

**BEFORE THE AUCKLAND UNITARY PLAN INDEPENDENT HEARINGS PANEL**

**IN THE MATTER** of the Resource Management Act 1991 and the Local Government (Auckland Transitional Provisions) Act 2010

**AND**

**IN THE MATTER** of Topic 035: Air quality C5.1

**AND**

**IN THE MATTER** of the submissions and further submissions set out in the Parties and Issues Report

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**STATEMENT OF REBUTTAL EVIDENCE OF GERDA INGRID KUSCHEL  
ON BEHALF OF AUCKLAND COUNCIL**

**(AIR QUALITY – REGIONAL AND DISTRICT OBJECTIVES AND POLICIES)**

**25 FEBRUARY 2015**

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## 1. INTRODUCTION

- 1.1 My name is Dr Gerda Ingrid Kuschel. I am a Director and Senior Air Quality Specialist at Emission Impossible Ltd. I have been engaged by Auckland Council to provide technical evidence to support the cost benefit analysis for the air quality provisions of the Proposed Auckland Unitary Plan (**PAUP**). I have spent more than 30 years working as a chemical engineer for a broad range of industries including oil & gas processing, metal smelting, research & development, government agencies and environmental consulting firms in Australasia. I have more than 20 years' experience in air quality management.
- 1.2 I hold the qualifications of a Bachelor of Chemical and Materials Engineering (University of Auckland) and a Doctor of Philosophy in Chemical and Materials Engineering (University of Auckland).
- 1.3 I am a Fellow, a Life Member and a past President of the Clean Air Society of Australia and New Zealand. I am also a member of the Resource Management Law Association and the Royal Society of New Zealand.
- 1.4 Prior to setting up Emission Impossible Ltd, I worked for Auckland Regional Council as a Senior Technical Specialist to assist with the implementation of the Resource Management (National Environmental Standards for Air Quality) Regulations 2004 (**NESAQ**) in the Auckland region. This included, *inter alia*, the development of Auckland's regional air quality management strategy and its associated emissions reduction targets<sup>1</sup>. Previously I was employed as an air quality scientist at the National Institute of Water and Atmospheric Research Ltd for nine years on a range of projects, including undertaking various air emissions inventories across New Zealand to highlight the key sources and contaminants for the development of management strategies.
- 1.5 I was the lead author of the *National Air Quality Compliance Strategy to meet the PM<sub>10</sub> Standard*<sup>2</sup>, which sets out the practices that regional councils can adopt to meet the ambient 24-hour standard set by the NESAQ for particulate

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<sup>1</sup> Kuschel G & Hill G (2006). *Report to Auckland Regional Council Environmental Management Committee on PM<sub>10</sub> Emissions Reduction Targets and Strategies by Sector Needed to Meet the AQNES in Auckland*, 10p. 9 October

<sup>2</sup> Kuschel *et al.* (2011). *Clean Healthy Air for All New Zealanders: The National Air Quality Compliance Strategy to Meet the PM<sub>10</sub> Standard*. Prepared by Gerda Kuschel, Rachael Nicoll and Greg Hill for Ministry for the Environment, NZ, August, available at <https://www.mfe.govt.nz/publications/air/clean-healthy-air-for-all-new-zealanders/>

matter less than 10 micrometres (**PM<sub>10</sub>**). In addition, I co-authored the companion *2011 Users' Guide to the Revised National Environmental Standards for Air Quality*<sup>3</sup>, which provides assistance on interpreting and implementing all of the NESAQ regulations, including Regulation 17 which deals with offsetting PM<sub>10</sub> emissions.

- 1.6 I was also the lead author of the *Updated Health and Air Pollution in New Zealand Study*<sup>4</sup> (**HAPINZ**), which investigated the effects and costs of air pollution in New Zealand. This involved the development of a detailed exposure model which considers exposure to PM<sub>10</sub> for each census area unit (**CAU**) across New Zealand - by source. It also involved the development of a health effects model which can be used to view results by the area of interest (e.g. by CAU or airshed or region or nationally). This health effects model can also run scenarios based on population and emission trends. This model is discussed further in my evidence at paragraphs 3.3, 3.4 and 4.2.
- 1.7 A more comprehensive description of my experience in air quality management is outlined in **Attachment A** of this evidence.
- 1.8 In preparing this rebuttal evidence, I have read the primary statements of evidence of Mr Gregory Akehurst (POAL)<sup>5</sup>, Mr Richard Chilton (PACT Group)<sup>6</sup>, Mr Peter Nunns (Auckland Council)<sup>7</sup>, Mr Jason Pene (Sanitarium)<sup>8</sup>, Ms Jennifer Simpson (NZ Steel)<sup>9</sup>, and Ms Louise Wickham (Auckland Council)<sup>10</sup>. This statement of evidence responds to the technical matters raised by submitters relating to the application of the HAPINZ health effects and exposure models in the cost-benefit analyses outlined in the evidence of Mr Nunns.

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<sup>3</sup> Nicoll *et al.* (2011). *2011 Users' Guide to the Revised National Environmental Standards for Air Quality*. Prepared by Rachael Nicoll, Gerda Kuschel and Greg Hill for Ministry for the Environment, NZ, August, available at <https://www.mfe.govt.nz/publications/air/clean-healthy-air-for-all-new-zealanders/>

<sup>4</sup> Kuschel *et al.* (2012). *Updated Health and Air Pollution in New Zealand Study*, including Vol 1 Summary Report, Vol 2 Technical Report, Health Effects Model and Exposure Model. Prepared by Emission Impossible and others for the Health Research Council of New Zealand, Ministry of Transport, Ministry for the Environment and NZ Transport Agency, NZ, March, available at <http://www.hapinz.org.nz/>

<sup>5</sup> Primary statement of evidence of Mr Greg Akehurst dated 19 February 2015, prepared on behalf of Ports of Auckland Ltd (submitter number 5137)

<sup>6</sup> Primary statement of evidence of Mr Richard Chilton dated 19 February, prepared on behalf of PACT Group (NZ) Ltd (submitter number 7109)

<sup>7</sup> Primary statement of evidence of Mr Peter Nunns dated 19 February 2015, prepared on behalf of Auckland Council

<sup>8</sup> Primary statement of evidence of Mr Jason Pene dated 19 February 2015, prepared on behalf of NZ Health Association Ltd trading as Sanitarium Health and Wellbeing Company (submitter number 4359)

<sup>9</sup> Primary statement of evidence of Ms Jennifer Simpson dated 19 February 2015, prepared on behalf of NZ Steel Ltd (submitter number 868)

<sup>10</sup> Primary statement of evidence of Ms Louise Wickham dated 19 February 2015, prepared on behalf of Auckland Council

- 1.9 I took part in the Expert Conferencing for Hearing Topic 035 on 1 December 2014 on behalf of Auckland Council and signed the Joint Statement developed at the conference.<sup>11</sup>
- 1.10 I confirm that I have read the Expert Witness Code of Conduct set out in the Environment Court of New Zealand's Practice Note 2014. I have complied with the Code of Conduct in preparing this evidence and I agree to comply with it while giving oral evidence before the Hearings Panel. 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. SCOPE OF EVIDENCE**

- 2.1 I am providing rebuttal evidence on the technical matters raised by submitters relating to the application of the HAPINZ health effects and exposure models in the cost-benefit analyses outlined in the primary evidence of Mr Nunns.
- 2.2 In particular, I respond to the following issues raised by submitters, that:
- (a) a region-wide approach for assessing air quality effects is too broad to allow for appropriate consideration of local effects (Mr Akehurst)
  - (b) the HAPINZ approach does not take into account the lower impact of industrial emissions on ambient air quality compared to other sources because it assumes the same linear relationship between emissions and ground-level concentrations of PM<sub>10</sub> and particulate matter less than 2.5µm (**PM<sub>2.5</sub>**), and as a result the benefit from reductions in industrial emissions is over-stated (Mr Chilton, Mr Jason Pene, Ms Jenny Simpson).
- 2.3 I address these issues in further detail in the following sections.

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<sup>11</sup> Expert Conference Joint Statement for hearing topic 035 – Air Quality, 1 December 2014

### 3. APPLICATION OF REGIONAL AVERAGE EXPOSURE RATES

- 3.1 Mr Akehurst states that Mr Nunns' framework for assessment is "*too broad to allow for appropriate consideration of local effects.*"<sup>12</sup> He then cites examples of the proximity to major roads and ports (where localised concentrations of pollutants are elevated) to support his argument.
- 3.2 Whilst I agree that localised health effects are indeed associated with proximity to these sources, these health effects are those relating to exposure to nitrogen dioxide (**NO<sub>2</sub>**) for roads and sulphur dioxide (**SO<sub>2</sub>**) for ports. Emissions of these contaminants are dominated by local sources and are not necessarily distributed region-wide.
- 3.3 In any case, the health effects modelling underpinning Mr Nunns' evidence utilised the HAPINZ model<sup>13</sup>. Importantly, this model is based on PM<sub>10</sub>. PM<sub>10</sub> is typically emitted from a broad range of sources that are spatially distributed (i.e. region-wide) and there is no threshold below which health effects do not occur. With regards to assessing health effects from air pollution, the vast majority of costs are dominated by effects caused by long-term exposure to PM<sub>10</sub>. As noted by Mr Pene<sup>14</sup>, the World Health Organisation<sup>15</sup> recognises that:

*"While emissions from domestic heating and cooking can normally be considered as a ground-level source, those from combustion plants can occur at a wide range of altitudes, ranging from ground level for most domestic boilers to heights of more than 300 metres for large power station chimneys. Consequently, per kilogram of pollutants emitted, the impact on ground-level concentrations is very different: the ground-level source leads to far higher local concentrations than the elevated point source, but the **elevated source influences areas much further afield because of the widespread dispersion of emissions.**"*

In other words emissions from industrial sources may not have significant local impacts but can and do influence regional air quality.

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<sup>12</sup> Evidence of Mr Akehurst at paragraph 3.1

<sup>13</sup> Kuschel *et al.* (2012). *Updated Health and Air Pollution in New Zealand Study*, including Vol 1 Summary Report, Vol 2 Technical Report, Health Effects Model and Exposure Model. Prepared by Emission Impossible and others for the Health Research Council of New Zealand, Ministry of Transport, Ministry for the Environment and NZ Transport Agency, NZ, March, available at <http://www.hapinz.org.nz/>

<sup>14</sup> Evidence of Mr Pene at paragraph 59

<sup>15</sup> WHO (2006). *Air Quality Guidelines – Global Update 2005* Nicoll *et al.* (2011). *2011 Users' Guide to the Revised National Environmental Standards for Air Quality*. Prepared by Rachael Nicoll, Gerda Kuschel and Greg Hill for Ministry for the Environment, NZ, August, available at <https://www.mfe.govt.nz/publications/air/clean-healthy-air-for-all-new-zealanders/>

3.4 I also note that the health effects modelling, although reported at the regional level, is based on emissions and population information for each CAU in the Auckland region. Consequently local differences (e.g. lower population densities in industrial areas) are reflected in the individual CAU results which are then aggregated to arrive at a regional total. It is these regional totals which are then used to arrive at average social costs per tonne of PM<sub>10</sub> emitted from all sources.

3.5 Given that:

- (1) PM<sub>10</sub> is emitted from a broad range of sources regionally;
- (2) the regional exposure of Aucklanders is calculated from the sum of local exposures;
- (3) there is no safe threshold for PM<sub>10</sub>; and
- (4) the time period for assessing consequential health effects is long-term (annual)

I consider the approach used in Mr Nunns' evidence is justified and appropriate.

#### **4. LOWER IMPACT OF INDUSTRY ON GROUND LEVEL CONCENTRATIONS**

4.1 Mr Chilton, Mr Pene and Ms Simpson quite correctly point out that "*most industrial discharges of PM<sub>10</sub> and PM<sub>2.5</sub> occur through relatively tall stacks*"<sup>16</sup>, meaning 1 tonne of PM<sub>10</sub> or PM<sub>2.5</sub> emitted from industry typically generates smaller ground level concentrations of PM<sub>10</sub> and PM<sub>2.5</sub> than would occur from domestic home heating and motor vehicles. They are therefore concerned that the assumptions used in benefit-cost analyses for Mr Nunns' evidence will result in the benefit from reductions in industrial emissions being overstated.

4.2 As noted earlier, the health effects modelling underpinning Mr Nunns' evidence utilised the HAPINZ model<sup>17</sup>. In this model (in particular the exposure model), industrial emissions were separated into two categories –

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<sup>16</sup> Evidence of Mr Chilton at paragraph 25

<sup>17</sup> Kuschel *et al.* (2012). *Updated Health and Air Pollution in New Zealand Study*, including Vol 1 Summary Report, Vol 2 Technical Report, Health Effects Model and Exposure Model. Prepared by Emission Impossible and others for the Health Research Council of New Zealand, Ministry of Transport, Ministry for the Environment and NZ Transport Agency, NZ, March, available at <http://www.hapinz.org.nz/>

those denoted as having “tall stacks” and those without. The tall stack category was created to specifically separate out the major industries to better account for their dispersion categories. This is why, for example, the HAPINZ modelling for the Auckland region in 2006 shows industrial emissions being associated with only 7.4% of the anthropogenic (human-generated) air pollution social costs when the Auckland Air Emissions Inventory for 2006<sup>18</sup> shows industrial emissions contributing 14.7% of the anthropogenic emissions.

- 4.3 In the modelling undertaken to evaluate the benefits and costs of the various offsetting policies in the PAUP, an average social benefit (from an avoided health cost) of \$399,000 per tonne of PM<sub>10</sub> emitted was determined based on the total from **all** anthropogenic sources. Given that the per tonne social costs associated with industry are likely **lower** than this average, it follows that the per tonne social costs for the other anthropogenic sources such as domestic fires and motor vehicles are likely **higher** than the average. Therefore, when evaluating the impact of an offsetting policy where one tonne of industrial PM<sub>10</sub> is most likely to be offset with one tonne from another anthropogenic source such as domestic fires, the benefits are (if anything) possibly under-stated.
- 4.4 Given the offsetting policies in the PAUP mirror Regulation 17 from the NESAQ, each tonne of PM<sub>10</sub> or PM<sub>2.5</sub> from a new industrial discharge which triggers these policies is required to be offset by taking out **at least one** tonne of PM<sub>10</sub> or PM<sub>2.5</sub> from another source (most likely domestic fires). This is irrespective of whether the new industrial discharge is or is not emitted from a tall stack.
- 4.5 In conclusion, whilst I acknowledge the relevant submitters’ concerns about the lesser impact of industrial stacks on ground level concentrations, this impact has already been taken into consideration in the health effects modelling. For the reasons I outlined, I therefore disagree with the statement that the benefits of reducing PM<sub>10</sub> or PM<sub>2.5</sub> emissions from industry by offsetting will be over-stated.

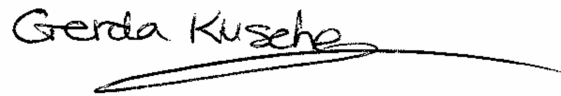
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<sup>18</sup> Xie *et al.* (2014). *Auckland air emissions inventory 2006*. Auckland Council technical report TR2014/015 prepared by S Xie, S Sridhar and J Metcalfe for Auckland Council, April, available at <http://www.aucklandcouncil.govt.nz/SiteCollectionDocuments/aboutcouncil/planspoliciespublications/technicalpublications/tr2014015aucklandairemissionsinventory2006.pdf>

**5. CONCLUSION**

- 5.1 In conclusion, I consider the HAPINZ models have been correctly interpreted by Mr Nunns when undertaking his cost benefit analysis and the concerns raised by submitters have been adequately addressed in the modelling.

*Gerda Kusche*



**GERDA KUSCHEL**  
**25 FEBRUARY 2015**



**ATTACHMENT A****CURRICULUM VITAE GERDA KUSCHEL****CAREER SUMMARY**

**Director and Senior Air Quality Specialist, Emission Impossible Ltd** (since 2008)

**Manager - Environmental Sustainability**, Auckland Regional Council (2 years)

**Senior Technical Specialist – Air Quality**, Auckland Regional Council (3 years)

**Regional Manager/Principal Scientist**, Urban Air Quality/Climate, NIWA (6 years)

**Senior Environmental Engineer**, Urban Air Quality/Climate, NIWA, NZ (3 years)

**Engineering Advisor**, Moai Restoration, Universidad de Chile, Easter Is. (3 months)

**Production Planning Manager**, Procter & Gamble Aust Pty Ltd, Australia (2 years)

**Lecturer**, School of Chem Eng & Industrial Chem, UNSW, Australia (1 year)

**Chemical Engineer**, Metal Smelting, Pasminco Research Centre, Australia (1 year)

**Research Engineer**, joint University of Auckland/ALCOA of Australia (WA), (5 years)

**Process Design Engineer**, Shell BP & Todd Oil Services Ltd, New Plymouth, NZ (1 year)

**QUALIFICATIONS**

**PhD**, Chemical & Materials Engineering (Auckland, NZ), 1990

**Bachelor of Engineering (Hons I)**, Chemical & Materials, University of Auckland, New Zealand, 1985

**FCASANZ**, Fellow of Clean Air Society of Australia and New Zealand, 2007

**AFFILIATIONS**

**Distinguished Service Medal**, Clean Air Society of Australia & New Zealand (2009)

**President**, Clean Air Society of Australia & New Zealand (2006-2008)

**Life Member**, Clean Air Society of Australia & New Zealand

**Member**, Resource Management Law Association

**Member**, Royal Society of New Zealand

**EMPLOYMENT HISTORY AND HIGHLIGHTS****2009 to date Emission Impossible Ltd****Senior Technical Specialist – Air Quality and Vehicle Emissions Management**

Providing specialist advice to a range of clients on the improved management of air quality and vehicle emissions.

Example projects include:

- Independent professional advisor to NZ Transport Agency on numerous transport and air quality related projects.
- Lead author and project leader on the Updated Health and Air Pollution in New Zealand Study
- Lead author on the National Air Quality Compliance Strategy for meeting the PM<sub>10</sub> Standard and co-author on the 2011 Users' Guide

- Co-ordinated and peer-reviewed State Highway tunnel monitoring campaigns undertaken at the Johnstone Hill's, Mt Victoria and Terrace tunnels in New Zealand
- Assisted with the design and reporting of remote sensing campaigns to assess trends in the light vehicle fleet and its emissions since 2003
- Co-authored the draft standard for assessing air quality for State Highway projects and assisted in the development of supporting tools such as a web-based screening tool, the SpatialViewer GIS monitoring information and eLearning packages
- Coordinated the operation and reporting of the national NO<sub>2</sub> ambient network for monitoring State Highways in New Zealand
- Peer-reviewed the updated cost-benefit analyses and air pollution health effects for the review of the Air Quality National Environmental Standards
- Developed environmental sustainability and public health policies for the Auckland Regional Land Transport Strategy

Example publications include:

- Kuschel, G (2014). *Investigations into reducing emissions from heavy duty diesel vehicles in Auckland—a summary report*. Prepared by Emission Impossible Ltd for Auckland Council. Auckland Council technical report, TR2014/018
- Kuschel G & Wickham L (2013). *Johnstone's Hill Tunnel air quality monitoring March to July 2010, Summary Report*. Prepared by Emission Impossible for NZ Transport Agency, NZ, May
- Kuschel G, Sridhar S & Hannaby R (2013). *Ambient air quality (nitrogen dioxide) monitoring network – Annual report 2007-2012*. Prepared by Emission Impossible for NZ Transport Agency, NZ, October
- Kuschel G et al (2012). *Updated Health and Air Pollution in New Zealand Study*, including Vol 1 Summary Report, Vol 2 Technical Report, Health Effects Model and Exposure Model. Prepared by Emission Impossible and others for the Health Research Council of New Zealand, Ministry of Transport, Ministry for the Environment and NZ Transport Agency, NZ, March
- Kuschel G, Nicoll R & Hill G (2011). *Clean Healthy Air for All New Zealanders: The National Air Quality Compliance Strategy to Meet the PM<sub>10</sub> Standard*. Prepared by Emission Impossible and Greg Hill for Ministry for the Environment, NZ, August

## 2004-2008 Auckland Regional Council (ARC)

### Manager – Environmental Sustainability (2007-2008)

Established and led the environmental sustainability team, which was set up to coordinate appropriate and effective responses to energy, climate change and sustainable transport issues facing the Auckland region.

Example projects include:

- Set up the Regional Energy Working Group and the Regional Climate Change Working Group to foster collaboration between Auckland local and regional councils, central government agencies and key stakeholders
- Co-designed the CarbonNow and CarbonFutures projects to establish consistent methodologies for accounting of greenhouse gas emissions and to develop effective emissions reduction scenarios
- Coordinated the preparation of the draft Auckland Regional Response to Climate Change and the draft Auckland Regional Energy Strategy

Example publications include:

- Kuschel G (2008). Wood burning: Where there's fire there's smoke. *Clean Air and Environmental Quality* 42(2), May
- Kuschel G (2007). Vehicle emissions, air quality, and the c-word (climate change) – An update on progress towards making transport in NZ sustainable. Invited opening address at the Inaugural Green Transport Conference held in Auckland, NZ, 19-20 November

### Senior Technical Specialist – Air Quality (2004 to 2007)

Provided specialist advice to regional government politicians, council staff and the general public on transport and air quality issues. Designed and led various air emissions research and education projects totalling \$1.0M p.a.

Example projects include:

- Developed the ARC's air quality management strategy, including securing political approval of regional emissions reduction targets, in order to meet the National Environmental Standards for Air Quality by 2013.
- Chaired an Environmental Sub-Committee to develop specific health, environmental and sustainability-related policies for the development of the 2005 Regional Land Transport Strategy, in conjunction with key stakeholders in the region (TLAs, MoT, Transit NZ, EECA, MfE, ARTA).
- Worked with MfE to co-ordinate and progress the development of a national Good Practice Guide for Assessing Vehicle Emissions to Air.
- Held workshops with bus operators and key stakeholders in 2004 to showcase initiatives being trialled to reduce air emissions from heavy duty diesel vehicles in Auckland.
- Acted as the lead technical spokesperson for the Big Clean Up "Clear the Air" campaign in May to July 2005 promoting the environmental benefits of tuning your car.
- Participated on the National Environmental Standards Research Advisory Group to review and discuss end-user outcomes from FRST Urban Air Quality project work being undertaken by NIWA and on the Joint Governmental Air Quality Taskforce to align work programmes being undertaken by MoT, MfE, and ARC.
- Drove in the 2004 and 2006 Energy Wise Rally and appeared at a number of public events to promote fuel efficient driving, biofuels, hybrid vehicles and the environmental impacts of people's transport choices.

Example publications include:

- Kuschel G & Bluett J (2007). *Remote sensing of vehicle emissions – helping to bust two of the great air quality myths?* Paper presented at the 14th IUAPPA World Clean Air Congress, held Brisbane, Australia, 9-13 September 2007 and published in the proceedings
- Metcalfe J, Kuschel G & Elder S (2006). *Vehicle Emissions Prediction Model Beta Version*. CD-ROM of model plus supporting documentation, December
- Metcalfe J, Fisher G, Sherman M & Kuschel G (2006). *Auckland Air Emissions Inventory 2004*, Technical Publication 292 prepared for Auckland Regional Council, Auckland, NZ, February 2006
- Kuschel G & Smith C (2006). *Environmental and Health Policies*, Technical Paper Number 22 to accompany the Auckland Regional Land Transport Strategy 2005 prepared for Auckland Regional Council, Auckland, NZ, February

### 1995-2004 National Institute of Water & Atmospheric Research Ltd (NIWA)

#### Auckland Regional Manager / Principal Scientist

As Regional Manager, responsible for project & financial administration together with personnel & resources management with revenues of \$5.2M and an operational budget of \$3.6M for the Auckland Region. Managed 60 staff working in fisheries stock assessment, fish habitats, aquaculture, marine natural products, climate, air quality, dispersion and meteorological modelling, aquatic chemistry, and hydrology projects across New Zealand.

As Principal Scientist in Urban Air Quality & Climate, responsible for managing accounts & projects in air quality & environmental issues totalling ~\$1.5M, with 12 direct reports.

Example projects include:

- Undertook various air emissions inventories across New Zealand to highlight the key sources and contaminants for the development of management strategies.
- Designed and participated in a range of transport emissions projects to provide critical information for the preparation of the National Vehicle Fleet Emission Control Strategy.

- Developed and presented lectures for UniTec Atmospheric Pollution course as part of the B.E. (Environmental) degree and participated on the Resource Management Advisory Committee assisting with UniTec's application for university status.
- Organised the 1996 National Air Quality Workshop series of twelve workshops covering Industrial Emissions, Motor Vehicle Emissions, Air Quality Management & Emissions Inventories, and Air Quality Modelling & Monitoring in Auckland, Wellington and Christchurch as a facilitator and co-presenter as well as editing and producing the proceedings.
- Delivered numerous technical and general presentations on motor vehicle emissions, home heating emissions, air quality topics in general, science / engineering and the environment at forums in both New Zealand and overseas.

Example publications include:

- Kuschel G, Bluett J, Fisher G, Xie S & Metcalfe J (2003). *Remote sensing of vehicle emissions. (It's monitoring, Jim – but not as we know it!)*. Paper presented at the 26th Australasian Transport Research Forum, Wellington, NZ, 1-3 October and published in the proceedings
- Kuschel G & Bluett J (2002). How significant are non-tailpipe emissions of PM<sub>10</sub> from roadways in New Zealand?. Paper presented at the 16th International Clean Air & Environment Conference, Christchurch, NZ, 19-22 August and published in the proceedings
- Kuschel G, Bluett J & Fisher G (2002). The application of open path monitoring for transport emission studies. Paper presented at the 16th International Clean Air & Environment Conference, Christchurch, NZ, 19-22 August and published in the proceedings
- Kuschel G & Timperley M (2000). Transport effects research: Driving future road transport policy. Paper presented at the 15th International Clean Air & Environment Conference, Sydney, Australia, 26-30 November and published in Vol 1 of the proceedings
- Kuschel G (2000). Transport effects on aquatic ecosystems: How much copper, zinc, and PAH do motor vehicles contribute to urban waterways?. Presented at the Sustainable Aquatic Habitats in Human Settlements Workshop, Hamilton, NZ, 26 July
- Kuschel G & Fisher G (1998). Hazardous air pollutants in New Zealand cities. Paper presented at the 11th World Clean Air & Environment Congress, Durban, South Africa, 13-18 September and published in the proceedings
- Kuschel G (1998). The Christchurch emissions inventory as a management tool for sustainable urban air quality. Paper presented at the finals of the Young Engineer of the Year Award at the 1998 IPENZ Conference, Auckland, NZ, 14 February
- Kuschel G & Lentz M (1998). Hazardous Ambient Air Contaminants (HAAC) Database Version 1.0. NIWA database prepared for Ministry for the Environment, set of 7 disks, June