

Partnership No: OC 300776

New Settlement Area, Heyford Park, Oxfordshire

Dorchester Trenchard Circle Post Remediation Vapour Risk Assessment

For: Dorchester Heyford Park Group Ltd

September 2020

R1742d-R02-v1 Final

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Signed for Smith Grant LLP

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NEW SETTLEMENT AREA, HEYFORD PARK, OXFORDSHIRE

TRENCHARD CIRCLE - POST REMEDIATION VAPOUR RISK ASSESSMENT

For: Dorchester Heyford Park Group Ltd

September 2020

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1. Introduction

- 1.1 Remediation earthworks to prepare the parcel of land referred to as 'Trenchard Circle' (Planning Ref. 16/00196/F) within the Heyford Park development, Upper Heyford for residential land use has been undertaken by Agetur UK Ltd. on behalf of Dorchester Homes.
- 1.2 The remedial works included the excavation and removal of two former heating oil tanks and underground pipework which served the former buildings and the removal of hydrocarbon impacted soils down to bedrock. Oxygen Release Compounds (ORC) were placed at the base of the remediation excavations to facilitate enhanced microbial degradation of any remaining hydrocarbon contaminants.
- 1.3 Supervision of the remedial works and the verification of their effectiveness through the collection of soil samples from the sides and bases of the excavations were undertaken by AAe Environmental Ltd. and the findings were reported within the Trenchard Circle Remedial Completion Report (ref. 173042/RCR/001; February 2018). AAe report that 6 validation samples resulted in exceedances of the remediation criteria following which further excavation and validation sampling was undertaken.
- 1.4 The Remedial Completion Report concluded that VOC resistant membranes should be installed and verified within all plots in accordance with current guidance. It is assumed that this standing recommendation is based on the potential for impacted bedrock to remain.
- 1.5 SGP recommended that further risk assessment could be undertaken using vapour monitoring wells to establish whether a residual VOC risk remains and to assess the potential for revising the recommendation on whether the installation of VOC resistant membranes is necessary. This is consistent with the approach adopted within other phases of the Heyford Park development.
- 1.6 Dorchester Homes duly instructed Smith Grant LLP to carry out a post-remediation vapour risk assessment. This report details the findings of the above assessment, provides a further quantitative risk assessment based on the results, and makes recommendations on further monitoring / precautionary mitigation measures, as necessary.

2. Methodology

2.1 Monitoring Locations and Installations

- 2.1.1 Installations for the monitoring of VOCs were constructed on 05.08.20 with a modification to British Standard BS8576:2013¹ (Section 10.2.3) and were located on an approximate 50m spacing in the footprints of the remediation excavations as indicated on Drawing D01. Due to the presence of dense gravel of weathered bedrock and shallow rockhead, the installation of shallow monitoring wells through use of a drilling rig was not considered feasible and so monitoring probes were installed within trial-pits. This involved the excavation of a narrow trial-pit to 1m depth and a 1.5m long steel vapour probe was then placed in the pit along the sidewall within a larger diameter drainage pipe. The pit was carefully backfilled with 10mm single-sized stone gravel placed down the drainage pipe to provide a 0.5m permeable fill packing around the response zone of the probe; the remaining 0.5m to ground level was then backfilled with the remaining trial-pit arisings and compacted. The drainage pipe was then removed, leaving the vapour probe in place with approximately 0.5m remaining above ground level. An annulus of hydrated bentonite pellets was then compacted at the surface to provide a sufficient seal between the probe and surrounding ground.
- 2.1.2 Following installation of the probes, passive diffusion tubes (provided by Gradko International Ltd.) with appropriate adsorption media for volatile aliphatic and aromatic hydrocarbons (<C16 and BTEX) were secured to the probe caps and sealed with PTFE tape. The diffusion tubes were then left in-situ for a period specified by the laboratory (2.5 weeks) to allow sufficient adsorption of determinants and achieve a suitable limit of detection (LOD) for comparison with assessment criteria.</p>



Figure 1. Vapour Probe Construction

Trial-pit excavated and steel vapour probes installed along sidewall.

Gravel packing placed at lower 0.5m of probe around response zone and pit backfilled

¹ BS 8576:2016 Guidance on investigations for ground gas – Permanent gases and Volatile Organic Compounds (VOCs)



Hydrated bentonite annulus placed at interface between probe and ground level to provide a sufficient seal Installation of diffusion tube supplied by Gradko International within top of probe and left in situ for 3 weeks

- 2.1.3 A travel blank (to check for cross-contamination which remained sealed) and an external tube to provide background concentrations located to the southeast along Larsen Road were also used during the monitoring period.
- 2.1.4 Diffusion tubes were left in-situ for a period of 2.5 weeks before collection on 21.08.20 and were then couriered to Gradko International Ltd. for analysis (lab ref. O04603R).

2.2 Derivation of Inhalation Assessment Criteria

- 2.2.1 To determine whether concentrations of the contaminants of concern were present at levels which may pose a risk to human health, derivation of assessment criteria was carried out.
- 2.2.2 The methodology for deriving assessment screening criteria for health impacts from VOCs at the receptor is set out in Appendix 9 of the VOC handbook². Tolerable Daily Soil Intake values or Index Doses (for non-carcinogens and carcinogens respectively) are multiplied by the body weight (13.3 kg) and divided by the inhalation rate (8.8 m³/day) of a child receptor as defined in the most recent published UK guidance (DEFRA C4SL). Most of the substances under consideration have toxicological inhalation data published in the "LQM/CIEH S4ULs for Human Health Risk Assessment" (S4UL) *Copyright Land Quality Management Limited reproduced with Permission* or CL:AIRE "Soil Generic Assessment Criteria for Human Health Risk Assessment".
- 2.2.3 TDIs and / or IDs used in the determination of inhalation assessment criteria are summarised in the table below:

² CIRIA C682: The VOCs Handbook: Investigating, assessing and managing risks from inhalation of VOCs at land affected by contamination 2009

Contaminant	Index Dose/Tolerable Daily Intake (µg/kg.bw.day ⁻¹)	Assessment Criteria (µg.m ³)
Benzene	1.4 (S4UL)	2.12
Toluene	1400 (S4UL)	2,115.91
Ethylbenzene	74.3 (S4UL)	112.29
m/p-xylene	60 (S4UL)	90.68
o-xylene	60 (S4UL)	90.68
Aliphatic Hydrocarbons (C56-C6)	5000 (S4UL)	7,556.82
Aliphatic Hydrocarbons (C6-C8)	5000 (S4UL)	7,556.82
Aliphatic Hydrocarbons (C8-C10)	290 (S4UL)	438.3
Aliphatic Hydrocarbons (C10-C12)	290 (S4UL)	438.3
Aliphatic Hydrocarbons (C12-C16)	290 (S4UL)	438.3
Aromatic Hydrocarbons (C5-C7)*	Benzene	Benzene
Aromatic Hydrocarbons (C7-C8)*	Toluene	Toluene
Aromatic Hydrocarbons (C8-C10)	60 (S4UL)	90.68
Aromatic Hydrocarbons (C10-C12)	60 (S4UL)	90.68
Aromatic Hydrocarbons (C12-C16)	60 (S4UL)	90.68

*Aromatic C5-C7 and C7-C8 correspond to benzene and toluene. As BTEX analysis has been undertaken repetition of these results in the aromatic fraction have not been reported.

2.2.4 The assessment criteria are inherently conservative as they assume long-term, constant exposure of residents over 24 hr periods, 365 days a year and a continuous source which does not diminish over time. However, for the most vulnerable receptors, infants and small children, significant amounts of time spent within dwellings may be anticipated.

3. Vapour Risk Assessment

3.1. Comparison of soil-vapour concentrations determined through diffusion tube monitoring are compared to the derived inhalation assessment criteria in the table below. The Gradko laboratory report is provided in Appendix A.

Contaminant	Assessment Criteria (ug/m ³)	Soil-Vapour Range of concentrations (ug/m ³)	Exceedances
Benzene	2.12	<0.7 – 1.1	None
Toluene	2,115.91	<0.7 – 1.4	None
Ethylbenzene	112.29	<0.6	None
m/p-xylene	90.68	<0.6 - 0.8	None
o-xylene	90.68	<0.6	None
Aliphatic Hydrocarbons (EC6-8)	7,556.82	<0.6 - 2.3	None
Aliphatic Hydrocarbons (EC8-10)	438.3	<0.6 - 0.7	None
Aliphatic Hydrocarbons (EC10-12)	438.3	<0.6 - 6.9	None
Aliphatic Hydrocarbons (EC12-16)	438.3	<0.6 - 23	None
Aromatic Hydrocarbons (EC5-7)	As Benzene	As Benzene	None
Aromatic Hydrocarbons (EC7-8)	As Toluene	As Toluene	None
Aromatic Hydrocarbons (EC8-10)	90.68	<0.6-31.4	None
Aromatic Hydrocarbons (EC10-12)	90.68	<0.6-7.8	None
Aromatic Hydrocarbons (EC12-16)	90.68	<0.6	None

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Table 2.	Derivation	of Assessment	Criteria and	Comparison to	o Soll-vapour	Concentrations

- 3.2. No exceedances of the derived assessment criteria were reported for any of the BTEX compounds or the aliphatic / aromatic hydrocarbon fractions.
- 3.3. The results are consistent with observations during a trial-pitting exercise carried out by SGP across the site (R1742d-L20200717) and during the installation of the vapour probes as no staining, sheens, odours or elevated PID readings were recorded which suggests the absence of any residual fuel contamination.

4. Conclusions and Recommendations

- 4.1. Previous remedial works within the site included the removal and verification of hydrocarbon impacted soils associated with a former heating oil tank and pipeline which once served a number of dwellings on the site. The remedial work was reported as being largely effective as evident by the verification samples collected from the base and sides of the excavation, however the reporting included a precautionary recommendation for the installation of a vapour protection measures within all proposed dwellings.
- 4.2. Given the reported absence of any unacceptable contamination, SGP have undertaken a VOC assessment to establish whether elevated hydrocarbon and BTEX compounds remain and assess whether vapour protection measures are required.
- 4.3. In-situ vapour monitoring was completed on an approximate 50m spacing with vapour probes located within the remediated areas where the removal of fuel impacted soils had previously taken place. Concentrations of BTEX and volatile hydrocarbons (<C16) within the soil-gas phase were compared to derived inhalation criteria. No exceedances were reported with concentrations significantly below the derived criteria.</p>
- 4.4. The results are consistent with findings of the remedial validation report which demonstrated the effective removal of impacted soils based on the validation data as well as the application of ORC to facilitate enhanced microbial degradation of any residual fuels. SGP have undertaken trial-pitting across the site during which time no contamination indicators such as staining, odours or elevated PID readings were reported which further demonstrates the absence of any residual contamination.
- 4.5. It is concluded that further monitoring or assessment is not required and that there is no requirement for the installation of VOC resistant gas protection measures within plots on the site.

General

4.6. This report has been prepared by SGP for the sole and exclusive use of Dorchester Heyford Park Group Ltd. Reasonable skill, care and diligence has been exercised within the budget available, and in accordance with the technical requirements of the brief. Notwithstanding the efforts made by the professional team in undertaking the assessment and preparing this report, it is possible that other ground conditions and contamination as yet undetected may exist. Reliance on the findings of this report must therefore be limited accordingly. Such reliance must be based on the whole report and not on extracts which may lead to incomplete or incorrect conclusions when taken out of context.

- 4.7. Any comments made on soil-air vapour conditions are based on observations or tests made at the time that the work was carried out. It should be noted that concentrations of substances may vary according to seasonal or weather-related effects, sometimes in an unpredictable fashion.
- 4.8. SGP reserves the right to alter any of the foregoing information in the event of new information being disclosed or provided and in the light of changes to legislation, guidelines and responses by the statutory and regulatory authorities.

DRAWING



APPENDIX A

Analytical Results





LABORATORY ANALYSIS REPORT

O04603R
Smith Grant LLP
Station House
Station Road
Ruabon, Wrexham
LL14 6DL
S0849
80815
24/08/2020
Tenax
R1742d

Quantitative Analysis of BTEX Estimation of ng on tube in accordance with ISO16000-6 and calculation of total TPH

Tube Number Gradko Lab Reference Exposure Time (mins)* Sample ID	GRA11828 02O0448 22906 V1			
втех		na on tube	ppb in air*	uam ⁻³ *
Benzene		<5	<0.2	<0.7
Toluene		<5	<0.2	<0.7
Ethylbenzene		<5	<0.1	<0.6
m/p-Xylene		<5	<0.1	<0.6
o-Xylene		<5	<0.1	<0.6
	NIST Library			
EC5-EC6 Aliphatic Hydrocarbons**	Quality Match	Estimated ng on tube 26	ppb in air* 0.6	<mark>µgm⁻³*</mark> 1.6
EC>6-EC8 Aliphatic Hydrocarbons**	NIST Library Quality Match	Estimated ng on tube <5	ppb in air* <0.1	
EC>8-EC10 Aliphatic Hydrocarbons**	NIST Library Quality Match	Estimated ng on tube <5	ppb in air* <0.1	
EC>10-EC12 Aliphatic Hydrocarbons**	NIST Library Quality Match	Estimated ng on tube <5	ppb in air* <0.1	

Samples have been tested within the scope of Gradko International Ltd. Laboratory Quality Procedures. Results within this report relate only to samples as received. Data provided by the client and any subsequent calculations shall be indicated by an asterisk (*), these calculations and results are not within the scope of our UKAS accreditation. Any queries concerning data in this report should be directed to the Laboratory Manager Gradko International Ltd. This report is not to be reproduced, except in full, without the written permission of Gradko International Ltd.

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	L. Gates, Laboratory Manager





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	NIST Library			
EC>12-EC16 Aliphatic Hydrocarbons**	Quality Match	Estimated ng on tube 125	ppb in air* 2.7	μgm ⁻³ * 23
EC5-EC7 Aromatic Hydrocarbons**		(Benzene)		
EC>7-EC8 Aromatic Hydrocarbons**		(Toluene)		
EC>8-EC10 Aromatic Hydrocarbons**	NIST Library Quality Match	Estimated ng on tube <5	ppb in air* <0.1	
EC>10-EC12 Aromatic Hydrocarbons**	NIST Library Quality Match	Estimated ng on tube <5	ppb in air* <0.1	
EC>12-EC16 Aromatic Hydrocarbons**	NIST Library Quality Match	Estimated ng on tube <5	ppb in air* <0.1	
Tube Number Gradko Lab Reference Exposure Time (mins)* Sample ID	003792 02O0449 22906 V2			
BTEX		ng on tube	ppb in air*	μgm ⁻³ *
Benzene		5.2	0.2	0.7
Toluene		<5	<0.2	<0.7
Ethylbenzene		<5	<0.1	<0.6
m/p-Xylene o-Xylene		<5 <5	<0.1 <0.1	<0.6 <0.6
EC5-EC6 Aliphatic Hydrocarbons**	NIST Library Quality Match	Estimated ng on tube <5	ppb in air* <0.1	
EC>6-EC8 Aliphatic Hydrocarbons**	Quality Match	Estimated ng on tube <5	ppb in air* <0.1	
EC>8-EC10 Aliphatic Hydrocarbons**	NIST Library Quality Match	Estimated ng on tube <5	ppb in air* <0.1	

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	L. Gates, Laboratory Manager





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EC>10-EC12 Aliphatic Hydrocarbons**	NIST Library Quality Match	Estimated ng on tube 17	ppb in air* 0.4	<mark>μgm⁻³*</mark> 2.4
	NIST Library Quality Match	Estimated ng on tube	ppb in air*	μgm ⁻³ *
EC>12-EC16 Aliphatic Hydrocarbons**		41	0.9	7.8
EC5-EC7 Aromatic Hydrocarbons**		(Benzene)		
EC>7-EC8 Aromatic Hydrocarbons**		(Toluene)		
	NIST Library			
EC>8-EC10 Aromatic Hydrocarbons**	Quality Match	Estimated ng on tube 60	ppb in air* 1.3	<mark>μgm⁻³*</mark> 6.2
	NIST Library			
EC>10-EC12 Aromatic Hydrocarbons**	Quality Match	Estimated ng on tube 17	ppb in air* 0.4	<mark>μgm⁻³*</mark> 1.9
	NIST Library			
EC>12-EC16 Aromatic Hydrocarbons**	Quality Match	Estimated ng on tube <5	ppb in air* <0.1	
Tube Number Gradko Lab Reference Exposure Time (mins)* Sample ID	GRA05093 02O0450 22907 V3			
BTEX		na on tube	oph in air*	uam ⁻³ *
Benzene		6.1	0.3	0.8
Toluene		6.4	0.2	0.8
Ethylbenzene		<5.0	<0.1	<0.6
m/p-Xylene o-Xylene		6.6 <5.0	0.2 <0.1	0.8 <0.6
	NIST Library			
EC5-EC6 Aliphatic Hydrocarbons**	Quality Match	Estimated ng on tube <5	ppb in air* <0.1	
	NIST Library			
EC>6-EC8 Aliphatic Hydrocarbons**	Quality Match	Estimated ng on tube <5	ppb in air* <0.1	
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EC>12-EC16 Aromatic Hydrocarbons**	Quality Match	Estimated ng on tube <5	ppb in air* <0.1	
EC>12-EC16 Aromatic Hydrocarbons**	Quality Match	Estimated ng on tube <5	ppb in air* <0.1	
EC>12-EC16 Aromatic Hydrocarbons**	NIST Library Quality Match	Estimated ng on tube <5	ppb in air* <0.1	
EC>10-EC12 Aromatic Hydrocarbons**	Quality Match NIST Library	Estimated ng on tube 70	ppb in air* 1.5	μgm ** 7.8
EC>8-EC10 Aromatic Hydrocarbons**	NIST Library	186	4.1	19.5
	NIST Library Quality Match	Estimated ng on tube	ppb in air*	μgm ⁻³ *
EC>7-EC8 Aromatic Hydrocarbons**		(Toluene)		
EC5-EC7 Aromatic Hydrocarbons**		(Benzene)	200 BČ	-
EC>12-EC16 Aliphatic Hydrocarbons**	NIST Library Quality Match	Estimated ng on tube 26	ppb in air* 0.6	<mark>µgm⁻³*</mark> 4.8
EC>10-EC12 Aliphatic Hydrocarbons**	NIST Library Quality Match	Estimated ng on tube 8	ppb in air* 0.2	<mark>μgm⁻³*</mark> 1.2
EC>8-EC10 Aliphatic Hydrocarbons**	NIST Library Quality Match	Estimated ng on tube <5	ppb in air* <0.1	

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EC>6-EC8 Aliphatic Hydrocarbons**	NIST Library Quality Match	Estimated ng on tube <5	ppb in air* <0.1	
EC>8-EC10 Aliphatic Hydrocarbons**	NIST Library Quality Match	Estimated ng on tube <5	ppb in air* <0.1	
EC>10-EC12 Aliphatic Hydrocarbons**	NIST Library Quality Match	Estimated ng on tube 47	ppb in air* 1.0	<mark>µgm⁻³*</mark> 6.9
EC>12-EC16 Aliphatic Hydrocarbons**	NIST Library Quality Match	Estimated ng on tube 111	ppb in air* 2.4	<mark>µgm⁻³*</mark> 18.8
EC5-EC7 Aromatic Hydrocarbons**		(Benzene)		
EC>7-EC8 Aromatic Hydrocarbons**		(Toluene)		
EC>8-EC10 Aromatic Hydrocarbons**	NIST Library Quality Match	Estimated ng on tube 43	ppb in air* 0.9	<mark>μgm⁻³*</mark> 4.5
EC>10-EC12 Aromatic Hydrocarbons**	NIST Library Quality Match	Estimated ng on tube 26	ppb in air* 0.6	<mark>μgm⁻³*</mark> 2.8
EC>12-EC16 Aromatic Hydrocarbons**	NIST Library Quality Match	Estimated ng on tube <5	ppb in air* <0.1	
Tube Number Gradko Lab Reference Exposure Time (mins)* Sample ID	004237 02O0452 22907 V5			
BTEX Benzene Toluene Ethylbenzene m/p-Xylene o-Xylene		ng on tube <5 <5 <5 <5 <5 <5	ppb in air* <0.2 <0.2 <0.1 <0.1 <0.1	μgm ⁻³ * <0.7 <0.6 <0.6 <0.6

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	E. Gates, Eaboratory Manager





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	NIST Library			
EC5-EC6 Aliphatic Hydrocarbons**	Quality Match	Estimated ng on tube <5	ppb in air* <0.1	
EC>6-EC8 Aliphatic Hydrocarbons**	NIST Library Quality Match	Estimated ng on tube <5	ppb in air* <0.1	
EC>8-EC10 Aliphatic Hydrocarbons**	NIST Library Quality Match	Estimated ng on tube <5	ppb in air* <0.1	
EC>10-EC12 Aliphatic Hydrocarbons**	NIST Library Quality Match	Estimated ng on tube 13	ppb in air* 0.3	<mark>µgm⁻³*</mark> 1.8
EC>12-EC16 Aliphatic Hydrocarbons**	NIST Library Quality Match	Estimated ng on tube 63	ppb in air* 1.4	<mark>µgm⁻³*</mark> 11.8
EC5-EC7 Aromatic Hydrocarbons**		(Benzene)		
EC>7-EC8 Aromatic Hydrocarbons**		(Toluene)		
EC>8-EC10 Aromatic Hydrocarbons**	NIST Library Quality Match	Estimated ng on tube 151	ppb in air* 3.3	<mark>µgm⁻³*</mark> 15.8
EC>10-EC12 Aromatic Hydrocarbons**	NIST Library Quality Match	Estimated ng on tube 56	ppb in air* 1.2	<mark>µgm⁻³*</mark> 6.2
EC>12-EC16 Aromatic Hydrocarbons**	NIST Library Quality Match	Estimated ng on tube <5	ppb in air* <0.1	

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Tube Number	003571	
Gradko Lab Reference	0200453	
Exposure Time (mins)*	22907	
Sample ID	V6	

BTEX		ng on tube	ppb in air*	μgm ⁻³ *
Benzene		8.1	0.3	1.1
		<5	<0.2	<0.7
		<5	<0.1	<0.6
n/p-Aylene		<5	<0.1	<0.0
0-Aylene		-9	~0.1	~0.0
	NIST Library			
	Quality Match	Estimated no on tube	ppb in air*	
EC5-EC6 Aliphatic Hydrocarbons**	duality matori	<5	<0.1	
		-		
	NIST Library			
	Quality Match	Estimated ng on tube	ppb in air*	
EC>6-EC8 Aliphatic Hydrocarbons**		<5	<0.1	
	NIST Library			
	Quality Match	Estimated ng on tube	ppb in air*	
EC>8-EC10 Aliphatic Hydrocarbons**		<5	<0.1	
	NIOT Library			
	NIST LIDrary	Estimated no on tube	nnh in airt	
EC>10-EC12 Aliphatic Hydrocarbons**	Quality Match	<5		
		-5	-0.1	
	NIST Library			
	Quality Match	Estimated ng on tube	ppb in air*	
EC>12-EC16 Aliphatic Hydrocarbons**		<5	<0.1	
EC5-EC7 Aromatic Hydrocarbons**		(Benzene)		
EC>7-EC8 Aromatic Hydrocarbons**		(Toluene)		
	NIST Library			
	Quality Match	Estimated no on tube	ppb in air*	µam ⁻³ *
EC>8-EC10 Aromatic Hydrocarbons**	,	299	6.5	31.4
.				
	NIST Library			
	Quality Match	Estimated ng on tube	ppb in air*	μgm ⁻³ *
EC>10-EC12 Aromatic Hydrocarbons**		67	1.5	7.1

Samples have been tested within the scope of Gradko International Ltd. Laboratory Quality Procedures. Results within this report relate only to samples as received. Data provided by the client and any subsequent calculations shall be indicated by an asterisk (*), these calculations and results are not within the scope of our UKAS accreditation. Any queries concerning data in this report should be directed to the Laboratory Manager Gradko International Ltd. This report is not to be reproduced, except in full, without the written permission of Gradko International Ltd.

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Signed	L. Gates, Laboratory Manager





LABORATORY ANALYSIS REPORT

	NIST Library Quality Match	Estimated no on tube	ppb in air*
EC>12-EC16 Aromatic Hydrocarbons**	adding matori	<5	<0.1
Tube Number Gradko Lab Reference Sample ID	GRA06732 02O0447 Blank		
BTEX Benzene Toluene Ethylbenzene m/p-Xylene o-Xylene		ng on tube <5 <5 <5 <5 <5 <5	
EC5-EC6 Aliphatic Hydrocarbons**	NIST Library Quality Match	Estimated ng on tube <5	
EC>6-EC8 Aliphatic Hydrocarbons**	NIST Library Quality Match	Estimated ng on tube <5	
EC>8-EC10 Aliphatic Hydrocarbons**	NIST Library Quality Match	Estimated ng on tube <5	
EC>10-EC12 Aliphatic Hydrocarbons**	NIST Library Quality Match	Estimated ng on tube <5	
EC>12-EC16 Aliphatic Hydrocarbons**	NIST Library Quality Match	Estimated ng on tube <5	
EC5-EC7 Aromatic Hydrocarbons**		(Benzene)	
EC>7-EC8 Aromatic Hydrocarbons**		(Toluene)	
EC>8-EC10 Aromatic Hydrocarbons**	NIST Library Quality Match	Estimated ng on tube <5	

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LABORATORY ANALYSIS REPORT

EC>10-EC12 Aromatic Hydrocarbons**	NIST Library Quality Match	Estimated ng on tube <5		
EC>12-EC16 Aromatic Hydrocarbons**	NIST Library Quality Match	Estimated ng on tube <5		
Tube Number Gradko Lab Reference Exposure Time (mins)* Sample ID	004215 02O0454 22919 External			
BTEX Benzene Toluene Ethylbenzene m/p-Xylene o-Xylene		ng on tube <5 10.4 <5 <5 <5	ppb in air* <0.2 0.4 <0.1 <0.1 <0.1	µgm ⁻³ ∗ <0.7 1.4 <0.6 <0.6 <0.6
EC5-EC6 Aliphatic Hydrocarbons**	NIST Library Quality Match	Estimated ng on tube 31	ppb in air* 0.7	<mark>μgm⁻³∗</mark> 2.3
EC>6-EC8 Aliphatic Hydrocarbons**	NIST Library Quality Match	Estimated ng on tube 9	ppb in air* 0.2	<mark>μgm⁻³*</mark> 0.7
EC>8-EC10 Aliphatic Hydrocarbons**	NIST Library Quality Match	Estimated ng on tube <5	ppb in air* <0.1	
EC>10-EC12 Aliphatic Hydrocarbons**	NIST Library Quality Match	Estimated ng on tube <5	ppb in air* <0.1	
EC>12-EC16 Aliphatic Hydrocarbons**	NIST Library Quality Match	Estimated ng on tube <5	ppb in air* <0.1	
EC5-EC7 Aromatic Hydrocarbons** EC>7-EC8 Aromatic Hydrocarbons**		(Benzene) (Toluene)		
Samples have been tested within the scope of Gradk samples as received. Data provided by the client and are not within the scope of our UKAS accreditation. Gradko International Ltd. This report is not to be re Form LOF32b Issue 9 – August 2019	o International Ltd. La l any subsequent calcul Any queries concernir eproduced, except in fu Ren	aboratory Quality Procedures. R lations shall be indicated by an a ng data in this report should be d Ill, without the written permissio port Number 004603R	esults within this repo sterisk (*), these calcu irected to the Labora n of Gradko Internat Page	ort relate only to ilations and results tory Manager ional Ltd. 9 of 10
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Signed.

L. Gates, Laboratory Manager





LABORATORY ANALYSIS REPORT

EC>8-EC10 Aromatic Hydrocarbons**	NIST Library	Estimated ng on tube	ppb in air*
	Quality Match	<5	<0.1
EC>10-EC12 Aromatic Hydrocarbons**	NIST Library	Estimated ng on tube	ppb in air*
	Quality Match	<5	<0.1
EC>12-EC16 Aromatic Hydrocarbons**	NIST Library	Estimated ng on tube	ppb in air*
	Quality Match	<5	<0.1
Results are not Blank corrected. Tenax is recommended for compounds in the	e range C6 to C28 a	nd may not retain Pentane e	ffectively.
Uptake Rates: Benzene 1.03 ng.ppm ⁻¹ .min ⁻¹ . Toluene 1.22 ng.ppm ⁻¹ .min ⁻¹ . Ethylbenzene 1.49 ng.ppm ⁻¹ .min ⁻¹ . m/p Xylene 1.49 ng.ppm ⁻¹ .min ⁻¹ . o-Xylene 1.49 ng.ppm ⁻¹ .min ⁻¹ . All other compounds: 2.00 ng.ppm ⁻¹ .min ⁻¹ .			
Reporting Limit Results reported as <5ng on tube are below t	the reporting limit.	5ng on tube	

Estimated results reported as <5ng on tube are below the reporting limit for the non-specific standard toluene.

Measurement Uncertainty BTEX compounds

±18.2% for quantitative analysis of BTEX compounds.

The reported expanded uncertainty is based on a standard uncertainty multiplied by a factor of k=2, providing a level of confidence of approximately 95%. Uncertainty of measurement has not been applied to the reported results.

Estimated results as ng on tube are calculated by reference to toluene in accordance with ISO 16000-6

**The classification and grouping of TPH compounds to CWG guidelines is not covered by our UKAS accreditation.

Analysts Name	Mariella Angelova	Date of Analysis	25/08/2020
Report Checked By	Linda Gates	Date of Report	27/08/2020

Analysis has been carried out in accordance with in-house method GLM 13

Samples have been tested within the scope of Gradko International Ltd. Laboratory Quality Procedures. Results within this report relate only to samples as received. Data provided by the client and any subsequent calculations shall be indicated by an asterisk (*), these calculations and results are not within the scope of our UKAS accreditation. Any queries concerning data in this report should be directed to the Laboratory Manager Gradko International Ltd. This report is not to be reproduced, except in full, without the written permission of Gradko International Ltd.

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