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

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SUPPLEMENTARY EVIDENCE OF AUDREY WAGENAAR ON BEHALF OF FULTON HOGAN LIMITED

RESPONSE TO PANEL QUESTIONS

DATED: 28 FEBRUARY 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 14th Minute (dated 10 February 2020).

5. In particular, I have been asked to provide commentary on those matters set out at Appendix 2 of the Minute.

6. Evidence filed by Dr Laurie Greenfield dated 21 February 2020.

Question 1 - Dr Kelvin Duncan

Does Ms Wagenaar have any response to Dr Kelvin Duncan (submitter who appeared at the hearing on Tuesday 3 December 2019) particularly in relation to …

7. My answers to the Panel's specific questions are set out under the underlined headings below.

<u>Use of PM_{10} instead of $PM_{2.5}$ in studies (in order to include all respirable particles)</u>

8. It is important to measure both $PM_{2.5}$ and PM_{10}. $PM_{2.5}$ is considered to be more toxic to people than PM_{10} (as noted by the more conservative air quality guidelines for $PM_{2.5}$ relative to $PM_{10,}$ which are described in detail in my primary evidence dated 23 September 2019). The measurement of PM_{10} (which includes the fraction of $PM_{2.5}$) is also important because the potential exposure source is a quarry and it is typical for crustal dust associated with a

quarry to be of a relatively larger particle size (e.g. coarse particulate).[1] It is also noted that the Ministry for the Environment (MfE 2020)[2] has also recently released draft documents for consultation providing proposed annual and 24-hour standards for $PM_{2.5}$.

Higher exposure to residents than workers because of 24/7 exposure

9. I am unclear to which type of monitoring Dr Duncan is referring to when he indicates "but this form of monitoring is fine for Health and Safety at Work purposes where workers are fit and healthy and are exposed to dust for only 2000 hours per year. But it is not acceptable for assessing risk to nearby residents who are exposed continuously, for 24/7/365 hours each year, and who may be far more susceptible to dust than workers, being older or younger and with possible conditions that make them much more susceptible. Furthermore, it is widely accepted that it is the cumulative dose that is important, and not the acute, hourly dose as shown in this figure" (Slide 13).

10. Dr Duncan does not provide a citation as to where the figures that he has provided in Slide 13, come from. It appears that the figures summarize the 1-hr and 24-hr PM_{10} data from a site (Site 1) investigated as part of the Mote study.[3] In the text associated with Slide 13, Dr Duncan indicates that the yellow line (apparently referring to the 24-hr graph, as the 1-hr graph does not have a 50 $\mu g/m^3$ line on it) represents an occupational screening criterion. He goes on to indicate that "if you accept the limits given in other countries for residents of 3 $\mu g/m^3$ (10 $\mu g/m^3$ is shown as the blue line) then there are numerous exceedances.

11. Dr Duncan does not provide a citation for the criteria that he is referring to. However, based on the numerical value, Dr Duncan appears to be comparing an annual criterion for respirable crystalline silica to 24-hr data for PM_{10}. It appears to me that there are two errors associated with Dr Duncan's interpretation of the data associated with Slide 13. The first error is that an air quality criterion specific to PM_{10} should be used to make the comparison with measured PM_{10} data. The air quality criteria for respirable crystalline silica should only be applied to measured or predicted data for respirable

[1] Strickland., M. 2018. Taking Another Look at Ambient Coarse Particles. Am J Respir Crit Care Med Vol 197, Iss 6, pp 697–707, Mar 15, 2018.
[2] Ministry for the Environment. 2020. Proposed Amendments to the National Environmental Standards for Air Quality – Particulate Matter and Mercury. Consultation Document. February 2020. Document Number ME1478. Available on-line at: https://www.mfe.govt.nz/publications/air/proposed-amendments-national-environmental-standards-air-quality-particulate-matter
[3] MOTE Measurement Networks (Mote 2018). Yaldhurst Air Quality Monitoring. Summary Report: 22 December – 21 April 2018. 19 June 2018. Prepared for Environment Canterbury.

crystalline silica. The second error is that the averaging times of the air quality criteria need to match the averaging time of the measured data. It is inappropriate to use an annual criterion for comparison to measured 24-hour data. It is more appropriate to use an air quality criterion based on a 24-hour averaging period. The 24-hour air quality standard for PM_{10} is 50 µg/m^3 (Ministry for the Environment, 2004).[4] It appears that Dr Duncan has misinterpreted the data he has provided in Slide 13.

12. Although it is true that residents are passively exposed on a continuous basis to constituents originating from an industrial facility relative to a worker who is typically only exposed during a work day - it does not necessarily mean that the dose (or cumulative dose) the residents are exposed to is higher. The dose is dependent on the exposure duration but also the exposure concentration. In general, workers are exposed to much higher concentrations of constituents than residents in nearby locations. Air quality concentrations are usually much lower in residential areas than within the facility itself.

13. It is also important to understand that air quality criteria for protection of the general public are derived to account for chronic exposure and sensitive sub-populations (e.g. specific adjustments are made on a chemical specific basis to account for these factors in the development of air quality criteria by regulatory agencies). The derivation of the air quality criteria applicable to this facility are described in detail (including adjustments made to extrapolate from occupational to non-occupational scenarios, inclusion of uncertainty factors to protect sensitive sub-populations) in my primary evidence dated 23 September 2019.

<u>Use of data from the personal monitor study to extrapolate annual exposure</u>

14. As noted in item 10 above, it is important when comparing data to air quality criteria that the averaging times are similar. It is inappropriate to extrapolate from a single 8-hour monitoring period (i.e. through the use of personal monitors) to an annual exposure. The duration of the personal monitoring represents only 8 out of 8760 hours in a year and there is no way to know if these conditions are representative of the entire year.

[4] Ministry for the Environment. 2004. Resource Management (National Environmental Standards for Air Quality) Regulations 2004. SR 2004/309. Reprint at 1 July 2017. Available on-line at: http://www.legislation.govt.nz/regulation/public/2004/0309/latest/DLM286835.html?search=ta_regulation_R_rc%40rinf%40rnif_an%40bn%40rn_25_a&p=3. Accessed September 2019.

Use of MOTE study data to adjust for an annual dose to do a dosimetric analysis

15. Dr Duncan indicates that he has calculated an annual dose from the MOTE Study with distance from the quarry and provides the results of his assessment in Slide 11. There is not enough information provided to determine how Dr Duncan derived his graph. However, Dr Duncan provides units for annual dose on the y-axis of his graph as mg. The units are incorrect as an exposure for air quality is presented as a concentration for inhalation exposure (mg/m^3 or $\mu g/m^3$) or as an exposure dose for oral exposure (mg/kg/day or µg/kg/day).

16. The text below the slide indicates "The usual acceptable level for an annual RCS cumulative dose is 3 mg per annum. This "safe" level would not be reached until the distance from the source is 2 km". Dr Duncan does not provide a citation for the air quality criteria that he references. However, the most typically selected annual criteria for respirable crystalline silica is from the California Environmental Protection Agency - Office of Environmental Health Hazard Assessment (Cal OEHHA; Cal OEHHA 2008)[5] and is 3 $\mu g/m^3$. I believe that Dr Duncan has confused dose (mg/year) with annual average concentrations ($\mu g/m^3$) and the two are not directly comparable. The Cal OEHHA (2008) annual air quality criteria is expressed as an annual average concentration ($\mu g/m^3$ not mg/year). The respirable crystalline silica data presented in the MOTE (2018) report are also in units of $\mu g/m^3$. In addition to the confusion between dose and annual average concentration, I believe that there may be a unit error associated with Dr Duncan's calculations which would affect his conclusions.

17. I am unclear as to how Dr Duncan conducted his extrapolation from the 24-hour period to the annual dosage shown in Slide 15 as he does not provide sufficient information (e.g. equations or conversion factors) to allow for replication of his approach or a determination as to whether or not his conclusions are correct. While he indicates that he has made a conversion to an annual dosage, the y-axis of the graph shows a title of cumulative risk (not a dosage) and the x-axis is unlabelled. Units are not provided for either axis. Dr Duncan indicates the "usual international limit" in the bottom left corner, but there is no citation provided and it is also unclear as to whether

[5] California Environmental Protection Agency, Office of Environmental Health Hazard Assessment (Cal OEHHA). 2008. Air Toxics Hot Spots Risk Assessment Guidelines Technical Support Document for the Derivation of Noncancer Reference Exposure Levels. June 2008. Air Toxicology and Epidemiology Branch, Office of Environmental Health Hazard Assessment. Oakland, CA. Available on-line at: https://oehha.ca.gov/media/downloads/crnr/noncancertsdfinal.pdf. Accessed September 2019.

this graph and the criterion are for respirable crystalline silica or PM_{10} (information not provided in slide caption).

18. Dr Duncan mentions respirable crystalline silica in the preceding paragraphs but also provides a dose response curve for PM_{10} in the next slide (Slide 16). Dr Duncan has also marked one resident's data (again unclear, which resident and data for which chemical) by hand on the graph and indicates that the data are 5 times the acceptable exposure dose. Given the unconventional approach, the uncertainties noted and his apparent confusion with the applicable air quality criteria noted in Item 10 above, I do not believe that Dr Duncan has made an accurate comparison.

19. Dr Duncan also indicates that the conventional risk level is 1 in 10,000 in the caption for Slide 15. I am unclear as to how Dr Duncan reached this conclusion and how it relates to the graph in Slide 15. Acceptable incremental lifetime cancer risk levels for carcinogens in New Zealand are generally 1 in 100,000. The annual criteria for respirable crystalline silica which I believe Dr Duncan may be referring to is based on a non-carcinogenic endpoint, so an incremental lifetime cancer risk would have no bearing on the assessment. For example, risks will be assessed using a hazard quotient approach and that would include consideration as to whether or not the hazard quotient is greater than one.

<u>Need for a longer-term study of RCS (at least a year)</u>

20. It is important to understand both the effects of short and longer-term exposures. Given the concerns noted by the community, I think it would be a good idea to conduct some additional monitoring; however, the duration of the monitoring is a point that needs to be decided and agreed upon by the air quality experts.

21. My opinion is also consistent with the following consent condition[6] *"The consent holder shall design and operate a Respirable Crystalline Silica (RCS) monitoring campaign in consultation with the Canterbury District Health Board (CDHB) and the Canterbury Regional Council."*

Question 2

In paragraph 7.4 of your Supplementary Evidence (dated 29 January 2020) you state "…concentrations below a specific threshold are eliminated by the body and

[6] Condition 7 – Appendix A, Evidence of Mr Bligh (dated 29th January 2020).

are not cumulative". How is this statement reconciled with the evidence of Dr Seddon-Smith (a submitter who appeared at the hearing on Wednesday 4 December 2019) who submitted that particles smaller than $PM_{2.5}$ are deposited in the bronchioles (which are the smallest parts of the lungs with cilia) before the alveoli. He stated these particles cannot be expelled and are therefore cumulative, causing tissue damage and inflammation. He stated this is why there is "no safe dose" and that even small amounts inhaled over time are not considered safe.

22. Chemicals will vary based on their mode of action and toxicological endpoint as to whether or not they are considered to be threshold or non-threshold chemicals. Threshold chemicals are generally considered to be those that are classified as non-carcinogens but there are exceptions to this rule based on mode of toxicological action. A threshold chemical means a person needs to be exposed to a dose above a specific threshold before a toxicological effect is expected to occur. Air quality criteria for threshold acting substances are set at a level below this threshold and a number of uncertainty factors are incorporated into the derivation to provide a margin of safety so that the threshold is not reached. The toxicokinetics of the chemical are also considered so that a cumulative dose will not occur that exceeds the threshold.

23. Non-threshold chemicals are generally carcinogens and are substances for which no threshold exists for toxicological effects (e.g. toxicological effects can occur even with limited or infrequent exposure).

24. The statement that I made in paragraph 7.4 is related to respirable crystalline silica. The air quality criteria for respirable crystalline silica is based on a threshold effect and therefore the statement is appropriate.

25. As noted in my previous statements, particulate matter is a substance that the World Health Organization (WHO) indicates that it is unlikely that there is a threshold below which no adverse effects are expected (WHO 2006).[7] WHO (2006) has derived guideline values that 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) rather than a negligible risk that would be fully protective of human health (WHO 2006). I do not consider that Dr Seddon-Smith is quite correct in indicating that there is no "safe dose" for $PM_{2.5}$. There is unlikely to be a

[7] 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.

dose associated with a negligible risk (e.g. zero risk) but it is not appropriate to indicate that concentrations below the criteria developed by the WHO, which is an international health regulatory agency, are “unsafe”. I have provided more detailed information on this topic in my supplementary evidence dated 28 November 2019.

Question 3

Paragraph 7.5(d) of your Supplementary Statement states “The WHO (2006) chronic (e.g. long term or annual) air quality guidelines are based on a $PM_{2.5}$ concentration that is just below the lower level of the range at which significant effects on survival were observed in several large international studies on cardiovascular and respiratory effects.”

Can a level just below the range of significant effects be interpreted as a ‘minor effect’ or “acceptable” and is this sufficiently precautionary given the level of uncertainty?

26. Yes, I think use of the WHO (2006) annual air quality guideline is sufficiently precautionary given the level of uncertainty as this most robust information available at the current time. It is noted that Ministry of Environment (2020) have recently released draft documents for consultation proposing that the WHO (2006) air quality criteria for annual and 24-hour $PM_{2.5}$ be adopted as standards. MfE (2020) also indicate the WHO (2006) air quality criteria are due to be updated later this year.

Question 4

In relation to Appendix 2 and Drs Seddon-Smith and Humphrey's comments 3. I remind the Commissioners and applicants including Ms Wagenaar and Mr Cudmore to read both of my submissions especially paragraphs 110-117, 121-130 in that of Dec 10th. They show that $PM_{2.5}$ and nanoparticle can deposit in bronchial lung tissue of humans with nanoparticles capable of entering the blood stream. The cytotoxic effects of these deposited $PM_{2.5}$ has been shown at low concentrations. It should be remembered that autopsies of smokers lungs who quit many years before show the presence of PM particles. With the evidence of McGowan, Heine and Minham Park supporting hierarchies of harmfulness the "no safe does" comment in the short and long time of Seddon-Smith gains creedence. These comments are quite likely to apply in the case of racehorses and Mr Fitch

quotes some reliable papers in support of his points whilst Mr Jorgensen cites no reputable scientific papers in support of his largely speculative opinions.[8]

27. 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). 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).

28. 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.

29. 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* (e.g. zero risk) that would be fully protective of human health (WHO 2006).

30. I agree with Dr Greenfield that there is no *negligible* risk level (e.g. zero risk) associated with particulate matter. The WHO (2006) air quality criteria are set based on *tolerable* or *acceptable* risk. As noted in my response to Question 2, a *tolerable* or *acceptable* risk as determined by an international health regulatory agency is not equivalent to an “unsafe” risk.

Audrey Wagenaar
28 February 2020

[8] Evidence of L Greenfield dated 21 February 2020 at paragraph 11.