LANDFILL GAS RISK ASSESSMENT

March 2025
163407/GRA

Report for:
Tetron Contracts Limited
Hadzor Court
Hadzor
Droitwich
WR9 7DR

INTRODUCTION

Report Context

AA Environmental Limited (AAe) has been commissioned by Tetron Contracts Limited to produce a Landfill Gas Risk Assessment in support of a variation to an inert landfill permit at Middleton Quarry.

The aim of the assessment is to support the application for an inert landfill permit and to assess the potential risk to sensitive receptors associated with landfill gas.

The landfill permit will only include inert waste types. Consequently, a quantitative gas risk assessment (e.g. using the EA's approved GasSim software) is not considered appropriate and has not been used. However, the assessment has been written with reference to the following:

- Environment Agency, Landfill Technical Guidance 03 (LFTGN03);
- Perimeter soil gas emissions criteria and associated management Industry Guidance; and
- Position Statement: Industry code of practice on perimeter soil gas (Version 1, August 2011).

Conceptual Site Model – Landfill Gas

The conceptual site model is shown in drawings 163407/CSM/001 and 002.

Sources

The main potential source for this gas risk assessment is the permanent deposit of waste within the cell. However, all waste types to be accepted will be inert which will therefore not give rise to notable levels of landfill gas. The permitted waste types are outlined in the Operational Working Plan. The extent of waste is shown in cross section plan drawing 163407/CSM/001.

Landfill gas is produced by the biological degradation of organic components. No organic matter will be present due to the nature of the wastes and it is therefore considered that the waste materials deposited at the site will not give rise to significant volumes of landfill gas. The potential for the generation of landfill gas is therefore considered to be very low.

Furthermore, the site will have strict waste acceptance procedures in place to ensure that only wastes consistent with Schedule 2 in the Operational Working Plan are accepted at the site.

Pathways

Technical Guidance LFTGN03 outlines the key potential pathways:

- Direct release to the atmosphere;
- Sub-surface migration through the ground or along service ducts / pipes;
- Indirect release to atmosphere e.g. from sub-surface landfill gas migration; and
- Direct release of combustion products to atmosphere e.g. from flares / engines.

The primary pathway for landfill gas within the site would be vertically to atmosphere through the waste column or sub-surface migration through the ground laterally through the side slopes to the underlying sandstone strata.

Given the inorganic nature of the waste, it is considered likely that there will be insufficient pressure differential to drive the landfill gas through low permeability waste to create a pathway. Furthermore, the waste will be deposited within a placed geological barrier with a permeability of < 1 x 10^{-7} m/s and will be restored by 0.5 m of restoration soils. The geological barrier will be investigated by a CQA Team and approved by the Environment Agency prior to any infilling. This will significantly reduce the likelihood of any potential pathway to a receptor.

Receptors

The surrounding land use is principally residential and agricultural land uses and the main off-site receptors are considered to be a residential area circa 20 m south east.

The potential receptors are outlined in Table 1 below:

Table 1. Potential receptor locations

Table 2. Sensitive Location Plan			
Receptor ID	**Description**	**Sensitivity**	**Distance from operational site**
Residential			
1	a) Dwelling off Heck and Pollington Lane	High	105 m north east
	b) Pollington Residential Area (south)		From 20 m south east
	c) Highfield Residential Area	Medium	From 585 m north north east
	d) Pollington Residential Area (east)		From 850 m east
Commercial			
2	a) Gowdall Lane Business Park	Medium	From 675 m north north east
3	a) Unknown	Medium	From 100 m north
	b) Marshalls Civils & Drainage/ Marshalls CPM		From 25 m east
	c) Heck and Pollington Lane Industrial Estate	Low	From 115 m west
	d) D M Cranes & Burgess Pet Care		From 700 m north north east
Agricultural			
4	a) Agricultural Land	Low	From 5m east
Educational			
5	a) Pollington Balne C Of E Primary School	Medium	From 675 m south
	b) Pollington Preschool		From 700 m south
Recreational			
6	a) Pollington Cricket Ground	Medium	From 195 m south east
	b) Pollington Playing Fields		From 535 m south east

The current gas conditions within the underlying strata are monitored by the borehole locations, shown in drawing 163407/D/006 Rev. B. At present, there are no in-waste boreholes. An area of historical waste has been placed adjacent to the northeastern boundary of the site. BH204 has been installed through the waste, however the slotted section of pipe begins 2 m below the waste deposit. The historical deposit is to be removed under a remediation Mobile Plant deployment and is not subject to this application. BH204 is located outside of the waste mass to be infilled, therefore this borehole can remain operational once waste is being imported to the site. The remaining three existing boreholes will be retained for monitoring up to four months prior to filling the waste mass. The existing monitoring boreholes which extend through more than 1 m of restoration soils as part of the final restoration of the site will be replaced prior to filling in that location. The new boreholes will have a minimum of three rounds of baseline data gathered prior to infilling. Proposed locations for the new gas and groundwater perimeter wells are shown in drawing 163407/D/006 Rev. B.

Current Monitoring

Gas monitoring boreholes BH201, BH202, BH203 and BH204 have been monitored since January 2021. The location of the boreholes are presented on drawing 163407/D/006 Rev. B. Background concentrations of methane, carbon dioxide and oxygen are recorded using a portable gas analyser together with the differential pressure (millibars) in each borehole. Table 2 outlines the number of times that each borehole has been monitored as well as the minimum, maximum and average for CH_4 and CO_2 value for each monitoring borehole.

Table 2. Maximum, Minimum and Average (%) gas monitoring values for perimeter boreholes

Borehole	Total Times Monitored	Maximum (%)		Minimum (%)		Average (%)	
		CH_4	CO_2	CH_4	CO_2	CH_4	CO_2
BH201	10	0.39	0.88	0.00	0.00	0.08	0.29
BH202	12	0.40	4.71	0.00	0.00	0.06	1.38
BH203	12	0.38	0.73	0.00	0.00	0.08	0.44
BH204	12	0.40	5.50	0.00	0.20	0.06	3.46

Results from the ground gas monitoring indicate that the CH_4 concentrations in all four boreholes were largely 0 %, with the maximum value of any of the monitoring rounds being 0.40 % CH_4. However, the average CO_2 value ranges from 0.29 % CO_2 to 3.46 % CO_2 by volume. With no obvious external cause for the readings, given the absence of waste near BH201 & BH203, and with BH202 & BH204 not being within the waste deposit, it can be assumed that the monitoring data represents natural background levels.

Current Compliance Limits

The EA Guidance LFTGN03, Table 8.2, presents trigger levels for gas monitoring boreholes. The trigger concentration (%v/v) for methane is given as 1% above agreed background concentration and for carbon dioxide is 1.5% above agreed background concentration. The baseline levels of methane have not exceeded 1%, and the current compliance limit of 1% CH_4 v/v is deemed suitable.

The baseline levels of CO_2 have exceeded the threshold in BH202 & BH204. Therefore, it would not be appropriate to include a compliance limit of 1.5% CO_2 at the site, as it is unlikely that the CO_2 levels would meet this threshold. The proposed CO_2 compliance limit for each of the boreholes were derived using a normally distributed data set with no outliers and following perimeter borehole Industry Guidance. Table 3 below sets out the monitoring frequency and the proposed compliance limit for CH_4 and CO_2 for each of the boreholes.

Table 3. Site Specific Levels for methane and carbon dioxide

Monitoring Location	Parameter	Monitoring frequency	Proposed Compliance Limit (v/v%)
BH201	Methane	Quarterly during operational phase. Quarterly after the completion of the restoration phase.*	1.00
	Carbon dioxide		1.50
BH202	Methane		1.00
	Carbon dioxide		5.70
BH203	Methane		1.00
	Carbon dioxide		1.50
BH204	Methane		1.00
	Carbon dioxide		6.00

Notes:
* = The frequency may be increased at the discretion of the operator in order to obtain sufficient data to support a surrender application.

LANDFILL GAS RISK ASSESSMENT

LFTGN03 provides guidance on the level of risk assessment that is considered appropriate for different types of sites and states that Tier 1 Hazard Identification and Risk Screening should be sufficient to deal with inert and non-reactive waste site risks. The site is predicted to generate negligible quantities of landfill gas due to

the nature of the waste types and the containment of waste within a geological barrier. Furthermore, the Operator will implement a detailed waste acceptance procedure and Environmental Management System (EMS) to ensure only permitted waste types are placed within the cell. Taking these factors into consideration, it is concluded that the overall risk is very low. A qualitative risk assessment is considered appropriate to determine the level of landfill gas risk at the site.

Accidents and their Consequences

EA guidance requires a number of accident and failure scenarios to be assessed to quantify the impact of given events. The reliability of landfill gas control measures and site engineering should be assessed and the main hazard that could lead to accidental emissions should be identified. Typical categories of accidents that may affect landfill gas control include, but not limited to:

- Loss of containment e.g. leakage, geological barrier failure, spillage;
- Loss of collection and/or treatment capability e.g. failure of pipework, control systems;
- Explosions and fires e.g. deep-seated landfill fire; and
- Failure of leachate extraction system and the effect on landfill gas extraction.

Qualitative Landfill Gas Risk Assessment

The potential hazards that exist from landfill gas are:

- Toxicity (acute and chronic);
- Ecotoxicity;
- Fire and explosion;
- Asphyxiation; and
- Odour.

The trace components of landfill gas pose an odour and toxicity risk whilst the bulk gases pose a risk of explosion and asphyxiation. CO_2 is also toxic and should be considered in the assessment of toxicity.

The results of the assessment indicate that the most significant accident/failure scenario is the acceptance of biodegradable waste into the landfill site which would arise from failure in the Operator's waste acceptance procedures. Preventative actions include a briefing to all staff about the waste acceptance procedures and importance on adherence to the procedures. In the event non-compliant waste is delivered to site, there is a quarantine procedure and non-compliance procedure when a load is identified. It is unlikely that biodegradable waste will be deposited within the landfill site.

LANDFILL GAS MANAGEMENT PLAN

Control Measures

Negligible quantities of landfill gas are predicted to be generated and no active gas management is proposed at the site.

Landfill Gas Monitoring & Sampling Plan

Currently there are four landfill gas monitoring boreholes, which have been installed within the natural strata of the site. BH204 is outside of the waste mass. Once the site is operational, the remaining three existing boreholes will be retained for monitoring up to four months prior to filling the waste mass. The existing monitoring boreholes which would extent through more than 1 m of restoration soils as part of the final restoration of the site will be replaced prior to filling in that location, such that 3 months of monitoring data can be obtained before waste is deposited.

The new perimeter boreholes will be constructed outside of the waste mass and used for gas monitoring. The construction will be subject to a CQA Validation Report and new derived thresholds will be calculated, supported by baseline monitoring. Proposed locations for the new gas and groundwater perimeter wells are shown in drawing 163407/D/006 Rev. B.

Once the site is restored, two extra gas perimeter boreholes are proposed in proximity to the residential sensitive receptor. There are no in-waste boreholes at present. The in-waste boreholes (GS01-08) will be installed following completion of the restoration soils across the site. In-waste gas borehole GS09 is proposed to be built in the southeast of the site, from the base up along with the waste. This is due to the proximity of sensitive receptors on the southeast of the site and the difficulty in installing perimeter boreholes in this location from the outset due to the steepness of the quarry face. Quarterly gas monitoring will be undertaken on the source as it rises to monitor gas risk from the source material.

The proposed monitoring programme is detailed in Table 4. GS09 will be monitored quarterly. The monitoring frequency will be reviewed accordingly with every Annual Report.

Table 4. Proposed Monitoring Programme

Monitoring Location	Parameter	Monitoring Frequency
Gas/Groundwater Monitoring Boreholes (within natural strata) BH201, BH202, BH203, BH204 If decommissioning of existing boreholes is required, new perimeter gas boreholes will be constructed in line with the CQA regime and new thresholds will be derived.	Methane, carbon dioxide, oxygen, meteorological data, atmospheric pressure, differential pressure and temperature	Quarterly during operational phase. Quarterly during closure/aftercare phase.*
In-waste Gas Monitoring Boreholes GS01-GS09	Methane, carbon dioxide, oxygen, meteorological data, atmospheric pressure, differential pressure and temperature	GS09: Once infilling commences in that area, quarterly during operational phase. GS01-GS09: Quarterly during closure/ aftercare phase.*
Notes: * = The frequency may be increased at the discretion of the operator in order to obtain sufficient data to support a surrender application.		

Compliance Limits

Compliance limits have been set for each of the four existing boreholes as presented in Table 3. The methane compliance limit is set at 1% in all boreholes. A compliance limit for CO_2 for each of the existing boreholes has been set in Table 3.

All in-waste gas monitoring boreholes (once they are installed) will be assessed against suggested EA Guidance values with 1% CH_4.

Landfill Gas Action Plan

Compliance limits have been set at a level which enables the site management to take timely and appropriate action. An appropriate action plan is required in the event that compliance limits are exceeded. In the event there is an exceedance, the action plan is set out in Table 5 below for the low risk site:

Table 5. Gas Action Plan

Step	Outcome	Action	Deadline
1	Concentration above compliance limit	Re-monitor	First re-monitoring will be within 48 hours Weekly for one month
2	Concentration above compliance limit	Check gas infrastructure (e.g. gas monitoring wells)	At the first weekly monitoring round of step 1
3	Concentration above compliance limit	Verify conceptual model (sources and pathways check) and plan for extended pathway assessment	Within the month of weekly monitoring
4	Concentrations continue above compliance limit in GS09 after remonitoring	Additional monitoring locations to be considered, which may include spiker bar survey over wider area, or bringing forward construction of more perimeter gas wells.	Following discussion of initial findings with EA

After each step has been taken, the Operator (or Operator's consultant) will notify the Environment Agency of the procedure's findings and possible solutions. In the unlikely event an extended pathway assessment is undertaken, it will be undertaken in accordance with the Industry Code of Practice document.

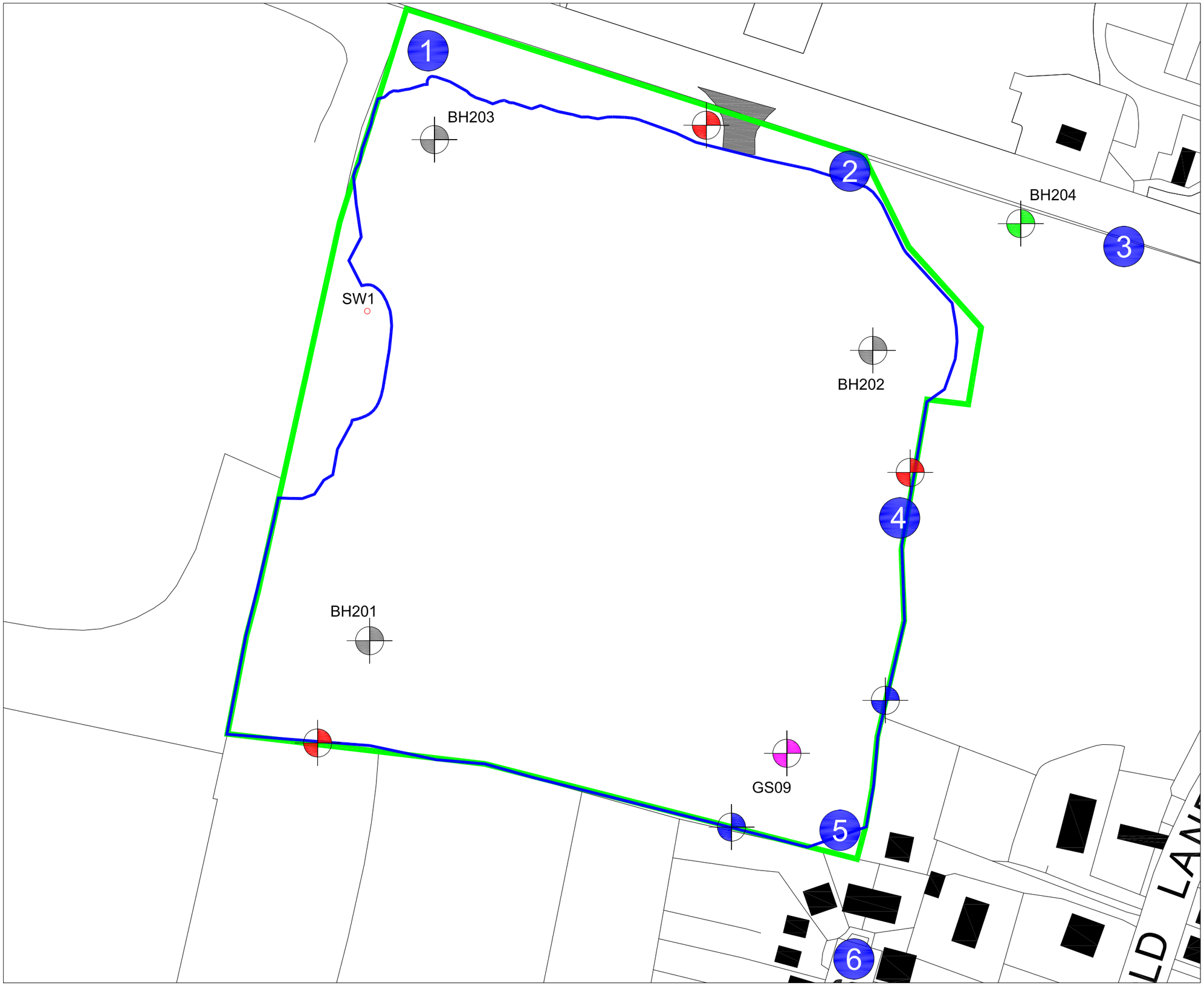
In Waste Gas Monitoring Boreholes

The in-waste gas boreholes (GS01-08) will most likely be installed at the end of the restoration. In-waste gas borehole GS09 will be built from the base up along with the waste infilling. This is done in order to monitor the gas risk to the nearby residential housing whilst the site is being infilled. In-waste gas monitoring locations will be in accordance with drawing 163407/D/007 Rev. B.

The last section needs rewording.
On completion of filling, monitoring will continue to demonstrate that the restored landfill is compliant with the conditions of the environmental permit. Once sufficient data has been gathered to demonstrate that this is the case a Closure Report will be prepare. This report will set out the monitoring regime for the aftercare phase of the landfill and is likely to specify a minimum of two years of gas monitoring to demonstrate continued compliance and suitability for surrender of the environmental permit.

Post-landfilling, data will be collected in line with Table 4. In the event there are no exceedances, the aim will be to put the site into closure. In the event that compliance limits are exceeded, the Gas Action Plan in Table 5 will come into effect. Gas monitoring will continue in line with the post-restoration monitoring frequency. If there are low gas values and gassing potential, the frequency may be downgraded in liaison with the EA and to best meet the surrender requirements of the environmental permit. The boreholes will be measured for methane, carbon dioxide, oxygen, atmospheric pressure, differential pressure, temperature and weather conditions.

Drawings



Key:

- Permit Boundary
- Extent of Excavation
- Tarmac Bellmouth Access/Egress
- Proposed Groundwater/Gas Perimeter Borehole
- Proposed Gas Perimeter Borehole
- Proposed In-Waste Gas Borehole*
- Existing Groundwater/Gas Perimeter Borehole
- Existing Groundwater/Gas Perimeter Borehole - to be decommissioned
- Visual Monitoring Location
- Surface Water Monitoring Location

Note:

The proposed borehole locations are outline design locations. Locations are subject to detailed design investigation and further inspection.

*: Proposed in-waste gas borehole GS09 is to be built from the base up along with the waste, due to the high sensitivity of the nearby residential properties. All other in-waste gas boreholes (depicted in Post-Landfill Monitoring Plan 163407/D/007) will be built after the waste has been infilled.

Rev.	Details	Drawn / Chkd.	Date

Project

Middleton Quarry, Pollington

Title

Monitoring Plan

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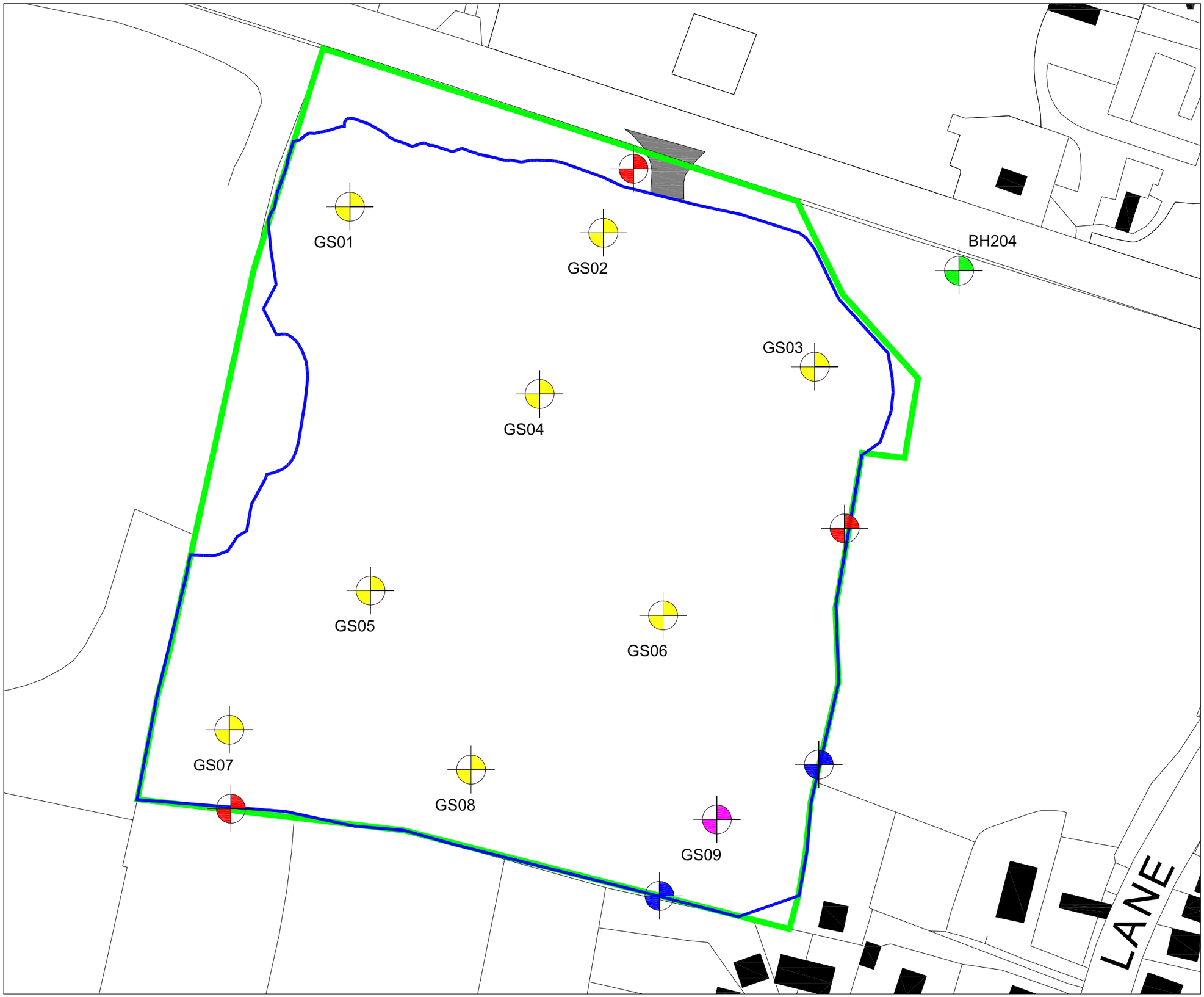
Scale	Date	Drg. No.	Rev.
1:1,250@A3	Mar'25	163407/D/006	B
	Drawn: VM / Chkd.: EB		



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Rev.	Details	Drawn / Chkd.	Date

Project

Middleton Quarry, Pollington

Title

Post Landfill Monitoring Plan

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1:1,250@A3	Mar'25	VM	EB	163407/D/007	B