

Our Ref: BEK/21924/211220/JW&S

20 December 2021

J Waring & Sons Limited

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Land located at the Former TVR Factory, Bristol Avenue, Blackpool - Ground Gas Risk Assessment

BEK Enviro (BEK) has been commissioned by J Waring & Sons Ltd (JW&S) to carry out a ground gas risk assessment for the proposed commercial development located at Former TVR Factory, Bristol Avenue, Blackpool (hereafter referred to as 'the site'). This report has been prepared to support a planning application for the development of 10 industrial units (B1, B2 and B8) with associated access roads, car parking with limited landscaped areas.

The site is located to the south of Bristol Avenue and is an irregular polygon, with a main rectangular area orientated in an east-west skew, with an eastern spur. The site is essentially derelict with an operational workshop/industrial activity in the north-west buildings. The site is considered to represent a low/medium source of ground contamination.

Previous reports/assessment have been carried out at the site and these include:

- PSA Design Limited – Phase 1 Land Quality Assessment - Report Ref: D2927-GR-01, dated February 2019)
- BEK Enviro Ltd - Site Investigation & Ground Assessment - Report Ref: BEK-21924-1, dated October 2021)

Five gas monitoring probes were installed at locations recommended by PSA Design following a review of the information presented in the Phase 1 Land Quality Assessment and a review of the ground conditions encountered during the site investigation carried out by BEK Enviro in October 2021.

This report is written for the sole use of J Waring & Sons Ltd and their appointed agents. No other third party may rely on or reproduce the contents of this report without the written approval of BEK.

Background Information

The site is located to the south of Bristol Avenue and is an irregular polygon, with a main rectangular area orientated in an east-west skew, with an eastern spur. The site is essentially derelict with an operational workshop/industrial activity in the north-west buildings.

The site details are summarised in the table below:

Detail	Remarks
Location	Nothern outskirts of Blackpool
Address	Bristol Avenue, Blackpool, FY2 0JF
NGR	332179E, 439690N
Area	1.82 ha
Known Services	No services plans have been provided/made available for the scheme to date.

Table 1: Summary of Site Details (adapted from Phase 1 Assessment)

The site area is an irregular polygon, with a main rectangular area oriented in an east-west skew, with an eastern spur. There are several brick building structures within the northern areas of the site. The buildings appear to have concrete floors. The occupants are generally vehicle/machine workshops, but there is also a gym. The rear concrete yards of the buildings are used for vehicle/equipment storage.

The open southern areas of the site are generally surfaced in concrete slabs, but with minor tarmac surfacing within the north-western area, with the elongated eastern spur is made up of unbound gravel surfacing. Some historical drainage infrastructure was recorded in the form of manhole covers across the site.

Based on the earliest available maps the site was undeveloped and occupied by open fields. At this time, a drain ran diagonally south-west to north-east through the site with a pond in the south-east corner. The site remained this way until 1938 when a laundry building was noted within the eastern strip of land at the site. The drain appeared to have been infilled/diverted/piped within the site on maps dating from 1951.

On maps dating from 1960 the pond in the south-east of the site was infilled with a works and depot located in the north at this time. By 1965 a bottling depot was present in the north-west building with a coach building works noted in the central northern building and a joinery works in the north-eastern building. The coach building works was labelled light engineering works from 1971. The central north and eastern building was renamed factory from 1981 and a large factory was constructed in the southern area circa 1989 with tank present in the centre and central eastern area of the site. The eastern building was renamed warehouse at this time. The site has remained this way until 2014 when the buildings in the east and southern areas of the site were demolished.

The areas surrounding the site were noted to be vacant on maps dating from 1847 with several ponds located within 250 m (closest 60 m north of the site). Circa 1930 a refuse disposal works was noted 13 m north of the site and Bristol Avenue highway was constructed along the northern boundary of the site. Housing was also constructed to the north-west of the site at this time. Further works buildings were constructed in the industrial estate within the vicinity of the site from 1960 and an electricity substation was constructed 30 m east circa 1965. A tank was noted 40 m north of the site circa 1989 at which time a large factory was built south-east of the site. Circa 2010 the south-eastern building was used as an ice arena and buildings to the north-east and south-east of the site were demolished.

In accordance with the PSA Design Land Quality Assessment, the presence of infilled ground within and off-site would suggest that further investigation is required to assess the gas risk at the site.

BEK Site Investigation (2021)

To further assess the risks from ground gas at the site, BEK carried out site investigation during August 2021. The investigation included the drilling of 12 window sample boreholes to 5.45 m bgl and the installation of five gas monitoring probes at targeted locations. The locations of the exploratory locations and gas monitoring probes are presented on BEK Drawing 21924-3.

The site investigation encountered laterally continuous heterogeneous made ground in each exploratory location varying in depth from 0.2 m (Borehole No WS5, WS9 and WS10) to 1.9 m (Borehole No WS7). The superficial strata underlying the made ground soils generally comprised 'soft to stiff brown/grey/red sandy silty clays with occasional sand pockets and gravels'. However, 'wet light brown/orange/brown fine to coarse clayey sands and gravel' lenses were encountered sporadically across the site being noted in Borehole No WS10 (1m to 2.5 m), Borehole No WS11 (1.5 m to 2 m), Borehole No WS12 (1 m to 3m). In Trial Pit No 5, 'soft silty sands' were encountered at 0.9m down to 1.4m with 'wet cobbles and gravel' extending down to 2.1m, with 'soft clays' at the base of the excavation. 'No recovery' was recorded within the superficial strata in five locations including Borehole No WS6 (3 m to 5.45 m), Borehole No WS11 (2 m to 5.45 m), Borehole No WS4 (3 m to 4 m), Borehole No WS8 (3 m to 4 m) and Borehole No WS14 (4 to 5.45 m).

The borehole records are presented in Annex A and these include details for the monitoring probes installed. The exploratory locations are illustrated on BEK Drawing No 21924-3, a copy of which is presented in Annex C.

Gas Monitoring

An engineer from BEK has monitored the boreholes on 6 occasions between 07 September 2021 and 08 December 2021 in order to assess the potential for the generation and migration of potentially hazardous gases arising from on site and off-site sources. Based on ground conditions encountered and an initial review of the monitoring results, this monitoring program is considered to be sufficient to characterise the ground gas regime at the site.

The monitoring visits were carried out at atmospheric pressures ranging between 978 mbar and 1021 mbar. The visits undertaken during low/falling pressures are considered to represent a worst case scenario for the generation and release of ground gas.

Each borehole was monitoring for the following parameters:

- Gas Flow Rates (l/hr)
- Gas Concentrations (methane, carbon dioxide, oxygen) (v/v)
- Water Level
- Barometric Pressure

A calibrated GFM436 Gas Data Analyser has been used to measure the above. The gas monitoring results are presented in Annex B.

Gas Risk Assessment

The gas risk assessment has been undertaken in accordance with BS8485:2015+A1:2019 and CIRIA 665. The method of assessment requires the calculation of the Gas Screening Value (GSV) for both carbon dioxide and methane.

The gas concentrations and borehole flow rates are used to calculate the GSV to provide a litres of gas per hour. This equals the maximum borehole flow rate (l/hr) x maximum gas concentration (v/v).

The gas monitoring results and the calculated GSVs are presented in the following table:



Monitoring Location	Range of Concentrations (% v/v)			Steady Flow Rate (l/hr)	Gas Screening Value (GSV) (based on maximum values) (l/hr)*	
	Carbon Dioxide	Methane	Oxygen		Carbon Dioxide	Methane
WS1	0.1	0	4.1 – 19.3	0	0.0001	0
WS3**	0.8 – 3.0	0 - 1.0	15.0 – 20.2	0	0.003	0.001
WS4	0.4 – 1.0	0	16.5 – 20.3	2.4	0.024	0
WS5***	0.1	0	20.3	0	0.0001	0
WS10****	3.4 – 5.3	0	8.5 – 10.8	4.8	0.2544	0

Table 1: Summary of Assessment of the BEK Gas Monitoring Data

* Where gas flow or concentrations were recorded as zero, the limit of detection of the gas analyser was used (0.1 l/hr and 0.1 % v/v)

** Borehole Window Sample WS3 monitored on 5 out of 6 occasions

*** Borehole Window Sample WS5 monitored on 2 out of 6 occasions

**** Borehole Window Sample WS10 monitored on 3 out of 6 occasions

Gas Screening Values (GSV)

Furthermore, no gas flows were detected from Borehole No WS1, WS3 and WS5 and therefore 0.1 l/hr (limit of detection) was used for the calculation of GSV for these boreholes. The calculated GSV values for carbon dioxide for WS1, WS3, and WS5 are below 0.07 l/hr which is very low risk (Characteristic Situation 1) and no precautions are required with regards to these boreholes. The calculated GSV values for methane for WS3 is below 0.07 l/hr which is very low risk (Characteristic Situation 1) and no precautions are required with regards to these boreholes.

The GSV for carbon dioxide for Window Sample Borehole WS4 is 0.024 l/hr which is below the GSV threshold of 0.07 l/hr therefore should also be characterised as Characteristic Situation 1 (Very Low Risk).

The GSV for Window Sample Borehole WS10 for carbon dioxide is 0.2544 l/hr which is identified as Characteristic Situation 2 (CS2).

Maximum Concentrations

Consideration has also been given to the maximum concentrations recorded during the gas monitoring program. CIRIA 665 provides ‘typical maximum’ concentration of 5% for carbon dioxide and 1% for methane (Modified Wilson and Card classification) and if these typical maximum concentrations are exceeded then consideration should be given to installing measures which adhere to Characteristic Situation 2.

It is noted that the 'typical maximum' concentration of 1% was not exceeded for methane within any of the boreholes (although a typical maximum of 1% of methane was recorded on one occasion (25th November 2021) within Window Sample Borehole WS3). Consideration should be given to increasing the increasing the risk level if typical maximums are exceeded however as the 1% typical maximum for methane was not exceeded and a maximum of 1% was only identified one on monitoring occasion in one borehole it is not considered necessary to increase the risk level.

The 'typical maximum' carbon dioxide concentration of 5% v/v was exceeded on one occasion (24th September 2021) in one window sample borehole (WS10). As the GSV value for Window Sample Borehole WS10 is considered to be Characteristic Situation 2 then gas mitigation measures are already considered necessary.

As such BEK recommends that the majority of the site is characterised as very low risk and would fall under Characteristic Situation 1 (CS1) and that no gas precautions are required. However, the area in the vicinity of Window Sample Borehole WS10 is low risk and Characteristic Situation 2 (CS2) and therefore gas mitigation measures are required for buildings in this area of the site.

Determination of Gas Protection Score

When determining the gas protection score, the Characteristic Situation and building type are taken into account. As discussed, the site has been Characterised as CS1 in the north and CS2 in the south. The proposed development will comprise Type C Buildings.

When determining the gas protection score, the Characteristic Situation and building type are taken into account. As discussed, the south of the site has been characterised as CS2. The proposed development will comprise Type C buildings (Commercial with small to large rooms). If the development changes from this then the risks will need to be re-assessed.

In accordance with Table 4 of BS8485:2015+A1:2019, it is considered that the gas protection score for this building type is:

CS2 Type C building = 2.5 points.

Determination of Protection Measures

A combination of two or more of the following protection measures should be used to achieve the Gas Protection Score:

- Structural barrier (floor slab)
- Ventilation measures
- Gas resistant membrane

Floor Slab

For the proposed floor slab will comprise a cast in situ monolithic reinforced ground-bearing raft or reinforced cast in situ suspended floor slab with minimal penetrations. Based on Table 5 of BS8485:2015+A1:2019, this will achieve a gas protection score of **1 point**. To achieve a score of **1.5 points**, the raft or suspended slab should be well reinforced to control cracking and have minimal penetrations cast in.

Ventilation Measures

Passive sub floor dispersal layer (venting layer can be a clear void or formed using no fines gravel, geocomposites, polystyrene void formers, etc) with a good performance which meets all of the requirements of Table 7 of BS8485:2015+A1:2019 will achieve a score of **1.5 points**.

Gas Resistant Membrane

A low permeability methane and carbon dioxide resistant membrane which meets all of the requirements of Table 7 of BS8485:2015+A1:2019 will achieve a score of **2 points**.

The manufacturer, membrane name and specification sheet should be forwarded to BEK and the EHO for assessment and approval prior to installation.

The membrane shall be extended across cavities and sealed around joints/service entries.

Gas Protection Score Summary

By implementing a floor slab and gas membrane in accordance with the above measures, the Gas Protection Score would be as follows:

Protection Measure	Score
Cast In Situ Monolithic Reinforced Ground-bearing Raft or suspended Floor Slab	1 or 1.5
Gas Resistant Membrane	2
Total	3/3.5

Alternatively, ventilation measures with a floor slab in accordance with the above measures, the Gas Protection Score would be as follows:

Protection Measure	Score
Cast In Situ Monolithic Reinforced Ground-bearing Raft or suspended Floor Slab	1 or 1.5
Ventilation Measures	1.5
Total	2.5/3

Conclusions

The qualitative assessment of the potential risks from ground gas indicates potentially significant source of ground gas on and off site. An assessment of the ground conditions confirms that the made ground does represent a potential risk but the risk level is considered to be very low/low.

BEK therefore recommends that the site is zoned with buildings in the south of the site (a Gas Measures Plan showing the buildings which require gas mitigation measures is included in Appendix C – Drawing No 21924-4) to include gas mitigation measures in accordance with CS2, as summarised below:

This assessment assumes that the new builds will be commercial with small to large rooms (building Type C a specified in BS8485:2015+A1:2019).

The gas mitigation measures will need to consist of a combination of two or more of the following protection measures to achieve a minimum Gas Protection Score of 2:

- Structural barrier (floor slab) - *Monolithic reinforced concrete cast in situ floor raft or suspended floor slab*
- Ventilation measures - *Good performance passive sub floor dispersal layer*
- Gas resistant membrane - *Gas resistant membrane installed across the full footprint of the buildings*
- *All joints and penetrations sealed.*

The installation of the measures should be carried out by experienced contractors with relevant qualifications and independently validated by environmental consultants with suitable experience and qualifications.

The installation of the measures will need to be presented in a Gas Measures Verification Plan along with contractor and consultant details.

I trust the above is satisfactory. Should you have any questions please contact the undersigned.

Yours sincerely



MICHAEL BUCKLEY BSc (Hons) MSc MEnvSci CEnv

Rev	Date	Details of Amendments



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ANNEX A

Borehole Records



GEO-ENVIRONMENTAL CONSULTANTS

GEO-ENVIRONMENTAL CONSULTING ENGINEERS

PROJECT NUMBER 21924 PROJECT NAME Former TVR Garage, Blackpool CLIENT JWS Ltd	DATE 6th August 2021 DRILLING METHOD Window Sample Borehole BOREHOLE NO WS6 SHEET 1/12
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COMPLETION	CASING uPVC	SCREEN uPVC Factory Slotted
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COMMENTS

Depth (m)	Depth (m)	Samples/ Test	Field Records	Water	Graphic Log	Material Description	Additional Observations	Elevation (m)
					Concrete	Concrete		
0.5	0.5	D=0.5 m			Wet grey fine to coarse sandy clayey gravel of brick and concrete (Made Ground)	Wet grey fine to coarse sandy clayey gravel of brick and concrete (Made Ground)		0.5
1	1 - 1.45	SPT (C) N=7	1,1/1,2,2,2		Firm to stiff grey sandy clay with occasional rounded gravel (Made Ground)	Firm to stiff grey sandy clay with occasional rounded gravel (Made Ground)		1
1.5	1.5	D=1.5 m			Stiff orange/brown sandy clay	Stiff orange/brown sandy clay		1.5
2	2 - 2.45	SPT (C) N=10	2,2/2,2,3,3		Stiff orange/brown sandy clay	Stiff orange/brown sandy clay		2
2.5					Stiff orange/brown sandy clay	Stiff orange/brown sandy clay		2.5
3	3 - 3.45	SPT (C) N=13	2,2/3,3,3,4		no recovery	no recovery		3
3.5					no recovery	no recovery		3.5
4	4 - 4.45	SPT (C) N=27	5,4/5,6,8,8		no recovery	no recovery		4
4.5					no recovery	no recovery		4.5
5	5 - 5.45	SPT (C) N=24	5,5/6,6,6,6		no recovery	no recovery		5
5.5					Termination Depth at: 5.45 m	Termination Depth at: 5.45 m		5.5
6					Termination Depth at: 5.45 m	Termination Depth at: 5.45 m		6
6.5					Termination Depth at: 5.45 m	Termination Depth at: 5.45 m		6.5



GEO-ENVIRONMENTAL CONSULTANTS

GEO-ENVIRONMENTAL CONSULTING ENGINEERS

PROJECT NUMBER 21924 PROJECT NAME Former TVR Garage, Blackpool CLIENT JWS Ltd	DATE 6th August 2021 DRILLING METHOD Window Sample Borehole BOREHOLE NO WS10 SHEET 2/12
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COMPLETION	CASING uPVC	SCREEN uPVC Factory Slotted
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COMMENTS

Depth (m)	Depth (m)	Samples/ Test	Field Records	Water	Well Instal.	Graphic Log	Material Description	Additional Observations	Elevation (m)
					A		Concrete		
0.5	0.5	D=0.5 m					Soft brown slightly organic sandy gravelly clay		0.5
1	1 - 1.45	SPT (C) N=15	2,3/4,4,4,3				Wet light brown fine to coarse slightly clayey sand		1
1.5	1.5	D=1.5 m							1.5
2	2 - 2.45	SPT (C) N=14	3,4/4,4,4,2						2
2.5									2.5
3	3.0	D=3.0 m					Firm to stiff brown sandy clay with occasional fine rounded angular gravel (becoming very stiff from 4 m)		3
3.5	3 - 3.45	SPT (C) N=7	2,2/1,2,2,2					3.5	
4	4 - 4.45	SPT (C) N=18	4,4/4,5,5,4					4	
4.5								4.5	
5	5 - 5.45	SPT (C) N=22	5,5/5,5,6,6					5	
5.5							Termination Depth at: 5.45 m		5.5
6									6
6.5									6.5



GEO-ENVIRONMENTAL CONSULTANTS

GEO-ENVIRONMENTAL CONSULTING ENGINEERS

PROJECT NUMBER 21924	DATE 6th August 2021
PROJECT NAME Former TVR Garage, Blackpool	DRILLING METHOD Window Sample Borehole
CLIENT JWS Ltd	BOREHOLE NO WS11
	SHEET 3/12

COMPLETION	CASING uPVC	SCREEN uPVC Factory Slotted
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COMMENTS

Depth (m)	Depth (m)	Samples/ Test	Field Records	Water	Graphic Log	Material Description	Additional Observations	Elevation (m)
						Concrete		
0.5	0.5	D=0.5 m				Soft dark grey sandy clay with frequent fine too coarse gravel of brick and concrete (Made Ground)		0.5
1	1 - 1.45	SPT (C) N=3	1,1/0,1,1,1			Soft brown very sandy clay		1
1.5	1.5	D=1.5 m				Wet brown/orange fine to coarse sand and rounded/angular gravels		1.5
2	2 - 2.45	SPT (C) N=4	1,0/1,0,1,2			no recovery - possibly very wet sands or gravels		2
2.5								2.5
3	3 - 3.45	SPT (C) N=12	2,2/2,2,4,4					3
3.5								3.5
4	4 - 4.45	SPT (C) N=25	4,5/5,6,6,8					4
4.5								4.5
5	5 - 5.45	SPT (C) N=23	5,5/5,6,6,6					5
5.5						Termination Depth at: 5.45 m		5.5
6								6
6.5								6.5



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GEO-ENVIRONMENTAL CONSULTING ENGINEERS

PROJECT NUMBER 21924	DATE 6th August 2021
PROJECT NAME Former TVR Garage, Blackpool	DRILLING METHOD Window Sample Borehole
CLIENT JWS Ltd	BOREHOLE NO WS12
	SHEET 4/12

COMPLETION	CASING uPVC	SCREEN uPVC Factory Slotted
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COMMENTS

Depth (m)	Depth (m)	Samples/ Test	Field Records	Water	Graphic Log	Material Description	Additional Observations	Elevation (m)
						Concrete		
0.5	0.5	D=0.5 m				Dark brown fine to coarse very clayey sand and gravel (Made Ground)		0.5
1	1.0	D=1.0 m						1
	1 - 1.45	SPT (C) N=8	1,1/2,2,2,2			Very wet brown/orange fine to coarse sandy slightly clayey gravels		1.5
1.5								1.5
2	2 - 2.45	SPT (C) N=9	2,3/3,2,2,2					2
2.5								2.5
3	3 - 3.45	SPT (C) N=13	2,2/3,3,3,4			Stiff to very stiff light brown very sandy clay with occasional rounded gravel		3
3.5	3.5	D=3.5 m						3.5
4	4 - 4.45	SPT (C) N=19	4,4/4,5,5,5					4
4.5								4.5
5	5 - 5.45	SPT (C) N=22	4,5/6,5,5,6					5
5.5						Termination Depth at: 5.45 m		5.5
6								6
6.5								6.5



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PROJECT NUMBER 21924	DATE 13th August 2021
PROJECT NAME Former TVR Garage, Blackpool	DRILLING METHOD Window Sample Borehole
CLIENT JWS Ltd	BOREHOLE NO WS1
	SHEET 5/12

COMPLETION	CASING uPVC	SCREEN uPVC Factory Slotted
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COMMENTS

Depth (m)	Depth (m)	Samples/ Test	Field Records	Water	Well Instal.	Graphic Log	Material Description	Additional Observations	Elevation (m)
0.5	0.5 D=0.5 m						Concrete		0.5
1	1.0 D=1.0 m	SPT (C) N=3	1,0/1,0,1,1				Soft dark grey/brown sandy silty clay with frequent fine to coarse gravel and occasional brick fragments and occasional black clinker (Made Ground)		1
1.5	1.5 D=1.5 m						Soft grey very sandy slightly sandy clay with frequent fine to coarse gravel		1.5
2	2 - 2.45	SPT (C) N=6	1,1/2,1,2,1				Firm to stiff brown slightly silty sandy clay with rare fine to medium angular to rounded gravel (becoming stiff from 3 m)		2
2.5									2.5
3	3.0 D=3.0 m	SPT (C) N=10	2,2/2,3,2,3						3
3.5									3.5
4	4 - 4.45	SPT (C) N=8	2,3/2,2,2,2						4
4.5									4.5
5	5 - 5.45	SPT (C) N=27	4,4/6,7,7,7						5
5.5							Termination Depth at: 5.45 m		5.5
6									6
6.5									6.5



GEO-ENVIRONMENTAL CONSULTANTS

GEO-ENVIRONMENTAL CONSULTING ENGINEERS

PROJECT NUMBER 21924	DATE 13th August 2021
PROJECT NAME Former TVR Garage, Blackpool	DRILLING METHOD Window Sample Borehole
CLIENT JWS Ltd	BOREHOLE NO WS4
	SHEET 6/12

COMPLETION	CASING uPVC	SCREEN uPVC Factory Slotted
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COMMENTS

Depth (m)	Depth (m)	Samples/ Test	Field Records	Water	Well Instal.	Graphic Log	Material Description	Additional Observations	Elevation (m)
0.2	D=0.2 m				A		Grey fine to coarse sandy gravel of limestone (Made Ground)		0.5
0.5							Firm to stiff red/brown slightly sandy clay with rare rootlets (Possibly reworked)		1
1.0	D=1.0 m						Firm to stiff red/brown sandy clay with rare fine to medium rounded gravel		1.5
1 - 1.45	SPT (C) N=8	1,1/2,2,2,2							2
1.5									2.5
2.0	D=2.0 m								3
2 - 2.45	SPT (C) N=6	1,1/1,2,1,2							3.5
2.5									4
3 - 3.45	SPT (C) N=5	1,1/1,2,1,1					No recovery		4.5
3.5									5
4 - 4.45	SPT (C) N=8	2,2/2,2,2,2					Stiff brown sandy clay		5.5
4.5									6
5 - 5.45	SPT (C) N=12	2,2/3,3,3,3							6.5
5.5							Termination Depth at: 5.45 m		
6									
6.5									



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PROJECT NUMBER 21924	DATE 13th August 2021
PROJECT NAME Former TVR Garage, Blackpool	DRILLING METHOD Window Sample Borehole
CLIENT JWS Ltd	BOREHOLE NO WS8
	SHEET 7/12

COMPLETION	CASING uPVC	SCREEN uPVC Factory Slotted
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COMMENTS

Depth (m)	Depth (m)	Samples/ Test	Field Records	Water	Well Instal.	Graphic Log	Material Description	Additional Observations	Elevation (m)
							Concrete		
0.5	0.5	D=0.5 m					Brown fine to coarse sand with frequent fine to coarse subangular gravel (Made Ground)		0.5
1	1 - 1.45	SPT (C) N=6	1,1/1,1,2,2				Firm to stiff red/brown slightly silty sandy clay with rare fine to coarse angular to rounded gravel		1
1.5									1.5
2	2 - 2.45	SPT (C) N=6	1,1/2,1,2,1						2
2.5									2.5
3	3 - 3.45	SPT (C) N=5	2,2/1,1,2,1				No recovery		3
3.5									3.5
4	4 - 4.45	SPT (C) N=8	2,2/2,2,2,2				Stiff brown slightly silty sandy clay with rare fine to coarse angular to rounded gravel		4
4.5									4.5
5	5 - 5.45	SPT (C) N=10	2,2/3,2,2,3						5
5.5							Termination Depth at: 5.45 m		5.5
6									6
6.5									6.5



GEO-ENVIRONMENTAL CONSULTANTS

GEO-ENVIRONMENTAL CONSULTING ENGINEERS

PROJECT NUMBER 21924	DATE 13th August 2021
PROJECT NAME Former TVR Garage, Blackpool	DRILLING METHOD Window Sample Borehole
CLIENT JWS Ltd	BOREHOLE NO WS14
	SHEET 8/12

COMPLETION	CASING uPVC	SCREEN uPVC Factory Slotted
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COMMENTS

Depth (m)	Depth (m)	Samples/ Test	Field Records	Water	Well Instal.	Graphic Log	Material Description	Additional Observations	Elevation (m)
0.5	0.5 D=0.5 m						Concrete		0.5
1	1 - 1.45	SPT (C) N=7	1,1/2,2,1,2				Brown fine to coarse sand with frequent fine to coarse subangular gravel (Made Ground)		1
1.5									1.5
2	2 - 2.45	SPT (C) N=7	1,1/1,2,2,2						2
2.5									2.5
3	3 - 3.45 D=3.0 m	SPT (C) N=8	1,2/2,2,2,2						3
3.5									3.5
4	4 - 4.45	SPT (C) N=8	1,1/2,2,2,2						4
4.5									4.5
5	5 - 5.45	SPT (C) N=9	1,2/2,2,3,2						5
5.5							Termination Depth at: 5.45 m		5.5
6									6
6.5									6.5



GEO-ENVIRONMENTAL CONSULTANTS

GEO-ENVIRONMENTAL CONSULTING ENGINEERS

PROJECT NUMBER 21924	DATE 20th August 2021
PROJECT NAME Former TVR Garage, Blackpool	DRILLING METHOD Window Sample Borehole
CLIENT JWS Ltd	BOREHOLE NO WS7
	SHEET 9/12

COMPLETION	CASING uPVC	SCREEN uPVC Factory Slotted
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COMMENTS

Depth (m)	Depth (m)	Samples/ Test	Field Records	Water	Well Instal.	Graphic Log	Material Description	Additional Observations	Elevation (m)
	0.2	D=0.2 m					Concrete		
	0.5	D=0.5 m					Yellow/brown fine to coarse sand (Made Ground)		0.5
	1	SPT (C) N=5	1,0/1,1,1,2				Fine black sandy gravel of coal (Made Ground)		1
	1.5	D=1.5 m					Grey fine to coarse slightly clayey sand and gravel with rare brick (Made Ground)(Slight Hydrocarbon Odour)		1.5
	2	SPT (C) N=5	1,1/1,1,1,2				Firm to stiff red/brown sandy clay with occasional fine to coarse gravel (becoming stiff from 3 m)		2
	2.5								2.5
	3	SPT (C) N=8	1,2/2,2,2,2						3
	3.5								3.5
	4	D=4.0 m							4
	4 - 4.45	SPT (C) N=12	2,2/2,3,3,4						4
	4.5								4.5
	5	SPT (C) N=14	2,3/3,3,4,4						5
	5.5						Termination Depth at: 5.45 m		5.5
	6								6
	6.5								6.5
















GEO-ENVIRONMENTAL CONSULTANTS

GEO-ENVIRONMENTAL CONSULTING ENGINEERS

PROJECT NUMBER 21924 PROJECT NAME Former TVR Garage, Blackpool CLIENT JWS Ltd	DATE 20th August 2021 DRILLING METHOD Window Sample Borehole BOREHOLE NO WS9 SHEET 10/12
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COMPLETION	CASING uPVC	SCREEN uPVC Factory Slotted
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COMMENTS

Depth (m)	Depth (m)	Samples/ Test	Field Records	Water	Well Instal.	Graphic Log	Material Description	Additional Observations	Elevation (m)
	0.2	D=0.2 m					Concrete overlying grey fine to coarse sand and gravel of brick, concrete, mudstone and limestone (Made Ground)		0.5
0.5							Firm to stiff brown/red sandy clay with occasional fine to medium gravel (becoming stiff from 2 m)		1
1	1 - 1.45	SPT (C) N=5	2,1/1,2,1,1						1.5
1.5									2
2	2 - 2.45	SPT (C) N=8	1,1/2,2,2,2						2.5
2.5									3
	3.0	D=3.0 m							3.5
3	3 - 3.45	SPT (C) N=8	1,2/2,2,2,2						4
3.5									4.5
4	4 - 4.45	SPT (C) N=9	1,2/2,2,3,2						5
4.5									5.5
5	5 - 5.45	SPT (C) N=8	2,2/2,2,2,2						6
5.5									6.5
							Termination Depth at: 5.45 m		6.5
6									6
6.5									6.5



GEO-ENVIRONMENTAL CONSULTANTS

GEO-ENVIRONMENTAL CONSULTING ENGINEERS

PROJECT NUMBER 21924	DATE 13th August 2021
PROJECT NAME Former TVR Garage, Blackpool	DRILLING METHOD Window Sample Borehole
CLIENT JWS Ltd	BOREHOLE NO WS3
	SHEET 11/12

COMPLETION	CASING uPVC	SCREEN uPVC Factory Slotted
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COMMENTS

Depth (m)	Depth (m)	Samples/ Test	Field Records	Water	Well Instal.	Graphic Log	Material Description	Additional Observations	Elevation (m)		
0.5	0.2	D=0.2 m					Soft red/brown sandy clay with occasional sandstone and rare angular brick cobbles (Made Ground)		0.5		
1	1 - 1.45	SPT (C) N=6	1,1/1,1,2,2							1	
1.5	1.5	D=1.5 m							Stiff brown very sandy clay with occasional sandy pockets		1.5
2	2 - 2.45	SPT (C) N=9	1,1/2,2,2,3								2
2.5											2.5
3	3 - 3.45	SPT (C) N=15	2,2/3,4,4,4						3		
3.5									3.5		
4	4.0	D=4.0 m							4		
4.5	4 - 4.45	SPT (C) N=12	2,2/3,3,3,3						4.5		
5	5 - 5.45	SPT (C) N=14	2,3/3,4,3,4						5		
5.5							Termination Depth at: 5.45 m		5.5		
6									6		
6.5									6.5		



GEO-ENVIRONMENTAL CONSULTANTS

GEO-ENVIRONMENTAL CONSULTING ENGINEERS

PROJECT NUMBER 21924	DATE 13th August 2021
PROJECT NAME Former TVR Garage, Blackpool	DRILLING METHOD Window Sample Borehole
CLIENT JWS Ltd	BOREHOLE NO WS5
	SHEET 12/12

COMPLETION	CASING uPVC	SCREEN uPVC Factory Slotted
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COMMENTS

Depth (m)	Depth (m)	Samples/ Test	Field Records	Water	Well Instal.	Graphic Log	Material Description	Additional Observations	Elevation (m)
	0.2	D=0.2 m			A		Grey fine to coarse sandy gravel of limestone (Made Ground)		
0.5							Firm to stiff red/brown sandy silty clay with occasional fine to coarse gravel (becoming stiff form 3 m)		0.5
1	1 - 1.45	SPT (C) N=8	2,2/2,2,2,2						1
1.5									1.5
2	2 - 2.45	SPT (C) N=5	2,2/1,1,2,1						2
2.5									2.5
3	3.0	D=3.0 m							3
3 - 3.45		SPT (C) N=8	2,2/2,2,2,2						3
3.5									3.5
4	4 - 4.45	SPT (C) N=11	2,2/2,3,3,3						4
4.5									4.5
5	5 - 5.45	SPT (C) N=10	2,2/3,2,2,3						5
5.5							Termination Depth at: 5.45 m		5.5
6									6
6.5									6.5



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ANNEX B

Gas Monitoring Data

Ground Gas Monitoring Record

Borehole	Gas Flow		Borehole Pressure (Pa)	Methane (% v/v)		Methane (%LEL*)		Carbon Dioxide (%v/v)		Oxygen (%v/v)		H2S PPM		CO PPM		Hex (%)		Depth to water (m bgl)	Depth to Base (m bgl)	Atmospheric Pressure (mB)	Comments	
	(l/hr)	(l/hr)		Initial	Steady	Initial	Steady	Initial	Steady	Initial	Steady	Initial	Steady	Initial	Steady	Initial	Steady					
	Initial	Steady																				
WS1	0.0	0.0		0.00	0.00			0.1	0.1	19.4	19.4	0.0	0.0	0.0	0.0			0.008	1.31	1.71	1019	
WS3	0.0	0.0		0.00	0.00			0.9	0.9	20.1	20.2	0.0	0.0	0.0	0.0			0.008	0.94	1.72	1019	
WS4	-13.9	-3.3		0.00	0.00			0.6	0.4	20.0	20.3	0.0	0.0	0.0	0.0			0.007	1.1	2.54	1021	
WS5	5.1	0.0		0.00	0.00			0.1	0.1	20.3	20.3	0.0	0.0	12.0	12.0			0.012	0.79	1.8	1020	
WS10	0.0	0.0		0.00	0.00			3.4	3.4	10.9	10.8	0.0	0.0	0.0	0.0			0.006	1.1	1.36	1021	

Notes:
 Monitoring should be for not less than 3 Minutes. However, if high concentrations of gases initially recorded, monitoring should be for up to 10 mins.
 * LEL = Explosive Limit = 5%v/v
 ND - Not Detected

Relevant Information at times of monitoring	
Monitored by: Weather : Equipment used: Visible signs of vegetation stress: Boreholes sampled for laboratory analysis: Other comments / observations:	James Mashiter Sunny, Clear GFM436 Gas Analyser None None None
 <p style="text-align: center; margin-top: 5px;">GEO-ENVIRONMENTAL CONSULTING ENGINEERS</p>	
Contract: TVR, Blackpool	
Date: 07/09/21	
Job No. 21924	
Sheet No. 1	

Ground Gas Monitoring Record

Borehole	Gas Flow		Borehole Pressure (Pa)	Methane (% v/v)		Methane (%LEL*)		Carbon Dioxide (%v/v)		Oxygen (%v/v)		H2S PPM		CO PPM		Hex (%)		Depth to water (m bgl)	Depth to Base (m bgl)	Atmospheric Pressure (mB)	Comments
	Initial	Steady		Initial	Steady	Initial	Steady	Initial	Steady	Initial	Steady	Initial	Steady	Initial	Steady	Initial	Steady				
WS1	0.4	0.0		0.00	0.00			0.1	0.1	19.4	19.3	0.0	0.0	0.0	0.0	0.007	0.007	1.37	1.71	1009	
WS3	0.0	0.0		0.00	0.00			0.9	0.9	20.1	20.1	0.0	0.0	0.0	10.0	0.006	0.006	0.96	1.74	1009	
WS4	0.0	0.0		0.00	0.00			0.6	0.6	20.1	20.1	0.0	0.0	0.0	10.0	0.006	0.006	1.22	2.77	1009	
WS5	0.0	0.0		0.00	0.00			0.2	0.1	20.4	20.3	0.0	0.0	0.0	10.0	0.007	0.007	0.81	1.79	1009	
WS10	0.0	0.0		0.00	0.00			5.2	5.3	8.8	8.5	0.0	0.0	0.0	0.0	0.007	0.007	1.28	1.36	1010	

Notes:
 Monitoring should be for not less than 3 Minutes. However, if high concentrations of gases initially recorded, monitoring should be for up to 10 mins.
 * LEL = Explosive Limit = 5%v/v
 ND - Not Detected

Relevant Information at times of monitoring	
Monitored by: Weather : Equipment used: Visible signs of vegetation stress: Boreholes sampled for laboratory analysis: Other comments / observations:	James Mashiter Overcast GFM436 Gas Analyser None None None
 <p>GEO-ENVIRONMENTAL CONSULTING ENGINEERS</p>	
Contract: TVR, Blackpool	
Date: 24/09/21	
Job No. 21924	
Sheet No. 2	

Ground Gas Monitoring Record

Borehole	Gas Flow		Borehole Pressure (Pa)	Methane (% v/v)		Methane (%LEL*)		Carbon Dioxide (%v/v)		Oxygen (%v/v)		H2S PPM		CO PPM		Hex (%)		Depth to water (m bgl)	Depth to Base (m bgl)	Atmospheric Pressure (mB)	Comments
	Initial	Steady		Initial	Steady	Initial	Steady	Initial	Steady	Initial	Steady	Initial	Steady	Initial	Steady	Initial	Steady				
	WS1	0.0		0.0		0.00	0.00			0.1	0.1	14.2	13.2	0.0	0.0	0.0	0.0				
WS3	0.0	0.0		0.00	0.00			0.8	0.8	16.7	15.2	0.0	0.0	0.0	0.0	0.004	0.007	0.05	1.74	1001	Submerged
WS4	0.0	0.0		0.00	0.00			0.5	0.5	19.1	19.3	0.0	0.0	0.0	0.0	0.005	0.003	0.42	2.76	1002	
WS5																					
WS10	89.6																	0	1.31	1002	Submerged

Notes:
 Monitoring should be for not less than 3 Minutes. However, if high concentrations of gases initially recorded, monitoring should be for up to 10 mins.
 * LEL = Explosive Limit = 5%v/v
 ND - Not Detected

Relevant Information at times of monitoring	
Monitored by: Jonathan Douglas Weather : Overcast, Raining Equipment used: GFM436 Gas Analyser Visible signs of vegetation stress: None Boreholes sampled for laboratory analysis: None Other comments / observations: None	
Contract: TVR, Blackpool	
Date: 19/10/21	
Job No. 21924	
Sheet No. 3	

Ground Gas Monitoring Record

Borehole	Gas Flow		Borehole Pressure (Pa)	Methane (% v/v)		Methane (%LEL*)		Carbon Dioxide (%v/v)		Oxygen (%v/v)		H2S PPM		CO PPM		Hex (%)		Depth to water (m bgl)	Depth to Base (m bgl)	Atmospheric Pressure (mB)	Comments
	(l/hr)	(l/hr)		Initial	Steady	Initial	Steady	Initial	Steady	Initial	Steady	Initial	Steady	Initial	Steady	Initial	Steady				
	Initial	Steady																			
WS1	0.4	0.0		0.00	0.00			0.1	0.1	14.1	14.1	0.0	0.0	6.0	6.0	0.002	0.002	0.92	1.74	994	
WS3	-13.9	0.0		0.00	0.00			0.8	0.8	16.7	16.7	0.0	0.0	0.0	0.0	0.000	0.000	0.52	1.75	993	
WS4	4.0	0.0		0.00	0.00			0.9	1.0	16.5	16.5	0.0	0.0	0.0	0.0	0.000	0.000	0.45	2.74		
WS5																					Removed during service works
WS10	89.6																	0	1.31	994	Submerged

Notes:

Monitoring should be for not less than 3 Minutes. However, if high concentrations of gases initially recorded, monitoring should be for up to 10 mins.

* LEL = Explosive Limit = 5%v/v

ND - Not Detected

Relevant Information at times of monitoring

Monitored by: Weather : Equipment used: Visible signs of vegetation stress: Boreholes sampled for laboratory analysis: Other comments / observations:	James Mashiter Rain GFM436 Gas Analyser None None None
--	---



Contract:
TVR, Blackpool

Date: **2nd November 2021**

Job No. 21924

Sheet No. **4**

Ground Gas Monitoring Record

Borehole	Gas Flow		Borehole Pressure (Pa)	Methane (% v/v)		Methane (%LEL*)		Carbon Dioxide (%v/v)		Oxygen (%v/v)		H2S PPM		CO PPM		Hex (%)		Depth to water (m bgl)	Depth to Base (m bgl)	Atmospheric Pressure (mB)	Comments
	Initial	Steady		Initial	Steady	Initial	Steady	Initial	Steady	Initial	Steady	Initial	Steady	Initial	Steady	Initial	Steady				
	(l/hr)	(l/hr)		(% v/v)	(%LEL*)	(%v/v)	(%v/v)	(%v/v)	(%v/v)	(%v/v)	(%v/v)	(%v/v)	(%v/v)	(%v/v)	(%v/v)	(%v/v)	(%v/v)				
WS1	-15.0	0.0	-	0.00	0.00	-	-	0.1	0.2	11.9	10.2	0.0	0.0	0.0	0.0	0.002	0.001	1.01	1.77	1017	
WS3	-30.0	0.0	-	0.00	1.00	-	-	0.9	3.0	15.5	15.0	0.0	0.0	0.0	0.0	0.000	0.002	0.45	1.68	1015	
WS4	0.0	0.0	-	0.00	0.00	-	-	0.4	0.4	19.6	19.6	0.0	0.0	0.0	0.0	0.000	0.000	0.88	2.71	1016	
WS5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1016	Removed during service works
WS10	0.0	0.0	-	0.00	0.00	-	-	1.1	1.1	17.0	17.4	0.0	0.0	0.0	0.0	0.001	0.000	0.92	1.29	1017	Submerged

Notes:
 Monitoring should be for not less than 3 Minutes. However, if high concentrations of gases initially recorded, monitoring should be for up to 10 mins.
 * LEL = Explosive Limit = 5%v/v
 ND - Not Detected

Relevant Information at times of monitoring										
Monitored by: Weather : Equipment used: Visible signs of vegetation stress: Boreholes sampled for laboratory analysis: Other comments / observations:	Johnny Douglas and Nicholas Furber Clear, 0% Cloud GFM436 Gas Analyser None None None	<div style="text-align: center;">  <p>GEO-ENVIRONMENTAL CONSULTING ENGINEERS</p> </div> <div style="margin-top: 10px;"> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="padding: 2px;">Contract:</td> <td style="padding: 2px;">TVR, Blackpool</td> </tr> <tr> <td style="padding: 2px;">Date:</td> <td style="padding: 2px;">25/11/21</td> </tr> <tr> <td style="padding: 2px;">Job No.</td> <td style="padding: 2px;">21924</td> </tr> <tr> <td style="padding: 2px;">Sheet No.</td> <td style="padding: 2px;">5</td> </tr> </table> </div>	Contract:	TVR, Blackpool	Date:	25/11/21	Job No.	21924	Sheet No.	5
Contract:	TVR, Blackpool									
Date:	25/11/21									
Job No.	21924									
Sheet No.	5									

Ground Gas Monitoring Record

Borehole	Gas Flow		Borehole Pressure (Pa)	Methane (% v/v)		Methane (%LEL*)		Carbon Dioxide (%v/v)		Oxygen (%v/v)		H2S PPM		CO PPM		Hex (%)		Depth to water (m bgl)	Depth to Base (m bgl)	Atmospheric Pressure (mB)	Comments
	Initial	Steady		Initial	Steady	Initial	Steady	Initial	Steady	Initial	Steady	Initial	Steady	Initial	Steady	Initial	Steady				
WS1	0.0	0.0		0.00	0.00			0.2	0.1	7.0	4.1	0.0	0.0	6.0	6.0	0.015	0.015	0.94	1.74	978	
WS3																					Borehole completely submerged by water, sand and stones
WS4	2.4	2.4		0.00	0.00			0.7	0.9	12.2	18.6	0.0	0.0	0.0	0.0	0.007	0.007	0.7	2.76	978	
WS5																					Removed during service works
WS10	4.8	4.8																0	1.29	978	Borehole submerged

Notes:
 Monitoring should be for not less than 3 Minutes. However, if high concentrations of gases initially recorded, monitoring should be for up to 10 mins.
 * LEL = Explosive Limit = 5%v/v
 ND - Not Detected

Relevant Information at times of monitoring		
Monitored by:	Alice Molyneux	Contract:
Weather :	wind and rain	TVR, Blackpool
Equipment used:	GFM436 Gas Analyser	Date: 08/12/21
Visible signs of vegetation stress:	None	Job No. 21924
Boreholes sampled for laboratory analysis:	None	Sheet No. 6
Other comments / observations:	None	





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ANNEX C

Drawings



Proposed Site Layout

LEGEND

-  WINDOW SAMPLE BOREHOLE
-  WINDOW SAMPLE BOREHOLE (WITH GAS/GROUNDWATER PROBE)
-  BUILDINGS REQUIRING GAS MEASURES IN ACCORDANCE WITH CHARACTERISTIC SITUATION 2 (CS2)



REV	DESCRIPTION	DATE	BY



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 Web: www.bekenviro.co.uk

CLIENT.
 J WARING AND SONS LTD

JOB TITLE.
 LAND AT FORMER TVR GARAGE,
 BRISTOL AVENUE, BLACKPOOL

DRAWING TITLE.
 PLOTS REQUIRING GAS MEASURES IN
 ACCORDANCE WITH CHARACTERISTIC
 SITUATION 2 (CS2)

SCALE © A3. NTS	DRAWN BY. D.E.	APPROVED BY. M.B.	DATE. 14/12/21
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DRAWING No. 21924-4	REV. -
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