

## LANDFILL GAS GENERATION AND RISK ASSESSMENT

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## **DRAWINGS**

### **Drawing LFGRA1 Conceptual Model**

The conceptual model has a modular structure. Each module incorporates the effects of additional processes. Progression to successive modules is only necessary if this information is required, e.g. LFG generation and emissions can be determined without proceeding through subsequent modules to optimise time and data collection constraints.

### **Drawing LFGRA2 Landfill Gas Management Plan ESSD7**

A plan of all internal, and external monitoring points for landfill gas and odours. The plan indicates all points where assessment and compliance limits have been set.

## **APPENDICES**

Appendix LFGRA1 Gas monitoring data from the perimeter

## **1.0 INTRODUCTION**

### **1.1 Report Context**

Enviroarm Limited were instructed by H Evason & Co to undertake the Environmental Permit Application for the site to take account of landfilling Phase 1 and in re-excavating Phase 2 and putting it through the waste recycling facility to the north of the brook and any inert waste returned to the landfill, in line with Environmental Permitting (England and Wales) Regulations 2016 requirements for a landfill gas risk assessment and should be read in conjunction with the Hydrogeological Risk Assessment Site Stability Assessment Environmental Site Setting and Design Amenity and Nuisance Risk Assessment.

The site entrance is located at National Grid Reference (NGR) SJ 47554 03875, the centre of the recycling area is SJ 74635 03869 and the centre of the landfill is at SJ 47680 03568, which lies approximately 9km south of Shrewsbury on the northern edge of Dorrington. The site is off the A49.

The site is a former quarry. The site is surrounded with large areas of agricultural land and the A49 is to the west and a railway line to the east.

Access to the site is directly off the A49 through lockable steel security gates.

The landfill site covers an area of approximately 31,000m<sup>2</sup> with a capacity of 225,222m<sup>3</sup>. The restoration area covers 5,000m<sup>2</sup> and has a void of 15,000m<sup>3</sup>.

Dorrington Quarry was operated from the 1920s as a sand and gravel quarry. Permission was granted by Shropshire County Council for restoration of the site in 1997.

This report presents a review of the Landfill Gas potential for generation within the site and in relationship to the surrounding environment.

### **1.2 Conceptual Site Model – Landfill Gas**

To include summary details cross referenced to DESID report relating to the following.

#### **Sources**

- The nature of the waste proposed to be landfilled at Dorrington Quarry Landfill is inert waste producing negligible volumes of methane and carbon dioxide. The permit application accepts only inert waste to the site. Therefore there is no likelihood of gas production, and gas extraction will not be required and utilisation is not feasible due to the inert nature of the wastes.

- The design of the containment, collection and treatment systems Not applicable.

### Pathways

- The primary pathways are direct aerial emissions of migration through the sub strata towards the receptors identified in the ESSD Report and detailed on Drawing ESSD 2.

### Receptors

The identification of all potential receptors.

**Table LFGRA 1 Receptor List identified on ESSD 2.**

Type of Receptor	Receptor Name	Location to site	Elevation m AOD
Domestic Dwelling Receptor	DR1	Properties Wayford House and Lower Wayford next to the entrance and shielded by a tree belt	95m AOD
Domestic Dwelling Receptor	DR2	Wayford Lodge ios near to brook which runs through the site off the A49.	95m AOD
Domestic Dwelling Receptor	DR3	Wayford House is off the A49 and is just to the west the site behind a tree belt.	103m AOD
Domestic Dwelling Receptor	DR4	Small cottages 500 metres east of the site with the railway track and fields between it and the site	100m AOD
Domestic Dwelling Receptor	DR5	Dunstone and Sundial; Cottages east south east of the site with railway track and fields between them and the site.	100m AOD
Domestic Dwelling Receptor	DR6	Dorrington village south west of the site with trees between Dorrington and site	108-104m AOD
Domestic Dwelling Receptor	DR7	The Brambles/Pasrk Terrace south west of site 400 metres from site.	112m AOD
Domestic Dwelling Receptor	DR8	Houses in Stapleton north west of the site.Grass and	97m AOD

<b>Receptor</b>		trees between site and Stapleton	
<b>Domestic Dwelling Receptor</b>	<b>DR9</b>	The Bungalow north of the sue off A49.	98m AOD
<b>Surface Water Receptor</b>	<b>SW1</b>	Tributary of Cound Brook that runs through the site.	90m AOD
<b>Surface Water Receptor</b>	<b>SW2</b>	Cound Brook which runs northwards and enters the Severn	89m AOD
<b>Surface Water Receptor</b>	<b>SW3</b>	A lake in a former sand pit to the north west of the site just before Stapleton	88m AOD
<b>Major roads and highways</b>	<b>HA1</b>	A49 which runs nrth and south of the site Cornets End Lane Road leads directly from the access and is the main road used for the site and is a link road onto the A4526.	96m AOD to the north of the site 103m AOD at site and 108m to the south
<b>Commercial Activity</b>	<b>IR1</b>	Gorse Farm RSPCA Centre with track fields and trees between it and site.	95m AOD
<b>Commercial Activity</b>	<b>IR2</b>	AT Wildes plant hire. Land and track between Wildes and site. Site to the south east of landfill.	98m AOD
<b>Commercial Activity</b>	<b>IR3</b>	Dorrington Business Park , south of site. Fields between site and BP.	112m AOD
<b>Commercial Activity</b>	<b>IR4</b>	Bulk Freight on west side of A49 to west of the site.	100m AOD
<b>Railway Track</b>	<b>R1</b>	Shrewsbury ot Hereford line.	95m AOD

- The receptors are considered to be of low sensitivity due to the nature of the waste being inert and the distance to the nearest receptors and the fact that passive venting also takes place at the landfill. Baseline data for methane and carbon dioxide has been obtained.
- The prioritisation and initial assessment of the potential impacts on each receptor. No impact is considered on each receptor due to the inert nature of the wastes

- Quantification of emissions and dispersion. Only small concentrations of carbon dioxide have been recorded within sand and gravel deposits, typical of soil gas atmospheres, however no methane has been detected within or outside the full and the carbon dioxide levels at baseline are within the OEL.

## **2.0 LANDFILL GAS RISK ASSESSMENT**

### **2.1 The Nature of the Landfill Gas Risk Assessment**

Due to the inert nature of the waste a simple assessment has been carried out which simply states that no gas generation is likely. The site will have no impact on the adjoining site as the road is to remain in place and the inert recycling area will not be filled. No other assessment has therefore been carried out.

### **2.2 The Proposed Assessment Scenarios**

#### **2.2.1 *Lifecycle Phases***

The inert landfill has 2 operational phases and each is completed and restored and then undergoes aftercare. There is no change expected in groundwater conditions, there is no mining subsidence and no long-term change expected to the waste mass composition with time.

All future phases will have a basal geological barrier and a side wall seal constructed. The side wall seal will be used to prevent any potential gas migration off site.

#### **2.2.2 *Accidents and their Consequences***

A primary concern would be due to damage of any internal gas monitoring points. To remove risk it is proposed to retro drill these on completion of each phase.

The justification for whether the specified accidents require quantitative assessment or not is not considered applicable.

Other potential effect include explosion but would require methane concentrations of 5%-15% and is unlikely at an inert landfill site and has been covered in Environmental Management Plans for Accidents and Occurrences and the site has an Emergency Plan.

### **2.3 The Generated Gases to be Modelled**

The actual or potential presence of gases of concern Gas concentrations are set out in Appendix LFGRA 1

No methane gas has been detected and only soil gas atmospheres of carbon dioxide within the external monitoring boreholes. The nature of the waste landfilled is inert and no motive force is likely in the waste mass.

## **2.4 Numerical Modelling**

### **2.4.1 *Justification for Modelling Approach and Software***

Not applicable

### **2.4.2 *Model Parameterisation***

Not applicable

### **2.4.3 *Sensitivity Analysis***

Not applicable

### **2.4.4 *Model Validation***

Not applicable

## **2.5 Risks to the Environment and Human Health**

The landfill gas risk assessment has addressed each of the considered scenarios (i.e. the different modelled phases of the lifecycle and the potential impact of accidents, which remain constant at an inert landfill site).

### **2.5.1 *Landfill Gas Emissions***

Not applicable

### **2.5.2 *Sub-surface Migration and Vegetation Stress***

Predicted leakage through proposed barriers. Not applicable

Comparison of predicted levels with background concentrations and the corresponding environmental benchmarks. See Appendices LFGRA 1

### **2.5.3 *Atmospheric Dispersion and Odour***

This is considered to be zero(0)

### **2.5.4 *Exposure***

The estimates of concentration or doses to which the population may be exposed are considered at all of the receptors to be zero(0).

### **2.5.5 *Global Atmospheric Impact***

The global impact is therefore considered as negligible from the gas monitoring points.



## **2.6 Landfill Gas Completion Criteria**

Landfill completion requires a consideration of whether the site, as a result of the disposal of controlled wastes, is likely or unlikely to cause pollution of the environment or harm to human health. As the landfill gas risk assessment must be undertaken for the whole lifecycle of the landfill, it follows that the process should result in the initial production criteria that identify when the unmanaged site is unlikely to cause pollution or harm and the licence can be surrendered.

No limits are proposed for the landfill and internal monitoring points will be used during closure to assess gas production and flow potential as criteria for the permit surrender.

### **3.0 LANDFILL GAS MANAGEMENT PLAN**

#### **3.1 Control Measures**

Landfill development is to operate the site as an inert landfill.

Emissions standards are not proposed for Dorrington Quarry Landfill due to lack of sensitive receptors.

Collection system (including the year you propose to start collecting landfill gas). Not applicable

Condensate management. Not applicable

Utilisation, flaring and treatment. Not applicable

Inspection, maintenance and servicing. Check that the vents are free from obstruction on a quarterly basis.

#### **3.2 Monitoring and Sampling Plan**

Gas monitoring boreholes and internal monitoring points within the waste mass are shown on LFGRA 1 and ESSD7. Gas monitoring will be carried out on a quarterly basis at each of the internal gas monitoring points and gas monitoring boreholes using an infra red gas analyser. Gas monitoring boreholes and gas monitoring points are summarised in Table LFGRA 2 below:

Sampling will be undertaken by staff appropriately trained in environmental monitoring procedures, and who are familiar with the equipment and its limitations. The Company warrants that the personnel engaged in monitoring activities are trained to undertake the task. These will comprise the companies own technical personnel, the site manager or nominated deputy, following appropriate training by technical personnel. All monitoring staff undergo a period of job training and in addition external courses are used to supplement internal training. Results will be validated by the sampling personnel detailed above.

Monitoring is to be carried out on a quarterly basis using an infra red gas analyser.

Gas monitoring from outside the waste mass will include for monitoring methane, carbon dioxide, oxygen, atmospheric pressure, relative pressure and the weather.

Internal gas vents will also be monitored for the same determinands

Data will be stored in the form of hard copies on site and an electronic version of the results.

**Table LFGRA 2: The nature and location of in-waste landfill gas wells and perimeter monitoring points**

<b>Phase 1</b>	<b>MP1.1-1.2</b>	Monitoring Point in waste	Design detail on ESSD 7
<b>Phase 2</b>	<b>MP2.1-2.2</b>	Monitoring Point in waste	Design detail on ESSD 7
<b>Perimeter</b>	<b>BH 1-7</b>	Monitoring Borehole outside waste. Combined gas and groundwater	Design detail on ESSD 7

**Table LFGRA 3: Monitoring frequencies for landfill gas**

<b>Determinands</b>	<b>Monitoring Frequencies</b>	<b>Units and Accuracies</b>
Methane (CH <sub>4</sub> )	Quarterly	%v/v ±0.5%
Carbon Dioxide (CO <sub>2</sub> )	Quarterly	%v/v ±0.5%
Carbon Monoxide (CH <sub>4</sub> )	Quarterly	-
Oxygen (O <sub>2</sub> )	Quarterly	%v/v ±0.5%
Atmospheric Pressure	Quarterly	±1 mb
Differential pressure	Quarterly	±0.1 mb
Meteorological Data	Quarterly	-

### 3.3 Action Plan

The criteria used to determine the severity of an event. No compliance limits are set for any of the external boreholes for either methane or carbon dioxide due to lack of sensitive receptors near to inert landfill areas

Actions taken by the operator as a result of:

abnormal changes observed in collected monitoring data, frequency of monitoring will be increased;

identified operational problems or failures of the gas control system not applicable;

a reported event e.g. an odour complaint, detailed investigation on site including use of a walk over survey using an FID to attempt to identify the source

Emergency procedures and protocols. Retro drilling and or covering and capping or isolate the area

Remedial actions would include changes to routine monitoring etc.

## **4.0 CONCLUSIONS**

### **4.1 Compliance with the Environmental Permitting Regulations, 2016**

The Dorrington Quarry Landfill site is and will continue to operate as an inert site and the current provisions are in accordance with the requirements of the Environmental Permitting (England and Wales) Regulations 2016. These relate to the following.

The Dorrington Quarry Landfill site is an inert site and will therefore not produce gas and gas migration is therefore not considered an issue.

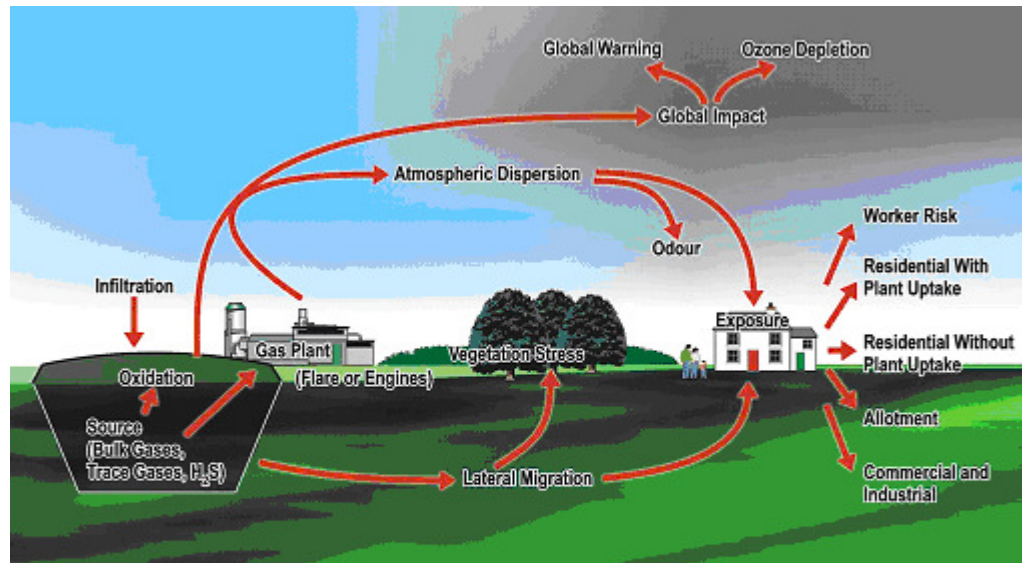
Due to the location of Dorrington Quarry Landfill no compliance limits are proposed for methane or carbon dioxide.

# **DRAWINGS**

## The Conceptual Model

The conceptual model (Figure 1.1) has a modular structure. Each module incorporates the effects of additional processes. Progression to successive modules is only necessary if this information is required, e.g. LFG generation and emissions can be determined without proceeding through subsequent modules to optimise time and data collection constraints.

Figure 1.1 The GasSim Conceptual Model



GasSim considers the landfill as one unit as, unlike [leachate](#), cells are rarely isolated with respect to LFG. The model is probabilistic with the exception of the [atmospheric dispersion](#) module. The model is divided into four parts, i.e. the:

- [source term](#);
- [emissions model](#);
- [environmental transport](#); and
- [exposure/impact](#).

The [source term](#) determines the generation of LFG for an individual site based on the mass of waste [deposited](#) and the waste composition of the [waste streams](#). The waste is degraded following a first-order decay model that calculates the LFG generation for up to 200 years. The emission model takes this output and uses it to calculate LFG emission of [bulk](#) and [trace](#) gases to the environment after allowing for LFG [collection](#), [flaring](#), [utilisation](#) (energy recovery), and [biological methane oxidation](#). This is undertaken by using information on the site gas collection system, [flare](#), [engine](#) and [engineered barriers](#) (cap and liner), if present. It

is assumed that LFG generated and not collected is in equilibrium and will be emitted from the landfill cap or liner at a steady state, i.e. the model does not consider transient storage of LFG. Additionally the model calculates the concentrations of other major and trace gases emitted from flares and engines following [combustion](#).

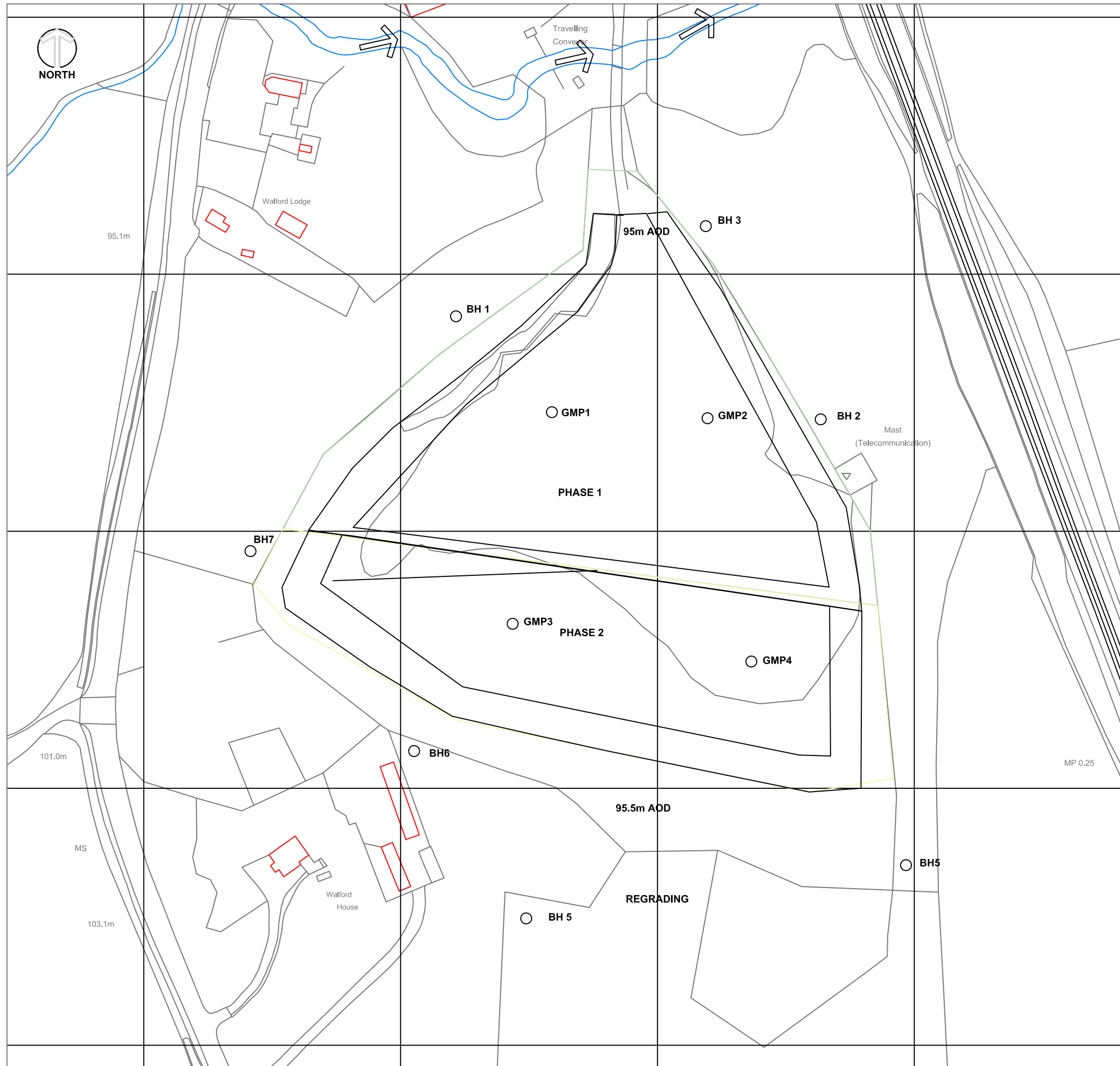
The [environmental transport](#) modules simulate the dispersion of emitted LFG via both atmospheric dispersion and [lateral migration](#), and it is recommended that these modules are used as a screening tool with more complicated modelling being undertaken if required. Atmospheric dispersion is modelled deterministically to determine the concentration of the species in the air and for both [wet](#) and [dry](#) deposition for on and off-site receptors, for a given year. GasSim simulates off-site dispersion using the R91 Gaussian plume type model (NRPB 1979 and 1981) determining the impact of emissions from engines, flares and the surface. On-site dispersion, within 20m of the site, is undertaken by a similar process except that the dispersion from surface emissions are slightly simplified by assuming a circular release area. The atmospheric dispersion data is used to determine the point at which odourous substances decline below their [odour threshold](#) limits and to assess the exposure on and off-site. **GasSim is designed as a screening tool. Hence R91, instead of a new generation model, is used to produce a rapid assessment. If the environmental risk or impact of the emissions is estimated to be high, a more detailed assessment using a new generation model will be required.**

Lateral migration simulates the transverse migration of landfill gas through the unsaturated subsurface by advection and diffusion. The geosphere has been simplified into one zone, which is simulated using a conservative 1-dimensional linear pathway to provide the maximum concentration at a given point. The gas concentrations along the pathway are then used to determine the potential for [vegetation stress](#) and the exposure to humans, including the migration into buildings.

Determining the [global warming potential](#) and [ozone depletion potential](#) of the emissions assesses the landfill's impact on the global atmosphere.

The [exposure module](#) simulates the impact for different critical groups using five exposure pathways:

- residential without plant uptake;
- residential with plant uptake;
- allotments;
- commercial and industrial; and
- worker (on-site).



**Legend**

- BH 1    **Gas Monitoring outside Site**
- GMP1    **Gas Monitoring inside landfill**

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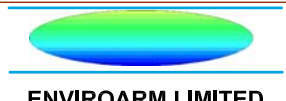
Client: **H Evason**

Project: **Dorrington Quarry  
Dorrington, Shropshire**

Title: **Landfill Gas Management**

CAD Ref: EL/DQP/1	Version: 1	Drawn by: ARM	Scale: Plan 1:1500@A3	Date: January 2021
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Drawing: **ESSD 7**

 **ENVIROARM LIMITED**



# **APPENDIX**



