

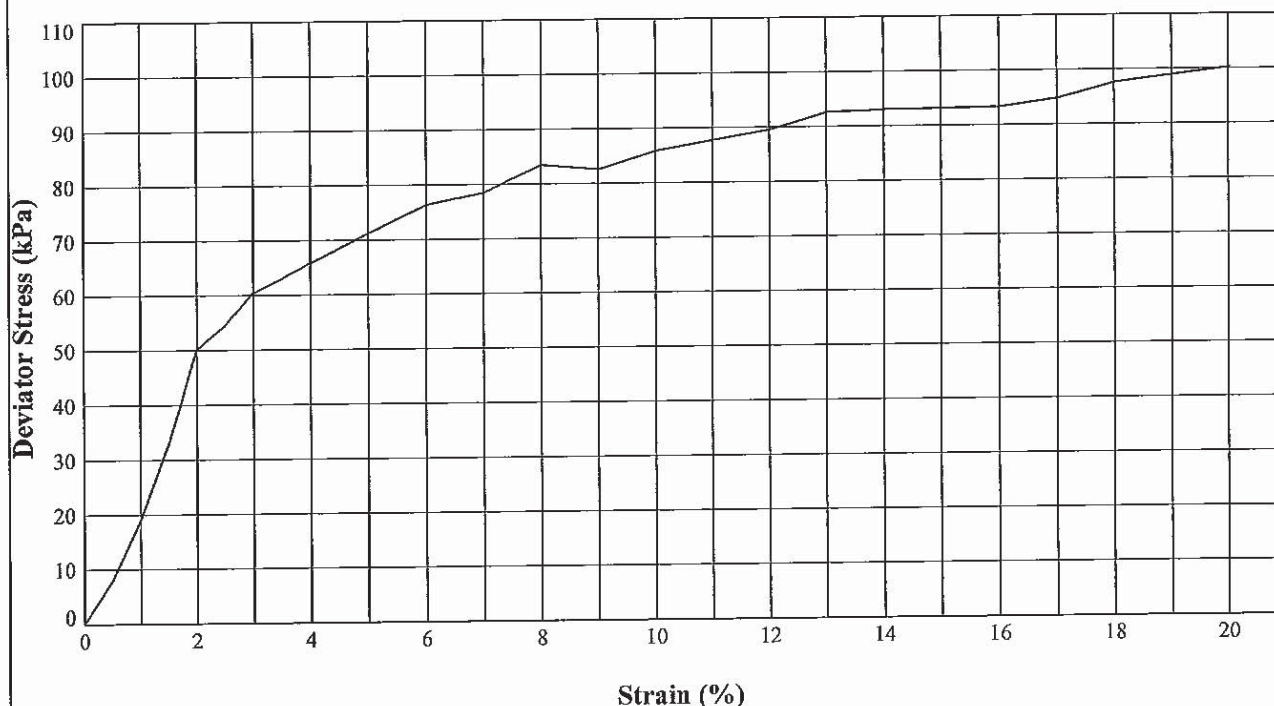
UNCONSOLIDATED QUICK UNDRAINED (SINGLE STAGE) TRIAXIAL COMPRESSION TEST

In accordance with BS1377:Part 7:1990, Clause 8

Borehole : **BH8A** Sample Ref: Sample Type: **U** Depth (m): **8.05**

Description : **Brownish black CLAY**

STAGE NUMBER		1	2	3
SAMPLE DETAILS	Sample Condition	Undisturbed		
	Orientation of sample	Vertical		
	Diameter (mm)	102.67		
	Height (mm)	209.68		
	Moisture Content (%)	35		
	Bulk Density (Mg/m ³)	1.95		
	Dry Density (Mg/m ³)	1.44		
TEST DETAILS	Membrane Thickness (mm)	0.24		
	Rate of Axial Displacement (%/min)	2.00		
	Cell Pressure (kPa)	160		
	Membrane Correction (kPa)	0.89		
	Corrected Deviator Stress (kPa)	100		
	Undrained Shear Strength (kPa)	50		
	Strain at Failure (%)	20.0		
	Mode of Failure	Compound		



Approved Signatories: P. KENT S. CAIRNS



STRUCTURAL SOILS
18 Frogmore Road
Hemel Hempstead
Hertfordshire
HP3 9RT

Compiled By

Date

Paul Kent

PAUL KENT

03/12/10

Contract

53 Fitzroy Park

Contract Ref:

581433

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of **20**



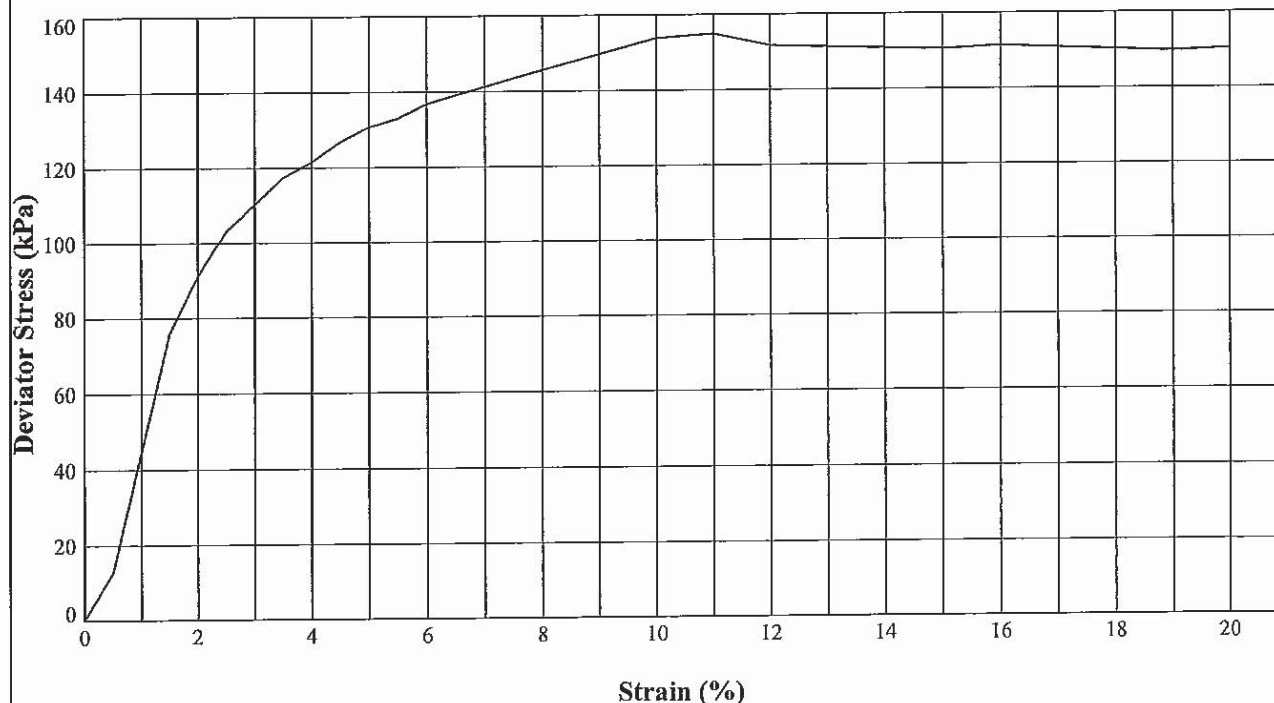
UNCONSOLIDATED QUICK UNDRAINED (SINGLE STAGE) TRIAXIAL COMPRESSION TEST

In accordance with BS1377:Part 7:1990, Clause 8

Borehole : **BH9A** Sample Ref: Sample Type: **U** Depth (m): **2.50**

Description : **Brown mottled grey CLAY with traces of roots and rootlets**

STAGE NUMBER		1	2	3
SAMPLE DETAILS	Sample Condition	Undisturbed		
	Orientation of sample	Vertical		
	Diameter (mm)	102.61		
	Height (mm)	209.99		
	Moisture Content (%)	29		
	Bulk Density (Mg/m ³)	1.97		
	Dry Density (Mg/m ³)	1.53		
TEST DETAILS	Membrane Thickness (mm)	0.24		
	Rate of Axial Displacement (%/min)	2.00		
	Cell Pressure (kPa)	50		
	Membrane Correction (kPa)	0.58		
	Corrected Deviator Stress (kPa)	155		
	Undrained Shear Strength (kPa)	78		
	Strain at Failure (%)	11.0		
	Mode of Failure	Compound		



Approved Signatories: P. KENT S. CAIRNS



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Contract Ref:

581433

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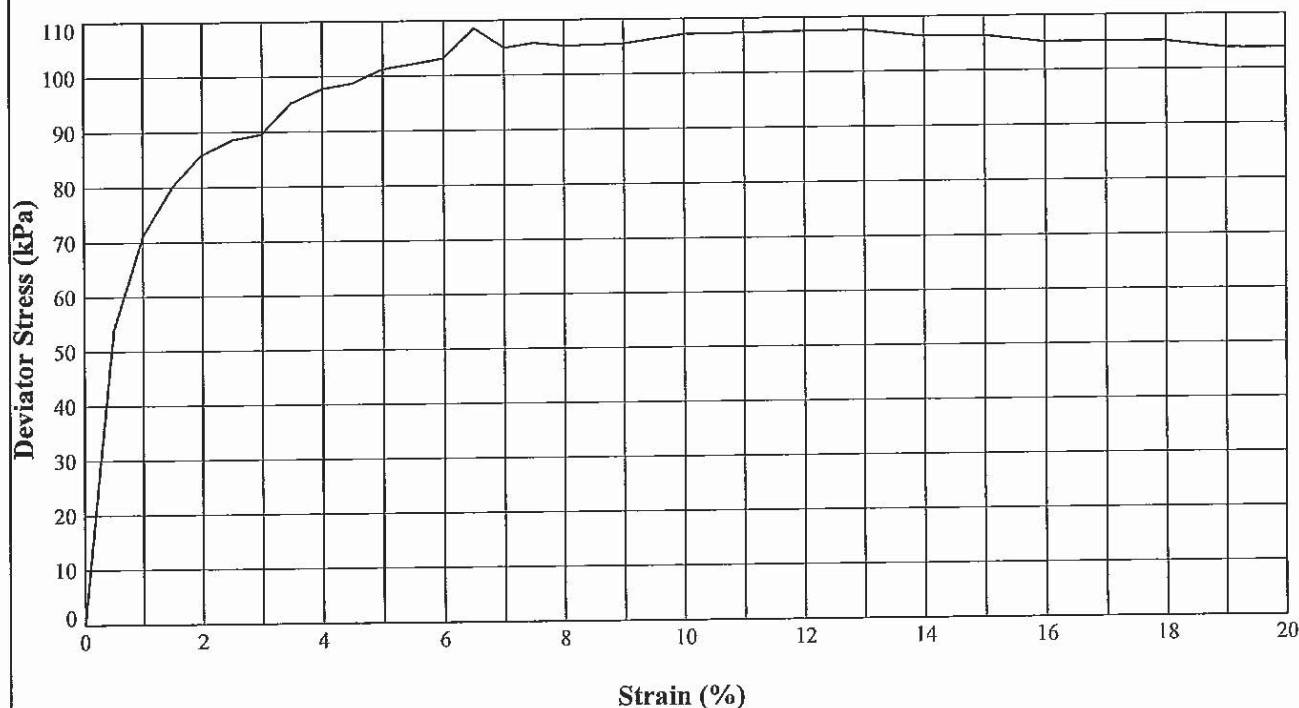
UNCONSOLIDATED QUICK UNDRAINED (SINGLE STAGE) TRIAXIAL COMPRESSION TEST

In accordance with BS1377:Part 7:1990, Clause 8

Borehole : **BH9A** Sample Ref: Sample Type: **U** Depth (m): **6.55**

Description : **Brownish black CLAY**

STAGE NUMBER		1	2	3
SAMPLE DETAILS	Sample Condition	Undisturbed		
	Orientation of sample	Vertical		
	Diameter (mm)	102.85		
	Height (mm)	208.14		
	Moisture Content (%)	31		
	Bulk Density (Mg/m ³)	2.00		
	Dry Density (Mg/m ³)	1.52		
TEST DETAILS	Membrane Thickness (mm)	0.24		
	Rate of Axial Displacement (%/min)	2.00		
	Cell Pressure (kPa)	130		
	Membrane Correction (kPa)	0.38		
	Corrected Deviator Stress (kPa)	109		
	Undrained Shear Strength (kPa)	54		
	Strain at Failure (%)	6.5		
	Mode of Failure	Brittle		



Approved Signatories: P. KENT S. CAIRNS



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18 Frogmore Road
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HP3 9RT

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03/12/10

Contract

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Contract Ref:

581433

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APPENDIX D

Chemical Laboratory Test Records

(This appendix contains 8 pages, including this)

FINAL ANALYTICAL TEST REPORT

Envirolab Job Number: 10/04101
Issue Number: 1
Date: 07 December, 2010

Client: RSK STATS Hemel Hempstead
18 Frogmore Road
Hemel Hempstead
Hertfordshire
UK
HP3 9RT

Project Manager: Clive Gerring
Project Name: 53 Fitzroy Park
Project Ref: 241919
Order No: Not specified
Date Samples Received: 29/11/10
Date Instructions Received: 29/11/10
Date Analysis Completed: 07/12/10

Prepared by:


Melanie Marshall
Laboratory Coordinator

Approved by:


Gill Scott
Laboratory Manager

Notes - Soil analysis

All results are reported as dry weight (<40°C).

Stones >10mm are removed from the sample prior to analysis and results corrected where appropriate.

Notes - General

For soil samples subscript A indicates analysis performed on the sample as received, D indicates analysis performed on dried & crushed sample.

Superscript M indicates method accredited to MCERTS.

Predominant Matrix Codes - 1 = SAND, 2 = LOAM, 3 = CLAY, 4 = LOAM/SAND, 5 = SAND/CLAY, 6 = CLAY/LOAM, 7 = OTHER. Samples with Matrix Code 7 are not predominantly a SAND/LOAM/CLAY mix and are not covered by our MCERTS accreditation. Secondary Matrix Codes - A = contains stones, B = contains construction rubble, C = contains visible hydrocarbons, D = contains glass/metal, E = contains roots/twigs.

IS indicates Insufficient sample for analysis. NDP indicates No Determination Possible. NFI indicates No Fibres Identified.

Superscript # indicates method accredited to ISO 17025.

Accreditation for TPH (C6-C40) applies to the range C6-C36 only.

Analytical results reflect the quality of the sample at the time of analysis only.

Opinions and interpretations expressed are outside the scope of our accreditation.

Envirolab Job Number: 10/04101

Client Project Name: 53 Fitzroy Park

Client Project Ref: 241919

Lab Sample ID	10/04101/1	10/04101/2	10/04101/3	10/04101/4	10/04101/5	10/04101/6	10/04101/7	10/04101/8	Units	Method ref
Client Sample No										
Client Sample ID	BH1A	BH2A	BH6A	BH8A	BH9A	BH2A	BH1A	BH1A		
Depth to Top	0.40	0.45	0.25	0.40	0.40	1.35	1.90	7.50		
Depth To Bottom	0.70	0.90	0.70	0.70	0.70	1.80				
Date Sampled	24-Nov-10	24-Nov-10	24-Nov-10	24-Nov-10	24-Nov-10	24-Nov-10	24-Nov-10	24-Nov-10		
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil		
Sample Matrix Code	6E	4AE	5AE	5AE	5AE	4AE	3	3		
ACM Screen _A	NFI	NFI	NFI	NFI	NFI	-	-	-		Visual
pH _D ^{M#}	7.6	7.4	7.2	8.2	8.3	7.5	8.0	8.2	pH	A-T-031s
Sulphate (water sol 2:1) _D ^{M#}	-	-	-	-	<0.01	0.05	0.23	0.41	g/l	A-T-026s
Organic matter _D ^{M#}	-	5.5	2.3	-	3.6	-	-	-	% w/w	A-T-032 OM
Arsenic _D ^{M#}	22	18	7	11	11	-	-	-	mg/kg	A-T-024
Boron (water soluble) _D ^{M#}	1.7	<1.0	<1.0	<1.0	<1.0	-	-	-	mg/kg	A-T-027s
Cadmium _D ^{M#}	0.8	<0.5	<0.5	<0.5	<0.5	-	-	-	mg/kg	A-T-024
Copper _D ^{M#}	75	55	19	24	24	-	-	-	mg/kg	A-T-024
Chromium _D ^{M#}	37	16	13	19	20	-	-	-	mg/kg	A-T-024
Lead _D ^{M#}	329	469	106	190	200	-	-	-	mg/kg	A-T-024
Mercury _D	0.56	0.24	0.23	0.57	0.82	-	-	-	mg/kg	A-T-024
Nickel _D ^{M#}	32	19	8	13	13	-	-	-	mg/kg	A-T-024
Selenium _D ^{M#}	2	1	<1	<1	<1	-	-	-	mg/kg	A-T-024
Zinc _D ^{M#}	397	241	54	79	89	-	-	-	mg/kg	A-T-024

Envirolab Job Number: 10/04101

Client Project Name: 53 Fitzroy Park

Client Project Ref: 241919

Lab Sample ID	10/04101/1	10/04101/2	10/04101/3	10/04101/4	10/04101/5	10/04101/6	10/04101/7	10/04101/8	Units	Method ref
Client Sample No										
Client Sample ID	BH1A	BH2A	BH6A	BH8A	BH9A	BH2A	BH1A	BH1A		
Depth to Top	0.40	0.45	0.25	0.40	0.40	1.35	1.90	7.50		
Depth To Bottom	0.70	0.90	0.70	0.70	0.70	1.80				
Date Sampled	24-Nov-10	24-Nov-10	24-Nov-10	24-Nov-10	24-Nov-10	24-Nov-10	24-Nov-10	24-Nov-10		
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil		
Sample Matrix Code	6E	4AE	5AE	5AE	5AE	4AE	3	3		
TPH CWG										
Ali >C5-C6 _A	-	<0.01	<0.01	-	<0.01	-	-	-	mg/kg	A-T-022s
Ali >C6-C8 _A	-	<0.01	<0.01	-	<0.01	-	-	-	mg/kg	A-T-022s
Ali >C8-C10 _A	-	<0.01	<0.01	-	<0.01	-	-	-	mg/kg	A-T-022s
Ali >C10-C12 _A [#]	-	<0.1	<0.1	-	<0.1	-	-	-	mg/kg	A-T-023s
Ali >C12-C16 _A [#]	-	<0.1	<0.1	-	<0.1	-	-	-	mg/kg	A-T-023s
Ali >C16-C21 _A [#]	-	<0.1	<0.1	-	<0.1	-	-	-	mg/kg	A-T-023s
Ali >C21-C35 _A [#]	-	<0.1	<0.1	-	16.5	-	-	-	mg/kg	A-T-023s
Total Aliphatics _A [#]	-	<0.1	<0.1	-	16.5	-	-	-	mg/kg	A-T-022+23s
Aro >C5-C7 _A	-	<0.01	<0.01	-	<0.01	-	-	-	mg/kg	A-T-022s
Aro >C7-C8 _A	-	<0.01	<0.01	-	<0.01	-	-	-	mg/kg	A-T-022s
Aro >C8-C9 _A	-	<0.01	0.02	-	0.03	-	-	-	mg/kg	A-T-022s
Aro >C9-C10 _A	-	<0.01	<0.01	-	<0.01	-	-	-	mg/kg	A-T-022s
Aro >C10-C12 _A [#]	-	<0.1	<0.1	-	<0.1	-	-	-	mg/kg	A-T-023s
Aro >C12-C16 _A [#]	-	<0.1	<0.1	-	<0.1	-	-	-	mg/kg	A-T-023s
Aro >C16-C21 _A [#]	-	17.4	<0.1	-	<0.1	-	-	-	mg/kg	A-T-023s
Aro >C21-C35 _A [#]	-	33.7	<0.1	-	<0.1	-	-	-	mg/kg	A-T-023s
Total Aromatics _A [#]	-	51.1	<0.1	-	<0.1	-	-	-	mg/kg	A-T-022+23s
TPH (Ali & Aro) _A [#]	-	51.1	<0.1	-	16.5	-	-	-	mg/kg	A-T-022+23s
BTEX - Benzene _A [#]	-	<0.01	<0.01	-	<0.01	-	-	-	mg/kg	A-T-022s
BTEX - Toluene _A [#]	-	<0.01	<0.01	-	<0.01	-	-	-	mg/kg	A-T-022s
BTEX - Ethyl Benzene _A [#]	-	<0.01	<0.01	-	<0.01	-	-	-	mg/kg	A-T-022s
BTEX - m & p Xylene _A [#]	-	<0.01	0.01	-	0.02	-	-	-	mg/kg	A-T-022s
BTEX - o Xylene _A [#]	-	<0.01	<0.01	-	0.01	-	-	-	mg/kg	A-T-022s
MTBE _A [#]	-	<0.01	<0.01	-	<0.01	-	-	-	mg/kg	A-T-022s

Envirolab Job Number: 10/04101

Client Project Name: 53 Fitzroy Park

Client Project Ref: 241919

Lab Sample ID	10/04101/1	10/04101/2	10/04101/3	10/04101/4	10/04101/5	10/04101/6	10/04101/7	10/04101/8	Units	Method ref
Client Sample No										
Client Sample ID	BH1A	BH2A	BH6A	BH8A	BH9A	BH2A	BH1A	BH1A		
Depth to Top	0.40	0.45	0.25	0.40	0.40	1.35	1.90	7.50		
Depth To Bottom	0.70	0.90	0.70	0.70	0.70	1.80				
Date Sampled	24-Nov-10	24-Nov-10	24-Nov-10	24-Nov-10	24-Nov-10	24-Nov-10	24-Nov-10	24-Nov-10		
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil		
Sample Matrix Code	6E	4AE	5AE	5AE	5AE	4AE	3	3		
PAH 16										
Acenaphthene _A ^{M#}	<0.01	0.06	<0.01	<0.01	<0.01	-	-	-	mg/kg	A-T-019s
Acenaphthylene _A ^{M#}	<0.01	0.07	<0.01	<0.01	<0.01	-	-	-	mg/kg	A-T-019s
Anthracene _A ^{M#}	0.04	0.32	0.07	<0.01	0.01	-	-	-	mg/kg	A-T-019s
Benzo(a)anthracene _A [#]	0.07	0.62	0.20	<0.01	<0.01	-	-	-	mg/kg	A-T-019s
Benzo(a)pyrene _A ^{M#}	0.04	1.43	0.05	<0.01	<0.01	-	-	-	mg/kg	A-T-019s
Benzo(b)fluoranthene _A ^{M#}	0.13	1.07	0.15	<0.01	<0.01	-	-	-	mg/kg	A-T-019s
Benzo(ghi)perylene _A ^{M#}	0.18	1.48	0.10	<0.01	<0.01	-	-	-	mg/kg	A-T-019s
Benzo(k)fluoranthene _A	0.14	1.26	0.14	<0.01	<0.01	-	-	-	mg/kg	A-T-019s
Chrysene _A ^{M#}	0.17	1.49	0.15	<0.01	<0.01	-	-	-	mg/kg	A-T-019s
Dibenzo(ah)anthracene _A [#]	<0.01	0.11	<0.01	<0.01	<0.01	-	-	-	mg/kg	A-T-019s
Fluoranthene _A ^{M#}	0.22	2.75	0.14	<0.01	0.05	-	-	-	mg/kg	A-T-019s
Fluorene _A ^{M#}	<0.01	0.05	<0.01	<0.01	<0.01	-	-	-	mg/kg	A-T-019s
Indeno(123-cd)pyrene _A [#]	<0.01	0.58	<0.01	<0.01	<0.01	-	-	-	mg/kg	A-T-019s
Napthalene _A ^{M#}	<0.01	0.10	0.02	0.02	0.02	-	-	-	mg/kg	A-T-019s
Phenanthrene _A ^{M#}	0.10	0.82	0.07	<0.01	0.04	-	-	-	mg/kg	A-T-019s
Pyrene _A ^{M#}	0.21	2.50	0.11	<0.01	0.05	-	-	-	mg/kg	A-T-019s
Total PAH _A [#]	1.30	14.7	1.21	0.02	0.18	-	-	-	mg/kg	A-T-019s

Envirolab Job Number: 10/04101

Client Project Name: 53 Fitzroy Park

Client Project Ref: 241919

Lab Sample ID	10/04101/9	10/04101/10	10/04101/11	10/04101/12	10/04101/13	10/04101/14			Units	Method ref
Client Sample No										
Client Sample ID	BH2A	BH6A	BH6A	BH8A	BH8A	BH9A				
Depth to Top	9.00	4.90	8.05	1.10	6.10	3.20				
Depth To Bottom			8.50							
Date Sampled	24-Nov-10	24-Nov-10	24-Nov-10	24-Nov-10	24-Nov-10	24-Nov-10				
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil				
Sample Matrix Code	3	3	3	3	3	3				
pH _D ^{M#}	8.9	8.6	8.6	7.6	8.2	7.4			pH	A-T-031s
Sulphate (water sol 2:1) _D ^{M#}	0.28	0.17	0.26	0.27	0.28	0.47			g/l	A-T-026s

FINAL ANALYTICAL TEST REPORT

Envirolab Job Number: 10/04194
Issue Number: 1
Date: 14 December, 2010

Client: RSK STATS Hemel Hempstead
18 Frogmore Road
Hemel Hempstead
Hertfordshire
UK
HP3 9RT

Project Manager: Clive Gerring
Project Name: 53 Fitzroy Park
Project Ref: 241919
Order No: Not specified
Date Samples Received: 02/12/10
Date Instructions Received: 02/12/10
Date Analysis Completed: 14/12/10

Prepared by:


Melanie Marshall
Laboratory Coordinator

Approved by:


John Gustafson
Director

Notes - Soil analysis

All results are reported as dry weight (<40°C).

Stones >10mm are removed from the sample prior to analysis and results corrected where appropriate.

Notes - General

For soil samples subscript A indicates analysis performed on the sample as received, D indicates analysis performed on dried & crushed sample.

Superscript M indicates method accredited to MCERTS.

Predominant Matrix Codes - 1 = SAND, 2 = LOAM, 3 = CLAY, 4 = LOAM/SAND, 5 = SAND/CLAY, 6 = CLAY/LOAM, 7 = OTHER.

Samples with Matrix Code 7 are not predominantly a SAND/LOAM/CLAY mix and are not covered by our MCERTS accreditation.

Secondary Matrix Codes - A = contains stones, B = contains construction rubble, C = contains visible hydrocarbons, D = contains glass/metal, E = contains roots/twigs.

IS indicates Insufficient sample for analysis. NDP indicates No Determination Possible. NFI indicates No Fibres Identified.

Superscript # indicates method accredited to ISO 17025.

Accreditation for TPH (C6-C40) applies to the range C6-C36 only.

Analytical results reflect the quality of the sample at the time of analysis only.

Opinions and interpretations expressed are outside the scope of our accreditation.

Envirolab Job Number: 10/04194

Client Project Name: 53 Fitzroy Park

Client Project Ref: 241919

Lab Sample ID	10/04194/1	10/04194/2	10/04194/3						Units	Method ref
Client Sample No										
Client Sample ID	BH1A	BH2A	Pond							
Depth to Top										
Depth To Bottom										
Date Sampled										
Sample Type	Water - GW	Water - GW	Water - GW							
Sample Matrix Code										
pH (w) _A [#]	7.3	7.3	7.5						pH	A-T-031w
Alkalinity (bicarbonate) _A	-	500	390						mg/l Ca CO ₃	A-T-038
Alkalinity (carbonate) _A	-	<15	<15						mg/l Ca CO ₃	A-T-038
Chloride (w) _A [#]	-	143	40						mg/l	A-T-026w
Sulphate (w) _A [#]	827	1753	66						mg/l	A-T-026w
Calcium (dissolved) _A [#]	-	457	95.3						mg/l	A-T-049
Lead (dissolved) _A [#]	-	1	-						µg/l	A-T-025
Magnesium (dissolved) _A [#]	-	208	23.6						mg/l	A-T-049
Potassium (dissolved) _A [#]	-	26.5	14.5						mg/l	A-T-049
Sodium (dissolved) _A [#]	-	217	28.6						mg/l	A-T-049
Benzo(a)pyrene (w) _A [#]	-	<0.01	-						µg/l	A-T-019w

APPENDIX E

CLEA Software Output Reports

(This appendix contains 13 pages, including this)

Generic Assessment Criteria for Human Health
Residential Scenario – Private Gardens

The human health generic assessment criteria (GAC) have been developed during a period of regulatory review and updating of the Contaminated Land Exposure Assessment (CLEA) project. Hence, the Environment Agency (EA) is in the process of publishing updated reports relating to the CLEA project and the GAC presented in this document may change to reflect these updates. This issue was prepared following the publication of soil guideline value reports and associated publications⁽¹⁾ for mercury, selenium, benzene, toluene, ethylbenzene and xylene in March 2009 plus arsenic and nickel in May 2009. Where available, the published soil guideline values (SGV)⁽¹⁾ have been used as GAC.

1. Model Selection

Soil assessment criteria (SAC) were calculated for compounds where SGV have not been published using CLEA v1.04. Groundwater assessment criteria (GrAC) protective of human health via the inhalation pathway were derived using the RBCA 1.3b model. RSK has updated the inputs within RBCA to reflect the UK guidance⁽²⁻⁵⁾. The SAC and GrAC collectively are termed GAC.

2. Conceptual Model

In accordance with EA Science Report SC050221/SR3⁽³⁾, the residential with private garden scenario considers risks to a female child between the ages of 0 and 6 years old. In accordance with Box 3.1, SR3⁽³⁾, the pathways considered for production of the SAC in the residential with gardens scenario are:

- Direct soil and dust ingestion;
- Consumption of homegrown produce;
- Consumption of soil attached to homegrown produce;
- Dermal contact with soil and indoor dust, and
- Inhalation of indoor and outdoor dust and vapours.

Figure 1 is a conceptual model illustrating these linkages.

The pathway considered in production of the GrAC is the volatilisation of compounds from groundwater and subsequent vapour inhalation by residents whilst indoors. Figure 2 illustrates this linkage. Although the outdoor air inhalation pathway is also valid, this contributes little to the overall risks owing to the dilution in outdoor air.

Within RBCA, the solubility limit of the determinant restricts the extent of volatilisation, which in turn drives the indoor air inhalation pathway. Whilst the same restriction is not built into the CLEA model, the model output cells are flagged red where the soil saturation limit has been exceeded. In accordance with the SGV report for xylene⁽¹⁾, where the soil saturation or solubility limit has been exceeded the GAC has been set at this limit. It should be noted this is a highly conservative assumption. Unless free-phase product is present, concentrations of the chemical are unlikely to be present at sufficient concentration to result in an exceedance of the health criteria value (HCV).

3. Input Selection

Chemical data was obtained from EA Report SC050021/SR7⁽⁵⁾ and the health criteria values (HCV) from the UK TOX reports (published 2002 and 2009) where available.

For total petroleum hydrocarbons (TPH), HCV and chemical specific parameters were taken from the TPH Criteria Working Group (TPHCWG). Until further information is available regarding whether the TPH fractions should be considered cumulatively and/or additional data becomes available regarding background exposure, RSK has taken the conservative view that 50% exposure to TPH fractions is derived from background. Thus, the mean daily intake has been set at 50% of the toxicological data. Aromatic hydrocarbons C₅-C₈ were not modelled since benzene and toluene are being modelled separately. The aromatic C₈-C₉ hydrocarbon fraction comprises ethylbenzene, xylene and styrene. Since ethylbenzene and xylene are being modelled separately, the physical, chemical and toxicological data for this band has been taken from styrene. Owing to the lack of UK-specific data, default information in the RBCA model was used to evaluate methyl tertiary butyl ether (MTBE). No published UK data was available for 1,2,4- and 1,3,5-trimethylbenzene, so information was obtained from the US EPA. Toxicity reports were generated by RSK in line with guidance in CLR9⁽⁷⁾ for 14 of the 16 USEPA polycyclic aromatic hydrocarbons (PAH). RSK notes that CLR9⁽⁷⁾ has been withdrawn and these toxicity reports may need to be updated using additional references included within SR2⁽²⁾. However, the data in these documents is considered to remain valid since it broadly follows the approach outlined in SR2. Therefore, the HCV from these reports was used with the chemical data obtained from SR7⁽⁵⁾, where available.

RBCA uses toxicity data for the inhalation pathway in different units to the CLEA model and cannot consider separately the mean daily intake (MDI), occupancy periods or breathing rates. Therefore, the HCV was amended to take account of:

- Amendments to the MDI using Table 3.4 of SR2⁽²⁾;
- A child weighing 13.3kg (average of 0-6 year old female in accordance with Table 4.6 of SR3⁽³⁾) and breathing 11.85m³ (average daily inhalation rate for a 0-6yr old female in accordance with Table 4.14 of SR3⁽³⁾); and
- The 50% rule (for petroleum hydrocarbons, trimethylbenzenes and MTBE)⁽²⁾ where MDI data is not currently available but background exposure is considered important in the overall exposure.

Physical Parameters

For the residential with private gardens scenario, the CLEA default building is a small two-storey terrace house with concrete ground bearing slab. The house is assumed to have a 100m² private garden consisting of lawn, flowerbeds and incorporating a 20m² plot for growing fruit and vegetables consumed by the residents. SR3⁽³⁾ notes this residential building type to be the most conservative in terms of protection from vapour intrusion. The building parameters are outlined in Table 5.

The parameters for a sandy loam soil type were used in line with SR3⁽³⁾. This includes a value of 6% for the percentage soil organic matter (SOM) within the soil. In RSK's experience, this is rather high for many sites. To avoid undertaking site specific risk assessments for this parameter, RSK has produced an additional set of SAC for an SOM of 1%.

For the GrAC, the depth to groundwater was taken as 2.5m based on RSK's experience of assessing the volatilisation pathway from groundwater.

4. GAC

The SAC were produced using the input parameters in Tables 1 to 5 and the GrAC using input parameters in Table 6. The final selected GAC are presented by pathway in Table 7 and the combined GAC in Table 8.

Figure 1

Conceptual Model for CLEA Residential Scenario – Private Gardens

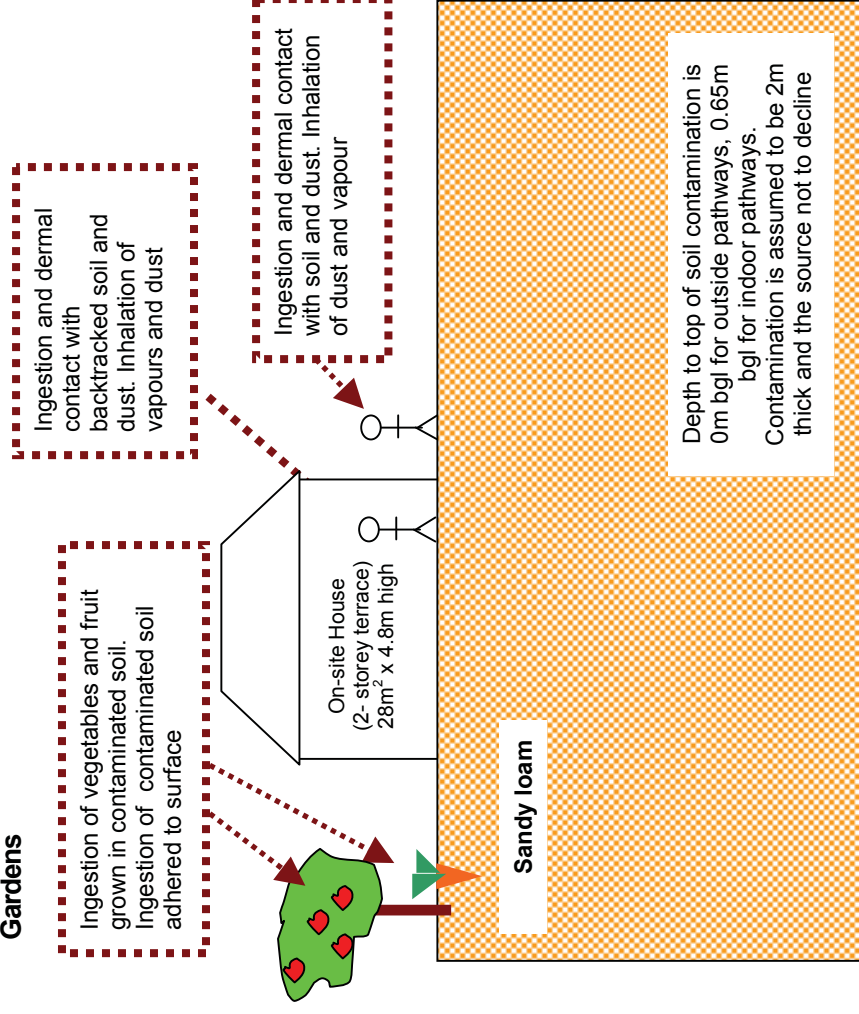


Table 1
Exposure Assessment Parameters for Residential Scenario - Private Gardens – Inputs for RBCA Model

Parameter	Value	Justification
Land use	Residential with homegrown produce	Chosen land use
Receptor	Female child age 1 to 6	Key generic assumption given in Box 3.1, SR3
Building	Small terraced house	Key generic assumption given in Box 3.1, report SC050021/SR3. Two storey small terraced house chosen as it is the most conservative residential building type in terms of protection from vapor intrusion (Section 3.4.6, SR3)
Soil type	Sandy Loam	Most common UK soil type (Section 4.3.1, From Table 3.1, SR3)
Start AC (age class)	1	Range of age classes corresponding to key generic assumption that the critical receptor is a young female child aged zero to six. From Box 3.1, report SC050021/SR3.
End AC (age class)	6	Representative of sandy loamy soil according to EA Guidance note dated January 2009 entitled 'Changes We Have Made to the CLEA Framework Documents'
SOM (%)	(i) 6	To provide SAC for sites where SOM <6% as often observed by RSK
pH	(ii) 1	Model default
	7	

Table 2
Residential with Private Gardens –Homegrown Produce Data for CLEA Model

	Consumption Rate (g FW kg ⁻¹ BW day ⁻¹) by Age Class						Dry Weight Conversion Factor	Homegrown Fraction (average)	Homegrown Fraction (high end)	Soil loading factor	Preparation correction factor
Name	1	2	3	4	5	6	g DW g ⁻¹ FW	-	-	g g ⁻¹ DW	-
Green vegetables	7.12	6.85	6.85	6.85	3.74	3.74	0.096	0.05	0.33	1.00E-03	2.00E-01
Root vegetables	10.69	3.30	3.30	3.30	1.77	1.77	0.103	0.06	0.4	1.00E-03	1.00E+00
Tuber vegetables	16.03	5.46	5.46	5.46	3.38	3.38	0.21	0.02	0.13	1.00E-03	1.00E+00
Herbaceous fruit	1.83	3.96	3.96	3.96	1.85	1.85	0.058	0.06	0.4	1.00E-03	6.00E-01
Shrub fruit	2.23	0.54	0.54	0.54	0.16	0.16	0.166	0.09	0.6	1.00E-03	6.00E-01
Tree fruit	3.82	11.96	11.96	11.96	4.26	4.26	0.157	0.04	0.27	1.00E-03	6.00E-01
Justification	Table 4.17, SR3						Table 6.3, SR3	Table 4.19, SR3		Table 6.3, SR3	

Table 3
Residential with Private Gardens – Land Use Data for CLEA Model

Parameter	Unit	Age Class					
		1	2	3	4	5	6
EF (soil and dust ingestion)	day yr ⁻¹	180	365	365	365	365	365
EF (consumption of homegrown produce)	day yr ⁻¹	180	365	365	365	365	365
EF (skin contact, indoor)	day yr ⁻¹	180	365	365	365	365	365
EF (skin contact, outdoor)	day yr ⁻¹	180	365	365	365	365	365
EF (inhalation of dust and vapour, indoor)	day yr ⁻¹	365	365	365	365	365	365
EF (inhalation of dust and vapour, outdoor)	day yr ⁻¹	365	365	365	365	365	365
Justification		Table 3.1, SR3					
Occupancy period (indoor)	hr day ⁻¹	23	23	23	23	19	19
Occupancy period (outdoor)	hr day ⁻¹	1	1	1	1	1	1
Justification		Table 3.2, SR3					
Soil to skin adherence factor (indoor)	mg cm ⁻² day ⁻¹	6.00E-02	6.00E-02	6.00E-02	6.00E-02	6.00E-02	6.00E-02
Soil to skin adherence factor (outdoor)	mg cm ⁻² day ⁻¹	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00
Justification		Table 8.1, SR3					
Soil and dust ingestion rate	g day ⁻¹	1.00E-01	1.00E-01	1.00E-01	1.00E-01	1.00E-01	1.00E-01
Justification		Table 6.2, SR3					

Table 4
Residential with Private Gardens – Receptor Data for CLEA Model

Parameter	Unit	Age Class						Justification
		1	2	3	4	5	6	
Body weight	kg	5.6	9.8	12.7	15.1	16.9	19.7	Table 4.6, SR3
Body height	m	0.7	0.8	0.9	0.9	1	1.1	
Inhalation rate	m ³ day ⁻¹	8.5	13.3	12.7	12.2	12.2	12.2	Table 4.14, SR3
Max exposed skin fraction (indoor)	m ² m ⁻²	0.32	0.33	0.32	0.35	0.35	0.33	Table 4.8, SR3
Max exposed skin fraction (outdoor)	m ² m ⁻²	0.26	0.26	0.25	0.28	0.28	0.26	

Table 5
Residential with Private Gardens – Soil and Building Inputs for CLEA Model

Parameter	Unit	Value	Justification
SOIL PROPERTIES for sandy loam			
Porosity, total	cm ³ cm ⁻³	0.53	Default soil type is sandy loam, section 4.3.1, SR3. Parameters for sandy loam from Table 4.4, SR3
Porosity, air filled	cm ³ cm ⁻³	0.20	
Porosity, water filled	cm ³ cm ⁻³	0.33	
Residual soil water content	cm ³ cm ⁻³	0.12	
Saturated hydraulic conductivity	cm s ⁻¹	3.56E-03	
van Genuchten shape parameter (<i>m</i>)	-	3.20E-01	
Bulk density	g cm ⁻³	1.21	Default value taken from Section 9.2.2, SR3
Threshold value of wind speed at 10m	m s ⁻¹	7.20	
Empirical function (<i>F_x</i>) for dust model	-	1.22	Value taken from Section 9.2.2, SR3
Ambient soil temperature	K	283	Annual average soil temperature representative of UK surface soils. Section 4.3.1, SR3
AIR DISPERSION MODEL			
Mean annual wind speed (10 m)	m s ⁻¹	5.00	Default value taken from Section 9.2.2, SR3
Air dispersion factor at height of 0.8 m	g m ⁻² s ⁻¹ per kg m ⁻³	2400	Values for a 0.01 ha site, appropriate to a residential land use in Newcastle (most representative city for UK). (from Table 9.1, SR3) Assumed child of 6 is not tall enough to reach 1.6m
Air dispersion factor at height of 1.6 m	g m ⁻² s ⁻¹ per kg m ⁻³	0	
Fraction of site with hard or vegetative cover	m ² m ⁻²	0.75	Section 3.2.6, SR3 based on residential land use
BUILDING PROPERTIES for small terrace house with ground-bearing floor slab			
Building footprint	m ²	28	From Table 3.3 and 4.21, SR3
Living space air exchange rate	hr ⁻¹	0.50	
Living space height (above ground)	m	4.8	
Living space height (below ground)	m	0.0	Assumed no basement
Pressure difference (soil to enclosed space)	Pa	3.1	From Table 3.3, SR3
Foundation thickness	m	0.15	
Floor crack area	cm ²	423	
Dust loading factor	µg m ⁻³	50	Default value for a residential site taken from Section 9.3, SR3
VAPOUR MODEL			
Default soil gas ingress rate	cm ³ s ⁻¹	25	Generic flow rate, Section 10.3, SR3
Depth to top of source (beneath building)	cm	50	Section 3.2.6, SR3 states source is 50cm below building or 65cm below ground surface
Depth to top of source (no building)	cm	0	Section 10.2, SR3 assumes impact from 0-1m for outdoor inhalation pathway
Thickness of contaminant layer	cm	200	Model default for indoor air, Section 4.9, SR4
Time average period for surface emissions	years	6	Time period of a 0 to 6 year old, Box 3.5, SR3
User-defined effective air permeability	cm ²	3.05E-08	Calculated for sandy loam using equations in Appendix 1, SR3

Figure 2
GrAC Conceptual Model for RBCA Residential with Gardens Scenario

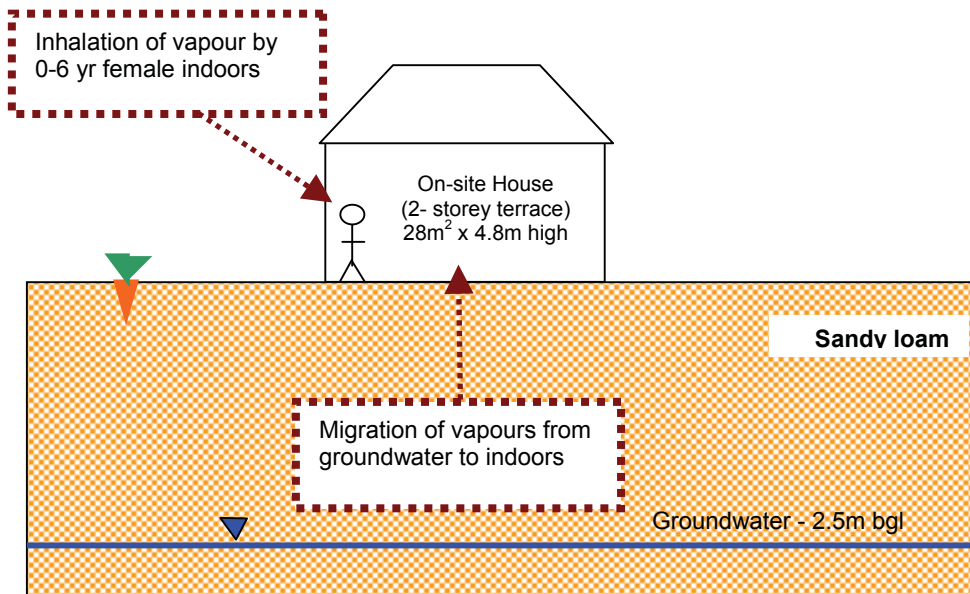


Table 6
Residential with Private Gardens RBCA Inputs

Parameter	Unit	Value	Justification
RECEPTOR			
Averaging time	Years	6	From Box 3.1, SR3
Receptor weight	kg	13.3	Average of CLEA 0-6 year old female data, Table 4.6, SR3
Exposure duration	Years	6	From Box 3.1, report , SR3
Exposure frequency	Days/yr	350	Weighted using occupancy period of 23 hours per day for 365 days of the year
SOIL TYPE – SANDY LOAM			
Total porosity	-	0.53	CLEA value for sandy loam. Parameters for sandy loam from Table 4.4, SR3
Volumetric water content	-	0.33	
Volumetric air content	-	0.20	
Dry bulk density	g cm ⁻³	1.21	CLEA value for saturated conductivity of sandy loam, Table 4.4, SR3
Vertical hydraulic conductivity	cm s ⁻¹	3.56E-3	
Vapour permeability	m ²	3.05E-12	Calculated for sandy loam using equations in Appendix 1, SR3
Capillary zone thickness	m	0.1	Professional judgement
Fraction organic carbon	%	(i) 0.0348	Representative of sandy loam according to EA Guidance note dated January 2009 entitled Changes We Have Made to the CLEA Framework Documents
		(ii) 0.0058	To provide SAC for site's where SOM < 6% as often observed by RSK
BUILDING			
Building volume/area ratio	m	4.8	Table 3.3, SR3
Foundation area	m ²	28	
Foundation perimeter	m	22	Calculated assuming building measures 7m x 4m to give 28m ² foundation area
Building air exchange rate	d ⁻¹	12	Table 3.3, SR3
Depth to bottom of foundation slab	m	0.15	
Foundation thickness	m	0.15	
Foundation crack fraction	-	0.0151	Calculated from floor crack area of 423 cm ² and building footprint of 28m ² in Table 4.21, SR3
Volumetric water content of cracks	-	0.33	Assumed equal to underlying soil type in assumption that cracks become filled with soil over time. Parameters for sandy loam from Table 4.4, SR3
Volumetric air content of cracks	-	0.2	
Indoor/outdoor differential pressure	Pa	3.1	From Table 3.3, SR3

REFERENCES

- 1) Environment Agency, 31 March 2009 and May 2009. Science Report SC050021 / benzene SGV, toluene SGV, ethylbenzene SGV, xylene SGV, mercury SGV, selenium SGV, nickel SGV and arsenic SGV. Supplementary information for the derivation of SGV for: benzene, toluene, ethylbenzene, xylene, mercury, selenium, nickel and arsenic. Contaminants in soil: updated collation of toxicological data and intake values for humans: benzene, toluene, ethylbenzene, xylene, mercury, selenium, nickel and arsenic.
- 2) Environment Agency, January 2009. Science Report SC050021/SR2 Human Health Toxicological Assessment of Contaminants in Soil.
- 3) Environment Agency, January 2009. Science Report SC050021/SR3 Updated Technical Background to the CLEA Model.
- 4) Environment Agency, January 2009. Science Report SC050021/SR4 CLEA Software (Version 1.04) Handbook.
- 5) Environment Agency. 2008. Science Report SC050021/SR7. Compilation of Data for Priority Organic Pollutants for Derivation of Soil Guideline Values.
- 6) Environment Agency and DEFRA. Contaminants in Soil: Collation of Toxicological Data and Intake Values for Humans. Numbers 1–12, 14, 16–25.
- 7) Environment Agency. March 2002. CLR 9. Contaminants in soil: Collation of Toxicological Data and Intake Values for Humans.

Table 7
Human Health Generic Assessment Criteria by Pathway for Residential Scenario - Private Gardens

Compound	GrAC (mg/l)	SAC Appropriate to Pathway SOM 1% (mg/kg)		Soil Saturation Limit (mg/kg)	SAC Appropriate to Pathway SOM 6% (mg/kg)		Soil Saturation Limit (mg/kg)
		Oral	Inhalation		Oral	Inhalation	
Metals							
Arsenic (b,c)	-	3.24E+01	8.50E+01	NR	3.24E+01	8.50E+01	2.35E+01
Cadmium	-	6.21E+01	4.25E+01	NR	6.21E+01	4.25E+01	2.93E+01
Chromium (hexavalent)	-	2.78E+02	4.25E+01	NR	2.78E+02	4.25E+01	3.76E+01
Copper	-	8.96E+03	6.08E+03	NR	8.96E+03	6.08E+03	4.74E+03
Lead (a)	-	4.50E+02	-	NR	4.50E+02	-	NR
Elemental Mercury (Hg ⁰) (b,d)	9.40E-03	-	1.70E-01	4.31E+00	-	1.02E+00	2.58E+01
Inorganic Mercury (Hg ²⁺) (b)	-	1.81E+02	2.55E+03	NR	1.81E+02	2.55E+03	1.69E+02
Methyl Mercury (Hg ⁴⁺) (b)	2.00E+01	1.39E+01	1.59E+01	7.33E+01	1.39E+01	6.53E+01	1.14E+01
Nickel (b,d)	-	5.31E+02	1.27E+02	NR	5.31E+02	1.27E+02	1.19E+02
Selenium (b,c)	-	3.51E+02	-	NR	3.51E+02	-	NR
Zinc (c)	-	2.53E+04	-	NR	2.53E+04	-	NR
Cyanide	-	2.66E+01	3.97E+00	NR	2.66E+01	3.97E+00	3.68E+00
Volatile Organic Compounds							
Benzene (b)	2.60E+01	1.12E-01	2.69E-01	1.22E+03	4.89E-01	1.04E+00	3.32E-01
Toluene (b)	1.90E+03	1.47E+02	6.26E+02	1.19E+02	7.59E+02	3.14E+03	6.11E+02
Ethylbenzene (b)	2.60E+02	1.06E+02	1.70E+02	6.52E+01	5.70E+02	9.32E+02	3.54E+02
Xylene - m	(b)	8.40E+01	5.56E+01	4.36E+01	1.09E+03	3.07E+02	2.40E+02
Xylene - o		1.00E+02	1.85E+02	4.52E+01	9.96E+02	3.27E+02	2.46E+02
Xylene - p		8.70E+01	1.91E+02	5.34E+01	5.76E+02	2.94E+02	2.28E+02
Total xylene		8.40E+01	5.56E+01	6.25E+02	1.09E+03	3.07E+02	2.40E+02
Methyl t-Butyl ether		1.75E+00	1.84E+02	1.66E+04	7.41E+00	3.70E+02	7.37E+00
Trichloroethene		2.83E+00	1.10E-01	1.54E+03	1.40E+01	5.11E-01	4.93E-01
Tetrachloroethene		1.06E+01	1.60E+00	1.43E+03	5.55E+01	8.21E+00	7.15E+00
1,1,1-Trichloroethane		3.20E+02	6.33E+00	2.60E+03	1.55E+03	2.84E+01	2.79E+01
1,1,1,2-Tetrachloroethane		5.19E+00	1.08E+00	2.60E+03	2.78E+01	5.83E+00	4.82E+00
1,1,2,2-Tetrachloroethane		2.70E+00	2.76E+00	2.67E+03	1.30E+01	1.24E+01	6.34E+00
Carbon Tetrachloride		1.05E+00	1.81E-02	1.52E+03	5.44E+00	8.99E-02	8.92E-02
1,2-Dichloroethane		3.06E-02	6.46E-03	3.41E+03	1.05E-01	1.60E-02	1.39E-02
Vinyl Chloride		1.90E-02	5.43E-04	1.36E+03	1.21E-02	1.07E-03	9.86E-04
1,2,4-Trimethylbenzene		7.50E-02	7.42E-01	1.03E+02	1.87E+02	4.19E+00	4.17E+00
1,3,5-Trimethylbenzene		4.70E-02	4.60E-01	9.47E+01	7.94E+01	2.59E+00	2.56E+00
Semi-Volatile Organic Compounds							
Acenaphthene		3.20E+00	7.34E+00	1.32E+02	7.49E+02	4.32E+01	4.09E+01
Acenaphthylene		4.20E+00	5.45E-01	3.89E+02	5.32E+01	3.21E+00	3.03E+00
Anthracene		2.10E-02	4.26E+04	3.60E+00	5.15E+04	7.40E+03	6.47E+03
Benzo(a)anthracene		3.80E-03	1.42E+01	1.71E+00	1.57E+01	2.05E+01	8.90E+00
Benzo(b)fluoranthene		2.00E-03	1.47E+01	1.22E+00	1.58E+01	2.87E+01	1.02E+01
Benzo(g,h,i)perylene		2.60E-04	2.35E+03	1.87E-02	2.40E+03	5.63E+04	2.30E+03
Benzo(k)fluoranthene		8.00E-04	1.50E+01	6.87E-01	1.59E+01	2.91E+01	1.03E+01
Chrysene		2.00E-03	1.37E+02	4.40E-01	1.55E+02	2.72E+02	9.90E+01
Dibenzo(a,h)anthracene		6.00E-04	1.53E+00	3.93E-03	1.59E+00	2.85E+00	1.02E+00
Fluoranthene		2.30E-01	1.12E+02	1.89E+01	1.50E+02	7.18E+01	4.85E+01
Fluorene		1.90E+00	2.35E+03	1.53E+02	6.86E+03	5.23E+02	4.86E+02
Indeno(1,2,3-cd)pyrene		2.00E-04	1.45E+01	6.14E-02	1.58E+01	2.86E+01	1.02E+01
Phenanthrene		5.30E-01	2.39E+03	7.06E+01	3.03E+03	6.33E+03	2.05E+03
Pyrene		1.30E-01	1.08E+03	2.20E+00	1.49E+03	6.93E+02	4.73E+02
Benzo(a)pyrene		3.80E-03	1.49E+00	9.11E-01	1.58E+00	2.90E+00	1.02E+00
Naphthalene		1.90E+01	2.68E+01	7.64E+01	1.43E+02	9.27E+00	8.71E+00
Phenol (c)	-	4.40E+02	-	4.16E+04	1.98E+03	-	-
							1.74E+05

GENERIC ASSESSMENT CRITERIA FOR HUMAN HEALTH - RESIDENTIAL WITH PRIVATE GARDENS

Table 7
Human Health Generic Assessment Criteria by Pathway for Residential Scenario - Private Gardens



Compound	GrAC (mg/l)	SAC Appropriate to Pathway SOM 1% (mg/kg)		Soil Saturation Limit (mg/kg)	SAC Appropriate to Pathway SOM 6% (mg/kg)		Soil Saturation Limit (mg/kg)
		Oral	Inhalation		Oral	Inhalation	
Total Petroleum Hydrocarbons							
Aliphatic hydrocarbons EC ₅ -EC ₆	1.00E+01	8.97E+03	2.47E+01	3.69E+02	4.31E+04	8.04E+01	1.20E+03
Aliphatic hydrocarbons >EC ₆ -EC ₈	5.40E+00	1.52E+04	5.11E+01	1.69E+02	6.62E+04	2.39E+02	7.93E+02
Aliphatic hydrocarbons >EC ₈ -EC ₁₀	2.30E-01	3.14E+03	1.11E+01	8.46E+01	4.12E+03	6.29E+01	4.79E+02
Aliphatic hydrocarbons >EC ₁₀ -EC ₁₂	3.40E-02	3.99E+03	5.36E+01	5.02E+01	4.34E+03	3.18E+02	2.98E+02
Aliphatic hydrocarbons >EC ₁₂ -EC ₁₆	7.60E-04	4.39E+03	2.48E+02	2.22E+01	4.41E+03	1.49E+03	1.33E+02
Aliphatic hydrocarbons >EC ₁₆ -EC ₂₁	-	8.84E+04	-	9.15E+00	8.84E+04	-	5.49E+01
Aliphatic hydrocarbons >EC ₂₁ -EC ₃₅	-	8.84E+04	-	6.45E+00	8.84E+04	-	3.87E+01
Aromatic hydrocarbons >EC ₅ -EC ₉	6.50E+01	1.66E+02	2.65E+02	6.20E+02	8.50E+02	1.54E+03	3.61E+03
Aromatic hydrocarbons >EC ₉ -EC ₁₀	7.40E+00	5.53E+01	1.77E+01	6.20E+02	2.83E+02	1.03E+02	3.61E+03
Aromatic hydrocarbons >EC ₁₀ -EC ₁₂	2.50E+01	8.04E+01	9.74E+01	3.72E+02	3.90E+02	5.74E+02	2.19E+03
Aromatic hydrocarbons >EC ₁₂ -EC ₁₆	5.80E+00	1.40E+02	5.05E+02	1.70E+02	6.01E+02	3.00E+03	1.01E+03
Aromatic hydrocarbons >EC ₁₆ -EC ₂₁	-	8.84E+04	-	5.99E+01	8.84E+04	-	3.59E+02
Aromatic hydrocarbons >EC ₂₁ -EC ₃₅	-	1.11E+03	-	4.82E+00	1.29E+03	-	2.89E+01

Notes:

1. Generic assessment criteria not calculated owing to low volatility of substance and therefore no pathway, or an absence of toxicological data.
EC - equivalent carbon. GrAC - groundwater assessment criteria. SAC - soil assessment criteria.

The CLEA model output is colour coded depending upon whether the soil saturation limit has been exceeded.

Calculated SAC exceeds soil saturation limit and may significantly effect the interpretation of any exceedances since the contribution of the indoor and outdoor vapour pathway to total exposure is >10%. This shading has also been used for the RBCA output where the theoretical solubility limit has been exceeded. SAC/GrAC is set at soil saturation/solubility limit.
Calculated SAC exceeds soil saturation limit but will not effect the SSV significantly since the contribution of the indoor and outdoor vapour pathway to total exposure is <10%.
Calculated SAC does not exceed the soil saturation limit.

For consistency where the theoretical solubility limit within RBCA has been exceeded in production of the GrAC, these cells have also been hatched red.
The SAC for organic compounds are dependant upon soil organic matter (SOM) (%) content. To obtain SOM from total organic carbon (TOC) (%) divide by 0.58. 1% SOM is 0.58% TOC. DL Rowell Soil Science: Methods and Applications, Longmans, 1994.
SAC for TPH fractions, polycyclic aromatic hydrocarbons, MTBE, BTEX and trimethylbenzene compounds were produced using an attenuation factor for the indoor air inhalation pathway of 10 to reduce conservatism associated with the vapour inhalation pathway, section 10.1.1, SR3

- (a) GAC taken as former Soil Guideline Value owing to uncertainty regarding toxicological approach to be adopted by the Environment Agency.
(b) GAC taken from the Environment Agency SGV reports published March and May 2009.
(c) SAC for selenium, zinc, phenol, aliphatic and aromatic hydrocarbons >EC₁₆ does not include inhalation pathway owing to absence of toxicity data. SAC for arsenic is only based on oral contribution (rather than combined) owing to the relative small contribution from inhalation in accordance with the SGV report.
(d) SAC for elemental mercury and nickel is based on the inhalation pathway only owing to an absence of toxicity for elemental mercury and in accordance with the SGV report for nickel.

Table 7

Table 8
Human Health Generic Assessment Criteria for Residential Scenario - Private Gardens

Compound	GrAC for Groundwater (mg/l)	SAC for Soil SOM 1% (mg/kg)	SAC for Soil SOM 6% (mg/kg)
Metals			
Arsenic	-	32	32
Cadmium	-	29	29
Chromium (hexavalent)	-	38	38
Copper	-	4,700	4,700
Lead	-	450	450
Elemental Mercury (Hg ⁰)	0.009	0.17	1.0
Inorganic Mercury (Hg ²⁺)	-	170	170
Methyl Mercury (Hg ⁺)	20	7.4	11
Nickel	-	130	130
Selenium	-	350	350
Zinc	-	25,000	25,000
Cyanide	-	3.7	3.7
Volatile Organic Compounds			
Benzene	26	0.08	0.33
Toluene	1,900	120	610
Ethylbenzene	260	65	350
Xylene - m	84	44	240
Xylene - o	100	45	250
Xylene - p	87	42	230
Total xylene	84	44	240
Methyl t-Butyl ether	2,200	1.8	7.4
Trichloroethene	1.8	0.11	0.49
Tetrachloroethene	3.6	1.4	7.2
1,1,1-Trichloroethane	26	6.2	28
1,1,1,2-Tetrachloroethane	14	0.89	4.8
1,1,2,2-Tetrachloroethane	14	1.4	6.3
Carbon Tetrachloride	0.06	0.02	0.09
1,2-Dichloroethane	0.3	0.005	0.01
Vinyl Chloride	0.02	0.0005	0.001
1,2,4-Trimethylbenzene	0.08	0.74	4.2
1,3,5-Trimethylbenzene	0.05	0.46	2.6
Semi-Volatile Organic Compounds			
Acenaphthene	3.2	7.1	41
Acenaphthylene	4.2	0.52	3.0
Anthracene	0.02	1,300	6,500
Benzo(a)anthracene	0.004	5.2	8.9
Benzo(b)fluoranthene	0.002	9.3	10
Benzo(g,h,i)perylene	0.0003	2,300	2,300
Benzo(k)fluoranthene	0.0008	9.6	10
Chrysene	0.002	80	99
Dibenzo(a,h)anthracene	0.0006	0.93	1.0
Fluoranthene	0.23	13	49
Fluorene	1.9	85	490
Indeno(1,2,3-cd)pyrene	0.0002	9.1	10
Phenanthrene	0.53	790	2,100
Pyrene	0.13	130	470
Benzo(a)pyrene	0.004	0.95	1.0
Naphthalene	19	1.5	8.7
Phenol	-	440	2,000
Total Petroleum Hydrocarbons			
Aliphatic hydrocarbons EC ₅ -EC ₆	10	25	80
Aliphatic hydrocarbons >EC ₆ -EC ₈	5.4	51	240
Aliphatic hydrocarbons >EC ₈ -EC ₁₀	0.23	11	63
Aliphatic hydrocarbons >EC ₁₀ -EC ₁₂	0.03	50	300
Aliphatic hydrocarbons >EC ₁₂ -EC ₁₆	0.0008	22	130
Aliphatic hydrocarbons >EC ₁₆ -EC ₂₁	-	88,000	88,000
Aliphatic hydrocarbons >EC ₂₁ -EC ₃₅	-	88,000	88,000
Aromatic hydrocarbons >EC ₉ -EC ₉	65	130	700
Aromatic hydrocarbons >EC ₉ -EC ₁₀	7.4	16	92
Aromatic hydrocarbons >EC ₁₀ -EC ₁₂	25	58	300
Aromatic hydrocarbons >EC ₁₂ -EC ₁₆	5.8	130	570
Aromatic hydrocarbons >EC ₁₆ -EC ₂₁	-	88,000	88,000
Aromatic hydrocarbons >EC ₂₁ -EC ₃₅	-	1,100	1,300

Notes:

- Generic assessment criteria not calculated owing to low volatility of substance and therefore no pathway, or an absence of toxicological data.
EC - equivalent carbon. GrAC - groundwater assessment criteria. SAC - soil assessment criteria.

The SAC for organic compounds are dependent on Soil Organic Matter (SOM) (%) content. To obtain SOM from total organic carbon (TOC) (%) divide by 0.58.
1% SOM is 0.58% TOC. DL Rowell Soil Science: Methods and Applications, Longmans, 1994.

SAC for TPH fractions, polycyclic aromatic hydrocarbons, MTBE, BTEX and trimethylbenzene compounds were produced using an attenuation factor for the indoor air inhalation pathway of 10 to reduce conservatism associated with the vapour inhalation pathway, section 10.1.1, SR3.

SAC for aliphatic C10-C12 and C12-C16 is taken as soil saturation limit in accordance with CLEA. For consistency with CLEA, the GrAC for aliphatic and aromatic C12-C16 hydrocarbons and all PAH (acenaphthylene) has been set as the theoretical solubility limit.

Calculated SAC exceeds soil saturation limit (SSL), thus SSL taken as SAC in line with recently published SGV. For consistency where the GrAC exceeds the solubility limit, GrAC has been set at the solubility limit. These are highly conservative since concentrations of the chemical are very unlikely to be at sufficient concentration to result in an exceedance of the health criteria value at the point of exposure (i.e. indoor air) provided free-phase product is absent.

APPENDIX F

HASWASTE Assessment

(This appendix contains 2 pages, including this)

HASWASTE v4. Envirolab's Contaminated Land Soil Hazardous Waste Assessment Tool.
Envirolab, Sandpits Business Park, Mottram Road, Hyde, Cheshire SK14 3AR.



Site Code and Name

TP/WS/BH
Depth (m)
Envirolab reference

Arsenic
CrVI or Chromium
Copper
Lead
Nickel
Zinc

Cadmium
Mercury
Selenium

Barium
Beryllium
Cobalt
Manganese
Molybdenum

Total USEPA 16 PAHs

Acenaphthene
Acenaphthylene
Anthracene
Benzo(a)anthracene
Benzo(a)pyrene
Benzo(b)fluoranthene
Benzo(ghi)perylene
Benzo(k)fluoranthene
Chrysene
Dibenzo(ah)anthracene
Fluoranthene
Fluorene
Indeno(123cd)pyrene
Naphthalene
Phenanthrene
Pyrene

Benzo(j)fluoranthene

Benzene
Toluene
Ethylbenzene
Xylenes
Trimethylbenzenes

Chlorobenzene
1,2-Dichlorobenzene
1,3-Dichlorobenzene
1,4-Dichlorobenzene
1,2,4-Trichlorobenzene
2-Chlorotoluene
4-Chlorotoluene

Trichloroethene (TCE)

Oil in Waste Carcinogenic H7

Total TPH

Petrol or (C6-C10)
Diesel or (C10-C25) or
(conservative C10-C35)
Lube Oil or (C25+) or
(conservative C21+)

8 IARC H7 Carcinogenic PAHs marker
test (applicable to LRO only)

Kerosene

Kerosene

Creosote

Creosote

pH Corrosive H8 (Irritant H4)

pH (soil)

pH (leachate)

Alkali Reserve (gNaOH/100g)

H4 Alkali Reserve test

H8 Alkali Reserve test

Produces Toxic Gases H12

Total Sulphide

Free Cyanide

Thiocyanate

Elemental/Free Sulphur

PCBs Total

Phenols Total by HPLC

Phenol

Cresols

Xylenols

1-Naphthol

Resorcinol

2,3,5,6-Tetrachlorophenol

2,4,5-Trichlorophenol

2,4,6-Trichlorophenol

2,4-Dichlorophenol

4-Chloro-3-methylphenol

Pentachlorophenol

Bis(2-ethylhexyl)phthalate

Butylbenzylphthalate

Di-n-butylphthalate

Visual Fibre Screen or Asbestos
ID (enter Y or N)

H7≥0.1%; H8≥1%;
H8≥25%

Hazard Codes

Thresholds

Irritant H4

Irritant H4

Harmful H5

Toxic H6 (Harmful H5)

Toxic H6 (Harmful H5)

Carcinogenic H7

Carcinogenic H7

Corrosive H8 (Irritant H4)

Toxic for Reproduction H10

Toxic for Reproduction H10

Mutagenic H11

Mutagenic H11

Ecotoxic H14

New Ecotoxic H14 individual
substance specific thresholds

New Ecotoxic H14 individual
substance specific thresholds

BH1A	BH2A	BH6A	BH8A	BH9A									
0.40	0.45	0.25	0.40	0.40									

mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
22	18	7	11	11									
37	16	13	19	20									
75	55	19	24	24									
329	469	106	190	200									
32	19	8	13	13									
397	241	54	79	89									

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0.01	0.06	0.01	0.01	0.01									
0.01	0.07	0.01	0.01	0.01									
0.04	0.32	0.07	0.01	0.01									
0.07	0.62	0.20	0.01	0.01									
0.04	1.43	0.05	0.01	0.01									
0.13	1.07	0.15	0.01	0.01									
0.16	1.46	0.10	0.01	0.01									
0.14	1.26	0.14	0.01	0.01									
0.17	1.49	0.15	0.01	0.01									
0.01	0.11	0.01	0.01	0.01									
0.22	2.75	0.14	0.01	0.05									
0.01	0.05	0.01	0.01	0.01									
0.01	0.58	0.01	0.01	0.01									
0.01	0.10	0.02	0.02	0.02									
0.10	0.82	0.07	0.01	0.04									
0.21	2.50	0.11	0.01	0.05									

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	51.1	0.1		16.5									
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#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
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7.6	7.4	7.2	8.2	8.3									

7.6	7.4	7.2	8.2	8.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7.6	7.4	7.2	8.2	8.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

N	N	N	N	N									
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%	%	%	%	%	%	%	%	%	%	%	%	%	%
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.006	0.004	0.002	0.003	0.003	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.063	0.084	0.019	0.033	0.036	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.010	0.006	0.003	0.004	0.004	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.012	0.005	0.004	0.006	0.007	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.048	0.068	0.015	0.028	0.028	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.048	0.068	0.015	0.028	0.028	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.006	0.004	0.002	0.003	0.003	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.448	0.381	0.105	0.166	0.177	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

0.00001	0.00006	0.00002	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
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0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
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