



18 Frogmore Road
Hemel Hempstead
Hertfordshire
HP3 8RT
UK

Our Ref: 27621 L26 (00) ad

14th March 2018

CALA Homes (South Home Counties) Limited
Tilford House,
Farnham Business Park,
Weydon Lane,
Farnham,
Surrey, GU9 8QT

FAO: Mr James Rwodzi

Dear James,

RE: Former West End Nursery, Angmering - Validation Plots 42 to 46

1. BACKGROUND

RSK Environment Limited (RSK) was commissioned by CALA Homes (South Home Counties) Limited (CALA) to carry out garden validation testing of Plots 42 to 46 of the former West End Nursery site off Roundstone Lane, Angmering, BN16 4AX. The site was previously occupied by a commercial nursery.

Several phases of site investigation, risk assessments, a remedial strategy and post remediation verification report (Phase 1A) have been completed for the former West End Nursery site by RSK. These are outlined in the following reports:

- RSK, 2015a. Geo-environmental Site Investigation, report ref: 27621 R01 (02), dated May 2016;
- RSK, 2015b. Additional Geo-environmental Site Investigation and Remediation, report ref: 27621 R02 (00), dated June 2015;
- RSK, 2016a. Remedial Strategy, report ref: 27621 R03 (02), dated August 2017;
- RSK, 2016b. Supplementary Geo-environmental Site Assessment, report ref: 27621 R04 (01), dated June 2016;
- RSK 2016c. Tank Validation, report ref: 27621 L01/ad, dated August 2016;
- RSK 2016d. Bund Validation Works, report ref: 27621 L02, dated October 2016;
- RSK 2016e. Asbestos Delineation Works Phase 1A – Plots 1 to 19, report ref: 27621 L04, dated October 2016;
- RSK, 2017. Asbestos Delineation Works Phase 1A – Plots 18 and 20 to 64, report ref: 27621 L05, dated February 2017; and
- RSK, 2017. Post-remediation Validation Report – Phase 1A, report ref: 27621 R06 (00), dated May 2017.

A number of impacted areas were found previously across the site including elevated concentrations of pesticides (one location), hydrocarbons, asbestos and metals.



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A first phase of remediation was undertaken at the site by Keltbray in accordance with recommendations contained within the approved remedial strategy for the site (RSK report ref: 27621 R03 (01), January 2016). The remedial works undertaken by Keltbray were documented in Completion Report, 6033.CR.LH.08072016V3, dated August 2016.

Throughout the Keltbray remedial works RSK attended site on an ad hoc basis to verify the works carried out. Validation works completed by RSK are detailed within the Post-Remediation Verification Report produced for Phase 1A, report ref: 27621 R06 (00), dated May 2017.

Based upon the remedial works carried out to date within Phase 1A, it is considered that the area is suitable for the proposed residential end use subject to the garden/soft landscaping verification works.

Since the development works commenced, RSK have collected a significant amount of additional data within Phase 1A (Plots 1-64). A letter report issued on 20th November 2017 by RSK, reference 27621-L19-dbj was compiled reviewing this data. In summary the report recommended that following on from an extended period of sub floor void monitoring that the gas regime could be downgraded from Amber 1/CS2 to Green/CS1. The downgrading of the gas regime means that no gas protection measures or verification by RSK are now required. This conclusion was approved by Arun District Council by email on 21st November 2017 and by the NHBC by email on 4th December 2017. Copies of these emails can be made available on request.

Validation of the topsoil and subsoil is ongoing, with RSK inspecting the completed gardens for presence of geo-membrane where applicable and cover layer thickness of subsoil and topsoil.

2. CAPPING LAYER REMEDIAL REQUIREMENTS

On the basis of the impacts previously identified at the site, it was recommended that a capping layer be incorporated into private garden areas to minimise risk to human health from any impacted soils. The specification for the capping layer, agreed with Arun District Council is as follows:

The capping layer in areas of identified impact (remaining bund materials, pesticide hotspot and made ground containing asbestos) and in the central landscaped area should be 600 mm thick to include a minimum of 150 mm clean imported topsoil and 450 mm clean imported/site-won subsoil with a geo-marker membrane at the base, which will act as a physical break layer. In lower risk areas (i.e. no impacts identified during the previous phases of works) the capping layer should be 450 mm to include a minimum of 150 mm clean imported topsoil and 300 mm clean imported/site-won subsoil.

Validation of the capping layer should consist of the following:

- In private gardens, testing should be carried out on the basis of one sample for every 50 m³ area of garden; and
- In communal soft landscaping areas, testing should be carried out on the basis of one sample for every 250 m³ of soft landscaping.

Based upon the recommendations above, this letter report represents a verification of the appropriate implementation of capping layer construction at relevant plots within the completed development.

The comments given in this report and the opinions expressed are based on the ground conditions encountered during the site work, on the results of laboratory analysis on soil samples and on available information. All works undertaken at the site are in accordance with the RSK Service Constraints presented in **Appendix A**.

3. SITE INSPECTION

RSK attended site on 21st and 22nd February, and 5th and 7th March 2018 to inspect and validate the capping layer (topsoil/subsoil) within the rear and front garden areas of Plots 42 to 46. Repeated visits were required due to the staggered installation of the capping layer across the gardens. Photographs from the site inspection are presented in **Appendix B**.

One hand-excavated trial pit was completed in the rear garden areas and one in each front garden of Plots 42 to 46. Pits were excavated to a depth of at least 450 mm below the existing ground level in Plots 42 and 44 to 46, and to 600 mm below ground in Plot 43, in accordance with the remedial strategy specification. Pits were excavated to allow for inspection and sampling of soils. The trial pit logs are presented in **Appendix C**.

The topsoil was of a uniform composition, comprising dark brown clayey sandy SILT, where sand is fine, and with abundant wood remains, frequent rootlets, and a weak organic matter odour. The topsoil was followed by the subsoil strata which comprised orangish brown slightly gravelly slightly sandy CLAY, where sand is fine, and gravel is subangular to rounded fine to medium flint, with rare chalk gravel and cobbles. In the front garden of Plots 42, 43 and 44, a layer of light orangish brown medium to coarse SAND was identified underlying the CLAY subsoil. In the front garden of Plot 46, the topsoil was instead underlain by a mix of CLAY topsoil, light brown angular to rounded fine to medium flint GRAVEL, and light grey subangular to rounded medium to coarse concrete-covered flint GRAVEL.

The depth of the capping layer within the garden was at least 450 mm across Plots 42 and 44 to 46, and at least 600 mm underlain by a geotextile marker layer across Plot 43. It is considered that this demonstrates compliance of the specified capping layer remedial measures. BLAZE have placed geotextile beneath the capping layer in the front gardens of Plots 42 to 46, although this is not required by the remedial strategy in accordance with these plots being identified as lower risk areas.

A site layout plan for Phase 1A is presented as **Figure 1**. The validation certificates for the imported topsoil are presented in **Appendix D**.

4. VERIFICATION TESTING

Soil samples were submitted for chemical laboratory testing comprising a standard suite of potential contaminants. Soil samples were submitted for the following suite of analysis:

- Selected heavy/semi/non-metals (including chromium VI);
- pH and sulphate;

- Speciated Total Petroleum Hydrocarbons (TPH)-CWG banding with Benzene, Toluene, Ethyl Benzene and Xylene (BTEX) and Methyl Tert Butyl Ether (MTBE) determination;
- Speciated Polycyclic Aromatic Hydrocarbons (PAH); and
- Asbestos screen.

A summary of the capping layer volumes is presented in **Table 1**.

Table 1: Summary of capping layer volumes

Plot Number	Combined topsoil/subsoil volume - front and rear (m ³)	Samples Tested
42	27.10	1
43	59.04	2
44	42.40	1
45	34.49	1
46	31.11	1

A total of 6 validation samples were collected from Plots 42 to 46 in accordance with the remedial requirements for Phase 1A. Based upon the testing strategy of 1 sample per 50 m³ it is considered that an appropriate number of samples have been obtained.

The chemical results are presented in **Appendix E** and indicate that concentrations of analytes are below the RSK GAC presented in **Appendix F**.

5. CONCLUSIONS

The results of the site inspection and laboratory testing have demonstrated that the topsoil and subsoil are chemically suitable for the proposed residential end-use and the capping layer has been completed to the required specification, comprising at least 450 mm across Plots 42 and 44 to 46 and at least 600 mm underlain by a geotextile marker layer across Plot 43. It is therefore considered that no further verification of the private garden areas of these plots is required.

It is considered that the inspection data for the garden areas are sufficient and that this letter report may be submitted to the NHBC, so that the appropriate land quality condition can be discharged based on the information provided.

We trust that the information discussed above is acceptable and recommend this report be submitted to the NHBC and Local Authority accordingly. Should you require RSK to submit this information on your behalf, please do not hesitate to contact us.

Yours sincerely,

For RSK Environment Limited



Andy Denton

Geo-environmental Consultant

Kirsten Fairall

Principal Geo-environmental Consultant

Enc.

Figure 1	Phase 1A - Site Location Plan
Appendix A	Service Constraints
Appendix B	Photographic Log
Appendix C	Trial Pit Logs
Appendix D	Topsoil Validation Certificates
Appendix E	Laboratory Certificates
Appendix F	RSK Generic Assessment Criteria

FIGURES



LEGEND

Site Boundary (Phase 1A)

600mm Capping Layer Required (total 1814.431m²)

450mm Capping Layer Required (total 3563.123m²)

Rev.	Date	Amendment	Drawn	Chkd.	Appd.



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Client
CALA HOMES (SOUTH HOME COUNTIES) LTD

Project Title
LAND AT WEST END NURSERY, ANGMERING

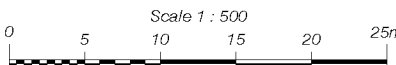
Drawing Title
PHASE 1A - SITE LOCATION PLAN

Drawn	Date	Checked	Date	Approved	Date
AP	10.05.17	CL	10.05.17	CL	10.05.17

Scale	Orig Size	Dimensions
1:500	A2	M

Project No.	Drawing File
27621	27621 Fig 1.dwg

Drawing No.	Rev.
FIGURE 1	P1





APPENDIX A

SERVICE CONSTRAINTS

1. This report and the site investigation carried out in connection with the report (together the "Services") were compiled and carried out by RSK Environment Limited (RSK) for CALA Homes (South Home Counties) Limited (the "client") in accordance with the terms of a contract between RSK and the "client". The Services were performed by RSK with the skill and care ordinarily exercised by a reasonable environmental consultant at the time the Services were performed. Further, and in particular, the Services were performed by RSK taking into account the limits of the scope of works required by the client, the time scale involved and the resources, including financial and manpower resources, agreed between RSK and the client.
2. Other than that expressly contained in paragraph 1 above, RSK provides no other representation or warranty whether express or implied, in relation to the Services.
3. Unless otherwise agreed the Services were performed by RSK exclusively for the purposes of the client. RSK is not aware of any interest of or reliance by any party other than the client in or on the Services. Unless expressly provided in writing, RSK does not authorise, consent or condone any party other than the client relying upon the Services. Should this report or any part of this report, or otherwise details of the Services or any part of the Services be made known to any such party, and such party relies thereon that party does so wholly at its own and sole risk and RSK disclaims any liability to such parties. Any such party would be well advised to seek independent advice from a competent environmental consultant and/or lawyer.
4. It is RSK's understanding that this report is to be used for the purpose described in the introduction to the report. That purpose was a significant factor in determining the scope and level of the Services. Should the purpose for which the report is used, or the proposed use of the site change, this report may no longer be valid and any further use of or reliance upon the report in those circumstances by the client without RSK's review and advice shall be at the client's sole and own risk. Should RSK be requested to review the report after the date hereof, RSK shall be entitled to additional payment at the then existing rates or such other terms as agreed between RSK and the client.
5. The passage of time may result in changes in site conditions, regulatory or other legal provisions, technology or economic conditions which could render the report inaccurate or unreliable. The information and conclusions contained in this report should not be relied upon in the future without the written advice of RSK. In the absence of such written advice of RSK, reliance on the report in the future shall be at the client's own and sole risk. Should RSK be requested to review the report in the future, RSK shall be entitled to additional payment at the then existing rate or such other terms as may be agreed between RSK and the client.
6. The observations and conclusions described in this report are based solely upon the Services that were provided pursuant to the agreement between the client and RSK. RSK has not performed any observations, investigations, studies or testing not specifically set out or required by the contract between the client and RSK. RSK is not liable for the existence of any condition, the discovery of which would require performance of services not otherwise contained in the Services. For the avoidance of doubt, unless otherwise expressly referred to in the introduction to this report, RSK did not seek to evaluate the presence on or off the site of asbestos, electromagnetic fields, lead paint, heavy metals, radon gas or other radioactive or hazardous materials.
7. The Services are based upon RSK's observations of existing physical conditions at the Site gained from a walk-over survey of the site together with RSK's interpretation of information including documentation, obtained from third parties and from the client on the history and usage of the site. The Services are also based on information and/or analysis provided by independent testing and information services or laboratories upon which RSK was reasonably entitled to rely. The Services clearly are limited by the accuracy of the information, including documentation, reviewed by RSK and the observations possible at the time of the walkover survey. Further RSK was not authorised and did not attempt to independently verify the accuracy or completeness of information, documentation or materials received from the client or third parties, including laboratories and information services, during the performance of the Services. RSK is not liable for any inaccurate information or conclusions, the discovery of which inaccuracies required the doing of any act including the gathering of any information which was not reasonably available to RSK and including the doing of any independent investigation of the information provided to RSK save as otherwise provided in the terms of the contract between the client and RSK.
8. The phase II or intrusive environmental site investigation aspects of the Services is a limited sampling of the site at pre-determined borehole and soil vapour locations based on the operational configuration of the site. The conclusions given in this report are based on information gathered at the specific test locations and can only be extrapolated to an undefined limited area around those locations. The extent of the limited area depends on the soil and groundwater conditions, together with the position of any current structures and underground facilities and natural and other activities on site. In addition chemical analysis was carried out for a limited number of parameters [as stipulated in the contract between the client and RSK] [based on an understanding of the available operational and historical information,] and it should not be inferred that other chemical species are not present.
9. Any site drawing(s) provided in this report is (are) not meant to be an accurate base plan, but is (are) used to present the general relative locations of features on, and surrounding, the site.



APPENDIX B PHOTOGRAPHIC LOG

PHOTOGRAPHIC LOG

Site Location: Land at West End Nursery, Angmering

Photo No.
1

Date:
21/02/2018

Overview of
Plot 42 front
garden



Photo No.
2

Date:
21/02/2017

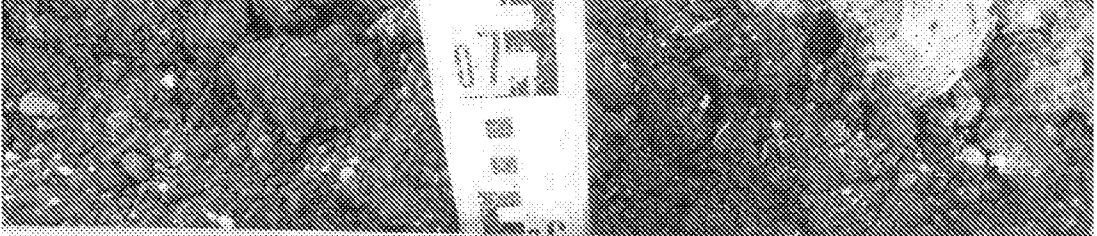
Plot 42 front
garden clean
capping is
800 mm thick



PHOTOGRAPHIC LOG	
Site Location: Land at West End Nursery, Angmering	
Photo No. 3	Photo No. 4
Date: 07/03/2018	Date: 07/03/2018
Overview of Plot 42 rear garden	Plot 42 rear garden clean capping is at least 700 mm thick
	

PHOTOGRAPHIC LOG

Site Location: Land at West End Nursery, Angmering

Photo No. 5	
Date: 21/02/2018	
Overview of Plot 43 front garden	
Photo No. 6	
Date: 21/02/2018	
Plot 43 front garden clean capping is 600 mm thick	

PHOTOGRAPHIC LOG

Site Location: Land at West End Nursery, Angmering

Photo No.
7

Date:
22/02/2018

Overview of
Plot 43 and
Plot 44 rear
gardens



Photo No.
8

Date:
05/03/2018

Plot 43 rear
garden clean
capping is
750 mm thick



PHOTOGRAPHIC LOG

Site Location: Land at West End Nursery, Angmering

Photo No. 9	
Date: 05/03/2018	
Plot 43 rear garden has marker membrane at base of pit	
Photo No. 10	
Date: 22/02/2018	
Plot 44 rear garden clean capping is 750 mm thick	

PHOTOGRAPHIC LOG

Site Location: Land at West End Nursery, Angmering

Photo No.
11

Date:
21/02/2018

Overview of
Plot 44 front
garden



Photo No.
12

Date:
21/02/2018

Plot 44 front
garden clean
capping is
750 mm thick



PHOTOGRAPHIC LOG

Site Location: Land at West End Nursery, Angmering

Photo No.
13

Date:
21/02/2018

Overview of
Plot 45 front
garden



Photo No.
14

Date:
21/02/2018

Plot 45 front
garden clean
capping is
750 mm thick



PHOTOGRAPHIC LOG

Site Location: Land at West End Nursery, Angmering

Photo No.
15

Date:
22/02/2018

Overview of
Plot 45 rear
garden



Photo No.
16

Date:
22/02/2018

Plot 45 rear
garden clean
capping is
800 mm thick



PHOTOGRAPHIC LOG

Site Location: Land at West End Nursery, Angmering

Photo No.
17

Date:
21/02/2018

Overview of
Plot 46 front
garden

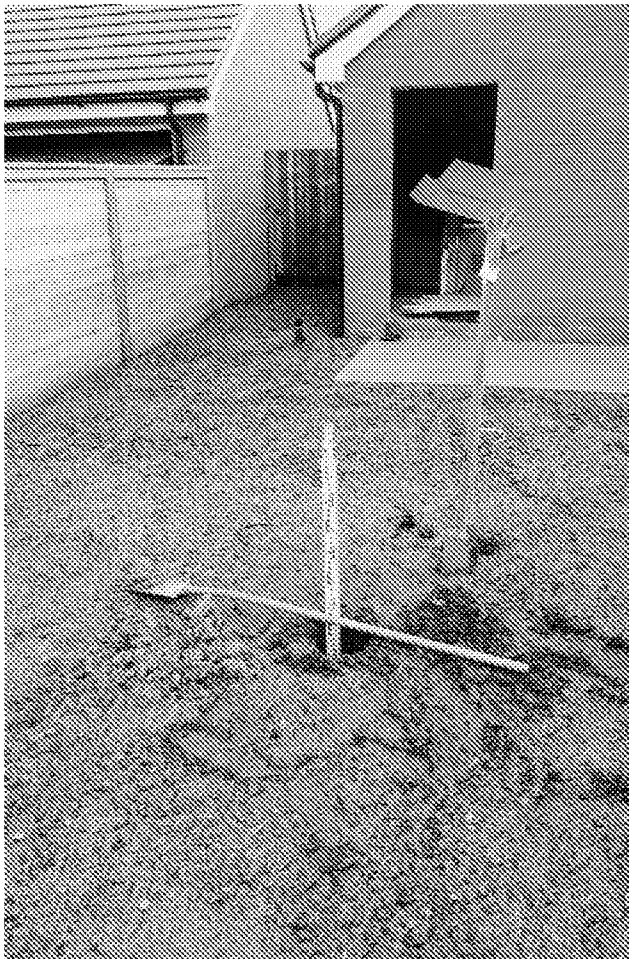
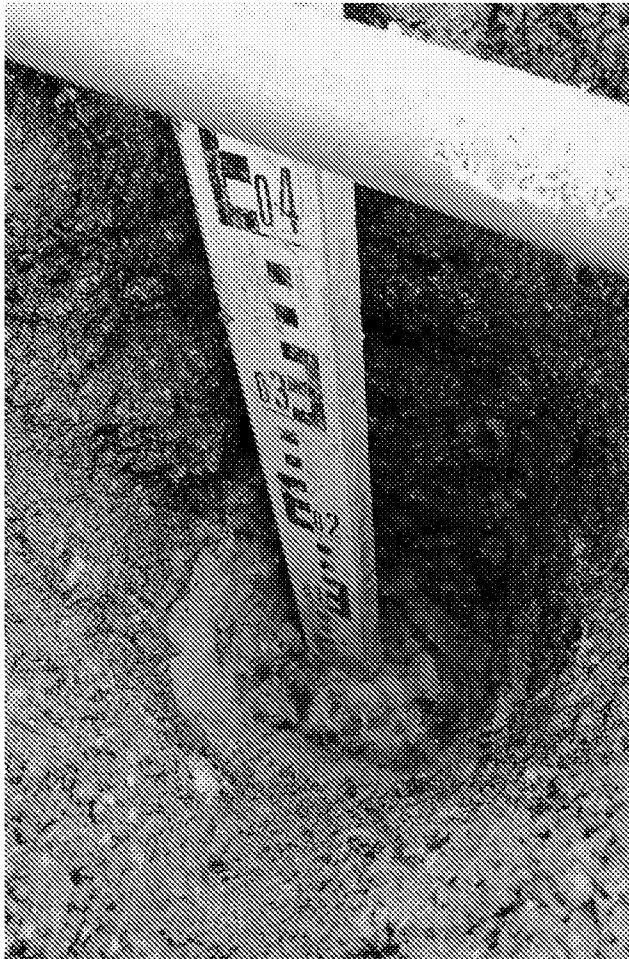


Photo No.
18

Date:
21/02/2018

Plot 46 front
garden clean
capping is
500 mm thick



PHOTOGRAPHIC LOG	
Site Location: Land at West End Nursery, Angmering	
Photo No. 19	Photo No. 20
Date: 07/03/2018	Date: 07/03/2018
Overview of Plot 46 rear garden	Plot 46 rear garden clean capping is 470 mm thick
	



APPENDIX C TRIAL PIT LOGS



TRIAL PIT LOG

Contract: Land at West End Nursery, Angmering		Client: CALA Homes (South Home Counties) Ltd		Trial Pit: HDP42
Contract Ref: 27621	Start: 07.03.18 End: 07.03.18	Ground Level: ---	Co-ordinates: ---	Sheet: 1 of 1

Samples and In-situ Tests				Water	Backfill	Description of Strata	Depth (Thick ness)	Material Graphic Legend
Depth	No	Type	Results					
						TOPSOIL: Dark brown slightly gravelly clayey sandy SILT. Sand is fine to medium. Gravel is rare, subangular to subrounded, fine to medium flint. Frequent wood remains. Weak organic matter odour.	(0.30) 0.30	
						SUBSOIL: Light brown sandy gravelly CLAY. Sand is fine. Gravel is abundant, subangular to subrounded, fine to medium flint.	(0.40) 0.70	
						Trial pit terminated at 0.70 m as required depth reached.		

General Remarks

1. Trial pit remained dry and stable during excavation.
2. Backfilled with arisings in approximate order of excavation.

All dimensions in metres

Scale:

1:25

Method

Hand dug

Plant

Used:

Hand tools

Logged

By:

ADenton

Checked

By:





Contract:		Client:		Trial Pit:
Land at West End Nursery, Angmering		CALA Homes (South Home Counties) Ltd		HDP42F
Contract Ref:	Start: 21.02.18	Ground Level:	Co-ordinates:	Sheet:
27621	End: 21.02.18	---	---	1 of 1

General Remarks				
1. Trial pit remained dry and stable during excavation. 2. Backfilled with arisings in approximate order of excavation.				
All dimensions in metres			Scale: 1:25	
Method Used Hand dug	Plant Used: Hand tools	Logged By: EHughes	Checked By:	

TRIAL PIT LOG

Contract: Land at West End Nursery, Angmering		Client: CALA Homes (South Home Counties) Ltd		Trial Pit: HDP43
Contract Ref: 27621	Start: 05.03.18 End: 05.03.18	Ground Level: ---	Co-ordinates: ---	Sheet: 1 of 1

Samples and In-situ Tests				Water	Backfill	Description of Strata	Depth (Thickness)	Material Graphic Legend
Depth	No	Type	Results					
						TOPSOIL: Dark brown clayey sandy SILT. Sand is fine. Abundant wood remains. Frequent rootlets. Weak organic matter odour.	(0.30)	
						SUBSOIL: Orangish brown slightly gravelly sandy CLAY. Sand is fine. Gravel is subangular to rounded fine to medium flint. 0.45m : chalk cobble 110 mm in size	(0.45)	
						Trial pit terminated at 0.75 m depth onto black marker membrane.	0.75	

General Remarks

1. Trial pit remained dry and stable during excavation.
2. Backfilled with arisings in approximate order of excavation.

All dimensions in metres

Scale:

1:25

Method

Plant

Logged

Checked

Used

Used:

By:

By:

Hand dug**Hand tools****JLaite**



TRIAL PIT LOG

Contract: Land at West End Nursery, Angmering		Client: CALA Homes (South Home Counties) Ltd		Trial Pit: HDP43F
Contract Ref: 27621	Start: 21.02.18 End: 21.02.18	Ground Level: ---	Co-ordinates: ---	Sheet: 1 of 1

Samples and In-situ Tests				Water	Backfill	Description of Strata	Depth (Thickness)	Material Graphic Legend
Depth	No	Type	Results					
0.10	1	ES	Tub+Jar+Vial			TOPSOIL: Dark brown clayey sandy SILT. Sand is fine. Abundant wood remains. Frequent rootlets. Weak organic matter odour.	0.20	
0.40	2	ES	Tub+Jar+Vial			SUBSOIL: Orangish brown slightly gravelly sandy CLAY. Sand is fine. Gravel is subangular to rounded fine to medium flint.	(0.35)	
						Light orangish brown medium to coarse SAND.	0.55	
						Trial pit terminated at 0.60 m depth onto orange marker membrane.	0.60	

General Remarks

1. Trial pit remained dry and stable during excavation.
2. Backfilled with arisings in approximate order of excavation.

All dimensions in metres

Scale:

1:25

Method

Hand dug

Plant

Used:

Hand tools

Logged

By:

EHughes

Checked

By:





TRIAL PIT LOG

Contract: Land at West End Nursery, Angmering			Client: CALA Homes (South Home Counties) Ltd		Trial Pit: HDP44
Contract Ref: 27621	Start: 22.02.18 End: 22.02.18	Ground Level: ---	Co-ordinates: ---	Sheet: 1 of 1	

Samples and In-situ Tests				Water	Backfill	Description of Strata	Depth (Thickness)	Material Graphic Legend
Depth	No	Type	Results					
						TOPSOIL: Dark brown clayey sandy SILT. Sand is fine. Abundant wood remains. Frequent rootlets. Weak organic matter odour.	(0.28) 0.28	
						SUBSOIL: Orangish brown slightly gravelly sandy CLAY. Sand is fine. Gravel is subangular to rounded fine to medium flint and chalk.	(0.42) 0.70	
						Trial pit terminated at 0.70 m as required depth reached.		

General Remarks

1. Trial pit remained dry and stable during excavation.
2. Backfilled with arisings in approximate order of excavation.

All dimensions in metres

Scale: **1:25**

Method Used: Hand dug	Plant Used: Hand tools	Logged By: EHughes	Checked By:	
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Contract: Land at West End Nursery, Angmering		Client: CALA Homes (South Home Counties) Ltd		Trial Pit: HDP44F
Contract Ref: 27621	Start: 21.02.18 End: 21.02.18	Ground Level: ---	Co-ordinates: ---	Sheet: 1 of 1

General Remarks				
1. Trial pit remained dry and stable during excavation. 2. Backfilled with arisings in approximate order of excavation.				
All dimensions in metres			Scale: 1:25	
Method Used Hand dug	Plant Used Hand tools	Logged By EHughes	Checked By	



TRIAL PIT LOG

Contract: Land at West End Nursery, Angmering		Client: CALA Homes (South Home Counties) Ltd		Trial Pit: HDP45	
Contract Ref: 27621	Start: 22.02.18 End: 22.02.18	Ground Level: ---	Co-ordinates: ---	Sheet: 1 of 1	

Samples and In-situ Tests				Water	Backfill	Description of Strata	Depth (Thickness)	Material Graphic Legend
Depth	No	Type	Results					
						TOPSOIL: Dark brown clayey sandy SILT. Sand is fine. Abundant wood remains. Frequent rootlets. Weak organic matter odour.	(0.35)	
						SUBSOIL: Orangish brown occasionally mottled brown with reddish brown staining slightly gravelly sandy CLAY. Sand is fine. Gravel is angular fine to medium flint.	(0.45)	
						0.40m : single medium gravel-sized brick fragment	0.80	
						Trial pit terminated at 0.80 m as required depth achieved.		

General Remarks

1. Trial pit remained dry and stable during excavation.
2. Backfilled with arisings in approximate order of excavation.

All dimensions in metres

Scale:

1:25

Method

Plant

Logged

Checked

Hand dug

Used:

Hand tools

By:

EHughes

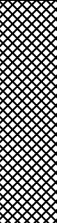
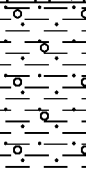
By:





TRIAL PIT LOG

Contract: Land at West End Nursery, Angmering			Client: CALA Homes (South Home Counties) Ltd		Trial Pit: HDP45F
Contract Ref: 27621	Start: 21.02.18 End: 21.02.18	Ground Level: ---	Co-ordinates: ---	Sheet: 1 of 1	

Samples and In-situ Tests				Water	Backfill	Description of Strata	Depth (Thick ness)	Material Graphic Legend
Depth	No	Type	Results					
0.30	1	ES	Tub+Jar+Vial			TOPSOIL: Dark brown clayey sandy SILT. Sand is fine. Abundant wood remains. Frequent rootlets. Weak organic matter odour.	0.18	
						SUBSOIL: Orangish brown slightly gravelly sandy CLAY. Sand is fine. Gravel is subangular to rounded fine to medium flint.	(0.57)	
						0.40m : single chalk cobble 70 x 60 x 60 mm in size		
						Trial pit terminated at 0.75 m depth onto orange marker membrane.		

General Remarks

1. Trial pit remained dry and stable during excavation.
2. Backfilled with arisings in approximate order of excavation.

All dimensions in metres

Scale: **1:25**

Method Hand dug	Plant Used: Hand tools	Logged By: EHughes	Checked By:	
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Contract:		Client:		Trial Pit:
Land at West End Nursery, Angmering		CALA Homes (South Home Counties) Ltd		HDP46
Contract Ref:	Start: 07.03.18	Ground Level:	Co-ordinates:	Sheet:
27621	End: 07.03.18	---	---	1 of 1

General Remarks	
1.	Trial pit remained dry and stable during excavation.
2.	Backfilled with arisings in approximate order of excavation.

Method Used: 155/21/DOC	Plant Used:	Logged By:	Checked By:	
Hand dug	Hand tools	ADenton		





APPENDIX D
TOPSOIL VALIDATION CERTIFICATES

Dispatch Note

Sold To BCT Services (South) Ltd Unit 3 Swanwick Business Park Hampshire Bridge Road Swanwick SO31 7GB		Job Site/Ship To: BCT Services (South) Ltd Crayfern Homes Wesid Place Raglan Avenue Durrington BN13 2AW	
Quote No. 23829	Job No. 39480	Salesperson No Sales Employee	Manager Ref 2244ra66
DESCRIPTION	QTY / UNIT	UNIT PRICE	EXTENDED PRICE
12/02/2018			
Container 8 Wheel Tipper	1.00 /		
Product Topsoil BS3882 (20MM)	18.00 / Tonnes		
			87.72
Company Representative (signature)			
Company Registration Number: 3629015		Company VAT Number: 816160744	

WEIGHBRIDGE TICKET

Ticket No. DO616319

CONVEYANCE NOTE

WOODHORN GROUP Ltd

Tangmere Composting Facility
City Fields Industrial Estate
Tangmere
West Sussex
PO25 2FP

Company Reg No 3629015
VAT No.816160744

Waste Carrier Licence no: C8DU163145

Time in 08:00
Date in 12/02/2018
Time Out 08:13
Date Out 12/02/2018
Vehicle V12TAT
Carrier T3 Transport Ltd
License No.
Client SCT Services (South) Ltd
Address Weald Place, Raglan Avenue,
Durrington, BN13 2AW, SIC

Permit
Zone
Product Topsoil 853882 (20MM)
EWC Code

1st Weight:	12760.00	Kg	P+
2nd Weight:	31760.00	Kg	@+
Net Weight:	18960.00	Kg	

By Signing this document I confirm that I have fulfilled
my duty to apply the waste hierarchy as required by
Regulation 12 of the waste (England and Wales)

Dispatch Note

Bill/Sold To: Blaze Construction Ltd 93 Leigh Road Hampshire Eastleigh SO50 9DQ	Job Site/Ship To: Blaze Construction Ltd CALA HOMES SITE CRESSWELL PARK ROUNDSTONE LANE ANGMERING
---	---

Quote No.	Job No.	Salesperson	Manager	Ref
23721	39570	No Sales Employee		809/15042

DESCRIPTION	QTY / UNIT	UNIT PRICE	EXTENDED PRICE
15/02/2018			
Container			
8 Wheel Tipper	1.00 /		
Product			
Topsoil BS3882 (20MM)	19.00 / Tonnes		
			82.58
_____ Company Representative (signature)			
Company Registration Number: 3825015		Company VAT Number: 816180744	

WEIGHBRIDGE TICKET

Ticket No. DO616718

CONVEYANCE NOTE

WOODHORN GROUP Ltd

Tangmere Composting Facility

City Fields Industrial Estate

Tangmere

West Sussex

PO20 2FF

Company Reg No 3629015

VAT No 816160744

Waste Carrier License no: CBDU182145

Time In 13:38
Date In 19/02/2018
Time Out 13:59
L Out 19/02/2018
Vehicle E10TJT
Carrier T/J Transport Ltd
License No
Client Blaze Construction Ltd
Address CRESSWELL PARK
ROUNDTONE LANE

Permit
Zone
Product Topsoil B63882 (20MM)
EWC Code
1st Weight 12,480.00 Kg P+
2nd Weight 28,100.00 Kg @+
Net Weight 15,620.00 Kg

By Signing this document I confirm that I have fulfilled
my duty to apply the waste hierarchy as required by
Regulation 12 of the waste (England and Wales)

THE WOODHORN GROUP

Date: 16/02/2018

Page: 1

Dispatch Note

Bill Sold To

Blaze Construction Ltd
83 Leigh Road
Hampshire
Eastleigh
SO50 9DQ

Job Site/Ship To:

Blaze Construction Ltd
CALA HOMES SITE
CRESSWELL PARK
ROUNDSTONE LANE
ANGMERING

Quote No.	Job No.	Salesperson	Manager	Ref
23722	39571	No Sales Employee		609/15042

DESCRIPTION	QTY / UNIT	UNIT PRICE	EXTENDED PRICE
20/02/2018			
Container			
8 Wheel Tipper	1.00 /		
Product			
Topsoil BS3682 (20MM)	19.00 / Tonnes		
			82.58
Company Representative (signature)			
Company Registration Number: 3629015			
Company VAT Number: 816160744			

WEIGHBRIDGE TICKET

Ticket No. DO616747

CONVEYANCE NOTE

WOODHORN GROUP Ltd

Tangmere Composting Facility

City Fields Industrial Estate

Tangmere

West Sussex

PO23 2FP

Company Reg No.3629015

VAT No.818160744

Waste Carrier Licence no: C8DU162145

Time In 07:58
Date In 20/02/2018
Time Out 08:17
Date Out 20/02/2018
Vehicle E18TJT
Carrier TJ Transport Ltd
License No
Client Blaze Construction Ltd
Address CRESSWELL PARK,
ROUNDSTONE LANE,

Permit

Zone

Product Topsoil BS3882 (20MM)-----

EW Code

1st Weight:	12,420.00	Kg	P+
2nd Weight:	30,600.00	Kg	@+
Net Weight:	18,180.00	Kg	

By Signing this document I confirm that I have fulfilled
my duty to apply the waste hierarchy as required by
Regulation 12 of the waste (England and Wales)



APPENDIX E

LABORATORY CERTIFICATES

FINAL ANALYTICAL TEST REPORT

Envirolab Job Number: 18/01628
Issue Number: 1

Date: 13 March, 2018

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

Project Manager: Catherine Latimer/Edward Hughes-Phillips/Joshua La
Project Name: Angmering
Project Ref: 27621
Order No: N/A
Date Samples Received: 23/02/18
Date Instructions Received: 05/03/18
Date Analysis Completed: 13/03/18

Prepared by:

Approved by:

Melanie Marshall
Laboratory Coordinator

Iain Haslock
Analytical Consultant

Envirolab Job Number: 18/01628

Client Project Name: Angmering

Client Project Ref: 27621

Lab Sample ID	18/01628/1	18/01628/2	18/01628/3	18/01628/4	18/01628/5	18/01628/6			Units	Method ref
Client Sample No	1	1	2	1	1	1				
Client Sample ID	Plot 42	Plot 43	Plot 43	Plot 44	Plot 45	Plot 46				
Depth to Top	0.10	0.10	0.40	0.40	0.30	0.40				
Depth To Bottom										
Date Sampled	21-Feb-18	21-Feb-18	21-Feb-18	21-Feb-18	21-Feb-18	21-Feb-18				
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES				
Sample Matrix Code	4AE	6AE	5A	6A	6A	6A				
% Stones >10mm _A	3.9	<0.1	17.3	4.2	30.4	22.5			% w/w	A-T-044
pH _D	7.78	7.90	8.08	8.11	8.25	9.35			pH	A-T-031s
Sulphate (water sol 2:1) _D ^{M#}	0.07	0.05	0.06	0.09	0.07	0.13			g/l	A-T-026s
Sulphate (acid soluble) _D ^{M#}	480	600	290	320	270	1200			mg/kg	A-T-028s
Arsenic _D ^{M#}	4	4	6	6	5	5			mg/kg	A-T-024s
Cadmium _D ^{M#}	1.2	0.8	1.0	1.2	1.2	0.6			mg/kg	A-T-024s
Copper _D ^{M#}	21	24	8	11	7	30			mg/kg	A-T-024s
Chromium _D ^{M#}	27	20	20	21	19	16			mg/kg	A-T-024s
Chromium (hexavalent) _D	<1	<1	<1	<1	<1	<1			mg/kg	A-T-040s
Lead _D ^{M#}	35	37	10	12	11	37			mg/kg	A-T-024s
Mercury _D	<0.17	<0.17	0.31	0.19	<0.17	<0.17			mg/kg	A-T-024s
Nickel _D ^{M#}	24	17	18	21	17	14			mg/kg	A-T-024s
Selenium _D ^{M#}	<1	2	<1	<1	<1	<1			mg/kg	A-T-024s
Zinc _D ^{M#}	73	75	41	47	39	57			mg/kg	A-T-024s

Envirolab Job Number: 18/01628

Client Project Name: Angmering

Client Project Ref: 27621

Lab Sample ID	18/01628/1	18/01628/2	18/01628/3	18/01628/4	18/01628/5	18/01628/6			Units	Method ref
Client Sample No	1	1	2	1	1	1				
Client Sample ID	Plot 42	Plot 43	Plot 43	Plot 44	Plot 45	Plot 46				
Depth to Top	0.10	0.10	0.40	0.40	0.30	0.40				
Depth To Bottom										
Date Sampled	21-Feb-18	21-Feb-18	21-Feb-18	21-Feb-18	21-Feb-18	21-Feb-18				
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES				
Sample Matrix Code	4AE	6AE	5A	6A	6A	6A				
Asbestos in Soil (inc. matrix)										
Asbestos in soil [#]	NAD	NAD	NAD	NAD	NAD	NAD				A-T-045
Asbestos ACM - Suitable for Water Absorption Test?	N/A	N/A	N/A	N/A	N/A	N/A				

Envirolab Job Number: 18/01628

Client Project Name: Angmering

Client Project Ref: 27621

Lab Sample ID	18/01628/1	18/01628/2	18/01628/3	18/01628/4	18/01628/5	18/01628/6			Units	Method ref
Client Sample No	1	1	2	1	1	1				
Client Sample ID	Plot 42	Plot 43	Plot 43	Plot 44	Plot 45	Plot 46				
Depth to Top	0.10	0.10	0.40	0.40	0.30	0.40				
Depth To Bottom										
Date Sampled	21-Feb-18	21-Feb-18	21-Feb-18	21-Feb-18	21-Feb-18	21-Feb-18				
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES				
Sample Matrix Code	4AE	6AE	5A	6A	6A	6A				
PAH 16										
Acenaphthene _A ^{M#}	0.01	0.04	<0.01	<0.01	<0.01	<0.01			mg/kg	A-T-019s
Acenaphthylene _A ^{M#}	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01			mg/kg	A-T-019s
Anthracene _A ^{M#}	<0.02	0.06	<0.02	<0.02	<0.02	<0.02			mg/kg	A-T-019s
Benzo(a)anthracene _A ^{M#}	0.11	0.18	<0.04	<0.04	<0.04	<0.04			mg/kg	A-T-019s
Benzo(a)pyrene _A ^{M#}	0.10	0.10	<0.04	<0.04	<0.04	<0.04			mg/kg	A-T-019s
Benzo(b)fluoranthene _A ^{M#}	0.11	0.12	<0.05	<0.05	<0.05	<0.05			mg/kg	A-T-019s
Benzo(ghi)perylene _A ^{M#}	<0.05	0.07	<0.05	<0.05	<0.05	<0.05			mg/kg	A-T-019s
Benzo(k)fluoranthene _A ^{M#}	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07			mg/kg	A-T-019s
Chrysene _A ^{M#}	0.14	0.19	<0.06	<0.06	<0.06	<0.06			mg/kg	A-T-019s
Dibenzo(ah)anthracene _A ^{M#}	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04			mg/kg	A-T-019s
Fluoranthene _A ^{M#}	0.25	0.46	<0.08	<0.08	<0.08	0.08			mg/kg	A-T-019s
Fluorene _A ^{M#}	0.01	0.03	<0.01	<0.01	<0.01	<0.01			mg/kg	A-T-019s
Indeno(123-cd)pyrene _A ^{M#}	0.10	0.12	<0.03	<0.03	<0.03	<0.03			mg/kg	A-T-019s
Naphthalene _A ^{M#}	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03			mg/kg	A-T-019s
Phenanthrene _A ^{M#}	0.14	0.31	<0.03	<0.03	<0.03	0.06			mg/kg	A-T-019s
Pyrene _A ^{M#}	0.22	0.37	<0.07	<0.07	<0.07	0.07			mg/kg	A-T-019s
PAH (total 16) _A ^{M#}	1.19	2.08	<0.08	<0.08	<0.08	0.23			mg/kg	A-T-019s

Envirolab Job Number: 18/01628

Client Project Name: Angmering

Client Project Ref: 27621

Lab Sample ID	18/01628/1	18/01628/2	18/01628/3	18/01628/4	18/01628/5	18/01628/6			Units	Method ref
Client Sample No	1	1	2	1	1	1				
Client Sample ID	Plot 42	Plot 43	Plot 43	Plot 44	Plot 45	Plot 46				
Depth to Top	0.10	0.10	0.40	0.40	0.30	0.40				
Depth To Bottom										
Date Sampled	21-Feb-18	21-Feb-18	21-Feb-18	21-Feb-18	21-Feb-18	21-Feb-18				
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES				
Sample Matrix Code	4AE	6AE	5A	6A	6A	6A				
TPH CWG										
Ali >C5-C6 _A [#]	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01			mg/kg	A-T-022s
Ali >C6-C8 _A [#]	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01			mg/kg	A-T-022s
Ali >C8-C10 _A [#]	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01			mg/kg	A-T-022s
Ali >C10-C12 _A [#]	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1			mg/kg	A-T-023s
Ali >C12-C16 _A [#]	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1			mg/kg	A-T-023s
Ali >C16-C21 _A [#]	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1			mg/kg	A-T-023s
Ali >C21-C35 _A [#]	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1			mg/kg	A-T-023s
Total Aliphatics _A	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1			mg/kg	A-T-023s
Aro >C5-C7 _A [#]	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01			mg/kg	A-T-022s
Aro >C7-C8 _A [#]	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01			mg/kg	A-T-022s
Aro >C8-C9 _A [#]	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01			mg/kg	A-T-022s
Aro >C9-C10 _A [#]	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01			mg/kg	A-T-022s
Aro >C10-C12 _A [#]	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1			mg/kg	A-T-023s
Aro >C12-C16 _A [#]	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1			mg/kg	A-T-023s
Aro >C16-C21 _A [#]	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1			mg/kg	A-T-023s
Aro >C21-C35 _A [#]	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1			mg/kg	A-T-023s
Total Aromatics _A	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1			mg/kg	A-T-023s
TPH (Ali & Aro) _A	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1			mg/kg	A-T-023s
BTEX - Benzene _A [#]	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01			mg/kg	A-T-022s
BTEX - Toluene _A [#]	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01			mg/kg	A-T-022s
BTEX - Ethyl Benzene _A [#]	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01			mg/kg	A-T-022s
BTEX - m & p Xylene _A [#]	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01			mg/kg	A-T-022s
BTEX - o Xylene _A [#]	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01			mg/kg	A-T-022s
MTBE _A [#]	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01			mg/kg	A-T-022s

REPORT NOTES

General:

This report shall not be reproduced, except in full, without written approval from Envirolab.

All samples contained within this report, and any received with the same delivery, will be disposed of one month after the date of this report.

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.

If results are in italic font they are associated with an AQC failure and there is insufficient sample to repeat the analysis. These are not accredited and are unreliable.

A deviating samples report is appended and will indicate if samples or tests have been found to be deviating. Any test results affected may not be an accurate record of the concentration at the time of sampling and, as a result, may be invalid.

Soil chemical analysis:

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

For samples with Matrix Codes 1 - 6 natural stones, brick and concrete fragments >10mm and any extraneous material (visible glass, metal or twigs) are removed and excluded from the sample prior to analysis and reported results corrected to a whole sample basis. This is reported as '% stones >10mm'.

For samples with Matrix Code 7 the whole sample is dried and crushed prior to analysis and this supersedes any "A" subscripts

All analysis is performed on the sample as received for soil samples which are positive for asbestos or the client has informed asbestos may be present and/or if they are from outside the European Union and this supersedes any "D" subscripts.

TPH analysis of water by method A-T-007:

Free and visible oils are excluded from the sample used for analysis so that the reported result represents the dissolved phase only.

Electrical Conductivity of water by Method A-T-037:

Results greater than 12900µS/cm @ 25°C / 11550µS/cm @ 20°C fall outside the calibration range and as such are unaccredited.

Asbestos:

Asbestos in soil analysis is performed on a dried aliquot of the submitted sample and cannot guarantee to identify asbestos if only present in small numbers as discrete fibres/fragments in the original sample.

Stones etc. are not removed from the sample prior to analysis.

Quantification of asbestos is a 3 stage process including visual identification, hand picking and weighing and fibre counting by sedimentation/phase contrast optical microscopy if required. If asbestos is identified as being present but is not in a form that is suitable for analysis by hand picking and weighing (normally if the asbestos is present as free fibres) quantification by sedimentation is performed. Where ACMs are found a percentage asbestos is assigned to each with reference to 'HSG264, Asbestos: The survey guide' and the calculated asbestos content is expressed as a percentage of the dried soil sample aliquot used.

Predominant Matrix Codes:

1 = SAND, 2 = LOAM, 3 = CLAY, 4 = LOAM/SAND, 5 = SAND/CLAY, 6 = CLAY/LOAM, 7 = OTHER, 8 = Asbestos bulk ID sample.

Samples with Matrix Code 7 & 8 are not predominantly a SAND/LOAM/CLAY mix and are not covered by our BSEN 17025 or MCERTS accreditations, with the exception of bulk asbestos which are BSEN 17025 accredited.

Secondary Matrix Codes:

A = contains stones, B = contains construction rubble, C = contains visible hydrocarbons, D = contains glass/metal,

E = contains roots/twigs.

Key:

IS indicates Insufficient Sample for analysis.

US indicates Unsuitable Sample for analysis.

NDP indicates No Determination Possible.

NAD indicates No Asbestos Detected.

N/A indicates Not Applicable.

Superscript # indicates method accredited to ISO 17025.

Superscript "M" indicates method accredited to MCERTS.

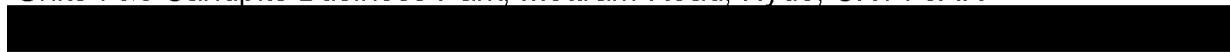
Subscript "A" indicates analysis performed on the sample as received.

Subscript "D" indicates analysis performed on the dried sample, crushed to pass a 2mm sieve

Please contact us if you need any further information.

Envirolab Deviating Samples Report

Units 7&8 Sandpits Business Park, Mottram Road, Hyde, SK14 3AR



Client: RSK Environment Ltd Hemel, 18 Frogmore Road, Hemel Hempstead, Hertfordshire, UK, HP3 9RT

Project No: 18/01628

Date Instructions Received: 05/03/2018 (am)

Cool Box Temperatures (°C): 4.8

Project: Angmering

Clients Project No: 27621

Lab Sample ID	18/01628/1	18/01628/2	18/01628/3	18/01628/4	18/01628/5	18/01628/6
Client Sample No	1	1	2	1	1	1
Client Sample ID/Depth	Plot 42 0.10m	Plot 43 0.10m	Plot 43 0.40m	Plot 44 0.40m	Plot 45 0.30m	Plot 46 0.40m
Date Sampled	21/02/18	21/02/18	21/02/18	21/02/18	21/02/18	21/02/18
Deviation Code						
F	✓	✓	✓	✓	✓	✓

Key

F

Maximum holding time exceeded between sampling date and analysis for analytes listed below

HOLDING TIME EXCEEDANCES

Lab Sample ID	18/01628/1	18/01628/2	18/01628/3	18/01628/4	18/01628/5	18/01628/6
Client Sample No	1	1	2	1	1	1
Client Sample ID/Depth	Plot 42 0.10m	Plot 43 0.10m	Plot 43 0.40m	Plot 44 0.40m	Plot 45 0.30m	Plot 46 0.40m
Date Sampled	21/02/18	21/02/18	21/02/18	21/02/18	21/02/18	21/02/18
EPH CWG	✓	✓	✓	✓	✓	✓

If, at any point before reaching the laboratory, the temperature of the samples has breached those set in published standards, e.g. BS-EN 5667-3, ISO 18400-102:2017, then the concentration of any affected analytes may differ from that at the time of sampling.



APPENDIX F

RSK GENERIC ASSESSMENT CRITERIA

Generic assessment criteria for human health: residential scenario with home-grown produce

Background

RSK's generic assessment criteria (GAC) were initially prepared following the publication by the Environment Agency (EA) of soil guideline value (SGV) and toxicological (TOX) reports, and associated publications in 2009⁽¹⁾. RSK GAC were updated following the publication of GAC by LQM/CIEH in 2009⁽²⁾. RSK GAC are periodically revised when updated information on toxicological, land use or receptor parameters is published.

Updates to the RSK GAC

In 2014, the publication of Category 4 Screening Levels (C4SL)^(3,4), as part of the Defra-funded research project SP1010, included modifications to certain exposure assumptions documented within EA Science Report SC050221/SR3 (herein after referred to as SR3)⁽⁵⁾ used in the generation of SGVs.

C4SL were published for six substances (cadmium, arsenic, benzene, benzo(a)pyrene, chromium VI and lead) for a sandy loam soil type with 6% soil organic matter, based on a low level of toxicological concern (LLTC; see Section 2.3 of research project report SP1010⁽³⁾). Where a C4SL has been published, the RSK GAC duplicates the C4SL published values using all input parameters within the SP1010 final project report⁽³⁾ and associated appendices⁽⁶⁾, and adopts them as GAC for these six substances.

For all other substances the C4SL exposure modifications, with the exception of the "top two" produce type approach taken in the C4SL, have been applied to the current RSK GAC. These include alterations to daily inhalation rates for residential and commercial scenarios, reducing soil adherence factors in children (age classes 1 to 12 only) for residential land use, reducing exposure frequency for dermal contact outdoors for residential land use, and updated produce type consumption rates (90th percentile) based on recent data from the National Diet and Nutrition Survey.

The RSK GAC have also been revised with updated toxicology published by LQM/CIEH in 2015⁽⁷⁾ or by the USEPA⁽¹⁴⁾, where a C4SL has not been published.

RSK GAC derivation for metals and organic compounds

Model selection

Soil assessment criteria (SAC) were calculated using the Contaminated Land Exposure Assessment (CLEA) tool v1.071, supporting EA guidance^(5,8,9) and revised exposure scenarios published for the C4SL⁽³⁾. Groundwater assessment criteria (GrAC) protective of human health via the inhalation pathway were derived using the RBCA 2.51 model with the Johnson and Ettinger model for soil and groundwater volatilisation. RSK has updated the inputs within RBCA to reflect EA guidance^(1,5,8,9). The SAC and GrAC collectively are termed GAC.

Conceptual model

In accordance with SR3⁽⁵⁾, the residential with home-grown produce scenario considers risks to a female child between the ages of 0 and 6 years old as the highest risk scenario. In accordance

with Box 3.1 of SR3⁽⁵⁾, the pathways considered for production of the SAC in the residential with home-grown produce scenario are

- direct soil and dust ingestion
- consumption of home-grown produce
- consumption of soil attached to home-grown produce
- dermal contact with soil and indoor dust
- inhalation of indoor and outdoor dust and vapours.

Figure 1 is a conceptual model illustrating these linkages.

In line with guidance in the EA SGV report for cadmium⁽¹⁾, the RSK GAC for cadmium has been derived based on estimates representative of lifetime exposure. Although young children are generally more likely to have higher exposures to soil contaminants, the renal toxicity of cadmium, and the derivation of the TDI_{oral} and TDI_{inh} , are based on considerations of the kidney burden accumulated over 50 years or so. It is therefore reasonable to consider exposure not just in childhood but averaged over a longer period.

The pathway considered in production of the GrAC is the volatilisation of compounds from groundwater and subsequent vapour inhalation by residents while 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 chemical restricts the extent of volatilisation, which in turn drives the indoor air inhalation pathway. While the same restriction is not built into the CLEA model, the CLEA model output cells are flagged red where the soil saturation limit has been exceeded.

With respect to volatilisation, the CLEA model assumes a simple linear partitioning of a chemical in the soil between the sorbed, dissolved and vapour phase⁽⁹⁾. The upper boundaries of this partitioning are represented by the maximum aqueous solubility and pure saturated vapour concentration of the chemical. The CLEA model estimates saturated soil concentrations where these limits are reached⁽⁹⁾. The CLEA software uses a traffic light system to identify when individual and/or combined assessment criteria exceed the lower of either the aqueous- or vapour-based soil saturation limits. Model output cells are flagged red where the saturated soil concentration has been exceeded and the contribution of the indoor and outdoor vapour pathway to total exposure is greater than 10%. In this case, further consideration of the following is required⁽⁹⁾:

- Free phase contamination may be present.
- Exposure from the vapour pathways will be over-predicted by the model, as in reality the vapour phase concentration will not increase at concentrations above saturation limits
- Where the vapour pathway contribution is greater than 90%, it is unlikely the relevant health criteria value (HCV) will be exceeded at soil concentrations at least a factor of ten higher than the relevant HCV.

Where the vapour pathway is the predominant pathway (contributes greater than 90% of exposure) or the only exposure route considered and the cell is highlighted red (SAC exceeds saturation limit), the risk based on the assumed conceptual model is likely to be negligible as the vapour risk is assumed to be tolerable at maximum possible soil concentrations. In such circumstances, the vapour pathway exposure should be considered based on the presence of free phase or non-aqueous phase liquid sources and the measured concentrations of volatile organic compounds (VOC) in the vapour phase. Screening could be considered based on setting

the SAC as the modelled soil saturation limits. However, as stated within the CLEA handbook⁽⁹⁾, this is likely to not be practical in many cases because of the very low saturation limits and, in any case, is highly conservative.

It should also be noted that for mixtures of compounds, free phase may be present where soil (or groundwater) concentrations are well below saturation limits for individual compounds.

Where the vapour pathway is only one of the exposure pathways considered, an additional approach can then be utilised as detailed within Section 4.12 of the CLEA model handbook⁽⁹⁾, which explains how to calculate an effective assessment criterion manually.

SR3⁽⁵⁾ states that, as a general rule of thumb, it is recognised that estimating vapour phase concentrations from dissolved and sorbed phase contamination by petroleum hydrocarbons are at least a factor of ten higher than those likely to be measured on-site. RSK has therefore applied an empirical subsurface to indoor air correction factor of 10 into the CLEA model chemical database and to outputs from the RBCA model for all petroleum hydrocarbon fractions (including BTEX, trimethylbenzenes and the polycyclic aromatic hydrocarbons (PAH) naphthalene, acenaphthene and acenaphthylene) to reduce this conservatism.

Input selection

The most up-to-date published chemical and toxicological data was obtained from EA Report SC050021/SR7⁽¹⁰⁾, the EA TOX⁽¹¹⁾ reports, the C4SL SP1010 project report and associated appendices^(3,6), the 2015 LQM/CIEH report⁽⁷⁾ or the USEPA IRIS database⁽¹⁴⁾. Where a C4SL has been published, the RSK GAC have duplicated the C4SL published values using all input parameters within the SP1010 final project report⁽³⁾ and associated appendices⁽⁶⁾, and has adopted them as GAC for these six substances. Toxicological and specific chemical parameters for aromatic hydrocarbon C₈–C₉ (styrene), 1,2,4-trimethylbenzene and methyl tertiary-butyl ether (MTBE) were obtained from the CL:AIRE Soil Generic Assessment Criteria report⁽¹¹⁾.

For TPH, aromatic hydrocarbons C₅–C₈ were not modelled, as this range comprises benzene and toluene, which are modelled separately. The aromatic C₈–C₉ hydrocarbon fraction comprises ethylbenzene, xylene and styrene. As ethylbenzene and xylene are being modelled separately, the physical, chemical and toxicological data for aromatic C₈–C₉ have been taken from styrene.

For the GrAC, the HCV used in the modelling were derived using the toxicological data for the SAC amended as follows:

- A child weighing 13.3kg (average of 0-6 year old female in accordance with Table 4.6 of SR3⁽⁵⁾) and breathing 8.77m³ (average daily inhalation rate for a 0-6yr old female in accordance with SP1010 final project report for the C4SL (Table 3.2⁽³⁾) and USEPA data⁽¹⁴⁾)
- Background inhalation (mean daily intake (MDI)) for a child (Age Classes 1-6)
- Residential amendments to the MDI for younger age groups following Table 3.4 and Section 3.4.1 of SR2⁽⁸⁾; amended to reflect average daily inhalation rates in accordance with SP1010 final project report for the C4SL (Table 3.2⁽³⁾) and USEPA data⁽¹²⁾.

Physical parameters

For the residential with home-grown produce scenario, the CLEA default building is a small, two-storey terrace house with a concrete ground-bearing slab. The house is assumed to have a 100m² private garden consisting of lawn and flowerbeds, incorporating a 20m² plot for growing fruit and vegetables consumed by the residents. SR3⁽⁵⁾ notes this residential building type to be

the most conservative in terms of potential for vapour intrusion. The building parameters used in the production of the RSK GACs are the default CLEA v1.06 inputs presented in Table 3.3 of SR3⁽³⁾, with a dust loading factor detailed in Section 9.3 of SR3⁽⁵⁾. The parameters for a sandy loam soil type were used in line with Table 4.4 of SR3⁽⁵⁾. This includes a value of 6% for the percentage of 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 SOM, RSK has produced an additional set of GAC for SOM of 1% and 2.5% for all substances using the CLEA tool.

For the GrAC, the depth to groundwater was taken as 2.5m based on RSK's experience of assessing the volatilisation pathway from groundwater. The GrAC were produced using the input parameters in Table 4.

Summary of modifications to the default CLEA SR3⁽⁵⁾ input parameters for residential with home-grown produce land-use scenario

In summary, the RSK GAC were produced using the default input parameters for soil properties, the air dispersion model, building properties and the vapour model detailed in SR3⁽⁵⁾. Modifications to the default SR3⁽⁵⁾ exposure scenarios based on the C4SL exposure scenarios⁽³⁾ are presented in Tables 2 and 3 below.

The final selected GAC are presented by pathway in Table 5 and the combined GAC in Table 6.

Figure 1: Conceptual model for residential scenario with home-grown produce

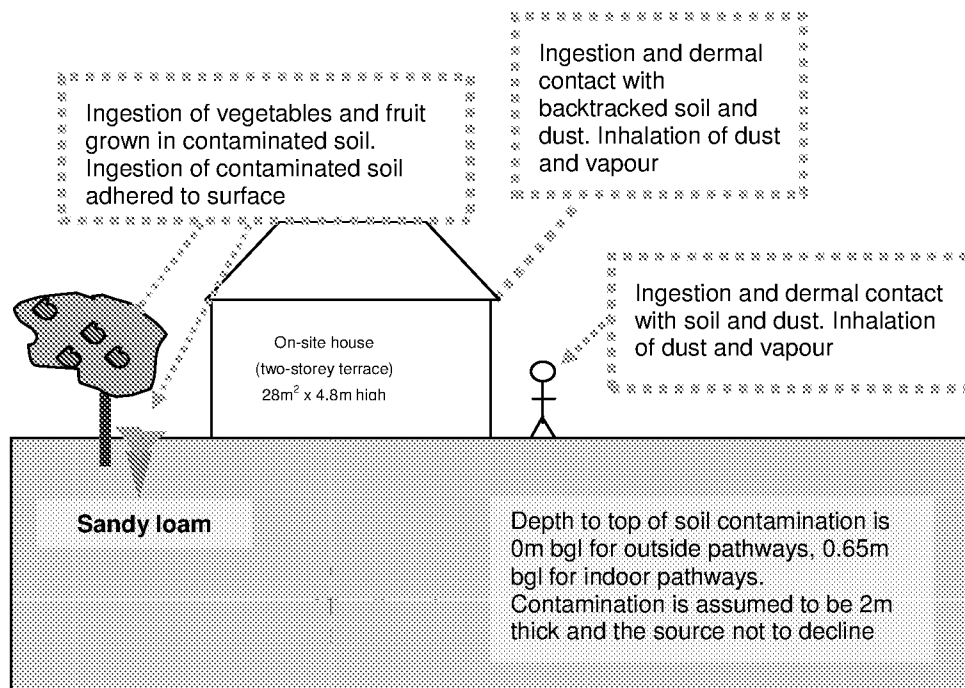


Table 1: Exposure assessment parameters for residential scenario with home-grown produce – inputs for CLEA model

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 ⁽⁵⁾
Building	Small terraced house	Key generic assumption given in Box 3.1, SR3. Small, two-storey terraced house chosen, as it is the most conservative residential building type in terms of protection from vapor intrusion (Section 3.4.6, SR3) ⁽⁵⁾
Soil type	Sandy Loam	Most common UK soil type (Section 4.3.1, from Table 3.1, SR3) ⁽⁵⁾
Start AC (age class)	1	Range of age classes corresponding to key generic assumption that the critical receptor is a young female child aged 0–6. From Box 3.1, SR3 ⁽⁵⁾
End AC (age class)	6	
SOM (%)	6	Representative of sandy loamy soil according to EA guidance note dated January 2009 entitled 'Changes We Have Made to the CLEA Framework Documents' ⁽¹³⁾
	1	To provide SAC for sites where SOM <6% as often observed by RSK
	2.5	
pH	7	Model default

Table 2: Residential with home-grown produce – modified home-grown produce data

Name	Consumption rate 90 th percentile (g FW kg ⁻¹ BW day ⁻¹) by age class						Dry weight conversion factor (g DW g ⁻¹ FW)	Home-grown fraction (average)	Home-grown fraction (high end)	Soil loading factor (g g ⁻¹ DW)	Preparation correction factor
	1	2	3	4	5	6					
Green vegetables	7.12	5.87	5.87	5.87	4.53	4.53	0.096	0.05	0.33	1.00E-03	2.00E-01
Root vegetables	10.7	2.83	2.83	2.83	2.14	2.14	0.103	0.06	0.4	1.00E-03	1.00E+00
Tuber vegetables	16	6.6	6.6	6.6	4.95	4.95	0.21	0.02	0.13	1.00E-03	1.00E+00
Herbaceous fruit	1.83	3.39	3.39	3.39	2.24	2.24	0.058	0.06	0.4	1.00E-03	6.00E-01
Shrub fruit	2.23	0.46	0.46	0.46	0.19	0.19	0.166	0.09	0.6	1.00E-03	6.00E-01
Tree fruit	3.82	10.3	10.3	10.3	5.16	5.16	0.157	0.04	0.27	1.00E-03	6.00E-01
Justification	Table 3.4, SP1010 ⁽³⁾						Table 6.3, SR3 ⁽⁵⁾	Table 4.19, SR3 ⁽⁵⁾		Table 6.3, SR3 ⁽⁵⁾	

Table 3: Residential with home-grown produce – modified and use and receptor data

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 home-grown 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	170	170	170	170	170	170
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 3.5, SP1010 ⁽³⁾ ; Table 3.1, SR3 ⁽⁵⁾					
Soil to skin adherence factor (outdoor)	mg cm ⁻² day ⁻¹	0.1	0.1	0.1	0.1	0.1	0.1
Justification		Table 3.5, SP1010 ⁽³⁾					
Inhalation rate	m ³ day ⁻¹	5.4	8.0	8.9/f	10.1	10.1	10.1
Justification		Mean value USEPA, 2011 ⁽¹²⁾ ; Table 3.2, SP1010 ⁽³⁾					
Notes: For cadmium , the exposure assessment for a residential land use is based on estimates representative of lifetime exposure AC1-18. This is because the TDI _{oral} and TDI _{inh} are based on considerations of the kidney burden accumulated over 50 years. It is therefore reasonable to consider exposure not just in childhood but averaged over a longer period. See the Environment Agency Science Report SC05002/ TOX 3 ⁽¹⁾ , Science Report SC050021/Cadmium SGV ⁽¹⁾ and the project report SP1010 ⁽³⁾ for more information.							

Figure 2: GrAC conceptual model for RBCA residential with home-grown produce scenario

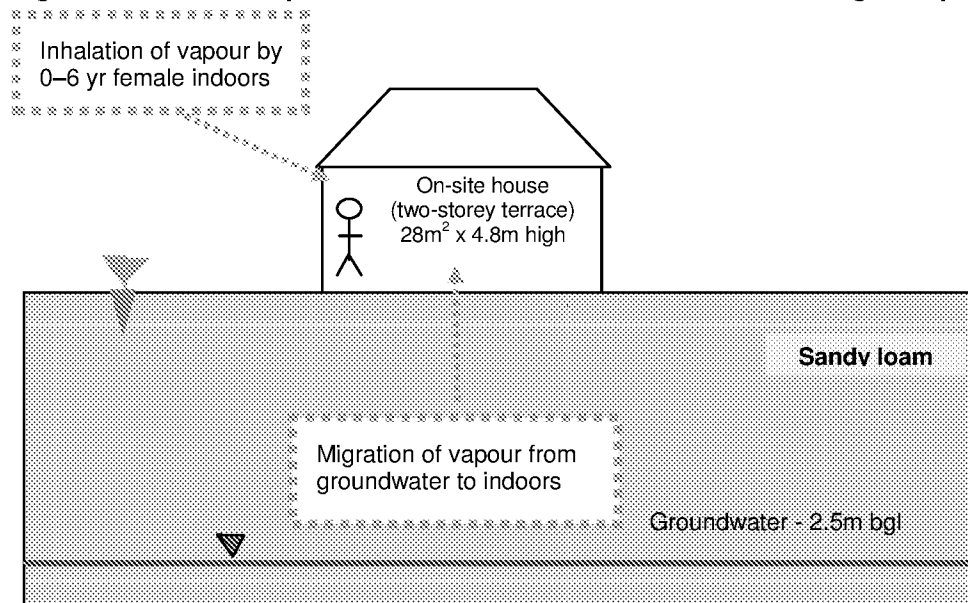


Table 4: Residential with home-grown produce – RBCA inputs

Parameter	Unit	Value	Justification
Receptor			
Averaging time	Years	6	From Box 3.1, SR3 ⁽⁵⁾
Receptor weight	kg	13.3	Average of CLEA 0–6 year old female data, Table 4.6, SR3 ⁽⁵⁾
Exposure duration	Years	6	From Box 3.1, report, SR3 ⁽⁵⁾
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 ⁽⁵⁾
Volumetric water content	-	0.33	
Volumetric air content	-	0.20	
Dry bulk density	g cm ⁻³ or kg/L	1.21	
Vertical hydraulic conductivity	cm s ⁻¹	3.56E-3	CLEA value for saturated conductivity of sandy loam, Table 4.4, SR3 ⁽⁵⁾ equivalent to 307 cm/day
Vapour permeability	m ²	3.05E-12	Calculated for sandy loam using equations in Appendix 1, SR3 ⁽⁵⁾
Capillary zone thickness	m	0.1	Professional judgement
Fraction organic carbon	%	0.0348	Representative of sandy loam according to EA guidance note dated January 2009 entitled 'Changes We Have Made to the CLEA Framework Documents' ⁽¹³⁾
Building			
Building volume/area ratio	m	4.8	Table 3.3, SR3 ⁽⁵⁾
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 ⁽⁵⁾ Building air exchange rate equivalent to 1.4E-04 s ⁻¹
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 ⁽⁵⁾
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 ⁽⁵⁾
Volumetric air content of cracks	-	0.2	
Indoor/outdoor differential pressure	Pa	3.1	From Table 3.3, SR3 ⁽⁵⁾ Equivalent to 31 g/cm/s ²

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GENERIC ASSESSMENT CRITERIA FOR HUMAN HEALTH - RESIDENTIAL WITH HOME-GROWN PRODUCE



Table 5

Human Health Generic Assessment Criteria by Pathway for Residential With Home-Grown Produce Scenario

Compound	Notes	GrAC (µg/l)	SAC Appropriate to Pathway SOM 1% (mg/kg)			Soil Saturation Limit (mg/kg)	SAC Appropriate to Pathway SOM 2.5% (mg/kg)			Soil Saturation Limit (mg/kg)	SAC Appropriate to Pathway SOM 6% (mg/kg)			Soil Saturation Limit (mg/kg)
			Oral	Inhalation	Combined		Oral	Inhalation	Combined		Oral	Inhalation	Combined	
Metals														
Arsenic	(a,b)	-	3.71E-01	5.26E-02	NR	NR	3.71E-01	5.26E-02	NR	NR	3.71E-01	5.26E-02	NR	NR
Cadmium	(a)	-	2.30E-01	4.89E-02	2.21E-01	NR	2.30E-01	4.89E-02	2.21E-01	NR	2.30E-01	4.89E-02	2.21E-01	NR
Chromium (III) - trivalent	(c)	-	1.84E-04	9.07E-02	NR	NR	1.84E-04	9.07E-02	NR	NR	1.84E-04	9.07E-02	NR	NR
Chromium (VI) - hexavalent	(a,d)	-	5.85E-01	2.09E-01	NR	NR	5.85E-01	2.09E-01	NR	NR	5.85E-01	2.09E-01	NR	NR
Copper	-	-	2.72E-03	1.41E-04	2.47E-03	NR	2.72E-03	1.41E-04	2.47E-03	NR	2.72E-03	1.41E-04	2.47E-03	NR
Lead	(a)	-	2.01E-02	NR	NR	NR	2.01E-02	NR	NR	NR	2.01E-02	NR	NR	NR
Elemental Mercury (Hg ⁰)	(d)	1.29E+01	NR	3.86E-01	NR	4.31E+00	NR	5.60E-01	NR	1.07E+01	NR	1.29E+00	NR	2.58E+01
Inorganic Mercury (Hg ²⁺)	-	-	3.99E-01	5.53E-03	3.91E-01	NR	3.99E-01	5.53E-03	3.91E-01	NR	3.99E-01	5.53E-03	3.91E-01	NR
Methyl Mercury (Hg ⁺)	-	2.22E-04	1.26E-01	1.87E-01	7.92E-00	7.33E+01	1.26E-01	5.62E-01	9.34E-00	1.42E+02	1.26E-01	7.86E-01	1.06E-01	3.04E+02
Nickel	(d)	-	1.27E-02	1.81E-02	NR	NR	1.27E-02	1.81E-02	NR	NR	1.27E-02	1.81E-02	NR	NR
Selenium	(b)	-	2.96E-02	NR	NR	NR	2.96E-02	NR	NR	NR	2.96E-02	NR	NR	NR
Zinc	(b)	-	3.86E-03	5.63E-07	NR	NR	3.86E-03	2.63E-07	NR	NR	3.86E-03	5.63E-07	NR	NR
Cyanide (free)	-	-	1.37E-00	1.87E-04	1.37E-00	NR	1.37E-00	1.87E-04	1.37E-00	NR	1.37E-00	1.87E-04	1.37E-00	NR
Volatile Organic Compounds														
Benzene	(a)	2.50E+04	2.62E-01	9.04E-01	2.09E-01	1.22E+03	3.28E-01	1.68E+00	4.09E+01	2.26E+03	1.15E+00	3.49E+00	2.73E-01	4.71E+03
Toluene	-	5.90E+05	1.33E-02	9.06E-02	1.31E-02	8.89E-02	5.43E-03	2.00E-03	2.37E-02	1.92E+03	7.36E-02	4.55E-03	6.77E-02	4.36E+03
Ethylbenzene	-	1.25E+05	1.10E-02	8.54E-01	4.74E-01	5.18E-02	2.61E-02	1.96E-02	1.18E-02	1.22E+03	6.00E-02	4.59E-02	2.80E-02	2.84E+03
Xylene - m	-	1.16E+05	2.10E-02	6.25E-01	5.82E-01	6.25E+02	5.01E-02	1.25E-02	1.45E-02	1.47E+03	1.19E+00	4.59E-02	3.27E-02	3.46E+03
Xylene - o	-	1.41E+05	1.32E-02	5.67E-01	6.07E-01	4.78E-02	4.95E-02	2.06E-02	1.43E-02	1.12E+03	1.05E-03	4.86E-02	2.58E-02	2.62E+03
Xylene - p	-	1.21E+05	1.56E-02	7.83E-01	5.86E-01	5.76E-02	4.70E-02	1.89E-02	1.33E-02	1.35E+03	1.08E-03	4.39E-02	2.10E-02	3.17E+03
Total xylene	-	1.16E+05	1.88E-02	7.83E-01	5.86E-01	6.25E+02	4.58E-02	1.69E-02	1.43E-02	1.47E+03	1.05E+00	4.39E-02	2.10E-02	3.46E+03
Methyl tertiary Butyl ether (MTBE)	-	9.32E+08	1.54E-02	1.04E-03	1.24E-02	2.04E+04	2.87E-02	1.89E-03	2.38E-02	3.31E+04	6.03E-02	3.21E-03	3.09E-02	6.27E+04
Trichloroethene	-	6.44E+01	2.03E-01	1.72E-02	1.82E-02	1.54E+03	6.20E-01	3.53E-02	3.40E-02	3.22E+03	1.41E+00	7.89E-02	7.53E-02	7.14E+03
Tetrachloroethene	-	4.08E-02	4.49E-00	1.79E-01	1.75E-01	4.24E+02	1.04E-01	4.03E-01	3.34E-01	9.51E+02	2.26E-01	3.21E-01	3.04E-01	2.18E+03
1,1,1-Trichloroethene	-	3.59E+04	3.29E-03	9.03E-00	8.77E-00	1.43E+03	7.28E-02	1.84E-01	1.80E-01	2.92E+03	1.89E-03	4.04E-01	3.34E-01	6.39E+03
1,1,1,2-Tetrachloroethane	-	2.84E+03	3.89E-00	1.54E-00	1.20E-00	2.60E+03	1.27E-01	2.59E-00	2.75E-00	6.02E+03	3.32E-01	5.29E-00	6.40E-00	1.40E+04
1,1,2,2-Tetrachloroethane	-	1.85E+04	2.81E-00	3.82E-00	1.94E-00	2.87E+03	5.10E-00	2.04E-00	3.47E-00	5.46E+03	1.36E-01	1.76E-01	1.57E-00	1.20E+04
Carbon Tetrachloride	-	6.10E+01	3.19E-00	2.59E-00	2.57E-02	1.52E+03	7.11E-00	2.69E-02	5.82E-02	3.32E+03	1.62E-01	1.22E-01	1.27E-01	7.54E+03
1,2-Dichloroethane	-	9.70E+01	3.17E-02	6.20E-03	7.13E-03	3.41E+03	5.73E-02	1.83E-02	1.06E-02	4.91E+03	1.08E-01	2.29E-02	1.68E-02	8.43E+03
Vinyl Chloride	-	6.20E+00	3.82E-05	7.73E-04	6.48E-04	1.36E+03	3.82E-03	1.80E-03	6.79E-04	1.76E+03	1.25E-02	1.35E-03	1.36E-03	2.69E+03
1,2,4-Trimethylbenzene	-	5.10E+03	NR	1.78E+00	NR	4.74E+02	NR	4.28E+00	NR	1.16E+03	NR	3.72E+00	NR	2.76E+03
1,3,5-Trimethylbenzene	(e)	-	NR	NR	NR	2.30E+02	NR	NR	NR	5.52E+02	NR	NR	NR	1.30E+03
Semi-Volatile Organic Compounds														
Acenaphthene	-	4.11E+03	2.27E-02	4.86E-04	2.86E-02	5.70E+01	5.41E-02	1.18E-05	5.38E-02	1.41E+02	1.18E-03	2.86E-05	1.17E-03	3.36E+02
Acenaphthylene	-	7.95E+03	1.95E-02	4.59E-04	1.84E-02	8.61E+01	4.48E-02	1.11E-05	4.40E-02	2.12E+02	9.78E-02	2.53E-05	9.74E-02	5.06E+02
Anthracene	-	-	2.43E-03	1.59E-05	2.39E-03	1.17E+00	5.59E-03	3.77E-05	5.45E-03	2.91E+00	1.10E-04	8.79E-05	1.09E-04	6.96E+00
Benz(a)anthracene	-	-	1.01E-01	2.47E-01	7.18E+00	1.71E+00	1.42E-01	4.27E+01	1.07E-01	4.28E+00	1.69E-01	5.26E-01	1.33E-01	1.03E+01
Benz(b)fluoranthene	-	-	2.96E+00	1.93E-01	2.56E+00	1.22E+00	5.89E+00	2.13E-01	3.29E+00	3.04E+00	4.43E+00	2.22E+01	3.89E+00	7.29E+00
Benz(g,h,i)perylene	-	-	3.77E-02	1.87E-02	3.14E-02	1.54E-02	4.09E-02	1.94E-03	3.86E-02	3.85E-02	4.23E-02	1.97E-03	3.48E-02	9.23E-02
Benz(k)fluoranthene	-	-	8.92E-01	5.41E-02	7.86E-01	6.87E-01	1.10E-02	5.79E+02	9.22E-01	1.72E+00	1.21E+02	5.91E-02	1.00E+02	4.12E+00
Chrysene	-	-	1.86E-01	1.19E-02	1.46E-01	4.40E-01	2.54E-01	1.49E-02	2.17E-01	1.10E+00	3.12E-01	1.60E-02	2.67E-01	2.64E+00
Dibenz(a,h)anthracene	-	-	2.90E-01	1.45E-00	2.41E-01	3.93E-03	3.42E-01	1.64E+00	2.64E-01	9.82E-03	3.89E-01	1.74E+00	3.04E-01	2.36E-02
Fluoranthene	-	-	2.67E-02	3.83E-04	2.25E+02	1.89E+01	5.83E-02	8.87E+04	5.80E-02	4.73E+01	9.00E-02	1.83E+05	8.96E-02	1.13E+02
Fluorene	-	-	1.77E-02	6.20E-03	1.72E-02	3.09E+01	4.18E-02	1.53E-04	4.07E-02	7.65E+01	6.88E-02	3.82E-04	8.77E-02	1.83E+02
Indeno(1,2,3-cd)pyrene	-	-	3.09E-01	2.12E-02	2.70E-01	6.13E-02	4.22E-01	2.38E-02	3.59E-01	1.53E+01	4.93E-01	2.50E-02	4.11E-01	3.68E-01
Phenanthrene	-	-	9.85E-01	7.17E-03	9.72E-01	3.60E+01	2.24E-02	1.76E-04	2.22E-02	8.96E+01	4.48E+02	4.07E-04	4.43E+02	2.14E+02
Pyrene	-	-	6.25E+02	6.79E-04	6.80E-02	2.20E+00	1.25E-03	2.04E-05	1.24E-03	5.49E+00	2.05E-03	4.23E-05	2.04E+03	1.32E+01
Benz(a)pyrene	(a)	-	4.96E-00	3.91E-01	NR	9.11E-01	4.96E-00	3.77E-01	NR	2.28E+00	4.96E-00	3.89E-01	NR	5.46E+00
Naphthalene	-	1.90E+04	3.79E-01	2.29E-01	1.27E-01	7.64E+01	5.68E-01	2.68E-01	3.04E-01	1.83E+02	1.53E-02	1.31E-02	7.06E-02	4.32E+02
Phenol	-	-	1.86E-02	4.58E-02	1.29E-02	2.42E+04	2.89E-02	6.96E-02	2.08E-02	3.81E+04	5.89E-02	1.19E-02	5.32E-02	7.03E+04

GENERIC ASSESSMENT CRITERIA FOR HUMAN HEALTH - RESIDENTIAL WITH HOME-GROWN PRODUCE



Table 5
Human Health Generic Assessment Criteria by Pathway for Residential With Home-Grown Produce Scenario

Compound	Notes	GrAC (µg/l)	SAC Appropriate to Pathway SOM 1% (mg/kg)			Soil Saturation Limit (mg/kg)	SAC Appropriate to Pathway SOM 2.5% (mg/kg)			Soil Saturation Limit (mg/kg)	SAC Appropriate to Pathway SOM 6% (mg/kg)			Soil Saturation Limit (mg/kg)
			Oral	Inhalation	Combined		Oral	Inhalation	Combined		Oral	Inhalation	Combined	
Total Petroleum Hydrocarbons														
Aliphatic hydrocarbons >EC ₉ -EC ₈		2.05E+04	4.99E+03	4.24E+01	4.28E+01	3.04E+02	1.13E+04	7.79E+01	7.78E+01	5.58E+02	2.50E+04	1.81E+02	1.80E+02	1.15E+03
Aliphatic hydrocarbons >EC ₉ -EC ₈		5.37E+03	1.49E+04	1.04E+02	1.03E+02	1.44E+02	3.43E+04	2.31E+02	2.31E+02	3.22E+02	7.11E+04	5.29E+02	5.29E+02	7.36E+02
Aliphatic hydrocarbons >EC ₉ -EC ₁₀		4.27E+02	1.61E+03	2.68E+01	2.67E+01	7.77E+01	2.91E+03	6.59E+01	6.51E+01	1.90E+02	4.26E+03	1.59E+02	1.54E+02	4.51E+02
Aliphatic hydrocarbons >EC ₁₀ -EC ₁₂		3.39E+01	4.57E+03	1.33E+02	1.32E+02	4.75E+01	5.51E+03	3.31E+02	3.26E+02	1.18E+02	5.98E+03	7.93E+02	7.65E+02	2.83E+02
Aliphatic hydrocarbons >EC ₁₀ -EC ₁₁		7.59E+01	6.27E+03	1.11E+03	1.06E+03	2.37E+01	6.34E+03	2.78E+03	2.41E+03	5.91E+01	6.36E+03	6.67E+03	4.34E+03	1.42E+02
Aliphatic hydrocarbons >EC ₁₈ -EC ₃₅	(b)	-	6.46E+04	NR	NR	8.48E+00	9.17E+04	NR	NR	2.12E+01	1.10E+05	NR	NR	5.09E+01
Aliphatic hydrocarbons >EC ₃₅ -EC ₄₄	(b)	-	6.46E+04	NR	NR	8.48E+00	9.17E+04	NR	NR	2.12E+01	1.10E+05	NR	NR	5.09E+01
Aromatic hydrocarbons >EC ₁₆ -EC ₉ (styrene)		2.90E+05	1.09E+01	5.25E+02	1.89E+01	6.26E+02	2.93E+01	1.36E+03	2.49E+01	1.44E+03	5.61E+01	2.79E+03	5.69E+01	3.35E+03
Aromatic hydrocarbons >EC ₁₆ -EC ₁₅		2.60E+04	5.76E+01	4.74E+01	5.45E+01	6.13E+02	1.39E+02	1.19E+02	8.36E+01	1.50E+03	3.07E+02	2.77E+02	1.94E+02	3.58E+02
Aromatic hydrocarbons >EC ₁₅ -EC ₁₂		2.45E+04	8.89E+01	2.58E+05	7.52E+01	3.64E+02	1.98E+05	6.49E+02	1.79E+02	8.99E+02	4.25E+02	1.68E+03	3.81E+02	2.15E+03
Aromatic hydrocarbons >EC ₁₂ -EC ₁₃		5.75E+03	1.47E+02	2.85E+03	1.45E+02	1.69E+02	3.96E+02	7.07E+03	3.96E+02	4.19E+02	6.81E+02	1.66E+04	6.74E+02	1.00E+03
Aromatic hydrocarbons >EC ₁₂ -EC ₂₁	(b)	-	2.69E+02	NR	NR	5.37E+01	5.45E+02	NR	NR	1.34E+02	3.34E+02	NR	NR	3.21E+02
Aromatic hydrocarbons >EC ₂₁ -EC ₂₂	(b)	-	1.09E+03	NR	NR	4.83E+00	1.47E+02	NR	NR	1.21E+01	1.70E+03	NR	NR	2.90E+01
Aromatic hydrocarbons >EC ₂₂ -EC ₄₄	(b)	-	1.09E+03	NR	NR	4.83E+00	1.47E+03	NR	NR	1.21E+01	1.70E+03	NR	NR	2.90E+01

Notes:

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 RSCA output where the theoretical solubility limit has been exceeded.
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 RSCA has been exceeded in production of the GrAC, these cells have also been hatched red.

The SAC for organic compounds are dependent 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, PAHs naphthalene, acenaphthene and acenaphthylene, 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) SAC for arsenic, benzerie, benzo(a)pyrene, cadmium, chromium VI and lead are derived using the C4SL toxicology data.
(b) SAC for selenium should not include the inhalation pathway as no expert group HCV has been derived; aliphatic and aromatic hydrocarbons >EC16 should not include inhalation pathway due to their non-volatile nature and inhalation exposure being minimal (oral, dermal and inhalation exposure is compared to the oral HCV); arsenic should only be based on oral contribution (rather than combined) owing to the relative small contribution from inhalation in accordance with the SGV report. The Oral SAC should be adopted for zinc and benzo(a)pyrene.
(c) SAC for CrIII should be based on the lower of the oral and inhalation SAC (see LQM/CIEH 2015 Section 6.8)
(d) SAC for elemental mercury, chromium VI and nickel should be based on the inhalation pathway only.
(e) SAC for 1,3,5-trimethylbenzene is not recorded owing to the lack of toxicological data, SAC for 1,2,4-trimethylbenzene may be used.

GENERIC ASSESSMENT CRITERIA FOR HUMAN HEALTH - RESIDENTIAL WITH HOME-GROWN PRODUCE



Table 6
Human Health Generic Assessment Criteria for Residential with home-grown produce

Compound	GrAC for Groundwater (µg/l)	SAC for Soil SOM 1% (mg/kg)	SAC for Soil SOM 2.5% (mg/kg)	SAC for Soil SOM 6% (mg/kg)
Metals				
Arsenic	-	37	37	37
Cadmium	-	22	22	22
Chromium (III) - trivalent	-	910	910	910
Chromium (VI) - hexavalent	-	21	21	21
Copper	-	2,500	2,500	2,500
Lead	-	200	200	200
Elemental Mercury (Hg ⁰)	12.90	0.2	0.6	1.2
Inorganic Mercury (Hg ²⁺)	-	39	39	39
Methyl Mercury (Hg ⁴⁺)	22180	10	10	10
Nickel	-	130	130	130
Selenium	-	258	258	258
Zinc	-	3,900	3,900	3,900
Cyanide (free)	-	1.4	1.4	1.4
Volatile Organic Compounds				
Benzene	23000	0.20	0.41	0.87
Toluene	590000	130	300	680
Ethylbenzene	124600	50	110	260
Xylene - m	115900	59	140	327
Xylene - o	141400	61	143	332
Xylene - p	121100	57	133	310
Total xylene	115900	57	133	310
Methyl tertiary-Butyl ether (MTBE)	9320000	130	250	510
Trichloroethene	64	0.02	0.03	0.08
Tetrachloroethene	408	0.2	0.4	0.9
1,1,1-Trichloroethane	35900	9	18	39
1,1,1,2-Tetrachloroethane	2800	1.2	2.8	6.5
1,1,2,2-Tetrachloroethane	18500	1.6	3.5	7.7
Carbon Tetrachloride	61	0.026	0.056	0.127
1,2-Dichloroethane	97	0.007	0.011	0.019
Vinyl Chloride	6	0.0006	0.0009	0.0014
1,2,4-Trimethylbenzene	5095	1.8	4.3	9.7
1,3,5-Trimethylbenzene	-	NR	NR	NR
Semi-Volatile Organic Compounds				
Acenaphthene	4110	230	540	1,170
Acenaphthylene	7950	180	440	970
Anthracene	-	2,400	5,500	10,900
Benzo(a)anthracene	-	7	11	13
Benzo(b)fluoranthene	-	2.6	3.3	3.7
Benzo(g,h,i)perylene	-	310	340	350
Benzo(k)fluoranthene	-	77	92	100
Chrysene	-	15	22	27
Dibenzo(a,h)anthracene	-	0.24	0.28	0.30
Fluoranthene	-	290	560	900
Fluorene	-	170	410	880
Indeno(1,2,3-cd)pyrene	-	27	36	41
Phenanthrene	-	100	220	440
Pyrene	-	620	1,240	2,040
Benzo(a)pyrene	-	5	5	5
Naphthalene	19000	13	30	71
Phenol	-	120	210	390
Total Petroleum Hydrocarbons				
Aliphatic hydrocarbons EC ₅ -EC ₈	20000	42	78	160
Aliphatic hydrocarbons >EC ₈ -EC ₈	5370	100	230	530
Aliphatic hydrocarbons >EC ₈ -EC ₁₀	427	27	65	154
Aliphatic hydrocarbons >EC ₁₀ -EC ₁₂	33.9	130 (48)	330 (118)	760 (283)
Aliphatic hydrocarbons >EC ₁₂ -EC ₁₆	0.759	1,100 (24)	2,400 (59)	4,300 (142)
Aliphatic hydrocarbons >EC ₁₆ -EC ₃₅	-	65,000 (8)	92,000 (21)	110,000
Aliphatic hydrocarbons >EC ₃₅ -EC ₄₄	-	65,000 (8)	92,000 (21)	110,000
Aromatic hydrocarbons >EC ₈ -EC ₉ (styrene)	290000	11	25	57
Aromatic hydrocarbons >EC ₉ -EC ₁₀	20000	30	80	190
Aromatic hydrocarbons >EC ₁₀ -EC ₁₂	24500	80	180	390
Aromatic hydrocarbons >EC ₁₂ -EC ₁₆	5750	140	330	670
Aromatic hydrocarbons >EC ₁₆ -EC ₂₁	-	260	540	930
Aromatic hydrocarbons >EC ₂₁ -EC ₃₅	-	1,100	1,500	1,700
Aromatic hydrocarbons >EC ₃₅ -EC ₄₄	-	1,100	1,500	1,700
Minerals				
Asbestos	-	No asbestos detected with ID or <0.001% dry weight ¹		

Notes:

¹ Generic assessment criteria not calculated owing to low volatility of substance and therefore no pathway, or an absence of toxicological data.

NR - SAC for 1,3,5-trimethylbenzene is not recorded owing to the lack of toxicological data, SAC for 1,2,4-trimethylbenzene may be used

EC - equivalent carbon, GrAC - groundwater assessment criteria, SAC - soil assessment criteria.

¹ LOD for weight of asbestos per unit weight of soil calculated on a dry weight basis using PLM, handpicking and gravimetry.

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 and GrAC for TPH fractions, PAHs naphthalene, acenaphthene and acenaphthylene, 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.

(VALUE IN BRACKETS)

The SAC has been set as the model calculated SAC with the saturation limit shown in brackets.

RSK has adopted an approach for petroleum hydrocarbons in accordance with LQM/CIEH whereby the concentration modelled for each petroleum hydrocarbon fraction has been tabulated as the SAC with the corresponding solubility or vapour saturation limits given in brackets.

For consistency where the GrAC exceeds the solubility limit, GrAC has been set at the solubility limit. The GrAC is 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.

GENERIC ASSESSMENT CRITERIA FOR PHYTOTOXIC EFFECTS

Several compounds can inhibit plant growth; hence it is important to have generic assessment criteria (GAC) to promote healthy plant growth. In the absence of other published GAC, the GAC have been obtained from legislation (UK and European) and guidance related to the use of sewage sludge on agricultural fields.

The Council of European Communities Sewage Sludge Directive (86/278/EEC) dated 1986, has been transposed into UK law by Statutory Instrument No. 1263, The Sludge (use in Agriculture) Regulations 1989 (Public Health England, Wales and Scotland), as amended in 1990 and The Sludge (use in Agriculture) Regulations (Northern Ireland) SR No, 245, 1990. In addition the Department of Environment (DoE) produced a Code of Practice (CoP) (Updated 2nd Edition) in 2006 which provided guidance on the application of sewage sludge on agricultural land (however the status of this document is unclear as it is on the archive section of the Defra website).

The directive seeks to encourage the use of sewage sludge in agriculture and to regulate its use in such a way as to “**prevent harmful effects on soil, vegetation, animals and man**”. To this end, it prohibits the use of untreated sludge on agricultural land unless it is injected or incorporated into the soil. Treated sludge is defined as having undergone “biological, chemical or heat treatment, long-term storage or any other appropriate process so as significantly to reduce its fermentability and the health hazards resulting from its use”. To provide protection against potential health risks from residual pathogens, sludge must not be applied to soil in which fruit and vegetable crops are growing, or less than ten months before fruit and vegetable crops are to be harvested. Grazing animals must not be allowed access to grassland or forage land less than three weeks after the application of sludge.

The specified limits of concentrations of selected elements in soil are presented in Table 4 of the updated 2nd Edition of the DoE Code of Practice and are designed to protect plant growth. It is noted that these values are more stringent than the values set in current UK regulations. However since they were amended following recommendations from the Independent Scientific Committee in 1993. (MAFF/DOE 1993). The GAC are presented in Table 1.

Table 1: Generic assessment criteria

Determinant	Generic assessment criteria (mg/kg)			
	pH 5.0 < 5.5	pH 5.5 < 6.0	pH 6.0 < 7.0	pH >7.0
Zinc	200	200	200	300
Copper	80	100	135	200
Nickel	50	60	75	110
Lead	300	300	300	300
Cadmium	3	3	3	3
Mercury	1	1	1	1
Note: Only compounds with assessment criteria documented within the Directive 86/278/EEC have been included, although criteria for 5 additional compounds have been presented within the 2006 CoP.				