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 for resource consents by Fulton Hogan Limited for the proposed establishment and operation of Roydon Quarry, Templeton

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STATEMENT OF EVIDENCE OF RICHARD JOHN JACKETT FOR THE NEW ZEALAND MOTOR CARAVAN ASSOCATION INC. (NZMCA)

NOISE

14 October 2019

SUMMARY STATEMENT

1. My name is Richard Jackett. I have been asked by NZMCA to provide evidence on noise impacts on the NZMCA Weedons site.

EXISTING ACOUSTIC ENVIRONMENT

2. On the 10th and 11th of September 2019 I visited NZMCA Weedons to observe the existing noise environment, see how the site is used by members, and to make a 24-hour noise measurement to establish the existing ambient noise level. I would summarise the noise environment as typical of working-rural surroundings, with steady distant road traffic noise, occasionally punctuated by passing trains and aircraft.

3. From speaking to members and observing their behaviour, it is clear they value the rural noise environment of NZMCA Weedons. The evening period, when they report that they often dine or socialise outside if the weather is good, is likely to be the most sensitive day time period of the day from a noise point of view.

4. My noise measurements were comparable with those of the Applicant's noise experts. They establish that – acoustically speaking – the daytime period starts before 7:00am and begins to taper off after 5:30pm. For this reason I support the Applicant's proposal to start the day-time period at 7:00am, half an hour earlier than specified in the Selwyn District Plan. By the same logic, the relative quiet of the evening period after 6pm should be maintained.

5. Both sets of measurements distinguish between LA90 background noise level – from constant sources such as distant traffic – and the overall noise level as measured by the LAeq parameter, which is dominated by sporadic aircraft overflights. It is the background noise level that will be affected by the introduction of quarrying noise, with the peaks in noise relatively unaffected.

EVALUATING THE NOISE EFFECTS

6. I consider that the Applicant's proposed assessment methodology of NZS 6802:2008 and proposed LAeq noise limits are appropriate. The assessment position for the proposed limits is "any point within any other site", which essentially means the boundary of the quarry.

7. The proposed limits introduce an evening period from 6pm to 8pm with a noise limit midway between the proposed day time and night time limits, which is in line with NZS 6802:2008 and supported by my ambient noise measurements. This provides appropriate protection of the evening noise environment.

8. The Applicant's Environmental Noise Assessment provides a predicted noise level for NZMCA Weedons, contours of noise levels for the surrounding area, and a description of the types of quarrying equipment that will contribute to the noise.

9. The permanent crushing and screening unit and the mobile crusher will have a distinctive repetitive sound that could be described as "rapid impulses", or more informally as "crunch-crunch-crunch-crunch-crunch-…". This type of 'special audible character' is recognised by NZS 6802:2008 as being "likely to arouse adverse community response at lower levels than noise without such characteristics". The standard requires that an adjustment of +5 dB must be made to the predicted noise levels to account for the distinctive character of the sound.

10. Determining the noise level at the assessment position (near the quarry boundary) from the noise assessment's noise contour plots, and adding the 5 dB penalty for the distinctive crushing noise, it can be expected that
    a. The day time limit is likely to be exceeded by up to 6 dB.
    b. The evening limit is likely to be exceeded by up to 5 dB.
    c. The night time noise limit is unlikely to be exceeded.

11. Without the 5 dB penalty the proposed day time limit would still be exceeded at the quarry boundary, but by a small amount that would not be noticable.

12. During some stages of excavation the quarry noise is likely to become the dominant source of background noise at NZMCA Weedons during the day, and exceed the existing background noise level by 5 dB. Into the evening both the quarry noise and traffic noise drop off to a similar level, but some quarry noises will still be audible because of their distinctive character. This is expected to cause adverse response and loss of amenity at NZMCA Weedons during the day and evening periods.

13. To allow the quarry to generally meet the proposed noise limits near the quarry boundary and to mitigate adverse effects on NZMCA Weedons, I propose that the consent conditions are amended as follows:
    a. Operation of the mobile crusher be restricted to the central portion of the quarry.
    b. No crushing or screening activities be permitted during the evening or night-time periods.
    c. Retain the Council's version of the proposed condition excluding use of tonal reversing beepers for all trucks.
    d. Trucks should avoid Curraghs Road unless the delivery address is on or adjacent to Curraghs Road.

14. Without these amended conditions in place I believe the noise from the operation of the quarry could cause unreasonable adverse effects and loss of amenity for NZMCA Weedons and its users.

INTRODUCTION

15. My name is Richard Jackett. I am a scientist with 18 years of professional experience in the field of acoustics. I hold a B.Sc. (Hons) in physics from Canterbury University. I am a member of the Institute of Physics and the Acoustical Society of New Zealand.

16. I currently work for WSP as Principal Engineering Scientist in acoustics. I have previously held acoustics positions at Parsons Brinckerhoff; Opus International Consultants; Civil Engineering Dynamics; the UK Department for Environment, Food, and Rural Affairs (Defra); and the UK's National Physical Laboratory. Over my career I have investigated or assessed noise from a variety of sources, including transportation, industry, construction, and residential/recreational activities including motorcaravan parks.

17. I have been asked by the New Zealand Motor Caravan Association (NZMCA) as a submitter to give evidence in this proceeding.

18. I have visited the NZMCA Weedons campground (NZMCA Weedons) on several occasions and in 2018 I provided a noise assessment to support NZMCA's resource consent application to the Selwyn District Council to expand their existing

operations on the site. I am familiar with the NZMCA Weedons site and the surrounding environment.

19. I have advised NZMCA on noise for several of their parks and have a general sense of how the parks operate and how they are used by members.

20. I have read the Environment Court's Practice Note 2014 and in particular part 7 that refers to the expert witnesses, and I agree to comply with it. My qualifications and experience are set out above. I am giving evidence in my capacity as a noise expert. I have not omitted to consider material facts known to me that might alter or detract from the opinions expressed in this evidence.

21. In preparing my evidence I have reviewed:
    a. The resource consent applications submitted by the Applicant, including the Environmental Noise Assessment.
    b. The further information provided by the Applicant.
    c. NZMCA's submission on the resource consent applications.
    d. The Selwyn District Council (SDC) s42A officers' report on noise (Jeremy Trevathan, 2/9/19) and the draft conditions (Andrew Henderson, 2/9/19).
    e. The Applicant's statement of evidence on noise (Jon Farren, 23/9/19).
    f. The relevant statutory documents.
    g. The evidence of:
        i. Mr James Imlach (NZMCA, 14/10/19)
        ii. Ms Lara Stace (Planning for NZMCA, 14/10/19)

SCOPE OF EVIDENCE

22. The purpose of my evidence is to provide noise evidence in support of the NZMCA's submission on the resource consent applications for the proposed establishment of Roydon Quarry by Fulton Hogan Limited.

23. On 7 August 2019, I attended a meeting with the noise experts engaged by Fulton Hogan, Selwyn District Council, Canterbury District Health Board, and Templeton Residents Association, and we discussed acoustic matters relating to the proposal. The intention is for the noise experts to produce a Joint Witness Statement prior to the Hearing.

24. The further information response dated 16 August 2019 provided some key changes to the proposal and the proposed conditions. Those changes alleviate some of the concerns surrounding noise that were detailed in the NZMCA's submission. However, the likelihood of adverse noise effects on the NZMCA Weedons Park from the proposed quarry remains.

25. My evidence outlines the existing ambient noise environment and members' usage of NZMCA Weedons. I will explain how the proposed quarrying activities will impact on the amenity of the site, and propose mitigation in the form of revised consent conditions for noise.

MEMBERS' USAGE OF THE NZMCA WEEDONS PARK

26. To understand how the NZMCA Weedons Park is used by NZMCA members, I attended in-person during morning, daytime, evening, and night time periods on 10 and 11 September 2019. I observed on-site activities and spoke informally with 7 members.

27. The members I spoke with reported that they choose to visit the park "to relax" and because of its "peaceful" rural surroundings. They typically go indoors early in the evening in winter, but in summer they enjoy sitting outside until sunset or beyond. Members mentioned that on nice days they might enjoy 'happy hour' at the outside tables in the early evening.

28. Members themselves are discouraged from creating noise in the early morning and evenings, and generator usage is limited to a maximum of 4 hours per day between 8am and 8pm by a member's code of conduct. This is to protect the amenity and sleep of members. I observed the code of conduct being followed whilst on site, and members I spoke to reported that the code is usually complied with.

29. Members were conscious of the noise environment, raising with me:
    a. the various construction activities that were taking place to the east
    b. the influence of the wind direction on the road traffic noise and on the aircraft approach/departure paths
    c. that it was much noisier that week than on a previous visit

d. two members independently shared their knowledge of which model of generator was the quietest and one quoted its rated noise level from memory.

The members I spoke to appeared to have a genuine interest in the noise environment, and they impressed on me that it was a central aspect of their enjoyment of the site.

30. In summary, the rural type noise environment of NZMCA Weedons appeared to be one of the main reasons they choose to spend time there. In my view, maintaining amenity over the evening period, and in particular during the 'day-light' savings portion of the year, would help to maintain their enjoyment of the park.

EXISTING NOISE ENVIRONMENT

31. I made attended noise measurements and observations over morning, daytime, evening, and night-time periods from 10 to 11 September 2019.

NATURE OF THE NOISE ENVIRONMENT

32. Throughout the daytime the dominant constant noise sources were the moderate nor-easterly wind in the nearby trees and road traffic noise perceived as coming from the north east (likely SH1 and Jones Road). Sheep bleating and birds singing contributed to the soundscape and sometimes to the measured noise level. Some traffic on Maddison Rd and Curraghs Road was also audible, and some construction activities to the north east were also audible. In the early evening, around 6pm, there was some generator noise from within the NZMCA site. Sporadic noise sources included aircraft on approach to Christchurch airport, particularly in the morning and late afternoon, and trains on the main line to the east of Jones Road.

33. At night time (after 8pm on the 10th Sept.) the wind noise had mostly disappeared, and traffic noise from SH1 and Jones Road dominated.

34. In the morning (11th Sept), with the wind coming from the south east, SH1 and Jones Rd traffic noise was perceived to originate from that direction, and construction noise from work at the Alston Rd - Jones Rd intersection over 1 km away was clearly audible (as a constant engine tone). Subjectively, the traffic and construction noise

were at a similar level. Sporadic aircraft and train noise occasionally dominated the noise environment.

35. I would summarise the noise environment as working-rural, with steady distant road traffic noise, occasionally punctuated by passing trains and aircraft.

EXISTING NOISE LEVELS

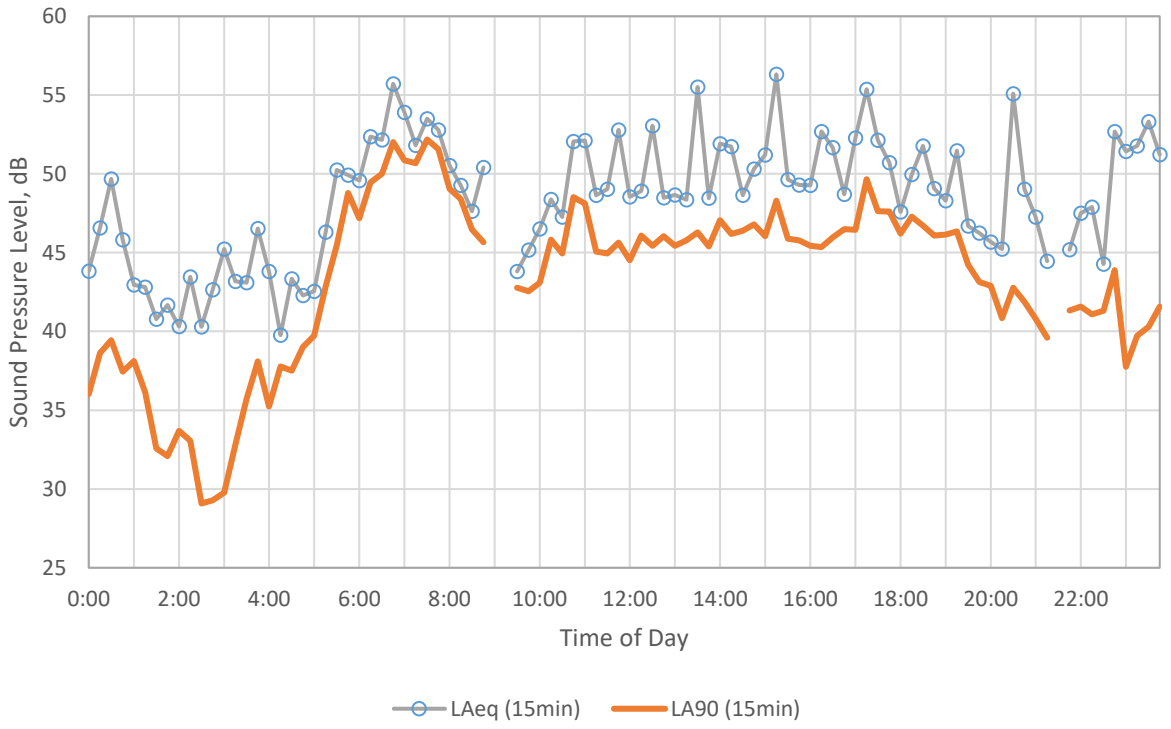
36. Over the 24-hour period between 10:30am 10 September and 10:30am 11 September 2019 I performed a noise survey using two calibrated Sound Level Meters (SLMs) in general accordance with NZS 6801:1999 *Acoustics – Measurement of Environmental Sound*. The measurement position was the north-east boundary of NZMCA Weedons, closest to the proposed quarry. The following statements draw from that survey, the details of which are omitted for brevity, but are contained in a measurement report which is available on request[1].

37. Noise levels at NZMCA Weedons for the different periods of day have been calculated in dB from 1-minute time-series data and are given in the following table:

Time	Period (wind direction)	Duration, t (hours)	LAeq Level (dB $L_{Aeq(t)}$)	Mean L90(15min) (dB)
6am - 7am	Early Morning (SW)	1	53.3	49.9
7am - 6pm	Day (moderate NE)	11	51.2	46.6
6pm - 8pm	Evening (NE)	2	49.3	45.4
8pm - 10pm	Late Evening (E)	2	49.6	41.5
10pm - 6am	Night (light SW)	8	47.4	38.0

[1] R. Jackett, *Memorandum: NZMCA Weedons – Ambient Noise Levels*, 16/09/2019

38. The measured noise level at NZMCA Weedons over the course of the 24-hour survey is presented in the following chart:



39. The LAeq noise level represents an 'energy average' of noise over the given time period, which means it is strongly influenced by the loudest noise event in a given timeframe, even if the duration of the event is short (e.g. a plane passing overhead).

40. The LA90 noise level provides an indication of the ambient noise level in the absence of sporadic events (e.g. trains, flights) but including the constant noise sources (e.g. SH1 traffic, wind noise). This is commonly referred to as the "background noise level", and for NZMCA Weedons under NE and SW wind directions this is dominated by the influence of SH1 traffic.

41. My measurements are comparable to those provided by the Applicant's Environmental Noise Assessment (reproduced in paragraph 33 of Mr. Farren's noise evidence), showing a similar pattern for both LAeq and LA90 indicators over the day.

42. I note that an earlier weekday visit to NZMCA Weedons under light nor-westerly winds yielded a measurement of 35 dB $L_{Aeq(1min)}$ (in the absence of aircraft noise) at 1pm, which is some 10 dB below the LA90 measured for the same time period under

nor-easterly winds. The westerly component caused unfavourable noise propagation conditions from SH1, and therefore the background noise level was much quieter (effectively 'half' as loud). This is to say that the wind direction may have a large influence on day-to-day changes in background noise level at NZMCA Weedons.

NOISE LIMITS

SELWYN DISTRICT PLAN NOISE LIMITS

43. Applicable noise limits for activities in the Rural zone are given by the Selwyn District Plan (SDP) in table C9.3. There is no perfect equivalence between the Plan's LA10 limit and the LAeq parameter used in the Application, but LAeq = LA10 – 3 dB is commonly used, as it has been in the Application Environmental Noise Assessment. The limits are measured at the notional boundary of particular activities, and are as follows:

    a. Day 07:30 to 20:00 60 dB L_{A10}

    b. Night 20:01 to 07:29 45 dB L_{A10} and 70 dB L_{Amax}

44. The SDP Rural zone definition of "noise sensitive activities" include "*travellers' accommodation except that which is designed, constructed and operated to a standard that mitigates the effects of noise on occupants*". This would appear to include caravans and motorcaravans, which do not enjoy the same level of acoustic insulation as permanent dwellings. The SDP definition of rural "sensitive activity" (I understand it is separately defined for the Airport-related provision) specifically includes "*Camping ground facility*". The SDP noise limits apply to the notional boundary of a dwelling. Although not explicitly stated in the Plan, as a noise-sensitive and lawfully-established activity, it is my view that it is appropriate for the noise limits to apply to the legal boundary of the NZMCA Weedons site (being the effective notional boundary).

45. Section *C0 Noise Measurement and Assessment* of the SDP makes provision for adjustments to the noise limits for special audible characteristics. In my view the special audible characteristics penalty of 5 dB should be applied to the SDP daytime noise limit, reducing it to 55 dB L_{A10}, and this discussed below.

46. On this basis, the equivalent SDP daytime noise limit in LAeq at the NZMCA boundary is 52 dB L_{Aeq}. The equivalent night-time noise limit is LAeq is 42 dB L_{Aeq} (because the special audible characteristic penalty is not applied when the crushing/screening unit is not operating).

THE APPLICANT'S PROPOSED NOISE LIMITS

47. I did not support the noise limits initially proposed by the Applicant in the Environmental Noise Assessment for the reason that they would not preserve the comparatively quiet period in the evening, and reduced the night-time period to just 8-hours. In the August RFI response the Applicant has modified the proposed hours of operation and consequently adjusted the hours over which the proposed noise limits apply.

48. The Applicant now proposes the following noise limits (in the August RFI response), to be assessed "shall not exceed the following limits at any point within any other site during the following times":

    a. Daytime 0700 to 1800 55 dB L_{Aeq}

    b. Evening 1800 to 2000 50 dB L_{Aeq}

    c. Night 2000 to 0700 45 dB L_{Aeq} and 70 dB L_{Amax}

49. The SDP limits (paragraph 46) apply at the notional boundary, which I interpret as the north-east legal boundary of NZMCA Weedons, whereas the Applicant's proposed limits are to apply essentially at the quarry boundary, approximately 270-metres closer to the noise source.

50. That considered, the proposed noise limits evaluated at the quarry boundary are as strict or more strict than than the District Plan limits evaluated at NZMCA Weedons, excluding any adjustments for special audible characteristics.

51. The Applicant has introduced an evening period, in line with NZS 6802:2008 and to recognise the surrounding community's greater sensitivity to noise in the evening, which makes a further concession of about 5 dB to the District Plan limits. I am in favour of this provision, and I note that it also reflects the decline in the existing background noise level that occurs between 6pm and 9pm (paragraph 38).

52. The only area where the proposed limits are significantly less stringent than the district plan is between 07:00 and 07:30, where the day time limit is proposed to apply. In my opinion this is justified by ambient measurements (paragraphs 37 and 38 of my evidence and figure 11 of the Applicant's Environmental Noise Assessment), which show that the noise from traffic already exceeds the district plan noise limit prior to 07:00.

53. In my view the noise limits proposed by the Applicant are reasonable when considered separately within each time period, but they may not protect against the cumulative effect of continuous exposure to the distinctive quarrying noise from 7:00am to 6:00pm, six days per week most of the year and 7:00am to 8:00pm, six days per week for 120 days per year.

SPECIAL AUDIBLE CHARACTERISTICS

54. The SDP, section *C0 Noise Measurement and Assessment*, states that "adjustments for special audible characteristics, if present, as provided for in Clause 4.3 and 4.4 of [NZS 6802:1991] shall apply and will have the effect of imposing a numerical noise limit 5 dBA more stringent than the L10 numerical limits stated in the rules".

55. NZS 6802:1991 in clause 4.3 states: "noise that has special audible characteristics, such as tonality or impulsiveness, is likely to arouse adverse community response at lower levels than noise without such characteristics".

56. Clause 6.3 of the current version of this standard, NZS 6802:2008, states: "where the sound being assessed has a distinctive character which may affect its subjective acceptability (for example it is noticeably impulsive or tonal), the representative sound level shall be adjusted to take this into account".

57. SDP and NZS 6802:1991 apply a 5 dB penalty to the noise limit, whereas NZS 6802:2008 differs by applying an "adjustment" of 5 dB to the predicted noise level. In the case of SDP and NZS 6802:2008 the level adjustment is mandatory, while in NZS 6802:1991 it is optional.

58. In my opinion the central processing plant and the mobile crusher will have special audible characteristics. The sound of a crusher/screener is distinctive: very repetitive, with rapid loud impulses several times per second (3 Hz is typical). The repetitive

"crunch-crunch-crunch-crunch-..." of the crusher/screener noise makes it hard to 'tune-out', as one might be able to do with the constant hum of distant traffic noise, for example.

59. Regarding special audible characteristics, the Environmental Noise Assessment states in section 4.2.1

"This correction accounts for the any particularly distinctive sound character, e.g. tonality or impulsiveness. However, noise from quarrying is not typified by such characteristics and therefore no adjustment is warranted under either version of the Standards."

60. In my opinion this interpretation is incorrect. The standard primarily requires the sound to have a "distinctive" character, which may be understood as an audible character that serves to distinguish it from other sounds. It is certainly the case that the repetitive impulses of the crushing/screening unit are unlike any other noise that currently exists in the vicinity of NZMCA Weedons. Further, the standard explicitly cites 'impulsive' as an example of a special audible character, and in Appendix B CB4.1 gives examples for impulsive characteristics including chipping hammers and panel beating. In my opinion, industrial chipping hammers are less acoustically impulsive than rock crushing.

61. Therefore, the central crusher/screener and the mobile crusher can be expected to cause adverse noise effects exceeding those implied by the predicted noise level alone.

62. Accepting that the crusher/screener has special audible characteristics has the following consequences:

    a. The SDP requires that the daytime limit shall be reduced by 5 dB to 55 dB L_{A10}, equivalent to about 52 dB L_{Aeq} evaluated at NZMCA Weedons.

    b. NZS 6802:2008 6.3.1 requires that "the representative [predicted] sound level shall be adjusted" to account for the distinctive character. Appendix B.4 of the Standard states that the adjustment shall be 5 dB.

    c. The Applicant's Environmental Noise Assessment introduced an evening period, in part, to recognise the community's greater sensitivity to noise in the

evening. The continuing use of equipment with such a recognisable acoustic character into that time period would be, in my opinion, at odds with that goal of protecting evening amenity.

d. Operation of any crushing/screening units during the night time would certainly exceed the SDP night time noise limit once the 5 dB penalty is applied, or the predicted noise levels are adjusted in the case of NZS 6802:2008. To be clear, operation of this type of unit at night time has not been proposed.

63. The cumulative effect of a full day of distinctive quarry noise followed by a continuation of that noise into the evening is, in my opinion, likely to cause annoyance at NZMCA Weedons, where a working rural noise environment might reasonably be expected during the day, but a tapering off of work activity and road traffic noise provides the expectation of a more organic noise environment in the evening.

64. The potential adverse effects due to the repetitive nature of the sounds are such that that in my view the operation of any outdoor crushing or screening equipment outside of core daytime hours of 07:00 to 18:00 should be excluded to maintain amenity in the evening and sleep at night. The easily recognisable acoustic signature of the crusher/screener would make such a condition straight-forward to enforce.

PREDICTED QUARRY NOISE LEVELS

65. My understanding of the proposed noise sources and levels is based on the Applicant's Environmental Noise Assessment, their August RFI response, and my previous experience of crusher/screener units operating on other sites.

LEVELS AT NZMCA WEEDONS

66. NZMCA Weedons Park is represented in the Applicant's Environmental Noise Assessment as receiver ID = 9. The nearest boundary of the proposed quarry is approximately 270 m to the north-east, and the fixed processing plant approximately 750 m to the north-east.

67. The Applicant's Environmental Noise Assessment predicts the following noise levels in dB $L_{Aeq(15min)}$ at NZMCA Weedons from quarrying activities alone:

Form Pit	Stage 1	Stage 3	Stage 5	Evening	Night
39	45	47	47	46	39

It is understood from Mr. Farren's evidence that whilst the staging plan has since changed, the predicted levels remain materially unchanged.

68. The Environmental Noise Assessment and August RFI response further detail a provision for occasional use of a mobile crushing plant during the daytime period, which is predicted to contribute additional noise to NZMCA Weedons of approximately 50 dB $L_{Aeq(15min)}$ at its closest approach.

69. The wind rose in figure 9 of the Applicant's Environmental Noise Assessment shows that about 50% of the time the wind direction is from the north-eastern quadrant, during which time NZMCA Weedons would be directly downwind from the quarry and subject to enhanced noise propagation. The Environmental Noise Assessment confirms that its predicted levels are calculated with this wind condition assumed.

70. I conclude that the upper bound of the LAeq(15min) noise levels predicted for NZMCA Weedons from all quarrying activities is:

    a. Day 07:00-18:00 52 dB $L_{Aeq(15min)}$
    b. Evening 18:00-20:00 46 dB $L_{Aeq(15min)}$
    c. Night 20:00-07:00 39 dB $L_{Aeq(15min)}$

(Note: the day level of 52 dB derives from the incoherent logarithmic sum of 50 dB and 47 dB)

71. These noise level predictions exclude noise from any trucks travelling to or from the quarry on John's Road, Curraghs Road, or Maddisons Road.

72. The predicted upper bound LAeq noise level at NZMCA Weedons during the day time is 52 dB L_{Aeq}, which is exactly the SDP limit, after the special audible character and LA10 to LAeq 'conversion' are accounted for.

73. The evening and night-time levels are comfortably below their respective SDP limits, evaluated at the NZMCA Weedons boundary.

NOISE LEVELS AT THE ASSESSMENT LOCATION

74. The Applicant's proposed limits essentially apply at the boundary of the quarry. The Application's Environmental Noise Assessment does not provide specific noise levels for the quarry boundary, only for individual receivers at various distances further back. However, predicted daytime noise levels at the south-western boundary of the quarry can be inferred from the noise contour plots in figures 16 and 17 and the mobile plant data in table 17 of the Assessment:

    a. Stage 3 and 5 excavation at the quarry boundary: 51 – 52 dB $L_{Aeq(15min)}$

    b. Mobile plant at 20 m from the quarry boundary: 54 dB $L_{Aeq(15min)}$

75. The combined predicted noise level at the quarry boundary is 56 dB $L_{Aeq(15min)}$, found by incoherent logarithmic summation of the above noise levels. This exceeds the proposed noise limit of 55 dB L_{Aeq}. This exceedance is only likely when the mobile crushing plant is operating on the south west portion of the quarry site. Note that this exceedance of the noise limit occurs before any adjustment has been made for 'special audible character'.

76. When the predicted day time level at the quarry boundary is adjusted upwards by 5 dB to account for the distinctive impulsive character of the crushing units, it exceeds the proposed noise level at the quarry boundary by 6 dB.

77. If crushing/screening contributes a special audible character to the evening noise emission, the predicted level at the quarry boundary is subsequently adjusted upwards by 5 dB, and figure 18 of the Assessment indicates that the evening noise limit of 50 dB L_{Aeq} would be exceeded at locations inside the 45 dB contour, by up to 5 dB.

78. Figure 19 of the Assessment shows that the night-time period will remain within its proposed noise limit. No adjustment is applied to this time period.

PERCEPTION OF NOISE

79. The ambient noise measurements made at NZMCA Weedons demonstrate that the LAeq level is heavily influenced by sporadic noise sources, principally air traffic. The background noise level, which excludes the sporadic events and has been estimated by the LA90 parameter by both Mr Farren and myself, is dominated by the constant hum of traffic on SH1 to the east. My ambient noise measurements (paragraphs 37 and 38), as well as those of Mr Farren (paragraph 33 of his evidence), have established that over the majority of the day the existing background noise level is approximately 5 dB to 10 dB below the LAeq level.

80. Based on the descriptions of equipment provided in table 15 of the Environmental Noise Assessment, the quarry is expected to generate noise of a mostly constant level, minute-by-minute. It will therefore affect the background noise level at NZMCA Weedons, whilst the sporadic peaks in noise level will remain relatively unaffected.

81. To evaluate the perception of noise and its effects, it is therefore appropriate to compare the predictions of quarry noise level with the background LA90 noise level at NZMCA Weedons, rather than the measured LAeq, which includes plane overflights. NZS 6802:2008 6.5.2 states that *"the intrusiveness of a specific sound is dependent on several factors. One of these factors is the level of the specific sound compared to the background sound level."*

82. The Environmental Noise Assessment, section 7.3 states

    "In terms of the actual aural experience of local noise-sensitive receivers, audibility is the key factor that governs how "noticeable" noise from the quarry is. This is a relative assessment against the existing noise environment, rather than a comparison of absolute levels and criteria."

    I generally agree with this assertion and, following section C6.1.2 of NZS 6802:2008, add that any distinctive character to the noise will enhance its audibility, and the duration will have an effect on its potential to cause annoyance.

83. The comparison of predicted noise level from the quarry (in LAeq) with the existing background noise level (in LA90) at NZMCA Weedons is summarised for the three periods of the day as follows:

a. During the day the quarry noise (52 dB $L_{Aeq(15min)}$) is predicted to exceed the existing background noise level (47 dB $L_{A90(15min)}$) by up to about 5 decibels. The quarry noise will be clearly audible to NZMCA Weedons occupants and be distinguishable as quarry activity due to its level, its direction of origin, and its acoustic character. During some stages of excavation and activity the quarry noise is likely to cause a moderate increase in background noise level, replacing road traffic noise as the dominant background noise source.

b. During the evening the quarry noise (46 dB $L_{Aeq(15min)}$) is predicted to be at a comparable level to the existing background noise (45 dB $L_{A90(15min)}$). Quarry activity will likely be distinguishable because of its distinctive acoustic character, which sets it aside from the other rural background noise sources. If no crushing/screening took place during this time the quarry noise would likely not be audible.

c. During the night the quarry noise (39 dB $L_{Aeq(15min)}$) is predicted to be at a comparable level to the existing background noise (38 dB $L_{A90(15min)}$) before 1am and after 4am. Between those hours the road traffic noise drops off in level to below 30 dB $L_{A90(15min)}$ and during this time the quarry noise could appear much louder than the other existing background sources, while still being relatively quiet in absolute terms.

84. In summary, during some stages of excavation the quarry noise is likely to become the dominant source of background noise at NZMCA Weedons during the day. Into the evening both the quarry noise and traffic noise drop off, but the quarry noise will still be audible because of its distinctive character. Over night the quarry noise may be audible from time to time depending on weather conditions, particularly in period from 1am to 4am.

REVERSING ALARMS

85. Mr. Henderson's proposed noise condition 47 requires that "all quarry-equipment, including trucks" that require audible alarms will be fitted with broadband reversing alarms and that tonal alarms are not permitted.

86. This wording differs subtly from that in the August RFI response (Noise – 31), which by my reading only applies to quarry-*based* equipment, and does not specifically include trucks.

87. I support Mr. Henderson's wording and believe that this is appropriate and necessary mitigation to the potential annoyance from reversing beepers.

TRUCK MOVEMENTS

88. Curraghs Road is 250 m to the north-east of NZMCA Weedons and within clear line of sight. I am concerned about the possibility of a significant increase in truck traffic along Curraghs Road due to the operation of the quarry, particularly any traffic in the evening or overnight, which would constitute an additional source of noise that is not considered by the noise level predictions above.

89. In the absence of other practicable measures of road traffic noise mitigation, I suggest that trucks travelling to or from the quarry should not be permitted to use Curraghs Road unless the source/destination is on or adjacent to Curraghs Road in line with Mr Henderson's proposed condition.

NOISE EFFECTS

90. The noise from full operation of the quarry is likely to be generally continuous, and will contribute to the background noise level, and therefore its potential effects should be evaluated against the existing LA90 background noise level (see paragraphs 79-82 above).

91. From my reading of the Environmental Noise Assessment it is unlikely that occasional 'peaks' in noise (LAmax) from quarry activity will be at such a level as to cause disturbance at NZMCA Weedons during full quarry operation.

92. Operation of crushing and screening plant will generate noise with a distinctive acoustic character, that could be described as "repetitive impulses". Noises with special audible characteristics are commonly accepted to be more annoying to communities than their noise level alone would indicate. Both the SDP and NZS 6802:2008 apply a 5 dB penalty on the noise level assessment (albeit in different

ways) in an attempt to compensate for the additional annoyance of distinctive sounds.

FOR THE DAYTIME PERIOD (07:00-18:00)

93. The daytime noise limit of 55 dB LAeq at the quarry boundary is appropriate.

94. The predicted day time noise level at the assessment location (at the quarry boundary), while the mobile crusher is in use, will exceed the noise limit by up to 6 dB once the distinctive character penalty is applied, and will exceed by 1 dB if it is not. This is likely to cause an adverse community response.

95. In terms of perception, the predicted day time noise level at NZMCA Weedons while the mobile crusher is in use will be 5 dB higher than the existing LA90 background noise level (which excludes sporadic events) and feature a distinctive characteristic. When work is close to NZMCA Weedons, and in some meteorological conditions, this will cause a moderate increase in background noise level, and the quarry noise will be easily distinguishable and dominate the noise environment.

96. Conversely, when work is taking place far from NZMCA Weedons, the mobile crusher is not in use, or the wind is generally from the south, the quarry noise may be below the ambient background noise level and inaudible.

97. The quarry will introduce distinctive sounds of heavy machinery into in a working rural environment; although the current noise environment is also already subject to relatively high levels of road, rail, and air transport noise, and occasionally noise from agricultural equipment.

98. Therefore, based on
    a. the exceedance of the proposed noise limit at the quarry boundary,
    b. the perceptibility of the noise at NZMCA Weedons, and
    c. the fact that it will be obviously attributable to the quarry,

    I conclude that it is very likely that daytime quarry noise will cause annoyance to NZMCA Weedons users under some operating and metrological conditions.

99. If the mobile crushing plant was restricted to operating only in the central portion of the site where the permanent plant is based, I would expect that to mitigate

noise effects on NZMCA Weedons as well as enabling the proposed day time noise limit to be achieved most of the time.

FOR THE EVENING TIME PERIOD (18:00-20:00)

100. The proposed evening noise limit of 50 dB LAeq at the quarry boundary is appropriate.

101. The predicted evening noise level at the assessment location (near the quarry boundary) exceeds the proposed limit by up to 5 dB after the distinctive character adjustment is applied. If the penalty is not applied the level is not predicted to exceed the limit.

102. In terms of perception, the predicted noise level at NZMCA Weedons is similar to the existing evening background noise level (which excludes sporadic events). When work is close to NZMCA Weedons, and in some meteorological conditions, the quarry noise will be audible and distinguishable from other noise sources, particularly the crushing/screening unit.

103. Conversely, when work is taking place far from NZMCA Weedons or the wind is generally from the south, the quarry noise may be below the ambient background noise level and inaudible.

104. The quarry will introduce the distinctive sound of heavy machinery into in a rural environment. As the evening draws on and the background road noise level drops off, the continuing operation of the quarry will contrast further with the surrounding rural noise environment.

105. My expectation from speaking to members is that noise effects during this time period are likely to be felt more keenly because they value the relative quiet of the evenings to relax outdoors and indoors. There may be a cumulative effect if the distinctive quarry noise heard during the working day also extends into the evening period, even if the absolute level reduces.

106. Therefore, based on
    a. the exceedance of the proposed noise limit at the quarry boundary,,
    b. the perceptibility of the noise at NZMCA Weedons,

c. the fact that it will be obviously attributable to activity at the quarry,
d. the quarry noise being at odds with the progressively more organic evening noise environment,
e. my understanding that many NZMCA Weedons users expect the evening will be a 'quiet' period, and
f. the cumulative effect of evening noise after a full day of quarry noise,

I conclude that it is very likely that the evening quarry noise will cause annoyance to NZMCA Weedons users under some operating and metrological conditions.

107. If the quarrying work can be justified to start earlier in the day to reflect the existing morning noise environment – as it has been and which I agree with – then by the same logic the existing evening noise environment should be maintained and noisy activities that detract from that should be restricted.

108. I consider that if crushing and screening work was prevented from occurring after 6pm it would remove the distinctive character of the sound, which would make it more acceptable to the users of NZMCA Weedons and would enable the noise limit to be achieved.

FOR THE NIGHT-TIME PERIOD (20:00-07:00)

109. The night-time noise limit of 45 dB L_{Aeq} at the quarry boundary is appropriate, and finishing the night-time period 30 mins early at 07:00 instead of the SDP's 07:30 is justified by the already high ambient noise levels at that time of day.

110. The predicted night-time noise level at the assessment location (near the quarry boundary) is below the proposed limit.

111. The predicted noise level at NZMCA Weedons is similar to the existing night-time background noise level (which excludes sporadic events). In some meteorological conditions the quarry noise will be audible and distinguishable from other noise sources, particularly if work occurs between 1am and 4am.

112. Truck movements along Curraghs Road during this time period could be disruptive.

113. I consider that while the overall noise level can comply with the limits the Applicant has proposed, taking a 'belt and braces' approach it would be prudent to specifically exclude some types of activity from occurring, even if these are not currently planned. No operation of crushing/screening plant should be permitted, nor any other activity with a special audible character, nor should any noisy activity occur outside of the central portion of the quarry site.

DRAFT CONDITIONS

114. Without appropriate additional conditions, I believe that operation of the proposed quarry will lead to unreasonable noise effects on NZMCA Weedons.

115. With minor alterations, Mr. Henderson's proposed draft conditions will be appropriate for managing most of the noise effects of the proposed quarry on NZMCA Weedons:

116. On the hours of operation: as in table 1 of Mr. Henderson's draft condition 19, but with the following modifications

    a. From 6:00am to 7:00am: specifically exclude any crushing and screening activity.

    b. From 6:00pm to 8:00pm: specifically exclude any crushing and screening activity.

    c. Sundays, public holidays, and between 8:00pm and 6:00am: specifically exclude any crushing and screening activity, any other activity with a distinctive audible character, and any noisy activity occurring outside of the central portion of the quarry site.

    d. Make explicit that activities not specified in the 'Range of Activities' for each time period are excluded from taking place during that period.

117. On use of the mobile crusher: Mr. Henderson's draft condition 30, but with the minimum setback distance for mobile plant increased from 250 m to 500 m from the south western boundary of the site, as is already the case for fixed plant. I understand that the provision for a mobile crusher is to allow extended capacity when required to meet demand and to enable different products to be produced, rather than being 'mobile' in the sense that it needs to move around on site. If that

understanding is correct in regards to the Applicant's intention for the crusher then the increased setback distance required to manage noise effects at NZMCA Weedons may not be onerous.

118. On reversing beepers: Mr. Henderson's draft noise condition 47 on reversing beepers should be retained, using his wording that encompasses all activities occurring on site. Mr. Bligh's wording excludes equipment not "based" at the quarry, which may undermine the intention of this condition to prevent tonal reversing beepers from being heard outside of the quarry, regardless of which exact vehicle is generating the tone.

119. On truck usage of Curraghs Road: I generally support Mr. Henderson's draft condition 37(a) that 'trucks may only use Curraghs Road if delivery is in the immediate vicinity', but leave to the panel's judgement whether "immediate vicinity" is sufficiently specific. An alternative may be "where the delivery is on or adjacent to Curraghs Road". I do not support Mr. Bligh's alternative condition 38(a), which deletes Curraghs Road from the list of restricted truck routes.

120. Without these conditions in place I consider the noise from the operation of the quarry could cause unreasonable adverse effects and loss of amenity for NZMCA Weedons and its users.