

**VERIFICATION OF PRE-CONSTRUCTION
REMEDiation WORKS**

**THE OLD DAIRY, LITTLEHAMPTON,
SUSSEX**

FOR

AJJP CONSTRUCTION LTD



39861-003

March 2017

Eastwood & Partners, St Andrew's House, 23 Kingfield Road, Sheffield S11 9AS

VERIFICATION OF PRE-CONSTRUCTION REMEDIAL WORKS

THE OLD DAIRY, LITTLEHAMPTON,
SUSSEX

FOR

AJJP CONSTRUCTION LTD

ISSUE 1

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Approved :



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Eastwood & Partners (Consulting Engineers) Limited Registered No 1835021

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1.0 INTRODUCTION

This report has been produced by Eastwood & Partners (Consulting Engineers) Limited, on behalf of AJJP Construction, for a site at The Old Dairy, Littlehampton, in Sussex. The purpose of this document is to detail the pre-construction remedial works undertaken, to deal principally with hydrocarbon impacted groundwater, and the subsequent verification of these works. These works were proposed in our Implementation Plan, reference 39861-002, dated 30 August 2016.

2.0 RATIONALE FOR REMEDIAL WORKS

Eastwood & Partners previously completed a hydrocarbon investigation for this site in July 2016, referenced 39861-001. The report includes a review of an earlier intrusive investigation undertaken on the site by Soils Ltd.

The ground conditions generally comprise made ground from the surface up to 1.4 m below ground level (bgl). The made ground in all of the pits comprised sandy gravelly clay, clayey gravelly sand or clayey sandy gravel. The gravel is flint, chalk, concrete, brick, glass and other debris, probably arising from the demolition of the buildings.

Beneath the made ground, silty sandy gravelly clay was generally encountered up to between 1.2 m and 3.4 m bgl. Four of Soil Ltd's exploratory holes also identified occasional layers of clayey or silty sand between depths of 1.2 m and 3.4 m bgl. Structureless chalk, recovered as clayey silty sandy gravel, was encountered below the clay and sand layers to the base of the holes at depths of up to 5 m bgl.

A hydrocarbon odour was noted in a number of the exploratory holes. Some samples were also noted to have blue/black or grey staining where the hydrocarbon odour was identified.

One sample of made ground, six samples of natural clay, four of chalk and five water samples were sent for testing following Soils Ltd's fieldwork. As part of Eastwood & Partners' investigation one sample of made ground, four samples of clay, eleven of the chalk and four water samples were sent for chemical testing. The samples of made ground and natural clay did not record any contaminants exceeding their assessment concentrations.

Two samples of the natural chalk tested recorded elevated concentrations of total petroleum hydrocarbons (TPH) and all of the water samples recorded several aliphatic fractions with concentrations that exceed solubility limits. Several of these fractions also had concentrations which exceed their environmental assessment values. Further to this, four samples of natural ground and all of the water samples recorded elevated values of several fuel related organic compounds (VOCs/SVOCs).

All the elevated results indicated the probable presence of phase-separated/free product and chromatograms on the samples indicated the contamination to comprise petrol and diesel. The elevated results were all located in the south west corner of the site and the concentrations of the contaminants was found to decrease eastwards in the direction of the groundwater flow.

It was recommended that open trenches were excavated in the south west corner of the site and hydrophobic pillows placed within them to remove the phase-separated/free product from the groundwater. It was recommended that any impacted soils should be excavated and stockpiled for treatment or removal.

3.0 REMEDIAL WORKS

3.1 Site Works

The remedial works were undertaken in two phases, the first involved excavation and was undertaken between 20 and 23 February 2017. The original scope of works comprised excavation of a number of trenches across the affected area. However, during excavation of the first trench it became apparent that due to the instability of the trench walls, this would not be possible. The remedial works were therefore updated to comprise six 3 m x 3 m pits excavated across the impacted area. Each of these was excavated to a depth which reached the water table, between 2.7 m and 4 m bgl. The Remediation Works Plan, drawing 39861/002, in Appendix 1, shows the location of the pits and photographs of the pits are included in Appendix 2.

Upon excavation, trench boxes were installed in each of the pits and safety fencing erected around them. Hydrophobic pillows were placed on the surface of the groundwater and the pits were then left open to enable the pillows to absorb any free product present.

The second phase of site works was completed on 3 March 2017 and comprised the removal of the saturated hydrophobic pillows from the excavations, sampling of the groundwater and backfilling of the excavations.

3.2 Evidence of Contamination

Grey/black staining, accompanied by a hydrocarbon odour was observed within the natural brown clay found underlying the made ground in the west of the site. The odour and staining then increased in the underlying chalk. A slight sheen was noted on the top of the groundwater, however significant quantities of free product were not observed. Generally the odour decreased towards the east.

Where soils exhibited a hydrocarbon odour these were stockpiled separately to the non-impacted soil, within a bunded area lined with polythene.

3.3 Sampling

On completion of the excavations one sample was obtained from each face and the base. A selection was sent for chemical testing. Three samples were also collected from the stockpile of hydrocarbon impacted soil and these were also sent for chemical analysis. Following removal of the hydrophobic pillows one water sample was collected from each pit, and again dispatched to the laboratory.

4.0 CHEMICAL TESTING

4.1 Soil

A total of eighteen soil samples from the base and sides of the excavations were sent for chemical testing. In addition to these, a further three samples from the stockpile of hydrocarbon impacted soil were also sent for testing. Each of the samples was tested for fully fractionated petroleum hydrocarbons with aliphatic and aromatic split (TPH CWG), benzene, toluene, ethylbenzene and xylenes (BTEX) and total organic carbon. All testing was undertaken by Chemtest and MCERTs accredited methodologies were used where available.

Copies of the test reports, 17-04779 and 17-04921, are included in Appendix 3 and the results are discussed below.

4.2 Water

Following removal of the saturated hydrophobic pillows a sample of the groundwater was collected from each of the excavations. All six samples were tested for TPH CWG, BTEX and total organic carbon. Again, all testing was undertaken by Chemtest and MCERTs accredited methodologies were used where available.

A copy of the test report 17-05500 is included in Appendix 3 and the results are discussed below.

4.3 Assessment Criteria

For the soils, the most conservative assessment criteria relating to a residential end use with home-grown produce have been used. Tables detailing the relevant assessment concentrations used are included in Appendix 3. The assessment concentrations used for the water are noted below.

4.4 Chemical Test Results

4.4.1 Soil

Of the twenty one samples collected, both from the stockpile of hydrocarbon impacted soil as well as the base and sides of the excavations, only one recorded concentrations of TPH above the detection limit. This was the sample from face A of RP3 which recorded a total TPH concentration of 52 mg/kg. However, none of the fractions were found to exceed their respective assessment concentrations.

BTEX compounds were detected in eight of the twenty one samples from the base and sides of the excavations, the results are summarised in the table below:

Location	Sample Ref	Recorded Concentration (µg/kg)				
		Benzene	Toluene	Ethylbenzene	m&p-Xylene	o-Xylene
RP1	D	2.8	18	360	1300	300
RP1	Base	<1.0	3.5	92	750	45
RP2	D	<1.0	2.4	1200	380	25
RP2	Base	<1.0	<1.0	49	49	<1.0
RP3	A	22	11	2000	2100	86
SP1	S1	17	8.8	1100	2500	61
SP1	S2	<1.0	2.1	210	460	12
SP1	S3	<1.0	2.3	1500	1600	28
Assessment Value		87	130,000	47,000	56,000	60,000

None of the compounds were recorded above their respective assessment values.

Therefore, it is concluded that the concentrations of TPH and BTEX in the soil do not pose a significant risk to human health.

4.4.2 Water

Only one of the six water samples recorded concentrations of TPH above the detection limit. The water sample from RP1 recorded a concentration of total TPH of 60 µg/l. This exceeds the UK Drinking Water Standard of 10 µg/l, however as the groundwater is not used as a potable water source this assessment value is considered to be highly conservative.

BTEX compounds were recorded above the detection limit in three of the samples, as summarised in the table below:

Location	Recorded Concentration (µg/l)				
	Benzene	Toluene	Ethylbenzene	m&p-Xylene	o-Xylene
RP1	45	<1.0	<1.0	<1.0	110
RP2	<1.0	<1.0	<1.0	<1.0	4.2
RP3	<1.0	<1.0	<1.0	<1.0	21
RP4	<1.0	<1.0	<1.0	<1.0	<1.0
RP5	<1.0	<1.0	<1.0	<1.0	<1.0
RP6	<1.0	<1.0	<1.0	<1.0	<1.0
Assessment Concentration	30 (300) ¹	50 (500) ¹	300 ²	30 ¹ / 500 ²	30 ¹ / 500 ²

¹ EQS Freshwater – initial value indicates acceptable annual average concentration and value in brackets refers to the maximum admissible peak concentration.

² WHO Health

Detectable concentrations were only recorded for benzene and o-Xylene. The elevated concentration of benzene does not exceed the maximum admissible peak concentration and, as it was not detected in the other five samples, the average concentration is significantly below the lower acceptable annual average assessment concentration. The average concentration of o-Xylene across the six samples is also significantly below the assessment concentration.

The testing is considered to demonstrate that the concentrations of both TPH and BTEX in the water across the site have been significantly reduced following the remediation works undertaken at the site and there is not considered to be a significant risk to aquatic life or human health from the residual presence of these in the groundwater.

5.0 CONCLUSION

Remediation works completed at the site comprised of the removal of hydrocarbon free product from the groundwater using hydrophobic pillows. Verification testing has demonstrated that the concentrations of hydrocarbons in the soil and groundwater have reduced significantly as a result of the remediation works. The residual levels remaining in the remediated areas are such that there is not considered to be a significant risk to receptors.

Additional remedial works required during the construction phases, such as vapour protection measures and capping of gardens and landscaped areas, are detailed in our Implementation Plan, reference 39861-002, dated 30 August 2016.

Appendix 1

Remediation Works Plan, 39861/002



INFORMATION WITHIN THIS DRAWING IS NOT NECESSARILY PRODUCED TO SCALE.
ALWAYS USE FIGURED DIMENSIONS AND CO-ORDINATES - IF IN DOUBT, ASK.

Key

Site Boundary

Approximate position of trial pits excavated
by Eastwood and Partners on 21.06.16



Approximate position of window sample
borehole drilled by Soils Limited on 28.04.16



Approximate position of trial pits excavated
by Soils Limited on 30-31.03.16



Approximate position of window sample
borehole drilled by soils limited on 01.12.15.



Approximate zone where free product
identified within groundwater.



Approximate location of hydrocarbon
remediation pit excavated between 20
and 23 February 2017. Each pit was
excavated to the groundwater table and
hydrophobic pillows used to soak up any free
product.



No excavations possible in this area due
to presence of demolition rubble
stockpile.



NOTE: The position of TP7 and TP8 are
assumed based on the trial pit logs and
their final depths as shown on the extent of
hydrocarbon contamination plan we have
recieved from the client - reference
20160404093322923.

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S11 9AS



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REMEDIATION WORKS PLAN

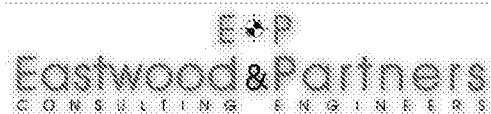
A	First Issue.					
REV	DESCRIPTION			SIG	CHK	DATE
SCALE WHEN PLOTTED AT A3 Approximately 1:500			DRAWING STATUS FOR INFORMATION			
DRAWN	CHECKED	DATE	DRAWING NUMBER		REV	
KM	RAN	29.03.17	39861/002		A	

Appendix 2

Site Photographs



Prepared	ET	Checked	CM	Date	29.03.2017	Photograph No	39861
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 23 Kingfield Road

 Sheffield S11 9AS

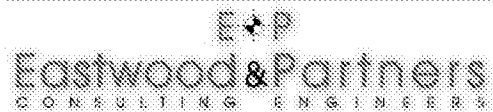
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LITTLEHAMPTON, SUSSEX

THE OLD DAIRY



Prepared	ET	Checked	CM	Date	29.03.2017	Photograph No	39861
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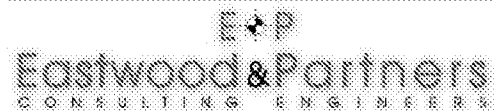
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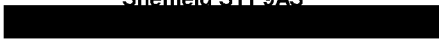
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Prepared	ET	Checked	CM	Date	29.03.2017	Photograph No	39861
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Prepared	ET	Checked	CM	Date	29.03.2017	Photograph No	39861
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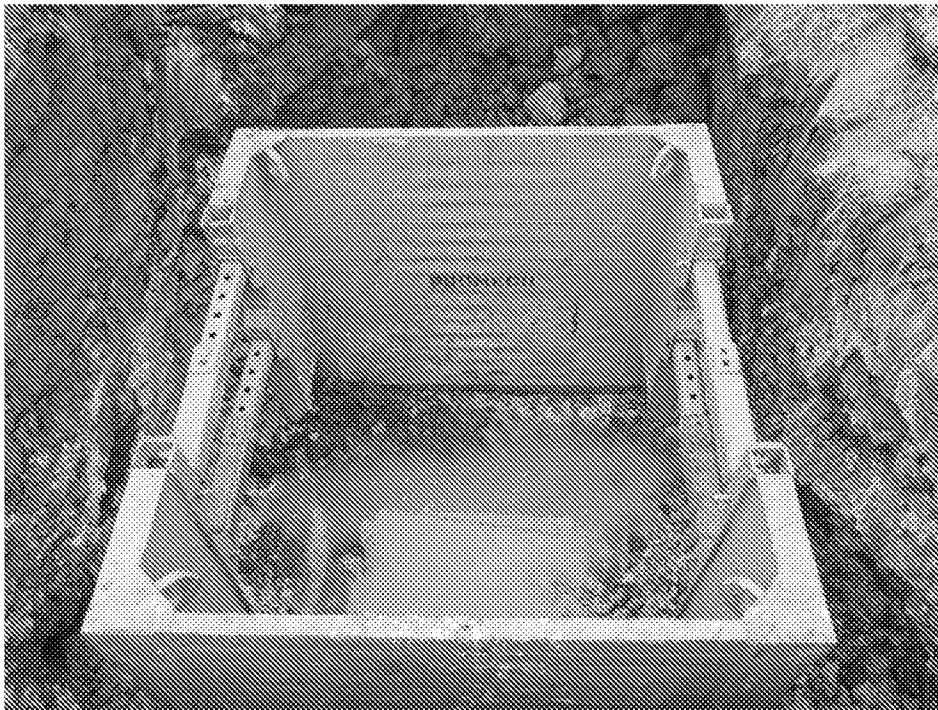
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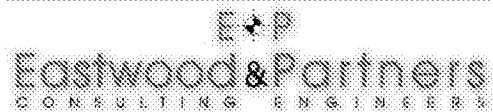
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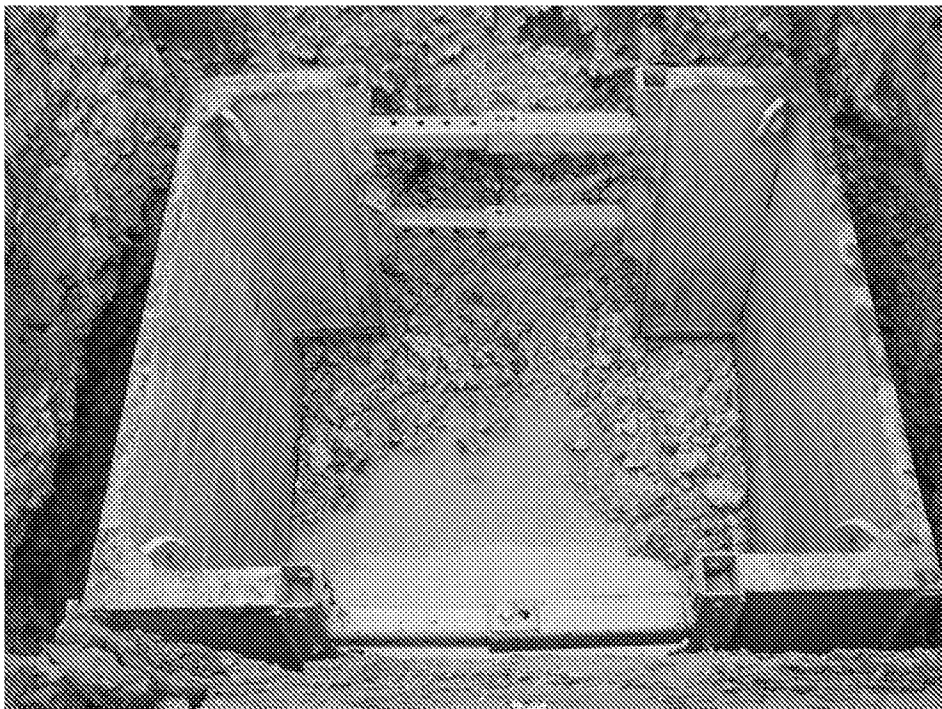
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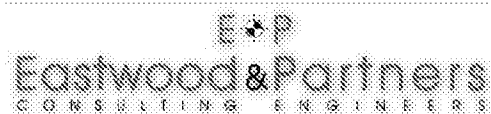
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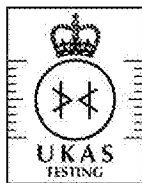
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THE OLD DAIRY

Appendix 3

Chemical test results (17-04779, 17-04921 and 17-05500)

Tables of Assessment Values



2183



Final Report

Report No.: 17-04779-1

Initial Date of Issue: 01-Mar-2017

Client Eastwood & Partners

Client Address: St. Andrews House
23 Kingfield Road
Sheffield
South Yorkshire
S11 9AS

Contact(s): Geo
Ruth Noble

Project 39861 Littlehampton

Quotation No.: **Date Received:** 27-Feb-2017

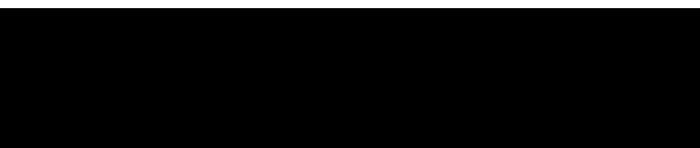
Order No.: 39861/CAT/RAN **Date Instructed:** 27-Feb-2017

No. of Samples: 12

Turnaround (Wkdays): 3 **Results Due:** 01-Mar-2017

Date Approved: 01-Mar-2017

Approved By:



Details: Martin Dyer, Laboratory Manager

Results - Soil

Project: 39861 Littlehampton

Client: Eastwood & Partners	Chemtest Job No.:				17-04779	17-04779	17-04779	17-04779	17-04779	17-04779	17-04779	17-04779	17-04779
Quotation No.:	Chemtest Sample ID.:				417479	417480	417481	417482	417483	417484	417485	417486	417487
Order No.: 39861/CAT/RAN	Client Sample Ref.:				SP1	SP1	SP1	RP1	RP1	RP1	RP2	RP2	RP2
	Client Sample ID.:				S1	S2	S3	FACE B	FACE D	BASE	FACE C	FACE D	BASE
	Sample Type:				SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
	Top Depth (m):							1.0	2.0		1.6	2.3	
	Date Sampled:				22-Feb-2017	22-Feb-2017	22-Feb-2017	22-Feb-2017	22-Feb-2017	22-Feb-2017	22-Feb-2017	22-Feb-2017	22-Feb-2017
Determinand	Accred.	SOP	Units	LOD									
Moisture	N	2030	%	0.020	17	17	18	15	18	17	12	20	20
Soil Colour	N	2040		N/A	Beige	Beige	Yellow, Loam	Brown	White	Brown	Brown	White	White
Other Material	N	2040		N/A	Stones	Stones	Stones	Stones	Stones	Stones	Stones	Stones	Stones
Soil Texture	N	2040		N/A	Sand	Sand	Loam	Loam	Sand	Clay	Sand	Sand	Sand
Total Organic Carbon	M	2625	%	0.20	< 0.20	0.23	< 0.20	0.27	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Aliphatic TPH >C5-C6	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C6-C8	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C8-C10	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C10-C12	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C12-C16	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C16-C21	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C21-C35	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Total Aliphatic Hydrocarbons	N	2680	mg/kg	5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Aromatic TPH >C5-C7	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C7-C8	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C8-C10	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C10-C12	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C12-C16	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C16-C21	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C21-C35	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Total Aromatic Hydrocarbons	N	2680	mg/kg	5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Total Petroleum Hydrocarbons	N	2680	mg/kg	10.0	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
Benzene	M	2760	µg/kg	1.0	17	< 1.0	< 1.0	< 1.0	2.8	< 1.0	< 1.0	< 1.0	< 1.0
Toluene	M	2760	µg/kg	1.0	8.8	2.1	2.3	< 1.0	18	3.5	< 1.0	2.4	< 1.0
Ethylbenzene	M	2760	µg/kg	1.0	1100	210	1500	< 1.0	360	92	< 1.0	1200	49
m & p-Xylene	M	2760	µg/kg	1.0	2500	460	1600	< 1.0	1300	750	< 1.0	380	49
o-Xylene	M	2760	µg/kg	1.0	61	12	28	< 1.0	300	45	< 1.0	25	< 1.0

Project: 39861 Littlehampton

Client: Eastwood & Partners	Chemtest Job No.:				17-04779	17-04779	17-04779
Quotation No.:	Chemtest Sample ID.:				417488	417489	417490
Order No.: 39861/CAT/RAN	Client Sample Ref.:				RP3	RP3	RP3
	Client Sample ID.:				FACE A	FACE B	FACE C
	Sample Type:				SOIL	SOIL	SOIL
	Top Depth (m):				3.5	0.9	2.6
	Date Sampled:				22-Feb-2017	22-Feb-2017	22-Feb-2017
Determinand	Accred.	SOP	Units	LOD			
Moisture	N	2030	%	0.020	18	16	15
Soil Colour	N	2040		N/A	White	Brown	Brown
Other Material	N	2040		N/A	Stones	Stones	Stones
Soil Texture	N	2040		N/A	Sand	Sand	Sand
Total Organic Carbon	M	2625	%	0.20	0.20	0.29	0.24
Aliphatic TPH >C5-C6	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C6-C8	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C8-C10	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C10-C12	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C12-C16	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C16-C21	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C21-C35	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Total Aliphatic Hydrocarbons	N	2680	mg/kg	5.0	< 5.0	< 5.0	< 5.0
Aromatic TPH >C5-C7	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C7-C8	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C8-C10	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C10-C12	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C12-C16	M	2680	mg/kg	1.0	1.4	< 1.0	< 1.0
Aromatic TPH >C16-C21	U	2680	mg/kg	1.0	17	< 1.0	< 1.0
Aromatic TPH >C21-C35	M	2680	mg/kg	1.0	34	< 1.0	< 1.0
Aromatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Total Aromatic Hydrocarbons	N	2680	mg/kg	5.0	52	< 5.0	< 5.0
Total Petroleum Hydrocarbons	N	2680	mg/kg	10.0	52	< 10	< 10
Benzene	M	2760	µg/kg	1.0	22	< 1.0	< 1.0
Toluene	M	2760	µg/kg	1.0	11	< 1.0	< 1.0
Ethylbenzene	M	2760	µg/kg	1.0	2000	< 1.0	< 1.0
m & p-Xylene	M	2760	µg/kg	1.0	2100	< 1.0	< 1.0
o-Xylene	M	2760	µg/kg	1.0	86	< 1.0	< 1.0

SOP	Title	Parameters included	Method summary
2030	Moisture and Stone Content of Soils(Requirement of MCERTS)	Moisture content	Determination of moisture content of soil as a percentage of its as received mass obtained at <37°C.
2040	Soil Description(Requirement of MCERTS)	Soil description	As received soil is described based upon BS5930
2625	Total Organic Carbon in Soils	Total organic Carbon (TOC)	Determined by high temperature combustion under oxygen, using an Eltra elemental analyser.
2680	TPH A/A Split	Aliphatics: >C5–C6, >C6–C8,>C8–C10, >C10–C12, >C12–C16, >C16–C21, >C21–C35, >C35– C44Aromatics: >C5–C7, >C7–C8, >C8– C10, >C10–C12, >C12–C16, >C16– C21, >C21– C35, >C35– C44	Dichloromethane extraction / GCxGC FID detection
2760	Volatile Organic Compounds (VOCs) in Soils by Headspace GC-MS	Volatile organic compounds, including BTEX and halogenated Aliphatic/Aromatics.(cf. USEPA Method 8260)*please refer to UKAS schedule	Automated headspace gas chromatographic (GC) analysis of a soil sample, as received, with mass spectrometric (MS) detection of volatile organic compounds.

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None of the results in this report have been recovery corrected

All results are expressed on a dry weight basis

The following tests were analysed on samples as received and the results subsequently corrected to a dry weight basis TPH, BTEX, VOCs, SVOCs, PCBs, Phenols

For all other tests the samples were dried at < 37°C prior to analysis

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Sample Deviation Codes

- A - Date of sampling not supplied
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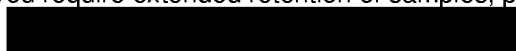
Sample Retention and Disposal

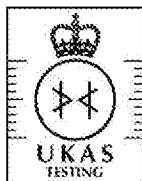
All soil samples will be retained for a period of 45 days from the date of receipt

All water samples will be retained for 14 days from the date of receipt

Charges may apply to extended sample storage

If you require extended retention of samples, please email your requirements to:





2183



Final Report

Report No.: 17-04921-1

Initial Date of Issue: 02-Mar-2017

Client Eastwood & Partners

Client Address: St. Andrews House
23 Kingfield Road
Sheffield
South Yorkshire
S11 9AS

Contact(s): Geo
Ruth Noble

Project 39861 - Littlehampton

Quotation No.: **Date Received:** 28-Feb-2017

Order No.: 39861/CAT/RAN **Date Instructed:** 28-Feb-2017

No. of Samples: 9

Turnaround (Wkdays): 3 **Results Due:** 02-Mar-2017

Date Approved: 02-Mar-2017

Approved By:

Details: Martin Dyer, Laboratory Manager

Results - Soil

Project: 39861 - Littlehampton

Client: Eastwood & Partners	Chemtest Job No.: 17-04921												
Quotation No.:	Chemtest Sample ID.: 418114												
Order No.: 39861/CAT/RAN	Client Sample Ref.: RP4												
	Client Sample ID.: Face A												
	Sample Type: SOIL												
	Date Sampled: 23-Feb-2017												
Determinand	Accred	SOP	Units	LOD									
Moisture	N	2030	%	0.020	15	11	14	15	15	15	13	17	23
Soil Colour	N	2040		N/A	Brown	Brown	White, White	Brown	Brown	Brown	Brown	Brown,	Brown
Other Material	N	2040		N/A	NONE	NONE	NONE	NONE	NONE,	NONE	NONE	NONE	NONE
Soil Texture	N	2040		N/A	Clay	Clay	Clay	Clay	Clay,	Clay	Clay	Clay	Clay
Total Organic Carbon	M	2625	%	0.20	0.25	< 0.20	< 0.20	0.35	0.24	0.28	0.27	0.22	0.38
Aliphatic TPH >C5-C6	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C6-C8	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C8-C10	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C10-C12	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C12-C16	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C16-C21	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C21-C35	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Total Aliphatic Hydrocarbons	N	2680	mg/kg	5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Aromatic TPH >C5-C7	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C7-C8	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C8-C10	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C10-C12	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C12-C16	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C16-C21	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C21-C35	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Total Aromatic Hydrocarbons	N	2680	mg/kg	5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Total Petroleum Hydrocarbons	N	2680	mg/kg	10.0	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
Benzene	M	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Toluene	M	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Ethylbenzene	M	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
m & p-Xylene	M	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
o-Xylene	M	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0

SOP	Title	Parameters included	Method summary
2030	Moisture and Stone Content of Soils(Requirement of MCERTS)	Moisture content	Determination of moisture content of soil as a percentage of its as received mass obtained at <37°C.
2040	Soil Description(Requirement of MCERTS)	Soil description	As received soil is described based upon BS5930
2625	Total Organic Carbon in Soils	Total organic Carbon (TOC)	Determined by high temperature combustion under oxygen, using an Eltra elemental analyser.
2680	TPH A/A Split	Aliphatics: >C5–C6, >C6–C8,>C8–C10, >C10–C12, >C12–C16, >C16–C21, >C21–C35, >C35– C44Aromatics: >C5–C7, >C7–C8, >C8– C10, >C10–C12, >C12–C16, >C16– C21, >C21– C35, >C35– C44	Dichloromethane extraction / GCxGC FID detection
2760	Volatile Organic Compounds (VOCs) in Soils by Headspace GC-MS	Volatile organic compounds, including BTEX and halogenated Aliphatic/Aromatics.(cf. USEPA Method 8260)*please refer to UKAS schedule	Automated headspace gas chromatographic (GC) analysis of a soil sample, as received, with mass spectrometric (MS) detection of volatile organic compounds.

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- < "less than"
- > "greater than"

Comments or interpretations are beyond the scope of UKAS accreditation

The results relate only to the items tested

Uncertainty of measurement for the determinands tested are available upon request

None of the results in this report have been recovery corrected

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The following tests were analysed on samples as received and the results subsequently corrected to a dry weight basis TPH, BTEX, VOCs, SVOCs, PCBs, Phenols

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Sample Retention and Disposal

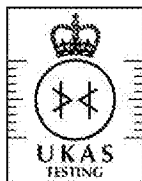
All soil samples will be retained for a period of 45 days from the date of receipt

All water samples will be retained for 14 days from the date of receipt

Charges may apply to extended sample storage

If you require extended retention of samples, please email your requirements to:





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Final Report

Report No.:	17-05500-1		
Initial Date of Issue:	09-Mar-2017		
Client	Eastwood & Partners		
Client Address:	St. Andrews House 23 Kingfield Road Sheffield South Yorkshire S11 9AS		
Contact(s):	Geo Ruth Noble		
Project	39861 Littlehampton		
Quotation No.:		Date Received:	07-Mar-2017
Order No.:	39861/CAT/RAN	Date Instructed:	07-Mar-2017
No. of Samples:	6		
Turnaround (Wkdays):	3	Results Due:	09-Mar-2017
Date Approved:	09-Mar-2017		
Approved By:			
Details:	Robert Monk, Technical Development Chemist		

Results - Water

Project: 39861 Littlehampton

Client: Eastwood & Partners	Chemtest Job No.:				17-05500	17-05500	17-05500	17-05500	17-05500	17-05500
Quotation No.:	Chemtest Sample ID.:				421136	421137	421138	421139	421140	421141
Order No.: 39861/CAT/RAN	Client Sample Ref.:				RP1	RP2	RP3	RP4	RP5	RP6
	Sample Type:				WATER	WATER	WATER	WATER	WATER	WATER
	Date Sampled:				03-Mar-2017	03-Mar-2017	03-Mar-2017	03-Mar-2017	03-Mar-2017	03-Mar-2017
Determinand	Accred.	SOP	Units	LOD						
Total Organic Carbon	U	1610	mg/l	2.0	12	11	11	8.2	8.4	7.4
Aliphatic TPH >C5-C6	N	1675	µg/l	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Aliphatic TPH >C6-C8	N	1675	µg/l	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Aliphatic TPH >C8-C10	N	1675	µg/l	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Aliphatic TPH >C10-C12	N	1675	µg/l	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Aliphatic TPH >C12-C16	N	1675	µg/l	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Aliphatic TPH >C16-C21	N	1675	µg/l	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Aliphatic TPH >C21-C35	N	1675	µg/l	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Aliphatic TPH >C35-C44	N	1675	µg/l	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Total Aliphatic Hydrocarbons	N	1675	µg/l	5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Aromatic TPH >C5-C7	N	1675	µg/l	0.10	29	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Aromatic TPH >C7-C8	N	1675	µg/l	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Aromatic TPH >C8-C10	N	1675	µg/l	0.10	31	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Aromatic TPH >C10-C12	N	1675	µg/l	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Aromatic TPH >C12-C16	N	1675	µg/l	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Aromatic TPH >C16-C21	N	1675	µg/l	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Aromatic TPH >C21-C35	N	1675	µg/l	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Aromatic TPH >C35-C44	N	1675	µg/l	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Total Aromatic Hydrocarbons	N	1675	µg/l	5.0	60	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Total Petroleum Hydrocarbons	N	1675	µg/l	10	60	< 10	< 10	< 10	< 10	< 10
Benzene	U	1760	µg/l	1.0	45	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Toluene	U	1760	µg/l	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Ethylbenzene	U	1760	µg/l	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
m & p-Xylene	U	1760	µg/l	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
o-Xylene	U	1760	µg/l	1.0	110	4.2	21	< 1.0	< 1.0	< 1.0

SOP	Title	Parameters included	Method summary
1610	Total/Dissolved Organic Carbon in Waters	Organic Carbon	TOC Analyser using Catalytic Oxidation
1675	TPH Aliphatic/Aromatic split in Waters by GC-FID(cf. Texas Method 1006 / TPH CWG)	Aliphatics: >C5–C6, >C6–C8, >C8– C10, >C10–C12, >C12–C16, >C16–C21, >C21–C35, >C35– C44 Aromatics: >C5–C7, >C7–C8, >C8– C10, >C10–C12, >C12–C16, >C16– C21, >C21– C35, >C35– C44	Pentane extraction / GCxGC FID detection
1760	Volatile Organic Compounds (VOCs) in Waters by Headspace GC-MS	Volatile organic compounds, including BTEX and halogenated Aliphatic/Aromatics. (cf. USEPA Method 8260)	Automated headspace gas chromatographic (GC) analysis of water samples with mass spectrometric (MS) detection of volatile organic compounds.

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Inorganic Compounds	Human Health - Residential with Homegrown Produce (mg/kg)
Arsenic	37
Cadmium	11
Chromium (III)	910
Chromium (VI)	6
Lead	200
Mercury	1.2
Nickel	180
Selenium	250
Copper	2400
Zinc	3700

Organic Compounds	Human Health - Residential with Homegrown Produce (mg/kg)		
	1% SOM	2.5% SOM	6% SOM
Naphthalene	2.3	5.6	13
Acenaphthene	210	510	1100
Acenaphthylene	170	420	920
Fluorene	170	400	860
Phenanthrene	95	220	440
Anthracene	2400	5400	11000
Fluoranthene	280	560	890
Pyrene	620	1200	2000
Benzo(a)anthracene	7.2	11	13
Chrysene	15	22	27
Benzo(b)fluoranthene	2.6	3.3	3.7
Benzo(k)fluoranthene	77	93	100
Benzo(a)pyrene	2.2	2.7	3.0
Dibenz(a,h)anthracene	0.24	0.28	0.3
Indeno(1,2,3-cd)pyrene	27	36	41
Benzo(g,h,i)perylene	320	340	350
Benzene	0.087	0.17	0.37
Toluene	130	290	660
Ethylbenzene	47	110	260
o-Xylene	60	140	330
m-Xylene	59	140	320
p-Xylene	56	130	310

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Contaminant	Phytotoxicity			
	pH 5.0 to 5.5	pH 5.5 to 6.0	pH 6.0 to 6.5	pH >7.0
Arsenic	50			
Cadmium	3			
Chromium	400			
Lead	300			
Mercury	1			
Nickel	50	60	75	110
Copper	80	100	135	200
Zinc	200	200	200	300

The assessment concentration for lead is the Category 4 Screening Level produced by Contaminated Land: Applications in Real Environments (CL:AIRE) and outlined in Appendix H of their report SP1010. The others have been taken from Nathanail, C. P., McCaffrey, C., Gillett, A., Ogden, R., and Nathanail, J., 2015, *'The LQM/CIEH S4ULs for Human Health Risk Assessment'*, Land Quality Press, Nottingham. The metals/metalloids are based on a sandy loam soil and 6% soil organic matter. The assessment values are not intended to be applied to individual sample results where materials are similar, as the levels of contaminants will have a natural variability across the site. Instead, the modified mean value should be compared with the assessment concentration.

The assessment values for phytotoxicity are the levels at which plant growth is thought to be affected. They are taken from the maximum permissible and advisable concentrations in soil after application of soil sludge given in the *'The Code of Good Agricultural Practice for the Protection of Soil'*, MAFF, 1998.

The assessment of sulphate, water soluble sulphate, elemental sulphur and sulphide is to determine the aggressive nature of the ground with respect to concrete and consequently the results are compared with BRE Special Digest 1:2005 *'Concrete in Aggressive Ground'*.

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TPH Fraction	Intended Land Use Residential (mg/kg)		
	1% SOM	2.5% SOM	6% SOM
Aliphatic EC 5-6	42	78	160
Aliphatic EC >6-8	100	230	530
Aliphatic EC >8-10	27	65	150
Aliphatic EC >10-12	130 (48) ^{vap}	330 (118) ^{vap}	760 (283) ^{vap}
Aliphatic EC >12-16	1100 (24) ^{sol}	2400 (59) ^{sol}	4,300 (142) ^{sol}
Aliphatic EC >16-35	65,000 (8.48) ^{f, sol}	92,000 (21) ^{f, sol}	110,000 ^f
Aliphatic EC >35-44	65,000 (8.48) ^{f, sol}	92,000 (21) ^{f, sol}	110,000 ^f
Aromatic EC 5-7	70	140	300
Aromatic EC >7-8	130	290	660
Aromatic EC >8-10	34	83	190
Aromatic EC >10-12	74	180	380
Aromatic EC >12-16	140	330	660
Aromatic EC >16-21	260 ^f	540 ^f	930 ^f
Aromatic EC >21-35	1,100 ^f	1,500 ^f	1,700 ^f
Aromatic EC >35-44	1,100 ^f	1,500 ^f	1,700 ^f

^f oral, dermal, and inhalation exposure compared with oral HCV

^{sol} S4UL presented exceeds the solubility saturation limit, which is presented in brackets

^{vap} S4UL presented exceed the vapour saturation limit, which is presented in brackets

The assessment criteria for each of the petroleum hydrocarbon fractions have been taken from Nathanail, C. P., McCaffrey, C., Gillett, A., Ogden, R., and Nathanail, J., 2015, *'The LQM/CIEH S4ULs for Human Health Risk Assessment'*, Land Quality Press, Nottingham. These are also all based on a sandy loam soil.

Within the Environment Agency Science Report P5-080/TR3, Askari, K. & Pollard, S., 2005 *'The UK Approach for Evaluating Human Health Risks from Petroleum Hydrocarbons in Soils'* it is stated that the assessment values should not be considered individually; instead the potential additive effects should be calculated. This is achieved by calculating an individual Hazard Quotient (HQ) for each fraction. The HQ is the proportion of the assessment concentration represented by the recorded concentration. The HQs are then added together to form a Hazard Index (HI) and where this exceeds unity a potential significant risk to human health may exist.

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