO criteria for particulate matter should be adopted and similarly recommends air quality criteria be adopted from the United States Environmental Protection Agency and the California Environmental Protection Agency for other substances.

12. “*Air standards for New Zealand are based on the broad assumption that there is some inevitable particulate emission simply from the congregation of human beings and the kind of things they like to do — heating fires, driving, gardening, even walking kicks up dust betimes. This all contributes to a background level of harm which accrues to habitation in conurbations and is*

³ Ministry for the Environment. 2016. *Good Practice Guide for Assessing Discharges to Air from Industry*. Wellington: Ministry for the Environment.

at least in some way taken into account by those who choose to live in such locations, and of course is more often taken into account by those who choose not to.

When we look carefully at the Wagenaar evidence, we see that these standards are not based on evidence of safety, but rather on a best guess estimate of lack of harm. Again, I repeat that in their evidence Wagenaar accepts that there is no proven safe dose of RCS.”

- 12.1 Please refer to item 7 for a detailed response to this statement.
13. *“Further, when assessing the quality of evidence, it is very important to note that No Adverse Effect Observed Levels of exposure are not the same as being safe. They are simply the levels below which no harm has yet been seen in the generally short and specific durations of exposure. Studies often miss harm which occurs over a long period of time, which is uncommon in occurrence or is”.*
- 13.1 It is important to note that the no-observed adverse effect levels are selected by matching toxicological study duration to the air quality averaging period. The same toxicological study is not generally used to develop a one-hour or 24-hour air quality standard and a chronic standard. For example, in the case of the chronic RCS air quality criteria, the epidemiological study participants were exposed for a 24-year period on average. The study duration and its applicability to a specific air quality averaging period (one-hour, 24-hour or annual) is an important consideration that regulatory agencies evaluate when selecting a study or studies to form the basis for their air quality criteria. It is also very important to note that the air quality criteria are not set at the no-observed adverse effect level but that a number of uncertainty factors are included into the derivation of an air quality criteria to account for the quality of the study and any uncertainties identified by the regulators to derive a value that is more conservative than the no-observed adverse effect level.
14. *“Wagenaar does not list any studies looking at chronic lower dose studies, and this is fair — there are none. There is essentially no scientific evidence whatsoever to support their point of view.”*
- 14.1 I am not quite clear how this is relevant because there are robust air quality criteria available for RCS and particulate from international regulatory

agencies that are recommended by the New Zealand Ministry for the Environment.⁴

15. *“To sum up the case to date, the Applicant’s primary evidence on the matter of human health and quarrying is not based in evidence, utilises a discredited study and inappropriately applies urban air quality studies to RCS and the air quality standards that should be applied to quarrying. Apart from not being based on any relevant (and I stress relevant) facts, it is a very good piece of work, provided you assume that air quality standards for smoke and diesel fumes apply to quarry dust.”*
- 15.1 I disagree with Dr. Seddon-Smith’s assessment that my primary evidence is not based on evidence, inappropriately applies urban air quality standards to RCS and quarrying and is not based on any relevant facts. My expert opinion is formed based on my professional experience and technical expertise in the toxicological derivation of and use of air quality criteria for the protection of human health.
16. Many of the statements made by Dr. Seddon-Smith with respect to my evidence are incorrect and not supported by technical science or accepted regulatory standards or guidance.

Dr Alistair Humphrey

17. I have been provided with hearing notes in relation to the evidence of Dr Humphrey. The notes indicate that he would like to raise the personal modelling study and that, even if this had been done perfectly, it would have been incorrect because it focused on silicosis. The notes show that he went on to indicate that specialists regularly see consequences of exposure to freshly ground and mined silica and the effects noted are sore throats, nose bleeds and conjunctivitis.
18. I understand Dr Humphrey is indicating that the personal monitoring study was focused on the wrong toxicological end points. In my opinion, silicosis would be an appropriate end point for comparison to an annual air quality criteria or chronic exposure. I cannot comment in greater detail on the personal monitoring study as it is not publically available. I have however viewed some of the data results as they are represented in appendices to Ms Wickham’s supplementary statement. I have not reviewed the study

⁴ Ministry for the Environment. 2016. *Good Practice Guide for Assessing Discharges to Air from Industry*. Wellington: Ministry for the Environment.

design or results in their entirety. There is also a shorter term air quality criteria available for RCS (1-hour; TCEQ) which is based on the toxicological endpoints of inflammation and cytotoxicity.

19. Unfortunately, I am not exactly sure what Dr Humphrey is referring to in terms of the types of patients he suggests the specialists are seeing and what type of exposure they have had (occupational, occupational without use of appropriate personal equipment, or the general public downgradient from a quarry).
20. I would be surprised if the general public was exposed to freshly mined and ground silica, but there is simply not enough in the notes I have viewed to confirm that or otherwise.
21. I also note that information is not provided as to whether the silica is airborne or if the patients were exposed directly to the silica through occupational activities. The concentration of respirable silica in air is not provided, nor is the duration of the exposure.
22. Dose-response is an important concept in toxicology and, without some further understanding of what type of silica patients were exposed to, the concentration of the RCS in the air or the exposure duration (acute or chronic), it is not possible for me to provide further commentary on the statement of Dr Humphrey.

Audrey Wagenaar

29 January 2020