13 June 2013 Ref: 1234

Brian Wild
Head, Albury Unit
Environment Protection Authority
PO Box 544
ALBURY NSW 2640

By email in the first instance: Brian Wild <Brian.Wild@epa.nsw.gov.au>

Dear Brian

Re: **Development Application No. 42-12/13: Resource recovery facility (organic composting): 'Kalawa', 92 Paterson Road, Gerogery (Lot 1 DP 174425 & Lot 9 DP 10665)**

Further to your letter to Cleanaway dated 21 May 2013 and the meeting between the EPA, Cleanaway, and Cleanaway's representatives at the Sydney offices of the EPA on 28 May 2013, responses to issues raised in the letter and discussed at the meeting are provided at:

- **Attachment 1 – *Responses to issues raised in EPA letter, 21 May 2013***
- **Attachment 2 – *Summary of information presented and discussed at the EPA meeting, 29 May 2013***

As requested, the information in **Attachment 2** has been presented as a stand-alone summary explanation in regard to the following key points:

- key process and operational factors potentially leading to or influencing odour generation; and
- justification of Specific Odour Emission Rates (SOERs) used in the Air Quality Assessment (AQA) in the Environmental Impact Statement (EIS) and additional trials in terms of:
  - origin, relevance, and methodology in regard to greenwaste, food waste, and liquid organic waste; and
  - key findings/observations in regard to worst-case-scenario assessments and conservatism.

I trust this information allows the EPA to finalise its assessment and issue General Terms of Approval.

Yours sincerely,
Blueprint Planning

James Laycock MPIA, CPP
PRINCIPAL PLANNER

/Encl.

ATTACHMENT 1:

Responses to issues raised in EPA letter, 21 May 2013

1. The composition of the waste at the proposed facility appears to be approximately 45 percent green waste and 55 percent food and liquid organics and greasetrap waste.

GHD advises that there was an error in the classification of bulk transfer station drop-offs in the EIS. This material was classified as 'putrescible' (Table 10.2, p. 10-2 of the EIS) when it should have been classified as 'non-putrescible', as garden waste is classified under the *Protection of the Environment Operations Act 1997* as 'non-putrescible' waste. The updated and correct version of the table provided in the EPA letter dated 21 May 2013 is presented below.

Source	Nature	Annual quantity (t)	%
Kerbside collected organics	Garden organics – (80% EPA estimate)	18,000	45
Kerbside collected organics	Food waste – (20% EPA estimate)	4,500	11.25
Bulk transfer station drop-offs	Garden waste	4,500	11.25
Commercial	Liquid organics including grease trap waste	5,000	12.5
Industrial	Food waste	8,000	20
	Total	**40,000**	**100%**
Green waste[1]		22,500	~56%
Food/liquid organics		17,500	~44%

2. The SOERs for covered windrows are based on emissions from 80 percent green waste and 20 percent food waste.

The first row of **Table 2** in **Attachment 2** of this document (p. 15) indicates that the SOERs used in the AQA for green waste and food waste are based on the 'Camden trial' which used a mixture of 80% green waste and 20% food waste.

At the proposed facility, composting will be undertaken via separately mixed batches of:

- green waste and food waste; and
- dry, pre-made, unscreened compost and grease trap waste.

<u>It is noted that food waste and grease trap waste will never be mixed in the same batch</u> and that the covered and aerated windrows will contain sections of either or both batch types depending upon operational requirements.

<u>Mixing of food waste or grease trap waste individually with green waste and pre-made compost respectively will aim to optimise the carbon to nitrogen (C:N) ratio and the moisture content, so the actual proportions used will depend upon the materials received in each load</u>. They may not be in the same proportions used in

[1] For the purposes of the EIS the term 'green waste' is interchangeable with the term 'garden waste'.

the 'Camden trial' (80:20), as the waste compositions may be different. For example, some green waste loads will be more woody than others, whilst some food waste loads will contain 'wetter' or more nitrogen rich food than other loads. So the proportions used will be based on the judgement of Cleanaway's experienced composting operators, rather than a set formula. It is noted that Cleanaway regularly tests prepared feedstock (C:N ratio and total water content) to demonstrate that the operators are blending and mixing the material correctly.

The Camden SOER data is based on a set of site conditions that are indicative of the proposed operations if the feedstock preparation was sub-optimal – see below. This data was used for modelling in the AQA as it was the only data available at the time of preparation of the EIS (and GHD believes this data reflects a worst-case-scenario as explained later in **Attachment 2** of this document).

Additional trials undertaken subsequent to the EIS at Timaru in New Zealand (focussing on food waste) and Wodonga (focussing on grease trap waste) enabled Cleanaway to measure and confirm the SOERs associated with each type of batch/mix proposed to be used (refer also to the response provided to the EPA by GHD dated 8 March 2013 and also specifically to **Attachment 2** of this document).

Cleanaway believes that there were shortcomings with the Camden trial methodology which was conducted by a third party in 2006: Cleanaway did not have operational control of the trial and the trial was undertaken by operators who were not experienced with aerated windrows or Gore® cover technology. It is believed that some of the key operational performance indicators (for example maintenance of porosity and moisture, and initial blending to achieve a specific C:N ratio) were not managed appropriately when establishing and operating the trial.

The Camden trial deficiencies were not fully appreciated by Cleanaway or GHD at the time of preparing the EIS. It was only once the results of the trials at Timaru and Wodonga became available that the degree of over-estimation (worst-case-scenario) associated with the use of the Camden SOERs (~10:1) was quantified. As windrows are the largest odour source, the effect on all-source OER is significant – a six-fold (6) overestimate during operating hours and an eighteen-fold (18) overestimate during non-operating hours (as discussed further in **Attachment 2** of this document).

3. A significantly higher percentage of food waste could lead to significantly higher odour emissions.

The EPA appears to have used aerated SOER data from Isolation Flux Chamber (IFC) methods from Wodonga and Camden to extrapolate emissions to ~10 OU m/s for the green waste/food waste blend (refer to the table below). While the extrapolation appears to be arithmetically correct, the assumptions on which the conclusion rests are not.

Aerated SOER (IFC)			
Site	Wodonga	Camden	Gerogery
% FW	0	20	45
SOER, OUm/s	0.3	4.7	10.2 *

In particular, the use of percentage food waste (FW) as an independent variable affecting SOER on Gore® covered windrows over the range 0 to 45% is not appropriate on several grounds, namely:

- the 15% grease trap waste in the Wodonga data is assumed not to influence SOER;
- the extrapolation to 45% food waste assumes that blending to this ratio will be undertaken – this is not proposed; and
- the use of Camden data as the central data point is considered invalid as the SOERs from that trial do not represent normal operations.

Furthermore, there is no known linear correlation between the proportion of food waste to green waste and SOERs.

The proposed facility will not compost at 45% food waste, as this would not achieve the optimum C:N ratio. Cleanaway is aiming for a C:N ratio in the range of 25:1 to 30:1, which means that there will be a significantly greater proportion of green waste than food waste in each mix. Typically this would mean that the proportion of food waste would be of the order of 15 to 20%.

Attachment 2 of this document includes a discussion of the key factors which influence the generation of odour. There are a variety of operational parameters which must be managed in order to avoid odour generation during composting (for example porosity, moisture content, and aeration). Whilst the nature of the raw material introduced to the composting process has a bearing upon its propensity to generate odour (through an incorrect C:N ratio), this is only one of several factors which will determine odour emissions from the proposed facility.

A literature review was undertaken by GHD to assess the likelihood of the 10 OUm/s projection occurring and for comparative SOER purposes, and in this regard Vipac undertook a study[2] of the Waste Transfer Station located at the Clyde Marshalling Yards in Sydney. This site received and stored kerbside municipal solid waste (MSW) (approximately 440 tonnes) in a sealed receivals building containing extraction fans connected to carbon bed filters. This sealed building effectively formed a large covered chamber and a good 'test case' of odour from municipal waste sources, as MSW is estimated to consist of 40% food waste (*NSW Waste Avoidance and Resource Recovery Strategy, Progress Report 2010*).

The mean of six IFC readings on delivered MSW provided an SOER of 3.9 OUm/s. The mean of six vent readings at the inlet to the carbon bed provided an SOER of 2.8 OUm/s. In this instance uncovered 100% domestic waste (MSW), assumed to

[2] Lunney, C., Trace, A., and Rivory, J. (2005). *Air Quality Impact of Waste Transfer Terminal*, 17th Int. Clean Air and Env. Conf., Hobart, May 2005.

be 40% food waste, provided an average SOER of 2.8 OUm/s. On this basis it is contended that the proposed Gore® cover facility (which will typically process food waste at approximately 15 to 20%) could therefore not provide an SOER of 10 OUm/s.
The sources and justification for the SOERs used in EIS emissions modelling are discussed in more detail in **Attachment 2** of this document. Whilst a number of SOERs are based on 100% green waste, in many cases these SOERs are associated with the determination of correction factors (which are relatively independent of the source of odour), or for sources which are expected to provide a minor contribution to total site emissions (for example the sedimentation pond).

The most important SOERs from an AQA impact modelling perspective (covered windrows and break apart/turning of windrows) utilised the available SOERs associated with covered, aerated windrows.

4. There is a "paucity of Gore cover composting data under local conditions".

As discussed in **Attachment 2** of this document, at the time when the EIS was prepared, it was recognised that there was a paucity of data associated with the operation of the Gore® cover composting system. This prompted Cleanaway to:

- undertake additional sampling on an operational facility at Timaru, New Zealand which was considered to be representative of the green waste and food waste blend proposed for the subject facility.
- establish and monitor a trial at Wodonga, Victoria which replicated the application, blending, and processing of grease trap waste and dry, pre-composted green waste material via the Gore® cover system which is proposed for the facility.

Both of these additional sampling programs which utilised the Gore® cover system are considered to be representative of the separate batching processes and mixes proposed to be undertaken.

As described in more detail in **Attachment 2** of this document, the conditions in an actively composting windrow beneath a Gore® cover are monitored and controlled to remain within a specific oxygen percentage range. The material is kept aerobic, optimising the biological processes which generate the heat typical of good composting and elevated temperatures within the windrow are independent of external ambient temperature. Therefore, whilst ambient climatic conditions may influence the nature and availability of raw materials entering the composting process, once the material is mixed/blended and placed under the controlled Gore® cover environment, external ambient conditions do not have a major bearing on the composting process or associated odour generation rates.

ATTACHMENT 2:

Summary of information presented and discussed at the EPA meeting, 29 May 2013

Key process and operational factors potentially leading to or influencing odour generation

By definition, composting is an aerobic process – it is the microbial transformation of organic matter in the presence of atmospheric oxygen. When the biological oxygen demand of the micro-organisms is met, the chemical processes they mediate do not produce offensive smelling volatile organic compounds (VOCs). If organic material is starved of oxygen, the aerobic micro-organisms are unable to survive and are displaced by anaerobic species (i.e. organisms that live in oxygen deprived environments). These species derive their energy from the organic material by using different biochemical processes which release numerous unpleasant smelling VOCs. Anaerobic decomposition also releases large quantities of methane, a combustible greenhouse gas. Allowing organic matter on a composting site to break down anaerobically (without oxygen) amounts to very poor process control.

There are several objectives to composting organic material:

- To convert organic waste into a benign and stable material.
- To pasteurise the organic material so that seeds and pathogenic organisms (i.e. bacteria, fungi or viruses that may cause human, animal or plant diseases) are destroyed.
- To reduce the volume/weight of organic material.
- To produce a beneficial soil conditioner/fertiliser.

Commercial composting mimics nature in the way organic matter is aerobically recycled, using natural organisms and natural processes.

Cleanaway uses Gore® cover technology to undertake process-controlled composting because it is tried and tested, it is reliable, and is internationally considered a best-practice method particularly in regard to odour control (Schmidt et al, 2009).

Best-practice composting involves the following steps in making good quality compost without generating offensive odours (see references at the end of this section):

1. Garden and food waste is collected together

A mixture of garden and food waste in bins keeps most of the material loose and exposed to oxygen. This ensures the material is less odorous than solid plugs of wet food waste on its own.

2. Organic waste is collected on a weekly basis

Regular collection does not permit material enough time to start breaking down in an odorous manner.

3. Good community liaison

By engaging with the community in Cleanaway's collection areas, Cleanaway is able to assist and encourage households to use the waste disposal system efficiently. With good public education, 'source separation' of organic waste is easily practised and the contamination of this material is greatly reduced. The material received at the composting site should therefore be of a high standard. The use of 'kitchen tidies' with corn starch liners is convenient for residents and also serves to keep the food waste component aerobic and odour free.

4. Material is processed the day it is received

Clean organic waste is delivered to the composting facility daily (Monday to Friday). Upon receipt, it is promptly decontaminated (any plastics, glass or pieces of metal are removed), mixed, shredded, and placed under a Gore® cover as explained below. At the end of each working day, the receivals shed is cleaned. No raw material is stored in the receivals shed or in open piles anywhere on site (with the exception of sawdust which is unequivocally regarded as benign). The potential for odour production is therefore reduced significantly.

5. The importance of feedstock preparation

It is the policy of Cleanaway to compost material without producing offensive odour in the first instance rather than to contain and control odour that has been allowed to be produced. Preparation of the raw material is vital in preventing odour in three fundamental ways:

5.1 The carbon to nitrogen ratio (<u>C:N ratio</u>) of the mix must be optimised in the 20 to 30 range – that is 20-30C:1N – preferably in the 25 to 30 band. If all other factors are well controlled, a C:N ratio of 20 and above will produce low-odour composting. Generally a C:N ratio above 30 is not encouraged as the mix will have too little nitrogen, composting will progress slowly, and the resultant product will be of poor quality. If the C:N ratio is below 20, odour potential greatly increases. With a ratio between 20 and 30 the process can be managed in a Gore® cover facility without producing offensive odours. From a C:N range of 18 to 20 it can be managed acceptably if other parameters are very tightly controlled but this range is not encouraged. A C:N ratio below 18 should be avoided. Low C:N ratios indicate nitrogen rich mixes and the lower the ratio, the greater the chance of odour being produced and the more offensive the odour will become. Every batch received is blended and mixed to meet the required C:N criteria as different ingredients have different C:N ratios. **Table 1** below illustrates how C:N ratios vary in compostable materials and why they need to be appropriately blended to create a suitable mix. Cleanaway considers this understanding vital to a successful composting operation.

Table 1: Compostable material and C:N characteristics

Organic material	Average C:N ratio	Acceptable C:N ratio range
Grass clippings	17	10-25
Leaves	55	40-80
Shrub trimmings	50	30-85
Hardwood chips	560	450-820
Softwood chips	640	212-1,300
Newsprint	625	400-850
Cardboard	560	(little variance)
Vegetable waste	12	10-25
Food waste	15	6-18
Meat waste	3.5	3-4
Grease trap waste	15	10-20

5.2 The moisture of the mix is very important. The ideal range for the initial total moisture content is 55 to 65%. If moisture content is below this range, the material will dry out during the course of composting and biological processes will slow and possibly cease. If biological processes cease, no odour will be produced, but the end product will be unstable and will resume composting as soon as it gets wet. If the moisture is above this range, the water will clog the fine pores in the organic material and exclude oxygen. This will lead to the material becoming anaerobic in part, or in full, and offensive odour will be produced.

Water is added to the material as it exits the shredder within the receivals shed at a rate required to bring the total moisture content into the optimal range of 55 to 65%.

5.3 The porosity of the mix is important to facilitate good aeration. The texture of the shredded material must be such that extensive air spaces are maintained in the mix throughout the composting process. If the texture is too fine, the particles of material pack together and air is unable to flow to all parts of the heap - anaerobic conditions will result. If it is too coarse, the material will tend to dry out too quickly. Optimal porosity enables sustained aerobic conditions to be maintained.

Whilst the above three factors are the most critical in terms of preparing raw material the following factors are also important in context:

5.4 Thorough mixing/blending is necessary to ensure wet and dense material is broken up and distributed amongst the mass of other material. This provides for better moisture distribution, improved porosity, and better C:N distribution through the heap.

5.5 The shredding operation not only achieves size reduction and good mixing but importantly it also rips apart the green waste, releasing oxidising enzymes, which have a deodorising effect on odorous food waste. Added to this is the dilution effect of mixing food waste with a much larger quantity of green waste. If any raw material is odorous, such odour is greatly attenuated by the mixing and dilution achieved by the shredding process.

5.6 Raw waste varies seasonally and from collection area to collection area. Different types of organic waste are also received. Good composting (which minimises the emission of odour) requires that a consistent composting mix be prepared despite variations in the ingredients. All operators will be trained to do this and various blending agents such as oversized previously composted material, coarse woody material, and sawdust (or equivalent) are available to enable appropriate blending to ensure that a suitable C:N ratio is achieved (refer to **Table 1** above), that moisture is optimised, and porosity is in the right range.

5.7 After the preparation of each batch and just before composting begins, samples are drawn for laboratory analysis to confirm compliance with good feedstock preparation.

5.8 Not all types of organic waste are mixed together for composting. For example, greasetrap waste is blended into dry pre-made compost (i.e. finished unscreened compost) and dry green waste material at 15 to 20% by weight. It is mixed well so that all the moisture is absorbed into the matrix and the grease is distributed throughout the mass. This blend is then composted without having any other food or green waste added. Abiding by this 'recipe' enables good composting without the production of offensive odour. When composters mix too much grease trap waste with too little solid 'bulking' material (finished compost product and/or green waste), the process becomes odorous. It is critical that the mix be prepared so that C:N ratio, moisture, and porosity are all in the optimum ranges as described above.

6. The importance of process control

The active phase of Gore® cover composting takes eight (8) weeks and during this time conditions within the windrows must be kept suitable for the composting micro-organisms to thrive. To this end, the following aspects of the composting process are monitored and controlled:

- Aeration. An oxygen probe is inserted into the windrowed material through a customised port in the Gore® cover and left in place until the heap is turned or moved. This probe measures oxygen content of the air within the heap. When the oxygen content drops too low (generally below approximately 10% - remembering that free atmospheric air contains approximately 21% oxygen), the probe transmits a signal to a computer which turns on a fan. The fan blows fresh air into the heap through two aeration channels in the concrete floor. Once oxygen levels rise to approximately 12%, the fan automatically switches off. In this way the environment in the heap is kept consistently aerobic and offensive odours are not generated. The aeration status of each batch of compost is shown on the control computer and the full aeration history of each batch is recorded. At any time the operator can see that aeration is being maintained and is given warning should oxygen levels trend below desired concentrations. The operator can thus take remedial action based on real time data before offensive odour begins to develop.

At this point it is important to explain how the Gore® cover enhances the composting process and functions in a manner superior to a rigid composting vessel:

- The Gore® cover fabric consists of a polytetrafluroethylene (PTFE) layer sandwiched between layers of highly durable woven polyester. The PTFE is very finely porous (average pore size of 0.02 microns) and only allows small molecules such as oxygen, carbon dioxide and water vapour to diffuse through. The diffusion occurs slowly, far slower than the rate of delivery of air supplied by the aeration fan. When the aeration fan turns on, a positive air pressure develops under the cover and the cover blows up. This positive pressure is maintained after the fan turns off for periods in excess of 10 minutes as the air gradually escapes through the cover. When air pressure equalisation is reached, the cover becomes flaccid. The benefit of this alternating pressurising and de-pressurising is that air (with the oxygen introduced through the aeration channels) is forced into all the interstitial spaces within the composting material, enabling very thorough aeration. In systems that do not develop a back-pressure, fresh air blown into the bottom of the heap tends to follow channels of least resistance and passes through leaving denser patches un-aerated. This gives rise to anaerobic pockets and the apparently contradictory phenomenon of odorous compost emerging from an aerated system. The use of Gore® covers eliminates this. The covers do, in fact, ensure better aeration.

- As the composting process progresses, hot moisture-laden air rises up through the material in each heap owing to natural convection aided by the air pressure gradient created by the aeration fan. When this air makes contact with the relatively cooler Gore® cover, the water vapour condenses on the inside of the cover, maintaining a wet layer that constantly drips back into the top layer of the compost. This has a first effect of greatly reducing water loss from the composting material (though the distribution within the heap is gradually skewed towards the top) and has a second effect of 'scrubbing' any VOCs from the air before it diffuses out of the heap. Any VOCs thus removed are subject to microbial breakdown in the compost. A well run Gore® cover facility therefore has two robust odour control systems – by remaining fully aerobic, obnoxious odours are not produced in the first place, but if any are generated, they are largely 'scrubbed' out and broken down within the heap by further processing.

- Temperature. Another probe measures temperatures along a one metre vertical profile in the heap. This data is displayed in real time on the control computer and is recorded as proof that the time-temperature requirement for pasteurisation as given in the *Australian Standard 4454-2012: Composts, Soil Conditioners and Mulches,* is met by each and every batch. Temperatures within the heap also serve as a useful tool informing the operator how the process is progressing. For example, low temperatures at inappropriate times are a clear warning that composting is being impeded and that the cause needs investigating. This provides advance warning before material becomes anaerobic and offensively odorous.

- Porosity. During composting, the material will gradually undergo a reduction in porosity as the material decomposes. This is expected and for this reason, the material is moved twice during the eight week active composting period. By moving the material from one pad to another, the material is 'fluffed up' and porosity is reinstated.

- Moisture. The composting micro-organisms require optimum moisture to perform well. As composting progresses, the material slowly loses water. At each turn, the material is inspected and if it is found to be too dry, extra water is added. During composting the moisture within the heap tends to migrate upwards and turning redistributes the moisture throughout the heap. If a heap becomes too dry odour will not be produced but microbial activity will cease and the composting process will not run to completion.

7. Contingencies

Composting requires good site management and good process management. If these are provided, odour does not become an issue. However, there is always a risk that reticulated electricity could fail or a process-critical machine could break down leading to a loss of process control. For this reason the site will have an emergency plan outlining specific contingency actions to keep operations running and to prevent compost material from becoming anaerobic. Examples of such actions are the hiring in of a generator to keep the Gore® pads, control system, and weighbridge functioning as well as hiring whatever other piece of equipment is required. With good machinery maintenance such issues are likely to be minimal and the site is located in an area where reticulated electricity supplies are known to be reliable.

8. *Housekeeping standards*

The professional operation of a composting site necessitates a high standard of housekeeping. This entails keeping all parts of the site clean and not allowing organic matter or water to accumulate in any place other than where it has expressly been positioned or required. Weeds, vermin, insects, and dust are therefore all controlled as a matter of routine operations. Cleanaway commits itself to high standards of site hygiene - another measure designed to lower the offensive odour potential from environmental sources on the site.

9. Management system standards and accreditation

Cleanaway has triple certification of its National Management System to ISO standards. This covers its Environmental Management, Occupational Health and Safety, and its Quality systems. This certification requires the company to use best-practice in its systems of management and it facilitates good process control and continuous improvement in its day-to-day procedures and practices.

10. References

Relevant references include:

- Australian Federal Department of Sustainability, Environment, Water, Population & Communities, (2012), *Food and Garden Organics – Best Practice Collection Manual.*
- deBertoldi, M. (Ed), (1996), *The Science of Composting,* Chapman & Hall.
- Diaz, L. F., Bidlingmaier, W., deBertoldi, M., and Stentiford, E. (Eds), (2007), *Compost Science and Technology, Waste Management.* Vol. 8, Elsevier Science & Technology.
- Epstein, E, (1997), *The Science of Composting.* CRC Press.
- Epstein, E, (2011), *Industrial Composting.* CRC Press.
- Haug, R. T., (1993), *The Practical Handbook of Compost Engineering.* Lewis Publishers.
- NC State University, (Undated), *Large-Scale Organic Materials Composting*.
- NSW DEC, (2003), *Environmental Guidelines: Composting and Related Organics Processing Facilities.*
- Schmidt, C. E., Card, T. R., and Kiehl, B. (2009), *Composting Trials Evaluate VOC Emissions Control,* BioCycle, April 2009.
- US Department of Agriculture, (2000), *Part 637, National Engineering Handbook, Chapter 2, Composting*.
- Victoria EPA, (1996), *Environmental Guidelines for Composting and Other Organics Recycling Facilities, Publication 508.*

Justification of Specific Odour Emission Rates (SOERs) used in the Air Quality Assessment (AQA) in the Environmental Impact Statement (EIS) and additional trials in terms of:

- ***origin, relevance, and methodology in regard to greenwaste, food waste, and liquid organic waste; and***
- ***key findings/observations in regard to worst-case-scenario assessments and conservatism.***

Existing EIS

1. The origin and relevance of SOERs used

The SOERs used in the existing AQA in the EIS have been collected from a number of sources. The most important SOERs for the AQA are the ones associated with the covered and aerated windrows. These were obtained from the following studies:

- 'Camden 2006' (Gore® covers, GW & GW/FW blend).
- 'Coldstream 2007-08' (Aerosorb® covers, GW).

At the time the EIS was prepared these SOERs were selected because there was a good apparent match for the SOERs associated with green waste material (1.78 OUm/s vs 1.87 OUm/s (refer to Table 10, p. 40 in the AQA)).

When preparing an AQA it is normal practice to cite SOER sources from other studies where direct measurements have been taken, the material being processed is similar, and the composting process itself is similar.

The full list of sources used in the AQA and the justification for their use is presented in **Table 2** below. (Copies of these sources were provided to the EPA by GHD in documentation dated 8 March 2013.)

Table 2: 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[3] (TOU)	Windrow 1 (100% green waste) and Windrow 2 mixed waste (80% green waste plus 20% food waste)	Table 10, p. 40	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[4] (ETC Reports 070263r, 080030r)	100% Green waste	Table 10, p. 40	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[5] (ETC Reports 080090r)	100% Green waste	Table 11, p. 42	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 Vic. The type of waste is not considered relevant for correction factor calculation.
Correction for crest vs sides	Coldstream ANL[4]	100% Green waste	Table 11, p. 42	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 previously provided (8 March 2013). The type of waste is not considered relevant for correction factor calculation.
Aeration of windrows	Coldstream ANL[4] (ETC Report 070197r)	100% Green waste	Section 7.1.4, pp. 42-43	Measured OER of a covered windrow under aeration at ANL Vic Coldstream. GHD used ANL Vic data over Camden, NSW data because measurements were conducted via the 'witches hat' method compared to IFC at Camden, NSW.

[3] URS, *Gore® Cover System Odour Emissions Assessment.* Report No. 43217479, 31 May 2007.
[4] GHD, *Odour Impact from Composting Operations – ANL Coldstream Green Waste Composting Facility*. Report No. 131899, March 2008.
[5] GHD, *Assessment of Use of Isolation Flux Chamber to Measure Windrow SOER – ANL Coldstream Green Waste Composting Facility –Addendum Report*. Report No. 148519, April 2008.

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[6] (ETC report 080279r and 080337r)	Green waste + 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 Cleanaway. The report can be provided to EPA in confidence. No turning emissions measurements were conducted at Camden, NSW.
Received raw green waste	URS[7]	100% Green waste	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[7]	100% Green waste	Table 13	No Cleanaway 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)	100% Green waste	Table 13	No Cleanaway 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)	100% Green waste	Table 13	No Cleanaway pond SOER data was available. Measured data from ANL Coldstream leachate pond was used.

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

[7] URS, *Odour Assessment of Proposed Composting Process at the ANL Premises, Lilydale*. Report No. 43283297, 28 August 2008.

2. Modelling methodology and results

The modelling methodology utilised in the AQA involved the following steps:

- SOER selection for individual unit processes and windrow phases (as described and presented in **Table 2** above):
  - Windrow data was sourced from the Camden measurements for green waste and food waste, except for Phase 3 and Maturation Windrows where ANL data was used.
  - Other SOERs were sourced for other unit processes and composting activities.

- SOER corrections to account for the IFC measurement technique and 'chimney effect':
  - The correction for the under-prediction of IFC on Aerosorb® covers as determined from the ANL Coldstream measurements was applied, together with the 'crest versus sides' factor found for Aerosorb®. **Table 3** below details the combined correction factor for each windrow phase. From this it can be seen that the primary windrow (P1) SOER is increased from 2.0 to 7.0 units.

<u>Table 3</u>: SOERs (OUm/s) used in the AQA for windrows

Phase	P1	P2	P3 & Maturation
IFC SOER (age-mean)	2.0[1]	0.79[1]	0.6[2]
Correction for IFC diversion	13.9	4.6	1.0
Correction for Crest vs Sides	0.25	0.25	1.0
Correction factor	**3.5**	**1.15**	**1.0**
Adopted SOER	**7.0**	**0.9**	**0.6**

[1] Camden.
[2] Coldstream (weeks 4 and 6).

- The corrected SOERs were then used in a calculation process to estimate site emissions by location/source and during day-time and night-time operations. These calculations are presented in **Table 4** below.

Table 4: Summary of SOER calculations used in the AQA

Source description	Source code		Emitting surface area (m^2)	SOER ($OU/m^2/s$)	OER (OU/min)		OER (%)
Operating hours							
Green waste stockpile – Receival Shed loading and Shredder	Shred	Loader	10	4	2,400	404,460	5.8
		Raw green waste	240	4	57,600		
		Shredder			344,460[8]		
Screening	Screen				297,600		4.2
All Loaders Loading	Load		5 x 4	5.34	6,408		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**

[8] Direct measurement downwind of shredder (Source: URS 2008, ANL Coldstream.)

The key points from the modelling of source emissions in the AQA are that:

- Phase 1 (P1) windrows are the primary source of odour.
- The *non-operating* hours OER is ~90% of the *operating* hours OER.
- Poor air dispersion events will generally occur during non-operating hours, therefore the emissions produced during the non-operating hours will define the 99th percentile odour contour.

The key points in regard to the movement and dispersion of odour emissions in the AQA are that:

- The movement and dispersion of odour is affected by a variety of factors including meteorological conditions and topography.
- Modelling was done in accordance with the EPA *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW*. The CALMET model simulates local meteorology, models each hour of the year and takes account of a spatially varying wind field. The dispersion is then simulated using the CALPUFF model which takes account of topographic influences on air movement.
- Modelling results are then presented as odour contours at the 99%ile non-exceedence level and for a 1 second average.
- Odour contours are then used to assess compliance against the EPA odour criterion and to gauge potential odour impact. The odour criterion is defined as a function of the human population potentially affected. The Table below (Table 7.5 from the *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW*) shows how the criterion ranges from 7 OU for an isolated rural residence through to 2 OU for an urban area. For the proposed composting facility, the 7 OU criterion would apply to the rural residences in the vicinity of the composting site, while the 2 OU criterion is relevant to the townships of Gerogery and Gerogery West.

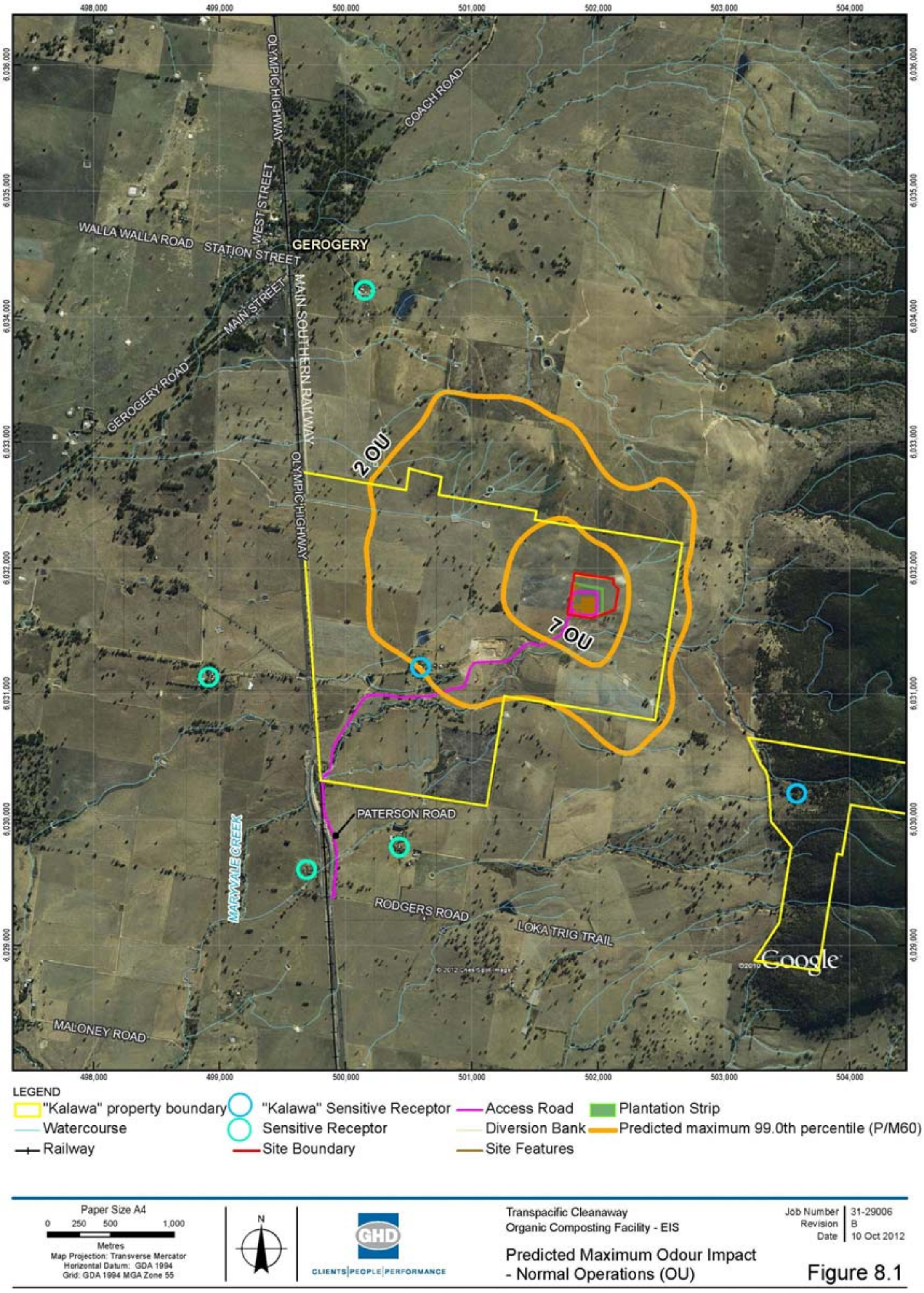
Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales

Table 7.5: Impact assessment criteria for complex mixtures of odorous air pollutants (nose-response-time average, 99th percentile) (EPA 2001)

Population of affected community	Impact assessment criteria for complex mixtures of odorous air pollutants (OU)
Urban (≥~2000) and/or schools and hospitals	2.0
~500	3.0
~125	4.0
~30	5.0
~10	6.0
Single rural residence (≤~2)	7.0

Figure 1 shows the predicted 99%ile odour levels (1 second average) based on the OER inventory as detailed in **Table 2** and **Table 3** above using the OU policy criterion from the *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW* (EIS, Figure 8.1, p. 8-7).

<u>Figure 1</u>: Predicted <u>maximum</u> odour impact in relation to identified sensitive receptors



3. Conclusions from the existing AQA

The project complies with the EPA odour criterion as follows:

- The 7 OU project criterion (the appropriate criterion for single rural residences) is predicted to be met at all rural residences.
- The nearest off-site residences all return predicted levels ≤ 2 OU. This is the level of performance that would be required for urban areas and other sensitive receptors such as schools and hospitals.

Additional odour sampling investigations

1. Background

The preparation of the AQA highlighted the importance of having 'technology and process specific' data. The Gore® cover technology, whilst in use in many overseas applications, is not currently used in any commercial applications in Australia (this is not to be confused with Aerosorb® covers).

Cleanaway recognised that:

- There would be benefit in obtaining additional SOER data specific to their proposed Gore® cover processes and operations.
- The Camden trial data may not be representative of the proposed operations because of the way it was operated and managed (by third parties who were not experienced with aerated composting).

As a result of the above, Cleanaway arranged for emissions sampling in accordance with the EPA *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW* to be undertaken at Timaru, New Zealand at a Gore® cover composting site which is managed by Cleanaway. This sampling was undertaken in September 2012 and was representative of the green waste and food waste blend proposed for the facility.

Feedback received from the EPA following lodgement of the EIS via letter dated 26 November 2012 and a meeting between EPA and GHD representatives on 6 December 2012 was that there were concerns associated with the lack of specific data on composting incorporating grease trap waste. In response Cleanaway undertook a 6 week trial and sampling program at Wodonga, Victoria between December 2012 and January 2013. This trial replicated the application and processing of grease trap waste and green waste material via the Gore® cover composting system.

2. Results

The SOER results from the Timaru operational sampling and the Wodonga trial together with the Camden data are presented in **Table 5** below.

<u>Table 5</u>: Summary of Gore® cover sampling SOER data from three sites

Data set	**Wodonga (Vic) (Dec 2012 – Jan 2013)**				**Camden (NSW) (2006)**		**Timaru (NZ) (Sept 2012)**	
Age (weeks)	Pre-prepared compost/green waste (85%) + grease trap (15%)				Green waste (80%) + food waste (20%)		green waste (85% garden waste) + 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**

A comparison of the Gore® cover SOER data from the three sources reveals the following:

- <u>Timaru and Wodonga SOERs are similar for both quiescent (non-aerated conditions) and aerated conditions</u>. Because the age-means under both operating conditions at both sites are similar it is concluded that there is little difference between grease trap and food waste additions.

- <u>Camden SOERs are much higher than the Timaru and Wodonga data</u> (by ~10 fold). The reason for this is considered to be due to non-optimal feedstock preparation during the 2006 Camden trial (C:N, moisture, porosity).

- <u>Correction for the IFC measurement method and the effect of aeration on Gore® is much less</u> than on Aerosorb® covers (a factor of 42:1 for Phase 1 Windrows during weeks 1 to 4) (refer to Appendix 2 of GHD correspondence to the EPA, 8 March 2013). The nature of the Gore® cover material (small pore spaces) means that it performs differently to other windrow cover materials (more effective capture of the VOCs which contribute to odour) and therefore a smaller correction factor is considered appropriate.

3. Conclusions based on post-AQA investigations

A summary and comparison of the AQA and Wodonga/Timaru data is presented in **Table 6** below.

<u>Table 6</u>: Comparison of AQA data (left table) with Wodonga/Timaru data (right table)

Source Description	Source Code	Emitting Surface Area (m^2)	SOER ($OU/m^2/s$)	OER (OU/min)
Operating Hours				
Greenwaste stockpile – Receival Area loading and Shredder	SHRED			404,460
Screening	SCREEN			297,600
All Loaders Loading	LOAD	5 x 4	5.34	6,408
Sedimentation Pond	POND	950	0.33	18,810
Windrow Phase 1	Phase 1	1900	48.6	5,540,400
Windrow Phase 2	Phase 2	950	7.6	433,200
Windrow Phase 3	Phase 3	950	4.1	233,700
Maturation Pad	MAT	950	1.2	68,400
Total				**7,002,978**
Non-Operating Hours				
Shredder	SHRED			0
Screening	SCREEN			0
All Loaders Loading	LOAD	5 x 4		0
Sedimentation Pond	POND	950	0.33	18,810
Windrow Phase 1	Phase 1	1900	48.6	5,540,400
Windrow Phase 2	Phase 2	950	7.6	433,200
Windrow Phase 3	Phase 3	950	4.1	233,700
Maturation Pad	MAT	950	1.2	68,400
Total				**6,294,510**

Source Description	Source Code	Emitting Surface Area (m^2)	SOER ($OU/m^2/s$)	OER (OU/min)
Operating Hours				
Greenwaste stockpile – Receival Area loading and Shredder	SHRED			404,460
Screening	SCREEN			297,600
All Loaders Loading	LOAD	5 x 4	5.34	6,408
Sedimentation Pond	POND	950	0.33	18,810
Windrow Phase 1	Phase 1	1900	1.36	155,193
Windrow Phase 2	Phase 2	950	1.36	77,357
Windrow Phase 3	Phase 3	950	0.48	27,494
Maturation Pad	MAT	950	1.2	68,400
Total				**1,055,722**
Non-Operating Hours				
Shredder	SHRED			0
Screening	SCREEN			0
All Loaders Loading	LOAD	5 x 4		0
Sedimentation Pond	POND	950	0.33	18,810
Windrow Phase 1	Phase 1	1900	1.36	155,193
Windrow Phase 2	Phase 2	950	1.36	77,357
Windrow Phase 3	Phase 3	950	0.48	27,494
Maturation Pad	MAT	950	1.2	68,400
Total				**347,254**

When the results of the post-AQA investigations and monitoring data are compared with the original AQA data, it is concluded that:

- The AQA over-estimates site OER by a factor of six (6) during operating hours.
- The AQA over-estimates site OER by a factor of eighteen (18) during non-operating hours.
- This overestimation is principally due to the original Camden data used in the AQA (which is what **Figure 1** in this document is predicated on in terms of a worst-case-scenario).
- The Gore® cover material has superior moisture and odour trapping performance properties (scrubbing) when compared with other cover products.

4. Revised odour contour mapping

Odour contour mapping appearing in the original AQA has been revised to take account of post-AQA investigations undertaken. It should be noted that the AQA contours have been modified by using the factors described above, rather than remodelling from base data. This approach is considered justified for the current purpose (to explain the revised results associated with the post-AQA data).

Indicative odour contours associated with the proposed facility during operating hours (and non-operating hours are presented below in **Figure 2** and **Figure 3** respectively.

The revised odour contour mapping indicates that:

- The 2 OU contour will be confined to the 'Kalawa' property during operating hours and to the facility itself during non-operating hours.
- The 7 OU project odour criterion is not exceeded at any receptor.

5. Conservatism and 'worst-case-scenario'

Conservatism has been introduced into a number of the calculation aspects of the AQA through:

- The use of Camden data: When compared with direct measurements on representative compost mixes at Timaru and Wodonga a conservative factor of approximately 10:1 has been introduced into SOERs.
- Windrow correction factors to take account of IFC underestimation and the 'chimney effect'. This represents a factor of 3.5 on Phase 1 Windrows and a factor of 1.15 on Phase 2 Windrows.
- The use of aeration factors based on ANL data obtained with a different windrow cover product. Wodonga data suggests a factor of 3.6:1 exists.
- The receivals shed area SOER value used: 4 OU m/s versus the direct measurement of the Wodonga grease trap waste receival which was 2.6 OUm/s.

Based upon the factors of conservatism described above and the background issues (now recognised) associated with the 2006 Camden Gore® cover trial, it is considered that the AQA modelling presented in the EIS represents a considered worst-case-scenario in terms of off-site odour impacts. It is noted that this worst-case-scenario complies with the odour criterion in the EPA *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW* (and by a significant margin).

<u>Figure 2</u>: Predicted maximum odour impact in relation to identified sensitive receptors - indicative odour contours (operating hours)

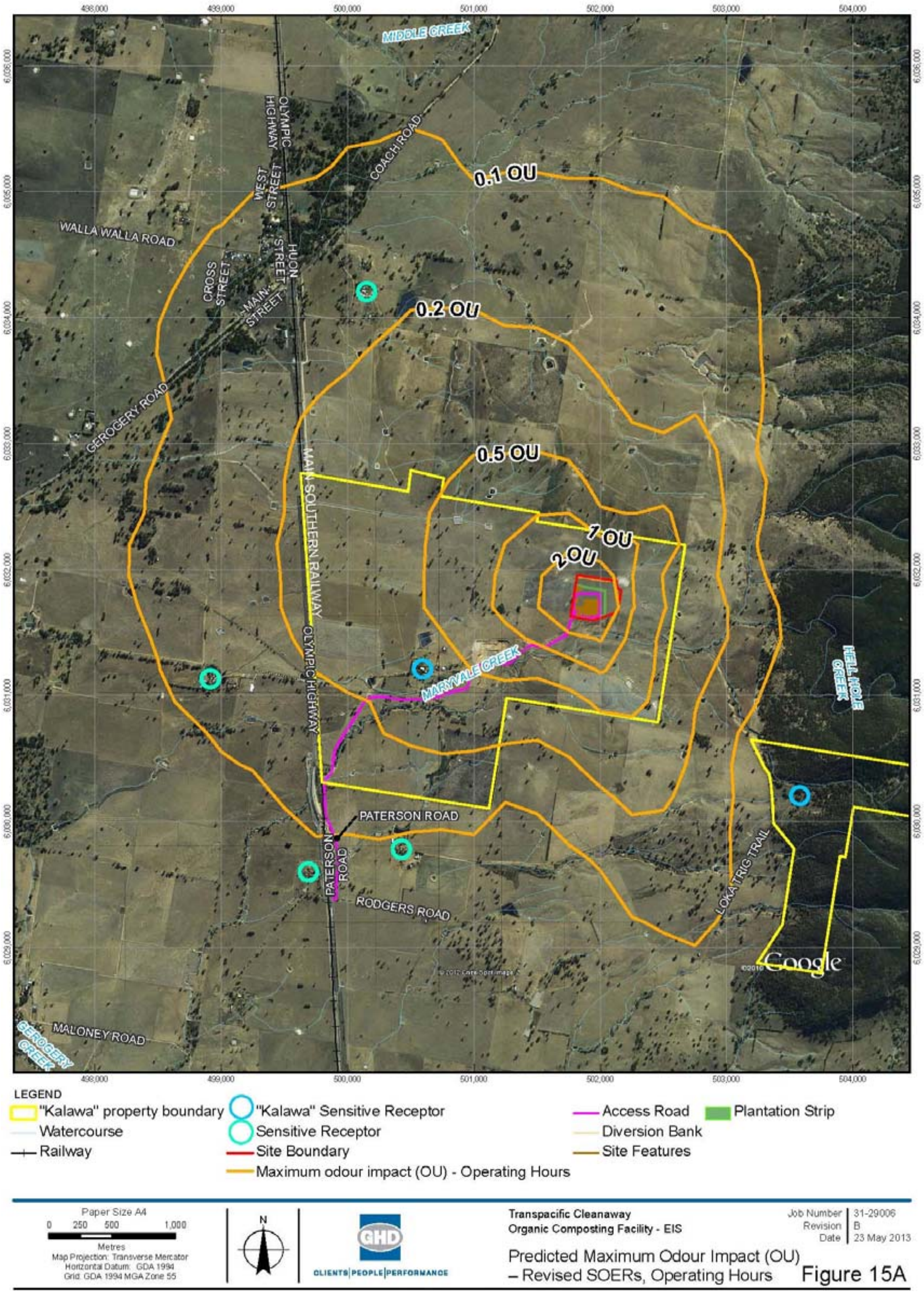
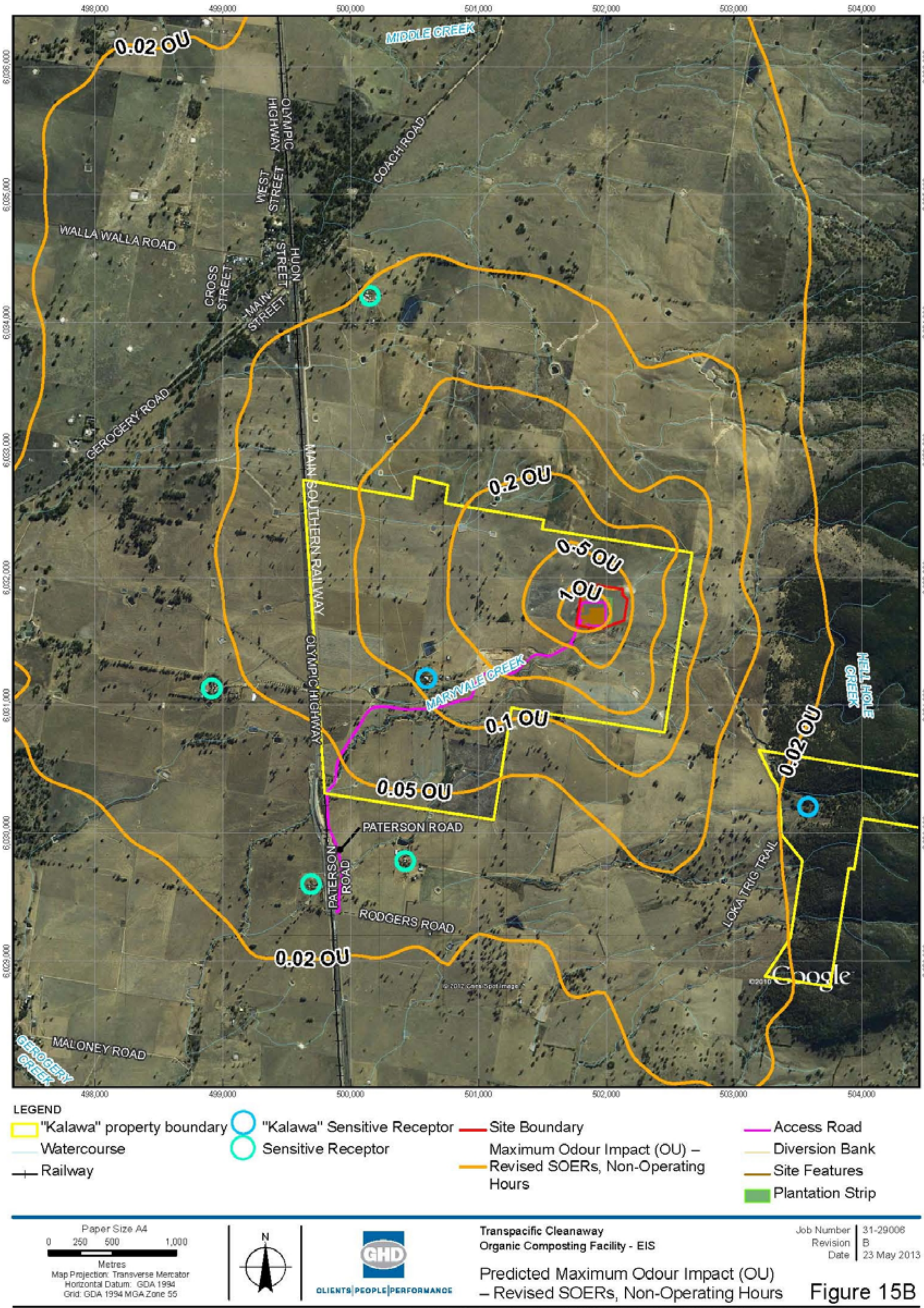


Figure 3: Predicted maximum odour impact in relation to identified sensitive receptors - indicative odour contours (non-operating hours)



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