

BEFORE THE CENTRAL OTAGO DISTRICT COUNCIL

**Resource Consent Application
RC210320**

IN THE MATTER OF The Resource Management Act 1991

AND

**IN THE MATTER OF Resource consent application for the
construction of a data centre and associated
facilities**

**BY Contact Energy Limited
Applicant**

STATEMENT OF EVIDENCE OF ELIZABETH PAXTON

3 FEBRUARY 2022

1.0 INTRODUCTION

- 1.1 My full name is Elizabeth Paxton.
- 1.2 I hold a Master of Arts (Cantab) in Mathematics from the University of Cambridge, United Kingdom and a Diploma in Acoustics and Noise Control from the Institute of Acoustics (the UK professional body for those working in Acoustics, Noise, Sound and Vibration). I also hold Membership of the Institute of Acoustics. Requirements of membership include that I am active in the field of professional acoustics and satisfy the Institute's requirements regarding level of qualifications and experience.
- 1.3 I have been employed as an Acoustic Consultant for six years, two of which have been in New Zealand with Marshall Day Acoustics (MDA). I have completed numerous assessments of environmental noise from new developments in New Zealand and the United Kingdom.
- 1.4 My role in the project has been to carry out noise predictions and assess noise effects from the development. I prepared a noise assessment report (my report) to accompany the resource consent application for the data centre. I have not visited the development site. To support my assessment of noise effects, I have relied on noise surveys carried out by my colleague Rob Hay.
- 1.5 Although this is not an Environment Court hearing, I confirm that I have read the Code of Conduct for expert witnesses contained in the Environment Court of New Zealand Practice Note 2014 and that I have complied with it when preparing my evidence.
- 1.6 In preparing this statement of evidence I have reviewed the following documents:
 - (a) The AEE accompanying the application
 - (b) The submissions raising noise concerns, and
 - (c) Portions of the section 42A report prepared by planning staff at Central Otago District Council relating to noise.

2.0 SCOPE OF EVIDENCE

- 2.1 The purpose of my evidence is to:
 - (a) Summarise my assessment findings and response to Council's section 92 request, updated to reflect additional source noise data received since the issue of my report.
 - (b) Respond to noise-related matters raised by submitters, and
 - (c) Respond to the section 42A report and proposed conditions of consent.

3.0 SUMMARY OF FINDINGS

- 3.1 My report concluded that noise levels from the data centre would meet the District Plan permitted noise standards and result in acceptable noise effects, subject to the installation of noise control measures.
- 3.2 Since the issue of my report, I have received additional noise data from Lake Parime (the company that will lease the site and operate the data centres) and updated my noise level predictions on this basis. Lake Parime have also clarified that air filters will not be installed to the container exhaust louvres.
- 3.3 The changes resulted in increased predicted noise levels at the nearest dwellings that risked exceedance of the District Plan limits.
- 3.4 To mitigate against the predicted increase in noise levels, additional noise reduction measures are required. I have assessed the effect of acoustic treatment to the north-west louvres of each containerised data centre. The overall change in noise levels compared with those predicted in my report would be imperceptible.

- 3.5 Predicted noise levels from the proposed development are at least 8 dB lower than the Central Otago District Plan noise limits.
- 3.6 Noise at these levels is unlikely to result in adverse effects, even in sensitive individuals.
- 3.7 In the context of the existing sound environment, noise from the data centre may be just audible at the nearest dwellings on quiet nights during hot weather, but it is likely to be inaudible at other times.
- 3.8 I agree with the conclusion of the section 42A Planners Report that adverse effects of the proposal will be adequately mitigated by the proposed noise control measures, noting that additional noise control measures are now proposed.
- 3.9 I have recommended some changes to the proposed consent conditions to allow for greater flexibility whilst maintaining good protection of residential amenity.
- 3.10 I conclude that noise effects will be acceptable.

4.0 NOISE CHARACTER AND PREDICTED NOISE LEVELS

The dominant noise sources are small fans with both broadband and tonal character

- 4.1 The main source of noise associated with the development will be small cooling fans in each of the data centre servers. Engineers from Lake Parime have advised that the fans will run at higher speeds at greater ambient temperatures, which means that noise levels will be higher during hot weather than at other times. My assessment is based on maximum temperatures for Clyde in the District Plan daytime and night-time periods, that is to say, the worst-case scenario.
- 4.2 Based on close proximity audio recordings of the servers provided by Lake Parime, the sound is a mixture of broadband noise and high frequency tonal components that I would describe as a whine. I anticipate that the exact pitch of the tonal components will vary depending on how fast the fans are running.
- 4.3 Tonality that is subjectively audible close to a sound source will not necessarily be audible at another assessment location due to differences in how sound propagates at different frequencies and the masking effect of other ambient noise sources.

Additional noise data has been received from Lake Parime

- 4.4 Since the issue of my report, I have updated my noise predictions based on additional noise data received from Contact Energy and follow-up discussions with Lake Parime. At the time of writing, the full report of the recent measurements was not available, but I have received sufficient information that I am confident in relying on the new data.
- 4.5 The new information comprises noise measurements of a containerised data centre at one of Lake Parime's existing sites. I understand from Lake Parime that this data centre is equivalent to those proposed to be installed at the application site in terms of size, construction, model and number of servers, and type of air filters.
- 4.6 The new measurements indicate lower noise emissions from the servers than previously assumed, but they were carried out at an ambient temperature of 0°C, which is significantly cooler than the historic maximum temperatures – 25°C for the night-time and 40°C for the daytime period – that were identified by Contact Energy based on local weather data. For my updated predictions, I have retained the higher source noise levels presented in my report to allow for the potential increase in noise emissions at higher temperatures.

4.7 The new noise data has enabled me to refine my calculations of noise break-out from inside the container to outside, including an improved estimate of the sound insulation performance of the proposed air filters. I have also established that air filters will not be installed on the air exhausts, contrary to my previous assumption, which results in increased noise break-out from the exhaust louvres.

Additional noise control treatments are proposed

4.8 To mitigate against increased noise break-out from the containers, additional noise control measures are required. I have assessed the effect of acoustic treatment to the north-west facing louvres of each container in addition to the south-east facing louvres to ensure a satisfactory result can be achieved. This acoustic treatment for all louvres should meet the insertion loss values in Table 1. The performance required at mid to high frequency has marginally decreased compared with my report as all louvres will now be treated.

Table 1: Minimum insertion loss requirements

Element	Minimum insertion loss (dBA)						
	Octave Band Centre Frequency (Hz)						
	63	125	250	500	1000	2000	4000
Container louvres	3	4	8	12	17	14	12

4.9 I understand that Lake Parime will investigate acoustic treatment options to optimise functionality without increasing noise emissions. A standard solution to achieve the required performance based on the existing servers would be to use 600 mm long, 50 % open area sound attenuators.

4.10 It may be possible to substitute the proposed servers with a quieter alternative. If an alternative server were proposed with lower noise emissions in a given frequency band than I have assumed, the required insertion loss values could be reduced by an equivalent amount whilst achieving the same performance overall.

4.11 Other noise control treatments will remain as described in sections 6.1 and 6.2 of my report.

4.12 In summary, my updated noise predictions include the changes to the noise input data discussed above and the following noise control measures, which are illustrated in Figure 1.

1. A 3.5 metre high noise control barrier around the north-east and south-east site boundaries
2. Absorbent facing to the inner face of barriers between the ends of each pair of containers, and
3. Acoustic treatment to all louvred areas of each data centre container.

Figure 1: Location of noise control measures



Predicted noise levels have not changed significantly since issue of my report

- 4.13 Updated predicted noise levels are shown in Table 2. In addition to the receiver locations considered in my report, I have presented noise levels at the site boundaries of the three submitters' properties. Predicted noise levels are within 3 dB at all receivers considered. This would be an imperceptible difference, so my assessment of effects can be considered to equally apply to these properties.
- 4.14 The character of the sound in the context of the existing environment and my assessment of noise effects are discussed below.

Table 2: Data centre predicted noise levels

Assessment location	Time period, hours	Predicted noise level, dB LA10	District Plan noise standard, dB LA10
Residential Area Boundary (1 Miners Lane)	0700 – 2300 (daytime)	36	55
	2300 – 0700 (night-time)	31	40
1 Sunderland Street	0700 – 2300 (daytime)	37	55
	2300 – 0700 (night-time)	32	40
3 Sunderland Street	0700 – 2300 (daytime)	35	55
	2300 – 0700 (night-time)	30	40
11 Sunderland Street	0700 – 2300 (daytime)	34	55
	2300 – 0700 (night-time)	29	40
Notional boundary of 37 Fruitgrowers Road (Rural Residential)	0700 – 2300 (daytime)	34	55
	2300 – 0700 (night-time)	29	40
Notional boundary of 28 Fruitgrowers Road (Rural)	0700 – 2300 (daytime)	35	55
	2300 – 0700 (night-time)	30	40

- 4.15 Predicted noise levels are significantly lower than the District Plan limits and national and international guideline levels for residential amenity.
- 4.16 Guideline values such as those provided by the World Health Organisation are the exposure levels that represent the onset of the effect for the general population. That is, at these noise levels, critical health effects only begin to appear in a small number of vulnerable or sensitive groups. On this basis I would not expect adverse effects to arise based on the absolute level of the noise.

Existing acoustic environment

- 4.17 As well as the absolute level of noise, the likelihood of adverse effects from a particular source can depend on whether the noise exceeds the level of ambient noise and the presence of special audible characteristics such as tonality.
- 4.18 In the daytime, I consider that ambient noise levels from sources including traffic on State Highway 8 and local roads will mask noise from the data centre so that it will generally be inaudible. Daytime noise effects will therefore be negligible.
- 4.19 My colleague Rob Hay¹ carried out night-time noise surveys to determine the existing ambient environment in the vicinity of the nearest noise-sensitive receivers to the site. He selected a night with still wind conditions and measured noise levels after 2300 hours, when there were few vehicles on nearby roads. I consider that the measured noise levels are representative of the lower end of the typical night-time noise level range at the relevant locations.
- 4.20 Noise levels measured on one night cannot capture the full range of ambient conditions that occur in Clyde, but by comparing predicted noise levels from the data centre with ambient noise levels on a calm night, my conclusions regarding the potential audibility of the noise are worst-case. When ambient noise levels are higher, noise from the data centre will be less audible and the potential for adverse noise effects will be lower.
- 4.21 Measured ambient noise levels are summarised in Table 3.

Table 3: Summary of Environmental Noise Level Measurements

Measurement Location	Measured Noise Levels, dB				Noise Sources and Comments
	L _{A10}	L _{Aeq}	L _{A90}	L _{Amax}	
28 Fruitgrowers Road	40	39	32	61	Broadband background sound including distant road traffic. Faint but noticeable 100 Hz tone
3 Miners Lane	44	42	40	56	Variable water noise from dam with distinct 100 Hz tone
1 Sunderland Street	47	43	36	51	Very distinct 100 Hz tone. Water noise from dam is dominant over traffic on SH8.

- 4.22 Predicted noise levels from the data centre are lower than the measured ambient levels at all assessment locations. Given the tonal character of the server noise, I consider that noise from the data centre may be just audible at the nearest dwellings on quiet nights with hot weather, but is likely to be inaudible at other times.

¹ Rob Hay is an Associate at Marshall Day Acoustics. He has worked as a consultant at Marshall Day for over 15 years and has been involved in many significant building and environmental acoustics projects throughout New Zealand.

- 4.23 I consider that the tonality is unlikely to be sufficiently noticeable to attract a Special Audible Character (SAC) correction according to NZS 6802:1991. However, I note that the District Plan noise standards would still be achieved if an SAC correction were applied.

Updated response to Section 92 request

- 4.24 Following the submission of my report, Central Otago District Council requested further information regarding cumulative noise effects of the proposal.
- 4.25 The calculated cumulative noise level, including existing sources and predicted worst-case noise levels from the data centre, is less than 1 dB higher than the existing ambient noise level at all receivers.
- 4.26 A change in sound level of 1 dB is imperceptible.

Changes to Lake Parime's proposed equipment and louvre treatments may be acceptable

- 4.27 I consider that alterations to Lake Parime's proposed servers and louvre treatments would be acceptable provided that the District Plan noise limits are still achieved.
- 4.28 In my opinion, the District Plan noise limits are appropriate to protect residential amenity in the context of the existing environment for the following reasons:
1. The District Plan night-time noise limits are at the lower end of national and international guidelines for protection of residential amenity. Night-time noise is likely to be the controlling factor for compliance based on noise data provided by Lake Parime to date.
 2. Noise levels achieving the District Plan night-time noise limits will not significantly exceed the ambient noise levels at any location.
 3. As per NZS 6802:1991 and Rule 12.7.4(i) of the District Plan, a 5 dB SAC correction would apply to distinctly tonal noise, which would result in a more stringent noise limit for sound that is distinctive against the ambient environment.
 4. The greatest possible increase to cumulative noise levels would occur if no SAC correction were applied and specific noise levels from the data centre equalled the permitted level of 40 dB L_{A10} . In this case, cumulative noise levels would increase by less than 3 dB, which would generally be imperceptible.

Assessment of noise effects

- 4.29 I conclude that noise effects from the development will be acceptable provided that the District Plan permitted noise limits are achieved.
- 4.30 If changes are made to the proposed server types, or if the proposed acoustic treatments to the container louvres do not meet the minimum insertion loss values in Table 1, I recommend that the proposals are reviewed by a suitably qualified acoustician to ensure that the District Plan noise limits will be achieved.

5.0 COMMENTS ON SUBMISSIONS

- 5.1 I have reviewed comments related to noise from the three submitters.
- 5.2 I have covered general concerns about expected noise levels above, and I would like to reiterate that noise can only cause adverse physical health effects at levels substantially greater than the District Plan permitted levels.
- 5.3 Annoyance and sleep disturbance due to noise varies significantly between individuals, but at the predicted levels in this case, international research finds that adverse health effects would not occur even in sensitive individuals.
- 5.4 Specific comments from submitters that I have not already addressed are covered below.

Claire and Lawrence Wilkes

- 5.5 The submitters note a technical non-compliance with District Plan Rules 12.7.4(i) and 12.7.4.(ii) that was identified in the AEE accompanying the application. I would like to clarify as follows:
- 5.6 Rule 12.7.4(i) relates to the methodology for measuring and assessing noise levels. The rule specifies that the 1991 versions of New Zealand Standards NZS 6801 and NZS 6802 should be used and clarifies certain provisions of NZS 6802.
- 5.7 The 1991 versions of the standards have been superseded by subsequent versions. The 2008 versions are the most recent and represent current best practice for measuring and assessing noise. The main difference between these versions is the recommended noise descriptor: L_{A10} is recommended in the 1991 version as opposed to L_{Aeq} in the 2008 version. For a time-constant source like the data centre servers, L_{Aeq} and L_{A10} are expected to be within 1 dB, so in this case there is no material difference between the two standards.
- 5.8 I have used the 1991 version of the standards to assess noise levels against the District Plan limits as specified in Rule 12.7.4(i) to arrive at my conclusions set out above. Compliance measurements of noise from the data centre would be carried out in accordance with the 2008 standards if consent conditions refer to this updated guidance, or otherwise in accordance with the 1991 standards as per the District Plan.
- 5.9 My colleague Mr Hay followed up to date guidance in NZS 6801:2008 when measuring existing ambient noise levels, but the measurements were also in accordance with the 1991 standard. Both the L_{A10} and L_{Aeq} noise levels were recorded for completeness.
- 5.10 Further, Chapter 15 of the November 2019 National Planning Standards requires that district plans adopt the 2008 versions of NZS 6801 and 6802. Any plan rules must also adopt noise assessment methodology using the L_{Aeq} rating level and L_{max} , provided that the noise to be assessed falls within the scope of NZS 6802:2008.
- 5.11 My report permits assessment of noise effects under both old and new frameworks.
- 5.12 The Section 42A report determines that Rule 12.7.4(ii) Construction Noise – is not applicable. I have not reviewed the proposed construction methodologies or predicted construction noise levels. However, based on the distance from the site to the nearest dwellings, I expect that the limits in the rule would be readily achieved if construction takes place during normal hours of 0730 to 1800 Monday to Saturday.

Nicholas Johnston and Bridget Haven Lloyd-Johnston

- 5.13 The submitters request a noise level limit of 50 dB L_{Aeq} Monday to Saturday 0700 to 2100 hours and Sunday 0900 to 1800 hours, with a limit of 40 dB L_{Aeq} at all other times.
- 5.14 These limits are 5 dB more restrictive than the District Plan limits during the daytime. They also apply a 40 dB L_{Aeq} limit from the earlier times of 2100 hours Monday to Saturday and 1800 hours on Sunday, compared with the 2200 hours start time in the District Plan.
- 5.15 Whilst I predict that these limits will be achieved, I consider that the more stringent limits are not necessary to protect residential amenity. I also note that modern district plans do not set differing noise levels during weekends as opposed to weekdays.

Wendy and John Muir

- 5.16 The submitters express concern that the topography of the area and prevailing winds will result in higher noise levels from the data centre.
- 5.17 I calculated noise levels from the data centre using SoundPlan v8.2 noise modelling software, which uses local terrain data to create a 3D map of the local area. The calculations are conservative as they assume that the wind is blowing from each noise source towards all sensitive receivers at the same time. This means that the predicted levels account for times when the wind is blowing from the data centre towards the township, and that noise levels will be lower than predicted when the wind blows in other directions.
- 5.18 Given the topography of the local area, at times when ambient noise levels are low, echoes may be audible from discrete sound events. Noise from the proposed data centre will not create a distinct echo because the noise will be continuous and will generally be well masked by other noise sources.
- 5.19 The submitters also refer to the experience of residents near American data centres. It would not be appropriate to draw comparisons based on anecdotal evidence, but I note that American regulations in some areas may permit higher noise levels in residential areas than the Central Otago District Plan. The scale of data centres and the type of ventilation and cooling system used can also significantly influence the level and character of the noise generated.

6.0 SECTION 42A REPORT AND CONDITIONS

- 6.1 I have reviewed the section of the report relating to noise and broadly concur with the conclusions. Concerns raised regarding noise survey duration and cumulative noise effects during noisier ambient conditions are discussed above.
- 6.2 The proposed conditions of consent relating to noise recommend that noise monitoring is carried out and that the noise mitigation measures in our report are installed. I support the intention of these conditions but have the following comments:
- 6.3 I recommend an additional condition that sets noise limits for the development in terms of the latest versions of the relevant standards, in line with current best practice guidance and the 2019 National Planning Standards, such as:

Condition X.

Noise from the operation of the datacentre shall comply with the following noise limits when measured in accordance with NZS 6801:2008 "Acoustics – Measurement of environmental sound" and assessed in accordance with NZS 6802:2008 "Acoustics – Environmental noise". The limits shall apply at any point within the notional boundary of any dwelling or within any Residential Resource Area:

On any day 0700 to 2200 hours

55 dB L_{Aeq}

2200 to 0700 hours

40 dB L_{Aeq} and 70 dB L_{AFmax}

6.4 Condition 5 requires that the proposed noise control treatments are installed as described my report. This should be amended to reference my updated noise control recommendations. I recommend the following wording:

The Consent Holder shall comply with noise limits specified in Condition X by incorporating the following noise control treatments

- i. A 3.5 metre high noise control barrier around the north-east and south-east site boundaries;*
- ii. Absorbent facing to the inner face of barriers between the ends of each pair of containers; and*
- iii. Either:*
 - a. Acoustic treatment to all louvred areas of each data centre container sufficient to meet the following parameters:*

<i>Element</i>	<i>Minimum insertion loss (dBA)</i>						
	<i>Octave Band Centre Frequency (Hz)</i>						
	<i>63</i>	<i>125</i>	<i>250</i>	<i>500</i>	<i>1000</i>	<i>2000</i>	<i>4000</i>
<i>Acoustic treatment to container louvres</i>	<i>3</i>	<i>4</i>	<i>8</i>	<i>12</i>	<i>17</i>	<i>14</i>	<i>12</i>

Or

- b. A combination of equipment selection and acoustic treatments that a Suitably Qualified and Experienced Professional with expertise in acoustics certifies will be sufficient to achieve the noise limits specified in Condition X.*

6.5 Condition 6 – I recommend that the wording ‘in order to confirm that actual noise levels are the same as predicted by the Marshall Day noise assessment provided in support of the application’ is changed to ‘in order to confirm that specific noise levels from the development do not exceed the limits in Condition X’. The current wording could result in investigation of additional noise mitigation if measured noise levels are marginally higher (or lower) than the predicted levels but still achieve the District Plan limits. As discussed above, I consider that these limits provide for suitable protection of residential amenity in the context of the existing sound environment.

6.6 Regarding the post-completion noise monitoring, I note that it will not be possible to determine compliance by measuring at the nearest dwellings if noise levels are consistent with my predictions. This is because the predicted level of noise from the data centre is lower than the ambient level. However, it will be possible to validate the predicted noise levels based on measurements at locations representative of the nearest dwellings, combined with measurements close to the site. In my opinion, the existing condition wording adequately covers this eventuality.

Elizabeth Paxton
3 February 2022