08 March 2013

James Laycock
Principal Planner
Blueprint Planning
1035 Table Top Road
TABLE TOP NSW 2640

Our ref: 31/29006/6541

Dear James

DA 42-12/13 - Proposed resource recovery facility (organic composting)
"Kalawa", 92 Paterson Rd, Gerogery
Response to EPA request for additional information

At your request GHD has compiled a response to the matters raised by the NSW Environment Protection Authority (EPA) in its letter to the Greater Hume Shire Council (GHSC) dated 26 November 2012. This response incorporates and builds on the discussions held between GHD (David Gamble, Anthony Dixon and Tim Pollock) and EPA officers (John Klepetko and Andrew Mattes) at the EPA's offices in Sydney on 6 December 2012.

In Attachment A of its letter to GHSC dated 26 November 2012, the EPA raised five 'areas of concern' in relation to the Air Quality Assessment (AQA) undertaken by GHD. GHD has responded to these areas of concern in the attached memo from GHD's Tim Pollock to Stephen Dahl dated 28 February 2013 (Appendix 1).

This letter responds specifically to the items raised in Attachment B of the EPA letter, which largely draws from the material prepared by GHD to respond to the issues raised in Attachment A. In addition to responding directly to these matters, this letter also provides additional background information on the project, the Gore^{TM} technology and management practices proposed to be utilised, and a discussion on more recent composting information obtained by GHD as a result of additional sampling and trials undertaken by Transpacific Cleanaway (TCL).

1 Background

In October 2012 TCL submitted a development application (DA 42-12/13) to the GHSC seeking planning approval to construct and operate an organic composting facility at Gerogery, NSW. The transformation and beneficial reuse of waste organic material via composting is a significant issue for government, and this issue has been reflected in TCL's recently renewed waste management contracts with a number of local government councils in the Albury-Wodonga region. The removal of organic waste material from landfill is also consistent with NSW and Victorian government policy, targets and initiatives and is also consistent with the 'Halve Waste' campaign being sponsored by local governments in the Albury-Wodonga region.

As part of the planning for the project, TCL undertook a series of pilot organic waste collection trials in Albury and Wodonga. A review of potential sites for the composting facility was also undertaken. One of the key factors contributing to the selection of the Gerogery site was the potential to locate the facility well away from sensitive receptors.

The application of Gore^{TM} technology in covered aerated composting situations is a relatively new concept in Australia. This does not mean that the technology or its application in large-scale composting situations carries significant technical risk. The technology is utilised widely overseas (over 150 installations in 20 different countries). There are a number of large-scale projects being implemented at present – for example a 520,000 t/year facility in Sicily and 1 million t/year facility in Kettleman City (150 miles north of Los Angeles, California, USA) owned by Los Angeles County and composting biosolids. The covered aerated composting process is described in the recently released *Food & Garden Organics Best Practice Collection Manual* (SeWPAC, 2012), and the Timaru, NZ facility operated by TCL is cited.

Because it is an innovation in terms of Australian applications, there is a relatively small set of odour emission rate data associated with Gore^{TM}. The AQA undertaken as part of EIS utilised a number of relevant data sets (as detailed in Appendix 1). Key data sources (for example for Phase 1 windrows) were obtained from the TCL data set associated with trials undertaken at Camden, NSW in 2006 using Gore^{TM} cover technology.

In recognition of the paucity of Gore^{TM} cover composting data under local conditions utilising a range of raw materials, TCL elected to undertake additional air emissions sampling programs. This resulted in additional information being collected from TCL's Timaru, NZ operations and from a specific trial in Wodonga, Vic. The results of this sampling and new information are summarised below and discussed in more detail in Appendices 1 and 2. Both trials have provided data which, although not based on an identical waste composition, can be adequately used for comparative purposes.

TCL undertook a composting trial at its Wodonga, Vic recycling depot between December 2012 and January 2013. The trial was undertaken in order to collect additional information on odour emissions from greenwaste and grease trap waste in an aerated process utilising the Gore^{TM} composting system.

A sampling program was also undertaken at the TCL Timaru, NZ site (September 2012) where a combination of greenwaste (85%) and foodwaste (15%) is composted on an operational basis.

At Wodonga the sampling of odour emissions was undertaken in four surveys between 18 December 2012 and 29 January 2013. Sampling was undertaken on aerated and quiescent windrows by The Odour Unit Pty Ltd (TOU) using the isolation flux chamber (IFC) method. A small number of draped wind tunnel samples were also collected by Emissions Testing Consultants Pty Ltd (ETC).

The results of the Wodonga trial indicate that specific odour emission rates (SOERs) during aeration show an approximate doubling from the quiescent values. It was noted that odour emission rates reduce significantly after the initial mixing of greenwaste and grease trap waste, and that offensive odour may be experienced at the initial mixing stage but is expected to become less offensive in a short period.

A comparison of the Wodonga, Vic results with other relevant data sets was also undertaken (refer Appendix 2). In particular, the recent TCL dataset from Timaru, NZ (September 2012) and the dataset obtained from a trial windrow at Camden, NSW (2006) were examined. The findings from the comparison were that the data measured in both the Timaru, NZ or the Wodonga, Vic trials were substantially lower than the Camden SOER data (used in the AQA).

Based on the results of more recent sampling, the odour emissions generated by the project are likely to be lower than those predicted in the AQA. **It should be noted that the AQA indicates that the project complies with all relevant EPA criteria**. This indicates that there is a likely increase in the margin of safety in regard to achieving such compliance.

SOERs associated with the Wodonga, Vic greenwaste and grease trap mix are of a similar level to those measured at Timaru, NZ (greenwaste and foodwaste). This suggests that grease trap waste yields only a marginal increase in SOER compared to food waste.

On the basis of the above, the substantial difference in SOER data suggests that the AQA modelled predictions of peak odour impact are substantially over-estimated.

2 Response to NSW EPA letter (Attachment B)

2.1 (1a) Demonstrate [that] air impacts have been assessed at all potentially affected receptors and under worst case scenarios

Air impacts have been assessed at all of the receptors shown in Table 3 of Section 3 (Appendix 1). This includes the Paintball Facility and Paterson's Quarry, which were not previously included.

'Worst-case-scenarios' have been used to assess air quality impacts at each receptor, as per Sections 3 and 5 (Appendix 1). As per the NSW *Approved Methods for Modelling and Assessment of Air Pollutants* (DEC, 2005), a Level 2 assessment was conducted for the AQA. A Level 2 assessment is a refined dispersion modelling technique using site specific input data. Hence the refined model CALMET/CALPUFF was utilised together with site specific data (Gore^{TM} cover SOERs for greenwaste windrows).

A Level 2 assessment applies the site specific data into a refined dispersion model to represent actual proposed operating conditions i.e. quiescent windrows, aeration and turning of windrows. The AQA incorporated the worst case emission rates as part of the proposed operations by applying the OER factors of increase for IFC under-estimates, aeration and turning to every hour of the year i.e. good and poor dispersion hours.

As per the NSW 'Approved Methods', the Level 2 assessment of impact uses the 99th percentile odour concentration (1 second average). The 99th percentile results presented in the AQA (for example Figure 15) provide the required indication of the range of odour concentrations expected throughout the year.

Only a Level 1 screening assessment requires 'worst case' input data with 'worst case' dispersion conditions, and only a Level 1 assessment would require the worst case 'peak' (100 percentile) odour concentration to be presented. A Level 1 assessment was not required for the project.

Modelling results for the Paintball Facility and Paterson's Quarry indicate that:

- The Paintball facility readily meets the population-dependent criterion even if the facility were to be continuously occupied by 20 participants (it currently employs three part-time staff, including the owners of 'Kalawa').
- Under a worst-case-scenario the quarry would operate every weekday (7am – 6pm) Monday to Friday, Saturdays (8am – 1pm) with no work occurring on Sundays. This corresponds to 3,120 hours in a year equating to 36% of the year. Thus the occupancy rate for the workers at the quarry is at most 36% of the year primarily during day-time during good dispersion conditions. Therefore the predicted concentration can be reduced by applying the percentage of time the workers would be on site. In reality the quarry operates much less than 36% of the year. The current planning consent allows the removal of 33,000 cubic metres of quarried material per year but currently it is estimated that only 10,000 cubic metres is removed per year (EIS Vol. 1, Section 15.1.3; DA 166-02/03, 21 July 2003, as modified 19 October 2012).

2.2 (1b) Include the proposed methods for validating the odour emission rates adopted in the assessment

The method used to validate the odour emission rates used for the AQA was to obtain and cross check SOER data from a variety of sources. The SOER for the most important source in terms of % odour contribution (Phase 1 windrows) was the Camden, NSW trial data using Gore™ cover technology. A full list of the SOERs used in the AQA together with a justification for their use is presented in Section 1, Table 1 of Appendix 1.

As agreed in discussions between GHD and the EPA (6 December 2012), copies of relevant extracts from the reports cited in this table and in the AQA have been compiled and are also presented in Appendix 1.

The quantity and composition of raw materials presented for composting (described in Section 10 of the EIS (Table 10.1)) are expected to vary seasonally and according to social overlays such as holiday times, socio-economic status and state of the economy. Project operations would make allowance for this by altering the blending and mixing to produce a consistent feedstock that is always suitable for composting.

2.3 (1c) Include the proposed contingency mitigation measures that will be implemented if the specific emission odour rates assumed in the assessment are not achieved in practice

TCL has advised GHD that it proposes to adopt the following contingency measures (to be incorporated into site certified management systems), should there be odour issues with the facility:

- Record all odour complaints.
- Investigate all odour complaints to determine if there is an onsite source and establish the cause of odour.
- Take corrective action, including eliminating specific waste sources or types if necessary. If odour is caused by incorrect feedstock preparation (which is the most likely scenario), the offending batch(es) would be adjusted or disposed of and the staff re-trained and guided to prevent reoccurrence.
- The process control equipment would be assessed and if any problem is identified, this would be repaired and/or addressed.

As described in Table 4 of Appendix 1, modelling undertaken as part of the AQA indicates that Phase 1 windrows (where the most active composting is taking place) provide the greatest contribution to odour emissions. The monitoring and management of these windrows is therefore considered to be a priority. However, all aspects of the operations (receivals through to maturation and screening) would be monitored to ensure that processes are performing consistent with design.

TCL maintains independently certified quality, OH&S, and environmental management systems. Management procedures including odour response, record keeping and contingency mitigation measures would be developed as part of establishing site operations.

2.4 (2) Include emission controls that, as a minimum are consistent with reasonably available technology and good environmental practice, for all plant and operations

The use of Gore^{TM} covers in an aerated composting system is a best practice technology. The recent Wodonga, Vic trial confirms considerable differences between Aerosorb^{TM} and Gore^{TM} cover technologies based on the nature of the cover material. The Gore^{TM} technology resulted in much lower odour emissions due to its semi-permeable and multilayered construction combined with the maintenance of a wet condensation layer on the inner surface which dissolves VOCs and causes them to re-enter the compost.

GHD considers that it is important to match appropriate technology with an appropriate site. The site selected for the composting facility is considered to be appropriate due to its relative isolation and small number of potential receptors. The conservative nature of odour modelling undertaken for the project shows that the predicted off-site odour levels will comply with EPA criteria with a reasonable margin of safety.

The management and operational aspects of a compost facility are considered to be the most important aspects of composting, more important than the technology choice. Sound management procedures are required to efficiently manufacture certified compost (to AS 4454-2012). These same management practices and documented site procedures are expected to contribute to good environmental performance.

TCL has proposed the following in terms of good site management and environmental practice:

- Staff recruitment – staff recruited would be selected carefully so that they have the right attitude and aptitude to understand and proactively operate the site in an environmentally responsible manner.
- Staff training – staff would be trained by an experienced compost plant operator so they know how to run the site correctly. Particular focus would be placed on knowing the raw feedstock and how to mix and blend it. Staff familiarity with composting fundamentals such as total moisture content, porosity and C:N ratio is essential.
- Staff would be supervised by an experienced operator so that they are familiar with process controls, aeration, temperature profiles, etc and written procedures would be prepared to guide them. Process parameters would be recorded in a detailed manner for every batch and every operation, to enable a database of operational parameters to be maintained.
- All incoming raw material batches would be assessed individually, as it is recognised that no two batches would be identical.
- Any issues with in-coming raw materials would be communicated immediately to collectors and council representatives and non-conforming loads and those containing inappropriate materials would be rejected.
- Prompt handling of material – all raw material received on each day would be processed that same day and added to a composting batch.
- Good housekeeping practices would be followed – the site would be cleaned daily.
- Repairs and maintenance would be undertaken pro-actively to ensure that equipment is performing appropriately.
- A quality control program, with a prescribed sampling regime would be implemented.

In short, the operation of a modern and professional compost facility is akin to running a factory or industrial process. The above-mentioned procedures reflect TCL's philosophy of a structured and sophisticated approach, appropriately trained people, and planning and supervision processes.

3 Conclusions

Successful odour management in composting operations is considered to require three key components:

- An appropriate site.
- Appropriate materials handling and processing technology.
- Appropriate management and management systems which monitor the performance of the project from the collection of raw materials, through the handling and processing phases right through to the dispatch of the final certified product

TCL is confident that odour emissions from the facility would be compliant with licence conditions, based on its experience with this technology elsewhere.

Odour modelling undertaken for this project by GHD as part of the AQA demonstrates that project compliance with appropriate odour criteria would be achieved. Recent investigations by TCL at Wodonga, Vic and Timaru, NZ indicate that this compliance is likely to be achieved with a reasonable margin of safety.

Yours faithfully
GHD Pty Ltd

David Gamble
Service Line Leader Waste Management
02 9239 7354

Appendix 1: GHD Memo – Response to Air Quality Report Issues – Modelling Aspects
Appendix 2: GHD Memo – Summary of Transpacific Cleanaway Wodonga Composting Trial

Appendix 1

Memo from T Pollock – EPA response (Doc 6545)

28 February 2013

To	Stephen Dahl, Senior Environmental Scientist, GHD		
Copy to			
From	Tim Pollock, Principal Environmental Engineer, GHD	Tel	61 2 6043 8700
Subject	Response to Air Quality Assessment report issues - modelling aspects	Job no.	31/29006

Steve

GHD Response to NSW EPA Areas of Concern

As requested, please see below our written response to the issues raised by the NSW EPA in Attachment A of its letter to the Greater Hume Shire Council (26 November 2012). This document has been informed by discussions that I had with the NSW EPA officers in their Sydney office on 6 December 2012.

We have responded specifically to the five 'areas of concern' (AOC) raised in Attachment A of the above letter. Responses to Attachment B of the EPA letter are contained in a separate letter, as they draw upon many of the responses to the Attachment A issues (which are addressed in this memo). Where appropriate we have presented additional information gained since the Air Quality Assessment (AQA) for the EIS (October 2012) was compiled. This memo should be read in conjunction with the AQA and my memo (19 Feb 2012) which summarises the results of the recent Transpacific Cleanaway (TCL) Wodonga, (Vic) composting trial.

1 AOC #1: Probable underestimation of specific odour emission rates (SOERs) from key sources

1.1 Key Sources of Emissions

The modelling approach undertaken by GHD was to identify key process stages and sources of emissions and to assign a specific odour emission rate (SOER) to each activity. The key sources and activities are presented in Table 9 of the AQA. Justification for the SOERs used is presented in Table 1 (of this document). The relative contribution (%) of the key sources to the total odour emissions for the site is presented in Table 4 of this document. From this table it can be seen that the major contribution in terms of odour emission rate (OER) (OUm^3/minute) is the Phase 1 windrow (79 % during operating hours and 88% outside operating hours). Considerable effort has been made to estimate emissions from Phase 1 windrows. This is explained in subsequent sections.

1.2 Sources of SOER information

As can be seen from Table 1 of this document, the SOERs used in the AQA came from a number of sources. The SOER for the major emissions source (Phase 1 windrows) was based on data gathered by TCL at Camden, NSW in 2006. This trial included composting of mixed waste (green waste 80% plus food waste 20%) using Gore™ cover technology. At the time of AQA compilation, this data was used as it was the only available. TCL advise that the Camden trial was undertaken with a "richer" waste mix than what is proposed for the Gerogery project, and that the site was not being operated by TCL. The operators (non TCL) did not have the training or proficiency which TCL staff possess.

Camden, NSW mixed waste (green waste plus food waste) SOERs were used in the AQA for both Phase 1 and 2 windrows. Table 11 of the AQA presents the Isolation Flux Chamber (IFC) SOERs that were used in the report before a series of conservative correction factors were applied.

The Phase 1 windrow SOER is 2 OUm/s ((7.7+1.1+0.36+0.85+0.07)/5 = 2.0), and the Phase 2 windrow SOER is 0.79 OUm/s ((0.07+2.0+0.29)/3 =0.79). Due to a lack of data at week 8 from the Camden, NSW measurements, data from another trial (Australian Native Landscapes (ANL), Coldstream data (2007-2008)) from weeks 7 and 8 was adopted for Phase 3 windrows, providing an SOER of 0.6 OUm/s ((0.4+0.8)/2 = 0.6).

As described in Section 7.1.4 of the AQA, the calculation and modelling of emission rates from windrows takes account of windrow size, aeration and aeration timing (% of time occurring).

1.3 Sources of conservatism (overestimation) in odour emission calculations

A number of sources of conservatism were introduced into the calculations performed in the AQA. These sources are as follows:

1.3.1 Factor of increase due to the use of an IFC to measure SOERs

The main source of conservatism is the factor of increase (correction factor) applied to OERs at Camden, NSW and the ANL facility at Coldstream Vic due to the use of IFC techniques to measure the SOERs. The basis for accepting that IFC measurements under-estimate windrow OERs is described in the referenced paper[1] (Attachment 1). This factor varies with windrow age and was applied to all three phases.

1.3.2 Correction for IFC diversion

The under-estimation of ridge SOER on windrows when IFCs are used was first recognised by Schmidt[2] and has previously been quantified by GHD on Aerosorb™ covered windrows at the ANL facility at Coldstream (Vic)[3]. The factor of under-estimation for a 'young' Phase 1 compost windrow (age 4 days) was found to be ~

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[1]Pollock T, Braun H "Odour Emission rate Measurements on Greenwaste Windrows" 19th Int. Clean Air &Env. Conf. 9-11 Sept 2009 , Perth WA.

[2] C Schmidt 2008 "Emissions Testing of Volatile Organic Compounds from Greenwaste Composting at the Modesto Compost Facility in the San Joaquin Valley" Contract: IWM 04072, CIWMB, May 2008.

[3]GHD 2008 "Assessment of Use of Isolation Flux Chamber to Measure Windrow SOER – ANL Coldstream Green Waste Composting Facility – Addendum Report", report #148519, April 2008.

20:1, while, for a 6 week old windrow, the factor had decreased to 1.5:1. Assuming a linear decrease in this factor over a 6 week phase gives an age-mean factor of ~ 11:1.

In the AQA, GHD conservatively assumed that the behaviour of the Gore^{TM} cover was similar to the Aerosorb^{TM} cover (GHD judged that the very much smaller pore size in the Gore^{TM} fabric (<1 micron) compared to the Aerosorb^{TM} fabric (~ 1 mm) would result in a lowered degree of under-estimation, but had no information on which to justify a lower value), and applied the same factors to account for the use of IFCs. GHD notes that in the Camden, NSW trial report (URS, 2006), DECCW had recommended that the 'witches hat' method be used, but URS had elected to use an IFC on the basis of their experience that '*this method does not allow sufficiently (sic) capture of odour emissions from static windrows, consequently URS considers the most appropriate method for measuring these sources is the isolation flux chamber or flux hood.'*

At the recent TCL composting trial undertaken in Wodonga, Vic (refer Trial Memo / Report) it was identified that the IFC factor of under-estimate was in fact much reduced when using the Gore^{TM} technology. This is attributed to the small pore size of the Gore^{TM} cover (which comprises a layer of PTFE sandwiched between two layers of polyester) and a condensation layer on the underside of the cover. The small pore size means that a higher pressure differential will develop across the Gore^{TM} cover compared to an Aerosorb^{TM} cover for a given flow rate of volatiles from the windrow. Hence the diversion of these volatiles away from the IFC 'foot print' due to the slight over-pressure in the IFC headspace will be less significant than for an Aerosorb^{TM} cover.

1.3.3 Correction for Crest vs Sides

This correction factor was used in the AQA (Section 7.1.3, Table 11) and applied to the Camden, NSW and ANL data. Refer to Attachment 1 for the basis of this factor.

1.3.4 Aeration Factor

In the AQA an aeration factor of 12:1 was applied during aeration using the ANL Aerosorb$^{\mathbf{TM}}$ measurements. This factor was applied to the quiescent SOER during the periods that windrows were not being aerated. As described in Section 7.1.4 of the AQA, the modelling explicitly accounted for the % time that the windrows were aerated as a function of the windrow age (refer Table 12 in the AQA).

This was subsequently found to be much lower from the Wodonga, Vic. trial (<4.4:1 for the 1 week old windrow and <2:1 for the 4 week old windrow).

Table 1 Sources of SOERs used in the AQA

Process/ Odour Source	SOER Source	Type of waste & proportion (if available)	Where / how used in the AQA	Comment including justification for use
Covered Windrows	Camden, NSW[1] (TOU Appendix A) (Attachment 2A)	Windrow 1 (100% greenwaste) and Windrow 2 mixed waste (80% greenwaste plus 20% food waste)	Table 10	Only Camden, NSW Gore™ cover SOER data was available for use at the time of the AQA. Preference given to use Gore™cover over Aerosorb™ cover data as this was to be used at the Gerogery facility. Note SOER measurements were conducted using the IFC method.
Covered Windrows	Coldstream ANL[2](ETC Reports 070263r, 080030r) (Attachment 2B)	100% Greenwaste	Table 10	Covered windrows with similar values to Camden, NSW for quiescent data – ANL Vic data was used only for windrow ages greater than that assessed in the Camden, NSW measurements.
Correction Factor for IFC Diversion	Coldstream ANL[3](ETC Reports 080090r) (Attachment 2C)	100% Greenwaste	Table 11	IFC under-estimates SOERs. Factors were applied to increase the windrow SOERs measured by IFC at Camden, NSW and ANL Vic. Note all Camden, NSW SOER measurements were conducted using the IFC method. The only measurements conducted for GHD which show this under-estimate effect were from ANL, Coldstream, Vic.
Correction for Crest vs sides	Coldstream ANL[2](see GHD memo #211999) (Attachment 1)	100% Greenwaste	Table 11	To account for the so called 'chimney effect' in composting greenwaste windrows. A reduction factor was applied to the Camden, NSW measurements. Refer published paper.
Aeration of Windrows	Coldstream ANL[2] ETC Report 070197r) (Attachment 2D)	100% Greenwaste	Section 7.1.4	Measured OER of a covered windrow under aeration at ANL Vic Coldstream. GHD used ANL, Coldstream, Vic data over Camden, NSW data because measurements were conducted via the 'witches hat' method compared to IFC at Camden, NSW.

Process/ Odour Source	SOER Source	Type of waste & proportion (if available)	Where / how used in the AQA	Comment including justification for use
Break apart/turning of windrows	SITA Brooklyn Facility[4] (ETC report 080279r and 080337r)	GW + food waste + grease trap waste	Section 7.1.5	To account for higher OERs during turning of a windrow. Only confidential measurements are available to GHD. These are confidential because the client is a competitor of TCL. The report can be provided to EPA in confidence. No turning emissions measurements were conducted at Camden, NSW.
Received raw greenwaste	URS[5] (Appendix F Table 4-2) (Attachment 2E)	100% Greenwaste	Table 13	No SOER measurements were made of the waste stream stockpiles in the Camden, NSW survey. Therefore measured ANL Coldstream data was used. A value of 4 OU/m^2/s was used based on pro-rating 1 day old and 1 week old greenwaste to give a 2 day old SOER.
Shredder	URS[5] (Appendix A, Section A1) (Attachment 2F)	100% Greenwaste	Table 13	No TCL shredder OER data was available. This value was used in a works approval for ANL and accepted by Victorian EPA.
Screening	Coldstream ANL[2] (ETC Report #080032r) (Attachment 2G)	100% Greenwaste	Table 13	No TCL screening OER data was available. This value was used in a works approval for ANL and accepted by Victorian EPA.
Sedimentation Pond	Coldstream ANL[2] (ETC Report #070071r) (Attachment 2H)	100% Greenwaste	Table 13	No TCL pond SOER data was available. Measured data from ANL Coldstream leachate pond was used.

[1] URS 2007 “Gore™ Cover System Odour Emissions Assessment” Report # 43217479, 31 May 2007

[2] GHD 2008 “Odour Impact from Composting Operations – ANLColdstream Green Waste Composting Facility”, report #131899, March 2008.

[3] GHD 2008 “Assessment of Use of Isolation Flux Chamber to Measure Windrow SOER – ANLColdstream Green Waste Composting Facility –Addendum Report”, report #148519, April 2008.

[4] Measurements for SITA Brooklyn Facility, October 2008.

[5] URS 2008 “Odour Assessment of Proposed Composting Process at the ANL Premises, Lilydale” Report # 43283297, 28 August 2008.

1.4 Results from recent odour monitoring at Timaru, NZ and Wodonga, Vic

Transpacific Cleanaway (TCL) undertook a composting trial at its Wodonga, Vic. recycling depot between December 2012 and January 2013. The trial was undertaken in order to collect additional information on odour emissions from greenwaste and grease trap waste in an aerated process utilising the Gore™ composting system. A trial was also undertaken at the TCL Timaru, NZ site (September 2012) where a combination of greenwaste (85%) and foodwaste (15%) is composted on an operational basis. Both trials have provided data which, although not based on an identical waste composition, can be adequately used for comparative purposes (refer Table 2).

At Wodonga, Vic the sampling of odour emissions was undertaken in four surveys between 18 December 2012 and 29 January 2013. Sampling was undertaken on aerated and quiescent windrows by The Odour Unit Pty Ltd (TOU) using the IFC method. A series of samples using the 'draped wind tunnel' method were also collected on the sampling undertaken on 15 January 2013 in order to gather comparative information on the two sampling methodologies. All analysis, olfactometry testing and the calculation of SOERs for IFCs was performed by TOU.

The results of the Wodonga trial indicate that:

- The SOERs during aeration show an approximate doubling from the quiescent values.
- Odour emission rates reduce significantly after the initial mixing of pre-made greenwaste and grease trap waste.
- Odour characterisation changed from a 'grease' or 'garbage' character in the initial mixing phase to 'dirt' ("dirt" being the American term for "soil"), 'musty' or 'compost' characteristics within a week, indicating that offensive odour may be experienced at the initial mixing stage but is expected to become less offensive in a short period.
- The draped wind tunnel gave higher SOERs on the aerated windrows than did the IFC.
- The factor of increase (difference between IFC and draped wind tunnel) for the sampling event undertaken was measured at 4.4:1 for the 1 week old windrow, and 2.2:1 for the 4 week old windrow. These values are well below the 12:1 factor found by GHD on an aerated windrow with an Aerosorb™ cover (a separate investigation) and subsequently used in the AQA. This result highlights the differences between windrow cover materials in their ability to contain volatile organics (and odour).

A comparison of the Wodonga, Vic results with other relevant data sets was also undertaken (refer Table 2). In particular the recent TCL dataset from Timaru, NZ (September 2012) and the dataset obtained from a trial windrow at Camden, NSW (2006) were examined. The findings from the comparison were:

- The Timaru, NZ and Wodonga, Vic trial SOER data were found to be substantially lower than the Camden, NSW SOER data used in the AQA.
- The Camden, NSW dataset was the only Gore™ windrow dataset available to GHD at the time of AQA compilation. The substantial difference between the AQA SOER data and the Timaru, NZ and Wodonga, Vic data suggests that the AQA modelled predictions of peak odour impact are substantially over-estimated.

- SOERs associated with the Wodonga greenwaste and grease trap mix are of a similar level to those measured at Timaru, NZ (greenwaste and foodwaste). This suggests that grease trap waste yields only a marginal increase in SOER compared to food waste.

1.5 Summary

The modelling undertaken for the AQA has evaluated all key odour sources and activities. The modelling indicates that Phase 1 windrows have the greatest modelled contribution to site odour emissions. The SOER used in Phase 1 windrow modelling (the key contributor of odour) was sourced from TCL Camden data which used Gore™ cover technology and IFC sampling techniques.

The data obtained from the Timaru, NZ and Wodonga, Vic investigations showed significantly lower SOERs when compared with those utilised in the AQA (Camden, NSW). A number of conservative correction factors have been applied as part of the windrow emissions modelling process undertaken in the AQA. On this basis the probability of underestimation of SOERs from key sources is considered very unlikely.

Table 2 Measured SOER Data on Gore covered Windrows, OUm/s

Data set	Wodonga (Vic) (Dec 2012 – Jan 2013)				Camden (NSW) (2006)		Timaru (NZ) (Sept 2012)	
Age, weeks	GW + grease trap				GW + food waste		GW (85% garden greens) + Food waste (15%)	
	IFC		Draped Tunnel		IFC		IFC	
	quiescent	aerated	quiescent	aerated	quiescent	aerated	quiescent	aerated
0	0.32	0.84			7.7	9.5	0.27	
1	0.10	0.22	-	0.97	1.1	5.1	0.25	0.89
2	0.15	0.32			0.36	1.76	0.36	0.47
3	-	-			0.85	11.9	0.042	0.087
4	0.18	0.2	4.7	0.43	0.07	0.5	0.023	0.073
5	0.14	0.14			2.0	6.2	0.11	0.30
6	-	-			0.29	1.7	0.10	0.22
7	-	-			0.4	1.2	0.065	0.133
8	-	-					-	-
Age mean	**0.18**	**0.34**			**1.6**	**4.7**	**0.15**	**0.31**

2 AOC #2: A lack of justification and data supporting the adopted SOERs

As discussed in the previous section of this document, the two main datasets for the SOERs associated with covered windrows which were used in the AQA were:

(i) the 2006 dataset reported by URS[4] for TCL at their Camden, NSW facility utilising Gore™ technology, and

(ii) the 2007-2008 dataset reported by GHD[5] for Australian Native Landscapes (ANL) utilising Aerosorb™ technology at their Coldstream, Victoria greenwaste composting facility.

A full list of SOERs used in the AQA together with a justification for their use is presented in Table 1.

As agreed in discussions between GHD and the EPA (6 December 2012), copies of relevant extracts from the reports cited in this Table and in the AQA have been compiled and are presented in Attachment 2.

3 AOC #3: Not all receptors are considered

A number of potential receptors were considered as part of the AQA. Receptors include 'sensitive receptors' external to the Kalawa property and 'Kalawa sensitive receptors' located on the property itself.

A summary of receptors is provided in Table 3. This summary table is a revision of Table 14 of the AQA and includes the additional 'Kalawa sensitive receptors' (Paintball Facility and Paterson's Quarry) which were not originally included.

A consideration of potential impacts on receptors 1 through 6 is presented in Section 9 of the AQA. In terms of receptors 7 and 8 the following comments are made:

Paintball Facility

The Paintball Facility readily meets the population-dependent criterion even if the facility were to be continuously occupied by 20 participants.

Quarry

Under a worst case scenario the quarry would operate every weekday (7 am – 6 pm) Monday to Friday, Saturdays (8 am – 1 pm) with no work occurring on Sundays. This corresponds to 3,120 hours in a year equating to 36% of the year. Thus the occupancy rate for the workers at the quarry is at most 36% of the year primarily during the day during good dispersion conditions. Therefore the predicted 99th percentile concentration can be reduced by applying the percentage of time the workers would be on site. This would reduce the Mean 99th percentile odour level to 5.6 OU with a range between 5.2 – 6.0 OU. This is below the 7 OU criterion.

In reality the quarry operates much less than 36% of the year. Current planning consent allows the removal of 33,000 cubic metres of quarried material per year but it is estimated that currently only 10,000 cubic metres is removed per year (EIS Vol. 1, Section 15.1.3; DA 166-02/03, 21 July 2003, as modified 19 October 2012)

[4] URS 2007 "Gore™ Cover System Odour Emissions Assessment" Report # 43217479, 31 May 2007.

[5] GHD 2008 "Odour Impact from Composting Operations – ANL Coldstream Green Waste Composting Facility", report #131899, March 2008.

It should be noted that the Paintball Facility and Paterson's Quarry are both operated by a consenting landowner.

Table 3 Predicted Peak Odour Levels at Selected Receptors

Receptor		Mean 99th Percentile Odour Level (OU)	Range 99th Percentile Odour Level (OU)	Adopted Criteria (OU)
ID#	Direction and Distance from Sources (km)			
1 (Residence)	Southwest (2.3)	0.9	0.8 – 1.0	7
2 (Residence)	Southwest (2.9)	0.8	0.7 - 0.9	7
3 (Residence)	West-southwest (2.9)	1.1	1.0 - 1.3	7
4 (Residence)	Northwest (2.9)	0.9	0.8 – 1.0	7
5 (Residence - "Kalawa" Homestead)[#]	West-southwest (1.3)	2.9	2.6 - 3.3	7
6 (Function Centre and Accommodation Cabins) [#]	Southeast (2.0)	0.25	0.24 - 0.26	7
7 Paintball Facility[#]	Southwest (1.2)	2.0	1.9 – 2.1	7
8 Paterson's Quarry[#]	Southeast (0.05)	15.5	14.4 – 16.6	7

# Indicates that the receptor is a '"Kalawa" receptor' and is located on land in the same ownership as the project site.

4 AOC #4: Proposed emission controls have not been demonstrated to comply with reasonably available technology and good environmental practice

4.1 Gore™ technology

The use of Gore™ covers in an aerated composting system is a best practice technology. The recent Wodonga Vic trial confirms considerable differences between Aerosorb™ and Gore™ cover technologies based on the nature of the cover material. The Gore™ technology resulted in much lower odour emissions due to its semi-permeable and multilayered construction combined with the maintenance of a wet condensation layer on the inner surface which dissolves volatile organic compounds (VOCs) and causes them to re-enter the compost.

Whilst the application of Gore™ technology in covered aerated composting situations is a relatively new concept in Australia, this does not mean that the technology or its application in large-scale composting situations carries significant technical risk. The technology is utilised widely overseas (over 150 installations in 20 countries). There are a number of large scale projects being implemented at present – for example a 520,000 t/year facility in Sicily and 1 million t/year facility in Kettleman City (150 miles from Los Angeles, California, USA) owned by Los Angeles County and composting biosolids. The covered aerated composting process is described in the recently released *Food & Garden Organics Best Practice Collection Manual* (SeWPAC, 2012), and the Timaru, NZ facility operated by TCL is cited.

4.2 Management Practices

The management and operational aspects of a compost facility are considered to be the most important aspects of composting, more important than the technology choice. Sound management procedures are required to efficiently manufacture certified compost (to AS 4454-2012). These same management practices and documented site procedures are expected to contribute to good environmental performance.

TCL has advised that the following project aspects are relevant and proposed in terms of good management and environmental practice:

- Staff recruitment – staff recruited would be selected carefully so that they have the right attitude and aptitude to understand and proactively operate the site in an environmentally responsible manner.
- Staff training – staff would be trained by an experienced compost plant operator so they know how to run the site correctly. Particular focus would be placed on knowing the raw feedstock and how to mix and blend it. Staff familiarity with composting fundamentals such as total moisture content, porosity and C:N ratio is essential.
- Staff would be supervised by an experienced operator so that they are familiar with process controls, aeration, temperature profiles, etc and written procedures would be prepared to guide them. Process parameters would be recorded in a detailed manner for every batch and every operation, to enable a database of operational parameters to be maintained.
- All incoming raw material batches would be assessed individually, as it is recognised that no two batches will be identical.
- Any issues with in-coming raw materials would be communicated immediately to collectors and council representatives and non-conforming loads and those containing inappropriate materials would be rejected.
- Prompt handling of material – all raw material received each day would be processed that same day and added to a composting batch.
- Good housekeeping practices would be followed – the site would be cleaned daily.
- Repairs and maintenance would be undertaken pro-actively to ensure that equipment is performing appropriately.
- A quality control program, with a prescribed sampling regime would be implemented.

In short, the operation of a modern and professional compost facility is akin to running a factory or industrial process. The above-mentioned procedures reflect TCL's philosophy of a structured and sophisticated approach, appropriately trained people, and planning and supervision processes.

4.3 Relative composition of Raw Materials

The raw materials presented for composting (described in Section 10 of the EIS (Table 10.1)) are expected to vary seasonally and according to social overlays such as holiday times, socio-economic status and state of the economy. Project operations would make allowance for this by altering blending and mixing to produce a consistent feedstock that is always suitable for composting. Only when, in exceptional cases, extreme physical or chemical contamination has occurred, would batches be rejected and sent to landfill. Regardless of the specific composition, the composting process involves keeping the material aerobic at all times, avoiding premature drying and ensuring that hygenisation is achieved through time-temperature requirements.

4.4 Contribution to Air Emissions

The raw material handling and composting process proposed by TCL involves a series of stages. Modelling undertaken in the AQA assessed each stage and its relative contribution to project odour emissions. Modelling included an evaluation of emissions during operating hours and non-operating hours. The relative contribution of each process stage to project emissions is presented in Table 4.

Based on the modelling undertaken as part of the AQA, key points from Table 4 in terms of emission sources, the appropriateness of technology and proposed practices are as follows:

- Phase 1 windrows dominate potential emissions at 79% of the total emissions during operating hours. If the three phases plus maturation windrows are combined then the windrow contribution increases to 89.6%.
- The Phase 1 windrow pad dominates because: (i) twice as many windrows are present on the pad, and (ii) the Phase 1 SOER is ~ 8 fold that of Phase 2.
- By comparison, the receivals area contributes 10% to site emissions. Therefore it makes no sense to devote capital expenditure to mitigate this small source, especially given that this source cannot be eliminated. Full enclosure of the receivals building and ducting to a bio-filter may remove some odour, but the bio-filter would be expected to contribute to the project OER.
- During non-operating hours the site OER reduces to ~ 90% of daytime values and night is when poor dispersion occurs. Hence, in relation to the meeting of the EPA 99th percentile criterion, *any reduction of OER from daytime-only sources would not decrease the extent of the 99th percentile contour or the degree of compliance with this criterion*.
- In other words, the off-site impact as defined by the EPA odour criterion is defined almost solely by the windrows. The adoption of Gore™ technology and the management of the windrows are expected to be the key factors affecting odour emissions.

Table 4 Source Contribution to Site OER- Normal Operations

Source Description	Source Code	Emitting Surface Area (m^2)	SOER ($OU/m^2/s$)	OER (OU/min)	Percentage of OER (%)
Operating Hours					
Greenwaste stockpile – Receival Area loading and Shredder	SHRED			404,460	5.8
Screening	SCREEN			297,600	4.2
All Loaders Loading	LOAD	5 x 4	5.34	6408	0.1
Sedimentation Pond	POND	950	0.33	18,810	0.3
Windrow Phase 1	Phase 1	1900	48.6	5,540,400	**79.1**
Windrow Phase 2	Phase 2	950	7.6	433,200	6.2
Windrow Phase 3	Phase 3	950	4.1	233,700	3.3
Maturation Pad	MAT	950	1.2	68,400	1.0
Total				**7,002,978**	**100.0**
Non-Operating Hours					
Shredder	SHRED			0	0
Screening	SCREEN			0	0
All Loaders Loading	LOAD	5 x 4		0	0
Sedimentation Pond	POND	950	0.33	18,810	0.3
Windrow Phase 1	Phase 1	1900	48.6	5,540,400	**88.0**
Windrow Phase 2	Phase 2	950	7.6	433,200	6.9
Windrow Phase 3	Phase 3	950	4.1	233,700	3.7
Maturation Pad	MAT	950	1.2	68,400	1.1
Total				**6,294,510**	**100.0**

5 AOC #5: Calculated worst case emission rates are not shown to be assessed with worst case drainage hours

As per the NSW *Approved Methods for Modelling and Assessment of Air Pollutants* (DEC,2005), a Level 2 assessment was conducted for the AQA.

A Level 2 assessment is a refined dispersion modelling technique using site specific input data. Hence the refined model CALMET/CALPUFF was utilised together with site specific data (Gore$^{\mathbf{TM}}$ cover SOERs for greenwaste windrows). A Level 2 assessment applies the site specific data into a refined dispersion model to represent actual proposed operating conditions i.e. quiescent windrows, aeration and turning of windrows. The AQA incorporated the worst case emission rates as part of the proposed operations by applying the OER factors of increase for IFC under-estimates, aeration and turning to every hour of the year i.e. good and poor dispersion hours.

As per the NSW Approved methods, the Level 2 assessment of impact uses the 99th percentile odour concentration (1 second average). The 99th percentile results presented in the AQA (for example Figure 15) provide the required indication of the range of odour concentrations expected 365 days of the year.

Only a Level 1 screening assessment requires ‘worst case’ input data with ‘worst case’ dispersion conditions, and only a Level 1 assessment would require the worst case ‘peak’ (100th percentile) odour concentration to be presented. A Level 1 assessment was not required in this case.

6 Summary

The key points in terms of GHD’s response to the areas of concern raised by the NSW EPA in its letter 26 November 2012 are as follows:

- Modelling undertaken for the AQA has evaluated all key odour sources and activities.
- SOER data from a number of relevant sources has been utilised. Data from the TCL Gore^{TM} cover trial at Camden (2006) was used to estimate windrow emissions where appropriate. As requested by the NSW EPA, the use of these SOER sources has been justified and is provided as an attachment to this document.
- Considerable conservatism was incorporated into the emissions modelling undertaken as part of the AQA. More recent investigations undertaken by TCL (on both grease trap/greenwaste and food/greenwaste mixes) indicate that the SOER data utilised in the AQA overestimates emissions.
- Gore^{TM} technology can be considered best practice and is widely used in overseas applications. A series of management practices proposed by TCL have been described. Professional practices supported by documented management systems and processes are considered to be critical to the successful operation of the facility.
- Information on two additional sensitive receptors has been provided. The Level 2 assessment of odour impact which has been undertaken indicates that the proposed TCL Gerogery project complies with the relevant NSW EPA odour criteria at all sensitive receptors.

Tim Pollock

Principal Environmental Engineer

Attachment 1 Technical Paper

Attachment 2 Supporting SOER Information

Attachment 1

ODOUR EMISSION RATE MEASUREMENTS ON GREEN WASTE WINDROWS

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Abstract

Measurement of odour emission rate from windrows in Australia has typically been conducted using isolation flux chambers placed on the windrow crest. There has been dispute as to whether the specific odour emission rate so obtained can be assumed to apply to the windrow sides as well as the crest, and this paper presents recent results of profile measurements over a green waste windrow.

The use of flux chambers on a permeable substrate is also suspect due to the potential for emanating odorous gases to divert around the chamber footprint due to the (small) over-pressure in the chamber. Results of a comparison trial to gauge this effect are also presented.

Finally, a new technique adopting a wind tunnel hood draped over the sides and top of the windrow is described and results given. The implications for the recently released Standard AS/NZS 4323.4 for area source emission rate measurement are also examined.

Keywords: green waste, windrow, odour emission rate, area source measurement, isolation flux hood

1. Introduction

This paper details the degree to which isolation flux chambers (IFCs) under-estimate the specific odour emission rate (SOER) from green waste (GW) windrows in the early weeks of composting. IFCs have been routinely used in Australia to measure windrow SOERs and were used extensively at a GW composting facility in Coldstream Victoria. The facility commenced operation in April 2007 and drew odour complaints from residential areas in Coldstream and Lilydale. EPA issued a pollution abatement notice (PAN) and one of the PAN conditions required an extensive OER measurement survey by IFC of all significant odour sources on-site. Subsequent dispersion modelling by the proponent's consultant using the SOER data indicated that the odour level predictions at complainant residences for a range of high complaint days were too low by an order of magnitude to explain the complaints.

Part of the discrepancy could be explained by the assumption used – that windrow emissions issue principally from the windrow crest rather than also from the inclined sides. For the windrow geometry used, the crest width to section perimeter is ~1:6, however subsequent SOER measurements along the windrow profile using an IFC showed that most emissions issued from the crest and shoulders of the windrow, with little from the inclined sides.

Further investigations comparing an IFC to a 'witches hat' passive emission capture device on the crests of week 1 and week 6 old GW windrows showed that the young windrow (when out-gassing is a maximum) returned an SOER 20-fold higher than did the IFC (ETC 2008). The factor of increase reduced to only 1.5:1 for the 6- week old windrow.

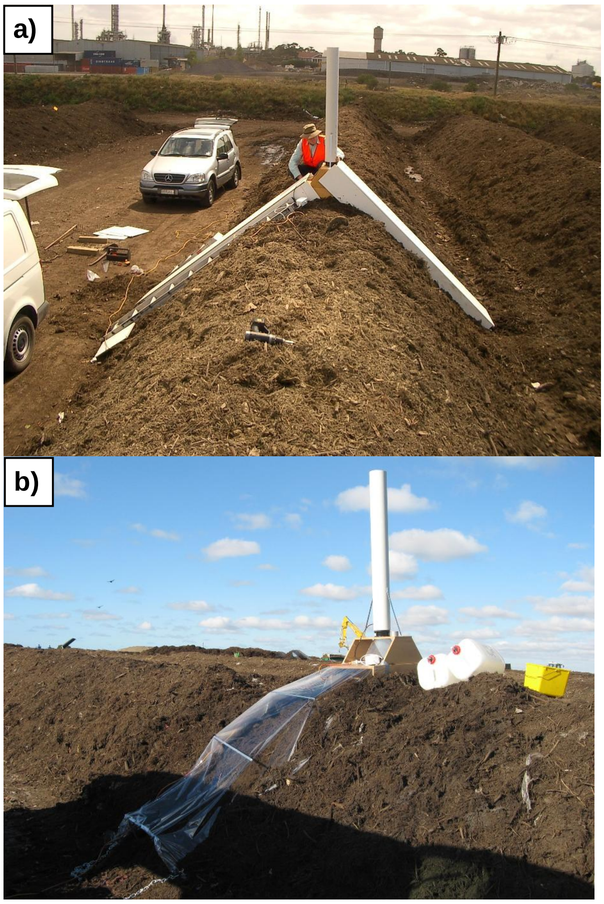
The odour dispersion modelling was repeated using the SOER correction factors for Stage 1 windrows (the single major OER source on site), and the mismatch between the complaint history and predicted odour levels was largely removed.

More recent SOER measurements on GW windrows, at a separate composting facility conducted by the authors has trialled a flow-through hood (or wind-tunnel) device – where the 'tunnel' is draped over the windrow profile, and emissions are extracted by a fan on the windrow crest. Figure 1 shows two versions of this device.

This paper presents the detail of these measurements and draws the implications that they have for accurate measurement of windrow

OER, and for the Australian Standard for area source OER measurement, AS/NZS 4323.4 2009.

Figure 1. Draped Tunnel – Mk 1 and 2 Versions



2. Existing Measurements on Windrows

SOER measurements on windrows in Australia have typically been conducted with IFCs, and sampled on the windrow crest. Table 1 lists some published measurements – the range of SOER values is large and is due to the unknown values of some influencing factors (blend of input waste streams, 'age' since formation, time since turning) for individual measurements.

Elements of this data-base have regularly been used by consultants to predict the off-site odour impact for proposed composting facilities, with the presumption that the IFC method to determine SOER is appropriate for this source type.

Table 1 - Published Windrow SOERs

Waste	Site	Age wks	SOER OU m/s	Note	Lab.
GW	Eastern Creek, NSW 1995	?	0.035	Max of 6	Zib
Grape marc rice straw	Leeton, NSW 2005	0.14 5	3.7 0.5		TOU
GW	Coldstream Vic, 2007	0-4 5-10	2.4 0.8	Stage 1 Stage 2	ETC

Zib – Pavel Zib & Associates TOU – The Odour Unit
ETC – Emission Testing Consultants

3. Limitations of IFC Measurement of SOER

The range of methods used to determine area source OER is clearly described in Gostellow et al (2003) in Section 3.4. Two types of OER measurement are distinguished;
(i) Downwind measurements of odour level and wind speed, either determining the OER flux profile direct, or by using a dispersion model to back-calculate and determine the SOER that best fits the measured odour levels.

(ii) Hood methods – where sub-sampling on the surface area is conducted using either a chamber with a sweep air or N_2 (ie. an IFC), or a wind tunnel where air is drawn over an exposed surface in a rectangular tunnel.

Tunnels have the advantage over IFCs in that the air flow rate can be varied so that effects such as wind stripping can be measured, however the minimum air flow rate of ~25 l/s is very much greater than the sweep rate used in IFCs (5 l/min) which places a detect limit on $SOER_{hood}$ of ~1.8 OU m/s (Pollock 1997). Most tunnels are somewhat cumbersome, requiring a carbon filter to treat incoming ambient air, and needing a tapered inlet section to ensure a uniform velocity profile in the test section.

On these grounds IFCs have been extensively used even in situations where tunnels would have been appropriate and would have yielded additional information on SOER as a function of ambient wind speed. Regulations in Australia have also favoured the use of IFCs as they have been extensively tested in the USA (Gholson et al 1989) and a standard for their construction and use has been issued by USEPA (Klenbusch 1986).

Limitations to the use of IFCs are described in Gostellow et al (2003) in section 3.4.2 and relate to the key parameters of;

- Sweep rate applied to the chamber
- Pressure differential in chamber
- Temperature/humidity in chamber head space

The first two are relevant to this discussion and are covered below.

Sweep rate must be set at levels that ensure that the equilibrium head space concentration for any of emitted constituent does not approach (<10%) the equilibrium value in a static (sweep rate = zero) chamber, so that suppression of the transfer is negligible. On liquid surfaces, suppression is important where the Henry's Law constant H of any constituent is less than 2.5 Pa. m^3/mol – i.e. where the mass transfer is gas-phase controlled. Where the transfer is liquid-phase controlled (H > 250 Pa. m^3/mol) then the sweep rate will not influence the transfer across the surface (Jiang and Kaye 1996).

Pressure differential in the chamber has also been recognised as affecting emission rates where there is a significant convective component of gases into the headspace. Examples of this on liquid surfaces include aeration of sewage as part of grit removal, and on permeable solid surfaces such as landfills and windrows.

The effect is not small, and for nitrous oxide emissions from soil, Denmead (1979) found that a -10 pa differential caused a 12-fold increase in emission rate. IFCs are normally operated with a 2 l/min sample rate, leaving 3 l/min to be exhausted through the bleed aperture in the chamber dome. The head loss through the bleed aperture ensures that the IFC pressure differential in the head-space is positive, so that IFC standard operation can be expected to under-estimate emissions where the transport across the surface is primarily advective rather than diffusive.

4. Inter-comparison of IFC and Passive Hood on GW Windrows

To determine the degree of under-estimation of SOER on the crest of GW windrows, a passive hood (or 'witches hat' - WH) was used to directly measure the odour level and flow-rate of the emitted gases. That is, no imposed sweep air is applied – instead the emission flow rate across the 'hat' footprint is measured at the throat of the hat. The WH used has a base diameter of 1 m and a throat diameter of 72 mm, giving an area ratio of 193:1. Hence an emission evolution velocity of ~1 mm/s will yield a throat velocity ~0.2 m/s, which can be readily measured. Both devices were placed on the crest of a covered (permeable fabric) GW windrow and the test repeated with their positions reversed. The tests were conducted on two windrows, one at 5 days after formation and one at 6 weeks. Figure 2 shows the placement of the IFC and the WH, and Table 2 gives the SOER results.

Figure 2. IFC and WH on Covered Windrow

Table 2 – SOER Results – Inter-comparison trial on GW Windrows

Windrow # Age	SOER IFC OUm/min	 OUm/s	 WH OUm/min	 OUm/s	SOER Ratio
#6 6 weeks	I0 9.1 8.2	0.15	12 14 16	0.23	1.2 1.5 1.95
#14 5 days	390 520 650	8.7	12,000 10,250 8,500	171	30.8 20 13.1

From Table 2 it can be seen that the SOER mean ratio between the WH and IFC on the young windrow is high at 20:1. This ratio reduces to 1.5 for the 6-week aged windrow, indicating that the convective component of the transfer has reduced substantially at this stage of composting. There may also be an effect to suppress some VOCs with low H in the IFC measurement on the young windrow that is not seen in the measurement on the older windrow. If it is assumed that the windrow SOER declined linearly with age, then the age-mean SOER for an array of Stage 1 windrows at various ages is given as 4.4 OU m/s based on the IFC results, and 86 OU m/s based on the WH results. That is, the WH measurements lead to a stage 1 windrow OER ~20-fold that given by IFC measurements. This large discrepancy between IFC and WH results has also been seen on bio-filter odour emissions (SEMA 2008). In that survey the SOER ratio of WH:IFC was 70:1 at 100% inflow to the bio-filter, and 25:1 at 70% inflow.

5. Draped Tunnel Results

More recent measurements of GW windrow SOER at another composting site were conducted with a tunnel draped over both inclined sides and crest of the windrow. The evolved gases within the tunnel could exit at the crest centre via a short stack. The stack was fitted with an axial flow fan at its base, so that effects of enhanced emission due to windstripping could be simulated. Figure 1b shows the mark 2 version, where the 'skin' of the tunnel is mylar© film which is single-use, thereby avoiding the possibility of contamination between tests.

The tunnel has the advantage that emissions from a complete section of the windrow surface are captured, so that the issue of emission distribution between crest and side is avoided. A drawback is that the odour level of incoming ambient air at the two tunnel inlets must be measured in addition to the stack exhaust.

5.1 Comparison to Crest-only SOER Measurement

An initial test was conducted to compare the results of crest SOER as measured by the WH to the mean SOER of crest and sides as measured by the tunnel. The tunnel tests were done at three fan-forced ventilation rates in addition to a test of the naturally convected emissions. Note that the tests were conducted on a windrow comprising grease trap and food waste streams in addition to the GW stream. As such, the SOER values will be higher (approximately 8 fold at this site) than from a 100% GW windrow.

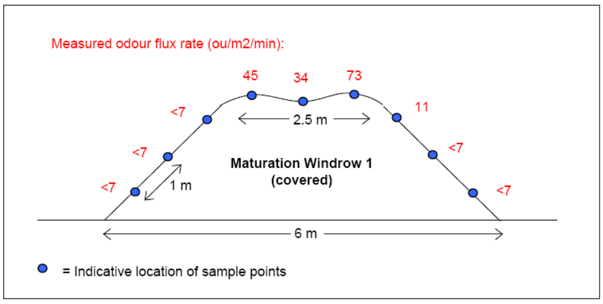
Table 3 shows that there is negligible difference between the SOERs as measured by the tunnel and that measured on the crest only as measured by the WH. The results support the contention that emissions from windrows are uniformly distributed over the sides and crest, and not predominantly from the crest due to the thermally induced 'chimney effect'. An earlier profile test at the first GW compost site on a covered windrow using an IFC had shown most of the odour emissions emanated from the crest and shoulders – Figure 3 shows the results of that test.

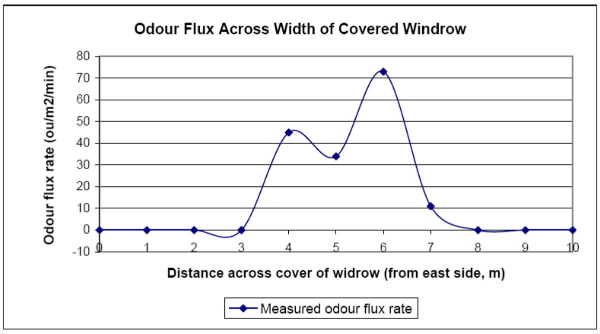
Table 3 – Comparison of SOER measurements from Draped Hood and Witches Hat

Parameter	Witches Hat	Draped Tunnel, Fan Setting			
		OFF	low	medium	full
OER/m, OU m^2/s	-	250	267	383	383
SOER[1] OU m/s	40	35.7	38.1	54.7	54.7
Q , m^3/min	-	1.9	2.3	4.0	5.6
Tunnel velocity[2], m/s	-	0.26	0.32	0.56	0.78

(1) Tunnel SOERs based on draped length = 7m (2) tunnel crossection; 0.6m wide by 0.2m high

Figure 3. SOER Profile on Covered Windrow





5.2 Effect of Wind Stripping

Table 3 shows a clear trend of increase in OER/m with tunnel velocity, with a 50% increase when the fan-induced velocity is doubled. A greater fan capacity would have allowed the trend to be confirmed up to velocities that could be expected to be imposed by the ambient wind.

6 Implications for Area source Measurement on Windrows

The protocol for Area Source Sampling – Flux Chamber technique has recently (March 2009) been released as Australian / New Zealand Standard, AS/NZS 4323.4 (2009). In essence the standard adopts the USEPA design for an IFC, and mandates extensive validation trials before any other chamber design would be accepted. The standard makes clear that the USEPA IFC's performance has not been validated on aerated surfaces, and its use is based on the premise that the test procedure does not significantly influence the emission rate of the source (across the chamber footprint).

6.1 Draped Tunnel

The notes to Section 7 (Sampling procedure) of AS/NZS 4323.4 make it clear that total enclosure of the area source is the most accurate method, as the issue of spatial variability in SOER is avoided. Windrows are typically 20 m to 100 m in length, so that total enclosure, while not impossible, would be cumbersome and time-consuming. However, given that the main variability of odour emissions is likely to be across the profile (due to the airflow induced by the warm core – the so-called chimney effect), rather than along the windrow length, then the draped tunnel described in Section 4 will integrate this effect to give an SOER that can be applied to the whole windrow surface. Variability in the GW material can cause longitudinal variation in windrow SOER, and a gauge of this will require several measurements with the draped tunnel along the windrow. Our measurements with the draped tunnel on a GW windrow at the second composting facility were done at the centre and quarter points along the windrow, and the results are given in Table 4.

Table 4 Measured Longitudinal variation in SOER of GW Windrow

Position	OER/m OUm^2/s	SOER(1) OUm/s	% from Mean
North	127	18.1	+20
Mid-Point	110	15.7	+4
South	80	11.4	-24
Mean	106	15.1	-

(1) draped length = 7 m

The results in Table 4 indicate that the longitudinal variability in SOER was less than +/- 25%. The individual measurements were singletons with an associated uncertainty of +/- 20%, so that the actual longitudinal variability could be substantially lower.

6.2 Modified USEPA IFC

An alternate solution to the under-prediction of SOERs on GW windrows was utilised in a VOC emission survey at the Modesto Compost facility, San Joaquin Valley, California (CIWMB 2007). In the Technical memorandum (Appendix A) to the report, a modification is described – the enlargement of the bleed orifice to 6 inch diameter. This modified IFC was used for all windrow ridge IFC measurements as a means of dramatically reducing the over-pressure in the chamber. In this system there would be the complication of exchange of ambient air across the orifice **into** the chamber, as the outflow of sweep air at 3 l/min equates to an orifice velocity of just 2.8 mm/s. However the system also used a carbon monoxide tracer in the sweep air, so that provided the orifice-mean exit velocity could be measured, the degree of exchange could be determined from the measured CO concentration in the sampled headspace.

The authors are unaware whether this was in fact done, and it is unlikely that the rigorous validation trials that would satisfy the requirements of AS/NZS 4323.4 have been conducted.

6.3 Choice of Method

The results presented show that IFCs substantially under-estimate (~20 fold) windrow SOER in the initial Stage 1 phase of composting when convective emissions are significant. Alternate sampling methods that largely avoid the over-pressure in the chamber headspace are:

- Witches hat
- Draped Tunnel
- IFC with enlarged bleed orifice

Witches hats are defined by the base / throat area ratio A_{BT}, and by the cone angle θ. For ready measurement of outflow, an $A_{BT} > 100$ would be required (assuming convective emission velocities are ~1 mm/s). Head loss through the cone-throat transition can be minimised by setting $\theta < 30^0$ and by a gradual transition to avoid flow separation.

We have found that ambient wind cross-flow at the WH exit can induce additional outflow due to the venturi effect, and this limits its usefulness in ambient conditions.

The draped tunnel requires additional time to setup and also requires an odour sample to be taken of the inlet air. As odour levels cannot be resolved to < 30 OU using AS/NZS 4323.3, this in turn places a limit on the minimum OER/m that can be measured. In addition, the inlet to outlet odour level ratio also provides a limit on the resolution of calculated SOER. For example, in the measurements on the GW windrow in Table 4, inlet odour levels ranged from 54 to 140 OU, and outlet levels ranged from 680 to 970 OU. As with conventional tunnel systems, the effect of velocity on OER/m can however be determined to give a measure of the effect of wind stripping in increasing windrow OER.

The modified IFC as reported by Dr C E Schmidt (CIWMB 2008) is likely to be most easily validated under the AS/NZS 4323.4 requirements, but will require the use of a tracer gas in the sweep air at a concentration >> than that in the atmosphere, or in the windrow emissions. Trials and CFD simulations could determine the optimum bleed orifice diameter. The 150 mm bleed diameter used in the Modesto trials gives an A_{BT} of $(42 /15)^2$ ~ 8:1, and it may be that the bleed diameter can be reduced without significantly increasing headspace pressure differential. There are also likely to be difficulties in achieving uniform mixing in the headspace with a bleed orifice diameter of 150 mm.

7. Conclusions

The survey results reported here show that IFC measurements on GW windrows in the first week of composting substantially under-estimate the windrow SOERs. Similar, though less marked, under-predictions of SOERs would be seen in the later weeks of Stage 1 (active phase) composting – while convective transport is still >> diffusive transport across the windrow crest.

These findings suggest that past assessments of greenwaste or mushroom substrate windrow composting facilities that have used isolation flux chamber data to characterise windrow OERs are likely to have under-predicted off-site odour impact.

As a consequence the IFC SOER data for windrows should not be used to characterise active phase windrow OER.

No alternate method has as yet been trialled and validated to the requirements of AS/NZS 4323.4.

The draped tunnel has proved to be a practical method to measure OER/m on active and maturation phase windrows, and has the advantage of measuring the perimeter-mean OER/m – rather than SOER on the crest only.

Further investigation to determine the relative merits of witches hats, draped tunnels and IFCs with enlarged orifices is recommended with a view to provide input to the next revision to AS/NZS 4323.4, and to provide guidance to practitioners.

8. References

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9. Acknowledgements

The authors acknowledge the permission of Australian Native Landscapes Pty Ltd, Biomass Solutions Pty Ltd and SITA Environmental Solutions Pty Ltd to publish data, as well as the input from Bill Denheld of Denheld Industrial Design

Attachment 2A

FINAL REPORT

Gore^{TM} Cover System
Odour Emissions Assessment

Prepared for

Cleanaway

Level 5, 146 Arthur Street
North Sydney
NSW 2060

31 May 2007

43217479

THE ODOUR UNIT

Cleanaway

Gore™ Cover System Demonstration

Odour Emission Study

Camden NSW

Final Report

2006

2 INTRODUCTION

In August 2005, Cleanaway commissioned The Odour Unit Pty Limited (TOU) to conduct an odour emissions study of their demonstration of the Gore™ Cover System. The Gore™ Cover System was being applied to the composting process of two discrete waste blends: kerbside collected garden organics (green waste) and, an 80-20 mixture of green waste and supermarket fruit and vegetable organics (food waste). The odour study was designed to monitor the spatial and temporal variations in odour emissions from the composting process over the eight-week period.

Cell 1 contained green waste, while Cell 2 contained green and food waste. Each cell was approximately 8 m x 20 m by 3 m high.

The Gore™ Cover System provides a relatively controlled environment where temperature and oxygen are monitored in order to provide the optimum conditions for waste material decomposition. The cover is also semi-permeable to gases. **Figure 2.1** illustrates the Gore™ Cover System in operation during the demonstration. Each cell is aerated as needed to maintain fully aerobic conditions. As cell aeration is discontinuous, two sampling conditions were adopted: airflow on and airflow off. In addition, the removal of the Gore™ Covers and turning or moving of the material in the cells was conducted on weeks 4 and 6 of the trial, and samples to determine the odour emissions during these events were collected.

This report outlines the goals of the odour study, and documents the sampling and testing methods and odour emission rate results. The study was conducted to comply with the methods outlined in the New South Wales Department of Conservation (NSW DEC) Draft Policy *Assessment and Management of Odour from Stationary Sources In NSW* (2001), and for the emission rates determined to be compatible with future odour dispersion modelling studies.

THE ODOUR UNIT

Appendix A

Odour Concentration Results

THE ODOUR UNIT

THE ODOUR UNIT PTY LIMITED

Odour Sample Measurement Results

Sample Location	TOU Sample ID	Sampling Date & Time	Analysis Date & Time	Panel Size	Valid ITEs	Sample Odour Concentration (as received, in the bag) (ou)	Specific Odour Emission Rate ($ou.m^3/m^2/s$)	Odour Character
#1 Pile 1 Uncovered Green Waste Only	SC 50439	01/11/2005 09:00	02/11/2005 16:22	5	10	15,300	8.339	Compost
#2 Pile 2 Uncovered Green + Food Waste	SC 50440	01/11/2005 09:15	02/11/2005 16:39	5	10	15,300	8.784	Compost, Piney
#3 Pile 1 Covered Air On	SC 50441	01/11/2005 10:13	02/11/2005 12:02	5	10	10,800	5.974	Compost
#5 Pile 1 Covered Air Off	SC 50442	01/11/2005 11:02	02/11/2005 13:37	5	10	14,300	8.303	Compost
#6 Pile 1 Covered Air Off	SC 50443	01/11/2005 11:14	02/11/2005 13:38	5	10	23,200	13.665	Compost
#7 Pile 2 Covered Air On	SC 50444	01/11/2005 11:45	02/11/2005 14:22	5	10	17,600	9.455	Compost
#10 Pile 2 Covered Air Off - Sample 1	SC 50445	01/11/2005 12:23	02/11/2005 14:54	5	10	15,300	8.559	Compost
#11 Pile 2 Covered Air Off - Sample 2	SC 50446	01/11/2005 12:33	02/11/2005 15:32	5	10	11,600	6.832	Compost
#4 Pile 1 Point Source Sampled Under Cover	SC 50447	01/11/2005 10:25	02/11/2005 16:01	5	10	23,200	--	Compost

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Form 06 - Sydney Laboratory
Odour Concentration Measurement Results

The measurement was commissioned by:

Organisation	Cleanaway Australia	Telephone	02 9245 6385
Contact	David Clark	Facsimile	02 9954 6703
Sampling Site	Camden	Email	David.Clark@cleanaway.com.au
Sampling Method	IFH	Sampling Team	TOU

Order details:

Order requested by	David Clark	Order accepted by	A. Balch
Date of order	October 2005	TOU Project #	1234
Order number	TBA	Project Manager	A. Balch
Signed by	TBA	Testing operator	D. Hepple

Investigated Item — Odour concentration in odour units 'ou', determined by sensory odour concentration measurements, of an odour sample supplied in a sampling bag. Odour character is also assessed, however, this assessment is not covered by AS4323.3:2001.

Identification — The odour sample bags were labelled individually. Each label recorded the testing laboratory, sample number, sampling location (or Identification), sampling date and time, dilution ratio (if dilution was used) and whether further chemical analysis was required.

Method — The odour concentration measurements were performed using dynamic olfactometry according to the Australian Standard 'Determination of Odour Concentration by Dynamic Olfactometry AS/NZS4323.3.2001. The odour perception characteristics of the panel within the presentation series for the samples were analogous to that for butanol calibration. Any deviation from the Australian standard is recorded in the 'Comments' section of this report.

Measuring Range — The measuring range of the olfactometer is $2^2 \leq \chi \leq 2^{18}$ ou. If the measuring range was insufficient the odour samples will have been pre-diluted. The machine is not calibrated beyond dilution setting 2^{17}. This is specifically mentioned with the results.

Environment — The measurements were performed in an air- and odour-conditioned room. The room temperature is maintained between 22°C and 25°C.

Measuring Dates — The date of each measurement is specified with the results.

Instrument Used — The olfactometer used during this testing session was:
ODORMAT SERIES V02

Instrumental Precision — The precision of this instrument (expressed as repeatability) for a sensory calibration must be $r \leq 0.477$ in accordance with the Australian Standard AS/NZS4323.3:2001.
ODORMAT SERIES V02: $r = 0.3313$ (6/12 July, 2005) Compliance – Yes

Instrumental Accuracy — The accuracy of this instrument for a sensory calibration must be $A \leq 0.217$ in accordance with the Australian Standard AS/NZS4323.3:2001.
ODORMAT SERIES V02: $A = 0.1872$ (6/12 July, 2005) Compliance – Yes

Lower Detection Limit (LDL) — The LDL for the olfactometer has been determined to be 16 ou (four times the lowest dilution setting)

Traceability — The measurements have been performed using standards for which the traceability to the national standard has been demonstrated. The assessors are individually selected to comply with fixed criteria and are monitored in time to keep within the limits of the standard. The results from the assessors are traceable to primary standards of *n*-butanol in nitrogen.

Date: Wednesday, 9 November 2005

Report Number / Panel Roster Number: SYD20051109_084

T. Schulz
Principal and Managing Director

D. Hepple
Authorised Signatory

THE ODOUR UNIT PTY LIMITED

Odour Panel Calibration Results

Reference Odorant	Reference Odorant Panel Roster Number	Concentration of Reference gas (ppb)	Panel Target Range for n-butanol (ppb)	Measured Concentration (ou)	Measured Panel Threshold (ppb)	Does this panel calibration measurement comply with AS/NZS4323.3:2001 (Yes / No)
n-butanol	SYD20051109_084	49,000	$20 \leq \chi \leq 80$	832	59	Yes

Comments None.

Disclaimer Parties, other than TOU, responsible for collecting odour samples hereby certify that they have voluntarily furnished these odour samples, appropriately collected and labelled, to The Odour Unit Pty Limited for the purpose of odour testing. The collection of odour samples by parties other than The Odour Unit Pty Limited relinquishes The Odour Unit Pty Limited from all responsibility for the sample collection and any effects or actions that the results from the test(s) may have.

Note This report shall not be reproduced, except in full, without written approval of The Odour Unit Pty Limited.

END OF DOCUMENT

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Odour Sample Measurement Results

Sample Location	TOU Sample ID	Sampling Date & Time	Analysis Date & Time	Panel Size	Valid ITEs	Sample Odour Concentration (as received, in the bag) (ou)	Specific Odour Emission Rate ($ou.m^3/m^2/s$)	Odour Character
Gore Cell 1 Covered Shaded - Air Off	SC 50474	15/11/2005 09:20	16/11/2005 10:17	4	8	664	0.397	Compost, Garbage
Gore Cell 1 Covered Shaded - Air Off	SC 50476	15/11/2005 10:00	16/11/2005 11:14	4	8	470	0.304	Compost, Earthy
Gore Cell 1 Covered Not Shaded - Air Off	SC 50478	15/11/2005 10:55	16/11/2005 12:13	4	8	1,120	0.542	Compost, Earthy
Gore Cell 1 Covered Shaded – Air On	SC 50480	15/11/2005 11:37	16/11/2005 13:43	4	8	1,220	0.747	Compost, Piney
Gore Cell 2 Covered Shaded - Air Off	SC 50475	15/11/2005 09:30	16/11/2005 10:46	4	8	431	0.275	Compost
Gore Cell 2 Covered Shaded - Air Off	SC 50477	15/11/2005 10:05	16/11/2005 11:44	4	8	724	0.450	Compost
Gore Cell 2 Covered Not Shaded - Air Off	SC 50479	15/11/2005 10:56	16/11/2005 13:17	4	8	790	0.369	Compost, Piney
Gore Cell 2 Covered Shaded - Air On	SC 50481	15/11/2005 11:47	16/11/2005 14:09	4	8	2,900	1.753	Compost
Gore Cell 1 Covered Point Source	SF 50006	15/11/2005 12:20	16/11/2005 14:51	4	8	71,500	--	Compost

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Form 06 - Sydney Laboratory
Odour Concentration Measurement Results

The measurement was commissioned by:

Organisation	Cleanaway Australia	Telephone	02 9245 6385
Contact	David Clark	Facsimile	02 9954 6703
Sampling Site	Camden	Email	David.Clark@cleanaway.com.au
Sampling Method	Isolation Flux Hood	Sampling Team	TOU

Order details:

Order requested by	David Clark	Order accepted by	A. Balch
Date of order	October 2005	TOU Project #	1234
Order number	TBA	Project Manager	A. Balch
Signed by	TBA	Testing operator	D. Hepple

Investigated Item	Odour concentration in odour units 'ou', determined by sensory odour concentration measurements, of an odour sample supplied in a sampling bag. Odour character is also assessed, however, this assessment is not covered by AS4323.3: 2001.
Identification	The odour sample bags were labelled individually. Each label recorded the testing laboratory, sample number, sampling location (or Identification), sampling date and time, dilution ratio (if dilution was used) and whether further chemical analysis was required.
Method	The odour concentration measurements were performed using dynamic olfactometry according to the Australian Standard 'Determination of Odour Concentration by Dynamic Olfactometry AS/NZS4323.3: 2001. The odour perception characteristics of the panel within the presentation series for the samples were analogous to that for butanol calibration. Any deviation from the Australian standard is recorded in the 'Comments' section of this report.
Measuring Range	The measuring range of the olfactometer is $2^2 \leq \chi \leq 2^{18}$ ou. If the measuring range was insufficient the odour samples will have been pre-diluted. The machine is not calibrated beyond dilution setting 2^{17}. This is specifically mentioned with the results.
Environment	The measurements were performed in an air- and odour-conditioned room. The room temperature is maintained between 22°C and 25°C.
Measuring Dates	The date of each measurement is specified with the results.
Instrument Used	The olfactometer used during this testing session was: ODORMAT SERIES V02
Instrumental Precision	The precision of this instrument (expressed as repeatability) for a sensory calibration must be $r \leq 0.477$ in accordance with the Australian Standard AS/NZS4323.3: 2001. ODORMAT SERIES V02: $r = 0.3313$ (6/12 July, 2005) Compliance – Yes
Instrumental Accuracy	The accuracy of this instrument for a sensory calibration must be $A \leq 0.217$ in accordance with the Australian Standard AS/NZS4323.3: 2001. ODORMAT SERIES V02: $A = 0.1872$ (6/12 July, 2005) Compliance – Yes
Lower Detection Limit (LDL)	The LDL for the olfactometer has been determined to be 16 ou (four times the lowest dilution setting)
Traceability	The measurements have been performed using standards for which the traceability to the national standard has been demonstrated. The assessors are individually selected to comply with fixed criteria and are monitored in time to keep within the limits of the standard. The results from the assessors are traceable to primary standards of n-butanol in nitrogen.

Date: Wednesday, 23 November 2005

Report Number / Panel Roster Number: SYD20051123_088

T. Schulz
Principal and Managing Director

D. Hepple
Authorised Signatory

THE ODOUR UNIT PTY LIMITED

Odour Panel Calibration Results

Reference Odorant	Reference Odorant Panel Roster Number	Concentration of Reference gas (ppb)	Panel Target Range for n-butanol (ppb)	Measured Concentration (ou)	Measured Panel Threshold (ppb)	Does this panel calibration measurement comply with AS/NZS4323.3:2001 (Yes / No)
n-butanol	SYD20051123_088	49,000	$20 \leq \chi \leq 80$	832	59	Yes

Comments None.

Disclaimer Parties, other than TOU, responsible for collecting odour samples hereby certify that they have voluntarily furnished these odour samples, appropriately collected and labelled, to The Odour Unit Pty Limited for the purpose of odour testing. The collection of odour samples by parties other than The Odour Unit Pty Limited relinquishes The Odour Unit Pty Limited from all responsibility for the sample collection and any effects or actions that the results from the test(s) may have.

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Odour Sample Measurement Results

Sample Location	TOU Sample ID	Sampling Date & Time	Analysis Date & Time	Panel Size	Valid ITEs	Sample Odour Concentration (as received, in the bag) (ou)	Specific Odour Emission Rate (ou.m^3/m^2/s)	Odour Character
Gore Cell 1 Covered Shaded - Air Off	SC 50497	30/11/2005 09:00	1/12/2005 11:00	4	8	152	0.086	Compost, Peat
Gore Cell 2 Covered Shaded - Air Off	SC 50498	30/11/2005 09:00	1/12/2005 11:25	4	8	128	0.075	Compost, Peat
Gore Cell 1 Covered Shaded - Air On	SC 50499	30/11/2005 09:55	1/12/2005 12:00	4	8	939	0.501	Compost, Peat
Gore Cell 2 Covered Shaded - Air On	SC 50500	30/11/2005 09:55	1/12/2005 13:10	4	8	861	0.561	Compost, Peat
Gore Cell 1 During Turning	SC 50502	30/11/2005 12:30	1/12/2005 14:28	4	8	4,100	--	Compost, Burnt, Pine
Gore Cell 2 During Turning	SC 50501	30/11/2005 15:00	1/12/2005 13:42	4	8	3,440	--	Compost, Garbage
Gore Cell 1 Uncovered Unshaded – Air On	SC 50503	30/11/2005 16:30	1/12/2005 15:10	4	8	9,740	5.380	Compost, Burnt, Pine
Gore Cell 2 Uncovered Unshaded – Air On	SC 50504	30/11/2005 17:00	1/12/2005 16:08	4	8	11,600	6.240	Compost, Garbage

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Form 06 - Sydney Laboratory
Odour Concentration Measurement Results

The measurement was commissioned by:

Organisation	Cleanaway Australia	Telephone	02 9245 6385
Contact	David Clark	Facsimile	02 9954 6703
Sampling Site	Camden	Email	David.Clark@cleanaway.com.au
Sampling Method	Isolation Flux Hood	Sampling Team	TOU

Order details:

Order requested by	David Clark	Order accepted by	A. Balch
Date of order	October 2005	TOU Project #	1234
Order number	TBA	Project Manager	A. Balch
Signed by	TBA	Testing operator	D. Hepple

Investigated Item	Odour concentration in odour units 'ou', determined by sensory odour concentration measurements, of an odour sample supplied in a sampling bag. Odour character is also assessed, however, this assessment is not covered by AS4323.3: 2001.
Identification	The odour sample bags were labelled individually. Each label recorded the testing laboratory, sample number, sampling location (or Identification), sampling date and time, dilution ratio (if dilution was used) and whether further chemical analysis was required.
Method	The odour concentration measurements were performed using dynamic olfactometry according to the Australian Standard 'Determination of Odour Concentration by Dynamic Olfactometry AS/NZS4323.3: 2001. The odour perception characteristics of the panel within the presentation series for the samples were analogous to that for butanol calibration. Any deviation from the Australian standard is recorded in the 'Comments' section of this report.
Measuring Range	The measuring range of the olfactometer is $2^2 \leq \chi \leq 2^{18}$ ou. If the measuring range was insufficient the odour samples will have been pre-diluted. The machine is not calibrated beyond dilution setting 2^{17}. This is specifically mentioned with the results.
Environment	The measurements were performed in an air- and odour-conditioned room. The room temperature is maintained between 22°C and 25°C.
Measuring Dates	The date of each measurement is specified with the results.
Instrument Used	The olfactometer used during this testing session was: ODORMAT SERIES V02
Instrumental Precision	The precision of this instrument (expressed as repeatability) for a sensory calibration must be $r \leq 0.477$ in accordance with the Australian Standard AS/NZS4323.3: 2001. ODORMAT SERIES V02: $r = 0.3313$ (6/12 July, 2005) Compliance – Yes
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Lower Detection Limit (LDL)	The LDL for the olfactometer has been determined to be 16 ou (four times the lowest dilution setting)
Traceability	The measurements have been performed using standards for which the traceability to the national standard has been demonstrated. The assessors are individually selected to comply with fixed criteria and are monitored in time to keep within the limits of the standard. The results from the assessors are traceable to primary standards of n-butanol in nitrogen.

Date: Wednesday, 9 December 2005

Report Number / Panel Roster Number: SYD20051207_093

T. Schulz
Principal and Managing Director

D. Hepple
Authorised Signatory

Odour Panel Calibration Results

Reference Odorant	Reference Odorant Panel Roster Number	Concentration of Reference gas (ppb)	Panel Target Range for n-butanol (ppb)	Measured Concentration (ou)	Measured Panel Threshold (ppb)	Does this panel calibration measurement comply with AS/NZS4323.3:2001 (Yes / No)
n-butanol	SYD20051207_093	49,000	$20 \le \chi \le 80$	861	57	Yes

Comments None.

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Odour Sample Measurement Results

Sample Location	TOU Sample ID	Sampling Date & Time	Analysis Date & Time	Panel Size	Valid ITEs	Sample Odour Concentration (as received, in the bag) (ou)	Specific Odour Emission Rate ($ou.m^3/m^2/s$)	Odour Character
Gore Cell 1 Covered Shaded - Air Off	SC 50534	14/12/2005 08:55	15/12/2005 10:36	5	10	362	0.222	Compost, Grassy
Gore Cell 2 Covered Shaded - Air Off	SC 50535	14/12/2005 08:55	15/12/2005 11:24	5	10	478	0.289	Compost
Gore Cell 1 Covered Shaded - Air On	SC 50536	14/12/2005 09:45	15/12/2005 13:26	5	10	832	0.530	Compost
Gore Cell 2 Covered Shaded - Air On	SC 50538	14/12/2005 09:45	15/12/2005 14:07	5	10	3,100	1.738	Compost
Gore Cell 1 During Pile Moving - Ambient	SC 50539	14/12/2005 10:50	15/12/2005 15:19	5	10	5,000	--	Compost, Sour
Gore Cell 2 During Moving - Ambient	SC 50540	14/12/2005 12:05	15/12/2005 16:11	5	10	5,790	--	Compost, Earthy, Sour
Gore Cell 1 Uncovered Air On After Moving	SC 50541	14/12/2005 15:25	15/12/2005 16:39	5	10	5,400	3.026	Compost, Earthy
Gore Cell 2 Uncovered Not Shaded - Air On	SC 50542	14/12/2005 15:55	15/12/2005 17:06	5	10	4,700	2.634	Compost, Earthy

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Form 06 - Sydney Laboratory
Odour Concentration Measurement Results

The measurement was commissioned by:

Organisation	Cleanaway Australia	Telephone	02 9245 6385
Contact	David Clark	Facsimile	02 9954 6703
Sampling Site	Camden	Email	David.Clark@cleanaway.com.au
Sampling Method	Isolation Flux Hood	Sampling Team	TOU

Order details:

Order requested by	David Clark	Order accepted by	A. Balch
Date of order	October 2005	TOU Project #	1234
Order number	TBA	Project Manager	A. Balch
Signed by	TBA	Testing operator	S. Hayes

Investigated Item	Odour concentration in odour units 'ou', determined by sensory odour concentration measurements, of an odour sample supplied in a sampling bag. Odour character is also assessed, however, this assessment is not covered by AS4323.3: 2001.
Identification	The odour sample bags were labelled individually. Each label recorded the testing laboratory, sample number, sampling location (or Identification), sampling date and time, dilution ratio (if dilution was used) and whether further chemical analysis was required.
Method	The odour concentration measurements were performed using dynamic olfactometry according to the Australian Standard 'Determination of Odour Concentration by Dynamic Olfactometry AS/NZS4323.3: 2001. The odour perception characteristics of the panel within the presentation series for the samples were analogous to that for butanol calibration. Any deviation from the Australian standard is recorded in the 'Comments' section of this report.
Measuring Range	The measuring range of the olfactometer is $2^2 \le \chi \le 2^{18}$ ou. If the measuring range was insufficient the odour samples will have been pre-diluted. The machine is not calibrated beyond dilution setting 2^{17}. This is specifically mentioned with the results.
Environment	The measurements were performed in an air- and odour-conditioned room. The room temperature is maintained between 22°C and 25°C.
Measuring Dates	The date of each measurement is specified with the results.
Instrument Used	The olfactometer used during this testing session was: ODORMAT SERIES V02
Instrumental Precision	The precision of this instrument (expressed as repeatability) for a sensory calibration must be $r \le 0.477$ in accordance with the Australian Standard AS/NZS4323.3: 2001. ODORMAT SERIES V02: $r = 0.3313$ (6/12 July, 2005) Compliance – Yes
Instrumental Accuracy	The accuracy of this instrument for a sensory calibration must be $A \le 0.217$ in accordance with the Australian Standard AS/NZS4323.3: 2001. ODORMAT SERIES V02: $A = 0.1872$ (6/12 July, 2005) Compliance – Yes
Lower Detection Limit (LDL)	The LDL for the olfactometer has been determined to be 16 ou (four times the lowest dilution setting)
Traceability	The measurements have been performed using standards for which the traceability to the national standard has been demonstrated. The assessors are individually selected to comply with fixed criteria and are monitored in time to keep within the limits of the standard. The results from the assessors are traceable to primary standards of n-butanol in nitrogen.

Date: Thursday, 22 December 2005

Report Number / Panel Roster Number: SYD20051222_101

T. Schulz
Principal and Managing Director

D. Hepple
Authorised Signatory

THE ODOUR UNIT PTY LIMITED

Odour Panel Calibration Results

Reference Odorant	Reference Odorant Panel Roster Number	Concentration of Reference gas (ppb)	Panel Target Range for n-butanol (ppb)	Measured Concentration (ou)	Measured Panel Threshold (ppb)	Does this panel calibration measurement comply with AS/NZS4323.3:2001 (Yes / No)
n-butanol	SYD20051222_101	49,000	$20 \le \chi \le 80$	956	51	Yes

Comments None.

Disclaimer Parties, other than TOU, responsible for collecting odour samples hereby certify that they have voluntarily furnished these odour samples, appropriately collected and labelled, to The Odour Unit Pty Limited for the purpose of odour testing. The collection of odour samples by parties other than The Odour Unit Pty Limited relinquishes The Odour Unit Pty Limited from all responsibility for the sample collection and any effects or actions that the results from the test(s) may have.

Note This report shall not be reproduced, except in full, without written approval of The Odour Unit Pty Limited.

END OF DOCUMENT

Attachment 2B

EMISSION TESTING CONSULTANTS

24 September 2007

Report No: 070263r

Australian Native Landscapes Pty Ltd
527 Maroondah Highway
Coldstream VIC 3770

Odour testing: September 2007
Windrows 2, 4, 7 and 12 and freshly shredded material

Dear Mr Tony Farriciello,

Tests were performed 12 September 2007 to determine emissions to air from Windrows 2, 4, 7 and 12 and freshly shredded material at the Coldstream plant of Australian Native Landscapes Pty Ltd.

Yours faithfully
Emission Testing Consultants

T. B.

Terry Burkitt
Director
terryburkitt@emission.com.au

NATA Accredited Laboratory Number 14601

NATA endorsed test report. This document shall not be reproduced, except in full.

Unit 2, 160 New Street, Ringwood, Victoria 3134
Ph: +61 3 9870 2644 Fax: +61 3 9870 4055 www.emission.com.au
ABN 74 474 273 172

SAMPLING OVERVIEW AND OBSERVATIONS

For diagrams of sampling locations refer to **'APPENDIX 1: Detailed sampling information'**.

Windrow 2

Windrow formation date:	31/8/07	
Windrow dimensions:	Length -	26.5 m
	Width (base) -	8.5 m
	Width (top) -	1.2 m
	Height -	3.0 m

The windrow was not aerated during testing and was covered.

Windrow surface sampling

Two odour samples (isolation flux) were collected on top of windrow 2.

1. Northern half of windrow: Integrated sample (singleton) from 2 points
2. Southern half of windrow: Integrated sample (singleton) from 2 points

Observations

The surface of the cover was warm and mildly damp.

A strong compost odour was observed close to the windrow surface cover.

Windrow 7

Windrow formation date:	10/9/07	
Windrow dimensions:	Length -	22.0 m
	Width (base) -	8.0 m
	Width (top) -	1.2 m
	Height -	3.5 m

The windrow was not aerated during testing and was covered.

Windrow surface sampling

Two odour samples (isolation flux) were collected on top of windrow 7.

1. Northern half of windrow: Integrated sample (singleton) from 2 points
2. Southern half of windrow: Integrated sample (singleton) from 2 points

Observations

The surface of the cover was warm and mildly damp.

A strong compost odour was observed close to the windrow surface cover.

Windrow 12

Windrow formation date:	22/8/07	
Windrow dimensions:	Length -	27.0 m
	Width (base) -	7.8 m
	Width (top) -	1.2 m
	Height -	3.0 m

The windrow was not aerated during testing and was covered.

Windrow surface sampling

Two odour samples (isolation flux) were collected on top of windrow 12.

1. Northern half of windrow: Integrated sample (singleton) from 2 points
2. Southern half of windrow: Integrated sample (singleton) from 2 points

Observations

The surface of the cover was warm and mildly damp.

A strong compost odour was observed close to the windrow surface cover.

ODOUR SAMPLING AND ANALYSIS PARAMETERS

Technique:	AS4323.3 - Forced Choice	
Date and time of analysis:	12/09/07 @ 1600 – 1830 hrs	
Pre-dilution: Covered windrow surfaces: Freshly disturbed surfaces:	8 L sample air + 8 L dilution air (1 in 2) 2 L sample air + 8 L dilution air (1 in 5)	
Pre-dilution equipment:	Dry Gas Meter 040	
Quality Requirements	**Acceptance criteria**	**Current value**
Panel n-Butanol threshold value (ppb)	20-80	65
Repeatability "r"	≤0.477	0.255
Repeatability "10r"	≤3.00	1.800
Accuracy "A"	<0.217	0.168

WEATHER OBSERVATIONS

Weather conditions were taken from the Bureau of Meteorology website for Coldstream (weather station 086383). Refer to APPENDIX 2: 'Weather Observations'.

North end

Location	**Windrow 2 - North end**
Date tested	12/09/2007
Equilibration time, hrs	1215-1239 & 1250-1314
Sample ID	73
Dilution ratio	1 in 2
Sampling time, hrs	1239-1241 & 1314-1316
Odour concentration, ou	**730**
Odour flux rate, ou/m²/min	**26**
Source area, m^2	**16**
Odour mass rate, ou/min	**420**
Surface temperature (°C)	-
Chamber temperature (°C)	19.4
Ambient temperature (°C)	15.0

Note: Odour mass rate is applicable to the northern half of the windrow only. Source area assumed to be half the length of the top of the windrow (13.25m x 1.2m).

North end

Location	**Windrow 4 - North end**
Date tested	12/09/2007
Equilibration time, hrs	0940-1004 & 1012-1036
Sample ID	115
Dilution ratio	1 in 2
Sampling time, hrs	1004-1006 & 1036-1038
Odour concentration, ou	**480**
Odour flux rate, ou/m²/min	**18**
Source area, m^2	**13**
Odour mass rate, ou/min	**240**
Surface temperature (°C)	-
Chamber temperature (°C)	21.0
Ambient temperature (°C)	15.0

Note: Odour mass rate is applicable to the northern half of the windrow only. Source area assumed to be half the length of the top of the windrow (11m x 1.2m).

The picture was taken after sampling when the cover on the south end was removed.

Windrow 7

Non-aerated & covered

South end

Location	Windrow 7 - South end
Date tested	12/09/2007
Equilibration time, hrs	1420-1444 & 1450-1514
Sample ID	183
Dilution ratio	1 in 2
Sampling time, hrs	1444-1446 & 1514-1516
Odour concentration, ou	**5500**
Odour flux rate, ou/m²/min	**210**
Source area, m^2	**13**
Odour mass rate, ou/min	**2700**
Surface temperature (°C)	-
Chamber temperature (°C)	20.3
Ambient temperature (°C)	15.3

Note: Odour mass rate is applicable to the southern half of the windrow only. Source area assumed to be half the length of the top of the windrow (11m x 1.2m).

Windrow 12

Non-aerated & covered

South end

Location	**Windrow 12 - South end**
Date tested	12/09/2007
Equilibration time, hrs	1106-1130 & 1135-1159
Sample ID	44
Dilution ratio	1 in 2
Sampling time, hrs	1130-1132 & 1159-1201
Odour concentration, ou	**5500**
Odour flux rate, ou/m²/min	**200**
Source area, m^2	**16**
Odour mass rate, ou/min	**3300**
Surface temperature (°C)	-
Chamber temperature (°C)	21.0
Ambient temperature (°C)	15.0

Note: Odour mass rate is applicable to the southern half of the windrow only. Source area assumed to be half the length of the top of the windrow (13.5m x 1.2m).

Freshly shredded material

Freshly disturbed

Location	**Freshly shredded & disturbed**
Date tested	12/09/2007
Equilibration time, hrs	1530 - 1554
Sample ID	140
Dilution ratio	1 in 5
Sampling time, hrs	1554 - 1556
Odour concentration, ou	**1800**
Odour flux rate, ou/m²/min	**67**
Surface temperature (°C)	32.8
Chamber temperature (°C)	22.7
Ambient temperature (°C)	15.0

APPENDIX 2: Weather observations

Coldstream, Victoria
September 2007 Daily Weather Observations

Date	Day	Temps		Rain	Evap	Sun	Max wind gust			9:00 AM						3:00 PM					
		Min	Max				Dir	Spd	Time	Temp	RH	Cld	Dir	Spd	MSLP	Temp	RH	Cld	Dir	Spd	MSLP
		°C	°C	mm	mm	hours	km/h		local	°C	%	8th	km/h		hPa	°C	%	8th	km/h		hPa
1	Sa	0	16	1.6			N	31	15:42	9.1	73		NNE	7	1029.2	15.4	51		N	10	1025.7
2	Su	0.3	18	0			N	41	9:48	11.6	66		N	15	1024.5	16.8	47		NNW	19	1020
3	Mo	4.6	13.3	1.6			SW	41	12:59	9.9	78		SW	13	1026.6	12.1	63		SSW	22	1027
4	Tu	-0.8	14.7	0.2			SE	33	17:11	8.6	68		ESE	11	1035.2	14.3	50		SSE	15	1031.2
5	We	-2.3	17.7	0			SSW	20	12:52	8.4	67		SE	4	1036.2	16.9	36		NW	6	1031.1
6	Th	1	18	0.2			N	31	11:35	10.9	68		S	9	1033.1	17.4	38		N	17	1027.4
7	Fr	3.2	19.8	0			NW	28	11:58	9.6	81		Calm		1026.9	19.4	35		E	4	1021.8
8	Sa	0.5	20.1	0			SSE	24	19:18	9.6	99		Calm		1023.5	19.6	31		WSW	7	1019
9	Su	0.8	19.6	0			N	39	10:04	12.9	66		Calm		1020.2	19.3	43		N	24	1014.9
10	Mo	7.1	18.6	0			NNE	63	11:32	13.9	70		NE	20	1007.7	17.2	56		N	26	1002.6
11	Tu	10.7	14.7	6.6			SW	44	15:50	11.5	92		W	17	1006.5	13.9	72		SW	22	1007.2
12	We	10.3	15.4	3.6			SW	22	4:54	11.5	89		W	9	1015.4	13.9	66		WSW	11	1013.7

15 February 2008

Report No: 080030r

Australian Native Landscapes Pty Ltd
527 Maroondah Highway
Coldstream VIC 3770

Odour testing: February 2008
Windrows 1 and 14

Dear Mr Tony Farriciello,

Tests were performed 11 February 2008 to determine emissions to air from Windrows 1 and 14 at the Coldstream plant of Australian Native Landscapes Pty Ltd.

Yours faithfully
Emission Testing Consultants

T. B

Terry Burkitt
Director
terryburkitt@emission.com.au

NATA Accredited Laboratory Number 14601

This document is issued in accordance with NATA's accreditation requirements.

SAMPLING OVERVIEW AND OBSERVATIONS

Windrow 1

Windrow formation date:	10/01/08	
Windrow dimensions:	Length -	22 m
	Width (base) -	8 m
	Width (top) -	2 m
	Height -	4 m

Test 1 - Covered

Windrow surface sampling

Two odour samples (isolation flux) were collected on top of windrow 1.

1. Southern half of windrow: Integrated sample (singleton) from 2 points
2. Northern half of windrow: Integrated sample (singleton) from 2 points

Observations

The material was light brown, fibrous and warm.

A distinct (moderate) earthy / compost odour was observed at the sampling location.

Test 2 – Uncovered & disturbed

Freshly disturbed material sampling

The cover was removed from the northern end of the windrow immediately after the completion of test 1. Material from the northern end was turned using a front end loader immediately prior to sampling.

Two odour samples (isolation flux) were collected.

Note: The equilibration time was reduced to 15 minutes in order to minimise the time between disturbance of the windrow material and sampling.

Observations

The material was dark brown, fibrous and warm.

A distinct (moderate) earthy / compost odour was observed at the sampling location.

TEST METHODS

The following methods are accredited with the National Association of Testing Authorities (NATA) and are approved for the sampling and analysis of gases. Specific details of the methods are available on request.

All sampling and analysis conducted in accordance with EPA Vic approved methods and EPA publication 440.1.

All parameters are reported adjusted to dry NTP conditions unless otherwise stated.

On site sampling guidelines: according to ETC method 1.

Odour sampling: according to ETC method 130 using an equilibrium flux chamber.

* *Given the recent development of the draft Australian Standard for area source measurement (AS4323.4), quality control protocols outlined in the draft standard were adopted if not otherwise stated in ETC method 130. Isolation flux chambers which are compliant with the draft standard and the specifications of USEPA user guide (1986 EPA/600/8) were used.*

Odour analysis: according to AS4323.3, by dynamic olfactometry (forced-choice technique). Panel n-butanol threshold determination by analysis against a NATA certified n-butanol gas standard.

All samples were analysed the same afternoon as collection.

DEVIATIONS FROM TEST METHODS

Freshly disturbed material sampling

The equilibration time was reduced to 15 minutes in order to minimise the time between disturbance of the windrow material and sampling.

RESULTS

Windrow 1 covered: Southern end

11 February 2008

Location	Windrow 1 (Southern end)
Date tested	11/02/2008
Equilibration time, hrs	0920-0950 & 0955-1025
Sample ID	18
Dilution ratio	1 in 2
Sampling time, hrs	0950-0954 & 1025-1030
Odour concentration, ou	**5200**
Odour flux rate, ou/m²/min	**180**
Source area, m^2	**20**
Odour mass rate, ou/min	**3600**
Chamber temperature (°C)	33.1
Ambient temperature (°C)	22.9

Note: Odour mass rate is applicable to the southern half of the windrow only. Source area assumed to be half the length of the top of the windrow (10m x 2m).

Windrow 1 uncovered & disturbed

11 February 2008

Location	Window 1 (Disturbed)	
Date tested	11/02/2008	
Equilibration time, hrs	1150 - 1206	
Sample identification	50	135
Sample dilution	1 in 6	1 in 6
Sampling time, hrs	1206 - 1208	1209 - 1210
Odour concentration, ou	9500	9000
Average odour concentration, ou	**9300**	
Average odour flux rate, ou/m²/min	**320**	
Surface temperature (°C)	58.8	
Chamber temperature (°C)	40.9	
Ambient temperature (°C)	27.6	

Windrow 14 covered: Northern end

11 February 2008

Location	**Windrow 14 (Northern end)**
Date tested	11/02/2008
Equilibration time, hrs	1054-1118 & 1129-1154
Sample ID	150
Dilution ratio	1 in 2
Sampling time, hrs	1118-1122 & 1154-1138
Odour concentration, ou	**1100**
Odour flux rate, ou/m²/min	**39**
Source area, m²	**23**
Odour mass rate, ou/min	**880**
Chamber temperature (°C)	51.1
Ambient temperature (°C)	26.0

Note: Odour mass rate is applicable to the northern half of the windrow only. Source area assumed to be half the length of the top of the windrow (15m x 1.5m).

APPENDIX 1: Weather observations

Date	Day	Temps		Rain	Evap	Sun	Max wind gust			9:00 AM						3:00 PM					
		Min	Max				Dir	Spd	Time	Temp	RH	Cld	Dir	Spd	MSLP	Temp	RH	Cld	Dir	Spd	MSLP
		°C	°C	mm	mm	hours	km/h		local	°C	%	8^{th}	km/h		hPa	°C	%	8^{th}	km/h		hPa
1	Fr	8.5	26.5	10.4			W	31	18:04	13.7	81		NE	7	1019.5	24.8	48		S	11	1015.7
2	Sa	13.6	30.6	0			WSW	41	13:53	19.5	78		W	9	1015.5	29.2	46		WSW	30	1012.4
3	Su	16.8	28.7	0			ESE	43	15:46	20	79		W	11	1016	27.9	53		SW	13	1011.5
4	Mo	17.2	32.2	0			SSE	31	17:51	20	81		Calm		1012.8	31.5	34		WSW	7	1008.5
5	Tu	17.1	23.7	0			SW	28	12:52	20.4	82		W	20	1011.4	23.5	66		SW	17	1009.6
6	We	14.5	25.1	0			SSE	28	16:25	20.4	81		WSW	6	1004.3	21.7	76		S	11	1000.6
7	Th	12.9	18.3	2.8			SW	52	2:10	13.5	93		WNW	4	1006	17.1	60		SSW	20	1007.2
8	Fr	12	19	0.4			SSE	39	16:59	13.8	62		SE	11	1011	14.3	79		SSW	22	1010.2
9	Sa	6	21.3	2.2			SE	43	15:32	12.6	92		NE	6	1013.6	20.5	49		S	15	1011.5
10	Su	5.5	23.9	0			S	39	17:33	12.4	88		N	2	1015.7	22.6	36		SSW	11	1012.6
11	Mo	5.9	29.2	0			SSE	30	18:52	13.2	87		N	7	1015.5	27.4	37		W	11	1009

Attachment 2C

EMISSION TESTING CONSULTANTS

14 April 2008

Australian Native Landscapes Pty Ltd
527 Maroondah Highway
Coldstream VIC 3770

Odour Testing – April 2008

Isolation flux chamber and witch's hat comparison

Dear Mr Tony Farriciello,

Tests were performed 8 April 2008 to compare odour flux rate results from the top surfaces of windrows 6 and 14 using the isolation flux chamber and witch's hat methodologies at the Coldstream plant of Australian Native Landscapes Pty Ltd.

Yours faithfully
Emission Testing Consultants

T. B

Terry Burkitt
Director

terryburkitt@emission.com.au

INTRODUCTION

Observation of steam emissions from active windrows at the site indicates that emissions predominantly occur from the top surface of the windrows due to convective rise through the windrow. Odour emission rates have been measured at the site using isolation flux chamber equipment.

Following discussions with Mr Tim Pollock (GHD Services Pty Ltd), the possibility that the air flow rate, if sufficiently high may impact on the isolation flux chamber test results was considered.

If the airflow exiting the top of the windrows was sufficiently high then it is possible that the isolation flux chamber may inhibit the air flow and therefore suppress the odour emission. This may result in an under estimation the actual odour emission.

A series of experiments were designed to compare results obtained from a 'witch's hat' collection hood and the isolation flux chamber. The difference between the principles of measurement of the two devices is as follows:

Isolation flux chamber

The isolation flux chamber is a dome shaped device that is placed on the surface of interest. The odour that diffuses off or is transported through the surface is captured in the dome. Sweep air is introduced at a known rate and air exits the chamber via a 'take off' sampling line and a bleed. After a period of equilibration a sample of air is drawn off for odour analysis. *This methodology is suitable for area sources where odour diffuses off the surface or is transported through the surface via a low air flow.*

Odour flux rates are calculated from the odour concentration measured, the sweep air flow rate and the diameter of the base of the isolation flux chamber. Odour flux rates are reported in units of ou/m^2/min.

Witches hat

The witch's hat is a hollow cone shaped device. The base (large diameter) is placed on the surface of interest. The odour transported through the surface is funnelled through device and out the exit (small diameter). Odour samples are collected at the exit (small diameter) end of the device. *This methodology is suitable for area sources where odour is transported through the surface via a high air flow.*

Odour flux rates are calculated from the odour concentration measured, the air flow rate measured at the exit end of the device and the diameter of the base of the device. Odour flux rates are reported in units of ou/m^2/min.

In both cases knowledge of the total emission area is required in order to calculate a total emission rate for the source (ou/min).

DEFINITIONS

The following symbols and abbreviations are used in this test report:

NTP	Normal temperature and pressure. Gas volumes and concentrations are expressed on a dry basis at 0°C, at discharge oxygen concentration and an absolute pressure of 101.325 kPa, unless otherwise specified.
Nm^3/min	Flow rate (m^3/min) at NTP conditions
Disturbance	A flow obstruction or instability in the direction of the flow that may impede accurate flow determination. This includes centrifugal fans, axial fans, partially closed or closed dampers, louvres, bends, connections, junctions, direction changes or changes in pipe diameter.
BSP	British standard pipe.
Odour unit	One odour unit (ou) is that concentration of odorant(s) at standard concentrations that elicits a physiological response from a panel (detection threshold) equivalent to that elicited by one Reference Odour Mass (ROM), evaporated in one cubic metre of neutral gas at standard conditions.
D	Duct diameter or equivalent duct diameter for rectangular ducts.
>	Greater than
<	Less than the minimum limit of detection using the specified method.
~	Approximately
NA	Not applicable

SAMPLING METHODOLOGY

Part 1: Comparison of Isolation flux chamber and witch's hat methods

Windrow 6: Test 1

Windrow 6 was constructed on 6/2/08 and was covered at the time of testing. The aeration system was turned off during testing.

The isolation flux chamber and the witch's hat were placed side by side on the northern end of the top of the windrow. Sand was used to 'seal' the devices to the top of the windrow. After equilibration of the isolation flux chamber odour samples (singletons) were collected simultaneously from each device.

Exit velocity measurements were conduced from a sample hole in the top section of the witch's hat when the wind-cross flow above the witch's hat exit was less than 0.4m/s. This was to minimise the impact of venturi effects across the top of the witch's hat.

Windrow 6: Test 2

After completion of test 1, the positions of the isolation flux chamber and the witch's hat were reversed. A second set of measurements were conducted in the same manner as test 1. The purpose of reversing the positions of the equipment was to account for the impact of localised variation in odour emission rate.

Windrow 14: Test 1

Windrow 14 was constructed on 3/4/08 and was covered at the time of testing. The aeration system was turned off during testing.

The isolation flux chamber and the witch's hat were placed side by side on the northern end of the top of the windrow. Sand was used to 'seal' the devices to the top of the windrow. After equilibration of the isolation flux chamber odour samples (singletons) were collected simultaneously from each device.

Exit velocity measurements were conduced from a sample hole in the top section of the witch's hat when the wind-cross flow above the witch's hat exit was less than 0.4m/s. This was to minimise the impact of venturi effects across the top of the witch's hat.

Windrow 14: Test 2

After completion of test 1, the positions of the isolation flux chamber and the witch's hat were reversed. A second set of measurements were conducted in the same manner as test 1. The purpose of reversing the positions of the equipment was to account for the impact of localised variation in odour emission rate.

Part 2: Preliminary assessment of external influences on the witch's hat

When measurements of air flow rate exiting the top of the windrows were conducted, using the witch's hat, significant variations were observed that appeared to be related to ambient wind speed. A series of tests were performed to assess external factors that may impact on the measured air flow and therefore the odour emission rate using the witch's hat.

The most significant effect was thought to be wind causing:

- a venturi effect across the top of the witch's hat and therefore increased flow through the witch's hat.
- intrusion of air around the base of the witch's hat and therefore increased flow through the witch's hat

The second point above is considered less likely where the witch's hat can be adequately sealed to the measurement surface (using sand for example).

Tests performed at Australian Native Landscapes Pty Ltd

Velocity measurements were conducted on the exit of the one witch's hat (ETC unit) at the following locations:

1. Top of windrow 6: comparison with and without a cross breeze present.
2. Mulched garden bed to the north of the stage 1 windrows. This was assumed to be largely inactive material and therefore no significant convective rise was expected.
3. Road surface to the north of the stage 1 (covered) windrows. No significant convective rise was expected.

Tests performed at Emission Testing Consultants Ringwood premises

Velocity measurements were conducted on the exit of two witch's hats (GHD unit and ETC unit) as shown in the following table:

Test	Witch's hats tested	Surface tested	Ambient conditions
1A	ETC unit & GHD unit	Concrete floor	No ambient air flow & shaded conditions (roller door closed)
1B	ETC unit & GHD unit	Concrete floor	Induced air flow of ~1.5 m/s at ground level (roller door closed)
2	ETC unit & GHD unit	Concrete floor	Units in sun, ~0.6 m/sec breeze (roller door open)
3	GHD unit	Water	No ambient air flow & shaded conditions (roller door closed)

TEST METHODS

The following methods are accredited with the National Association of Testing Authorities (NATA) and are approved for the sampling and analysis of gases. Specific details of the methods are available on request.

All parameters are reported adjusted to NTP conditions unless otherwise stated.

On site sampling guidelines: according to ETC method 1.

Flow rate and velocity (witch's hat exits and wind speed): using a hot wire or vane anemometer. Temperature determined using a calibrated thermocouple and digital pyrometer.

Note: *Emission Testing Consultants are not NATA accredited for sampling by this method.*

Odour sampling (isolation flux): according to ETC method 130 using an equilibrium flux chamber.

* *Given the recent development of the draft Australian Standard for area source measurement (AS4323.4), quality control protocols outlined in the draft standard were adopted if not otherwise stated in ETC method 130.* <u>*Isolation flux chambers which are compliant with the draft standard and the* specifications of USEPA user guide (1986 EPA/600/8) *were used.*</u>

Odour sampling (witch's hat): sample collection using a 'witch's hat' and collection into Nalophan sample bags using the 'lung' principle.

Note: *Emission Testing Consultants are not NATA accredited for sampling by this method.*

Odour analysis: according to AS4323.3, by dynamic olfactometry (forced-choice technique). Panel n-butanol threshold determination by analysis against a NATA certified n-butanol gas standard. Sampling conducted in duplicate. Concentrations reported on a wet NTP basis.

DEVIATIONS FROM TEST METHODS

Odour

A sample dilution of greater than 1 in 9 is greater than the maximum stipulated in AS4323.3. Where this was required it is indicated in the 'odour sampling and analysis parameters' section of this report.

ODOUR SAMPLING AND ANALYSIS PARAMETERS

All odour samples collected on windrow 6 were analysed on 8 April 2008. The windrow 14 Test 1 (isolation flux) sample was also run on 8 April 2008. The olfactometer was then contaminated and no further samples were analysed.

The olfactometer was cleaned and the remaining windrow 14 samples run on 9 April 2008 following an additional 1 in 10 post dilution (giving a total dilution of 1 in 22).

A sample dilution of greater than 1 in 9 is greater than the maximum stipulated in AS4323.3.

Odour panel 8 April 2008

Technique:	**AS4323.3 - Forced Choice**	
Date and time of analysis:	8/4/08 @ 1600 - 1715hrs	
Pre-dilution:	8 L sample air + 8 L dilution air (1 in 2)	
Pre-dilution equipment:	Dry Gas Meter 040	
Quality Requirements	**Acceptance criteria**	**Current value**
Panel n-Butanol threshold value (ppb)	20-80	57
Repeatability “r”	≤0.477	0.224
Repeatability “10r”	≤3.00	1.67
Accuracy “A”	<0.217	0.151

Odour panel 9 April 2008

Technique:	**AS4323.3 - Forced Choice**	
Date and time of analysis:	9/4/08 @ 1400 - 1530hrs	
Pre-dilution:	8 L sample air + 8 L dilution air (1 in 2)*	
Pre-dilution equipment:	Dry Gas Meter 040	
Quality Requirements	**Acceptance criteria**	**Current value**
Panel n-Butanol threshold value (ppb)	20-80	49
Repeatability “r”	≤0.477	0.248
Repeatability “10r”	≤3.00	1.77
Accuracy “A”	<0.217	0.139

* A further post dilution of 1 in 10 was conducted on all odour samples run on 9 April 2008 (refer to Note above).

RESULTS - PART 1: Comparison of isolation flux chamber and witch's hat methods

Windrow 6 – Test 1 (Isolation flux chamber)

8 April 2008

Location	Windrow 6 - Test 1 (isolation flux chamber)
Date tested	8/04/2008
Equilibration time, hrs	0856 - 0920
Sample ID	98
Dilution ratio	1 in 2
Sampling time, hrs	0920 - 0925
odour concentration, ou	**290**
odour flux rate, ou/m²/min	**10**
Chamber temperature (°C)	23.0
Ambient temperature (°C)	21.0

Windrow 6 – Test 2 (Isolation flux chamber)

8 April 2008

T2

Location	Windrow 6 - Test 2 (isolation flux chamber)
Date tested	8/04/2008
Equilibration time, hrs	0936 - 0957
Sample ID	77
Dilution ratio	1 in 2
Sampling time, hrs	0957 - 1002
odour concentration, ou	**230**
odour flux rate, ou/m²/min	**8.2**
Chamber temperature (°C)	28.7
Ambient temperature (°C)	22.3

Windrow 6 – Test 1 (Witch's hat)

8 April 2008

Flow Results	0080090	
Time of flow tests	0920-0925	hrs
Stack dimensions at sampling plane	72	mm
Velocity at sampling plane	0.22	m/s
Average temperature	23	°C
Flow rate at discharge conditions	0.054	m^3/min
Flow rate at wet NTP conditions	0.049	m^3/min

Odour Results 0080090	Sample ID	Sampling Times	Concentration	Odour flux rate, ou/m²/min
Odour (Exit)	170	0920-0925	190 ou	12

Windrow 6 – Test 2 (Witch's hat)

8 April 2008

Flow Results			W6 T2080090
Time of flow tests	0957-1002	hrs	
Stack dimensions at sampling plane	72	mm	
Velocity at sampling plane	0.25	m/s	
Average temperature	29	°C	
Flow rate at discharge conditions	0.061	m^3/min	
Flow rate at wet NTP conditions	0.055	m^3/min	

Odour Results W6 T2080090	Sample ID	Sampling Times	Concentration		Odour flux rate, ou/m²/min
Odour (Exit)	20	0957-1002	230	ou	16

Windrow 14 – Test 1 (Isolation flux chamber)

8 April 2008

T1

Location	Windrow 14 - Test 1 (isolation flux chamber)
Date tested	8/04/2008
Equilibration time, hrs	1031 - 1055
Sample ID	73
Dilution ratio	1 in 2
Sampling time, hrs	1055 - 1100
odour concentration, ou	**11000**
odour flux rate, ou/m²/min	**390**
Chamber temperature (°C)	36.7
Ambient temperature (°C)	23.4

Windrow 14 – Test 2 (Isolation flux chamber)

8 April 2008

T2

Location	Windrow 14 - Test 2 (isolation flux chamber)
Date tested	8/04/2008
Equilibration time, hrs	1106 - 11330
Sample ID	166
Dilution ratio	1 in 2
Sampling time, hrs	1130 - 1135
odour concentration, ou	**18000**
odour flux rate, ou/m²/min	**650**
Chamber temperature (°C)	37.9
Ambient temperature (°C)	23.7

Windrow 14 – Test 1 (Witch's hat)

8 April 2008

Flow Results W 14 T1080090		
Time of flow tests	1055-1100	hrs
Stack dimensions at sampling plane	72	mm
Velocity at sampling plane	0.43	m/s
Average temperature	37	°C
Flow rate at discharge conditions	0.11	m^3/min
Flow rate at wet NTP conditions	0.092	m^3/min

Odour Results W 14 T1080090	Sample ID	Sampling Times	Concentration	Odour flux rate, ou/m²/min
Odour (Exit)	3	1055-1100	100,000 ou	12,000

Windrow 14 – Test 2 (Witch's hat)

8 April 2008

Flow Results W14 T2080090		
Time of flow tests	1135-1140	hrs
Stack dimensions at sampling plane	72	mm
Velocity at sampling plane	0.40	m/s
Average temperature	38	°C
Flow rate at discharge conditions	0.098	m^3/min
Flow rate at wet NTP conditions	0.085	m^3/min

Odour Results W14 T2080090	Sample ID	Sampling Times	Concentration	Odour flux rate, $ou/m^2/min$
Odour (Exit)	46	1135-1140	78,000 ou	8,500

RESULTS - PART 2: Preliminary assessment of external influences on the witch's hat

Uncontrolled at ANL

8 April 2008

TEST 1: Top of windrow 6: comparison with and without a cross breeze present	Measured velocity at top (m/s)	Calculated velocity at base (m/s)
ETC Unit: Cross breeze < 0.4 m/s	0.25	0.0013
ETC Unit: Cross breeze ~ 3 m/s	0.65	0.0034
TEST 2: On 'garden bed' located to the north of maturation windrows	**Measured velocity at top (m/s)**	**Calculated velocity at base (m/s)**
ETC Unit: Cross breeze (not measured)	0.25	0.0013
TEST 3: On road located to the north of maturation windrows	**Measured velocity at top (m/s)**	**Calculated velocity at base (m/s)**
ETC Unit: Cross breeze (not measured)	0.35	0.0018

Notes: Tests 1; unit were placed on the surface and 'sealed' to the surface using sand.

Tests 2 and 3; unit was placed on the surfaces and not 'sealed' to the surface.

Semi controlled at ETC

8 April 2008

Test 1A (smoke tube showing exit flow)

TEST 1A: Shaded & no wind (roller door closed)	Measured velocity at top (m/s)	Calculated velocity at base (m/s)
ETC unit - On concrete surface	0.08	0.00041
GHD unit - On concrete surface	0.15	0.0010
TEST 1B: 1.5m/s induced airflow at ground level (roller door closed)	**Measured velocity at top (m/s)**	**Calculated velocity at base (m/s)**
ETC unit - On concrete surface	0.2	0.0010
GHD unit - On concrete surface	0.85	0.0058
TEST 2: In sun and 0.6 m/s breeze (roller door open)	**Measured velocity at top (m/s)**	**Calculated velocity at base (m/s)**
ETC unit - On concrete surface	0.28	0.0015
GHD unit - On concrete surface	0.35	0.0024
TEST 3: Sealed on 3cm of water (roller door closed)	**Measured velocity at top (m/s)**	**Calculated velocity at base (m/s)**
GHD unit - On water surface	< 0.01	< 0.0001

Notes: Tests 1 and 2; units were placed on the concrete floor and not ‘sealed’ to the floor.

CONCLUSIONS

A significant difference was observed in the measured odour emission rate using the two methods as shown in the following table:

Isolation flux chamber		Witch's hat		Ratio
Windrow Test No.	**Flux rate Ou/m^2/min**	**Windrow Test No.**	**Flux rate Ou/m^2/min**	**Hat / chamber**
Windrow 6 Test 1	10	Windrow 6 Test 2	16	1.6
Windrow 6 Test 2	8.2	Windrow 6 Test 1	12	1.4
			Average	**1.5**
Windrow 14 Test 1	390	Windrow 14 Test 2	8,500	18
Windrow 14 Test 2	650	Windrow 14 Test 1	12,000	21
			Average	**20**

Note: Test 1 isolation flux chamber results are compared with test 2 witch's hat results because they correspond to testing on the same location on the windrow. This reduces the impact of spatial variation.

The difference between the two methods was low (a factor of 1.5) for windrow 6 but high (factor of 20) for windrow 14.

The isolation flux chamber gives a lower odour emission rate compared to the witch's hat. The difference was greater on windrow 14 (constructed on 3/4/08) than windrow 6 (constructed on 6/2/08). This is most likely due to higher convective flow off windrow 14. The convective flow would be expected to be higher from more active windrows such as windrow 14.

External factors such as wind may impact significantly on the measured convective flow off the windrows.

Sealing the bottom edge of the witch's hat (using sand) has been shown to be imperative.

Attachment 2D

EMISSION TESTING CONSULTANTS

30 July 2007

Report No: 070197r

Australian Native Landscapes Pty Ltd
527 Maroondah Highway
Coldstream VIC 3770

Odour testing – July 2007

Dear Mr Tony Farriciello,

Tests were performed 23 & 24 July 2007 to determine emissions to air from Windrows 4, 7, 9 and 11 at the Coldstream plant of Australian Native Landscapes Pty Ltd.

Yours faithfully
Emission Testing Consultants

T. B.

Terry Burkitt
Director

terryburkitt@emission.com.au

NATA Accredited Laboratory Number 14601

NATA endorsed test report. This document shall not be reproduced, except in full.

DEFINITIONS

The following symbols and abbreviations are used in this test report:

NTP	Normal temperature and pressure. Gas volumes and concentrations are expressed on a dry basis at 0°C, at discharge oxygen concentration and an absolute pressure of 101.325 kPa, unless otherwise specified.
Nm^3/min	Flow rate (m^3/min) at NTP conditions
Odour unit	One odour unit (ou) is that concentration of odorant(s) at standard concentrations that elicits a physiological response from a panel (detection threshold) equivalent to that elicited by one Reference Odour Mass (ROM), evaporated in one cubic metre of neutral gas at standard conditions.
>	Greater than
<	Less than the minimum limit of detection using the specified method.
~	Approximately
NA	Not applicable

SAMPLING OVERVIEW AND OBSERVATIONS

For diagrams of sampling locations refer to **'APPENDIX 1: Detailed sampling information'**.

Windrow 4 (aerated) – Uncovered

During the sampling period, the computer controlled blower serving the windrow was disabled. The blower was manually switched on prior to the testing and left on during the test period.

The cover of the windrow was removed 15 minutes prior the sampling.

Windrow dimensions:	Length -	24 m
	Width -	8 m
	Height -	2.6 m

Blower duct sampling

Air flow rate measurements were conduct at the beginning and end of the testing period.

A single integrated odour sample was collected; half the sample was taken at the beginning of the test period and the second half at the end of the test period. The sample was undiluted.

Windrow surface sampling

Three odour samples were collected from the top of the windrow using a 'collection hood' after the blower was started:

- ***1 minute after blower start up:***

  A single odour sample was collected on top of windrow 4. The sample location was approximately at the middle of the windrow.

- ***30 minutes after blower start up:***

  A single integrated odour sample was collected on top of windrow 4. The sample locations were approximately equally spaced along the windrow length (4 points).

- ***2 hours after blower start up:***

  A single integrated odour sample was collected on top of windrow 4. The sample locations were approximately equally spaced along the windrow length (4 points).

Air velocities were measured from the exit of the 'collection hood' and surface velocities calculated.

Observations

The material was dark brown in colour and fibrous. Condensation from the inner surface of the cover was observed on the surface layer of material

A very strong (sharp) compost odour was observed close to the windrow surface.

Windrow 7 (non-aerated) – Uncovered

The windrow was not aerated and uncovered.

Windrow dimensions:	Length -	22.5 m
	Width -	7.6 m
	Height -	2.5 m

Windrow surface sampling

Two odour samples (isolation flux) were collected on top of windrow 7. The sample locations were on top of the windrow at the centres of the northern and southern halves of the windrow.

Observations

The material was light brown in colour and fibrous. The surface of the material was mildly damp.

A strong compost odour was observed close to the windrow surface.

Windrow 9 (aerated) – Uncovered

During the sampling period, the computer controlled blower serving the windrow was disabled. The blower was manually switched on prior to the testing and left on during the test period.

The windrow was uncovered.

Windrow dimensions:	Length -	23 m
	Width -	6.5 m
	Height -	2.7 m

Blower duct sampling

Air flow rate measurements were conduct at the beginning and end of the testing period.

A single integrated odour sample was collected; half the sample was taken at the beginning of the test period and the second half at the end of the test period. The sample was undiluted.

Windrow surface sampling

Three odour samples were collected from the top of the windrow using a 'collection hood' after the blower was started:

- ***1 minute after blower start up:***

  A single odour sample was collected on top of windrow 9. The sample location was approximately at the middle of the windrow.

- ***30 minutes after blower start up:***

  A single integrated odour sample was collected on top of windrow 9. The sample locations were approximately equally spaced along the windrow length (3 points).

- ***2 hours after blower start up:***

  A single integrated odour sample was collected on top of windrow 9. The sample locations were approximately equally spaced along the windrow length (3 points).

Air velocities were measured from the exit of the 'collection hood' and surface velocities calculated.

Observations

The material was light brown in colour and fibrous. The surface of the material was mildly damp.

A strong compost odour was observed close to the windrow surface.

Windrow 11 (aerated) – Covered section

During the sampling period, the computer controlled blower serving the windrow was disabled. The blower was manually switched on prior to the testing and left on during the test period.

The windrow was uncovered.

Windrow dimensions:	Length -	28 m (16.7 m covered & 11.3m uncovered)
	Width -	7.5 m
	Height -	3 m

Blower duct sampling

Air flow rate measurements were conduct at the beginning and end of the testing period.

A single integrated odour sample was collected; half the sample was taken at the beginning of the test period and the second half at the end of the test period. The sample was undiluted.

Windrow surface sampling

Three odour samples were collected from the top of the windrow using a 'collection hood' after the blower was started:

- ***1 minute after blower start up:***

  A single odour sample was collected on top of windrow 11. The sample location was approximately at the middle of the covered section of the windrow.

- ***30 minutes after blower start up:***

  A single integrated odour sample was collected on top of windrow 11. The sample locations were approximately equally spaced along the covered section of the windrow length (3 points).

- ***2 hours after blower start up:***

  A single integrated odour sample was collected on top of windrow 11. The sample locations were approximately equally spaced along the covered section of the windrow length (3 points).

Air velocities were measured from the exit of the 'collection hood' and surface velocities calculated.

Observations

The surface of the cover was hot and damp.

A strong compost odour was observed close to the windrow surface.

Windrow 11 (aerated) – Uncovered section

During the sampling period, the computer controlled blower serving the windrow was disabled. The blower was manually switched on prior to the testing and left on during the test period.

The windrow was uncovered.

Windrow dimensions:	Length -	28 m (16.7 m covered & 11.3m uncovered)
	Width -	7.5 m
	Height -	3 m

Blower duct sampling

Air flow rate measurements were conduct at the beginning and end of the testing period.

A single integrated odour sample was collected; half the sample was taken at the beginning of the test period and the second half at the end of the test period. The sample was undiluted.

Windrow surface sampling

Three odour samples were collected from the top of the windrow using a 'collection hood' after the blower was started:

- ***1 minute after blower start up:***

  A single odour sample was collected on top of windrow 11. The sample location was approximately at the middle of the uncovered section of the windrow.

- ***30 minutes after blower start up:***

  A single integrated odour sample was collected on top of windrow 11. The sample locations were approximately equally spaced along the uncovered section of the windrow length (2 points).

- ***2 hours after blower start up:***

  A single integrated odour sample was collected on top of windrow 11. The sample locations were approximately equally spaced along the uncovered section of the windrow length (2 points).

Air velocities were measured from the exit of the 'collection hood' and surface velocities calculated.

Observations

The material was light brown in colour and fibrous. The surface of the material was mildly damp.

A strong compost odour was observed close to the windrow surface.

SAMPLING PLANE REQUIREMENTS

Criteria for Sampling Planes for compliance to Australian Standard (AS 4323.1-1995)

Table 1

Type of flow disturbance	*Minimum distance upstream from disturbance, diameters (D)*	*Minimum distance downstream from disturbance, diameters (D)*
Bend, connection, junction, direction change, exit	*> 2D*	*>6D*
Louvre, butterfly damper (partially closed or closed)	*>3D*	*>6D*
Axial fan	*>3D*	*>8D (see note)*
Centrifugal fan	*>3D*	*>6D*

Note: The plane should be selected as far as practicable from a fan. Flow straighteners may be required to ensure the position chosen meets the check criteria listed in items (a) to (f) below.

(a) The gas flow is basically in the same direction at all points along each sampling traverse.

(b) The gas velocity at all sampling points is greater than 3 m/sec.

(c) The gas flow profile at the sampling plane shall be steady, evenly distributed and not have a cyclonic component which exceeds an angle of 15° to the duct axis, when measured near the periphery of a circular sampling plane.

(d) The temperature difference between adjacent points of the survey along each sampling traverse is less than 10% of the absolute temperature, and the temperature at any point differs by less than 10% from the mean.

(e) The ratio of the highest to lowest pitot pressure difference shall not exceed 9:1 and the ratio of the highest to lowest gas velocities shall not exceed 3:1. For isokinetic testing with the use of impingers, the gas velocity ratio across the sampling plane shall not exceed 1.6:1.

(f) The gas temperature at the sampling plane should preferably be above the dewpoint.

SAMPLING PLANE OBSERVATIONS

Windrow 4 blower duct

The sampling plane was not in accordance with ***Table 1*** of **AS4323.1** but the conditions of checklist ***(a)*** to ***(f)*** of ***AS 4323.1*** were met.

Windrow 9 & 11 blower ducts

The sampling plane was in accordance with ***Table 1*** of **AS4323.1** and the conditions of checklist ***(a)*** to ***(f)*** of ***AS 4323.1*** were met.

TEST METHODS

The following methods are accredited with the National Association of Testing Authorities (NATA) and are approved for the sampling and analysis of gases. Specific details of the methods are available on request.

All sampling and analysis conducted in accordance with EPA Vic approved methods and EPA publication 440.1.

All parameters are reported adjusted to dry NTP conditions unless otherwise stated.

On site sampling guidelines: according to ETC method 1.

Sampling plane criteria: according to AS 4323.1-1995. Selection of sampling positions.

Flow rate and velocity (blower ducts): according to ISO 10780:1994, using a pitot tube and differential manometer. Temperature determined using a calibrated thermocouple and digital pyrometer.

Flow rate and velocity (windrow surface): measured from the 75mm diameter exit of the collection hood using a digital impellor anemometer. Temperature determined using a calibrated thermocouple and digital pyrometer. Surface velocity calculated based upon the ratio of the exit diameter (75mm) and the surface diameter (1000mm) of the collection hood.

Moisture content: according to ETC method 50, by psychometric observation.

Odour sampling (non-aerated windrows)*: according to ETC method 130 using an equilibrium flux chamber.

* *Given the recent development of the draft Australian Standard for area source measurement (AS4323.4), quality control protocols outlined in the draft standard were adopted if not otherwise stated in ETC method 130. Isolation flux chambers which are compliant with the draft standard and the* specifications of USEPA user guide (1986 EPA/600/8) *were used.*

Odour sampling (aerated windrows): by collection of grab samples from the surface using a 1000 mm in diameter collection hood with a 75 mm outlet. Samples were collected as integrated samples from multiple points on the windrows.

Odour sampling (blower ducts): sample collection according to AS4323.3, by collection into using the 'lung' principle.

Odour analysis: according to AS4323.3, by dynamic olfactometry (forced-choice technique). Panel n-butanol threshold determination by analysis against a NATA certified n-butanol gas standard.

All samples were analysed the same afternoon as collection.

DEVIATIONS FROM TEST METHODS

There were no deviations from standard methods.

ODOUR SAMPLING AND ANALYSIS PARAMETERS

23/7/07:

Technique:	**AS4323.3 - Forced Choice**	
Date and time of analysis:	23/07/07 @ 1700 – 1915 hrs	
Pre-dilution: Windrow 7 surface: Windrow 9 & 11 surfaces: Blower ducts:	2 L sample air + 8 L dilution air (1 in 5) 8 L sample air + 8 L dilution air (1 in 2) 9 L sample air + 8 L dilution air (1 in 1.9) Nil	
Pre-dilution equipment:	Dry Gas Meter 040	
Quality Requirements	**Acceptance criteria**	**Current value**
Panel n-Butanol threshold value (ppb)	20-80	29
Repeatability “r”	≤0.477	0.376
Repeatability “10r”	≤3.00	2.375
Accuracy “A”	<0.217	0.132

24/7/07:

Technique:	**AS4323.3 - Forced Choice**	
Date and time of analysis:	24/07/07 @ 1600 – 1815 hrs	
Pre-dilution: Windrow 4 surface: Windrow 11 surface: Blower ducts:	8 L sample air + 8 L dilution air (1 in 2)* 8 L sample air + 8 L dilution air (1 in 2) Nil	
Pre-dilution equipment:	Dry Gas Meter 040	
Quality Requirements	**Acceptance criteria**	**Current value**
Panel n-Butanol threshold value (ppb)	20-80	24
Repeatability “r”	≤0.477	0.459
Repeatability “10r”	≤3.00	2.878
Accuracy “A”	<0.217	0.126

* A further 1 in 10 dilution was required in order to bring the samples within the working range of the olfactometer.

WEATHER OBSERVATIONS

Weather conditions were taken from the Bureau of Meteorology website for Coldstream (weather station 086383). Refer to **APPENDIX 2: ‘Weather Observations’**.

RESULTS

Windrow 4 (aerated) – Uncovered

24 July 2007

Sampling Plane Details	Winrow 4
Distance upstream from disturbance:	> 2 D from connection
Distance downstream from disturbance:	~ 3 D from Centrifugial fan
Discharge to air:	N/A
Size and number of ports:	2 x 1 inch holes
Access to ports:	Ground level
Conformance with AS 4323.1 Table 1:	No*
Non conformance with these items of AS 4323.1:	Conforms with all items

**Sampling points increased as per the requirements of AS4323.1 -1995*

Blower Duct Flow Results	Winrow 4	
Time of flow tests	1040 and 1245	hrs
Stack dimensions at sampling plane	300	mm
Velocity at sampling plane	6.6	m/s
Average temperature	15	°C
Moisture content	1.3	%v/v
Flow rate at discharge conditions	28	m³/min
Flow rate at wet NTP conditions	28	m³/min
Flow rate at dry NTP conditions	27	m³/min

Odour Results	Sample ID	Sampling Times	Concentration	Mass rate
Windrow surface				
1 min after fan switched on	125	1035-1039	110,000 ou	3,100,000 ouv/min
30 mins after fan switched on	168	1105-1109	110,000 ou	2,900,000 ouv/min
2 hrs after fan switched on	180	1235-1239	100,000 ou	2,800,000 ouv/min
Blower duct	7	1040-1043 & 1240-1243	< 30 ou	< 800 ouv/min

Note: Odour mass rates calculated using the flow rate (NTP wet conditions) measured at the blower duct.

Refer to "**SAMPLING PLANE OBSERVATIONS**" on page 8.

Windrow 7 (non-aerated) – Uncovered
South end
23 July 2007

Location	South end windrow 7
Date tested	23/07/2007
Equilibration time, hrs	1045 - 1109
Sample ID	115
Dilution ratio	1 in 5
Sampling time, hrs	1110 - 1111
Odour concentration, ou	**4300**
Odour flux rate, ou/m²/min	**160**
Surface temperature (°C)	63.4
Chamber temperature (°C)	19.2
Ambient temperature (°C)	15.0

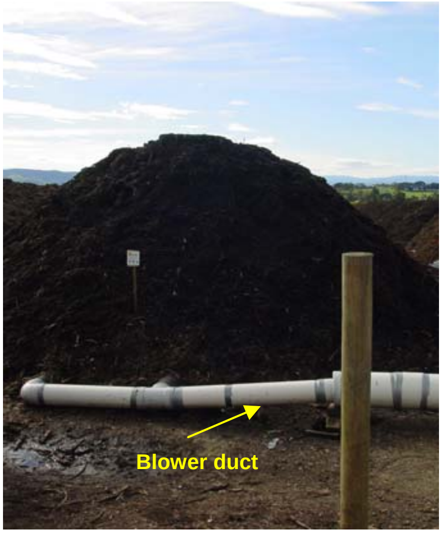
Windrow 7 (non-aerated) – Uncovered
North end
23 July 2007

Location	North end windrow 7
Date tested	23/07/2007
Equilibration time, hrs	1040 - 1104
Sample ID	172
Dilution ratio	1 in 5
Sampling time, hrs	1105 - 1106
Odour concentration, ou	**2900**
Odour flux rate, ou/m²/min	**110**
Surface temperature (°C)	61.0
Chamber temperature (°C)	22.0
Ambient temperature (°C)	15.0

Windrow 9 (aerated) – Uncovered

23 July 2007

Sampling Plane Details	
Distance upstream from disturbance:	> 2 D from connection
Distance downstream from disturbance:	> 6 D from change in diameter
Discharge to air:	N/A
Size and number of ports:	2 x 1 inch holes
Access to ports:	Ground level
Conformance with AS 4323.1 Table 1:	Yes
Non conformance with these items of AS 4323.1:	Conforms with all items



Blower Duct Flow Results		
Time of flow tests	1135 and 1341	hrs
Stack dimensions at sampling plane	150	mm
Velocity at sampling plane	18	m/s
Average temperature	17	°C
Moisture content	1.2	%v/v
Flow rate at discharge conditions	19	m^3/min
Flow rate at wet NTP conditions	18	m^3/min
Flow rate at dry NTP conditions	18	m^3/min

Odour Results	**Sample ID**	**Sampling Times**	**Concentration**	**Mass rate**
Windrow surface				
1 min after fan switched on	44	1125-1129	2,700 ou	49,000 ouv/min
30 mins after fan switched on	150	1155-1201	3,200 ou	58,000 ouv/min
2 hrs after fan switched on	89	1325-1331	5,200 ou	94,000 ouv/min
Blower duct	17	1135-1138 & 1333-1336	230 ou	4,200 ouv/min

Note: Odour mass rates calculated using the flow rate (NTP wet conditions) measured at the blower duct.

Refer to "**SAMPLING PLANE OBSERVATIONS**" on page 8.

Windrow 11 (aerated) – Covered section

23 July 2007

Sampling Plane Details	Windrow 11 (covered)
Distance upstream from disturbance:	> 2 D from connection
Distance downstream from disturbance:	> 6 D from centrifugal fan
Discharge to air:	N/A
Size and number of ports:	2 x 1 inch holes
Access to ports:	Ground level
Conformance with AS 4323.1 Table 1:	Yes
Non conformance with these items of AS 4323.1:	Conforms with all items

Blower Duct Flow Results	Windrow 11 (covered)	
Time of flow tests	1212 and 1422	hrs
Stack dimensions at sampling plane	150	mm
Velocity at sampling plane	17	m/s
Average temperature	20	°C
Moisture content	1.1	%v/v
Flow rate at discharge conditions	18	m^3/min
Flow rate at wet NTP conditions	18	m^3/min
Flow rate at dry NTP conditions	17	m^3/min

Odour Results	Sample ID	Sampling Times	Concentration	Mass rate
Windrow surface				
1 min after fan switched on	1	1206-1210	8,600 ou	90,000 ouv/min
30 mins after fan switched on	128	1236-1242	9,100 ou	95,000 ouv/min
2 hrs after fan switched on	133	1406-1412	6,500 ou	68,000 ouv/min
Blower duct	181	1213-1216 & 1414-1417	170 ou	1,800 ouv/min

Notes: Blower Duct Flow Results represent the *total flow measured within the blower duct*.

Odour mass rates calculated using the flow rate (NTP wet conditions) measured at the blower duct multiplied by a factor of 0.596. The factor represents the proportion of the windrow that was covered.

Refer to "**SAMPLING PLANE OBSERVATIONS**" on page 8.

Windrow 11 (aerated) – Uncovered section

24 July 2007

Sampling Plane Details	Windrow 11
Distance upstream from disturbance:	> 2 D from connection
Distance downstream from disturbance:	> 6 D from centrifugal fan
Discharge to air:	N/A
Size and number of ports:	2 x 1 inch holes
Access to ports:	Ground level
Conformance with AS 4323.1 Table 1:	Yes
Non conformance with these items of AS 4323.1:	Conforms with all items

Blower Duct Flow Results	Windrow 11	
Time of flow tests	0945 and 1150	hrs
Stack dimensions at sampling plane	150	mm
Velocity at sampling plane	18	m/s
Average temperature	19	°C
Moisture content	0.89	%v/v
Flow rate at discharge conditions	19	m^3/min
Flow rate at wet NTP conditions	19	m^3/min
Flow rate at dry NTP conditions	18	m^3/min

Odour Results	Sample ID	Sampling Times	Concentration	Mass rate
Windrow surface				
1 min after fan switched on	77	0940-0944	4,700 ou	35,000 ouv/min
30 mins after fan switched on	82	1010-1014	5,800 ou	44,000 ouv/min
2hrs after fan switched on	141	1140-1144	5,500 ou	41,000 ouv/min
Blower duct	51	0945-0948 & 1145-1148	47 ou	350 ouv/min

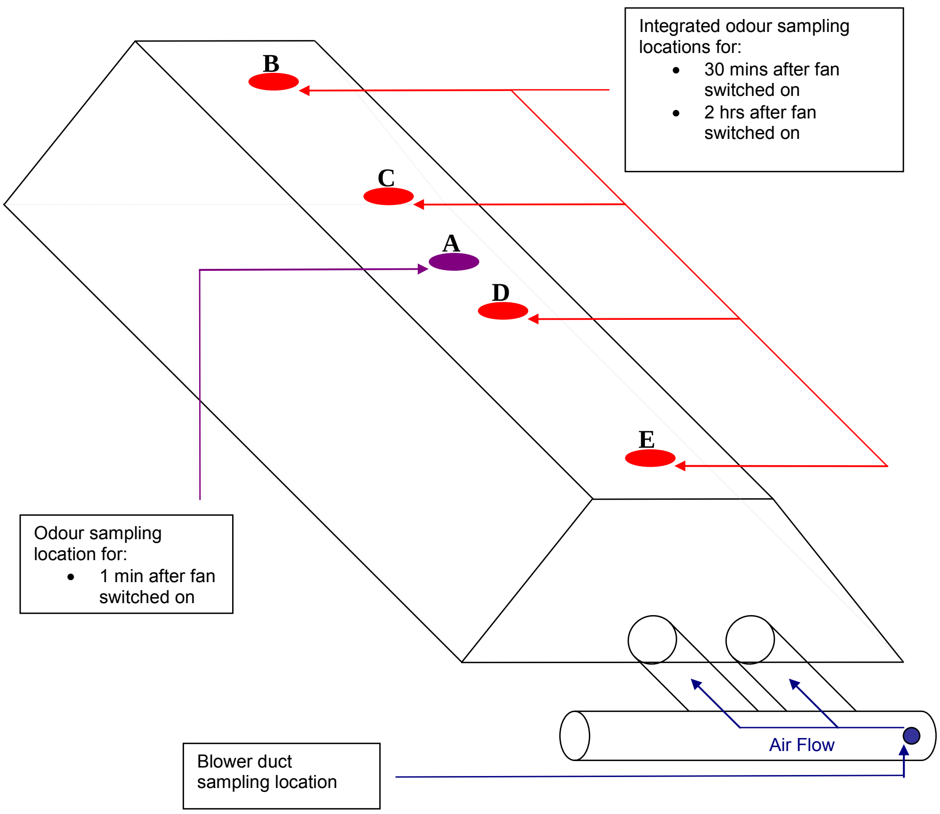
Notes: Blower Duct Flow Results represent the *total flow measured within the blower duct*.

Odour mass rates calculated using the flow rate (NTP wet conditions) measured at the blower duct multiplied by a factor of 0.404. The factor represents the proportion of the windrow that was uncovered.

Refer to "**SAMPLING PLANE OBSERVATIONS**" on page 8.

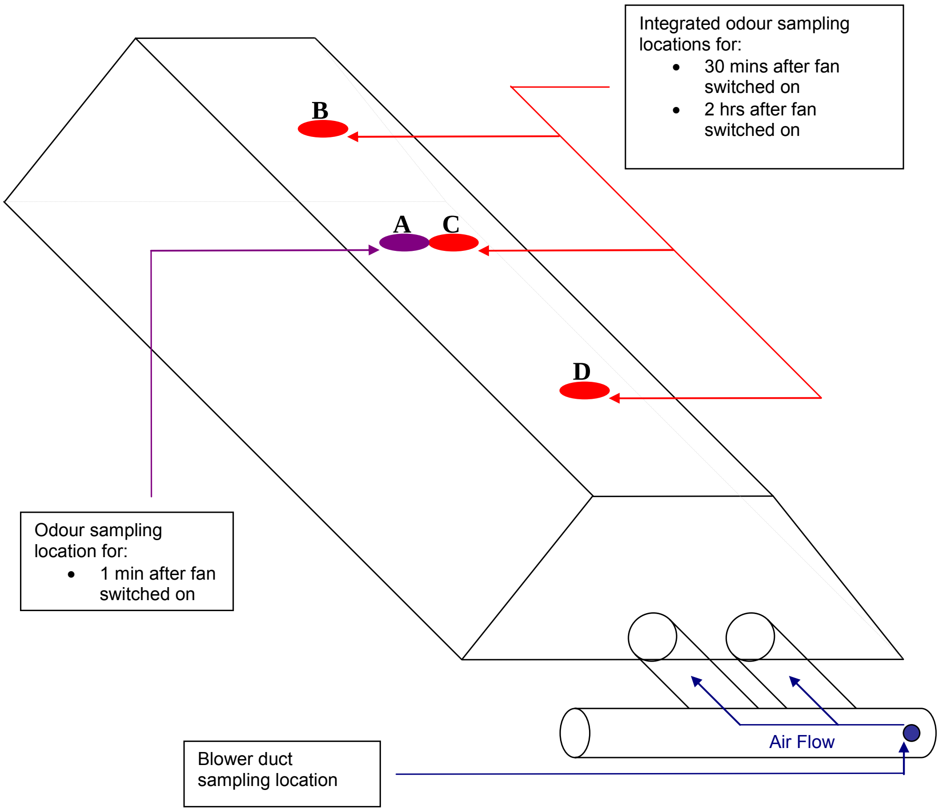
APPENDIX 1: Detailed sampling information (aerated windrows)

Windrow 4 - Sampling locations and information



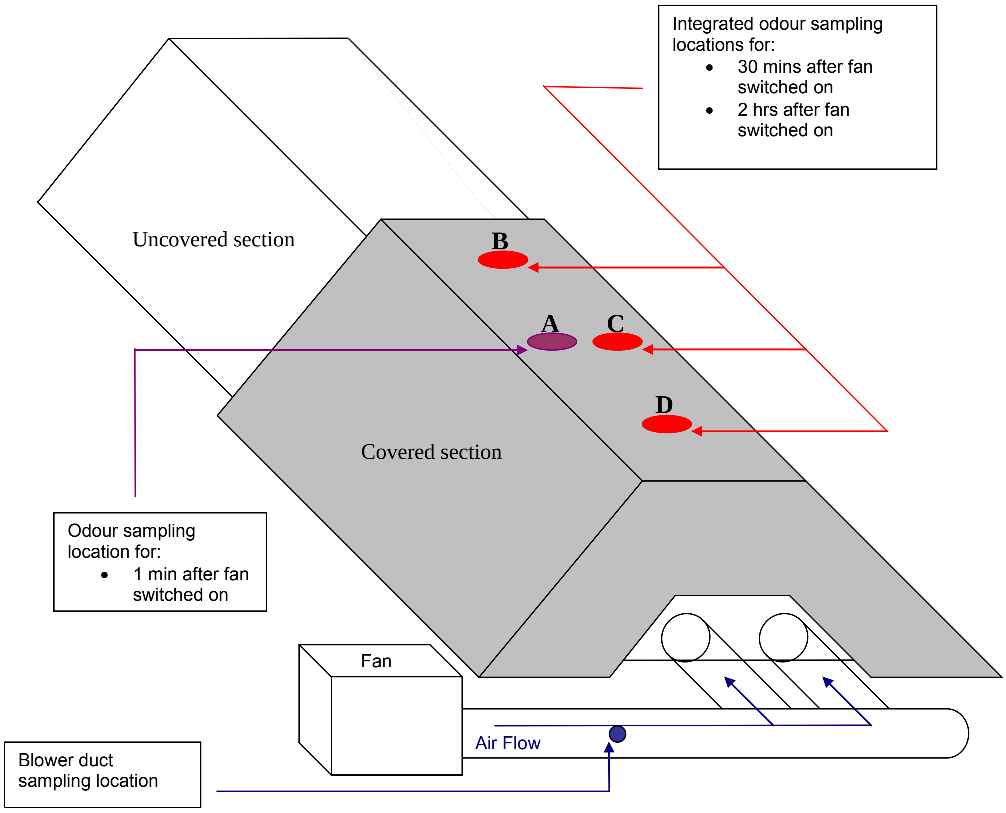
Sampling Locations		Surface temperature (°C)	Surface velocity (m/s)
A	*1 min after fan switched on*	80	0.0090
B	*30 mins after fan switched on*	76	0.0084
	2 hrs after fan switched on	76	0.013
C	*30 mins after fan switched on*	75.8	0.014
	2 hrs after fan switched on	76	0.014
D	*30 mins after fan switched on*	76	0.011
	2 hrs after fan switched on	76	0.014
E	*30 mins after fan switched on*	76	0.011
	2 hrs after fan switched on	76	0.014

Windrow 9 - Sampling locations and information



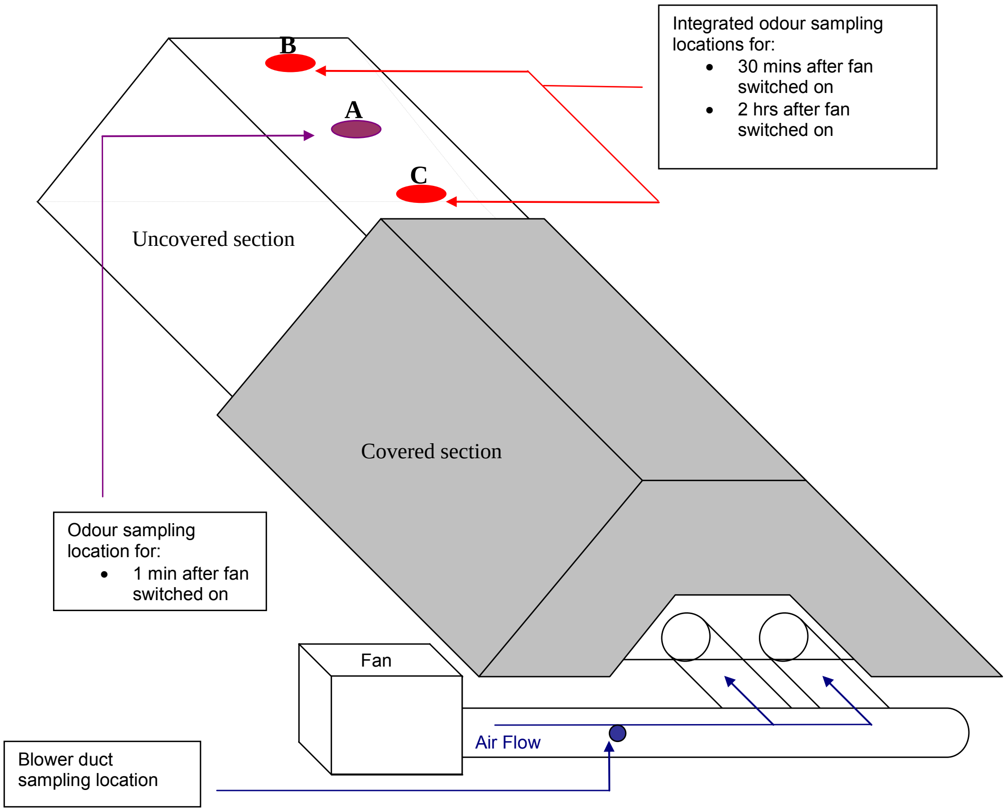
Sampling Locations		Surface temperature (°C)	Surface velocity (m/s)
A	*1 min after fan switched on*	58.7	0.0096
B	*30 mins after fan switched on*	58	0.0079
	2 hrs after fan switched on	57.9	0.0090
C	*30 mins after fan switched on*	58.2	0.0090
	2 hrs after fan switched on	57.8	0.0096
D	*30 mins after fan switched on*	58.4	0.0073
	2 hrs after fan switched on	57.9	0.0090

Windrow 11 (covered) - Sampling locations and information



Sampling Locations		Surface temperature (°C)	Surface velocity (m/s)
A	*1 min after fan switched on*	-	0.0096
B	*30 mins after fan switched on*	-	0.0068
	2 hrs after fan switched on	-	0.0079
C	*30 mins after fan switched on*	-	0.012
	2 hrs after fan switched on	-	0.014
D	*30 mins after fan switched on*	-	0.0068
	2 hrs after fan switched on	-	0.0073

Windrow 11 (uncovered) - Sampling locations and information



Sampling Locations		Surface temperature (°C)	Surface velocity (m/s)
A	*1 min after fan switched on*	54.3	0.0068
B	*30 mins after fan switched on*	54.3	0.0068
	2 hrs after fan switched on	57.5	0.0079
C	*30 mins after fan switched on*	54.2	0.0068
	2 hrs after fan switched on	57.6	0.0079

APPENDIX 2: Weather observations

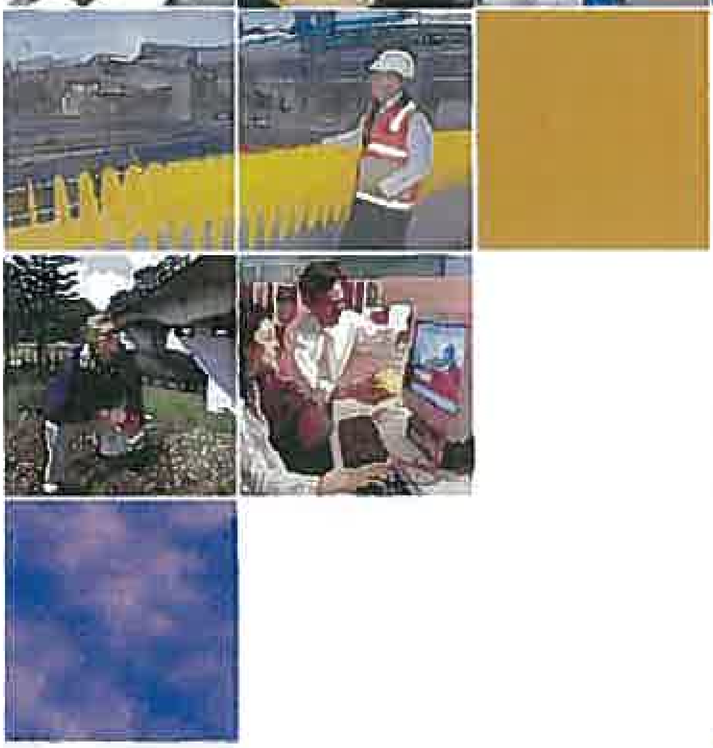
Coldstream, Victoria
July 2007 Daily Weather Observations

Date	Day	Temps		Rain	Evap	Sun	Max wind gust			9:00 AM						3:00 PM					
		Min	Max				Dir	Spd	Time	Temp	RH	Cld	Dir	Spd	MSLP	Temp	RH	Cld	Dir	Spd	MSLP
		°C	°C	mm	mm	hours	km/h		local	°C	%	8th	km/h		hPa	°C	%	8th	km/h		hPa
1	Su	7.7	13.7	5.6			N	35	17:27	10.4	81		N	15	1008	12	76		N	17	1006.6
2	Mo	9.2	11.8	0			N	50	13:08	9.7	80		N	9	1011.8	10.7	69		N	28	1008.2
3	Tu	4.9	15.3	2			NNE	39	16:33	9.8	99		N	9	1011.9	13.9	69		N	26	1009.3
4	We	9.8	14.2	2.2			NW	44	11:42	11.6	75		NW	17	998.5	13.8	58		W	19	999.2
5	Th	7.5	11.3	2.8			NNE	37	5:34	7.7	81		NW	7	994.4	10.2	74		W	11	1000
6	Fr	1.2	10.3	2.2			N	56	12:48	5.1	99		Calm		1011	7.6	87		N	22	1009.2
7	Sa	0.7	11	4.8			SW	26	14:57	4.5	99		Calm		1012.2	8.5	84		SW	19	1012
8	Su	3.8	12.8	5.2			SSE	39	15:24	5	98		NNE	6	1021.3	12.2	76		SSE	19	1021.8
9	Mo	5	13.9	0.2			SE	39	15:30	9.7	84		S	17	1028.2	12.6	72		SSE	19	1026.8
10	Tu	-0.8	12.6	0			NNW	11	13:21	0.6	99		Calm		1029.9	11.6	75		Calm		1027.4
11	We	-2.2	13.6	0			N	30	14:35	0.4	99		Calm		1027.9	11.8	61		N	15	1024.2
12	Th	0.4	10.8	2.2			W	15	12:30	7.2	99		Calm		1025.8	9.9	89		ENE	2	1024.1
13	Fr	3.1	11.5	7.6			W	30	14:51	7.5	99		W	9	1024.5	10	85		WSW	22	1023
14	Sa	5	10.8	7.8			N	13	14:00	5.5	99		ESE	6	1024.3	9	84		Calm		1022.6
15	Su	0.9	10.9	0.8			WSW	19	12:37	6.1	100		Calm		1025.4	9.5	72		Calm		1024
16	Mo	0.1	10.9	0			N	43	14:34	7	78		N	19	1024.4	10.2	71		N	28	1021.4
17	Tu	5	9.5	0			NNW	61	4:34	9.2	58		N	35	1013.6	5.3	88		N	13	1013.9
18	We	3	8.4	16.8			W	20	2:24	3.7	99		Calm		1027.3	8.1	83		SSE	7	1028.1
19	Th	1.6	10.3	3.8			S	28	15:06	7.1	99		SW	9	1033.4	9.8	87		SSW	13	1032.4
20	Fr	3.6	11.8	2.8			SE	19	19:26	6.6	99		Calm		1034.8	11.4	70		SW	7	1032.7
21	Sa	0.9	11.8	0			SE	13	7:04	3.3	99		SE	7	1034.6	11.2	67		Calm		1031.7
22	Su	-2.9	12.9	0.4			N	35	13:05	0.9	99		Calm		1033.9	12.6	55		NNW	22	1030.7
23	Mo	-0.6	14.1	0			N	44	12:44	4.1	99		SSW	4	1030.6	12.9	59		N	22	1026.9
24	Tu	4.1	16.3	0			N	46	10:00	12.2	59		N	15	1025.6	15.6	48		N	24	1021.7
25	We	3.6	17.9	0			N	52	14:34	12.4	64		NNE	17	1020.5	17.8	47		N	37	1016.1
26	Th	8.4		0.6						12.1	81		N	15	1015.8						
Statistics for the first 26 days of July 2007																					
Mean		3.2	12.3							6.9	89			8	1021.1	11.1	72			15	1019.8
Lowest		-2.9	8.4	0						0.4	58		Calm		994.4	5.3	47		Calm		999.2
Highest		9.8	17.9	16.8			NNW	61		12.4	100		N	35	1034.8	17.8	89		N	37	1032.7
Total				67.8																	

Attachment 2E

REPORT

Odour Assessment of the ANL Composting Facility, Lilydale



Prepared for

Yarra Ranges Shire Council

Anderson Street
Lilydale
VIC 3140

17 July 2007

43283297

URS

Section 4 Methodology

Equation 4-1 Calculation of odour emission rates based on odour concentration from a fluxhood sample

$$E = \frac{C \times F}{A}$$

Where:
E is the emission rate in $ou/m^2/s$
C is the measured concentration of the sample in ou/m^3
F is the sweep gas flow rate in m^3/s
A is the surface area within the flux hood in m^2

Equation 4-2 Calculation of odour emission rates based on odour concentrations from a grab sample

$$E = C \times F$$

Where:
F is the measured velocity flow of the plume in m/s

Table 4-2 Odour emission rates based on odour sampling

Sample	Windrow	Surface Odour Emission Rate $OU/m^2/s$
One day old greenwaste	3	3.16
One week old greenwaste	1, 2	7.58
Five week old compost	5-7	0.05
Six month old compost	8-15	0.27
Freshly turned windrow (grab sample on turning)	5	3360
Freshly turned windrow (flux hood sample 30 mins after turning)	5	17.05
Leachate pond	-	0.27

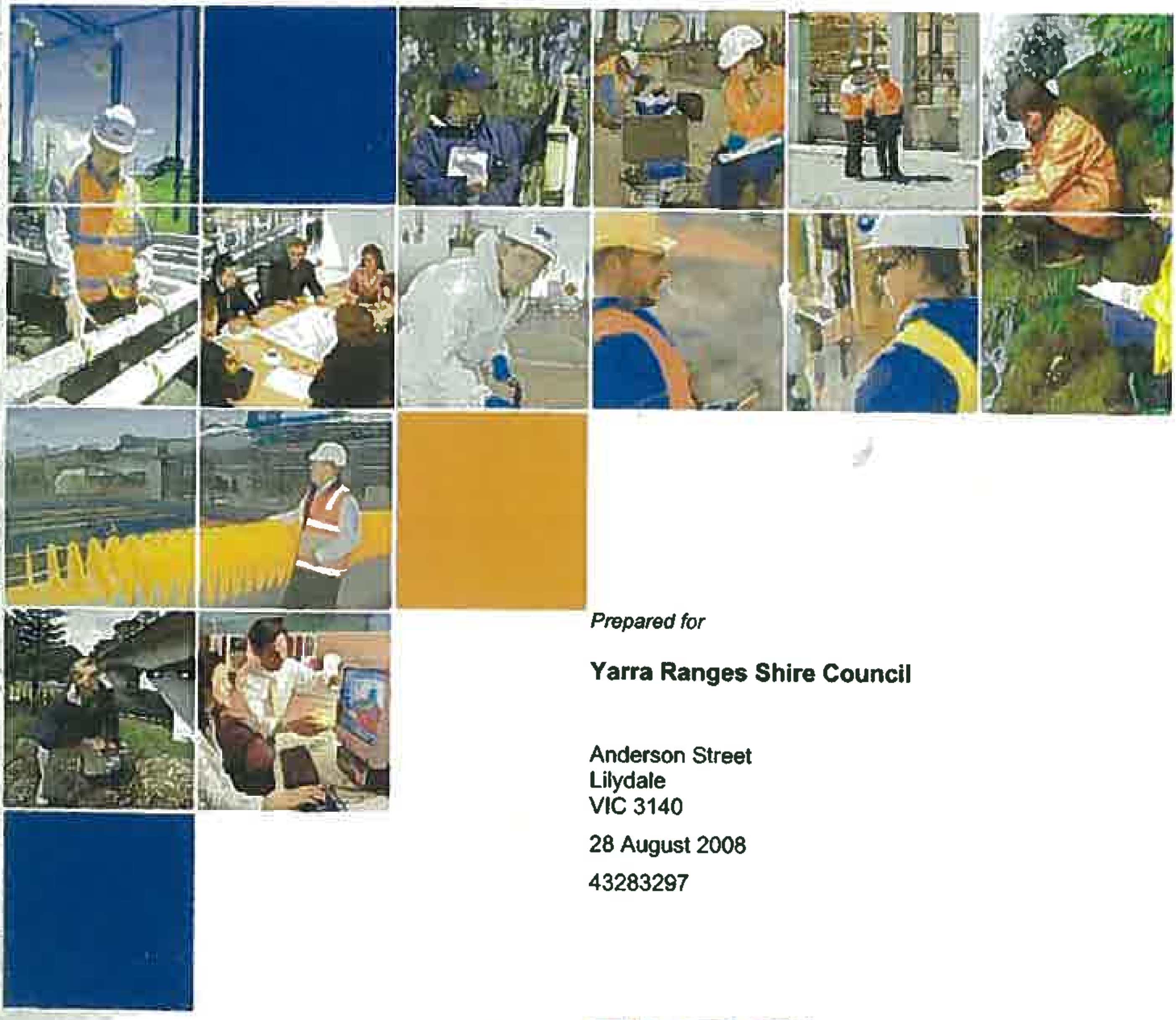
Once the SOER were generated, the surface area of the sources (windrows) were required to generate odour emission rates for each source, and the site in total. The surface area of each windrow is greater than the base area due to the elevation of the pile. Council officers measured the height, width and length of each windrow on 14th March 2007. This data was used to estimate the surface area of the windrows. Table 4-3 shows the measurements as detailed within Rhett English's Affidavit of the 16th March 2007.

Attachment 2F

August 08 TJP

REPORT

Odour assessment of proposed composting process at the ANL Premises, Lilydale



Prepared for

Yarra Ranges Shire Council

Anderson Street
Lilydale
VIC 3140

28 August 2008

43283297

URS

Emission Estimation — Appendix A

Assumptions made by URS in calculating odour emission rates and model inputs are described below.

A.1 Shredding of green waste

Emission rates used for the shredder were the same as those used in the 7 March 2008 and 18 March 2008 reports, being 5741 OU/second.

A.2 Shredded green waste stockpile

Isolation Flux Hood (IFH) samples of 1 week old shredded green waste taken by URS in March 2007 provided an odour concentration of 12,000 OU. The results of these tests were included as Appendix B-A of the 7 July 2007 report and Appendix F of the 7 March 2008 report. Using the flux rate of the nitrogen sweep gas (5 L/min), and the base area of the IFH (16"), this provides an odour emission rate of 7.7 OU/m^2/second.

Testing by ETC (8 April 2008) showed that the results obtained using IFH sampling techniques are under estimated by a factor of 20 in comparison to measurements using a Witches hat for very young windrows, due to the large fluxes generated in the first few weeks. This under estimation drops to 1.5 times by week 6. The Premises procedure shows that green waste will remain in the stockpile for a maximum of 5 days. The flux rate determined by URS using IFH testing has been increased 20 fold to account for this under estimation compared to the Witches Hat method, giving an emission rate from the shredded green waste stockpile of approximately 154 OU/m^2/second.

Modelling of the stockpile has been undertaken using an area source of dimensions 25m X 9m X 8, taken from the proposed layout of the Premises provided by GHD in its August 2008 report. Odour sampling of the green waste stockpile by URS in March 2007 was taken at approximately waist height on the stockpile side. The odour emission rate has therefore been applied equally over the entire surface area of the stockpile.

To reflect the modelling of a three dimensional stockpile as a two dimensional source in the modelling, the odour emission rate ~~has been multiplied~~ by a surface to footprint ratio of 2.04:1 to provide the emission rate used in the modelling of 314.5 OU/m^2/sec.

3.42 : 1

A.3 Creation of Stage 1 windrows

No testing has been undertaken for disturbance of the green waste stockpile. It is not therefore possible to model the odour emissions that arise when the green waste is transferred into a Stage 1 windrows. It is considered, however that the odour emission rate is likely to be higher than the emission rate that occurs during transference from Stage 1 windrows to Stage 2 windrows. This is likely as water is added and no aeration or temperature control is used in the green waste stockpile, which is likely to produce anaerobic conditions. Movement of the green waste stockpile is likely to be a major odour source from the proposed process, however no data is currently available to determine the impact on the surrounding residents.

A.4 Bio-filters

The trial Stage 1 windrow and bio-filter were 50m X 9m X 4m and 8m X 5m (40m^2) respectively. The proposed Stage 1 windrows will also be 50m X 9m X 4m.

Modelling by GHD (August 2008 report) has included 1 bio-filter, of size 16m X 10m (160m^2) for the treatment of odour from 8 Stage 1 windrows. The 'indicative proposed site layout' included as part of GHD's August 2008 report shows 9 Stage 1 windrows and 2 bio-filters. As there is a discrepancy between the proposed site layout,

Attachment 2G

26 February 2008

Report No: 080032r

Page: 1 of 9

Australian Native Landscapes Pty Ltd
527 Maroondah Highway
Coldstream VIC 3770

Odour testing: February 2008
Trommel

Dear Mr Tony Farriciello,

Tests were performed 13 February 2008 to determine emissions to air from the Trommel at the Coldstream plant of Australian Native Landscapes Pty Ltd.

Yours faithfully
Emission Testing Consultants

Terry Burkitt
Director
terryburkitt@emission.com.au

NATA Accredited Laboratory Number 14601
This document is issued in accordance with NATA's accreditation requirements.

INTRODUCTION

Trommel

Sampling was conducted at two downwind locations; the western and southern sides during trommel operation.

Upwind sampling was also conducted during trommel operation.

DEFINITIONS

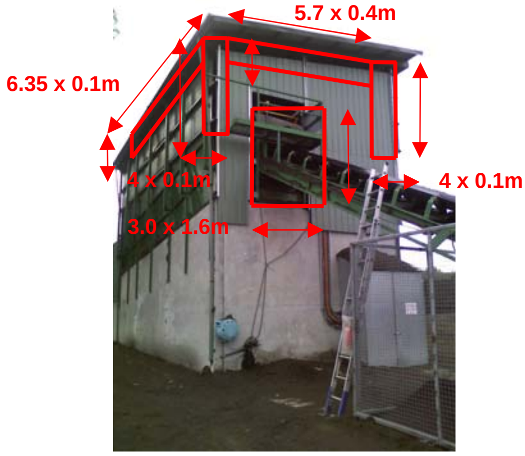
The following symbols and abbreviations are used in this test report:

NTP	Normal temperature and pressure. Gas volumes and concentrations are expressed on a dry basis at 0°C, at discharge oxygen concentration and an absolute pressure of 101.325 kPa, unless otherwise specified.
Nm^3/min	Flow rate (m^3/min) at NTP conditions
Odour unit	One odour unit (ou) is that concentration of odorant(s) at standard concentrations that elicits a physiological response from a panel (detection threshold) equivalent to that elicited by one Reference Odour Mass (ROM), evaporated in one cubic metre of neutral gas at standard conditions.
>	Greater than
<	Less than the minimum limit of detection using the specified method.
~	Approximately
NA	Not applicable

SAMPLING OVERVIEW AND OBSERVATIONS

Trommel

Wind direction and air flow



West & north face emission areas

Wind direction and air flow

South face emission areas

Windrow 14 was being processed through the trommel during the monitoring programme.

Air was entering the eastern face of the trommel building and observed to be exiting gaps in the northern and western faces of the building and the lower 2m of the western and central bays in the southern face.

The major exit points were:

1. Horizontal slot in western wall below roof level (5.7m x 0.4m)
2. Western half of horizontal slot in northern wall below roof level (6.35m x 0.1m)
3. Vertical slot in south west corner (4m x 0.1m)
4. Vertical slot in north west corner (4m x 0.1m)
5. Conveyer entry point (3m x 1.6m). Effective area assumed to be half the total area (1.5m x 1.6m).
6. Western and central bays in southern face (2m x 8m). Based on dust observations; emissions assumed to be from lower 2m of the two bays only.

Integrated odour samples (grab) and velocity measurements were performed at the following locations:

A. Point 1 – Single integrated odour and simultaneous velocity measurements from 4 equally spaced points.
B. Point 6 – Single integrated odour and simultaneous velocity measurements from 4 equally spaced points within each of the two bays (ie total of 8 points; 4 per bay).
C. Single upwind sample approximately 20m south east of the trommel building.

Downwind sampling was conducted at A and B simultaneously. The upwind sample was collected immediately after the downwind sampling was completed.

<u>Assumptions:</u>

- The odour concentration and velocity at exit points 2 to 5 were equal to those measured at point 1 (safe access was not possible to points 2 to 5).
- Emissions from exit point 6 were not continuous. Sampling was conducted during a period of positive exit air flow.

TEST METHODS

The following methods are accredited with the National Association of Testing Authorities (NATA) and are approved for the sampling and analysis of gases. Specific details of the methods are available on request.

All sampling and analysis conducted in accordance with EPA Vic approved methods and EPA publication 440.1.

All parameters are reported adjusted to dry NTP conditions unless otherwise stated.

On site sampling guidelines: according to ETC method 1.

Odour sampling (trommel): sample collection according to AS4323.3, by collection into Nalophan sample bags using the 'lung' principle.

Flow rate and velocity (trommel): using a digital impellor anemometer. Temperature determined using a calibrated thermocouple and digital pyrometer. Sampling was conducted 'at the centre of equal areas' in accordance with AS4323.1.

Notes:

Emission Testing Consultants are not accredited by NATA for sampling using an anemometer.

Odour analysis: according to AS4323.3, by dynamic olfactometry (forced-choice technique). Panel n-butanol threshold determination by analysis against a NATA certified n-butanol gas standard.

All samples were analysed the same afternoon as collection.

DEVIATIONS FROM TEST METHODS

There were no deviations from standard methods.

ODOUR SAMPLING AND ANALYSIS PARAMETERS

Technique:	AS4323.3 - Forced Choice	
Date and time of analysis:	13/02/08 @ 1300 – 1400 hrs	
Pre-dilution: Trommel	Nil	
Quality Requirements	**Acceptance criteria**	**Current value**
Panel n-Butanol threshold value (ppb)	20-80	59
Repeatability “r”	≤0.477	0.353
Repeatability “10r”	≤3.00	2.25
Accuracy “A”	<0.217	0.16

WEATHER OBSERVATIONS

Weather conditions were obtained from:

1. The Bureau of Meteorology website for Coldstream (weather station 086383). Refer to **APPENDIX 1**
2. ANL weather station (ANL Coldstream – 15 minute average values). Refer to **APPENDIX 2**

RESULTS

Trommel: West and north face emission areas

13 February2008

Flow Results		Trommel080032
Time of flow tests	0850 - 0900	hrs
Total exit area	6.1	m^2
Velocity at sampling plane	2.1	m/s
Average temperature	14	°C
Flow rate at discharge conditions	770	m^3/min
Flow rate at wet NTP conditions	730	m^3/min
Flow rate at dry NTP conditions	730	m^3/min

Odour Results Trommel080032	**Sample ID**	**Sampling Times**	**Concentration**			**Mass rate**	
Odour (Exit)	98	0850-0900		79	ou	58,000	ouv/min
Odour (upwind)	125	0920-0928	<	30	ou	-	ouv/min

Note: Odour mass rate is calculated based upon the total estimated emission area (refer to diagrams on page 3). Total emission area is estimated to be 6.1m^2.

Trommel: Southern face emission areas

13 February 2008

Flow Results		Trammel080032
Time of flow tests	0850 - 0900	hrs
Dimensions at sampling plane	8000 x 2000	mm
Velocity at sampling plane	0.39	m/s
Average temperature	14	°C
Flow rate at discharge conditions	370	m^3/min
Flow rate at wet NTP conditions	360	m^3/min
Flow rate at dry NTP conditions	360	m^3/min

Odour Results (Trammel080032)	Sample ID	Sampling Times	Concentration			Mass rate	
Odour (Exit)	4	0850-0900		110	ou	38,000	ouv/min
Odour (Upwind)	125	0920-0928	<	30	ou	-	ouv/min

Note: Odour mass rate is calculated based upon the estimated emission area shown in red in the diagram above. Emission area is assumed to be 8m x 2m.

APPENDIX: Weather observations (Bureau of Meteorology)

Date	Day	Temps		Rain	Evap	Sun	Max wind gust			9:00 AM						3:00 PM					
		Min	Max				Dir	Spd	Time	Temp	RH	Cld	Dir	Spd	MSLP	Temp	RH	Cld	Dir	Spd	MSLP
		°C	°C	mm	mm	hours		km/h	local	°C	%	8^{th}		km/h	hPa	°C	%	8^{th}		km/h	hPa
1	Fr	8.5	26.5	10.4			W	31	18:04	13.7	81		NE	7	1019.5	24.8	48		S	11	1015.7
2	Sa	13.6	30.6	0			WSW	41	13:53	19.5	78		W	9	1015.5	29.2	46		WSW	30	1012.4
3	Su	16.8	28.7	0			ESE	43	15:46	20	79		W	11	1016	27.9	53		SW	13	1011.5
4	Mo	17.2	32.2	0			SSE	31	17:51	20	81			Calm	1012.8	31.5	34		WSW	7	1008.5
5	Tu	17.1	23.7	0			SW	28	12:52	20.4	82		W	20	1011.4	23.5	66		SW	17	1009.6
6	We	14.5	25.1	0			SSE	28	16:25	20.4	81		WSW	6	1004.3	21.7	76		S	11	1000.6
7	Th	12.9	18.3	2.8			SW	52	2:10	13.5	93		WNW	4	1006	17.1	60		SSW	20	1007.2
8	Fr	12	19	0.4			SSE	39	16:59	13.8	62		SE	11	1011	14.3	79		SSW	22	1010.2
9	Sa	6	21.3	2.2			SE	43	15:32	12.6	92		NE	6	1013.6	20.5	49		S	15	1011.5
10	Su	5.5	23.9	0			S	39	17:33	12.4	88		N	2	1015.7	22.6	36		SSW	11	1012.6
11	Mo	5.9	29.2	0			SSE	30	18:52	13.2	87		N	7	1015.5	27.4	37		W	11	1009
12	Tu	13.2	25.8	0			SW	41	13:42	18.9	76		NNE	4	1008.4	24	58		SW	26	1006.8
13	We	10.8	20.5	0			S	44	14:38	13.5	59		SSE	15	1016.7	19.5	40		S	22	1015.9
14	Th	13.4		0.6						14.3	96		SSW	6	1020.6						

Attachment 2H

21 March 2007 **Report No:** 070071r

Australian Native Landscapes Pty Ltd
527 Maroondah Highway
Coldstream VIC 3770

Emission Testing – March 2007
Leachate pond

Dear Mr Tony Farriciello,

Tests were performed on 14 March 2007 to determine emissions to air from the Leachate pond at the Coldstream plant of Australian Native Landscapes Pty Ltd.

Yours faithfully
Emission Testing Consultants

T. B

Terry Burkitt
Director

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NATA Accredited Laboratory Number 14601

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DEFINITIONS

The following symbols and abbreviations are used in this test report:

NTP	Normal temperature and pressure. Gas volumes and concentrations are expressed on a dry basis at 0°C, at discharge oxygen concentration and an absolute pressure of 101.325 kPa, unless otherwise specified.
Nm^3/min	Flow rate (m^3/min) at NTP conditions
Odour unit	One odour unit (ou) is that concentration of odorant(s) at standard concentrations that elicits a physiological response from a panel (detection threshold) equivalent to that elicited by one Reference Odour Mass (ROM), evaporated in one cubic metre of neutral gas at standard conditions.

SAMPLING LOCATION DESCRIPTIONS AND OBSERVATIONS

Leachate pond (south)

Sampling

Duplicate odour samples (isolation flux) were collected from the southern end of the leachate pond. Sampling was conducted approximately 3m from the bank (refer to **'APPENDIX 2: Sampling locations'**).

Observations

The water was dark brown in colour and opaque. A slight oily film was observed on the surface.

A strong offensive odour was observed down wind of the pond.

Leachate pond (north)

Sampling

Duplicate odour samples (isolation flux) were collected from the northern end of the leachate pond. Sampling was conducted approximately 3m from the bank (refer to **'APPENDIX 2: Sampling locations'**).

Observations

The water was dark brown in colour and opaque. A slight oily film was observed on the surface.

A strong offensive odour was observed down wind of the pond.

TEST METHODS

The following methods are accredited with the National Association of Testing Authorities (NATA) and are approved for the sampling and analysis of gases. Specific details of the methods are available on request.

All sampling and analysis conducted in accordance with EPA Vic approved methods and EPA publication 440.1.

On site sampling guidelines: according to ETC method 1.

Odour sampling (isolation flux): according to ETC method 130 using an equilibrium flux chamber.

Given the recent development of the draft Australian Standard for area source measurement (AS4323.4), quality control protocols outlined in the draft standard were adopted if not otherwise stated in ETC method 130. Isolation flux chambers which are compliant with the draft standard and the specifications of USEPA user guide (1986 EPA/600/8) *were used.*

Odour analysis: according to AS4323.3, by dynamic olfactometry (forced-choice technique). Panel n-butanol threshold determination by analysis against a NATA certified n-butanol gas standard. Sampling conducted in duplicate. Concentrations reported on a wet NTP basis.

Odour analysis was conducted with 6 member odour panels.

All samples were analysed the same afternoon as collection.

DEVIATIONS FROM TEST METHODS

There were no deviations from standard methods.

ODOUR SAMPLING AND ANALYSIS PARAMETERS

Technique:	**AS4323.3 - Forced Choice**	
Date and time of analysis:	14/04/07 @ 1400 – 1530 hrs	
Pre-dilution:	2 L sample air + 10 L dilution air (1 in 6)	
Pre-dilution equipment:	Dry Gas Meter 040	
Quality Requirements	**Acceptance criteria**	**Current value**
Panel n-Butanol threshold value (ppb)	20-80	61
Repeatability "r"	≤0.477	0.229
Repeatability "10r"	≤3.00	1.70
Accuracy "A"	<0.217	0.189

WEATHER OBSERVATIONS

Weather conditions were taken from the Bureau of Meteorology website for Coldstream (weather station 086383). Refer to **'APPENDIX 1: Weather observations'** for details.

RESULTS

Leachate pond (south)

14 March 2007

Location	**Leachate pond (south)**	
Date tested	14/3/07	
Equilibration time, hrs	0920 - 0950	
Sample identification	51	172
Sample dilution	1 in 6	1 in 6
Sampling time, hrs	0950 - 0951	0955 - 0956
odour concentration, ou	600	640
Average odour concentration, ou	**620**	
Average odour flux rate, ou/m²/min	**23**	
Source area*, m^2	**930**	
odour mass rate*, ou/min	**21000**	
Surface temperature (°C)	21.3	
Chamber temperature (°C)	17.9	
Ambient temperature (°C)	16.8	

**** The source area reported is half the total area of the leachate pond. The odour mass rate represents the odour emissions from the southern half of the leachate pond only.***

Leachate pond (north)

14 March 2007

Location	Leachate pond (north)	
Date tested	14/3/07	
Equilibration time, hrs	1007 - 1036	
Sample identification	134	169
Sample dilution	1 in 6	1 in 6
Sampling time, hrs	1036 - 1037	1041 - 1042
odour concentration, ou	420	570
Average odour concentration, ou	**490**	
Average odour flux rate, ou/m²/min	**18.0**	
Source area*, m^2	**930**	
odour mass rate*, ou/min	**17000**	
Surface temperature (°C)	22.3	
Chamber temperature (°C)	21.7	
Ambient temperature (°C)	17.8	

**** The source area reported is half the total area of the leachate pond. The odour mass rate represents the odour emissions from the northern half of the leachate pond only.***

APPENDIX 1: Weather observations

Coldstream, Victoria
March 2007 Daily Weather Observations

Date	Day	Temps Min	Temps Max	Rain	Evap	Sun	Max wind gust Dir	Max wind gust Spd	Max wind gust Time	9:00 AM Temp	9:00 AM RH	9:00 AM Cld	9:00 AM Dir	9:00 AM Spd	9:00 AM MSLP	3:00 PM Temp	3:00 PM RH	3:00 PM Cld	3:00 PM Dir	3:00 PM Spd	3:00 PM MSLP
		°C	°C	mm	mm	hours	km/h		local	°C	%	8th	km/h		hPa	°C	%	8th	km/h		hPa
1	Th	13.6	27.9	0			SSE	37	15:46	18.6	85		NW	4	1010	27.2	50		SSW	17	1007.1
2	Fr	14.1	32	0			SE	28	18:18	18.1	86		Calm		1007.9	30.4	37		W	9	1003
3	Sa	13.8	36.8	0			SW	52	15:12	25	54		N	7	1002.8	35.2	23		NNW	17	1000.4
4	Su	15.6	24.8	0.4			SSE	35	18:48	17.8	82		W	13	1011.8	24	42		W	19	1011
5	Mo	14.4	22.3	0			S	43	11:45	16.6	61		SSW	17	1018.3	21.2	41		SSW	26	1018.7
6	Tu	10.1	27.2	0			NE	37	12:32	15.6	58		ESE	15	1021.8	26.2	29		S	6	1017.6
7	We	6	31.1	0			N	54	11:18	20.1	55		N	15	1015.6	29.4	32		N	28	1009.4
8	Th	14.1	21.4	1.2			SW	39	12:37	15.9	85		N	7	1013.1	20.5	47		SW	24	1012.9
9	Fr	9.2	26.6	0			SSE	44	11:06	14.9	71		S	7	1015.8	24.7	38		SSW	15	1012.3
10	Sa	5.5	32.5	0			SE	20	19:09	14.4	86		E	6	1010.4	30.7	26		SW	7	1005
11	Su	11.5	25	0			WSW	43	13:07	18.5	75		WSW	11	1005.7	23.7	49		SSW	26	1007.3
12	Mo	14.6	21.7	0			SSW	48	13:15	15.3	57		SSE	17	1017.8	20.5	43		S	22	1017.3
13	Tu	3.9	26	0			S	37	17:31	10.3	92		Calm		1023.1	25	33		SSW	15	1018.9
14	We	5.5	31.8	0			W	28	13:47	12.9	80		NE	4	1020.3	30.2	24		WSW	7	1014.4
Statistics for the first 21 days of March 2007																					
Mean		10.8	27							16.1	78			7	1014.8	25.5	42			15	1011.9
Lowest		2.7	20.5	0						8.6	49		Calm		1002.8	18.8	23		Calm		1000.4
Highest		19	36.8	9.6			N	54		25	99		#	17	1023.1	35.2	99		N	28	1018.9
Total				24																	

Weather conditions were taken from the Bureau of Meteorology website for Coldstream (weather station 086383).

APPENDIX 2: Sampling locations

Note: The above image does not show the recent upgrades to the leachate pond or the site.

Appendix 2
Memo from T Pollock - Wodonga Composting Trial Report (Doc 6529)

19 February 2013

To	Transpacific Cleanaway, Blueprint Planning		
Copy to			
From	Tim Pollock	Tel	61 2 6043 8716
Subject	Summary of Transpacific Cleanaway Wodonga Composting Trial - Dec - Jan 2013	Job no.	31/29006

1 Summary

Transpacific Cleanaway (TCL) undertook a composting trial at its Wodonga recycling depot between December 2012 and January 2013. The trial was undertaken in order to collect additional information on odour emissions from greenwaste and grease trap waste in an aerated process utilising the Gore® composting system.

The sampling of odour emissions was undertaken in four surveys between 18 December 2012 and 29 January 2013. Sampling was undertaken on aerated and quiescent windrows by the The Odour Unit (TOU) using the isolation flux chamber (IFC) method, a NSW EPA approved methodology. A series of samples using the 'draped wind tunnel' method was also collected on the sampling undertaken on the 15th January 2013 in order to gather comparative information on the two sampling methodologies. All analysis, olfactometry testing and the calculation of Specific Odour Emission Rates (SOERs) for IFCs was performed by TOU.

The results of the trial indicate that:

- The SOERs during aeration show an approximate doubling from the quiescent values.
- Odour emission rates reduce significantly after the initial mixing of greenwaste and greasetrap waste.
- Odour characterisation changed from a 'grease' or 'garbage' character in the initial mixing phase to 'dirt', 'musty' or 'compost' characteristics within a week or two, indicating that offensive odour may be experienced at the initial mixing stage but is expected to become less offensive in a short period.
- The draped wind tunnel gave higher SOERs on the aerated windrows than did the IFC.
- The factor of increase (difference between IFC and draped wind tunnel) for the sampling event undertaken was measured at 4.4:1 for the 1 week old windrow, and 2.2:1 for the 4 week old windrow. These values are well below the 12:1 factor found by GHD on an aerated windrow with an Aerosorb cover (a separate investigation) and subsequently used in the Gerogery EIS. This result highlights the potential differences between windrow cover materials in their ability to contain volatile organics (and odour).

A comparison with other relevant data sets has also been undertaken. In particular the recent TCL dataset from Timaru, New Zealand (September 2012) and the dataset obtained from a trial windrow at Camden (2006) were examined. The findings from the comparison were:

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- The Camden SOER data (used in the Gerogery EIS) were found to be substantially higher than that measured in either the Timaru or Wodonga trials.
- The Camden dataset was the only Gore® windrow dataset available to GHD at the time of EIS compilation. The substantial difference in SOER data means that the EIS modelled predictions of peak odour impact are substantially over-estimated.
- SOER's associated with the Wodonga greenwaste and grease trap mix are similar to those measured at Timaru (greenwaste and foodwaste). This suggests that grease trap waste yields only a marginal increase in SOER compared to food waste.

2 Trial Background & Objectives

TCL has sought planning consent to construct and operate an organics composting facility at Gerogery, NSW. The planning application required the compilation of an EIS which included the consideration of potential air impacts associated with air emissions. An air emissions modelling exercise consistent with NSW EPA requirements was undertaken. This modelling was undertaken using SOER data obtained from a variety of sources. TCL's compost trial at Camden (2006) (involving a blend of green waste and food waste) was used as the primary source of the SOER data for the EIS.

Whilst covered and aerated windrow composting has been practiced in Australia for some time, Gore® composting technology has not been operationally utilised in Australia. In addition, the TCL proposal included the incorporation of grease trap waste into the mix of kerbside collected greenwaste and food waste materials to be composted. No specific SOER data was available on the Gore® composting process utilising grease trap material.

TCL collected SOER data from the Timaru (New Zealand) Gore® cover composting operation in September 2012. This site composts a mix of green waste (85%) and food waste (15%).

TCL considered that it would be helpful for this and future composting projects to collect specific information on the application of Gore® cover technology in an Australian situation, and to collect SOER data on covered windrow emissions for a grease trap waste added to a green waste base. Accordingly TCL initiated a trial at the Wodonga recycling depot.

Key objectives of the trial were therefore to:

- Compile SOER data on the composting of a greenwaste and grease trap waste mix using Gore® cover technology.
- Make a preliminary comparison between IFC and draped wind tunnel sampling methods in order to provide an indication of the potential difference in results between methods and the level of conservatism built into the odour modelling conducted for the Gerogery project.
- Undertake a high level comparison of SOER data obtained from three separate TCL composting trials and facilities.

2.1 Trial Design & Methods

2.1.1 Equipment

The trial was undertaken on a gravel hardstand at the rear of the TCL depot in Wodonga. It involved the following components:

- A bed of large dimension shredded wood, bark and sticks approximately 300 mm thick.
- An aeration system, manifold and dual diffuser pipes inserted within the bed of organic material and covered with woodchips to ensure good air movement into the base of the windrow.
- A Gore cover (tarpaulin) capable of covering the windrow, held in place with straps and weights.
- A number of temperature and oxygen sensors incorporated into probes inserted into the windrow at appropriate locations. The sensors provide real time information on windrow conditions at different locations and are linked to a logger and PC.

The trial simulated as closely as possible the proposed arrangements for the Gerogery project.

2.1.2 Raw Material and Composting Arrangements

Greenwaste comprising old oversize material (same as the bed), timber, tree and garden residues was utilised.

An initial bed of old sticks and organic material (simulating oversize composted material) was placed in a layer approximately 300 mm thick in an open ended bin. Raw liquid grease trap material (as received) was then applied via a hose (approximately 500 L) from an adjacent vacuum truck / tanker. The mixing ratio was approximately 4:1 by weight (4 parts solid to 1 part liquid/sludge). The resultant mix was not sloppy or wet (after mixing it was still drier than what was optimal- requiring the addition of water). This was repeated with freshly chipped green waste and grease trap (approximately 500 L) material being added. The material was progressively mixed and extra water added to optimize the moisture content for composting. It was then transferred to the bed of oversize organic material, where a windrow / heap approximately 2 m high, with a base approximately 5 m x 8 m was constructed over the bed containing two aeration / diffuser pipes. The Gore® cover was placed over the heap, anchored in place and the two probes (oxygen and temperature) were inserted.

An initial windrow / heap was constructed on the 18th December 2012. A second heap was constructed on the 5th January 2013. The two heaps were separated in the windrow by a similar quantity of bed material (oversize organic matter). This allowed the heaps to be separated for air emissions testing.

A series of photographs showing the equipment, raw materials and windrows are provided in Attachment 1.

2.2 Air Emissions Sampling and Testing Program

An air emissions sampling program was undertaken by TOU using the IFC NSW EPA approved methodology. Sampling was undertaken on 18 December 2012, 15 January 2013, 22 January 2013 and 29 January 2013.

Sampling was undertaken on both heaps in “aeration on” (active) and “aeration off” (quiescent) operating phases. The timing of the sampling and the creation of two heaps approximately 3 weeks apart allowed for emissions associated with the maturation of the heaps to be trended over time.

Emissions sampling using the ‘draped wind tunnel’ method was undertaken by Emission Testing Consultants (ETC) at the same time and under the same operating conditions on the 15 January 2013.

Testing and analysis of all samples, including olfactometry analysis was undertaken by TOU at their laboratory in Sydney.

The raw data and results from the sampling and testing program are presented in Attachment 2.

3 Results and Observations

The results of the trial are presented in Table 1 below. For comparative purposes data from Timaru (New Zealand) and Camden has also been included. The Camden data (2006) was utilised in the EIS produced for the project. The Timaru sample data was collected in September 2012.

3.1 Wodonga Trial results

- A progressive decrease in SOER occurs with windrow age. The most significant decrease occurs after an initial period (within the first week) ie. following the blending of the grease trap waste into the solid material.
- The SOER data at week 4 appears anomalous, and is considered by TCL to reflect a decrease in moisture content during a series of unusually high temperature days, resulting in a reduced efficacy of the Gore® membrane to reduce transmittal of odorants. Under commercial scale operating conditions, water would be added to compensate for this, but in the case of this trial, this would have involved disturbing the whole heap structure, so it was decided not to do it.
- The SOERs during aeration show an approximate doubling from the quiescent values.
- Odour characterisation changed from a ‘grease’ or ‘garbage’ character in the initial mixing phase to ‘dirt’, ‘musty’ or ‘compost’ characteristics within a week or two, indicating that offensive odour may be experienced at the initial mixing stage but is expected to become less offensive in a short period.

3.1.1 IFC vs draped wind tunnel

- The draped tunnel data for this sampling event is valid only for the aerated measurements (the quiescent measurements were inadvertently taken with the tunnel fan on full. This had the effect of super-imposing an unrealistic wind stripping effect).
- The draped wind tunnel gave higher SOERs on the aerated windrows than did the IFC, reflecting the limitation of IFCs when used on permeable and semi-permeable surfaces.
- The factor of increase (difference between IFC and draped wind tunnel) for the sampling event undertaken was measured at 4.4:1 for the 1 week old windrow (0.22 vs. 0.97), and 2.2:1 for the 4 week old windrow (0.2 vs. 0.43).

- These values are well below the 12:1 factor found by GHD on an *aerated* windrow with an Aerosorb® cover (a separate investigation) and subsequently used in the EIS (Air Quality Assessment, section 7.1.4). This result highlights the differences between windrow cover materials in their ability to reduce emissions of volatile organics (and odour). The Aerosorb® cover material consists of fully woven fabric. The Gore® cover material consists of a PTFE layer sandwiched between two polyester layers. It is semi-permeable and has the capacity to reduce the movement of water and volatile organics from the composting material to the environment.

Table 1 Measured SOER Data on Gore covered Windrows, OUm/s

Data set	Wodonga (Vic) (Dec 2012 – Jan 2013)				Camden (NSW) (2006)		Timaru (NZ) (Sept 2012)	
Age, weeks	GW + grease trap				GW + food waste		GW (85% garden greens) + Food waste (15%)	
	IFC		Draped Tunnel		IFC		IFC	
	quiescent	aerated	quiescent	aerated	quiescent	aerated	quiescent	aerated
0	0.32	0.84			7.7	9.5	0.27	
1	0.10	0.22	-	0.97	1.1	5.1	0.25	0.89
2	0.15	0.32			0.36	1.76	0.36	0.47
3	-	-			0.85	11.9	0.042	0.087
4	0.18	0.2	4.7	0.43	0.07	0.5	0.023	0.073
5	0.14	0.14			2.0	6.2	0.11	0.30
6	-	-			0.29	1.7	0.10	0.22
7	-	-			0.4	1.2	0.065	0.133
8	-	-					-	-
Age mean	**0.18**	**0.34**			**1.6**	**4.7**	**0.15**	**0.31**

31/29006/6529

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3.2 Comparison with other relevant data sets

- The Wodonga IFC data returns age-mean SOERs for quiescent and aerated windrows that are marginally greater than the corresponding Timaru data (20% and 10% respectively). This suggests that grease trap waste yields only a marginal increase in SOER compared to food waste.
- The Camden dataset shows substantially higher SOER values, both for green waste and mixed (GW + food waste) waste windrows. TCL consider that the design and execution of the trial may have led to the sub-optimal performance of the Gore system in this instance.
- The combined correction factor to account for the (i) under-estimation of IFCs on a Gore cover (based on IFC vs. draped wind tunnel results (diversion)) and (ii) the effect of aeration, is very much lower than that found for an Aerosorb cover (4.4:1 compared to 3.5 (diversion)) x 12 (aeration) = 42:1 for phase 1 (weeks 1 to 4). Hence the EIS has substantially over-estimated the SOERs for the windrows.
- Allowing for the mean percentage of time of aeration in phase 1 of 20%, the factor of increase to correct for IFC underestimation used in the EIS modelling is (20% x 42 + 80% x 3.5 = 11.2). The revised factor of increase to correct for IFC underestimation for phase 1 windrows based on the Wodonga data is (4.4 + 2.2)/2 =3.3. Hence the reliance on data from windrows with Aerosorb covers has resulted in an overestimate of (11.2/3.3 = 3.4) for phase 1 windrows.
- The SOERs used in the EIS were based on the Camden data which are substantially higher than either the Wodonga or Timaru data. This is another factor (~ 10:1) which further increases the degree of over-estimation in the EIS results.

Please contact me should you wish to discuss further.

Regards

Tim Pollock
Principal Environmental Engineer

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Attachment 1 – Photographs from Wodonga Trial

Aeration equipment, manifold and probes

Organic bed with woody material containing the aeration pipes

Greenwaste being shredded

Grease trap waste application

Oversize material used in bed and buffer

Construction of windrow / heap

Aeration pipes in base of windrow

Gore cover with aeration operating (first heap)

	
Installation of air sampling equipment	First and second heap separated with inert buffer material
	
Temperature and oxygen probes inserted into composting material	IFC and draped wind tunnel sampling

Attachment 2 – Analytical Results

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NATA
Accreditation Number: 14974

Odour Concentration Measurement Results

The measurement was commissioned by:

Organisation	Transpacific Industries Group	Telephone	(02) 8700 2114
Contact	Geoff Hemm	Facsimile	(02) 9708 3399
Sampling Site	Wodonga, Vic	Email	Geoff.Hemm@transpac.com.au
Sampling Method	Isolation Flux Hood	Sampling Team	J. Schulz

Order details:

Order requested by	Geoff Hemm	Order accepted by	S. Hayes
Date of order	12/12/2012	TOU Project #	Q1848R.03
Order number	Refer to correspondence	Project Manager	J. Schulz
Signed by	Refer to correspondence	Testing operator	A. Schulz

Investigated Item — Odour concentration in odour units 'ou', determined by sensory odour concentration measurements, of an odour sample supplied in a sampling bag.

Identification — The odour sample bags were labelled individually. Each label recorded the testing laboratory, sample number, sampling location (or Identification), sampling date and time, dilution ratio (if dilution was used) and whether further chemical analysis was required.

Method — The odour concentration measurements were performed using dynamic olfactometry according to the Australian Standard 'Determination of Odour Concentration by Dynamic Olfactometry AS/NZS4323.3:2001. The odour perception characteristics of the panel within the presentation series for the samples were analogous to that for butanol calibration. Any deviation from the Australian standard is recorded in the 'Comments' section of this report.

Measuring Range — The measuring range of the olfactometer is $2^2 \leq \chi \leq 2^{18}$ ou. If the measuring range was insufficient the odour samples will have been pre-diluted. The machine is not calibrated beyond dilution setting 2^{17}. This is specifically mentioned with the results.

Environment — The measurements were performed in an air- and odour-conditioned room. The room temperature is maintained between 22°C and 25°C.

Measuring Dates — The date of each measurement is specified with the results.

Instrument Used — The olfactometer used during this testing session was:
ODORMAT SERIES V04

Instrumental Precision — The precision of this instrument (expressed as repeatability) for a sensory calibration must be $r \leq 0.477$ in accordance with the Australian Standard AS/NZS4323.3:2001.
ODORMAT SERIES V04: $r = 0.3234$ (September 2012) Compliance – Yes

Instrumental Accuracy — The accuracy of this instrument for a sensory calibration must be $A \leq 0.217$ in accordance with the Australian Standard AS/NZS4323.3:2001.
ODORMAT SERIES V04: $A = 0.1995$ (September 2012) Compliance – Yes

Lower Detection Limit (LDL) — The LDL for the olfactometer has been determined to be 16 ou (4 times the lowest dilution setting)

Traceability — The measurements have been performed using standards for which the traceability to the national standard has been demonstrated. The assessors are individually selected to comply with fixed criteria and are monitored in time to keep within the limits of the standard. The results from the assessors are traceable to primary standards of n-butanol in nitrogen.

Date: Friday, 21 December 2012

Panel Roster Number: SYD20121219_103

J. Schulz
NSW Laboratory Coordinator

A. Schulz
Authorised Signatory

Odour Sample Measurement Results
Panel Roster Number: SYD20121219_103

Sample Location	TOU Sample ID	Sampling Date & Time	Analysis Date & Time	Panel Size	Valid ITEs	Nominal Sample Dilution	Actual Sample Dilution (Adjusted for Temperature)	Sample Odour Concentration (as received, in the bag) (ou)	Sample Odour Concentration (Final, allowing for dilution) (ou)	Specific Odour Emission Rate (ou.m^3/m^2/s)
Sample #1 – Fresh Grease Blended (Uncovered)	SC12668	18/12/2012 1204hrs	19/12/2012 1133hrs	5	10	-	-	588	588	0.34
Sample #2 – Grease Only	SC12669	18/12/2012 1314hrs	19/12/2012 1231hrs	5	10	-	-	4,390	4,390	2.62
Sample #3 – Fresh Grease Blend Gore Cover (Non-Aerated)	SC12667	18/12/2012 1440hrs	19/12/2012 1103hrs	5	10	-	-	588	588	0.32
Sample #4 – Fresh Grease Blend Gore Cover (Aerated)	SC12666	18/12/2012 1510hrs	19/12/2012 1032hrs	5	10	-	-	724	724	0.84

Note: The following are not covered by the NATA Accreditation issued to The Odour Unit Pty Ltd:
1. The collection of Isolation Flux Hood (IFH) samples and the calculation of the Specific Odour Emission Rate (SOER).
2. Final results that have been modified by the dilution factors where parties other than The Odour Unit Pty Ltd. have performed the dilution of samples.

Odour Panel Calibration Results

Reference Odorant	Reference Odorant Panel Roster Number	Concentration of Reference gas (ppb)	Panel Target Range for n-butanol (ppb)	Measured Concentration (ou)	Measured Panel Threshold (ppb)	Does this panel calibration measurement comply with AS/NZS4323.3:2001 (Yes / No)
n-butanol	SYD20121219_103	50,000	$20 \leq \chi \leq 80$	832	60	Yes

Comments None.

Disclaimer Parties, other than TOU, responsible for collecting odour samples hereby certify that they have voluntarily furnished these odour samples, appropriately collected and labelled, to The Odour Unit Pty Ltd for the purpose of odour testing. The collection of odour samples by parties other than The Odour Unit Pty Ltd relinquishes The Odour Unit Pty Ltd from all responsibility for the sample collection and any effects or actions that the results from the test(s) may have.

Note This report shall not be reproduced, except in full, without written approval of The Odour Unit Pty Ltd. Any attachments to this Report are not covered by the NATA Accreditation issued to The Odour Unit Pty Ltd.

END OF DOCUMENT

THE ODOUR UNIT

Aust. Technology Park
Locomotive Workshop
Suite 16012
2 Locomotive Street
Eveleigh NSW 2015

Phone: +61 2 9209 4420
Facsimile: +61 2 9209 4421
Email: tschulz@odourunit.com.au
Internet: www.odourunit.com.au
ABN: 53 091 165 061

Accreditation Number: 14974

Odour Concentration Measurement Results

The measurement was commissioned by:

Organisation	Transpacific Industries Group	Telephone	(02) 8700 2114
Contact	Geoff Hemm	Facsimile	(02) 9708 3399
Sampling Site	Wodonga, Vic	Email	Geoff.Hemm@transpac.com.au
Sampling Method	Isolation Flux Hood	Sampling Team	J. Schulz

Order details:

Order requested by	Geoff Hemm	Order accepted by	S. Hayes
Date of order	12/12/2012	TOU Project #	Q1848R.03
Order number	Refer to correspondence	Project Manager	J. Schulz
Signed by	Refer to correspondence	Testing operator	A. Schulz

Investigated Item	Odour concentration in odour units 'ou', determined by sensory odour concentration measurements, of an odour sample supplied in a sampling bag.
Identification	The odour sample bags were labelled individually. Each label recorded the testing laboratory, sample number, sampling location (or Identification), sampling date and time, dilution ratio (if dilution was used) and whether further chemical analysis was required.
Method	The odour concentration measurements were performed using dynamic olfactometry according to the Australian Standard 'Determination of Odour Concentration by Dynamic Olfactometry AS/NZS4323.3:2001. The odour perception characteristics of the panel within the presentation series for the samples were analogous to that for butanol calibration. Any deviation from the Australian standard is recorded in the 'Comments' section of this report.
Measuring Range	The measuring range of the olfactometer is $2^2 \leq \chi \leq 2^{18}$ ou. If the measuring range was insufficient the odour samples will have been pre-diluted. The machine is not calibrated beyond dilution setting 2^{17}. This is specifically mentioned with the results.
Environment	The measurements were performed in an air- and odour-conditioned room. The room temperature is maintained between 22°C and 25°C.
Measuring Dates	The date of each measurement is specified with the results.
Instrument Used	The olfactometer used during this testing session was: ODORMAT SERIES V04
Instrumental Precision	The precision of this instrument (expressed as repeatability) for a sensory calibration must be $r \leq 0.477$ in accordance with the Australian Standard AS/NZS4323.3:2001. ODORMAT SERIES V04: $r = 0.3234$ (September 2012) Compliance – Yes
Instrumental Accuracy	The accuracy of this instrument for a sensory calibration must be $A \leq 0.217$ in accordance with the Australian Standard AS/NZS4323.3:2001. ODORMAT SERIES V04: $A = 0.1995$ (September 2012) Compliance – Yes
Lower Detection Limit (LDL)	The LDL for the olfactometer has been determined to be 16 ou (4 times the lowest dilution setting)
Traceability	The measurements have been performed using standards for which the traceability to the national standard has been demonstrated. The assessors are individually selected to comply with fixed criteria and are monitored in time to keep within the limits of the standard. The results from the assessors are traceable to primary standards of n-butanol in nitrogen.

Date: Friday, 18 January 2013

Panel Roster Number: SYD20130116_001

J. Schulz
NSW Laboratory Coordinator

A. Schulz
Authorised Signatory

Odour Sample Measurement Results
Panel Roster Number: SYD20130116_001

Sample Location	TOU Sample ID	Sampling Date & Time	Analysis Date & Time	Panel Size	Valid ITEs	Nominal Sample Dilution	Actual Sample Dilution (Adjusted for Temperature)	Sample Odour Concentration (as received, in the bag) (ou)	Sample Odour Concentration (Final, allowing for dilution) (ou)	Specific Odour Emission Rate (ou.m^3/m^2/s)
Sample #1 – (Side A) 4 Weeks Non-aerated	SC13001	15/01/2013 1135hrs	16/01/2013 1022hrs	4	8	-	-	362	362	0.18
Sample #2 – (Side A) 4 Weeks Aerated	SC13004	15/01/2013 1300hrs	16/01/2013 1201hrs	4	8	-	-	197	197	0.20
Sample #3 – (Side B) 1 Week Non-aerated	SC13006	15/01/2013 1400hrs	16/01/2013 1334hrs	4	8	-	-	197	197	0.10
Sample #4 – (Side B) 1 Week Aerated	SC13009	15/01/2013 1515hrs	16/01/2013 1456hrs	4	8	-	-	215	215	0.22

Note: The following are not covered by the NATA Accreditation issued to The Odour Unit Pty Ltd:

1. The collection of Isolation Flux Hood (IFH) samples and the calculation of the Specific Odour Emission Rate (SOER).
2. Final results that have been modified by the dilution factors where parties other than The Odour Unit Pty Ltd. have performed the dilution of samples.

THE ODOUR UNIT

THE ODOUR UNIT PTY LIMITED

NATA

Accreditation Number: 14974

Odour Sample Measurement Results
Panel Roster Number: SYD20130116_001

Sample Location	TOU Sample ID	Sampling Date & Time	Analysis Date & Time	Panel Size	Valid ITEs	Nominal Sample Dilution	Actual Sample Dilution (Adjusted for Temperature)	Sample Odour Concentration (as received, in the bag) (ou)	Sample Odour Concentration (Final, allowing for dilution) (ou)	Specific Odour Emission Rate ($ou.m^3/m^2/s$)
ID# 1035 (Side A) 4 Weeks Non-aerated	SC13002	15/01/2013 1213hrs	16/01/2013 1110hrs	4	8	-	-	256	256	4.17
ID# 1036 (Side A) 4 Weeks Wind Tunnel Inlet	SC13003	15/01/2013 1213hrs	16/01/2013 1138hrs	4	8	-	-	108	108	N/A
ID# 1037 (Side A) 4 Weeks Aerated	SC13005	15/01/2013 1310hrs	16/01/2013 1311hrs	4	8	-	-	181	181	0.40
ID# 1038 (Side B) 1 Week Non-aerated	SC13007	15/01/2013 1430hrs	16/01/2013 1359hrs	4	8	-	-	197	197	0
ID# 1039 (Side B) 1 Week Wind Tunnel Inlet	SC13008	15/01/2013 1430hrs	16/01/2013 1429hrs	4	8	-	-	197	197	N/A
ID# 1040 (Side B) 1 Week Aerated	SC13010	15/01/2013 1512hrs	16/01/2013 1523hrs	4	8	-	-	197	197	0.77

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Odour Panel Calibration Results

Reference Odorant	Reference Odorant Panel Roster Number	Concentration of Reference gas (ppb)	Panel Target Range for n-butanol (ppb)	Measured Concentration (ou)	Measured Panel Threshold (ppb)	Does this panel calibration measurement comply with AS/NZS4323.3:2001 (Yes / No)
n-butanol	SYD20130116_001	50,000	$20 \leq \chi \leq 80$	1,449	35	Yes

Comments None.

Disclaimer Parties, other than TOU, responsible for collecting odour samples hereby certify that they have voluntarily furnished these odour samples, appropriately collected and labelled, to The Odour Unit Pty Ltd for the purpose of odour testing. The collection of odour samples by parties other than The Odour Unit Pty Ltd relinquishes The Odour Unit Pty Ltd from all responsibility for the sample collection and any effects or actions that the results from the test(s) may have.

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END OF DOCUMENT

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Internet: www.odourunit.com.au
ABN: 53 091 165 061

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Accreditation Number: 14974

Odour Concentration Measurement Results

The measurement was commissioned by:

Organisation	Transpacific Industries Group	Telephone	(02) 8700 2114
Contact	Geoff Hemm	Facsimile	(02) 9708 3399
Sampling Site	Wodonga, Vic	Email	Geoff.Hemm@transpac.com.au
Sampling Method	Isolation Flux Hood	Sampling Team	J. Schulz

Order details:

Order requested by	Geoff Hemm	Order accepted by	S. Hayes
Date of order	12/12/2012	TOU Project #	Q1848R.03
Order number	Refer to correspondence	Project Manager	J. Schulz
Signed by	Refer to correspondence	Testing operator	A. Schulz

Investigated Item	Odour concentration in odour units 'ou', determined by sensory odour concentration measurements, of an odour sample supplied in a sampling bag.
Identification	The odour sample bags were labelled individually. Each label recorded the testing laboratory, sample number, sampling location (or Identification), sampling date and time, dilution ratio (if dilution was used) and whether further chemical analysis was required.
Method	The odour concentration measurements were performed using dynamic olfactometry according to the Australian Standard 'Determination of Odour Concentration by Dynamic Olfactometry AS/NZS4323.3:2001. The odour perception characteristics of the panel within the presentation series for the samples were analogous to that for butanol calibration. Any deviation from the Australian standard is recorded in the 'Comments' section of this report.
Measuring Range	The measuring range of the olfactometer is $2^2 \leq \chi \leq 2^{18}$ ou. If the measuring range was insufficient the odour samples will have been pre-diluted. The machine is not calibrated beyond dilution setting 2^{17}. This is specifically mentioned with the results.
Environment	The measurements were performed in an air- and odour-conditioned room. The room temperature is maintained between 22°C and 25°C.
Measuring Dates	The date of each measurement is specified with the results.
Instrument Used	The olfactometer used during this testing session was: ODORMAT SERIES V04
Instrumental Precision	The precision of this instrument (expressed as repeatability) for a sensory calibration must be $r \leq 0.477$ in accordance with the Australian Standard AS/NZS4323.3:2001. ODORMAT SERIES V04: $r = 0.3234$ (September 2012) Compliance – Yes
Instrumental Accuracy	The accuracy of this instrument for a sensory calibration must be $A \leq 0.217$ in accordance with the Australian Standard AS/NZS4323.3:2001. ODORMAT SERIES V04: $A = 0.1995$ (September 2012) Compliance – Yes
Lower Detection Limit (LDL)	The LDL for the olfactometer has been determined to be 16 ou (4 times the lowest dilution setting)
Traceability	The measurements have been performed using standards for which the traceability to the national standard has been demonstrated. The assessors are individually selected to comply with fixed criteria and are monitored in time to keep within the limits of the standard. The results from the assessors are traceable to primary standards of n-butanol in nitrogen.

Date: Friday, 25 January 2013

Panel Roster Number: SYD20130123_003

J. Schulz
NSW Laboratory Coordinator

A. Schulz
Authorised Signatory

THE ODOUR UNIT PTY LIMITED

Accreditation Number: 14974

Odour Sample Measurement Results
Panel Roster Number: SYD20130123_003

Sample Location	TOU Sample ID	Sampling Date & Time	Analysis Date & Time	Panel Size	Valid ITEs	Nominal Sample Dilution	Actual Sample Dilution (Adjusted for Temperature)	Sample Odour Concentration (as received, in the bag) (ou)	Sample Odour Concentration (Final, allowing for dilution) (ou)	Specific Odour Emission Rate ($ou.m^3/m^2/s$)
Sample #1 – (Side A) 5 Weeks Non-aerated	SC13023	22/01/2013 0950hrs	23/01/2013 1026hrs	4	8	-	-	256	256	0.14
Sample #2 – (Side A) 5 Weeks Aerated	SC13024	22/01/2013 1030hrs	23/01/2013 1050hrs	4	8	-	-	256	256	0.27
Sample #3 – (Side B) 2 Weeks Non-aerated	SC13025	22/01/2013 1140hrs	23/01/2013 1115hrs	4	8	-	-	304	304	0.15
Sample #4 – (Side B) 2 Weeks Aerated	SC13026	22/01/2013 1215hrs	23/01/2013 1136hrs	4	8	-	-	304	304	0.32

Note: The following are not covered by the NATA Accreditation issued to The Odour Unit Pty Ltd:

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Odour Panel Calibration Results

Reference Odorant	Reference Odorant Panel Roster Number	Concentration of Reference gas (ppb)	Panel Target Range for n-butanol (ppb)	Measured Concentration (ou)	Measured Panel Threshold (ppb)	Does this panel calibration measurement comply with AS/NZS4323.3:2001 (Yes / No)
n-butanol	SYD20130123_003	50,000	$20 \leq \chi \leq 80$	1,218	41	Yes

Comments None.

Disclaimer Parties, other than TOU, responsible for collecting odour samples hereby certify that they have voluntarily furnished these odour samples, appropriately collected and labelled, to The Odour Unit Pty Ltd for the purpose of odour testing. The collection of odour samples by parties other than The Odour Unit Pty Ltd relinquishes The Odour Unit Pty Ltd from all responsibility for the sample collection and any effects or actions that the results from the test(s) may have.

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END OF DOCUMENT

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Odour Concentration Measurement Results

The measurement was commissioned by:

Organisation	Transpacific Industries Group	Telephone	(02) 8700 2114
Contact	Geoff Hemm	Facsimile	(02) 9708 3399
Sampling Site	Wodonga, Vic	Email	Geoff.Hemm@transpac.com.au
Sampling Method	Isolation Flux Hood	Sampling Team	J. Schulz

Order details:

Order requested by	Geoff Hemm	Order accepted by	S. Hayes
Date of order	12/12/2012	TOU Project #	Q1848R.03
Order number	Refer to correspondence	Project Manager	J. Schulz
Signed by	Refer to correspondence	Testing operator	D. Hepple

Investigated Item — Odour concentration in odour units 'ou', determined by sensory odour concentration measurements, of an odour sample supplied in a sampling bag.

Identification — The odour sample bags were labelled individually. Each label recorded the testing laboratory, sample number, sampling location (or Identification), sampling date and time, dilution ratio (if dilution was used) and whether further chemical analysis was required.

Method — The odour concentration measurements were performed using dynamic olfactometry according to the Australian Standard 'Determination of Odour Concentration by Dynamic Olfactometry AS/NZS4323.3:2001. The odour perception characteristics of the panel within the presentation series for the samples were analogous to that for butanol calibration. Any deviation from the Australian standard is recorded in the 'Comments' section of this report.

Measuring Range — The measuring range of the olfactometer is $2^2 \leq \chi \leq 2^{18}$ ou. If the measuring range was insufficient the odour samples will have been pre-diluted. The machine is not calibrated beyond dilution setting 2^{17}. This is specifically mentioned with the results.

Environment — The measurements were performed in an air- and odour-conditioned room. The room temperature is maintained between 22°C and 25°C.

Measuring Dates — The date of each measurement is specified with the results.

Instrument Used — The olfactometer used during this testing session was:
ODORMAT SERIES V04

Instrumental Precision — The precision of this instrument (expressed as repeatability) for a sensory calibration must be $r \leq 0.477$ in accordance with the Australian Standard AS/NZS4323.3:2001.
ODORMAT SERIES V04: $r = 0.3234$ (September 2012) Compliance – Yes

Instrumental Accuracy — The accuracy of this instrument for a sensory calibration must be $A \leq 0.217$ in accordance with the Australian Standard AS/NZS4323.3:2001.
ODORMAT SERIES V04: $A = 0.1995$ (September 2012) Compliance – Yes

Lower Detection Limit (LDL) — The LDL for the olfactometer has been determined to be 16 ou (4 times the lowest dilution setting)

Traceability — The measurements have been performed using standards for which the traceability to the national standard has been demonstrated. The assessors are individually selected to comply with fixed criteria and are monitored in time to keep within the limits of the standard. The results from the assessors are traceable to primary standards of n-butanol in nitrogen.

Date: Thursday, 31 January 2013

Panel Roster Number: SYD20130130_007

J. Schulz
NSW Laboratory Coordinator

A. Schulz
Authorised Signatory

Odour Sample Measurement Results
Panel Roster Number: SYD20130130_007

Sample Location	TOU Sample ID	Sampling Date & Time	Analysis Date & Time	Panel Size	Valid ITEs	Nominal Sample Dilution	Actual Sample Dilution (Adjusted for Temperature)	Sample Odour Concentration (as received, in the bag) (ou)	Sample Odour Concentration (Final, allowing for dilution) (ou)	Specific Odour Emission Rate (ou.m^3/m^2/s)
Sample #1 – (Side A) 6 Weeks Non-aerated	SC13054	29/01/2013 1126hrs	30/01/2013 1022hrs	4	8	-	-	558	558	0.30
Sample #2 – (Side A) 6 Weeks Aerated	SC13055	29/01/2013 1209hrs	30/01/2013 1054hrs	4	8	-	-	664	664	0.69
Sample #3 – (Side B) 3 Week Non-aerated	SC13056	29/01/2013 1255hrs	30/01/2013 1128hrs	4	8	-	-	664	664	0.35
Sample #4 – (Side B) 3 Week Aerated	SC13057	29/01/2013 1255hrs	30/01/2013 1200hrs	4	8	-	-	861	861	0.90

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Odour Panel Calibration Results

Reference Odorant	Reference Odorant Panel Roster Number	Concentration of Reference gas (ppb)	Panel Target Range for n-butanol (ppb)	Measured Concentration (ou)	Measured Panel Threshold (ppb)	Does this panel calibration measurement comply with AS/NZS4323.3:2001 (Yes / No)
n-butanol	SYD20130130_007	50,000	$20 \leq \chi \leq 80$	1,024	49	Yes

Comments None.

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END OF DOCUMENT

THE ODOUR UNIT

MEMORANDUM

TO: Geoff Hemm

COMPANY: Transpacific Industries

CC:

FROM: James Schulz

DATE: 7 February 2013

COMPANY: The Odour Unit

JOB NO: Q1848R

NO OF PAGES: 1
Including cover sheet

REPLY REQUIRED NO

ORIGINAL TO FOLLOW NO

SUBJECT: ODOUR CHARACTER OF ODOUR SAMPLES TESTED ON 19/12/2012

Geoff,

Please find below the odour character for the samples that were analysed on 19/12/2012 at our Sydney laboratory (Roster Number: SYD20121219_103).

Sample Location	TOU Sample ID	Sampling Date & Time	Analysis Date & Time	Odour Character
Sample #1 – Grease Blended, Uncovered	SC12668	18/12/2012 1204 hrs	19/12/2012 1133 hrs	Greenwaste, pine
Sample #2 – Grease Tray	SC12669	18/12/2012 1314 hrs	19/12/2012 1231 hrs	Grease
Sample #3 – Gore Cover, Fan Off	SC12667	18/12/2012 1440 hrs	19/12/2012 1103 hrs	Garbage, grease
Sample #4 – Gore Cover, Fan On	SC12666	18/12/2012 1510 hrs	19/12/2012 1032 hrs	Garbage, grease

Kind Regards,
James Schulz

THE ODOUR UNIT

MEMORANDUM

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COMPANY: Transpacific Industries

CC:

FROM: James Schulz

DATE: 7 February 2013

COMPANY: The Odour Unit

JOB NO: Q1848R

NO OF PAGES: 1
Including cover sheet

REPLY REQUIRED NO

ORIGINAL TO FOLLOW NO

SUBJECT: ODOUR CHARACTER OF ODOUR SAMPLES TESTED ON 15/01/2013

Geoff,

Please find below the odour character for the samples that were analysed on 15/01/2013 at our Sydney laboratory (Roster Number: SYD20130116_001).

Sample Location	TOU Sample ID	Sampling Date & Time	Analysis Date & Time	Odour Character
Sample #1 – Gore Cover, 4 Weeks Old, Fan Off	SC13001	15/01/2013 1135 hrs	16/01/2013 1022 hrs	Musty, earthy, dusty
Sample #2 – Gore Cover, 4 Weeks Old, Fan On	SC13004	15/01/2013 1300 hrs	16/01/2013 1201 hrs	Musty
Sample #3 Gore Cover, 1 Week Old, Fan Off	SC13006	15/01/2013 1400 hrs	16/01/2013 1334 hrs	Musty, dirt
Sample #4 – Gore Cover, 1 Week Old, Fan On	SC13009	15/01/2013 1515 hrs	16/01/2013 1456 hrs	Musty, dirt, soil, earthy
1035 – Side A – Non-aerated	SC13002	15/01/2013 1213hrs	16/01/2013 1110 hrs	Musty
1036 – Inlet to Wind Tunnel, Side A	SC13003	15/01/2013 1213hrs	16/01/2013 1138 hrs	Musty

THE ODOUR UNIT PTY LTD

Australian Technology Park, Locomotive Workshop, Suite 16012, 2 Locomotive St, Eveleigh NSW 2015.

(61 2) 9209 4420 Lab
(61 2) 9209 4421 Fax

Sample Location	TOU Sample ID	Sampling Date & Time	Analysis Date & Time	Odour Character
1037 – Side A, Non-aerated	SC13005	15/01/2013 1310hrs	16/01/2013 1311 hrs	Musty, dirt
1038 – Side B, Non-aerated	SC13007	15/01/2013 1430hrs	16/01/2013 1359 hrs	Musty, dirt
1039 – Inlet to Wind Tunnel, Side B	SC13008	15/01/2013 1430hrs	16/01/2013 1429 hrs	Musty, dirt
1040 – Side B, Aerated	SC13010	15/01/2013 1512hrs	16/01/2013 1523 hrs	Musty, dirt, pine

Kind Regards,
James Schulz

THE ODOUR UNIT

MEMORANDUM

TO: Geoff Hemm

COMPANY: Transpacific Industries

CC:

FROM: James Schulz

DATE: 7 February 2013

COMPANY: The Odour Unit

JOB NO: Q1848R

NO OF PAGES: 1
Including cover sheet

REPLY REQUIRED NO

ORIGINAL TO FOLLOW NO

SUBJECT: ODOUR CHARACTER OF ODOUR SAMPLES TESTED ON 22/01/2013

Geoff,

Please find below the odour character for the samples that were analysed on 22/01/2013 at our Sydney laboratory (Roster Number: SYD20130123_003).

Sample Location	TOU Sample ID	Sampling Date & Time	Analysis Date & Time	Odour Character
Sample #1 – (A), Gore Cover, 5 Weeks Old, Non-aerated	SC13023	22/01/2013 0950 hrs	23/01/2013 1026 hrs	Dirty, dusty
Sample #2 – (A), Gore Cover, 5 Weeks Old, Aerating	SC13024	22/01/2013 1030 hrs	23/01/2013 1050 hrs	Soil, dirt, dusty
Sample #3 – (B), Gore Cover, 2 Weeks Old, Non-aerated	SC13025	22/01/2013 1140 hrs	23/01/2013 1115 hrs	Greenwaste, soil, dusty
Sample #4 – (B), Gore Cover, Aerating	SC13026	22/01/2013 1215 hrs	23/01/2013 1136 hrs	Greenwaste, dirt, soil

Kind Regards,
James Schulz

MEMORANDUM

TO: Geoff Hemm

COMPANY: Transpacific Industries

CC:

FROM: James Schulz

DATE: 7 February 2013

COMPANY: The Odour Unit

JOB NO: Q1848R

NO OF PAGES: 1 Including cover sheet

REPLY REQUIRED NO

ORIGINAL TO FOLLOW NO

SUBJECT: ODOUR CHARACTER OF ODOUR SAMPLES TESTED ON 30/01/2013

Geoff,

Please find below the odour character for the samples that were analysed on 30/01/2013 at our Sydney laboratory (Roster Number: SYD20130130_007).

Sample Location	TOU Sample ID	Sampling Date & Time	Analysis Date & Time	Odour Character
Sample #1 – Side A, Gore Cover, 6 Weeks Old, Non-aerated	SC13054	29/01/2013 1126 hrs	30/01/2013 1022 hrs	Compost, musty
Sample #2 – Side A, Gore Cover, 6 Weeks Old, Aerated	SC13055	29/01/2013 1209 hrs	30/01/2013 1054 hrs	Compost, musty
Sample #3 – Side B, Gore Cover, 3 Weeks Old, Non-aerated	SC13056	29/01/2013 1255 hrs	30/01/2013 1128 hrs	Compost
Sample #4 – Side B, Gore Cover, 3 Weeks Old, Aerating	SC13057	29/01/2013 1327 hrs	30/01/2013 1200 hrs	Compost

Kind Regards,
James Schulz

Australian Technology Park, Locomotive Workshop, Suite 16012, 2 Locomotive St, Eveleigh NSW 2015.

(61 2) 9209 4420 Lab
(61 2) 9209 4421 Fax

emissiontestingconsultants
Environmental Partners

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Unit 2, 160 New Street,
Ringwood, VIC 3134
Phone +61 3 9870 2644
Freecall 1300 782 007
Fax +61 3 9870 4055

PERTH
Unit 3, 4 Monash Gate,
Jandakot, WA 6164
Phone +61 8 9417 9133
Freecall 1300 782 007

www.emission.com.au
ABN 74 474 273 172

Date: 24 January 2013

Report No: 130008r

GHD Services Pty Ltd
Suite 5, 105 Hume Street
Wodonga VIC 3690

Emission Testing – January 2013
Cleanaway Wodonga – Windrow Trial

Dear Mr Stephen Dahl,

Tests were performed 15 January 2012 to determine odour emissions to air from the Trial Windrow at the Wodonga plant of Cleanaway.

Yours faithfully
Emission Testing Consultants

Ben Minchinton BSc
Field Consultant

bm@emission.com.au

EXECUTIVE SUMMARY

Emission Testing Consultants (ETC) was engaged by GHD Services Pty Ltd to perform odour monitoring of a Trial Windrow at the Wodonga plant operated by Cleanaway.

The Trial Windrow consisted of two types of material separated by an inert woodchip buffer. The two types of material were:

- Side A (Stack 1) – Old material approx 4 weeks old (formed on 18/12/2012)
- Side B (Stack 2) – Fresh material approx 1 week old (formed on 5/01/2013)

Side A (Stack 1) was found to be slightly shorter than Side B (Stack 2), however, Side A was wider at the base.

Covering the windrowed material was a gauze material (Gore™) which is permeable to air. Beneath the windrowed material is a dual manifold system connected to a fan that provides aeration for the pile. During normal operation the fan turns on intermittently depending on the oxygen levels within the pile.

Testing was performed during both the quiescent and aerated phases on both sides of the windrow.

All testing was performed using the draped wind tunnel method. During the quiescent phase, a small fan on the hood was used to draw air across the surface of the windrow. During the aerated phase, the inlet to the tunnel was closed so that all air was captured and funnelled through the hood.

The draped wind tunnel method was performed in conjunction with the isolation flux hood method performed by The Odour Unit. All odour sampling was performed using The Odour Unit equipment. All samples were analysed by The Odour Unit.

All results have been reported as Odour Flux Rate in two forms: ouv/m^2/min of windrow surface area and ouv/min/m of windrow length.

RESULTS

Side A (Old Material) – Quiescent

15 January 2013


Flow Results	Ambient air MW	Old Stockpile - Quiescent 130008
Time of flow test	1140	hrs
Stack dimensions at sampling plane	155	mm
Velocity at sampling plane	4.8	m/s
Average temperature	36	°C
Flow rate at discharge conditions	5.4	m^3/min
Flow rate at wet NTP conditions	4.7	m^3/min

Odour Results (Old Stockpile - Quiescent 130008 4.7)	Sampling Times	Concentration at NTP Wet		Odour Flux Rate ($ouv/m^2/min$)		Odour Flux Rate (ouv/min/m)	
Odour	1153-1213	260	ou	440	$ouv/m^2/min$	3,600	ouv/min/m
Odour (Adjusted for Inlet)	1153-1213	150	ou	250	$ouv/m^2/min$	2,100	ouv/min/m
Odour (Inlet)	1153-1213	110	ou	180	$ouv/m^2/min$	1,500	ouv/min/m

Note: Mass rate has been expressed as both per m^2 (based on the area of the wind tunnel) and per linear metre of the windrow (based on the cross sectional width of the windrow).

Side A (Old Material) – Aerated

15 January 2013


Flow Results	Ambient air MW	Old Stockpile - Quiescent 130008
Time of flow test	1300	hrs
Stack dimensions at sampling plane	155	mm
Velocity at sampling plane	0.37	m/s
Average temperature	38	°C
Flow rate at discharge conditions	0.42	m^3/min
Flow rate at wet NTP conditions	0.36	m^3/min

Odour Results (Old Stockpile - Quiescent 130008 0.36)	**Sampling Times**	**Concentration at NTP Wet**	**Odour Flux Rate ($ouv/m^2/min$)**	**Odour Flux Rate (ouv/min/m)**
Odour	1250-1310	180 ou	24 ouv/m^2/min	190 ouv/min/m

Note: Mass rate has been expressed as both per m^2 (based on the area of the wind tunnel) and per linear metre of the windrow (based on the cross sectional width of the windrow).

Side B (Fresh Material) – Quiescent

15 January 2013

 

Flow Results	Ambient air MW	New Stockpile - Quiescent 130008
Time of flow test	1350	hrs
Stack dimensions at sampling plane	155	mm
Velocity at sampling plane	4.8	m/s
Average temperature	42	°C
Flow rate at discharge conditions	5.5	m^3/min
Flow rate at wet NTP conditions	4.7	m^3/min

Odour Results (New Stockpile - Quiescent 130008 4.7)	Sampling Times	Concentration at NTP Wet			Odour Flux Rate ($ouv/m^2/min$)			Odour Flux Rate (ouv/min/m)		
Odour	1414-1430		200	ou		380	ouv/m^2/min		2,700	ouv/min/m
Odour (Adjusted for Inlet)	1414-1430	<	30*	ou	<	60*	ouv/m^2/min	<	400*	ouv/min/m
Odour (Inlet)	1414-1430		200	ou		380	ouv/m^2/min		2,700	ouv/min/m

* Detection limit has not been supplied by The Odour Unit and therefore is assumed to be the same as ETC's detection limit.

Note: Mass rate has been expressed as both per m^2 (based on the area of the wind tunnel) and per linear metre of the windrow (based on the cross sectional width of the windrow).

Side B (Fresh Material) – Aerated

15 January 2013

Flow Results	Ambient air MW	New Stockpile - Aerated 130008
Time of flow test	1300	hrs
Stack dimensions at sampling plane	155	mm
Velocity at sampling plane	0.57	m/s
Average temperature	38	°C
Flow rate at discharge conditions	0.64	m^3/min
Flow rate at wet NTP conditions	0.56	m^3/min

Odour Results New Stockpile - Aerated 130008 0.56	**Sampling Times**	**Concentration at NTP Wet**	**Odour Flux Rate ($ou_v/m^2/min$)**	**Odour Flux Rate ($ou_v/min/m$)**
Odour	1455-1512	200 ou	46 $ou_v/m^2/min$	320 $ou_v/min/m$

Note: Mass rate has been expressed as both per m^2 (based on the area of the wind tunnel) and per linear metre of the windrow (based on the cross sectional width of the windrow).

TEST METHODS

Windrow testing was performed using a perimeter enclosure (draped tunnel).

The windrow perimeter enclosure consisted of an apex section made of coated chipboard and a side section consisting of aluminium hoops covered with polyester film (© "Mylar").The apex piece had fitted on its top an acrylic funnel, fan, and chimney.

Note that only half the top and one side of a windrow was enclosed.

A half-slice section of the windrow was therefore completely enclosed bottom to top. The width of this enclosure and hence windrow slice was 615 mm. The total length of the enclosure (including fan housing) for was 4.52 metres (Side A) and 3.92 metres (Side B).

Flow measurements and odour sample collection (singleton sample) were performed in the chimney section atop the transition piece.

A single odour sample was also collected at the entry end (bottom) of the perimeter enclosure at the same time as the sample collected from the chimney. This inlet odour was subtracted from the exit odour to provide an adjusted odour level equating to the odour produced solely by the windrow.

DEFINITIONS

The following symbols and abbreviations are used in test reports:

BSP	British standard pipe.
Concentration	Mass of analyte per cubic metre expressed at NTP dry conditions (ng, µg or mg/m^3).
Flow rate at discharge conditions	Volume of gas flow per unit time expressed at discharge temperature, pressure and moisture content (m^3/min).
Flow rate at wet NTP conditions	Volume of gas flow per unit time expressed at 0°C, an absolute pressure of 101.325 kPa and discharge moisture content (m^3/min).
Mass rate	Mass of analyte per unit time (µg, mg or g/min).
NTP	Normal temperature and pressure. Gas volumes and concentrations are expressed on a wet basis at 0°C, at discharge oxygen concentration and an absolute pressure of 101.325 kPa, unless otherwise specified.
Odour concentration	Number of odour units (ou).
Odour flux rate	Odour emission rate per unit surface area per unit time (ouv/m^2/min).
Odour mass rate	Odour emission rate per unit time (ouv/min).
Odour unit	One odour unit (ou) is that concentration of odorant(s) at standard concentrations that elicits a physiological response from a panel (detection threshold) equivalent to that elicited by one Reference Odour Mass (ROM), evaporated in one cubic metre of neutral gas at standard conditions.
Sampling plane	Location at which measurements were conducted.
Velocity	Gas velocity expressed at discharge temperature, pressure and moisture content (m/s)
<	Less than the minimum limit of detection using the specified method.