



GROUNDTECH
CONSULTING

STAND LANE, RADCLIFFE

PERMANENT GROUND GAS RISK
ASSESSMENT

DEBTAL

FEBRUARY 2024

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CLIENT CONTACT	SCOTT ASPEN
For and Behalf of Groundtech Consulting	
SIGNATURE	
AUTHOR	Jack Perkins MSc (Hons)
SIGNATURE	
CHECKED	Luke Harrison BSc (Hons) FGS
SIGNATURE	
REVIEWED	James Doyle BSc (Hons) CGeol FGS

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Plans		
<i>Plan Reference</i>	<i>Revision</i>	<i>Title</i>
GRO-23304-P01	-	Project Location Plan
GRO-23304-P04	-	Exploratory Hole Location Plan

1.0 INTRODUCTION

The gas monitoring programme has been completed at Stand Lane in Radcliffe, please find enclosed the addendum ground gas assessment for the proposed commercial and residential development.

This ground gas assessment has been produced in accordance with the new and established guidance documents BS 8485:2019, BS 8576:2013 and CIRIA Report C665 (November 2007) to discharge Land Quality pre-commencement planning conditions.

In preparing the Gas Assessment the following documents were reviewed and should be read in conjunction with this report:

- *Groundtech Consulting Ltd Preliminary Risk Assessment (PRA) referenced GRO-23304-4918 and dated 14 November 2023.*
- *Groundtech Consulting Ltd Geo-Environmental Appraisal referenced GRO-23304-4919 and dated 21 December 2023.*

2.0 SUMMARY OF PRELIMINARY RISK ASSESSMENT

2.1 Preliminary Risk Assessment Information

A Preliminary Risk Assessment was undertaken by Groundtech Consulting referenced GRO-23304-4918 and dated 14 November 2023.

The site is disused and unoccupied, the surfacing comprises of patches of grass and shrubbery scattered across the site and sandy gravelly clay Made Ground associated with the historic development of the public house, car parking and unspecified buildings.

From the information obtained from the preliminary risk assessment, no significant onsite sources of permanent ground gases have been identified which may affect the redevelopment of the site. The former public house, associated car parking and unspecified buildings historically on site indicate the likelihood of Made Ground underlying the site which may be a source of ground gases such as carbon dioxide and methane.

Limited potential offsite sources of ground gases have been identified through the PRA. It is considered likely that the Stand Lane Colliery and nearby cotton mill are a potential source of deep Made Ground and therefore ground gases, which may migrate through the glaciofluvial strata and into the proposed development across the site. The infilled reservoirs nearby can also provide a source depending on the material used for the infill.

The onsite and offsite sources mentioned above are potential sources of ground gas and there is a plausible pathway to migrate into confined spaces in the proposed development.

The risk associated with ground gases to the end users based on information from the Preliminary Risk Assessment is considered to be *Moderate*.

2.2 Ground Model

Made Ground

Made Ground was encountered across the site. Deeper Made Ground was encountered towards the northwestern and central area of the site to a maximum depth of 1.90m bgl. The southeastern area of the site indicated shallower Made Ground, from ground level to a maximum depth of 0.90m bgl.

Three main populations of Made Ground were encountered as part of the investigation and comprised of a firm to stiff brown and grey sandy gravelly clay with gravel of mixed lithologies to a maximum depth of 1.8m bgl in all exploratory hole locations. A dark brown gravelly sand with gravel of mixed lithologies within TP02, TP05, TP06 and TP07 to a maximum depth of 1.90m bgl. TP03 and TP04 encountered a dark grey ashy gravelly sand with minor constituents of brick and concrete with a faint hydrocarbon odour to a maximum depth of 0.50m bgl.

Locally to SuDS1 in the northern end of site, tarmac surfacing in SuDS1 to a maximum depth of 0.2m bgl.

Natural Ground

The natural strata encountered generally confirmed the published geological records. Two main natural strata were encountered during the ground investigation comprising of a brown clayey sand within WS03, WS05 and TP04 between depths of 1.2m and 1.9m bgl and a firm to stiff sandy Clay in all exploratory holes to a maximum depth of 3.0m bgl.

Bedrock

Bedrock was not encountered during the investigation.

Groundwater

Perched groundwater was encountered observed in WS01 at 1.6m bgl within the sandy gravelly clay Made Ground. Groundwater seepage was encountered within the sandy clay in SuDS01 at 1.8m bgl.

The exploratory hole positions are shown on the Exploratory Hole Location Plan *GRO-23304-P04* and the logs are in *Appendix 2*.

3.0 GROUND GAS RISK ASSESSMENT

3.1 Gas Monitoring

During the Ground Investigation works, monitoring standpipes were installed in the following holes and a summary of the installations is provided in the table below.

Location	Depth (m bgl)	Response Zone (m bgl)	Targeted Strata	Reason
WS01	2.60	1.00 – 2.60	Made Ground/Natural Cohesive	Ground Gas
WS03	3.00	1.00 – 3.00	Natural Cohesive/Granular	Ground Gas
WS05	1.70	0.70 – 1.70	Natural Cohesive/Granular	Ground Gas

The standpipes consisted of polyvinyl chloride (pvc) pipe - a bentonite seal was placed around the plain pipe and a clean gravel pack was placed around the slotted pipe.

Four ground gas monitoring visits have been completed between 14 November 2023 and 11 January 2024. Monitoring of the weather conditions and predicted atmospheric pressures (Met Office Surface Pressure Charts) was carried out up to 72 hours in advance of proposed monitoring visits in order that a reasonable period of data was obtained to determine atmospheric trends, and also to target the 'worst case' scenario.

Permanent gas and flow rate monitoring was carried out using a GFM436 infrared gas monitor with integral electronic flow analyser. The measurements taken are listed below:

- Oxygen (O₂), carbon dioxide (CO₂) and methane (CH₄) as the percentage volume in air (%v/v).
- Hydrogen sulphide (H₂S) and carbon monoxide (CO) as the percentage volume in air (%v/v).
- Lower Explosive Limit (% LEL) of methane.
- Atmospheric and borehole pressure, including pressure trend.
- Flow measurements (l/hr).
- Weather and ground surface conditions.

Both peak and steady state conditions were monitored to understand the behaviour of the permanent ground gas, the steady state conditions were recorded by allowing the gas monitor to run for a minimum of 3 minutes.

Permanent gas and groundwater monitoring results are presented in *Appendix 3*.

3.2 Gas Monitoring Results

During the monitoring period, no concentrations of methane (CH₄) have been recorded within the standpipes. However, detectable levels of carbon dioxide (CO₂) were recorded within the standpipes up to a maximum concentration of 5.5%v/v. Associated minimum oxygen (O₂) concentrations ranged between 9.8% v/v and 20.2% v/v.

No positive gas flow rates were recorded during the gas monitoring programme.

Groundwater levels were recorded within the standpipes ranging from 0.81m to 1.70m bgl during the monitoring period and was consistently within the response zone of the standpipes.

The atmospheric pressure ranged between 986mb and 1026mb during the monitoring period and was carried out during periods of rising, steady and falling barometric pressure.

3.3 Characterisation of the Gas Screening Value (GSV)

In accordance with BS 8485:2019 and CIRIA Report C665, November 2007 - an adequate risk assessment can be undertaken based on the following limiting factors:

- *The proposed development has been considered as **Moderate to high Sensitivity** based on the site being developed with residential and commercial use (Table 5.5 – Typical/Idealised frequency and period of monitoring, after Wilson et al, 2005).*
- *The risk associated with the generation potential of a source is considered as **moderate**, (assessment based on the environmental setting) as well as observations noted during the fieldworks.*
- *Negligible flow rates have been recorded (Table 8.5 – Modified Wilson & Card classification).*

Based upon the results recorded, in accordance with BS 8485:2019 and CIRIA Report C665 - the risk to the site from ground gases has been assessed by converting the results to gas screening values (GSVs), calculated by multiplying the typical maximum gas concentrations with the recorded maximum positive flow rates. In addition, individual “hazardous gas flow rates” (Qhg) have been derived for each monitoring event.

$$GSV (l/hr) = \text{max borehole flow rate (l/hr)} \times \text{max gas concentration (\%)}$$

For this assessment, the maximum recorded concentration of carbon dioxide of 5.5%v/v has been used to calculate the GSV. As no flow rates have been detected, the limit of detection of the gas analyser of 0.1l/hr has been used to calculate the GSV.

$$\text{Carbon Dioxide GSV} = 0.055 (5.5\%) \times 0.1 = 0.0055 \text{ l/hr}$$

3.4 Assessment

Cohesive Made Ground was encountered across the site associated with the historical buildings. Deeper Made Ground was encountered towards the northwestern and central area of the site to a maximum depth of 1.90m bgl. The southeastern area of the site indicated shallower Made Ground, from ground level to a maximum depth of 0.90m bgl.

Ground gas monitoring was carried out as multiple potential ground gas sources were identified within influencing distance of the site.

Methane has not been detected and a maximum concentration of carbon dioxide of 5.5% v/v has been recorded over the monitoring period.

Onsite sources of contamination have been identified through the Made Ground that was encountered across the site, as previously identified through the Preliminary Risk Assessment. Made Ground was later encountered across the site as an unnamed well and basement were located underlying the site. The sources of Made Ground are likely to be the cause of ground gas concentrations across the site.

In order to assess the ground gas regime beneath the site and the need to incorporate ground gas precautions, guidance was taken from BS 8485:2019. Based on the site being developed with residential and commercial end use, the Wilson and Card method has been used to carry out the assessment.

When considering the results, in accordance with BS 8485:2019 (Modified Wilson and Card Classification), it can be seen that the GSV values for carbon dioxide correspond with CS1 criteria (GSV of less than 0.07l/hr) and gas protection measures are not required.

However, higher concentrations of carbon dioxide have been occasionally encountered over threshold value of 5.0% v/v in one of the three monitoring wells. The source of the carbon dioxide is considered to be the Made Ground associated with the former basement infill, which comprises inert materials such as brick, concrete, plastic, sandstone and ceramic. Based on the nature of the material, the Made Ground is not considered to be a significant gas generating source. In addition, the existing well is to be backfilled in accordance with EA guidance, which will not provide an additional gas source. Therefore, Characteristic Situation 1 conditions prevail, and no ground gas precaution measures are required.

Characteristic Situation 1

An extract of the Modified Wilson and Card table is presented below:

Characteristic Situation (Wilson and Card)	Methane		Carbon Dioxide	
	Wilson and Card		Wilson and Card	
	Gas Screening Value (l/hr)	Typical Maximum Concentration (%v/v)	Gas Screening Value (l/hr)	Typical Maximum Concentration (%v/v)
1	<0.07	<1	<0.07	<5
2	<0.7	Borehole flow rate not greater than 70l/hr	<0.7	Borehole flow rate not greater than 70l/hr
3	<3.5		<3.5	
4	<15	Quantitative Risk Assessment Required	<15	Quantitative Risk Assessment Required
5	<70		<70	
6	>70		>70	

The proposed residential and commercial development is classified as a Building Type B in accordance with BS 8485:2019 and the site is designated as CS1 therefore, 0 points of protection are required for the proposed development.

3.5 Radon Gas

The site lies in an area where radon protective measures are not required within new structures.

3.6 Conclusions

Gas protection measures are not required within the proposed development at the site.

No radon precautions are necessary.

It is recommended that confirmation of these findings is made with the Local Authority prior to any irrevocable action being taken.

4.0 RELEVANT INDUSTRY REFERENCES

CIRIA C665 *"Assessing Risks Posed by Hazardous Ground Gases to Buildings"* 2007.

Wilson & Card *"Proposed method classifying gassing sites"* *Ground Engineering*" 1999.

Card & Steve Wilson in *"A pragmatic approach to ground gas risk assessment for the 21st Century"*

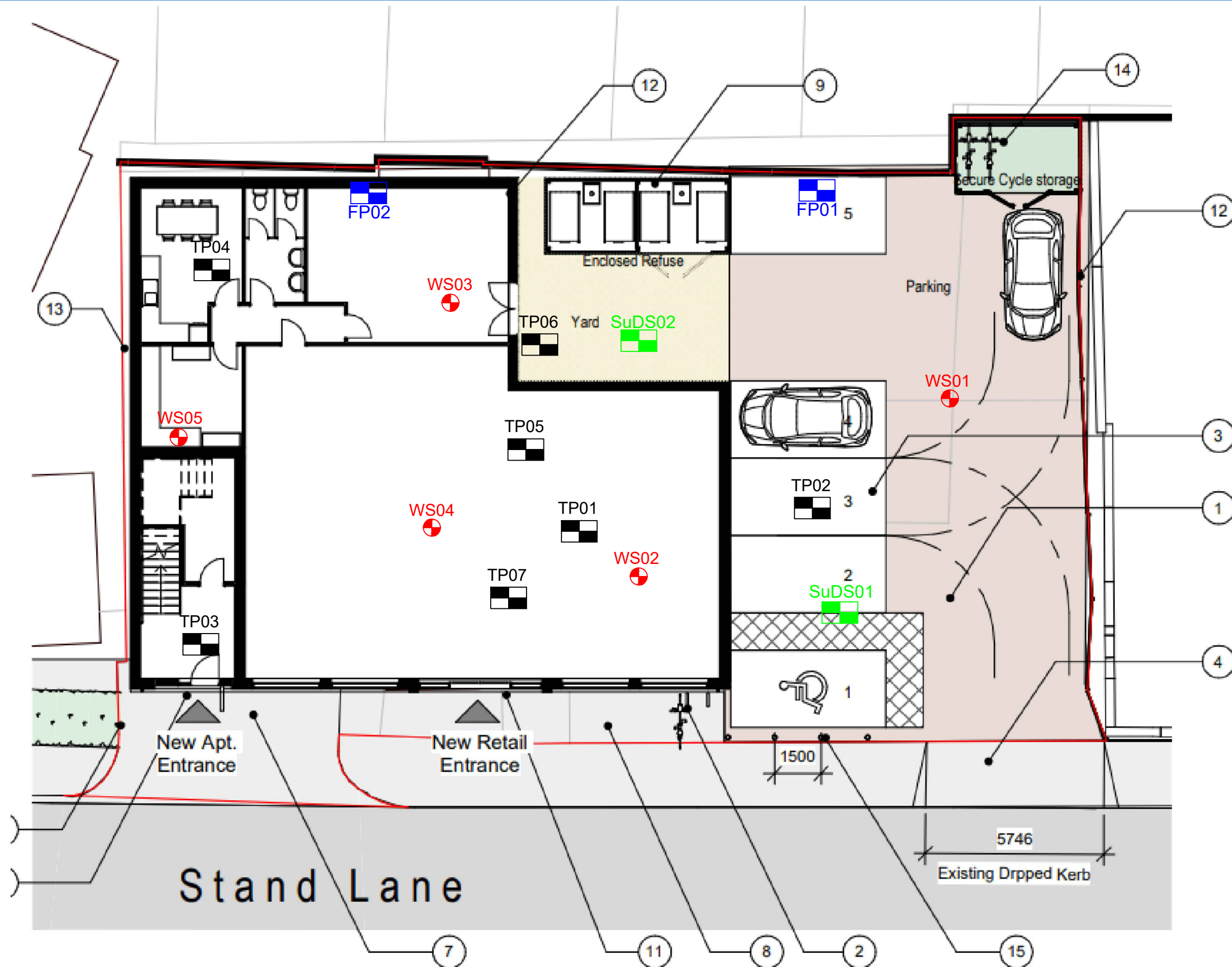
CIRIA/Environmental Protection UK Ground gas seminar 2011

BS 8576:2013 *'Guidance on investigations for ground gas – Permanent gases and Volatile Organic Compounds (VOCs)'*

BS 8485:2015+A1:2019 *'Code of practise for the design of protective measures for methane and carbon dioxide ground gases for new buildings'*

NHBC *"Hazardous Ground Gas – an essential guide for housebuilders"* April 2023

APPENDIX 1 - Plans



APPENDIX 2 - Exploratory Hole Logs



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Borehole Log

Borehole No.

WS01

Sheet 1 of 1

Project Name: STAND LANE

Project No.
GRO-23304

Co-ords: -

Hole Type
WS

Location: RADCLIFFE

Level:

Scale
1:25

Client: BELL MUNRO CONSULTING LIMITED

Dates: 31/10/2023 -

Logged By
JP

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.20	ES					MADE GROUND: Firm dark grey brown mottled grey slightly sandy gravelly clay. Gravel is angular to subrounded fine to coarse of mixed lithologies of brick, concrete, sandstone and ceramics. Sand is fine to medium.	1
		1.00	D						
		1.20		N=8 (1,1/1,1,2,4)				No recovery.	
					1.70				
		2.00		N=13 (2,3/3,3,3,4)				Firm to stiff dark brown very sandy gravelly CLAY. Sand is fine to medium. Gravel is subrounded to rounded fine to medium of mixed lithologies including quartzite and limestone.	2
		2.10	ES						
		2.60		N=50 (5,9/50 for 275mm)	2.60			End of borehole at 2.60 m	3
									4
									5

Remarks

1. Location cleared of services using a handheld Cable Avoidance Tool (CAT). 2. Hand excavated inspection pit to 1.20m bgl. 3. Groundwater seepage encountered at 1.60m rising to 1.00m. 4. Borehole terminated at 2.60m bgl due to SPT refusal. 5. Monitoring standpipe installed to 2.60m bgl (1.00m plain, 1.60m slotted).





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Borehole Log

Borehole No.

WS02

Sheet 1 of 1

Project Name: STAND LANE

Project No.
GRO-23304

Co-ords: -

Hole Type
WS

Location: RADCLIFFE

Level:

Scale
1:25

Client: BELL MUNRO CONSULTING LIMITED

Dates: 31/10/2023 -

Logged By
JP

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.50	ES					MADE GROUND: Firm to stiff dark brown mottled grey slightly sandy gravelly clay with moderate cobble content of brick. Gravel is angular to subrounded fine to coarse of brick, concrete and sandstone. Sand is fine to medium.	1
		1.20		N=18 (8,5/4,8,3,3)					
		1.65		N=50 (25 for 50mm/50 for 60mm)	1.60 1.65				
								Grey CONCRETE End of borehole at 1.65 m	2
									3
									4
									5

Remarks

1. Location cleared of services using a handheld Cable Avoidance Tool (CAT). 2. Hand excavated inspection pit to 1.20m bgl. 3. Borehole terminated at 1.65m bgl due to concrete obstruction. 4. Backfilled with arisings.





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Borehole Log

Borehole No.

WS03

Sheet 1 of 1

Project Name: STAND LANE

Project No.
GRO-23304

Co-ords: -

Hole Type
WS

Location: RADCLIFFE

Level:

Scale
1:25

Client: BELL MUNRO CONSULTING LIMITED

Dates: 31/10/2023 -

Logged By
JP

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.70	ES		0.90			MADE GROUND: Firm dark brown mottled grey slightly sandy gravelly clay with moderate cobble content of brick. Gravel is angular to subrounded fine to coarse of brick, concrete and sandstone. Sand is fine to medium.	
		1.20		N=10 (1,1/2,2,2,4)				Loose brown slightly clayey SAND. Sand is fine to medium.	1
		1.50	ES						
		2.00 2.00	D	N=19 (2,3/4,4,6,5)	1.90			Stiff brown sandy CLAY. Sand is fine to coarse.	2
		2.80	ES						
		3.00		N=50 (6,10/50 for 230mm)	3.00			End of borehole at 3.00 m	3
									4
									5

Remarks

1. Location cleared of services using a handheld Cable Avoidance Tool (CAT). 2. Hand excavated inspection pit to 1.20m bgl. 3. Groundwater seepage encountered at 2.00m. 4. Borehole terminated at 3.00m bgl due to SPT refusal. 5. Monitoring standpipe installed to 3.00m bgl (1.00m plain, 2.00m slotted).





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Borehole Log

Borehole No.

WS04

Sheet 1 of 1

Project Name: STAND LANE

Project No.
GRO-23304

Co-ords: -

Hole Type
WS

Location: RADCLIFFE

Level:

Scale
1:25

Client: BELL MUNRO CONSULTING LIMITED

Dates: 31/10/2023 -

Logged By
JP

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.40	ES					MADE GROUND: Firm dark grey brown mottled grey slightly sandy gravelly clay. Gravel is angular to subrounded fine to medium of mixed lithologies of brick, concrete, sandstone and ceramics. Sand is fine to medium.	
					0.80				
		1.20		N=11 (0,1/2,3,3,3)				Firm dark brown mottled grey slightly sandy gravelly CLAY. Gravel is subrounded to rounded fine to medium of mixed lithologies including quartzite and sandstone. Sand is fine to medium.	1
		1.60	ES		1.65				
		1.90	ES					Stiff brown sandy CLAY. Sand is fine to coarse.	
		2.00		N=50 (3,5/50 for 245mm)	2.00			End of borehole at 2.00 m	2
									3
									4
									5

Remarks

1. Location cleared of services using a handheld Cable Avoidance Tool (CAT). 2. Hand excavated inspection pit to 1.20m bgl. 3. Borehole terminated at 2.00m bgl due to SPT refusal. 4. Backfilled with arisings.





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Borehole Log

Borehole No.

WS05

Sheet 1 of 1

Project Name: STAND LANE

Project No.
GRO-23304

Co-ords: -

Hole Type
WS

Location: RADCLIFFE

Level:

Scale
1:25

Client: BELL MUNRO CONSULTING LIMITED

Dates: 31/10/2023 -

Logged By
JP

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.20	ES					MADE GROUND: Firm brown mottled grey slightly sandy gravelly clay. Gravel is angular to subrounded fine to medium of mixed lithologies of brick, concrete, sandstone and ceramic. Sand is fine to medium.	
		0.90	ES		0.80				
		1.00	D					Loose brown slightly clayey SAND. Sand is fine to medium.	1
		1.20		N=11 (3,3/2,2,3,4)	1.20				
		1.40	ES					Stiff dark brown sandy CLAY. Sand is fine to medium.	
		1.70		N=50 (25 for 50mm/50 for 285mm)	1.70			End of borehole at 1.70 m	2
									3
									4
									5

Remarks

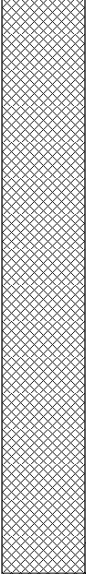
1. Location cleared of services using a handheld Cable Avoidance Tool (CAT). 2. Hand excavated inspection pit to 1.20m bgl. 3. Borehole terminated at 1.70m bgl due to SPT refusal. 5. Monitoring standpipe installed to 1.70m bgl (0.70m plain, 1.00m slotted).



Trial Pit Log

Trialpit No
TP02
Sheet 1 of 1

Project Name: STAND LANE	Project No. GRO-23304	Co-ords: - Level:	Date 18/12/2023
Location: RADCLIFFE		Dimensions (m): Depth 1.90	Scale 1:25 Logged JR
Client: BELL MUNRO CONSULTING LIMITED		1.8 1.2	

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
				1.90			MADE GROUND: Dark brown gravelly fine to coarse sand with a moderate cobble content of brick. Gravel is angular to subangular fine to coarse of brick, concrete, wood, ceramics, and plastic. Concrete slab encountered at 1.90m bgl. End of pit at 1.90 m	1 2 3 4 5

Remarks: 1. Location cleared of utilities using handheld Cable Avoidance Tool (CAT). 2. No groundwater encountered. 3. Trial pit excavated to 1.90m bgl. 4. Trial pit terminated due to concrete slab at 1.90m bgl. 5. Trial pit backfilled with arisings.

Stability: Stable



Trial Pit Log

Trialpit No

TP03

Sheet 1 of 1

Project Name:	STAND LANE
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Project No.
GRO-23304

Co-ords:	-
Level:	

Date
18/12/2023

Location: RADCLIFFE

Dimensions
(m):

1.8

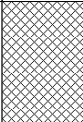
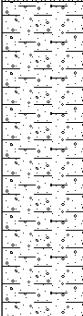
Scale
1:25

Client: BELL MUNRO CONSULTING LIMITED

Depth
1.45

1.3

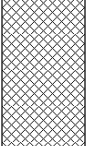
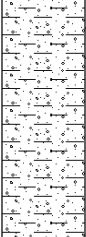
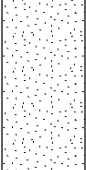
Logged
JR

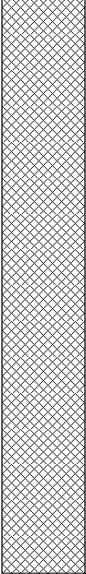
Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
			HVP=78	0.40			MADE GROUND: Dark grey black ashy gravelly fine to coarse sand. Gravel is angular to subrounded fine to coarse of brick, concrete, and ash. Faint hydrocarbon odour present.
							Firm grey mottled brown gravelly sandy CLAY. Gravel is angular to rounded fine to coarse of chert and sandstone. Sand is fine to coarse.
				1.45			Drain encountered at 1.40m bgl. End of pit at 1.45 m

Remarks:	1. Location cleared of utilities using handheld Cable Avoidance Tool (CAT). 2. No groundwater encountered. 3. Trial pit excavated to 1.45m bgl. 4. Trial pit terminated due to drain encountered at 1.40m bgl. 5. Trial pit backfilled with arisings.
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Stability: Stable



				Trial Pit Log				Trialpit No TP04 Sheet 1 of 1	
Project Name: STAND LANE				Project No. GRO-23304		Co-ords: - Level:		Date 18/12/2023	
Location: RADCLIFFE				Dimensions (m): Depth 2.10		1.15 1.9		Scale 1:25 Logged JR	
Client: BELL MUNRO CONSULTING LIMITED									
Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description		
	Depth	Type	Results						
▼			HVP=83	0.50			MADE GROUND: Dark grey black ashy gravelly fine to coarse sand with bands of light brown fine to coarse sand. Gravel is angular to subrounded fine to coarse of brick, concrete, and ash. Faint hydrocarbon odour present.		
				1.30			Firm grey mottled brown gravelly sandy CLAY. Gravel is angular to rounded fine to coarse of chert and sandstone. Sand is fine to coarse. <i>Metal pipe encountered at 0.60m bgl.</i>		
				1.90			Light brown fine to coarse SAND.		
				2.10			Firm grey mottled brown gravelly sandy CLAY. Gravel is angular to rounded fine to coarse of chert and sandstone. Sand is fine to coarse.		
								End of pit at 2.10 m	
Remarks:				1. Location cleared of utilities using handheld Cable Avoidance Tool (CAT). 2. Groundwater seepage encountered at 1.60m bgl. 3. Trial pit excavated to 2.10m bgl. 4. Soil percolation test carried out from 1.05m bgl to 2.10m bgl. 5. Trial pit backfilled with arisings.					
Stability:				Stable					

				Trial Pit Log				Trialpit No TP05 Sheet 1 of 1		
Project Name: STAND LANE				Project No. GRO-23304		Co-ords: - Level:		Date 18/12/2023		
Location: RADCLIFFE				Client: BELL MUNRO CONSULTING LIMITED		Dimensions (m): Depth 1.90		3 1.5		
Scale 1:25		Logged JR								
Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description			
	Depth	Type	Results							
				1.90			MADE GROUND: Dark brown ashy gravelly fine to coarse sand with a high cobble content of brick and a moderate cobble content of wood, concrete, and metal. Gravel is angular to subangular fine to coarse of brick, concrete, ash, wood, ceramics, metal, and plastic. Concrete slab encountered at 1.90m bgl. End of pit at 1.90 m			
							1			
							2			
							3			
							4			
							5			
Remarks:				1. Location cleared of utilities using handheld Cable Avoidance Tool (CAT). 2. No groundwater encountered. 3. Trial pit excavated to 1.90m bgl. 4. Trial pit terminated due to concrete slab at 1.90m bgl and instability of pit walls. 5. Trial pit backfilled with arisings.						
Stability:				Unstable						

Trial Pit Log

Trialpit No

TP06

Sheet 1 of 1

Project Name: STAND LANE

Project No.
GRO-23304

Co-ords: -
Level:

Date
18/12/2023

Location: RADCLIFFE

Dimensions
(m):

1.9

Scale

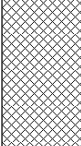
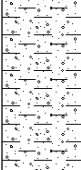
1:25

Client: BELL MUNRO CONSULTING LIMITED

Depth
1.10

1:1

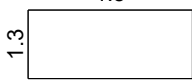
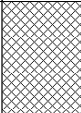
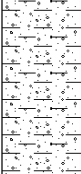
Logged
JR

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
			HVP=47	0.50			MADE GROUND: Dark brown gravelly fine to coarse sand with a moderate cobble content of brick. Gravel is angular to subangular fine to coarse of brick, concrete, wood, ceramics, and plastic.	
				1.10			Firm brown mottled grey gravelly sandy CLAY. Gravel is angular to rounded fine to coarse of chert and sandstone. Sand is fine to coarse.	1
							End of pit at 1.10 m	2
								3
								4
								5

Remarks: 1. Location cleared of utilities using handheld Cable Avoidance Tool (CAT). 2. No groundwater encountered. 3. Trial pit excavated to 1.10m bgl. 4. Trial pit backfilled with arisings.

Stability: Stable



				Trial Pit Log			Trialpit No TP07 Sheet 1 of 1			
Project Name: STAND LANE				Project No. GRO-23304		Co-ords: - Level:		Date 18/12/2023		
Location: RADCLIFFE				Dimensions (m): Depth 1.00		1.8 		Scale 1:25 Logged JR		
Client: BELL MUNRO CONSULTING LIMITED										
Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description			
	Depth	Type	Results							
			HVP=31	0.40			MADE GROUND: Dark brown gravelly fine to coarse sand with a moderate cobble content of brick. Gravel is angular to subangular fine to coarse of brick, concrete, wood, ceramics, and plastic.			
				1.00			Firm brown mottled grey gravelly sandy CLAY. Gravel is angular to rounded fine to coarse of chert and sandstone. Sand is fine to coarse.			
							End of pit at 1.00 m			
							1			
							2			
							3			
							4			
							5			
Remarks: 1. Location cleared of utilities using handheld Cable Avoidance Tool (CAT). 2. No groundwater encountered. 3. Trial pit excavated to 1.00m bgl. 4. Trial pit backfilled with arisings.										
Stability: Stable										

Project Name:	STAND LANE
---------------	------------

Project No.
GRO-23304

Co-ords:	-
Level:	

Date
01/11/2023

Location: RADCLIFFE

Dimensions
(m):

1.8

Scale
1:25

Client: BELL MUNRO CONSULTING LIMITED

Depth
2.30

1.2

Logged
JP

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
▼				0.20			MADE GROUND: Grey tarmac.	1 -
							MADE GROUND: Firm dark brown mottled grey slightly sandy gravelly clay with high cobble content of brick. Gravel is angular to subrounded fine to coarse of mixed lithologies including brick, concrete and sandstone. Sand is fine to medium.	
				1.60			Stiff brown sandy CLAY. Sand is fine to medium.	2 -
				2.30			End of pit at 2.30 m	3 -
								4 -
								5 -

Remarks:	1. Location cleared of services using a handheld Cable Avoidance Tool (CAT). 2. Trial pit excavated to 2.30m bgl. 3. Water seepage at 1.80m bgl. 4. Soil percolation test unable to be carried out due to water seepage. 5. Backfilled with arisings.
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Stability: Unstable.



Trial Pit Log

Trialpit No

SuDS02

Sheet 1 of 1

Project Name: STAND LANE

Project No.
GRO-23304

Co-ords:	-
Level:	

Date
01/11/2023

Location: RADCLIFFE

Dimensions
(m):

1.8

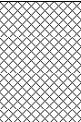
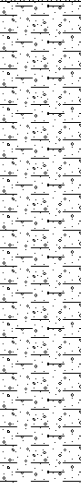
Scale

Client: BELL MUNRO CONSULTING LIMITED

Depth
2.00

0.8

1.25
Logged
JP

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
				0.40			MADE GROUND: Firm dark grey brown mottled grey slightly sandy gravelly clay with high cobble content of brick. Gravel is angular to subrounded fine to coarse of mixed lithologies including brick, concrete, rebar and sandstone. Sand is fine to medium.
							Firm brown mottled grey slightly sandy gravelly CLAY. Gravel is subangular to subrounded fine to coarse of mixed lithologies including quartzite and sandstone. Sand is fine to medium.
				2.00			End of pit at 2.00 m

Remarks:	1. Location cleared of services using a handheld Cable Avoidance Tool (CAT). 2. Trial pit excavated to 2.00m bgl. 3. No groundwater encountered. 4. Soil percolation test carried out from between 1.30m to 2.00m bgl. 5. Backfilled with arisings.
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Stability: Stable.



Project Name:	STAND LANE
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Project No.
GRO-23304

Co-ords:	-
Level:	

Date
01/11/2023

Location: RADCLIFFE

Dimensions
(m):

1.3

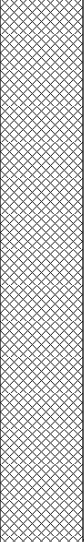
Scale
1:25

Client: BELL MUNRO CONSULTING LIMITED

Depth
1.80

1.9

Logged
JP

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
				1.80			MADE GROUND: Firm dark grey brown mottled grey slightly sandy gravelly clay with high cobble content of brick. Gravel is angular to subrounded fine to coarse of mixed lithologies including brick, concrete, sandstone, rebar, wood and plastic. Sand is fine to medium.
							Concrete slab encountered at 1.79m bgl. End of pit at 1.80 m

Remarks:	1. Location cleared of services using a handheld Cable Avoidance Tool (CAT). 2. Machine dug pit excavated to 1.80m bgl. 3. No groundwater encountered. 4. Backfilled with arisings.
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Stability: Unstable.



APPENDIX 3 - Final Gas Monitoring Results

SITE NAME:		STAND LANE, RADCLIFFE				ENGINEER:		Ethan Hitchcow				
CLIENT:		DEBTAL				DATE:		14/11/2023				
JOB NO:		GRO-23304										
Pressure Trend:		Steady	Weather:	Overcast			Equipment:		GFM 436			
Ambient:		O ₂ (%v/v)	CH ₄ (%v/v)	CO ₂ (%v/v)	LEL	H ₂ S (ppm)	CO (ppm)					
Start		20.2	0.0	0.0	0.0	0.0	0.0					
Finish		20.2	0.0	0.0	0.0	0.0	0.0					

BH Ref.	Gas Flow Rate (l/hr)		Borehole Pressure (mb)	Methane (%v/v)			Carbon Dioxide (%v/v)		Oxygen (%v/v)		Hydrogen Sulphide (ppm)		Carbon Monoxide (ppm)		Q _{hg} CO ₂ (l/hr)	Q _{hg} CH ₄ (l/hr)	Atmos Press (mb)	PID (ppm)	Sheen (Y/N)	LNAPL (Y/N)	DNAPL (Y/N)	Depth to Water (m bgl)
	Peak	Steady		Peak	Steady	LEL	Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady								
WS01	0.0	0.0	0.00	0.0	0.0	0.0	0.6	0.1	20.1	20.2	0.0	0.0	0.0	0.0	0.0006	0.0000	986	N	N	N/A	N/A	1.10
WS03	0.0	0.0	0.00	0.0	0.0	0.0	5.2	4.8	10.9	11.1	0.0	0.0	0.0	0.0	0.0052	0.0000	986	N	N	N/A	N/A	1.23
WS05	0.0	0.0	0.00	0.0	0.0	0.0	0.9	0.1	19.1	20.1	0.0	0.0	0.0	0.0	0.0009	0.0000	986	N	N	N/A	N/A	0.81
Notes:																						

SITE NAME:		STAND LANE, RADCLIFFE				ENGINEER:		Ethan Hitchcow				
CLIENT:		DEBTAL				DATE:		28/11/2023				
JOB NO:		GRO-23304										
Pressure Trend:		Falling	Weather:	Overcast			Equipment:		GFM 436			
Ambient:		O ₂ (%v/v)	CH ₄ (%v/v)	CO ₂ (%v/v)	LEL	H ₂ S (ppm)	CO (ppm)					
Start		20.3	0.0	0.0	0.0	0.0	0.0					
Finish		20.3	0.0	0.0	0.0	0.0	0.0					

BH Ref.	Gas Flow Rate (l/hr)		Borehole Pressure (mb)	Methane (%v/v)			Carbon Dioxide (%v/v)		Oxygen (%v/v)		Hydrogen Sulphide (ppm)		Carbon Monoxide (ppm)		Q _{hg} CO ₂ (l/hr)	Q _{hg} CH ₄ (l/hr)	Atmos Press (mb)	PID (ppm)	Sheen (Y/N)	LNAPL (Y/N)	DNAPL (Y/N)	Depth to Water (m bgl)
	Peak	Steady		Peak	Steady	LEL	Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady								
WS01	0.0	0.0	0.00	0.0	0.0	0.0	0.3	0.3	18.4	18.6	0.0	0.0	0.0	0.0	0.0003	0.0000	996	N	N	N/A	N/A	1.11
WS03	0.0	0.0	0.00	0.0	0.0	0.0	5.5	4.9	9.8	10.3	0.0	0.0	0.0	0.0	0.0055	0.0000	997	N	N	N/A	N/A	1.41
WS05	0.0	0.0	0.00	0.0	0.0	0.0	0.7	0.1	19.4	19.8	0.0	0.0	0.0	0.0	0.0007	0.0000	997	N	N	N/A	N/A	0.84
Notes:																						

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SITE NAME:		STAND LANE, RADCLIFFE				ENGINEER:		Ethan Hitchcow				
CLIENT:		DEBTAL				DATE:		13/12/2023				
JOB NO:		GRO-23304										
Pressure Trend:		Rising	Weather:	Overcast			Equipment:		GFM 436			
Ambient:		O ₂ (%v/v)	CH ₄ (%v/v)	CO ₂ (%v/v)	LEL	H ₂ S (ppm)	CO (ppm)					
Start		20.4	0.0	0.0	0.0	0.0	0.0					
Finish		20.4	0.0	0.0	0.0	0.0	0.0					

BH Ref.	Gas Flow Rate (l/hr)		Borehole Pressure (mb)	Methane (%v/v)			Carbon Dioxide (%v/v)		Oxygen (%v/v)		Hydrogen Sulphide (ppm)		Carbon Monoxide (ppm)		Q _{hg} CO ₂ (l/hr)	Q _{hg} CH ₄ (l/hr)	Atmos Press (mb)	PID (ppm)	Sheen (Y/N)	LNAPL (Y/N)	DNAPL (Y/N)	Depth to Water (m bgl)
	Peak	Steady		Peak	Steady	LEL	Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady								
WS01	0.0	0.0	0.00	0.0	0.0	0.0	0.5	0.1	18.1	20.1	0.0	0.0	0.0	0.0	0.0005	0.0000	993	-	N	N/A	N/A	1.05
WS03	0.0	0.0	0.00	0.0	0.0	0.0	4.2	3.6	12.7	13.9	0.0	0.0	0.0	0.0	0.0042	0.0000	993	-	N	N/A	N/A	1.42
WS05	0.0	0.0	0.00	0.0	0.0	0.0	0.6	0.3	19.4	20.1	0.0	0.0	10.0	0.0	0.0006	0.0000	993	-	N	N/A	N/A	0.82
Notes:																						

SITE NAME:		STAND LANE, RADCLIFFE				ENGINEER:		Ethan Hitchcow				
CLIENT:		DEBTAL				DATE:		11/01/2024				
JOB NO:		GRO-23304										
Pressure Trend:		Steady	Weather:	Overcast			Equipment:		GFM 436			
Ambient:		O ₂ (%v/v)	CH ₄ (%v/v)	CO ₂ (%v/v)	LEL	H ₂ S (ppm)	CO (ppm)					
Start		20.4	0.0	0.0	0.0	0.0	0.0					
Finish		20.4	0.0	0.0	0.0	0.0	0.0					

BH Ref.	Gas Flow Rate (l/hr)		Borehole Pressure (mb)	Methane (%v/v)			Carbon Dioxide (%v/v)		Oxygen (%v/v)		Hydrogen Sulphide (ppm)		Carbon Monoxide (ppm)		Q _{hg} CO ₂ (l/hr)	Q _{hg} CH ₄ (l/hr)	Atmos Press (mb)	PID (ppm)	Sheen (Y/N)	LNAPL (Y/N)	DNAPL (Y/N)	Depth to Water (m bgl)
	Peak	Steady		Peak	Steady	LEL	Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady								
WS01	0.0	0.0	0.00	0.0	0.0	0.0	1.7	1.0	10.9	18.3	0.0	0.0	0.0	0.0	0.0017	0.0000	1025	-	N	N/A	N/A	1.09
WS03	0.0	0.0	0.00	0.0	0.0	0.0	2.8	2.0	12.5	15.1	0.0	0.0	0.0	0.0	0.0028	0.0000	1026	-	N	N/A	N/A	1.70
WS05	0.0	0.0	0.00	0.0	0.0	0.0	0.6	0.5	20.0	20.2	0.0	0.0	10.0	0.0	0.0006	0.0000	1025	-	N	N/A	N/A	0.96
Notes:																						

APPENDIX 4 - Limitations

Limitations

This report (Report) forms part of the Services and if applicable Additional Services undertaken by Groundtech Consulting Ltd pursuant to a written contract (Agreement) which contains detailed provisions including express limitations of the liability of Groundtech Consulting Ltd.

This Report was prepared using reasonable skill and care as stated in the Agreement for the purpose including intended end use stated by the Client (Purpose) and the liability of Groundtech Consulting Ltd in respect of the form and content of this Report is no greater than its liability under the Agreement. All records, measurements notes, or any other data (Data) obtained by or for the benefit of the Consultant were obtained at a specific point in time and it may not be assumed by the Client or any person relying on this Report that the Data will remain unaffected by the passage of time, the seasons, weather conditions, changes in the water table or the carrying out and completion of works at the Site.

Unless otherwise agreed this Report has been prepared exclusively for the use and reliance of the Client and may not be relied upon, by any other party except as provided for in the Agreement. A third party who relies on this Report, does so at their own and sole risk and Groundtech Consulting Ltd has no liability to such parties.

Groundtech Consulting Ltd that this Report is to be used for the Purpose. The Purpose was instrumental in determining the scope and of the Services provided. If the Purpose should change, the Client may not be able to rely on the Report without the separate agreement of Groundtech Consulting Ltd.

Since the Report was written, later changes in legislation, statutory requirements and industry best practices have not been considered and this should be allowed for. Ground conditions can also change (see below) and should be investigated if there is any significant delay in acting on the findings of this Report. The period of time may result in changes in site conditions, regulatory or other legal provisions, technology or economic conditions which could render the Report inaccurate or unreliable. The information and conclusions in this Report should not be relied upon in the future without written confirmation from Groundtech Consulting Ltd that it is safe to do so.

The observations and conclusions outlined in this Report are based exclusively on the services that were provided as set out in the agreement between the client and Groundtech Consulting Ltd.

Groundtech Consulting Ltd is not liable for the existence of any condition, the discovery of which would require additional investigation outside the agreed scope of works or core competency. The Report is based upon Groundtech Consulting Ltd's observations of existing physical conditions at the Site gained from site reconnaissance together with interpretation of information including documentation, obtained from third parties and from the Client on the history and usage of the Site. The findings and recommendations contained in this Report are based in part upon information provided by third parties, and Groundtech Consulting Ltd have relied upon such information assuming it to be correct.

Groundtech Consulting Ltd accepts no responsibility for errors or inaccuracies in third party information presented in this Report. Groundtech Consulting Ltd was not authorised to independently verify the accuracy or completeness of information, documentation or materials received from the client or third parties, including laboratories and information services, during the performance of the Services or Additional Services. Groundtech Consulting Ltd is not liable for any inaccurate information, misrepresentation of data or conclusions, which may inform the scope of investigation undertaken by Groundtech Consulting Ltd and forms the contract with the client.

Where field investigations have been carried out these have been restricted to a level of detail required to achieve the stated objectives of the work. Ground conditions may also vary due to the ground's heterogeneous properties and because investigation exploratory locations only allow examination of the ground at discrete locations. The potential exists for ground conditions to be encountered which are different to those considered in this Report, particularly between exploratory holes. The extent of the limited area depends on the soil and groundwater conditions, together with other constraints such as the position of any existing structures and underground utilities. If so stipulated in the Agreement, geo-environmental testing was carried out for a limited number of parameters based on an understanding of the available operational and historical information, and it should not be inferred that other chemical species are not present.

Any groundwater conditions entered on the exploratory hole records are those observed at the time of investigation. The groundwater level often has not had time to reach equilibrium and a monitoring period is required. Furthermore, groundwater levels are subject to seasonal variation or changes in local drainage conditions and groundwater levels may occur at other times of the year which are higher than were recorded during this investigation.

Any site drawings provided in this Report are preliminary and used to present the general relative locations of features on, and surrounding, the Site.

