



GB Card & PARTNERS

21 January 2022

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BY EMAIL ONLY

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Please reply to: Laura Bacon/Dr Geoff Card

Dear Terry

Holly Bank Cottage, Holly Bank, Muswell Hill – Ground Gas Review

Introduction

The development at Holly Bank is understood to have been completed in June 2020. It comprised the construction of six residential dwellings, with ground floor levels between 0.8m below ground level (bgl) and 1.3mbgl. Areas of soft landscaping and parking are also included as part of the development. The development plan is shown in Figure 1.

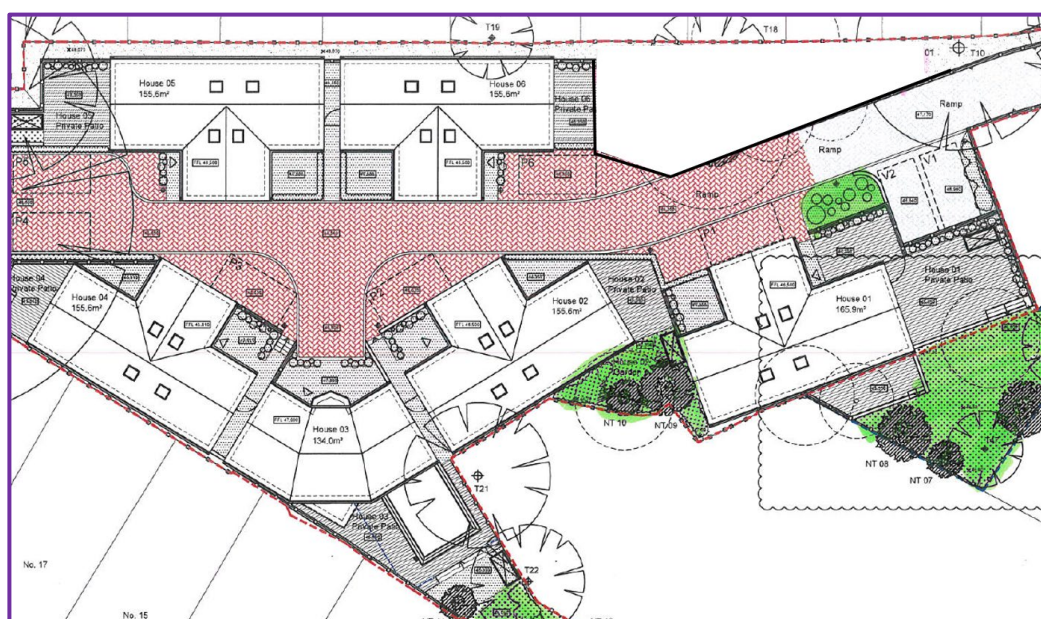


Figure 1: Proposed development plan

GB Card & Partners (GBCP) have been instructed by JSW Consultants (on behalf of Hollybanks LLP) to undertake a review of the available data relevant to the ground gas regime and mitigation measures incorporated into the development.

The documents that GBCP have reviewed are as follows:



ICE South West
Civil Engineering Awards

consultancy engineering business environment
member



1. Site Analytical Services Limited (2017). *Report on a Ground Investigation*, Hollybanks, Muswell Hill, London, N19 3TN. Ref: 17/27180. October 2017.

Frequently, gas protection measures are specified solely based on the maximum measured gas concentration, with no consideration given to the spatial distribution and frequency of the readings, borehole gas flow rates, surface gas emission rate or the nature of the gassing source. GBCP have addressed these aspects within this review and have made recommendations accordingly.

Data Review

The site is mapped to be underlain by the London Clay Formation. Head deposits might partially mantle the London Clay given the proximity of the outcrop boundary. An extract from Sheet 256 of the British Geological Survey 1:50,000 map series is presented below in Figure 2.

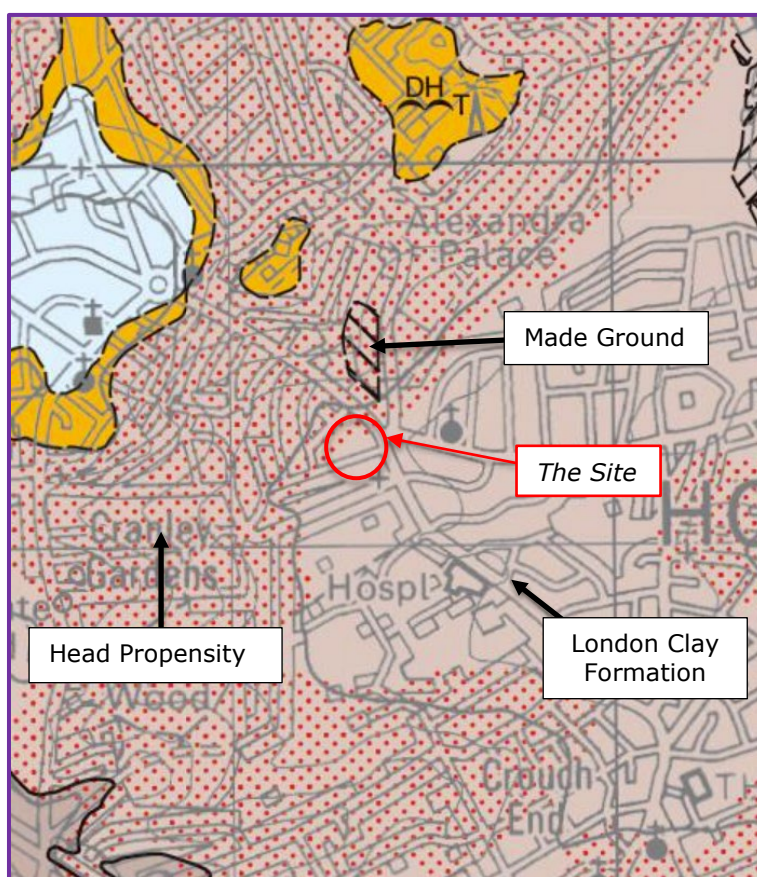


Figure 2: Extract from BGS Geology Map Sheet 256

The ground investigation undertaken by SAS comprised the formation of one rotary percussive borehole to a depth of 20mbgl, three continuous auger boreholes to depths of 5mbgl and five hand-excavated trial pits to depths of 1mbgl. Soil samples were also collected for laboratory analysis. The ground conditions encountered during the investigation are summarised in Table 1 below.



Table 1: Ground conditions

Description	Depth m (bgl)	Thickness m
MADE GROUND: Dark brown/black/blue fine to coarse grained clayey/silty SAND and/or silty CLAY with fragments of brick, tarmac and concrete. Localised tarmac and type 1 gravel over concrete.	0.0	0.7 - 1.5
LONDON CLAY FORMATION: Stiff to very stiff, mottled brown/grey/blue silty sandy CLAY with occasional gypsum crystals.	0.7 - 1.5	Not proven >20.0

Three boreholes were completed with gas/groundwater monitoring wells with response zones from 1m to 5mbgl. Boreholes BH2 and BH3 had response zones partially within the Made Ground and London Clay Formation, whilst the response zone within borehole BH4 was only in the London Clay Formation. Gas monitoring was undertaken on four occasions during August and September 2017. The key results from the gas monitoring are presented in Table 2 below.

Table 2: Gas monitoring results

Date	Atmospheric pressure (mb)	Borehole ID	Max. Flow (l/hr)	Max. CH ₄ (%)	Max. CO ₂ (%)	Min. O ₂ (%)	Max. VOC (ppm)
29/08/2017	1009	BH2	< 0.1	0.0	1.8	20.3	0.645
		BH3	< 0.1	0.0	1.8	21.4	0.991
		BH4	< 0.1	0.0	9.0	13.2	0.310
12/09/2017	1000	BH2	< 0.1	0.0	1.9	20.2	-
		BH3	< 0.1	0.0	1.9	19.3	-
		BH4	< 0.1	0.0	8.3	11.8	-
22/09/2017	1017	BH2	< 0.1	0.0	2.2	20.5	-
		BH3	< 0.1	0.0	2.7	19.9	-
		BH4	< 0.1	0.0	8.0	14.5	-
26/09/2017	1018	BH2	< 0.1	0.0	2.1	20.4	-
		BH3	< 0.1	0.0	2.6	20.0	-
		BH4	< 0.1	0.0	7.7	15.4	-

In accordance with BS8485:2015+A1:2019¹, the borehole hazardous gas flow rate (Q_{hg}) has been calculated to characterise the ground gas regime monitored on the site. The Q_{hg} is calculated by the following equation:

¹ BSI. (2019). *Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings*. BS 8485:2015+A1:2019.



$$Q_{hg} = \text{borehole flow rate (l/h)} \times \text{gas concentration (as decimal fraction)}$$

The calculated values of Q_{hg} are shown in Table 3 below. The *Gas Screening Value* (GSV) is defined as the flow rate of a specific hazardous gas (in this cases methane or carbon dioxide) representative of a site or zone, derived from the Q_{hg} values and taking account of all other influencing factors, in accordance with a conceptual site model. For this site the '*worst credible*' approach is adopted for calculating the GSV. The '*worst credible*' GSV is calculated by assessing the data from each monitoring location and adopting the highest GSV. Using the worst credible GSV a Characteristic Situation (CS) for the site can be calculated (Wilson and Card)².

Table 3: Ground gas assessment

Borehole ID	Q_{hg} CH ₄ (l/hr)	Q_{hg} CO ₂ (l/hr)	CS Methane	CS Carbon Dioxide
BH2	0.0	0.0022	CS1	CS1
BH3	0.0	0.0027	CS1	CS1
BH4	0.0	0.009	CS1	CS1*

*Consider increasing to CS2 due to CO₂ > 5%

Gas wells are an artificial construction in the ground that can cause gas concentrations in the well headspace that are not necessarily representative of sustained surface gas emissions³. GBCP considers that the concentrations of carbon dioxide encountered in BH4 are typical of background concentrations in the London Clay due to calcareous intrusions within the stratum and are not indicative of the ground gas regime for the site with regard to the design of gas protection measures. The response zone of the borehole is entirely within the London Clay Formation which is not considered to be a source of hazardous ground gas.

Publicly available maps show that there are no historic or active landfills within 1km of the site⁴. An infilled pond/stream was identified 30m south of the site within the Ground Investigation report prepared by SAS. GBCP do not consider this infilled pond/stream to pose a significant risk to the site due to (1) the location and limited nature of the infill and (2) the general low permeability of the London Clay Formation which would form a barrier to ground gas migration.

Based on the composition of the Made Ground encountered and the thicknesses recorded, it is considered unlikely that this poses a significant risk in terms of ground gas. Additionally, limited carbon dioxide concentrations (< 5%) and methane concentrations below the limit of detection of the analyser were detected within boreholes BH2 and BH3, which had response zones partially within the Made Ground.

² CIRIA (2007). *Assessing risks posed by hazardous ground gases to buildings*. CIRIA Report C665.

³ CL:AIRE (2012). *A Pragmatic Approach to Ground Gas Risk Assessment*. RB17, November 2012.

⁴ Groundsure – Landfills: <https://www.groundsure.io/#> Accessed on 16/12/2021.



Based upon the assessment of the data and the review of the ground model. The *Characteristic Situation* for carbon dioxide for BH4 is *CS1* which is indicative of a *very low* risk based upon the risk classification set out in BS8485:2015+A1:2019¹.

Recommendations

Based on the above data review and assessment, GBCP consider that ground gas at the site poses a negligible risk to future site occupiers. For this reason, no specific gas protection measures are recommended to be incorporated into the residential development.

Notwithstanding this, the residential development has already incorporated inherent gas protection in the building construction which are as follows-

1. Cast in-situ reinforced concrete slab.
2. Waterproofing measures detailed in the drawing provided in Appendix A.

We trust this Ground Gas Review is satisfactory for your purposes. Please do not hesitate to contact us if you have any questions or require further assistance.

Yours sincerely

Dr Geoffrey Card, Managing Director
GB Card and Partners

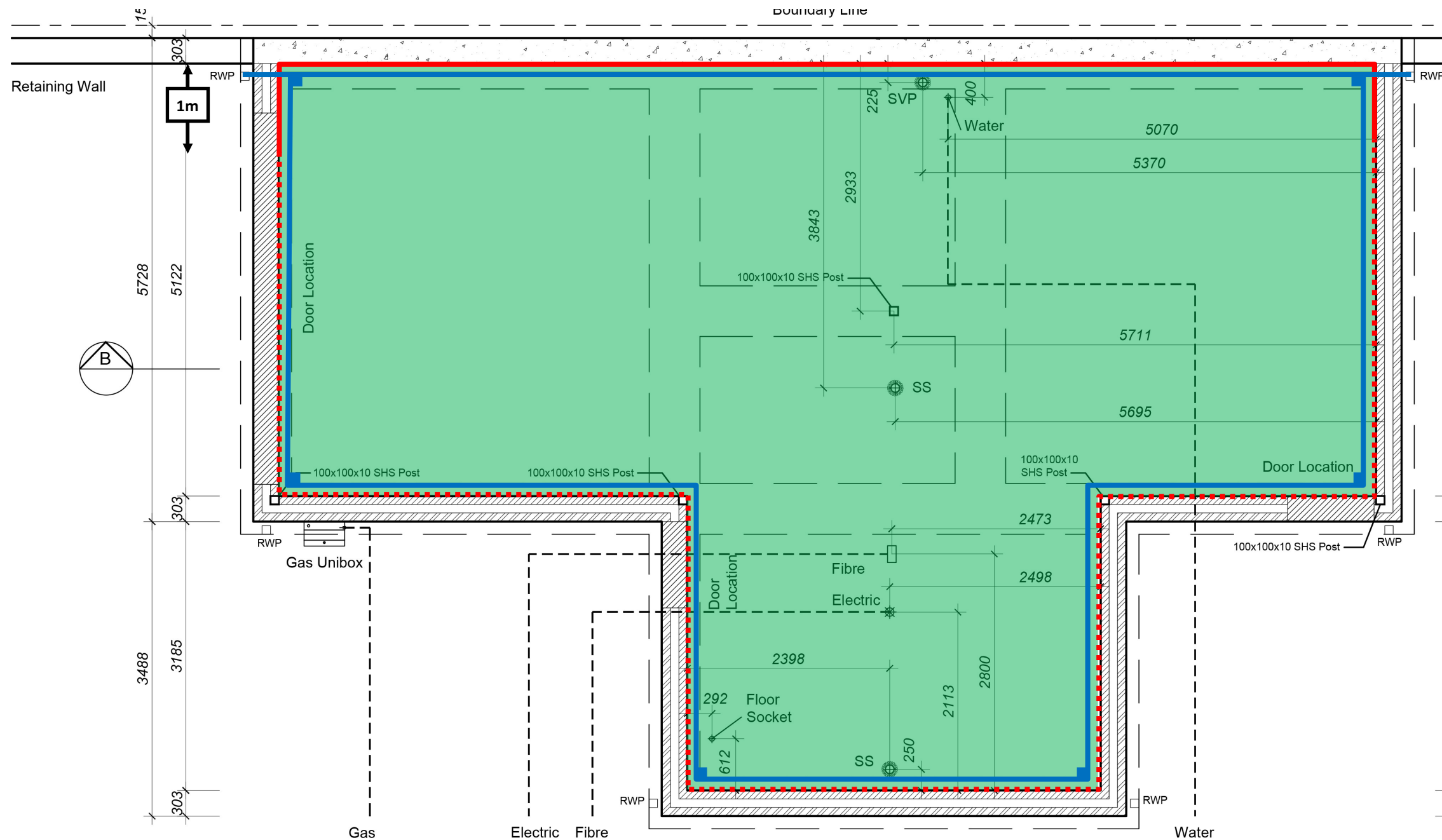
Appendix A – Waterproofing design

Appendix A

Waterproofing design



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House 1, Holly Bank

Muswell Hill, London, N10 3TE

Version: 1.0

Date: 23/01/19

Waterproofing Layout—Not To Scale

Apply anti-lime coating to new concrete walls. Apply 8mm cavity drain membrane with fixings at 400 centres to height of DPC on retaining wall (approx. 1.6m), return 1m past the walls on either side of the retaining wall.

Apply 8mm cavity drain membrane to height of DPC on all perimeter walls (approx. 300mm).

Aqua drains leading to gravity drainage for the disposal of ground water.

Proposed locations of inspection ports for maintenance in accordance with BS8102:2009.

Apply anti-lime coating, XPS closed cell insulation and 20mm cavity drain membrane to floors.



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