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3rd March 2022

Our reference: 52022 L07 (00)

Taylor Wimpey South East
Weald Court
103 Tonbridge Road
Tonbridge
Kent
TN11 9HL

Roxanne,

Re: Shorncliffe garrison – Somerset barracks: Garden Validation works – Plots 489 – 495

1. INTRODUCTION

RSK Environment Ltd (RSK) were commissioned by Taylor Wimpey South East (TWSE) to carry out garden validation works on selected plots within the Somerset Barrack development located in Shorncliffe, Folkestone.

This letter report details works conducted by RSK in order to validate the soils placed within Plots 489 – 495 in accordance with the requirements of the detailed remedial strategy (Ref: 52022 R01 (01)) and salient National House Building Council (NHBC) requirements and Local Authority planning conditions.

Previous investigations undertaken by RSK have been detailed in the following reports:

- Somerset Barracks, Detailed Remediation Strategy ref. 52022 R01 (01), dated September 2018
- Somerset Barracks, Interim Verification Report ref. 52022 L03, dated 11th December 2018 and,
- Supplementary Verification Report ref. 522022 L08, dated 12th October 2020.

Pertinent information from these reports has been summarised in Section 2.

This letter report is subject to the RSK service constraints given in **Appendix A.**

2. BACKGROUND

In brief, RSK were commissioned to undertake two rounds of intrusive exploratory works in 2013 and 2016. Both reports conclude that Made Ground is generally considered suitable for retention in areas of future soft-landscaping save for those localised impact containing ACM (SBWS102 only), Polycyclic Aromatic Hydrocarbons (SBTP103 only), and heavy metal Lead (WS12).

In 2018, RSK were commissioned to produce an Outline Remediation Strategy (29180 GN#1) in order to consolidate findings (to date) and outline the need for any further delineative works within these localised areas. A Detailed Remediation Strategy (52022 R01 (01), dated September 2018) was drafted in order to build upon the outline strategy.

Following the successful completion of these targeted remedial works RSK were commissioned to draft an 'Interim Verification Report' (ref. 52022 L03, dated December 2018) within which details of works completed and those outstanding (Section 4) were provided.

In October 2020 a supplementary verification report was produced detailing the completion of all outstanding works. In addition, the report highlights localised areas of previously unforeseen ground conditions encountered during construction.

More specifically, throughout 2019 and into 2020 RSK competed a number of return site visits to view and advise upon the removal of localised remnant substructures (predominantly footings) within the central and eastern extents of the subject site.

Surrounding these substructures (in all instances), were areas of deeper Made Ground that whilst devoid of visual/olfactory evidence of contaminative impact, did contain variable anthropogenic contents including brick, metal and glass.

Following discovery and in accordance with the Detailed Remediation Strategy (52022 R01 (01), recommendations were made to include these areas for subsequent 'clean' capping comprising 600mm and 450mm clean cover where proposed development is for soft-landscaping within private gardens or public open space respectively.

Affected plots identified include: Plots 448-456, Plots 403-423 and Plots 486-495. The following garden validation report has been drafted to address Plots 489-495. A sample location plan has been presented as **Figure 1** of this letter report.

3. SITE WORKS

A suitably qualified RSK engineer attended site on 14th February 2022 to inspect soils, confirm the depth of cover and collect representative samples for subsequent laboratory analysis.

Residential plots 490-495 comprise a single apartment block with associated communal/public open space soft-landscaping around the periphery.

Plot 489 is situated within a small residential 'coach house' building with no associated soft-landscaping. On this basis, the requirement for soil validation works associated with Plot 489 has been omitted.

At the time of the site visit, soils around the apartment block (490-495) were undergoing final cut to the top of subsoil formation, with the removal of remaining constriction platform (crush) and installation of the final topsoil dressing.

In total, four (4no.) inspection pits were advanced within areas of proposed soft-landscaping around the apartment block (490-495) to minimum depth of 450mm below the final finished formation level.

The sampling locations have been marked on **Figure 1** with a selection of photographic log of the work included in **Appendix B**.

A summary of the ground conditions encountered has been provided in **Table 1**.

Table 1: Summary of Ground Conditions

Sample location	Strata	Depth Range (m)	Date	Description
TP1	Subsoil	0.00 – 0.60	14.02.22	Brown slightly gravelly SAND. Gravel is fine to medium subangular to subrounded flint, concrete and masonry fragments.
TP2	Subsoil	0.00 – 0.60		Brown slightly gravelly clayey SAND. Gravel is fine to medium subangular to subrounded flint, concrete and masonry fragments.
TP3	Subsoil	0.00 – 0.45		Orange brown slightly gravelly clayey SAND. Gravel is fine to medium subangular to subrounded flint, concrete and masonry fragments.
Topsoil (East face of block)	Topsoil	0.00 – 0.15		Dark brown silty SAND with rare fine masonry fragments
	Subsoil	0.15 – 0.45		Brown silty SAND with rare fine sandstone and masonry fragments

No visual or olfactory evidence of contamination was identified within any of the soils encountered during the verification work. Anthropogenic inclusions were limited to rare to occasional fine to medium masonry and concrete fragments alone.

3.1 LABORATORY testing and ANALYSIS

In total, three (3no.) representative soil samples were submitted for laboratory analysis including two (2no. subsoils and one (1no.) topsoil. The laboratory test results have been included in **Appendix C**.

Laboratory results have been compared against RSK validation criteria set as human health generic assessment criteria (GAC) for public open space within close proximity to residential housing, presented in **Appendix D**.

None of the soil samples submitted for laboratory analysis exceeded their respective validation criteria for communal/public open space end-use.

4. CONCLUSIONS

Based upon the information obtained as part of these verification works, RSK are satisfied that the soils within the soft-landscaping around the apartment block 490-495 are deemed suitable for their intended end-use.

We trust this validation report is acceptable and can be passed to relevant authorities for their information. Should you have any queries with the content of this report, please do not hesitate to contact us.

Yours sincerely

For RSK Environment Ltd

[redacted]

Niki Dubber

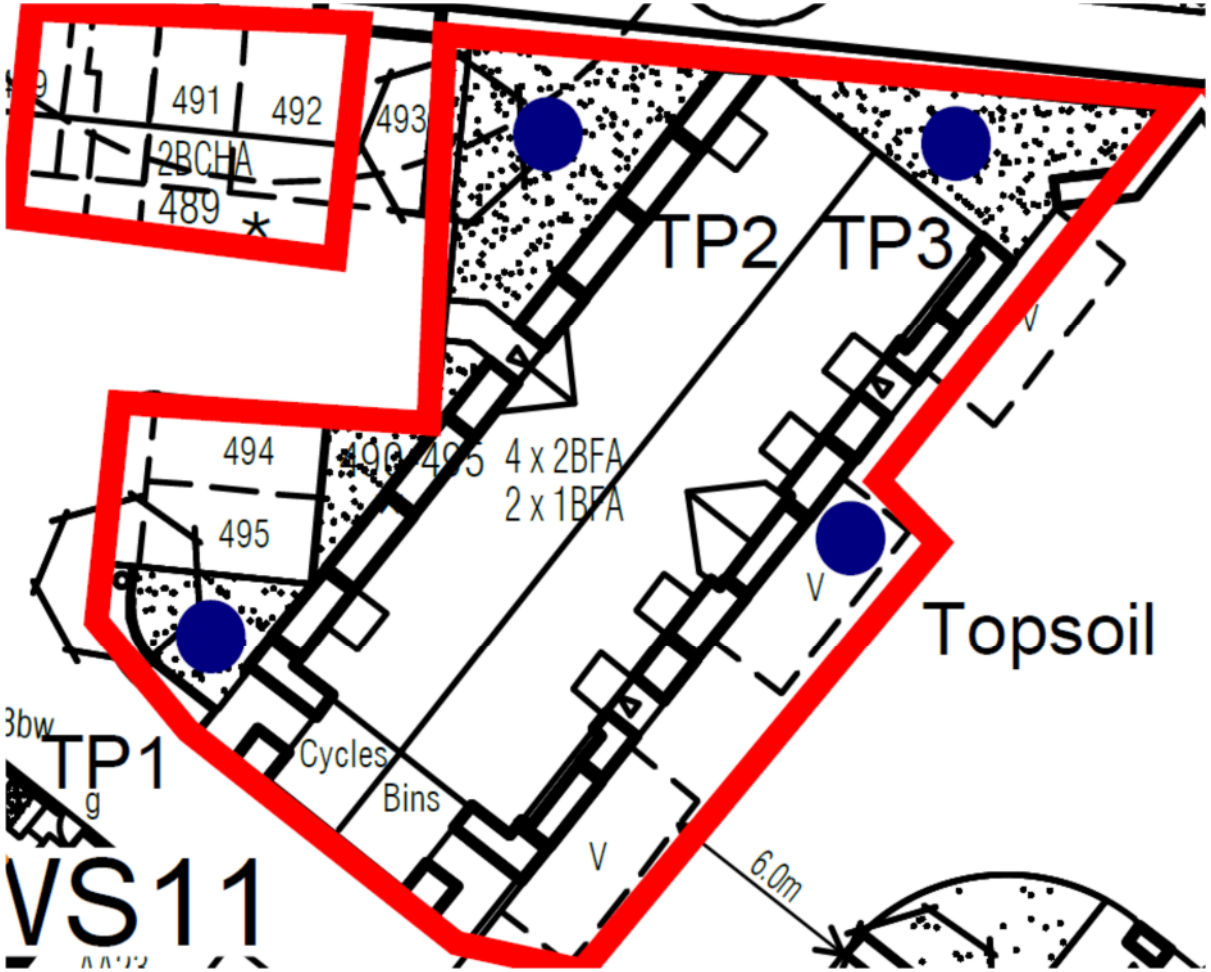
Principal Geo-Environmental Consultant

Enclosed:

Figure 1	Sample location plan
Appendix A	Service constraints
Appendix B	Photographic record
Appendix C	Chemical testing laboratory certificates
Appendix D	RSK validation and Generic Assessment Criteria (GAC)

FIGURES

Sample locations



RSK GEOSCIENCES	**SAMPLE LOCATION PLAN**	**Client:**	Taylor Wimpey South East	**Figure No:**	1
		Site:	Shorncliffe Garrison – Somerset Barracks	**Job No:**	52022
		Scale:	NTS	**Drawn by:**	ND

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 Taylor Wimpey South East (the "Client") in accordance with the terms of RSK Environment Standard Terms and Conditions. The Services were performed by RSK with the reasonable skill and care ordinarily exercised by an 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 in writing, 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 of this report, 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 which 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, invasive plants, electromagnetic fields, lead paint, heavy metals, radon gas or other radioactive or hazardous materials, unless specifically identified in the Services.
7. The Services are based upon RSK's observations of existing physical conditions at the Site gained from a visual inspection 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, unless specifically identified in the Services or accreditation system (such as UKAS ISO 17020:2012 clause 7.1.6):
    a. The Services were based on information and/or analysis provided by independent testing and information services or laboratories upon which RSK was reasonably entitled to rely.
    b. The Services were limited by the accuracy of the information, including documentation, reviewed by RSK and the observations possible at the time of the visual inspection.

c. The Services 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 intrusive environmental site investigation aspects of the Services are a limited sampling of the site at pre-determined locations based on the known historic / 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 properties of the materials adjacent and local conditions, together with the position of any current structures and underground utilities and 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 scope 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. Features (intrusive and sample locations etc) annotated on site plans are not drawn to scale but are centred over the approximate location. Such features should not be used for setting out and should be considered indicative only.

10. The comments given in this report and the opinions expressed are based on the ground conditions encountered during the site work and on the results of tests made in the field and in the laboratory. However, there may be conditions pertaining to the site that have not been disclosed by the investigation and therefore could not be taken into account. In particular, it should be noted that there may be areas of made ground not detected due to the limited nature of the investigation or the thickness and quality of made ground across the site may be variable. In addition, groundwater levels and ground gas concentrations and flows, may vary from those reported due to seasonal, or other, effects and the limitations stated in the data should be recognised.

11. Asbestos is often observed to be present in soils in discrete areas. Whilst asbestos-containing materials may have been locally encountered during the fieldworks or supporting laboratory analysis, the history of brownfield and demolition sites indicates that asbestos fibres may be present more widely in soils and aggregates, which could be encountered during more extensive ground works.

12. Unless stated otherwise, only preliminary geotechnical recommendations are presented in this report and these should be verified in a Geotechnical Design Report, once proposed construction and structural design proposals are confirmed.

APPENDIX B: PHOTOGRAPHIC RECORD

RSK GEOSCIENCES	Report No: 52022 L07	PHOTOGRAPHIC LOG
Client name: Taylor Wimpey South East	**Site Location:** Somerset Barracks, Shorncliffe	14.02.2022

Photo No. 1	
Direction Photo Taken: East	
Description: TP 2 – removal of construction platform (crush) underway in proposed soft-landscaped area (background), exposing top of subsoils and pending final topsoil dressing	

Photo No. 2	 
Direction Photo Taken: N/a	
Description: TP1 Soils observed >450mm – no evidence of contaminative impact	

Photo No. 3	 
Direction Photo Taken: Southwest	
Description: Topsoil sample location along eastern face of apartment block. Minimum thickness (150mm) achieved	

APPENDIX C: CHEMICAL TESTING LABORATORY CERTIFICATES

Becky Drewett
RSK
Anerley Court
Half Moon Lane
Hildenborough
Tonbridge
Kent
TN11 9HU

Derwentside Environmental Testing Services Ltd
Unit 1
Rose Lane Industrial Estate
Rose Lane
Lenham Heath
Kent
ME17 2JN
t: 01622 850410

DETS Report No: 22-01644

Site Reference:	Somerset Barracks
Project / Job Ref:	52022
Order No:	None Supplied
Sample Receipt Date:	14/02/2022
Sample Scheduled Date:	21/02/2022
Report Issue Number:	1
Reporting Date:	01/03/2022

Authorised by:

[redacted]

Dave Ashworth
Technical Manager

Dates of laboratory activities for each tested analyte are available upon request.

Opinions and interpretations are outside the laboratory's scope of ISO 17025 accreditation. This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service. The results reported herein relate only to the material supplied to the laboratory. This certificate shall not be reproduced except in full, without the prior written approval of the laboratory.

DETS Ltd
Unit 1, Rose Lane Industrial Estate
Rose Lane
Lenham Heath
Maidstone
Kent ME17 2JN
Tel : 01622 850410

Soil Analysis Certificate						
DETS Report No: 22-01644	**Date Sampled**	14/02/22	14/02/22	14/02/22		
RSK	**Time Sampled**	None Supplied	None Supplied	None Supplied		
Site Reference: Somerset Barracks	**TP / BH No**	TP01	TP03	TS01		
Project / Job Ref: 52022	**Additional Refs**	None Supplied	None Supplied	None Supplied		
Order No: None Supplied	**Depth (m)**	0.30	0.50	0.10		
Reporting Date: 01/03/2022	**DETS Sample No**	587148	587149	587150		

Determinand	Unit	RL	Accreditation					
Asbestos Screen (S)	N/a	N/a	ISO17025	Not Detected	Not Detected	Not Detected		
pH	pH Units	N/a	MCERTS	9.3	8.7	7.6		
Total Sulphate as SO_4	mg/kg	< 200	MCERTS	2796	831	502		
Total Sulphate as SO_4	%	< 0.02	MCERTS	0.28	0.08	0.05		
W/S Sulphate as SO_4 (2:1)	mg/l	< 10	MCERTS	361	64	39		
W/S Sulphate as SO_4 (2:1)	g/l	< 0.01	MCERTS	0.36	0.06	0.04		
TOC (Total Organic Carbon)	%	< 0.1	MCERTS	0.6	0.6	1.1		
Arsenic (As)	mg/kg	< 2	MCERTS	8	9	8		
Cadmium (Cd)	mg/kg	< 0.2	MCERTS	< 0.2	< 0.2	< 0.2		
Chromium (Cr)	mg/kg	< 2	MCERTS	19	20	18		
Copper (Cu)	mg/kg	< 4	MCERTS	12	10	11		
Lead (Pb)	mg/kg	< 3	MCERTS	38	28	20		
Mercury (Hg)	mg/kg	< 1	MCERTS	< 1	< 1	< 1		
Nickel (Ni)	mg/kg	< 3	MCERTS	15	19	7		
Selenium (Se)	mg/kg	< 2	MCERTS	< 3	< 3	< 3		
Zinc (Zn)	mg/kg	< 3	MCERTS	102	53	44		

Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than 30°C. The Method Description page describes if the test is performed on the dried or as-received portion
Subcontracted analysis (S)

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Soil Analysis Certificate - Speciated PAHs						
DETS Report No: 22-01644	**Date Sampled**	14/02/22	14/02/22	14/02/22		
RSK	**Time Sampled**	None Supplied	None Supplied	None Supplied		
Site Reference: Somerset Barracks	**TP / BH No**	TP01	TP03	TS01		
Project / Job Ref: 52022	**Additional Refs**	None Supplied	None Supplied	None Supplied		
Order No: None Supplied	**Depth (m)**	0.30	0.50	0.10		
Reporting Date: 01/03/2022	**DETS Sample No**	587148	587149	587150		

Determinand	Unit	RL	Accreditation					
Naphthalene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1		
Acenaphthylene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1		
Acenaphthene	mg/kg	< 0.1	MCERTS	0.22	< 0.1	< 0.1		
Fluorene	mg/kg	< 0.1	MCERTS	0.32	< 0.1	< 0.1		
Phenanthrene	mg/kg	< 0.1	MCERTS	2.53	0.16	< 0.1		
Anthracene	mg/kg	< 0.1	MCERTS	0.64	< 0.1	< 0.1		
Fluoranthene	mg/kg	< 0.1	MCERTS	3.65	0.34	< 0.1		
Pyrene	mg/kg	< 0.1	MCERTS	3.12	0.31	< 0.1		
Benzo(a)anthracene	mg/kg	< 0.1	MCERTS	1.34	0.11	< 0.1		
Chrysene	mg/kg	< 0.1	MCERTS	1.47	0.17	< 0.1		
Benzo(b)fluoranthene	mg/kg	< 0.1	MCERTS	1.44	0.18	< 0.1		
Benzo(k)fluoranthene	mg/kg	< 0.1	MCERTS	0.54	< 0.1	< 0.1		
Benzo(a)pyrene	mg/kg	< 0.1	MCERTS	1.12	0.13	< 0.1		
Indeno(1,2,3-cd)pyrene	mg/kg	< 0.1	MCERTS	0.60	< 0.1	< 0.1		
Dibenz(a,h)anthracene	mg/kg	< 0.1	MCERTS	0.19	< 0.1	< 0.1		
Benzo(ghi)perylene	mg/kg	< 0.1	MCERTS	0.55	< 0.1	< 0.1		
Total EPA-16 PAHs	mg/kg	< 1.6	MCERTS	17.7	< 1.6	< 1.6		

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Soil Analysis Certificate - TPH CWG Banded						
DETS Report No: 22-01644	**Date Sampled**	14/02/22	14/02/22	14/02/22		
RSK	**Time Sampled**	None Supplied	None Supplied	None Supplied		
Site Reference: Somerset Barracks	**TP / BH No**	TP01	TP03	TS01		
Project / Job Ref: 52022	**Additional Refs**	None Supplied	None Supplied	None Supplied		
Order No: None Supplied	**Depth (m)**	0.30	0.50	0.10		
Reporting Date: 01/03/2022	**DETS Sample No**	587148	587149	587150		

Determinand	Unit	RL	Accreditation					
Aliphatic >C5 - C6	mg/kg	< 0.01	NONE	< 0.01	< 0.01	< 0.01		
Aliphatic >C6 - C8	mg/kg	< 0.05	NONE	< 0.05	< 0.05	< 0.05		
Aliphatic >C8 - C10	mg/kg	< 2	MCERTS	< 2	< 2	< 2		
Aliphatic >C10 - C12	mg/kg	< 2	MCERTS	< 2	< 2	< 2		
Aliphatic >C12 - C16	mg/kg	< 3	MCERTS	< 3	< 3	< 3		
Aliphatic >C16 - C21	mg/kg	< 3	MCERTS	< 3	< 3	< 3		
Aliphatic >C21 - C34	mg/kg	< 10	MCERTS	< 10	< 10	< 10		
Aliphatic (C5 - C34)	mg/kg	< 21	NONE	< 21	< 21	< 21		
Aromatic >C5 - C7	mg/kg	< 0.01	NONE	< 0.01	< 0.01	< 0.01		
Aromatic >C7 - C8	mg/kg	< 0.05	NONE	< 0.05	< 0.05	< 0.05		
Aromatic >C8 - C10	mg/kg	< 2	MCERTS	< 2	< 2	< 2		
Aromatic >C10 - C12	mg/kg	< 2	MCERTS	< 2	< 2	< 2		
Aromatic >C12 - C16	mg/kg	< 2	MCERTS	2	< 2	< 2		
Aromatic >C16 - C21	mg/kg	< 3	MCERTS	18	< 3	< 3		
Aromatic >C21 - C35	mg/kg	< 10	MCERTS	< 10	< 10	< 10		
Aromatic (C5 - C35)	mg/kg	< 21	NONE	< 21	< 21	< 21		
Total >C5 - C35	mg/kg	< 42	NONE	< 42	< 42	< 42		

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Soil Analysis Certificate - BTEX / MTBE							
DETS Report No: 22-01644	**Date Sampled**	14/02/22	14/02/22	14/02/22		
RSK	**Time Sampled**	None Supplied	None Supplied	None Supplied		
Site Reference: Somerset Barracks	**TP / BH No**	TP01	TP03	TS01		
Project / Job Ref: 52022	**Additional Refs**	None Supplied	None Supplied	None Supplied		
Order No: None Supplied	**Depth (m)**	0.30	0.50	0.10		
Reporting Date: 01/03/2022	**DETS Sample No**	587148	587149	587150		

Determinand	Unit	RL	Accreditation					
Benzene	ug/kg	< 2	MCERTS	< 2	< 2	< 2		
Toluene	ug/kg	< 5	MCERTS	< 5	< 5	< 5		
Ethylbenzene	ug/kg	< 2	MCERTS	< 2	< 2	< 2		
p & m-xylene	ug/kg	< 2	MCERTS	< 2	< 2	< 2		
o-xylene	ug/kg	< 2	MCERTS	< 2	< 2	< 2		
MTBE	ug/kg	< 5	MCERTS	< 5	< 5	< 5		

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Soil Analysis Certificate - Sample Descriptions	
DETS Report No: 22-01644	
RSK	
Site Reference: Somerset Barracks	
Project / Job Ref: 52022	
Order No: None Supplied	
Reporting Date: 01/03/2022	

DETS Sample No	TP / BH No	Additional Refs	Depth (m)	Moisture Content (%)	Sample Matrix Description
587148	TP01	None Supplied	0.30	10.6	Brown gravelly sand with stones and concrete
587149	TP03	None Supplied	0.50	12.7	Brown gravelly sand with stones and concrete
587150	TS01	None Supplied	0.10	18.3	Brown sandy clay with stones

Moisture content is part of procedure E003 & is not an accredited test
Insufficient Sample I/S
Unsuitable Sample U/S

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Maidstone
Kent ME17 2JN
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Soil Analysis Certificate - Methodology & Miscellaneous Information

DETS Report No: 22-01644

RSK

Site Reference: Somerset Barracks

Project / Job Ref: 52022

Order No: None Supplied

Reporting Date: 01/03/2022

Matrix	Analysed On	Determinand	Brief Method Description	Method No
Soil	D	Boron - Water Soluble	Determination of water soluble boron in soil by 2:1 hot water extract followed by ICP-OES	E012
Soil	AR	BTEX	Determination of BTEX by headspace GC-MS	E001
Soil	D	Cations	Determination of cations in soil by aqua-regia digestion followed by ICP-OES	E002
Soil	D	Chloride - Water Soluble (2:1)	Determination of chloride by extraction with water & analysed by ion chromatography	E009
Soil	AR	Chromium - Hexavalent	Determination of hexavalent chromium in soil by extraction in water then by acidification, addition of 1,5 diphenylcarbazide followed by colorimetry	E016
Soil	AR	Cyanide - Complex	Determination of complex cyanide by distillation followed by colorimetry	E015
Soil	AR	Cyanide - Free	Determination of free cyanide by distillation followed by colorimetry	E015
Soil	AR	Cyanide - Total	Determination of total cyanide by distillation followed by colorimetry	E015
Soil	D	Cyclohexane Extractable Matter (CEM)	Gravimetrically determined through extraction with cyclohexane	E011
Soil	AR	Diesel Range Organics (C10 - C24)	Determination of hexane/acetone extractable hydrocarbons by GC-FID	E004
Soil	AR	Electrical Conductivity	Determination of electrical conductivity by addition of saturated calcium sulphate followed by electrometric measurement	E022
Soil	AR	Electrical Conductivity	Determination of electrical conductivity by addition of water followed by electrometric measurement	E023
Soil	D	Elemental Sulphur	Determination of elemental sulphur by solvent extraction followed by GC-MS	E020
Soil	AR	EPH (C10 – C40)	Determination of acetone/hexane extractable hydrocarbons by GC-FID	E004
Soil	AR	EPH Product ID	Determination of acetone/hexane extractable hydrocarbons by GC-FID	E004
Soil	AR	EPH TEXAS (C6-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C40)	Determination of acetone/hexane extractable hydrocarbons by GC-FID for C8 to C40. C6 to C8 by headspace GC-MS	E004
Soil	D	Fluoride - Water Soluble	Determination of Fluoride by extraction with water & analysed by ion chromatography	E009
Soil	D	Fraction Organic Carbon (FOC)	Determination of TOC by combustion analyser.	E027
Soil	D	Organic Matter (SOM)	Determination of TOC by combustion analyser.	E027
Soil	D	TOC (Total Organic Carbon)	Determination of TOC by combustion analyser.	E027
Soil	AR	Exchangeable Ammonium	Determination of ammonium by discrete analyser.	E029
Soil	D	FOC (Fraction Organic Carbon)	Determination of fraction of organic carbon by oxidising with potassium dichromate followed by titration with iron (II) sulphate	E010
Soil	D	Loss on Ignition @ 450oC	Determination of loss on ignition in soil by gravimetrically with the sample being ignited in a muffle furnace	E019
Soil	D	Magnesium - Water Soluble	Determination of water soluble magnesium by extraction with water followed by ICP-OES	E025
Soil	D	Metals	Determination of metals by aqua-regia digestion followed by ICP-OES	E002
Soil	AR	Mineral Oil (C10 - C40)	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge	E004
Soil	AR	Moisture Content	Moisture content; determined gravimetrically	E003
Soil	D	Nitrate - Water Soluble (2:1)	Determination of nitrate by extraction with water & analysed by ion chromatography	E009
Soil	D	Organic Matter	Determination of organic matter by oxidising with potassium dichromate followed by titration with iron (II) sulphate	E010
Soil	AR	PAH - Speciated (EPA 16)	Determination of PAH compounds by extraction in acetone and hexane followed by GC-MS with the use of surrogate and internal standards	E005
Soil	AR	PCB - 7 Congeners	Determination of PCB by extraction with acetone and hexane followed by GC-MS	E008
Soil	D	Petroleum Ether Extract (PEE)	Gravimetrically determined through extraction with petroleum ether	E011
Soil	AR	pH	Determination of pH by addition of water followed by electrometric measurement	E007
Soil	AR	Phenols - Total (monohydric)	Determination of phenols by distillation followed by colorimetry	E021
Soil	D	Phosphate - Water Soluble (2:1)	Determination of phosphate by extraction with water & analysed by ion chromatography	E009
Soil	D	Sulphate (as SO4) - Total	Determination of total sulphate by extraction with 10% HCl followed by ICP-OES	E013
Soil	D	Sulphate (as SO4) - Water Soluble (2:1)	Determination of sulphate by extraction with water & analysed by ion chromatography	E009
Soil	D	Sulphate (as SO4) - Water Soluble (2:1)	Determination of water soluble sulphate by extraction with water followed by ICP-OES	E014
Soil	AR	Sulphide	Determination of sulphide by distillation followed by colorimetry	E018
Soil	D	Sulphur - Total	Determination of total sulphur by extraction with aqua-regia followed by ICP-OES	E024
Soil	AR	SVOC	Determination of semi-volatile organic compounds by extraction in acetone and hexane followed by GC-MS	E006
Soil	AR	Thiocyanate (as SCN)	Determination of thiocyanate by extraction in caustic soda followed by acidification followed by addition of ferric nitrate followed by colorimetry	E017
Soil	D	Toluene Extractable Matter (TEM)	Gravimetrically determined through extraction with toluene	E011
Soil	D	Total Organic Carbon (TOC)	Determination of organic matter by oxidising with potassium dichromate followed by titration with iron (II) sulphate	E010
Soil	AR	TPH CWG (ali: C5- C6, C6-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C34, aro: C5-C7, C7-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C35)	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge for C8 to C35. C5 to C8 by headspace GC-MS	E004
Soil	AR	TPH LQM (ali: C5-C6, C6-C8, C8-C10, C10-C12, C12-C16, C16-C35, C35-C44, aro: C5-C7, C7-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C35, C35-C44)	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge for C8 to C44. C5 to C8 by headspace GC-MS	E004
Soil	AR	VOCs	Determination of volatile organic compounds by headspace GC-MS	E001
Soil	AR	VPH (C6-C8 & C8-C10)	Determination of hydrocarbons C6-C8 by headspace GC-MS & C8-C10 by GC-FID	E001

D Dried
AR As Received

APPENDIX D: RSK VALIDATION AND GENERIC ASSESSMENT CRITERIA (GAC)

Generic assessment criteria for human health: Public open space (near residential housing) scenario

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. The publication of C4SL introduced two new land-use scenarios relating to public open spaces.

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 have been applied to the RSK GAC. The current RSK GAC also use 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 v1.06, supporting EA guidance[(5,8,9)] and revised exposure scenarios published for the C4SL[(3)].

Conceptual model

This GAC derivation considers POS_{Resi} to relate to public open space in close proximity to residential housing. This includes predominantly grassed areas adjacent to high-density housing such as a green surrounded by houses, in accordance with the C4SL POS_{Resi} land-use scenario[(3)]. This would also include smaller areas incorporated in newer developments.

The POS_{Resi} scenario considers risk to a child receptor (female) between the ages of >3 and <9years old. In accordance with Section 3.6.3.3 of the SP1010 project report[(3)], exposure assumptions are based on the adaptation of the CLEA residential land–use scenario without consumption of home-grown produce and vapour ingress to the building. The pathways considered for production of the SAC in the POS_{Resi} scenario are

- ingestion of soil and dust (outdoors and indoors respectively)

- dermal contact with soil (outdoors; and soil-derived dust indoors)
- inhalation of dust (outdoors and indoors)
- inhalation of vapours outdoors.

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.

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 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 correction factor of 10 into the CLEA chemical database for all petroleum hydrocarbons (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[1] 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 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 C_5–C_8 were not modelled, as this range comprises benzene (>EC5-EC7) and toluene (>EC7-EC8), which are modelled separately.

Physical parameters

For the POS_{Resi} scenario, project report SP1010[3] considers the potential for soil to be tracked into nearby houses with the potential for ingestion and inhalation of dust within the house. The CLEA default building is a small, two-storey terrace house.

POS_{resi} is considered to be a predominantly grassed area of up to 500m^2 (0.05 ha) with up to 50% potentially being bare soil. The input parameters were based on the air dispersion model and the vapour model detailed in SR3[5]. Full details of the land use scenario are presented in Table 3.6 of project report SP1010[3].

The parameters for a sandy loam soil type were used in line with 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 this parameter, RSK has produced an additional set of SAC for an SOM of 1% and 2.5%.

The SAC were produced using the input parameters in Table 1 below and Table 3.6 of project report SP1010[3]. The GAC by pathway are presented in Table 2 and the combined GAC presented in Table 3.

Figure 1: Conceptual model for CLEA public open space (residential) scenario

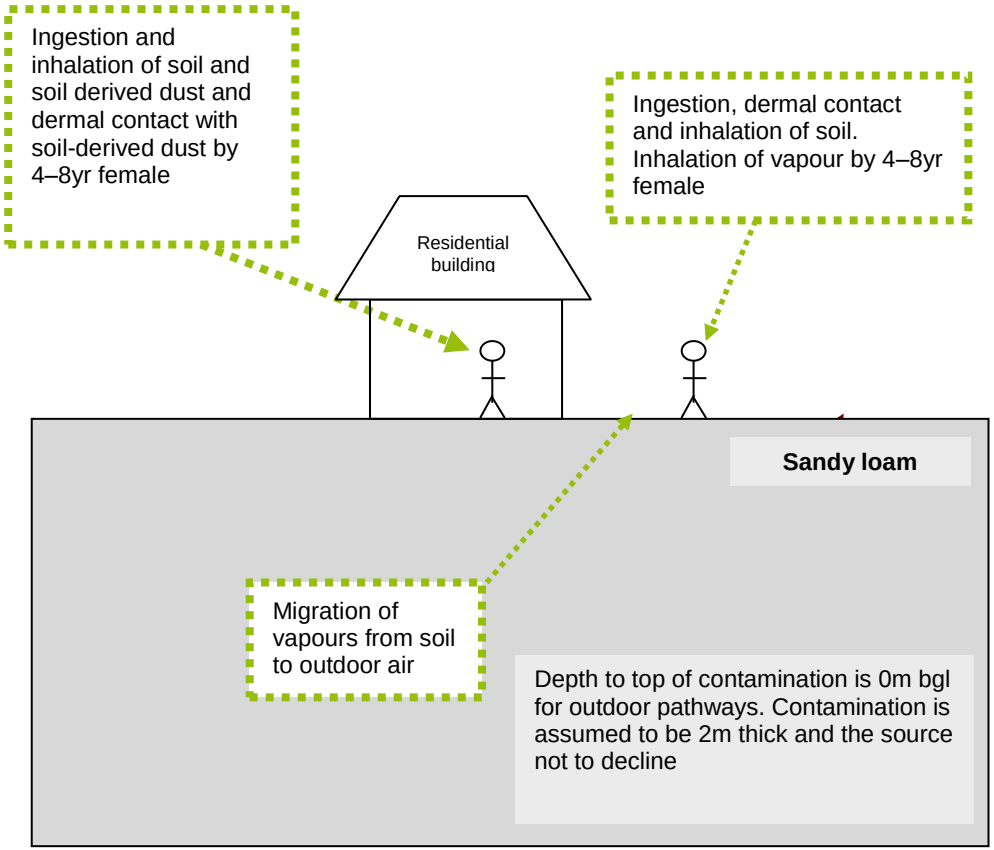


Table 1: Exposure assessment parameters for public open space (residential) scenario – inputs for CLEA model

Parameter	Value	Justification
Land use	Public open space (residential)	Chosen land use. Table 3.6 of SP1010[3]
Receptor	Female child	Taken as female child exposed over 6 years from 4 to 8 years, Table 3.6, SP1010[5]
Soil type	Sandy loam	Most common UK soil type (Section 4.3.1, Table 4.4, SR3[5]).
Start age class (AC)	4	Range of AC corresponding to key generic assumption that the critical receptor is a young female child aged 4–8 years (>3-<9). From Table 3.6, SP1010[5]
End AC	9	
SOM (%)	6	Representative of sandy loam 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

References

1. Environment Agency (2009), Science Reports SC050021 - SGV and TOX reports for: benzene, toluene, ethylbenzene, xylene, mercury, selenium, nickel, arsenic, cadmium, phenol, dioxins, furans and dioxin-like PCBs'; 'Supplementary information for the derivation of SGV for: benzene, toluene, ethylbenzene, xylene, mercury, selenium, nickel, arsenic, cadmium, phenol, dioxins, furans and dioxin-like PCBs' and 'Contaminants in soil: updated collation of toxicological data and intake values for humans: benzene, toluene, ethylbenzene, xylene, mercury, selenium, nickel, arsenic, cadmium, phenol, dioxins, furans and dioxin-like PCBs'. Available at: https://www.gov.uk/government/publications/contaminants-in-soil-updated-collation-of-toxicological-data-and-intake-values-for-humans and https://www.gov.uk/government/publications/land-contamination-soil-guideline-values-sgvs (accessed 4 February 2015)

2. Nathanial, C. P., McCaffrey, C., Ashmore, M., Cheng, Y., Gillet, A. G., Ogden, R. C. and Scott, D. (2009), *LQM/CIEH Generic Assessment Criteria for Human Health Risk Assessment*, second edition (Nottingham: Land Quality Press).

3. Contaminated Land: Applications in Real Environment (CL:AIRE) (2014), 'Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination', Revision 2, DEFRA research project SP1010.

4. Department for Environment, Food and Rural Affairs (Defra) (2014), 'SP1010: Development of Category 4 Screening Levels for assessment of land affected by contamination – Policy Companion Document', Revision 2.

5. Environment Agency (2009), *Science Report – SC050021/SR3. Updated technical background to the CLEA model* (Bristol: Environment Agency).

6. Contaminated Land: Applications in Real Environment (CL:AIRE) (2014), 'Appendices C to H). DEFRA research project SP1010'.

7. Nathanial, C. P., McCaffrey, C., Gillet, A. G., Ogden, R. C. and Nathanial, J. F. (2015), *The LQM/CIEH S4ULs for Human Health Risk Assessment* (Nottingham Land Quality Press).

8. Environment Agency (2009), *Human health toxicological assessment of contaminants in soil. Science Report – Final SC050021/SR2* (Bristol: Environment Agency).

9. Environment Agency (2009), *Science Report – SC050021/SR4 CLEA Software (version 1.05) Handbook* (Bristol: Environment Agency).

10. Environment Agency (2008), *Science Report SC050021/SR7. Compilation of Data for Priority Organic Pollutants for Derivation of Soil Guideline Values* (Bristol: Environment Agency).

11. CL:AIRE (2009), *Soil Generic Assessment Criteria for Human Health Risk Assessment* (London: CL:AIRE).

12. USEPA (2011), *Exposure factors handbook*, EPA/600/R-090/052F (Washington DC: Office of Research and Development).

13. Environment Agency (2009), 'Changes made to the CLEA framework documents after the three-month evaluation period in 2008', released January 2009.

14. USEPA (2010). Hydrogen cyanide and cyanide salts. Integrated Risk Information Systems (IRIS) Chemical Assessment Summary. September 2010. https://www.epa.gov/iris (accessed 9 December 2015)

GENERIC ASSESSMENT CRITERIA FOR HUMAN HEALTH - PUBLIC OPEN SPACE (IN CLOSE PROXIMITY TO RESIDENTIAL HOUSING)

Table 2

Human Health Generic Assessment Criteria for Public Open Space (in close proximity to residential housing)

Compound	Notes	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)	7.92E+01	5.31E+02	NR	NR	7.92E+01	5.31E+02	NR	NR	7.92E+01	5.31E+02	NR	NR
Cadmium	(a)	3.64E+02	4.94E+02	2.20E+02	NR	3.64E+02	4.94E+02	2.20E+02	NR	3.64E+02	4.94E+02	2.20E+02	NR
Chromium (III) - trivalent	(c)	3.98E+04	1.54E+03	NR	NR	3.98E+04	1.54E+03	NR	NR	3.98E+04	1.54E+03	NR	NR
Chromium (VI) - hexavalent	(a,d)	1.18E+02	2.08E+01	NR	NR	1.18E+02	2.08E+01	NR	NR	1.18E+02	2.08E+01	NR	NR
Copper		2.15E+04	1.95E+04	1.20E+04	NR	2.15E+04	1.95E+04	1.20E+04	NR	2.15E+04	1.95E+04	1.20E+04	NR
Lead	(a)	6.26E+02	NR	NR	NR	6.26E+02	NR	NR	NR	6.26E+02	NR	NR	NR
Elemental Mercury (Hg^0)	(d)	NR	1.57E+01	NR	4.31E+00	NR	1.58E+01	NR	1.07E+01	NR	1.58E+01	NR	2.58E+01
Inorganic Mercury (Hg^{2+})		1.28E+02	4.62E+03	1.24E+02	NR	1.28E+02	4.62E+03	1.24E+02	NR	1.28E+02	4.62E+03	1.24E+02	NR
Methyl Mercury (Hg^{4+})		3.97E+01	5.86E+03	3.94E+01	7.33E+01	3.97E+01	7.06E+03	3.95E+01	1.42E+02	3.97E+01	8.43E+03	3.95E+01	3.04E+02
Nickel	(d)	3.74E+02	2.31E+02	NR	NR	3.74E+02	2.31E+02	NR	NR	3.74E+02	2.31E+02	NR	NR
Selenium	(b)	1.14E+03	NR	NR	NR	1.14E+03	NR	NR	NR	1.14E+03	NR	NR	NR
Zinc	(b)	8.08E+04	4.62E+07	NR	NR	8.08E+04	4.62E+07	NR	NR	8.08E+04	4.62E+07	NR	NR
Cyanide (free)		8.02E+01	1.75E+04	8.01E+01	NR	8.02E+01	1.75E+04	8.01E+01	NR	8.02E+01	1.75E+04	8.01E+01	NR
Volatile Organic Compounds													
Benzene	(a)	1.44E+02	8.35E+03	1.41E+02	1.22E+03	1.44E+02	1.12E+04	1.42E+02	2.26E+03	1.44E+02	1.58E+04	1.43E+02	4.71E+03
Toluene		5.61E+04	6.86E+06	5.57E+04	8.69E+02	5.61E+04	9.88E+06	5.58E+04	1.92E+03	5.61E+04	1.42E+07	5.59E+04	4.36E+03
Ethylbenzene		2.52E+04	4.74E+05	2.39E+04	5.18E+02	2.52E+04	6.95E+05	2.43E+04	1.22E+03	2.52E+04	9.98E+05	2.46E+04	2.84E+03
Xylene - m		4.53E+04	4.14E+05	4.08E+04	6.25E+02	4.53E+04	6.05E+05	4.22E+04	1.47E+03	4.53E+04	8.62E+05	4.31E+04	3.46E+03
Xylene - o		4.53E+04	4.28E+05	4.10E+04	4.78E+02	4.53E+04	6.22E+05	4.23E+04	1.12E+03	4.53E+04	8.84E+05	4.32E+04	2.62E+03
Xylene - p		4.53E+04	4.07E+05	4.08E+04	5.76E+02	4.53E+04	5.93E+05	4.22E+04	1.35E+03	4.53E+04	8.46E+05	4.31E+04	3.17E+03
Total xylene		4.53E+04	4.07E+05	4.08E+04	6.25E+02	4.53E+04	5.93E+05	4.22E+04	1.47E+03	4.53E+04	8.46E+05	4.31E+04	3.46E+03
Methyl tertiary-Butyl ether (MTBE)		7.57E+04	5.10E+06	7.46E+04	2.04E+04	7.57E+04	6.33E+06	7.48E+04	3.31E+04	7.57E+04	8.36E+06	7.51E+04	6.27E+04
Trichloroethene		1.26E+02	1.94E+03	1.19E+02	1.54E+03	1.26E+02	2.76E+03	1.21E+02	3.22E+03	1.26E+02	3.98E+03	1.22E+02	7.14E+03
Tetrachloroethene		1.44E+03	1.97E+04	1.39E+03	4.24E+02	1.44E+03	2.88E+04	1.40E+03	9.51E+02	1.44E+03	4.21E+04	1.41E+03	2.18E+03
1,1,1-Trichloroethane		1.51E+05	1.46E+06	1.37E+05	1.43E+03	1.51E+05	2.06E+06	1.41E+05	2.92E+03	1.51E+05	2.98E+06	1.44E+05	6.39E+03
1,1,1,2 Tetrachloroethane		1.45E+03	5.44E+04	1.41E+03	2.60E+03	1.45E+03	7.78E+04	1.42E+03	6.02E+03	1.45E+03	1.09E+05	1.43E+03	1.40E+04
1,1,2,2-Tetrachloroethane		1.45E+03	8.07E+04	1.42E+03	2.67E+03	1.45E+03	1.07E+05	1.43E+03	5.46E+03	1.45E+03	1.42E+05	1.43E+03	1.20E+04
Carbon Tetrachloride		1.01E+03	4.08E+03	8.86E+02	1.52E+03	1.01E+03	5.95E+03	9.23E+02	3.32E+03	1.01E+03	8.76E+03	9.50E+02	7.54E+03
1,2-Dichloroethane		3.03E+01	6.29E+02	2.89E+01	3.41E+03	3.03E+01	7.45E+02	2.91E+01	4.91E+03	3.03E+01	9.52E+02	2.94E+01	8.43E+03
Vinyl Chloride		3.53E+00	2.95E+02	3.49E+00	1.36E+03	3.53E+00	3.35E+02	3.50E+00	1.76E+03	3.53E+00	4.13E+02	3.50E+00	2.69E+03
1,2,4-Trimethylbenzene		NR	2.48E+02	NR	4.74E+02	NR	2.49E+02	NR	1.16E+03	NR	2.50E+02	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		1.49E+04	3.25E+06	1.48E+04	5.70E+01	1.49E+04	3.64E+06	1.48E+04	1.41E+02	1.49E+04	3.94E+06	1.48E+04	3.36E+02
Acenaphthylene		1.49E+04	3.21E+06	1.48E+04	8.61E+01	1.49E+04	3.61E+06	1.48E+04	2.12E+02	1.49E+04	3.91E+06	1.48E+04	5.06E+02
Anthracene		7.44E+04	1.94E+07	7.41E+04	1.17E+00	7.44E+04	2.06E+07	7.41E+04	2.91E+00	7.44E+04	2.14E+07	7.41E+04	6.96E+00
Benzo(a)anthracene		3.84E+01	1.11E+02	2.85E+01	1.71E+00	3.84E+01	1.13E+02	2.86E+01	4.28E+00	3.84E+01	1.14E+02	2.87E+01	1.03E+01
Benzo(a)pyrene	(a)	1.04E+01	3.89E+01	NR	9.11E-01	1.04E+01	3.93E+01	NR	2.28E+00	1.04E+01	3.95E+01	NR	5.46E+00
Benzo(b)fluoranthene		9.67E+00	2.83E+01	7.21E+00	1.22E+00	9.67E+00	2.86E+01	7.23E+00	3.04E+00	9.67E+00	2.89E+01	7.24E+00	7.29E+00
Benzo(g,h,i)perylene		8.53E+02	2.50E+03	6.36E+02	1.54E-02	8.53E+02	2.51E+03	6.37E+02	3.85E-02	8.53E+02	2.52E+03	6.37E+02	9.23E-02
Benzo(k)fluoranthene		2.55E+02	7.49E+02	1.90E+02	6.87E-01	2.55E+02	7.56E+02	1.91E+02	1.72E+00	2.55E+02	7.61E+02	1.91E+02	4.12E+00
Chrysene		7.68E+01	2.21E+02	5.70E+01	4.40E-01	7.68E+01	2.24E+02	5.72E+01	1.10E+00	7.68E+01	2.27E+02	5.74E+01	2.64E+00
Dibenzo(a,h)anthracene		7.68E-01	2.25E+00	5.73E-01	3.93E-03	7.68E-01	2.27E+00	5.74E-01	9.82E-03	7.68E-01	2.29E+00	5.75E-01	2.36E-02
Fluoranthene		3.10E+03	8.82E+05	3.08E+03	1.89E+01	3.10E+03	9.10E+05	3.09E+03	4.73E+01	3.10E+03	9.27E+05	3.09E+03	1.13E+02
Fluorene		9.91E+03	2.34E+06	9.87E+03	3.09E+01	9.91E+03	2.57E+06	9.87E+03	7.65E+01	9.91E+03	2.73E+06	9.87E+03	1.83E+02
Indeno(1,2,3-cd)pyrene		1.10E+02	3.19E+02	8.17E+01	6.13E-02	1.10E+02	3.24E+02	8.20E+01	1.53E-01	1.10E+02	3.26E+02	8.22E+01	3.68E-01
Naphthalene		4.89E+03	1.93E+04	3.90E+03	7.64E+01	4.89E+03	2.53E+04	4.10E+03	1.83E+02	4.89E+03	3.16E+04	4.24E+03	4.32E+02
Phenanthrene		3.08E+03	8.12E+05	3.07E+03	3.60E+01	3.08E+03	8.61E+05	3.07E+03	8.96E+01	3.08E+03	8.94E+05	3.07E+03	2.14E+02
Pyrene		7.43E+03	2.11E+06	7.41E+03	2.20E+00	7.43E+03	2.18E+06	7.41E+03	5.49E+00	7.43E+03	2.22E+06	7.41E+03	1.32E+01
Phenol		1.31E+05	1.11E+04	1.02E+04	2.42E+04	1.31E+05	1.12E+04	1.03E+04	3.81E+04	1.31E+05	1.12E+04	1.03E+04	7.03E+04

GENERIC ASSESSMENT CRITERIA FOR HUMAN HEALTH - PUBLIC OPEN SPACE (IN CLOSE PROXIMITY TO RESIDENTIAL HOUSING)

Table 2

Human Health Generic Assessment Criteria for Public Open Space (in close proximity to residential housing)

Compound	Notes	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_5-EC_6		6.31E+05	2.03E+06	5.75E+05	3.04E+02	6.31E+05	2.74E+06	5.91E+05	5.58E+02	6.31E+05	3.92E+06	6.04E+05	1.15E+03
Aliphatic hydrocarbons >EC_6-EC_8		6.31E+05	3.16E+06	5.97E+05	1.44E+02	6.31E+05	4.68E+06	6.09E+05	3.22E+02	6.31E+05	6.99E+06	6.16E+05	7.36E+02
Aliphatic hydrocarbons >EC_8-EC_{10}		1.26E+04	3.80E+05	1.25E+04	7.77E+01	1.26E+04	5.83E+05	1.26E+04	1.90E+02	1.26E+04	8.74E+05	1.26E+04	4.51E+02
Aliphatic hydrocarbons >EC_{10}-EC_{12}		1.26E+04	8.12E+05	1.26E+04	4.75E+01	1.26E+04	1.23E+06	1.26E+04	1.18E+02	1.26E+04	1.80E+06	1.26E+04	2.83E+02
Aliphatic hydrocarbons >EC_{12}-EC_{16}		1.26E+04	2.07E+06	1.26E+04	2.37E+01	1.26E+04	2.95E+06	1.26E+04	5.91E+01	1.26E+04	3.99E+06	1.26E+04	1.42E+02
Aliphatic hydrocarbons >EC_{16}-EC_{35}	(b)	2.51E+05	NR	NR	8.48E+00	2.51E+05	NR	NR	2.12E+01	2.51E+05	NR	NR	5.09E+01
Aliphatic hydrocarbons >EC_{35}-EC_{44}	(b)	2.51E+05	NR	NR	8.48E+00	2.51E+05	NR	NR	2.12E+01	2.51E+05	NR	NR	5.09E+01
Aromatic hydrocarbons >EC_8-EC_{10}		5.05E+03	2.16E+05	5.02E+03	6.13E+02	5.05E+03	3.21E+05	5.03E+03	1.50E+03	5.05E+03	4.60E+05	5.04E+03	3.58E+03
Aromatic hydrocarbons >EC_{10}-EC_{12}		5.05E+03	4.48E+05	5.04E+03	3.64E+02	5.05E+03	6.34E+05	5.04E+03	8.99E+02	5.05E+03	8.52E+05	5.04E+03	2.15E+03
Aromatic hydrocarbons >EC_{12}-EC_{16}		5.05E+03	1.02E+06	5.05E+03	1.69E+02	5.05E+03	1.29E+06	5.05E+03	4.19E+02	5.05E+03	1.52E+06	5.05E+03	1.00E+03
Aromatic hydrocarbons >EC_{16}-EC_{21}	(b)	3.77E+03	NR	NR	5.37E+01	3.77E+03	NR	NR	1.34E+02	3.77E+03	NR	NR	3.21E+02
Aromatic hydrocarbons >EC_{21}-EC_{35}	(b)	3.77E+03	NR	NR	4.83E+00	3.77E+03	NR	NR	1.21E+01	3.77E+03	NR	NR	2.90E+01
Aromatic hydrocarbons >EC_{35}-EC_{44}	(b)	3.77E+03	NR	NR	4.83E+00	3.77E+03	NR	NR	1.21E+01	3.77E+03	NR	NR	2.90E+01

Notes:

Public open space (resi) and (park) GAC are based on the exposure parameters detailed within SP1010 "Development of Category 4 Screening Levels for Assessment of Land affected by Contamination", Final, 20th December 2013

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 affect the interpretation of any exceedances as the contribution of the indoor and outdoor vapour pathway to total exposure is >10%.

Calculated SAC exceeds soil saturation limit but the exceedance will not affect the SAC significantly as the contribution of the indoor and outdoor vapour pathway to total exposure is <10%.

Calculated SAC does not exceed the soil saturation limit.

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, PAHs napthalene, acenaphthene and acenaphthylene, 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, benzene, 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 - PUBLIC OPEN SPACE (IN CLOSE PROXIMITY TO RESIDENTIAL HOUSING)

Table 3
Human Health Generic Assessment Criteria for Public Open Space (in close proximity to residential housing)

Compound	SAC for Soil SOM 1% (mg/kg)	SAC for Soil SOM 2.5% (mg/kg)	SAC for Soil SOM 6% (mg/kg)
Metals			
Arsenic	79	79	79
Cadmium	220	220	220
Chromium (III) - trivalent	1,540	1,540	1,540
Chromium (VI) - hexavalent	21	21	21
Copper	12,000	12,000	12,000
Lead	630	630	630
Elemental Mercury (Hg^0)	16	16	16
Inorganic Mercury (Hg^{2+})	120	120	120
Methyl Mercury (Hg^{4+})	39	39	40
Nickel	230	230	230
Selenium	1,100	1,100	1,100
Zinc	81,000	81,000	81,000
Cyanide (free)	80	80	80
Volatile Organic Compounds			
Benzene	140	140	140
Toluene	55,700	55,800	55,900
Ethylbenzene	23,900	24,300	24,600
Xylene - m	40,800	42,200	43,100
Xylene - o	41,000	42,300	43,200
Xylene - p	40,800	42,200	43,100
Total xylene	40,800	42,200	43,100
Methyl tertiary-Butyl ether (MTBE)	74,600	74,800	75,100
Trichloroethene	120	120	120
Tetrachloroethene	1,400	1,400	1,400
1,1,1-Trichloroethane	140,000	140,000	140,000
1,1,1,2 Tetrachloroethane	1,400	1,400	1,400
1,1,2,2-Tetrachloroethane	1,400	1,400	1,400
Carbon Tetrachloride	886	923	950
1,2-Dichloroethane	29	29	29
Vinyl Chloride	3.5	3.5	3.5
1,2,4-Trimethylbenzene	250	250	250
1,3,5-Trimethylbenzene	NR	NR	NR
Semi-Volatile Organic Compounds			
Acenaphthene	14,800	14,800	14,800
Acenaphthylene	14,800	14,800	14,800
Anthracene	74,100	74,100	74,100
Benzo(a)anthracene	29	29	29
Benzo(a)pyrene	10	10	10
Benzo(b)fluoranthene	7	7	7
Benzo(g,h,i)perylene	640	640	640
Benzo(k)fluoranthene	190	191	191
Chrysene	57	57	57
Dibenzo(a,h)anthracene	0.57	0.57	0.58
Fluoranthene	3,100	3,100	3,100
Fluorene	9,900	9,900	9,900
Indeno(1,2,3-cd)pyrene	82	82	82
Naphthalene	4,900	4,900	4,900
Phenanthrene	3,100	3,100	3,100
Pyrene	7,400	7,400	7,400
Phenol	440*	690*	1,300*
Total Petroleum Hydrocarbons			
Aliphatic hydrocarbons EC_5-EC_6	570,000 (304)	590,000	600,000
Aliphatic hydrocarbons >EC_6-EC_8	600,000	610,000	620,000
Aliphatic hydrocarbons >EC_8-EC_{10}	13,000	13,000	13,000
Aliphatic hydrocarbons >EC_{10}-EC_{12}	13,000	13,000	13,000
Aliphatic hydrocarbons >EC_{12}-EC_{16}	13,000	13,000	13,000
Aliphatic hydrocarbons >EC_{16}-EC_{35}	250,000	250,000	250,000
Aliphatic hydrocarbons >EC_{35}-EC_{44}	250,000	250,000	250,000
Aromatic hydrocarbons >EC_8-EC_{10}	5,000	5,000	5,000
Aromatic hydrocarbons >EC_{10}-EC_{12}	5,000	5,000	5,000
Aromatic hydrocarbons >EC_{12}-EC_{16}	5,000	5,000	5,000
Aromatic hydrocarbons >EC_{16}-EC_{21}	3,800	3,800	3,800
Aromatic hydrocarbons >EC_{21}-EC_{35}	3,800	3,800	3,800
Aromatic hydrocarbons >EC_{35}-EC_{44}	3,800	3,800	3,800
Minerals			
Asbestos	No asbestos detected with ID or <0.001% dry weight[1]		

Notes:

'-' 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.

* The GAC for Phenol is based on a threshold which is protective of direct contact (SC050021/Phenol SGV report)

Public open space (resi) and (park) GAC are based on the exposure parameters detailed within SP1010 "Development of Category 4 Screening Levels for Assessment of Land affected by Contamination", Final, 20th December 2013

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, PAHs napthalene, acenaphthene and acenaphthylene, 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.