

Before the Board of Inquiry
Waterview Connection Project

in the matter of: the Resource Management Act 1991

and

in the matter of: a Board of Inquiry appointed under s 149J of the Resource Management Act 1991 to decide notices of requirement and resource consent applications by the NZ Transport Agency for the Waterview Connection Project

Rebuttal evidence of **Siiri Wilkening (Construction Noise)** on behalf of the **NZ Transport Agency**

Dated: 2 February 2011

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REBUTTAL EVIDENCE OF SIIRI WILKENING ON BEHALF OF THE NZ TRANSPORT AGENCY

INTRODUCTION

- 1 My full name is Siiri Wilkening. I refer the Board of Inquiry to the statement of my qualifications and experience set out in my evidence in chief (*EIC*)¹ (dated November 2010).
- 2 I repeat the confirmation given in that statement that I have read and agree to comply with the Code of Conduct for Expert Witnesses in the Environment Court.

PURPOSE OF EVIDENCE

- 3 The purpose of this rebuttal evidence is to respond to certain aspects of the evidence lodged by submitters. Specifically, my evidence responds to the statements of:
 - 3.1 Nevil Hegley, Auckland Council (Evidence No. 111-2);
 - 3.2 Paul Conder, Unitec Institute of Technology (Evidence No. 160-1);
 - 3.3 Poul Israelson, Unitec Institute of Technology (Evidence No. 160-2);
 - 3.4 Andrew Tauber, Apartments Ltd (Evidence No. 75-1)
 - 3.5 George Richardson, Townscape Securities Auckland Ltd (Evidence No. 101-1);
 - 3.6 Robert Black, Waterview Primary School (Evidence No. 175 and 176-2);
 - 3.7 Brett Skeen, Waterview Primary School (Evidence No. 175 and 176-3);
 - 3.8 Duncan McKenzie, Living Communities (Evidence No. 167-3);
 - 3.9 Vivien Dostine, NZ Horse & Recreation (Evidence No. 174-1);
 - 3.10 Bernadette McBride, Te Atatu Pony Club (Evidence No. 64-1);
 - 3.11 Geoffrey Wood, West Auckland Pony Club (Evidence No. 105-1);

¹ References in this statement to my EIC refer to my Construction Noise evidence (No. 10) (rather than my separate Operational Noise EIC).

3.12 Alex Wardle and Piers Monaghan (Evidence No. 61-1);

3.13 Jinhua Wu (Evidence No. 59-1); and

3.14 Janet Petersen (Evidence No. 111-7).

4 I have also read the statements of all other submitters and consider that I have addressed any further reference to construction noise effects raised by those statements in my Technical Report² and EIC.

5 I have read the Section 42A report provided by Mr Hunt in relation to construction noise effects. My evidence responds to the relevant issues set out in that report.

6 I have also read the Section 42A report (dated 7 December 2010) and its Addendum (dated 20 December 2010) by Environmental Management Services in relation to construction noise effects. My evidence responds to the relevant issues set out in that Report and its Addendum.

7 Noise and vibration expert caucusing for the Project was undertaken on 20 January 2011. Issues discussed, and agreements reached, at that caucusing are discussed in my evidence below.

EXPERT CAUCUSING – NOISE AND VIBRATION

8 Expert caucusing relating to noise and vibration issues was held on 20 January 2011.

9 In attendance were Mr Hunt (commissioned by the Board), Mr Hegley (on behalf of Auckland Council), Mr Millar and myself (on behalf of NZTA), with Mr Sullivan (of Norman Disney & Young) acting as facilitator.

10 The disputed issues pertaining to construction noise were:

10.1 Night-time construction noise criteria for Sectors 1 to 7 (raised by Mr Hunt and Mr Hegley);

10.2 Night-time pile driving (raised by Mr Hegley);

10.3 Timing of implementation of operational barriers (raised by Mr Hegley and Mr Hunt);

10.4 Timing of implementation of (operational) building modification mitigation (raised by Mr Hegley); and

10.5 Indoor noise criteria assessment periods (raised by Mr Hunt).

² Technical Report G.05: Assessment of Construction Noise Effects.

- 11 I note that we reached agreed positions on all of the points noted above. A joint statement regarding the positions agreed at caucusing is being finalised.
- 12 The agreements reached during caucusing involved the formulation of additional conditions and the rewording of other proposed conditions. These conditions are discussed below and are set out in **Annexure A** to this evidence.

Night-time construction Noise Criteria

- 13 Mr Hegley’s and Mr Hunt’s concerns relating to the “blanket” application of elevated night-time construction noise criteria were discussed at caucusing. Following discussion, it was agreed that these concerns could be resolved by placing an obligation on the construction contractor to notify affected residents of night-time works at least 5 days prior to commencement of such works.
- 14 While I consider that this obligation needs only be incorporated into the CNVMP, the experts ultimately agreed to add this obligation to proposed Condition CNV.1, which sets out the content of the CNVMP, as follows:

CNV.1 ...

The CNVMP shall, as a minimum, address the following:

i. ...

xv. Methods for ensuring affected residents are notified of scheduled night-time works (i.e. any works during the hours of 2000–0630) at least 5 days prior to the commencement of any such works.

Night-time pile driving

- 15 Mr Hegley’s concerns regarding noise from night-time pile driving on the causeway was resolved by advice from the NZTA that no pile driving will occur on the causeway at night due to safety reasons.
- 16 Therefore, I have recommended a new Condition CNV.8 which notes this restriction as follows:

CNV.8 Pile driving shall not be undertaken at night (i.e. during the hours of 2000 – 0630).

Timing of implementation of operational noise barriers

- 17 On the issue of timing of implementation of operational noise barriers, agreement on the wording of a new condition (CNV.7) was reached during caucusing. Condition CNV.7 states:

CNV.7 Where practicable, permanent (traffic) noise barriers required in any sector as Detailed Mitigation Options for operational noise following completion of the Project (in accordance with Conditions ON.3 to ON.5) shall be erected prior to major construction works occurring.

Timing of implementation of (operational) building modification mitigation

- 18 Agreement was reached between the experts that any requirement for early installation of Building Modification Mitigation (e.g. glazed windows) cannot be absolute, i.e. there cannot be a requirement that Building Modification Mitigation be implemented prior to construction because such mitigation requires the involvement of and decisions by third parties. However, in order to alert the contractor to the benefits of installing such modification early to mitigate construction noise, we agreed that the practicability of implementation of Building Modification Mitigation should be investigated prior to construction. We agreed to require the inclusion of this obligation in the CNVMP by amending CNV.1 as follows:

CNV.1 ...

The CNVMP shall, as a minimum, address the following:

i ...

xiv. Investigation of the practicability of implementing Building Modification Mitigation, as required in accordance with Conditions ON.6 to ON.11, prior to commencement of construction within 100m of the relevant dwelling.

- 19 I note that the agreed amendment does not alter the obligation on the contractor to establish construction noise mitigation and meet the required noise limits.

Indoor noise criteria assessment periods

- 20 Mr Hunt questioned the reasoning behind the assessment periods of the indoor noise levels, specifically the 8 hour night-time and 16 hour daytime periods for structure-borne noise, and 6 hours for school days.³
- 21 Proposed Condition CNV.2(iii) relates to structure-borne noise from tunnelling. Such noise would be of a constant character and is unlikely to include sudden high noises or "isolated noise events" as suggested by Mr Hunt. However, changing the assessment period would not change the outcome of the condition. I have therefore clarified that the condition relates to structure-borne noise from

³ Malcolm Hunt Associates Section 42A Report, Section 3.4.

tunnelling and agreed to change the proposed condition in accordance with Mr Hunt's suggestion as follows:⁴

- CNV.2 Construction noise (excluding noise from blasting Monday to Saturday inclusive) shall be measured and assessed in accordance with NZS 6803:1999 "Acoustics - Construction Noise" and shall, as far as practicable, comply with the following criteria:

Note: in CNV.2, (T) means a duration between 15 minutes and 60 minutes, in accordance with NZS6803:1999

...

- iii Project Construction Noise Criteria: Internal Structure-borne Noise from Tunnelling for Residential Receivers

0600-2200	35 dB $L_{Aeq(\text{16hr})-(T)}$	All habitable rooms
2200-0600	30 dB $L_{Aeq(\text{8hr})-(T)}$	Bedrooms

- 22 Further, I have, in my technical assessment and EIC, recommended an internal noise criterion of 45 dB $L_{Aeq(9am\ to\ 3pm)}$ for classrooms as this time period corresponds with common school days. I note that the WHO sets a time base of "during class" in relation to school classrooms.
- 23 Since conducting my assessment and drafting my EIC, further discussions with Unitec have shown that teaching hours at Unitec facilities do not correspond with the standard 9 to 3 school day. I have, therefore, adjusted the wording of the condition as shown in paragraph 42 below. I understand from Mr Hunt that this adjustment alleviates his concern in relation to the assessment period for internal noise levels in teaching areas.
- 24 For simplification, a further change to the construction noise conditions was discussed involving the assessment duration of all noise criteria in proposed Condition CNV.2. NZS6803:1999 requires that the assessment is "representative of the sounds under investigation". It notes further that "the measurement sample time should not exceed one hour, and 15 minutes will often be adequate."
- 25 Therefore, instead of repeating the assessment duration in each table of CNV.2, I recommend a note referencing all tables in CNV.2 as set out in **Annexure A**.

⁴ I note that air-borne night-time noise from other construction activities would be assessed against draft Condition CNV.2i. The recommended criteria are external criteria.

NEVIL HEGLEY, AUCKLAND COUNCIL (111-2)

- 26 I understand that the caucusing outcomes, addressed in paragraphs 8 to 25 above and to be recorded in a Joint Caucusing Statement, have addressed each of the concerns, relating to construction noise, raised by Mr Hegley in his evidence on behalf of the Auckland Council.

SECTION 42A REPORT – NOISE & VIBRATION – MALCOLM HUNT

- 27 Mr Hunt produced a Section 42A Report, which raised a number of construction noise issues,⁵ all of which have been resolved in expert caucusing. One issue in which agreement was reached without the need to amend conditions was that of indoor noise criteria.⁶
- 28 In his Section 42A Report, Mr Hunt discusses the recommended indoor noise criteria of my assessment as set out in proposed Condition CNV.2. He appears to have confused my recommendations relating to indoor noise levels from structure-borne noise (from tunnelling) and indoor noise levels for educational facilities (from above ground construction activities). I discuss each issue separately below.

Structure-borne noise

- 29 The main concern in relation to structure-borne noise (also known as re-radiated noise) is sleep disturbance during night-time due to vibration from tunnelling activities being transmitted through the ground into the structure where it is experienced as noise. I have derived indoor noise criteria recommended to apply to structure-borne noise from tunnelling from the World Health Organisation guidelines⁷ (not AS/NZS2107 as stated by Mr Hunt).⁸
- 30 I understand Mr Hunt concurs with my recommended night-time noise criterion for structure-borne noise set out in proposed Condition CNV.2(iii) of 30 dB L_{Aeq}.⁹
- Airborne-noise in teaching facilities*
- 31 In his Report, Mr Hunt disagreed with my determination of a suitable internal noise level for teaching facilities, which I developed in response to the concerns of Waterview Primary School. In his opinion, the requirements of NZS6803 should be applied, i.e. external criterion minus 20 decibels, rather than the

⁵ As set out in the Joint Statement.

⁶ Malcolm Hunt Associates Section 42A Report, Section 3.3.

⁷ EIC paragraph 28 and Technical Report G.5, Section 5.2.

⁸ Malcolm Hunt Associates Section 42A Report, Section 3.3.

⁹ Malcolm Hunt Associates Section 42A Report, Section 3.3.

requirements of AS/NZS2107. He states that “indoor limits from 2107:2000 are higher and may not provide adequate protection for sensitive receivers”.¹⁰

- 32 While this approach may be strictly correct, I disagree with its application in this case as it will actually result in an increased noise criterion, which I consider to be unsuitable for teaching environments. The NZS6803 daytime noise criterion at 1 metre from the façade is 70 dB L_{Aeq} . Using Mr Hunt’s approach, the internal noise criterion would then be 50 dB L_{Aeq} ¹¹ with external doors and windows closed, without the requirement for alternative ventilation.
- 33 I understand that Mr Hunt now agrees with my recommended criteria of 40 and 45 dB L_{Aeq} for the school hall and classrooms respectively, with the provision of alternative ventilation, which I consider is a better outcome for schools. These criteria are based on the recommended design levels of AS/NZS2107:2000 of 35 to 45 dB L_{Aeq} for primary school classrooms as discussed in paragraph 26 of my EIC.
- 34 I acknowledge that AS/NZS2107 states that it is not intended for the determination of acceptable noise levels from transit or variable noise, such as construction noise like jack hammer or pile-drivers.¹² I interpret this exception as being intended to apply to specific isolated high noise events. General construction noise, e.g. trucks and excavators operating along a construction site generate a more even noise, which in my opinion can be appropriately assessed against the guidelines of AS/NZS 2107, especially in this circumstance where construction noise will have a lengthy duration.
- 35 I note that Mr Hunt’s findings concur with my assessment in relation to Waterview Primary School, Waterview Kindergarten,¹³ St Francis Primary School, the treatment of buildings where non-compliance may occur and the treatment of construction yards.

¹⁰ Malcolm Hunt Associates Section 42A Report, Section 3.3 (2).

¹¹ Daytime weekday noise criterion of 70 dB L_{Aeq} – 20 dB = 50 dB L_{Aeq} .

¹² Other noise sources, for which AS/NZS2107 should not be used as a prescription tool, include aircraft noise, railway noise, crowd noise and emergency vehicle audible warning devices. This indicates that intermittent and high noise generating sources should not be assessed against this standard as they have a greater effect than near continuous noise sources.

¹³ I note that Mr Hunt agrees with the temporary relocation of the kindergarten (Section 42A Report, Section 3.9), which is now to be permanent.

PAUL CONDER, UNITEC INSTITUTE OF TECHNOLOGY (160-1)

- 36 I attended a meeting with Unitec on 18 January 2011 where the issues raised in Mr Conder's and Mr Israelson's¹⁴ statements were discussed. I incorporate the agreements reached during that meeting in my discussion below.
- 37 In his statement, Mr Conder acknowledges that NZTA "will comply with the relevant [NZS6803] standards"¹⁵ but requests that "there needs to be a higher standard to reflect the needs, health and safety of students".¹⁶ In Mr Conder's opinion, this higher standard should specifically cover Unitec, its exam times and its 8am to 9pm operating hours.¹⁷
- 38 Similar to all other residents, students and workers in the area, occupants of the Unitec campus will be affected to some degree by noise arising from this Project. These effects will be managed by setting noise criteria and following processes if noise criteria cannot be met at times.
- 39 The teaching facilities at the Unitec site are generally a considerable distance from construction works on the Great North Road Interchange (>100 m) and the closest construction yard (>300 m). Accordingly, these facilities will receive lower construction noise levels than those received by receivers closer to the works. I do not consider that additional measures will be required for Unitec nor will the effects be unreasonable based on the assessment I have undertaken.
- 40 Mr Conder acknowledges that "the NZTA have [sic] proposed an amended noise condition in relation to educational facilities (Condition CNV.2)"¹⁸ and seeks that the specified hours of Condition CNV.2(iv) be extended from 9 am to 3 pm, to 8 am to 9 pm to encompass Unitec's operating hours.¹⁹ I note that the criteria of proposed Condition CNV.2(iv) have been included in the conditions to account for Waterview Primary School and Kindergarten, which are immediately adjacent to the construction site, rather than for Unitec.

¹⁴ Refer paragraph 45.

¹⁵ Conder Evidence, paragraph 3.3.

¹⁶ Conder Evidence, paragraph 3.3.

¹⁷ Conder Evidence, paragraphs 3.2 to 3.4 and 4.2.

¹⁸ Conder Evidence, paragraph 4.1.

¹⁹ Conder Evidence, paragraph 4.2.

- 41 I have inspected²⁰ the Unitec buildings closest to Great North Road and SH16 and note that these buildings currently have internal noise levels from ambient external noise that are well in excess of the recommended criteria. These exceedances are due to the majority of windows being louvered and unsealed and therefore acoustically virtually transparent. Current noise levels are elevated and Unitec appears to have been operating and teaching in this environment for several years.
- 42 Therefore, I do not agree that the educational internal noise criteria I have recommended should apply to Unitec teaching areas without appropriate limitation. Accordingly, I recommend the following adjustments to proposed Condition CNV.2(iv):

CNV.2 Construction noise (excluding noise from blasting Monday to Saturday inclusive) shall be measured and assessed in accordance with NZS 6803:1999 "Acoustics - Construction Noise" and shall, as far as practicable, comply with the following criteria:

Note: in CNV.2, (T) means a duration between 15 minutes and 60 minutes, in accordance with NZS6803:1999

...

- iv Project Construction Noise Criteria: Internal noise for Licensed Educational Facilities

Time period	Project Construction Noise Criteria Inside	
0900—1500 <u>Teaching hours</u>	45 dB $L_{Aeq(6hr)(T)}$ <u>OR</u> <u>existing, whichever is the higher</u>	Classrooms, library, offices, <u>teaching laboratories, manual arts workshops</u>
0900—1500 <u>Teaching hours</u>	40 dB $L_{Aeq(6hr)(T)}$ <u>OR</u> <u>existing, whichever is the higher</u>	School halls, <u>lecture theatres</u>

Note: in CNV.2(iv) "Teaching hours" means:
Primary schools and Kindergartens: 9 am to 3 pm
Unitec: 8 am to 9 pm

- 43 This amendment extends the time period of the internal noise criteria as requested by Unitec and specifically includes Unitec

²⁰ The inspection was for the preliminary assessment of potential Building Modification Mitigation in relation to traffic noise. The building has been identified as a Category C building in the traffic noise assessment. Refer my EIC, paragraph 55 and Technical Report G.12.

facilities. However, it avoids the NZTA having to provide 'mitigation' to address existing noise issues unrelated to the Project. I note that construction noise mitigation measures will still ensure that Project-related construction noise is addressed and meets the external noise criteria set out in the proposed conditions. The existing noise levels within Waterview Primary School are generally within the CNV.2(iv) noise limits and the school will be unaffected by the amendment.

- 44 I note that the Unitec 1 building has been identified in the operational noise assessment as a "Category C" building, i.e. building modification mitigation may be required for this building. During the meeting on 18 January 2011 with representatives of Unitec it was agreed that the NZTA will investigate the practicability of early installation of building modification mitigation, likely to consist of improved glazing and alternative ventilation, on the Unitec building, which would also mitigate potential, but unlikely, construction noise effects.²¹

**POUL ISRAELSON, UNITEC INSTITUTE OF TECHNOLOGY
(160-2)**

- 45 Mr Israelson's statement supports Mr Conder's statement (discussed above) and does not raise any further issues. My response to the issues covered in Mr Israelson's statement (particularly with respect to his proposed amendment of proposed Condition CNV.2(iv)) is set out in paragraphs 36 to 43.

ANDREW TAUBER, APARTMENTS LTD (75-1)

- 46 Mr Tauber's statement relates to construction noise effects on the property at 1510 Great North Road. The buildings are leased by Unitec as student accommodation.

Noise Criteria

- 47 Mr Tauber is concerned about unspecified reports, which he considers advise residents that "more tolerance to noise should be permitted because Great South [sic] Rd is already noisy [sic]".²² If Mr Tauber's concern is the higher night-time construction noise criterion of 60 dB L_{Aeq} recommended for Sectors 1 to 7, I note that 1510 Great North Road is located in Sector 8, for which I have recommended the standard night-time construction noise limit of 45 dB L_{Aeq} (refer proposed Condition CNV.2). This criterion is as specified in the New Zealand Construction Noise Standard NZS 6803:1999.

²¹ I note that this supports my statement in paragraph 18 that, where practicable, building modification mitigation will be installed early in the construction process.

²² Tauber Statement, paragraph 5b, pg. 7.

- 48 I recognise that the buildings at 1510 Great North Road are on the cusp of Sectors 7 and 8, with different night-time noise criteria recommended for Sectors 7 (60 dB L_{Aeq}) and 8 (45 dB L_{Aeq}). I note that the noise criteria apply at the receiving environment, i.e. the lower night-time noise criterion of Sector 8 is applicable to 1510 Great North Road, even if the noise is produced in Sector 7.

Construction Yard

- 49 Mr Tauber states that “[i]t is unacceptable to contemplate students trying to sleep during the construction operations proposed to be conducted on a 24 hour basis, and in particular between 10pm and 6am”.²³ I have assumed Mr Tauber’s concerns relate specifically to Construction Yard 7 and the northern tunnel portal where the tunnel type changes from a drilled tunnel to a cut-and-cover tunnel, both of which are located 35 metres north of the building at 1510 Great North Road. In addition, Mr Tauber questions whether barriers are suitable to shield the buildings from construction noise due to the steep terrain and gully layout.²⁴ Instead, Mr Tauber requests that “NZTA double glaze all apartment windows, and install air conditioning units” and “re-clad the buildings with special acoustic cladding in order that students can sleep at night”.²⁵
- 50 Construction Yard 7 will contain a number of activities²⁶ of which not all will result in high noise levels, e.g. noise from storage and offices can generally comply with the relevant noise criteria recommended in the conditions. The final layout of the activities in the yard has not yet been determined, but will be finalised by the contractor. However, by taking into consideration the location of noise sensitive receivers, such as 1510 Great North Road, locating high noise generating activities away from the buildings,²⁷ installing solid site fences and managing the site appropriately (all of which the CNVMP will require), I consider that the noise criteria set out in CNV.2 can generally be met.
- 51 With the above measures implemented, I do not consider it necessary to provide double glazing to all apartment windows, air conditioning and acoustic re-cladding of the façades as noise limits can be met without such measures.²⁸
- 52 However, should it become apparent through the course of construction of the Project that compliance with the noise criteria cannot be achieved, any additional mitigation involving building

²³ Tauber Evidence, paragraph 5b, pg 7.

²⁴ Tauber Evidence, paragraph 5b, pg. 8.

²⁵ Tauber Evidence, paragraph 8b, pg. 12.

²⁶ Technical Report G.5, Section 8.7.2 and Table 8.24.

²⁷ As recommended in Technical Report G.5, Section 7.5.

²⁸ Tauber Evidence, paragraph 8b, pg. 12.

modification, such as requested by Mr Tauber, would only be required for those apartments facing the construction works. Apartments facing east, south or west (e.g. into the Oakley Creek bush area) would not require any such works as they will be shielded from the works by the placement of the 1510 Great North Road building itself.

GEORGE RICHARDSON, TOWNSCAPE SECURITIES AUCKLAND LTD (101-1)

- 53 Mr Richardson’s statement also relates to 1510 Great North Road and focuses on the recommended construction noise criteria, details of construction equipment and the potential for temporary relocation of residents as a mitigation option.

Construction noise criteria

- 54 I note that Mr Richardson confuses operational and construction noise limits set out in the Auckland City District Plan. He asserts that the District Plan noise limits will be exceeded by up to 20 decibels during construction.²⁹ Operational noise limits for ongoing activities in certain zones (e.g. residential or commercial zones) are different to noise criteria during construction. While noise from ongoing activities in such zones is assessed in accordance with NZS6802, construction noise is assessed in accordance with NZS6803. Construction noise limits are markedly higher than ongoing activity noise limits because construction is of a temporary nature, even if, as in this case, duration is extended. I observe that construction projects of this type could not be undertaken anywhere in an urban environment if assessed against ongoing activity noise limits.
- 55 Mr Richardson questions the lack of detail relating to construction equipment, timing and noise level predictions.³⁰ I have stated that my assessment is based on “reasonable assumption”³¹ and that final methodology and equipment will need to be used for the finalisation of the CNVMP. To date, no contractor has been appointed and therefore the detail available in relation to actual equipment and timing cannot be obtained. However, my assessment is based on experience with a number of large infrastructure construction projects (which allows me to conclude that the proposed noise limits can be met) and in my opinion constitutes a reasonable basis of assessment. In any event, the contractors will need to structure their activities to comply with the noise limits proposed in the conditions and avoid unnecessary noise at all times.

²⁹ Richardson Statement, table on pg 8.

³⁰ Richardson Evidence, Section 1, pg. 9.

³¹ Technical Report G.5, Section 4.

Temporary relocation

- 56 My recommendation³² regarding temporary relocation of residents during limited times of high noise generation in the vicinity of the buildings is of concern to Mr Richardson.³³ I note that I have recommended that "such a measure will be considered only as a last resort".³⁴ At this stage, my predictions indicate that during tunnelling immediately below the buildings of 1510 Great North Road, internal structure-borne noise may be above the recommended noise criteria of the World Health Organisation.³⁵ Such an exceedance would need to be confirmed through noise surveys once tunnelling approaches the building.
- 57 If the recommended internal noise criteria for structure-borne noise are found to be exceeded, there is no alternative mitigation option that could be implemented as structure-borne noise is caused by vibration rather than airborne noise propagation. In this instance, temporary relocation may be the only option to avoid adverse noise effects, particularly during night-time.³⁶ Such a management measure requires ongoing consultation and cooperation of all affected parties and has been implemented successfully for other projects in the Auckland area.³⁷
- 58 I understand that should relocation of any affected resident become necessary the NZTA will provide sufficient notice of any relocation. In addition, the NZTA will liaise with Unitec so that the contractors can avoid either exam periods or the lead up to them. Ms Linzey discusses these procedures in more detail in her rebuttal evidence.
- 59 The choice and implementation of management and mitigation measures will be refined and finalised in the CNVMP by the contractor, who will have detailed information regarding the equipment to be used, duration of operations and timing and will have close contact with affected parties, including those residing in 1510 Great North Road. I consider that my recommendations are reasonable and practicable, but may need refinement throughout the construction process depending on the circumstances that may eventuate.³⁸

³² My EIC, paragraph 62.

³³ Richardson Evidence, Section 1, pg. 9.

³⁴ Technical Report G.5, Section 7.9.

³⁵ Draft Condition CNV.2(iii).

³⁶ Ms Linzey's rebuttal evidence.

³⁷ For example, the Vic Park Tunnel project involved temporary relocation of residents during high noise generating night-time construction activities.

³⁸ Appendix C of Technical Report G.5: CNVMP Section 14 CNVMP Review. This section notes that the CNVMP is a living document which requires updating as work progresses in order to remain relevant and practicable.

ROBERT BLACK, WATERVIEW PRIMARY SCHOOL (175 AND 176-2)

- 60 Mr Black's statement concerns construction noise effects on Waterview Primary School and discusses the duration of construction, construction noise criteria and proposed mitigation.³⁹
- 61 I agree that Waterview Primary School will be particularly affected by the construction of the Project. Therefore, meetings with the school have been held and issues have been clarified. From an acoustic point, I understand that the NZTA is willing to relocate the junior school to the area of the school grounds furthest from the construction site. I consider that this relocation will provide a suitable separation of the most sensitive receivers (as identified by the school) from the works. In addition, upgrading of classrooms and the hall is required to achieve the internal noise criteria set out in CNV.2(iv) and in conjunction with alternative ventilation, will achieve a suitable acoustic teaching environment for students of the school. The NZTA will carry out these mitigation works.

Noise barriers

- 62 I have recommended that construction noise barriers be installed along Herdman Street and the school's eastern boundary facing Great North Road and the construction site. I understand from Mr Black's statement⁴⁰ that he is concerned about the form of these barriers. Along Herdman Street, the proposed barrier would not be of excessive height (2 metres above the school ground level, similar to a normal boundary fence). However, the barrier along the eastern school boundary would need to be higher (in the order of 4 metres) to provide effective shielding.
- 63 I have inspected the school site and found that the school pool is closest to the proposed barrier and that currently a solid barrier is already installed along that boundary (approximately 2 metres high). The closest buildings are 20 metres from the proposed barrier and of similar heights (i.e. approximately 4 to 5 metres high).
- 64 I remain of the opinion that the implementation of the proposed barriers in conjunction with the proposed upgrade to the school buildings will result in noise levels which are suitable for the teaching environment and for the students of the school. Upgrading the buildings only would not achieve any noise level reduction for the outdoor areas such as the playground and pool, and impracticable façade treatments may be required unless external noise levels are first mitigated to the greatest degree practicable.

³⁹ Black Evidence, paragraphs 51, 53, 54 and 55.

⁴⁰ Black Evidence, paragraph 55.

Microphones

- 65 I note that Mr Black states that NZTA staff have “suggested microphones might be a mitigation option”.⁴¹ I will discuss voice amplification systems shortly in relation to a mitigation suggestion by Mr Duncan McKenzie (at paragraphs 70 to 75). At this point I note that I am not aware of any NZTA representative having suggested the use of such systems, and note that I do not consider them to be appropriate mitigation for Waterview Primary. Instead, I am of the opinion that these systems should not be seen as a mitigation measure until all other avenues of noise level reduction have been explored as they lead to increased noise levels for children without reducing the unwanted noise in the first instance.

BRETT SKEEN, WATERVIEW PRIMARY SCHOOL (175 AND 176-3)

- 66 Mr Skeen’s submission relates to Waterview Primary School and notes a number of issues, many of which have been discussed during meetings with the school.
- 67 Mr Skeen suggests that “[a]ll school buildings will require alternative ventilation and double glazing”.⁴² I do not consider such measures to be necessary. The intention for the Project is to achieve internal noise criteria for construction noise as set out in CNV.2(iv). Those rooms that will require upgrading in order to achieve these criteria will be determined (and upgraded) prior to noisy construction occurring. Accordingly, I anticipate that the rooms in the school block furthest from Great North Road may not require alternative ventilation and only some classrooms will require upgraded glazing.
- 68 The statement also requests the “[i]nstallation of a sound system so children can clearly hear the teaching instructions”.⁴³ I discuss this issue in paragraphs 70 to 75.
- 69 I agree with Mr Skeen’s comments that acoustic barriers along the northern and eastern boundaries should be provided.⁴⁴ These comments concur with my recommendations.⁴⁵

⁴¹ Black Evidence, paragraph 42.

⁴² Skeen Evidence, paragraph 28(c).

⁴³ Skeen Evidence, paragraph 40(e).

⁴⁴ Skeen Evidence, paragraph 62(b).

⁴⁵ My EIC, paragraph 105.

DUNCAN MCKENZIE, LIVING COMMUNITIES (167-3)

- 70 In his statement, Mr McKenzie comments on the “provision of additional facilities at [Waterview Primary School] (including audio in classrooms to mitigate effects of construction noise)”.⁴⁶ He notes that such facilities have “been adopted elsewhere in conjunction with NZTA designations including at Wymondley Road Primary School”.⁴⁷
- 71 I agree that, in specific circumstances, the installation of a voice amplification system for some classrooms is a suitable management measure to reduce the effect of long duration noise effects, e.g. for schools under the flight path of major airports. However, such systems should be considered only when a number of other factors have been explored and corrected first. These factors include confirmation that classrooms have a suitable reverberation time, that façades are well insulated and that internal noise levels cannot be reduced despite the first two issues having been addressed.
- 72 Voice amplification systems function by increasing the volume of a teacher’s voice through a microphone and loudspeaker system. In classrooms that are not appropriately acoustically treated this can mean that the noise level in a classroom would need to be increased above levels that are suitable for children to listen to during the school day. While the signal to noise ratio (the ratio of the volume of the teacher’s voice compared with the volume of the background noise from children and external noise sources) is increased, the overall noise level is also increased.
- 73 I recommend that instead of the installation of such a system, the affected classrooms are treated so that the noise level from construction noise is reduced to the criteria recommended in proposed Condition CNV.2(iv). These criteria are set out in AS/NZS2107:2000, which sets out suitable internal noise levels for a number of internal spaces including primary school teaching environments.
- 74 Achieving the recommended internal noise criteria of Condition CNV.2(iv) will require improvement of the building façades of the most affected classrooms. However, details have not yet been finalised as to the required works.
- 75 Providing voice amplification without upgrading the building façades would lead to significantly increased internal noise levels in these

⁴⁶ McKenzie Evidence, paragraph 8.17.2.

⁴⁷ I understand that the fit-out of Wymondley Road Primary School was done as part of a side agreement through the Public Works Act and did not relate to the mitigation of construction noise.

classrooms which would be, in my opinion, an undesirable outcome for the pupils and teachers at the school.

VIVIEN DOSTINE, NZ HORSE & RECREATION (174-1)

- 76 Ms Dostine is concerned⁴⁸ that sudden or loud noises may impact the welfare of the horses and ponies at the Te Atatu Pony Club, which is located immediately adjacent to Construction Yard 1.
- 77 I have recommended that 2 metre high solid site hoardings be installed to enclose the entire construction yard.
- 78 Construction Yard 1 is intended to be used for material handling and general vehicle movements. I consider that truck movements should not constitute a problem for the horses as the Pony Club is located immediately adjacent to the existing SH16. I note that Ms Dostine states that the horses are "habituated to a certain level of road/motorway noise".⁴⁹ Noise level predictions show that current noise levels on the club land range from 60 to 70 dB $L_{Aeq(24hour)}$. These are elevated noise levels, and the proposed activities in the construction yard are unlikely to be higher than these levels.
- 79 I therefore consider that any adverse effects on horses can be managed such that there would be insignificant additional noise effects on the Pony Club.

BERNADETTE MCBRIDE, TE ATATU PONY CLUB (64-1)

- 80 Ms McBride also provides evidence in relation to the potential noise effects from Construction Yard 1 on the Te Atatu Pony Club.
- 81 Ms McBride's statement and correspondence from D B Bond, a veterinarian, seek that 3 metre high solid concrete boundary fencing be installed around the Construction Yard.⁵⁰ I have already recommended in paragraph 77 above, that solid site hoardings be constructed around the yard, however I disagree that such hoarding would need to consist of concrete. Acoustic barriers operate by reducing noise transmission through the barrier to result in an insignificant level. The main path of noise is then around or above the wall.
- 82 In order to achieve such noise level reduction (through the barrier), the barrier material needs to be of sufficient weight, generally 10 to 12 kg/m², and have no gaps between panels and between panels

⁴⁸ Dostine Evidence, paragraph 5(d)i.

⁴⁹ Dostine Evidence, paragraph 5d.

⁵⁰ McBride Evidence, paragraph 5(c)i, and D B Bond Letter, attached to McBride Evidence.

and the ground. These specifications can be achieved by using 17 mm ply sheets or 9 mm fibre cement sheets. With a barrier of this weight in place, it is not then necessary to use heavier barrier materials, such as concrete, because the main path of noise would then be over or around the barrier. Reducing the path of noise through the barrier by using heavier material would provide no further noise level reduction. Therefore, I do not consider it necessary to provide concrete barriers.

- 83 Ms McBride also requests in her submission that “night noise and sudden sharp noises must be controlled and avoided”.⁵¹ I consider that with good site management such control can generally be provided. Measures for good site management will be set out in the CNVMP.⁵²

GEOFFREY WOOD, WEST AUCKLAND PONY CLUB (105-1)

- 84 Mr Wood’s submission relates to construction noise effects on horses, specifically loud and sudden noises.⁵³ I have addressed these issues in paragraphs 76 to 79.

ALEX WARDLE AND PIERS MONAGHAN (61-1)

- 85 The submitters are concerned about construction noise effects on their property at 15 Berridge Ave, Point Chevalier.⁵⁴ They note in their statement that Berridge Ave “is not included in the area considered for temporary or permanent noise barrier solutions”.⁵⁵
- 86 The list of roads included in my EIC⁵⁶ was not intended to be exhaustive and I confirm that management of construction noise will involve the assessment and mitigation of construction noise to all affected residences in the vicinity of the Project, including to the dwellings in Berridge Ave. No plans have yet been prepared showing the exact location of temporary construction noise barriers, as this level of detail will be addressed in the CNVMP. However, I have not excluded any areas from my assessment.
- 87 The submitters state that the removal of pine trees adjacent to the submitters’ property “will increase negative impacts of both noise and visual intrusion”.⁵⁷ Vegetation would need to be extremely

⁵¹ McBride Evidence, paragraph 5(c)i.

⁵² Appendix C of Technical Report G.5: CNVMP Section 11.2, 11.3 and 11.7. These sections can be extended during finalisation by the contractor.

⁵³ Wood Evidence, paragraph 4 and 5(iv).

⁵⁴ Wardle and Monaghan Evidence, paragraphs 1 and 6(a).

⁵⁵ Wardle and Monaghan Evidence, paragraph 6(b). Permanent (traffic) noise barriers are discussed in my operational rebuttal evidence.

⁵⁶ My EIC, paragraph 71.

⁵⁷ Wardle and Monaghan Evidence, paragraph 7.

dense and have a depth of at least 50 metres to provide any meaningful noise reduction effect. Generally, road-side vegetation is of lesser density and depth and does not provide a noticeable acoustic benefit, though visual shielding may be perceived to reduce noise levels. Therefore, in my opinion, removal of vegetation will not have had an adverse effect on noise levels for dwellings in Berridge Ave.

JINHU WU (59-1)

- 88 Mr Wu is concerned about construction noise effects on dwellings in Hendon Ave, specifically 101 to 105 Hendon Ave.⁵⁸ These are the closest houses to the alignment which are intended to be retained on the southern side of Hendon Ave.
- 89 The effect on these dwellings has been described in both my Technical Report⁵⁹ and the CNVMP.⁶⁰ Dwellings at 101 to 105 Hendon Ave are identified as potentially requiring the closure of windows and mechanical ventilation⁶¹ and will also receive mitigation in the form of construction noise barriers.⁶²
- 90 Overall, with the implementation of the recommended mitigation measures, I consider the majority of significant construction noise effects can be addressed. Any remaining issues would be dealt with on a case-by-case basis as recommended in the technical documentation.

JANET PETERSEN (111-7)

- 91 Ms Petersen's statement on behalf of the Auckland Council is in relation to air quality issues. However, consideration of the enclosure of the concrete batching plants is also relevant in terms of noise mitigation. Ms Peterson states that "information should be provided"⁶³ in relation to the potential enclosure of the plants. The materials used for the construction of the enclosures are most important for noise level reductions achieved, therefore I comment on this issue.
- 92 My technical assessment⁶⁴ states that concrete batch plants should be fully enclosed in order to allow continuous operation 24 hours per day, 7 days per week. As details in relation to the final location and

⁵⁸ Wu Evidence, paragraph 5(a).

⁵⁹ Technical Report G.5, Section 8.9.7.

⁶⁰ Appendix C of Technical Report G.5: CNVMP Section 12.11.

⁶¹ Appendix C of Technical Report G.5: CNVMP Appendix E.

⁶² Technical Report G.5, Section 8.9.10.

⁶³ Petersen Evidence, paragraph 6.2.

⁶⁴ Technical Report G.5, Table 8.36.

type of concrete batch plant are not available yet, my assessment is based on typical batch plant layouts and designs.

- 93 A full enclosure would incorporate a large building, typically an aluminium shed with internal wall and roof lining such as fibre cement sheets and roller doors. If possible, all plant associated with the batching process should be located inside the same building to avoid openings for trucks or materials to pass through frequently.
- 94 I consider that the mitigation of noise effects from the batch plants by means of full enclosure should be set out in a condition as follows:

CNV.9 The concrete batch plants shall be fully enclosed.

- 95 Other noise sources associated with the plant, e.g. external slump stands, air compressors and vibrators, should be housed in separate acoustic enclosures similar to the main enclosure.
- 96 Detailed design of the enclosures will need to be undertaken by the contractor once appointed and with the input of an acoustic consultant in order to ensure that noise levels are mitigated to a suitable level.

SECTION 42A REPORT AND ADDENDUM – ENVIRONMENTAL MANAGEMENT SERVICES

- 97 Environmental Management Services (*EMS*) has provided a Section 42A report (dated 7 December 2010) and a Section 42A Addendum report (dated 20 December 2010). I have read both as they pertain to noise and comment on both reports below.
- 98 The Section 42A Report and Addendum do not make reference to Mr Hunt's Section 42A Report and do not appear to summarise Mr Hunt's expert opinion in relation to potential noise effects of the Project. The noise issues addressed in the EMS Section 42A Report and Addendum have generally not been noted by the Board's noise expert as an issue of disagreement.
- 99 I have already addressed the majority of construction noise issues in my EIC and this rebuttal, including the fact that expert caucusing resulted in agreement of all noise experts. However, the following additional construction noise issues have been raised in the EMS reports:
- 99.1 Construction noise effects on Avondale Motor Park;
- 99.2 Confirmation as to compliance of structure-borne noise with criteria;

99.3 Construction noise criteria as agreed performance standards;

99.4 Potential improvement of building envelopes in Sector 9;

99.5 Construction noise criteria for the Waterview Kindergarten;
and

99.6 Noise from the concrete batch plant.

Avondale Motor Park

100 The EMS Report notes that “during the planned 5 year construction period for ... Sector [9] there can be expected to be significant noise ... effects” and goes on to “note the proximity of the Avondale Motor Park where there are permanent residents living in accommodation with little acoustic insulation.”⁶⁵

101 Avondale Motor Park is located immediately adjacent to Construction Yards 8 and 9. Caravans and tents would provide little to no protection against noise intrusion due to their light-weight construction.

102 I understand that accommodation at the caravan park is not intended to be permanent. Caravans are not classed as a dwelling in accordance with NZS6803. Nevertheless, I have proposed that the caravans in the motor park be addressed similarly to any other residential dwelling affected by the Project construction. This means that the construction yards will be shielded from the neighbouring residential areas, including the motor park, by means of high barriers.⁶⁶

103 Notwithstanding the above, noise levels inside the temporary accommodation (caravans and tents) are likely to be well above those in conventional dwellings. Therefore, it is likely that part of the Motor Park may not be able to be utilised for accommodation purposes during the construction of the Project. I consider that this may affect approximately half of the Motor Park, including sites closest to the Construction Yards.

Compliance with Structure-borne noise criteria

104 The EMS Report requests confirmation that structure-borne noise from tunnelling can comply with the recommended criteria.⁶⁷

105 I have discussed this issue in my EIC in paragraph 62 where I recommend a methodology of monitoring and implementation of alternative mitigation, such as temporary relocation, if the recommended criteria are unable to be met.

⁶⁵ EMS Section 42A Report, paragraph 10.10.35.

⁶⁶ EIC paragraph 71.

⁶⁷ EMS Section 42A report, Table in sec 16.2 in relation to paragraph 10.9.19.

- 106 In my opinion, this methodology provides a practical solution to the uncertainty related to structure-borne noise generation and effects. I note that during caucusing, agreement was reached over the recommended relevant noise criteria for structure-borne noise.
- 107 In relation to the recommended temporary relocation of residents for times when tunnelling results in an exceedance of the recommended structure-borne noise criteria, EMS notes that “[t]his specific issue has not arisen in the submissions. It is possible that potentially affected parties are not aware of this risk and further consultation on this matter to alert parties to how this might be managed will be important.”⁶⁸
- 108 I note that the potential for temporary relocation to avoid structure-borne noise effects has been discussed in my Technical Report⁶⁹ and EIC,⁷⁰ which resulted in a number of other noise issues being raised in submitter evidence. I note also that relocation was raised in the evidence of Messrs Conder, Israelson and Richardson, which I have already addressed.⁷¹
- 109 In its Section 42A Addendum, in relation to 1510 Great North Road, EMS states that “[t]emporary relocation is not a desirable response given the proposed and extended time for the construction works.”⁷² The longest duration for any relocation would not exceed two weeks, which is the longest period during which tunnelling with a tunnelling machine would occur below 1510 Great North Road. I do not consider this to be an “extended time for the construction works”.⁷³
- 110 The EMS Addendum requests clarification as to where “re-generated” noise has been discussed in my EIC.⁷⁴ I have discussed structure-borne noise in my EIC in paragraphs 28, and 60 to 62, and make specific reference throughout my EIC as required in response to submissions and to address potential issues. I note that Mr Hunt, in his Section 42A Report, did not consider that clarification was required in relation to potential exceedance of structure-borne noise criteria.

⁶⁸ EMS Section 42A Report, paragraph 10.9.20.

⁶⁹ Technical Report G.5, Section 7.9 and Table 8.28.

⁷⁰ EIC paragraphs 62 and 92.

⁷¹ Evidence statements 160-1, 160-2 and 101-1 respectively.

⁷² EMS Section 42A Addendum, paragraph 3.7.13.

⁷³ I also note that Mr Hunt, the Board’s noise expert, considers that temporary relocation is an acceptable management measure and did not include its discussion in his S42A report.

⁷⁴ EMS Section 42A Addendum paragraph 3.7.15, referencing Mr Millar’s evidence paragraph 39.

Noise criteria as agreed performance standards

- 111 The EMS Addendum notes the importance to “establish agreed performance standards in the relevant management plan(s) and conditions that cannot be changed”.⁷⁵ I note that in Section 2 of the CNVMP contained in Appendix C of my Technical Report sets out “Noise Performance Standards”, which are the same criteria set out in Condition CNV.2 (as amended). Although the CNVMP may be amended, my assessment has been based on the assumption that the criteria included in CNV.2 will not change materially and that these criteria are binding through being included in a designation condition.
- 112 I note that Mr Hunt in his Section 42A Report and subsequent caucusing agreed with the recommended construction noise criteria and acknowledges, through proposed Condition CNV.1(xv) (refer paragraph 13 above) that some flexibility is required for large construction projects such as this.

Potential upgrade of building envelopes in Sector 9

- 113 I have recommended that dwellings in Sector 9, which may be affected by noise from the proposed concrete batching plant, could receive building envelope improvements and alternative ventilation in order to achieve suitable internal noise levels.
- 114 EMS requests further “clarification for the Board to appreciate the nature of the works envisaged and how consent conditions could be given effect to”⁷⁶ in relation to the potential upgrades. My assessment⁷⁷ provides an indicative area for at-risk dwellings which may require mechanical ventilation. However, affected dwellings and proposed mitigation measures will not be confirmed until the design and layout of the batching plant is finalised. As the potentially required improvements are dependent on the existing dwelling, e.g. wall and roof materials, glazing, joinery, insulation, I cannot provide specifics at this stage.
- 115 However, generally, the building elements which require upgrades in the first instance include joinery and glazing. Associated with the requirement to keep external doors and windows closed, alternative ventilation is often required to be installed as well.
- 116 I note that the proposed conditions⁷⁸ provide for this building modification mitigation to be offered to building owners at the NZTA’s cost.

⁷⁵ EMS Section 42A Addendum paragraph 3.7.9.

⁷⁶ EMS Section 42A Addendum paragraph 3.7.16.

⁷⁷ Technical report G.5, Appendix C: CNVMP, Appendix Table 8.36.

⁷⁸ Refer Operational Noise Condition ON-6 to ON-11.

- 117 Mr Hunt in his Section 42A Report comments on my recommendation relating to the upgrade of building envelopes⁷⁹ and considers it an appropriate measure.

Noise criteria for the Waterview Kindergarten

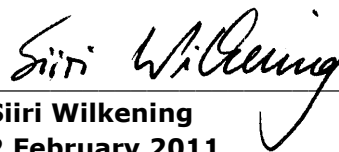
- 118 In its Section 42A Report, EMS notes that "the Kindergarten provides sleeping facilities for children which requires [sic] lower maximum noise levels."⁸⁰ No specific noise criteria are recommended in the Section 42A Report.
- 119 Mr Hunt, the Board's noise expert, supports the recommended construction noise criteria in proposed Condition CNV.2(iv). I consider that the recommended criteria for teaching facilities are appropriate for construction and note that they are below those recommended by NZS6803 as discussed in paragraph 32. Further, the Kindergarten is being relocated away from the construction area.

Noise from the concrete batch plant

- 120 EMS, similarly to Ms Peterson, requests clarification⁸¹ regarding the proposed batch plant enclosure. I have discussed this issue in paragraphs 91 to 96 above.

AMENDMENTS TO CONDITIONS

- 121 I have recommended several amendments to the proposed construction noise conditions where appropriate in response to statements of evidence, further consideration and caucusing. While these conditions are set out in the body of my rebuttal evidence, I have summarised them again in the attached **Annexure A**. I am advised the NZTA agrees to these amendments.


 Siiri Wilkening
 2 February 2011

⁷⁹ Malcolm Hunt Associated Section 42A Report, Section 3.5, pg. 12.

⁸⁰ EMS Section 42A Report paragraph 10.8.60.

⁸¹ EMS Section 42A Report paragraph 10.10.69.

**ANNEXURE A: PROPOSED NOISE AND VIBRATION
CONDITIONS – CONSTRUCTION (WITH AMENDMENTS) ⁸²**

CNV.1	<p>The NZTA shall implement and maintain a Construction Noise and Vibration Management Plan (CNVMP) throughout the entire construction period of the Project.</p> <p>The CNVMP shall describe the measures adopted to, as far as practicable, meet:</p> <p>(a) the noise criteria set out in Condition CNV.2 <u>and 3</u> below; and</p> <p>(b) the vibration criteria set out in Condition CNV.34 below.</p> <p>The CNVMP shall, as a minimum, address the following:</p> <ol style="list-style-type: none"> i. Construction noise and vibration criteria; ii. Hours of operation, including times and days when noisy and/or vibration inducing construction activities would occur; iii. Machinery and equipment to be used; iv. Vibration testing of equipment to confirm safe distances to buildings prior to construction; v. Preparation of building condition surveys of critical dwellings prior to, during and after completion of construction works; vi. Roles and responsibilities of personnel on site; vii. Construction operator training procedures; viii. Methods for monitoring and reporting on construction noise and vibration; ix. Mitigation options, including alternative strategies where full compliance with the relevant noise and/or vibration criteria cannot be achieved; x. Management schedules containing site specific information; xi. Measures for liaising with and notifying potentially affected receivers of proposed construction activities; and xii. Methods for receiving and handling complaints about construction noise and vibration-; xiii. <u>Measures for preventing the occurrence of rogue fly rock, including management of charge weights and face loading procedures, stemming of charge holes and profiling of the face to maintain minimum burden (face cover);</u> xiv. <u>Investigation of the practicability of implementing Building Modification Mitigation, as required in accordance with conditions ON.6 to ON.11, prior to commencement of construction within 100m of the relevant dwelling; and</u> xv. <u>Methods for ensuring affected residents are notified of scheduled night-time works (i.e. any works during the hours of 2000 – 0630) at least 5 days prior to the commencement of any such works.</u>
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⁸² Amendments to the proposed redlined conditions as set out in my EIC are shown in blue, bold, underline and strikethrough.

CNV.2	<p>Construction noise (<u>excluding noise from blasting Monday to Saturday inclusive</u>) shall be measured and assessed in accordance with NZS 6803:1999 "Acoustics - Construction Noise" and shall, as far as practicable, comply with the following criteria:</p> <p><u>Note: in CNV.2, (T) means a duration between 15 minutes and 60 minutes, in accordance with NZS6803:1999</u></p> <p>i. Project Construction Noise Criteria: Residential Receivers</p> <table border="1" style="width: 100%; border-collapse: collapse; text-align: center;"> <thead> <tr style="background-color: #cccccc;"> <th style="padding: 5px;">Time of week</th> <th style="padding: 5px;">Time period</th> <th colspan="3" style="padding: 5px;">Project Construction Noise Criteria (Long Term Construction) dB</th> </tr> <tr> <td></td> <td></td> <td style="padding: 5px;">Sectors 1 to 7</td> <td style="padding: 5px;">Sectors 8 and 9</td> <td style="padding: 5px;">All Sectors</td> </tr> <tr> <td></td> <td></td> <td style="padding: 5px;">$L_{Aeq(10-60\text{ min})}(T)$</td> <td style="padding: 5px;">$L_{Aeq(10-60\text{ min})}(T)$</td> <td style="padding: 5px;">L_{AFmax}</td> </tr> </thead> <tbody> <tr> <td rowspan="4" style="padding: 5px;">Monday – Saturday</td> <td style="padding: 5px;">0630-0730</td> <td style="padding: 5px;">60</td> <td style="padding: 5px;">45</td> <td style="padding: 5px;">75</td> </tr> <tr> <td style="padding: 5px;">0730-1800</td> <td style="padding: 5px;">70</td> <td style="padding: 5px;">70</td> <td style="padding: 5px;">85</td> </tr> <tr> <td style="padding: 5px;">1800-2000</td> <td style="padding: 5px;">65</td> <td style="padding: 5px;">65</td> <td style="padding: 5px;">80</td> </tr> <tr> <td style="padding: 5px;">2000-0630</td> <td style="padding: 5px;">60</td> <td style="padding: 5px;">45</td> <td style="padding: 5px;">75</td> </tr> <tr> <td rowspan="4" style="padding: 5px;">Sundays and Public Holidays</td> <td style="padding: 5px;">0630-0730</td> <td style="padding: 5px;">45</td> <td style="padding: 5px;">45</td> <td style="padding: 5px;">75</td> </tr> <tr> <td style="padding: 5px;">0730-1800</td> <td style="padding: 5px;">60</td> <td style="padding: 5px;">45</td> <td style="padding: 5px;">85</td> </tr> <tr> <td style="padding: 5px;">1800-2000</td> <td style="padding: 5px;">45</td> <td style="padding: 5px;">45</td> <td style="padding: 5px;">75</td> </tr> <tr> <td style="padding: 5px;">2000-0630</td> <td style="padding: 5px;">45</td> <td style="padding: 5px;">45</td> <td style="padding: 5px;">75</td> </tr> </tbody> </table> <p>ii. Project Construction Noise Criteria: Commercial and Industrial Receivers</p> <table border="1" style="width: 100%; border-collapse: collapse; text-align: center;"> <thead> <tr style="background-color: #cccccc;"> <th style="padding: 5px;">Time period</th> <th style="padding: 5px;">Project Construction Noise Criteria (Long Term Construction) dB</th> </tr> </thead> <tbody> <tr> <td></td> <td style="padding: 5px;">$L_{Aeq(10-60\text{ min})}(T)$</td> </tr> <tr> <td style="padding: 5px;">0730-1800</td> <td style="padding: 5px;">70</td> </tr> <tr> <td style="padding: 5px;">1800-0730</td> <td style="padding: 5px;">75</td> </tr> </tbody> </table>	Time of week	Time period	Project Construction Noise Criteria (Long Term Construction) dB					Sectors 1 to 7	Sectors 8 and 9	All Sectors			$L_{Aeq(10-60\text{ min})}(T)$	$L_{Aeq(10-60\text{ min})}(T)$	L_{AFmax}	Monday – Saturday	0630-0730	60	45	75	0730-1800	70	70	85	1800-2000	65	65	80	2000-0630	60	45	75	Sundays and Public Holidays	0630-0730	45	45	75	0730-1800	60	45	85	1800-2000	45	45	75	2000-0630	45	45	75	Time period	Project Construction Noise Criteria (Long Term Construction) dB		$L_{Aeq(10-60\text{ min})}(T)$	0730-1800	70	1800-0730	75
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CNV.2 cont.	iii. Project Construction Noise Criteria: Internal <u>Structure-borne Noise from Tunnelling</u> for Residential Receivers											
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2200-0600 1800-0730	30 dB $L_{Aeq(\cancel{16hr})(8hr)(T)}$	Bedrooms										
	iv. <u>Project Construction Noise Criteria: Internal Noise for Licensed Educational Facilities</u>											
	<table border="1"> <thead> <tr> <th>Time period</th> <th colspan="2">Project Construction Noise Criteria Inside</th> </tr> </thead> <tbody> <tr> <td>0900—1500 <u>Teaching hours</u></td> <td>45 dB $L_{Aeq(\cancel{6hr})(T)}$ <u>or existing,</u> <u>whichever is the higher</u></td> <td>Classrooms, library, offices, <u>teaching laboratories,</u> <u>manual arts workshops</u></td> </tr> <tr> <td>0900—1500 <u>Teaching hours</u></td> <td>40 dB $L_{Aeq(\cancel{6hr})(T)}$ <u>or existing,</u> <u>whichever is the higher</u></td> <td>School hall, <u>lecture theatres</u></td> </tr> </tbody> </table> <p>Note: in CNV.2(iv) "Teaching hours" means: <u>Primary schools and Kindergartens: 9 am to 3 pm</u> <u>Unitec: 8 am to 9 pm</u></p>			Time period	Project Construction Noise Criteria Inside		0900—1500 <u>Teaching hours</u>	45 dB $L_{Aeq(\cancel{6hr})(T)}$ <u>or existing,</u> <u>whichever is the higher</u>	Classrooms, library, offices, <u>teaching laboratories,</u> <u>manual arts workshops</u>	0900—1500 <u>Teaching hours</u>	40 dB $L_{Aeq(\cancel{6hr})(T)}$ <u>or existing,</u> <u>whichever is the higher</u>	School hall, <u>lecture theatres</u>
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CNV.3	Project Construction Noise Criteria: Airblast (excluding Sundays)		
	Category	Type of Blasting Operations	Peak Sound Pressure Level (L _{Zpeak} dB)
	Human Comfort Limits		
	Sensitive Site	Operations lasting longer than 12 months or more than 20 Blasts	115 dB for 95% blasts per year. 120 dB maximum unless agreement is reached with occupier that a higher limit may apply
	Sensitive Site	Operations lasting less than 12 months or less than 20 Blasts	120 dB for 95% blasts per year. 125 dB maximum unless agreement is reached with occupier that a higher limit may apply
	Occupied non-sensitive sites such as factories and commercial premises	All blasting	125 dB maximum unless agreement is reached with the occupier that a higher limit may apply. For sites containing equipment sensitive to vibration, the vibration should be kept below manufacturer's specifications of levels that can be shown to adversely affect the equipment operation
	Damage Control Limits		
	Structures that include masonry, plaster and plasterboard in their construction and also unoccupied structures of reinforced concrete or steel construction	All Blasting	133 dB unless agreement is reached with owner that a higher limit may apply.
	Service structures such as pipelines, powerlines and cables located above ground	All Blasting	Limit to be determined by structural design methodology

CNV.3 <u>4</u>	Construction vibration received by any building shall be measured and assessed in accordance with the German Standard DIN 4150-3:1999 "Structural vibration – Part 3: Effects of vibration on structures", and shall, as far as practicable, comply with the criteria set out in that Standard.
CNV.4 <u>5</u>	Notwithstanding Condition CNV. 3 4 above, (a) Blasting activities shall be conducted so that 95% of the blasts undertaken (measured over any twenty blasts on the foundation of any building outside the designation boundary) shall produce peak particle velocities not exceeding 5mm/s and 100% of the blasts undertaken shall produce peak particle velocities not exceeding 10mm/s irrespective of the frequency of the blast measured. (b) Construction activities, which occur within Sectors 1, 6, 8 and 9 and, which are identified in Technical Report no. G.19 Assessment of Vibration Effects, as being at a 'High Risk' of exceeding the DIN 4150-3:1999 criteria (being excavation, piling, compaction and drilling) shall be conducted so that 95% of the activities undertaken (measured over at least 20 representative samples of the relevant activity on any residential building) shall produce peak particle velocities not exceeding the relevant criterion in DIN 4150-3:1999 and 100% of the activities undertaken shall not exceed 10mm/s irrespective of the frequency of the activity measured.
CNV.5 <u>6</u>	Blasting shall be undertaken between 09:00h and 17:00h, Monday to Saturday, except that blasting may be undertaken between 09:00h and 17:00h on Sundays where: (a) The blasting is at least 50m inside the Sector 8 tunnel; (b) The blasting produces peak particle velocities <u>at any residential building</u> not exceeding 0.5mm/s; and (c) The Project construction noise criteria set out in CNV.2 (i)-(iv) (iii) for Sundays is complied with.
<u>CNV.7</u>	<u>Where practicable, permanent (traffic) noise barriers required in any Sector as Detailed Mitigation Options for operational noise following completion of the Project (in accordance with conditions ON.3 to ON.5) shall be erected prior to major construction works occurring.</u>
<u>CNV.8</u>	<u>Pile driving shall not be undertaken at night (i.e. during the hours of 2000–0630).</u>
<u>CNV.9</u>	<u>The concrete batch plants shall be fully enclosed.</u>