

Before an Independent Hearings Panel  
appointed by Christchurch City Council

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*under:* the Resource Management Act 1991

*in the matter of:* the hearing of submissions on Plan Change 14 (Housing  
and Business Choice) to the Christchurch District Plan

*and:* **Christchurch International Airport Limited**  
Submitter 852

Rebuttal evidence of Laurel Smith (acoustics)

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Dated: 14 November 2023

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Counsel: A M Lee (annabelle.lee@chapmantripp.com)  
J M Appleyard (jo.appleyard@chapmantripp.com)

chapmantripp.com  
T +64 3 353 4130  
F +64 4 472 7111

PO Box 2510  
Christchurch 8140  
New Zealand

Auckland  
Wellington  
Christchurch



## **REBUTTAL EVIDENCE OF LAUREL SMITH**

- 1 My full name is Laurel Jean Smith. I am a consultant in the acoustical consulting practice of Marshall Day Acoustics Limited (*Marshall Day*).
- 2 I provided a statement of evidence in relation to the relief sought by Christchurch International Airport Limited (*CIAL*) in relation to the proposed Plan Change 14 (Housing and Business Choice) to the Christchurch District Plan (*PC14*) dated 20 September 2023 (*primary evidence*). My qualifications, experience and involvement with CIAL are set out in my primary evidence and I do not repeat those here.
- 3 I also participated in the expert conferencing on airport noise for PC14 and am a signatory of the joint witness statement (*Airport Noise JWS*) dated 7 November 2023.

### **CODE OF CONDUCT**

- 5 Although this is not an Environment Court hearing, I note that in preparing my evidence I have reviewed the Code of Conduct for Expert Witnesses contained in the Environment Court Practice Note 2023. I have complied with it in preparing my evidence on technical matters. I confirm that the technical matters on which I give evidence are within my area of expertise, except where relying on the opinion or evidence of other witnesses. I have not omitted to consider material facts known to me that might alter or detract from my opinions expressed.

### **SCOPE OF EVIDENCE**

- 6 My rebuttal evidence responds to briefs of evidence from and the expert conferencing with:
  - 6.1 **Professor John Paul Clarke** on behalf of Miles Premises Ltd and Equus Trust; and
  - 6.2 **Dr Stephen Chiles** on behalf of Waka Kotahi NZ Transport Agency.
- 7 My colleague, Mr Christopher Day, also responds to Professor Clarke in his rebuttal evidence.
- 8 In summary, my rebuttal evidence addresses:
  - 8.1 Aircraft fleet and duration for the updated noise contour forecast;
  - 8.2 Available evidence on quantifying aircraft noise effects;

- 8.3 Background and other noise sources;
- 8.4 Separation versus mitigation of noise sensitive activities;
- 8.5 Long term management of aircraft noise effects; and
- 8.6 Reverse sensitivity effects on airport operations.

### **RESPONSE TO PROFESSOR CLARKE**

- 9 Professor Clarke's primary evidence largely covers the topics of the updated noise contour inputs and research on the annoyance response to aircraft noise.
- 10 One of Professor Clarke's main criticisms of the updated noise contours is that the aircraft fleet used for the modelling is not representative of the next generation of aircraft that will be operating when the airport is forecast to reach ultimate capacity (i.e. 2084).
- 11 Data for these aircraft is not available in the modelling software. It is Professor Clarke's view that next generation aircraft will likely be 5 dB quieter than current aircraft (paragraph 20) and that these will likely be a substantial part of the operating fleet in 2050 (paragraph 36).
- 12 My response to Professor Clarke's criticism of using available noise data (i.e. current fleet) to model ultimate capacity (circa 2084) is as follows:
  - 12.1 It is not common practice to apply an overall *quiet aircraft* factor (e.g. a 5 dB discount) to future modelled contours;
  - 12.2 Christchurch Airport's contours will be reviewed before 2050 at which time available data on next generation aircraft and altered air space management will be taken into account.
- 13 In summary, the inputs to the updated noise contours have been prepared by a team of experts and peer reviewed by an independent team of experts and found to be appropriate for the Christchurch Airport context which includes a regular review period.

### **RESPONSE TO DR CHILES**

- 14 I have endeavoured to distil Dr Chiles' evidence to summarise and respond to his main conclusions. Section 8 of Dr Chiles' evidence is most relevant to the Airport Noise Qualifying Matter as it comments directly on the potential effects of residential intensification inside the updated 50 dB  $L_{dn}$  aircraft noise contour.

- 15 In paragraph 8.5 Dr Chiles criticises the Council’s S42A analysis in two ways. He considers:
- 15.1 The noise effects analysis is based on conservative assumptions that are unsound (i.e. 2018 World Health Organisation (*WHO*) Guidelines); and
  - 15.2 The assessment does not address the context of other environmental sound.
- 16 In my view this criticism is unreasonable given Dr Chiles does not offer an alternative method for quantifying aircraft noise effects, nor does he offer any opinion on how other noise sources affect the Airport Noise Qualifying Matter. I address these two topics in more detail later in my rebuttal evidence.
- 17 The other main topics of Dr Chiles’ evidence relate to:
- 17.1 Acoustic mitigation as a method to address the noise effects rather than separating activities;
  - 17.2 Airport operational restrictions to reduce aircraft noise effects on existing residents.
- 18 Dr Chiles does not address reverse sensitivity in evidence but provides comments on this in the Airport Noise JWS.
- 19 I have prepared my rebuttal evidence addressing these five topics with direct references to matters raised in Dr Chiles’ evidence and the Airport Noise JWS.

#### **Quantifying Aircraft Noise Effects**

- 20 In the Airport Noise JWS, Dr Chiles prefers the 2018 WHO Guidelines over any alternative as a reference for aircraft noise annoyance response, however he considers they should not be applied in isolation and a broader qualitative assessment is required. Dr Chiles’ evidence discusses the factors to consider in the broader qualitative assessment in paragraph 4.4 and I have summarised these below:
- 20.1 Sleep disturbance effects **could** be taken to relate to noise exposure inside buildings while other effects such as annoyance **may** relate to a combination of indoor and outdoor noise;
  - 20.2 It **could** be assumed that adverse health effects relating to indoor noise would not arise if buildings were acoustically treated with ventilation and temperature control;

- 20.3 The relative influence of outdoor amenity on adverse health effects **might** be reduced in high density apartment buildings;
- 20.4 Non-acoustical factors **can** vary an individual's response to noise;
- 20.5 There are combined health effects for residents exposed to multiple noise sources or multiple types of emissions;
- 20.6 The adverse effects **might** vary for situations where the exposure is concentrated in a shorter period compared with being regular throughout the year;
- 21 In addition to these factors, Dr Chiles implies in evidence and the Airport Noise JWS that elevated background noise in busy urban areas could be another mitigating factor somehow. Presumably he means it might reduce the impact of or increase tolerance to aircraft noise.
- 22 As Dr Chiles states, unfortunately there are evidential gaps to individually support or quantify the above list of possibilities. Hence, he suggests a qualitative assessment instead. The implication is that the 2018 WHO Guidelines relationships do not include respondents living in noisy urban environments, or insulated and thermally controlled buildings, or high density apartment buildings, or with limited outdoor space and as such, the noise effects in these situations could be appreciably lower.
- 23 I do not think it is reasonable to assume that all the studies included in the 2018 WHO Guidelines related to uninsulated, passively ventilated, standalone buildings with spacious gardens, located in low noise areas, where people always sleep with windows open and all respondents hold a negative view of the airport authority.
- 24 I do not have the expertise to comment on the veracity of the research relied upon by the 2018 WHO Guidelines, however it appears to include a reasonably broad range of airports, climates and living situations which show a range of different response curves. It is possible and probable that many of the variable factors Dr Chiles has raised are represented in the research samples and the final regression curves represent the combination of a wide range of factors both positive and negative.
- 25 In summary, I recommend caution in making a qualitative assessment that assumes the annoyance and sleep disturbance response for residents in acoustically insulated, high density buildings in urban areas will be substantially lower than the 2018 WHO Guidelines relationships. The European Union member states are required to apply the 2018 WHO Guidelines relationships for the

purpose of quantifying aircraft noise effects. For the purpose of PC14, I consider it is reasonable to apply the same relationships to quantify the noise effects.

- 26 In paragraphs 8.1 to 8.6 Dr Chiles concludes the 2018 WHO Guidelines relationships represent unrealistically high estimates of potential adverse effects if considering high density, acoustically mitigated apartment buildings with small balconies located in urban areas because:
- 26.1 With small balconies, outdoor noise is less important and adverse effects should be primarily associated with indoor conditions which can be controlled; and
  - 26.2 The WHO 2018 Guidelines relationships do not relate specifically to acoustically insulated and ventilated buildings.
- 27 My view on the first point [26.1] is:
- 27.1 From personal experience I disagree that outdoor noise is less important in apartments, however I cannot provide an expert opinion on this matter;
  - 27.2 From an evidential perspective, both Dr Chiles and I agree, there is no evidence supporting that outdoor noise is less important in apartment situations;
  - 27.3 From a mathematical approach, replacing less dense development with high density apartments results in more households (i.e. more people) with adversely affected outdoor living.
- 28 My view on the second point [26.2] is set out at paragraphs [23] and [24] above. In addition, I consider that the impact of acoustic insulation on the annoyance and sleep disturbance responses may not be significant for the following reasons:
- 28.1 Annoyance relates to indoor and outdoor noise and acoustic insulation does not mitigate outdoor effects;
  - 28.2 The 2018 WHO Guidelines relationships show evidence of annoyance and sleep disturbance effects at aircraft noise levels where typical indoor design criteria are achievable in untreated buildings with open windows (i.e. 40 dB  $L_{dn}$  and 30 dB  $L_{night}$  are typical mitigation design criteria<sup>1</sup>). This

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<sup>1</sup> Assuming a 15dB outdoor to indoor reduction with open windows, these correlate with 27% highly annoyed at 55 dB  $L_{dn}$  and 15% highly sleep disturbed at 45 dB  $L_{night}$ .

supports the view that acoustic insulation does not mitigate all effects;

- 28.3 In the New Zealand context, acoustic insulation, ventilation and air-conditioning is a compromise that comes with disbenefits such as operating costs, disconnection from the outdoors, undesirability of living/sleeping in air-conditioned spaces;
- 28.4 It is reasonable to assume that the 2018 WHO Guidelines relationships include respondents living in climates that necessitate insulated and thermally controlled buildings as well as respondents living in apartments with mechanical services meaning the response curves are not devoid of responses from acoustically insulated buildings.
- 28.5 Dr Chiles and I agree there is a lack of evidence to quantify the benefit of acoustically mitigated dwellings. A separate study referenced in the 2018 WHO Guidelines showed a reduction in annoyance associated with acoustic mitigation however the evidence was rated low quality.

### **Background and Other Noise Sources**

29 Another key topic in Dr Chiles' evidence and the Airport Noise JWS is the consideration of background and other noise sources. This theme arises several times in slightly different ways as summarised below but without any specific recommendations or conclusions:

- 29.1 In the Airport Noise JWS, Dr Chiles considers that background and other noise should be considered as part of a broader qualitative assessment. He does not expand on how this should apply.
- 29.2 In paragraph 4.4(e) of his evidence, he explains research has shown there are combined effects from overlapping exposure from different sources or emission types. He does not expand on how to apply this information.
- 29.3 In paragraph 8.4 of his evidence, Dr Chiles explains the urban context of PC14 means that adverse health effects are likely to arise from other noise sources such as road traffic. He is not explicit but appears to suggest that this somehow negates the need for the Airport Noise Qualifying Matter. I do not agree that increased noise exposure in some way mitigates the effects. Also, a relevant point is that aircraft noise is shown to be more annoying than road traffic noise<sup>2</sup>.

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<sup>2</sup> 2018 WHO Guidelines.

29.4 In paragraph 8.5 of his evidence, he criticises the Council's S42A report for not considering other environmental noise. Despite raising the topic several times in evidence, he has not provided any recommendation on how this matter could be quantified or qualified other than implying it is a mitigating factor to some degree. I have responded to the impact of the urban context on the 2018 WHO Guidelines relationships in paragraphs 22 - 26 of this rebuttal evidence.

### **Separation vs Mitigation**

30 In paragraph 5.3 to 5.6 of his evidence, Dr Chiles discusses methods for managing adverse noise effects and reasons why separating residential activity from noise sources is not always good planning.

31 The discussion mostly relates to road traffic. I am unable to make the connection between his comments on road traffic and the relevance to residential intensification under aircraft flight paths.

32 In the context of PC14, the term separation is (unintentionally) misrepresentative. PC14 relates to increasing residential density. The Airport Noise Qualifying Matter would not completely exclude new noise sensitive activities inside the 50 dB  $L_{dn}$  contour, rather it would maintain the current development capacity, which is not insignificant.

33 In paragraph 5.6 Dr Chiles describes a practical alternative to separating residential activities from noise sources is acoustic insulation and ventilation however he concedes in the Airport Noise JWS this brings other disbenefits related to keeping windows and doors shut and little can be done to mitigate effects for outdoor living. I do not agree that winter gardens are a method of mitigating outdoor noise effects as these are enclosed spaces not outdoor spaces.

34 In summary, I consider that a mitigation approach results in an inferior outcome for residents. It would not mitigate all the effects and it introduces compromised living conditions as described in [28.3] above.

### **Long Term Management of Aircraft Noise Effects**

35 In paragraph 5.2 of his evidence, Dr Chiles says he does not consider the 2018 WHO Guidelines criteria (45 dB  $L_{dn}$  and 40 dB  $L_{night}$ ) are inappropriate but that a longer-term strategic approach is required to work towards them. In my opinion, intensifying housing inside 50 dB  $L_{dn}$  is working in the opposite direction to the WHO criteria. Conversely controlling intensification inside 50 dB  $L_{dn}$  is a step in the right direction.



- 36 In paragraphs 6.7 and 7.4 Dr Chiles questions whether the updated air noise contours are appropriate as they would enable increased noise exposure for existing residents. He suggests in paragraph 6.7 and the Airport Noise JWS that this would be contrary to the airport's duty to reduce existing noise exposure and avoid unreasonable noise.
- 37 In my view, raising this matter in relation to PC14 demonstrates one aspect of reverse sensitivity in action. An airport is likely to face this type of questioning and pressure at every planning process. The ICAO 'Balanced Approach' which includes land use planning as one of the four pillars, also recommends that the fourth pillar, airport operational restrictions, is a last resort.
- 38 The relative importance of efficient airport operations compared with residential intensification is for planners and decisionmakers to determine. However, in the context of a Qualifying Matter, I understand there is recognition in the legislation relevant to PC14 that residential intensification may not be appropriate if it could affect the safe and efficient operation of regionally or nationally significant infrastructure.<sup>3</sup> I discuss reverse sensitivity next.

#### **Reverse Sensitivity**

- 39 In the Airport Noise JWS, Dr Chiles considers that operational restrictions on airports do not necessarily correlate with the number of people exposed to aircraft noise. Like Dr Chiles, I am not aware of any research directly correlating these two measures. However, there is data showing that internationally the prevalence of airport operational restrictions has been increasing (refer Figure 3 of Mr Day's primary evidence).
- 40 When the impact of aircraft noise on a population is assessed, the scale of effects is quantified by the number of people affected. Enabling residential intensification inside the 50 dB  $L_{dn}$  contour under the Runway 29 approach flight paths not only increases the scale of effects but also adds weight to a case for restricted cross-runway use or night-time restrictions.
- 41 The number of people affected is also used as a measure for noise reduction targets. Schiphol Airport is an example where the airport is required to implement operational restrictions (which involve caps on movements and curfews) to meet targets based on number of houses inside contours and number of people highly annoyed and highly sleep disturbed.
- 42 Some forms of reverse sensitivity on airports are related to non-acoustical factors and arise in areas outside airport noise contours. Whereas other forms of reverse sensitivity resulting in operational

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<sup>3</sup> RMA, section 77I(e).

restrictions arise through planning policy. In these situations, the number of people with measurable effects (i.e. those inside airport noise contours) is the only objective and logical method available for weighing up the costs and benefits of imposing operational restrictions. As knowledge and data grows, this assessment is likely to involve a comparison of population health cost against the commercial cost of airport restrictions. It follows that the greater the number of people affected, the greater the health cost in this equation.

- 43 Also, the scale of operational restrictions will likely be influenced by the number of people affected much like the situation currently happening at Schiphol Airport. The cost of the operational restrictions required to achieve a 19% reduction of houses affected by 48 dB  $L_{\text{night}}$  or more, is estimated at an average of €710,000 per house<sup>4</sup>.
- 44 In summary, I consider reverse sensitivity is not only complaints from resident groups influenced by non-acoustical factors. Reverse sensitivity can also affect airport efficiency through planning processes where objective measures are used for decision making. Increasing the number of people affected by aircraft noise through enabling intensification will influence these measures and hence possibly affect future airport efficiency.

**Laurel Smith**

**14 November 2023**

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<sup>4</sup> Appendix F of Assessment of Noise Effects Report in Appendix 1 of Laurel Smith's primary evidence