A GROUND GAS RISK ASSESSMENT FOR:

PHASE 1B OF A RESIDENTIAL DEVELOPMENT AT WHITFIELD, DOVER, KENT

CLIENT: Halsbury Homes (South East) Limited

REFERENCE: JAH/18.185/GGRA

DATE: 6 June 2019

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1. INTRODUCTION

It is proposed to develop Phase 1B of the wider residential development at Whitfield, Dover, Kent (Fig. 18.185/GGRA/01) for residential end use. At the instruction of Halsbury Homes (South East) Limited (the "Client"), an investigation was carried out to provide information on the subsoil conditions to enable an assessment of the potential ground gas risks.

The report has been carried out in general accordance with accepted best practice and methodologies (BS10175:2011+A2:2017, BS5930:2015, BS8485:2015+A1:2019, BS8576:2013, and CIRIA C665 (Wilson et al, 2007)). The assessment and recommendations contained within this report are based on data from a series of exploratory holes and a subsequent monitoring programme. Extrapolation between and to other parts of the site is considered within the light of the geo-environmental setting as interpreted, but no responsibility can be accepted for conditions varying from those on which the report is based.

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2. BACKGROUND INFORMATION

The site and surrounding development area has been subject to many phases of investigation. The following reports were considered relevant to the development of Phase 1B, and a summary is provided were applicable.

Reports pertinent to Phase 1B

Interpretive Ground Investigation Report, A F Howland Associates Limited (2018a)

A geotechnical ground investigation covering Phase 1B and 1C, comprising 10 No. windowless dynamic sampling holes (referenced WS01 to WS10), 12 No. dynamic cone penetrometer tests (referenced CBR01 to CBR12), 15 No. trial pits (referenced TP01 to TP15), and six number trial pits with subsequent soakage testing (referenced BRE01 to BRE06).

Factual Ground Investigation Report, A F Howland Associates Limited (2018b)

A factual investigation covering Phase 1B comprising 4 No. trial pits with subsequent soakage testing (referenced BRE07 to BRE09 and BRE09A).

Report available for the wider development area

Interpretive Ground Investigation Report – Whole development site overview, Southern Testing Laboratories Limited (2009)

A Geotechnical and contamination ground investigation was carried out for the entire development site, comprising a phase I desk study and preliminary intrusive investigation of 25 No. trial pits spaced at 150 m centres, all with accompanying dynamic cone penetrometer tests, and 8No. with subsequent soakage tests. The wider development area was identified as lying within an area requiring radon protection to be implemented. Only infilled chalk pits were identified as a potential source of ground gases that may impact upon the proposed end use of the development. Given the size and age of filling of these pits, they were concluded to not pose a significant gas risk to the wider site and only pose a localised risk within their immediate vicinity. No such pits were noted within the area defined as Phase 1B of the development.

Interpretive Ground Investigation Report - Phase 1A, WSP | Parsons Brinckerhoff (2016)

A geotechnical and contamination ground investigation, including a ground gas risk assessment for Phase 1A of the development. Three rounds of ground gas monitoring targeting the potential ground gas generation from the shallow chalk underlying the site were carried out. The results of the monitoring determined that the site was within Characteristic Situation 1 and protective measures were not required.

Factual Ground Investigation Report, A F Howland Associates Limited (2019)

A factual investigation for the proposed public open spaces, to the north and south of Phase C, comprising 23 No. trial pits with subsequent soakage testing (referenced BRE101 to BRE122 and BRE122A).

2.1 SITE LOCATION AND DESCRIPTION

The area of investigation lies approximately a kilometre north east of the village of Whitfield, approximately 3.5 km north of Dover, Kent, at National Grid reference 631116 E, 145265 N and at an elevation of between 105 and 115 m above Ordnance Datum (aOD).

The site and immediate surrounding area were formerly agricultural land, which is undergoing residential development. The first phase of development is nearing completion to the south east of the site (Phase 1A). The main construction and storage compound is immediately to the north of the site, with parts of the site currently being used to store construction materials and soil stockpiles.

2.2 GEOLOGY

The regional geology as mapped for the area by the British Geological Survey (BGS, 2019) shows a bedrock geology of the Seaford Chalk Formation overlain by superficial deposits. There is an inferred fault within the bedrock geology that approximately cuts across the northern part of the site on a north east to south west alignment. Superficial deposits of the Clay-with-Flints Formation are mapped along the north western boundary of the site. Superficial Head deposits are mapped across the remainder of the site, comprising clay, silt, sand and gravel. The superficial geology in the lower part of the site was previously referred to as Dry Valley and Nailbourne Deposits in the WSP and Southern Testing reports.

The superficial geology is topographically controlled, with the Clay-with-Flints Formation mapped on flat topographic highs, whilst Head deposits are found within the dry valleys, which in this area of Kent trend on a north east to south west alignment.

2.3 HISTORICAL INFORMATION

A detailed history of the site was provided within the Southern Testing report. The site was understood to have been former agricultural fields/wooded areas from as early as 1874. Several small chalk pits were noted across the wider development area between 1874 and 1907/08. None of the former chalk pits are mapped on or adjacent to Phase 1B of the development.

2.4 CONCEPTUAL MODEL

The conceptual model uses the data and evidence obtained during the investigation using the principle of "source-pathway-receptor". In this case, the source can be defined as the potentially infilled land on and around the site.

The potential pathways are considered to be the local geology and/or any infilled materials and the receptors are the end users and structures of the proposed development.

Following the risk assessment calculation in Appendix E, a low risk is concluded from infilled chalk pits, impacting upon the proposed end users and structures. An intrusive investigation was requested by the Client, as a form of due diligence prior to development taking place.

3. INTRUSIVE INVESTIGATION

3.1 FIELDWORK

The fieldwork was carried out on 17 April 2019 and comprised five windowless dynamic sampling holes. Subsequently, gas and water monitoring was carried out to gain information on the prevailing ground gas regime.

The exploratory hole positions were set out to target potential gas flow through natural strata towards and into the proposed structures as shown approximately on drawing 18.185/GGRA/02. The National Grid references, and the elevation of the hole positions relative to Ordnance Datum, were measured using a Hemisphere S320 VRS GPS (RTK) system. A cable avoidance tool (CAT) was used to sweep the exploratory hole positions and the immediate surrounding area to locate any potential services and the location adjusted as necessary. A starter pit was also excavated by hand to a depth of 1.2 m at the hole positions to provide direct inspection for services or buried obstructions.

Sampling, soil descriptions and *in situ* tests were carried out in accordance with BS EN1997-2:2007 Eurocode 7 and its UK National Annex supported by BS 5930: 2015.

The **windowless dynamic sampling holes**, referenced WS101 to WS105, were carried out with a tracked window sampling rig to a target depth of 3.0 m below ground level (bgl). The sampling system utilises a 63.5 kg weight falling a distance of 750 mm to drive rods and sampling tubes into the ground, these are then extracted and the continuous samples described and subsampled for possible laboratory testing.

On completion of the holes, slotted standpipes were installed. The standpipes comprised a PVC access tube slotted at the base, surrounded by a granular filter, and sealed at the top by a bentonite seal. A gas bung was attached to the top of each installation to allow monitoring to take place. The standpipes were installed as detailed in the following table.

Windowless dynamic sampling hole	Depth achieved (m bgl)	Standpipe Response Zone (m bgl)	Target Stratum
WS101	3.00	1.00-3.00	Chalk
WS102	3.00	1.00-3.00	Superficial clay
WS103	3.00	1.00-3.00	Chalk
WS104	3.00	1.00-3.00	Chalk
WS105	3.00	1.00-3.00	Chalk

Table 1 – Standpipe installation details

The exploratory holes were monitored for groundwater ingress during fieldwork, but none was encountered.

Subsequent to the completion of the fieldwork, AFHA returned to site to carry out **gas and water monitoring** on three occasions (30/04/2019, 17/05/2019, and 22/05/2019) . Gas monitoring was carried out using a Geotechnical Instruments GA5000 portable gas analyser, in general accordance with the guidelines presented in CIRIA C665 (Wilson et al, 2007) and BS 8576:2013 and involved the following steps:

- Average flow was monitored for a period of one minute.
- Gases (CH_4, CO_2, O_2, CO and H_2S) were monitored for a minimum period of three minutes, if any significant readings were noted (≥0.5% CH_4, ≥2.0% CO_2); the period was extended to ten minutes.
- Over the respective monitoring period, gas readings were logged every thirty seconds.

Details of the strata encountered, the sampling, monitoring records are shown on records appended to this report.

3.2 GROUND CONDITIONS

3.2.1 Soils

A broadly similar profile was found in each of the exploratory holes, which comprised shallow made ground or disturbed ground underlain by the Seaford Chalk Formation. However, the precise boundary between the two formations can be difficult to determine given the similarity in the deposits.

Shallow made ground and/or disturbed ground was encountered at each of the positions, with the exception of WS103, between 0.10 and 0.70 m thick. This material consisted of a silty variably clayey variably sandy flint and chalk gravel, with rare brick fragments in WS101.

The underlying **natural soils** comprised a sequence of structureless chalk (CIRIA Grade Dc/Dm), within each of the holes with the exception of WS102. In WS102 the natural soil was noted to comprise a silty slightly sandy clay with rare flint cobbles.

3.2.2 Ground Gas

The results of ground gas monitoring are summarised within Table 2 below.

Window sample reference	Response zone (mbgl)/strata	No. of monitoring occasions	Peak methane (% v/v)	Peak carbon dioxide (% v/v)	Range of oxygen levels (% v/v)	Peak flow (l/hr)	Shallowest water level (m bgl)	Range of atmospheric pressure during monitoring (mb)
WS101	1.00-3.00 Chalk	3	0.0-0.1	0.4-1.4	17.2-18.6	0.2	DRY	996-1013
WS102	1.00-3.00 Clay	3	0.0	0.7-2.3	19.0-21.2	0.2	DRY	996-1014
WS103	1.00-3.00 Chalk	3	0.0	1.0-1.6	19.1-21.2	0.2-0.3	DRY	996-1014
WS104	1.00-3.00 Chalk	3	0.0	0.7-1.6	19.0-21.6	0.1-0.3	DRY	996-1014
WS105	1.00-3.00 Chalk	3	0.0	1.3-1.8	18.9-21.3	0.1-0.2	DRY	997-1014

Table 2 - Summary of gas and vapour monitoring results

The results show very low concentrations of methane between 0.0 and 0.1% (v/v). Low concentrations of carbon dioxide were recorded across the site, between 0.4 and 2.3% (v/v). Oxygen levels varied across the site between 17.2 and 21.3% (v/v). Peak borehole flow values were between 0.1 and 0.3 l/h. The monitoring was undertaken over a variety barometric pressures. As a result, it is considered that the dataset provides a good indication of the characteristics of the prevailing gas regime.

The concentrations of gases recorded on site, are broadly similar to the concentrations recorded on the neighbouring Phase 1A, although higher flow readings were recorded for Phase 1A (WSP, 2016).

4. GROUND GAS RISK ASSESSMENT

4.1 GENERAL

It is understood that the proposed scheme will involve the construction of residential properties with garages, private gardens, and associated infrastructure.

The proposed layout has been provided on a drawing by Halsbury Homes (South East) Limited, referenced W1C-01a and dated May 2018, a copy of which is appended.

The quantitative risk assessment presented below is intended to establish the potential risk to human end-users and structures from ground gas being generated from the identified on and off site sources.

4.2 RISK ASSESSMENT

4.2.1 Radon

The site is situated within an area potentially affected by naturally occurring radon gas, as between 3 and 5% of homes are above the action level. In areas where radon may pose a risk, construction practices such as foundations provide a pathway for gases to permeate into building, which can then accumulate, concentrating and then posing a risk to human health. It is likely that basic radon protection measures will be required (BRE, 2015).

4.2.2 Methane, Carbon Dioxide, Oxygen, Carbon Monoxide, and Hydrogen Sulphide

Soil gas may also occur as a result of the degradation of organic matter, which can occur in buried landfill or within organic material. The gas composition varies according to the type and phase of breakdown that is occurring at any given time. Initially, carbon dioxide may be predominant, with significant quantities of hydrogen also being evolved. Methane (about 65%) and carbon dioxide (about 35%) are the major constituents produced during anaerobic/methanogenic phases of decomposition. Methane and carbon dioxide can develop explosive or flammable mixes with oxygen, or can cause oxygen depletion and act as an asphyxiate.

No concentrations of carbon monoxide or hydrogen sulphide were recorded during the monitoring regime. As such these gases are concluded to not pose a significant risk to the proposed human end users or buildings.

The risks associated with the remaining ground gases have been assessed in general accordance with BS 8485:2015+A1:2019 and CIRIA C665 (Wilson et al, 2007). These describe a characterisation system and provide a risk based approach designed to allow gas protection measures to be selected appropriately. The characterisation process begins by the calculation of a borehole hazardous gas flow rate (Q_{hg}) or gas screening value (GSV), both calculated in the same manner. Q_{hg} is derived from the maximum recorded borehole flow (l/hr) and maximum concentration of a particular ground gas (% (v/v)), either methane or carbon dioxide. The Q_{hg} is calculated as follows:

$$Q_{hg} = q\left(\frac{C_{hg}}{100}\right)$$

Where,

q = borehole flow rate and,

C_{hg} = maximum gas concentration.

For example, monitoring data giving a maximum flow rate of 3.5 l/hr and a maximum concentration of 4.0 % (v/v) methane would have a Q_{hg} of 0.14 l/hr [3.5 x (4.0/100)].

The Q_{hg} is then used to assign a characteristic situation to the site. These range from CS1 to CS6 and correspond with a very low to very high risk as shown in Table 2 of BS8485:2015+A1:2019.

In order to inform a choice of ground gas protection measures, BS 8485:2015+A1:2019 uses a pre-determined building type and the determined characteristic situation to derive a gas protection score. This takes into account the differing types of development which may occur on a given site and their relative sensitivities. The building types proposed here fit closest with the following description.

- Type A – Private ownership with no building management controls. Some small rooms present and probably traditional building construction. E.g. typical residential dwelling.

After the derivation of the gas protection score, gas protection measures, comprising structural barriers, ventilation measures and gas protection membranes, are chosen to meet the required score for the development. Each protection measure has its own score. This allows greater flexibility and choice over the gas protection measures employed in order to take into account construction methods or other site constraints. Gas protection scores and associated protection measures can be found in Tables 4 – 7 of BS 8485:2015+A1:2019.

The Q_{hg} for methane and carbon dioxide and the corresponding characteristic situation (CS) have been calculated in the following table.

Window sample reference	Peak methane (%)	Peak carbon dioxide (%)	Peak flow (l/hr)	Q_{hg} methane	Q_{hg} carbon dioxide	Characteristic gas situation (CS)
WS101	0.1	1.4	0.2	0.0002	0.0028	CS1
WS102	0	2.3	0.2	0	0.0046	CS1
WS103	0	1.6	0.3	0	0.0048	CS1
WS104	0	1.6	0.3	0	0.0048	CS1
WS105	0	1.8	0.2	0	0.0036	CS1

[1]Increased from CS1 due to methane concentration greater than 1.0 % (v/v) and/or carbon dioxide concentration greater than 5.0 % (v/v), as per the table 2 of BS8485:2015+A1:2019

Table 3 – Calculated Q_{hg} and CS values

It is concluded that the site should be classified as CS1 (a site of very low risk), and it is concluded that no gas protection measures are necessary, with respect to potential, methane, carbon dioxide, depleted oxygen, carbon monoxide, or hydrogen sulphide.

4.3 GAS PROTECTION MEASURES

4.3.1 Radon

It is likely that radon protection measures will be required in the construction of new dwellings in accordance with BRE 211 (BRE, 2015). The two main methods of achieving radon protection in new buildings are active or passive. The passive method typically involves providing a barrier to the radon and, where the construction method allows, additional natural underfloor ventilation. The active method typically consists of providing natural or mechanical (fan-assisted) underfloor ventilation as an integral part of the services of the building.

It is understood that basic protection measures should be sufficient for the proposed development (BRE, 2015), and as such a passive method of protection could be adopted. A well installed 1200 gauge damp-proof membrane (DPM) modified and extended to form a radon barrier across the footprint of the building should prove sufficient to meet the requirements of basic radon protection measures.

4.4 CONCLUSION

The site was noted to lie within an area potentially affected by radon gas. Basic protection measures will be required for any new dwellings constructed as part of the development. It is anticipated that a well installed 1200 gauge DPM should provide a suitable radon barrier.

Spot gas monitoring was carried out at the site. The gas regime for the site based upon the methane and carbon dioxide concentrations correspond to a characteristic situation 1 (a site of very low risk). No carbon monoxide or hydrogen sulphide was recorded. Based upon these results no additional gas protection measures due to methane, carbon dioxide, depleted oxygen, carbon monoxide, and hydrogen sulphide are considered necessary

The protection measures for radon gas provided are considered to be achievable within the context of the development and are typical of those required to provide the necessary mitigation for the identified risks. The approach outlined above does not constitute a detailed design of the gas protection measures and is specifically given as an outline of the combination of measures available to mitigate the prevailing risk. Therefore, the gas protection measures to be incorporated within the development should be subject to a detailed design once the exact construction details of the proposed structures are known and therefore the applicability of the various measures can be fully assessed.

5. SUMMARY

1. A ground gas risk assessment was carried out to support Phase 1B of the residential development at Whitfield, Dover, Kent.
2. The previous desk study for the entire development identified that the site former infilled chalk pits were present, which were concluded to not pose a significant risk to entire development, and only pose a localised risk within their immediate vicinity. Based upon this a ground gas risk assessment has been carried out to mitigate this risk for this stage of the development.
3. The site was situated within an area potentially affected by radon gas. Basic protection measures will be required for any new dwellings constructed as part of the development. It is anticipated that a well installed 1200 gauge DPM should provide a suitable radon barrier.
4. The investigation confirmed a layer of shallow made ground/disturbed ground overlying a sequence of structureless chalk (CIRIA Grade Dc/Dm), with the exception of WS102 which encountered a silty slightly sandy clay. Five monitoring wells were installed targeting the underlying natural soils.
5. Spot monitoring was carried out, maximum concentrations of 0.1% (v/v) methane and 2.3% (v/v) carbon dioxide were recorded. The gas regime for the site corresponds to a characteristic situation CS1 (very low risk), and it is concluded no additional protection measures with respect to methane and carbon dioxide are required.
6. No carbon monoxide or hydrogen sulphide was recorded during the monitoring, and as such are considered to not pose a risk to the proposed human end users or buildings
7. Gas protection should be provided to all buildings suitable to protect against radon. Following the completion of the gas protection measures, verification by an independent contractor should be sought, the findings of which should be submitted to the Local Authority for approval.

Prepared by:	Checked by:	Authorised by:
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A F HOWLAND ASSOCIATES
6 June 2019

APPENDIX A: REFERENCES

A F HOWLAND ASSOCAITES LIMITED (AFHA). 2018a. A report on a ground investigation for Phase 1B and 1C residential development, Whitfield, Dover, Kent. Report ref. DJM/18.185, dated 6 July 2018.

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APPENDIX B: WINDOWLESS DYNAMIC SAMPLING AND INSTRUMENTATION RECORDS

KEY

L	Plastic liner sample (from window sampler)
D	Small disturbed sample
dd/mm/yy: 1.0 **dd/mm/yy: dry**	Date, water level at the borehole depth at the end of shift and the start of the following shift

Each sample type is numbered sequentially with depth and relates to the depth range quoted

All depths and measurements are given in metres, except as noted

Strata descriptions compiled by visual examination of liner samples obtained after BS EN1997-2:2007 Eurocode 7 and its UK National Annex supported by BS 5930:2015 and modified in accordance with laboratory test results where applicable

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Geotechnical Engineers

Machine : Dando Terrier 2002 **Method :** Windowless Dynamic Sampling	**Dimensions** 102mm to 1.00m 87mm to 2.00m 75mm to 3.00m	**Ground Level (mOD)** 109.69	**Site** Richmond Park, Whitfield, Dover **Client** Halsbury Homes (South East) Limited	**Number** **WS101** **Job Number** 18.185
	Location 631127 E 145308 N	**Dates** 17/04/2019	**Engineer**	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
0.00-1.00	L1			109.54	(0.15) 0.15	MADE GROUND (While silty sandy subangular to subrounded fine to coarse chalk gravel)		
0.50	D1			108.99	(0.55) 0.70	MADE GROUND (Dark brown silty gravelly clay. Gravel is angular to subrounded fine to coarse brick, chalk and flint)		
0.80	D2					White with black flecks structureless CHALK recovered as slightly silty angular to subrounded fine to coarse chalk GRAVEL. Clasts are extremely to very weak and low density. (Grade Dc)		
1.00-2.00	L2					...becoming recovered as slightly clayey silty GRAVEL		
1.50	D3							
					(1.80)	...becoming recovered as slightly silty GRAVEL		
2.00-3.00	L3							
2.50	D4			107.19	2.50	White with black flecks structureless CHALK recovered as slightly clayey gravelly SILT. Clasts are extremely weak and low density. (Grade Dm)		
					(0.50)			
			17/04/2019:DRY	106.69	3.00	Complete at 3.00m		

Remarks
1. Location CAT scanned prior to excavation
2. No groundwater encountered
3. Slotted Standpipe installed to 3.00 m

Scale (approx)	Logged By
1:25	DJM

Figure No. 18.185.WS101

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Site	Borehole Number
Richmond Park, Whitfield, Dover	**WS101**

Installation Type	Dimensions	Client	Job Number
Single Installation	Internal Diameter of Tube [A] = 50 mm	Halsbury Homes (South East) Limited	18.185

Location	Ground Level (mOD)	Engineer	Sheet
631127 E 145308 N	109.69		1/1

Legend	Water	Instr (A)	Level (mOD)	Depth (m)	Description
					Concrete
			109.49	0.20	
					Bentonite Seal
			108.69	1.00	
					Slotted Standpipe
			106.69	3.00	

Groundwater Strikes During Drilling

Date	Time	Depth Struck (m)	Casing Depth (m)	Inflow Rate	Readings 5 min	Readings 10 min	Readings 15 min	Readings 20 min	Depth Sealed (m)

Groundwater Observations During Drilling

Date	Start of Shift					End of Shift				
	Time	Depth Hole (m)	Casing Depth (m)	Water Depth (m)	Water Level (mOD)	Time	Depth Hole (m)	Casing Depth (m)	Water Depth (m)	Water Level (mOD)
17/04/19							3.00		DRY	

Instrument Groundwater Observations

Inst. [A] Type : Slotted Standpipe

Date	Instrument [A]			Remarks
	Time	Depth (m)	Level (mOD)	
30/04/19	09:35	DRY		Ground gas monitoring
17/05/19	09:20	DRY		Ground gas monitoring
22/05/19	12:35	DRY		Ground gas monitoring

Remarks

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Site: Richmond Park, Whitfield, Dover				**Number** WS102
Machine : Dando Terrier 2002 **Method :** Windowless Dynamic Sampling	**Dimensions** 102mm to 1.00m 87mm to 2.00m 75mm to 3.00m	**Ground Level (mOD)** 107.28	**Client** Halsbury Homes (South East) Limited	**Job Number** 18.185
	Location 631183 E 145309 N	**Dates** 17/04/2019	**Engineer**	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
0.00-1.00	L1			107.18	(0.10) 0.10	MADE GROUND (Brown silty slightly sandy gravelly clay. Gravel is angular to subrounded fine to coarse flint and chalk)		
						Firm to stiff orange brown mottled dark brown silty slightly sandy CLAY. With rare flint cobbles		
0.50	D1							
1.00-2.00	L2							
1.50	D2				(2.90)			
2.00-3.00	L3							
2.50	D3							
			17/04/2019:DRY	104.28	3.00	Complete at 3.00m		

Remarks
1. Location CAT scanned prior to excavation
2. No groundwater encountered
3. Slotted Standpipe installed to 3.00 m

Scale (approx)	Logged By
1:25	DJM

Figure No. 18.185.WS102

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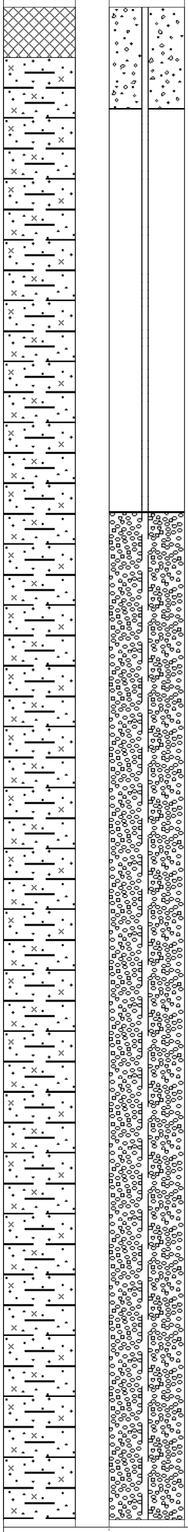
Site	Borehole Number
Richmond Park, Whitfield, Dover	WS102

Installation Type	Dimensions	Client	Job Number
Single Installation	Internal Diameter of Tube [A] = 50 mm	Halsbury Homes (South East) Limited	18.185

Location	Ground Level (mOD)	Engineer	Sheet
631183 E 145309 N	107.28		1/1



Level (mOD)	Depth (m)	Description
		Concrete
107.08	0.20	Bentonite Seal
106.28	1.00	Slotted Standpipe
104.28	3.00	

Groundwater Strikes During Drilling

Date	Time	Depth Struck (m)	Casing Depth (m)	Inflow Rate	Readings 5 min	10 min	15 min	20 min	Depth Sealed (m)

Groundwater Observations During Drilling

Date	Start of Shift Time	Depth Hole (m)	Casing Depth (m)	Water Depth (m)	Water Level (mOD)	End of Shift Time	Depth Hole (m)	Casing Depth (m)	Water Depth (m)	Water Level (mOD)
17/04/19							3.00		DRY	

Instrument Groundwater Observations

Inst. [A] Type : Slotted Standpipe

Date	Instrument [A] Time	Depth (m)	Level (mOD)	Remarks
30/04/19	09:55	DRY		Ground gas monitoring
17/05/19	09:30	DRY		Ground gas monitoring
22/05/19	12:42	DRY		Ground gas monitoring

Remarks

A F Howland Associates
Geotechnical Engineers

Site	Number
Richmond Park, Whitfield, Dover	**WS103**

Machine / Method	Dimensions	Ground Level (mOD)	Client	Job Number
Machine : Dando Terrier 2002 **Method :** Windowless Dynamic Sampling	102mm to 1.00m 87mm to 2.00m 75mm to 3.00m	108.49	Halsbury Homes (South East) Limited	18.185
	Location 631162 E 145349 N	**Dates** 17/04/2019	**Engineer**	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
0.00-1.00	L1					White with black flecks structureless CHALK recovered as silty angular to subrounded fine to coarse chalk GRAVEL. Clasts are extremely weak and low density. (Grade Dc)		
1.00-2.00	L2							
					(3.00)			
2.00-3.00	L3							
			17/04/2019:DRY	105.49	3.00	Complete at 3.00m		

Remarks
1. Location CAT scanned prior to excavation
2. No groundwater encountered
3. Slotted Standpipe installed to 3.00 m

Scale (approx)	Logged By
1:25	DJM

Figure No. 18.185.WS103

A F Howland Associates
Geotechnical Engineers

Site	Borehole Number
Richmond Park, Whitfield, Dover	**WS103**

Installation Type	Dimensions	Client	Job Number
Single Installation	Internal Diameter of Tube [A] = 50 mm	Halsbury Homes (South East) Limited	18.185

Location	Ground Level (mOD)	Engineer	Sheet
631162 E 145349 N	108.49		1/1

Legend	Water	Instr (A)	Level (mOD)	Depth (m)	Description
			108.29	0.20	Concrete
			107.49	1.00	Bentonite Seal
			105.49	3.00	Slotted Standpipe

Groundwater Strikes During Drilling

Date	Time	Depth Struck (m)	Casing Depth (m)	Inflow Rate	Readings 5 min	10 min	15 min	20 min	Depth Sealed (m)

Groundwater Observations During Drilling

Date	Start of Shift Time	Depth Hole (m)	Casing Depth (m)	Water Depth (m)	Water Level (mOD)	End of Shift Time	Depth Hole (m)	Casing Depth (m)	Water Depth (m)	Water Level (mOD)
17/04/19							3.00		DRY	

Instrument Groundwater Observations

Inst. [A] Type : Slotted Standpipe

Date	Instrument [A] Time	Depth (m)	Level (mOD)	Remarks
30/04/19	10:05	DRY		Ground gas monitoring
17/05/19	09:42	DRY		Ground gas monitoring
22/05/19	12:52	DRY		Ground gas monitoring

Remarks

A F Howland Associates
Geotechnical Engineers

Site	Richmond Park, Whitfield, Dover		**Number**	**WS104**
Machine : Dando Terrier 2002 **Method :** Windowless Dynamic Sampling	**Dimensions** 102mm to 1.00m 87mm to 2.00m 75mm to 3.00m	**Ground Level (mOD)** 106.46	**Client** Halsbury Homes (South East) Limited	**Job Number** 18.185
	Location 631201 E 145407 N	**Dates** 17/04/2019	**Engineer**	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
0.00-1.00	L1			106.31	(0.15) 0.15	DISTURBED GROUND (White mottled brown silty sandy angular to subangular fine to medium chalk gravel)		
0.50	D1					White mottled orange brown with black flecks structureless CHALK recovered as slightly clayey silty angular to subrounded fine to coarse chalk GRAVEL. Clasts are extremely weak and low density. (Grade Dc)		
1.00-2.00	L2							
1.50	D2				(2.85)			
2.00-3.00	L3							
2.50	D3							
			17/04/2019:DRY	103.46	3.00	Complete at 3.00m		

Remarks
1. Location CAT scanned prior to excavation
2. No groundwater encountered
3. Slotted Standpipe installed to 3.00 m

Scale (approx)	Logged By
1:25	DJM

Figure No. 18.185.WS104

A F Howland Associates
Geotechnical Engineers

Site	Borehole Number
Richmond Park, Whitfield, Dover	WS104

Installation Type	Dimensions	Client	Job Number
Single Installation	Internal Diameter of Tube [A] = 50 mm	Halsbury Homes (South East) Limited	18.185

Location	Ground Level (mOD)	Engineer	Sheet
631201 E 145407 N	106.46		1/1

Legend	Water	Instr (A)	Level (mOD)	Depth (m)	Description
			106.26	0.20	Concrete
			105.46	1.00	Bentonite Seal
			103.46	3.00	Slotted Standpipe

Groundwater Strikes During Drilling

Date	Time	Depth Struck (m)	Casing Depth (m)	Inflow Rate	Readings 5 min	Readings 10 min	Readings 15 min	Readings 20 min	Depth Sealed (m)

Groundwater Observations During Drilling

Date	Start of Shift					End of Shift				
	Time	Depth Hole (m)	Casing Depth (m)	Water Depth (m)	Water Level (mOD)	Time	Depth Hole (m)	Casing Depth (m)	Water Depth (m)	Water Level (mOD)
17/04/19							3.00		DRY	

Instrument Groundwater Observations

Inst. [A] Type : Slotted Standpipe

Date	Instrument [A]			Remarks
	Time	Depth (m)	Level (mOD)	
30/04/19	10:20	DRY		Ground gas monitoring
17/05/19	09:52	DRY		Ground gas monitoring
22/05/19	13:02	DRY		Ground gas monitoring

Remarks

A F Howland Associates
Geotechnical Engineers

Site	Number
Richmond Park, Whitfield, Dover	WS105

Machine : Dando Terrier 2002 Method : Windowless Dynamic Sampling	Dimensions 102mm to 1.00m 87mm to 2.00m 75mm to 3.00m	Ground Level (mOD) 104.67	Client Halsbury Homes (South East) Limited	Job Number 18.185
	Location 631254 E 145367 N	Dates 17/04/2019	Engineer	Sheet 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
0.00-1.00	L1			104.57	(0.10) 0.10	MADE GROUND (Brown silty slightly sandy angular to subrounded fine to coarse glass, ceramic, flint and chalk gravel)		
0.30	D1				(0.50)	Stiff orange brown mottled dark brown silty slightly sandy CLAY. With rare flint cobbles		
				104.07	0.60	White with black flecks structureless CHALK recovered as silty angular to subrounded fine to coarse chalk GRAVEL. Clasts are extremely to very weak and low density. (Grade Dc)		
0.80	D2							
1.00-2.00	L2							
1.50	D3							
					(2.40)			
2.00-3.00	L3							
2.50	D4							
			17/04/2019:DRY	101.67	3.00	Complete at 3.00m		

Remarks
1. Location CAT scanned prior to excavation
2. No groundwater encountered
3. Slotted Standpipe installed to 3.00 m

Scale (approx)	Logged By
1:25	DJM

Figure No.
18.185.WS105

A F Howland Associates
Geotechnical Engineers

Site	Borehole Number
Richmond Park, Whitfield, Dover	WS105

Installation Type	Dimensions	Client	Job Number
Single Installation	Internal Diameter of Tube [A] = 50 mm	Halsbury Homes (South East) Limited	18.185

Location	Ground Level (mOD)	Engineer	Sheet
631254 E 145367 N	104.67		1/1

Legend	Water	Instr (A)	Level (mOD)	Depth (m)	Description
					Concrete
			104.47	0.20	
					Bentonite Seal
			103.67	1.00	
					Slotted Standpipe
			101.67	3.00	

Groundwater Strikes During Drilling

Date	Time	Depth Struck (m)	Casing Depth (m)	Inflow Rate	Readings 5 min	Readings 10 min	Readings 15 min	Readings 20 min	Depth Sealed (m)

Groundwater Observations During Drilling

Date	Start of Shift					End of Shift				
	Time	Depth Hole (m)	Casing Depth (m)	Water Depth (m)	Water Level (mOD)	Time	Depth Hole (m)	Casing Depth (m)	Water Depth (m)	Water Level (mOD)
17/04/19							3.00		DRY	

Instrument Groundwater Observations

Inst. [A] Type : Slotted Standpipe

Date	Instrument [A]			Remarks
	Time	Depth (m)	Level (mOD)	
30/04/19	10:30	DRY		Ground gas monitoring
17/05/19	10:02	DRY		Ground gas monitoring
22/05/19	13:07	DRY		Ground gas monitoring

Remarks

APPENDIX C: GAS MONITORING RESULTS

A F Howland Associates
Geotechnical Engineers

Ground Gas Monitoring Results

Site : Richmond Park, Whitfield, Dover

Client : Halsbury Homes (South East) Limited

Engineer :

Job Number 18.185

Sheet 1 / 3

BH/WS	Date / Time	Security Code	Date Last Calibration	Date Factory Calibration	Next Service Due	Operator	Site Condition	Standpipe Condition	Wind Speed (Knots)
WS101	30/04/2019 09:33	[4C31B0A2]	26/04/2019	16/10/2018	16/10/2019	DJM	Overcast Ground dry	Tap fully closed Dip - dry	5.2
WS101	17/05/2019 09:20	[FE487A75]	07/05/2019	16/10/2018	16/10/2019	DJM	Overcast Light rain Ground dry Ground compacted	Tap fully closed Dip - dry	8.0
WS101	22/05/2019 12:30	[1FA4BC74]	07/05/2019	16/10/2018	16/10/2019	DJM	Partly cloudy Sunny Ground dry Ground compacted	Tap fully closed Dip - dry	0.6
WS102	30/04/2019 09:52	[4C31B0A2]	26/04/2019	16/10/2018	16/10/2019	DJM	Overcast Ground dry	Tap fully closed Dip - dry	5.2
WS102	17/05/2019 09:30	[FE487A75]	07/05/2019	16/10/2018	16/10/2019	DJM	Overcast Light rain Ground dry Ground compacted	Tap fully closed	8.0
WS102	22/05/2019 12:39	[1FA4BC74]	07/05/2019	16/10/2018	16/10/2019	DJM	Partly cloudy Sunny Ground dry Ground compacted	Tap fully closed	0.6
WS103	30/04/2019 10:02	[4C31B0A2]	26/04/2019	16/10/2018	16/10/2019	DJM	Overcast Ground dry	Tap fully closed Dip - dry	5.2
WS103	17/05/2019 09:42	[FE487A75]	07/05/2019	16/10/2018	16/10/2019	DJM	Overcast Light rain Ground dry Ground compacted	Tap fully closed	8.0
WS103	22/05/2019 12:49	[1FA4BC74]	07/05/2019	16/10/2018	16/10/2019	DJM	Partly cloudy Sunny Ground dry Ground compacted	Tap fully closed	0.6
WS104	30/04/2019 10:16	[4C31B0A2]	26/04/2019	16/10/2018	16/10/2019	DJM	Overcast Ground dry	Cracked cover Tap fully closed Dip - dry	5.2
WS104	17/05/2019 09:52	[FE487A75]	07/05/2019	16/10/2018	16/10/2019	DJM	Overcast Light rain Ground dry Ground compacted	Tap fully closed Dip - dry	8.0
WS104	22/05/2019 12:58	[1FA4BC74]	07/05/2019	16/10/2018	16/10/2019	DJM	Partly cloudy Sunny Ground dry Ground compacted	Tap fully closed Dip - dry	0.6
WS105	30/04/2019 10:27	[4C31B0A2]	26/04/2019	16/10/2018	16/10/2019	DJM	Overcast Ground dry	Tap fully closed Dip - dry	5.2
WS105	17/05/2019 10:02	[FE487A75]	07/05/2019	16/10/2018	16/10/2019	DJM	Overcast Light rain Ground dry Ground compacted	Tap fully closed	8.0
WS105	22/05/2019 13:07	[1FA4BC74]	07/05/2019	16/10/2018	16/10/2019	DJM	Partly cloudy Sunny Ground dry Ground compacted	Tap fully closed	0.6

A F Howland Associates Geotechnical Engineers	Ground Gas Monitoring Results

Site : Richmond Park, Whitfield, Dover

Client : Halsbury Homes (South East) Limited

Engineer :

Job Number 18.185

Sheet 2 / 3

BH/WS	Date / Time	Flow Pod (l/h)	CH4 (%)	Peak CH4 (%)	CH4 LEL (%)	CO2 (%)	PEAK CO2 (%)	O2 (%)	Min O2 (%)	Balance (%)	Baro (mb)	Rel Pressure (mb)	CO (ppm)	H2S (ppm)	Temp (°C)
WS101	30/04/2019 09:23:00	0.2	0.0	0.0	0.0	0.9	0.9	18.0	18.0	81.1	1013	0.0	0.0	0.0	10.8
WS101	30/04/2019 09:24:00		0.0	0.0	0.0	0.8	0.8	18.1	18.1	81.1			0.0	0.0	10.8
WS101	30/04/2019 09:25:00		0.0	0.0	0.0	0.9	0.9	18.0	18.0	81.1			0.0	0.0	10.8
WS101	30/04/2019 09:26:00		0.0	0.0	0.0	0.9	0.9	17.9	17.9	81.2			0.0	0.0	10.8
WS101	30/04/2019 09:27:00		0.0	0.0	0.0	0.9	0.9	17.5	17.5	81.6			0.0	0.0	10.8
WS101	30/04/2019 09:28:00		0.0	0.0	0.0	0.9	0.9	17.3	17.3	81.8			0.0	0.0	10.8
WS101	30/04/2019 09:29:00		0.0	0.0	0.0	0.8	0.9	17.2	17.2	82.0			0.0	0.0	10.8
WS101	17/05/2019 09:14:00	0.2	0.1	0.1	2.0	1.4	1.4	18.5	18.5	80.0	996	0.0	0.0	0.0	13.1
WS101	17/05/2019 09:15:00		0.0	0.0	0.0	1.3	1.3	18.6	18.6	80.1			0.0	0.0	13.1
WS101	17/05/2019 09:15:00		0.0	0.0	0.0	1.4	1.4	18.6	18.6	80.0			0.0	0.0	13.1
WS101	17/05/2019 09:16:00		0.0	0.0	0.0	1.4	1.4	18.6	18.6	80.0			0.0	0.0	13.1
WS101	17/05/2019 09:16:00		0.0	0.0	0.0	1.4	1.4	18.6	18.6	80.0			0.0	0.0	13.1
WS101	17/05/2019 09:17:00		0.0	0.0	0.0	1.4	1.4	18.6	18.6	80.0			0.0	0.0	13.1
WS101	17/05/2019 09:17:00		0.0	0.0	0.0	1.4	1.4	18.6	18.6	80.0			0.0	0.0	13.1
WS101	22/05/2019 12:24:00	0.2	0.0	0.0	0.0	0.4	0.4	18.6	18.6	80.9	1007	0.0	0.0	0.0	17.7
WS101	22/05/2019 12:25:00		0.0	0.0	0.0	0.4	0.4	18.5	18.5	81.0			0.0	0.0	17.7
WS101	22/05/2019 12:26:00		0.0	0.0	0.0	0.4	0.4	18.4	18.4	81.1			0.0	0.0	17.7
WS101	22/05/2019 12:26:00		0.0	0.0	0.0	0.4	0.4	18.3	18.3	81.2			0.0	0.0	17.7
WS101	22/05/2019 12:27:00		0.0	0.0	0.0	0.4	0.4	18.3	18.3	81.2			0.0	0.0	17.7
WS101	22/05/2019 12:27:00		0.0	0.0	0.0	0.4	0.4	18.3	18.3	81.2			0.0	1.0	17.7
WS101	22/05/2019 12:28:00		0.0	0.0	0.0	0.3	0.4	18.3	18.3	81.3			0.0	1.0	17.7
WS102	30/04/2019 09:40:00	0.2	0.0	0.0	0.0	2.3	2.3	20.6	20.6	77.1	1014	-0.1	4.0	0.0	10.8
WS102	30/04/2019 09:41:00		0.0	0.0	0.0	2.1	2.1	20.6	20.6	77.3			2.0	0.0	10.8
WS102	30/04/2019 09:41:00		0.0	0.0	0.0	2.3	2.3	20.6	20.6	77.1			3.0	0.0	10.8
WS102	30/04/2019 09:42:00		0.0	0.0	0.0	2.3	2.3	20.6	20.6	77.1			3.0	0.0	10.8
WS102	30/04/2019 09:42:00		0.0	0.0	0.0	2.3	2.3	20.6	20.6	77.1			3.0	0.0	10.8
WS102	30/04/2019 09:43:00		0.0	0.0	0.0	2.3	2.3	20.6	20.6	77.1			3.0	0.0	10.8
WS102	30/04/2019 09:43:00		0.0	0.0	0.0	2.3	2.3	20.6	20.6	77.1			3.0	0.0	10.8
WS102	30/04/2019 09:44:00		0.0	0.0	0.0	2.3	2.3	20.7	20.6	77.0			3.0	0.0	10.8
WS102	30/04/2019 09:44:00		0.0	0.0	0.0	2.2	2.3	20.7	20.7	77.1			3.0	0.0	10.8
WS102	30/04/2019 09:45:00		0.0	0.0	0.0	2.1	2.2	20.7	20.7	77.2			3.0	0.0	10.8
WS102	30/04/2019 09:45:00		0.0	0.0	0.0	2.0	2.1	20.8	20.7	77.2			3.0	0.0	10.8
WS102	30/04/2019 09:46:00		0.0	0.0	0.0	1.9	1.9	20.8	20.8	77.3			3.0	0.0	10.8
WS102	30/04/2019 09:47:00		0.0	0.0	0.0	1.8	1.9	20.9	20.8	77.3			3.0	0.0	10.8
WS102	30/04/2019 09:47:00		0.0	0.0	0.0	1.7	1.8	20.9	20.9	77.4			2.0	0.0	10.8
WS102	30/04/2019 09:48:00		0.0	0.0	0.0	1.6	1.7	20.9	20.9	77.5			2.0	0.0	10.8
WS102	30/04/2019 09:48:00		0.0	0.0	0.0	1.5	1.6	21.0	20.9	77.5			2.0	0.0	10.8
WS102	30/04/2019 09:49:00		0.0	0.0	0.0	1.4	1.5	21.1	21.0	77.5			2.0	0.0	10.8
WS102	30/04/2019 09:49:00		0.0	0.0	0.0	1.2	1.4	21.1	21.1	77.7			2.0	0.0	10.8
WS102	30/04/2019 09:50:00		0.0	0.0	0.0	1.1	1.2	21.1	21.1	77.8			2.0	0.0	10.8
WS102	30/04/2019 09:50:00		0.0	0.0	0.0	1.1	1.1	21.2	21.1	77.7			1.0	0.0	10.8
WS102	30/04/2019 09:51:00		0.0	0.0	0.0	1.0	1.0	21.2	21.2	77.8			1.0	0.0	10.8
WS102	17/05/2019 09:24:00	0.2	0.0	0.0	0.0	0.7	0.7	21.0	21.0	78.3	996	0.0	0.0	0.0	13.1
WS102	17/05/2019 09:25:00		0.0	0.0	0.0	0.7	0.7	21.1	21.1	78.2			0.0	0.0	13.1
WS102	17/05/2019 09:25:00		0.0	0.0	0.0	0.7	0.7	21.1	21.0	78.2			0.0	0.0	13.1
WS102	17/05/2019 09:26:00		0.0	0.0	0.0	0.7	0.7	21.1	21.1	78.2			0.0	0.0	13.1
WS102	17/05/2019 09:26:00		0.0	0.0	0.0	0.7	0.7	21.1	21.1	78.2			0.0	0.0	13.1
WS102	17/05/2019 09:27:00		0.0	0.0	0.0	0.7	0.7	21.1	21.1	78.2			0.0	0.0	13.1
WS102	17/05/2019 09:27:00		0.0	0.0	0.0	0.7	0.7	21.1	21.1	78.2			0.0	0.0	13.1
WS102	22/05/2019 12:34:00	0.2	0.0	0.0	0.0	1.3	1.3	19.2	19.2	79.5	1008	0.1	0.0	1.0	17.7
WS102	22/05/2019 12:34:00		0.0	0.0	0.0	1.2	1.2	19.1	19.1	79.7			0.0	1.0	17.7
WS102	22/05/2019 12:35:00		0.0	0.0	0.0	1.3	1.3	19.1	19.1	79.6			0.0	1.0	17.7
WS102	22/05/2019 12:35:00		0.0	0.0	0.0	1.3	1.3	19.0	19.0	79.7			0.0	1.0	17.7
WS102	22/05/2019 12:36:00		0.0	0.0	0.0	1.3	1.3	19.0	19.0	79.7			0.0	1.0	17.7
WS102	22/05/2019 12:36:00		0.0	0.0	0.0	1.3	1.3	19.0	19.0	79.7			0.0	1.0	17.7
WS102	22/05/2019 12:37:00		0.0	0.0	0.0	1.3	1.3	19.0	19.0	79.7			0.0	1.0	17.7
WS103	30/04/2019 09:57:00	0.2	0.0	0.0	0.0	1.5	1.5	21.1	21.1	77.4	1014	0.1	0.0	0.0	10.8
WS103	30/04/2019 09:58:00		0.0	0.0	0.0	1.4	1.4	21.1	21.1	77.5			0.0	0.0	10.8
WS103	30/04/2019 09:58:00		0.0	0.0	0.0	1.5	1.5	21.1	21.1	77.4			0.0	0.0	10.8
WS103	30/04/2019 09:59:00		0.0	0.0	0.0	1.5	1.5	21.2	21.1	77.3			0.0	0.0	10.8
WS103	30/04/2019 09:59:00		0.0	0.0	0.0	1.5	1.5	21.2	21.2	77.3			0.0	0.0	10.8
WS103	30/04/2019 10:00:00		0.0	0.0	0.0	1.5	1.5	21.2	21.2	77.3			0.0	0.0	10.8
WS103	30/04/2019 10:00:00		0.0	0.0	0.0	1.6	1.6	21.2	21.2	77.2			0.0	0.0	10.8
WS103	17/05/2019 09:36:00	0.3	0.0	0.0	0.0	1.4	1.4	21.2	21.2	77.4	996	-0.1	0.0	0.0	13.1
WS103	17/05/2019 09:37:00		0.0	0.0	0.0	1.3	1.3	21.2	21.2	77.5			0.0	0.0	13.1
WS103	17/05/2019 09:37:00		0.0	0.0	0.0	1.4	1.4	21.2	21.2	77.4			0.0	0.0	13.1
WS103	17/05/2019 09:38:00		0.0	0.0	0.0	1.4	1.4	21.2	21.2	77.4			0.0	0.0	13.1
WS103	17/05/2019 09:38:00		0.0	0.0	0.0	1.4	1.4	21.2	21.2	77.4			0.0	0.0	13.1
WS103	17/05/2019 09:39:00		0.0	0.0	0.0	1.4	1.4	21.2	21.2	77.4			0.0	0.0	13.1
WS103	17/05/2019 09:39:00		0.0	0.0	0.0	1.4	1.4	21.2	21.2	77.4			0.0	0.0	13.1
WS103	22/05/2019 12:42:00	0.2	0.0	0.0	0.0	1.0	1.0	19.1	19.1	79.9	1008	0.0	0.0	1.0	17.7
WS103	22/05/2019 12:43:00		0.0	0.0	0.0	0.9	0.9	19.1	19.1	80.0			0.0	1.0	17.7
WS103	22/05/2019 12:43:00		0.0	0.0	0.0	0.1	0.9	19.3	19.1	80.6			0.0	1.0	17.7
WS103	22/05/2019 12:44:00		0.0	0.0	0.0	0.9	0.9	19.1	19.1	80.0			0.0	1.0	17.7
WS103	22/05/2019 12:44:00		0.0	0.0	0.0	0.9	0.9	19.1	19.1	80.0			0.0	1.0	17.7
WS103	22/05/2019 12:45:00		0.0	0.0	0.0	1.0	1.0	19.1	19.1	79.9			0.0	1.0	17.7
WS103	22/05/2019 12:45:00		0.0	0.0	0.0	1.0	1.0	19.1	19.1	79.9			0.0	1.0	17.7
WS103	22/05/2019 12:46:00		0.0	0.0	0.0	1.0	1.0	19.1	19.1	79.9			0.0	1.0	17.7
WS103	22/05/2019 12:47:00		0.0	0.0	0.0	1.0	1.0	19.1	19.0	79.9			0.0	1.0	17.7
WS104	30/04/2019 10:10:00	0.1	0.0	0.0	0.0	0.8	0.8	21.5	21.5	77.7	1014	0.2	0.0	0.0	10.8
WS104	30/04/2019 10:10:00		0.0	0.0	0.0	0.8	0.8	21.6	21.6	77.6			0.0	0.0	10.8

A F Howland Associates
Geotechnical Engineers

Ground Gas Monitoring Results

Site : Richmond Park, Whitfield, Dover

Client : Halsbury Homes (South East) Limited

Engineer :

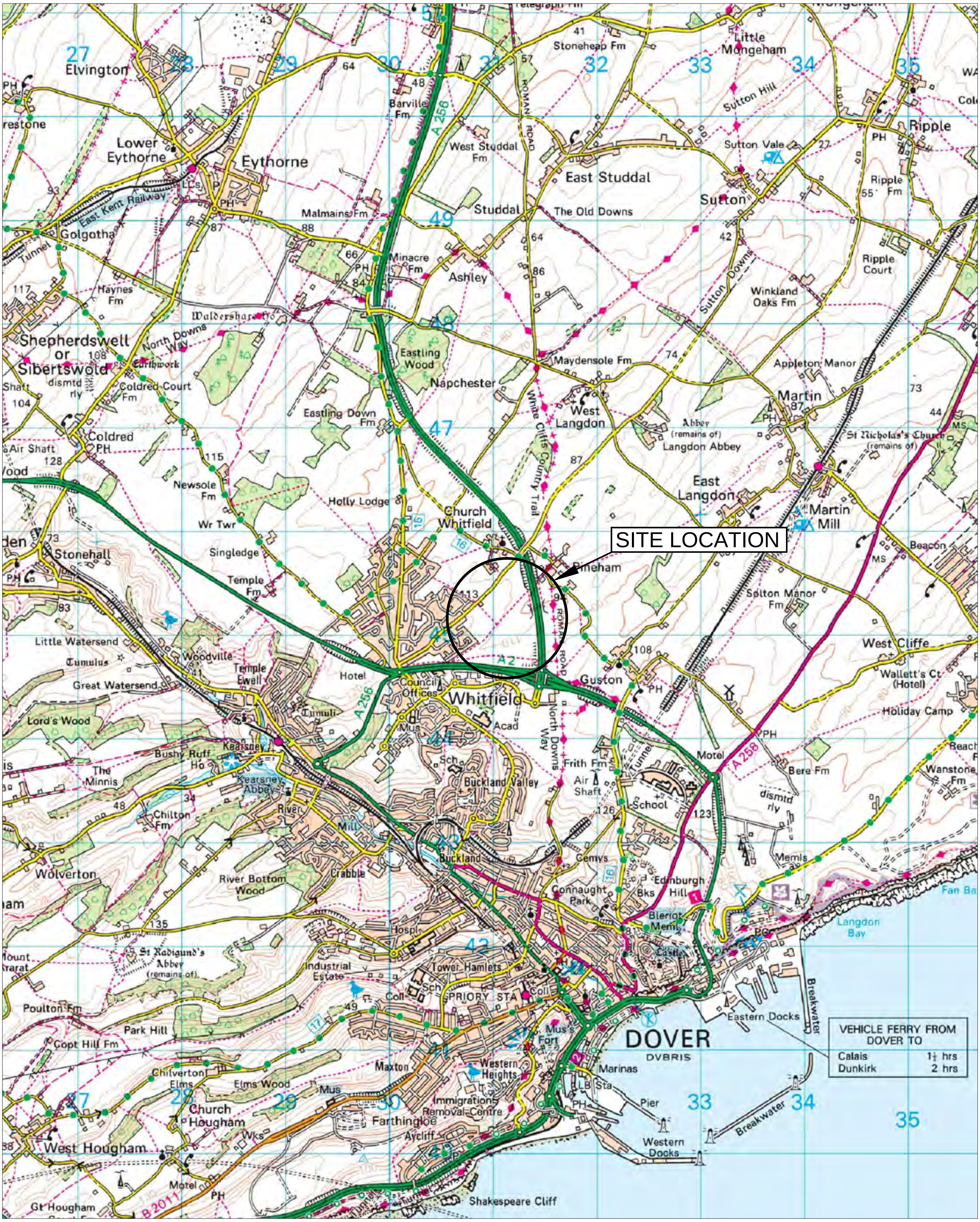
Job Number 18.185

Sheet 3 / 3

BH/WS	Date / Time	Flow Pod (l/h)	CH4 (%)	Peak CH4 (%)	CH4 LEL (%)	CO2 (%)	PEAK CO2 (%)	O2 (%)	Min O2 (%)	Balance (%)	Baro (mb)	Rel Pressure (mb)	CO (ppm)	H2S (ppm)	Temp (°C)
WS104	30/04/2019 10:11:00		0.0	0.0	0.0	0.9	0.9	21.6	21.6	77.5			0.0	0.0	10.8
WS104	30/04/2019 10:11:00		0.0	0.0	0.0	0.9	0.9	21.6	21.6	77.5			0.0	0.0	10.8
WS104	30/04/2019 10:12:00		0.0	0.0	0.0	0.9	0.9	21.6	21.6	77.5			0.0	0.0	10.8
WS104	30/04/2019 10:12:00		0.0	0.0	0.0	0.9	0.9	21.6	21.6	77.5			0.0	0.0	10.8
WS104	30/04/2019 10:13:00		0.0	0.0	0.0	0.9	0.9	21.6	21.6	77.5			0.0	0.0	10.8
WS104	17/05/2019 09:47:00	0.2	0.0	0.0	0.0	1.5	1.5	21.2	21.2	77.3	996	0.0	0.0	0.0	13.1
WS104	17/05/2019 09:47:00		0.0	0.0	0.0	1.5	1.5	21.2	21.2	77.3			0.0	0.0	13.1
WS104	17/05/2019 09:48:00		0.0	0.0	0.0	1.5	1.5	21.2	21.2	77.3			0.0	0.0	13.1
WS104	17/05/2019 09:48:00		0.0	0.0	0.0	1.6	1.6	21.2	21.2	77.2			0.0	0.0	13.1
WS104	17/05/2019 09:49:00		0.0	0.0	0.0	1.6	1.6	21.2	21.2	77.2			0.0	0.0	13.1
WS104	17/05/2019 09:49:00		0.0	0.0	0.0	1.6	1.6	21.2	21.2	77.2			0.0	0.0	13.1
WS104	17/05/2019 09:50:00		0.0	0.0	0.0	1.6	1.6	21.2	21.2	77.2			0.0	0.0	13.1
WS104	22/05/2019 12:53:00	0.3	0.0	0.0	0.0	0.7	0.7	19.0	19.0	80.3	1009	0.1	0.0	1.0	17.7
WS104	22/05/2019 12:53:00		0.0	0.0	0.0	0.7	0.7	19.0	19.0	80.3			0.0	1.0	17.7
WS104	22/05/2019 12:54:00		0.0	0.0	0.0	0.7	0.7	19.0	19.0	80.3			0.0	1.0	17.7
WS104	22/05/2019 12:54:00		0.0	0.0	0.0	0.7	0.7	19.0	19.0	80.3			0.0	1.0	17.7
WS104	22/05/2019 12:55:00		0.0	0.0	0.0	0.7	0.7	19.0	19.0	80.3			0.0	1.0	17.7
WS104	22/05/2019 12:55:00		0.0	0.0	0.0	0.7	0.7	19.0	19.0	80.3			0.0	1.0	17.7
WS104	22/05/2019 12:56:00		0.0	0.0	0.0	0.7	0.7	19.0	19.0	80.3			0.0	1.0	17.7
WS104	22/05/2019 12:57:00		0.0	0.0	0.0	0.7	0.7	19.1	19.1	80.2			0.0	1.0	17.7
WS105	30/04/2019 10:22:00	0.1	0.0	0.0	0.0	1.3	1.3	21.3	21.3	77.4	1014	0.0	0.0	0.0	10.8
WS105	30/04/2019 10:23:00		0.0	0.0	0.0	1.2	1.2	21.3	21.3	77.5			0.0	0.0	10.8
WS105	30/04/2019 10:23:00		0.0	0.0	0.0	1.3	1.3	21.3	21.3	77.4			0.0	0.0	10.8
WS105	30/04/2019 10:24:00		0.0	0.0	0.0	1.3	1.3	21.3	21.3	77.4			0.0	0.0	10.8
WS105	30/04/2019 10:24:00		0.0	0.0	0.0	1.3	1.3	21.3	21.3	77.4			0.0	0.0	10.8
WS105	30/04/2019 10:25:00		0.0	0.0	0.0	1.3	1.3	21.3	21.3	77.4			0.0	0.0	10.8
WS105	30/04/2019 10:25:00		0.0	0.0	0.0	1.3	1.3	21.3	21.3	77.4			0.0	0.0	10.8
WS105	17/05/2019 09:56:00	0.1	0.0	0.0	0.0	1.8	1.8	20.7	20.7	77.5	997	0.0	0.0	0.0	13.1
WS105	17/05/2019 09:57:00		0.0	0.0	0.0	1.7	1.7	20.7	20.7	77.6			0.0	0.0	13.1
WS105	17/05/2019 09:57:00		0.0	0.0	0.0	1.8	1.8	20.7	20.7	77.5			0.0	0.0	13.1
WS105	17/05/2019 09:58:00		0.0	0.0	0.0	1.8	1.8	20.7	20.7	77.5			0.0	0.0	13.1
WS105	17/05/2019 09:58:00		0.0	0.0	0.0	1.8	1.8	20.7	20.7	77.5			0.0	0.0	13.1
WS105	17/05/2019 09:59:00		0.0	0.0	0.0	1.8	1.8	20.7	20.7	77.5			0.0	0.0	13.1
WS105	17/05/2019 09:59:00		0.0	0.0	0.0	1.8	1.8	20.7	20.7	77.5			0.0	0.0	13.1
WS105	22/05/2019 13:02:00	0.2	0.0	0.0	0.0	1.5	1.5	18.9	18.9	79.6	1009	0.0	0.0	1.0	17.7
WS105	22/05/2019 13:03:00		0.0	0.0	0.0	1.4	1.4	19.0	19.0	79.6			0.0	1.0	17.7
WS105	22/05/2019 13:03:00		0.0	0.0	0.0	1.5	1.5	19.1	19.0	79.4			0.0	1.0	17.7
WS105	22/05/2019 13:04:00		0.0	0.0	0.0	1.5	1.5	19.1	19.1	79.4			0.0	1.0	17.7
WS105	22/05/2019 13:04:00		0.0	0.0	0.0	1.5	1.5	19.1	19.1	79.4			0.0	1.0	17.7
WS105	22/05/2019 13:05:00		0.0	0.0	0.0	1.5	1.5	19.2	19.1	79.3			0.0	1.0	17.7
WS105	22/05/2019 13:05:00		0.0	0.0	0.0	1.5	1.5	19.2	19.2	79.3			0.0	1.0	17.7

APPENDIX D: DRAWINGS

Drawing 18.185/GGRA/01	Site Location Plan
Drawing 18.185/GGRA/02	Exploratory Hole Location Plan
Drawing W1C-01a	Halsbury Homes (South East) Limited – Proposed Site plan



North

Circle indicates approximate location of site

Scale 1: 50,000 @ A4

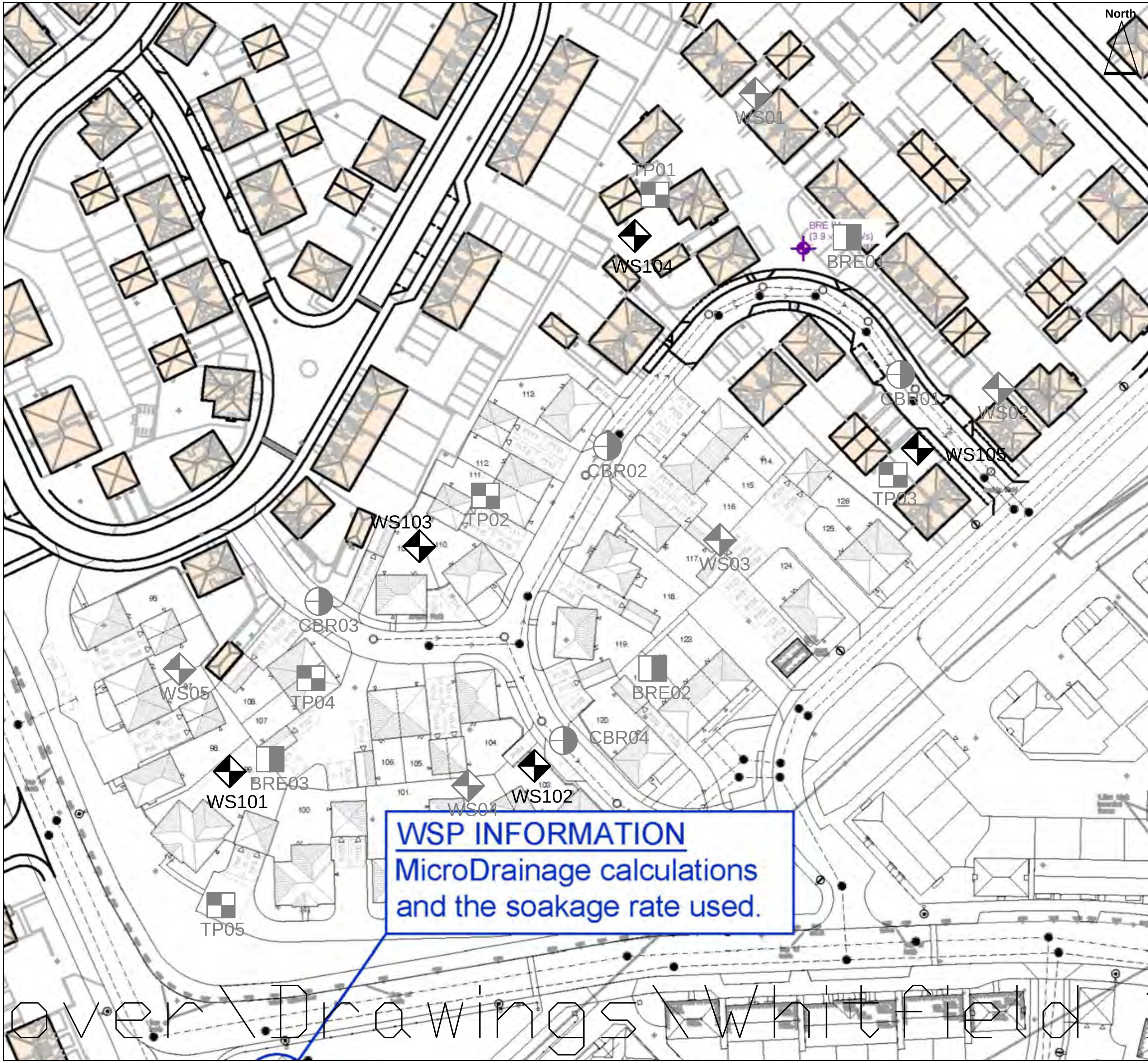
A F Howland Associates
Geotechnical Engineers

Site: Richmond Park, Whitfield, Dover, Kent

SITE LOCATION PLAN

Client : Halsbury Homes (South East) Limited

Date : June 2019 **Dwg :** 18.185/GGRA/01



Key:

Windowless dynamic sampling location and reference

Previous exploratory hole location and reference

Rev	Date	Revision Description	Drwn	Chkd

A F Howland Associates
Geotechnical Engineers

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web: www.howland.co.uk
mail: admin@howland.co.uk

Client: Halsbury Homes

Site: Phase 1B Whitfield, Dover, Kent

Job No.: 18.185

Drawing Title: EXPLORATORY HOLE LOCATION PLAN

Date: June 2019

Drawing No: 18.185/GGRA/02

Scale: 1:1000 @ A4

INDICATIVE LANDSCAPING PROPOSALS

TREE PLANTING

Species	Approx. % Mix	Application
Carpinus betulus	38	*Primary Street Frontages overlooking Open Spaces or main streets*
Liquidambar styraciflua	6	*Primary Street Frontages overlooking Open Spaces or main streets*
Ulmus 'New Horizon'	2	*Plot frontages creating street frontages*
Tilia cordata 'Green Spire'	6	*Plot frontages creating street frontages*
Malus triobata	5	*Plot frontages creating street frontages*
Magnolia kobus	5	*Plot frontages creating street frontages*
Corylus colurna	10	*Plot frontages creating street frontages*
Betula utilis jacquemontii	6	*Plot frontages creating street frontages*
Betula utilis 'Edinburgh'	10	*Plot frontages creating street frontages*
Betula pendula 'Dalecarlica'	2	*Plot frontages creating street frontages*
Acer campestre 'Streetwise'	5	*Plot frontages creating street frontages*
Acer platanoides 'Crimson Sentry'	5	*Plot frontages creating street frontages*

FRONTAGE HEDGEROWS	
Beech Hedgerow Fagus Sylvatica.	*Selected private dwelling street frontages*
Privet Hedgerow - Ligustrum ovalifolium.	*Selected private dwelling street frontages*
Osmanthus Burkwoodii Hedgerow.	*Selected private dwelling street frontages*
Buxus sempervirens Box Hedgerow.	*Selected private dwelling street frontages*

FRONTAGE GROUNDCOVER PLANTING AREAS

Ornamental mix areas as follows;	Approx. % desired	*Primary Street Frontages overlooking Open Spaces or main streets.*
Pennisetum orientale	20%	
Lavandula angustifolia 'Vera'	20%	
Helleborus argutifoliu	20%	
Festuca glauca	20%	
Euonymus fortunei 'Silver Queen'	20%	

Large size mix areas as follows;	Approx. % desired	*Selected street frontages.*
Weigela florida 'Foliis Purpureis'	19%	
Viburnum tinus 'Eve Price'	15%	
Ilex aquifolium 'Silver Queen'	10%	
Elaeagnus ebbingei 'Gilt Edge'	18%	
Cornus stolonifera 'Kelsey Gold'	20%	
Ceanothus 'Blue Cushion'	18%	

Medium size mix areas as follows;	Approx. % desired	*Selected street frontages.*
Weigela 'Mont Blanc'	25%	
Hebe 'Nicola's Blush'	20%	
Euonymus fortunei 'Silver Queen'	20%	
Escallonia 'Red Elf'	20%	
Brachyglottis 'Sunshine'	15%	

Low size mix areas as follows;	Approx. % desired	*Selected street frontages.*
Spiraea japonica 'Fire Light'	20%	
Prunus laurocerasus 'Otto Luyken	20%	
Lonicera nitida 'May Green'	20%	
Hebe rakaiensis	20%	
Ceanothus thyrsiflorus repens	20%	

PHASE 1C - ACCOMMODATION SCHEDULE.

REF	Houstype	Area (sq.ft)	Bedrooms	TOTAL No. PLOTS	
Flat	1BF.	655	1	12	*4.8% - 1 Bed dwellings*
Flat	2BF.	598	2	12	
B.	Brancaster	829	2	76	*35.5% - 2 Bed dwellings.*
L.	Langham	914	3	62	
Th.	Thornham (Kent block)	897	3	12	
Ox.	Oxburgh (Kent block)	1137	3	3	
R.	Ravingham	1195	3	12	*35.8% - 3 Bed dwellings.*
Ho.	Holkham (A or B)	1257	4	14	
Au.	Audley	1355	4	5	
Bl.	Blickling	1410	4	5	
W.	Waverton	1575	4	5	*11.7% - 4 Bed dwellings.*
D.	Dedham	1875	5	2	
Ha.	Hanover	2001	5	6	
Mu.	Mundham (A or B)	2171	5	22	*12.2% - 5 Bed dwellings.*
				248	TOTAL

1:1000 — 0m 10m 20m 30m 40m 50m 100m 150m 200m

NOTE: THIS DRAWING TO BE READ IN CONJUNCTION WITH DRAWINGS W1CS - 01 & W1CN - 01 SUBMITTED WITH THIS PLANNING APPLICATION SEE .

"A" Minor amends to Plot Nos, Landscape schedule added 29-11-18.

HALSBURY

Seymour House Loddon Norfolk NR14 6JD
- Tel 01508 521500 -

PROJECT:

RESIDENTIAL DEVELOPMENT
PHASE 1C
WHITFIELD
KENT.

TITLE:

PHASE 1C - COMPLETE SCHEME.

Scale: 1: 1000 @ A0 size. | Date: May 2018.

DRG NO: W1C - 01a

Loc: Dover,Whitfield / Architecture / Phase 1C / Drawings / Whitfield phase 1c v74.dwg

APPENDIX E: RISK ASSESSMENT CLASSIFICATION

Classification	Definition	Examples
High Likelihood	There is a pollution linkage and an event which would either appear very likely in the short term and almost inevitable over the long term, or, there is evidence at the receptor of harm or pollution.	Free product visible on surface of sensitive water body or in the soil. On site or adjacent gassing 'landfill site'.
Likely	There is a pollution linkage and all the elements are present and in the right place which means that it is probable that an event will occur. Circumstances are such that an event is not inevitable, but possible in the short term and likely over the long term.	Potentially contaminative land use i.e. 'Brownfield' site, fuel storage depot, factory, petrol station etc. Sensitive receptors to be introduced as part of site redevelopment. Potentially infilled land identified on site or off-site with credible migration pathway.
Low Likelihood	There is a pollution linkage and circumstances are possible under which an event could occur. However, it is by no means certain that even over a longer period such event would take place, and is less likely in the shorter term.	Potential source of contamination identified i.e. historical land use as allotments or domestic above ground fuel storage tanks, areas of burning garden waste. Possible off-site infilled land.
Unlikely	There is a pollution linkage but circumstances are such that it is improbable that an event would occur even in the very long term.	No significant potential sources of contamination identified e.g. 'Greenfield' site. No potential sources of ground gas.

TABLE E1: CLASSIFICATION OF PROBABILITY

Classification	Definition	Examples
Severe	**Short term (acute) risk to human health.** Short term risk of pollution of sensitive water resource. Catastrophic damage to buildings/property. A short term risk to a particular ecosystem.	High concentrations of cyanide on the surface of an informal recreation area. Major spillage of contaminants from site into controlled water. Credible source of ground gas.
Medium	**Chronic damage to Human Health.** **Pollution of sensitive water resources.** A significant change in a particular ecosystem, or organism forming part of such ecosystem.	Concentrations of a contaminant from site exceeds the generic, or site specific assessment criteria. Leaching of contaminants from a site to a Secondary or Principal aquifer or watercourse.
Mild	**Pollution of non-sensitive water resources.** Significant damage to buildings/structures and crops ("significant harm" as defined in the Circular on Contaminated Land, DETR, 2000). Damage to sensitive buildings/structures or the environment.	Concentrations of a contaminant do not exceed the generic, or site specific assessment criteria. Leaching of contaminants from a site to an Unproductive Aquifer. Damage to building rendering it unsafe to occupy (e.g. foundation damage resulting in instability).
Minor	Harm, although not necessarily significant harm, which may result in a financial loss, or expenditure to resolve. Non-permanent health effects to human health (easily prevented by means such as Personal Protective Equipment, etc).	The presence of contaminants at such concentrations that protective equipment is required during site works. The loss of plants in a landscaping scheme.

TABLE E2: CLASSIFICATION OF CONSEQUENCE

APPENDIX E: RISK ASSESSMENT CLASSIFICATION (CONTINUED)

Classification	Definition
Very High Risk	There is a high probability that severe harm could arise to a designated receptor from an identified hazard or there is evidence that severe harm is occurring. The risk, if realised, is likely to result in a substantial liability. **Urgent investigation and remediation will be required.**
High Risk	Harm or chronic damage is likely to arise to a designated receptor from an identified hazard. **Investigation is required and remediation is likely to be required** to ensure the site is suitable for a proposed use.
Moderate Risk	It is possible that harm or chronic damage could arise to a designated receptor from an identified hazard. However, it is relatively unlikely that any such harm would be severe. **Investigation and remediation are likely to be required** to ensure the site is suitable for a proposed use.
Low/Moderate Risk	It is possible that harm or chronic damage could arise to a designated receptor from an identified hazard. **Investigation is likely to be required.** However, circumstances are such that investigation may prove the consequence to be mild and the site suitable for use without remediation.
Low Risk	It is possible that harm could arise to a designated receptor from an identified hazard but it is likely that this harm, if realised, would at worst be mild. **Investigation is unlikely to be required.**
Very Low Risk	There is a low possibility that harm could arise to a receptor. In the event of such harm being realised it is not likely to be severe. **Investigation is not required.**

TABLE3: DESCRIPTION OF RISK

		CONSEQUENCE			
		Severe	Medium	Mild	Minor
PROBABILITY	High likelihood	Very High	High	Moderate	Low/Moderate
	Likely	High	Moderate	Low/Moderate	Low
	Low likelihood	Moderate	Low/Moderate	Low	Very Low
	Unlikely	Low/Moderate	Low	Very Low	Very Low

TABLE E4: DETERMINATION OF RISK

Risk assessment classification v1.1 dated 08/03/2019

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