



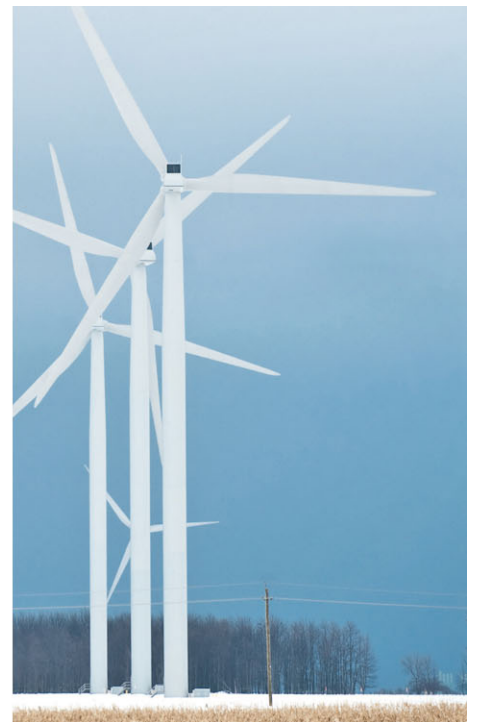
ROBIN JONES & SONS LTD
Plant Hire - Aggregate Supply - Muck Away



RJS Civil Engineering Ltd

Parrys Quarry Environmental Permit Application

Odour Management Plan



9 June 2014

AMEC Environment & Infrastructure UK Limited

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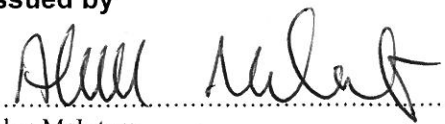
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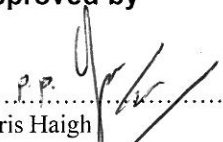
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Parrys Quarry Environmental Permit Application

Odour Management Plan

9 June 2014

AMEC Environment & Infrastructure
UK Limited



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1. Introduction

1.1 Background

In 2011 Robin Jones and Sons Limited has commissioned AMEC Environment and Infrastructure (UK) Limited (AMEC) to provide, inter alia, an odour management plan (OMP) for the proposed landfilling activities a Parry's Quarry, to support the permit Application process.

Following a review of the report by the Environment Agency Wales, now Natural Resources Wales (NRW), a Schedule 5 Notice was issued by NRW which contained several identified issues with the odour management plan. Detailed responses have been made to these Schedule 5 issues and these are contained in a separate document but a summary of the main points and responses to them are included below.

This report contains an updated impact assessment of emissions of NO_x from the landfill gas electricity generation plant and flare that will be operational on the site and also an evaluation of the fugitive emissions of hydrogen sulphide (H₂S), carbon disulphide (CS₂) and odour from the landfill operations.

1.2 Purpose of this Odour Management Plan

The purpose of this odour management plan (OMP) is to provide a framework within which the proposed Parry's Quarry landfill site can be operated and managed so that the risk of odour annoyance or nuisance arising for the local community is prevented or minimised as far as is practicable. It details appropriate operational and control measures for the management and control of odour on the site, in addition to providing details such as contact names and methods for direct communication with neighbouring local communities. It is also a requirement that the OMP must be compliant with the requirements of Environment Agency Horizontal Guidance document H4¹.

1.2.1 OMP Objectives

OMPs should be developed with three pollution prevention objectives clearly in mind:

- to employ all appropriate methods to minimise the emissions of odorous substances and subsequent exposure/ impact;
- to prevent exposure of people outside the site to levels of odour which would result in annoyance (unacceptable pollution); and
- to minimise the risk of unplanned odour release incidents or accidents which would result in annoyance.

¹ Environment Agency (2011) H4 Odour management. How to Comply with your Environmental permit

This OMP will serve to aid the decision-making process on the choice of controls, general site design, and operational practice in line with current industry best practice. The OMP is a working document with the specific aims of ensuring:

- odour impact is considered as part of routine inspections;
- to minimise the risk of unplanned odour releasing incidents or accidents that could result in annoyance;
- odour is primarily controlled at source by good operational practices, the correct use and maintenance of plant, and operator training; and
- all appropriate measures are taken to prevent or, where that is not reasonably practicable, to minimise odorous emissions to air from the landfill.

1.2.2 OMP Methods

The methodologies presented take full account of Environment Agency (EA) guidance documentation, as detailed below:

- LFTGN 03: Guidance on the management of landfill gas, dated September 2004;
- LFTGN 04: Guidance for monitoring trace components in landfill gas version 3.0, dated 2010;
- LFTGN 07: Guidance for monitoring landfill gas surface emissions version 2.0, dated 2010;
- Internal Guidance for the Regulation of Odour at Waste Management Facilities;
- Environment Agency Technical Guidance Note H4 – Odour Management 2011;
- Environment Agency Guidance for the Landfill Sector EPR S5.02, dated March 2009; and
- Appendix 10, How to apply for an environmental permit Part B: New permit guidance notes.

All OMPs, including this document, contain a number of basic elements:

- sources, releases and impacts;
- controls;
- monitoring;
- contingencies;
- emergency plans.
- Community Interaction; and

- Responsible Persons.

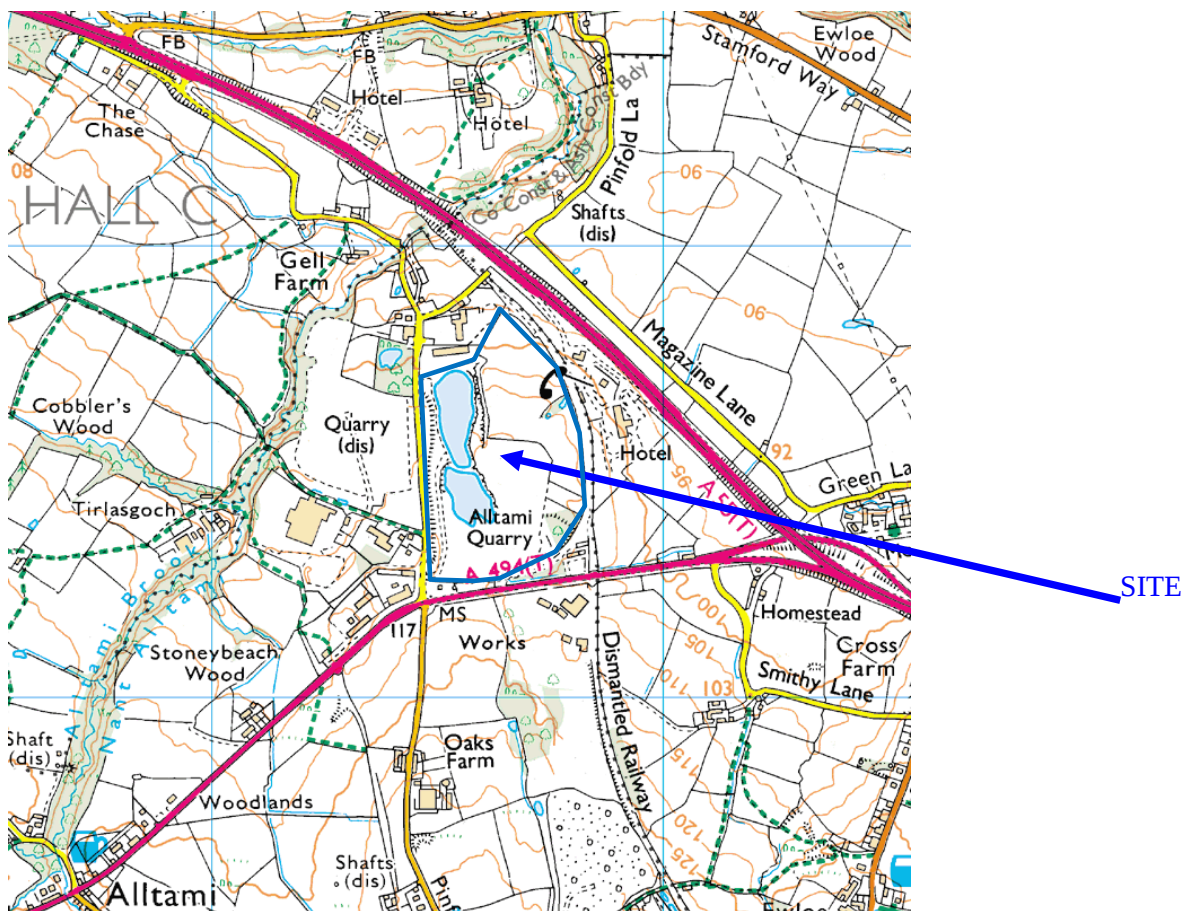
Appendix A contains examples of standard forms that are used for site inspections, daily assessment reports, odour complaint record forms and OMP review records.

2. Site Description

2.1 Site Location and Nearby Receptors

Robin Jones and Sons Ltd currently operates a waste transfer station and conducts mineral extraction activities at the Parry's Quarry site. This site is located 1km to the northeast of the village of Alltami, Flintshire, north-east Wales, lying to the west of the junction of the A55(T) with the A494h. The location of the site is shown in Figure 2.1.

Figure 2.1 Location Map



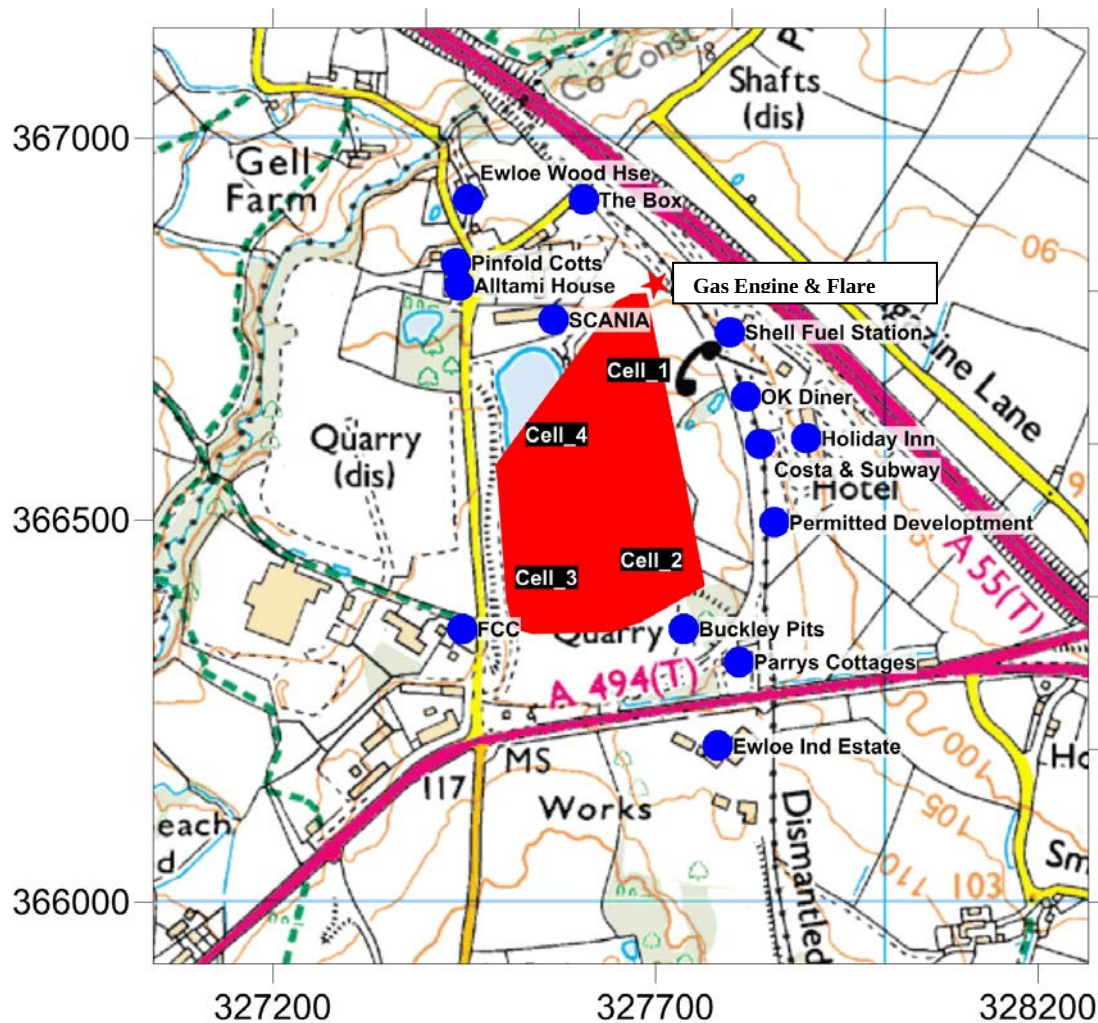
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There are a number of industrial, commercial and residential properties within relatively close proximity to the proposed landfill site, to the south, south-west, east and north. These are identified in Table 2.1 and Figure 2.2 below.

Table 2.1 Details of Sensitive Receptors

Receptor Name		Easting (m)	Northing (m)
1	Parry's Cottages	327808	366314
2	Holiday Inn	327897	366607
3	Shell Service Station	327799	366746
4	The Box	327606	366919
5	Alltami House	327443	366807
6	Pinfold Cottage	327439	366837
7	Ewloe Wood House	327455	366919
8	Costa & Subway Outdoor Eating Areas	327836	366600
9	Ewloe Barns Industrial Estate	327781	366204
10	SCANIA and other business/industrial units (to north of site)	327567	366762
11	FCC and other office/ business units (to south-west of site)	327447	366357
12	OK Diner Restaurant	327817	366661
13	Permitted Development (to south-east of site)	327855	366497

Figure 2.2 Locations of Sensitive Receptors Relative to Landfill Site

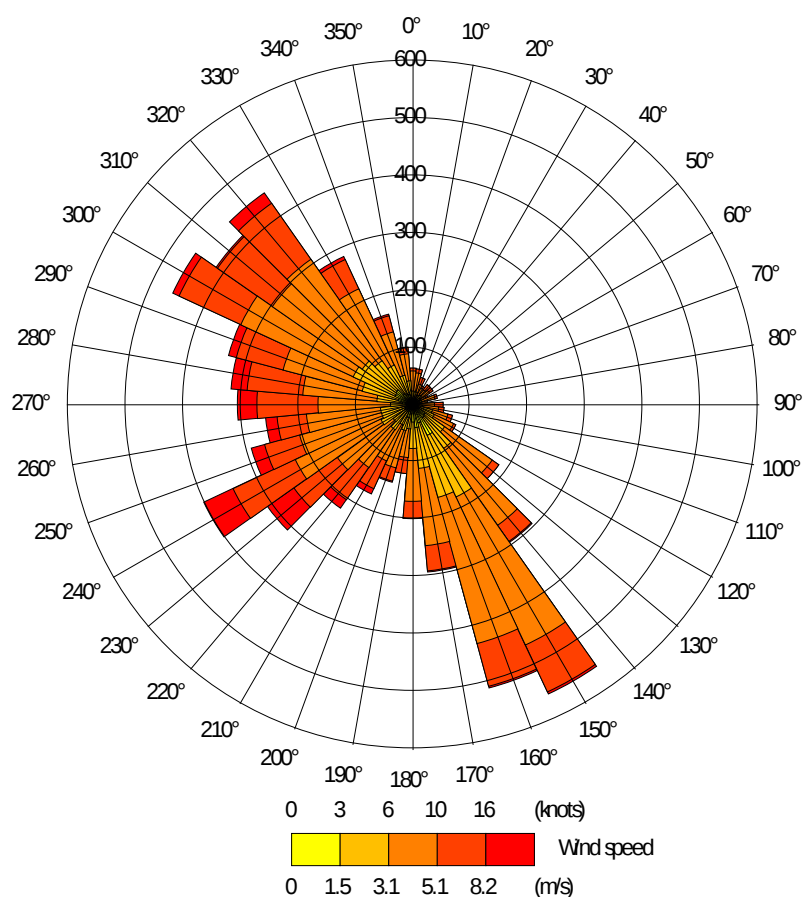


2.2 Local Meteorology

There is a Meteorological Office synoptic recording station at Hawarden some 7 km to the east of the site and a wind rose, showing the typical distribution and frequency of occurrence of different wind speeds and directions, in this case for 2007, is contained below in Figure 2.3. The wind rose depicts a prevailing south-easterly component over the modelled area, with lesser westerly and north-westerly components.

From this it would appear that locations to the north-west, south-east and east of the landfill site would be most at risk of any odour impacts arising from emissions from the landfill site.

Figure 2.3 2007 Hawarden Wind Rose



2.3 Current and Planned Site Activities

2.3.1 Current Activities

The site is currently operated by the applicant for the quarrying of materials for civil engineering purposes. Quarrying of the economic brick-making material at the site, especially the unit known as the Buckley Fireclay or Buckley Blue (the lower mudstones of the Ruabon Marl (Buckley) Formation), will continue in parallel with the proposed site restoration by landfilling with site-derived materials being utilised for engineering purposes as far as possible. The company currently operates under planning permission and Environmental Permit No. .

2.3.2 Planned Activities

The site was granted planning permission at appeal in 2009 and is to be permitted and operated as a non-hazardous landfill site accepting domestic, commercial and industrial wastes, i.e. municipal solid waste (MSW). The site will be landfilled at a rate of 105,000 tonnes per annum over a 15 year period. The expected wastes will contain a significant putrescible content which historically requires active landfill gas management to prevent unacceptable

emissions to the environment. The site will be divided into four cells of areas as shown in Table 2.2 below (these can also be seen in Figure 2.2 above). The operational hours for the site will be 07.30h – 18.00h Mondays to Fridays and 08.00h – 13.00h Saturdays, with no operation on Sundays.

Daily and intermediate cover material will be sourced largely from within the site's existing resources and the final cap for each component of the four main cells will be at least 1 metre of low permeability native clay cover over finished surfaces, overlain by vegetated topsoil.

Table 2.2 Landfill Cell Areas

Landfill Cell	Area (m ²)
Cell 1	14,958
Cell 2	17,808
Cell 3	26,309
Cell 4	19,732

2.3.3 Landfill Gas Management

Landfill gas will be actively extracted and collected from the decomposing deposited wastes as soon as is practicable after deposition and daily/ intermediate covering. The gas will be conveyed by pipeline to a gas utilisation and flaring compound on the north-east section of the site, where it will be combusted in a spark ignition engine to generate electricity for export to the Grid. When there is insufficient gas to run the engine and when the engine is undergoing planned maintenance, the gas will be combusted in an efficient enclosed flare. Further details can be found in the landfill gas management plan ().

2.3.4 Leachate Management

The site will effectively operate as two hydraulic cells draining towards the perimeter at the interface of Cells 1 & 2 (east) and Cells 3 & 4 (west) at leachate heights of less than 84m AOD or as a single hydraulic unit at higher leachate heights, when the site is operated under hydraulic containment principals. The leachate collection system will consist of a continuous drainage blanket, lateral collection pipes, perimeter header pipes, cleanouts, leachate pump stations and a leachate rising main to the public foul sewer.

3. Sources, Releases and Impacts of Odour

This document has been compiled with specific regard to the non hazardous landfilling operations at the site. There are three primary potential odour sources associated with landfill sites accepting non hazardous (potentially putrescible) wastes:

- landfill gas (LFG);
- leachate; and
- incoming wastes.

A Landfill Gas Risk Assessment (LFGRA) has been produced in support of the Environmental Permit application for the site and concludes that, based on the predicted rates of fill and likely waste to be deposited, air quality impacts are likely to be minimal. On this basis the site could possibly be regarded as being of low risk in relation to the potential for odour release. However, there are sensitive receptors relatively close to the site boundary in the prevailing downwind directions, which upgrades this rating to medium risk, thus requiring a high degree of competent site management in respect of odour control.

3.1 Potential Odour Sources

This section provides an inventory of all potential odour sources under the full range of usual operating conditions.

The measures to control odour have been considered in the context of the installation setting and the operations that will be carried out. A summary of the operations are as follows:

- Engineering of cells;
- Deposition of new waste to the required waste fill level;
- Installation of landfill gas and leachate management systems; and
- Recapping and restoration of cells.

This OMP has been developed for the installation to ensure that any potential odour release is managed to an acceptable level.

3.2 Activities that Produce Odour and Points of Release

Potential sources of odour at Parry's Quarry landfill site that may arise from specific engineering operations associated with the landfill operations are considered below.

3.2.1 Engineering Operations

Engineering operations considered to represent a potential risk of odour release are as follows:

- Temporary partial shut-down of landfill gas extraction system;
- Damage caused by other site operations;
- Gas management – draining of condensate;
- Leachate management – collection, ponding and disposal; and
- Old waste, which is partially degraded, and is disturbed by digging or drilling.

3.2.2 Landfilling Operations

Potential odour sources from landfilling operations will be associated with the deposit of fresh waste and the degradation of already filled waste, therefore possible odour sources may be as follows:

- Biodegradable waste that has been stored for significant periods prior to delivery;
- Any potentially malodorous waste; and
- Landfill gas and leachate, containing compounds with low odour thresholds e.g. organo-sulphur compounds, aromatic hydrocarbons, esters and carboxylic acids.

4. Control Measures

This OMP describes the specific techniques and measures that will be adopted at Parry's Quarry Landfill to minimise any potential release of odours as a result of the landfilling and associated activities. The following sections detail the management techniques and procedures, and odour control measures that will be employed for each aspect of the scheme.

4.1 Waste Transport, Acceptance and Deposition

The operational control techniques employed to minimise the potential for odour generation at Parry's Quarry during transport, acceptance and deposition of waste are as follows:

- The site management will liaise with the waste producers and transport contractors, with a view to minimising the storage and transport periods for the waste being delivered to the site;
- Waste identified as being difficult due to their odorous nature will be required to book at site one day in advance;
- Waste producers and carriers will be required to demonstrate that any potentially odorous waste has been treated prior to delivery at site;
- Waste carriers will be required to deliver loads consisting of, or containing, malodorous wastes, in enclosed vehicles. The use of open tipper, open skip vehicles or vehicles contained only by nets for such wastes will not be permitted;
- Any malodorous waste shall be recorded as to composition, date and time received at site;
- Any malodorous waste received will be tipped at the bottom of the working face and immediately covered by a minimum thickness of 1 m of other non-malodorous waste;
- Malodorous waste will not be accepted at the site when unfavourable weather conditions would hinder effective dispersion of residual odours. Unfavourable weather conditions would be times of low wind speeds (less than Force 3 on the Beaufort Scale (see Appendix A)) with the wind blowing directly towards the nearest sensitive receptors;
- The process of progressively compacting waste using mobile compaction equipment will assist in the prevention of odours.

4.2 Provision of Cover Materials

The Landfill Manager will ensure there are adequate supplies of daily and intermediate cover material available at the installation. A layer of suitable cover material will be applied to deposited waste at the end of each working day. This will assist in controlling odour from recently deposited and any disturbed waste; in addition to the

provision of daily cover, flanks likely to be exposed for a long duration will have an intermediate cap applied to ensure potential emissions are kept to a minimum.

4.3 **Progressive Capping of Completed Areas**

The landfill will be progressively capped and restored in a series of discreet phase as soon as practicable once infilling activities are complete.

4.4 **Disturbance of Previously Emplaced Waste**

Wherever possible, measures will be taken to ensure that previously emplaced waste is not disturbed, exposed or moved. Landfill operators should follow procedures to prevent any over-tipping that would require the deposited waste to be disturbed at a later date. In the event that any waste must be excavated (e.g. during the installation of gas and leachate wells, or re-grading of profiles), it will be removed and buried at the tipping face at the earliest opportunity.

4.5 **Landfill Gas Extraction System**

To minimise the risk of fugitive releases of landfill gas the following measures will be employed:

- The gas extraction system will be operated in accordance to the site Permit;
- A sacrificial gas extraction system will be introduced to the future filling area as soon as practicable;
- Gas field balancing will be undertaken to prevent fugitive emissions of landfill gas and to restrict oxygen ingress;
- Following completion of each area the permanent gas extraction infrastructure (wells, spurs and pipe work) will be developed as soon as is practicable;
- The integrity of the gas system will be monitored on a regular basis;
- Side slopes must be adequately covered to exclude air and prevent odour release;
- As far as possible, infrastructure will not be located in close proximity to sensitive receptors; and
- Shut-down/isolation for maintenance to gas extraction system will be planned to avoid unfavourable meteorological conditions.

4.6 **Leachate Management**

To minimise the risk of fugitive emission of odour from leachate the following measures will be employed:

- Leachate wells will be covered;

- Holding tanks are kept closed;
- The site is regularly inspected for evidence of fugitive leachate emissions;
- As far as possible, infrastructure will not be located in close proximity to sensitive receptors. Where this is not possible, appropriate measures will be taken (i.e., covering/enclosure, extraction and discharge of treated air);
- Leachate head will be maintained in accordance with the site's Permit and Hydrogeological Risk Assessment; and
- Prevailing meteorological conditions will be taken into consideration when planning leachate collection, recirculation, and disposal activities.

4.7 Odour Management Misting Sprays

If considered necessary, odour management sprays containing a masking or neutralising agent may be utilised around sensitive areas of the installation. These can be mixed in the bowser to treat larger areas in emergency situations. In addition, pumped knapsack sprays containing odour masking agents will be maintained on site for use in emergency situations to prevent any potential odour nuisance arising off-site. Their use will be monitored closely to ensure their effectiveness and the use of compounds that are considered more offensive than the odour then are being used to mask will be avoided.

4.8 Liaison with Neighbours

If at any time an action that is likely to cause temporary odour is being considered (e.g. the drilling of gas wells), then before such action is taken the area manager or operations manager will be informed. Neighbours who may be affected will be contacted in advance to advise them of the operation being undertaken and that any odour will be of a temporary nature. The same provisions would apply in advance of any other work activities that could give rise to excessive odour emissions, such as re-excavation of deposited wastes or work on the leachate collection and pre-treatment system.

5. Failure and Abnormal Event Scenarios

In accordance with the requirements of Environment Agency's draft Technical Guidance Note H4, types of failure or abnormal events considered to have the potential to result in an odour impact have been considered. These have been identified as abnormal meteorological conditions and failures of certain control measures detailed above. Failure and abnormal event scenarios are presented in Appendix B.

5.1 Abnormal Meteorological Conditions

Extreme meteorological conditions that promote the generation of odour and inhibit its effective dispersion (i.e. high temperatures, low wind speeds and/or stable atmospheric conditions) may result in impact at receptor locations. Even with the application of control measures, such as using meteorological forecasts, in-filling operations away from receptors and immediate covering of the waste, an impact could still occur under extreme conditions.

5.2 Failure of Control Measures

Failures in the control measures employed have the potential to result in impacts at receptor locations. Failures also have the potential to result in an increase in the magnitude of odour emissions and consequentially potentially higher odour concentration at receptors.

Potential failures in control measures include:

- Damage to or material failure of the gas extraction network, requiring shut-off and replacement of infrastructure, may result in short term passive venting of landfill gas. The magnitude of impact will be dependent on wind direction but could potentially result in elevated odour concentrations at receptor locations;
- Failure of the engines and subsequent failure of the flare resulting in landfill gas emissions to atmosphere. The magnitude of impact will be dependent on wind direction but could potentially result in elevated odour concentrations at receptor locations.

Responses to failure and abnormal events are addressed in Section 7 and Appendix B.

6. Monitoring Measures

To ensure that the control measures in Section 4 are effective, the landfill site operator will employ monitoring techniques as outlined in this section of the document. The company operates a Corporate Management System that encompasses the requirements of ISO 9001 Quality Management Systems and ISO 14001 Environmental Management Systems. The following monitoring activities will be regularly undertaken to ensure continuous improvement:

- Site inspections by the site manager or deputy (as outlined below);
- Site audits conducted by the company's management;
- Site audits and inspections by the Environment Agency;
- Site Inspections by the Planning Authority;
- Inspections by specialist contractors (e.g. landfill gas energy conversion companies);
- Third party audits.

6.1 Meteorological Monitoring

Meteorological forecasts and conditions are and will continue to be monitored routinely to enable potential odour problems to be predicted and necessary remedial actions, such as modifications to the method of working or the use of deodorising sprays, to be implemented. Meteorological data will be recorded as per LFTGN035, as derived from the Landfill Directive. Details are presented in Table 6.1.

Table 6.1 Meteorological Monitoring

Landfill Directive Requirements	Operational and Restored Phases
Rainfall volumes	Recorded daily
Minimum & maximum temperatures	Recorded daily
Wind speed & direction	Recorded continuously, reported yearly as a wind rose
Evaporation	Recorded daily
Barometric pressure	Recorded daily
Atmospheric humidity	Recorded daily

The meteorological data will form part of the monthly/ quarterly records submitted to the Environment Agency as a requirement of the operating Permit.

6.2 Site Walk-Over Surveys

The site manager (or deputy) will be responsible for ensuring that monthly site walkover surveys will be carried out on all capped, temporarily capped and covered areas in order to identify any imperfections in the caps or cover that could be sources of emissions to atmosphere. In the event that any imperfections are identified, they shall be rectified as soon as is practicable. The use of a hand-held portable flame ionization detector (FID) or methane monitoring device is often helpful in identifying areas where emissions to atmosphere from the landfill surface occur. Such a walkover survey could also be usefully conducted in response to an off-site complaint.

6.3 Olfactory Monitoring Procedure

All site personnel will be responsible for reporting any odour problems immediately to the site manager (or deputy). The Site Manager will ensure that regular inspections are made of the installation and its perimeter in order to identify any sources of odour and to establish whether any odours are discernible at the perimeter of the installation. The survey will be carried out in accordance with the monitoring protocol contained within the Environment Agency's Technical Guidance Note H4: Horizontal Guidance for Odour. Particular attention will be paid to the active operational parts of the installation.

In the event that odour is detected at the installation boundary, additional monitoring will be undertaken at the sensitive receptors in accordance with Appendix B. Further olfactory monitoring will be undertaken in response to complaints. The procedure has been adapted from the Environment Agency guidance document Internal Guidance for the Regulation of Odour at Waste Management Facilities for application to Parry's Quarry Landfill.

The assessor will ensure that he/she has not been subject to landfill odours in the 30 minutes prior to the assessment and are compliant with the requirements laid down in the Olfactory Survey procedure (detailed in Appendix B) in order to ensure that they are not suffering from odour fatigue and will be sensitive to landfill odours.

The assessor will undertake the olfactory survey at the location of the complaint and at potentially sensitive receptor locations in the vicinity downwind from the site. At each location observations will be made concerning the intensity of the odour, its persistence and character (these details will be logged following the instruction provided in the pro forma, see Appendix B).

If odour is detected at the assessment location and is judged to be a moderate odour then the Landfill Manager (or Deputy) will be notified immediately and the olfactory survey will continue to attempt to determine the extent of the odour plume, as follows:

- A suitable location downwind of the landfill and potentially sensitive receptor at which the odour plume is unlikely to extend will be selected for assessment;
- The survey will then continue toward the landfill until landfill odour is perceived; and
- Assessment points perpendicular to the plume axis and equidistant from the landfill site will then be monitored, subject to access requirements.

6.4 Complaint Monitoring

Complaints will be monitored and actioned in accordance with the site's Working Plan. The complaint shall be recorded in accordance with the Permit and shall include: the date and nature of complaint, time of complaint, name of complainant (if given), a summary of any investigation undertaken in response to the complaint and the results of the investigation and any actions taken.

6.5 Monitoring Frequency

Monitoring frequencies are as detailed in Table 6.2 below.

Table 6.2 Monitoring Frequencies

Parameter	Monitoring Technique	Frequency
Meteorology	Recording conditions at 15:00 GMT	Daily
	Wind speed and direction	Continuous
Odour	Olfactory monitoring	Weekly installation and perimeter checks.
		Boundary odour detection will induce receptor monitoring.
		Increased frequency in response to complaints
	Complaint	Continuous (24 hours) via telephone reporting system

6.6 Responsible Persons

Responsible persons are detailed within Appendix C.

6.7 Records

A daily record relating to the management and monitoring of odour will be maintained. It will include the following details:

- The results of inspections and olfactory monitoring carried out by site personnel;
- Weather conditions including atmospheric pressure, wind speed and wind direction;
- Problems including date, time, duration, prevailing weather conditions and cause of problem;
- Complaints received including address of complainant;
- Details of corrective action taken, and any subsequent changes to operational procedures; and
- An evaluation of the effectiveness of the techniques used.

7. Compliance Action Plans

7.1 Control and Trigger Levels

The control trigger levels are presented below in Table 7.1.

Table 7.1 Control and Trigger Levels

Parameter	Monitoring Technique	Control Level
Odour	Olfactory monitoring	Moderate odour recorded at sensitive receptor. (Persistent / transient nature noted and considered)
	Complaint monitoring	Complaint received

7.2 Compliance Actions

Exceedence of the control & trigger level will necessitate further investigation into the causes and determine whether further monitoring is required. The actions to be taken in the event of an exceedence will be dictated by the nature and extent of the exceedence(s) (e.g. by considering the magnitude of exceedence and whether it was event driven or on-going).

7.3 Response to Complaints

The receipt of a complaint relating to odour during in-filling is treated as an exceedence of a control level. The primary response will be as detailed in accordance with the site's complaints procedure. An investigation will then be initiated into the cause of the complaint, this will involve as necessary:

- An olfactory survey following the procedure detailed in Section 5.2;
- Perimeter and receptor methane monitoring;
- An examination of the site activities at the time of the complaint;
- An examination of the meteorological conditions at the time of the complaint;
- A review of the effectiveness of gas collection containment; and
- A review of the effectiveness of the landfill cap.

If the complaint is verified it will be treated as an exceedence of the control level. The outcome of the investigation will determine the corrective actions to be implemented (see Section 7.2.3 below).

7.3.1 Detection of Moderate Odour during Olfactory Survey

The detection of a moderate odour, (i.e. 'odour easily detected while walking and breathing normally, possibly offensive'), will initiate a more extensive olfactory survey to determine the extent of the odour plume (as described in Section 6.2). An investigation will then be initiated into the cause of the odour.

7.3.2 Corrective Actions

The outcome of an investigation will determine the corrective actions to be implemented, they will consider, but not be limited to:

- Re-locating the deposition area to a more favourable position with regard to potentially sensitive receptors e.g. disposing wastes in a different part of the active cell as far as practicable;
- Implementing procedures to prevent in-filling in particular locations under the meteorological conditions prevalent at the time of the complaint;
- Changes to application of daily cover i.e. depth or more immediate covering;
- Increasing gas extraction rate;
- Installing additional pin wells to increase gas extraction efficiency;
- Remediation to the landfill cap;
- Acceptance of a specific waste type can be placed on hold pending further investigations; and
- Update of OMP if new procedures are created.

7.4 Reporting

An exceedence of a control level will be investigated (as described above) and recorded in accordance with current operating procedures. This includes recording the following:

- The nature of the incident;
- The date of occurrence/s;
- The results of the investigation;
- The details of responses/ action plans implemented; and
- The event will be marked within the site's incident log.

The report will be made available to the Environment Agency on request.

Appendix A

Beaufort Wind Scale

Force	Wind (Knots)	WMO Classification	On Land
0	Less than 1	Calm	Calm, smoke rises vertically
1	1-3	Light Air	Smoke drift indicates wind direction, still wind vanes
2	4-6	Light Breeze	Wind felt on face, leaves rustle, vanes begin to move
3	7-10	Gentle Breeze	Leaves and small twigs constantly moving, light flags extended
4	11-16	Moderate Breeze	Dust, leaves, and loose paper lifted, small tree branches move
5	17-21	Fresh Breeze	Small trees in leaf begin to sway
6	22-27	Strong Breeze	Larger tree branches moving, whistling in wires
7	28-33	Near Gale	Whole trees moving, resistance felt walking against wind
8	34-40	Gale	Twigs breaking off trees, generally impedes progress
9	41-47	Strong Gale	Slight structural damage occurs, slate blows off roofs
10	48-55	Storm	Seldom experienced on land, trees broken or uprooted, "considerable structural damage"
11	56-63	Violent Storm	
12	64+	Hurricane	

Appendix B

Failure and Abnormal Event Summary Table

Odour Generating Process	Release Points	Abnormal Situation/ Failure	Potential Outcome	Control Measure	Action (Responsible Person)
Decomposition of waste in transit and in active cell.	Active cell and deposition area	Extended duration of stable meteorological conditions	Elevated odour concentrations at receptors.	Meteorological forecasts, re-locate infill operation, suspension of operations. Olfactory surveys and complaint monitoring.	Progressive initiation of control measures as necessary, and complaint investigation in accordance with Section 7.3. (Landfill Manager)
Decomposition of waste within cells.	Fugitive release through un-capped areas.	Failure of gas extraction in cells.	Elevated odour concentrations at receptors.	Additional / full time monitoring and maintenance of gas system. Routine maintenance and monitoring of gas extraction system, olfactory surveys and complaint monitoring.	Rapid maintenance of gas extraction system, surface testing using methane as an indicator, appropriate remediation and monitor meteorological conditions (Landfill Manager)

Appendix C

Olfactory Survey Pro-formas

Assessor Name	
Signature if requirements of Reference Table 1 (see below) have been met	
Date	
Start time	
Finish time	
Complaint location	
Wind direction	
Wind speed (m/s)	
Atmospheric pressure (mBar)-falling/rising/stable	
Cloud cover (oktas)	
Temperature (C)	

Location ¹	Odour Intensity ²	Odour Extent ³	Odour Description ⁴

1 Begin at complaint location

2 Refer to Reference Table 2

3 Refer to Reference Table 3

4 Describe the character of the odour (e.g. rotten eggs, musty, drains, waste, landfill gas, sewage, agricultural, etc)

If odour intensity is judged as “moderate” at any sensitive receptor location the Landfill Manager must be immediately notified, then the extent of the plume should be investigated using the Table that follows overleaf:

Location ¹	Odour Intensity ²	Odour Extent ³	Odour Description ⁴

1 Describe location e.g. street name, house number etc

2 Refer to Reference Table 2

3 Refer to Reference Table 3

4 Describe the character of the odour (e.g. rotten eggs, musty, drains, waste, landfill gas, sewage, agricultural, etc)

Choose a suitable location downwind of the landfill and sensitive receptor at which the odour plume is unlikely to extend, continue toward the site until a faint odour is detectable.

Select further assessment points perpendicular to the plume axis and equidistant from the landfill site to determine extent of plume.

Reference Tables

Reference Table 1: Assessor Rules and Preparation

Requirements of Assessors
Assessor has not been exposed to Landfill odours for previous 30 minutes Assessor has not smoked or consumed strongly flavoured food or drink in previous 30 minutes Scented toiletries should not be applied immediately before or during assessment. Vehicle used for assessment should not contain deodoriser and care should be taken concerning odour in windscreen wash.

Reference Table 2: Odour Intensity

Odour Intensity	Description
1	No detectable odour
2	Faint odour (barely detectable, need to stand still and inhale facing into wind)
3	Moderate odour (odour easily detectable while walking and breathing normally, possibly offensive)
4	Strong odour (bearable, but offensive odour – makes clothes hair/smell)
5	Very strong odour (encourages one to move well away from the locality)

Reference Table 3: Odour Extent

Odour Extent	Description
1	Localised and not persistent (only detected during brief periods when wind drops or blows)
2	Not persistent, as above, but detected away from site boundary
3	Persistent but fairly localised
4	Persistent and pervasive up to 50m from site boundary
5	Persistent and widespread (odour detected >50m from site boundary)

Appendix D

Responsible Persons

The site manager, his/ her appointed deputy and environmental monitoring technicians will carry out odour monitoring. The role of the technicians will be essential to confirm the findings of the inspections carried out by the installation personnel and thereby minimise the potential impacts of odour fatigue.

Control Measure	Responsible Person	
	Implementation on Site	Overall Manager
Waste storage and infilling operations In accordance with Section 4	Landfill Site Manager	Operations Director
Provision of Cover material in accordance with Section 4.2		
Progressive capping of completed areas in accordance with Section 4.3		
Maintenance of gas extraction in accordance with Section 4.5		
Gas collection and treatment in accordance with Section 4.5		
Covering of Leachate wells in accordance with Section 4.6		
Meteorological monitoring in accordance with Section 6.1		
Olfactory Surveys in accordance with Section 6.2		
Complaint monitoring in accordance with Section 6.3		