



31/07/2023 (revised 15/08/2023)

Our ref: ICE0180/LD01/230731

Mr. Tom Luke
Blewgarth
The Warren
Caversham
Reading
RG4 7TH

Dear Tom,

RE: Blewgarth, The Warren, Caversham, Reading, RG4 7TH – Groundwater and Ground Gas Monitoring Results

Further to our Phase I Desk Study Report (ICE0180-DSR-JUL23), we are pleased to present the results of the confirmatory groundwater levels and ground gas monitoring visit which was undertaken on the 30th June 2023.

It is understood that the redevelopment proposals comprise the demolition works of the existing house and associated retaining walls to create space for the construction of a new 5-bedroom residential property with services and associated development infrastructure.

A ground investigation was undertaken by others and comprised three boreholes to a maximum depth of 4.0m below existing ground level (bgl).

As previously noted, a Phase I Desk Study Report was produced by IBEX Consulting Engineers Limited (IBEX) on behalf of Mr. Tom Luke, referenced ICE0180-DSR-JUL23, dated July 2023 entitled 'Blewgarth, The Warren, Caversham, Reading, RG4 7TH, Phase I Desk Study Report'.

An allowance was made to undertake one monitoring visit to confirm the ground gas concentrations (if any) as well as groundwater levels across the site. Standpipes were installed within WS01, WS02 and WS03 and monitored across the site. These positions were monitored for methane, carbon dioxide, oxygen, volatile organic compounds (VOC) and borehole gas flow on a single occasion during June 2023.

Ground Gas

Background

A Phase I Desk Study pertaining to the site was undertaken during July 2023. The historic mapping within the desk study indicated that the site remained undeveloped until circa 1956 when it was shown to have been developed for a residential use. The site remained unaltered on the later map editions. The surrounding land uses have been shown to comprise predominantly residential development and community facilities including, a boat house (Reading Canoe Club), Caversham Court Gardens and allotments. Over the mapping period the land located c.80m to the south was shown to comprise a chalk pit, which possibly infilled (landfill). This area had since been developed by a residential property with associated private garden. River Thames was located c.49m to the south of the site.

This infilled chalk pit is understood to be a historical landfill site which was recorded as being located 80m south of the site and was noted to have operated between December 1970 and May 1979 with deposited wastes

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comprising commercial, household and liquid sludge wastes. This historical landfill may represent an offsite source of ground gases (carbon dioxide and methane, the latter being less likely for the authorised waste types).

Ground conditions beneath the site comprised chalk of the Seaford Chalk Formation and Newhaven Chalk Formation (Undifferentiated). Given that the surrounding areas and boundaries of the site had been developed previously, there is the potential for a thickness of Made Ground to be present over the natural deposits. These ground conditions contain a mixed permeability of strata, some more permeable strata are anticipated to be present within the encountered soils, although it is considered unlikely that continuous migration pathways would be present beneath the site.

Ground Gas/ Vapour Monitoring

As previously noted, three ground gas monitoring standpipes were installed to depths of 4m bgl (WS01, WS02 and WS03) and monitored on a single occasion during June 2023.

During the monitoring, whilst no Methane concentration was recorded, Carbon Dioxide was recorded in the range of 0.3-3.2% v/v. Oxygen was recorded within the range of 18.4-20.8% v/v. No borehole flow rate was recorded. VOCs were recorded ranging between 0.3-1.4ppm and atmospheric pressure was recorded at between 1011mb and 1012mb during the monitoring visit.

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Location	Date	Time (sec)	CH ₄ (%)	CO ₂ (%)	O ₂ (%)	Flow (l/hr)	VOC (ppm)	Pressure (mb)	GWL (m bgl)	GSV/Ohgs		Characteristic Situation		CS1 Limiting Value Check			NHBC										
										CH ₄	CO ₂	BS8485 & C665		Flow	CH ₄	CO ₂	CH ₄		CO ₂								
																			GSV	Conc.	GSV	Conc.					
WS01	30.06.2023	0	0.0	0.3	20.8	0.0	0.3	1012	Dry	0.000	0.000	CS1	CS1	NO	NO	NO	GREEN	GREEN	GREEN	GREEN							
WS01	30.06.2023	10	0.0	1.1	19.9	0.0	0.3	1012	Dry	0.000	0.000	CS1	CS1	NO	NO	NO	GREEN	GREEN	GREEN	GREEN							
WS01	30.06.2023	20	0.0	1.2	19.4	0.0	0.3	1012	Dry	0.000	0.000	CS1	CS1	NO	NO	NO	GREEN	GREEN	GREEN	GREEN							
WS01	30.06.2023	30	0.0	1.2	19.1	0.0	0.3	1012	Dry	0.000	0.000	CS1	CS1	NO	NO	NO	GREEN	GREEN	GREEN	GREEN							
WS01	30.06.2023	60	0.0	1.2	19.0	0.0	0.3	1012	Dry	0.000	0.000	CS1	CS1	NO	NO	NO	GREEN	GREEN	GREEN	GREEN							
WS01	30.06.2023	90	0.0	1.2	19.0	0.0	0.3	1012	Dry	0.000	0.000	CS1	CS1	NO	NO	NO	GREEN	GREEN	GREEN	GREEN							
WS01	30.06.2023	120	0.0	1.2	19.0	0.0	0.3	1012	Dry	0.000	0.000	CS1	CS1	NO	NO	NO	GREEN	GREEN	GREEN	GREEN							
WS01	30.06.2023	180	0.0	1.2	19.0	0.0	0.3	1012	Dry	0.000	0.000	CS1	CS1	NO	NO	NO	GREEN	GREEN	GREEN	GREEN							
WS02	30.06.2023	0	0.0	0.4	20.7	0.0	1.4	1011	1.73	0.000	0.000	CS1	CS1	NO	NO	NO	GREEN	GREEN	GREEN	GREEN							
WS02	30.06.2023	10	0.0	2.3	19.7	0.0	1.4	1011	1.73	0.000	0.000	CS1	CS1	NO	NO	NO	GREEN	GREEN	GREEN	GREEN							
WS02	30.06.2023	20	0.0	3.2	18.9	0.0	1.4	1011	1.73	0.000	0.000	CS1	CS1	NO	NO	NO	GREEN	GREEN	GREEN	GREEN							
WS02	30.06.2023	30	0.0	3.2	18.8	0.0	1.4	1011	1.73	0.000	0.000	CS1	CS1	NO	NO	NO	GREEN	GREEN	GREEN	GREEN							
WS02	30.06.2023	60	0.0	3.2	18.8	0.0	1.4	1011	1.73	0.000	0.000	CS1	CS1	NO	NO	NO	GREEN	GREEN	GREEN	GREEN							
WS02	30.06.2023	90	0.0	3.2	18.8	0.0	1.4	1011	1.73	0.000	0.000	CS1	CS1	NO	NO	NO	GREEN	GREEN	GREEN	GREEN							
WS02	30.06.2023	120	0.0	3.2	18.8	0.0	1.4	1011	1.73	0.000	0.000	CS1	CS1	NO	NO	NO	GREEN	GREEN	GREEN	GREEN							
WS02	30.06.2023	180	0.0	3.2	18.7	0.0	1.4	1011	1.73	0.000	0.000	CS1	CS1	NO	NO	NO	GREEN	GREEN	GREEN	GREEN							
WS03	30.06.2023	0	0.0	0.7	20.7	0.0	1.4	1011	3.85	0.000	0.000	CS1	CS1	NO	NO	NO	GREEN	GREEN	GREEN	GREEN							
WS03	30.06.2023	10	0.0	1.4	19.7	0.0	1.4	1011	3.85	0.000	0.000	CS1	CS1	NO	NO	NO	GREEN	GREEN	GREEN	GREEN							
WS03	30.06.2023	20	0.0	1.7	18.6	0.0	1.4	1011	3.85	0.000	0.000	CS1	CS1	NO	NO	NO	GREEN	GREEN	GREEN	GREEN							
WS03	30.06.2023	30	0.0	1.7	18.4	0.0	1.4	1011	3.85	0.000	0.000	CS1	CS1	NO	NO	NO	GREEN	GREEN	GREEN	GREEN							
WS03	30.06.2023	60	0.0	1.7	18.4	0.0	1.4	1011	3.85	0.000	0.000	CS1	CS1	NO	NO	NO	GREEN	GREEN	GREEN	GREEN							
WS03	30.06.2023	90	0.0	1.7	18.4	0.0	1.4	1011	3.85	0.000	0.000	CS1	CS1	NO	NO	NO	GREEN	GREEN	GREEN	GREEN							
WS03	30.06.2023	120	0.0	1.7	18.4	0.0	1.4	1011	3.85	0.000	0.000	CS1	CS1	NO	NO	NO	GREEN	GREEN	GREEN	GREEN							
WS03	30.06.2023	180	0.0	1.7	18.4	0.0	1.4	1011	3.85	0.000	0.000	CS1	CS1	NO	NO	NO	GREEN	GREEN	GREEN	GREEN							

Figure 1: Ground Gas and Groundwater Monitoring Results

Ground Gas Risk Assessment

Recommendations on acceptable gas levels recorded in the ground beneath or adjacent to buildings are given in a variety of publications. For the purpose of this assessment, the results have been evaluated in terms of British Standard BS8485+A1 entitled 'Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings' (2019), CIRIA C665, 'Assessing risks posed by hazardous ground gases to buildings' (2007), NHBC report 10627-R01(04) entitled 'Guidance on evaluation of development proposals where methane and carbon dioxide are present' (2007), and CL:AIRE Research Bulletin RB17, 'A pragmatic approach to ground gas risk assessment' (2012).

It should be noted, that British Standard BS8485 and NHBC report 10627-R01(04) as referenced above, give different thresholds for the requirements for ground gas protection measures for carbon dioxide. The use of the 'traffic light'



classification given in the NHBC report 10627-R01(04) is only appropriate where the proposed buildings have a floor plan of c.8.00m x 8.00m, giving a floor area of c.64m², a minimum clear void of 150mm, and a complete volume change of the sub-floor void every 24hrs. Where the proposed structures do not conform to these criteria, as is the case for the proposed redevelopment, the classification system given in BS8485 should be used.

CS	Hazard potential	Site characteristic GSV ^{A)} L/h	Additional factors
CS1	Very low	<0.07	Typically <1% methane concentration and <5% carbon dioxide concentration (otherwise consider an increase to CS2)
CS2	Low	0.07 to <0.7	Typical measured flow rate <70 L/h (otherwise consider an increase to CS3)
CS3	Moderate	0.7 to <3.5	–
CS4	Moderate to high	3.5 to <15	–
CS5	High	15 to <70	–
CS6	Very high	>70	–

^{A)} The figures used in this column are empirical.

NOTE The CS is equivalent to the characteristic GSV in CIRIA C665 [6].

Table 1: CS by site characteristic GSV

Ground Gas Sources

The desk study identified a potential offsite source of bulk gases associated with the historic landfill site located circa 80m south of the site. No onsite sources of ground gas were identified within the desk study.

The ground conditions identified to be present beneath the site were of mixed composition containing both clay based (cohesive) soils within the upper layers overlying the putty chalk over more competent layers of the chalk. Based on these encountered ground conditions it is considered that continuous migrations pathways for ground gases are unlikely to be present beneath the site, due to the presence of the cohesive soils and/or structureless putty chalk. It is anticipated that the thickness of clayey soils between the off-site landfill and the site (beneath the alluvial deposits or River Thames) are very likely to be increased due to nature of fluvial deposition process. Therefore, it is now IBEX opinion that there is no '**credible pathway**' between the off-site landfill and the site itself.

Natural Soils

Natural soils with a high carbonate content, such as Chalk, or sedimentary rocks with small volumes of organic material, can represent a low production source of carbon dioxide, which does not represent a risk to development. Soils such as the **White Chalk Subgroup** are sedimentary rocks which were laid down in a sea environment. They can contain high volumes of soft white friable microporous limestone composed of coccolith biomicrites with a varying proportion of larger shell fragments. Flint characterises the White Chalk Subgroup, occurring as nodular courses, tabular beds and linings to fractures. At various levels clay sized material occurs as marl seams and partings. Close to the surface the upper few metres are invariably discoloured brown, due to leaching from the overlying strata. The interface with any overlying stratum is invariably extremely irregular as a result of localised weathering and general solution. Weathering by frost action may extend to a depth of several metres.



When boreholes are drilled into the soils it allows oxygen to be introduced and various chemical and biological processes take place locally, immediately around the well that can result in the generation of higher concentrations of methane and/or carbon dioxide in the wells than within the wider soil mass. The rate of gas generation and the volume produced is extremely small and high concentrations in a monitoring well do not necessarily indicate a risk to buildings.

This is a very slow process typically with a turnover of many thousands of years. Thus, surface emissions of methane and carbon dioxide from such sources are negligible. It can cause high gas concentrations in monitoring wells that are not representative of the risk to buildings, even those including basements. Such conditions are widespread throughout the UK with no known incidents of carbon dioxide emissions into buildings from this natural process.

Assessment of Gas Monitoring Data

No plausible significant on-site source of carbon dioxide has been established; therefore it is considered that carbon dioxide is being produced mainly via biological respiration within the soils beneath the site and as such is from low risk sources. In addition, no significant gas concentrations were recorded during the site visit. On this basis, the site was considered to be Characteristic Situation 1 (BS and CIRIA). This coupled with the lack of any significant flow rates identified within any of the boreholes would suggest that gases are not migrating onto the site from these identified sources.

Gas primarily migrates via either pressure driven (advective) flow or via diffusive flow. No notable significant borehole flow rates were recorded across the site during the monitoring period. As such, gas present beneath the site will diffuse through the soils forming a continuum between the source and ground level, with only minor concentrations of gas reaching ground level, and no perceivable flow. The majority of gas will remain trapped in the soil pores or sorbed to soil particles. As no significant flow rates have been recorded during the monitoring this suggests that any carbon dioxide is residual gas trapped within the soil pores, which is only being recorded and monitored due to the actual drilling and construction of the monitoring wells within these soil pores, and as such is not representative of the risks posed to proposed buildings on site.

As such it is considered that some concentrations of carbon dioxide recorded are being produced via biological respiration within the soils beneath the site and as such are from low risk sources.

Closure

We trust we have interpreted your instructions correctly. Should you have any queries please do not hesitate to contact us.

Yours sincerely

For and on Behalf of IBEX Consulting Engineers Limited



**Levent Dogan BSc, MSc, PGDip, CEng MCiHT, AMICE, AMIEnvSc
Director**

