BEFORE INDEPENDENT HEARING COMMISSIONERS
AT RANGIORA / WAIMAKARIRI

I MUA NGĀ KAIKŌMIHANA WHAKAWĀ MOTUHAKE
KI RANGIORA / WAIMAKARIRI

IN THE MATTER	**of the Resource Management Act 1991**
AND	
IN THE MATTER	**of the hearing of submissions and further submissions on the Proposed Waimakariri District Plan**
HEARING TOPIC:	**Stream 5**

STATEMENT OF REBUTTAL EVIDENCE OF LANCE MICHAEL JIMMIESON ON BEHALF OF KĀINGA ORA – HOMES AND COMMUNITIES

(VENTILATION)

07 AUGUST 2023

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1. EXECUTIVE SUMMARY

1.1 Basis of Evidence

1.1.1 This evidence is aimed at achieving acceptable levels of indoor air quality to ensure the creation of lifelong healthy homes, as well as ensuring minimum levels of comfort are achieved for dwellings located within noise affected areas, where it is accepted that external doors and windows will be required to remain closed to ensure the integrity of specialist acoustic treatment, and in order to ensure acceptable internal noise levels are maintained within all habitable rooms.

1.2 Review of S42A

1.2.1 Having reviewed the S42A report provided by Waimakariri District Council (**the Council**) referring to the ventilation requirements as expressed in NOISE R-14, NOISE-R16, NOISE R-18 and NOISE-RXX (Ventilation), it is noted that specific design parameters have not been provided and rely solely on the New Zealand Building Code. These solutions do not address the potential for overheating, or when additional ventilation could be necessary. I have proposed alterations as set out within this document.

1.3 Applicable Standards

1.3.1 In carrying out my assessment, I have referred to applicable NZ and Australian Standards, the NZ Building Code G4/AS1, and CIBSE guidance as reference documents for recommending solutions proposed for adoption into the Waimakariri Proposed District Plan (**PDP**). Standards include NZS4303:1990 - Ventilation for acceptable indoor air quality, AS 1668.2-2002 - The use of ventilation and air conditioning in buildings - Part 2: Mechanical ventilation in buildings, MoE DQLS Indoor Air Quality and Thermal Comfort (v2.0) and CIBSE Guide A Environmental Design.

1.4 Compliance

1.4.1 It is important to retain sufficient flexibility in the PDP to allow a range of compliance methods by designers, while ensuring minimum standards are clearly articulated and achieved. The adoption of minimum ventilation

rates based on and referenced to established codes, such as the NZ Building Code and Industry organisations such as CIBSE (Chartered Institute of Building Services Engineers) together with minimum / maximum internal temperature ranges (18ºC – 25ºC), will result in a combined requirement for heating, cooling and ventilation systems to ensure compliance. Ambient Design has also been stipulated to ensure design consistency across the various climate zones throughout New Zealand. Compliance is required to be demonstrated for each separate habitable space and consideration towards other intermittent ventilation systems required under separate codes for bathrooms, laundries and kitchens is required. As such, capital costs, maintenance costs and running (energy consumption) costs must all be considered by the system designer. Choice of fuels should also be considered within a sustainability framework, including exclusion of fossil fuels, in-line with current government carbon reduction strategies.

1.5 Minimum heating, cooling and ventilation requirements

1.5.1 Regarding minimum heating, cooling and ventilation requirements, my evidence will address the following matters:

a) Mechanical ventilation compliant with section 1.5, Mechanical Ventilation of NZBC G4/AS1 is to be provided for all habitable rooms.

b) Ventilation, heating and cooling, is to be provided for each separate habitable space, including each bedroom, assuming bedroom doors will be closed.

c) Ventilation system(s) are to be adjustable by the occupants only where non-compliant or fixed windows are installed. Otherwise minimum ventilation rates can be fixed airflow.

d) All controls and ancillary items to effect the correct operation of the above systems is to be provided.

e) A suitable heating system that is controllable by the occupant and capable of maintaining a minimum internal design temperature of 18oC, while operating within the specified noise criteria of 35 dB LAeq(30s) when measured 1 metre away from any inlet/outlet. Equipment breakout noise must also fit within this criteria.

f) A suitable cooling system that is controllable by the occupant and capable of maintaining a maximum internal design temperature of

25oC, while operating within the specified noise criteria of 35 dB LAeq(30s) when measured 1 metre away from any inlet/outlet. Equipment breakout noise must also fit within this criteria.

g) The design is to be based on the NIWA 2.5% design weather dataset (i.e. 24 hour data as published by NIWA) for ensuring heating and cooling solutions work appropriately 24/7 for the geographic location in which the dwelling is located.

1.5.2 Where buildings are fitted with non-compliant or fixed windows, the minimum ventilation requirement should be increased to 1 air change per hour and a flushing function capable of 2 air changes per hour may also be provided.

1.5.3 Alternatively, a specific engineered system can be proposed by a suitably qualified and experienced HVAC expert, provided the above outcomes can be met or exceeded.

1.6 Further considerations

1.6.1 As this is a specialist area of engineering, it is expected that Council would benefit from requiring a peer review process by submitters, similar to that used for Building Consent processing.

A further consideration is the development of a set of ‘Acceptable Solutions’ or ‘Examples’ of complying designs to better inform applicants of what complying documents might look like.

2. INTRODUCTION

2.1 Name & Position

2.1.1 My full name is Lance Michael Jimmieson. I am a specialist Building Services Engineer and Managing Director of Jacksons Engineering Advisers Limited, having been an owner and Managing Director for the past 23 years. I lead a team of 26 Building Services consulting engineers in the design, construction, and assessment of building services, working across New Zealand and internationally.

2.2 Qualifications and experience

2.2.1 I have a NZ Certificate in Engineering (HVAC) from the Central Institute of Technology obtained in 1981 and approximately 43 years of experience in the Heating, Ventilation and Air Conditioning (**HVAC**) industry. I have developed specialist skills in diagnosing problems and improving the performance of existing buildings, leading a company specialising in the upgrade and improvement of existing building stock. I am a course developer and trainer in Building Services courses operated by Carbon and Energy Professionals New Zealand, as well as publishing technical white papers to help train industry professionals, further demonstrating my focus on improving the service delivery from the Building Services sector.

2.3 Evidence response

2.3.1 This evidence statement responds to the ventilation standards within the Noise Chapter provisions of the PDP, as set out in the S42A report.

2.4 Recommended Amendments

2.4.1 The recommended amendments to the provisions under consideration in Hearing Stream 5 that are included in Attachment B to Mr Lindenberg's statement of evidence include my input and recommendations.

2.5 Basis of Evidence

2.5.1 In preparing this evidence I have read the relevant PDP provisions and the supporting Section 42A report together with the associated appendices prepared by Council staff.

2.6 Code of Conduct

2.6.1 Although this is a Council hearing, I confirm that I have read the Expert Witness Code of Conduct set out in the Environment Court's Practice Note 2023. I have complied with the Code of Conduct in preparing this evidence and agree to comply with it while giving evidence.

2.7 Area of Expertise

2.7.1 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.

2.8 Scope of Evidence

2.8.1 My evidence covers submissions and further submissions on the Waimakariri District Councils Proposed District Plan Change in relation to the provisions that manage the mechanical ventilation and thermal performance of buildings from an occupant perspective, where natural ventilation via openings windows is not acceptable due to external noise, as defined by others.

2.9 Matters addressed

2.9.1 My evidence will address the following matters:

a) The amendments I propose for the heating, cooling and ventilation provisions set out in NOISE-R14, NOISE-R16, NOISE-R18 and NOISE-RXX (Ventilation).

b) The reasons for the amendments and why they are generally aligned with creating healthy and comfortable internal environments within the affected dwellings where the use of openable windows is restricted.

c) The reasons why I generally do not support high levels of mechanical ventilation (3+ air changes per hour) for internal space temperature control.

2.9.2 Where appropriate and relevant, my evidence will reference and rely on previous work undertaken by Jackson Engineering Advisers for Queenstown Lakes District Council and Wellington City Council. My

evidence will reference the evidence of Mr Lindenberg and Mr Styles for Kāinga Ora.

3. HEATING, COOLING AND VENTILATION OF BUILDINGS

3.1 Housing within noise affected areas

3.1.1 Addressing the effects of high noise environments on residential housing requires a combination of design, engineering, and policy measures to mitigate potentially detrimental effects on residents' health, well-being, and overall quality of life.

3.2 External Measures

3.2.1 Measures undertaken to the external environment of the affected housing may include:

a) Land use planning and zoning, including noise mapping to identify high-noise areas such as vehicle and rail corridors, airports and industrial areas.

b) Noise regulations and enforcement.

c) The use of urban green space and buffer zones.

d) The use of noise barriers such as sound walls.

3.3 Direct Measures

3.3.1 Measures applied directly to affected housing may include:

a) Building design considerations such as location and orientation and soundproofing by the use of noise-reducing materials in walls, floors, and ceilings.

b) The use of specialised glazing to provide better noise insulation from external sources.

c) Ensuring gaps and cracks in the structure are properly sealed, ensuring integrity of the noise envelope.

3.4 Thermal Comfort

3.4.1 Internal space temperature limits are not set out in the New Zealand Building Code for many building usage types. Minimum internal space temperatures are required by the New Zealand Building Code G5 for

retirement homes and early childhood centres only. Upper limits are not set. These requirements do not apply to the majority of buildings constructed for commercial or residential use. I consider a suitable reference guide to be the Chartered Institute of Building Services Engineers (CIBSE) – Guide A Environmental Design Table 1.5. This provides guidance on internal temperature limits with a proposed minimum winter indoor temperature of 18°C and a maximum summer indoor temperature of 25°C. These temperatures are to be achieved within the ambient limits published by NIWA – 2.5% 24 Hour data, within the applicable location.

3.5 Effects of sealing a Building

3.5.1 With the building envelope closed up (doors and windows closed), even with high rates of mechanical ventilation, the internal temperatures will rise well past the prevailing ambient temperatures on clear sunny days. While beneficial to external noise reduction, the added acoustic insulation will also increase the thermal insulation properties of the building, effectively trapping more heat within the building, during periods of high solar gain. For this reason, the provision of air conditioning (mechanical cooling), will be essential to limit internal temperatures to less than 25^{o}C.

3.5.2 Without the ability to open windows to provide ventilation to all habitable spaces, mechanical ventilation will be required.

3.5.3 Ventilation rates are typically kept to a minimum during winter periods to avoid wasting energy by over-ventilating with cold outside air, which would also require higher capacity heating plant. Similarly, once air conditioning (mechanical cooling) is introduced, summer ventilation rates are also required to be kept to a minimum to avoid wasting energy by over-ventilating with very warm outside air, also requiring larger capacity plant. My recommendation is therefore that continuous minimum ventilation rates are maintained year round. This is described further under section 3.8 – Ventilation.

3.6 Occupant Control

3.6.1 Residential houses and most apartment buildings are normally equipped with openable windows and/or external doors.

3.6.2 In standard buildings, ventilation rates are achieved by a human response to prevailing climate and building operating conditions by opening or closing doors and windows. A wide range of ventilation effectiveness is achievable through an occupants' ability to open or close external doors or windows to an extent they deem appropriate in response to climatic conditions. This infers that higher or lower ventilation rates can be achieved due to events such as temporary increases in occupancy numbers, periods of high internal moisture, washing and drying clothes etc. A human response also caters for periodic or extraordinary events such as recovery from a water leak within the house or re-habitation of a dwelling after an extended absence.

3.6.3 However, to ensure the effectiveness of the direct building related measures (Ref: 3.3 above) required to allow normal activities such as holding a conversation or listening to television or music to continue without interruption, it is essential that all external doors and windows remain closed during periods of high external noise, regardless of the prevailing ambient conditions.

3.6.4 If a dwelling is required to operate with all of its external doors and windows closed, this innate ability for residents to manage their own internal environment is lost, so must be replaced or replicated by engineered solutions.

3.7 Engineered Solutions

3.7.1 The required engineered solutions fall into two categories:

1. Ventilation requirements – **In terms of Indoor Air Quality.**
2. Thermal comfort – An aspect of **Indoor Environmental Quality.**

3.7.2 I will look at these two aspects independently, with the aim of identifying any modifications required to the PDP to ensure minimum standards are established to supplement existing Codes and Standards, thereby ensuring fundamental indoor air quality and thermal comfort requirements will be met for residential housing, specifically designed and constructed within high noise environments.

3.7.3 As a point of clarification, **Indoor Air Quality (IAQ)** specifically refers to the management of the quality of the air within a building, including the presence of pollutants and contaminants. On the other hand, **Indoor**

Environmental Quality (IEQ) is a broader concept that encompasses the overall quality of the indoor environment, including factors such as air quality, thermal comfort, lighting, acoustics, and ergonomics, all of which can impact the health, well-being, and satisfaction of building occupants.

3.8 Ventilation

3.8.1 The purpose of providing ventilation to residential houses is to maintain an acceptable level of indoor air quality and to promote a healthy and comfortable living environment. Ventilation involves the exchange of indoor air with fresh outdoor air to remove pollutants, excess moisture which can lead to mould growth or interstitial condensation, odours, and other contaminants from within the indoor space. Adequate ventilation contributes towards a reduced risk of respiratory illnesses, allergies, and asthma by preventing the buildup of airborne pollutants and allergens.

3.8.2 The minimum general ventilation requirements for buildings are set out in the New Zealand Building Code, under section G4. The acceptable solution (G4/AS1) requires occupiable spaces to have either an openable window area equivalent to 5% of the floor area (per space), or mechanical ventilation complying with NZS 4303:1990 and AS1668.2:2002. NZBC G4 also requires mechanical exhaust ventilation to cooktops, showers and baths.

3.8.3 Consideration is needed to ensure ventilation solutions acknowledge all aspects of NZBC compliance to ensure integrated, practical, and cost-effective solutions are available, taking into account interactions between all ventilation and air conditioning systems within a dwelling – whether they be operating intermittently or permanently.

3.8.4 Some aspects of ventilation are already covered under existing legislation as per section 1.1.2 of NZ Building Code G4 and referenced standards NZS4303 and AS1668.2:2002. These include:

a) Ventilation for bathrooms and laundries to extract moisture laden air at source.

b) Ventilation for internal toilets to extract foul air.

c) Ventilation for kitchen cooktops to extract cooking smells and contaminants at source.

d) A requirement under NZBC G4 section 1.5.3 that building interiors ventilated by mechanical systems shall maintain positive pressure.

3.8.5 It is expected that common forms of natural ventilators such as window trickle or passive ventilators (NZBC G4 1.3.5) will not apply within noise affected areas unless suitably attenuated ventilators can be provided under a specific design process.

3.8.6 Having reviewed the S42A report provided by Waimakariri District Council referring to the ventilation requirements as expressed in NOISE-R14, NOISE-R16, NOISE-R18 and NOISE-RXX (Ventilation), I note that specific design parameters have not been provided and rely solely on the New Zealand Building Code. These solutions do not address the potential for overheating of the dwelling, or times when additional ventilation could be beneficial.

3.8.7 It is my opinion that attempting to achieve mechanical ventilation airflow rates similar to that achieved by openable windows is of minimal benefit to the building occupants. The cooling effect will be limited and typically does not provide the sensitivity of control of a window operated by a real person. High rates of outside air ventilation along with the use of mechanical heating and cooling equipment will drive a requirement for much higher capacity heating and cooling equipment, with resultant increases in capital costs, energy consumption and operating costs.

3.8.8 Where opening windows are not provided or are inadequate to meet the requirements of NZBC G4, supplementary levels of mechanical ventilation (up to 1 air change per hour as per CIBSE Guide A Environmental Design Table 1.5) are proposed on a pro-rata basis, relative to the extent of opening windows provided (in relation to the building code requirements). i.e., where no opening windows are provided a minimum of 1 to 2 air changes per hour of mechanical ventilation will be required.

3.9 Minimum additional ventilation standards for housing in noise affected areas

3.9.1 It is important to tie the basis of proposed minimum standards to existing legislation and established benchmarks to ensure consistency for designers and compliance bodies, such as Councils. In setting out minimum standards of ventilation, it is important to accommodate

different methods of achieving compliance where natural ventilation cannot be readily provided. Compliance may be achieved by any or a combination of mechanical ventilation systems such as exhaust air fans, supply air fans, ventilation systems integrated into heating and air conditioning systems, energy / heat recovery ventilation (HRV/ERV) systems that help to exchange indoor and outdoor air while conserving energy.

3.9.2 I propose alterations to NOISE-R14, NOISE-R16, NOISE-R18 and NOISE-RXX (Ventilation) based on the following comments.

3.9.3 Where opening windows are not provided or are inadequate to meet the requirements of NZBC G4, supplementary levels of mechanical ventilation (up to 1ACH as per CIBSE Guide A Environmental Design Table 1.5) are proposed on a pro-rata basis relative to the extent of opening windows provided (in relation to the building code requirements). i.e. where no opening windows are provided, a minimum of 1 air change per hour of mechanical ventilation will be required.

3.9.4 Overheating of internal spaces due to climatic conditions and/or internal heat generation has historically been managed by the home occupants via opening windows. Where windows are inadequate (less than 5% of floor area), cannot be physically opened, or external noise levels dictate that windows cannot be opened without compromising living standards, it is accepted that some additional form of climate control (cooling) is required to achieve acceptable indoor air temperatures.

3.9.5 I note that even where increased amounts of outdoor air ventilation are provided, internal space temperatures will not necessarily be considered comfortable during periods of high temperature weather. Even where large quantities of outdoor air ventilation are provided, it is likely that internal space temperatures will rise above external temperatures due to factors such as solar gain (sunlight entering through glazed elements of the building and heating up internal features) and internal heat loads typically generated by electrical appliances and people within the building.

3.9.6 I recommend that the proposed internal space temperature limits in the PDP are achieved based upon an agreed weather condition. I propose designers are required to use a 2.5% design weather dataset (i.e. 24

hour data as published by NIWA) for ensuring heating and cooling solutions work appropriately for the geographic location. This requires the designer to select a heating or cooling device which could maintain the internal space temperature between 18-25°C year-round, based upon a regionalised historical average outside air temperature which would not be exceeded more than 2.5% of the duration of a typical year.

3.9.7 An acceptable alternative method to calculate minimum ventilation rates is to model the build-up of carbon dioxide CO_2 within each habitable space, so that a maximum value of 850PPM is not exceeded.

3.10 Cooling

3.10.1 Temperature Control falls within the Indoor Environmental Quality sphere. Proper ventilation can also assist with regulating indoor temperatures by allowing the exchange of indoor air with the outside air, particularly during moderate seasons.

3.10.2 Overheating of internal spaces due to climatic conditions and/or internal heat generation has historically been managed by the home occupants via opening windows. Where windows are inadequate (less than 5% of floor area), cannot be physically opened, or external noise levels dictate that windows cannot be opened without compromising living standards, it is accepted that some additional form of climate control is required to achieve acceptable indoor air temperatures.

3.10.3 Even with significantly elevated ventilation rates (6-8 air changes per hour), it is inevitable that dwellings will overheat (above 25^{o}C indoor temperature) during warm clear days, when the windows will be closed, in order to achieve the required reduction in external to internal noise levels. I believe that air conditioning, providing mechanical cooling, will be required to maintain acceptable indoor air temperatures.

3.10.4 I propose that the PDP rules include provision to install air conditioning system(s) to ensure year round comfort conditions can be maintained in all habitable rooms within the prescribed ambient conditions. The air conditioning will operate simultaneously with the prescribed minimum rates of outside air ventilation. Note that high rates of ventilation are incompatible with the operation of air conditioning equipment.

3.10.5 I propose alterations to NOISE-R14, NOISE-R16, NOISE-R18 and NOISE-RXX (Ventilation) based on these comments.

4. CONCLUSIONS

4.1. If windows must be closed to achieve the design noise levels, are non-compliant (windows less than 5% of floor area) or are fixed pane, the building is to be designed, constructed and maintained with mechanical heating, cooling and ventilation systems as set in clause 4.3 below.

4.2 Due to the requirement to simultaneously achieve acceptable levels of indoor air quality (to ensure the creation of lifelong healthy homes), ensure minimum levels of comfort (Internal temperatures of 18 – 25°C) and acceptable internal noise levels, minimum requirements for dwellings' fitted with openable windows should be based on clause 4.3 below.

4.3. Minimum heating, cooling and ventilation requirements

a) Mechanical ventilation compliant with section 1.5, Mechanical Ventilation of NZBC G4/AS1 is to be provided for all habitable rooms.

b) Ventilation, heating and cooling, is to be provided for each separate habitable space, including each bedroom, assuming bedroom doors will be closed.

c) Ventilation system(s) are to be adjustable by the occupants only where non-compliant or fixed windows are installed. Otherwise minimum ventilation rates are to fixed airflow.

d) All controls and ancillary items to effect the correct operation of the above systems is to be provided.

e) A suitable heating system(s) that is controllable by the occupant and capable of maintaining a minimum internal design temperature of 18oC, while operating within the specified noise criteria of 35 dB LAeq(30s) when measured 1 metre away from any outlet/inlet is to be provided. Equipment breakout noise must also fit within this criteria.

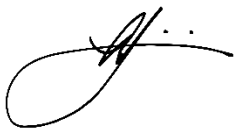
f) A suitable cooling system that is controllable by the occupant and capable of maintaining a maximum internal design temperature of 25oC, while operating within the specified noise criteria of 35 dB

LAeq(30s) when measured 1 metre away from any outlet/inlet is to be provided. Equipment breakout noise must also fit within this criteria.

g) The design is to be based on the NIWA 2.5% design weather dataset (i.e. 24 hour data as published by NIWA) for ensuring heating and cooling solutions work appropriately 24/7 for the geographic location in which the dwelling is located.

4.4 Where buildings are fitted with non-compliant or fixed windows, the minimum ventilation requirement should be increased to 1 air change per hour and a flushing function capable of up to 2 air changes per hour may also be provided.

4.5 Alternatively, a specific engineered system can be proposed by a suitably qualified and experienced HVAC expert, provided the above outcomes can be met or exceeded.



Lance Michael Jimmieson

07 August 2023

5. SUPPLEMENTARY INFORMATION:

5.1 Indoor Air Quality Vs Indoor Environmental Quality

Indoor Air Quality (IAQ) and Indoor Environmental Quality (IEQ) are related but distinct concepts that refer to different aspects of the indoor environment. While both are concerned with the well-being of occupants within buildings, they focus on different parameters and factors. Here's the difference between the two:

5.2 Indoor Air Quality (IAQ):

Indoor Air Quality specifically refers to the **'quality of the air'** within a building or enclosed space.

It focuses on the presence and concentration of various pollutants and contaminants in the indoor air that can affect the health and comfort of occupants. Common indoor air pollutants include:

- Particulate matter (e.g., dust, pollen)
- Volatile organic compounds (VOCs) from building materials and household products
- Carbon dioxide (CO_2) from human respiration
- Mold
- Bacteria / viruses
- Allergens

Improper ventilation, the use of certain products or materials, and the presence of pollutants from external sources (e.g., traffic, industrial emissions) or internal sources (bacteria / viruses) can all contribute to poor indoor air quality.

IAQ management involves strategies such as proper ventilation, air filtration, air cleaning, source control of contaminants and the use of low-emission building materials.

5.3 Indoor Environmental Quality (IEQ):

Indoor Environmental Quality is a broader concept that encompasses various factors contributing to the overall **'quality of the indoor environment'**, beyond just air quality. IEQ takes into account not only indoor air quality but also factors such as thermal comfort, lighting, acoustics, and ergonomic considerations within the space.

IEQ recognizes that multiple elements of the indoor environment interact and influence the well-being, productivity, and comfort of building occupants. In addition to addressing IAQ issues, IEQ initiatives may focus on:

- Ensuring proper temperature levels are maintained
- Ensuring proper humidity levels are maintained
- Providing adequate and well-designed lighting and natural daylighting
- Minimising noise pollution
- Creating ergonomic and comfortable spaces for occupants