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Odour Management Plan- Liquid Waste Treatment Facility

16 Kerr Road, Ingleburn, NSW

Addressee(s): Bulk Recovery Solutions Pty Ltd

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This report must be regarded as draft and without prejudice until the above study components have been each marked as final, and the document has been signed and dated below.



Martin Doyle

28th June 2021

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1. INTRODUCTION

Bulk Recovery Solutions Pty Ltd (BRS) gained Development Consent from the NSW Department of Planning, Industry & Environment (DPIE) on 26 May 2021 for State Significant Development (SSD) 8593. SSD 8593 is associated with the expansion and continued operation of the Ingleburn Resource Recovery Facility (RRF) located at 16 Kerr Road, Ingleburn, NSW, occupying Lot 16 of Deposited Plan (DP) 717203 (the Site). Through SSD 9583, BRS sought an increase in the throughput capacity of liquid waste at the RRF from 11 000 tonnes per annum (tpa) to 125 000 tpa (the Project).

Northstar Air Quality Pty Ltd (Northstar) has been commissioned by BRS to prepare an Odour Management Plan (OMP) to satisfy Conditions B8, B9, B10, and B11 of the Development Consent for SSD 8593. The OMP forms part of the Operational Environmental Management Plan (OEMP) as required by Condition C5 of the Development Consent.

This OMP has been prepared in accordance with the requirements of the Development Consent, and with due reference to the following regulations and guidance documents:

- *Protection of the Environment (Operations) Act 1997*;
- NSW DEC (2006) Technical framework: Assessment and management of odour from stationary sources in NSW; and
- NSW DEC (2006) Technical notes: Assessment and management of odour from stationary sources in NSW.

The current Development Consent was supported by an Air Quality Impact Assessment (AQIA) performed by Todoroski Air Sciences (TAS) (Todoroski Air Sciences, 2018). Following review by NSW Environment Protection Authority (EPA) and DPIE, additional information and clarification regarding the management of odour at the Site was requested, and subsequently provided by TAS in a Response to Submissions (Todoroski Air Sciences, 2019).

1.1. Development Consent Requirements

The Development Consent conditions related to odour management are presented in **Table 1**, including the sections of this OMP where they are addressed.

Development Consent conditions B12, B13, and B14 relate to commencement of operations and an odour audit which are not covered by this OMP.

Table 1 Development Consent Requirements

Condition	Requirement	Addressed
Odour Management		
B8	The Applicant must ensure the development does not cause or permit the emission of any offensive odour (as defined in the POEO Act).	This OMP
B9	All fugitive emission points associated with the storage of liquid waste and the dissolved air flotation device (DAF) must be fitted with carbon filters which are fit for purposes and prevent or minimise the emission of odour.	Section 3.3
B10	The Applicant must ensure all liquid waste is transported to site in vacuum sealed trucks.	Section 3.3
Odour Management Plan		
B11	Prior to the commencement of operation of the development, the Applicant must prepare an Odour Management Plan (OMP) to the satisfaction of the Planning Secretary. The OMP must form part of the OEMP required by condition C5. The OMP must	N/A
	a) be prepared by a suitable qualified and experienced person(s) whose appointment has been endorsed by the Planning Secretary;	Section 1
	b) describe a program that is capable of evaluating the performance of the operation and determining compliance with key performance indicators;	Section 3.5
	c) identify the controls measures that will be implemented for each emission source including preventative maintenance to ensure emission control infrastructure is operating efficiently;	Section 3.3
	d) include a carbon breakthrough strategy;	Section 3.4
	e) include proactive and reactive response mechanisms; and	Section 3.12
	f) nominate the following for each of the proposed controls: <ul style="list-style-type: none"> i. key performance indicator; ii. monitoring method; iii. location, frequency and duration of monitoring; iv. record keeping; v. complaints register; vi. response procedures; vii. performance review; and viii. compliance monitoring. 	Section 3.5 Section 3.11 Section 3.8 Section 3.9 Section 3.10

1.2. Authorship

This OMP has been prepared by Northstar, a specialist air quality consultancy.

Northstar consultants all have tertiary qualifications in relevant environmental areas and are Certified Air Quality Professionals (CAQP) as issued by CASANZ. All reports are subject to internal QA/QC procedures prior to issue.

2. LEGISLATION, REGULATION AND GUIDANCE

Impacts from odorous air contaminants are often nuisance-related rather than health-related. Odour performance goals guide decisions on odour management but are generally not intended to achieve “no odour”, but manage odour impacts to an acceptable level.

2.1. Definitions of Odour

The detectability of an odour is a sensory property that refers to the theoretical minimum concentration that produces an olfactory response or sensation. This point is called the odour detection threshold (ODT) and defines one odour unit (OU). An odour goal of less than 1 OU would (by definition) result in no odour impact being detectable in laboratory conditions. In practice, the character of an odour can only be judged by the receiver’s reaction to it, and preferably only compared to another odour under similar social and regional conditions.

Based on the literature available, the level at which an odour is perceived to be a nuisance can range from 2 OU to 10 OU (or greater) depending on a combination of the following factors:

- **Odour quality:** whether an odour results from a pure compound or from a mixture of compounds. Pure compounds tend to have a higher threshold (lower offensiveness) than a mixture of compounds.
- **Population sensitivity:** any given population contains individuals with a range of sensitivities to odour. The larger a population, the greater the number of sensitive individuals it contains.
- **Background level:** whether a given odour source, because of its location, is likely to contribute to a cumulative odour impact. In areas with more closely-located sources it may be necessary to apply a lower threshold to prevent offensive odour.
- **Public expectation:** whether a given community is tolerant of a particular type of odour and does not find it offensive, even at relatively high concentrations. For example, background agricultural odours may not be considered offensive until a higher threshold is reached than for odours from a landfill facility.
- **Source characteristics:** whether the odour is emitted from a stack (point source) or from an area (diffuse source). Generally, the components of point source emissions can be identified and treated more easily using control equipment than diffuse sources. Point sources tend to be located in urban areas, while diffuse sources are more prevalent in rural locations.
- **Health effects:** whether a particular odour is likely to be associated with adverse health effects. In general, odours from agricultural activities are less likely to present a health risk than emissions from industrial facilities, for example.

2.2. Regulation of Odour

Odour assessment criteria adopted in the performance of the AQIA for SSD 8593 (not represented in this OMP) are a design tool rather than a regulatory tool. They allow determination of whether modelled impacts of odour may meet criteria at surrounding sensitive receivers. Following approval of a project, the benchmark for operational facilities is not the odour impact assessment criteria, but whether the emission of odour is 'offensive', or being prevented or minimised using best management practices.

The *Protection of the Environment (Operations) Act* 1997 (POEO) is applicable to scheduled activities in NSW and emphasises the importance of preventing 'offensive odour'. Chapter 5, Part 5.4, Section 129 provides the requirements for the control of emissions of odour from licenced activities. The operations at the Proposal site would be scheduled activities under the POEO Regulations, and the principles contained within the POEO framework are applicable.

For reference, "offensive odour" is defined within the POEO Act as:

an odour:

- (a) that, by reason of its strength, nature, duration, character or quality, or the time at which it is emitted, or any other circumstances:*
 - (i) is harmful to (or is likely to be harmful to) a person who is outside the premises from which it is emitted, or*
 - (ii) interferes unreasonably with (or is likely to interfere unreasonably with) the comfort or repose of a person who is outside the premises from which it is emitted, or*
- (b) that is of a strength, nature, duration, character or quality prescribed by the regulations or that is emitted at a time, or in other circumstances, prescribed by the regulations.*

This OMP aims to ensure that offensive odour is appropriately controlled in accordance with the POEO Act.

3. ODOUR MANAGEMENT PLAN

3.1. Process Description

A detailed description of the Project is not presented within this OMP, although those activities with the potential to emit odour are discussed in some detail to allow the approach to odour management to be appropriately outlined.

The Project will accept the following liquid waste types:

- Drilling mud and non-destructive drilling mud;
- Cement slurry;
- Concrete washout;
- Oily water (J120);
- Sewage sludge including sewer grit or screenings;
- Stormwater;
- Groundwater (including M250, J100, N160, and F100);
- Industrial wastewater;
- Leachate; and
- Firewater (N140).

Liquid wastes are transported to Site in vacuum-sealed trucks, which are pumped directly into sealed storage tanks located within the building enclosure for processing. All sealed storage tanks are fitted with carbon filters to treat any air ventilated through working losses when filling the tanks. These filters also manage any breathing losses, should they occur.

Wastes with a solid component are passed through screens to remove both large and fine solid materials prior to further treatment which may include addition of coagulants, flocculants, or processing through filter press or screw press.

Processing of liquid wastes includes dissolved air flotation (DAF), biological treatment, sludge thickening and dewatering. Chemical addition and pH correction also occurs, depending on the waste to be treated.

The ventilation extraction system for the DAF includes a hooded ventilation system discharging through carbon filters to mitigate odour from this process.

The sludge material resulting from the processing of liquid wastes is collected and encapsulated in concrete to minimise the generation of odour from this source, or mixed with less odorous materials to reduce and manage its odour generation potential by dilution.

3.2. Potential Emission Sources

Based on the above brief description, emissions of odour have the potential to be emitted from the following processes performed at the Site, should they not be managed appropriately:

- Delivery of liquid wastes to site.
- Transfer of liquid wastes from delivery vehicles to storage vessels.
- Transfer of liquid wastes containing solids (drilling mud and muddy waters) to collection pit.
- Transfer of liquid wastes from storage to processing equipment.
- Liquid wastes processing.
- Storage of processed liquids.
- Storage of processed solids.
- Removal of treated liquid from site.
- Removal of solid wastes from site.

3.3. Odour Mitigation Measures

As required by the Development Consent, the OMP is required to identify the controls measures that will be implemented for each identified emission source including preventative maintenance to ensure emission control infrastructure is operating efficiently.

Control measures have been identified through review of the AQIA, Response to Submissions, and those committed to by BRS.

The Site Manager will be responsible for the implementation of the measures outlined within this OMP. Preventative maintenance associated with all tanks, pipes, processing equipment, and carbon filters used at the Site for the purposes of day-to-day operations will also be the responsibility of the Site Manager. Such preventative maintenance will include, but not be limited to:

- Daily visual inspections of all tanks, fittings and pipework to ensure that no leakages are present.
- Annual pressure testing of all tanks, fittings and pipework to ensure ongoing integrity.
- Regular maintenance of all processing equipment, in accordance with manufacturers recommendations.
- Inspection and replacement of carbon filters used on storage and processing tanks, and the DAF plant (also refer **Section 3.4**).

Table 2 Odour mitigation measures implemented at the Site

Identifier	Activity	Potential for odour emissions	Proposed management measure
OMP 1.1	Delivery of liquid wastes to site	Emissions from open trucks	All materials to be delivered to site in vacuum sealed trucks
OMP 1.2			Only one liquid waste truck will operate in the main building at any one time
OMP 2.1	Transfer of liquid wastes from delivery vehicles to storage vessels	Spillage between delivery and storage tanks	All liquid materials to be transferred using pipes
OMP 2.2		Overflow of tanks, loss of containment	All tanks and stored chemicals will be appropriately bunded
OMP 2.3		Overflow of tanks, loss of containment	Spill kits, including booms and adsorbents, to be provided at transfer location
OMP 3.1	Transfer of liquid wastes containing solids (drilling mud and muddy waters) to collection pit	Emissions from collection pit	Keep door of building closed when possible
OMP 3.2			Spill kits, including booms and adsorbents, to be provided at transfer location
OMP 4.1	Transfer of liquid wastes from storage to processing equipment	Spillage between storage and processing tanks	All liquid materials to be transferred using pipes
OMP 4.2			Spill kits, including booms and adsorbents, to be provided at transfer location
OMP 5.1	Liquid wastes processing	Emissions during waste processing, agitation, flocculation and coagulation	Liquid waste processing to be performed in sealed tanks to prevent odour emissions
OMP 5.2			Carbon filters to be installed on DAF to mitigate odour

Identifier	Activity	Potential for odour emissions	Proposed management measure
OMP 6	Storage of raw and processed liquids	Emissions from storage tanks	All tanks sealed with carbon filters to remove odour from working and breathing losses
OMP 7.1	Storage of processed solids	Emissions from odorous solids	Identified odorous materials to be blended with other materials to minimise odour
OMP 7.2			Sludge material to be processed and encapsulated in concrete as soon as practicable
OMP 8	Removal of treated liquid from site	Emissions from treated liquids	Treated liquid discharged to sewer under commercial discharge licence
OMP 9	Removal of solid wastes from site	Emissions from removed solids	Removal of residuals from liquid waste processing (using 20 t trucks) would occur during day and evening time periods only

3.4. Carbon Breakthrough Strategy

The carbon filtration units used at the Site will be employed in two ways:

- Located on sealed tanks to mitigate odour resulting from breathing and working losses; and
- Installed on the hood over the Dissolved Air Flotation (DAF) unit.

Given that the filters associated with the sealed tanks will not be subject to a significant rate of airflow, as air would passively move across the face of the filter, these will be replaced on a bi-monthly basis initially, with that frequency to be extended or reduced as required, based on performance.

The performance will be assessed through daily visual inspection to observe any visual signs of filter saturation or blockage deforming the filter media and breakthrough involving physical failure of the filter media. These observations would form part of the daily odour inspection, as described in **Section 3.11.1**.

It is recommended that odour observations are made daily to determine the filter performance over time and recorded on a daily inspection log to record those inspections and assist in determining typical filter longevity *prior to* reduced performance or failure.

If the visual and odour inspections are insufficient at identifying reduced performance before failure, it would be recommended to fit a simple differential pressure gauge across the filter media to monitor filter performance and change the filter before differential pressure exceeds 85 % of the failure point and record daily pressure readings on the inspection log.

The carbon filters associated with the DAF unit will be placed within the extraction hood and would therefore be subject to an increased airflow compared to the tank filters. It is recommended that a parallel daily inspection procedure is followed and recorded in a similar manner to that described above.

For all carbon filters, it is recommended that sufficient spare supplies are maintained to negate operation with under-performing filters, and to accommodate filter failure through unforeseen manufacturing defect.

3.5. Key Performance Indicators

The key objectives of this OMP are to prevent, minimise and/or control the impacts of the Project on local air quality. To achieve these objectives, management measures have been outlined in **Section 3.3**. The success of the management measures will be determined through compliance with Key Performance Indicators (KPIs) as summarised in **Table 3**.

Table 3 KPIs associated with the performance of the operation

Measure	Target	Timeframe	Responsibility	Documentation
Meeting relevant air quality criteria	Comply with requirements of Development Consent and POEO Act (see Section 2)	At all times	Site Manager	Environmental inspection checklist
Complaints regarding odour	Zero complaints. Any complaints would be investigated (see Section 3.8)	At all times	Site Manager	Complaints register
Offensive odour emissions	Any offensive odour emissions investigated immediately. Review controls applied and increase controls or modify activities	At all times	Site Manager	Environmental inspection checklist Site Manager's daily checklist

3.6. Roles and Responsibilities

The appropriate implementation of this OMP will be the responsibility of the Site Manager. This responsibility includes monitoring the OMP's effectiveness and rectifying any deficiencies in the OMP.

All employees must comply with the terms and conditions of the OMP and adopt the specified procedures for management of odour nuisance impacts, including corrective actions.

It will be the responsibility of the Site Manager to perform checks at the commencement of each working day to ensure that all odour control measures are in good working order. A record will be kept of the daily checks performed, and the records retained for inspection by Council and EPA upon request.

This OMP is a live document that will be reviewed upon commissioning, and on an annual basis thereafter, as a minimum, to ensure that it remains relevant to Site operations and to determine whether improvements can be implemented.

3.7. Training

All Site personnel (permanent or contractor) will undergo training to enable the identification of the potential sources of odour at the Site and the operating procedures and management strategies which are in place to minimise the emission of odour from those sources. The training will ensure that all employees understand the importance of odour control and are aware of all measures in place to minimise odour emissions.

Records will be kept of the training provided to all Site personnel.

3.8. Complaints Handling Procedure

BRS will operate a telephone complaints line during its operating hours with the number publicly notified via the BRS website.

BRS will keep a record of any complaint made to the Site or any employee or any agent of the Site in relation to odour from the Site. A Complaint Register will be maintained on the company website and will be produced to any authorised officer of the Council or EPA if requested. Records of individual complaints will include the following information, as a minimum:

- Date and time of complaint.
- Method by which the complaint was made.
- Personal details of the complainant (if provided).
- Nature of the complaint.
- The details of an initial response to the complaint.
- Action taken by BRS and any follow up actions.
- If no action was taken, the reason why no action was taken.

A copy of an Odour Complaint Record is provided in **Appendix A** of this OMP and may be used or adapted for use as required.

Weather conditions corresponding to the time of the complaint will also be noted in the logbook for assessment purposes.

For any complaint received relating to odour emission from the Site, the following measures will be taken:

- The Site Operations Manager or Site Environmental Officer will review and follow up all the complaints within one business day of receiving the complaint;
- Fill out the appropriate Odour Complaint Record sheet,
- Perform a site inspection, noting all odour producing activities taking place and the mitigation methods being used. If the complaint was related to an event in the recent past, if possible, note any odour producing activities that were underway at that time and initiate any remedial action necessary;
- As soon as possible, visit the area from where the complaint originated to ascertain if the issue persists;
- It is important to verify if another source of odour other than the activities of the Site is causing the complaint and collect appropriate evidence of this (photos and/or videos as appropriate);
- Once investigations have been completed, contact the complainant to explain any problems found and remedial actions taken; and
- If necessary, update any relevant procedures to prevent any recurrence of problems and record any remedial action taken.

3.9. Non-Compliance Response Procedure

In the event that the procedure in **Section 3.8** indicates that Site operations may have contributed to odour experienced off-site, the following actions will be taken:

- The event will be investigated to determine possible emission sources including investigation into the prevailing wind conditions experienced at the time of the possible exceedance and the operations being performed on site at that time to identify the possible source of the odour;
- Where the source is identified as the Site, operational activities will be altered until a favourable outcome can be achieved (e.g. reduction in hourly receipt and processing rate, increased rate of holding tank emptying, increased rate of removal of waste materials [dependent on the findings of the investigation]);
- Perform site boundary odour surveys (downwind, twice per day until four successive downwind observations indicate 'no discernible odour' at the boundary, resulting from Site operations) to ensure that the additional implemented controls are sufficient to mitigate the impact;
- Note all details of complaint, response and resolution to include within the Annual Return; and
- Any non-compliance with the Development Consent will be reported to NSW EPA and DPIE.

3.10. Performance Review

A review of environmental performance of the Site is to be completed each year. In relation to odour, an audit will be performed by an independent party to assess compliance with the measures outlined within this OMP.

The findings of the independent audit may trigger a review and update to this OMP.

3.11. Odour Monitoring Procedures

Sampling and testing for odours shall be performed to ensure compliance to the site environmental management plan and will be monitored in the site workplace inspection, HSE committee meetings and regular site walk throughs and inspections and including external site visits from regulatory bodies as appropriate. This monitoring would be performed for an initial period of 12 months, after which time the results will be reviewed to determine whether the frequency should be increased or decreased.

The monitoring and maintenance plan includes a number of visual inspections, data sets to be recorded and basic tests of operating equipment on a set plan of varying frequency. Fugitive odour sources that could result in a negative impact will be identified, recorded and escalated to the Maintenance Manager through routine process and equipment checks during an Operators shift.

Compliance of this OMP with the consent conditions and any other relevant requirements will be measured according to the following performance indicators:

- The frequency and nature of complaints reported to BRS in relation to odour at the Site; and,
- Compliance with this OMP, as indicated by the independent odour audit, performed under Condition B13.

3.11.1. Daily Odour Inspections

Daily site inspections will be undertaken in order to identify and mitigate offensive odours from the Site before the odours can lead to exceedances of the adopted criteria. These will be undertaken by trained operational staff, with verified odour sensitivity who will typically be personnel not normally exposed to the interior of the BRS building.

A register with the following information must be completed:

- Time and date of the inspection;
- Weather conditions at the time of the inspection;
- Any unusual activities occurring on site with potential for offensive odour generation;
- The status of the treatment system (e.g. DAF on/off);
- Visual and odour inspection of the carbon filters on the storage tanks and DAF extraction unit(s) (see **Section 3.4**);
- Any odours observed, including the character, location and strength; and
- Any sources of the odours identified during the walk over.

The findings of the daily odour inspections will be reviewed after three months from commissioning to assess whether the frequency of the inspections should be altered to optimise value. In addition to the daily odour inspection, all employees will be reminded on a regular basis to report any perceived offensive odour around the plant immediately to the Site Manager. Any offensive odours identified through the daily inspections that are confirmed to originate from the Site will be investigated and mitigated in accordance with this OMP.

3.11.2. Monthly Odour Surveys

To confirm the site is operating in compliance with the adopted criteria, monthly odour surveys will be undertaken. These surveys will be undertaken by an independent contractor. The purpose of these surveys is to provide independent observational data to understand the odour impacts of the Site operations as well as other odour sources within the surrounding area.

The results of the monthly odour surveys will be reviewed after three months from commissioning to assess whether the frequency of the surveys should be changed to quarterly or other frequency.

3.12. Proactive and Reactive Response Procedure

The Site Manager will be responsible for the performance of daily odour inspections as described in **Section 3.11.1** to ensure that operations are relocated, modified and/or halted as required to ensure adverse air quality impacts are not realised at off-site sensitive receptor locations. The Site Manager will assess the results of the daily odour inspections, monthly odour surveys and odour audit, to verify the successful implementation of this plan.

3.13. Continual Improvement

In order to address Condition B13 of the Development Consent (Odour Audit), BRS will engage a suitably qualified expert to complete an odour audit within 6 months of commencement of operation. The odour audit will be carried out when large amounts of liquid waste are present on the Site.

Condition B13 of the Development Consent states that the audit must:

- a. be carried out by a suitably qualified, experienced and independent person (s), whose appointment has been endorsed by the Secretary;
- b. audit the development in full operation;
- c. include a summary of odour complaints and any actions that were carried out to address the complaints;
- d. assess the operation against odour impacts predictions in the EIS;
- e. review design and management practices in the development against industry best practice for odour management; and
- f. include an action plan that identifies and prioritises additional any odour mitigation measures that may be necessary to reduce odour emissions.

APPENDIX A: ODOUR COMPLAINT RECORD

Odour Complaint Record

Complainant Contact Details			
Date and time complaint received			
Contact details for complainant			
Complaint Details			
Date and time start	/ /	:	am pm
Date and time stop	/ /	:	am pm
Location(s) of the odour			
Description of the odour			
Persistence <i>see note 1</i>	<input type="checkbox"/> Constant <input type="checkbox"/> Intermittent		
Intensity <i>see note 2</i>	<input type="checkbox"/> 6 extremely strong <input type="checkbox"/> 5 very strong	<input type="checkbox"/> 4 strong <input type="checkbox"/> 3 distinct	<input type="checkbox"/> 2 weak <input type="checkbox"/> 1 very weak
<input type="checkbox"/> generally <input type="checkbox"/> at its worst			
Prevailing weather conditions at the time of the odour complaint			
General description (dry, rain, windy, still etc)			
Temperature			
General wind direction <i>see note 3</i>			
General wind strength <i>see note 4</i>			
Operational details, actions, resolution			
Operations during odour complaint			
Identified causes			
Actions taken			
Cause resolved	<input type="checkbox"/> Yes <input type="checkbox"/> No		
Follow up required	<input type="checkbox"/> Yes <input type="checkbox"/> No		
Complainant informed of outcome	<input type="checkbox"/> Yes <input type="checkbox"/> No		
Signed			
Date	/ /		

Odour Complaint Record

Notes

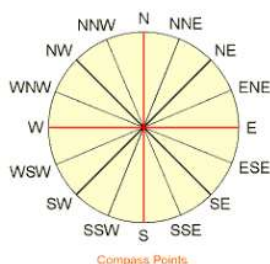
1. Persistence. Please record the descriptor that best describes the extent of the odour observation:

- Constantly: odour was observed virtually constantly between the stated start and stop times
- Intermittently: odour was observed intermittently between the stated start and stop times

2. Odour Intensity. Using the scale below, estimate how intense the odour was generally or at its worst (as appropriate)

6	Extremely strong: Overpowering odour triggering a physical reaction (i.e. gaging, eyes watering etc.) or an involuntary action (i.e. turning away from odour, covering nose etc.).	3	Distinct: Mid way between a weak and strong odour, this is a clearly defined odour, immediately recognisable and tolerable.
5	Very strong: A strong odour that may initiate an involuntary action that you subsequently control. Odour is barely tolerable and exposure is uncomfortable	2	Weak: This is a clearly defined odour (i.e. without uncertainty/guessing), immediately recognisable but not yet strong enough to be considered distinct and readily tolerable.
4	Strong: A clearly defined odour that is immediately recognisable and is tolerable but mildly uncomfortable.	1	Very weak: A very faint odour. The VDI definition of a very weak odour requires the odour to be clearly defined without uncertainty or guessing involved.

3. Wind Direction.



4. Wind Strength

0	Calm	Calm. Smoke rises vertically
1	Light air	Wind motion visible on smoke
2	Light breeze	Wind felt on exposed skin. Leaves rustle.
3	Gentle breeze	Leaves and smaller twigs in constant motion
4	Moderate breeze	Dust and loose paper raised. Small branches move
5	Fresh breeze	Moderate branches move. Small trees begin to sway.
6	Strong breeze	Large branches in motion. Overhead wires whistle. Umbrella use is difficult. Empty rubbish bins tip.
7+	Near gale	Wind effects greater than above