

Circle Square Building 3

Updated Ground Gas Risk Assessment

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Client Address: York House, York Street, Manchester, M2 3BB

Site Address: Circle Square Development, Brancaster Rd, Manchester, M60 7HB

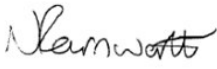
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1.0 Introduction

1.1 Project Background

In January 2023 Curtins were instructed by Bruntwood Ltd to undertake an updated ground gas risk assessment of a site known as Building No. 3 Circle Square located at Newman Street, Manchester, M60 7HB.

The proposed development on site comprises a 14-storey office development with ground floor commercial uses, along with road development off Newman Street, soft landscaping including an area of public open space on the west of site and hardstanding around the existing sub stations in the southwest of the site. The proposed development plans are included within *Appendix A* of this report.

Curtins previously carried out a ground gas risk assessment for the site as part of Ground Investigation works. This report is intended to provide a revised ground gas risk assessment following recent enabling works and earthworks which have materially altered the site's Conceptual Site Model. Alongside a full review of the site's environmental, historical and geological setting, the extent of earthworks and enabling works has been reviewed to inform a revised semi quantitative ground gas risk assessment.

1.2 Scope of Services

The updated ground gas assessment has the following objectives:

- a) Confirm the appropriate British Standards used to derive the investigation and assessment of the site with respect to ground gas risk.
- b) Describe the nature and extent of enabling works and earthworks recently undertaken on the site.
- c) Establish the ground gas conceptual site model, derived in accordance with appropriate current British Standards and guidance including Land Contamination Risk Management.
- d) Summarise the factual information obtained through intrusive investigation and subsequent monitoring of ground gas monitoring wells.
- e) Provide a consolidated assessment of ground gas risk based on the available data sources with the assessment undertaken in accordance with current British Standards and best practice guidance.

1.3 References

1.3.1 Regulatory Framework

The following current British Standards have formed the basis of the approach to, and undertaking of, the ground gas risk assessment at the site:

1. BS8485:2015+A1:2019 - Code of practice for the design of protective measures for methane

and carbon dioxide ground gases for new buildings.

2. BS8576:2013 - Guidance on investigations for ground gas - Permanent gases and volatile organic compounds (VOCs).

Additional guidance documents referred to herein to supplement this assessment include:

3. CIRIA (2007) - Assessing risks posed by hazardous ground.
4. CL:AIRE (2012) – A Pragmatic Approach to Ground Gas Risk Assessment, Research Bulletin 17 (RB17).

1.3.2 Existing Reports

Reference is also made to the following Curtins geo-environmental reports undertaken for the site:

5. Curtins (2022) Circle Square, Building 3 Phase 1 Preliminary Risk Assessment Report Ref. 080-CUR-00-XX-RP-GE-001 P02.
6. Curtins (2022) Circle Square, Building 3 Phase 2 Ground Investigation Report Ref. CS3-CUR-03-XX-RP-G-0002.
7. Curtins (2022) Circle Square, Building 3 Remediation Strategy Ref. CS3-CUR-03-XX-RP-G-0003.

Curtins previous ground gas risk assessment was included in Curtins Phase 2 Ground Investigation report and recommendations for ground gas protection measures were detailed in Curtins Remediation Strategy.

2.0 The Site

The following section aims to highlight the geological and anthropogenic features within influencing distance of the site (based on the available previous reporting (Ref.3&4)), which are considered to represent relevant potential ground gas sources at the development site. The extent of recent enabling and earthworks is also discussed in this section.

2.1 Current Setting

The site boundary includes Brancaster Road, between Oxford Road and Princess Street, an area of vacant land, bordered by a temporary hoarding, is located directly west of Princess Street and north of the recently constructed multi-storey car park.

A small access road is present west of the hoarding and south of Brancaster Road, branching into two routes around an area of grassed soft landscaping. The first road branch runs adjacent to the Manchester Technology Centre, and the second as an exit route from the car park. A small substation and two larger substation buildings are located at the southern end of the soft landscaping.

The southern portion of the site is located beneath Mancunian Way (A57(M)), currently used as a car park. Concrete pillars/columns support the overpass. Hatch, an outdoor food and drink venue, is located directly west of the southern boundary. The site location and boundary are illustrated in *Figure 2.1*.

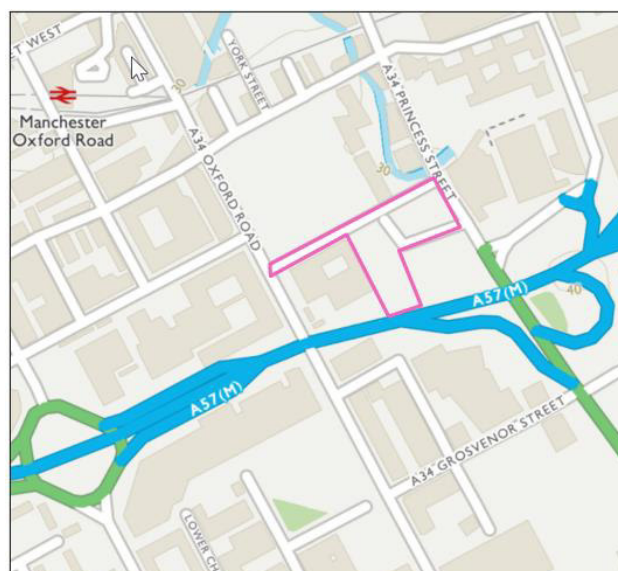


Figure 2.1- Site Location Plan

The surrounding land use generally comprises commercial and high-rise residential land use, the Mancunian Way is present south of the site with an overpass covering part of the southern boundary, Oxford Road train station is present 250m northwest of the site.

2.2 Previous Site Use

Earliest available historical mapping (1848) show the site was mainly occupied by terraced properties with a timber yard on the north east of the site. By 1923, a church and school are present in the southwest of the site.

By 1948 the timber yard was replaced by Medlock Works (rubber footwear) and clothing factories, and the church and school have been demolished except a singular building in the southwest. By 1954, the St Augustine school is noted with two buildings to the southwest of the site. A chimney was recorded in the south of the site. By 1987, the area southwest of the factory building is undeveloped wooded area. The site was cleared by 1990 and a new unnamed building constructed with the remainder of the site is occupied by car parking relating to Armstrong House. The building was demolished circa 2017.

Throughout the site's history, its local surroundings are generally occupied by industrial land use.

2.3 Published Geology

A study of the Envirocheck and British Geological Survey (BGS) 1:50,000 mapping records (Solid and Drift) for Manchester (Sheet 085) dated 2010 as presented in Curtins Phase 1 report indicates the following geological and hydrogeological succession underlying the site.

- **Superficial Deposits:** Glacial Till, Devensian; overlying
- **Solid Geology:** Chester Formation (sandstone)

2.3.1 Made Ground Deposits

BGS mapping records do not indicate the presence of Made Ground on site, however the borehole records indicate a limited thickness is likely to be present underlying the site.

2.3.2 Superficial Deposits

Superficial deposits are recorded as Glacial Till deposits comprising a heterogenous mixture of clays, sands and gravels varying widely in size and shape.

2.3.3 Bedrock Deposits

The site is underlain by the Chester Pebble Beds Formation of Early Triassic Age, typically recorded as conglomerates and reddish-brown cross-bedded, pebbly sandstones with subordinate beds of red-brown mudstone.

2.3.4 BGS Recorded Borehole Logs

There is one BGS recorded boreholes log available for within 50m of the site.

Table 2.3.4 – Summary of BGS Recorded Borehole Logs

Record Reference	Location (NGR)	Details (bottom to top of strata/details/thickness of strata)
SJ89NW248	50m (east) (384446, 397390)	0.00m to 3.05m bgl Brown, CLAY (3.05m) 3.05m to 18.29m bgl Soft red SANDSTONE (15.24m) 18.29m to 25.91m bgl Red SANDSTONE with marl veins (7.62m) 25.91m to 32.00m bgl Hard red SANDSTONE (6.10m) 32.00m to 64.62m bgl Pebble bed SANDSTONE (32.61m) 64.62m to 76.51m bgl Hard red SANDSTONE with large pebbles (11.89m) 76.51m bgl Borehole complete

2.3.5 Mining

A review of the Coal Authority interactive mapping for the area indicates that the site is located within a Coal Mining Reporting Area but not within a Development High Risk Area. There are no recorded or probable surface, shallow or future coal mine workings within and as such the risk from coal mining to the development is **Low**.

2.3.6 Radon

The site is located within a Lower Probability Radon Area (less than 1% of homes are estimated to be at or above the Action Level). No radon protective measures are necessary.

If a basement is proposed, a radon specialist should be contacted for advice.

2.4 Landfill

There are no recorded landfill sites within 1km of the site.

The Phase 1 report (Ref. 1) identifies no potentially infilled land (non-water/water) within 250m of the site.

2.5 Encountered Ground Conditions (Curtins Ground Investigations)

2.5.1 Scope of Works

Several phases of investigation have been undertaken by Curtins within the wider Circle Square Development site as summarised below.

Prior to the building demolition, intrusive investigation was undertaken by Curtins in June 2019, comprising 4 No. window sample boreholes and 2 No. cable percussion boreholes with rotary coring follow on. Additional investigation was undertaken in August 2020 when the site was used and a contractor compound with further ground investigation in March 2022 following removal of the compound. The 2020 investigation included 2 No. cable percussion boreholes, and the 2022 investigation included 5 No. window sample boreholes.

Boreholes were undertaken in positions beneath the proposed building footprint, reflecting the area not investigated in 2019 and to undertake additional soil sampling, in-situ testing, ground gas monitoring and groundwater level monitoring.

In 2019, ground gas and groundwater monitoring standpipes were installed within the 2no. cable percussion boreholes and WS03, and in 2022 WS102, WS103 and WS105 were installed. Selected soil samples were subjected to laboratory analysis. Two groundwater samples were taken in 2022. A total of twelve ground gas monitoring visits have been undertaken.

2.5.2 Summary of Ground Conditions

Made Ground typically comprises as granular or concrete surface cover, underlain by dark brown/dark grey sandy gravelly clay with cobbles. Gravels/cobbles comprise brick, concrete, sandstone. Locally, fragments of tarmac, mudstone, quartzite, siltstone, ash, charcoal and wood were also recorded. A thin layer of organic matter/vegetation was recorded in WS102 (1.70-1.80m bgl).

Made Ground was recorded to depths of between 1.60m to 7.50m bgl. Deeper Made Ground was described as 'reworked' ground, comprising soft dark brown slightly silty, gravelly clay in BHA and BHB. WS102, WS104 and WS105 recorded similar soils from depths of between 2.70m to 4.50m bgl. Made Ground was typically deepest towards the central portion of the proposed building footprint.

Cohesive Glacial Till was recorded beneath Made Ground, from 1.60m to 7.50m bgl. Soils are typically recorded as firm or stiff dark brown or brown slightly gravelly silty clay. Gravels are typically recorded as fine and medium, sub-rounded sandstone, siltstone, mudstone and coal.

The bedrock (Chester Formation) comprises medium strong locally weak, reddish-brown medium to coarse grained arenaceous sandstone from 9.50m to 11.00m bgl. The surface was heavily weathered in BHA (8.20m to 9.50m bgl), recovered as very dense reddish brown slightly gravelly medium and coarse sand. The quality of the rock improves with depth.

Perched water was encountered within the Made Ground and within the cohesive Glacial Till. No groundwater monitoring has been undertaken within the bedrock.

2.6 2022 Enabling Works & Earthworks

Enabling works and Earthworks were undertaken by Bemus in 2022 in order to prepare the site for proposed construction works. Bemus have provided information on the extent of works undertaken as summarised below. No formal Specification or Completion report has been provided.

The enabling and earthworks scope/strategy was as follows:

- Site strip to remove any topsoil or artificial hard surfacing materials.
- Undertake reduced level excavation to piling platform formation level.
- Site turn down to proposed pile cut off level of the new foundations or natural undisturbed soils – between 2m & 2.4m below pile mat formation.

- Removal of all existing relic foundations / structures.
- Break down and record position of all existing circular concrete piles.

Bemus further noted that as part of the reduced level excavations any suitable granular Made Ground was set aside and subsequently re-used. Any soils deemed unsuitable, including organic type soils that were encountered were disposed of off-site at suitably licensed waste management facilities.

Bemus note that this operation was carried out to the majority of the proposed building footprint, approximately between Gridline 5 & 12 and A to G. Gridlines are shown within Bridge Architect's Proposed Ground Floor Plan Ref. CS3-BAR-03-00-DR-A-05-0120 in Appendix A. Excavation (turn) levels are provided in Bemus' Drawing Ref. A0 200PL02/001, also enclosed in Appendix A. Turn levels are shown to be between 30.60 and 32.10m AOD.

Across the remainder of the area beneath the proposed building footprint, which was generally the higher ground (to the rear of the existing retaining structures that ran along grid line H & 5, formally known as Cloak St), undisturbed natural clays were generally found at pile mat formation.

Bemus state the design of the proposed piling mat prescribed a split-level solution and the piling mat design thickness was 650mm, the level of each piling mat and the location of the step was as follows:

Grid Line 1 to 10 (western side of proposed building) 34.400m AOD

Grid Line 10 to 21 (eastern side of proposed building) 32.800m AOD

Based on the existing topography Bemus state that this design resulted in excavation depths to piling mat formation level ranging from 0.5m to 2.5m between Grid Line 1 and 10, and 1.85m to 2.85m between Grid Line 10 and 21.

3.0 Conceptual Site Model

3.1 Source Appraisal

Potential gas generation sources are assessed below with respect the available historical, geological, and ground investigation information, along with an assessment of how the recent enabling and earthworks is likely to have impacted these identified sources.

When considering the gas generation potential of the potential sources, reference has been made to Clause 8.7 in BS8576 Figure 6 as extracted below:

Very low	- Natural carbonate soil and strata, e.g. chalk and limestone. - Natural soil strata with a low degradable organic content, e.g. alluvium, peat. - In-filled pond less than 15 m diameter, in-filled before 1930s to 1940s. - Made ground with low degradable organic content (e.g. up to 5% organic material such as pieces of wood, pieces of paper, rags, etc. with a high proportion of ash and no food or other easily degradable waste). - Mine workings shallow or shaft (where there is clear evidence that they are flooded). (Gas in coal is historically generated and is trapped or adsorbed so the actual current generation rate is very low but it accumulates in workings and large volumes can be emitted very quickly.) - Inert landfill sites. (Lack of regulation in the past means that most sites are never entirely inert – they can include timber, plasterboard and even domestic refuse and consequently care is needed when assessing such sites. They might require a higher risk classification.)
Low	- Natural soil strata with a high degradable organic content (DOC). - Made ground with total organic carbon (TOC) up to 6% (e.g. dock silt. No food or other easily degradable waste). - Foundry sand (includes phenolic binders, rags and wood that decay, albeit at low rates). - Landfill 1945 to mid 1960s (see also "moderate"). Higher TOCs might not always indicate high degradability. For example, coke breeze can contain up to 51% TOC but only 4% DOC. In this case, the assessor should estimate what proportion of the TOC is degradable.
Moderate	- Sewage sludge. - Mine workings – unflooded, more than 50 years since last worked (gas is liberated from coal when mine workings are excavated; this continues for up to about 50 years). - Landfill 1945 to mid 1960s (this could also be "low" or, if disturbed, "high").
High	- Landfill mid 1960s to early 1990s. - Mine workings – unflooded – less than 50 years since last worked.
Very high	- Municipal landfill sites. - Landfill early 1990s onwards.

Figure 4 – Excerpts of Clause 8.7 BS8576

3.1.1 Historical Map Review

Review of historical maps shows limited sources of ground gas. Made Ground imported to site from unknown sources as part of the various development phases has the potential to contain significant putrescible content which may represent a source of ground gas. The reason for the extensive Made Ground beneath the proposed building footprint is not evident in historic mapping. It is possible that the River Medlock once extended beneath the site and as diverted prior to earliest historic mapping or deeper Made Ground could be as a result of historical infrastructure e.g. deep Victorian Sewers. Deeper Made Ground may have an increased gassing potential, where containing significant putrescible material.

3.1.1 Published Geology Review

Review of the published recorded geology does not highlight a potential source for gas. Where Alluvial soils are found beneath Made Ground this may be indicative of a former River Channel and can have an increased gassing potential where containing organic matter.

3.1.1 Encountered Ground Conditions Review

Review of encountered ground conditions from investigations records limited significant gassing sources within the Made Ground. Made Ground was of variable thickness, recorded at up to 7.50m thickness in BHA. Locally fragments of ash and charcoal were recorded, however these are recorded as minor, secondary constituents. A thin layer of organic matter/vegetation was recorded in WS102 (1.70-1.80m bgl). Descriptions of such organic inclusions in and of themselves do not highlight a significant source of gas generation. Gases can be held within the pore spaces of these materials but typically are not generated from the material sufficient to force migration. Furthermore the lateral and vertical extent of this material is limited. Made Ground is therefore considered to have a 'Very Low' gas generation potential in accordance with clause 8.7 below.

Natural soils encountered during ground investigations are also typically considered to have a low degradable content. Minor organic secondary constituents were recorded including coal gravel locally and 'wood' fragments (in BHB at 7.00-8.60m bgl only). No evidence of Alluvial superficial soils was identified. Natural Soils are therefore considered to have a 'Very Low' gas generation potential in accordance with clause 8.7 below.

3.1.1 Ground Conditions Post Earthworks Review

Review of recent earthworks and enabling works indicates there has been a betterment of conditions on site. As part of the earthworks strategy and the associated reduced level dig any unsuitable soils including organic soils were removed from site to a depth of between 2-2.4m bgl (30.06 and 30.10m AOD). This includes in the area of WS102 where a thin organic layer was previously recorded at 1.60-1.80m bgl (circa 32.30-32.10m AOD-based on previous topographical survey), reduced level excavations were undertaken to around 31.60m AOD in this area, therefore removing this material.

The site is not situated within a radon affected area with less than 1% of properties above the radon action level.

3.1.2 Off-site Sources

A review of potential off-site sources does not highlight any known potential sources of gas with no known historic or active landfills within 500m of the site boundary.

There has been numerous cycles of development locally and therefore similar potential gas generation sources are identified as on site including Made Ground of unknown composition associated with construction and filling.

Where alluvial soils are present around the River Medlock to north of site these may have organic, putrescible inclusions.

Off-site soils are considered to have a 'Very Low' gas generation potential in accordance with clause 8.7 below.

3.1.3 Summary of Sources

When assessing the ground model the following sources are considered to be remaining credible, albeit with very low generation potential:

S1: Limited degradable content within Made Ground soils on site (below depth of earthworks).

S2: Limited degradable content within natural soils on site (below depth of earthworks).

S3: Potential degradable content within Made Ground soils off-site.

S4: Potential degradable content within natural soils off-site.

3.2 Pathway Appraisal

Within natural soils and rocks ground gas can migrate through pore spaces (in unconsolidated strata), fractures, joints and bedding planes (consolidated strata). Man made pathways can also be formed through, for example, mine shafts, foundations and drainage runs.

Typically, gas follows pressure differentials caused by internal or external stimulus, for example active generation of gas through organic matter degradation or rising water levels.

In accordance with Clause 5.2 of BS8485:2015, *'All potential pathways should be identified, which includes natural geological pathways, services, underground structures and mine workings. Pathways that are not credible should be discounted.'*

Gas migration through cohesive superficial deposits is not anticipated to be significant given the predominance of cohesive soils. Made Ground soils are predominantly cohesive but some migration may be possible through granular inclusions or service construction. The recent earthworks and enabling works is likely to have limited potential migration in the upper deposits through construction of piling mat formed with compacted engineered fill.

3.2.1 Summary of Pathways

When assessing the ground model and source characteristics of the site the following are considered to be remaining credible pathways:

P1: Vertical migration through permeable strata along pressure differential pathways to surface.

P2: Horizontal migration caused by gas generation within Made Ground soils, followed by lateral and vertical flow through permeable strata along pressure differential pathways to the surface.

4.0 Ground Gas Risk Assessment

The ground gas risk assessment adopts a tiered approach and uses the Guidance documents previously referenced. In the first instance this involves an evaluation of the Conceptual Site Model (as discussed in Section 3.0) and thereafter validating this conceptual model with the ground gas data, the semi-quantitative risk assessment.

4.1 Monitoring Well Installations

Ground gas and groundwater monitoring 50mm diameter slotted pipes were installed within the cable percussion boreholes BH01 and BH02 (2019), and window sample boreholes WS03 (2019) and WS102, WS103, and WS105 (2022).

A bentonite seal was placed at the top and bottom of each of the exploratory holes, surrounding the screened sections of the pipe. A gravel surround was installed in the annulus between the sides of the borehole and the slotted sections of the pipe.

The monitoring wells were designed to assess the potential for ground gas and monitor groundwater levels. The screened sections therefore focused on the more permeable deposits and Made Ground deposits, where ground gas and groundwater may be encountered.

A summary of the response zones are presented in *Table 4.1*.

Table 4.1 – Monitoring Well Response Zones

Investigation Date		Borehole Ref.	Response Zone m bgl (m AOD)	Strata Description(s)
2019	BH01	6.00 – 9.00 (29.89 – 36.89)	Cohesive Glacial Till, thin sand band	
	BH02	3.00 – 8.00 (31.80 – 26.80)	MADE GROUND, cohesive Glacial Till and granular Glacial Till	
	WS03	0.20 – 1.20 (33.70 – 32.70)	MADE GROUND	
2022	WS102	1.00 – 2.00 (33.00 – 32.00)	MADE GROUND	
	WS103	1.50 – 4.00 (32.50 – 30.00)	MADE GROUND	
	WS05	1.00 – 3.00 (37.80 – 35.80)	MADE GROUND	

A copy of the borehole logs can be referred to in *Appendix B* of this report.

4.2 Frequency of Monitoring and Factual Data Summary

The appropriate monitoring and frequency of such should be determined by the Conceptual Site Model following the framework defined in BS8576. As detailed in Section 3 using the framework defined BS8576 Figure 6, the overall gas generation potential of sources on the site is '**Very Low**'. This is based on a conservative worst-case scenario and considers the highest source generation potential.

BS8576 Figure 6 also provides further guidance on monitoring frequencies for 'Very Low' risk sites.

Figure 6 Decision matrix for initial monitoring

Gas monitoring requirements	Generation potential of source				
	Very low	Low	Moderate	High	Very high
Gas monitoring might not be necessary					
Gas monitoring over a period of 2 months with up to weekly measurements					
Gas monitoring over a period of 2 months up to 6 months with up to fortnightly readings					
Gas monitoring over a period of 6 months up to 12 months with up to fortnightly readings. Use high frequency monitoring where appropriate					

NOTE The darker the section on the matrix, the more likely it is that monitoring is needed.

Figure 6: Excerpt of Figure 6 BS8576

Based on the requirements defined in the appropriate British Standards, readings taken over two months with up to weekly measurements is considered appropriate for this site.

This idealised frequency of monitoring has been exceeded with monitoring undertaken across two phases given the phased ground investigation works.

During the 2019 investigation, six gas monitoring visits have been undertaken between 26th June and 30th August 2019 with barometric pressure recorded between 989 and 1026mb. Rising barometric pressure was recorded on the 12th July 2019. Steady pressure was recorded on 26th June, 30th July and 9th August. Due to inability to access BH01 and BH02 during those monitoring visits, no ground gas monitoring data is available for those boreholes. Furthermore WS01, WS02 and WS04 were terminated prematurely due to consistently encountered a concrete obstruction. Ground gas data is therefore only available for WS03 from the 2019 intrusive investigation.

Five return ground gas monitoring visits were undertaken between 17th March and 16th June 2022, including the three monitoring wells installed in 2022, and BH02, whilst BH01 could not be located. Barometric pressures were recorded between 1010mb and 1019mb, including two visits where falling barometric state was recorded.

The frequency and duration of monitoring is considered to be in full compliance with both current Standards and guidance referenced above. Various monitoring rounds were also undertaken during periods of low atmospheric pressure and when atmospheric pressure trends were falling.

4.3 Ground Gas Monitoring Results

The results log sheets are contained within *Appendix E* and summarised in *Table 4.3a* and *Table 4.3b*.

Table 4.3a – Summary of Ground Gas Monitoring Results (2019)

Borehole Ref.	Maximum Methane Concentration (%)	Maximum Carbon Dioxide Concentration (%)	Minimum Steady Oxygen Concentration (%)	Maximum gas flow (l/hr)
WS03	<0.1	0.7	8.5	<0.1

As discussed in *Section 3.2*, similar ground gas readings were recorded over six monitoring visits in WS3/1 following the 2015 preliminary investigation.

Carbon Monoxide (CO) and Hydrogen Sulphide (H₂S) was recorded below the instrument's detection limit within all the monitoring wells throughout the 2019 monitoring period.

During the 2019 monitoring period, Methane (CH₄), was recorded below the limit of detection of the monitoring instrument. Carbon Dioxide (CO₂) was recorded in peak concentrations of up to 0.7% v/v, and no elevated air flow was recorded.

Table 4.3b – Summary of Ground Gas Monitoring Results (2022)

Borehole Ref.	Maximum Methane Concentration (%)		Maximum Carbon Dioxide Concentration (%)		Minimum Steady Oxygen Concentration (%)	Maximum gas flow (l/hr)	
	Max	SS	Max	SS		Max	SS
WS102	4.8	4.8	0.3	<0.1	7.3	67.8 ¹	<0.1
WS103	<0.1	<0.1	<0.1	<0.1	3.3	3.9	<0.1
WS105	<0.1	<0.1	0.6	0.6	8.9	<0.1	<0.1
BH02 (2019)	<0.1	<0.1	1.1	0.9	14.1	<0.1	<0.1

¹ – Steady state air flow rate recorded within 1 minute.

During the 2022 investigation, CH₄ concentrations were recorded below the limit of detection in all wells, with exception of WS102, where maximum concentrations of up to 4.8% v/v were recorded. CO₂ concentrations of up to 1.1% v/v were recorded.

Concentrations of carbon monoxide and hydrogen sulphide were recorded up to 6ppm and 4ppm respectively.

4.3.1 Consideration of Elevated Peak Flow Rates

The greatest peak air flow rates were recorded in WS102, up to 67.8 l/hr on Visit 4. Elevated peak flow rates were also recorded in WS103 at a peak of 3.9 l/hr on Visit 2. On occasions where an elevated

flow rate was recorded the entirety (or almost the entirety) of the response zone in these boreholes is flooded. The peak air flow rate reduced to a steady state within 1 minute on all occasions.

It is considered that the peak high flow rates in these flooded boreholes is likely to be linked to rising shallow groundwater in the solid section of the well installation causing an increase in internal pressure within the pipework, which is released, and subsequently equalised, when the valve tap is opened, resulting in the high observed peak flows preceding the considerably lower steady flow. This 'piston effect' is detailed within BS8485:2015 and CL:AIRE Research Bulletin RB 17.

The peak flow rates in WS102 and WS103 are therefore discounted from the borehole hazardous gas flow rate calculations in Section 4.4.

4.3.2 Consideration of Elevated Methane

Clause 6.4 of BS8485 states that where typical gas concentrations are $>1\%v/v$ for methane consideration should be given to increasing a CS1 classification to CS2.

Levels of methane typically across the site were recorded at below method detection limit except for within WS102. Methane in WS102 was recorded above 1% during 2022 monitoring visits on visit 2, visit 4 & visit 5, recorded at a highest concentration of 4.8% on visit 4. Water level was recorded at between 0.87m and 1.10m bgl on these monitoring visits and so the well screen was fully flooded (or very close to) on each of these occasions.

WS102 recorded a thin band of organic matter and buried vegetation from 1.70m and 1.80m bgl which may have acted as a source for small volumes of methane. Gases can be held within the pore spaces of these materials but typically are not generated from the material sufficient to force migration.

Gas concentrations are not consistent between monitoring rounds and are noted to fluctuate between 0.6% and the peak levels of methane observed.

Consideration should be given the impact of the monitoring well itself. As detailed in CL:AIRE Research Bulletin 17 (RB17), gas wells are an artificial construction in the ground that can in some instances cause high gas concentrations from or in the well headspace that are not necessarily representative of sustained surface gas emissions. These can be caused by numerous factors, such as the degradation of organic materials in silts or standing groundwater. In addition, gas concentrations in the ground (or monitoring well) should not be confused with volume of gas present. The two are very different and a small volume of gas can give rise to a high concentration in a monitoring well as noted in RB17. Gas trapped within pore spaces in the soil can readily collect in monitoring wells installed in the ground providing this over estimation of total gas concentration.

Elevated peak flows were recorded within this monitoring but dissipated to steady state flow rates of <0.1 l/hr and are therefore considered to be associated with flooding of the response zone as described in Section 4.3.1 creating a piston effect. Elevated methane is often associated with the same effect,

small volumes of methane dissolved in groundwater degas from the solution and build up in the headspace and the headspace becomes pressurised as groundwater levels rise.

In order for a positive gas flow to be generated and sustained there needs to be significant gas generation (e.g. degradable putrescible wastes) or a conduit for pressure differentials between surface and gas at depth (e.g. mine entries, geological faults etc). No conditions for gas flow generation have been identified based on historical data review or during the recent intrusive works. As such, the lack of sustained flow recorded in monitoring wells is expected based on the Conceptual Site Model.

It is further noted that given the extent of recent earthworks any shallow organic soils or materials (including that identified in WS102) will have been disturbed during the reduced level dig. The earthworks contractor has described how such material would have been considered unsuitable for re-use and disposed of off-site.

Given the lack of significant sources of methane identified, the variations in recorded concentrations and the lack of sustained flow it is considered that the recorded methane concentrations are artificially inflated by mechanisms within or associated to the well itself and are unlikely to be reflective of the true ground gas regime.

As no viable mechanism for flow has been identified and in view of the recent earthworks acting to remove any minor unsuitable/organic materials from the upper soils which has a (minor) gas generation potential, it is assessed that the Conceptual Site Model does not warrant an increase in Characteristic Situation from CS1 to CS2 based on methane concentrations in WS102 alone.

Further to the above, consideration has also been given to the potential combustibility of the recorded methane and oxygen concentrations recorded on the site. The mixture of methane and oxygen recorded in WS102 were not considered explosive or potentially capable of forming explosive mixtures with air.

4.4 Interpretation of Gas Monitoring Data and Conceptual Site Model

In accordance with BS8485:2019 consideration of the recorded soil gas flow rates, enables hazardous gas flow rates (Q_{hg}) to be evaluated. Q_{hg} is derived for both 'borehole' and 'worst case check' scenarios and a comparison made in support of an appropriate assessment of ground gas risk. For a 'borehole' scenario (highest hazardous gas flow rate i.e. in a single borehole, on discrete monitoring event) steady state flow rates and maximum gas concentrations are adopted, whilst for a 'worst case check' scenario (highest Q_{hg} across the entire dataset irrespective of location and discrete monitoring events) peak flows and gas concentrations are adopted (discounting any which have been deemed to be unrepresentative, such as those in flooded wells).

Evaluation of the 'borehole' scenario (highest gas flow rate in a single borehole) and 'worst case check' (highest hazardous gas flow rate that is theoretically possible, i.e. in any borehole) records a maximum Q_{hg} of 0.0048 l/hr for methane and 0.0011 l/hr for carbon dioxide.

The 'worst case check' Q_{hg} indicates a Characteristic Situation 1 (CS1) gas regime, not requiring protection measures.

As discussed in Section 4.3 it is assessed that the Conceptual Site Model does not warrant an increase in Characteristic Situation from CS1 to CS2 based on methane concentrations in WS102.

The potential risks from ground gases to the excavations are to be dealt with by the Contractor, in accordance with the Confined Space Regulations, during construction. Appropriate ground gas monitoring and safety measures should be in place during the works, as the potential presence of ground gases could pose a risk in any confined spaces of deep excavations.

4.5 Hazardous Gas Risk Ratings

A **Characteristic Situation 1** classification is therefore deemed suitable for the site and as such the development does not require gas protection measures. The risk to end users from hazardous ground gas migration into internal airspaces is therefore considered to be Low.

Contractors undertaking excavations should undertake their own risk assessments with regards to risks posed by working in confined spaces.

The site is not situated within a radon affected area with less than 1% of properties above the radon action level. The likelihood of Radon gas affecting the buildings is therefore considered to be Unlikely.

5.0 Conclusions

Curtins have re-assessed the risk from hazardous ground gases on the proposed development site with consideration of the recent enabling works and earthworks which have materially altered the Conceptual Site Model (CSM).

The Conceptual Site Model, based on environmental, historical, and geological setting, review of intrusive investigation data and review of recent earthworks, identified limited remaining ground gas generation sources, all of which were noted to have a 'Very Low' gas generation potential. Limited migration pathways were also identified.

Eleven ground gas monitoring visits were undertaken by Curtins in total across two phases of ground investigation, albeit with only one borehole monitored during the 2019 programme. The frequency and duration of monitoring is considered to be in full compliance with both current Standards and guidance.

Evaluation of the 'borehole' scenario (highest gas flow rate in a single borehole) and 'worst case check' (highest hazardous gas flow rate that is theoretically possible, i.e. in any borehole) records a maximum Q_{hg} of 0.0048 l/hr for methane and 0.0011 l/hr for carbon dioxide. Peak gas concentrations in 'flooded' boreholes are discounted as deemed to be unrepresentative. The 'Worst Case Check' indicates a Characteristic Situation 1 (CS1) gas regime, not requiring protection measures.

Elevated methane was encountered in one monitoring well previously (WS102) at a maximum concentration of 4.7%. As no viable mechanism for flow has been identified and in view of the recent earthworks acting to remove any minor unsuitable/organic materials from the upper soils where (minor) gas generation potential was previously noted, it is assessed that the Conceptual Site Model does not warrant an increase in Characteristic Situation from CS1 to CS2 based on methane concentrations in WS102 alone.

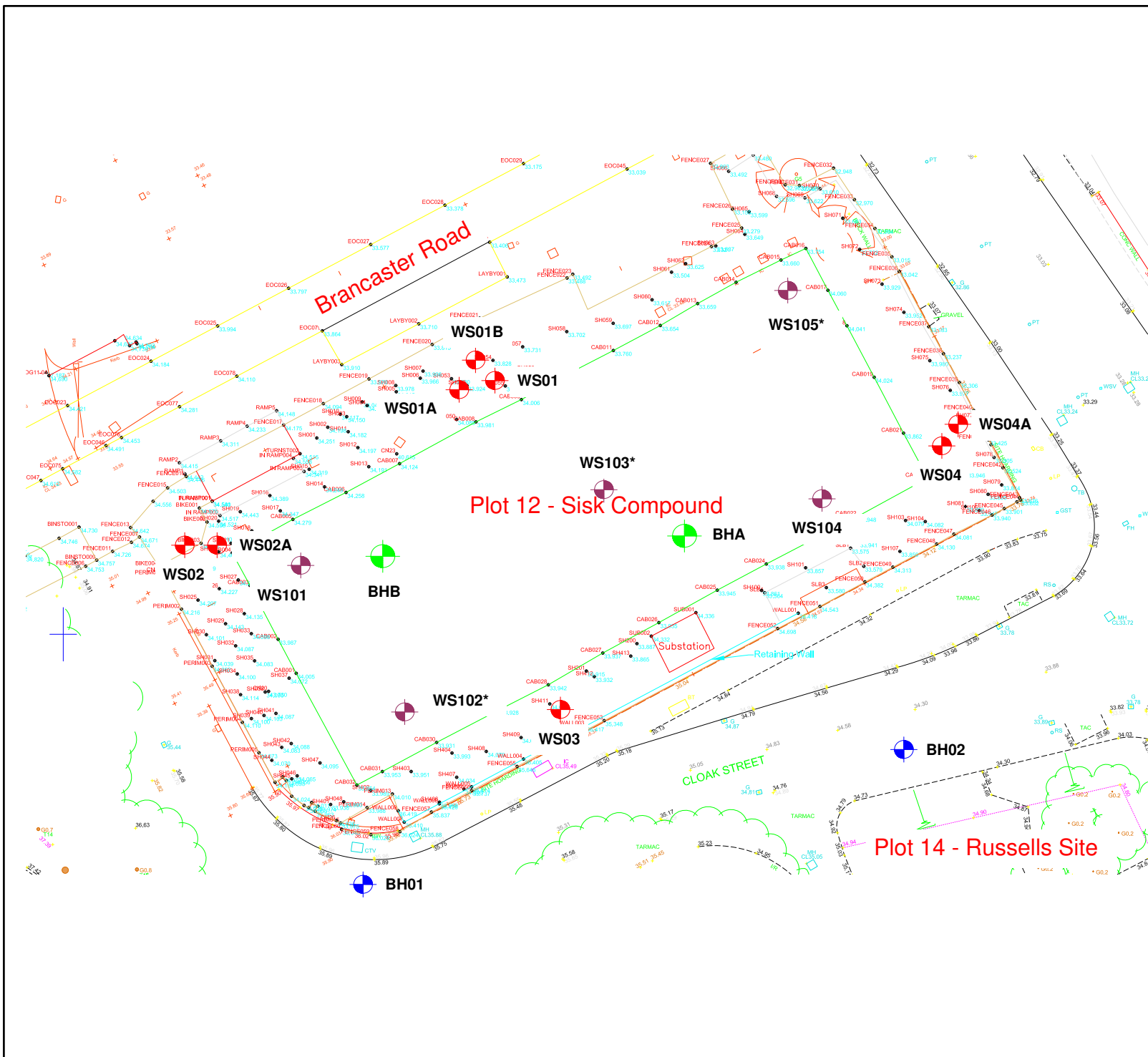
The site is not situated within a radon affected area with less than 1% of properties above the radon action level. The likelihood of Radon gas affecting the buildings is therefore considered to be Unlikely and radon protection measures are not considered necessary.

No ground gas protection measures are therefore considered to be required within the proposed development. It is recommended that Curtins Remediation Strategy report is updated to account for these changes.

Appendices

Appendix A Drawings

- *Curtins Exploratory Hole Location Plans*
- *Bemus Pile Locations and Excavation (Turn) Levels Drawing*
- *Bridge Architects Proposed Ground Floor Plan*



PREVIOUS BOREHOLES



CABLE PERCUSSIVE BOREHOLE LOCATIONS
WITH ROTARY (CORED) FOLLOW ON



WINDOW SAMPLE BOREHOLE LOCATIONS



CABLE PERCUSSIVE BOREHOLE LOCATION
AUGUST 2020 INVESTIGATION

2022 INVESTIGATION BOREHOLES



WINDOW SAMPLE BOREHOLE LOCATIONS

Rev:	Description:	Date:	By:	Chkd:
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Birmingham - Bristol - Cardiff - Douglas - Edinburgh - Kendal - Leeds - Liverpool - London - Manchester - Nottingham

Status:

INFORMATION

Project:

CIRCLE SQUARE, PLOT 12

Drg Title:

EXPLORATORY HOLE LOCATION PLAN
(ADDITIONAL GI)

Scale:	Size:	First Issue:	Drawn:	Checked:
NTS	A3	14/03/2022	PN	NF

Drg No:	Rev:
---------	------

CS12-CUR-12-XX-DR-GE-80004

P01

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397400N

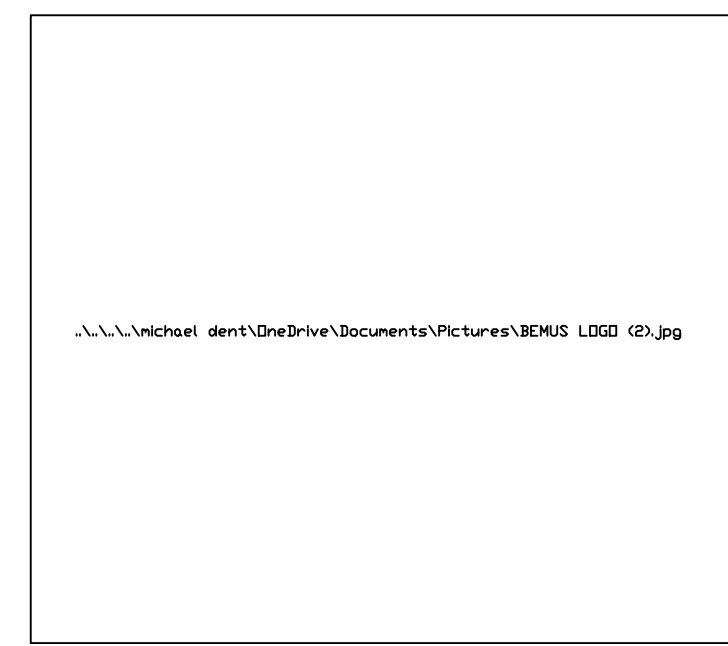
397350N



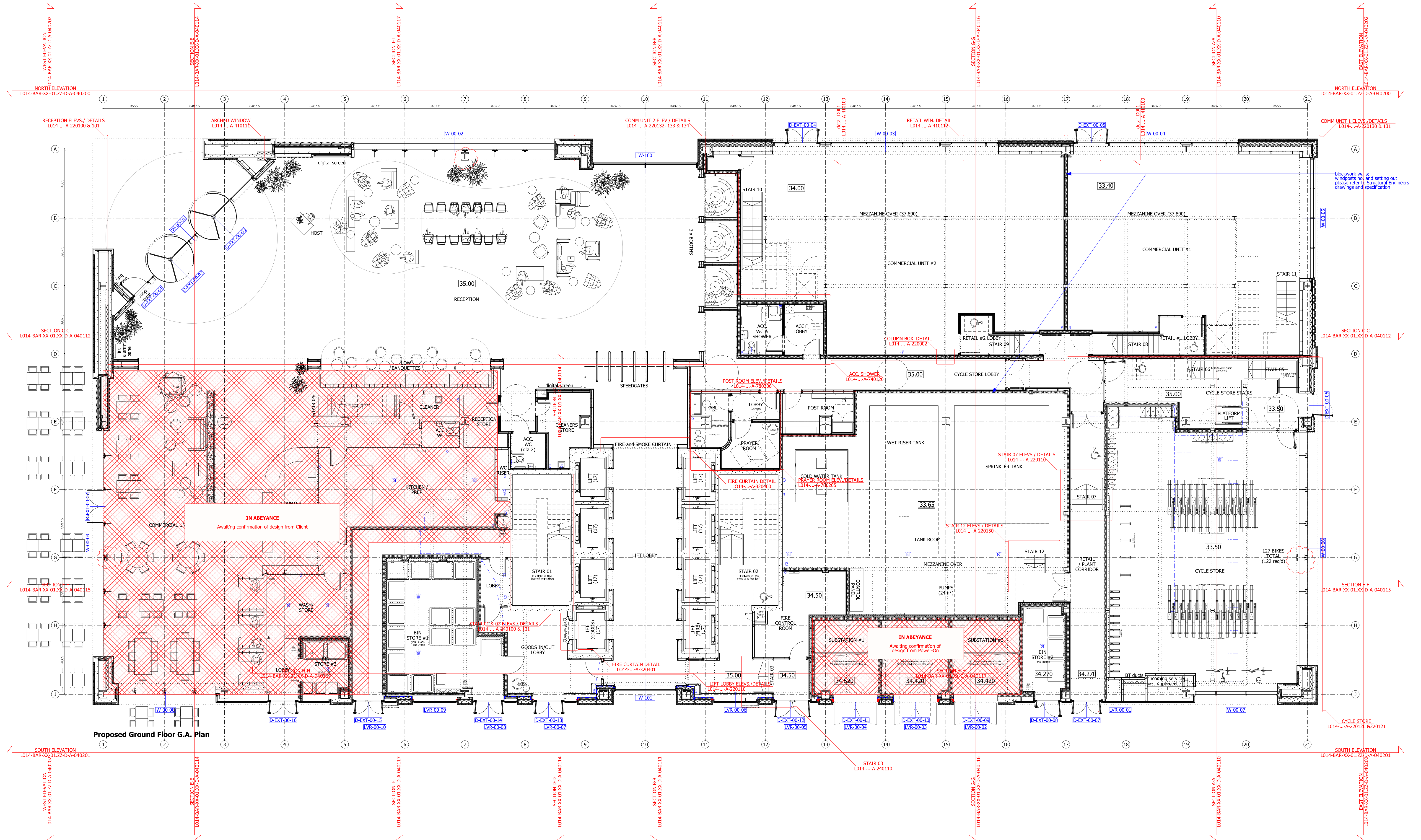
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None	Existing	Northings	Height
MP1	384293.82	397328.46	35.74
MP2	384387.44	397328.40	36.07
MP3	384388.57	397331.51	35.54
MP4	384409.47	397345.04	34.51
MP5	384424.86	397357.15	33.63
MP6	384412.60	397360.86	32.96
MP7	384359.73	397357.72	34.60
SO1	384245.81	397302.92	36.23
SO2	384321.85	397341.59	35.48
SO3	384346.06	397365.55	34.50
SO4	384402.53	397389.08	32.79
MC3	384339.62	397281.99	36.55

LEGEND

- BUILDING LINE
- PILE LOCATED DURING EXCAVATION
- ASSUMED PILE LOCATION (BY OTHERS)
- EXCAVATION (TURN) LEVEL
- GRIDLINES



Client Brunwood	
Drawing Title PILE LOCATIONS & EXCAVATION (TURN) LEVELS Circle Square Manchester	
Scale(s) N.T.S	Surveyor MD
Date SEPT 22	Drawn MD
Job Number 1034	Checked SD
Sheet Size & Drg Number & Revision A0 200PL02/001	



PLEASE NOTE
THE DOOR, WINDOW, SCREEN AND LOUVRES REFERENCE NUMBERS
XX - REFERS TO FLOORS/LEVELS: 01, 03, 05, 07, 09, 11, 13
YY - REFERS TO FLOORS/LEVELS: 02, 04, 06, 08, 10, 12
WINDOWS **W-100** & **W-101**: VERTICAL STRIP GLAZING
(LEVEL 00 = LEVEL 14)

ALL DIMENSIONS TO BE CHECKED ON SITE
PRIOR TO CONSTRUCTION/ERECTION.

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STAGE 4 - TENDER DESIGN INTENT

bridge
architects

project No.3 Circle Square
client Bruntwood SdTech
job no. 0256
drawing no. L014-BAR-20-01.GF-D-A-040100

drawing title
drawing created
drawing rev

Proposed Ground Floor Plan (PP 00)
1:100 @ A1; 1:200 @ A3
March 2022
P05

revision notes
rev P01 - 2022-04-06 - Stage 3/Work in Progress Issue
rev P02 - 2022-06-17 - Stage 3 Issue
rev P03 - 2022-08-01 - Stage 4 Issue
rev P04 - 2022-09-12 - Stage 4 - PRELIMINARY Issue
rev P05 - 2022-11-14 based for Stage 4 - Tender Design Intent

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Appendix B Factual Data

- *Curtins Exploratory Hole Logs*
- *Curtins Ground Gas Monitoring Data & Calibration Certs*



Borehole Log

Borehole No.

WS01

Sheet 1 of 1

Project Name: Circle Square Plot 12

Project No.
069467

Co-ords: -

Hole Type
WS

Location: Manchester

Level: 33.90

Scale
1:50

Client: Bruntwood Circle Square 12 Ltd

Dates: 14/06/2019 - 14/06/2019

Logged By

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.25	ES		0.05 0.30	33.85 33.60		ASPHALT. MADE GROUND of light brown gravelly fine to medium SAND with low cobble content of brick and concrete. Gravel is angular to subangular, fine to coarse of brick, concrete and asphalt. End of borehole at 0.30 m	1 2 3 4 5 6 7 8 9 10

Remarks

Service inspection pit hand excavated from GL to 0.30m. Borehole terminated at 0.30m bgl due to concrete obstruction. No groundwater encountered.





Borehole Log

Borehole No.

WS01A

Sheet 1 of 1

Project Name: Circle Square Plot 12

Project No.
069467

Co-ords: -

Hole Type
WS

Location: Manchester

Level: 33.90

Scale
1:50

Client: Bruntwood Circle Square 12 Ltd

Dates: 14/06/2019 - 14/06/2019

Logged By

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.05	33.85		ASPHALT.	
					0.30	33.60		MADE GROUND of light brown gravelly fine to medium SAND with low cobble content of brick and concrete. Gravel is angular to subangular, fine to coarse of brick, concrete and asphalt. (SUB-BASE)	
								End of borehole at 0.30 m	1
									2
									3
									4
									5
									6
									7
									8
									9
									10

Remarks

Service inspection pit hand excavated from GL to 0.30m. Borehole terminated at 0.30m bgl due to concrete obstruction. No groundwater encountered.





Borehole Log

Borehole No.

WS01B

Sheet 1 of 1

Project Name: Circle Square Plot 12

Project No.
069467

Co-ords: -

Hole Type
WS

Location: Manchester

Level: 33.90

Scale
1:50

Client: Bruntwood Circle Square 12 Ltd

Dates: 14/06/2019 - 14/06/2019

Logged By

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.05	33.85		ASPHALT.	
					0.25	33.65		MADE GROUND of light brown gravelly fine to medium SAND with low cobble content of brick and concrete. Gravel is angular to subangular, fine to coarse of brick, concrete and asphalt. (SUB-BASE)	
								End of borehole at 0.25 m	1
									2
									3
									4
									5
									6
									7
									8
									9
									10

Remarks

Service inspection pit hand excavated from GL to 0.25m. Borehole terminated at 0.25m bgl due to concrete obstruction. No groundwater encountered.





Borehole Log

Borehole No.

WS02

Sheet 1 of 1

Project Name: Circle Square Plot 12

Project No.
069467

Co-ords: -

Hole Type
WS

Location: Manchester

Level: 34.40

Scale
1:50

Client: Bruntwood Circle Square 12 Ltd

Dates: 14/06/2019 - 14/06/2019

Logged By

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.10	ES		0.05 0.20	34.35 34.20		ASPHALT. MADE GROUND of light brown gravelly fine to medium SAND with low cobble content of brick and concrete. Gravel is angular to subangular, fine to coarse of brick, concrete and asphalt. (SUB-BASE)	
					0.75	33.65		MADE GROUND of firm brown slightly gravelly CLAY with low cobble content of brick. Gravel is angular to subangular, fine to coarse of brick, concrete, slate and sandstone. End of borehole at 0.75 m	1 2 3 4 5 6 7 8 9 10

Remarks

Service inspection pit hand excavated from GL to 0.75m Borehole terminated at 0.75m bgl due to concrete obstruction. No groundwater encountered.





Borehole Log

Borehole No.

WS02A

Sheet 1 of 1

Project Name: Circle Square Plot 12

Project No.
069467

Co-ords: -

Hole Type
WS

Location: Manchester

Level: 34.40

Scale
1:50

Client: Bruntwood Circle Square 12 Ltd

Dates: 14/06/2019 - 14/06/2019

Logged By

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.05	34.35		ASPHALT.	
					0.15	34.25		MADE GROUND of light brown gravelly fine to medium SAND with low cobble content of brick. Gravel is angular to subangular, fine to coarse of brick, concrete, asphalt. (SUB-BASE)	
					0.70	33.70		MADE GROUND of firm brown slightly gravelly CLAY with low cobble content of brick. Gravel is angular to subangular, fine to coarse of brick, concrete, slate and sandstone. End of borehole at 0.70 m	1
									2
									3
									4
									5
									6
									7
									8
									9
									10

Remarks

Service inspection pit hand excavated from GL to 0.70m. Borehole terminated at 0.60m bgl due to concrete obstruction. No groundwater encountered.





Borehole Log

Borehole No.

WS03

Sheet 1 of 1

Project Name: Circle Square Plot 12

Project No.
069467

Co-ords: -

Hole Type
WS

Location: Manchester

Level: 33.90

Scale
1:50

Client: Bruntwood Circle Square 12 Ltd

Dates: 14/06/2019 - 14/06/2019

Logged By

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.20	ES					MADE GROUND of stiff light brown grey very gravelly slightly sandy CLAY with moderate cobble content of brick. Gravel in angular to subrounded, fine to coarse of brick, concrete and slate.	1
		0.80	ES						
		1.20		N=34 (4,6/8,10,8,8)	1.60	32.30		Soft light brown mottled grey slightly gravelly CLAY. Gravel is subrounded to subangular, fine to medium of sandstone.	2
		2.00		N=5 (2,1/2,1,1,1)	2.20	31.70			
		2.40 - 2.60	D					Stiff brown slightly gravelly CLAY. Gravel is subrounded to subangular, fine to coarse of sandstone.	3
		3.00		N=12 (1,2/3,3,3,3)					
		4.00		N=12 (1,2/3,3,3,3)					
		5.00		N=14 (2,2/2,2,4,6)	5.00	28.90			
								End of borehole at 5.00 m	5
									6
									7
									8
									9
									10

Remarks

Service inspection pit hand excavated from GL to 1.20m. Groundwater encountered at 0.65m bgl.





Borehole Log

Borehole No.

WS04

Sheet 1 of 1

Project Name: Circle Square Plot 12

Project No.
069467

Co-ords: -

Hole Type
WS

Location: Manchester

Level: 33.40

Scale
1:50

Client: Bruntwood Circle Square 12 Ltd

Dates: 14/06/2019 - 14/06/2019

Logged By

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.02	33.38		ASPHALT.	
					0.60	32.80		MADE GROUND of light brown gravelly fine to medium SAND. Gravel is angular to subangular, fine to coarse of brick, concrete and asphalt. (SUB-BASE)	
								End of borehole at 0.60 m	
									1
									2
									3
									4
									5
									6
									7
									8
									9
									10

Remarks

Service inspection pit hand excavated from GL to 0.60m. Borehole terminated at 0.60m bgl due to concrete obstruction. No groundwater encountered.





Borehole Log

Borehole No.

WS04A

Sheet 1 of 1

Project Name: Circle Square Plot 12

Project No.
069467

Co-ords: -

Hole Type
WS

Location: Manchester

Level: 33.40

Scale
1:50

Client: Bruntwood Circle Square 12 Ltd

Dates: 14/06/2019 - 14/06/2019

Logged By

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.05	33.35		ASPHALT.	
					0.55	32.85		MADE GROUND of light brown gravelly fine to medium SAND. Gravel is angular to subangular, fine to coarse of brick, concrete and asphalt. (SUB-BASE) End of borehole at 0.55 m	
									1
									2
									3
									4
									5
									6
									7
									8
									9
									10

Remarks

Service inspection pit hand excavated from GL to 0.55m. Borehole terminated due at 0.55m bgl due to concrete obstruction. No groundwater encountered.





Borehole Log

Borehole No.

BH01

Sheet 1 of 1

Project Name: Circle Square Plot 12

Project No.
069467

Co-ords: -

Hole Type
CP

Location: Manchester

Level: 35.89

Scale
1:50

Client: Bruntwood Circle Square 12 Ltd

Dates: 01/06/2019 - 01/06/2019

Logged By
ES

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.05			0.05	35.84		Asphalt surface slab	
		0.20			0.20	35.69		Dark brown to black fine to coarse sub rounded to angular asphalt and concrete GRAVEL. High concrete cobble content. (Made Ground).	
		0.70	ES					Dark orangey brown sandy fine to coarse sub rounded to angular concrete and sandstone GRAVEL. Low concrete and sandstone cobble content. (Made Ground).	1
		1.20		N=18 (2,3/3,4,5,6)					
		2.00	ES		1.80	34.09		Soft to firm dark brown mottled reddy brown sandy gravelly CLAY. Gravel is fine to coarse sub rounded to angular sandstone.	2
		2.00		N=14 (2,2/2,3,4,5)					
		3.00	U		2.60	33.29		Firm to stiff dary grey slightly gravelly CLAY. Gravel is fine to coarse rounded to sub angular sandstone.	3
		3.40	D						
		3.80	D						
		4.00		N=15 (2,2/3,3,4,5)					
		4.20	ES						
		4.60	D						
		4.90	D						
		5.00	U						5
		5.40	D						
		6.00		N=20 (2,3/3,4,6,7)					6
		6.20	B						
		7.10			7.10	28.79		Orange brown fine to coarse sub rounded to sub angular SAND.	7
		7.30			7.30	28.59		Soft to firm occasionally stiff dark brown very sandy slightly gravelly CLAY. Gravel is fine to coarse sub rounded to angular sandstone.	8
		7.40	D	N=50 (6,7/50 for 225mm)					
		7.50							
		7.80	D						
		8.50	D						
					9.40	26.49		End of borehole at 9.40 m	9
									10

Remarks

Water seepage at 2.0 m and groundwater level at 9.5 m. Refer to Geocore logs for rock logs and core recovery parameters.





Borehole Log

Borehole No.

BH02

Sheet 1 of 1

Project Name: Circle Square Plot 12

Project No.
069467

Co-ords: -

Hole Type
CP

Location: Manchester

Level: 34.80

Scale
1:50

Client: Bruntwood Circle Square 12 Ltd

Dates: 15/06/2019 - 16/06/2019

Logged By

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.30			0.30	34.50		ASPHALT	
		0.45	ES		0.65	34.15		MADE GROUND of light brown gravelly fine to medium SAND. Gravel is angular to subangular of concrete.	
		1.00	ES					MADE GROUND of light brown yellow gravelly medium to coarse SAND. Gravel is subangular to subrounded, fine to medium including sandstone, concrete and brick.	1
		1.20		50 (25 for 135mm/50 for 30mm)					
		2.00		N=25 (3,3/3,3,14,5)					2
		2.60			2.60	32.20			
		3.00		N=15 (4,5/5,3,3,4)	3.00	31.80		MADE GROUND of firm dark grey slightly gravelly slightly sandy CLAY with a moderate cobble content of brick. Gravel is angular to subangular, fine to coarse including brick, metal and ceramic.	3
		3.00 - 3.10	ES						
		3.70	ES		3.60	31.20		MADE GROUND of firm dark grey black gravelly slightly sandy CLAY. Gravel is subangular to subrounded including brick and ceramic. Strong odour noted.	4
		4.00		N=23 (2,5/4,6,6,7)					
		4.70 - 4.80	D						
		5.00		N=26 (3,5/5,5,7,9)					5
		6.00	D						6
		6.50		N=29 (3,4/6,6,8,9)					7
		7.80			7.80	27.00		Reddish brown slightly gravelly medium to coarse SAND. Gravel is subrounded, fine to coarse of sandstone (Weathered Sandstone)	8
		8.00		N=51 (11,13/51 for 228mm)					
		9.00			9.00	25.80		End of borehole at 9.00 m	9
									10

Remarks

Service inspection pit excavated from GL to 1.20m. Groundwater encountered at 3.10m bgl. Refer to Geocore logs for rock logs and core recovery parameters.



Rock Core Photos – BH01



Rock Core Photos – BH01



Rock Core Photos – BH01



Rock Core Photos – BH02



Rock Core Photos – BH02





Borehole Log

Borehole No.

BHA

Sheet 1 of 2

Project Name: Circle Square Plot 12

Project No.
069467.304Co-ords: 384372306.03 -
397359534.19Hole Type
CP

Location: Manchester

Level: 32.02

Scale
1:50

Client: John Sisk & Son Ltd

Dates: 04/08/2020 - 04/08/2020

Logged By
RT

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		1.20		N=8 (3,1/2,2,2,2)	2.60	29.42		MADE GROUND of firm dark grey very gravelly clay with occasional cobbles. Gravel is medium to coarse and sub-angular to angular of concrete, timber, brick, metal, ceramic, siltstone and sandstone. Cobbles are sub-angular of brick and concrete. <i>Grey concrete boulder along the southern side of the hand pit. Between 0.60 - 0.80m bgl.</i>	1
		2.00		N=6 (2,3/2,1,2,1)					2
		3.00		N=7 (2,1/1,2,2,2)					3
		4.00		N=5 (2,2/1,1,2,1)	7.50	24.52			4
		5.00		N=8 (2,1/2,2,1,3)					5
		6.00		N=6 (1,2/2,1,2,1)					6
		7.50		N=11 (2,2/2,3,3,3)	8.20	23.82		Firm dark brown slightly gravelly silty CLAY. Gravel is fine to medium and sub-rounded of coal, sandstone and siltstone.	8
		9.00		50 (8,9/50 for 170mm)				Very dense reddish-brown slightly gravelly medium to coarse SAND. Gravel is fine to coarse and sub-rounded of sandstone (Weathered Sandstone).	9
					9.50	22.52		Reddish-brown SANDSTONE bedrock.	10
								Continued on next sheet	

Remarks

Service inspection pit excavated from GL to 1.20m. Groundwater encountered at 7.50m, strike rose to 7.00m after 20minutes. Chiseling for an hour between 9.00m to 10.00m. Borehole complete at 10.10m bgl within sandstone bedrock.





Borehole Log

Borehole No.

BHA

Sheet 2 of 2

Project Name: Circle Square Plot 12

Project No.
069467.304Co-ords: 384372306.03 -
397359534.19Hole Type
CP

Location: Manchester

Level: 32.02

Scale
1:50

Client: John Sisk & Son Ltd

Dates: 04/08/2020 - 04/08/2020

Logged By
RT

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		10.00		50 (25 for 60mm/50 for 50mm)	10.10	21.92		End of borehole at 10.10 m	
									11
									12
									13
									14
									15
									16
									17
									18
									19
									20

Remarks

Service inspection pit excavated from GL to 1.20m. Groundwater encountered at 7.50m, strike rose to 7.00m after 20minutes. Chiseling for an hour between 9.00m to 10.00m. Borehole complete at 10.10m bgl within sandstone bedrock.





Borehole Log

Borehole No.

BHB

Sheet 1 of 2

Project Name: Circle Square Plot 12

Project No.
069467.304Co-ords: 384393596.13 -
397356537.25Hole Type
CP

Location: Manchester

Level: 34.21

Scale
1:50

Client: John Sisk & Son Ltd

Dates: 05/08/2020 - 05/08/2020

Logged By
RT

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		1.20		N=14 (3,3/4,3,3,4)				MADE GROUND of firm dark grey very gravelly clay with occasional cobbles. Gravel is medium to coarse and sub-angular to angular of concrete, timber, brick, metal, ceramic, siltstone and sandstone. Cobbles are sub-angular of brick and concrete.	1
		2.00		N=12 (4,3/2,3,3,4)					2
		3.00		N=5 (2,1/2,1,1,1)	3.00	31.21		MADE GROUND of soft blackish-brown very gravelly clay. Gravel is medium to coarse and sub-angular of brick, concrete, sandstone and siltstone.	3
		4.00		N=5 (2,2/1,1,2,1)	3.80	30.41		MADE GROUND of soft dark brown gravelly clay. Gravel is fine to coarse and sub-rounded to sub-angular of brick, ash, coal, siltstone and sandstone (reworked clay).	4
		5.00		N=7 (2,2/2,1,2,2)					5
		6.00		N=10 (3,3/3,2,3,2)					6
		7.00			7.00	27.21		Firm dark brown very silty gravelly CLAY. Gravel is fine to medium and sub-rounded of coal, wood fragments, sandstone and siltstone.	7
		7.50		N=10 (3,3/2,3,3,2)					8
		8.60			8.60	25.61		Reddish-brown slightly gravelly sand. Gravel is fine to medium of sandstone. Between 8.50 - 8.60m bgl.	9
		9.00		N=11 (3,2/3,3,2,3)				Firm dark brown slightly gravelly CLAY. Gravel is fine to medium and rounded of sandstone and siltstone.	9
								Continued on next sheet	10

Remarks

Service inspection pit excavated from GL to 1.20m. Groundwater encountered at 3.00m and 10.50m, strike at 3.00m did not rise after 20minutes, strike at 10.50m rose to 8.50m after 20minutes. Chiseling for an hour between 11.50m to 12.00m. Borehole complete at 12.10m bgl within sandstone bedrock.





Borehole Log

Borehole No.

BHB

Sheet 2 of 2

Project Name: Circle Square Plot 12

Project No.
069467.304Co-ords: 384393596.13 -
397356537.25Hole Type
CP

Location: Manchester

Level: 34.21

Scale
1:50

Client: John Sisk & Son Ltd

Dates: 05/08/2020 - 05/08/2020

Logged By
RT

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		10.50		N=40 (6,8/9,10,11,10)	10.50	23.71		Dense dark grey SAND and GRAVEL with frequent cobbles. Gravel is rounded of siltstone and sandstone. Cobbles are rounded of siltstone. Reddish-brown SANDSTONE bedrock.	11
		11.00		50 (25 for 30mm/50 for 25mm)	11.00	23.21			
		12.00		50 (25 for 35mm/50 for 30mm)	12.10	22.11			
								End of borehole at 12.10 m	12
									13
									14
									15
									16
									17
									18
									19
									20

Remarks

Service inspection pit excavated from GL to 1.20m. Groundwater encountered at 3.00m and 10.50m, strike at 3.00m did not rise after 20minutes, strike at 10.50m rose to 8.50m after 20minutes. Chiseling for an hour between 11.50m to 12.00m. Borehole complete at 12.10m bgl within sandstone bedrock.





Borehole Log

Borehole No.

WS101

Sheet 1 of 1

Project Name: Circle Square Building 3
(Formerly Plot 12)Project No.
B080355.300

Co-ords: -

Hole Type
WS

Location: Circle Square, Manchester

Level:

Scale
1:20

Client: Bruntwood Circle Square 12 Ltd

Dates: 02/03/2022 - 02/03/2022

Logged By
TW

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.10	ES		0.10			MADE GROUND: Concrete over, light brown, compact, slightly cobbley sandy gravel. Sand is fine to medium. Gravel is fine to coarse, angular sandstone, concrete and roadstone. Cobbles of concrete. (SUBBASE)	1
		0.20			0.20			MADE GROUND: Concrete boulder (required breaking out).	
		0.40			0.40			MADE GROUND: Brown, slightly clayey sandy gravel. Sand is fine to medium. Gravel is fine to coarse, angular brick, tarmac, concrete, sandstone, mudstone, quartzite and siltstone. Occasional cobbles of brick. (BRICK FILL)	
		1.20	D	50 (25 for 95mm/50 for 170mm)	1.20			MADE GROUND: Very stiff, brown, sandy very gravelly clay. Sand is fine to medium. Gravel is fine to coarse, angular brick, ash, charcoal, sandstone, mudstone, quartzite and siltstone. Brick cobbles present from 0.9 to 1.0m bgl.	
		1.20 - 1.65			1.20 - 1.65				2
					1.47			Large obstruction at 1.45m bgl which could not be advanced through.	
								End of borehole at 1.47 m	3
									4

Remarks

Service inspection pit hand excavated from GL to 1.20m. No groundwater encountered. Borehole refused at 1.40m bgl on obstruction in Made ground, attempted re-drilling and also refused at 1.40m bgl. Borehole backfilled with arisings.





Borehole Log

Borehole No.

WS102

Sheet 1 of 1

Project Name: Circle Square Building 3
(Formerly Plot 12)Project No.
B080355.300

Co-ords: -

Hole Type
WS

Location: Circle Square, Manchester

Level:

Scale
1:20

Client: Bruntwood Circle Square 12 Ltd

Dates: 02/03/2022 - 02/03/2022

Logged By
TW

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.20	ES		0.10			MADE GROUND: Roadstone over, light brown, compact, slightly cobbly sandy gravel. Sand is fine to medium. Gravel is fine to coarse, angular sandstone, concrete and roadstone. Cobbles of concrete. (SUBBASE)	
		1.20			0.90			MADE GROUND: Brown, slightly clayey gravelly sand. Sand is fine to medium. Gravel is fine to coarse, angular brick, tarmac, concrete, sandstone, mudstone, quartzite and siltstone. Occasional cobbles of brick and quartzite. (BRICK FILL)	
		1.20 - 1.65	D	N=14 (5,6/4,3,4,3)	1.60			MADE GROUND: Firm, brown, slightly sandy very gravelly clay. Sand is fine to medium. Gravel is fine to coarse, angular brick, ash, charcoal, sandstone, mudstone, quartzite and siltstone.	1
					1.80			MADE GROUND: Firm, dark greyish brown, slightly gravelly very sandy clay. Sand is fine to medium. Gravel is fine to coarse, angular to subangular brick, ash, charcoal, sandstone, mudstone, quartzite and siltstone.	
		2.00		N=13 (3,3/3,4,3,3)	2.00			MADE GROUND: Firm, dark greyish brown, slightly gravelly very sandy clay. Sand is fine to medium. Gravel is fine to coarse, angular to subangular brick, ash, charcoal, sandstone, mudstone, quartzite and siltstone.	
					2.70			MADE GROUND: Firm, brown and orangish brown, andy gravelly clay. Sand is fine to medium. Gravel is fine to coarse, angular to subangular brick, charcoal, sandstone and mudstone.	2
		2.90	D		2.90			MADE GROUND: Firm, brown and orangish brown, andy gravelly clay. Sand is fine to medium. Gravel is fine to coarse, angular to subangular brick, charcoal, sandstone and mudstone.	
					3.00			Firm, orangish brown, slightly silty sandy CLAY. Sand is fine. (POSSIBLY REWORKED)	
								End of borehole at 3.00 m	3
									4

Remarks

Service inspection pit hand excavated from GL to 1.20m. No groundwater encountered. Borehole aborted in possibly re-worked natural soil due to anomaly readings from UXO magnetometer. Borehole installed with ground gas/water monitoring well in shallower Made Ground strata to 2.0m bgl.





Borehole Log

Borehole No.

WS103

Sheet 1 of 2

Project Name: Circle Square Building 3
(Formerly Plot 12)Project No.
B080355.300

Co-ords: -

Hole Type
WS

Location: Circle Square, Manchester

Level:

Scale
1:20

Client: Bruntwood Circle Square 12 Ltd

Dates: 02/03/2022 - 02/03/2022

Logged By
TW

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.20			MADE GROUND: Roadstone over, light brown, compact, slightly cobbley sandy gravel. Sand is fine to medium. Gravel is fine to coarse, angular sandstone, concrete and roadstone. Cobbles of concrete. (SUBBASE)	
					0.50			MADE GROUND: Brown, slightly clayey gravelly sand. Sand is fine to medium. Gravel is fine to coarse, angular brick, tarmac, concrete, sandstone, mudstone, quartzite and siltstone. Occasional cobbles of brick and quartzite. (BRICK FILL)	
		1.00	ES					MADE GROUND: Stiff, brown, sandy gravelly clay. Sand is fine to medium. Gravel is fine to coarse, angular brick, ash, charcoal, sandstone, mudstone, quartzite and siltstone. Occasional cobbles of brick and concrete.	1
		1.20		N=15 (5,3/3,4,4,4)					
					1.50			MADE GROUND: Medium dense, black, slightly clayey sandy gravel. Sand is fine to medium. Gravel is fine to coarse, angular brick, ash, charcoal, sandstone and mudstone.	
		1.60	ES		1.70			MADE GROUND: Medium dense, orangish brown, fine to medium sand.	
					1.85			MADE GROUND: Very soft, dark greyish brown, sandy gravelly clay. Sand is fine to medium. Gravel is fine to coarse, angular brick, ash, charcoal, sandstone and mudstone.	2
		2.00		N=1 (0,0/0,1,0,0)					
		2.00 - 2.45	D		2.20			MADE GROUND: Very soft, dark grey, slightly silty sandy gravelly clay. Sand is fine to medium. Gravel is fine to coarse, angular brick, ash, charcoal, sandstone and mudstone.	
		3.00		N=0 (0,0/0,0,0,0)	3.00			MADE GROUND: Very soft, wet, dark grey, slightly silty clayey gravelly sand. Sand is fine to medium. Gravel is fine to coarse, angular ash, charcoal, sandstone and mudstone. <i>Core barrell pushed off line and getting stuck on cobbles in Made Ground at 1.0m bgl.</i>	3
					3.60			MADE GROUND: Very soft, wet, dark grey, slightly sandy slightly gravelly silty clay. Sand is fine to medium. Gravel is fine to coarse, angular ash, charcoal, sandstone and mudstone.	
		4.00		N=3 (0,0/0,1,1,1)					4

Continued on next sheet

Remarks

Service inspection pit hand excavated from GL to 1.20m. Groundwater encountered at 3.00m bgl. Borehole terminated at 4.00m bgl after core barrell knocked off line and stuck in Made Ground at 1.00m bgl. Borehole installed with ground gas/water monitoring well in Made Ground to 4.00m bgl.





Borehole Log

Borehole No.

WS103

Sheet 2 of 2

Project Name: Circle Square Building 3
(Formerly Plot 12)Project No.
B080355.300

Co-ords: -

Hole Type
WS

Location: Circle Square, Manchester

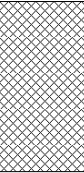
Level:

Scale
1:20

Client: Bruntwood Circle Square 12 Ltd

Dates: 02/03/2022 - 02/03/2022

Logged By
TW

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		4.00 - 4.45	D		4.45			End of borehole at 4.45 m	
									5
									6
									7
									8

Remarks

Service inspection pit hand excavated from GL to 1.20m. Groundwater encountered at 3.00m bgl. Borehole terminated at 4.00m bgl after core barrell knocked off line and stuck in Made Ground at 1.00m bgl. Borehole installed with ground gas/ water monitoring well in Made Ground to 4.00m bgl.





Borehole Log

Borehole No.

WS104

Sheet 1 of 1

Project Name: Circle Square Building 3
(Formerly Plot 12)Project No.
B080355.300

Co-ords: -

Hole Type
WS

Location: Circle Square, Manchester

Level:

Scale
1:20

Client: Bruntwood Circle Square 12 Ltd

Dates: 02/03/2022 - 02/03/2022

Logged By
TW

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.30	ES	N=50 (25 for 95mm/50 for 255mm)	0.30			MADE GROUND: Concrete over, light brown, compact, slightly cobbly sandy gravel. Sand is fine to medium. Gravel is fine to coarse, angular sandstone, concrete and roadstone. Cobbles of concrete. (SUBBASE)	1
		0.70			0.70			MADE GROUND: Brown, slightly cobbly gravelly sand. Sand is fine to medium. Gravel is fine to coarse, angular brick, tarmac, concrete, sandstone, mudstone, quartzite and siltstone. Occasional cobbles of brick and quartzite. (BRICK FILL)	
		1.00			1.00			MADE GROUND: Yellowish brown, slightly clayey gravelly sand. Sand is fine to medium. Gravel is fine to coarse, angular brick, concrete, tarmac, sandstone and mudstone.	
		1.20			1.20			MADE GROUND: Very stiff, brown, sandy gravelly clay. Sand is fine to medium. Gravel is fine to coarse, angular brick, concrete, sandstone and mudstone.	
		1.70	N=4 (3,2/2,1,1,0)		1.70			MADE GROUND: Very stiff, dark greyish brown, sandy gravelly clay. Sand is fine to medium. Gravel is fine to coarse, angular brick, ash, charcoal, sandstone and mudstone.	2
		2.00			2.00			Abundant ash and tarmac from 1.90 to 2.0m bgl. MADE GROUND: Loose, black, slightly clayey sandy gravel. Sand is fine to medium. Gravel is fine to coarse, angular brick, ash, charcoal, sandstone and mudstone.	
		2.80 - 3.00	D		2.80			Firm, orangish brown, slightly silty sandy slightly gravelly CLAY. Sand is fine. Gravel is fine to medium, subangular mudstone and siltstone. (POSSIBLY REWORKED)	3
					3.45			End of borehole at 3.45 m	4

Remarks

Service inspection pit hand excavated from GL to 1.20m. Groundwater encountered at 2.00m bgl. Borehole collapsed twice to 2.30m bgl from 3.0m bgl despite re-drilling. Borehole backfilled with arising.





Borehole Log

Borehole No.

WS105

Sheet 1 of 2

Project Name: Circle Square Building 3
(Formerly Plot 12)Project No.
B080355.300

Co-ords: -

Hole Type
WS

Location: Circle Square, Manchester

Level:

Scale
1:20

Client: Bruntwood Circle Square 12 Ltd

Dates: 02/03/2022 - 02/03/2022

Logged By
TW

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.30			MADE GROUND: Concrete over, light brown, compact, slightly cobbley sandy gravel. Sand is fine to medium. Gravel is fine to coarse, angular sandstone, concrete and roadstone. Cobbles of concrete. (SUBBASE)	
					1.00			MADE GROUND: Light brown, compact, slightly cobbley gravelly sand. Sand is fine to medium. Gravel is fine to coarse, angular brick, tarmac, concrete, sandstone, mudstone, quartzite and siltstone. Occasional cobbles of brick and quartzite. (BRICK FILL)	
		1.20		N=29 (5,5/5,7,7,10)				MADE GROUND: Stiff, dark greyish brown, sandy gravelly clay. Sand is fine to medium. Gravel is fine to coarse, angular brick, ash, charcoal, sandstone and mudstone. Occasional cobbles of brick.	1
								<u>Layer of ash from 1.50 to 1.70m bgl.</u>	
		1.75	ES					<u>Green and brown sand band with white Made Ground material (unknown composition) from 1.70 to 1.80m bgl.</u>	
		2.00		N=1 (1,0/0,1,0,0)				<u>Becoming very soft at 2.0m bgl.</u>	2
					2.70			MADE GROUND: Very soft, wet, brown, sandy gravelly clay. Sand is fine to medium. Gravel is fine to coarse, angular brick, charcoal, sandstone and mudstone.	
		3.00 3.00 - 3.45	D	N=3 (1,0/0,1,1,1)					3
					3.70				
					3.90			MADE GROUND: Very loose, black, wet, slightly clayey sandy gravel. Sand is fine to medium. Gravel is fine to coarse, angular brick, ash, charcoal, sandstone and mudstone.	
		4.00	ES						4

Continued on next sheet

Remarks

Service inspection pit hand excavated from GL to 1.20m. Groundwater encountered at 2.00m bgl. Borehole collapsed twice to 3.20m bgl from 4.0m bgl despite re-drilling. Borehole installed with ground gas/water monitoring well in Made Ground to 3.00m bgl.





Borehole Log

Borehole No.

WS105

Sheet 2 of 2

Project Name: Circle Square Building 3
(Formerly Plot 12)Project No.
B080355.300

Co-ords: -

Hole Type
WS

Location: Circle Square, Manchester

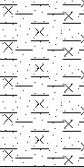
Level:

Scale
1:20

Client: Bruntwood Circle Square 12 Ltd

Dates: 02/03/2022 - 02/03/2022

Logged By
TW

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		4.00 4.00 - 4.45	D	N=6 (0,0/2,1,2,1)	4.45			Soft, orangish brown, slightly silty sandy CLAY. Sand is fine. (POSSIBLY REWORKED)	
								----- End of borehole at 4.45 m	5 6 7 8

Remarks

Service inspection pit hand excavated from GL to 1.20m. Groundwater encountered at 2.00m bgl. Borehole collapsed twice to 3.20m bgl from 4.0m bgl despite re-drilling. Borehole installed with ground gas/water monitoring well in Made Ground to 3.00m bgl.



Curtins

Merchant Exchange, 17-19 Whitworth Street West, Manchester, M1 5WG

Tel: 0161 236 2394

Fax: 0161 228 7902

**GAS MONITORING LOG SHEET**

Project: Circle Square Plot 12 **Date:** 26/06/2019 & 27/06/2019
Job Number: B069467 **Visit:** 1
Client: Bruntwood **Weather:** Sunny
Barometric State: Steady **Ground Conditions:** Dry

Borehole Reference	Barometric Pressure mb	Flow l/hr		Methane %		Carbon Dioxide %		Oxygen %	Hydrogen Sulphide ppm	Carbon Monoxide ppm	Water Level m bgl	Borehole Base m bgl	Note
		Max	SS	Max	SS	Max	SS						
WS03	1026	0.0	0.0	0.0	0.0	0.0	0.0	8.5	0	0	0.95	1.15	
BH01													
BH02													

Notes**Logged by**

PN

*1% gas volume = 10,000 ppm**Flow rate, methane and carbon dioxide reported as 'maximum' (max) and 'steady state' (SS) readings.**All other gases recorded at 'steady state' unless otherwise stated*

Curtins

Merchant Exchange, 17-19 Whitworth Street West, Manchester, M1 5WG

Tel: 0161 236 2394

Fax: 0161 228 7902

**GAS MONITORING LOG SHEET**

Project: Circle Square Plot 12 **Date:** 12/07/2019
Job Number: B069467 **Visit:** 2
Client: Bruntwood **Weather:** Overcast
Barometric State: Rising **Ground Conditions:** Wet

Borehole Reference	Barometric Pressure mb	Flow l/hr		Methane %		Carbon Dioxide %		Oxygen %	Hydrogen Sulphide ppm	Carbon Monoxide ppm	Water Level m bgl	Borehole Base m bgl	Note
		Max	SS	Max	SS	Max	SS						
WS03	1010	0.0	0.0	0.0	0.0	0.0	0.0	15.7	0	1	0.47	0.99	
BH01													1
BH02													1

Notes

1 Unable to access exploratory holes due to deliveries on site.

Logged by

ZH

*1% gas volume = 10,000 ppm**Flow rate, methane and carbon dioxide reported as 'maximum' (max) and 'steady state' (SS) readings.**All other gases recorded at 'steady state' unless otherwise stated*

Curtins

Merchant Exchange, 17-19 Whitworth Street West, Manchester, M1 5WG

Tel: 0161 236 2394

Fax: 0161 228 7902

**GAS MONITORING LOG SHEET**

Project: Circle Square Plot 12 **Date:** 22/07/2019
Job Number: B069467 **Visit:** 3
Client: Bruntwood **Weather:** Sunny
Barometric State: Steady **Ground Conditions:** Dry

Borehole Reference	Barometric Pressure mb	Flow l/hr		Methane %		Carbon Dioxide %		Oxygen %	Hydrogen Sulphide ppm	Carbon Monoxide ppm	Water Level m bgl	Borehole Base m bgl	Note
		Max	SS	Max	SS	Max	SS						
WS03	1009	0.0	0.0	0.0	0.0	0.0	0.0	14.6	0	0	0.54	1.00	1
BH01													
BH02													

Notes

1 Hydrogen Sulphide and Carbon Monoxide constantly fluctuating throughout.

Logged by

AHW

*1% gas volume = 10,000 ppm**Flow rate, methane and carbon dioxide reported as 'maximum' (max) and 'steady state' (SS) readings.**All other gases recorded at 'steady state' unless otherwise stated*

Curtins

Merchant Exchange, 17-19 Whitworth Street West, Manchester, M1 5WG

Tel: 0161 236 2394

Fax: 0161 228 7902

**GAS MONITORING LOG SHEET**

Project: Circle Square Plot 12 **Date:** 30/07/2019
Job Number: B069467 **Visit:** 4
Client: Bruntwood **Weather:** Overcast
Barometric State: Steady **Ground Conditions:** Dry

Borehole Reference	Barometric Pressure mb	Flow l/hr		Methane %		Carbon Dioxide %		Oxygen %	Hydrogen Sulphide ppm	Carbon Monoxide ppm	Water Level m bgl	Borehole Base m bgl	Note
		Max	SS	Max	SS	Max	SS						
WS03	1000	0.0	0.0	0.0	0.0	0.7	0.7	14.4	0	0	0.47	1.00	
BH01													
BH02													

Notes**Logged by**

ZH

*1% gas volume = 10,000 ppm**Flow rate, methane and carbon dioxide reported as 'maximum' (max) and 'steady state' (SS) readings.**All other gases recorded at 'steady state' unless otherwise stated*

Curtins

Merchant Exchange, 17-19 Whitworth Street West, Manchester, M1 5WG

Tel: 0161 236 2394

Fax: 0161 228 7902

**GAS MONITORING LOG SHEET**

Project: Circle Square Plot 12 **Date:** 09/08/2019
Job Number: B069467 **Visit:** 5
Client: Bruntwood **Weather:** Dry
Barometric State: Steady **Ground Conditions:** Damp

Borehole Reference	Barometric Pressure mb	Flow l/hr		Methane %		Carbon Dioxide %		Oxygen %	Hydrogen Sulphide ppm	Carbon Monoxide ppm	Water Level m bgl	Borehole Base m bgl	Note
		Max	SS	Max	SS	Max	SS						
WS03	989	0.0	0.0	0.0	0.0	0.0	0.0	16.5	0	0	0.50	0.99	
BH01													
BH02													

Notes**Logged by**

PN

*1% gas volume = 10,000 ppm**Flow rate, methane and carbon dioxide reported as 'maximum' (max) and 'steady state' (SS) readings.**All other gases recorded at 'steady state' unless otherwise stated*

Curtins

Merchant Exchange, 17-19 Whitworth Street West, Manchester, M1 5WG

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**GAS MONITORING LOG SHEET**

Project: Circle Square Plot 12 **Date:** 30/08/2019
Job Number: B069467 **Visit:** 6
Client: Bruntwood **Weather:** Overcast
Barometric State: Steady **Ground Conditions:** Dry

Borehole Reference	Barometric Pressure mb	Flow l/hr		Methane %		Carbon Dioxide %		Oxygen %	Hydrogen Sulphide ppm	Carbon Monoxide ppm	Water Level m bgl	Borehole Base m bgl	Note
		Max	SS	Max	SS	Max	SS						
WS03	1014	0.0	0.0	0.0	0.0	0.0	0.0	7.0	0	0	0.64	0.99	1
BH01													
BH02													

Notes

1 Gas tap open

Logged by

PN

*1% gas volume = 10,000 ppm**Flow rate, methane and carbon dioxide reported as 'maximum' (max) and 'steady state' (SS) readings.**All other gases recorded at 'steady state' unless otherwise stated*

Curtins

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Fax: 0161 228 7902

**GAS MONITORING LOG SHEET**

Project: Circle Sq Building 3 - Add W&E **Date:** 17/03/2022
Job Number: B080355 **Visit:** 1
Client: Bruntwood **Weather:** Sunny
Barometric State: Rising **Ground Conditions:** Wet

Borehole Reference	Barometric Pressure mb	Flow l/hr		Methane %		Carbon Dioxide %		Oxygen %	Hydrogen Sulphide ppm	Carbon Monoxide ppm	Water Level m bgl	Borehole Base m bgl	Note
		Max	SS	Max	SS	Max	SS						
WS102	1030										1.00	2.13	1
WS103	1030										1.74	3.45	1
WS105	1030										2.29	3.15	1
BH01													2
BH02	1030										7.70	7.73	1

Notes

- 1 Boreholes not gas monitored due to monitor malfunction.
2 BH01 could not be located.

Logged by

TW

*1% gas volume = 10,000 ppm**Flow rate, methane and carbon dioxide reported as 'maximum' (max) and 'steady state' (SS) readings.**All other gases recorded at 'steady state' unless otherwise stated*

Curtins

Merchant Exchange, 17-19 Whitworth Street West, Manchester, M1 5WG

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**GAS MONITORING LOG SHEET**

Project: Circle Sq Building 3 - Add WS **Date:** 20/05/2022
Job Number: B080355 **Visit:** 2
Client: Bruntwood **Weather:** Cloudy
Barometric State: Falling **Ground Conditions:** Dry

Borehole Reference	Barometric Pressure mb	Flow l/hr		Methane %		Carbon Dioxide %		Oxygen %	Hydrogen Sulphide ppm	Carbon Monoxide ppm	Water Level m bgl	Borehole Base m bgl	Note
		Max	SS	Max	SS	Max	SS						
WS102	1015	0.9	0.0	1.5	1.5	0.3	0.0	20.8	0	0	0.87	2.13	1,2
WS103	1015	3.9	0.0	0.0	0.0	0.0	0.0	6.3	0	0	1.67	3.45	3
WS105	1015	0.0	0.0	0.0	0.0	0.1	0.1	13.3	0	0	2.30	3.15	2
BH01													4
BH02	1015	0.0	0.0	0.0	0.0	0.7	0.7	16.6	0	0	7.72	7.73	

Notes**Logged by**

- 1 Steady state gas flow reached after 1 min.
- 2 Developed for water sampling - bailed dry.
- 3 Steady state gas flow reached after 10 seconds.
- 4 Borehole not located.

TW

*1% gas volume = 10,000 ppm**Flow rate, methane and carbon dioxide reported as 'maximum' (max) and 'steady state' (SS) readings.**All other gases recorded at 'steady state' unless otherwise stated*

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GAS MONITORING LOG SHEET

Project:	Circle Sq Building 3 - Add W	Date:	31/05/2022
Job Number:	B080355	Visit:	3
Client:	Bruntwood	Weather:	Cloudy
Barometric State:	Steady	Ground Conditions:	Wet

Borehole Reference	Barometric Pressure mb	Flow l/hr		Methane %		Carbon Dioxide %		Oxygen %	Hydrogen Sulphide ppm	Carbon Monoxide ppm	Water Level m bgl	Borehole Base m bgl	Note
		Max	SS	Max	SS	Max	SS						
WS102	1011										0.91	2.13	1,2
WS103	1011	0.2	0.0	0.0	0.0	0.0	0.0	6.8	0	0	1.75	3.45	3
WS105	1011	0.0	0.0	0.0	0.0	0.5	0.5	10.5	0	0	2.33	3.15	2
BH01													4
BH02	1011	0.0	0.0	0.0	0.0	0.4	0.4	17.4	0	0	Dry	7.73	

Notes**Logged by**

- 1 Borehole flooded - unable to be gas monitored
- 2 Groundwater sample taken from borehole
- 3 Steady state gas flow reached after 10 seconds.
- 4 Borehole not located.

TW

1% gas volume = 10,000 ppm

Flow rate, methane and carbon dioxide reported as 'maximum' (max) and 'steady state' (SS) readings.

All other gases recorded at 'steady state' unless otherwise stated

Curtins

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**GAS MONITORING LOG SHEET**

Project: Circle Sq Building 3 - Add W **Date:** 06/06/2022
Job Number: B080355 **Visit:** 4
Client: Bruntwood **Weather:** Overcast
Barometric State: Steady **Ground Conditions:** Dry

Borehole Reference	Barometric Pressure mb	Flow l/hr		Methane %		Carbon Dioxide %		Oxygen %	Hydrogen Sulphide ppm	Carbon Monoxide ppm	Water Level m bgl	Borehole Base m bgl	Note
		Max	SS	Max	SS	Max	SS						
WS102	1011	67.8	0.0	4.8	4.8	0.0	0.0	7.3	4	6	1.10	2.12	1
WS103	1012	0.0	0.0	0.0	0.0	0.0	0.0	3.3	2	0	1.74	3.38	
WS105	1012	0.0	0.0	0.0	0.0	0.6	0.6	9.0	2	0	2.31	3.18	
BH01	-	-	-	-	-	-	-	-	-	-	-	-	2
BH02	1011	0.0	0.0	0.0	0.0	1.1	0.9	14.1	2	0	Dry	7.76	

Notes

- 1 - Steady state air flow rate recorded after 1 minute. LEL >99.9%.
2 - Borehole BH01 could not be located.

Logged by

MH

*1% gas volume = 10,000 ppm**Flow rate, methane and carbon dioxide reported as 'maximum' (max) and 'steady state' (SS) readings.**All other gases recorded at 'steady state' unless otherwise stated*

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**GAS MONITORING LOG SHEET**

Project: Circle Sq Building 3 - Add W **Date:** 10/06/2022
Job Number: B080355 **Visit:** 5
Client: Bruntwood **Weather:** Sunny
Barometric State: Steady **Ground Conditions:** Dry

Borehole Reference	Barometric Pressure mb	Flow l/hr		Methane %		Carbon Dioxide %		Oxygen %	Hydrogen Sulphide ppm	Carbon Monoxide ppm	Water Level m bgl	Borehole Base m bgl	Note
		Max	SS	Max	SS	Max	SS						
WS101	1012	36.1	0.0	2.7	2.7	0.0	0.0	15.7	0	3	0.90	2.14	1
WS103	1012	0.8	0.0	0.0	0.0	0.0	0.0	4.5	0	0	1.69	3.37	2
WS105	1012	0.0	0.0	0.0	0.0	0.5	0.5	8.9	2	0	2.31	3.18	
BH01	-	-	-	-	-	-	-	-	-	-	-	-	3
BH02	1010	0.0	0.0	0.0	0.0	0.5	0.4	18.1	1	0	Dry	7.76	

Notes

- 1 - Steady state air flow rate recorded after 40 seconds.
2 - Steady state air flow rate recorded after 3 seconds.
3 - Could not located BH01.

Logged by

MH

*1% gas volume = 10,000 ppm**Flow rate, methane and carbon dioxide reported as 'maximum' (max) and 'steady state' (SS) readings.**All other gases recorded at 'steady state' unless otherwise stated*

Curtins

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**GAS MONITORING LOG SHEET**

Project: Circle Sq Building 3 - Add W **Date:** 16/06/2022
Job Number: B080355 **Visit:** 6
Client: Bruntwood **Weather:** Clear
Barometric State: Falling **Ground Conditions:** Dry

Borehole Reference	Barometric Pressure mb	Flow l/hr		Methane %		Carbon Dioxide %		Oxygen %	Hydrogen Sulphide ppm	Carbon Monoxide ppm	Water Level m bgl	Borehole Base m bgl	Note
		Max	SS	Max	SS	Max	SS						
WS101	1019	0.0	0.0	0.6	0.6	0.0	0.0	18.9	0	3	0.92	2.17	1
WS103	1019	0.0	0.0	0.0	0.0	0.0	0.0	4.6	0	2	1.67	3.39	1
WS105	1019	0.0	0.0	0.0	0.0	0.5	0.5	10.0	0	1	2.09	3.19	1
BH01	-	-	-	-	-	-	-	-	-	-	-	-	-
BH02	1018	0.0	0.0	0.0	0.0	0.4	0.2	19.9	0	1	dry	7.77	1

Notes

1 Steady state gas flow atchieved instantly

Logged by

RuT

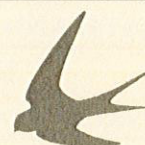
*1% gas volume = 10,000 ppm**Flow rate, methane and carbon dioxide reported as 'maximum' (max) and 'steady state' (SS) readings.**All other gases recorded at 'steady state' unless otherwise stated*

TEST DATE AND CONDITIONS	
Date	09/04/19
Atmospheric Pressure	1003mB
Ambient Temp	23.8°C
Envionics Serial No.	2633

GAS DATA LTD

Pegasus House
Seven Stars Estate
Wheler Rd
Coventry
CV3 4LB

Tel 02476303311 Fax 02476307711



GFM436-1 FINAL INSPECTION & CALIBRATION CHECK CERTIFICATE

INSTRUMENT DETAILS	
Serial No	Customer
12002	Gas Data Hire Fleet

INSTRUMENT CHECKS			
Keyboard	✓	Pump Flow	500cc/min
Display Contrast	✓	Pump Flow @ -200mB	300cc/min
Clock Set / Running	✓	S/W Version	G436.0027/0002
Labels Fitted	✓	Recalibration Date	09/04/20

GAS CHECKS							
Calibration Gas		Instrument Gas Channels Read					
Gas Type	Applied Conc.	CH4 (%)	tol. (% vol.)	CO2 (%)	tol. (% vol.)	O2 (%)	tol. (% vol.)
N2	100%	0.0	0.0	0.0	0.0	0.0	+/-0.1
CH4	5%	5.1	+/-0.3	0.0	0.0	0.0	+/-0.1
	60%	59.8	+/-3.0	0.0	0.0	0.0	+/-0.1
CO2	5%	0.0	0.0	5.1	+/-0.3	0.0	+/-0.1
	40%	0.0	0.0	60.2	+/-3.0	0.0	+/-0.1
O2	20.9%	0.0	0.0	0.1	+0.1	20.8	+/-0.5

OPTIONAL GAS CHECKS							
Calibration Gas		Instrument Gas Channels Read					
Gas Type	Applied Conc.	Label	H2S	CO		Hexane	tol. (% vol.)
		Range	5000ppm	2000ppm		2.00%	
N2	100%		0	0		0	+/- 5.0
H2S	1500ppm		1500	0			+/- 5.0
CO	1000ppm		60	994			+/- 5.0
Hexane	2.00%					1.876	+/- 10.0

PRESSURE CHECKS							
Calibration Pressure		Instrument Pressure Channels Read					
Pressure @	Applied Pressure	Atmospheric [Ap] (mB)	tol. (mB)				
All Ports	Current Atmospheric	1003	+/-2.0				
Ap Port (Internal)	+800mB(a)	802	+/-5.0				
	+1200mB(a)	1203	+/-5.0				

TEST DATE AND CONDITIONS	
Date	09/04/19
Atmospheric Pressure	1003mB
Ambient Temp	23.8°C
Envionics Serial No.	2633

GAS DATA LTD

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Wheler Rd
Coventry
CV3 4LB

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GFM436-1 FINAL INSPECTION & CALIBRATION CHECK CERTIFICATE

FLOW CHECKS					
Calibration Flow		Instrument Flow Channels Read			
Applied Flow (l/hour)	Applied Pressure (Pa)	Flow [Flow] (l/hour)	tol. (l/hour)	Differential Pressure [Dp] (Pa)	tol. (Pa)
-30.0	-366	-30.1	+/-3.0	-364	+/-50
-3.0	-18	-2.7	+/-1.0	-17	+/-6
0.0	0	0.0	0.0	0	0.0
+3.0	14	2.8	+/-0.5	13	+/-3
+30.0	308	29.9	+/-3.0	310	+/-50
+60.0	898	59.5	+/-6.0	894	+/-130
+90.0	1802	89.8	+/-9.0	1795	+/-250

TEMPERATURE CHECK		
Calibration Temperature	Instrument Temperature Channel Read	
Applied Equivalent Temperature (°C)	Temperature [Temp] (°C)	tol. (°C)
-10.0	-10.5	+/- 2.0
0.0	0.0	+/- 1.0
30.0	30.0	+/- 1.0
60.0	60.0	+/- 1.0
100.0	100.0	+/- 1.0

Notes:

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 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. Certificate NQA 8374. Valid until 22/03/2019

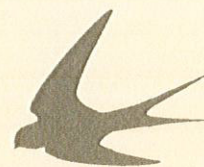
TEST DATE AND CONDITIONS	
Date	10/04/19
Atmospheric Pressure	1007 mB
Ambient Temp	20.6 °C
EnviroNics Serial No.	3268

GAS DATA LTD

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GFM436-1 (MCERTS) OUTWARD INSPECTION & QUALITY CHECK SHEET

INSTRUMENT DETAILS					
SO Number	Instrument Banner	Instrument Serial Number + SW Version	Job Number(s)		
322353	GFM436	12002 V27.02	16057	—	—

Calibration Technician JSP

DATE 9-4-19

Inspection Technician JSP

DATE 10/04/19

INSTRUMENT CHECKS		Pass (P), Fail (F) or not applicable(NA)	INSTRUMENT PACKING LIST		Tick if included
Function Tests	Dust Caps Fitted	P	Instrument		✓
	Keyboard Test (All keys)	P	Leather Case		✓
	Backlight Test	P	Instrument Strap		✓
	Clock Set / Running	P	AC Battery Charger (UK)		✓
	Comms Test	P	AC Battery Charger (EURO)		X
	Pump Flow Test (In & Out)	P	AC Battery Charger (US)		X
	Overall Leak Test (30mb)	N/A	AC Battery Charger (AUS)		X
	Battery Charge Test	P	Gas Sample Pipe		✓
	Service Date set to?	09/04/20	Hard Carry Case		✓
Channel Tests	Data Logging Enabled?	P	Spares Pot		✓
	Verify CH4/LEL/Hexane/PID	P	Allen Key		✓
	Verify CO2	P	Flow Sample Pipe		✓
	Verify O2	P	Temperature Probe		X
	Verify H2S	P	Vane Anemometer		X
	Verify CO	P	USB Cable		✓
	Verify LEL	P	USB Memory Stick		✓
	Verify 1st Option gas	N/A	SM V5 Software	Ver 5.7	✓
	Verify atmospheric pressure	P	Internal Filter Pack	Qty	X
	Verify differential pressure	P	External Filter Pack	Qty	X
	Verify flow	P	Field Guide		X
	Verify temperature probe input	P	Extra Items:		
	Verify vane anemometer input	P			
	Jobcard(s) completed and signed	P			
	Jobcard(s) booked off database	P			
DataBase Checks	Calibration certificate completed	P	Comments		
	Complete & print QI record	N/A			
	No. of Calibration label fitted	9619			
	MCERTS label displayed	P			
H2S Range	Warranty label fitted	P			
	H2S Range from SO	5000 ppm			
	H2S Range from cal cert	5000 ppm			
	Over-range value correct?	P			

TEST DATE AND CONDITIONS			
Date		18/08/2021	
Atmospheric Pressure		999	mB
Ambient Temperature		21.9	°C
EnviroNics Serial No.		5089	

**GFM436 Final Inspection & Calibration
Check Certificate**

GAS DATA LTD

Unit 4, Fairfield Court

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Wheler Rd

Coventry

CV3 4LJ

Tel 02476303311

Fax 02476307711



Customer	Gas Data
Certificate Number	122649
Order Number	329200

Serial Number	12000
Software Version	G436-00.0027/0009

Recalibration Due Date
18/08/22

Instrument Checks					
Keyboard	✓		Display Contrast	✓	
Pump Flow In	500	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 %	
	60	60	39.7	40	20.9	20.9
	Accept ±3.0		Accept ±3.0		Accept ±0.5	
	5	5	5	5	6	6
	Accept ±0.3		Accept ±0.3		Accept ±0.3	
Zero Reading 100% N ₂	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	1000	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	70		1000		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		999	Accept ± 2.0
AP Port (Internal)	+800 mB	800	Accept ± 5.0
	+1200mb	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	-30.1	Accept ± 3.0	-370	-374	Accept ± 50
-3	-3	Accept ± 1.0	-18	-18	Accept ± 6.0
0	0	Accept ± 0.0	0	0	Accept ± 0.5
3	3	Accept ± 0.5	16	15	Accept ± 3.0
30	30	Accept ± 3.0	330	328	Accept ± 50
60	60	Accept ± 6.0	987	987	Accept ± 130
90	90.7	Accept ± 9.0	1937	1973	Accept ± 250

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

Technician:
<i>Jack Rutland</i>

Date Tested:
<i>19/08/2021</i>

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 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.

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