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Our Ref: 23561/L02/arj

18 May 2011

Abbey Developments Limited
Abbey House,
2 Southgate Road,
Potters Bar, Hertfordshire,
EN6 5DU

For attention of: Mr Chris Jeffery

RE: 7 HEARNFIELD DRIVE, LITTLEHAMPTON
REMEDATION STRATEGY

Dear Sirs

1. PROJECT BACKGROUND

RSK STATS Geconsult Limited (RSK) was commissioned by Abbey Developments Limited (Abbey) to produce a site remediation strategy for the land at 7 Hearnfield Drive, Littlehampton.

The site is currently occupied by undeveloped land with overgrown vegetation and two stockpiles of soil and rubble in the central and western areas. The development proposals include the construction of 24No. low rise residential properties with private gardens, new access roads and associated infrastructure.

1.1 Aims and Objectives

The objective of this remedial strategy is to minimise the environmental risks and hazards associated with residential development of the site. The long-term aims of the remediation programme are to reduce the risks from contamination to future residents.



INVESTORS
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2. PREVIOUS SITE ASSESSMENT

RSK carried out a Geo-Environmental Site Assessment in January 2011. As part of this investigation, RSK were provided with two previous investigation reports for the site. The previous reports are listed below:

- *Site Investigation letter report, ref: 08.5283/RM dated 27th February 2008, by Constructive Evaluation Building & Materials Test Consultants;*
- *Ground Investigation Report, ref: J10126 dated September 2010, by Wilson Bailey Geotechnical & Environmental; and*
- *Geo-Environmental Site Assessment, ref: 23561R01(00) dated January 2011 by RSK STATS Geoconsult Ltd.*

Findings of the previous reports by others are summarised in the RSK January 2011 report. Recommendations made by RSK are outlined below:

2.1 Shallow Soils

Elevated concentrations of Benzo(a)Pyrene (BaP) were identified in the vicinity of TP1 and TP2 in the Wilson Bailey report at depths of 0.5 metres below ground level (mbgl). RSK also found elevated concentrations of BaP in the vicinity of WS3 at depths between ground level and 0.5m.

The stockpile identified in the far west of the site was found to contain elevated concentrations of lead and Benzo(a)Pyrene. RSK recommend this stockpile is removed from site and disposed of at an appropriately licensed landfill facility. Under no circumstances should this material be reused on site. WAC testing may be required by the receiving landfill prior to disposal.

2.2 Ground Gas

A preliminary gas monitoring round was undertaken on the 9th December 2010. Concentrations of methane, carbon dioxide, oxygen and Lower Explosive Limits (LEL) were recorded using a portable Infra Red Gas Analyser. Atmospheric pressure, differential pressure and flow rates were also recorded.

In order to assess the significance of ground gases at the site, measured concentrations and flow rates were used to generate GSVs. As the new development is to comprise low-rise housing, the concentrations of recorded ground gases have been compared with the generic NHBC Traffic Light system, as presented within the NHBC ground gases guide and CIRIA Report 665 (2007).

Assessment of gas screening values characterised the site as Green under the NHBC Traffic Light System. Gas protection measures were not deemed necessary.

2.3 Recommendations

The following recommendations were outlined:

- *A minimum clean cover thickness of 300mm topsoil will need to be imported into private rear garden areas affected by hotspot contamination; and*
- *The soils in the stockpile in the far west of the site have been found to contain elevated concentrations of lead and BaP and require removal from site with appropriate disposal at a licensed facility.*

3. REMEDIAL STRATEGY

Due to the nature of the made ground encountered on site and the presence of elevated concentrations of BaP in shallow soils in the vicinity of TP1, TP2 and WS3, remedial works are required to ensure the site is suitable for the proposed residential end-use.

A site plan is presented as Figure 1 identifying the affected areas. Should the layout of the proposed development be amended then the plan will need to be reviewed. Currently it is understood that 6No. units are affected by the remedial strategy.

3.1 Private Rear Garden Areas – Plots 20, 21 and 24

For implementation of the capping layer in private rear garden areas, made ground should be removed to a depth of 600mm below existing ground levels and disposed of appropriately. Following the removal of made ground, imported clean certified materials should be placed in the private rear garden areas comprising a minimum of 300mm topsoil and 300mm subsoil. The purpose of this is to ensure sufficient volume of made ground is removed from the affected private rear garden areas and allow a suitable growing medium for the completed gardens.

3.2 Hotspot Contamination – Plots 13-15

Elevated concentrations of BaP were identified in the vicinity of WS3 in the RSK January 2011 report. WS3 is located below the footprint of the proposed houses on the development plan. On this basis it is recommended to remove the hotspot in the area and backfill the excavation with suitable subsoil materials. Any imported materials used for backfill should be suitably validated with chemical test certificates. It is recommended to excavate an area 5m by 5m to a depth of 600mm below existing ground levels.

3.3 Contaminated Material Waste Options

The option considered to be most appropriate owing to time constraints associated with the development is:

- Contaminated soils arising from any of the remedial works be disposed of at a suitably approved licensed landfill facility.

Copies of Waste Transfer Notes should be provided to RSK for any soils removed off site to be included in the post remedial verification document for the site.

3.4 Dealing with Unforeseen Conditions

Should previously unidentified visual or olfactory residues, asbestos, buried drums, drains, interceptors, fuel storage tanks or any other unexpected hazards be discovered during site works, the site contractor should inform immediately the Site Manager and/or contact the appointed Site Chemist or RSK, Hemel Hempstead (01442 437500). Work should be postponed in the immediate area of the discovery and the area cordoned off. The discovery should be inspected, sampled and/or analysed to assess the potential risk and residues may be required to be removed by a specialist contractor. Storage tank contents and free product on collected water not previously detected may have to be removed by tanker.

4. ENABLING WORKS AND POLLUTION CONTROL

4.1 Drains, Interceptors and Soakaways

Prior to redevelopment, these features should be emptied of all liquids/sludges and chemical analysis should be undertaken to determine an appropriate disposal method. Subject to regulatory authority agreement this may be by foul sewer or, alternatively, by effluent tanker for offsite treatment/disposal. Collected water should not be disposed of via any ground surface, drain or surface watercourse without the appropriate regulatory consents to discharge. Drainage structures should then be broken out and excavated where necessary or grouted and sealed.

4.2 Dust Suppression and Wheel/Vehicle Washing

In dry windy weather or during dust generating works (e.g. crushing and stockpiling), precautions should be taken to minimise dust generation by the use of water sprays and road sweepers. Haulage vehicles should be sheeted before leaving site and wheel washing should be practised at the site exit if vehicles are to run across exposed sediments.

Ideally, haulage vehicles should be kept on hardstanding areas where possible. It would be prudent to use road sweepers periodically to ensure that roads to and from the site are also kept clean.

4.3 Noise and Vibration

All works should be carried out in accordance with the Environmental Protection Act 1990 (EPA 90) and BS 4142 1990 'industrial noise affecting residential areas', and BS 5228 'Noise control on construction sites' (where applicable). Site noise and vibration requirements if specified within the planning consent should also be adhered to.

5. VALIDATION AND SAMPLING REGIME

Validation of the rear garden areas in the affected plots will be carried out in line with the following regime:

- *Private rear garden areas in plots 20, 21 and 24 will be subject to capping layer inspection to confirm that the correct thickness of imported materials has been placed; and*
- *Testing of the topsoil and underlying subsoil will be carried out on the basis of one composite sample from plots 20 and 21 and one sample from plot 24;*
- *Following removal of the hotspot below plots 13-15, chemical testing will be carried out on the remaining soils to confirm successful remediation has been completed; and*
- *All other materials will be subjected to chemical testing every 150m² where required.*

5.1 Chemical Testing

Testing of the imported topsoil and subsoil samples collected for validation purposes will be submitted to the laboratory and analysed for the following determinants:

- Speciated total petroleum hydrocarbons (TPH) with aromatic and aliphatic carbon banding, including benzene, toluene, ethyl benzene, xylenes (BTEX) and MTBE;
- 16 No. speciated polycyclic aromatic hydrocarbons (PAH); and
- Metals: Arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium and zinc.

The results of the laboratory analyses will be compared against the appropriate RSK derived Generic Assessment Criteria (GAC) as presented in Appendix B. The GAC have been derived to be protective of human health for a residential with private gardens scenario and therefore are suitable for this validation exercise.

5.2 Validation Statement/Report

A validation report should be produced on completion of the site remedial works by the environmental consultant and should be issued to the relevant authorities for comment. This document should include the following sections:

- Plans showing the positions and extents of any remediated areas;
- Site Photographs;
- The description of any remedial methods used;
- Details of any waste disposal movements and waste transfer notes;
- The results of soil validation sampling and analysis; and
- Details of consultations with regulatory authorities.

6. WASTE MANAGEMENT

A remedial strategy that removes soils is deemed the most appropriate approach for this site. Contaminated soils arising from any of the remedial excavations can be disposed of at a suitably approved licensed landfill facility.

On site soil treatment by a programme of bioremediation is not considered economically viable or feasible given that the identified contamination is BaP.

6.1 Classification and Disposal

Any excavated material and excess spoil should always be classified prior to removal from site as required by 'Duty of Care' (Environmental Protection Act 1990) legislation. This means that material has to be given a proper description and waste classification prior to removal consequently, details of the materials required for disposal, together with certificates of chemical analysis should be sent to a suitably licensed waste disposal contractor for classification and to confirm compliance with their license conditions.

HAZWASTE assessment of the made ground in RSK report 23561-R01 (January 2011) did not classify the made ground as hazardous material. As such the soils excavated from garden areas as part of the remedial works should be disposed of as non-hazardous waste. WAC testing should be carried out to further classify the material for disposal at landfill.

Duty of care documentation (e.g. waste transfer notes etc) for waste disposal and source certification of imported materials should be kept on record for verification purposes.

6.2 Segregation and Stockpiling of Excavated Materials

Any distinct areas of contamination (identified by visual/olfactory means) should be stockpiled separately until removed off site to a licensed waste facility under 'Duty of Care' (EPA 1990) or alternatively loaded directly onto lorries for waste transfer. Temporary stockpiled material should be placed on suitable material (i.e. polythene sheeting, lapped up at the edges) to prevent migration (leaching) of contaminants to underlying soils, groundwater, drains or other receptors and adequately bunded where long term stockpiling is required.

Areas of exposed contaminated made ground or natural soils at formation level are to be either covered with a layer of validated crushed concrete material or fenced off with appropriate 'contaminated land' signage. This will prevent direct contact between potentially contaminated soil and the site operatives, plant equipment etc, minimising the need for full PPE for site operatives whilst working within these areas during the construction phase.

6.3 Re-Use of Materials

It is not considered that the shallow soils excavated from hotspots on site will be suitable for re-use due to the presence of elevated concentrations of BaP. Shallow soil arisings produced from areas outside the affected areas may be suitable for re-use subject to further assessment.

7. OTHER CONSIDERATIONS

There remains the possibility of unidentified contaminated soils on site. Should any contamination be encountered during the site works then works should cease and an environmental consultant be contacted immediately.

Groundworkers and contractors coming into contact with shallow soils on site should be equipped with the appropriate PPE, specifically to include gloves, to minimise contact with the impacted soils.

The regulatory authorities must approve the strategy outlined within this letter report. It is considered that the Local Authority be issued with a copy of this report for comment and approval. As part of the validation process, verification letter reports will be issued for review to demonstrate the remedial works have been completed to a satisfactory standard.



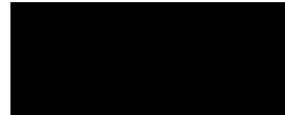
We trust our comments are satisfactory, but should you have any queries please do not hesitate to contact us.

Yours sincerely,

For RSK STATS Geoconsult Ltd



Andrew James
Geo-Environmental Engineer



Nigel Austin
Director - Geosciences

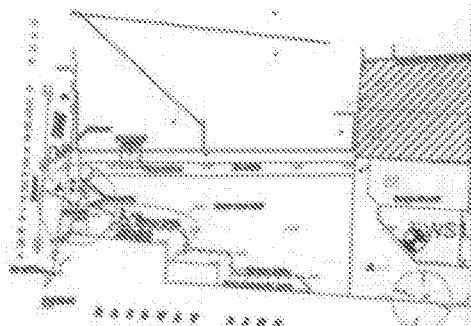
FIGURES

NOTES:-

Any soils imported onto site must first be cleared for suitability by the Environmental Consultant.

A 600mm thick clean verified topsoil/subsoil layer is required in all affected garden areas.

Please note in the event that visual or of factory evidence of contamination is encountered, the material should be segregated and placed on visqueen sheeting and covered. An Environmental Consultant should attend site to assess the area of contamination.



Approximate location
filled well / soakaway

LEGEND

- Trial Pits (Wilson & Barley - June 2010)
- Probeholes (RSK - November 2010)
- Removal of made ground in garden areas to 600mm below existing ground levels and cover layer of 300mm topsoil/ 300mm subsoil

P1	17.05.11	First Issue	RS	ARJ	ARJ
Rev.	Date	Amendment	Drawn	Checked	Appd.



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Client

ABBEY DEVELOPMENTS LIMITED

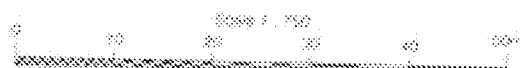
Project Title

7 HEARNFIELD DRIVE
LITTLEHAMPTON

Drawing Title

REMEDIATION PLAN

Drawn	Date	Checked	Date	Approved	Date
RS	17.05.11	ARJ	17.05.11	ARJ	17.05.11
Scale	Orig Size		Dimensions		
1:750	A3		m		
Project No.			Drawing File		
23561 L02			23561 L02.dwg		
Drawing Title					Rev.
FIGURE 1					P1



APPENDIX A

Service Constraints

RSK STATS GEOCONSULT LIMITED**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 STATS Geoconsult Limited (RSK) for Abbey Developments Ltd (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 terms 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 endorse 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 purposes 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 this 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 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, 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 walk-over 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

RSK Generic Assessment Criteria

Generic Assessment Criteria for Human Health
Residential Scenario – Private Gardens

The human health generic assessment criteria (GAC) have been developed during a period of regulatory review and updating of the Contaminated Land Exposure Assessment (CLEA) project. Hence, the Environment Agency (EA) is in the process of publishing updated reports relating to the CLEA project and the GAC presented in this document may change to reflect these updates. This issue was prepared following the publication of soil guideline value reports and associated publications⁽¹⁾ for mercury, selenium, benzene, toluene, ethylbenzene and xylene in March 2009, arsenic and nickel in May 2009, cadmium and phenol in June 2009, dioxins, furans and dioxin-like PCBs in September 2009. It was also produced following publication of GAC by LQM⁽²⁾. Where available, the published soil guideline values (SGV)⁽³⁾ have been used as GAC.

1. Model Selection

Soil assessment criteria (SAC) were calculated using CLEA v1.06 and the supporting UK guidance⁽¹⁻⁶⁾. Groundwater assessment criteria (GrAC) protective of human health via the inhalation pathway were derived using the RBCA 1.3b model. RSK has updated the inputs within RBCA to reflect the UK guidance⁽¹⁻⁶⁾. The SAC and GrAC collectively are termed GAC.

2. Conceptual Model

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

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

Figure 1 is a conceptual model illustrating these linkages.

The pathway considered in production of the GrAC is the volatilisation of compounds from groundwater and subsequent vapour inhalation by residents whilst indoors. Figure 2 illustrates this linkage. Although the outdoor air inhalation pathway is also valid, this contributes little to the overall risks owing to the dilution in outdoor air. Within RBCA, the solubility limit of the determinant restricts the extent of volatilisation, which in turn drives the indoor air inhalation pathway. Whilst the same restriction is not built into the CLEA model, the CLEA model output cells are flagged red where the soil saturation limit has been exceeded.

An assumption used in the CLEA model is that of simple linear partitioning of a chemical in the soil between the sorbed, dissolved and vapour phase⁽⁴⁾. The upper boundaries of this partitioning are represented by the aqueous solubility and pure saturated vapour concentration of the chemical. 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 saturation limits. Where model output cells are flagged red the soil or vapour saturation limit has been exceeded and further consideration of the SAC to be used within the assessment is required. One approach that could be adopted is to use the 'modelled' solubility saturation limit or vapour saturation limit of the compound as the SAC. However, as stated within the CLEA Handbook⁽⁴⁾ this is likely to not be practical in many cases because of the very low limits

and is in any case highly conservative. Unless free-phase product is present, concentrations of the chemical are unlikely to be present at sufficient concentration to result in an exceedance of the health criteria value (HCV).

RSK has adopted an approach for petroleum hydrocarbons in accordance with LQM/CIEH⁽⁶⁾ whereby the concentration modelled for each petroleum hydrocarbon fraction has been tabulated as the SAC with the corresponding solubility or vapour saturation limit given in brackets. Therefore, when using the SAC's to screen laboratory analysis the assessor should take note if a given SAC has a corresponding solubility or vapour saturation limit (in brackets), and subsequently incorporate this piece of information within the screening analytical discussion. If further assessment is required following this process then an additional approach can be utilised as detailed within Section 4.12 of the CLEA model manual⁽⁴⁾ which explains how to calculate an effective assessment criterion manually.

3. Input Selection

Chemical data was obtained from EA Report SC050021/SR7⁽⁵⁾ and the health criteria values (HCV) from the UK TOX⁽¹⁾ reports where available. For SAC for total petroleum hydrocarbons (TPH) and polycyclic aromatic hydrocarbons (PAH) toxicological and chemical specific parameters were obtained from the LQM/CIEH report⁽⁶⁾. Similarly, toxicological and specific chemical parameters for the volatile organic compound 1,2,4-trimethylbenzene were obtained from EIC/AGS/CL:AIRE⁽⁷⁾.

For total petroleum hydrocarbons (TPH), aromatic hydrocarbons C₈-C₉ were not modelled since benzene and toluene are being modelled separately. The aromatic C₈-C₉ hydrocarbon fraction comprises ethylbenzene, xylene and styrene. Since ethylbenzene and xylene are being modelled separately, the physical, chemical and toxicological data for this band has been taken from styrene.

Owing to the lack of UK-specific data, default information in the RBCA model was used to evaluate methyl tertiary butyl ether (MTBE). No published UK data was available for 1,3,5-trimethylbenzene, so information was obtained from the US EPA as in the RBCA model. RBCA uses toxicity data for the inhalation pathway in different units to the CLEA model and cannot consider separately the mean daily intake (MDI), occupancy periods or breathing rates. Therefore, the HCV in RBCA was amended to take account of:

- Amendments to the MDI using Table 3.4 of SR2⁽²⁾,
- A child weighing 13.3kg (average of 0-6 year old female in accordance with Table 4.6 of SR3⁽³⁾) and breathing 11.85m³ (average daily inhalation rate for a 0-6 yr old female in accordance with Table 4.14 of SR3⁽³⁾), and
- The 50% rule (for petroleum hydrocarbons, 1,3,5-trimethylbenzene and MTBE)⁽²⁾ where MDI data is not available but background exposure is considered important in the overall exposure.

4. Physical Parameters

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

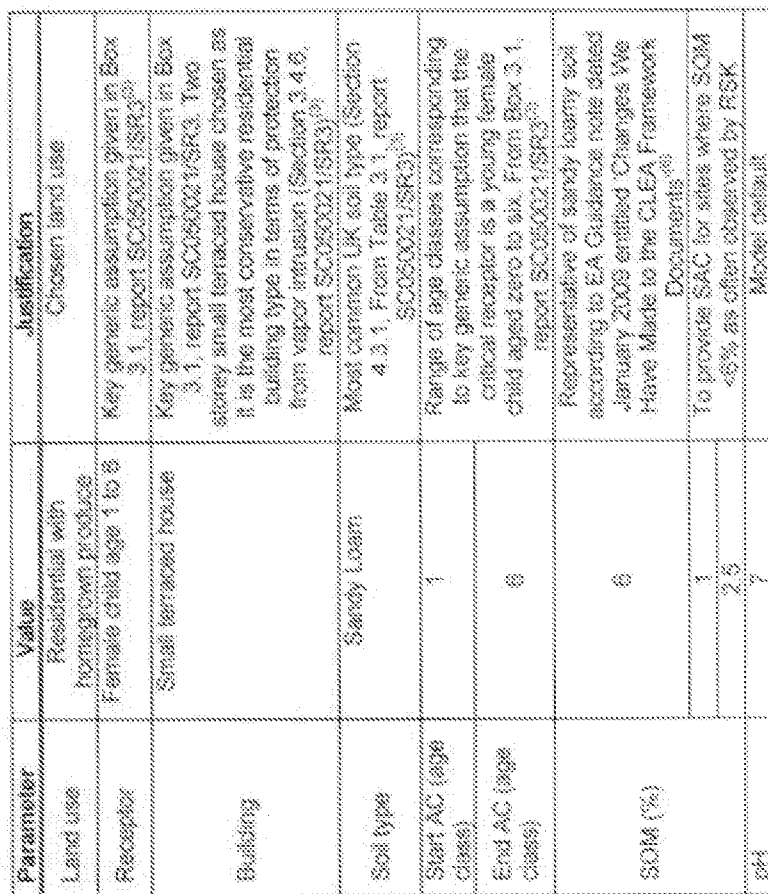
The parameters for a sandy loam soil type were used in line with SR3⁽³⁾. This includes a value of 6% for the percentage soil organic matter (SOM) within the soil. In RSK's experience, this is rather high for many sites. To avoid undertaking site specific risk assessments for this parameter, RSK has produced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

additional set of SAC for an SOM of 1% and 2.5%. For the GrAC, the depth to groundwater was taken as 2.5m based on RSK's experience of assessing the volatilisation pathway from groundwater.

5. GAC

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

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



GENERIC ASSESSMENT CRITERIA FOR HUMAN HEALTH
Residential Scenario – Private Gardens



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

	Consumption Rate (g FW kg ⁻¹ BW day ⁻¹) by Age Class						Dry Weight Conversion Factor	Homegrown Fraction (average)	Homegrown Fraction (high end)	Soil loading factor	Preparation correction factor
Name	1	2	3	4	5	6	g DW/g ⁻¹ FW	-	-	g g ⁻¹ DW	-
Green vegetables	7.12	6.85	6.85	6.85	3.74	3.74	0.096	0.05	0.33	1.00E-03	2.00E-01
Root vegetables	10.69	3.30	3.30	3.30	1.77	1.77	0.103	0.06	0.4	1.00E-03	1.00E+00
Tuber vegetables	16.03	5.46	5.46	5.46	3.38	3.38	0.21	0.02	0.13	1.00E-03	1.00E+00
Herbaceous fruit	1.83	3.96	3.96	3.96	1.85	1.85	0.058	0.06	0.4	1.00E-03	6.00E-01
Shrub fruit	2.23	0.54	0.54	0.54	0.16	0.16	0.188	0.09	0.6	1.00E-03	6.00E-01
Tree fruit	3.82	11.96	11.96	11.96	4.26	4.26	0.157	0.04	0.27	1.00E-03	6.00E-01
Justification	Table 4.17, SR3 ⁽²⁾						Table 6.3, SR3 ⁽²⁾	Table 4.19, SR3 ⁽²⁾		Table 6.3, SR3 ⁽²⁾	

GENERIC ASSESSMENT CRITERIA FOR HUMAN HEALTH
Residential Scenario – Private Gardens



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

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

Of note, 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_{in} – are based on considerations of the kidney burden accumulated over 50 years. It is therefore reasonable to consider exposure not only in childhood but averaged over a longer time period. See the Environment Agency Science report: SC05002 / TOX 3⁽¹⁾ and Science Report SC050021 / Cadmium SGV⁽¹⁾ for more information.

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

Parameter	Unit	Age Class						Justification
		1	2	3	4	5	6	
Body weight	kg	5.6	9.8	12.7	15.1	16.9	18.7	Table 4.6, SR3 ⁽²⁾
Body height	m	0.7	0.8	0.9	0.9	1	1.1	
Inhalation rate	m ³ day ⁻¹	8.5	13.3	12.7	12.2	12.2	12.2	Table 4.14, SR3 ⁽²⁾
Max exposed skin fraction (indoor)	m ² m ⁻²	0.32	0.33	0.32	0.35	0.35	0.33	Table 4.6, SR3 ⁽²⁾
Max exposed skin fraction (outdoor)	m ² m ⁻²	0.28	0.26	0.25	0.28	0.28	0.26	

See cadmium note as per Table 3 above.

GENERIC ASSESSMENT CRITERIA FOR HUMAN HEALTH
Residential Scenario – Private Gardens



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

Parameter	Unit	Value	Justification
SOIL PROPERTIES for sandy loam			
Porosity, total	$\text{cm}^3 \text{cm}^{-3}$	0.53	Default soil type is sandy loam, section 4.3.1, SR3 ⁽²⁾ Parameters for sandy loam from Table 4.4, SR3 ⁽²⁾
Porosity, air filled	$\text{cm}^3 \text{cm}^{-3}$	0.20	
Porosity, water filled	$\text{cm}^3 \text{cm}^{-3}$	0.33	
Residual soil water content	$\text{cm}^3 \text{cm}^{-3}$	0.12	
Saturated hydraulic conductivity	cm s^{-1}	3.56E-03	
van Genuchten shape parameter (m)	-	3.20E-01	
Bulk density	g cm^{-3}	1.21	
Threshold value of wind speed at 10m	m s^{-1}	7.20	Default value taken from Section 9.2.2, SR3 ⁽²⁾
Empirical function (F_s) for dust model	-	1.22	Value taken from Section 9.2.2, SR3 ⁽²⁾
Ambient soil temperature	K	283	Annual average soil temperature representative of UK surface soils, Section 4.3.1, SR3 ⁽²⁾
AIR DISPERSION MODEL			
Mean annual wind speed (10 m)	m s^{-1}	5.00	Default value taken from Section 9.2.2, SR3 ⁽²⁾
Air dispersion factor at height of 0.8 m	$\text{g m}^{-2} \text{s}^{-1}$ per kg m^{-3}	2400	Values for a 0.01 ha site, appropriate to a residential land use in Newcastle (most representative city for UK), (from Table 0.1, SR3) ⁽²⁾ Assumed child of 6 is not tall enough to reach 1.6m
Air dispersion factor at height of 1.6 m	$\text{g m}^{-2} \text{s}^{-1}$ per kg m^{-3}	0	
Fraction of site with hard or vegetative cover	$\text{m}^2 \text{m}^{-2}$	0.75	Section 3.2.6, SR3 ⁽²⁾ based on residential land use
BUILDING PROPERTIES for small terrace house with ground-bearing floor slab			
Building footprint	m^2	28	From Table 3.3 and 4.21, SR3 ⁽²⁾
Living space air exchange rate	hr^{-1}	0.50	
Living space height (above ground)	m	4.8	
Living space height (below ground)	m	0.0	Assumed no basement
Pressure difference (soil to enclosed space)	Pa	3.1	From Table 3.3, SR3 ⁽²⁾
Foundation thickness	m	0.15	
Floor crack area	cm^2	423	
Dust loading factor	$\mu\text{g m}^{-2}$	50	Default value for a residential site taken from Section 9.3, SR3 ⁽²⁾
VAPOUR MODEL			
Default soil gas ingress rate	$\text{cm}^3 \text{s}^{-1}$	25	Generic flow rate, Section 10.3, SR3 ⁽²⁾
Depth to top of source (beneath building)	cm	50	Section 3.2.6, SR3 ⁽²⁾ states source is 50cm below building or 55cm below ground surface
Depth to top of source (no building)	cm	0	Section 10.2, SR3 ⁽²⁾ assumes impact from 0-1m for outdoor inhalation pathway
Thickness of contaminant layer	cm	200	Model default for indoor air, Section 4.9, SR4 ⁽⁴⁾
Time average period for surface emissions	years	6	Time period of a 0 to 6 year old, Box 3.5, SR3 ⁽²⁾
User-defined effective air permeability	cm^3	3.06E-08	Calculated for sandy loam using equations in Appendix 1, SR3 ⁽²⁾

GENERIC ASSESSMENT CRITERIA FOR HUMAN HEALTH
Residential Scenario – Private Gardens



Figure 2
GrAC Conceptual Model for RBCA Residential with Private Gardens
Scenario

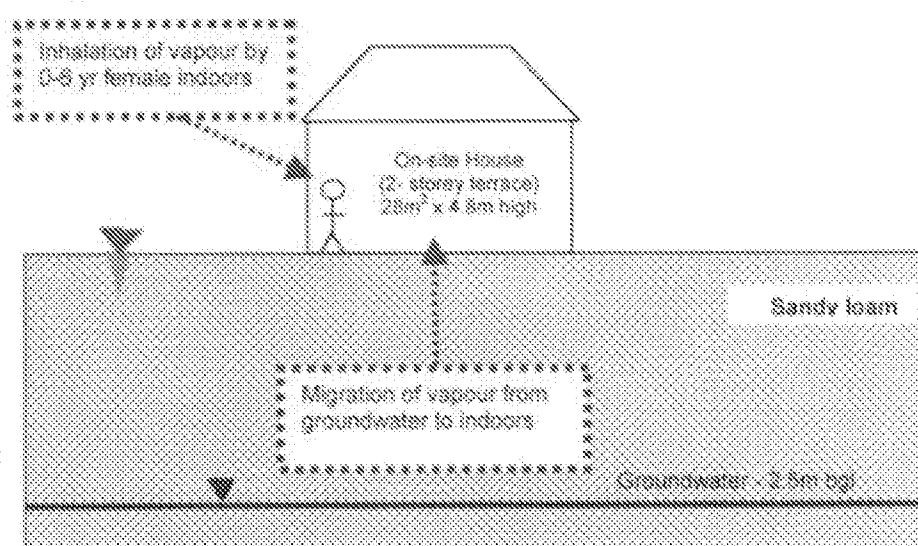


Table 6
Residential with Private Gardens RBCA Inputs

Parameter	Unit	Value	Justification
RECEPTOR			
Averaging time	Years	6	From Box 3.1, SR3 ⁽²⁾
Receptor weight	kg	13.3	Average of CLEA 0-6 year old female data, Table 4.6, SR3 ⁽²⁾
Exposure duration	Years	6	From Box 3.1, report, SR3 ⁽²⁾
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 ⁽²⁾
Volumetric water content	-	0.33	
Volumetric air content	-	0.20	
Dry bulk density	g cm ⁻³	1.21	CLEA value for saturated conductivity of sandy loam, Table 4.4, SR3 ⁽²⁾
Vertical hydraulic conductivity	cm s ⁻¹	3.56E-3	
Vapour permeability	m ²	3.05E-12	Calculated for sandy loam using equations in Appendix 1, SR3 ⁽²⁾
Capillary zone thickness	m	0.1	Professional judgement
Fraction organic carbon	%	(i) 0.0348	Representative of sandy loam according to EA Guidance note dated January 2009 entitled Changes We Have Made to the CLEA Framework Documents (ref)
		(ii) 0.0068	To provide SAC for site's where SOM < 6% as often observed by RSK
BUILDING			
Building volume/area ratio	m	4.8	Table 3.3, SR3 ⁽²⁾
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 ⁽²⁾
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 ⁽²⁾
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 ⁽²⁾
Volumetric air content of cracks	-	0.2	
Indoor/outdoor differential pressure	Pa	3.1	From Table 3.3, SR3 ⁽²⁾

James W. McMillan Company, 14999, 15000, 15001, 15002, 15003, 15004, 15005, 15006, 15007, 15008, 15009, 15010, 15011, 15012, 15013, 15014, 15015, 15016, 15017, 15018, 15019, 15020, 15021, 15022, 15023, 15024, 15025, 15026, 15027, 15028, 15029, 15030, 15031, 15032, 15033, 15034, 15035, 15036, 15037, 15038, 15039, 15040, 15041, 15042, 15043, 15044, 15045, 15046, 15047, 15048, 15049, 15050, 15051, 15052, 15053, 15054, 15055, 15056, 15057, 15058, 15059, 15060, 15061, 15062, 15063, 15064, 15065, 15066, 15067, 15068, 15069, 15070, 15071, 15072, 15073, 15074, 15075, 15076, 15077, 15078, 15079, 15080, 15081, 15082, 15083, 15084, 15085, 15086, 15087, 15088, 15089, 15090, 15091, 15092, 15093, 15094, 15095, 15096, 15097, 15098, 15099, 15100, 15101, 15102, 15103, 15104, 15105, 15106, 15107, 15108, 15109, 15110, 15111, 15112, 15113, 15114, 15115, 15116, 15117, 15118, 15119, 15120, 15121, 15122, 15123, 15124, 15125, 15126, 15127, 15128, 15129, 15130, 15131, 15132, 15133, 15134, 15135, 15136, 15137, 15138, 15139, 15140, 15141, 15142, 15143, 15144, 15145, 15146, 15147, 15148, 15149, 15150, 15151, 15152, 15153, 15154, 15155, 15156, 15157, 15158, 15159, 15160, 15161, 15162, 15163, 15164, 15165, 15166, 15167, 15168, 15169, 15170, 15171, 15172, 15173, 15174, 15175, 15176, 15177, 15178, 15179, 15180, 15181, 15182, 15183, 15184, 15185, 15186, 15187, 15188, 15189, 15190, 15191, 15192, 15193, 15194, 15195, 15196, 15197, 15198, 15199, 15200, 15201, 15202, 15203, 15204, 15205, 15206, 15207, 15208, 15209, 15210, 15211, 15212, 15213, 15214, 15215, 15216, 15217, 15218, 15219, 15220, 15221, 15222, 15223, 15224, 15225, 15226, 15227, 15228, 15229, 15230, 15231, 15232, 15233, 15234, 15235, 15236, 15237, 15238, 15239, 15240, 15241, 15242, 15243, 15244, 15245, 15246, 15247, 15248, 15249, 15250, 15251, 15252, 15253, 15254, 15255, 15256, 15257, 15258, 15259, 15260, 15261, 15262, 15263, 15264, 15265, 15266, 15267, 15268, 15269, 15270, 15271, 15272, 15273, 15274, 15275, 15276, 15277, 15278, 15279, 15280, 15281, 15282, 15283, 15284, 15285, 15286, 15287, 15288, 15289, 15290, 15291, 15292, 15293, 15294, 15295, 15296, 15297, 15298, 15299, 15300, 15301, 15302, 15303, 15304, 15305, 15306, 15307, 15308, 15309, 15310, 15311, 15312, 15313, 15314, 15315, 15316, 15317, 15318, 15319, 15320, 15321, 15322, 15323, 15324, 15325, 15326, 15327, 15328, 15329, 15330, 15331, 15332, 15333, 15334, 15335, 15336, 15337, 15338, 15339, 15340, 15341, 15342, 15343, 15344, 15345, 15346, 15347, 15348, 15349, 15350, 15351, 15352, 15353, 15354, 15355, 15356, 15357, 15358, 15359, 15360, 15361, 15362, 15363, 15364, 15365, 15366, 15367, 15368, 15369, 15370, 15371, 15372, 15373, 15374, 15375, 15376, 15377, 15378, 15379, 15380, 15381, 15382, 15383, 15384, 15385, 15386, 15387, 15388, 15389, 15390, 15391, 15392, 15393, 15394, 15395, 15396, 15397, 15398, 15399, 15400, 15401, 15402, 15403, 15404, 15405, 15406, 15407, 15408, 15409, 15410, 15411, 15412, 15413, 15414, 15415, 15416, 15417, 15418, 15419, 15420, 15421, 15422, 15423, 15424, 15425, 15426, 15427, 15428, 15429, 15430, 15431, 15432, 15433, 15434, 15435, 15436, 15437, 15438, 15439, 15440, 15441, 15442, 15443, 15444, 15445, 15446, 15447, 15448, 15449, 15450, 15451, 15452, 15453, 15454, 15455, 15456, 15457, 15458, 15459, 15460, 15461, 15462, 15463, 15464, 15465, 15466, 15467, 15468, 15469, 15470, 15471, 15472, 15473, 15474, 15475, 15476, 15477, 15478, 15479, 15480, 15481, 15482, 15483, 15484, 15485, 15486, 15487, 15488, 15489, 15490, 15491, 15492, 15493, 15494, 15495, 15496, 15497, 15498, 15499, 15500, 15501, 15502, 15503, 15504, 15505, 15506, 15507, 15508, 15509, 15510, 15511, 15512, 15513, 15514, 15515, 15516, 15517, 15518, 15519, 15520, 15521, 15522, 15523, 15524, 15525, 15526, 15527, 15528, 15529, 15530, 15531, 15532, 15533, 15534, 15535, 15536, 15537, 15538, 15539, 15540, 15541, 15542, 15543, 15544, 15545, 15546, 15547, 15548, 15549, 15550, 15551, 15552, 15553, 15554, 15555, 15556, 15557, 15558, 15559, 15560, 15561, 15562, 15563, 15564, 15565, 15566, 15567, 15568, 15569, 15570, 15571, 15572, 15573, 15574, 15575, 15576, 15577, 15578, 15579, 15580, 15581, 1558

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1. The first step in the process of identifying a problem is to recognize that a problem exists. This is often done by comparing current performance with a desired state or goal. If there is a significant difference, a problem is identified.

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The following information was obtained from the Department of Health and Human Services, U.S. Government Printing Office, Washington, D.C., 20540.

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Abstract

Compound	CRCL for Groundwater (mg/l)	SAC for Soil SOIL 1% (mg/kg)	SAC for Soil SOIL 1.5% (mg/kg)	SAC for Soil SOIL 6% (mg/kg)
Metals				
Antimony	-	50	50	50
Barium	-	10	10	10
Bismuth	-	100	100	100
Chromium (VI) - hexavalent	-	4.3	4.3	4.3
Copper	-	2,500	2,500	2,500
Lead	-	400	400	400
Mercuric Methyl (Pb)	0.008	0.12	0.12	0.12
Methyl Mercury (Pb)	-	100	100	100
Nickel	-	7.4	7.4	7.4
Silver	-	100	100	100
Vanadium	-	200	200	200
Zinc	-	1,000	1,000	1,000
Zirconium	-	5.7	5.7	5.7
Volatile Organic Compounds				
Acetone	-	1,000	1,000	1,000
Acrylonitrile	1,000	1,000	1,000	1,000
Benzenesulfone	100	100	100	100
Carbon - 10	100	100	100	100
Carbon - 15	100	100	100	100
Carbon - 20	100	100	100	100
Carbon - 25	100	100	100	100
Carbon - 30	100	100	100	100
Carbon - 35	100	100	100	100
Carbon - 40	100	100	100	100
Carbon - 45	100	100	100	100
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Carbon - 665	100	100	100	100
Carbon - 670	100	100	100	100
Carbon - 675	100	100	100	100
Carbon - 680	100	100	100	100
Carbon - 685	100	100	100	100
Carbon - 690	100	100	100	100
Carbon - 695	100	100	100	100
Carbon - 700	100	100	100	100
Carbon - 705	100	100	100	100
Carbon - 710	100	100	100	100
Carbon - 715	100	100	100	100
Carbon - 720	100	100	100	100
Carbon - 725	100	100	100	100
Carbon - 730	100	100	100	100
Carbon - 735	100	100	100	100
Carbon - 740	100	100	100	100
Carbon - 745	100	100	100	100
Carbon - 750	100	100	100	100
Carbon - 755	100	100	100	100
Carbon - 760	100	100	100	100
Carbon - 765	100	100	100	100
Carbon - 770	100	100	100	100
Carbon - 775	100	100	100	100
Carbon - 780	100	100	100	100
Carbon - 785	100	100	100	100
Carbon - 790	100	100	100	100
Carbon - 795	100	100	100	100
Carbon - 800	100	100	100	100
Carbon - 805	100	100	100	100
Carbon - 810	100	100	100	100
Carbon - 815	100	100	100	100
Carbon - 820	100	100	100	100
Carbon - 825	100	100	100	100
Carbon - 830	100	100	100	100
Carbon - 835	100	100	100	100
Carbon - 840	100	100	100	100
Carbon - 845	100	100	100	100
Carbon - 850	100	100	100	100
Carbon - 855	100	100	100	100
Carbon - 860	100	100	100	100
Carbon - 865	100	100	100	100
Carbon - 870	100	100	100	100
Carbon - 875	100	100	100	100
Carbon - 880	100	100	100	100
Carbon - 885	100	100	100	100
Carbon - 890	100	100	100	100
Carbon - 895	100	100	100	100
Carbon - 900	100	100	100	100
Carbon - 905	100	100	100	100
Carbon - 910	100	100	100	100
Carbon - 915	100	100	100	100
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Carbon - 925	100	100	100	100
Carbon - 930	100	100	100	100
Carbon - 935	100	100	100	100
Carbon - 940	100	100	100	100
Carbon - 945	100	100	100	100
Carbon - 950	100	100	100	100
Carbon - 955	100	100	100	100
Carbon - 960	100	100	100	100
Carbon - 965	100	100	100	100
Carbon - 970	100	100	100	100
Carbon - 975	100	100	100	100
Carbon - 980	100	100	100	100
Carbon - 985	100	100	100	100
Carbon - 990	100	100	100	100
Carbon - 995	100	100	100	100
Carbon - 1000	100	100	100	100
Semi-Volatile Organic Compounds				
Acetophenone	-	100	100	100
Acrylonitrile	1,000	100	100	100
Acrylonitrile	1,000	100	100	100
Acrylonitrile	1,000	100	100	100
Acrylonitrile	1,000	100	100	100
Acrylonitrile	1,000	100	100	100
Acrylonitrile	1,000	100	100	100
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Acrylonitrile	1,000	100	100	100
Acrylonitrile	1,000	100	100	100
Acrylonitrile	1,000	100	100	100
Acrylonitrile	1,000	100	100	100
Acrylonitrile	1,000	100	100	100
Acrylonitrile	1,000	100	100	100
Acrylonitrile	1,000	100		

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[illegible]

SMILES for 1044 fluorobenzene, polycyclic aromatic hydrocarbons, 97263, 97274 and bis(phenyl)sulfone compounds were confirmed using an alternative filter for the entire or alternative pathways. It is to reduce misclassification associated with the current classification pathway. Section 1.1.1. 97263

The GRAC has been set as the model calculated GRAC with the calibration limit shown is brackets.

The consistency where the GRAC exceeds the modeling limit, GRAC_m, has been set at the modeling limit. The GRAC_m encompasses some concentrations of the chemical are very unlikely to be at sufficient concentration to result in an occurrence of the health concern (see the third point of discussion). A more conservative group would include those

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