



Client:

J Walker Homes Limited
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35 Joshua Lane
Middleton
Manchester
M24 2AY

Architect/Consultant

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Ground Gas Risk Assessment

Development at Greenhill Road, Middleton

October 2023

Site Ref: 6127/VGH-GRA v1.00

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Ground Gas Risk Assessment

1. Introduction

This report forms the gas risk assessment following the completion of a Phase I & II intrusive investigation for a Development at Greenhill Road, Middleton. Further background details are provided within the previously issued Phase I report referenced 6127/VGH-PCLRA and dated July 2023 and the Phase II report referenced 6127/VGH and dated September 2023. The work was commissioned following acceptance of the quotation and an instruction to proceed issued on behalf of the Client J Walker Homes Limited on 09/08/2023.

The approximate grid reference for the centre of the site is 388610, 405180. The particular area of the site scheduled for investigation is outlined with a solid red line on the site plan in Appendix A1. The positions of exploratory holes are also indicated on the plan.

2. Description of the Site

2.1 Present

The site is located directly to the south of the Greenhill Road in the Middleton Junction area of Oldham, Greater Manchester. The site forms an irregular L shape and can be accessed from Greenhill Road and Smethurst Street. The topography of the site is relatively level.

At the time of the site visit the site was sub divided into three distinct plots.

1. Area one is the former junction vehicle refuelling garage and associated repair work shop to the rear. There are numerous visual indications refuelling infrastructure including vapour vents, interceptors drains and manholes at Underground Storage Tanks (USTs herein). Four bunded above ground diesel tanks were noted to the rear of the former forecourt building. It was noted that the pump island and any forecourt canopy had been long since decommissioned and the ground cover at the forecourt had been disturbed in places. The building to the rear of the forecourt building had been used for general maintenance and repair work and there were several parts from vehicles noted across the external area including wheels and panels. A large area of open scrubland incorporating brambles and other self-establishing undergrowth species is present to the rear.
2. Area two has until recently been used as a plant nursery and consequently there are several poly/mesh

tunnels for horticultural purposes and a pair of shipping containers for storage. There was no evidence of the use of pesticides or herbicides and there were no obvious visual or olfactory observations of contaminants noted during the site walkover of this area.

3. Area three is used as a storage yard for an interior decorator/builder and there was evidence of a bonfire and a general builders waste in a skip at the site. Used paint containers had been bagged in special blue Dulux trade waste scheme disposal bags ready for recycling. Storage containers were noted to contain ceramic tiles and other decorating and building materials. Asides from the afore mentioned bonfire and surface waste. There were no other obvious visual or olfactory observations of contaminants noted during the site walkover in this area.

2.2 Proposed

The proposal is to develop the site with 24 residential dwelling houses with associated private gardens and off road residents parking as well as an access road.

3. Ground Gas

A preliminary risk assessment undertaken as part of the Phase I report indicated a moderate potential for the presence of ground gas on this site with a moderate risk from historically infilled ground potentially present both on and within 250m of the site. The subsurface stratigraphy obtained from the exploratory holes on this site has proved between 1.00 to 4.10m of made ground deposits exist beneath the site. Putrescible materials capable of generating ground gases at significant quantities such that the proposed development would be impacted have not been noted. Hydrocarbon odours were noted in WS01, WS02 & WS03.

The ground gas monitoring protocol used by GeoAssist follows standard practice and measures flow rates followed by gas concentrations. The gas concentrations are measured by pumping for 60 seconds followed by a 5 second stabilization period. Once readings have been logged the instrument is then purge pumped in atmosphere for the same period. The gas analysis equipment is manufactured by Gas Data Limited and is serviced and maintained at the manufacturers recommended intervals and calibrated every 12 months.

Findings from this ground gas risk assessment confirm that made ground with the potential of producing quantities of ground gas has not been identified on the site.

Gas monitoring has been carried out over a period of 12 weeks over 3 calendar months during July to October 2023 and has incorporated periods of low and falling pressure in accordance with best practice guidance.

Analysis of the gas monitoring data recorded from the installations show that Carbon Dioxide has been detected at levels between 0.4 and 18.3 % v/v within the exploratory holes. Peak CO₂ levels were detected in WS02 during the monitoring readings undertaken on the 28/07/2023. Hydrogen Sulphide and Carbon Monoxide have not been

detected during the monitoring period. Peak flow rates upto 1.1 l/hr from the installations have been recorded during the monitoring period. Methane has been detected in exploratory holes WS01, WS02 & WS03 at levels between 0.0 and 40.2 % v/v. Abnormally high methane values are a good indicator that other hydrocarbons are present in the exploratory holes. Methane has only been detected in the former petrol forecourt area which is also the location of the underground storage tanks. PID readings from the soil profile during the Phase II contaminated land risk assessment ground investigation indicated the presence of hydrocarbons in soil samples at between 3.00m to 5.50m depth in the forecourt /UST area and analysis laboratory testing at similar levels in WS01, WS02 and WS03 all showed levels of Petroleum hydrocarbons elevated above the limit of detection or in the case of the sample from WS02 elevated above the assessment criteria for soils on residential sites. The presence of hydrocarbons is known to make infra-red methane calibrations read excessively high or even over range rendering the results meaningless. The instrument used is equipped with an additional hexane calibration of the infra-red sensor which is used to indicate and quantify hydrocarbon gasses. The hexane channel value is valid for readings up to 2.00% hexane. At 100% methane concentration the hexane reading will typically show 0.200 to 0.300% and will continue to rise if there is a hydrocarbon problem present. Typical Hexane readings are summarised in the table below and indicate that the high methane readings are a result of hydrocarbon cross sensitivity do not preclude the presence of low levels of methane at the site.

Exploratory Hole	Methane Reading	PID	Hexane	PID correction Factor	Corrected PID	Corrected Methane
WS01	14.5	11.0	0.342	>10.5	>110	Not Applied
WS02	34.6	13.7	0.557	>10.5	>143.9	10 to 15%
WS03	10.6	6.9	0.285	9.9	68.3	Not Applied

The combined worst-case Gas Screening Values (GSVs) in accordance with Ciria C665 Table 8.5 are calculated at less than 0.7 l/hr across the site.

The Characteristic Situation is assessed to be 2 in accordance with Ciria R149 as a consequence of Carbon Dioxide exceeding the 5% v/v level across the entire site and Methane exceeding 1% v/v level across the former forecourt area where USTs are known to be present. The levels of methane determined by the reading are known to be over estimations as a result of hydrocarbon cross sensitivity as indicated by the hexane calibration channel. Consequently, it is recommended to zone the site and the levels of protection required are dependent on the location of the foundations utilised across the development.

The NHBC Traffic Light System for low rise housing developments has been adopted for gas mitigation measures and allows for safe and economical ground gas mitigation measures to be designed across the site. The NHBC Traffic light System provides Gas Screening Value (GSV) thresholds for carbon dioxide and methane along with typical gas maximum concentrations for both gases. The small print associated with the method states that GSV thresholds should not generally be exceeded however typical maximum gas concentrations can be exceeded.

The worst case scenario shows that the calculated GSVs for CO₂ falls well below the Green / Amber 1 Threshold

GSVs of 0.78. However, for methane, the GSV falls into the amber 2 category. In addition, peak CO₂ readings exceed the amber 1 category and hence Amber 2 protection levels are recommended for the site. The summary table below provides commentary where typical maximum concentrations are noted elevated above the threshold for Amber 1.

A hydrocarbon membrane should be installed within the foundations of any enclosed structure across the former garage and forecourt area as depicted in the Plan which form appendix A5 to this report.

Given the likely foundation solution at the site, the NHBC traffic light system for low rise housing development is deemed to provide appropriate measures to protect the development from the ingress of ground gases at this site. It should be noted that the NHBC measures require a minimum air exchange rate of one subfloor volume per 24hrs. It is imperative that the incorporation of gas measures into any foundation solution is confirmed prior to being constructed on site. Provided this precaution is adhered to then measures are likely to provide effective and economical gas mitigation measures for the proposed development.

Table 14.1 NHBC Traffic Light System Typical scope of gas protection measures.

Traffic Light Classification	Methane ¹		Carbon Dioxide ¹	
	Typical Maximum Concentration ³ (%v/v)	Gas Screening Value ^{2,4} (l/hr)	Typical Maximum Concentration ³ (%v/v)	Gas Screening Value ^{2,4} (l/hr)
Green	1	0.16	5	0.78
Amber 1	5	0.63	10	1.56
Amber 2	20	1.56	30	3.10
Red				

Table 14.2: Ground Gas Protection Measures Required for the Traffic Lights

Traffic Light	Ground Gas Protection Measures Required
Green	Ground gas protection measures are not required.
Amber 1	Low-level ground gas protection measures are required, using a membrane and ventilated sub-floor void that creates a permeability contrast to limit the ingress of gas into buildings. Gas protection measures are to be installed as prescribed in BRE 414. Ventilation of the sub-floor void should be designed to provide a minimum of one complete volume change per 24 hours.
Amber 2	High-level ground gas protection measures are required, creating a permeability contrast to prevent ingress of gas into buildings. Gas protection measures are to be installed as prescribed in BRE 414. Membranes used should always be fitted by a specialist contractor and should be fully certified (see Appendix E). As with Amber 1, ventilation of the sub-floor void should be designed to provide a minimum of one complete volume change per 24 hours.
Red	Standard residential housing is not normally acceptable without further Ground Gas Risk Assessment and/or possible remedial mitigation measures to reduce/remove the source of the ground gases. In certain circumstances, active protection methods could be applied, but only when there is a legal agreement assuring the management and maintenance of the system for the life of the property.

4. Conceptual Model

The updated conceptual model based on the information and test results presented in this report including contamination sources, pathways and receptors is presented below.

Table 4.0 Amended Conceptual Site Model based on information as presented within this report.

Potential Source /Hazard	Nature of Hazard (Risk Level to site given a Residential end use)	Contaminants Associated with Source	Potential Pathway	Potential Receptor
<i>Previous ON SITE Land uses:</i>				
1. Garage Vehicle Refuelling & Repair UST petrol AST Diesel Oils	Ground contamination Moderate Risk	Arsenic Lead TPH	Dermal Contact Ingestion Inhalation	Site Users Construction workers Future Buildings & Services Groundwater
	Gas from in-filled ground NHBC Amber 2 from Ciria C665	Methane <20 following HC correction. Carbon Dioxide>10%v/v	Vertical and Lateral Migration	Site Users Future Buildings & Services
2. Builders Merchant Allotment gardens	Ground contamination Moderate Risk	Arsenic Lead Asbestos Fibres	Dermal Contact Ingestion Inhalation	Site Users Construction workers Future Buildings & Services Groundwater
	Gas from in-filled ground NHBC Amber 2 from Ciria C665	Carbon Dioxide>10%v/v	Vertical and Lateral Migration	Site Users Future Buildings & Services
3. Railway Land	Ground contamination Moderate Risk	Arsenic Lead Asbestos Fibres	Dermal Contact Ingestion Inhalation	Site Users Construction workers Future Buildings & Services Groundwater
	Gas from in-filled ground NHBC Amber 2 from Ciria C665	Carbon Dioxide>10%v/v	Vertical and Lateral Migration	Site Users Future Buildings & Services
<i>Previous OFF SITE land uses within 250m as indicated by Historical Plans Including:</i>				
4. Cotton Mills Associated Chimneys Boilers	Ground contamination Low Risk	None Identified	Inhalation of soil dust	Site Users Construction workers
	Gas from in-filled ground See Gas Risk Assessment	None	Vertical and Lateral Migration	Site Users Future Buildings & Services
5. works / warehouse	Ground contamination Low Risk	None Identified	Dermal Contact Ingestion Inhalation	Site Users Construction workers
	Gas from in-filled ground See Gas Risk Assessment	None	None	Site Users Future Buildings & Services
6. Coal Workings	Geotechnical Hazard Low Risk	None	Ground Collapse Subsidence	Humans (site users) Future Buildings & Services
	Ground contamination Low Risk	None	None	Site Users Services
	Mine Gas Low Risk	None	None	Humans (site users) Future Buildings & Services

5. Conclusion

The gas regime identified at the site (Amber2) requires gas mitigation measures in accordance with NHBC risk based system (Amber 2).

The gas risk assessment should be confirmed following final design of the foundation solution to confirm suitability prior to installation.

The hydrocarbon membrane area is based on current site conditions and will require further investigation and assessment following certified removal of all USTs and ASTs and associated infrastructure.

The developer and any sub-contractors thereof should be notified that post construction validation inspections will be a requirement of the LPA for membranes used for gas resistance. Inspections must be undertaken as work progresses and following installation. Photographic evidence of installations will be required to confirm the installation meets the required performance level. It is the duty of the developer to ensure that the necessary inspections are arranged in a timely manner and with sufficient notice such that inspection visits can be arranged.

The complete gas risk assessment forms appendix A2 to this report.

Table 14.2: Ground Gas Protection Measures Required for the Traffic Lights

Traffic Light	Ground Gas Protection Measures Required
Green	Ground gas protection measures are not required.
Amber 1	Low-level ground gas protection measures are required, using a membrane and ventilated sub-floor void that creates a permeability contrast to limit the ingress of gas into buildings. Gas protection measures are to be installed as prescribed in BRE 414. Ventilation of the sub-floor void should be designed to provide a minimum of one complete volume change per 24 hours.
Amber 2	High-level ground gas protection measures are required, creating a permeability contrast to prevent ingress of gas into buildings. Gas protection measures are to be installed as prescribed in BRE 414. Membranes used should always be fitted by a specialist contractor and should be fully certified (see Appendix E). As with Amber 1, ventilation of the sub-floor void should be designed to provide a minimum of one complete volume change per 24 hours.
Red	Standard residential housing is not normally acceptable without further Ground Gas Risk Assessment and/or possible remedial mitigation measures to reduce/remove the source of the ground gases. In certain circumstances, active protection methods could be applied, but only when there is a legal agreement assuring the management and maintenance of the system for the life of the property.



Matthew Benson MSc GMICE
Geotechnical/Environmental Engineer



Mark Richardson MSc CEng MICE
Technical Director

Field investigations have been restricted to a level of detail required to achieve the stated objectives of the work. Ground conditions are, and can be, variable and have only been tested at isolated locations across the site. Therefore, the potential exists for ground conditions to be encountered which are different to those considered in this report.

Ground gas measurements were undertaken for a range of typical gases based on a professional understanding of the historical and operational data available at the time and it should not be inferred or otherwise, that other ground gases are not present.

This report has been prepared by GeoAssist Limited with all reasonable professional skill, care and diligence within the terms of the contract with J Walker Homes Limited. The report is confidential to J Walker Homes Limited, their/the named persons, advisors and bankers, and GeoAssist Limited accepts no responsibility of whatever nature to third parties to whom this report may be divulged. GeoAssist Limited owns the copyright in this report. All rights are reserved, and unauthorised use is prohibited. J Walker Homes Limited may use the report for their/her/his own purposes.

Appendix A

A1	Site Plan & Exploratory Hole Locations
A2	Gas Monitoring Results & Risk Assessment
A3	Exploratory Hole Logs
A4	Gas Monitor Calibration Certificate
A5	Zoned Areas



A1 Site Plan

Site Name	Development at Greenhill Road
Location	Middleton
GeoAssist Ref	6127VGH
Client	J Walker Homes Limited
	Joshua House 35 Joshua Lane Middleton Manchester M24 2AY
Planning Consultant	Trevena Blake & Associates
NGR (centre of site)	388610,405180
Production Date	September 2023
Survey Method	
Surveyor	Others
Status	Final v1.00
Base Survey	OSGB36



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Site Reference:	6127 VGH
Project Site:	Development at Greenhill Road
Project Location:	Middleton
Client:	J Walker Homes Limited

Ground Gas Readings

Date - Time	BH	CH4 (%)	CO2 (%)	O2 (%)	H2S (ppm)	CO (ppm)	LEL (%)	aP (mb)	Flw (l/h)	H2O (m)	PID
28/07/2023	WS01	28.8	11.4	2.0	0.0	0.0	>>>>	993	0.0	4.90	11.3
28/07/2023	WS02	38.6	18.3	0.2	0.0	0.0	>>>>	993	0.0	4.65	0.2
28/07/2023	WS03	15.6	9.8	0.0	0.0	0.0	>>>>	993	0.0	3.95	4.6
28/07/2023	WS06									4.70	
28/07/2023	WS09	0.0	7.1	11.7	0.0	1.0	0.0	992	0.0	2.45	10.8
28/07/2023	WS12	0.0	4.1	16.1	0.0	0.0	<<<<	992	0.0	2.35	9.3
08/08/2023	WS01	22.6	8.8	6.1	0.0	0.0	>>>>	1003	0.0	4.90	11.2
08/08/2023	WS02	35.6	17.4	0.9	0.0	0.0	>>>>	1003	0.0	4.60	6.2
08/08/2023	WS03	16.3	10.5	0.0	0.0	0.0	>>>>	1003	0.7	3.95	10.5
08/08/2023	WS06	0.0	7.0	9.7	0.0	0.0	0.0	1002	0.0	4.70	19
08/08/2023	WS09	0.0	9.7	9.1	0.0	0.0	<<<<	1002	0.0	2.45	
08/08/2023	WS12	0.0	4.7	15.6	0.0	0.0	<<<<	1002	0.0	2.40	
17/08/2023	WS01	0.0	0.4	20.0	0.0	0.0	<<<<	1012	0.0	Dry	1.3
17/08/2023	WS02	30.0	18.0	0.0	0.0	0.0	>>>>	1011	0.0	4.65	8.5
17/08/2023	WS03	15.3	10.8	0.2	0.0	0.0	>>>>	1011	0.4	4.10	5.5
17/08/2023	WS06	0.0	7.3	11.7	0.0	0.0	<<<<	1011	-0.2	Dry	
17/08/2023	WS09	0.0	10.7	4.8	0.0	0.0	<<<<	1012	0.0	2.50	
17/08/2023	WS12	0.0	4.8	15.9	0.0	0.0	<<<<	1011	0.0	2.45	
29/08/2023	WS01	34.2	13.5	0.0	0.0	0.0	>>>>	999	0.4	Dry	
29/08/2023	WS02	28.5	17.1	1.7	0.0	0.0	>>>>	1000	0.0	4.65	
29/08/2023	WS03	15.1	10.2	0.9	0.0	0.0	>>>>	1000	0.3	4.15	
29/08/2023	WS06	0.0	7.7	9.8	0.0	0.0	<<<<	998	0.0	Dry	
29/08/2023	WS09										
29/08/2023	WS12	0.0	4.9	15.8	0.0	0.0	<<<<	999	0.0	2.40	
04/09/2023	WS01	20.5	9.7	5.3	0.0	0.0	>>>>	1012	0.0	Dry	
04/09/2023	WS02	9.5	6.6	13.2	0.0	0.0	>>>>	1011	0.0	4.75	
04/09/2023	WS03	7.8	5.9	9.2	0.0	0.0	>>>>	1012	0.0	4.20	
04/09/2023	WS06	0.0	4.7	13.1	0.0	0.0	0.0	1011	0.0	Dry	
04/09/2023	WS09	0.0	3.0	15.5	0.0	0.0	0.0	1011	0.0	2.50	
04/09/2023	WS12	0.0	4.7	16.3	0.0	0.0	0.0	1011	0.0	2.50	
15/09/2023	WS01	34.6	13.6	0.1	0.0	0.0	>>>>	1002	0.1	Dry	
15/09/2023	WS02	24.6	17.1	1.8	0.0	0.0	>>>>	1003	0.0	4.70	
15/09/2023	WS03	16.4	10.9	0.0	0.0	0.0	>>>>	1003	0.3	4.25	
15/09/2023	WS06	0.0	8.8	7.9	0.0	0.0	0.0	1003	0.0	Dry	
15/09/2023	WS09										
15/09/2023	WS12	0.0	4.7	16.5	0.0	0.0	0.0	1002	0.0	2.55	
20/09/2023	WS01	40.2	13.7	0.0	0.0	0.0	>>>>	978	1.1	Dry	
20/09/2023	WS02	26.8	17.0	2.1	0.0	0.0	>>>>	979	0.0	4.65	
20/09/2023	WS03	16.5	11.0	0.0	0.0	0.0	>>>>	979	0.0	4.20	
20/09/2023	WS06	0.0	9.8	6.3	0.0	0.0	0.0	978	0.0	Dry	
20/09/2023	WS09										
20/09/2023	WS12	0.0	5.1	15.7	0.0	0.0	<<<<	978	0.0	2.50	
09/10/2023	WS01	0.0	0.5	20.2	0.0	0.0	>>>>	1011	-0.4	Nil	15.6
09/10/2023	WS02	24.8	16.1	3.2	0.0	0.0	>>>>	1011	0.0	4.60	1.2
09/10/2023	WS03	4.8	4.5	13.0	0.0	0.0	>>>>	1011	1.0	4.10	3.2

Site Reference:	6127 VGH
Project Site:	Development at Greenhill Road
Project Location:	Middleton
Client:	J Walker Homes Limited

Ground Gas Readings

Date - Time	BH	CH4 (%)	CO2 (%)	O2 (%)	H2S (ppm)	CO (ppm)	LEL (%)	aP (mb)	Flw (l/h)	H2O (m)	PID
09/10/2023	WS06										
09/10/2023	WS09	0.0	10.4	6.5	0.0	0.0	<<<<	1010	0.0	2.45	
09/10/2023	WS12	0.0	5.2	15.9	0.0	0.0	<<<<	1012	0.0	2.40	
17/10/2023	WS01	21.4	13.0	1.3	0.0	0.0	>>>>	1007	0.4	Dry	13
17/10/2023	WS02	30.2	18.1	0.7	0.0	0.0	>>>>	1008	0.0	4.55	7.3
17/10/2023	WS03	16.4	10.9	0.5	0.0	0.0	>>>>	1007	0.9	4.05	12.2
17/10/2023	WS06										
17/10/2023	WS09										
17/10/2023	WS12	0.0	4.8	16.2	0.0	0.0	0.0	1007	0.0	2.40	

Site Reference:	6127 VGH
Project Site:	Development at Greenhill Road
Project Location:	Middleton
Client:	J Walker Homes Limited

Factual Data Summary										Interpretation& Risk Assessment					
BH Ref.	Response zone/strata	Evidence of Gas contamination	No of Monitoring occasions	Max. Recorded Methane ***	Max. Recorded Carbon Dioxide (%)	Min. Oxygen (%)	Max. Recorded Flow (l/hr)	Water Level (mbgl)	Atmospheric Pressure Range (mb)	Is Water Level within top 10% of the response zone?	Are readings considered representative	Explanation / Justification	Gas Screening Value (GSV) Methane*	Gas Screening Value (GSV) Carbon Dioxide*	Risk Classification & Characteristic Situation **
WS01	1.00 - 5.00 Made Ground over Clay over Sand	Yes - odour	9	40.2	13.7	0.0	1.1	4.9	978-1012	No	Yes		0.442	0.151	Low Risk Characteristic Situation 2
WS02	1.00 - 5.00 Made Ground over Clay and Sand	Yes - odour	9	38.6	18.3	0.0	0.0	4.6	979-1011	No	Yes		0.039	0.018	Low Risk Characteristic Situation 2
WS03	1.00 - 5.00 Made Ground over Clay over Sand	Yes - odour	9	16.5	11.0	5.0	1.0	4.0	979-1012	No	Yes		0.165	0.110	Low Risk Characteristic Situation 2
WS06	1.00 - 5.00 Made Ground over Clay and Sand	No	6	0.0	9.8	5.0	0.0	4.7	978-1011	No	Yes		0.000	0.010	Low Risk Characteristic Situation 2
WS09	1.00 - 5.00 Sand with Clay	No	5	0.0	10.7	5.0	0.0	2.5	992-1012	No	Yes		0.442	0.011	Low Risk Characteristic Situation 2
WS12	1.00 - 4.00 Made Ground over Sand	No	9	0.0	5.2	5.0	0.0	2.4	978-1012	No	Yes	0	0.000	0.005	Low Risk Characteristic Situation 2
Worst Case	1.00 - 5.00m Made Ground over Gravel	No	47	40.2	18.3	5.0	1.1	2.4	978-1012	No	Yes		0.442	0.201	Low Risk Characteristic Situation 2

*** Methane & hydrocarbon cross sensitivity influenced readings

* Where no flow measured, GSV value is determined with an instrument minimum value of 0.1 l/hr

** Risk classification/Characteristic situation based on GSV and Methane >1% /CO2 >5% and other influencing factors



Consultant:

Trevena Blake & Associates

Client:

J Walker Homes Limited

Project:

Development at Greenhill Road

Location:

Middleton

Equipment:

Archway Dart Rig

Ref:

WS02

Sheet:

1

Ground Level:

103.85 m.AOD

Co-ordinates:

Easting: 388604.2(m)
Northing: 405238.3(m)

Dates:

20/07/2023 to 20/07/2023

Drilling Foreman:	STRATUM DESCRIPTION	Depth (Thick) (m)	Reduced Level (mAOD)	Strata Legend/ Standpipe Backfill	Samples/Tests		Field Records
					Depth (m) from to	Sample Type/No	
0	TARMAC	0.05	103.80				
	Brown/grey sandy gravel with brick and concrete fragments - MADE GROUND	(1.15)			0.80	C1	
-1		1.20	102.65		1.00	CP1	3
	Firm brown with grey slightly gravelly sandy silty clay - MADE GROUND	(0.50)	102.15		1.70	D1	
	Dark grey sandy gravel, cinders and ash - MADE GROUND	1.90	101.95		2.00	CP2	2
-2	Firm brown gravelly sandy silty clay - MADE GROUND	(0.40)	101.55		2.50	CP3	6
	Dark grey organic very sandy silty CLAY	2.50	101.35		3.00	CP4	7
	Loose brown/grey silty fine to medium SAND - Hydrocarbon Odour	(1.00)			3.50	CP5	24
-3		3.50	100.35		3.90	C2	
	Medium dense to dense light grey silty fine to medium SAND - Hydrocarbon Odour	(0.70)			4.00	CP6	31
-4		4.20	99.65		4.50	CP7	7
	Firm brown/grey gravelly sandy to very sandy silty CLAY	(1.00)			4.70	D2	
-5		5.20	98.65		5.00	CP8	12
	Medium dense brown with occasional black slightly silty fine to medium SAND	(0.80)			5.70	D3	
-6		6.00	97.85		5.90	CP9	19
	Exploratory Hole complete at 6.00m						
-7							
-8							
-9							
-10							

Remarks:

20/07/2023: Inspection pit excavated to 1.00m to avoid services

The groundwater conditions entered on the exploratory hole logs are those observed at the time of the drilling operations and the water level may not have reached equilibrium with the surrounding water level prior to the record being taken.

Standing groundwater levels will be subject to seasonal variation or changes in local drainage conditions and could be higher at certain times of the year particularly after periods of heavy rainfall.

Logged:

M Benson

Date:

26/07/2023

Checked:

M Richardson

Date:

14/08/2023

Site Ref:

6127/VGH

Scale 1:50



Consultant:
Trevena Blake & Associates

Client:
J Walker Homes Limited

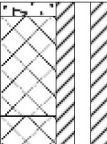
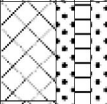
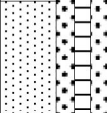
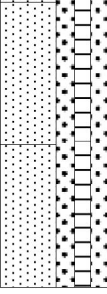
Project: Development at Greenhill Road
Location: Middleton

Equipment:
Archway Dart Rig

Ref: **WS03**
Sheet: 1

Ground Level: 103.52 m.AOD
Co-ordinates: Easting: 388609.2(m)
Northing: 405222.1(m)
Dates: 19/07/2023 to 19/07/2023

Drilling Foreman: M Walton
STRATUM DESCRIPTION
Engineer/Geologist: M Benson

Depth (Thick) (m)	Reduced Level (mAOD)	Strata Legend/ Standpipe Backfill	Samples/Tests		Blow Count N/(U)	Field Records
			Depth (m) from	to		
0.10	103.42					
(0.70)						
0.80	102.72		0.80			
1.00	102.52		1.00		C1 CP1	3 PID at 1.10m - 51ppm
(0.70)			1.50		C2	PID at 1.50m - 91ppm
1.70	101.82		2.00		CP2	2
2.00	101.52		2.00			
2.20	101.32		2.50		CP3 C1	1
(0.80)			2.50			
3.00	100.52		3.00		CP4	6
(1.00)			3.30	3.40	D1	PID at 3.50m - 50ppm
4.00	99.52		4.00		CP5	22 PID at 3.90m - 100ppm
(1.00)			4.90		CP6	16 19/07/2023: On completion of exploratory hole at 5.00m. Casing at 5.00m. Standing water level at 5.00m with casing. On withdrawal of casing groundwater/gas monitoring standpipe installed to 5.00m with response zone from 1.00m to 5.00m.
5.00	98.52					
Exploratory Hole complete at 5.00m						
6						
7						
8						
9						
10						

Remarks: 19/07/2023: Inspection pit excavated to 1.00m to avoid services. Breaking out concrete - 30mins

The groundwater conditions entered on the exploratory hole logs are those observed at the time of the drilling operations and the water level may not have reached equilibrium with the surrounding water level prior to the record being taken.
Standing groundwater levels will be subject to seasonal variation or changes in local drainage conditions and could be higher at certain times of the year particularly after periods of heavy rainfall.

Logged: M Benson
Date: 26/07/2023
Checked: M Richardson
Date: 14/08/2023
Site Ref: 6127/VGH
Scale 1:50

GeoAssist Limited Consultant: Trevena Blake & Associates Client: J Walker Homes Limited		Exploratory Hole Record Sheet Project: Development at Greenhill Road Location: Middleton Equipment: Archway Dart Rig					Ref: WS04 Sheet: 1				
		Ground Level: 104.91 m.AOD Co-ordinates: Easting: 388607.4(m) Northing: 405211.6(m) Dates: 20/07/2023 to 20/07/2023									
Drilling Foreman: M Walton STRATUM DESCRIPTION Engineer/Geologist: M Benson		Depth (Thick) (m)	Reduced Level (mAOD)	Strata Legend/ Standpipe Backfill	Samples/Tests			Field Records			
					Depth (m) from to	Sample Type/No	Blow Count N/(U)				
0 CONCRETE		0.05	104.86								
Dark brown/grey sandy gravel and brick fragments with occasional rootlets - MADE GROUND		(0.95)									
		1.00	103.91								
1 Dark grey/brown gravelly sandy silty clay with brick and concrete fragments - MADE GROUND		(2.00)									
									0.80	C1	8
									1.00	CP1	
				1.50	1.60	D1					
2				2.00		CP2	1				
		3.00	101.91								
3 Grey organic silty fine to medium SAND		3.20	101.71								
Loose to medium dense brown with grey slightly clayey silty fine to medium SAND		(0.80)									
		4.00	100.91								
4 Medium dense brown slightly silty fine to medium SAND		(0.70)									
		4.70	100.21								
5 Medium dense brown with black silty fine to medium SAND with black coal fragments		(1.30)									
		5.00									
				5.90		CP6	17	Wet from 5.00m depth			
6 Exploratory Hole complete at 6.00m		6.00	98.91								
						CP7	19	20/07/2023: On completion of exploratory hole at 6.00m. Casing at 4.00m. Standing water level at 4.90m with casing. On withdrawal of casing exploratory hole backfilled and reinstated.			
7											
8											
9											
10											

Remarks: 20/07/2023: Inspection pit excavated to 1.00m to avoid services

The groundwater conditions entered on the exploratory hole logs are those observed at the time of the drilling operations and the water level may not have reached equilibrium with the surrounding water level prior to the record being taken.

Standing groundwater levels will be subject to seasonal variation or changes in local drainage conditions and could be higher at certain times of the year particularly after periods of heavy rainfall.

Logged: M Benson

Date: 26/07/2023

Checked: M Richardson

Date: 14/08/2023

Site Ref: 6127/VGH

Scale 1:50

GeoAssist Limited Consultant: Trevena Blake & Associates Client: J Walker Homes Limited		Exploratory Hole Record Sheet Project: Development at Greenhill Road Location: Middleton Equipment: Archway Dart Rig					Ref: WS05 Sheet: 1 Ground Level: 104.16 m.AOD Co-ordinates: Easting: 388586.1(m) Northing: 405198.9(m) Dates: 20/07/2023 to 20/07/2023		
Drilling Foreman: M Walton Engineer/Geologist: M Benson STRATUM DESCRIPTION		Depth (Thick (m)	Reduced Level (mAOD)	Strata Legend/ Standpipe Backfill	Samples/Tests Depth (m) from to		Sample Type/No	Blow Count N/(U)	Field Records
0 Thin tarmac over brown/grey sandy gravel, brick and concrete fragments - MADE GROUND		(0.60) 0.60	103.56		0.30		C1		
1 Brown/grey gravelly sandy silty clay - MADE GROUND		(0.60) 1.20	102.96		1.00		CP1	2	
2 Very soft to soft brown with light grey very low to low strength gravelly sandy silty clay with organic inclusions - MADE GROUND					1.30 1.40		D1		
					1.80 1.90		D2 CP2	Nil	Hand vane at 1.80m - 19kPa
		(2.90)			2.00				
3					3.00		CP3	Nil	
									Hand vane at 3.70m - 22kPa
4		4.10	100.06		4.00		CP4	4	
Grey/brown very silty CLAY with rootlets		4.30	99.86						
5 Firm to stiff brown with grey gravelly sandy to very sandy silty CLAY with dark grey organic inclusions					5.00		CP5	8	
		(1.70)							
6 Exploratory Hole complete at 6.00m		6.00	98.16		5.90		CP6	10	20/07/2023: On completion of exploratory hole at 6.00m. Casing at 4.00m. Standing water level at 5.90m with casing. On withdrawal of casing exploratory hole backfilled and reinstated.
7									
8									
9									
10									
Remarks: 20/07/2023: Inspection pit excavated to 1.00m to avoid services The groundwater conditions entered on the exploratory hole logs are those observed at the time of the drilling operations and the water level may not have reached equilibrium with the surrounding water level prior to the record being taken. Standing groundwater levels will be subject to seasonal variation or changes in local drainage conditions and could be higher at certain times of the year particularly after periods of heavy rainfall.								Logged: M Benson Date: 26/07/2023 Checked: M Richardson Date: 14/08/2023 Site Ref: 6127/VGH Scale 1:50	

GeoAssist Limited Consultant: Trevena Blake & Associates Client: J Walker Homes Limited		Exploratory Hole Record Sheet Project: Development at Greenhill Road Location: Middleton Equipment: Archway Dart Rig					Ref: WS07 Sheet: 1 Ground Level: 104.99 m.AOD Co-ordinates: Easting: 388584.2(m) Northing: 405171.4(m) Dates: 21/07/2023 to 21/07/2023	
Drilling Foreman: M Walton Engineer/Geologist: M Benson STRATUM DESCRIPTION		Depth (Thick) (m)	Reduced Level (mAOD)	Strata Legend/ Standpipe Backfill	Samples/Tests		Field Records	
					Depth (m) from to	Sample Type/No	Blow Count N/(U)	
0 Poor vegetation over brown clayey gravelly TOPSOIL Brown/grey sandy gravel with brick, glass and slate fragments - MADE GROUND		0.10	104.89					
1		(1.90)			0.60 1.00	C1 CP1		
2 Medium dense brown SAND and GRAVEL		2.00	102.99		2.00	CP2	25	
Firm to stiff brown medium to high strength slightly gravelly sandy silty CLAY		2.30	102.69		2.50 2.60	D1		Hand penetrometer at 2.50m - 82kPa
3 Medium dense brown with occasional black silty fine to medium SAND with occasional gravel and ironstaining in parts		(0.70) 3.00	101.99		3.00	CP3	13	
4		(3.00)			3.50 3.60 4.00	D2 CP4		
5					5.00	CP5	21	
6 Exploratory Hole complete at 6.00m		6.00	98.99		5.90	CP6	15	21/07/2023: On completion of exploratory hole at 6.00m. Casing at 3.00m. Standing water level Nil with casing. On withdrawal of casing exploratory hole backfilled and reinstated.
7								
8								
9								
10								
Remarks: The groundwater conditions entered on the exploratory hole logs are those observed at the time of the drilling operations and the water level may not have reached equilibrium with the surrounding water level prior to the record being taken. Standing groundwater levels will be subject to seasonal variation or changes in local drainage conditions and could be higher at certain times of the year particularly after periods of heavy rainfall.							Logged: M Benson Date: 26/07/2023 Checked: M Richardson Date: 14/08/2023 Site Ref: 6127/VGH Scale 1:50	

Remarks: The groundwater conditions entered on the exploratory hole logs are those observed at the time of the drilling operations and the water level may not have reached equilibrium with the surrounding water level prior to the record being taken. Standing groundwater levels will be subject to seasonal variation or changes in local drainage conditions and could be higher at certain times of the year particularly after periods of heavy rainfall.	Logged: M Benson Date: 26/07/2023 Checked: M Richardson Date: 14/08/2023 Site Ref: 6127/VGH Scale 1:50
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Logged: M Benson
Date: 26/07/2023
Checked: M Richardson
Date: 14/08/2023
Site Ref: 6127/VGH
Scale 1:50

GeoAssist Limited Consultant: Trevena Blake & Associates Client: J Walker Homes Limited		Exploratory Hole Record Sheet Project: Development at Greenhill Road Location: Middleton Equipment: Archway Dart Rig					Ref: WS10 Sheet: 1 Ground Level: 102.69 m.AOD Co-ordinates: Easting: 388629.2(m) Northing: 405203.5(m) Dates: 25/07/2023 to 25/07/2023			
Drilling Foreman: M Walton Engineer/Geologist: M Benson		STRATUM DESCRIPTION		Depth (Thick) (m)	Reduced Level (mAOD)	Strata Legend/ Standpipe Backfill	Samples/Tests Depth (m) from to Sample Type/No		Blow Count N/(U)	Field Records
0		Poor vegetation over brown gravel with roots - MADE GROUND		0.10	102.59					
		Sandstone/concrete cobble - MADE GROUND		0.30	102.39					
		Grey/brown sandy gravel, cinders, ash and concrete fragments - MADE GROUND		(0.90)			0.50	C1		
1		Grey clayey silty SAND with gravel		1.20	101.49		1.00	CP1	8	
				1.50	101.19		1.30 1.40	D1		
		Soft to firm brown with light brown and grey low to medium strength very silty CLAY with organic inclusions		(0.70)			1.90 2.00	D2		Hand vane at 1.90m - 48kPa
2		Dark grey gravelly very silty SAND		2.20	100.49		2.00	CP2	4	
		Soft to firm dark brown organic very sandy CLAY		2.40	100.29		2.20 2.30	D3		Wet from 2.40m depth
				(0.40) 2.80	99.89					
3		Brown/light brown silty fine to medium SAND with organic inclusions		3.00	99.69		3.00	CP3	21	
		Medium dense dark grey/brown SAND and GRAVEL with cobbles		(1.00)						
4		Exploratory Hole complete at 4.00m		4.00	98.69		3.90	CP4	29	25/07/2023: On completion of exploratory hole at 4.00m. Casing at 3.00m. Standing water level at 2.10m without casing. On withdrawal of casing exploratory hole backfilled and reinstated.
5										
6										
7										
8										
9										
10										
Remarks: The groundwater conditions entered on the exploratory hole logs are those observed at the time of the drilling operations and the water level may not have reached equilibrium with the surrounding water level prior to the record being taken. Standing groundwater levels will be subject to seasonal variation or changes in local drainage conditions and could be higher at certain times of the year particularly after periods of heavy rainfall.								Logged: M Benson Date: 26/07/2023 Checked: M Richardson Date: 14/08/2023 Site Ref: 6127/VGH Scale 1:50		

Remarks: The groundwater conditions entered on the exploratory hole logs are those observed at the time of the drilling operations and the water level may not have reached equilibrium with the surrounding water level prior to the record being taken. Standing groundwater levels will be subject to seasonal variation or changes in local drainage conditions and could be higher at certain times of the year particularly after periods of heavy rainfall.	Logged:	M Benson
	Date:	26/07/2023
	Checked:	M Richardson
	Date:	14/08/2023
	Site Ref:	6127/VGH
	Scale 1:50	

GeoAssist Limited Consultant: Trevena Blake & Associates Client: J Walker Homes Limited		Exploratory Hole Record Sheet Project: Development at Greenhill Road Location: Middleton Equipment: Archway Dart Rig					Ref: WS12 Sheet: 1 Ground Level: 103.63 m.AOD Co-ordinates: Easting: 388657.5(m) Northing: 405149.6(m) Dates: 26/07/2023 to 26/07/2023			
Drilling Foreman: M Walton Engineer/Geologist: M Benson		STRATUM DESCRIPTION		Depth (Thick) (m)	Reduced Level (mAOD)	Strata Legend/ Standpipe Backfill	Samples/Tests Depth (m) from to Sample Type/No		Blow Count N/(U)	Field Records
0 Grass over dark grey clayey TOPSOIL Dark grey with brown sandy gravel, cinders and ash with brick and concrete fragments - MADE GROUND		0.10	103.53							
1		(1.20)								
2		1.30	102.33							
Brown/light brown silty fine to medium sand with roots and occasional - MADE GROUND		(1.10)								
3		2.40	101.23							
Brown brick rubble/cobble - MADE GROUND		2.60	101.03							
4		4.00	99.63							
Medium dense brown/grey silty fine to medium SAND		(1.00)								
5		5.00	98.63							
Exploratory Hole complete at 5.00m										
6										
7										
8										
9										
10										

Remarks:

The groundwater conditions entered on the exploratory hole logs are those observed at the time of the drilling operations and the water level may not have reached equilibrium with the surrounding water level prior to the record being taken.
Standing groundwater levels will be subject to seasonal variation or changes in local drainage conditions and could be higher at certain times of the year particularly after periods of heavy rainfall.

Logged: M Benson

Date: 26/07/2023

Checked: M Richardson

Date: 14/08/2023

Site Ref: 6127/VGH

Scale 1:50

TEST DATE AND CONDITIONS			
Date		23/11/2022	
Atmospheric Pressure Ambient Temperature EnviroNics Serial No.		967	mB
		19.6	°C
		5089	

**GFM436 Final Inspection & Calibration
Check Certificate**

GAS DATA LTD

Unit 4, Fairfield Court

Seven Stars Estate

Wheler Rd

Coventry

CV3 4LJ

Tel 02476303311



Fax 02476307711

Customer	GeoAssist Ltd
Certificate Number	123690
Order Number	332653

Serial Number	13237
Software Version	G436-00.0027/0010

Recalibration DUE Date
23/11/23

Instrument Checks					
Keyboard	✓		Display Contrast	✓	
Pump Flow In	450	Accept > 200 cc/min	Pump Flow @ -200mB	300	Accept > 200 cc/min
Clock Set / Running	✓		Labels Fitted	✓	

Gas Checks						
Sensor	CH ₄		CO ₂		O ₂	
	Instrument Gas	True Gas Value %	Instrument Gas	True Gas Value %	Instrument Gas	True Gas Value %
	Readings %		Readings %		Readings %	
	59.7	60	40.1	40	20.9	20.9
	Accept ±3.0		Accept ±3.0		Accept ±0.5	
	5.1	5	5.1	5	6.0	6
	Accept ±0.3		Accept ±0.3		Accept ±0.3	
Zero Reading 100% N ₂	0.0	0	0.0	0	0.0	0
	Accept ±0.0		Accept ±0.0		Accept ±0.1	

Optional Gas Checks						
Applied Gas & Range		Concentration Tested @ (ppm)	Instrument Readings (ppm)			
Gas Type	Range (ppm)		Zero Reading		Instrument Gas Reading	
H ₂ S	5000	1500	0	Accept ±0.0	1500	Accept ±5.0
CO	2000	1000	0	Accept ±0.0	999	Accept ±5.0
Hexane	2.0%	2.0%	0	Accept ±0.0	1.99	Accept ±10.0

Cross Gas Effects									
Applied Gas (ppm)		Instrument Readings (ppm)							
Gas Type	Concentration	Toxic 1:	H2S	Toxic 2:	CO	Toxic 3:	HEX		
H2S	1500	1500		0		0			
CO	1000	30		999		0			
Hexane	2.0%	0		0		1.99			

Pressure Checks			
Atmospheric Pressure [AP] (mB)			
Current Atmospheric Pressure (mB)		Instrument Atmospheric Pressure Reading (mB)	
AP Open Ports		967	Accept ± 2.0
AP Port (Internal)	+800 mB	800	Accept ± 5.0
	+1200 mB	1200	Accept ± 5.0

Flow Checks					
Borehole Flow			Differential Pressure		
Applied Reading (l/h)	Instrument Reading (l/h)		Applied Pressure (Pa)	Instrument Reading (Pa)	
-30	-29.8	Accept ± 3.0	-346	-348	Accept ± 50
-3	-3.0	Accept ± 1.0	-18	-18	Accept ± 6.0
0	0.0	Accept ± 0.0	0	0	Accept ± 0.5
3	3.0	Accept ± 0.5	17	17	Accept ± 3.0
30	30.0	Accept ± 3.0	388	386	Accept ± 50
60	60.5	Accept ± 6.0	1191	1201	Accept ± 130
90	92.2	Accept ± 9.0	2349	>>>>	Accept ± 250

Temperature Checks		
Calibration Temperature	Instrument Temperature Reading $^{\circ}\text{C}$	
Applied Temperature $^{\circ}\text{C}$		
-10	-10.0	Accept ± 2.0
0	0.0	Accept ± 1.0
30	30.0	Accept ± 1.0
60	60.0	Accept ± 1.0
100	100.0	Accept ± 1.0

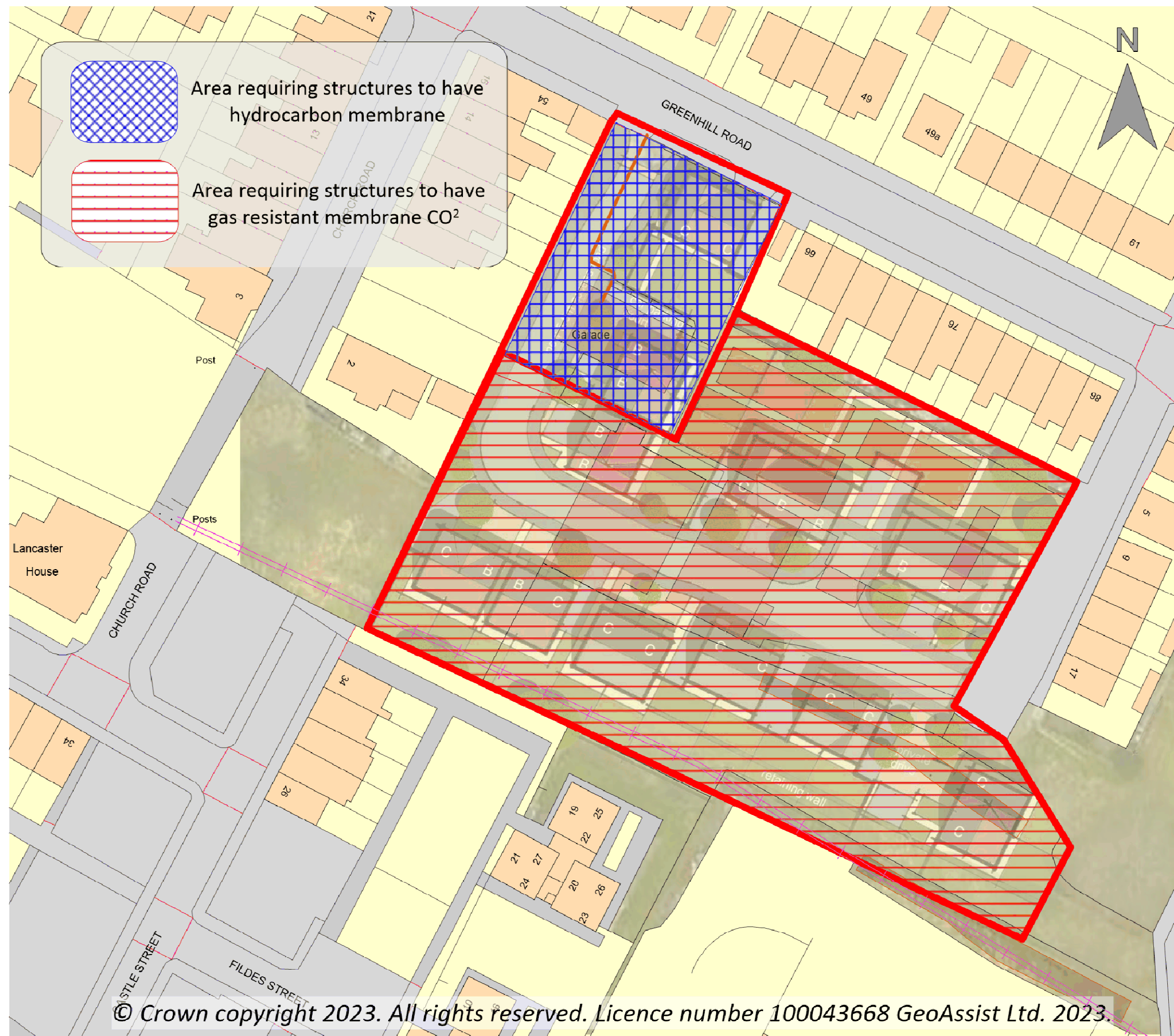
Technician:
Jack Rutland

Date Tested:
23/11/2022

The instrument identified by the serial number stated above has been tested by Gas Data personnel for calibration accuracy on the date and under the ambient conditions stated. Gas Data Ltd internal BS EN ISO9001:2015, BS EN ISO14001:2015, BS EN ISO45001:2018 compliant workshop procedures were followed to apply known calibration test gases, gas flow rates, pressures and temperatures of the values stated.

The results displayed on the instrument at each stage are recorded above.

Gas Data Ltd is certified to BS EN ISO9001:2015, BS EN ISO14001:2015, BS EN ISO45001:2018.



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A5 Zoned Areas

Site Name	Development at Greenhill Road
Location	Middleton
GeoAssist Ref	6127VGH
Client	J Walker Homes Limited
	Joshua House 35 Joshua Lane Middleton Manchester M24 2AY
Planning Consultant	Trevena Blake & Associates
NGR (centre of site)	388610,405180
Production Date	November 2023
Survey Method	
Surveyor	Others
Status	Final v1.00
Base Survey	OSGB36

Note:

The hydrocarbon membrane area is based on current site conditions and will require further investigation and assessment following certified removal of all USTs and ASTs and associated infrastructure.