

Before the Board of Inquiry  
Waterview Connection Project

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*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 **Peter Millar (Vibration)** on behalf of the  
**NZ Transport Agency**

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## **REBUTTAL EVIDENCE OF PETER MILLAR ON BEHALF OF THE NZ TRANSPORT AGENCY**

### **INTRODUCTION**

- 1 My full name is Peter James Millar. I refer the Board of Inquiry to the statement of my qualifications and experience set out in my evidence in chief (*EIC*) (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 will respond to the evidence of:

#### **Entities with interest in 1510 Great North Rd**

- 3.1 Andrew Tauber/Apartments Limited (Evidence No 75-1)
- 3.2 George Richardson/Townscape Securities Auckland Ltd (Evidence No 101-1)
- 3.3 Paul Conder/Unitec Institute of Technology (*Unitec*) (Evidence No 160-1)
- 3.4 Poul Israelson/Unitec (Evidence No 160-2)

#### **Others**

- 3.5 Angela Bull/The National Trading Company of New Zealand Limited (*NTC*) (Evidence No 76-1)
  - 3.6 Robert Black (Evidence No 186-1)
  - 3.7 Alex Wardle and Piers Monaghan (Evidence No 61-1)
  - 3.8 Orchid Atimalala/Housing New Zealand Corporation (*Housing NZ*) (Evidence No. 197-1)
  - 3.9 Wendy John/Friends of Oakley Creek (*FOOC*) (Evidence No. 179-1)
- 4 In addition, I will comment on relevant aspects of the Section 42A Report prepared by Environmental Management Services dated 7 December 2010)<sup>1</sup> and the Section 42A Report prepared by

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<sup>1</sup> I do not consider there is anything of relevance to vibration to discuss in the EMS Addendum dated 20 December 2010, other than the comment about Pak'n Save, which is addressed in this rebuttal evidence in my response to Ms Bull and in my comments on the Section 42A Report itself.

Malcolm Hunt Associates dated December 2010, as it relates to vibration. I will also comment on the outcome of the expert caucusing discussions.

### **1510 GREAT NORTH RD**

- 5 Four briefs of submitter evidence relate to the effects of vibration on the student hostel building at 1510 Great North Road. Mr Tauber<sup>2</sup> has general concerns about vibration effects, which I consider have already been addressed in Technical Report G.19: Assessment of Vibration Effects (*the Technical Report*) and in my EIC. However, I briefly discuss below, Mr Tauber's concern regarding vibration testing on his property. Mr Richardson<sup>3</sup> raises particular issues of disturbance and disruption to occupants and recommends specific testing at the site, and Messrs Conder<sup>4</sup> and Israelson<sup>5</sup> have concerns about the proposal for temporary relocation of residents if effects cannot be sufficiently mitigated.

#### **Andrew Tauber for Apartments Limited**

- 6 Mr Tauber expresses concern<sup>6</sup> that, in his view, the NZTA has not performed any specific vibration tests on his property. Vibration tests would not be conducted on a specific property but by testing similar vibration sources. In this situation, there are no tunnelling works of this scale in New Zealand to monitor so we rely on published information to prepare estimates. I note that the accuracy of the predictions can be measured once tunnel excavation commences (at a distance from 1510 Great North Road) and, if required, adjustments can then be made to ensure compliance with the recommended limits. I also note that I was involved in the Vector tunnel which, while of smaller diameter, was excavated successfully by tunnelling machines without causing any damage due to vibration effects.

#### **George Richardson for Townscape Securities Auckland Ltd**

- 7 Mr Richardson has incorrectly estimated that the clearance of the buildings at 1510 Great North Road to the tunnel is 4.5m,<sup>7</sup> whereas the closest clearance will actually be 18m from the tunnel crown to the ground beneath the northern building in the complex. The southern building will have about 23m clearance. While predictions for vibrations are highly dependent on the construction equipment being used, I consider the clearance for both buildings will be adequate to ensure that vibrations induced by construction can be controlled within the recommended limits.

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<sup>2</sup> Tauber Evidence, paragraph 5(e).

<sup>3</sup> Richardson Evidence, page 10.

<sup>4</sup> Conder Evidence, paragraph 3.

<sup>5</sup> Israelson Evidence, paragraph 3.11.

<sup>6</sup> Tauber Evidence, paragraph 5(e).

<sup>7</sup> Richardson Evidence, page 10.

- 8 Mr Richardson argues<sup>8</sup> that the “Victoria Park tunnel is causing damage beyond the area expected to buildings along its route due to settlement and vibration”. I have sought information from the VPT Project Alliance Manager on any vibration damage from the Vic Park Tunnel project. The only complaint of any significance is with respect to a fallen tree on the cliff face in St Mary’s Bay. In my opinion, the tree is too far from the works and remote from the tunnelling for its collapse to have been caused by tunnel construction vibrations
- 9 Accordingly, I disagree with Mr Richardson’s comments regarding the Vic Park Tunnel project and do not consider it has any negative implications for the Project and the proposed mitigation measures as they relate to vibration.
- 10 Mr Richardson states that the “drilling rig” is larger than used in NZ to date. The detail of the equipment to be used is not finalised but is likely to be a road header similar to that used for construction of the Johnstone Hill tunnel on the Albany to Puhoi motorway. The largest machine used in NZ was a full face tunnel boring machine of 11m diameter for excavation of the second Manapouri tailrace tunnel, smaller but in much harder rock.
- Paul Conder and Poul Israelson for Unitec**
- 11 As noted, Mr Conder and Mr Israelson, on behalf of Unitec, are concerned about construction effects, including vibration effects, on Unitec facilities, in particular 1510 Great North Road (which I understand is leased by Unitec)<sup>9</sup>.
- 12 It is accepted that tunnelling works undertaken at night are likely to be perceptible to residents immediately above the working space, but vibration levels should not cause discomfort. It is possible, however, that ‘reradiated’ or ‘regenerated’ noise generated by tunnelling-induced vibration effects could, as Ms Wilkening notes,<sup>10</sup> cause some disturbance. In that event, an option of last resort is to temporarily relocate residents during the period that the tunnelling works in close proximity to their properties may affect them. This relocation could include the residents of 1510 Great North Road. The possibility of relocation and the processes by which it would be managed are discussed further in the evidence of Ms Wilkening on construction noise and Ms Linzey on social effects. I understand that the NZTA has agreed with Unitec not to relocate students during exam time or during the period leading up to exams.
- 13 Construction of the Project will commence beyond the property at 1510 Great North Road, which will provide the contractor with the

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<sup>8</sup> Richardson Evidence, page 5.

<sup>9</sup> Section 3 of Mr Conder’s evidence and paragraph 3.11 of Mr Israelson’s evidence.

<sup>10</sup> Siiri Wilkening, Construction Noise EIC, paragraph 62.

opportunity to monitor vibration levels in advance of work beneath the property to confirm these levels are within DIN4150 recommended limits, or to coordinate mitigation or relocation if necessary.

- 14 Once under the property at 1510 Great North Road, the excavations should progress rapidly, typically 3-10m/day depending on method, so the period during which vibrations may be detected by hostel residents will be of short duration. A relocation of two weeks at most is anticipated for the residents of 1510 Great North Road.

#### **ANGELA BULL FOR NTC**

- 15 In her evidence on behalf of NTC, Angela Bull primarily focuses on settlement concerns (which are addressed by Mr Gavin Alexander), but also seeks assurance that vibration levels transmitted to the Pak'n Save building on New North Road will not exceed "appropriate" conditions.<sup>11</sup>
- 16 The recommended limits for commercial buildings in DIN4150 are a factor of 2 above the levels for residential structures. As the area surrounding the Pak'n Save site includes residential properties, the lower vibration limits will apply to the area and vibration levels will not be an issue for the Pak'n Save building.

#### **ROBERT BLACK**

- 17 Mr Black considers vibration impacts on Waterview School and homes need to be adequately assessed pre and post construction and "[a]ll homes within 200m of the construction zone must be included [in such an assessment] as many have 60 year old tile roofs and are up to 80 years old."<sup>12</sup>
- 18 The residential vibration limits recommended by DIN4150 were established based on monitoring (undertaken at the time DIN9150 was formulated) of structures of a range of ages, including structures greater than 80 years old. Accordingly, DIN4150 recommends a lower limit (about 60%) for sensitive and historic structures.
- 19 Published information<sup>13</sup> shows a low possibility of surficial damage (eg hairline cracking of plaster) to residential structures at peak particle velocities of less than 12mm/s and that structural damage is unlikely below 50mm/s. So the standard for residential structures includes a factor of more than 2 against the risk of cosmetic damage

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<sup>11</sup> Bull Evidence, paragraph 7.

<sup>12</sup> Black Evidence, paragraph 14.

<sup>13</sup> E.g. Siskend DE, Stagg MS, Kopp JW and Dowding CH. "Structure Response and Damage Produced by Ground Vibrations from Surface Mine Blasting." Report of Investigations 8507, 1980. Bureau of Mines, US Dept of Interior.

and a factor of 10 for structural damage. I therefore do not consider any further margin, such as specifying a lower limit for historic or sensitive structures, is required for the Project.

- 20 I also note that pre- and post-construction surveys are to be undertaken of all structures in the vicinity of the works.<sup>14</sup> These surveys will identify any residences that are potentially at risk of damage from vibration and will enable appropriate mitigation measures to be applied.

#### **ALEX WARDLE AND PIERS MONAGHAN**

- 21 Ms Wardle considers vibration levels affecting her property at 15 Berridge Ave will be increased during construction, particularly from activities within Construction Yard 4, and once the Project is operational.<sup>15</sup>
- 22 Yard 4 is located within the existing Great North Road Interchange ramp system and is located about 50m from the residence at 15 Berridge Ave. No works are proposed to the ramp nearest 15 Berridge Ave, which is about 20m distance. Instead, the closest Project works are approximately 140m from 15 Berridge Ave. I consider the distances from 15 Berridge Ave to the yard and any significant construction works are sufficient to ensure there will be no perceptible levels of ground transmitted vibrations at the residence of 15 Berridge Ave.
- 23 I do not expect vibrations resulting from operating traffic will result in vibrations at 15 Berridge Ave exceeding the recommended operational vibration limits in the Norwegian Standard NS8176.E:2005 given the 20m distance between 15 Berridge Ave and the nearest ramp. These limits are below the DIN4150 criteria and will also ensure there is no potential for damage to structures.

#### **ORCHID ATIMALALA FOR HOUSING NZ**

- 24 I note that Ms Atimalala states she is satisfied that the proposed conditions and CNVMP "will provide appropriate measures to avoid, remedy or mitigate noise and vibration effects on [Housing NZ] tenants".<sup>16</sup> Ms Linzey will address issues relating to consultation on vibration effects, including Ms Atimalala's request for an amendment to the CNVMP to address consultation with Housing NZ on vibration effects.<sup>17</sup>

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<sup>14</sup> Refer Condition CNV.1(v).

<sup>15</sup> Wardle & Monaghan Evidence, paragraph 4.

<sup>16</sup> Atimalala Evidence, paragraph 6.11.

<sup>17</sup> Atimalala Evidence, paragraphs 6.14 and 9.1.

### **WENDY JOHN FOR FRIENDS OF OAKLEY CREEK**

- 25 Stream erosion resulting from tunnel vibration was identified as a potential issue by Ms John on behalf of FOOC.<sup>18</sup> Vibration standards designed to prevent superficial damage to buildings will provide more than adequate protection against stream bank instability. I consider the risk of additional bank failures due to vibration will be negligible.<sup>19</sup>

### **COMMENT ON EMS SECTION 42A REPORT**

- 26 The Section 42A Report prepared by Environmental Management Services Ltd identifies several issues relating to vibration that it considers may require further consideration.

#### **Section 10.2.25 – Receiving Environment adjacent to the Te Atatu Interchange**

- 27 The EMS Section 42A Report identifies<sup>20</sup> a requirement for “[p]rovision of acceptable mitigation addressing visual and vibration effects for residences adjacent to Te Atatu Interchange (Milich Terrace, Alwyn Avenue, Titoki Street, Royal View Way for example)”.

- 28 Construction activities for the proposed works at the Te Atatu Interchange are expected to include piling and general road construction operations. Works of this type have been successfully completed in other areas of Auckland by using appropriately selected construction methods which limit vibration levels to the DIN4150 standard. I consider similar methods may be applied to the Project to ensure vibration levels do not cause damage to structures or disturbance to residents.

#### **Section 10.9.35 Pak’n Save**

- 29 The Section 42A Report authors seek confirmation “that there are appropriate conditions to address vibration, settlement or other construction issues associated with the operation of the Pak’n Save supermarket on New North Road”. The potential issues relating to the Pak’n Save and the relief sought by NTC relate primarily to settlement, which is addressed in the rebuttal evidence of Mr Gavin Alexander. As for vibration, I note that this issue has been addressed above in response to the evidence of Ms Bull.

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<sup>18</sup> John Evidence, section 7

<sup>19</sup> I note this point is also addressed in the rebuttal evidence of Mr Eddie Sides in his response to Ms John.

<sup>20</sup> EMS Section 42A Report, Table in section 16.2. Note that, while the vibration concern is raised in section 10.2.25 of the Report, the concern is incorrectly listed in the Section 16 Conclusions section of the Report as 10.2.24 (which relates to noise effects in the same area).



**MALCOLM HUNT ASSOCIATES SECTION 42A REPORT**

- 30 Mr Hunt's Report supports the vibration criteria proposed for the Project and the application of the CNVMP, noting<sup>21</sup> "the selection of appropriate vibration criteria and the use of a CNVMP are both supported as methods to manage the effects of vibration during the construction phase". Mr Hunt concludes that operational vibration effects will be minor.<sup>22</sup>
- 31 As a result of caucusing held with the Board's vibration expert Malcolm Hunt on 20 January and subsequent discussions, Mr Hunt, Ms Wilkening and I have agreed to amend proposed Condition CNV.1 to require that potentially affected residents along the Project alignment be advised in advance of tunnel excavation or significant surface construction. As of today, the wording of that condition is still being finalised and I anticipate that it will be set out in the agreed caucusing statement of noise and vibration experts.



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Peter Millar  
February 2011

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<sup>21</sup> MHA Report, section 3.6.

<sup>22</sup> MHA Report, section 4.3.