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 limits given in brackets. Therefore, when using the SAC 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 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 Handbook[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 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 C_5-C_8 were not modelled since benzene and toluene are being modelled separately. The aromatic C_8-C_9 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 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 11.85m^3 (average daily inhalation rate for a 0-6yr old female in accordance with Table 4.14 of SR3[3]; and
- The 50% rule (for petroleum hydrocarbons, trimethylbenzenes and MTBE)[2] where MDI data is not available but background exposure is considered important in the overall exposure.

4. Physical Parameters

For the residential without gardens scenario, the CLEA default building is a small two-storey terrace house with concrete ground bearing slab. 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 3.

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 3 and the GrAC using the input parameters in Table 4. The GAC by pathway are presented in Table 5 with the combined GAC presented in Table 6.

Figure 1
Conceptual Model for CLEA Residential Scenario – without Gardens

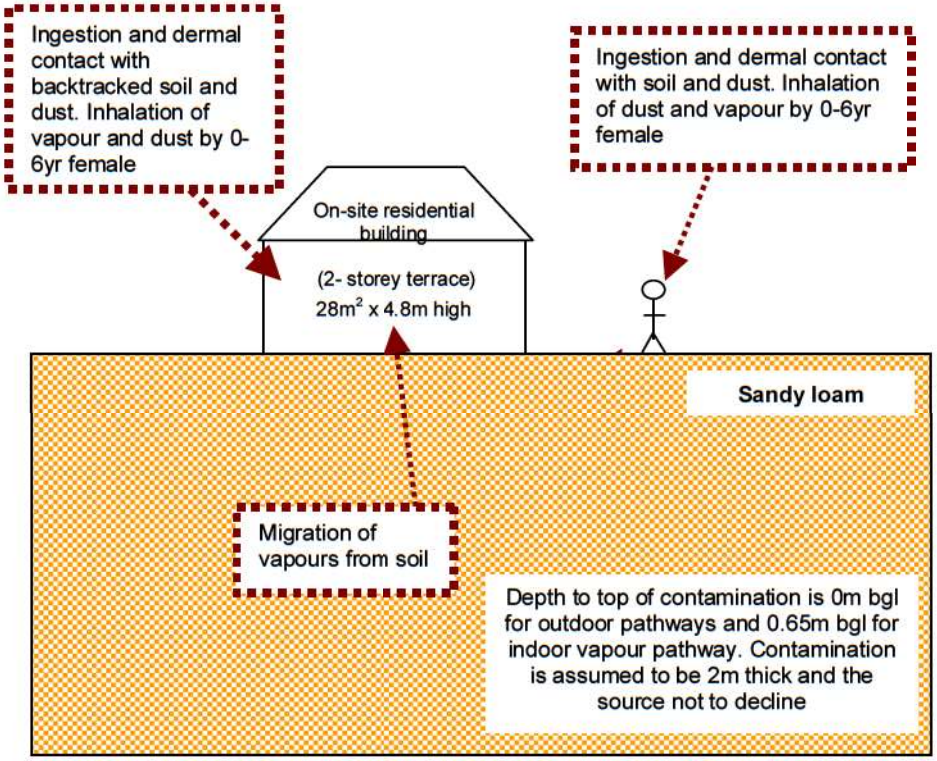

Table 1
Exposure Assessment Parameters for Residential Scenario – without Gardens – Inputs for CLEA model.

Parameter	Value	Justification
Land use	Residential without homegrown produce	Chosen land use
Receptor	Female Child	Taken as female child exposed over 6 years from 0-6 years, Box 3.1, SR3[3]
Building	Small terraced house	Key generic assumption given in Box 3.1, SR3[3]. Two storey small terraced house chosen as it is the most conservative residential building type in terms of protection from vapour intrusion (Section 3.2.6, report SC050021/SR3[3]). Table 3 presents building specific input data
Soil type	Sandy loam	Most common UK soil type (Section 4.3.1, Table 4.4, SR3[3]). Table 4 presents soil-specific input data
Start age class (AC)	1	Range of AC corresponding to key generic assumption that the critical receptor is a young female child aged zero to six. From Box 3.1, SR3[3]. Data specific to the receptor is presented in Table 2
End AC	6	
SOM (%)	6	Representative of sandy loam according to EA Guidance note dated January 2009 entitled 'Changes We Have Made to the CLEA Framework Documents'[8]
	1	To provide SAC for site's where SOM < 6% as often observed by RSK
	2.5	
pH	7	Model default

Table 2
Residential without Gardens – Land use and Receptor Data for CLEA Model

Parameter	Unit	Age Class					
		1	2	3	4	5	6
Exposure frequency (EF) (soil and dust ingestion)	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[3]					
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[3]					
Soil ingestion rate	g/day	0.1	0.1	0.1	0.1	0.1	0.1
Justification		Table 6.2, SR3[3]					
Soil to skin adherence factor – (indoor)	mg soil/cm^2 skin	0.06	0.06	0.06	0.06	0.06	0.06
Soil to skin adherence factor – (outdoor)	mg soil/cm^2 skin	1	1	1	1	1	1
Justification		Table 8.1, SR3[3]					
Body Weight	kg	5.6	9.8	12.7	15.1	16.9	19.7
Body height	m	0.7	0.8	0.9	0.9	1	1.1
Justification		Table 4.6, SR3[3]					
Inhalation Rate	m^3 day^{-1}	8.5	13.3	12.7	12.2	12.2	12.2
Justification		Table 4.14, SR3[3]					
Max exposed skin fraction (indoor)	m^2 m^{-2}	0.32	0.33	0.32	0.35	0.35	0.33
Max exposed skin fraction (outdoor)	m^2 m^{-2}	0.26	0.26	0.25	0.28	0.28	0.26
Justification		Table 4.8, SR3[3]					

*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_{inh} 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: SC050021 / TOX 3[1] and Science Report SC050021 / Cadmium SGV[1] for the full AC1-18 Land use Data suite.*

Table 3
Residential without Gardens – Soil, Air and Building Specific Inputs for CLEA Model

Parameter	Unit	Value	Justification
SOIL PROPERTIES for sandy loam			
Porosity, total	$cm^3\ cm^{-3}$	0.53	Default soil type is sandy loam, section 4.3.1, SR3[3] Parameters for sandy loam from Table 4.4, SR3[3]
Porosity, air filled	$cm^3\ cm^{-3}$	0.20	
Porosity, water filled	$cm^3\ cm^{-3}$	0.33	
Residual soil water content	$cm^3\ cm^{-3}$	0.12	
Saturated hydraulic conductivity	$cm\ s^{-1}$	0.00356	
Van Genuchten shape parameter (*m*)	-	0.3201	
Bulk density	$g\ cm^{-3}$	1.21	
Threshold value of wind speed at 10m	$m\ s^{-1}$	7.2	Default value taken from Section 9.2.2, SR3[3]
Empirical function (F_x) for dust model	-	1.22	Value taken from Section 9.2.2, SR3[3]
Ambient soil temperature	K	283	Annual average soil temperature of UK surface soils. Section 4.3.1, SR3[3]
AIR DISPERSION MODEL			
Mean annual wind speed (10 m)	$m\ s^{-1}$	5.0	Default value taken from Section 9.2.2, SR3[3]
Air dispersion factor at height of 0.8 m	$g\ m^{-2}\ s^{-1}$ per kg m^{-3}	2400	From Table 9.1, SR3[3]. Values for a 0.01 ha site, appropriate to a residential land use in Newcastle (representative city for UK, section 9.2.1, SR3[3])
Fraction of site with hard or vegetative cover	$m^2\ m^{-2}$	0.75	Section 3.2.6, SR3[3] for residential land use
BUILDING PROPERTIES for house with ground-bearing floor slab			
Building footprint	m^2	28	From Table 3.3 and 4.21, SR3[3]
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 and 4.21, SR3[3]
Foundation thickness	m	0.15	
Floor crack area	cm^2	423	
Dust loading factor	$\mu g\ m^{-3}$	50	Default value for a residential site taken from Section 9.3, SR3[3]
VAPOUR MODEL			
Default soil gas ingress rate	$cm^3\ s^{-1}$	25	Generic flow rate, Section 10.3, SR3[3]
Depth to top of source (beneath building for indoor exposure)	cm	50	Section 3.2.6, SR3[3] states source is 50cm below building or 65cm below ground surface
Depth to top of source (outdoors)	cm	0	Section 10.2, SR3[3] 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 0–6 year old, Box 3.5, SR3[3]
User-defined effective air permeability	cm^2	3.05E-08	Calculated for sandy loam using equations in Appendix 1, SR3[3]

Figure 2
GrAC Conceptual Model for RBCA Residential without Gardens Scenario

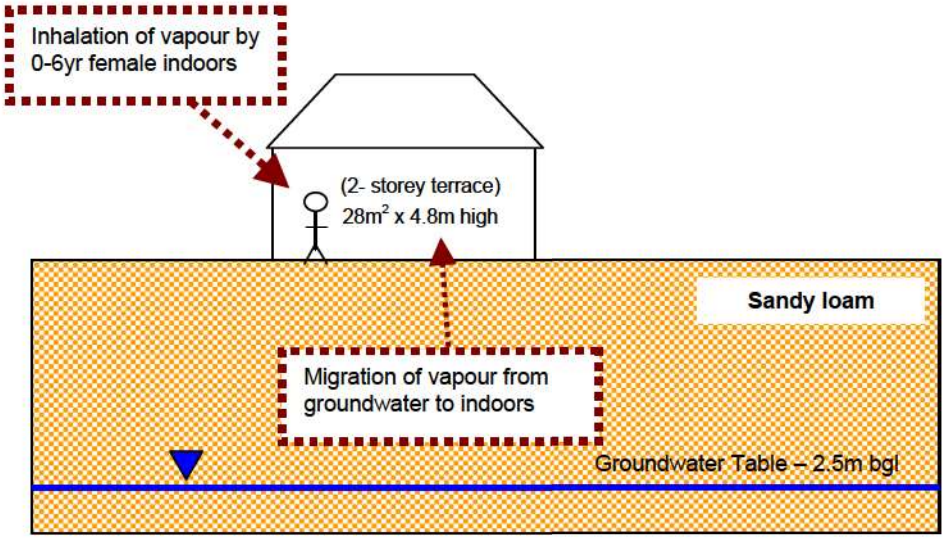

Table 4
Residential without Gardens RBCA Inputs

Parameter	Unit	Value	Justification
RECEPTOR			
Averaging time	Years	6	From Box 3.1, SR3[3]
Receptor weight	kg	13.3	Average of CLEA 0-6 year old female data, Table 4.6, SR3[3]
Exposure duration	Years	6	From Box 3.1, report , SR3[3]
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[3]
Volumetric water content	-	0.33	
Volumetric air content	-	0.20	
Dry bulk density	g cm^{-3}	1.21	
Vertical hydraulic conductivity	cm s^{-1}	3.56E-3	CLEA value for saturated conductivity of sandy loam, Table 4.4, SR3[3]
Vapour permeability	m^2	3.05E-12	Calculated for sandy loam using equations in Appendix 1, SR3[3]
Capillary zone thickness	m	0.1	Professional judgement
BUILDING			
Building volume/area ratio	m	4.8	Table 3.3, SR3[3]
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[3]
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[3]
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[3]
Volumetric air content of cracks	-	0.2	
Indoor/outdoor differential pressure	Pa	3.1	From Table 3.3, SR3[3]

GENERIC ASSESSMENT CRITERIA FOR HUMAN HEALTH - RESIDENTIAL WITHOUT GARDENS

Table 5

Human Health Generic Assessment Criteria by Pathway for Residential Scenario Without Gardens

Compound	Notes	GrAC (mg/l)	SAC Appropriate to Pathway SOM 1% (mg/kg)			Soil Saturation Limit (mg/kg)	SAC Appropriate to Pathway SOM 2.5% (mg/kg)			Soil Saturation Limit (mg/kg)	SAC Appropriate to Pathway SOM 6% (mg/kg)			Soil Saturation Limit (mg/kg)
			Oral	Inhalation	Combined		Oral	Inhalation	Combined		Oral	Inhalation	Combined	
Metals														
Arsenic	(c)	-	3.50E+01	8.50E+01	-	NR	3.50E+01	8.50E+01	-	NR	3.50E+01	8.50E+01	-	NR
Cadmium		-	1.21E+02	1.85E+02	8.49E+01	NR	1.21E+02	1.85E+02	8.49E+01	NR	1.21E+02	1.85E+02	8.49E+01	NR
Chromium (III) -oxide		-	1.98E+04	3.55E+03	3.01E+03	NR	1.98E+04	3.55E+03	3.01E+03	NR	1.98E+04	3.55E+03	3.01E+03	NR
Chromium (VI) - hexavalent		-	8.40E+01	4.25E+00	4.12E+00	NR	8.40E+01	4.25E+00	4.12E+00	NR	8.40E+01	4.25E+00	4.12E+00	NR
Copper		-	1.08E+04	1.04E+04	6.20E+03	NR	1.08E+04	1.04E+04	6.20E+03	NR	1.08E+04	1.04E+04	6.20E+03	NR
Lead	(a)	-	4.50E+02	-	-	NR	4.50E+02	-	-		4.50E+02	-	-	NR
Elemental Mercury (Hg^0)	(d)	9.40E-03	-	1.70E-01	-	4.31E+00	-	4.24E-01	-	1.07E+01	-	1.02E+00	-	2.58E+01
Inorganic Mercury (Hg^{2+})		-	2.62E+02	2.55E+03	2.38E+02	NR	2.62E+02	2.55E+03	2.38E+02	NR	2.62E+02	2.55E+03	2.38E+02	NR
Methyl Mercury (Hg^{4+})		2.00E+01	1.80E+01	1.59E+01	8.43E+00	7.33E+01	1.80E+01	1.59E+01	1.13E+01	1.42E+02	1.80E+01	6.53E+01	1.41E+01	3.04E+02
Nickel	(d)	-	7.86E+02	1.27E+02	-	NR	7.86E+02	1.27E+02	-	NR	7.86E+02	1.27E+02	-	NR
Selenium	(c)	-	5.95E+02	-	-	NR	5.95E+02	-	-	NR	5.95E+02	-	-	NR
Zinc	(c)	-	4.05E+04	2.55E+07	-	NR	4.05E+04	2.55E+07	-	NR	4.05E+04	2.55E+07	-	NR
Cyanide		-	7.69E+02	1.15E+02	1.06E+02	NR	7.69E+02	1.15E+02	1.06E+02	NR	7.69E+02	1.15E+02	1.06E+02	NR
Volatile Organic Compounds														
Benzene		7.00E+00	2.58E+01	2.69E-01	2.66E-01	1.22E+03	2.58E+01	4.99E-01	4.90E-01	2.26E+03	2.58E+01	1.04E+00	9.98E-01	4.71E+03
Toluene		1.90E+03	1.98E+04	6.26E+02	6.07E+02	8.69E+02	1.98E+04	1.38E+03	1.29E+03	1.92E+03	1.98E+04	3.14E+03	2.71E+03	4.36E+03
Ethylbenzene		2.60E+02	8.88E+03	1.70E+02	1.67E+02	5.18E+02	8.88E+03	3.98E+02	3.81E+02	1.22E+03	8.88E+03	9.32E+02	8.43E+02	2.84E+03
Xylene - m		8.40E+01	1.60E+04	5.56E+01	5.54E+01	6.25E+02	1.60E+04	1.31E+02	1.30E+02	1.47E+03	1.60E+04	3.07E+02	3.02E+02	3.46E+03
Xylene - o		1.00E+02	1.60E+04	5.98E+01	5.95E+01	4.78E+02	1.60E+04	1.40E+02	1.39E+02	1.12E+03	1.60E+04	3.27E+02	3.21E+02	2.62E+03
Xylene - p		8.70E+01	1.60E+04	5.34E+01	5.33E+01	5.76E+02	1.60E+04	1.26E+02	1.25E+02	1.35E+03	1.60E+04	2.94E+02	2.88E+02	3.17E+03
Total xylene		8.40E+01	1.60E+04	5.56E+01	5.54E+01	6.25E+02	1.60E+04	1.31E+02	1.30E+02	1.47E+03	1.60E+04	3.07E+02	3.02E+02	3.46E+03
Methyl tertiary butyl ether (MTBE)		2.20E+03	4.45E+02	1.84E+02	1.81E+02	1.66E+04	4.45E+02	2.40E+02	2.00E+02	2.16E+04	4.45E+02	3.70E+02	2.68E+02	3.34E+04
Trichloroethene		1.80E+00	4.63E+02	1.10E-01	1.10E-01	1.54E+03	4.63E+02	2.30E-01	2.30E-01	3.22E+03	4.63E+02	5.11E-01	5.11E-01	7.14E+03
Tetrachloroethene		3.60E+00	1.20E+03	1.03E+00	1.03E+00	4.24E+02	1.20E+03	2.30E+00	2.30E+00	9.51E+02	1.20E+03	5.28E+00	5.26E+00	2.18E+03
1,1,1-Trichloroethane		2.60E+01	5.34E+04	6.33E+00	6.33E+00	1.43E+03	5.34E+04	1.29E+01	1.29E+01	2.92E+03	5.34E+04	2.84E+01	2.84E+01	6.39E+03
1,1,1,2-Tetrachloroethane		1.40E+01	5.07E+02	1.08E+00	1.08E+00	2.60E+03	5.07E+02	2.50E+00	2.49E+00	6.02E+03	5.07E+02	5.83E+00	5.76E+00	1.40E+04
1,1,2,2-Tetrachloroethane		1.40E+01	5.07E+02	2.76E+00	2.74E+00	2.67E+03	5.07E+02	5.65E+00	5.58E+00	5.46E+03	5.07E+02	1.24E+01	1.21E+01	1.20E+04
Carbon tetrachloride		5.50E-02	1.25E+02	1.81E-02	1.81E-02	1.52E+03	1.25E+02	3.97E-02	3.96E-02	3.32E+03	1.25E+02	8.99E-02	8.99E-02	7.54E+03
1,2-Dichloroethane		3.00E-01	1.07E+01	6.46E-03	6.46E-03	3.41E+03	1.07E+01	9.32E-03	9.31E-03	4.91E+03	1.07E+01	1.60E-02	1.60E-02	8.43E+03
Vinyl chloride		1.90E-02	1.25E+00	5.43E-04	5.43E-04	1.36E+03	1.25E+00	7.02E-04	7.02E-04	1.76E+03	1.25E+00	1.07E-03	1.07E-03	2.69E+03
1,2,4-Trimethylbenzene		7.50E-02	-	4.08E-01	-	5.57E+02	-	9.91E-01	-	1.36E+03	-	2.33E+00	-	3.25E+03
1,3,5-Trimethylbenzene		4.70E-02	1.28E+03	4.60E-01	4.60E-01	9.47E+01	1.28E+03	1.10E+00	1.10E+00	2.26E+02	1.28E+03	2.59E+00	2.58E+00	5.33E+02
Semi-Volatile Organic Compounds														
Acenaphthene		3.20E+00	4.85E+03	3.46E+03	2.02E+03	5.70E+01	4.85E+03	8.54E+03	3.09E+03	1.41E+02	4.85E+03	2.30E+04	3.91E+03	3.36E+02
Acenaphthylene		4.20E+00	4.85E+03	3.27E+03	1.95E+03	8.61E+01	4.85E+03	8.03E+03	3.02E+03	2.12E+02	4.85E+03	1.91E+04	3.87E+03	5.06E+02
Anthracene		2.10E-02	2.43E+04	1.08E+05	1.98E+04	1.17E+00	2.43E+04	2.65E+05	2.22E+04	2.91E+00	2.43E+04	6.15E+05	2.33E+04	6.96E+00
Benzo(a)anthracene		3.80E-03	1.12E+01	5.55E+00	3.71E+00	1.71E+00	1.12E+01	9.83E+00	5.23E+00	4.28E+00	1.12E+01	1.41E+01	6.22E+00	1.03E+01
Benzo(b)fluoranthene		2.00E-03	1.15E+00	1.79E+01	6.99E+00	1.22E+00	1.15E+01	1.97E+01	7.25E+00	3.04E+00	1.15E+01	2.05E+01	7.36E+00	7.29E+00
Benzo(g,h,i)perylene		2.60E-04	7.35E+01	1.27E+02	4.66E+01	1.54E-02	7.35E+01	1.32E+02	4.72E+01	3.85E-02	7.35E+01	1.34E+02	4.75E+01	9.23E-02
Benzo(k)fluoranthene		8.00E-04	1.62E+01	2.66E+01	1.01E+01	6.87E-01	1.62E+01	2.83E+01	1.03E+01	1.72E+00	1.62E+01	2.91E+01	1.04E+01	4.12E+00
Chrysene		2.00E-03	1.62E+01	1.95E+01	8.84E+00	4.40E-01	1.62E+01	2.45E+01	9.74E+00	1.10E+00	1.62E+01	2.72E+01	1.01E+01	2.64E+00
Dibenzo(a,h)anthracene		6.00E-04	1.46E+00	2.13E+00	8.65E-01	3.93E-03	1.46E+00	2.42E+00	9.09E-01	9.82E-03	1.46E+00	2.56E+00	9.28E-01	2.36E-02
Fluoranthene		2.30E-01	1.01E+03	2.69E+04	9.72E+02	1.89E+01	1.01E+03	6.23E+04	9.93E+02	4.73E+01	1.01E+03	1.28E+05	1.00E+03	1.13E+02
Fluorene		1.90E+00	3.23E+03	4.35E+03	1.85E+03	3.09E+01	3.23E+03	1.07E+04	2.48E+03	7.65E+01	3.23E+03	2.54E+04	2.87E+03	1.83E+02
Indeno(1,2,3-cd)pyrene		2.00E-04	6.95E+00	1.04E+01	4.17E+00	6.13E-02	6.95E+00	1.17E+01	4.35E+00	1.53E-01	6.95E+00	1.22E+01	4.43E+00	3.68E-01
Phenanthrene		5.30E-01	1.00E+03	5.04E+03	8.37E+02	3.60E+01	1.00E+03	1.23E+04	9.28E+02	8.96E+01	1.00E+03	2.86E+04	9.70E+02	2.14E+02
Pyrene		1.30E-01	2.42E+03	6.18E+04	2.33E+03	2.20E+00	2.42E+03	1.44E+05	2.38E+03	5.49E+00	2.42E+03	2.97E+05	2.40E+03	1.32E+01
Benzo(a)pyrene		3.80E-03	1.62E+00	2.62E+00	1.00E+00	9.11E-01	1.62E+00	2.81E+00	1.03E+00	2.28E+00	1.62E+00	2.90E+00	1.04E+00	5.46E+00
Naphthalene		1.90E+01	1.58E+03	1.64E+00	1.64E+00	7.64E+01	1.58E+03	3.93E+00	3.92E+00	1.83E+02	1.58E+03	9.27E+00	9.22E+00	4.32E+02
Phenol		-	9.17E+04	3.11E+02	3.10E+02	4.16E+04	9.17E+04	4.20E+02	4.18E+02	8.15E+04	9.17E+04	5.21E+02	5.19E+02	1.74E+05

GENERIC ASSESSMENT CRITERIA FOR HUMAN HEALTH - RESIDENTIAL WITHOUT GARDENS

Table 5

Human Health Generic Assessment Criteria by Pathway for Residential Scenario Without Gardens

Compound	Notes	GrAC (mg/l)	SAC Appropriate to Pathway SOM 1% (mg/kg)			Soil Saturation Limit (mg/kg)	SAC Appropriate to Pathway SOM 2.5% (mg/kg)			Soil Saturation Limit (mg/kg)	SAC Appropriate to Pathway SOM 6% (mg/kg)			Soil Saturation Limit (mg/kg)
			Oral	Inhalation	Combined		Oral	Inhalation	Combined		Oral	Inhalation	Combined	
Total Petroleum Hydrocarbons														
Aliphatic hydrocarbons EC_5-EC_6		1.00E+01	2.23E+05	2.98E+01	2.98E+01	3.04E+02	2.23E+05	5.47E+01	5.47E+01	5.58E+02	2.23E+05	1.13E+02	1.13E+02	1.15E+03
Aliphatic hydrocarbons >EC_6-EC_8		5.40E+00	2.23E+05	7.27E+01	7.27E+01	1.44E+02	2.23E+05	1.62E+02	1.62E+02	3.22E+02	2.23E+05	3.72E+02	3.71E+02	7.36E+02
Aliphatic hydrocarbons >EC_8-EC_{10}		2.30E-01	4.45E+03	1.89E+01	1.88E+01	7.77E+01	4.45E+03	4.60E+01	4.59E+01	1.90E+02	4.45E+03	1.09E+02	1.09E+02	4.51E+02
Aliphatic hydrocarbons >EC_{10}-EC_{12}		3.00E-02	4.45E+03	9.34E+01	9.29E+01	4.75E+01	4.45E+03	2.32E+02	2.29E+02	1.18E+02	4.45E+03	5.57E+02	5.38E+02	2.83E+02
Aliphatic hydrocarbons >EC_{12}-EC_{16}		8.00E-04	4.45E+03	7.82E+02	7.45E+02	2.37E+01	4.45E+03	1.95E+03	1.69E+03	5.91E+01	4.45E+03	4.68E+03	3.04E+03	1.42E+02
Aliphatic hydrocarbons >EC_{16}-EC_{35}	(c)	-	4.53E+04	-	-	8.48E+00	6.41E+04	-	-	2.12E+01	7.66E+04	-	-	5.09E+01
Aliphatic hydrocarbons >EC_{35}-EC_{44}	(c)	-	4.53E+04	-	-	8.48E+00	6.41E+04	-	-	2.12E+01	7.66E+04	-	-	5.09E+01
Aromatic hydrocarbons >EC_5-EC_7		-	1.98E+04	2.66E+02	2.63E+02	1.22E+03	1.98E+04	4.95E+02	4.83E+02	2.26E+03	1.98E+04	1.03E+03	9.78E+02	4.71E+03
Aromatic hydrocarbons >EC_7-EC_8		-	1.98E+04	6.26E+02	6.07E+02	8.69E+02	1.98E+04	1.38E+03	1.29E+03	1.92E+03	1.98E+04	3.14E+03	2.71E+03	4.36E+03
Aromatic hydrocarbons >EC_8-EC_9 (styrene)		7.40E+00	5.34E+03	2.65E+02	2.61E+02	6.20E+02	5.34E+03	6.47E+02	6.27E+02	1.52E+03	5.34E+03	1.54E+03	1.41E+03	3.61E+03
Aromatic hydrocarbons >EC_9-EC_{10}		7.40E+00	1.78E+03	3.33E+01	3.32E+01	6.13E+02	1.78E+03	8.16E+01	8.07E+01	1.50E+03	1.78E+03	1.94E+02	1.89E+02	3.58E+03
Aromatic hydrocarbons >EC_{10}-EC_{12}		2.50E+01	1.78E+03	1.82E+02	1.77E+02	3.64E+02	1.78E+03	4.48E+02	4.17E+02	8.99E+02	1.78E+03	1.07E+03	8.66E+02	2.15E+03
Aromatic hydrocarbons >EC_{12}-EC_{16}		5.80E+00	1.78E+03	2.00E+03	1.25E+03	1.69E+02	1.78E+03	4.96E+03	1.59E+03	4.19E+02	1.78E+03	1.18E+04	1.71E+03	1.00E+03
Aromatic hydrocarbons >EC_{16}-EC_{21}	(c)	-	1.29E+03	-	-	5.37E+01	1.31E+03	-	-	1.34E+02	1.32E+03	-	-	3.21E+02
Aromatic hydrocarbons >EC_{21}-EC_{35}	(c)	-	1.33E+03	-	-	4.83E+00	1.33E+03	-	-	1.21E+01	1.33E+03	-	-	2.90E+01
Aromatic hydrocarbons >EC_{35}-EC_{44}	(c)	-	1.33E+03	-	-	4.83E+00	1.33E+03	-	-	1.21E+01	1.33E+03	-	-	2.90E+01

Notes:

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

NR - the compound is not volatile and therefore a soil saturation limit not calculated within CLEA

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

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

Calculated SAC exceeds soil saturation limit and may significantly effect the interpretation of any exceedances since the contribution of the indoor and outdoor vapour pathway to total exposure is >10%. This shading has also been used for the RBCA output where the theoretical solubility limit has been exceeded. The SAC has been set as the model calculated SAC with the saturation limits shown in brackets.

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

Calculated SAC does not exceed the soil saturation limit.

For consistency where the theoretical solubility limit within RBCA has been exceeded in production of the GrAC, these cells have also been hatched red.

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

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

(a) GAC taken as former Soil Guideline Value owing to uncertainty regarding toxicological approach to be adopted by the Environment Agency.

(b) GAC taken from the Environment Agency SGV reports published 2009.

(c) SAC for selenium, aliphatic and aromatic hydrocarbons >EC16 do not include inhalation pathway owing to absence of toxicity data. SAC for arsenic is only based on oral contribution (rather than combined) owing to the relative small contribution from inhalation in accordance with the SGV report.

(d) SAC for elemental mercury, chromium VI and nickel are based on the inhalation pathway only owing to an absence of toxicity for elemental mercury, in accordance with the SGV report for nickel and LQM report for chromium VI.

RSK GROUP PLC

Table 6
Human Health Generic Assessment Criteria for Residential Without Gardens

Compound	GrAC for Groundwater (mg/l)	SAC for Soil SOM 1% (mg/kg)	SAC for Soil SOM 2.5% (mg/kg)	SAC for Soil SOM 6% (mg/kg)
Metals				
Arsenic	-	35	35	35
Cadmium	-	85	85	85
Chromium (III) - oxide	-	3,000	3,000	3,000
Chromium (VI) - hexavalent	-	4.3	4.3	4.3
Copper	-	6,200	6,200	6,200
Lead	-	450	450	450
Elemental Mercury (Hg0)	0.0094	0.17	0.42	1.0
Inorganic Mercury (Hg2+)	-	240	240	240
Methyl Mercury (Hg4+)	20	8.4	11	14
Nickel	-	130	130	130
Selenium	-	600	600	600
Zinc	-	41,000	41,000	41,000
Cyanide	-	110	110	110
Volatile Organic Compounds				
Benzene	7	0.27	0.49	1.0
Toluene	1,900	610	1,289	2,700
Ethylbenzene	260	170	381	840
Xylene - m	84	55	130	300
Xylene - o	100	60	139	320
Xylene - p	87	53	125	290
Total xylene	84	55	130	300
Methyl tertiary butyl ether (MTBE)	2,200	160	199.55	270
Trichloroethene	1.8	0.11	0.2	0.51
Tetrachloroethene	3.6	1.0	2.3	5.3
1,1,1-Trichloroethane	26	6.3	12.9	28
1,1,1,2-Tetrachloroethane	14	1.1	2.5	5.8
1,1,2,2-Tetrachloroethane	14	2.7	5.58	12
Carbon tetrachloride	0.055	0.02	0.040	0.09
1,2-Dichloroethane	0.30	0.006	0.0093	0.02
Vinyl chloride	0.019	0.0005	0.0007	0.001
1,2,4-Trimethylbenzene	0.075	0.4	0.99	2.3
1,3,5-Trimethylbenzene	0.047	0.5	1.10	2.6
Semi-Volatile Organic Compounds				
Acenaphthene	3.2	2,000 (57)	3,100 (141)	3,900 (340)
Acenaphthylene	4.2	2,000 (86)	3,000 (212)	3,900 (510)
Anthracene	0.021	20,000 (1.2)	22,000	23,000
Benzo(a)anthracene	0.004	3.7	5.2	6.2
Benzo(b)fluoranthene	0.002	7.0	7.3	7.4
Benzo(g,h,i)perylene	0.0003	47	47	48
Benzo(k)fluoranthene	0.0008	10	10	10
Chrysene	0.002	8.8	9.7	10
Dibenzo(a,h)anthracene	0.0006	0.87	0.91	0.93
Fluoranthene	0.23	970	993	1,000
Fluorene	1.9	1,900 (31)	2,500 (77)	2,900 (180)
Indeno(1,2,3-cd)pyrene	0.0002	4.2	4.4	4.4
Phenanthrene	0.53	840 (36)	930	970
Pyrene	0.13	2,300	2,400	2,400
Benzo(a)pyrene	0.004	1.0	1.0	1.0
Naphthalene	19	1.6	3.9	9.2
Phenol	-	310	420	520
Total Petroleum Hydrocarbons				
Aliphatic hydrocarbons EC_5-EC_6	10	30	55	110
Aliphatic hydrocarbons >EC_6-EC_8	5.4	73	160	370
Aliphatic hydrocarbons >EC_8-EC_{10}	0.23	19	46	110
Aliphatic hydrocarbons >EC_{10}-EC_{12}	0.03	93 (48)	230 (118)	540 (280)
Aliphatic hydrocarbons >EC_{12}-EC_{16}	0.0008	746 (24)	1,700 (59)	3,000 (140)
Aliphatic hydrocarbons >EC_{16}-EC_{35}	-	45,000	64,000 (21)	77,000
Aliphatic hydrocarbons >EC_{35}-EC_{44}	-	45,000	64,000 (21)	77,000
Aromatic hydrocarbons >EC_6-EC_9 (styrene)	7.4	260	627	1,400
Aromatic hydrocarbons >EC_9-EC_{10}	7.4	33	81	190
Aromatic hydrocarbons >EC_{10}-EC_{12}	25	180	417	870
Aromatic hydrocarbons >EC_{12}-EC_{16}	5.8	1,300 (170)	1,600 (419)	1,700
Aromatic hydrocarbons >EC_{16}-EC_{21}	-	1,300	1,300	1,300
Aromatic hydrocarbons >EC_{21}-EC_{35}	-	1,300	1,300	1,300
Aromatic hydrocarbons >EC_{35}-EC_{44}	-	1,300	1,300	1,300

Notes:

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

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

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

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

The SAC has been set as the model calculated SAC with the saturation limit shown in brackets.
For consistency where the GrAC exceeds the solubility limit, GrSV has been set at the solubility limit. These are highly conservative since concentrations of the chemical are very unlikely to be at sufficient concentration to result in an exceedance of the health criteria value at the point of exposure (i.e. indoor air) provided free-phase product is absent.

REFERENCES

1) Environment Agency, 31 March 2009, May 2009 and September 2009. Science Report SC050021 / benzene SGV, toluene SGV, ethylbenzene SGV, xylene SGV, mercury SGV, selenium SGV, nickel SGV, arsenic SGV, cadmium SGV, phenol SGV, dioxins, furans and dioxinlike PCBs SGVs. Supplementary information for the derivation of SGV for: benzene, toluene, ethylbenzene, xylene, mercury, selenium, nickel, arsenic, cadmium, phenol, dioxins, furans and dioxin-like PCBs. 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.

2) Environment Agency, January 2009. Science Report SC050021/SR2 Human Health Toxicological Assessment of Contaminants in Soil.

3) Environment Agency, January 2009. Science Report SC050021/SR3 Updated Technical Background to the CLEA Model.

4) Environment Agency, January 2009. Science Report SC050021/SR4 CLEA Software (Version 1.04) Handbook.

5) Environment Agency. 2008. Science Report SC050021/SR7. Compilation of Data for Priority Organic Pollutants for Derivation of Soil Guideline Values.

6) Land Quality Management (LQM) and Chartered Institute of Environmental Health (CIEH) 2009. The LQM/CIEH Generic Assessment Criteria for Human Health Risk Assessment. 2nd Edition.

7) The Soil Generic Assessment Criteria for Human Health Risk Assessment, Report ref. ISBN 978-1-905046-20-1, December 2009, published by CL:AIRE

8) Changes made to the CLEA framework documents after the 3 month evaluation period in 2008, released January 2009 by the Environment Agency.

APPENDIX F

HAS-WASTE Assessment

As cmpds (AsS), Cd (CdO), CrVI cmpds ($FeCrO_4$), Cu (Cu_2O), Inorg Hg cmpds (HgO), Pb cmpds ($PbSO_4$), Ni ($NiCO_3$), Se cmpds (SeS) and Zn as ZnO. Also Ba ($BaCO_3$), Be cmpds ($BeSO_4$), Co (CoO), Mn (MnO_2) and Mo (MoO_3).

HASWASTE v4. Envirolab's Contaminated Land Soil Hazardous Waste Assessment Tool.

Envirolab, Sandpits Business Park, Mottram Road, Hyde, Cheshire SK14 3AR.

envirolab

Site Code and Name: 241882 - Salisbury Square, Old Hatfileld

TP/WS/BH		BH1	BH1	BH1	BH1	BH2	BH2	BH2	BH2	BH2	BH2	WS1	WS1	WS2	WS2
Depth (m)		0.20	0.70	1.5-1.7	2.3-2.5	0.25	0.50	0.90	1.40	3.00	4.90	0.2-0.3	0.5-0.6	0.2-0.3	0.5-0.6
Envirolab reference															
		mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Arsenic		26	23	12	7	23		23	11	11	14		12		23
CrVI or Chromium		29	29	29	15	23		30	30	30	18		30		29
Copper		17	50	14	3	17		16	33	18	9		26		17
Lead		14	278	21	5	14		43	46	35	16		68		17
Nickel		43	32	28	9	35		35	21	21	15		21		42
Zinc		105	177	46	17	87		97	62	55	40		80		95
Cadmium		0.6	0.6	0.5	0.5	0.5		0.5	0.5	0.5	0.5		0.5		0.5
Mercury		0.2	0.2	0.2	0.2	0.2		0.2	0.2	0.2	0.2		0.2		0.2
Selenium		1	2	1	1	1		1	1	1	1		1		1
Barium															
Beryllium															
Cobalt															
Manganese															
Molybdenum															
Total USEPA 16 PAHs															
Acenaphthene		0.01	0.01	0.02	0.01	0.01		0.04			0.02		0.02		0.01
Acenaphthylene		0.01	0.05	0.01	0.01	0.01		0.14			0.01		0.01		0.01
Anthracene		0.01	0.07	0.01	0.01	0.01		0.19			0.01		0.02		0.01
Benzo(a)anthracene		0.01	0.36	0.01	0.01	0.01		0.57			0.01		0.04		0.01
Benzo(a)pyrene		0.02	0.47	0.01	0.01	0.01		0.94			0.01		0.04		0.01
Benzo(b)fluoranthene		0.01	0.33	0.01	0.01	0.01		0.70			0.01		0.03		0.01
Benzo(ghi)perylene		0.01	0.71	0.02	0.01	0.01		1.01			0.01		0.09		0.01
Benzo(k)fluoranthene		0.02	0.48	0.02	0.01	0.01		0.76			0.01		0.03		0.01
Chrysene		0.01	0.70	0.03	0.01	0.02		1.48			0.02		0.13		0.01
Dibenzo(ah)anthracene		0.01	0.10	0.01	0.01	0.01		0.14			0.01		0.01		0.01
Fluoranthene		0.01	0.78	0.07	0.01	0.03		1.90			0.03		0.14		0.03
Fluorene		0.01	0.01	0.01	0.01	0.01		0.03			0.01		0.01		0.01
Indeno(123cd)pyrene		0.01	0.27	0.01	0.01	0.01		0.58			0.01		0.03		0.01
Naphthalene		0.01	0.03	0.11	0.02	0.01		0.04			0.02		0.02		0.01
Phenanthrene		0.02	0.17	0.06	0.01	0.02		0.65			0.02		0.05		0.02
Pyrene		0.01	0.75	0.06	0.02	0.03		1.71			0.03		0.13		0.02
Benzo(j)fluoranthene															
Benzene		0.01													
Toluene		0.01													
Ethylbenzene		0.01													
Xylenes		0.01													
Trimethylbenzenes															
Chlorobenzene															
1,2-Dichlorobenzene															
1,3-Dichlorobenzene															
1,4-Dichlorobenzene															
1,2,4-Trichlorobenzene															
2-Chlorotoluene															
4-Chlorotoluene															
Trichloroethene (TCE)															
Oil in Waste Carcinogenic H7															
Total TPH	≥1,000mg/kg	0.1											10.0	10.0	
Petrol or (C6-C10)	≥1,000mg/kg														
Diesel or (C10-C25) or (conservative C10-C35)	≥10,000mg/kg														
Lube Oil or (C25+) or (conservative C21+)	≥1,000mg/kg														
If IARC H7 Carcinogenic PAHs marker test (applicable to LRO only)	≥1%														
Kerosene															
Kerosene															
Creosote															
Creosote															
pH Corrosive H8 (Irritant H4)															
pH (soil)	≤2 H8 ≥11.5														
pH (leachate)	≤2 H8 ≥11.5														
Alkali Reserve (gNaOH/100g)															
H4 Alkali Reserve test	≥13	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
H8 Alkali Reserve test	≥14.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Produces Toxic Gases H12															
Total Sulphide	≥1,400mg/kg														
Free Cyanide	≥1,200mg/kg														
Thiocyanate	≥2,600mg/kg														
Elemental/Free Sulphur															
PCBs Total															
Phenols Total by HPLC															
Phenol		0.2		0.2			0.2			0.2		0.2		0.2	
Cresols															
Xylenols															
1-Naphthol															
Resourcinol															
2,3,5,6-Tetrachlorophenol															
2,4,5-Trichlorophenol															
2,4,6-Trichlorophenol															
2,4-Dichlorophenol															
4-Chloro-3-methylphenol															
Pentachlorophenol															
Bis(2-ethylhexyl)phthalate															
Butylbenzylphthalate															
Di-n-butylphthalate															
Visual Fibre Screen or Asbestos ID (enter Y or N)	H7≥0.1%; H5≥3%; H6≥25%														

Hazard Codes	Thresholds	%	%	%	%	%	%	%	%	%	%	%	%	%	%
Irritant H4	≥10%	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Irritant H4	≥20%	0.009	0.006	0.006	0.002	0.007	0.000	0.007	0.004	0.004	0.003	0.000	0.004	0.000	0.008
Harmful H5	≥25%	0.013	0.053	0.010	0.003	0.011	0.000	0.015	0.015	0.011	0.006	0.000	0.018	0.001	0.013
Toxic H6 (Harmful H5)	≥0.1%H5<7%; H6≥7%	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Toxic H6 (Harmful H5)	≥3%H5<25%; H6≥25%	0.013	0.010	0.008	0.003	0.011	0.000	0.011	0.006	0.006	0.005	0.000	0.006	0.000	0.012
Carcinogenic H7	≥0.1%	0.010	0.010	0.010	0.005	0.008	0.000	0.010	0.010	0.010	0.006	0.000	0.010	0.000	0.010
Carcinogenic H7	≥1%	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Corrosive H8 (Irritant H4)	≥5%H4<10%; H8≥10%	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Toxic for Reproduction H10	≥0.5%	0.009	0.041	0.006	0.002	0.007	0.000	0.007	0.007	0.005	0.003	0.000	0.010	0.000	0.008
Toxic for Reproduction H10	≥5%	0.002	0.041	0.003	0.001	0.002	0.000	0.006	0.007	0.005	0.002	0.000	0.010	0.000	0.002
Mutagenic H11	≥0.1%	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Mutagenic H11	≥1%	0.009	0.006	0.006	0.002	0.007	0.000	0.007	0.004	0.004	0.003	0.000	0.004	0.000	0.008
Ecotoxic H14	≥1.0	0.150	0.298	0.104	0.043	0.126	0.000	0.153	0.126	0.112	0.073	0.000	0.142	0.000	0.144
New Ecotoxic H14 individual substance specific thresholds	≥0.0025%	0.00000	0.00004	0.00000	0.00000	0.00000	0.00000	0.00007	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
New Ecotoxic H14 individual substance specific thresholds	≥0.025%	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Consider other individual contaminants on a case by case basis.

Table 3.2 of Annex VI of the CLP Regulation including 1st ATP (sometimes called ATSP1).

As cmpds (AsS), Cd (CdO), CrVI cmpds ($FeCrO_4$), Cu (Cu_2O), Inorg Hg cmpds (HgO), Pb cmpds ($PbSO_4$), Ni ($NiCO_3$), Se cmpds (SeS) and Zn as ZnO. Also Ba ($BaCO_3$), Be cmpds ($BeSO_4$), Co (CoO), Mn (MnO_2) and Mo (MoO_3).

HASWASTE v4. Envirolab's Contaminated Land Soil Hazardous Waste Assessment Tool.

Envirolab, Sandpits Business Park, Mottram Road, Hyde, Cheshire SK14 3AR.

envirolab

Site Code and Name: 241882 - Salisbury Square, Old Hatfileld

TP/WS/BH		WS3	WS3	WS4	WS4	TP1	TP1	TP2	TP3						
Depth (m)		0.2-0.3	0.5-0.6	0.2-0.3	0.5-0.6	0.10	0.40	0.50	0.10						
Envirolab reference															
		mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Arsenic				22	18	10		12	22						
CrVI or Chromium				21	20	18		20	29						
Copper				14	11	22		37	174						
Lead				39	10	66		84	345						
Nickel				30	33	14		18	33						
Zinc				73	70	80		112	306						
Cadmium				0.5	0.5	0.5		0.5	0.9						
Mercury				0.2	0.2	0.2		0.2	1.0						
Selenium				1	1	1		1	2						
Barium															
Beryllium															
Cobalt															
Manganese															
Molybdenum															
Total USEPA 16 PAHs															
Acenaphthene				0.01	0.01	0.02		0.13							
Acenaphthylene				0.01	0.01	0.05		0.01							
Anthracene				0.01	0.01	0.09		1.60							
Benzo(a)anthracene				0.01	0.01	0.33		3.24							
Benzo(a)pyrene				0.01	0.01	0.47		2.33							
Benzo(b)fluoranthene				0.01	0.01	0.44		2.29							
Benzo(ghi)perylene				0.01	0.01	0.68		1.90							
Benzo(k)fluoranthene				0.01	0.01	0.36		2.64							
Chrysene				0.01	0.02	0.71		5.27							
Dibenzo(ah)anthracene				0.01	0.01	0.05		0.42							
Fluoranthene				0.01	0.03	0.84		8.88							
Fluorene				0.01	0.01	0.01		0.17							
Indeno(123cd)pyrene				0.01	0.01	0.26		1.42							
Naphthalene				0.00	0.01	0.01		0.02							
Phenanthrene				0.01	0.03	0.22		3.49							
Pyrene				0.01	0.02	0.79		6.11							
Benzo(j)fluoranthene															
Benzene		0.01													
Toluene		0.01													
Ethylbenzene		0.01													
Xylenes		0.01													
Trimethylbenzenes															
Chlorobenzene															
1,2-Dichlorobenzene															
1,3-Dichlorobenzene															
1,4-Dichlorobenzene															
1,2,4-Trichlorobenzene															
2-Chlorotoluene															
4-Chlorotoluene															
Trichloroethene (TCE)															
Oil in Waste Carcinogenic H7															
Total TPH	≥1,000mg/kg	10.0			0.0										
Petrol or (C6-C10)	≥1,000mg/kg														
Diesel or (C10-C25) or (conservative C10-C35)	≥10,000mg/kg														
Lube Oil or (C25+) or (conservative C21+)	≥1,000mg/kg														
8 IARC H7 Carcinogenic PAHs marker test (applicable to LRO only)	≥1%	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Kerosene															
Kerosene															
Creosote															
Creosote															
pH Corrosive H8 (Irritant H4)															
pH (soil)	≤2 H8 ≥11.5														
pH (leachate)	≤2 H8 ≥11.5														
Alkali Reserve (gNaOH/100g)															
H4 Alkali Reserve test	≥13	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
H8 Alkali Reserve test	≥14.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Produces Toxic Gases H12															
Total Sulphide	≥1,400mg/kg														
Free Cyanide	≥1,200mg/kg														
Thiocyanate	≥2,600mg/kg														
Elemental/Free Sulphur															
PCBs Total					0.005										
Phenols Total by HPLC															
Phenol															
Cresols															
Xylenols															
1-Naphthol															
Resourcinol															
2,3,5,6-Tetrachlorophenol															
2,4,5-Trichlorophenol															
2,4,6-Trichlorophenol															
2,4-Dichlorophenol															
4-Chloro-3-methylphenol															
Pentachlorophenol															
Bis(2-ethylhexyl)phthalate															
Butylbenzylphthalate															
Di-n-butylphthalate															
Visual Fibre Screen or Asbestos ID (enter Y or N)	H7≥0.1%; H8≥3%; H6≥25%														

Hazard Codes	Thresholds	%	%	%	%	%	%	%	%	%	%	%	%	%	%
Irritant H4	≥10%	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Irritant H4	≥20%	0.000	0.000	0.006	0.007	0.003	0.000	0.004	0.007	0.000	0.000	0.000	0.000	0.000	0.000
Harmful H5	≥25%	0.001	0.000	0.013	0.009	0.015	0.000	0.020	0.077	0.000	0.000	0.000	0.000	0.000	0.000
Toxic H6 (Harmful H5)	≥0.1%H5<7%; H6≥7%	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Toxic H6 (Harmful H5)	≥3%H5<25%; H6≥25%	0.000	0.000	0.009	0.009	0.004	0.000	0.006	0.010	0.000	0.000	0.000	0.000	0.000	0.000
Carcinogenic H7	≥0.1%	0.000	0.000	0.007	0.007	0.006	0.000	0.007	0.010	0.000	0.000	0.000	0.000	0.000	0.000
Carcinogenic H7	≥1%	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Corrosive H8 (Irritant H4)	≥5%H4<10%; H8≥10%	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Toxic for Reproduction H10	≥0.5%	0.000	0.000	0.006	0.007	0.010	0.000	0.012	0.050	0.000	0.000	0.000	0.000	0.000	0.000
Toxic for Reproduction H10	≥5%	0.000	0.000	0.006	0.001	0.010	0.000	0.012	0.050	0.000	0.000	0.000	0.000	0.000	0.000
Mutagenic H11	≥0.1%	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Mutagenic H11	≥1%	0.000	0.000	0.006	0.007	0.003	0.000	0.004	0.007	0.000	0.000	0.000	0.000	0.000	0.000
Ecotoxic H14	≥1.0	0.000	0.000	0.120	0.105	0.117	0.000	0.159	0.445	0.000	0.000	0.000	0.000	0.000	0.000
New Ecotoxic H14 individual substance specific thresholds	≥0.0025%	0.00000	0.00000	0.00000	0.00000	0.00003	0.00000	0.00032	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
New Ecotoxic H14 individual substance specific thresholds	≥0.025%	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Consider other individual contaminants on a case by case basis.

Table 3.2 of Annex VI of the CLP Regulation including 1st ATP (sometimes called ATSP1).

Gascoyne Holdings Ltd

Salisbury Square, Old Hatfield, Hertfordshire, AL9 5AD

Updated Geotechnical and Geo-Environmental Report

1922048-R01 (01)

RSK GEOSCIENCES

NOVEMBER 2021

RSK GENERAL NOTES

Project No.: 1922048-R01

Title: Geotechnical and Geo-Environmental Report: Salisbury Square, Old Hatfield, AL9 5AD

Client: Gascoyne Holdings Ltd

Date: 25th November 2021

Office: RSK Environment Limited, 18 Frogmore Road, Hemel Hempstead, Herts, HP3 9RT. Tel 01442 437500

Status: 01

Author [redacted]

Signature

Technical reviewer [redacted]

Signature

Project manager [redacted]

Signature

Quality reviewer [redacted]

Signature

Revision control sheet				
Revision ref.	**Date**	**Reason for revision**	**Amended by:**	**Approved by:**
00	31/08/2021	Update of previous 2011 report	[redacted]	see above
01	25/11/21	Updated development wording & plan	[redacted]	See above

CONTENTS

FIGURES

APPENDICES

EXECUTIVE SUMMARY

Commissioning and purpose of assessment	RSK Environment Limited (RSK) was commissioned by JB Planning Associates, on behalf of Gascoyne Holdings Ltd, to carry out an update of a previous Phase 1 and 2 geotechnical and geo-environmental investigation of the land at of the Salisbury Square area of Old Hatfield, grid reference 523321^{E} 208687^{N}. The overall aim of the project was to assess land contamination sources and geotechnical constraints to the proposed development.
DESK-BASED ASSESSMENT	
Site description and proposed development	The site currently comprises mixed commercial and residential use, occupies an area of 0.9 hectares and is being considered for development for mixed residential and commercial use following demolition of the existing shopping parade.
History of site and surrounding area	The site was formerly used for residential and commercial/industrial uses. Several potentially contaminative current activities have been identified in the surrounding area, mainly including made ground, various industrial uses in surrounding areas and Hatfield Brewery.
Previous site investigation (SI) reports	One site investigation was previously undertaken for the site in 2011. This report is an update of the Phase 1 and 2 geotechnical and geo-environmental investigation.
Geology and environmental setting	The Site is underlain by Glacial Gravels (Kesgrave Catchment Subgroup) overlying the White Chalk Subgroup, according to published geological data for the site and surrounding area. There is also likely to be made ground associated with former developments. The site is not located within an 'Affected Area' in regards to radon and is not located within previous coal mining areas. The site lies in an area with a low likelihood of chalk mining, however two man-made mining cavities are located approximately 91 m east of the site and 138 m south of the site. Environmental receptors identified comprise: • end users of the site; • controlled waters, being defined as all surface water, groundwater or perched water; • building structures and services placed in or on the ground; and • other targets such as the "environment", including any flora and fauna on or near the site and construction and maintenance workers who will have chronic but potentially higher levels of exposure than end users.
Site reconnaissance findings	The majority of the northern portion of the site was observed to be covered by hardstanding. Two large landscaped areas are located in the central portion of Salisbury Square and a shopping parade was identified in the central portion of the site.

Initial conceptual site model (CSM) and preliminary risk assessment (PRA)	Potentially complete contaminant linkages identified with a risk estimate of moderate to low or above include end users of the site, controlled waters, building structures and neighbouring flora and fauna. Uncertainties and data gaps have been identified in the CSM at desk study stage and should be considered in the design of future intrusive investigation if proposed.
INTRUSIVE INVESTIGATION & ASSESSMENT	
SI scope	The site investigation involved the following: • Advancement of boreholes by light cable percussive methods; • Advancement of boreholes by drive-in-sampler methods; • Monitoring well installation; • Advancement of trial pits using hand tools; • PID screening of soil samples; • Water level monitoring in shallow installations; and • Ground gas monitoring in monitoring well installations;
SI factual findings	The site investigation identified the presence of the following strata: • Made ground (1.8 to 4.9 m thickness) across the site; • Granular glacial deposits (shallow) (0.5 to 3.0 m thickness); • Lowestoft Formation (6.5 to 7.9 m thickness); and • Kesgrave Catchment Subgroup (termination depth at 14.5 mbgl).
Refined conceptual site model and geo-environmental assessment	Based on the results of the site investigation and generic quantitative risk assessment (GQRA), the contaminant risks that have been identified to be present include: • Lead in regard to human health risk; and • Potential organic contaminants with respect to plastic potable water supply pipes.
Geotechnical assessment	The ground conditions encountered in the northern area of the site do not appear suitable for the design and construction of conventional shallow spread foundations for the proposed terraced houses. Relatively deep trench fill foundations appear technically feasible with considerations made for the depth of made ground within the site. Alternatively, the near-surface ground conditions appear suitable for the use of selected ground improvement techniques that would facilitate the use of shallow spread footings supported on the improved ground.
Recommendations including issues for further assessment	The following recommendations are made for further assessment/ remediation of the site to address the risks identified above and to address remaining uncertainties: • Mitigation/further assessment surrounding identified lead hotspot within the northern portion of the site.
The information given in this summary is necessarily incomplete and is provided for initial briefing purposes only. The summary must not be used as a substitute for the full text of the report.	

1 INTRODUCTION

1.1 Commissioning

RSK Environment Limited (RSK) was commissioned by JB Planning Associates, on behalf of Gascoyne Holdings Ltd (the 'Client') to carry out a Phase 1 and 2 geotechnical and geo-environmental investigation of the Salisbury Square area of Old Hatfield. The project initially was carried out to an agreed brief as set out in RSK's original proposal letter of 27th September 2010.

The report was initially updated in August 2021 in light of site plan changes and updated criteria for the site and updated again for the production of this report in light of further alterations to the development proposals. RSK's service constraints are shown in **Appendix A**.

The project was commissioned in order to identify the potential for hazardous substances or conditions to exist on, at or near the site and therefore, via the development of a Conceptual Site Model (CSM), identify the necessity for and extent of mitigation measures to be employed in relation to the proposed improvement of Salisbury Square. There are four aspects to this improvement, as follows:

- Open up Salisbury Square by reinstating the original road through the heart of the Old Town which will reconnect the square to the surrounding streets and railway station with emphasis on pedestrian access;
- Construction of 64 car parking spaces associated with residential and commercial developments and relocating 13 existing parking spaces. Construction of 31 new parking spaces associated with the Job Centre building, however will be located outside the red outline of the updated site plan in **Appendix B**;
- Construction of a new building containing three flats, eleven offices and one retail unit, plus erection of a terrace of five homes with associated infrastructure.
- Some of the existing buildings are to be made more visually interesting by small architectural interventions such as enhancing the shop windows with traditional details and improved signage; and
- Provide better located accessible shops with residential accommodation. Open space is to be provided in the form of a town square off reinstated vehicular access.

1.2 Objectives

The objective of the work is to:

- Assess the source, type and level of contamination (if present) throughout the site;
- Determine whether concentrations of contaminants would preclude the proposed future use of the site for low-density residential or public open space land use and whether remedial actions/management is required;

- to identify any land contamination and/or geotechnical constraints to the proposed development and to support discharge of relevant planning conditions and relevant building control requirements;
- To identify the need for any additional investigation or remediation works to demonstrate that the site is suitable for its proposed use; and
- To evaluate potential client environment liabilities as part of the due diligence process for acquisition/ disposal.

1.3 Scope of works

The scope of this assessment has been developed in accordance with relevant British Standards and authoritative technical guidance as referenced throughout the report. As this assessment was initially conducted in 2011, the program was designed in accordance with relevant guidance of the time and has been updated, where practical, to updated guidelines superseding those applied in 2011. The assessment of the contamination status of the site is in line with the technical approach presented in Land Contamination Risk Management (LCRM) (Environment Agency, 2021) – which supersedes CLR11 Model Procedures for Land Contamination – and in general accordance with BS 10175: 2011 + A2 2017 (BSI, 2017). It is also compliant with relevant planning policy and guidance.

The scope of the intrusive investigation has been designed in line with the recommendations of BS5930:1999 Code of practice for site investigations (BSI, 1999), which maintains compliance with BS EN 1997-1 and 1997-2 and their related standards. It has also been developed in general accordance with BS 10175: 2001.

This report adopts the technical approach presented in Contaminated Land Report 11 “Model Procedures for the Management of Land Contamination” (Environment Agency 2004) for applying a risk management process when dealing with land affected by contamination.

A brief summary of relevant legislation and policy relating to land contamination is given in **Appendix C**.

The scope of works for the assessment has included the following:

Desk Study:

- The history of development and industry on the site, including a study of archival Ordnance Survey mapping and other sources of historical information as appropriate, e.g. local archives, trade directories and planning records;
- A study of local geology, hydrogeology and surface water setting;
- The identification of potential geological hazards, including radon and solution features that are known to be present in the Hatfield area;
- A review of relevant environmental data held by appropriate statutory authorities, e.g. the local Environmental Health Department and the Environment Agency, obtained in the form of a GroundSure Report and, where appropriate, through direct contact;
- A site reconnaissance survey;

- Liaison where possible with current/previous owners/occupiers of the site; and
- A preliminary conceptual model of contamination on the site identifying possible pollutant linkages.

Site Investigation

- Forming of exploratory holes at locations to be finalised during the desk study and site reconnaissance;
- Sinking of two light cable percussive boreholes to provisionally 15 m depths;
- One day of drive-in window sampler boreholes to provisionally 3 m depths;
- Three shallow hand pits in the proposed ground level car parking area (currently soft landscaping) to collect samples for contamination testing; and
- Associated sampling and on site testing, including three in situ CBR determinations using the clegg hammer apparatus and the use of a photo-ionisation detector (PID) to screen for the presence of volatile organic compounds.

During the investigation, it was considered prudent to install ground gas monitoring wells owing to the thickness of fill material in certain areas of the site. As such, three monitoring wells were installed, and an allowance made for 2 no. monitoring visits after the fieldwork to provide an initial assessment of development requirements.

Updated Desk Study

- Updated study of local geology, hydrogeology and surface water setting;
- An updated review of relevant environmental data held by appropriate statutory authorities; and
- Interpretation of results against updated guidelines.

1.4 Existing reports

The following reports detailing previous works at the site were made available for review:

- RSK, “Geotechnical and Geoenvironmental Report”. Report ref: 241882-01 (01), dated 23rd March 2011; and
- RSK, “Supplementary Geo-Environmental Information Pertaining to the Discharge of Planning Condition 20”. Letter ref: 27975-L02 (01), dated 3rd September 2015.

This report is an update of the original 2011 report, taking into account the recommendations made within the 2015 supplementary letter report.

1.5 Limitations

This report is subject to the RSK service constraints given in **Appendix A** and limitations that may be described through this document.

This report should be considered in light of any changes in legislation, statutory requirement or industry practices that may have occurred subsequent to the date of issue.

The "vicinity" of the site for the purposes of this report, is defined as locations situated within an approximate 250 m radius of the site, although certain sources of contamination and / or sensitive targets further than 250 m may also have been considered.

The opinions and recommendations expressed in this report are based on the ground conditions encountered during the site work, the results of field and laboratory testing and interpretation between exploratory holes. The material encountered and samples obtained represent only a small proportion of the materials present on-site, therefore other conditions are likely to prevail at the site which have not been revealed by this investigation.

The environmental reconnaissance survey consisted of a general external inspection of the site aimed at identifying any obvious signs of potential sources of ground contamination. A detailed internal inspection of the buildings was outside the brief for the study.

As an Exploratory Investigation, the results may not provide sufficient data to make detailed estimates of the quantities involved in any remediation work, if required.

The results of RSK laboratory tests are covered by UKAS accreditation, but opinions and interpretations expressed in the report and on the site work records are outside the scope of this accreditation. Where laboratory testing has been carried out at a sub-contractor laboratory, this laboratory is an approved sub-contractor in accordance with the requirements of the RSK quality management system and is UKAS accredited for the relevant range of tests undertaken.

2 SITE DETAILS

2.1 Site location

Site location details are presented in **Table 1** and a site location plan is provided on **Figure 1**.

Table 1 Site location details

Site name	Salisbury Square, Old Hatfield
Full site address and postcode	The site is located at National Grid reference 523321E 208687N, as shown on **Figure 1**.
National Grid reference (centre of site)	523321^{E} 208687^{N}

2.2 Site description

The site covers approximately 0.9 hectares and comprises ground-level car parking within the northern portion of the site and Salisbury Square with surrounding retail and commercial units in the south. The parade of shops separating the car park to the north from Salisbury Square to the south includes a convenience store, restaurants, an accounting firm, heating contractor and health care service.

2.3 Surrounding land uses

The Site is located in Old Hatfield, within a predominantly commercial setting. Immediate surrounding land uses are described in **Table 2**.

Table 2 Surrounding land uses

North	A mixed commercial and residential development at Dunhams Courtyard is located immediately to the north of the eastern part of the site. This site is partly bisected by a viaduct, which provides access to Hatfield House and Hatfield Park to the east. Commercial and recreational land-use occupies the majority of the land further to the north. The River Lea runs west-to-east approximately 1.2 km beyond the northern site boundary.
East	A mixture of retail, commercial and residential properties are located immediately beyond the eastern site boundary in 'Old Hatfield'. Hatfield park is situated approximately 200 to 250 m to the northeast and east of the site. A large pond is located in Hatfield House approximately 500 m to the east of the site. Furthermore, a number of field drains are located within the grounds themselves. An office building forms the southern part of the eastern site boundary.
South	A number of retail and office units are located along the southern site boundary. An electricity sub station is located approximately 46 m to the south of the site. The land further to the south occupies a mixture of retail, commercial and residential units, forming part of Old Hatfield.

West	Great North Road (A1000) runs north-to-south immediately adjacent to the western site boundary. Hatfield railway station lies approximately 50 m further to the west with the associated railway lines running parallel to the western site boundary immediately beyond. A number of industrial units are located immediately beyond the railway tracks to the west approximately 100 to 150 m from the site, including unspecified 'works', factories and car servicing and repairs.

2.4 Reconnaissance Survey

The site was originally visited on 13th January 2011 and again on 27 August 2021. The aim of the survey was to identify the range of potentially contaminative activities carried out on the site and in the immediate vicinity, and any obvious potential sources of ground contamination.

2.5 Development plans

The proposed layout of the site, at the time of preparing this report, is shown in **Appendix B**.

The redevelopment involves the improvement of the Salisbury Square area of Old Hatfield with a mixed commercial and residential development. The proposed development specifically comprises the demolition of existing shopping parade with seven maisonettes above including retaining wall structures; alterations to existing and construction of new parking areas; layout of public spaces; erection of new building containing three flats, eleven offices and one retail unit (Use Class E – Commercial, Business and Service); Erection of a terrace of five houses with parking and footways; foul and surface water drainage and all ancillary works.

The commercial units are also to include basement level. A ground level parking area is proposed across the site associated with the residential and commercial developments and public access totalling 77 car spaces.

No details of the proposed ground levels have been provided therefore for the purpose of this report it has been assumed that the current levels will remain unchanged.

3 DESK-BASED ASSESSMENT

The desktop study was designed generally to meet the objectives of a preliminary (phase 1) investigation, as defined by BS 10175:2001 and this assessment relates to LCRM Stage 1, Tier 1 preliminary risk assessment and Tier 2 Generic quantitative risk assessment. The "vicinity" of the site for the purposes of this report is defined as locations situated within an approximate 250 m radius of the site, although certain sources and/ or sensitive targets further than 250 m may also have been considered.

The study aims principally to identify and assess the potential risks and liabilities associated with contamination of the ground, on and in the vicinity of the site. While this includes consideration of current operations and housekeeping on the site, the report does not constitute a comprehensive environmental audit of the site, as covered under ISO 14001.

3.1 Site history

3.1.1 Historical development record

The development history of the site and surrounding area based upon assessment of historical plans and records is detailed in **Table 3**. The historical maps reviewed are shown within the environmental database report in **Appendix D**.

Table 3 Summary of historical development

Date from	Date to	Historical Land Use (on-site)	Area of site
1879	1922	The earliest available map edition of 1879 indicates that the southern portion of the site formed part of Hatfield Brewery with small areas of soft landscaping / courtyards located adjacent to the central part of the eastern site boundary and to the extreme north. A Public House was located in the north-western portion of the site at this time, in a similar location to the present day. Great North Road encroached onto the site, along the western site boundary. A street referred to as 'Arm and Sword Yard' provided access across the site between Great North Road to the east and Park Road to the west, leading to a number of terraced residential properties in the northern portion of the site. The majority of the northern portion of the site appeared to be occupied by residential land-use at this time, with the exception of a large factory/warehouse-type building located in the north-eastern corner.	Whole Site
1922	1937	The configuration and general land-use across the site seemed to remain largely unchanged with the exception of the slight relocation of the Public House to the east up until the early 1920's. At this point, the construction of a Public Hall in the centre of the site coincided with the closure Hatfield Brewery, although a	Whole Site

Date from	Date to	Historical Land Use (on-site)	Area of site
		number of the buildings remained in place in the southern part of the site. A bank was also located in the far southeast corner at this stage.	
1937	1969	By the late 1930's to 1950's, a large proportion of the site had been redeveloped. The larger buildings in the south, previously associated with the brewery, had been demolished and replaced with a number of smaller units. Furthermore, the terraced properties and warehouse-type building in the north of the site had been demolished and a number of smaller buildings had been constructed. This redevelopment was utilised as an unspecified 'Works', occupying a large proportion of the site with the exception of the Public House in the north-west and 'Viaduct Villas' in the north-east. Great North Road had been retained, running approximately north-to-south along the western site boundary	Whole Site
1969	2010	The buildings formerly located in the central portion of the site had been demolished by the late 1960's, leaving an area of open space. The electricity substation located within the northern part of the eastern site boundary had been constructed by this time. By the mid- 1970's, Great North Road had been re-routed beyond the western site boundary and the site had been redeveloped to a similar layout as that of the current day, with car parking and the Hatfield Arms Public House in the North, Salisbury Parade in the centre, and Salisbury Square to the south. A minor road had been replaced by car parking for Black Horse House (off-site) in the north-west corner by the mid-1990's.	Whole Site
2010	2021	The site remains relatively unchanged since.	Whole Site

Date from	Date to	Historical Land Use (off-site)	Distance (m) and orientation
1879	1922	By the mid to late 1800s, Hatfield Railway Station and associated running lines had been constructed 60 m to the west of the site. Immediately south of Hatfield Station was a large residential property referred to as 'The Cottage'. Undeveloped land occupied the area to the west of the railway lines during the 1870's, slowly becoming occupied with terraces of residential properties through to the latter part of the 19th Century. Hatfield Brewery extended from the site itself to the southwest and two Smithys' located some 100 m and 120 m beyond, respectively.	All directions surrounding the site

Date from	Date to	Historical Land Use (off-site)	Distance (m) and orientation
		A relatively small Gas Works was located further southwest, some 180 m from the site, immediately west of the railway lines. Old Hatfield had been developed by this time and extended to the south and east of the site comprising a mixture of residential and commercial elements. The viaduct had been constructed by this time some 20 m to the north of the site, providing access to Hatfield Park and Hatfield House to the east. The land further to the north was largely undeveloped with open fields/allotments and occasional isolated dwellings. A small pond (Reed Pond), some 50m in length was located some 180 m to the southwest.	
1922	1960	The general configuration of Old Hatfield itself appeared to remain relatively unchanged into the early 20th Century. The premises associated with Hatfield Brewery to the immediate southwest had been partially demolished by the early 1920's. A Fire Station is also marked in the Batterdale area on the map labelled 1922, some 110 m to the southwest of the site. The majority of the alterations to the surrounding land into the mid-20th Century involved the continued expansion of residential land-use to the west of the railway lands and the assumed residential development of the Batterdale area to the immediate southwest of the site.	All directions surrounding the site
1960	1969	The emphasis on light industrial land-use increased into the early 1960's. Namely, unspecified 'Works' located 40 m northwest, 120 m south and 90 m southwest (two), a garage immediately east of the eastern (south) site boundary, 120 m south and 130 m south, a factory 70 m southwest and a builders yard beyond the railway lines around 160 m southwest. A depot had also replaced the former gas works, around 180 m to the southwest.	All directions surrounding the site
1969	2010	By the late 1960's, the residential and light industrial elements in the Batterdale area to the southwest had almost entirely been replaced by landscaping surrounding the St Teresa's Church area. This coincided with vast residential development beyond the viaduct to the north of the site. The residential dwellings immediately beyond the railway lines to the west of the site had also been demolished by this time and replaced by a Woodwork Factory, Printing Works, and a Tool Factory at	All directions surrounding the site

Date from	Date to	Historical Land Use (off-site)	Distance (m) and orientation
		distances of 150 m northwest, 120 m west and 170 m southwest, respectively. The light industrial development in this particular area continued into the 1980's with additional units including Engineering Works (120 m west), Heating and Ventilation Works (130 m west), Meat Processing Works (130 m west) and a Depot (140 m southwest). The former 'Works' 40 m to the northwest of the site had been demolished and replaced by a depot at this point. Furthermore, the Batterdale area had also been redeveloped with residential and commercial premises by this time. The most significant change during this period, however, was the re-routing of Great North Road to the west of the site.	
2010	2021	The surrounding area remained largely unchanged up until the current time, with the exception of an alteration in the light industrial use of the units to the west of the railway lines to comprise units associated with Medical Equipment Supplies and Pharmaceuticals, Precision Engineers and Concrete Products.	All directions surrounding the site
Relevant information sources: Historical OS maps ☒ Town plans ☐ Information from the Local Planning Authority ☐ Aerial photography ☒ Previous reports ☒			
Note: Reference to published historical maps provides invaluable information regarding the land use history of the site, but historical evidence may be incomplete for the period pre-dating the first edition and between successive maps.			

On-site historical use namely as a brewery (c. 1800 to 1920), presumed warehouse in the north of the site (c. 1800's to 1930's) and various works (c. 1940's to c. 1970's) pose a concern for contamination within the site. The Contaminants of concern include petroleum hydrocarbons, polycyclic aromatic hydrocarbon (PAHs) and asbestos.

Off-site industrial uses and presence of a railway pose contamination concerns of fuel oils, PAHs, heavy metals, solvents and other common industrial contaminants. Details of contaminant concerns are presented in **Section 6**.

3.1.2 Unexploded ordnance

A review of publicly available unexploded ordnance (UXO) risk maps indicates that the site is located in an area with low potential for wartime bombs to be present (Zetica, 2021).

3.2 Information from environmental database report

Relevant environmental permits and incidents detailed within the environmental database report (see **Appendix D**) are summarised below in **Table 4**.

Table 4 Summary of environmental permits, landfills and incidents

Data type	Entries on-site	Entries <250 m from site	Entries >250 m from site of relevance	Details
Agency and hydrological				
Environmental permits – incorporating Integrated Pollution Prevention and Control, Integrated Pollution Controls, Local Authority Integrated Pollution Prevention and Control	-	-	-	-
Enforcement and prohibition notices	-	-	-	-
Pollution incidents to controlled waters, Prosecutions relating to controlled waters, Substantiated pollution incident register, Water Industry Act referrals	-	1	-	Off-site <250 m: Property type unknown, Wash Lane, South Mymms, Ref. N1960182, issued 7/04/1996.
Discharge consents	-	1	-	Off-site <250 m: Hatfield Railway Club, Ref. Cntw.0652, issued 9/08/1990, revoked 1/10/1996.
Registered radioactive substances	-	-	-	-
Landfill and waste				
Active landfills	-	-	-	-
Historic / closed landfills	-	-	-	-
Other waste management licences	-	-	-	-
Potentially in-filled land (pit, quarry, pond, marsh, river, stream, dock etc)	-	1	-	Offsite <250 m: Water, unknown filled ground, date of mapping 1883.

Data type	Entries on-site	Entries <250 m from site	Entries >250 m from site of relevance	Details
Hazardous substances/ industrial land uses				
Control of Major Accident Hazards (COMAH) sites	-	-	-	-
Explosives sites, Notification of Installations Handling Hazardous Substances (NIHHS), Planning hazardous substance consents/ enforcements	-	-	-	-
Contaminated land Part 2A register entries and notices*	-	-	-	-
Contemporary trade directory entries	1	42	8	Refer to Envirocheck report in **Appendix D**.
Fuel station entries				
Note: Entries have only been included within the table where they are located within a 250 m radius of the site or, where they fall outside of this radius but are considered to comprise a significant entry. ****no entries or notices were found regarding Part 2A for Welwyn Hatfield Council***				

3.3 Information from regulatory authorities

3.3.1 Planning records

Planning records held by Welwyn Hatfield Borough Council predominantly relate to the change of use of a number of the buildings surrounding Salisbury Square itself, rather than detail on the actual site area. Readily available records date back to 1989, from which point the majority of the alterations relate to the buildings surrounding Salisbury Square. The records indicate the majority of applications granted relate to the conversion of the residential properties to flats and change in retail use of the surrounding shops.

3.3.2 Local Authority environmental health department information

The Environmental Health Department of Welwyn Hatfield Borough Council has no records of contamination in connection with the site. However, the report notes the possibility for potential contamination issues associated with the historical legacy of the site, specifically in relation to the use of part of the site as Hatfield Brewery from approximately 1800 to 1920.

A copy of the response is included in **Appendix E**.

3.3.3 Site services

Buried utility services and their backfill can provide preferential pathways for gas, vapour or groundwater to migrate along to another part of the site or to a receptor. They can also represent significant constraints to development.

Services identified on-site during the walkover are detailed in **Section 4**.

3.4 Site geology

3.4.1 Anticipated geological sequence

The published 1:50,000 scale geological map of the area (Sheet No 239 'Hertford') indicates that the site is underlain by the Kesgrave Catchment Subgroup over the White Chalk Subgroup. According to the map referred to above, the site is very close (generally within 100 m) to an outcrop of cohesive Lowestoft Formation to the south of the site.

BGS borehole logs have also been obtained from the site vicinity, specifically from the site at Hatfield Station to the west. These logs indicate a sequence of Glacial Deposits comprising Glacial Gravels (Kesgrave Catchment Subgroup) and Lowestoft Formation (Lowestoft Formation) to a depth of approximately 17 m bgl, overlying the White Chalk Subgroup to the terminal depth of the borehole at 122 m bgl. Groundwater was initially encountered within the chalk at approximately 27 m bgl.

On the basis of the published geological maps of the area, the full succession of natural strata in the vicinity of the site is likely to comprise:

Table 5 Conjectural Site Geology

Strata	Description	Estimated thickness	Permeability
Superficial Soils/Drift			
Lowestoft Formation (possibly in southern portion of site)	Sandy clay with flint and chalk	5 to 10 m	Low
Kesgrave Catchment Subgroup	Sand and gravels containing rounded bunter pebbles	10 to 15 m	High
Solid Geology Deposits			
White Chalk Subgroup	Soft white chalk with flints	>30 m	Low
Relevant information sources: BGS Geoindex ☒ BGS borehole logs ☐ Previous SI reports ☐			

With reference to the historical data there have clearly been some/several phases of construction and demolition on the site and therefore the presence of made ground should be expected.

3.4.2 Radon

The environmental database report indicates that the site is not located within an 'Affected Area'. An 'Affected Area' is one with 1% or more homes above the radon Action Level of 200 Bq m^{-3}. Therefore, the risk of significant ingress of radon into structures on-site is considered to be low and no radon protective measures are required within new dwellings (or extensions) at the site. Note the site-specific assessment within the environmental database report is at a higher resolution and therefore provides greater detail than that publicly available in the indicative radon atlas at www.ukradon.org.

3.5 Mining and quarrying

Evidence has been sought to identify any mining, quarrying and landfilling operations, past and present which have taken place in the vicinity of the site. The sources of information referenced in this element of the desk study include:

- Environmental database report;
- Records held by Local Authority (Hatfield Chalk Mines Map) / Environment Agency;
- Old Ordnance Survey maps and plans (see Section 3); and
- Geological maps (see Section 4.1).

The environmental database report indicates that the site is located in an area where the likelihood of chalk mining is unlikely (some small scale mining may have occurred, but restricted in extent). Furthermore, a map of potential local chalk mines produced by Welwyn Hatfield Borough Council confirms that no known historic chalk mining occurred beneath the site itself. However, a small chalk former chalk mine is noted on the same map, some 50 m to the northeast of the site (referred to as Area 25-Hill House). The Hatfield Chalk Mines map produced by Welwyn Hatfield Borough Council is included in **Appendix E**.

3.5.1 Coal mining area

The Coal Authority are a statutory consultee to Local Planning Authorities in respect of building development within the defined coal mining areas of England, Wales and Scotland where a planning application is required.

An initial site appraisal has been carried out based on the information provided on the Coal Authority Interactive Viewer of the UK Coalfield areas.

This indicates the site lies outside the Coal Authority Consultation Area and is not located within a coalfield area.

The key findings from review of the datasets from the Coal Authority Interactive Viewer and the Coal Mining report are summarised in **Table 6**.

Table 6 Summary of key coal mining information

Item	Applicable to site?	Comment
Development High Risk Area on-site	No	N/A
Coal mine entries	No	N/A
Past shallow workings (recorded)	No	N/A
Probable shallow workings	No	N/A
Coal seam outcrops	No	N/A
Surface mining (opencast)	No	N/A

3.5.2 Areas of other (rock or mineral) mining

The site lies in an area with a known history of mining of Chalk with two man-made mining cavities located approximately 91 m east of the site and 138 m south of the site.

3.6 Hydrogeology

Based on the published geological map referred to above, the hydrogeology of the site is likely to be characterised by the presence of a deep aquifer within the White Chalk Subgroup. Any cohesive Lowestoft Formation overlying the White Chalk Subgroup is likely to act as an aquitard.

The anticipated depth to the water table in the White Chalk Subgroup, i.e. the thickness of the unsaturated zone, is in the order of 25 to 30 m below ground level. However, perched groundwater may be present above any particularly cohesive soils. The regional direction of groundwater flow is to the northeast.

A summary of the hydrogeological setting of the site, with respect to the anticipated geological sequence set out in **Section 3.4** is presented below in **Table 7**.

Table 7 Summary of hydrogeological setting

Condition	Description
Aquifer characteristics	The White Chalk Subgroup beneath the site classified by the Environment Agency (EA) as a Principal Aquifer (as indicated on the Environment Agency Groundwater Vulnerability Map of the area, Sheet No. 39 'West London'. Furthermore, the Kesgrave Catchment Subgroup has been classified as a Secondary (A) Aquifer. The Principal Aquifer has been classified with a High (Urban) Vulnerability rating. Soil information for urban areas is less reliable and based on fewer observations that in rural areas. The worst case (i.e. high leaching potential) is therefore assumed until proved otherwise. The Lowestoft Formation is classified as a 'Non productive strata'.
Depth to groundwater and flow	The regional direction of groundwater flow is anticipated to be to the northeast.

Condition	Description
Groundwater recharge/ attenuation	Most of the site is currently covered with buildings and hardstanding and therefore this will limit infiltration to ground and groundwater recharge, except where SUDS are present.
Licensed groundwater abstractions	The environmental database report indicates that there are no groundwater abstractions within a 1 km radius of the site.
Source protection zones	Information available in the Envirocheck report indicates that the site does not lie within a currently designated groundwater Source Protection Zone (SPZ).

3.7 Hydrology

A summary of the hydrology within the site area is summarised in **Table 8**.

Table 8 Summary of hydrology in site area

Condition	Description
Surface watercourses/features	There are no ponds, streams or drainage ditches on or adjacent to the site. The nearest identified surface watercourse / feature to the site (with the exception of small ponds and drainage ditches within Hatfield Park to the east) is the River Lea located approximately 1.2 km to the north of the site. It should be noted that the environmental database also makes reference to an extended culvert which runs approximately southwest-to-northeast, marginally encroaching across the site boundary in the extreme northwest corner. This minor culverted channel appears to flow northwards and opens some 380 m to the north of the site before eventually flowing into the River Lea. The base flow of the River Lea is likely to be recharged by groundwater in north by both the shallow and deep aquifer in the site area. A linkage between the river and any ground or groundwater contamination beneath the site may therefore exist, however, the culvert is assumed to be in an isolated channel and therefore is not considered to present an additional pathway between the site and the River Lea.
Surface water abstractions	There are no surface water abstractions identified by the environmental database, within a 1 km radius of the site.
Site drainage	Surface drainage from the site appears to be discharged into a combined sewerage system, however no evidence has been received to support this assumption.
Preliminary flood risk assessment	The indicative floodplain map for the area, published by the EA, shows that the site does not lie within a floodplain. A flood risk assessment (FRA) is outside the scope of this report.

3.8 Sensitive land uses

Table 9 provides a summary of any environmentally sensitive areas identified within 250 m of the site based on the environmental database report.

Table 9 Environmentally sensitive areas

Feature	Present within 250 m of site?	Details	Likely pathways from site?
International designations – Ramsar wetland, Special Area of Conservation (SAC), Special Protection Area (SPA)	No	-	-
National designations – Site of Special Scientific Interest (SSSI), National Nature Reserve (NNR), ancient woodland	No	-	-
Local designations – Local Nature Reserve, Site of Importance for Nature Conservation (SINC)	No	-	-
Nearest high sensitivity development, e.g. residential	n/a	-	-

4 SITE RECONNAISSANCE FINDINGS

A site reconnaissance survey was completed on 13th January 2011 and again on 27 August 2021 by RSK. The aim of the survey was to identify the range of potentially contaminative activities carried out on the site and in the immediate vicinity, and any obvious potential sources of ground contamination.

The characteristics of the site observed during the walkover and from current ordnance Survey maps are summarised in **Table 10**.

Photographic records are included in **Appendix F** detailing the main features identified below.

Whilst the walkover summary includes consideration of operations observed at the time of inspection and housekeeping on the site as potential sources of contamination, it does not constitute a comprehensive environmental audit of the site, as covered under ISO 14001.

Table 10 Site reconnaissance findings

Feature	Description
Physical characteristics	
Site topography	The site generally slopes to the south with the most steeply sloping land within the car park area in the northern portion of the site.
Surface cover	With the exception of the raised area of soft landscaping in the centre of Salisbury Square, the majority of the site is covered by hardstanding in the form of bituminous hardstanding, pre-cast concrete slabs, and concrete paving slabs.
Site drainage	It is assumed that the existing surface water drainage is discharged into a combined sewerage system. However, we have not received any evidence to support this assumption.
Surface water	An existing culverted watercourse runs across the southern portion of the site. The exact location and orientation is shown on the WSP Drawing No. 1458-D-001, 'Outline Foul Water and Surface Water Drainage Proposals', which is also included as part of the overall submission.
Trees and hedges	The majority of the northern portion of the site is covered by hardstanding (concrete), with sections of the car park separated by hedges and a small number of trees. Two large landscaped areas are located in the central part of Salisbury Square which comprises two grassed areas with a number of plants, deciduous trees and two coniferous trees.
Invasive species	Details of invasive species had not been reported in previous 2011 report.
Existing buildings on-site	Salisbury Parade is located in the central portion of the site. These four separate buildings include 7 units of deck-access maisonette residential flats located above shops. This divides Salisbury Square from the car

Feature	Description
	park area to the north. The Hatfield Arms public house (to be retained) is located in the northwest corner of the site. A number of buildings are located on the eastern and western site boundaries, including a number of vacant units.
Retaining walls and adjacent buildings on or close to site boundary	A number of buildings form the site boundary, particularly within the Salisbury Square area in the southern part of the site. With the exception of the marginally raised landscaped area supported by a brick-faced wall within Salisbury Square, no retaining walls were identified.
Basements on-site	It is assumed that the historic buildings within the Salisbury Square area of the site had basements. However, there was no evidence of backfilled basements at the time of the site reconnaissance survey.
Made ground, earthworks and quarrying	None directly observed, however potentially present as part of raised landscaped area.
Potentially unstable slopes on or close to site	None observed
Buried and overhead services present	There are a number of manhole covers on site, furthermore, plans provided by the client detail a number of utilities beneath the site (both active and redundant).
Environmental characteristics	
Underground/ above ground storage tanks and pipework	None observed
Potentially hazardous materials storage and use	None observed
Asbestos-containing materials	No obvious asbestos construction materials were observed but a detailed survey of the buildings would be required to confirm the presence or otherwise of asbestos-containing materials.
Waste storage	Waste from the offices/retail units is stored in wheely bins.
Fly-tipping	None observed
Electricity sub-stations/ transformers	There is an existing sub-station located within the eastern portion of the site.
Evidence of possible land contamination on-site	None observed
Potential off-site sources of ground contamination	The railway land and light industrial premises to the west of the site are the most significant potential off-site sources of contamination. However, it is noted that a number of these premises are not

Feature	Description
	topographically up-gradient and the current activities are not considered to pose a significant risk to the subject site.

No potentially significant ground contamination issues associated with the current activities on and in the vicinity of the site were identified during the site reconnaissance survey. Hydrocarbon contamination in the form of leaks and spills from parked cars could be a potential source, however, no significant surface staining was noted that the time of the site investigation.