

Woodberry Day Nursery
F.A.O. Shane Beauchamp
Our Ref: 17077/SGRA
January 2019

Dear Shane

RE: Day Nursery, 208 London Road, Waterloooville, Hampshire PO7 7AN – Soil Gas Monitoring

Woodberry Day Nursery, commissioned Soils Limited to undertake a Soil Gas Risk Assessment at the above-named site.

This letter report must be read in conjunction with the following documents:

- Preliminary Investigation Report (Soils Limited report ref.:17077/PIR, dated August 2018)
- Main Investigation Report (Soils Limited report ref.: 17077/MIR Rev. 2.01, dated September 2018).

Introduction

The Preliminary Investigation Report undertaken on the site identified a low risk of soil gas associated with an adjacent infilled pond.

A soil gas risk assessment at the site was commissioned. Given the findings of the investigations to date and the proposed residential development, a total of five gas monitoring visits were undertaken over a period of approximately four months.

This letter report documents the findings of the soil gas monitoring and makes recommendations for gas protection measures, where required.

General

The site at the time of the investigation was vacant and unoccupied comprising a dilapidated two storey residential dwelling with a separate single storey domestic garage and shed. The site was generally flat with a slight dip to the north and was predominantly grass with areas of concrete and pavements associated with a driveway and some scattered mature trees and vegetation in the garden area.

Site Works

Two trial hole locations (WS3 and WS4) were fitted with combined soil gas and groundwater level monitoring standpipes. A total of five site visits were undertaken between 1st October 2018 and 14th January 2019.

The monitoring well installations comprised 25mm ID HPDE pipework with a response zone comprising slotted pipe with non-calcareous gravel pack surround with a bentonite seal above. The

headworks comprised a single gas tap within a metal stopcock cover set in concrete.

Ground Conditions

A summary of the ground conditions encountered at the test hole locations during the site works are presented in Table 1.

Made Ground/Topsoil (MG/TS) London Clay Formation (LCF)

Table 1. Ground Conditions

Strata	Epoch	Depth Encountered (m bgl)		Typical Thickness (m)	Typical Description
		Top	Bottom		
Topsoil	Recent	GL	0.50	0.40	Turf over soft dark orange brown gravelly SILT with occasional brick fragments, rootlets and fine angular to sub-angular gravel.
Made Ground	Recent	0.30	1.00	0.60	Dark orange grey mottled brown CLAY with rare rootlets, fine angular gravel and fine ash fragments.
LCF	Eocene	0.40	5.00 ¹	Not proven ²	Light orange grey mottled brown slightly sandy CLAY.

Note: ¹ Final depth of trial hole, ² Base of strata not encountered. GL – Ground Level.

Soil Gas Monitoring Records

Monitoring was undertaken on five separate occasions over a period of approximately four months. These included targeting periods of low and falling pressure where possible. The results of the monitoring are provided within Table 2.

Table 2. Soil Gas Results

Date (Baro)	Trial Hole	CH ₄ (%)	CO ₂ (%)	O ₂ (%)	H ₂ S (ppm)	CO (ppm)	LEL (%)	aP (mb)	Flow (l/h)	Dp	H ₂ O (m bgl)	Base of Hole (m)	VOC (ppm)	CS ¹
01/10/2018	ATM	0.0	0.0	21.3	0.0	0.0	0.0	1023	-	-	-	-	0.0	
	WS3	0.0	0.0	20.9	0.0	0.0	0.0	-	0.0	0.0	1.20	3.85	0.0	I
	WS4	0.0	0.5	20.8	0.0	0.0	0.0	-	0.0	0.0	1.65	1.90	0.0	I
25/10/2018	ATM	0.0	0.0	21.2	0.0	0.0	0.0	1015	-	-	-	-	0.0	
	WS3	0.0	1.2	20.2	0.0	0.0	0.0	-	0.0	0.0	1.17	3.85	0.0	I
	WS4	0.0	0.3	20.9	0.0	0.0	0.0	-	0.0	0.0	1.46	1.90	0.0	I
08/11/2018	ATM	0.0	0.0	21.1	0.0	0.0	0.0	1005	-	-	-	-	0.0	
	WS3	0.0	0.3	21.0	0.0	0.0	0.0	-	0.0	0.0	1.02	3.85	0.0	I
	WS4	0.0	0.3	20.8	0.0	0.0	0.0	-	0.0	0.0	1.48	1.90	0.0	I
12/12/2018	ATM	0.0	0.0	21.4	0.0	0.0	0.0	1017	-	-	-	-	0.0	
	WS3	0.0	0.0	21.3	0.0	0.0	0.0	-	0.0	0.0	0.95	3.85	0.0	I
	WS4	0.0	0.0	21.2	0.0	0.0	0.0	-	0.0	0.0	0.32	1.90	0.0	I
14/01/2019	ATM	0.0	0.0	18.3	0.0	0.0	0.0	1016	-	-	-	-	0.0	
	WS3	0.0	0.8	17.8	0.0	0.0	0.0	-	0.0	0.0	1.07	3.86	0.0	I
	WS4	0.0	0.0	18.6	0.0	0.0	0.0	-	0.0	0.0	0.68	1.90	0.0	I
Maximum		0.0	0.0	21.3	0.0	0.0	0.0	1023	0.0	0.0			0.0	I
Minimum		0.0	1.2	17.8	0.0	0.0	0.0	1005	0.0	0.0			0.0	I

Note: Zero reading = below the equipment detection limit. ¹ Characteristic Situation CO₂/CH₄ (BS8485 & C665).

The highest concentration of carbon dioxide (CO₂) was recorded at 1.2% by volume in WS3 on 25th October 2018.

The lowest concentration of oxygen (O₂) was recorded at 17.8% by volume in WS3 on 14th January 2019.

No concentrations of methane, either total or LEL, (CH₄), Carbon Monoxide (CO) and hydrogen sulphide (H₂S) were recorded above instrument detection limit.

No positive gas flow was recording during observation.

Concentrations of Volatile Organic Compounds (VOCs) within the monitoring wells were measured using a Photo-Ionisation Detector (PID). Results recorded no concentrations above instrument detection limit.

Data Quality

A review was made of the quality of the available data for the site, which can be viewed in Table 3. CIRIA 665 (2007) and BS 8485:2015 stress the need for risk assessments to be based on good quality data and give guidance as to best practice in this respect.

Table 3. Review of Data Quality

Data Type	Current Situation	UK Practice
Geological and hydro-geological conditions	With regard to soil gas risk assessment the data from Preliminary Investigation and logged trial holes was good.	CIRIA 665, Wilson and Card (2007) and BS 8485:2015 recommend that geology and hydrogeology be fully understood.
Monitoring period	The monitoring has been undertaken on a total of five occasions over a four month period. Monitoring has been undertaken over a range weather conditions including low and high atmospheric pressures.	CIRIA 665 recommends approximately 3-month monitoring over a range of weather conditions.
Gas data sets	Borehole flow velocity has been measured on each monitoring occasion.	Borehole flow velocity and borehole gas volume required to define characteristic gas saturation. Modified Wilson and Card, Table 8.5 of CIRIA 665 (2007)/Table 2 of BS 8485:2015.

Data quality was characterised as satisfactory, covering a range of atmospheric pressure trends. Geological and hydrogeological conditions have been investigated and fully understood.

Risk Assessment

Based on the documentation presented in the "BS 8485:2015, Code of practice for the characterisation and remediation from soil gas in affected developments" the hazardous gas flow rate (Q_{hg}) was calculated using Equation 1:

$$Q_{hg} = (C_{hg}/100) * q \quad \text{Equation 1}$$

Where:

C_{hg} is the measured hazardous gas concentration (in percentage volume-by-volume).

q is the flow rate in litres per hour of combined gases found by direct measurement.

The Q_{hg} for carbon dioxide was calculated using Equation 2a.

$$\begin{aligned} Q_{hg} \text{ (l/hr)} &= \text{gas concentration} * \text{borehole flow rate (l/hr)} && \text{Equation 2a} \\ &= 1.2/100 * 0.1 = \mathbf{0.0012 \text{ l/h}} \end{aligned}$$

The maximum carbon dioxide concentration was taken as the gas concentration and 0.1l/hr was taken for the borehole flow rate.

Based on a *Site Characteristic hazardous gas flow rate* (Q_{hg}) of 0.0012 l/hr, the site fell into a **Characteristic Gas Situation 1 (CS1)**, for which no special precautions are required as given in the "Guidance on methane and carbon dioxide, NHBC 2007" (refer to Tables 11.1 and 11.2).

A total of five gas monitoring visits were undertaken over a period of approximately four months to assess the risk posed to the site from the identified sources of soil gas. Given the findings of the five visits as outlined in this letter report, further monitoring is not considered necessary.

Should you have any further questions please do not hesitate to contact the undersigned.

Yours sincerely



Tim Rudkin BSc. (Hons.), MSc., FGS.
Graduate Geo-Environmental Engineer
tr@soilslimited.co.uk
For and on behalf of Soils Limited