

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

**REPLY EVIDENCE OF ROGER STEVEN CUDMORE
ON BEHALF OF FULTON HOGAN LIMITED**

PM₁₀ EMISSIONS AND PM₁₀ OFFSETTING

DATED: 3 MARCH 2020

Counsel Acting: David Caldwell

Email: david.caldwell@bridgesidechambers.co.nz

Telephone: 64 21 221 4113

P O Box 3180

Christchurch 8013

Introduction

1. My name is Roger Steven Cudmore. I have been engaged by Fulton Hogan Limited to provide evidence on air quality management and related impact assessments associated with the proposed Roydon Quarry (the **Proposal**).
2. I have previously provided evidence to the Hearing Panel regarding the air quality effects of the Proposal, including:
 - (a) My evidence in chief (dated 23 September 2019);
 - (b) My rebuttal evidence (dated 21 October 2019);
 - (c) My supplementary rebuttal evidence of Dr Fitch's evidence (dated 30 October 2019);
 - (d) My supplementary rebuttal evidence of Louise Wickham's evidence (dated 6 November 2019);
 - (e) My summary evidence dated 13 November 2019;
 - (f) My supplementary statement on air quality (dated 29 January 2020);
and
 - (g) My supplementary statement on PM₁₀ offsetting dated 5 February 2020.¹
3. I presented my last two statements to the Hearing Panel on 5 February 2020.
4. In addition, a collation of my initial evidence in respect of PM₁₀ emissions from the Roydon Quarry was filed by legal counsel for Fulton Hogan on 29 November 2019.
5. In combination, the various items of evidence I have prepared address (relevant to PM₁₀ emissions):
 - (a) Compliance with Regulation 17(1) of the NES for Air Quality; and
 - (b) In the event the Commissioners do not agree with my opinion on compliance, the amount of PM₁₀ that would need to be offset for the Proposal; and

¹ Supplementary statement of Roger Cudmore on behalf of Fulton Hogan Limited – PM₁₀ offsetting dated 5 February 2020.

- (c) In light of the amount needed, whether the three options I was asked to consider would achieve a reduction of at least the same amount of PM₁₀ in the same airshed.
6. I have been asked by Fulton Hogan to provide this reply evidence in response to the most recently filed evidence of Deborah Ryan, Charles Kirkby, Louise Wickham and Laurence Greenfield - on PM₁₀ offsets.
7. I re-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 paragraphs 4 to 8 of my evidence in chief.

Deborah Ryan

8. I have reviewed Ms Ryan's paragraph 3.4 regarding further evidence² that supports the exclusion of quarry generated PM₁₀ emissions at 500 m, or further, from the airshed boundary. This provides further substantive support to my view on this matter.
9. In response to paragraph 3.5, my use of the term "average arc" in relation to wind directions could be explained better. My analysis assessed the different ranges of wind directions that would place active quarrying areas up wind of the airshed for each year (stage) of quarry development. Each stage has a different location with respect to the airshed boundary. Therefore, for each stage, there is a particular range (or in other words, "arc") of key wind directions, which direct emissions towards the airshed boundary (**ASB**). This results in different percentages of time estimated for emissions to impact at the ASB each year. The average is 38% of the time (cf 40% assessed by Ms Ryan) for all stages within 500 m of the ASB, and an average of 34% for all stages within the whole proposed site.
10. If offsetting needed to apply to the whole quarry site, the difference between 40% and 34% is material (see Table 1 paragraph 53). It remains my opinion the latter value should be applied to the estimated total site PM₁₀ emissions for the reasons set out at paragraphs 20 to 22 of my 5 February evidence.
11. Table 1 of my evidence of 5 February 2020 provided my estimates of offset values based on each experts' calculations of annual emissions (whole site and < 500 m from the ASB) and then reducing these to account for the frequency of winds blowing from the site towards the ASB. I have updated

² IAQM, *Guidance on the Assessment of Mineral Dust Impacts for Planning*, May 2016 (v1.1)

this table to demonstrate the impact of the experts' different wind frequency assumptions upon the estimated offset values. This is presented later in this evidence at paragraph 53.

12. The differences in PM₁₀ emission calculations between myself and Ms Ryan are relatively small. We both estimate an offset of 0.4 T/yr for emissions within 500 m of the ASB. My overall site emissions estimate of 1.6 T/yr compared to Ms Ryan's figure of 2.1 T/yr (22% difference) is solely a result of our difference in the processing plant emissions.
13. As discussed in my 5 February evidence, the Roberts Road option for an offset provides a larger offset than necessary under any of the air quality experts' assessments.

Charles Kirkby

14. In paragraphs 6 and 7, Mr Kirkby indicates that my exclusion of emissions beyond 500 m is not a conservative approach. However, I consider it is an appropriate approach and the fact that PM₁₀ particles can travel considerable distances is entirely irrelevant. What is relevant is the effect on PM₁₀ concentrations from quarry activities that are 500 m away or more from the ASB. My view is that concentrations of PM₁₀ as a result of quarrying activities located this far away will be barely measurable at the ASB. The magnitude of short and long term PM₁₀ concentrations at the ASB determines the need for an offset and the potential for any health effects. The fact PM₁₀ from far away sources can travel to the ASB and beyond, does not mean that a problematic concentration of PM₁₀ will arise. This is primarily because the further away a source is from the ASB, then the greater the dilution of PM₁₀ discharges from that source will be when these reach the ASB.
15. In response to paragraph 8, I confirm the quantification of emissions from the processing plant and other sources that would be 500 m, or more from the ASB, has been explained in Appendix A of the JWS dated 9 December 2019.
16. In paragraph 9 (last sentence) of his evidence, Mr Kirkby suggests there have been additional, unwarranted discounts except possibly for those from the processing plant. To be clear, I have recommended that only emissions within 500 m of the ASB would justify any offset (if any offset is considered necessary). Therefore, I have excluded process plant emissions and those associated with the mobile process plant and vehicle movements that are 500 m or more away from the ASB.

17. I note that in paragraphs 11-13, Mr Kirkby states he also obtained a frequency of 38% for the emissions directed to the ASB. I agree with this figure for emissions within 500 m of the ASB.
18. In paragraph 16, Mr Kirkby says not all Pound Rd emissions (around 8%) go into the airshed. While I do not agree entirely with his conclusion, I do not consider this makes a material difference given the Pound Rd emissions (excluding clean filling operations) are estimated at 1.6 T/yr (see Table 1, paragraph 53). An 8% reduction would still result in an available offset of 1.47 T/yr.
19. Furthermore, all emissions from Pound Rd quarry are released within the ASB. The ASB boundary is very close to the western side of Pound Rd, but nevertheless any emissions from Pound Rd that travel towards the ASB that is to the west, must disperse into air within the ASB before dispersing beyond the ASB.
20. The differences in the emissions summarised by Mr Kirkby, in his Table at paragraph 17, result from topsoil stripping emissions at Roberts Rd being included in the February 2020 emission calculations (these were not included in the previous assessment provided in my evidence dated 6 November, 2019). The increased emission values in February 2020, resulted from higher conveyor transfer point emissions (compared to previous evidence) calculated for the process plant at Pound Rd. Overall, the combined PM₁₀ emissions from Roberts and Pound Rd (excluding all truck movement emissions) increased from 0.32 T/yr to 0.5 T/yr. These refinements were made following discussions during the December 2019 JWS.
21. The truck movement related emissions provided in paragraph 32 and 36 of my February 2020 evidence, accounted for movements of truck on unpaved roads within both Roberts and Pound Rd. These emissions were not included in the November 2019 evidence. This is because we obtained more accurate site information on the actual extent of unpaved roads within both sites in early 2020, when asked by Fulton Hogan to address the offset options in more detail. In 2019 we did not have accurate unpaved road data, which was not a concern, as the total site emissions (of approximately 3 T/yr – set out in Table G8 of my evidence dated 6 November 2019) appeared sufficiently high to provide an adequate offset for the Proposal.
22. The table presented by Mr Kirkby in paragraph 17 confirms the significance of truck induced emissions from conventional unpaved roads. This matter

was discussed at the 5 February hearing and I confirmed that use of reject material on access roads is not standard practice for existing quarries. Its use does not produce the fine silt layer that is synonymous with conventional unpaved roads. The use of reject material to cover unpaved roads is an additional control measure that is not required by existing air discharge consents for quarry sites in Canterbury.

23. The differences in PM₁₀ emission calculations between myself and Mr Kirkby are not large. We respectively estimate similar offsets of 0.4 T/yr and 0.52 T/yr for emissions within 500 m of the ASB. My overall site emission of 1.6 T/yr compared to Mr Kirkby's figure of 2.4 T/yr (33% difference) is mostly a result of our different estimates for the processing plant emissions, and Mr Kirkby's higher assumed distances for truck movements to the associated mobile crushing. Therefore, our main difference relates to the relevance of emissions that are 500 m or more away from the ASB. This is illustrated by the data in Table 1, paragraph 53 of this evidence.

Louise Wickham

24. In paragraph 6, Ms Wickham contends there is no room for error in my assessment with regards to Regulation 17. I refer the Commissioners to paragraph 8 of my evidence dated 5 February 2020. It remains my opinion there is room for error in my analysis of the reduction factor and therefore my assessment of compliance with Regulation 17. Ms Ryan's figures also allow room for error.
25. In response to Ms Wickham's paragraph 7 – I have previously discussed the 80% reduction of crushing emissions and refer the Commissioners to paragraphs 39 and 14 respectively of my evidence dated 29 January 2020 and 5 February 2020. If the consent conditions limit the crushing to no smaller than AP20 product (as I understand is proposed), then having around 50% of material going through any crusher is assured. As is an order of magnitude reduction in PM₁₀ emissions compared to process plant producing fine chip product where all material is crushed and produce far greater PM₁₀ emissions per tonne.
26. It also means there are no additional screens processing finely crushed material, which is a significant factor in dust emissions. It is not immaterial with respect to the extent of emissions, as suggested by Ms Wickham, because screening of finely crushed material produces significant dust emissions.

27. In response to paragraph 8, I confirm that 84% reduction in PM₁₀ emissions due to use of reject material (also referred to as pea gravel) is published in the Australian National Pollution Inventory (**NPI**) for fugitive emissions. Mr Kirkby references this in Appendix C of the 9 December JWS. Ms Wickham's contention that I just assumed the reduction value is not correct. The NPI value is cited for exposed areas which includes roads in my view and which Mr Kirkby and Ms Ryan agree with.
28. Ms Wickham's footnote at the bottom of page 3 of her evidence indicates that she only accepts this factor for exposed areas – this infers Ms Wickham does not accept this reduction for unpaved roads and so her estimates of emissions are significantly higher than myself and other experts have calculated for reject material covered access roads.
29. Therefore, I disagree with the suggestion by Ms Wickham that the 84% reduction of emissions for covering unpaved roads with reject material is simply "assumed" and is based on no published data.
30. At paragraph 9 Ms Wickham says that all her emission estimates assume at least 70% reduction due to water control. I consider this is not entirely correct and refer the commissioners to paragraph 5, Appendix B of the December JWS. Ms Wickham and Mr Kirkby do not apply the 70% reduction factor to material unloading activities when undertaking their emission calculations.
31. In response to paragraphs 12 – 15, I reiterate my previous evidence and comments to the Panel regarding PM₁₀ emissions during the establishment phase. The soil conditions outside of the summer months are likely to be damp and this, plus watering, is very likely to result in a low potential for PM₁₀ emissions. Further to this, I understand the central bund will be constructed from material sourced from the future central processing area. Likewise, the material for developing the outer bund would be sourced from around the boundary region of the site. As such, I consider Ms Wickham's analysis of truck movement distances per year, and use of conservative emission factor equations, have grossly overstated the extent of PM₁₀ emissions from this development phase of the Proposal. I reiterate my view that operation phase emissions are likely to be higher than those generated from the construction of the bunds outside of early to late summer months of the year.
32. Given my reasons above, Ms Wickham's emission values for the construction phase, as summarised in paragraphs 13 – 15, and Appendix B of her

evidence, are not reliable in my view and over-state the significance of these emissions, compared to the estimates of emissions for the operational phases of the proposal.

33. Paragraph 17 of Ms Wickham's evidence quotes facts regarding quantities of soil and bund lengths that I do not dispute. However, these facts alone do not support her conclusion that the Proposal cannot comply with Regulation 17.
34. Paragraph 18 refers to Appendix C of her evidence, which summarises the Bay of Plenty Regional Council's guidance for demonstrating appropriate offsets. In my opinion, and much like the NES itself, the guide is not drafted in a way that makes it applicable to a quarry. Rather it seems to relate to point source discharges. Despite this, Ms Wickham has used the guide to critique the validity of my assessment of the possible offset requirement for this Proposal. Given the apparent lack of consideration for activities like quarrying, I think this is an inappropriate use of the guide.
35. In my experience, the guide is not widely used within the NZ air quality management discipline. This is not surprising given its confused use of air quality terminology (i.e. criterion item no. x inappropriately refers to emissions instead of concentrations) and its requirement for the use of Rotorua meteorological data.
36. In response to paragraph 21, I reiterate my view that emissions from the Proposal will not impact on the level of NES exceedance with respect to PM₁₀ within the Christchurch airshed. There is effectively zero effect on NES compliance due to the Proposal. That being so, an offset is not required in order to achieve a "zero overall effect" (as set out in Ms Wickham's paragraph 22).
37. Paragraph 32 discusses 40% as a reasonable assumption of time for which the quarry emissions are directed towards the ASB. I agree with this within 500m of the ASB. I assessed a value of 38% as an average value for areas within 500 m of the ASB. However, I remain of the view the appropriate figure to apply, if requiring an offset for the overall site, is 34%.
38. In response to paragraph 33, I have explained the approach I used for my refined analysis in paragraph 20 of my evidence dated 5 February 2020 and other experts could have undertaken a similar analysis in my view. That would entail marking out different areas of the overall quarry that would be

open for each year of its life and then assessing how this altered the arc of wind directions that would direct emissions from this area towards the ASB.

39. Paragraphs 34 and 35 are similar to those in Mr Kirkby's evidence, with respect to PM₁₀ travelling long distances. The mere presence of a PM₁₀ particle is not problematic. The fact it can travel a long way is similarly not problematic and this is not a relevant consideration for determining the distance beyond which emissions do not need to be accounted for by an offset. It is only an issue if the resultant concentration at the ASB becomes problematic. This is unlikely for quarry sources at 500 m or more away.
40. In my opinion, the assumption in paragraph 37 is not correct and assumes an unrealistic scenario as being a critical state. Firstly, it is not at all the case that my emission estimates assume perfect management control. For example, the assumptions of 70% reduction in PM₁₀ for water control, and likewise 84% for use of reject material, assume a relatively imperfect level of control using these measures. These measures, when applied to a practically achievable extent, can achieve close to 100% control, so they inherently allow for realities of day to day management. The equations themselves are conservative and applied using conservative assumptions across the board e.g. conservatively low moisture contents and conservative high silt levels.
41. Furthermore, achieving the environmental goals does not require perfect management, but requires the realistic implementation of effective management and monitoring that is encouraged through the comprehensive and impactful conditions of consent that are proposed. These conditions require a significant degree of automatic alarming and real-time monitoring that is not prone to human error or the discretion of staff.³
42. This allows for a degree of imperfection such as a sprinkler occasionally not working, or unfavourable wind conditions, while still achieving low levels of nuisance and health effects beyond the site boundary.

³ Applicant's proposed conditions for CRC192410 Air Discharge Permit –

- Condition 4 - Meteorological monitoring station, particularly h) which requires the data be recorded using an electronic data logging system;
- Conditions 5 and 6 - Real time PM10 Monitors;
- Conditions 11-13 - works ceasing under certain conditions and not restarting until certain thresholds are met;
- Condition 23(f) - All plant within CPSA 500 m from site boundary;
- Condition 23(g) - Fixing water sprays or fogging to plant;
- Condition 24 - Automated dust suppression system outside of working hours.

43. I understand that the Proposal will have dedicated day to day management and control, including daytime and after hours, but this does not equate to perfect on-site management and control. I maintain the view, the design of the quarry combined with dedicated management and maintenance of monitoring and mitigation systems would ensure that dust emissions are adequately controlled. The proposed conditions of consent are designed to give certainty that effective management would occur in practice at all times.⁴
44. I do not understand the last sentence of Ms Wickham's paragraph 38. It is not "technical" – I have not seen any statement, policy or guidance which supports such a general statement about quarry emissions and their "fit" with airsheds. I also confirm that Ms Wagenaar's understanding is correct in regards the relatively small fraction of PM₁₀ associated with the quarry emissions, that is within the PM_{2.5} size range. I understand that all other air quality experts have agreed with my view that PM_{2.5} emissions are not an issue for the Proposal.

Laurence Greenfield

45. I have reviewed the supplementary evidence provided by Dr Greenfield. In his paragraph 10, he suggests that I made extrapolations and opinions from unsound original data. He also appears to question why one cannot/does not undertake what he considers would be reliable, NZ-based research to assist with the decisions regarding this application. I assume his apparent frustration relates to the reliability of the Yaldhurst Study ambient PM₁₀ data set. I disagree with Dr Greenfield on both points.
46. I have thoroughly assessed this key data set and stand by my previous evidence that the data set is comprehensive, as detailed in paragraphs 19 to 23 of my evidence dated 29 January 2020. From my previous assessment of

⁴ Applicant's proposed conditions for CRC192410 – Air Discharge Permit -

- Condition 4 - Meteorological monitoring station;
 - Conditions 5 and 6 - Real time PM10 Monitors;
 - Condition 7 - RCS monitoring campaign in consultant with CDHB and CRC;
 - Condition 8 - installation and maintenance of monitoring equipment;
 - Condition 10 – no quarrying within 200 m of a house without written approval;
 - Conditions 11-13 - works ceasing under certain conditions and not restarting until certain thresholds are met;
 - Condition 14 – no visible dust beyond boundaries;
 - Condition 15 – no more than 625,000 tonnes in any 12 month period and no larger than AP20;
 - Condition 20 – progressive rehab with all sub stages to be rehabbed within 6 months of cleanfilling;
 - Condition 23 – detailed dust suppression measures including b) use of conveyors as primary form of transporting, f) all plant at least 500 m from boundaries, g) sprays and fogging on plant;
 - Condition 24 - Automated dust suppression system outside of working hours.
- RC185627 - SDC Land Use -
- Condition 25 - Table 2 – Open Area for quarrying limited to 26 hectares with only 5 ha of dust generating area;
 - Condition 27 - all plant at least 500 m from boundaries;
 - Condition 28 - no quarrying within 200 m of a house without written approval.

the Yaldhurst study data, I have concluded that it covers a full range of wind conditions (including worst case for dust generation) and that normal levels of dryness within the quarries would have occurred.

47. Dr Greenfield states his view that independent and experienced “air” scientists (likely to be university based) should review all aspects of the Proposal and the Yaldhurst data set. I consider that I am a very experienced air quality expert. I am also regularly engaged to provide independent expert advice and assessments on Resource Management Act matters. I have read the Code of Conduct for expert witnesses. I fully understand the obligation of independence and appreciate the significance of it.
48. In my opinion, the data set for Yaldhurst provides the best evidence to evaluate air quality impacts from the Proposal. Furthermore, not only is it the best available, but it is sufficient/robust enough to undertake a comprehensive assessment of potential PM₁₀ impacts from the proposal. As such, I consider the Commissioners can rely upon the assessments I have provided and make an informed decision on the application.
49. From my experience over many years, I recognise that there is no such thing as perfect science or data – particularly in the area of RMA where we are making predictions about the future. Although, in this instance, the available information is far more comprehensive than has been available for similar applications in the past. In particular, the available data for PM₁₀ is much better than what air quality experts normally have to inform our assessments.

Summary of PM₁₀ offset values

50. Table 1 below provides a summary of the range of estimated offset values. This is an update of the Table 1 provided in my evidence dated 5 February 2020. This provides estimates of annual PM₁₀ emissions that would cross the ASB. These are based on the varying wind direction frequencies assessed by each expert and as provided in their most recent evidence.
51. It is clear that either of the offset options discussed in my 5 February evidence would provide a sufficient PM₁₀ reduction to offset the emissions from the Proposal. This outcome is clear irrespective of which wind frequency values are assumed, or what area of the total Proposal site (total or areas < 500 m from the ASB) is considered necessary for an offset.
52. As I have stated earlier, the opinion of Mr Kirkby that 8% of the Pound Road emissions do not impact on the airshed, does not matter. The estimated

Pound Road site annual emission, when reduced by 8%, still provides an adequate offset for the Proposal's emissions.

53. Table 1: Summary of experts PM₁₀ emission estimates (tonnes/yr)

	Cudmore	Ryan	Kirkby	Wickham
Whole Site (34% wind frequency*)	0.5	0.7	0.8	1.0
Whole Site (40% wind frequency*)	0.6	0.8	1.0	1.2
< 500 m of airshed boundary (38% wind frequency*)	0.38	0.38	0.49	0.65
< 500 m of airshed boundary (40% wind frequency*)	0.40	0.40	0.52	0.68

Note: * The percentages are the variety of values assumed for the percentage of time that the wind blows emissions from the active quarry areas towards airshed boundary.

Conclusion

54. I conclude from Table 1 above, that Fulton Hogan's preferred offset option (should you decide one is needed) – being extraction at Roberts Road - would be more than adequate to ensure a neutral PM₁₀ outcome within the ASB (as discussed in my evidence dated 5 February 2020, Paragraphs 32 onwards).

Roger Cudmore

3 March 2020