IN THE MATTER of the Resource Management Act 1991 ("**RMA**")

AND

IN THE MATTER of submissions by the New Zealand Transport Agency (submitter 742, further submitter 1202) and KiwiRail Holdings Ltd (submitter 846, further submitter 1272) on the Proposed Waikato District Plan ("**Proposed Plan**")

STATEMENT OF EVIDENCE OF STEPHEN GORDON CHILES ON BEHALF OF WAKA KOTAHI NZ TRANSPORT AGENCY AND KIWIRAIL HOLDINGS LIMITED

NOISE AND VIBRATION

1. INTRODUCTION

1.1 My full name is Dr Stephen Gordon Chiles. I have the qualifications of Doctor of Philosophy in Acoustics from the University of Bath and Bachelor of Engineering in Electroacoustics from the University of Salford, UK. I am a Chartered Professional Engineer, Fellow of the UK Institute of Acoustics and Member of the Resource Management Law Association.

1.2 I am self-employed as an acoustician through my company Chiles Ltd. I have been employed in acoustics since 1996, as a research officer at the University of Bath, a principal environmental specialist for the Waka Kotahi NZ Transport Agency ("**Waka Kotahi**"), a consultant for the international firms Arup, WSP, and URS, and for the specialist firms Marshall Day Acoustics and Fleming & Barron. I am contracted as the principal advisor to provide the Environmental Noise Analysis and Advice Service to the Ministry of Health and regional public health services.

1.3 I have been involved in many situations relating to noise and vibration effects on new or altered sensitive activities around existing established infrastructure. I was an Independent Commissioner for plan changes for Queenstown and Wanaka Airports and a plan variation for Port Nelson, which dealt particularly

with reverse sensitivity effects in relation to noise. I have previously been engaged to advise Auckland Transport (roads), Christchurch City Council (airport) and Environment Canterbury (port) on reverse sensitivity noise issues. I jointly led the review of Waka Kotahi's reverse sensitivity policy for state highways and development of its current guide.[1] I have presented acoustics evidence for Waka Kotahi and KiwiRail Holdings Ltd ("**KiwiRail**") on numerous plan changes and plan reviews. I advised Waka Kotahi and KiwiRail with respect to draft provisions for a potential National Planning Standard addressing adverse effects on new sensitive land uses, or alterations to existing uses, near road and rail corridors. I was previously responsible for producing draft provisions for Clause G6 of the New Zealand Building Code relating to reverse sensitivity for the Ministry of Business, Innovation and Employment.

1.4 I am convenor of the New Zealand reference group for "ISO" acoustics standards, an observer of the "IEC" committee for acoustics instrumentation standards and a member of the joint Australian and New Zealand committees responsible for acoustics standards. I was Chair of the 2012 New Zealand acoustics standards review, Chair for the 2010 wind farm noise standard, and a member for the 2008 general environmental noise standards.

Code of Conduct

1.5 I confirm that I have read the Expert Witness Code of Conduct set out in the Environment Court's Practice Note 2014. I have complied with the Code of Conduct in preparing this evidence and will continue to comply with it while giving oral evidence at the hearing. Except where I state that I am relying on the evidence of another person, this written evidence is within my area of expertise. I have not omitted to consider material facts known to me that might alter or detract from the opinions expressed in this evidence.

Scope of evidence

1.6 My statement relates to the Proposed Plan. I have prepared this statement on behalf of KiwiRail and Waka Kotahi in relation to their functions as transport network utility operators in the Waikato District. KiwiRail and Waka Kotahi share an interest in and seek similar relief through their submissions on provisions relating to noise and vibration effects from the road and rail networks, as well as reverse sensitivity.

[1] NZ Transport Agency, *Guide to the management of effects on noise sensitive land use near to the state highway network*, September 2015.

1.7 The submissions seek that new rules be included in the Proposed Plan to manage adverse effects caused by new and altered buildings containing sensitive activities establishing near existing state highway and railway corridors. The purpose of these provisions is to protect the health and amenity of occupants of those buildings, and to avoid or mitigate potential reverse sensitivity effects on those transport corridors. The submissions are informed by advice I have previously provided to both KiwiRail and Waka Kotahi.

1.8 My evidence relates to the management of railway and road-traffic noise and vibration effects with respect to public health and amenity. It will address:

(a) noise and vibration effects arising from road and rail infrastructure, including associated reverse sensitivity effects;

(b) methods to manage effects on new and altered buildings containing sensitive activities near existing infrastructure, as well as reverse sensitivity effects on existing infrastructure arising as a result of such activities;

(c) the appropriateness of the relief sought by KiwiRail and Waka Kotahi, from an acoustics and public health perspective; and

(d) the recommendations of the Council officer in the section 42A report in relation to the relief sought by KiwiRail and Waka Kotahi.

1.9 I have prepared my evidence based on my experience assessing and managing future and existing state highway and railway sound and vibration, at numerous locations throughout New Zealand.

1.10 My evidence should be read alongside that of Pam Butler (KiwiRail) and Mike Wood (Waka Kotahi).

1.11 I have previously prepared a statement of evidence dated 30 January 2020 on behalf of Waka Kotahi for Hearing 10 of the Proposed Plan. That previous statement was in relation to building set-backs in the Residential Zone. Those set-backs address state highway noise effects in the area closest to state highways. I am now discussing broader controls in this evidence, applying over a wider area up to 100 metres from state highways and railways. From an acoustics perspective, I consider it appropriate that both the set back rules and the new rules applying up to 100 metres from state highways and railways apply together.

2. NOISE AND VIBRATION EFFECTS FROM ROAD AND RAIL INFRASTRUCTURE

2.1 It is widely accepted nationally and internationally that sound and vibration from road and rail networks have the potential to cause adverse health and amenity effects on people living nearby. This has been documented by authoritative bodies such as the World Health Organisation ("**WHO**"),[2] including a relatively recent publication by WHO Europe in October 2018 ("**2018 WHO Guidelines**"), which sets out guidelines for managing environmental noise.[3] These WHO publications are underpinned by robust scientific research. I am not aware of any fundamental disagreement in the acoustics profession with the information published by WHO regarding road and rail noise effects.

2.2 The 2018 WHO Guidelines are based on a critical review of academic literature and followed a rigorous protocol to determine the quality of evidence of adverse effects. With respect to sound from road and rail networks, the 2018 WHO Guidelines note the following adverse effects: ischaemic heart disease, hypertension, high annoyance and sleep disturbance. Based on the strength of the evidence of adverse effects, WHO makes recommendations to policymakers to reduce road and rail sound exposure to below a range of guideline values. The relief sought by KiwiRail and Waka Kotahi on the Proposed Plan is consistent with this direction, as an integral part of their broader noise management activities. I describe below some of the steps and actions that Waka Kotahi and KiwiRail implement as part of this management approach.

2.3 With respect to vibration, Norwegian Standard NS 8176[4] provides a summary of annoyance and disturbance relationships associated with vibration from land-based transport. These relationships show that adverse effects occur at vibration exposures typically found around existing road and rail networks. This primary issue relates to people in buildings being disturbed due to feeling vibration, but there is also an interrelated issue that the same vibration can cause buildings to radiate noise inside.

2.4 Where these adverse noise and vibration effects are not adequately managed, consequential reverse sensitivity effects on KiwiRail and Waka Kotahi are likely to arise in addition to health effects on residents.

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[2] World Health Organisation, Guidelines for community noise, 1999; World Health Organisation, Burden of disease from environmental noise, 2011.
[3] World Health Organisation, Environmental noise guidelines for the European region, 2018.
[4] Norwegian Standard NS 8176:2017 Vibration and shock - Measurement of vibration in buildings from landbased transport and guidance to evaluation of its effects on human beings.

2.5 In my experience, road and rail networks are particularly susceptible to reverse sensitivity effects. Roads and railways are generally an accepted part of our environment, although my experience from investigating complaints on behalf of KiwiRail and Waka Kotahi is that many people do not appreciate the actual effects of living with road and rail sound and vibration when they choose to build new houses, or alter existing dwellings, near existing road and railway corridors. Even when a site has been visited during the day, prospective residents might not have envisaged the continuing sound into the evening when they could be relaxing outside in the summer, or at night when trying to sleep with windows open. In my experience, people also comment they had not anticipated the steadily increasing traffic that occurs on most state highways over time, and often the changing traffic composition such as an increase in the proportion of trucks at night. Likewise, people often do not appreciate that railway networks can be subject to significant fluctuations in activity, particularly with respect to freight train movements.

2.6 I understand that KiwiRail and Waka Kotahi regularly receive complaints about road and rail sound and vibration from residents who have moved into houses and subdivisions built adjacent or in close proximity to pre-existing or designated transport corridors. These include requests for asphalt road surfacing, noise barriers, speed restrictions, prohibition of heavy vehicles or engine braking, and building of alternative/realigned networks.

2.7 I have been involved in numerous cases throughout New Zealand where people in houses (as well as other sensitive activities) that were established near to pre-existing roads and railways have then affected the operation of that infrastructure. Examples include a house constructed some distance from the pre-existing East Coast Main Trunk railway near Hamilton where the owner sought that trains be required to operate at a limited speed to reduce vibration at the house. In terms of road noise, residential subdivisions were established adjacent to the existing State Highway 6 to the south of Nelson, and residents then campaigned for the road surface to be upgraded from a chip seal to porous asphalt to reduce noise.

2.8 Regardless of whether complaints are made, KiwiRail and Waka Kotahi have social and environmental responsibilities requiring consideration of all neighbours near the road and rail networks.

3. METHODS TO MANAGE ADVERSE EFFECTS

3.1 Where not appropriately managed, adverse effects from road and railway sound and vibration can occur at many existing properties located near state highway and railway networks throughout New Zealand. I have previously been, and am currently, involved in numerous different activities undertaken by KiwiRail and Waka Kotahi to manage and reduce this sound and vibration where practicable. These include development of quieter road surfaces, installation of noise barriers, installation of ballast mat, rail grinding and tamping, ballast cleaning and replacement, investigation into engine braking noise, repair of road surfaces to address vibration issues, and automated monitoring of rolling stock wheel condition. For new or altered roads, Waka Kotahi seeks to apply NZ 6806,[5] which provides guidance on the assessment of noise, recommended noise criteria and potential mitigation measures. However, practicable improvements are often constrained, and the operation of the state highway and railway networks can result in effects which cannot be internalised, such as noise and vibration.

3.2 For new buildings being constructed, or existing buildings being altered, near to the state highway and railway networks, it is relatively straight-forward to control internal sound and vibration through the building location, design and systems (like acoustic insulation and mechanical ventilation). In most cases, it is practical to achieve acceptable internal sound and vibration levels using such measures. Likewise, screening can be used in some cases to achieve reasonable external sound levels, which is important to provide for outdoor amenity associated with normal domestic activity. Thus, with careful design of building location, orientation and materials, future occupants of the building can be protected from the most significant adverse effects associated with state highway and railway sound and vibration.

3.3 Land use controls to avoid or manage adverse noise and vibration effects on new sensitive activities or alterations to such activities are critical in protecting sensitive activities from adverse noise and vibration effects. Such controls, in turn, are fundamental to managing the potential for reverse sensitivity effects on road and rail networks. The location of incompatible sensitive activities in proximity to road or rail infrastructure can lead to noise and vibration effects on, and complaints from, sensitive users. As these effects cannot be internalised, there must be appropriate land use controls in place to manage sensitive development near these transport corridors.

[5] New Zealand Standard NZS 6806:2010 Acoustics – Road-traffic noise – new and altered roads

3.4 Such controls are common in most district plans I am familiar with throughout the country, including to some extent in the operative Waikato District Plan. In the operative Waikato Section there are setback requirements from roads such that constructing or altering buildings is a non-complying activity within 25 metres of the Waikato Expressway (e.g. Rule 25.53), and there are requirements for acoustic insulation of buildings around Hamilton Airport and within road designations in Appendix M. However, these controls do not go far enough to mitigate noise effects from the state highway because the 25 metre setback only addresses the most significant effects. There are no rules within the plan controlling noise effects beyond that setback. I expand on this further below when discussing the relief sought.

3.5 Rules in other district plans commonly control the location and design of sensitive activities such as housing, where such activities seek to locate near existing sound sources such as roads, railways, airports, ports, quarries, industrial sites, industrial and business zones, gun clubs and motorsport facilities. For new houses near existing roads and railways, examples of second generation operative district plans containing controls include: Christchurch, Dunedin, Tauranga, Hamilton, Palmerston North and Hutt City. In all these example plans, there are requirements to achieve reasonable internal noise levels in sensitive spaces near roads and railways. Other aspects of the controls vary between these plans.

3.6 In the case of the Proposed Plan, Appendix 1 already details sound insulation and ventilation requirements (rules) for sensitive land uses seeking to establish in a wide range of noisy environments, including in areas affected by gun club, airport, power station and commercial noise. However, road and rail noise and vibration are not explicitly addressed by these controls in Appendix 1. The controls for other noise sources in the Proposed Plan are consistent with the general approach for road and rail noise proposed in the submissions of KiwiRail and Waka Kotahi. In my opinion, it is illogical and inconsistent from the perspective of protecting human health, for the Proposed Plan to contain land-use controls for sensitive activities near a range of other sound sources but to largely omit controls near road and rail networks.

4. RELIEF SOUGHT – KIWIRAIL

4.1 KiwiRail's submission seeks to introduce permitted activity performance standards for new or altered buildings containing noise sensitive activities near railways. Within 100 metres of a railway network, buildings would need to be designed to result in reasonable levels of indoor railway noise and vibration,

such that sensitive activities could occur without undue disturbance. The controls are designed to avoid adverse health effects that would otherwise be caused by sound and vibration exposure of future occupants.

4.2 To provide flexibility for people establishing or altering noise sensitive activities, the provisions that are sought to be added to Appendix 1 of the Proposed Plan include alternative compliance pathways of either designing to specified maximum noise and vibration levels, or demonstrating the railway is screened, or by using specified constructions. If windows are required to be closed to achieve reasonable internal noise levels, then an alternative ventilation system would be required. In cases where it is not practicable to comply with the requirements, or the landowner does not wish to comply with the standards, land-use consent could be sought as a restricted discretionary activity under the provisions sought by KiwiRail.

4.3 Acoustically, a better method of avoiding adverse effects would be simply to prohibit sensitive activities from locating near the rail network, but I understand from an integrated planning perspective that this may give rise to undesirable outcomes. In my opinion, the proposed controls provide a pragmatic approach of allowing development near rail corridors, subject to reasonable site and building design. Rather than relying on the most restrictive option in terms of distance or internal noise levels, the criteria are set at a moderate level, which in my view will provide controls that ensure reasonable protection from adverse health effects for the majority of the population. I consider that this is appropriate. KiwiRail's relief achieves this balance through the following measures:

(a) The distance for application of the rule over 100 metres will not capture all adverse rail noise effects (ie those that extend beyond 100m from the railway) but will address the most significant effects in my view.

(b) The maximum rail noise level to be met in bedrooms is 35 dB $L_{Aeq(1h)}$. The WHO 2018 Guidelines recommend a criterion of 44 dB L_{night} but applied outside buildings and averaged over the night period for a year. This WHO value assumes windows may be open, resulting in internal sound levels of around 30 dB. The criterion proposed by KiwiRail is slightly higher (more lenient) than the WHO recommendation by around 5 dB. I consider this a pragmatic approach to address the most significant adverse health effects, without imposing undue constraints on development of noise sensitive activities.

(c) The indoor vibration limit proposed by KiwiRail would only apply within 60 metres of a railway. As for the 100 metre distance used for noise effects, the application of the vibration criterion to only 60 metres will exclude some adverse vibration effects that are likely to occur at greater distances, but I consider this is a pragmatic approach to address the most significant vibration effects. The vibration criterion is in accordance with a recognised standard ("**NS 8176**"),[6] and in my opinion is appropriate to manage adverse effects on people. As for the noise limits I consider the vibration criterion proposed by KiwiRail to be pragmatic. It does not provide absolute protection but is set at a level whereby 15% of the population would still be expected to be disturbed by vibration.

4.4 In my opinion, the relief sought by KiwiRail will provide for new and altered buildings near rail corridors that provide people with acceptable indoor living conditions. This should manage adverse health and amenity effects experienced by those people to a reasonable degree, which in turn should manage reverse sensitivity effects on KiwiRail.

5. RELIEF SOUGHT – WAKA KOTAHI

5.1 The submission by Waka Kotahi seeks an identical approach of permitted activity performance standards for new or altered buildings containing sensitive land uses near state highways and railways, to that sought by KiwiRail for buildings near railways. Within 100 metres of a state highway carriageway or railway, buildings would need to be designed to result in reasonable levels of indoor noise. The submission seeks a new section with specified design sound levels to be added to Appendix 1 to the Proposed Plan. The Waka Kotahi submission does not include the text for this new section of Appendix 1. As for the KiwiRail submission, the Waka Kotahi submission proposes that in cases where it is not practical to comply with the permitted activity performance standards, or the landowner does not wish to comply with the standards, land-use consent could be sought as a restricted discretionary activity.

5.2 I recommend the following amendments to the provisions in KiwiRail's submission to address road specific matters:

(a) The table of design noise levels should be augmented with an additional column for road noise, and the existing maximum noise

[6] Norwegian Standard NS 8176:2017 Vibration and shock - Measurement of vibration in buildings from land based transport and guidance to evaluation of its effects on human beings.

level column being labelled as applying to rail noise. For road noise the $L_{Aeq(24h)}$ parameter should be specified (in place of the $L_{Aeq(1h)}$ used for rail noise) in accordance with NZS 6806 and as mandated by the Noise and Vibration Metrics National Planning Standard. The decibel values in the new maximum road noise level column should be the same as the existing maximum rail noise level column, other than for sleeping spaces which should increase to 40 dB for roads. This is to account for the typical diurnal variations in traffic flows and the 24 hour averaging using the $L_{Aeq(24h)}$ parameter.

(b) The line-of-sight requirement for roads should be to all points of the road surface, and not 3.8m above the road. The 3.8m height provision should remain for railways. This is because for highways the dominant sound is from the tyre/road interface, whereas for railways locomotive engines/exhausts can be dominant in some circumstances.

(c) The vibration standard should only apply within 40 metres of a state highway as there are normally lower vibration emissions from roads than railways. The 60 metre distance should be retained for railways.

(d) The specified source noise level should only apply to railways. For roads the requirement should be for road noise to be based on measured or predicted noise levels plus 3 dB.

5.3 Mr Wood attaches a copy of the proposed text for Appendix 1 in his evidence, based on my recommendations set out above in paragraph 5.2. The new provisions are generally in accordance with the new section set out in the KiwiRail submission, with minor amendments for road specific matters. The submission by KiwiRail is based on combined provisions for road and rail noise and vibration that have been developed jointly by KiwiRail and Waka Kotahi. However, as KiwiRail is only responsible for managing the rail corridor, not the state highway network, its submission only addresses rail noise and vibration, and has removed those parts of the combined provisions that relate to roads. While there are minor nuances between the relief sought by KiwiRail and Waka Kotahi, the fundamental controls sought are consistent.

5.4 In my opinion, these amendments, which are needed to account for road specific matters, are required to achieve an equivalent standard of pragmatic controls, as I have discussed above with respect to rail noise and vibration.

5.5 On the basis of the amended provisions attached to Mr Wood's evidence, in my opinion the relief sought by Waka Kotahi should result in new and altered

buildings near state highways that provide people with acceptable indoor living conditions. This should manage adverse health and amenity effects experienced by those people to a reasonable degree, which in turn should manage reverse sensitivity effects on Waka Kotahi.

6. RESPONSE TO SECTION 42A REPORT

6.1 In the Section 42A report, the Council officer, Mr Mackie, recommends accepting in part the submissions by KiwiRail and Waka Kotahi relating to road and railway noise and vibration.[7] I generally agree with the discussion of these issues by Mr Mackie. My comments below primarily relate to Mr Mackie's proposed drafting and the mechanics of how the provisions would operate. In this respect, I agree with the recommended amendments to the provisions set out by Mr Mackie in the Section 42A report, with the additional changes set out in Mr Wood's evidence.

6.2 KiwiRail and Waka Kotahi sought either district wide controls for new and altered buildings containing sensitive land uses near state highways and railways, or the same controls repeated in each relevant zone. In terms of noise and vibration effects on people, either location for the controls can achieve the same outcome. Mr Mackie has recommended repeating the controls in each zone rather than making them district wide.[8] All rules for individual zones would require compliance with the same provisions in Appendix 1.

6.3 Mr Mackie has recommended that the new controls should not be included for the Reserve, Industrial, Heavy Industrial, Business and Business Town Centre Zones as other existing controls would serve the same function.[9] For the Reserve, Industrial and Heavy Industrial Zones, I agree with Mr Mackie that a discretionary or non-complying activity status for sensitive land uses would mean that additional controls are unnecessary. I disagree with Mr Mackie that there are already adequate general sound insulation and ventilation controls in Business and Business Town Centre Zones , such that a separate control just relating to road and rail noise and vibration is unnecessary. In my opinion the existing provisions in Appendix 1.6 of the Proposed Plan, relied on by Mr Mackie for acoustic insulation in the Business and Business Town Centre Zones, would be inappropriate to control effects of road and rail noise and vibration.

6.4 The internal design sound level in Appendix 1.6 is inadequately defined / ambiguous, and there is no requirement for ventilation if windows are closed.

[7] S42A report, 290.
[8] S42A report, 288.
[9] S42A report, 286.

There are also no vibration controls and no alternative compliance pathways. By contrast, the proposed provisions for activities near road and rail corridors attached to the evidence of Mr Wood set out robust requirements, while allowing flexibility so that compliance can be demonstrated in the most efficient manner for different circumstances. I therefore recommend that the specific new road and rail requirements proposed by KiwiRail and Waka Kotahi should apply in the Business and Business Town Centre Zones.

6.5 For the new section to be added in Appendix 1, Mr Mackie has largely adopted the provisions included in the KiwiRail submission. I support these provisions, subject to appropriate amendments to account for road noise and vibration as well as rail noise and vibration, as I have set out above and as shown in the attachment to the evidence of Mr Wood.

6.6 Mr Mackie has only accepted the relief proposed by Waka Kotahi in part with respect to new subdivisions.[10] Rather than requiring building platforms to be 100 metres from a state highway or railway as sought by Waka Kotahi, Mr Mackie has recommended not including a performance standard. He has recommended general consideration of road and rail noise as a matter of restricted discretion. Mr Mackie has also recommended removal of setback requirements from state highways and railways. Setbacks can reduce the need for building controls and can provide for outdoor amenity. An alternative control for outdoor amenity can be to specify a maximum external noise level outside new residential activities. For roads this requirement could be added to the new rules in Appendix 1 as *"Any new buildings for residential activity must have external road noise levels less than 57 dB $L_{Aeq(24h)}$ at all points 1.5 metres above ground level within the proposed notional boundary"*.

7. CONCLUSION

7.1 Sound and vibration from road and rail corridors can give rise to adverse health and amenity effects on sensitive land uses located nearby. The research and guidelines relating to these effects are widely accepted internationally and applied in New Zealand.

7.2 KiwiRail and Waka Kotahi continuously work to reduce existing sound and vibration exposure and to manage the effects of their operations on existing sensitive activities. However, due to the nature of their operations, KiwiRail and

[10] S42A, 289-290.

Waka Kotahi are unable to internalise all noise and vibration effects associated with their activities.

7.3 Adverse effects on new and altered buildings for sensitive activities can be avoided and managed through well understood controls in district plans. In my opinion, it is therefore critical that the Proposed Plan includes appropriate land use controls to manage the location of sensitive activities near road and rail corridors, to protect these users from adverse effects and in turn to manage potential reverse sensitivity effects on KiwiRail and Waka Kotahi. I am not aware of any acoustic or health justification to compound existing issues and allow more people to be subject to adverse health and amenity effects, when the new exposure can be avoided or otherwise appropriately mitigated.

7.4 In my opinion the submissions by KiwiRail and Waka Kotahi on the Proposed Plan, with the amendments set out in the attachment to the evidence of Mr Wood, seek appropriate and pragmatic rules that would manage the most significant adverse effects on new and altered sensitive activities near existing road and rail corridors.

7.5 The Section 42A report recommends accepting the main parts of the proposed rules sought by KiwiRail and Waka Kotahi. In my evidence, I have set out a number of areas where I consider some amendments are needed to the proposed drafting of the version of the provisions recommended in the Section 42A report.

Dr Stephen Chiles
Acoustician
29 September 2020