Before Independent Hearings Commissioners Appointed by 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 STATEMENT OF ROGER STEVEN CUDMORE ON BEHALF OF FULTON HOGAN LIMITED

PM10 OFFSETTING

DATED: 5 FEBRUARY 2020
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 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 Louise Wickham’s evidence (dated 6 November 2019);
   
   (d) My summary evidence dated 13 November 2019; and
   
   (e) My supplementary evidence dated 29 January 2020.

3. I have been asked by Fulton Hogan to provide further supplementary evidence to this hearing in response to the following:

   3.1 Compliance with Reg 17(1) and specifically paragraphs 118 and 119 and Table 4 of my evidence in chief dated 23/09/2019; and

   3.2 The amount of PM<sub>10</sub> that needs to be offset; and

   3.3 Consideration of how the amount of PM<sub>10</sub> could be offset.

Compliance with Reg 17(1)

4. I was previously asked by the commissioners why - in paragraph 118 of my primary evidence - I suggested that a maximum increase in PM<sub>10</sub> due to the Proposal would be 2.4 μg/m<sup>3</sup>, when in fact the higher value of 2.7 μg/m<sup>3</sup> is listed in Table 4 of that evidence. My recollection is that I confirmed the 2.7 figure as being the highest number in Table 4 and this should have been referenced in paragraph 118.

5. However, I further commented this highest value was based on a monitoring site directly impacted by dust sources upwind that are not representative of what would occur at the Proposal site. I considered it appropriate to include this highest value (associated with northwest wind conditions) for transparency, but I disregarded it when assessing the likelihood of compliance with Regulation 17(1).

6. I maintain the correctness of my approach. It is clear to me the Asphalt and Concrete Batch plants are situated immediately upwind of the ambient particulate monitoring site (Site 3). They would have significantly influenced the monitoring results and therefore overstated the maximum rise in PM<sub>10</sub> concentration that occurs due to the conventional quarrying areas at Yaldhurst.

7. I note that when Ms Ryan was questioned about the same data, she also indicated a view that the data from Site 3 was compromised by the presence of these particulate sources and is not applicable to the Proposal.

8. Therefore, it remains my opinion that highest, relevant, estimated PM<sub>10</sub> rise in Table 4 of my primary evidence, is 2.4 μg/m<sup>3</sup> (24 hour average). My primary
evidence then explains that in order to achieve the Regulation 17(1) compliant figure of 2.5 µg/m³ (24 hour average), the emissions from Roydon would need to be 10 times less than the those from the Yaldhurst quarry zone. Based on analysis of emissions from both the Yaldhurst and Roydon site, I then concluded the calculated difference in emissions (between the two sites) indicated that this level of reduction was likely to be greater than a factor of 10.

Formation of bunds

9 With respect to PM₁₀ emissions during construction phase, particularly during bund formation. As stated in paragraph 17 of the second JWS I have not calculated construction phase emission as I consider that the Proposal’s PM₁₀ emissions during construction will be lower than the emissions associated with the operational phase. I refer the commissioners to paragraph 75 of my evidence in chief and paragraph 7 of my 21st October rebuttal evidence where I have discussed this.

10 I also refer the commissioners to paragraph 17 of the second JWS. Both Ms Ryan and I consider that the PM₁₀ emission factors for bund formation used by Ms Wickham are unrealistically high and she has assumed unrealistically high travel distances. I also note she assumed an unrealistically low soil moisture of 1% in her analysis (Table D-2, section 2.1 of Appendix D of 2nd JWS dated 9 December 2019). A realistic soil moisture value during bund formation is over 8% which experts have agreed on in the JWS.

11 I therefore consider it even more unlikely that the NES regulation 17 (1) requirements would be breached by emissions associated with the bund formation stage given the nature of the soil involved, time of year (outside of summer months) and proposed mitigation. As such an offset for this phase of the project is not required in my opinion.

How much PM₁₀ needs to be offset?

12 The amount of PM₁₀ that needs to be offset is the amount of PM₁₀ that is estimated to enter the airshed. I have calculated a range of values for the offset based on the range of total annual PM₁₀ emissions estimates contained in the second JWS. I have then reduced the amount by calculating the portion of time when wind conditions would blow site emissions away from the airshed boundary. I understand my peers all agree that a significant component of the total annual PM₁₀ discharge from the site will never reach the airshed due to the winds patterns at the site.

13 Table 1 of the second JWS dated 9th December 2019 provides a range of estimates of total PM₁₀ discharged from the total site per year (i.e. ranging from my estimate of 1.6 tonnes/year to Ms Wickham’s highest estimate of 2.9 tonnes/year):

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<tr>
<td>13.1</td>
<td>Cudmore, 1.6 tonnes/year;</td>
</tr>
<tr>
<td>13.2</td>
<td>Ryan, 2.1 tonnes/year;</td>
</tr>
<tr>
<td>13.3</td>
<td>Kirkby, 2.4 tonnes/year;</td>
</tr>
<tr>
<td>13.4</td>
<td>Wickham, 2.9 tonnes/yr.</td>
</tr>
</tbody>
</table>

Differences with Ms Ryan

14 We have attempted to explain the differences between the experts in the second JWS. I will attempt to condense that further. The difference between myself and
Ms Ryan is due only to the figure attributed to process plant emissions (where she assumes the same PM_{10} discharge as Mr Kirkby and Ms Wickham). Consequently, her value is 0.47 tonnes/year higher than my estimate for aggregate processing. All her other estimates are the same as mine.

As stated in paragraph 13 of the second JWS, I consider that these estimates of process plant emissions do not account for the inherently lower potential for PM_{10} from top/base coarse crushing and screening plants.

Given the process plant is situated 500 m from the airshed boundary, I do not consider the acceptance of my estimate, or that of other experts, for the processing plant emissions is that important. In my opinion, these emissions are sufficiently far from the airshed boundary such that they are unlikely to affect ambient concentrations and therefore do not need to be considered when determining an appropriate level of offset. I noted this in paragraph 61 of my rebuttal evidence dated 6 November 2019.

Differences with Mr Kirkby and Ms Wickham

As I have just discussed, Mr Kirkby and Ms Wickham has attributed the same number to the process plant emissions as Ms Ryan and for the same reasons.

Putting the processing plant aside, Mr Kirkby and Ms Wickham respectively have higher loading/unloading and truck movement emissions than myself and Ms Ryan by 0.3 tonnes per year (Mr Kirby) and 0.8 tonnes/year (Ms Wickham). I consider these more conservative values are not realistic and ignore the Proposal design and accepted control factors. I refer the commissioners to paragraphs 36 and 37 of my supplementary evidence dated 29 January 2020 regarding this view.

How much PM_{10} will affect the airshed?

Of the estimated total annual PM_{10} discharge, only some of it will affect the airshed. In my opinion, the following should be subtracted from the total estimates discussed above:

- Emissions occurring at or beyond 500m of the airshed boundary; and
- A portion of the total annual emissions that equates to the fraction of time that winds at the site would not blow towards the airshed.

Reduction for wind conditions

In her primary evidence dated 17 October 2019, Ms Wickham estimates the airshed will be impacted by PM_{10} emissions from the site for 42.5% of all winds. This is the percentage of time that the wind coming from 180° to 315° over a whole year.

I have undertaken a more refined analysis of the variation in actual percentage value, taking into account the changing locations of the active 3.2 ha stripping/excavation and clean filling strips within the overall quarry site. For the total site, I found that for all operational years, the wind would blow PM_{10} emissions towards the site boundary on average 34% of the total time.

As set out above and below, it remains my opinion the annual emission estimates can be reduced to account for both the percentage of time within a year that the wind directs the site PM_{10} emissions towards the airshed boundary (i.e. when the site is upwind of the airshed boundary) and distance from the boundary. The percentage of time the wind blows toward the airshed differs slightly depending...
on whether the whole site is to be offset, or only areas within 500 m of the airshed boundary. For areas within 500 m of the airshed boundary, the wind would on blow PM$_{10}$ emissions towards the site boundary for 38% of the total time on average.

The differences in estimates of downwind frequency are due to the different arc of wind directions that would result in the Proposal’s emissions being blown towards the airshed boundary. Ms Wickham appears to have assessed this arc of directions based on the whole site being upwind at any one time. I have assessed the average arc of directions when considering all possible future locations of the active quarry area (3.2 ha). For active quarry areas within 500 m of the airshed boundary, the average arc of downwind wind directions is generally wider than those beyond 500 m. Therefore, the average downwind frequency (38%) for areas within 500 m of airshed boundary is slightly higher than the average value (34%) for the whole site.

As I have stated in paragraph 61 of my rebuttal evidence dated 6 November 2019, I consider that the PM$_{10}$ emissions associated with processing and other quarrying activities that are 500 m or more from the airshed boundary are likely to have negligible impact on PM$_{10}$ levels at the airshed boundary. I have estimated these emissions to be 0.6 tonnes/year.

The Appendices to the 2nd JWS provide break-downs of total PM$_{10}$ emission estimates calculated for Roydon by all experts. From this, the varying estimates of emissions within 500 m of the airshed boundary, as assessed by all experts, are able to be identified. These are as follows:

24.1 Cudmore, 1.0 tonnes/year;
24.2 Ryan, 1.0 tonnes/year;
24.3 Kirkby, 1.3 tonnes/year; and
24.4 Wickham, 1.7 tonnes/yr.

**Emission range if reductions applied**

I have estimated the quantum of PM$_{10}$ offsets on two basis; for the whole site and for emissions within 500 m of the airshed boundary:

25.1 For the whole site basis, all expert’s total emissions figure is reduced by 34% to account for the wind frequency that blows the emissions to the airshed boundary;

25.2 For the within 500 m of the airshed boundary basis, these emissions (shown above in paragraphs 24.1 to 24.4) are reduced by 38% to account for the wind frequency that blow emissions to the airshed boundary.

For example, my estimate of the total site emission of 1.6 tonnes/yr x 34% wind frequency gives a figure of 0.54 tonnes/year and my estimate of the emissions within 500 m of the airshed boundary of 1.0 tonnes/year x 38% wind frequency gives a figure of 0.38 tonnes per year (rounded to 0.4 in Table 1 below).

Table 1 below is based the same calculations applied to each experts’ estimates (summarised within the second JWS);
Table 1: Summary of experts PM$_{10}$ emission estimates (tonnes/yr)

<table>
<thead>
<tr>
<th></th>
<th>Cudmore</th>
<th>Ryan</th>
<th>Kirkby</th>
<th>Wickham</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whole Site</td>
<td>0.54</td>
<td>0.7</td>
<td>0.8</td>
<td>1.0</td>
</tr>
<tr>
<td>$&lt; 500$ m of airshed boundary</td>
<td>0.4</td>
<td>0.4</td>
<td>0.5</td>
<td>0.65</td>
</tr>
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**Fulton Hogan’s quarries within airshed boundary**

28 Fulton Hogan’s existing quarry operations at Pound Road and Roberts Road are within the Christchurch airshed. Roberts Road holds an air discharge consent (CRC150304) that allows aggregate extraction and the transporting of extracted gravel to the Pound Road quarry for processing. This consent expires in October 2022.

29 Pound Road holds an air consent (CRC960393.2) that enables the site to import, process aggregate and sell processed product. There is also provision within the existing Pound Road air discharge permit to discharge total particulate to atmosphere from an asphalt plant and sand drying operations.

30 I have overseen calculations of PM$_{10}$ emissions associated with the above two sites including, topsoil stripping, wind erosion, truck movements, extraction and processing clean filling, and loading/unloading operations using the same US EPA emission factor equations and controls assumed for the Proposal (as summarised in the 2$^{nd}$ JWS).

31 For example, a standard control factor (70% reduction via water suppression) has been applied to the emission associated with truck movements on unpaved roads. A further reduction of 84% (due to covering by reject materials) was assumed for the Proposal but has not been considered for the established quarry sites. This is because neither Pound Road nor Roberts Road sites has unsealed road covered by reject material.

**Potential off-set from Roberts Road Extraction**

32 The Roberts Road quarry extracts aggregates at a maximum rate of 370 tonnes/hr. Once the extraction operation is completed by 2022, PM$_{10}$ emissions from the extraction will stop. I have estimated the PM$_{10}$ emissions associated with the extraction process and based on extraction rates and actual distances travelled on unpaved road. These include:

- Topsoil stripping: 0.1 tonnes/year
- Gravel loading: 0.1 tonnes/year
- Trucks carrying aggregates to Pound Road on unpaved road (within Roberts road site): 3.3 tonnes/year

33 The calculated magnitude of PM$_{10}$ emissions over time from the above sources at Roberts Rd are shown in the figure below. Note these do not include the reduction in wind erosion induced emissions as a consequence of the site’s gradual rehabilitation, nor the eventual reduction in emissions when clean filling operations and rehabilitation has been completed. This is because these latter emission reductions would occur irrespective of the aggregate extraction ceasing or not.
The figure below represents the above plot of reducing emissions over time, as an increase in PM$_{10}$ reductions over time (blue line) due to the cessation of aggregate extraction at Roberts Rd. The dotted lines in the figure below indicate the varying PM$_{10}$ offsets required for the whole site at Roydon (accounting with wind frequency), as predicted by myself and applying the wind reduction factor to the total site emissions that have been estimated by fellow air quality experts. This shows that ceasing aggregate extraction and transportation at Roberts Road is likely to reduce annual PM$_{10}$ emissions by more than three times the range of values estimated for Roydon quarry (Table 1 paragraph 15).

In conclusion, ceasing aggregate extraction at Roberts Road by 2022 is estimated to reduce PM$_{10}$ emissions by 3.5 tonnes/year, which is in excess of all the experts' estimates for annual PM$_{10}$ emissions from Roydon.

**Potential off-set from Pound Road - Gravel Processing**

The Pound Road site nominally processes 370 tonnes/hr (cf: 500 tonnes/hr proposed for Roydon) and has areas of unpaved gravel road (not covered with reject material or sealed). If processing activities at Pound Road were to cease, there would be a significant reduction in PM$_{10}$ emissions into the airshed. The reduction will come from the following processes:

- Gravel unloading: 0.2 tonnes/year
- Gravel processing: 0.1 tonnes/year
- Trucks on unpaved road (within Pound road site) delivering raw material from Roberts Road: 0.7 tonnes/year
- Trucks on unpaved road carrying products for sale: 0.6 tonnes/year

The calculated magnitude of reduced PM$_{10}$ emissions from various sources that would be associated cessation of processing at Pound Rd and paving of some unsealed roads, are shown in the figure below. Again, these reductions do not include emissions associated with site rehabilitation similar to that discussed in Paragraph 33.

The figure below represents the above plot of reducing emissions over time, as an increase in PM$_{10}$ reductions over time (blue line) due to the cessation of aggregate processing at Pound Rd. The dotted lines in the figure below indicate the varying PM$_{10}$ offsets required for the whole site at Roydon, as predicted by myself and when applying the wind reduction factor to the total site emissions that have been estimated by fellow air quality experts. This shows that ceasing aggregate processing at Pound Road and providing a full sealed access way to a paved sales area, is likely to reduce annual PM$_{10}$ emissions by a significantly greater quantity than these range of values summarised for Roydon quarry in Table 1 (paragraph 15).
I conclude that the option of ceasing processing at Pound Road and providing a fully sealed access way to a paved sales area would reduce PM$_{10}$ emissions by 1.6 tonnes/year, which is in excess of all experts estimates for PM$_{10}$ from Roydon (when accounting for wind patterns at the site).

Finally, I refer the commissioners to table 1, paragraph 63 of my rebuttal evidence dated 6 November 2019. This indicates that the site air discharge consent at Pound Rd also allows for a discharge of total particulate to air from an Asphalt and Sand Bagging Plant (I estimate this would allow approximately 20 tonnes/year of PM$_{10}$ discharge into the air from the plant’s discharge stack. I understand this emission is contained within ECAN’s current emission inventory of consented industrial discharges of PM$_{10}$ for the Christchurch airshed. As such, a 5% reduction in this consent discharge limit would equate to the highest estimate of PM$_{10}$ emissions into the airshed (i.e. Ms Wickham’s 2.9 tonne/year in total reducing to 1 tonne/yr blowing toward the airshed when accounting for wind patterns at the site).

Dated 5 February 2020

Roger Cudmore

Principal - Golder Associates (NZ) Limited