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BEFORE AN INDEPENDENT HEARINGS COMMISSIONER AT NELSON

COUNCIL REF: RM200488, RM200489 AND RM220578

UNDER THE	Resource Management Act 1991
IN THE MATTER OF	Land use consent applications by CJ Industries Limited to extract gravel from 134 Peach Island Road, Motueka from the berm of the Motueka River and on the landward side of the stopbank at Peach Island with vehicle access via a right of way over 493 Motueka River West Bank Road, Crown land and unformed legal road (RM200488 and RM200489); and discharge permit application by CJ Industries Limited to discharge contaminants to land from backfill material associate with the proposed gravel extraction (RM220578).

STATEMENT OF EVIDENCE OF JOACHIM LANG ON BEHALF OF VALLEY RESIDENTS AGAINST GRAVEL EXTRACTION (NOISE)

Dated: 11 November 2022

QUALIFICATIONS AND EXPERIENCE

1. My full name is Joachim Lang. I am an acoustic consultant and have my own consultancy called Nelson Acoustics.

2. I hold a Masters Degree of Electrical Engineering with Acoustics from the Technical University of Berlin. I have worked in the field of acoustics for approximately thirty years. and I have previously been employed in Germany by Mueller BBM – one of the biggest acoustic consultancies in Europe- as well as BESB in Berlin. I have worked as an independent acoustic consultant for over 25 years now. I have been involved in measurements and reports used in court proceedings and I have conducted measurements and reports for resource consent applications to the Tasman and Nelson District Councils.

CODE OF CONDUCT

3. I confirm that the evidence given is within my area of expertise, except where I state that I am relying on information supplied to me by another source. I have not omitted to consider material facts known to me that might alter or detract from the opinions that I express. I have no commercial relationship with the Valley Residents save my role as an expert in relation to this application.

4. I confirm that I have read the Code of Conduct for expert witnesses contained in the Environment Court Practice Note 2014. My evidence has been prepared in compliance with that Code.

BACKGROUND AND ROLE

5. My evidence is given on behalf of Valley Residents Against Gravel Extraction Inc (Valley R.A.G.E), a submitter on CJ Industries Limited's resource consent applications to extract and transport gravel from Peach Island, Motueka.

6. In preparing my evidence I have:

6.1 visited the proposed site of the quarry, taken noise measurements and calculated noise attenuation during sound propagation and in relation to the noise-barrier proposed by the Applicant

6.2 used a sound level meter with data logger LT SL-4033SD which meets IEC 61672 class 1 specifications. The device was calibrated before and after the measurement with a Protech QM1598 acoustic calibrator

6.3 reviewed the Applicant's Assessment of Environmental Effects, an in particular Appendix C: The Assessment of Noise report prepared by Hegley Acoustic Consultants

6.4 reviewed the evidence statements of Rhys Hegley (uploaded to the Council site on 15 July 2022 and 4 November 2022)

6.5 reviewed the memorandum of Daniel Winter, Team Leader Environmental Health at Tasman District Council dated 11 October 2022

6.6 reviewed those parts of the Council s42A reports relevant to noise matters

6.7 reviewed the relevant noise provisions in the Tasman Resource Management Plan including Rule 17.5.2.1(c)

6.8 reviewed NZS 6802:2008 Acoustics – Environmental Noise and NZS 6801: 2008 Acoustics – Measurement of Environmental Sound

6.9 reviewed ISO 9613-2 Acoustics — Attenuation of sound during propagation outdoors — Part 2: General method of calculation, and

6.10 reviewed submissions relating to noise.

SCOPE OF EVIDENCE

7. The purpose of my evidence is to discuss the potential noise levels and noise disturbance effects of CJ Industries Limited's proposed quarry as well as the measures it proposes to adopt, avoid, remedy or mitigate acoustic effects.

8. My evidence:

   8.1 evaluates the appropriateness of the standards, guidelines and methodology used by CJ Industries to assess potential noise from the proposed quarry development,

   8.2 assesses the existing noise environment,

   8.3 assesses the potential noise effects of the proposed development on nearby residences,

   8.4 assesses the measures CJ Industries proposes to use to address potential effects,

   8.5 determines whether CJ Industries' proposed operations will be unreasonable in the context of the environment in which they will occur

   8.6 evaluates the conclusions reached by CJ Industries as to the potential noise effects of the extraction of aggregate and transport of aggregate materials

EXECUTIVE SUMMARY

9. In my expert opinion I consider the excavation and machinery noise as unsuitable for this environment and an excessive disturbance. My colleague and I measured ambient levels on a calm day as being under 40dBA LA_{90}. This is a similar measurement to that taken by Mr Winter from the Tasman District Council. This level is well below the predicted noise levels of the excavation noise.

10. The noise levels of the operation have to be under the required plan limits at all times during a 15min interval and at all days without exception (for example unfavourable wind conditions etc).

11. I took measurements of the type of heavy machinery such as excavators that the Applicant proposes to use for the operation. This machinery has special audible characteristics such as an audible tonal component as well a strong impulsive character. Therefore a 5dBA adjustment needs to be applied and also a 3dBA margin for errors as well together with a +3dBA adjustment for atmospheric conditions such as winds over 5 Beaufort, which is common in New Zealand and in this valley. The average wind-speed per day in Ngatimoti in the years from 2009 to 2017 was between 8km/h -15km/h and maximum average wind-speeds over 32km/h for several hours.

12. In accordance with my assessment, the quarry operation would exceed the permitted activity limits in the Tasman Resource Management Plan (the Plan).

13. While I appreciate the noise limit in the Plan for the Rural 1 Zone is **L_{Aeq} 55dB** during the day, in my opinion, the nature of the machinery and gravel extraction noise requires more stringent regulations than the ones required by the Plan. I agree with the council reporting planner and Mr Winter that the proposed operation is not anticipated in this particular environment. I also agree that the noise limits need to reasonable and must maintain an appropriate level of amenity. Many of the local residents talk in their submissions about the existing amenity levels (such as Ollie and Nataliya Langridge (submission #109 and 132 for land use, and 54 and 55 for discharge permit applications).

14. I do not agree with Mr Winter and the council reporting planner that a noise level of 51dB LAeq is reasonable in this environment, in particular given the special audible characteristics of the machinery the Applicant proposes to use.

15. In my view, a noise limit of 45dBA is appropriate in this environment and this level will be exceeded by the proposed operation.

DESCRIPTION OF LOCATION

16. The location of the proposed operation is at 134 Peach Island Road, Motueka which is next to the Motueka River and surrounded by several residential dwellings. (For details and plans please refer to the Planscapes Report).

BACKGROUND

17. The zoning for this location is rural 1 and the Tasman District Council resource management plan rules for this zone state:

> "…. Noise generated by the activity, when measured at or within the notional boundary of any dwelling in a Rural zone (other than any dwelling on the site from which the noise is being generated)… does not exceed:
>
> **Day Time**
> L_{Aeq}: 55 dB
> **Other Times**
> L_{Aeq}: 40 dB and L_{AFmax}: 70 dB
>
> b) Daytime means 7am to 9pm Monday to Friday, and 7am to 6pm Saturdays.
> All other times are night times including Sundays and public holidays.
> All measurements and assessment in accordance with ZS6801:2008 and NZS6802:2008."

18. NZS6802 states:

> C4.1 "The degree of protection will depend upon the nature of the area under consideration. A residential area in a quiet environment may reasonably expect a higher degree of protection than a residential area in an already relatively noisy environment. Sound which is acceptable on a commercial site adjacent to a residential area, may be unacceptable if received in a quiet residential area (e.g. from a home occupation). Many Territorial Authorities have, for instance set L10 limits of 50 dBA daytime and 40 dBA night-time for such areas. **In some cases, limits have been set up to 10 dBA below the existing background level in order to ensure no degradation of the existing sound environment and long term the sound level may be reduced"** (my emphasis).

19. Many District councils rules require L_{aeq} to be below 40dB at other times than daytime and the daytime limits to be under 50dBA. This applies to rural zones (no matter whether they are used residential or not) and includes Auckland, Christchurch, Marlborough, Palmerston North and others. Considering that the location here is rural and residential the specific character of this environment has

to be considered as well. This is a point also made by Mr Winter and the reporting officer.

20. This is also emphasised in NZS6802 which states:

> "Community reaction to noise is determined not only by the sound level, but also by the characteristics of the noise itself and the previous exposure of the community to noise. This Standard provides a guide for estimating the acceptability of sound based on sound level, and when community reaction is influenced by other factors, the assessment procedure may require modification."
>
> And:
>
> "However, when the sound(s) under investigation does comply this does not necessarily satisfy the duty to adopt the best practicable option for controlling noise under section 16 of the Resource Management Act."

21. It is therefore the decision of the Council to decide whether the maximum levels in the plan are applicable or if a more stringent level needs to be applied.

22. NZS6802:91 defines background noise levels as:

> "Description of background sound: The descriptor for background sound in this Standard is L95. NZS 6801 includes procedures for the determination of background sound."

23. In addition, NZS6802:2008 states:

> "A3.1 The result of the measurement and assessment will determine whether the activity in question complies with the relevant consent condition, rule or national environmental standard during the day the measurements were taken. No averaging of measurements from one day to the next is permitted."

24. Furthermore NZS6802:2008 states:

> "A3.2 If the activity complies on one day and not another, the activity may be deemed non-compliant under the conditions which cause the higher level, or non-compliant overall. For this reason, an appropriate assessment would be one which assesses the worst-case level with regards to day-to-day variation."

This means that the day when the activity has the highest noise level is to be assessed.

25. WHO guidelines also pick up on this issue. The WHO states on their website (https://www.who.int/docstore/peh/noise/Comnoise-4.pdf):

> *"When the noise is composed of a large proportion of low-frequency sounds a still lower guideline value is recommended, because low frequency noise (e.g. from ventilation systems) can disturb rest and sleep even at low sound pressure levels. It should be noted that the adverse effect of noise partly depends on the nature of the source. A special situation is for newborns in incubators, for which the noise can cause sleep disturbance and other health effects. If the noise is not continuous, LAmax or SEL are used to indicate the probability of noise induced awakenings. Effects have been observed at individual LAmax exposures of 45 dB or less. Consequently, it is important to limit the number of noise events with a LAmax exceeding 45 dB. Therefore, the guidelines should be based on a combination of values of 30 dB LAeq,8h and 45 dB LAmax. To protect sensitive persons, a still lower guideline value would be preferred when the background level is low. Sleep disturbance from intermittent noise events increases with the maximum noise level. Even if the total equivalent noise level is fairly low, a small number of noise events with a high maximum sound pressure level will affect sleep.*
>
> *To protect sensitive persons, a still lower guideline value would be preferred when the background level is low.*
>
> *Noise with low frequency components require even lower levels. It is emphasized that for intermittent noise it is necessary to take into account the maximum sound pressure level as well as the number of noise events. Guidelines or noise abatement measures should also take into account residential outdoor activities.*
>
> *Specific Environments Noise measures based solely on LAeq values do not adequately characterize most noise environments and do not adequately assess the health impacts of noise on human well-being. It is also important to measure the maximum noise level and the number of noise events when deriving guideline values. If the noise includes a large proportion of low-frequency components, values even lower than the guideline values will be needed, because low-frequency components in noise may increase the adverse effects considerably. When prominent low-frequency components are present, measures based on A-weighting are inappropriate. However, the difference between dBC (or dBlin) and dBA will give crude information about the presence of low-frequency components in noise. If the difference is more than 10 dB, it is recommended that a frequency analysis of the noise be performed.*
>
> *Dwellings*
>
> *In dwellings, the critical effects of noise are on sleep, annoyance and speech interference. To avoid sleep disturbance, indoor guideline values for bedrooms are 30 dB LAeq for continuous noise and 45 dB LAmax for single sound events. Lower levels may be annoying, depending on the nature of the noise source.*
>
> *To protect the majority of people from being moderately annoyed during the daytime, the outdoor sound pressure level should not exceed 50 dB LAeq. These values are based on annoyance studies, but most countries in Europe have adopted 40 dB LAeq as the maximum*

> *allowable level for new developments (Gottlob 1995). Indeed, the lower value should be considered the maximum allowable sound pressure level for all new developments whenever feasible."*

26. So the WHO states that daytime levels should not exceed 50 dBA to avoid people from being moderately annoyed. In a residential area I think it is not appropriate for people to be even moderately annoyed.

27. WHO also states that when low frequencies are present (as it is the case here) A weighted levels are not appropriate for assessment and a spectrum analysis needs to be carried out. As quoted above: "*When the noise is composed of a large proportion of low-frequency sounds a still lower guideline value is recommended, because low frequency noise (e.g. from ventilation systems) can disturb rest and sleep even at low sound pressure levels."*

28. The Resource Management Act states:

> "Duty to avoid unreasonable noise: Every occupier of land (including any premises and any coastal marine area), and every person carrying out an activity in, on, or under a water body or the coastal marine area, shall adopt the best practicable option to ensure that the emission of noise from that land or water does not exceed a reasonable level."

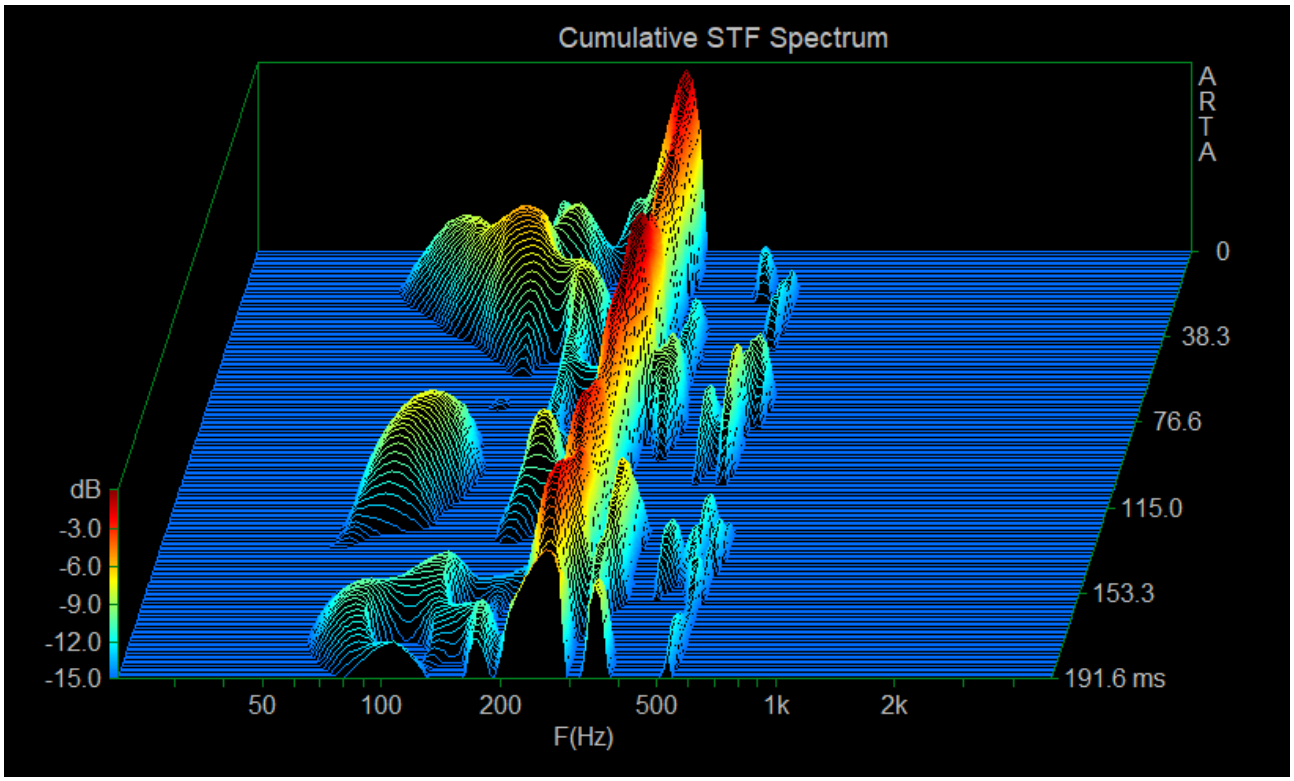
29. I consider any audible machinery noise and in particular at the levels proposed by this operation, to be unreasonable in this environment and especially because they will contain special audible characteristics.

30. NZS6802 states:

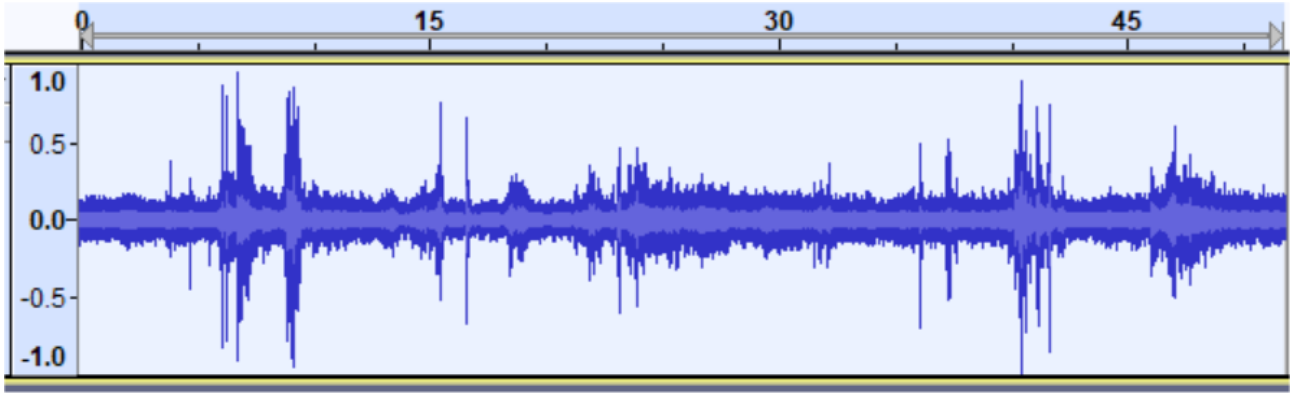
> "Special audible characteristics
>
> Noise that has special audible characteristics, such as tonality or impulsiveness, is likely to arouse adverse community response at lower levels than noise without such characteristics. At present there is no simple objective procedure available to quantify special audible characteristics, and subjective assessment is therefore necessary, (supported where appropriate by objective evidence, e.g. frequency analyses)."

31. When listening to excavation and truck noise it becomes apparent that this noise has special audible characteristics such as tonality and impulsiveness and the frequency analyses provides some objective evidence for this.

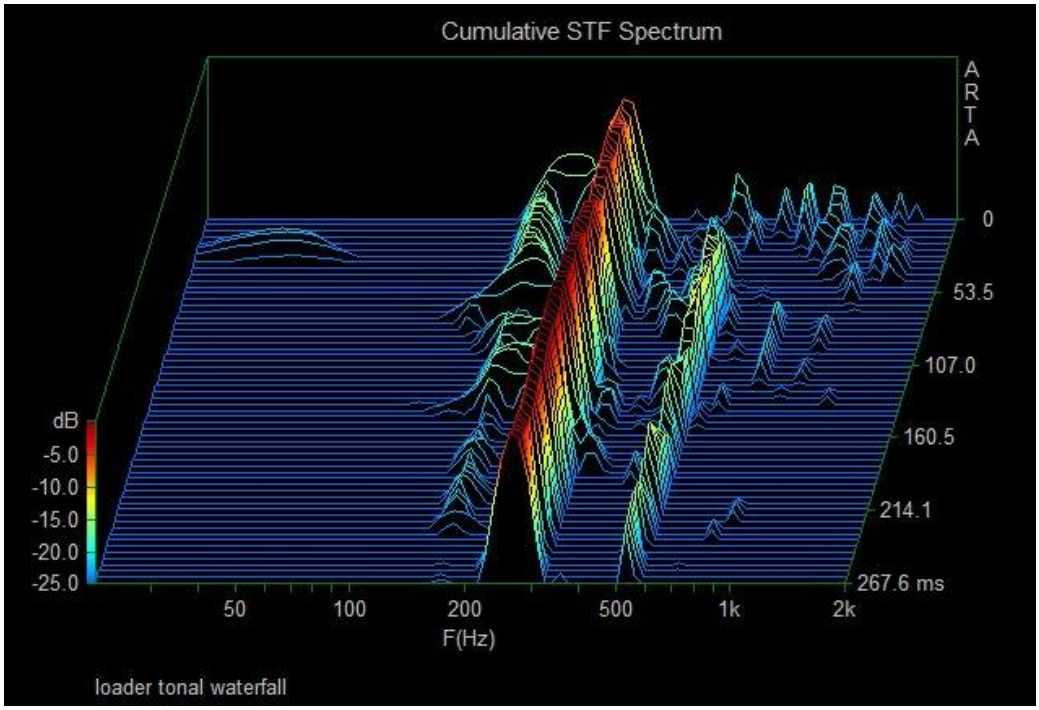
32. The graphs below show a strong tonal component at around 260Hz of a 20t excavator of the type that the applicant proposes, recorded by me on 9.November 2022 near Motueka.

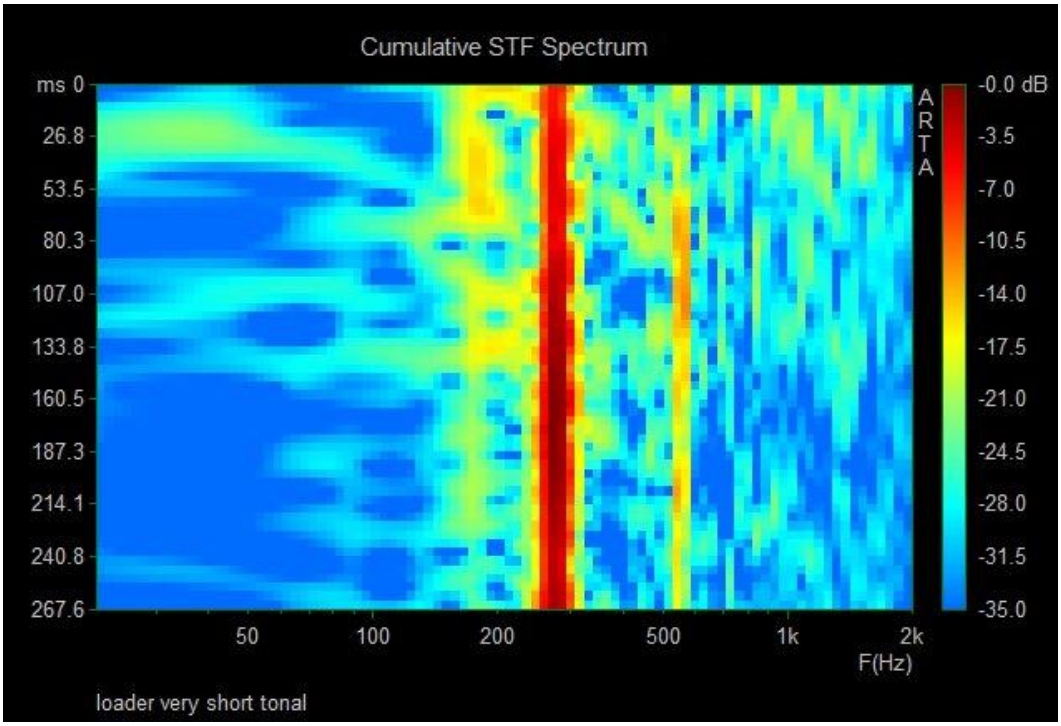


33. The following graph shows the impulsiveness of this excavator scooping gravel from the river and dumping it into a truck. The audio file can be found on youtube: https://www.youtube.com/watch?v=l5Q22VGA02Q



34. Additionally a video clip from youtube (https://www.youtube.com/watch?v=JvzUNfbKobI) was analysed at 41sec-44sec into the clip (no reverse beeping noise present at that time). The graphs below also show a strong tonal component of a Cat 972M standard loader at around 270Hz.

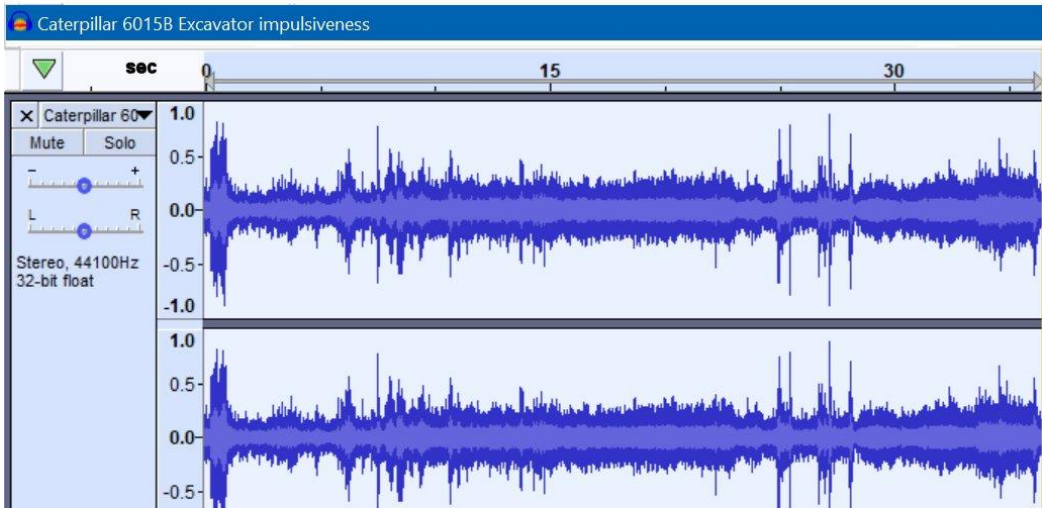




35. The tonal components are not present all the time and they also vary in pitch and intensity, however this has to be considered as an intermittent tonal component and certainly has characteristic that cannot be considered random or unobtrusive.

36. This clip on youtube also demonstrates the tonal characterisitics : https://www.youtube.com/watch?v=lTkmDxb0F5U

37. The amplitude/time graph over 35sec of this 6015B Caterpillar Excavator shows a high impulsiveness of the excavator, see below:



38. Analysed from youtube videoclip: https://www.youtube.com/watch?v=M9Ki29rLGEQ

39. When listening to excavation and truck noise it becomes apparent that this noise has special audible characteristics such as tonality and impulsiveness and the frequency and time analyses provides some objective evidence for this.

40. The NZ standard clearly states that impulsive noises are a special audible characteristic and that a subjective evaluation can be "*supported where appropriate by objective evidence, e.g. frequency analyses".* Which I have done in the analysis with graphs above.

41. While construction and excavation noises from a large number of machinery creates more randomness at several kilometres distance, a single machine at close proximity does not have any randomness but clearly has impulsive character as demonstrated above.

42. Therefore a 5dBA special audible characteristics adjustment must be made.

CALCULATIONS

43. I disagree with the findings of Hegley Acoustics in several points as outlined below.

44. The Hegley report does not mention any calculations with noise spectra as required by ISO 9613-2 but only total levels. Since the noise from the operation has a high level of low noise components this has to be taken into consideration, especially since low frequencies travel with much less attenuation over the ground and also bend around obstacles, such as bunds.

45. The notional boundary of the houses at 131 and 132 Peach Island Road are approximately 130m away from the closest excavation position, and the notional boundary of the house at 458 Motueka River West Bank road is 190m away from the closest excavation position.

46. A bund has not been included in the calculations below and will be addressed further down.

47. Why Hegley acoustics calculates a higher level for 470 and 472 Motueka River West Bank Road, which are further away than no 458, is unclear.

48. A 35t excavator produces a L_{AW} of around 114dB (as cited in https://www.acoustics.asn.au/conference_proceedings/AAS2009/papers/p11.pdf). But assuming an excavator with lesser tonnage is used we subtract 6dBA from this value and use 108dBA for the excavating machinery.

49. The following spectra have been measured from the above sound samples of an excavator (normalized to 118dB and 108dBA total as discussed above):

Frequency - Hz	63	125	250	500	1k	2k	4k	8k	Total unweighted	A weighted
Power level - dB	115	112	111	106	102	95	84	57	118	108

50. The levels will certainly differ slightly from machine to machine, an uncertainty of plus/minus 3dBA can be expected.

51. But assuming the above values of Lw =118dB for the excavator we calculated the following L_{Aeq} at different distances.

20t loader					
Frequency - Hz	Lw	LAW	LAeq 50m	at 130m	at 190m
level - dB	117.7	108	63	55	51
20t excavator					
Frequency - Hz	Lw	LAW	LAeq 50m	at 130m	at 190m
level - dB	110	106	61	53	49

52. These values were calculated according to ISO 9613-2 with ground factor 0.6, temp 20 degrees, humidity 70% and an average height of 2.5m.

53. ISO 9613-2 uses a downwind situation of 1-5m/s windspeed. According to the international Beaufort Scale that is 3 Beaufort, which means gentle breeze, id est leaves and twigs in constant motion. In contrast 5 Beaufort mean fresh breeze, small trees in leave begin to sway, crested wavelets form on inland waters. Considering that the property is in a valley a fresh breeze can be expected on many days. So a 3dBA higher level for stronger winds is to be added.

54. ISO 9613-2 states: Estimated accuracy for broadband noise: 0-5m height and 0-1000m distance: plus/minus 3dB. Therefore a margin of 3dBA needs to be applied to ensure that the noise levels will not exceed the set limits at any time.

55. A confidence range of 1dBA is absolutely unrealistic, especially considering that noise is stochastic and the levels that have been assumed are average levels with an uncertainty of plus minus 3dB.

56. MAS environmental UK writes:

> "We try to avoid using predicted sound levels when it is possible to take real-world measurements. This is to rule out any potential error and loss of accuracy, including not using road counts to estimate the sound level of a road as a replacement of measuring the road with a sound level meter."
>
> Ground height and building heights can be hugely important in noise mapping results by affecting the sound path-lengths and barrier efficacy. However, the ground levels used for modelling often cannot be easily inspected from a resulting noise map included with a noise impact assessment."

57. In the past I have measured a gravel extraction operation in Golden Downs and found that the noise level at 30m was 76dBA, according to noisemapping this value should have dropped to 60dBA at 210m, however the measurements showed levels of 6dBA more, id est 66dBA. This was caused by reflections from the hills across the river. In this case here the situation is similar since the river is surrounded by hills on each side and impulsive sounds produce echoes as noticed when we conducted tests in the valley. This indicates that noise mapping is not always as accurate as suggested. Further measurements on a calm day (Beaufort 1) in the valley showed that a small excavator operating at 691 Motueka River West Bank Road produce a noise level of $L_{AW(15min)}$ = 105dB and was measured at 200m down the river at a level of L_{Aeq} = 50dB. However, noise mapping resulted in a level of L_{Aeq} = 48dB under the assumption of no barrier. The excavator was operating behind a dwelling of 7m height though, it was therefore shielded and without a line of sight. Calculations with a barrier of similar dimensions would have resulted in a L_{Aeq} well below 40dB. Again this was caused by the reflections of the hills close by. An accuracy of 1dB for calculations is therefore absolutely unrealistic.

58. Additionally it is very likely that there is not only one machine operating but several at the same time. If 2 machines of similar noise levels operate close to each other then then total noise level would be 3dBA higher for both machines together. This is omitted in the Hegley Acoustic report. If four machines operate close together then the total would be approximately 6dBA higher.

59. Calculating only the noise of the machinery is not adequate in this case since the loading and handling of gravel, stones etc. produces much more noise than the

machinery itself. We conducted measurements of a similar operation in the Golden Downs and Motueka area and the measured noise levels were much higher than just the machinery itself. The dumping of rocks and gravel onto trucks and loaders produces a very high level of noise especially when the trucks are empty and the rocks fall onto the metal surface. Noise levels of L_{AW} = 120dB and more are typical. It is therefore not realistic to assume max levels of L_{AW} = 108dB.

60. The limits in the plan are meant as upper limits and not average limits. So those upper limits need to be achieved at any one time and not just on calm days. The worst scenario has to be assumed, which in this case is: several machines working close together, strong wind from and an unfavourable direction and noise from gravel and rock material producing excessive noise. This can easily be over a 15 minute interval as defined by the standard and the highest possible value has to be calculated.

61. Additionally, a 3dBA margin should be adopted considering the uncertainty about the machinery.

62. So to sum up the unfavourable conditions:

Dumping gravel and rocks on trucks L_{AW} = 120dB would result in a L_{Aeq} = 63dB at 190 metres, plus unfavourable windspeed and direction +3dBA, plus special audible characteristic since the noise is clearly impulsive plus 5dBA, plus a 3dBA margin of error brings the rated value for 458 Motueka River West Bank road to L_{Aeq} = 74dB.

63. NZS6802:2008 states: "However, when the sound(s) under investigation does comply this does not necessarily satisfy the duty to adopt the best practicable option for controlling noise under section 16 of the Resource Management Act."

64. "Best practicable option in relation to emission of noise means the best method for preventing or minimising the adverse effects on the environment considering, among other things, certain matters defined in the Resource Management Act."

65. The idea behind those rules is that people can enjoy their property without unreasonable noise considering the existing environment. This is a rural environment not an inner city environment and therefore much less background noise is present.

Even levels of 40dBA of machinery noise can be quite disturbing especially on a quiet day and with a background level of under 40dBA (as measured on 4.8.22 from 4.15pm – 4.30pm with little wind (Beaufort 1).

66. It is therefore my opinion that the maximum daytime level should be below 45dBA to maintain the rural characteristic of the area since machinery and excavation noise is not typical for this environment. Considering that this operation is planned to be carried out for over 15 years adds to the impact that the noise has on the residents.

67. As demonstrated above this machine has tonal components and a high component of low frequencies which are also more disturbing than broadband noise and therefore a 5dBA adjustment for special audible characteristics should be made.

68. It also has to be noted that the NZ standard NZS6802:2008 allows for an adjustment of minus 5dBA if noise is present less than 30% of the time. In other words this could mean that the gravel extraction could be 5dBA louder than the limit in the plan if present less than 30% of the prescribed time. Although this is the rule in NZS6802 it is my opinion that a 5dBA higher level for several hours a day is an excessive disturbance in this kind of environment. I therefore agree with Mr Winter that the maximum allowed noise level should be reduced accordingly.

NOISE BARRIERS

69. CEDR states:

> "The nature of sound is crucial because low frequency sounds, due to their large wavelength, bend more easily over a sound barrier than high frequency sounds. The result is that the sound spectrum recorded before the installation of a noise barrier is situated rather in the medium- and high-frequency region than the spectrum recorded after the installation of a noise barrier. This also means that a noise barrier will be less effective along a road with a high percentage of trucks emitting a sound of a lower frequency than the sound that cars would normally emit.
>
> If the noise barrier dimensions are well proportioned, and taking into account all these parameters, a LAeq reduction of 10 dB(A) can be achieved at ground level in an area situated closely behind the noise barrier. As the distance to the noise barrier increases, the noise level reduction decreases. At a distance of 250 meters, the LAeq reduction is limited to a few dB(A).
> "

(Cited at https://www.cedr.eu/download/Publications/2017/CEDR-TR2017-02-noise-barriers.pdf)

70. At 130m distance (for the properties at 131 and 132 Peach Island Road) the calculated levels would be around 4dBA higher than at 190m distance.

71. If a bund of 3m height is constructed then this reduces the noise level at the boundary by 5-10dBA (a reduction of 10dBA is considered the maximum according to the ISO standard), which brings down the rated from L_{Aeq} = 78dBA to 68dBA at best.

72. If the bund is over 100m away from the noise source then a maximum reduction of 5dBA can be expected.

CONCLUSION

73. In my opinion the suggested maximum noise levels of 51dBA will be exceeded by the operation of the gravel extraction. It is my belief that the maximum noise levels of 55dBA are not appropriate for this location and we recommend that max rated levels of 45dBA should be applied.

74. Additionally, an adjustment of +5dBA should be applied because of the special audible characteristics as demonstrated above, plus adjustment for unfavourable windspeed and direction of +3dBA, as well as a +3dBA error margin.

75. The assumption of a maximum noise level of L_{AW} = 108dB for the machinery is not accurate for this kind of operation since it omits the fact that usually several machines operate at the same time, for example excavator and dump truck but also the noise from the dumping of the stones and rocks onto the trucks produces much higher noise levels than the machinery as our measurements have shown.

76. The construction of a 3m high bund is inadequate to reduce noise levels to an acceptable level.

77. The special rural character of the location requires more stringent maximum allowed levels so residents can live in the area without major disturbance.

Signed:

Joachim Lang – Nelson Acoustics

APPENDIX A
GLOSSARY OF TERMINOLOGY:

A,B,C-weighting
Defined by IEC 61672-1 takes into account the average sensitivity of human's ear as a function of frequency. It is used to convert a physical quantity of sound pressure into a psychacoustic quantity to quantify how noise is perceived by humans.

dB Decibel
The unit of sound level. Expressed as a logarithmic ratio of sound pressure P relative to a reference pressure of
Pr=20 µPa i.e. dB = 20 x log(P/Pr)

dBA
The unit of sound level which has its frequency characteristics modified by a filter (A-weighted) so as to more closely approximate the frequency bias of the human ear.

L_{A90} (t)
The A-weighted soundlevel just exceeded for 90% of the measurement period and calculated by statistical analysis. Also referred to as the background noise level.
The suffix "t" represents the time period to which the noise level relates, e.g. (8 h) would represent a period of 8 hours, (15 Min) would represent a period of 15 minutes and (2200-0700) would represent a measurement time between 10 pm and 7 am.

L_{Amax}
The A-weighted maximum noise level. This is not equal to the peak level.

L_{Aeq} (t)
The A-weighted equivalent continuous sound level having the same total sound energy as the fluctuating level measured.

STC
Sound Transmission Class calculated according to the ASTM E413 classification