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# Rezoning Application for Lot 1 DP 1191203, Nelsons Plains

# Peer Review - Odour

Report Number 610.13824-R1

17 April 2014

Port Stephens Council
116 Adelaide Street,
RAYMOND TERRACE, NSW

Version: Revision 0

# Rezoning Application for Lot 1 DP 1191203, Nelsons Plains

# Peer Review - Odour

PREPARED BY:

SLR Consulting Australia Pty Ltd
ABN 29 001 584 612
2 Lincoln Street Lane Cove NSW 2066 Australia

(PO Box 176 Lane Cove NSW 1595 Australia)
T: 61 2 9427 8100 F: 61 2 9427 8200
E: sydney@slrconsulting.com www.slrconsulting.com

**DOCUMENT CONTROL**

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# 1 BACKGROUND

SLR Consulting Australia Pty Ltd (SLR) was commissioned by Port Stephens Council (Council) to conduct an independent review of the odour assessment prepared to support a development application for the rezoning of Lot 1 DP 1191203 (600 Seaham Road, Nelsons Plains, NSW) (*the Project Site*) for residential use.

The information/materials provided to SLR includes the following correspondence, presented in chronological order of preparation:

- Le Mottee Group (December 2013) Addendum to Planning Proposal Lot 1 DP 1014480 – 600 Seaham Road, Nelson Plains, 16 December 2013 (ref: 5596).
- SKM (February 2014) Rezoning Application for Lot 1 DP 1191203, Nelsons Plains, 24 February 2014 (ref: EN04374).

Based on the review of the above documentation and discussion with Council, it is understood that the project goals for the study are as follows:

- Review the above documentation.
- Provide a succinct summary of the information presented in those documents against the information that would be expected to accompany an odour assessment.
- Provide a summary document of any identified issues / deficiencies and/or errors that may affect the conclusions drawn from those reports.
- Provide recommendations to Council.

# 2 INTRODUCTION

My name is Gary Graham, and I am currently employed as a Technical Director – Air Quality with SLR. Within SLR, I perform the role of Technical Discipline Manager – Air Quality. I am a Chartered Scientist (CSci), Chartered Environmentalist (CEnv) and Chartered Member of the Chartered Institute of Water and Environmental Management (C.WEM MCIWEM).

I hold a Bachelor's Degree (with Honours) in Environmental Science, and a Masters Degree in Wastes Management.

I have over 20 years' experience in environmental management, predominantly involved in providing advice to industry and government in relation to air quality in Europe, Asia and Australia. I have provided advice to the World Bank, UK Government and a wide range of central government departments and local governments, the Australian Department of Defence, and a comprehensive cross section of private companies, across all industry sectors. I have been previously engaged by Port Stephens Council to provide independent advice in regard to matters of odour control.

I have provided expert testimony and witness on issues associated with air quality policy, odour, dust, climate change and spray drift, and at Public Inquiry in the UK.

I respectfully make my recommendations without any conflicting interest in this matter, and consider this to represent my independent opinion.

A copy of my CV is provided in **Appendix A** of this report.

# 3 REVIEW OF RELEVANT DOCUMENTATION

The following documentation was reviewed, and provided below in **Section 3.1** and **Section 3.2** is a summary of my understanding of the key points raised and the conclusions presented. This documentation is not reproduced in this review, and reference should be made to the relevant documentation for full details.

**Section 4** presents a summary of any significant issues that require further clarification with further commentary where required.

## 3.1 Le Mottee Group Letter (December 2013)

The letter prepared by Paul Le Mottee (Le Mottee Group) addressed to the General Manager, Port Stephens Council, presents an opinion of "*no odour issue of any consequence*" based upon a lack of odour complaint records against the operation of the chicken sheds.

## 3.2 SKM Odour Assessment Report (February 2014)

The SKM Odour Assessment Report ('the report') presents a predictive modelling assessment of the potential odour impact of the operation of the three chicken farms on the Project Site.

The report details a modelling assessment with the following features.

**Table 1 Summary of Modelling Assumptions**

| | |
|---|---|
| Model | AUSPLUME v6.0 |
| Meteorology | RAAF Williamtown, 2011 |
| Terrain | Flat |
| Emission source type | Volume sources |
| Emission rates | Constant over the range of $7.42x10^3$ OU/s and $4.26x10^3$ OU/s.<br>This odour emission rate appears to be based upon an assumed odour emission rate of 180 $OUm^3/s$ per 1000 birds, estimated shed dimensions and a bird density of 19 birds/$m^2$. |
| Cartesian receptor grid | 377,000m,6,378,000m to<br>382,000m,6,383,000m<br>50m resolution |

The conclusions of the report are stated in page 13 of the report:

> *The following conclusions have been made from the modelling and assessment:*
>
> - *Odour concentrations at Lot 1 DP 1191203 are predicted to meet EPA odour assessment criteria, subject to the provision of building envelopes on lots 758, 736, 735, 734, 733, 732, 731 and 730 to control the location of the dwellings on these allotments. The building envelopes can be enforced at the DA Stage as Section 88B restrictions on the title when the lots are created.*
> - *Odour due to the poultry farms has not historically been an issue for the existing rural residential development in the area. Therefore, the model results are likely to be a conservative estimate of the extent of odour impacts due to the poultry farms.*

# 4 ISSUES TO BE ADDRESSED

## 4.1 Le Mottee Group Letter (December 2013)

There is justification and validity of using empirical evidence (i.e. observations) to determine the odour impacts of an operational facility. In a number of cases, historical observations can be considered to represent a significant (and defensible) source of data to determine whether odour complaints are likely in the future.

In NSW, the relevant guidance document regarding the assessment of odour impacts is provided in the NSW DEC (2006) *Technical Framework – Assessment and management of odour from stationary sources in NSW* ('the Technical Framework').

DEC (2006) makes the following comment concerning the required difference in approach between the assessment of operational facilities and the modelling assessment of planned facilities:

> *Once a facility is operational the benchmark for the facility is no longer the odour assessment criteria but whether the emission of odour is:*
>
> - *'offensive' (for scheduled activities), or*
> - *being prevented or minimised using best management practices (for scheduled and non-scheduled activities).*
>
> *There may be instances where the odour impact assessment for a new activity indicates that 'offensive odour' impacts are unlikely, but once operational, 'offensive odour' impacts do occur. This may happen due to a lack of meteorological or odour emission data used in the assessment, or an operator's failure to conduct an activity in accordance with best management practice. It is therefore important that the proponent consider what options are available to control odour for new and modified activities at the assessment/planning stages of the proposal.*
>
> *It is not intended that existing activities will routinely have their operations assessed against the odour assessment and ground-level concentration criteria; they have been developed as a **design** tool, to predict the odour impacts, rather than as a **regulatory** tool. Nevertheless, these criteria may be used to help with assessing the likely impacts when odour complaints or problems do arise and to develop odour mitigation strategies as required.*

The validity of using historical observations (including odour complaints records) to evaluate future environmental performance depends on a number of factors.

The legitimacy of using complaints experienced at one location as a proxy for impacts at another location and a commentary regarding the two locations (i.e. the *child care centre* and the *Project Site*) should accompany the use of complaint history in this manner which should identify any features that may limit such a conclusion. In regard to odour, this may include

- a review of the distances to the point of discharge of the odour sources;
- the respective land uses;
- the time and duration of exposure;
- distribution of prevailing wind direction throughout the year;
- any identifiable issues of desensitisation, etc.

The location of the "*child care centre*" has not been positively identified, but it is assumed to be the Jacaranda Grove Pre School, 697 Seaham Rd, Nelsons Plains NSW 2324. It is noted that this location is within 80m of the nearest chicken shed. A map of the child care centre location is provided in **Figure 1**.

**Figure 1 Location Map – Jacaranda Grove Pre School**

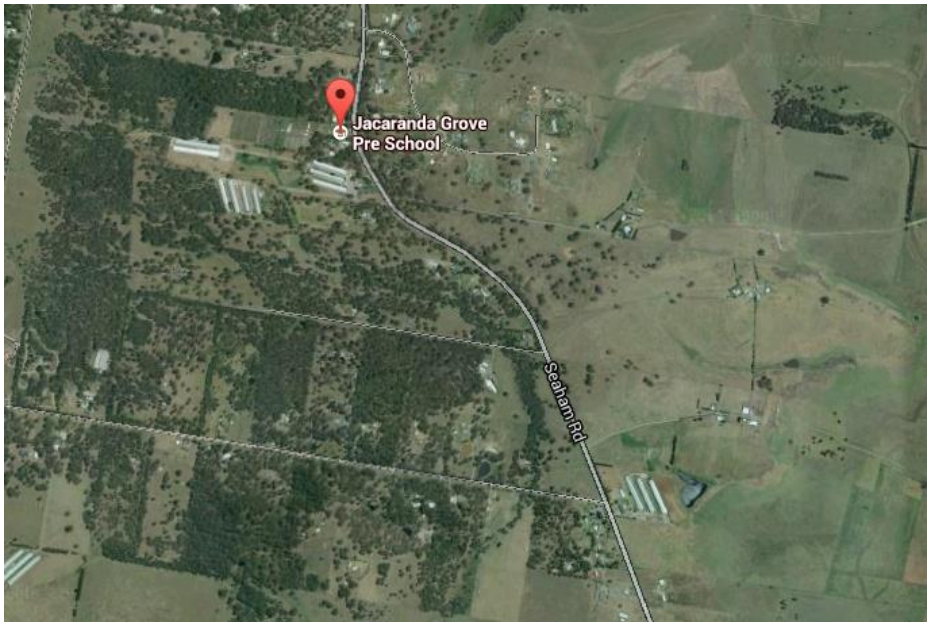


Image courtesy of Google Earth

## 4.2 SKM Odour Assessment Report (February 2014)

The review of the modelling assessment presented in the report provided has identified a number of issues that should be addressed, should the report be used as the basis of the impact assessment. These are briefly outlined below (presented in no order):

(a) AUSPLUME is acknowledged to currently be an approved modelling technique in NSW, and is noted to be acceptable for use under certain conditions. It is widely accepted that AUSPLUME has limitations when used in locations of complex terrain (which this is not) and in situations of complex meteorology, and particularly in calm wind conditions. As odour impacts are exacerbated during periods of poor dispersion (including calm wind conditions), the use of AUSPLUME (or other Gaussian dispersion modelling techniques) is questioned for this study, particularly as the receptors are located in the near-field.

(b) Further to (a), a review of the top ten predicted odour impacts presented in the report shows a significant number of the peak concentrations are predicted to occur at night time, when calm wind conditions and associated poor dispersion are experienced. It is noted that these data are the 100$^{th}$ percentile results.

| Rank | Value | Time Recorded (hh,dd/mm/yy) | Coordinates |
|---|---|---|---|
| 1 | 6.79E+01 | 23, 05/01/11 | (378800, 6380500, 0.0) |
| 2 | 6.52E+01 | 19, 03/06/11 | (378800, 6380500, 0.0) |
| 3 | 6.44E+01 | 23, 15/03/11 | (378600, 6380500, 0.0) |
| 4 | 6.30E+01 | 24, 10/08/11 | (378800, 6380500, 0.0) |
| 5 | 6.30E+01 | 03, 13/08/11 | (378800, 6380500, 0.0) |
| 6 | 6.25E+01 | 04, 09/09/11 | (378800, 6380500, 0.0) |
| 7 | 6.22E+01 | 04, 22/04/11 | (378600, 6380500, 0.0) |
| 8 | 5.87E+01 | 21, 11/08/11 | (378800, 6380500, 0.0) |
| 9 | 5.87E+01 | 04, 15/08/11 | (378800, 6380500, 0.0) |
| 10 | 5.78E+01 | 24, 02/09/11 | (378900, 6380500, 0.0) |

(c) The use of meteorological data from RAAF Williamtown needs some further justification on a number of issues:

- The Bureau of Meteorology (BOM) monitoring station at RAAF Williamtown is noted to be located approximately 18 kilometres (km) to the south-east, and as such may be considered to be reasonably proximate to the Project Site. It is also acknowledged that there are limited alternative sources of meteorological observation data in the area. However, given the near-coastal location of RAAF Williamtown, it is reasonable to conclude that the wind environment may be significantly different to the Project Site, and this needs to be justified.
- The selection of the meteorological data period of 2011 should be discussed i.e. is the 2011 year representative of long-term prevailing conditions?

(d) The constant emission rate of 180 OU.m$^3$/s per 1000 birds has been derived from "Gallagher et al (2007)" although it is noted that the report does not present the details of the referenced paper. It is respectfully assumed that this might be the paper referenced in the footnotes (although this is merely an assumption and should be confirmed)[1]. As the emission rate is fundamental to the SKM report, it is recommended that the derivation and justification of the use of this emission rate is requested. It is noted that there is a substantial variation in the measured odour emission rates from broiler farms. Numerous studies show a significant variation in odour emission by a range of factors including the ventilation rate (RIRDC 2010, APCRC 2011).

(e) Further to (d), it is noted that Gallagher et al (2007) presents data to demonstrate that the odour emission rate from chicken sheds varies by batch cycle age. Further studies (Rahaman et al 2013, Lacey et al 2004) have demonstrated variation in emission rates by other factors, including external temperature, bedding moisture and age, bird population density (etcetera) and justification of the adoption of a constant emission rate should be provided.

(f) The justification of the modelling assessment against an odour assessment criterion of 4 OU has been outlined in the report, based upon the anticipated population density at the Project Site, and this seems to be reasonable. It is noted that in other parts of NSW an odour criterion of 2 OU is applied to denser housing developments, which is an issue for Council to determine.

(g) Notwithstanding the observation presented in (f), the odour criterion of 2 OU is to be applied at schools and hospitals. Reference should be made to DEC (2006), Table 3.1 which is reproduced below for clarity. Visual interpretation of the isopleth presented in *Figure 5-1* of the report suggests a predicted odour concentration of between 20 OU and 10 OU is predicted at the location of Jacaranda Grove Pre School, which would suggest that odour nuisance at this location is anticipated.

| Population of affected community | Odour assessment criteria (OU) |
|---|---|
| Rural single residence (≤2) | 7 |
| ~10 | 6 |
| ~30 | 5 |
| ~125 | 4 |
| ~500 | 3 |
| Urban area (≤2000) and/or schools and hospitals | 2 |

(h) It is noted that *page 10* of the report states that Cartesian receptors are located at a resolution of 50m. However, the data presented on *page 22* shows that the receptor resolution used in the modelling is 100m. This should be clarified.

(i) Further to (h), given the distance from the sheds to the Project Site, it is recommended that the receptor resolution (i.e. the distance between receptor locations) is reduced to avoid unnecessary bias by the selected gridding methodology.

1 Erin M. Gallagher, Neale A. Hudson, Mark W. Dunlop, Gavin Parsci, Jae Ho Sohn, Michael G. Atzeni, David Duperouzel, Gary Collman and Peter Nichola, *Odour Emissions from Tunnel Ventilated Poultry Housing*, 14th IUAPPA World Congress, Brisbane 2007

(j) Section 5 of the report implies that a peak-to-mean adjustment to the 99$^{th}$ percentile 1-hour odour concentrations has been applied, although the report does not provide any clarification of what specific factor has been applied.

# 5 RECOMMENDATIONS

A number of weaknesses in the SKM report have been identified, as outlined above in **Section 4.2**. Should discussions between Council and Portree Park Pty Ltd (the proponent) determine that a modelling assessment approach is the preferred methodology to determine any constraint for development from odour, it is recommended that Council seek further verification of the issues outlined above.

At face value, the overall predictions of odour impacts seem to be broadly consistent with that which might be typically (and broadly) anticipated, and consistent with the standard buffer distances typically applied across Australia.

However, it is also recommended that Council may consider an alternative approach following the broad methodology adopted in the Le Mottee Letter, i.e. one reliant upon historical and current observation over an assessment reliant upon predictive modelling.

Notwithstanding the issues outlined above in regard to the modelling assessment, and taking the lack of odour complaint records at face value (this assumption is made without prejudice), there appears to be a disconnect between the footprint of the odour predicted through the modelling study against the lack of complaints. For example, the modelling assessment predicts an odour concentration of between 20 OU and 10 OU at the Jacaranda Grove Pre School, but the opinion expressed in the Le Mottee letter suggests a lack of odour complaints / impact at this location. Given the offensiveness of odour from poultry farms, a concentration of between 20 OU and 10 OU would easily correlate to a distinct odour, and given the transition of children through the school and the sensitivity of such a use to odour, it seems counter-intuitive to suggest that the population is desensitised to the odour from poultry farms. However, in order to draw sufficient certainty on the use of observations, it is recommended that supplementary evidence is requested, which should include the following. Please note that the following may be implemented reasonably inexpensively and quickly.

- A structured discussion with a selection of staff / parents attending the Jacaranda Grove Pre School to determine their opinion of the odour experienced (if at all) at the location and in the wider community. This should be performed in accordance with the German Standard VDI 3883. [This might be completed with a day's interviews and a few days for analysis and write up].
- A campaign of field odour assessment should be performed to evaluate the odour strength, character and hedonic tone at the boundary of and across the Project Site. This should be performed on a number of occasions during conditions conducive for poor odour dispersion, with observations of odour conditions and prevailing meteorology at various times of the day, including early morning and evening. It is recommended that these are performed by an appropriately experienced and qualified consultant with a known nasal acuity in accordance with AS 4323.3. [This might be completed within a few weeks (weather dependant)].

Without prejudice of the outcome of the issues previously discussed, it is recommended that Council consider the issue of a certificate issued under the Environmental Planning and Assessment Act (1979), Section 149, Part 5. It is considered that this would offer a prudent mechanism for the minimisation of potential odour nuisance in the future. By informing any prospective purchaser (in the contract for the sale of land) that the land may be affected by odour impacts, individuals that are particularly sensitive to odour may avoid such land. An example of the wording is provided below:

*"ODOUR IMPACT - This land is in close proximity to operating poultry farms, and periodically residents of this site may experience odour from the operation of these stables. You are further advised that the sources have no intention to cease operation at this stage."*

# 6 REFERENCES


- APCRC (Australian Poultry CRC) 2011, 'Dust and odour emissions from meat chicken sheds', *Project No 04-45*
- Rahaman F, Lawrence K, Starke G, Graham G and Doyle M (2013) Estimation of Odour Emissions from Broiler Farms – An Alternative Approach. Proceedings of the 21st Clean Air Society for Australia and New Zealand, Sydney 2013
- Gallagher EM, Hudson NA, Dunlop MW, Parsci G, Sohn JH, Atzeni MG, Duperouzel D, Collman G and Nichola P, *Odour Emissions from Tunnel Ventilated Poultry Housing*, 14th IUAPPA World Congress, Brisbane 2007
- Lacey R., Mukhtar S., Carey J., and Ullman J. 2004, 'A review of literature concerning odors, ammonia and dust from broiler production facilities' *Journal of Applied Poultry Research, Vol. 13, No 3*
- Le Mottee Group (December 2013) *Addendum to Planning Proposal Lot 1 DP 1014480 – 600 Seaham Road, Nelson Plains*, 16 December 2013 (ref: 5596).
- RIRDC (Rural Industries Research and Development Corporation) 2010, *'Trials of odour control technologies on broiler farms' RIRDC Publication No 10/102*
- SKM (February 2014) Rezoning Application for Lot 1 DP 1191203, Nelsons Plains, 24 February 2014 (ref: EN04374).


# 7 CLOSURE

This report has been prepared by SLR with all reasonable skill, care and diligence, and taking account of the manpower and resources devoted to it by agreement with the client. Information reported herein is based on the interpretation of data collected and has been accepted in good faith as being accurate and valid.

This report is for the exclusive use of Port Stephens Council. No warranties or guarantees are expressed or should be inferred by any third parties. This report may not be relied upon by other parties without written consent from SLR.

SLR disclaims any responsibility to the client and others in respect of any matters outside the agreed scope of the work.

# GARY GRAHAM
Technical Director - Air Quality

**Curriculum Vitae**

## QUALIFICATIONS
Bachelor of Science with Honours BSc (hons), Environmental Science, 1992
Master of Science (MSc), Wastes Management, 1994

## MEMBERSHIP
- Elected Member of Clean Air Society of Australia and New Zealand (CASANZ) Committee for NSW, NSW Treasurer
- Member of the Chartered Institution of Water and Environmental Management (MCIWEM)
- Chartered Scientist (CSci)
- Chartered Environmentalist (CEnv)
- Chartered Water and Environmental Manager (C.WEM)
- Institute of Acoustics Certificate and Competence in Environmental Noise Measurement (IoA CoC)

## BACKGROUND
Gary is a Technical Director and the Technical Discipline Manager for Air Quality with SLR with around 20 years experience in environmental consultancy.

He is a *Chartered Scientist* (CSci), *Chartered Environmentalist* (CEnv), *Chartered Water and Environmental Manager* (C.WEM MCIWEM) and a project manager with extensive experience in multi-disciplinary consultancy with an emphasis within the air quality, climate change, environmental permitting, compliance, environmental planning and waste management sectors.

He has provided technical consultancy advice to an extensive portfolio public and private sector clients, including the World Bank, European Bank for Reconstruction and Development, central government agencies in Europe and Australia, (including Australian DOD, NSW DECCW/EPA, UK DEFRA and Highways Agency), local government, development agencies, energy, industry, infrastructure, wastewater, and urban renewal sectors.

He has substantial experience in advising clients through the environmental assessment process, and has directed and managed multi-disciplinary Environmental Assessments for a wide range of developments, including being lead environmental advisor and co-ordinator for the master-planning of a £5.5 billion development in NW England.

He provides peer review services on behalf of Councils and frequently provides expert witness and testimony in the NSW LEC and WA SAT on air quality policy, dust, odour, climate change and spray drift issues, and at Public Inquiry in the UK.

## SPECIAL EXPERTISE
- Peer review of technical reports
- Expert witness
- Management of Environmental Impact Assessment studies and planning applications
- Air quality management
- Industrial regulation

## SELECTED PROJECT EXPERIENCE
Provided below are a selection of expert witness, peer review, technology and process due diligence and EIA co-ordination projects.

**Expert Witness, NSW, Australia, Confidential, 2014, Consultant**
Odour expert on a land use planning matter before the NSW LEC.

**Peer Review, NSW, Port Stephens Council, 2014, Consultant**
Peer review of an odour and land use planning development application.

**Expert Witness, NSW, Australia, Australian Turf Club, 2014, Consultant**
Odour expert on a land use planning matter before the NSW LEC.

**Technical Expert, NSW, Australia, Infrastructure NSW, 2013-14, Consultant**
Technical expert acting on behalf of INSW in detailed discussions with NSW EPA regarding localised power generation in metropolitan Sydney.

**Peer Review, WA, Australia, Confidential, 2013, Consultant**
Peer review of various environmental and technology aspects of waste management options.

**Expert Witness, NSW, Australia, NSW EPA, 2013, Consultant**
Expert witness regarding the odour generation from landfill design options.

**Peer Review, VIC, Australia, Port of Melbourne Corporation, 2013, Consultant**
Peer review of air quality impact assessment reporting.

**Independent Expert Witness, NSW, Australia, NSW Land and Environment Court, 2013-14, Consultant**
Appointed directly by NSW LEC as an independent expert and joint party arbitrator on an ongoing LEC odour control matter in NSW.

**Expert Witness, NSW, Australia, NSW EPA, 2013, Consultant**
Provision of technical review and expert witness reports on behalf of NSW EPA for a confidential and highly sensitive public health issue regarding emergency emissions to air from an industrial process.

**Expert Witness, WA Limestone, WA, Australia 2011-13, Project Director and Consultant**
Provision of detailed evaluations of background air quality, review of BAT and expert witness and testimony in the WA SAT.

**Peer Review, NSW, Australia, Port Stephens Council, 2011-12, Project Director and Consultant**
A peer review of odour reports and supplementary data surrounding a composting facility to determine constraints for the rezoning of land from agricultural to residential use.

**Retained Odour Expert – Multiple Sites, NSW, Australia, McDonalds, 2011-14, Project Director**
Provision of odour impact assessment reports for development applications for *numerous sites* in NSW. Preparation of numerous expert testimony and witness statements in the NSW LEC.

**Peer Review, NSW, Australia, City of Sydney Council, 2011, Project Director and Consultant**
Commissioned by City of Sydney Council to undertake a peer review of odour reports for the relocation of a smash repair facility in close proximity to existing residential properties.

**VOC Exposure from Household Sources, Australia, OEH, 2010, Technical Reviewer**

Technical reviewer of a research project on behalf of NSW OEH to quantify the risk from exposure to VOCs from consumer products.

**Odour Management, NSW, Australia, Client Confidential, 2010, Project Director and Consultant**
Preparation of a detailed investigation concerning the environmental impacts a kitchen ventilation system, including the development of abatement options, technology trials, attendance at public meetings and representation to the Council.

**Coal Mine Expansion, VIC, Australia, Vallance, 2010, Project Manager**
Representation of client at mine planning meetings to discuss the design and implementation of environmental control measures.

**UHG Phase II Mine Extension, Energy Resources, Mongolia, 2009, Technical Expert**
Provision of a detailed air quality and climate change assessment in accordance with IFC protocols for a large box cut mine, railway, airstrip and infrastructure development in Mongolia.

**Odour Assessment – Expert Witness, NSW Australia, Client Confidential, 2009, Expert Witness**
Provision of expert statements and witness for a respondent to an industrial process development in NSW. Preparation of expert statements and expert witness in Class 1 proceedings in the NSW LEC.

**Odour Assessment – Expert Witness, NSW Australia, Client Confidential, 2009, Expert Witness**
Provision of expert statements and witness for a respondent to an industrial process development in NSW. Preparation of expert statements and expert witness in Class 4 proceedings in the NSW LEC.

**Environmental Management Plans, Victoria, Australia, Client Confidential, 2009, Technical Expert**
Preparation of a range of detailed EMPs for a major infrastructure development in South Australia.

**Pre-Acquisition Advice, UK, Aggregates UK, 2008, Project Director**
Provision of bespoke dust advice to a minerals extraction company proposing an opencast aggregate site to be located in close proximity to an operational military airfield. Design of long-term baseline dust and (real-time) particulate monitoring, and design of assessment methodologies to predict dust arisings to facilitate dust control mitigation measures.

**Liverpool Water Environmental Co-ordinator, UK, The Peel Group, 2008, Project Manager**
Project management and co-ordination of all environmental services (air, climate change, noise, sustainability, water, ecology, asbestos, ground contamination) for a flagship 61ha urban regeneration, GBP5.5billion mixed use development in NW England.

**Industrial Regulation Advice, UK, Bioflame plc, 2006-08, Project Director and Client Manager**
Provision of all environmental advice to an biomass energy company in UK. This involved provision of 4no IPPC permit submissions, detailed discussion with the UK EA regarding the development of BAT assessment methodologies for the energy sector, numerous submission to support planning applications in sensitive areas, and ad-hoc advice regarding all environmental issues.

**New Raynesway Grade Separated Junction EIA, Spondon, Derby, UK, UK Highways Agency, 2008, Expert Witness**
Project director of air quality input into an Environmental Assessment Report to support an substantial infrastructure realignment, including climate change adaption options. Expert witness at subsequent public inquiry.

**Manchester Airport Freight Forwarding Unit EIA, UK, Manchester Airport plc, 2008, Project Manager**
Project manager for a multi-disciplinary EIA to support the planning application.

**Farnworth EIA, UK, Cathco Property Group, 2008, Project Manager**
EIA co-ordination for a full ES submission, including all front-end work, description, socio-economics, transportation, visual impact, landscaping, ground conditions, hydrology, noise and vibration, air quality, climate change, waste management, archaeology and sustainability

**Denbigh EIA, UK, Cathco Property Group, 2007 Project Manager**
EIA co-ordination for a full ES submission, including all front-end work, description, socio-economics, transportation, visual impact, landscaping, ground conditions, hydrology, noise and vibration, air quality, climate change, waste management, archaeology and sustainability.

**PFI Hospital Site GHG Emissions Trading Scheme Applications – Scotland, UK, Balfour Beatty Capital Projects Ltd, 2007, Project Manager**
Detailed advise and consultation with DEFRA concerning an EU-ETTS permit application for a PFI hospital site in Scotland.

**Manchester Airport Terminal 3 Apron Extension EIA, UK, Manchester Airport plc, 2007, Project Manager**
Project manager of the integrated EIA to support the planning application. The EIA included the predicted air quality impact resulting from the operational phase aircraft emissions and road traffic using the road networks immediately surrounding the proposed development site, and appraisal for climate change options.

**Carbon Footprinting Calculator, UK, Client Confidential, 2007, Technical Expert**
Development and preparation of a bespoke foot printing tool for a blue-chip UK food retailer.

**Beverley Southern Relief Road EIA, UK, East Riding of Yorkshire Council, 2007, Technical Expert**
Project director of an air quality assessment of potential impacts associated with a major infrastructure development in UK.

**A1 Dualling and Realignment DMRB Stage 2/3 Assessment , UK, Highways Agency / Laing O'Rouke, 2007, Technical Expert**
Assessment of proposed expansion of infrastructure on the strategic road network.

**Bioverda Energy EIA, PPC, COMAH Assessments, UK, Bioverda Energy 2006-08 Project Manager**
Provision of multi-facetted studies for simultaneous submission of EIA, PPC and COMAH submissions for a substantial bioenergy plant in NE England.

**SITA Energy from Waste Plant PPC, UK, SITA, 2006, Project Manager**
Project manager for a substantial IPPC permit variation for a large energy from waste (EfW) plant in northern England.

**PFI Hospital Site GHG Emissions Trading Scheme Applications – NE England, UK, Balfour Beatty Capital Projects Ltd, 2006 Project Manager**
Preparation of Greenhouse Gas EU-ETTS permit application for a PFI hospital site in NE England. Additional advice was given regarding regulation under IPPC.

**Fibres Worldwide PPC, UK, Fibres Worldwide, 2006, Project Director**
Project director for a large air quality assessment to support an IPPC Permit Application for Fibres Worldwide Ltd, and Humber Energy. Dispersion modelling studies were undertaken for scores of organic pollutants from approximately 150 intermittently operating sources.

**Countess of Chester Health Park Environmental Expert, UK, English Partnerships, 2006-08, Project Director**
Design and implementation of dust, noise and vibration control programme during demolition and construction work neighbouring an operation acute hospital and analytical laboratory. Project Director for all environmental and asbestos works over a three year period.

**Preston East Employment Park EIA, UK, English Partnerships, 2005, Project Director**
Project director of the air quality, noise, geo-environmental and water assessments within the Environmental Statement for a prestigious employment park to be situated to the east of Preston, Lancashire on behalf of English Partnerships.

**ForthQuarter Development EIA, UK, ForthQuarter plc, 2005, Technical Expert**
Detailed assessment using DMRB methodology of air quality impacts as the result of a redevelopment of a disused gasworks for residential end-use in Granton, Edinburgh.

**Liverpool Garden Festival EIA, UK, 2004-05 Project Manager**
Management of air quality, noise & vibration, water quality and contaminated land issues for large brownfield site in Liverpool.

**Loss of Amenity Study, UK, Norfolk Environmental Waste Services, 2003-04 Project Manager**
Responsible for investigating 'loss of amenity' issues with regard to a planning application for the extension of a working landfill and composting site.

**Merseytravel Mersey Rapid Transit EIA, UK, Merseytravel plc, 1997-99, Technical Expert**
Responsible for the production of an air quality EIA for inclusion in an Environmental Statement for the proposed infrastructure development throughout Liverpool city centre. Also responsible for the provision of environmental advice during geotechnical investigations along the route of the proposed scheme. Responsible for the design of landfill gas monitoring wells across a disused landfill site as part of the scheme and implementation of assessment scheme.

**Odour Impact Assessment (multiple sites), UK, Grampian Water, 1998-06, Project Director**
Predicted odour impacts associated with a proposed development of a number of Wastewater Treatment Works in the UK and determination of BAT for odour control.

**Air Quality Review and Assessments (Stages 1, 2 and 3), UK, Local Authorities (numerous), 1996-2000, Technical Expert**
Undertook all aspects of the Air Quality Review and Assessment procedures for a wide range of local authorities in the UK, including establishment of long-term ambient air quality networks, data validation, QA/QC compliance, reporting, consultation with public and central government, reporting and advice regarding the declaration of Air Quality Management Areas under their obligations defined by the Environment Act 1995.

**Background Environmental Investigation, UK, Bellway Homes, 1997, Project Manager**
Project management of a detailed background environmental investigation concerning the site of a proposed residential development in Cheshire.

**An Assessment of the Risks to Human Health of Waste Transfer Stations, UK, Environment Agency R&D, 1996-98, Project Manager**
Project manager for a research project on behalf of the UK Environment Agency, involving a risk assessment from airborne dusts and aerosols, biological agents, noise and electro-magnetic forces.

**Environmental Auditing (Pre-acquisition), UK, Client Confidential, 1996, Consultant**
Responsible for pre-acquisition environmental audits of a large number of commercial and industrial sites.