

CONTAMINATED LAND INTRUSIVE INVESTIGATION

Oak Tree Farm
Crawlboys Lane
Ludgershall
Wiltshire
SP11 9PL



April 2021

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1 Introduction and scope of work

Apple Environmental has been appointed to undertake an intrusive soil contamination investigation at Oak Tree Farm, Ludgershall SP11 9PL. This report has been prepared in support of the erection of five dwellings with access, gardens, and parking, along with a new agricultural store (Planning Ref. 19/05595/FUL).

An environmental desk study and preliminary risk assessment previously undertaken by Apple Environmental for the site (Report Ref. CL/2812/OAK) had identified a potential land contamination concern, due principally to general poultry farming activities, including possible hardcore and made-ground deposits and the possible presence of asbestos materials.

Due to the proposal to introduce soft landscaped garden areas, the conceptual model within the aforementioned desk study had highlighted a perceived risk from the above sources, with potentially significant pathway linkages enabling contamination to reach receptors.

In considering this, the contaminants deemed to be potentially present included general inorganics, hydrocarbons (both petroleum and poly-aromatic), agrochemical residue, asbestos, and possible ground gases.

An intrusive investigation was subsequently recommended in order to determine the presence and extent of any such contamination, and to assess the overall risk more fully. The investigation has principally focussed on the proposed garden areas to be associated with the dwellings.

The aims of this work therefore have been to devise and implement an appropriate strategy such that it has been possible to:

- determine the nature of the sub-surface material on-site;
- determine the presence of unacceptable ground contamination in specified areas, along with its nature and extent;
- assess the degree to which the site itself could be contributing to the contamination of environmental media off-site;
- observe or presume contaminant-pathway-receptor relationships on site; and
- assess the risk to future users of the site, as well as building structures and services.

This type of assessment relies upon visual examination of the area and sub-surface material, as well as the laboratory analysis of material samples.

As such, the specific objectives are:

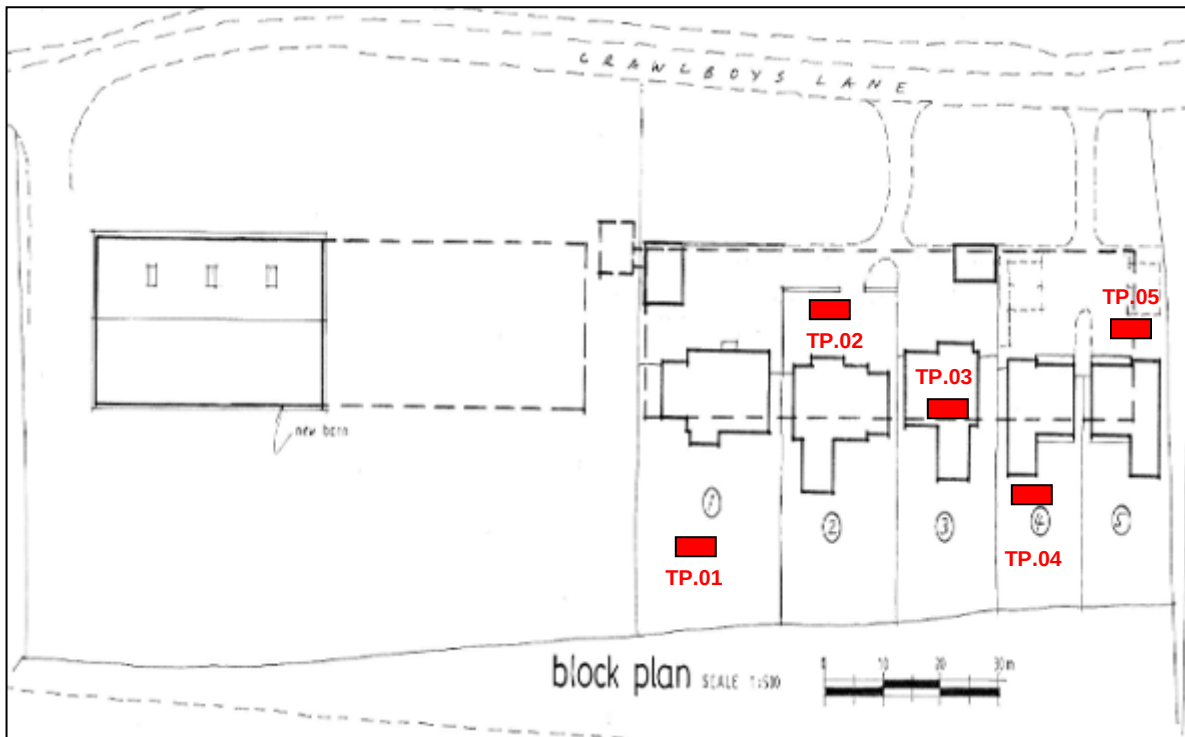
- to excavate trial pits at five separate locations at the site to a minimum depth of 1000mm;
- to characterise the nature of the sub-surface material at each of these locations;
- to collect at least two soil samples from each of the pits for laboratory analysis representing the direct contact zone (100 - 200mm) and the indirect contact zone (500 - 600mm);
- to collect additional soil samples from where there may be any other specific or noticeable contamination concern;
- to analyse the soil samples for a range of contamination indicators;
- to ascertain the significance of all chemical or physical data obtained;
- to determine the risk to future users based upon residential usage; and
- to make appropriate recommendations in order to reduce and/or eliminate any risks, as identified.

2 Methodology

As stated above, the overall aim of this investigation is to assess the sub-surface of the site in order to determine any risk that may be present as a result of ground contamination.

For this purpose, five trial pits were excavated across the site to a minimum depth of 1000mm, at the locations shown below in Figure 1.

Figure 1 Plan showing the approximate sampling locations



■ Trial pit sampling locations

The soil profile from each investigated location has been logged within Section 3 below, along with photographs showing the material excavated.

As stated, soil samples were collected from each of the trial pits representing depths of 100 - 200mm and 500 - 600mm.

All of these soil samples were placed immediately into sterilised containers and transferred into refrigerated cold-boxes until removed for analysis.

Chemical analysis was undertaken for the following determinands:

- arsenic, boron, cadmium, chromium, copper, lead, mercury, nickel, selenium, zinc;
- sulphate, sulphide, chloride, cyanide, ammonia and asbestos;
- benzene, toluene, ethylbenzene and xylene (all isomers);
- polycyclic aromatic hydrocarbons (speciated), petroleum hydrocarbons (banded TPHCWG);
- phenols, organochlorine pesticides, and non-speciated VOCs*.

* Photo-ionisation detection was undertaken in-situ on the removed soil material in order to detect vapours originating from any VOC residue (fuels/solvents etc.) that may be present in each excavated area. This was performed by means of an externally calibrated Phocheck Tiger PID, for which calibration certification has been appended to this report.

All chemical analyses were undertaken by a UKAS accredited laboratory. Laboratory certification has been appended to this report.

3 On-site observations

The ground surface across the site principally exists as a surface covering of stones and pebbles, underlain by a thin layer of sandy or chalky loam soil, overlying the natural geology.

There was no significant made-ground or hardcore detected.

It is understood that the bedrock beneath the site is characterised by the Seaford Chalk Formation, with overlying superficial glacial deposits. The latter are characterised by sand, silt, clay and gravels.

Both of these formations were observed across the site.

In general, it would appear that the site had previously been levelled, by means of bringing soil and chalk down from the adjacent higher ground to the southwest, in order to create a flat section of land. This has resulted in a surface layer of chalk in places overlying the superficial glacial deposits.

The sub-surface material strata logs have been reproduced below in Tables 1 to 5 along with any detailed observations.

Photographs showing the removed material have been appended to each strata log (Photographs 1 to 5).

Table 1 Strata log - Location **TP.01**

Location ID	Depth (mm)	Notes
TP.01	0 - 30	Stones
	30 - 150	Light brown and white, sandy, chalky loam with gravels and flint fragments (10 - 30mm)
	150 - 1000	Moist marly chalk with flints (50 - 150mm diameter)
Groundwater	-	Groundwater was not reached

Photograph 1 Trial pit and removed soil material - Location TP.01



Table 2 Strata log - Location **TP.02**

Location ID	Depth (mm)	Notes
TP.02	0 - 30	Stones
	30 - 200	Light brown and white, sandy, chalky loam with gravels flint fragments (10 - 30mm)
	200 - 1000	Moist marly chalk with flints (50 - 150mm diameter)
Groundwater	-	Groundwater was not reached

Photograph 2 Trial pit and removed soil material - Location TP.02



Table 3 Strata log - Location **TP.03**

Location ID	Depth (mm)	Notes
TP.03	0 - 30	Stones
	30 - 230	Light brown and white, sandy, chalky loam with gravels and flint fragments (10 - 50mm)
	230 - 1000	Moist clayey sand with gravels (10 - 40mm)
Groundwater	-	Groundwater was not reached

Photograph 3 Trial pit and removed soil material - Location TP.03



Table 4 Strata log - Location **TP.04**

Location ID	Depth (mm)	Notes
TP.04	0 - 30	Stones
	30 - 130	Light brown and white, sandy, chalky loam with gravels and flint fragments (10 - 60mm)
	130 - 1000	Moist clayey sand with gravels (10 - 40mm)
Groundwater	-	Groundwater was not reached

Photograph 4 Trial pit and removed soil material - Location TP.04



Table 5 Strata log - Location **TP.05**

Location ID	Depth (mm)	Notes
TP.05	0 - 30	Stones
	30 - 180	Light brown and white, sandy, chalky loam with gravels and flint fragments (10 - 70mm)
	180 - 680	Moist clayey sand with gravels (10 - 40mm)
	680 - 1000	Very soft, moist sandy, clayey, chalk with gravels and flint fragments (10 - 70mm)
Groundwater	-	Groundwater not present

Photograph 5 Trial pit and removed soil material - Location TP.05



4 Results from soil analyses

The results from the soil analyses are displayed in Tables 9 to 15 below. Any determinand detected has been highlighted in **bold** type.

Table 9 Results for specified inorganics in soil - metals

Determinand (mg/kg)	TP.01		TP.02		TP.03	
	Depth 100-200mm	Depth 500-600mm	Depth 100-200mm	Depth 500-600mm	Depth 100-200mm	Depth 500-600mm
Arsenic	6	2	6	8	6	5
Boron	< 1	< 1	< 1	< 1	< 1	< 1
Cadmium	0.3	< 0.2	0.5	0.2	0.3	0.2
Chromium	10	3	11	22	14	13
Hexavalent chromium	< 2	< 2	< 2	< 2	< 2	< 2
Copper	13	10	9	7	7	7
Lead	14	3	11	15	12	9
Mercury (total)	< 1	< 1	< 1	< 1	< 1	< 1
Nickel	11	5	10	17	11	10
Selenium	< 3	< 3	< 3	< 3	< 3	< 3
Zinc	32	13	41	54	36	35

Table 9 (Cont.)

Results for specified inorganics in soil - metals

Determinand (mg/kg)	TP.04		TP.05	
	Depth 100-200mm	Depth 500-600mm	Depth 100-200mm	Depth 500-600mm
Arsenic	6	9	3	2
Boron	< 1	< 1	< 1	< 1
Cadmium	< 0.2	< 0.2	< 0.2	< 0.2
Chromium	19	21	6	5
Hexavalent chromium	< 2	< 2	< 2	< 2
Copper	4	9	9	9
Lead	14	14	4	4
Mercury (total)	< 1	< 1	< 1	< 1
Nickel	11	18	6	6
Selenium	< 3	< 3	< 3	< 3
Zinc	39	50	18	16

Table 10 Results for specified inorganics in soil - non-metals

Determinand (mg/kg)	TP.01		TP.02		TP.03	
	Depth 100-200mm	Depth 500-600mm	Depth 100-200mm	Depth 500-600mm	Depth 100-200mm	Depth 500-600mm
Cyanide (total)	<2	<2	<2	<2	<2	<2
Sulphate (total)	678	504	605	683	506	566
Sulphide	<5	<5	<5	<5	<5	<5
Chloride	10	12	9	11	11	21
Asbestos	None detected	None detected	None detected	None detected	None detected	None detected
	TP.04		TP.05			
	Depth 100-200mm	Depth 500-600mm	Depth 100-200mm	Depth 500-600mm		
Cyanide (total)	<2	<2	<2	<2		
Sulphate (total)	607	748	405	411		
Sulphide	<5	<5	<5	<5		
Chloride	7	7	11	7		
Asbestos	None detected	None detected	None detected	None detected		

Table 11 Results for specified hydrocarbons in soil

Determinand (mg/kg)	TP.01		TP.02		TP.03	
	Depth 100-200mm	Depth 500-600mm	Depth 100-200mm	Depth 500-600mm	Depth 100-200mm	Depth 500-600mm
Benzene	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Toluene	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Ethylbenzene	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
p & m-Xylene	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
o-Xylene	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
MTBE	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Phenols	< 2	< 2	< 2	< 2	< 2	< 2
	TP.04		TP.05			
	Depth 100-200mm	Depth 500-600mm	Depth 100-200mm	Depth 500-600mm		
Benzene	<0.002	<0.002	<0.002	<0.002		
Toluene	<0.005	<0.005	<0.005	<0.005		
Ethylbenzene	<0.002	<0.002	<0.002	<0.002		
p & m-Xylene	<0.002	<0.002	<0.002	<0.002		
o-Xylene	<0.002	<0.002	<0.002	<0.002		
MTBE	<0.005	<0.005	<0.005	<0.005		
Phenols	< 2	< 2	< 2	< 2		

Table 12 Results for poly-aromatic hydrocarbons in soil

Determinand (mg/kg)	TP.01		TP.02		TP.03	
	Depth 100-200mm	Depth 500-600mm	Depth 100-200mm	Depth 500-600mm	Depth 100-200mm	Depth 500-600mm
Naphthalene	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Acenaphthylene	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Acenaphthene	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Fluorene	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Phenanthrene	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Anthracene	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Fluoranthene	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Pyrene	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(a)anthracene	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Chrysene	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(b)fluoranthene	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(k)fluoranthene	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(a)pyrene	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Indeno(123-cd)pyrene	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Dibenzo(ah)anthracene	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(ghi)perylene	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Coronene	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Total PAHs	<1.6	<1.6	<1.6	<1.6	<1.6	<1.6

Table 12 (Cont.) Results for poly-aromatic hydrocarbons in soil

Determinand (mg/kg)	TP.04		TP.05	
	Depth 100-200mm	Depth 500-600mm	Depth 100-200mm	Depth 500-600mm
Naphthalene	< 0.1	< 0.1	< 0.1	< 0.1
Acenaphthylene	< 0.1	< 0.1	< 0.1	< 0.1
Acenaphthene	< 0.1	< 0.1	< 0.1	< 0.1
Fluorene	< 0.1	< 0.1	< 0.1	< 0.1
Phenanthrene	< 0.1	< 0.1	< 0.1	< 0.1
Anthracene	< 0.1	< 0.1	< 0.1	< 0.1
Fluoranthene	< 0.1	< 0.1	< 0.1	< 0.1
Pyrene	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(a)anthracene	< 0.1	< 0.1	< 0.1	< 0.1
Chrysene	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(b)fluoranthene	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(k)fluoranthene	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(a)pyrene	< 0.1	< 0.1	< 0.1	< 0.1
Indeno(123-cd)pyrene	< 0.1	< 0.1	< 0.1	< 0.1
Dibenzo(ah)anthracene	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(ghi)perylene	< 0.1	< 0.1	< 0.1	< 0.1
Coronene	< 0.1	< 0.1	< 0.1	< 0.1
Total PAHs	<1.6	<1.6	<1.6	<1.6

Table 13 Results for petroleum hydrocarbons in soil

Determinand (mg/kg)	TP.01		TP.02		TP.03	
	Depth 100-200mm	Depth 500-600mm	Depth 100-200mm	Depth 500-600mm	Depth 100-200mm	Depth 500-600mm
Aliphatic C5 - C6	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Aliphatic C6 - C8	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Aliphatic C8 - C10	< 2	< 2	< 2	< 2	< 2	< 2
Aliphatic C10 - C12	< 2	< 2	< 2	< 2	< 2	< 2
Aliphatic C12 - C16	< 3	< 3	< 3	< 3	< 3	< 3
Aliphatic C16 - C21	< 3	< 3	< 3	< 3	< 3	< 3
Aliphatic C21 - C34	< 10	< 10	< 10	< 10	< 10	< 10
Total Aliphatic (C5 - 34)	<21	< 21	< 21	< 21	< 21	< 21
Total Aliphatic (C35 - 40)	< 10	< 10	< 10	< 10	< 10	< 10
Aromatic C5 - C7	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Aromatic C7 - C8	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Aromatic C8 - C10	< 2	< 2	< 2	< 2	< 2	< 2
Aromatic C10 - C12	< 2	< 2	< 2	< 2	< 2	< 2
Aromatic C12 - C16	< 2	< 2	< 2	< 2	< 2	< 2
Aromatic C16 - C21	< 3	< 3	< 3	< 3	< 3	< 3
Aromatic C21 - C35	< 10	< 10	< 10	< 10	< 10	< 10
Total Aromatic (C5 -35)	< 21	< 21	< 21	< 21	< 21	< 21
Total Aromatic (C35-40)	< 10	< 10	< 10	< 10	< 10	< 10
Total (C6 - 40)	<42	<42	<42	<42	<42	<42

Table 13 (Cont.) Results for petroleum hydrocarbons in soil

Determinand (mg/kg)	TP.04		TP.05	
	Depth 100-200mm	Depth 500-600mm	Depth 100-200mm	Depth 500-600mm
Aliphatic C5 - C6	< 0.01	< 0.01	< 0.01	< 0.01
Aliphatic C6 - C8	< 0.05	< 0.05	< 0.05	< 0.05
Aliphatic C8 - C10	< 2	< 2	< 2	< 2
Aliphatic C10 - C12	< 2	< 2	< 2	< 2
Aliphatic C12 - C16	< 3	< 3	< 3	< 3
Aliphatic C16 - C21	< 3	< 3	< 3	< 3
Aliphatic C21 - C34	< 10	< 10	< 10	< 10
Total Aliphatic (C5 - 34)	<21	< 21	< 21	< 21
Total Aliphatic (C35 - 40)	< 10	< 10	< 10	< 10
Aromatic C5 - C7	< 0.01	< 0.01	< 0.01	< 0.01
Aromatic C7 - C8	< 0.05	< 0.05	< 0.05	< 0.05
Aromatic C8 - C10	< 2	< 2	< 2	< 2
Aromatic C10 - C12	< 2	< 2	< 2	< 2
Aromatic C12 - C16	< 2	< 2	< 2	< 2
Aromatic C16 - C21	< 3	< 3	< 3	< 3
Aromatic C21 - C35	< 10	< 10	< 10	< 10
Total Aromatic (C5 -35)	< 21	< 21	< 21	< 21
Total Aromatic (C35-40)	< 10	< 10	< 10	< 10
Total (C6 - 40)	<42	<42	<42	<42

Table 14 Non-specified VOCs - measured by means of photo-ionisation detection in-situ

TP.01		TP.02		TP.03	
Depth 100-200mm	Depth 500-600mm	Depth 100-200mm	Depth 500-600mm	Depth 100-200mm	Depth 500-600mm
<0.1 ppm	<0.1 ppm	<0.1 ppm	<0.1 ppm	<0.1 ppm	<0.1 ppm
TP.04		TP.05			
Depth 100-200mm	Depth 500-600mm	Depth 100-200mm	Depth 500-600mm		
<0.1 ppm	<0.1 ppm	<0.1 ppm	<0.1 ppm		

Table 15 Results for organochlorine pesticides

Determinand (mg/kg)	TP.02	TP.04		TP.02	TP.04
	Depth 100-200mm	Depth 100-200mm		Depth 100-200mm	Depth 100-200mm
Aldrin	< 0.02	< 0.02	Hexachlorobenzene (HCB)	< 0.02	< 0.02
alpha-HCH	< 0.02	< 0.02	Isodrin	< 0.02	< 0.02
beta-HCH	< 0.02	< 0.02	Methoxychlor	< 0.02	< 0.02
cis-chlordane	< 0.02	< 0.02	o,p' - DDD	< 0.02	< 0.02
delta-HCH	< 0.02	< 0.02	o,p' - DDE	< 0.02	< 0.02
Dieldrin	< 0.02	< 0.02	o,p' - DDT	< 0.02	< 0.02
Endosulfan A	< 0.02	< 0.02	p,p' - DDD	< 0.02	< 0.02
Endosulfan B	< 0.02	< 0.02	p,p' - DDE	< 0.02	< 0.02
Endrin	< 0.02	< 0.02	p,p' - DDT	< 0.02	< 0.02
gamma-HCH (Lindane)	< 0.02	< 0.02	trans-chlordane	< 0.02	< 0.02
Heptachlor	< 0.02	< 0.02	Trifluralin	< 0.02	< 0.02
Heptachlor epoxide	< 0.02	< 0.02			

5 Interpretation

Tables 16 to 18 below show the soil guideline concentrations used as part of this assessment.

Where Environment Agency guideline values are unavailable, soil guideline concentrations derived using CLEA software packages and other published guidelines have been consulted. In all instances guideline values for residential end-use with home-grown produce have been considered.

For the purposes of this assessment therefore, the following guideline criteria have been referred to:

- Environment Agency Category 4 Screening Levels (2014);
- CIEH (LQM) GAC 3rd Edition (residential end-use);
- Atkins ATRISK SSVs (residential end-use with home-grown produce);
- GAC CLEA generated value for residential end-use with home-grown produce; and
- others, as available.

Note that for some guideline values a choice of soil organic matter (SOM) concentration is provided whereby different guideline concentrations exist for SOM values of between 1% and 6%.

In this instance the guideline value for 1% SOM was referred to, as the mean organic content was determined as 0.6%; which approximates to 1% SOM.

Table 16 Soil guideline concentrations referred to for this assessment

Determinand (mg/kg)	Guideline concentration for 1% SOM	Origin
Arsenic	37	Atkins ATRISK Category 4 Screening Level
Boron	290	LQM/CIEH S4ULs (CLEA 1.06) for residential with home-grown produce
Cadmium	22.1	Atkins ATRISK Category 4 Screening Level
Chromium	14300	Atkins ATRISK (CLEA 1.07) for residential with home-grown produce
Chromium VI	20.5	Atkins ATRISK Category 4 Screening Level
Copper	4730	Atkins ATRISK (CLEA 1.07) for residential with home-grown produce
Lead	200	Category 4 Screening Level ^(a)
Mercury (elemental)	0.0863	Atkins ATRISK (CLEA 1.07) for residential with home-grown produce
Mercury (inorganic Hg ²⁺)	180	Atkins ATRISK (CLEA 1.07) for residential with home-grown produce
Nickel	136	Atkins ATRISK (CLEA 1.07) for residential with home-grown produce
Selenium	375	Atkins ATRISK (CLEA 1.07) for residential with home-grown produce
Zinc	20000	Atkins ATRISK (CLEA 1.07) for residential with home-grown produce
Free Cyanide	34	Atkins ATRISK (CLEA 1.07) for residential with home-grown produce
Sulphate	10000	ICRCL Action Value domestic gardens ^(b)
Sulphide	1000	ICRCL Action Value all uses ^(b)
Phenols (SOM 1%)	267	Atkins ATRISK (CLEA 1.07) for residential with home-grown produce
Benzene (SOM 1%)	0.137	Atkins ATRISK (C4SL) for residential with home-grown produce
Toluene (SOM 1%)	113	Atkins ATRISK (CLEA 1.07) for residential with home-grown produce
Ethylbenzene (SOM 1%)	50.7	Atkins ATRISK (CLEA 1.07) for residential with home-grown produce
o-Xylene (SOM 1%)	26.4	Atkins ATRISK (CLEA 1.07) for residential with home-grown produce
m-Xylene (SOM 1%)	25	Atkins ATRISK (CLEA 1.07) for residential with home-grown produce
p-Xylene (SOM 1%)	24	Atkins ATRISK (CLEA 1.07) for residential with home-grown produce

(a) Quoted for residential land-use 0-7 year-old child taking into account bioavailability, with exposure parameters as detailed in report SR3.

(b) This 'withdrawn' value has been quoted in the absence of any other available published guideline.

Table 17 Soil guideline concentrations for PAHs referred to for this assessment

Determinand (mg/kg)	Guideline concentration for 1% SOM	Origin
Naphthalene	2.3	LQM/CIEH S4ULs (CLEA 1.06) for residential with home-grown produce
Acenaphthylene	608	Atkins ATRISK (CLEA 1.07) for residential with home-grown produce
Acenaphthene	210	LQM/CIEH S4ULs (CLEA 1.06) for residential with home-grown produce
Fluorene	735	Atkins ATRISK (CLEA 1.07) for residential with home-grown produce
Phenanthrene	95	LQM/CIEH S4ULs (CLEA 1.06) for residential with home-grown produce
Anthracene	10200	Atkins ATRISK (CLEA 1.07) for residential with home-grown produce
Fluoranthene	983	Atkins ATRISK (CLEA 1.07) for residential with home-grown produce
Pyrene	668	Atkins ATRISK (CLEA 1.07) for residential with home-grown produce
Benzo(a)anthracene	7.2	LQM/CIEH S4ULs (CLEA 1.06) for residential with home-grown produce
Chrysene	15	LQM/CIEH S4ULs (CLEA 1.06) for residential with home-grown produce
Benzo(b)fluoranthene	2.6	LQM/CIEH S4ULs (CLEA 1.06) for residential with home-grown produce
Benzo(k)fluoranthene	77	LQM/CIEH S4ULs (CLEA 1.06) for residential with home-grown produce
Benzo(a)pyrene	2.2	LQM/CIEH S4ULs (CLEA 1.06) for residential with home-grown produce
Indeno(123-cd)pyrene	27	LQM/CIEH S4ULs (CLEA 1.06) for residential with home-grown produce
Dibenzo(ah)anthracene	0.24	LQM/CIEH S4ULs (CLEA 1.06) for residential with home-grown produce
Benzo(ghi)perylene	320	LQM/CIEH S4ULs (CLEA 1.06) for residential with home-grown produce

Table 18 Soil guideline concentrations for TPHs referred to for this assessment

Determinand (mg/kg)	Guideline concentration for 1% SOM	Origin
Aliphatic TPH C5-C6	42.7	Atkins ATRISK (CLEA 1.07) for residential with home-grown produce
Aliphatic TPH C6-C8	99.3	Atkins ATRISK (CLEA 1.07) for residential with home-grown produce
Aliphatic TPH C8-C10	13.9	Atkins ATRISK (CLEA 1.07) for residential with home-grown produce
Aliphatic TPH C10-C12	81.7	Atkins ATRISK (CLEA 1.07) for residential with home-grown produce
Aliphatic TPH C12-C16	385	Atkins ATRISK (CLEA 1.07) for residential with home-grown produce
Aliphatic TPH C16-C35	210000	Atkins ATRISK (CLEA 1.07) for residential with home-grown produce
Aliphatic TPH C35-C44	65000	LQM/CIEH S4ULs (CLEA 1.06) for residential with home-grown produce
Aromatic TPH C5-C7	0.137	Atkins ATRISK (CLEA 1.07) for residential with home-grown produce
Aromatic TPH C7-C8	113	Atkins ATRISK (CLEA 1.07) for residential with home-grown produce
Aromatic TPH C8-C10	20.5	Atkins ATRISK (CLEA 1.07) for residential with home-grown produce
Aromatic TPH C10-C12	70	Atkins ATRISK (CLEA 1.07) for residential with home-grown produce
Aromatic TPH C12-C16	165	Atkins ATRISK (CLEA 1.07) for residential with home-grown produce
Aromatic TPH C16-C21	319	Atkins ATRISK (CLEA 1.07) for residential with home-grown produce
Aromatic TPH C21-C35	1120	Atkins ATRISK (CLEA 1.07) for residential with home-grown produce
Aromatic TPH C5-C35	1100	LQM/CIEH S4ULs (CLEA 1.06) for residential with home-grown produce

6 Summary of analyses

As detailed above, five trial pits were excavated on this site to a depth of 1000mm, from each of which two soil samples were collected for laboratory analysis, representing depths of 100 - 200mm and 500 - 600mm.

In doing so, the results reproduced in Tables 9 to 15 above have shown that there were no determinands present above any corresponding referenced soil guideline criteria, when considered for residential development with home-grown produce.

Similarly there were also no substances detected at a concentration close to their corresponding guideline level.

7 Review of conceptual model and risk assessment

Using the sampling results and observations made, the conceptual site model (CSM) from the Phase 1 desk study can now be reviewed and updated. In doing so any uncertainties highlighted within that report can now be readdressed and the corresponding risk reassessed.

In reviewing this conceptual model, Table 19 below highlights any perceived pollutant pathway linkages that may be present.

It should be noted that the following re-assessment of risk, has been made on the basis that there will be soft landscaped recreational areas associated with the proposed dwellings, as well as the presumption that groundworks will be undertaken for the installation of footings and new services etc.

The risk matrix used for this purpose is reproduced below in Figure 2.

Figure 2 Risk assessment algorithm

Potential severity	Risk rating						Severity of hazard	Probability of hazard	Overall risk
	5	5	10	15	20	25	5 = Fatality	1 = Improbable	1 - 6 Low
	4	4	8	12	16	20	4 = Major	2 = Remote	8 - 12 Medium
	3	3	6	9	12	15	3 = Minor	3 = Possible	15 - 25 High
	2	2	4	6	8	10	2 = Negligible	4 = Probable	
	1	1	2	3	4	5	1 = None	5 = Certainty	
		1	2	3	4	5			
	Probability						Severity of hazard x probability = risk rating		

Table 19 Reviewed comments relating to perceived risk

Contaminants identified	Potential pathways	Perceived level of risk	Comments and reasoning
None detected	Digestion of soil or soil-derived dust	4	In the absence of any identifiable soil contamination the risk from the digestion of soil is very low.
	Dermal contact with soil or soil-derived dust	4	In the absence of any identifiable soil contamination the risk from direct or indirect contact with the soil is very low.
	Inhalation of soil or soil-derived dust	4	In the absence of any identifiable soil contamination the risk from the inhalation of soil is very low.
	Ingestion of vegetables	4	In the absence of any identifiable soil contamination the risk from the digestion of home-grown fruit and vegetables is very low.
	Inhalation and/or ignition of gases and/or vapours	4	In the absence of any high concentration of organic material the risk from exposure to ground gases is very low.
	Contact with groundwater	2	In the absence of any identifiable soil contamination the risk to groundwater is very low.
	Direct contact with buildings and services	2	In the absence of any aggressive soil contaminants the risk to underground building fabric and services is very low.

8 Summary and recommendations

8.1 Summary

This report has considered a section of land on Oak Tree Farm where it has been proposed to locate five new dwellings.

The corresponding desk study had highlighted some potential for the land to have been impacted by on-site activities as a result of its recent use as a poultry farm, and therefore intrusive investigation had been recommended.

For this purpose, five trial pits were excavated across this section of land, down to a minimum depth of 1000mm, allowing the subsurface to be both visually characterised, and assessed for possible contamination.

The findings from this investigation were that the soil down to this depth appears to have originated from the subject site itself, although it may well have been redistributed at some point in time, in order to create an area of level ground upon which to construct the former poultry sheds.

As such the soil beneath the surface appeared to comprise both the natural chalk bedrock and the original overlying superficial glacial deposits of this specific location, although it was not necessarily seen as the natural stratigraphic progression in places.

With regards to contamination, soil samples were obtained from two separate depths at each investigation location, and analysed for the determinands highlighted in the conceptual site model (CSM).

In doing so, there were no determinands detected at a concentration close to, or exceeding, any corresponding guideline criteria for residential development with associated gardens. Similarly there were no visual or olfactory concerns noted. This has therefore enabled any uncertainties within the original CSM to be addressed, and the overall risk to be reassessed with greater reassurance.

On the basis of these findings, and the corresponding revision of the CSM, the overall risk to all highlighted receptors from exposure to soil contamination would appear to be very low.

8.2 Recommendations

Despite this report concluding that the risk to identified receptors should be very low, it recognises the fact that undiscovered contamination could potentially be present in other uninvestigated areas.

It is therefore recommended that an informal observation strategy is put in place during any groundworks that may take place, as part of this development.

More specifically, should the ground be suspected of being contaminated by sight, odour, or otherwise, then excavation work should cease immediately and the concern investigated further.

Work should not continue in any such area of concern until it has been considered to be safe to do so.

9 Limitations

This work has been undertaken in accordance with Apple Environmental Limited's standard terms and conditions.

The findings represent the professional opinion of the report author. All work carried out is based upon Apple Environmental Limited's current professional knowledge and understanding. It is therefore stated that the conclusions of this report have been based upon information gathered from a number of sources and it can only be assumed that this information provided was accurate and correct.

Intrusive investigation undertaken as part of this work has been restricted to a level of detail required to achieve the stated objectives of this work. The results of any measurements taken may vary spatially or with time, and further confirmatory measurements may wish to be considered, as necessary.

It is also pointed out that soil sampling, may only provide a general indication of contamination present. There is always the possibility that other undetected contaminants exist, or, that detected contaminants may exist at a greater concentration than that specified in areas of the site that have not been intrusively investigated.

10 References and specific sources of information

1. Investigation of potentially contaminated sites - code of practice (BSI 10175:2011+A2:2017)
2. Using Soil Guideline Values - Environment Agency Science Report SC050021/SGV (March 2009)
3. The LQM/CIEH Generic Assessment Criteria for Human Health Risk Assessment CIEH 3rd Ed. - Land Quality Management Ltd. (2015)
4. Atkins ATRISK SSCs (July 2017)
5. CLEA Software (Version 1.05) Handbook - Environment Agency Science Report SC050021/SR4 (January 2014)
6. ICRCL 59/83 Trigger Concentrations - Department of the Environment (1983)
7. Land Affected by Contamination - Planning Practice Guidance - The Department for Communities and Local Government (June 2014)
8. The National Planning Policy Framework (Revised) - February 2019
9. Model procedures for the management of contaminated land (CLR-11) - Environment Agency (September 2004)
10. Contaminated Land Risk Assessment: A Guide to Good Practice (C552) - CIRIA (2001)
11. SP1010 - Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination - CL:AIRE (September 2014)
12. British Geological Survey. Geology of Britain:
<http://mapapps.bgs.ac.uk/geologyofbritain/home.html?>

APPENDICES

Laboratory data
Calibration certification



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DETS Report No: 21-04608

Site Reference: None Supplied

Project / Job Ref: CL/3153/OAK

Order No: None Supplied

Sample Receipt Date: 12/04/2021

Sample Scheduled Date: 12/04/2021

Report Issue Number: 1

Reporting Date: 19/04/2021

Authorised by:

Dave Ashworth
Technical Manager

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

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



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Soil Analysis Certificate						
DETS Report No: 21-04608	Date Sampled	08/04/21	08/04/21	08/04/21	08/04/21	08/04/21
Apple Environmental Ltd	Time Sampled	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Site Reference: None Supplied	TP / BH No	TP.01/01/3153	TP.01/02/3153	TP.02/01/3153	TP.02/02/3153	TP.03/01/3153
Project / Job Ref: CL/3153/OAK	Additional Refs	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Order No: None Supplied	Depth (m)	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Reporting Date: 19/04/2021	DETS Sample No	536862	536863	536864	536865	536866

Determinand	Unit	RL	Accreditation	(n)				
Asbestos Screen ^(S)	N/a	N/a	ISO17025	Not Detected	Not Detected	Not Detected	Not Detected	Not Detected
pH	pH Units	N/a	MCERTS	8.4	8.4	8.2	7.8	8.3
Total Cyanide	mg/kg	< 2	NONE	< 2	< 2	< 2	< 2	< 2
Total Sulphate as SO ₄	mg/kg	< 200	MCERTS	678	504	605	683	506
Total Sulphate as SO ₄	%	< 0.02	MCERTS	0.07	0.05	0.06	0.07	0.05
W/S Sulphate as SO ₄ (2:1)	mg/l	< 10	MCERTS	67	48	11	123	27
W/S Sulphate as SO ₄ (2:1)	g/l	< 0.01	MCERTS	0.07	0.05	0.01	0.12	0.03
Sulphide	mg/kg	< 5	NONE	< 5	< 5	< 5	< 5	< 5
Total Organic Carbon (TOC)	%	< 0.1	MCERTS	0.1	0.4	0.4	0.7	0.5
W/S Chloride (2:1)	mg/kg	< 1	MCERTS	10	12	9	11	11
W/S Chloride (2:1)	mg/l	< 0.5	MCERTS	4.8	6.1	4.4	5.3	5.3
Arsenic (As)	mg/kg	< 2	MCERTS	6	2	6	8	6
W/S Boron	mg/kg	< 1	NONE	< 1	< 1	< 1	< 1	< 1
Cadmium (Cd)	mg/kg	< 0.2	NONE	0.3	< 0.2	0.5	0.2	0.3
Chromium (Cr)	mg/kg	< 2	MCERTS	10	3	11	22	14
Chromium (hexavalent)	mg/kg	< 2	NONE	< 2	< 2	< 2	< 2	< 2
Copper (Cu)	mg/kg	< 4	MCERTS	13	10	9	7	7
Lead (Pb)	mg/kg	< 3	MCERTS	14	3	11	15	12
Mercury (Hg)	mg/kg	< 1	MCERTS	< 1	< 1	< 1	< 1	< 1
Nickel (Ni)	mg/kg	< 3	MCERTS	11	5	10	17	11
Selenium (Se)	mg/kg	< 2	MCERTS	< 3	< 3	< 3	< 3	< 3
Zinc (Zn)	mg/kg	< 3	MCERTS	32	13	41	54	36
Total Phenols (monohydric)	mg/kg	< 2	NONE	< 2	< 2	< 2	< 2	< 2
TPH - Aliphatic >C35 - C40	mg/kg	< 10	NONE	< 10	< 10	< 10	< 10	< 10
TPH - Aromatic >C35 - C40	mg/kg	< 10	NONE	< 10	< 10	< 10	< 10	< 10
TPH - Aliphatic / Aromatic (C6 - C40) - Total	mg/kg	< 42	NONE	< 42	< 42	< 42	< 42	< 42

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

(n) Please note we are only MCERTS accredited (UK soils only) for sand, loam and clay and any other matrix is outside our scope of accreditation



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Soil Analysis Certificate						
DETS Report No: 21-04608	Date Sampled	08/04/21	08/04/21	08/04/21	08/04/21	08/04/21
Apple Environmental Ltd	Time Sampled	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Site Reference: None Supplied	TP / BH No	TP.03/02/3153	TP.04/01/3153	TP.04/02/3153	TP.05/01/3153	TP.05/02/3153
Project / Job Ref: CL/3153/OAK	Additional Refs	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Order No: None Supplied	Depth (m)	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Reporting Date: 19/04/2021	DETS Sample No	536867	536868	536869	536870	536871

Determinand	Unit	RL	Accreditation	(n)	(n)	(n)	(n)	(n)
Asbestos Screen ^(S)	N/a	N/a	ISO17025	Not Detected	Not Detected	Not Detected	Not Detected	Not Detected
pH	pH Units	N/a	MCERTS	8.1	7.9	6.5	8.3	8.3
Total Cyanide	mg/kg	< 2	NONE	< 2	< 2	< 2	< 2	< 2
Total Sulphate as SO ₄	mg/kg	< 200	MCERTS	566	607	748	405	411
Total Sulphate as SO ₄	%	< 0.02	MCERTS	0.06	0.06	0.07	0.04	0.04
W/S Sulphate as SO ₄ (2:1)	mg/l	< 10	MCERTS	46	13	153	21	22
W/S Sulphate as SO ₄ (2:1)	g/l	< 0.01	MCERTS	0.05	0.01	0.15	0.02	0.02
Sulphide	mg/kg	< 5	NONE	< 5	< 5	< 5	< 5	< 5
Total Organic Carbon (TOC)	%	< 0.1	MCERTS	0.6	1.6	0.8	0.4	0.5
W/S Chloride (2:1)	mg/kg	< 1	MCERTS	21	7	7	11	7
W/S Chloride (2:1)	mg/l	< 0.5	MCERTS	10.4	3.4	3.5	5.5	3.5
Arsenic (As)	mg/kg	< 2	MCERTS	5	6	9	3	2
W/S Boron	mg/kg	< 1	NONE	< 1	< 1	< 1	< 1	< 1
Cadmium (Cd)	mg/kg	< 0.2	NONE	0.2	< 0.2	< 0.2	< 0.2	< 0.2
Chromium (Cr)	mg/kg	< 2	MCERTS	13	19	21	6	5
Chromium (hexavalent)	mg/kg	< 2	NONE	< 2	< 2	< 2	< 2	< 2
Copper (Cu)	mg/kg	< 4	MCERTS	7	4	9	9	9
Lead (Pb)	mg/kg	< 3	MCERTS	9	14	14	4	4
Mercury (Hg)	mg/kg	< 1	MCERTS	< 1	< 1	< 1	< 1	< 1
Nickel (Ni)	mg/kg	< 3	MCERTS	10	11	18	6	6
Selenium (Se)	mg/kg	< 2	MCERTS	< 3	< 3	< 3	< 3	< 3
Zinc (Zn)	mg/kg	< 3	MCERTS	35	39	50	18	16
Total Phenols (monohydric)	mg/kg	< 2	NONE	< 2	< 2	< 2	< 2	< 2
TPH - Aliphatic >C35 - C40	mg/kg	< 10	NONE	< 10	< 10	< 10	< 10	< 10
TPH - Aromatic >C35 - C40	mg/kg	< 10	NONE	< 10	< 10	< 10	< 10	< 10
TPH - Aliphatic / Aromatic (C6 - C40) - Total	mg/kg	< 42	NONE	< 42	< 42	< 42	< 42	< 42

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



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Soil Analysis Certificate - Speciated PAHs						
DETS Report No: 21-04608	Date Sampled	08/04/21	08/04/21	08/04/21	08/04/21	08/04/21
Apple Environmental Ltd	Time Sampled	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Site Reference: None Supplied	TP / BH No	TP.01/01/3153	TP.01/02/3153	TP.02/01/3153	TP.02/02/3153	TP.03/01/3153
Project / Job Ref: CL/3153/OAK	Additional Refs	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Order No: None Supplied	Depth (m)	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Reporting Date: 19/04/2021	DETS Sample No	536862	536863	536864	536865	536866

Determinand	Unit	RL	Accreditation	(n)				
Naphthalene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Acenaphthylene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Acenaphthene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Fluorene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Phenanthrene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Anthracene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Fluoranthene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Pyrene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(a)anthracene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Chrysene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(b)fluoranthene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(k)fluoranthene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(a)pyrene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Indeno(1,2,3-cd)pyrene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Dibenz(a,h)anthracene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(ghi)perylene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Coronene	mg/kg	< 0.1	NONE	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Total Oily Waste PAHs	mg/kg	< 1	MCERTS	< 1	< 1	< 1	< 1	< 1
Total Dutch 10 PAHs	mg/kg	< 1	MCERTS	< 1	< 1	< 1	< 1	< 1
Total EPA-16 PAHs	mg/kg	< 1.6	MCERTS	< 1.6	< 1.6	< 1.6	< 1.6	< 1.6
Total WAC-17 PAHs	mg/kg	< 1.7	NONE	< 1.7	< 1.7	< 1.7	< 1.7	< 1.7

(n) Please note we are only MCERTS accredited (UK soils only) for sand, loam and clay and any other matrix is outside our scope of accreditation



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Soil Analysis Certificate - Speciated PAHs						
DETS Report No: 21-04608	Date Sampled	08/04/21	08/04/21	08/04/21	08/04/21	08/04/21
Apple Environmental Ltd	Time Sampled	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Site Reference: None Supplied	TP / BH No	TP.03/02/3153	TP.04/01/3153	TP.04/02/3153	TP.05/01/3153	TP.05/02/3153
Project / Job Ref: CL/3153/OAK	Additional Refs	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Order No: None Supplied	Depth (m)	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Reporting Date: 19/04/2021	DETS Sample No	536867	536868	536869	536870	536871

Determinand	Unit	RL	Accreditation	(n)		(n)	
Naphthalene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1
Acenaphthylene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1
Acenaphthene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1
Fluorene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1
Phenanthrene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1
Anthracene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1
Fluoranthene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1
Pyrene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(a)anthracene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1
Chrysene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(b)fluoranthene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(k)fluoranthene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(a)pyrene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1
Indeno(1,2,3-cd)pyrene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1
Dibenz(a,h)anthracene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(ghi)perylene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1
Coronene	mg/kg	< 0.1	NONE	< 0.1	< 0.1	< 0.1	< 0.1
Total Oily Waste PAHs	mg/kg	< 1	MCERTS	< 1	< 1	< 1	< 1
Total Dutch 10 PAHs	mg/kg	< 1	MCERTS	< 1	< 1	< 1	< 1
Total EPA-16 PAHs	mg/kg	< 1.6	MCERTS	< 1.6	< 1.6	< 1.6	< 1.6
Total WAC-17 PAHs	mg/kg	< 1.7	NONE	< 1.7	< 1.7	< 1.7	< 1.7



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Soil Analysis Certificate - TPH CWG Banded

DETS Report No: 21-04608	Date Sampled	08/04/21	08/04/21	08/04/21	08/04/21	08/04/21
Apple Environmental Ltd	Time Sampled	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Site Reference: None Supplied	TP / BH No	TP.01/01/3153	TP.01/02/3153	TP.02/01/3153	TP.02/02/3153	TP.03/01/3153
Project / Job Ref: CL/3153/OAK	Additional Refs	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Order No: None Supplied	Depth (m)	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Reporting Date: 19/04/2021	DETS Sample No	536862	536863	536864	536865	536866

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

(n) Please note we are only MCERTS accredited (UK soils only) for sand, loam and clay and any other matrix is outside our scope of accreditation



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Soil Analysis Certificate - TPH CWG Banded

DETS Report No: 21-04608	Date Sampled	08/04/21	08/04/21	08/04/21	08/04/21	08/04/21
Apple Environmental Ltd	Time Sampled	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Site Reference: None Supplied	TP / BH No	TP.03/02/3153	TP.04/01/3153	TP.04/02/3153	TP.05/01/3153	TP.05/02/3153
Project / Job Ref: CL/3153/OAK	Additional Refs	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Order No: None Supplied	Depth (m)	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Reporting Date: 19/04/2021	DETS Sample No	536867	536868	536869	536870	536871

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



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Soil Analysis Certificate - BTEX / MTBE						
DETS Report No: 21-04608	Date Sampled	08/04/21	08/04/21	08/04/21	08/04/21	08/04/21
Apple Environmental Ltd	Time Sampled	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Site Reference: None Supplied	TP / BH No	TP.01/01/3153	TP.01/02/3153	TP.02/01/3153	TP.02/02/3153	TP.03/01/3153
Project / Job Ref: CL/3153/OAK	Additional Refs	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Order No: None Supplied	Depth (m)	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Reporting Date: 19/04/2021	DETS Sample No	536862	536863	536864	536865	536866

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

(n) Please note we are only MCERTS accredited (UK soils only) for sand, loam and clay and any other matrix is outside our scope of accreditation



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Soil Analysis Certificate - BTEX / MTBE						
DETS Report No: 21-04608	Date Sampled	08/04/21	08/04/21	08/04/21	08/04/21	08/04/21
Apple Environmental Ltd	Time Sampled	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Site Reference: None Supplied	TP / BH No	TP.03/02/3153	TP.04/01/3153	TP.04/02/3153	TP.05/01/3153	TP.05/02/3153
Project / Job Ref: CL/3153/OAK	Additional Refs	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Order No: None Supplied	Depth (m)	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Reporting Date: 19/04/2021	DETS Sample No	536867	536868	536869	536870	536871

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



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Soil Analysis Certificate - Organochlorine Pesticides						
DETS Report No: 21-04608	Date Sampled	08/04/21	08/04/21			
Apple Environmental Ltd	Time Sampled	None Supplied	None Supplied			
Site Reference: None Supplied	TP / BH No	TP.02/01/3153	TP.04/01/3153			
Project / Job Ref: CL/3153/OAK	Additional Refs	None Supplied	None Supplied			
Order No: None Supplied	Depth (m)	None Supplied	None Supplied			
Reporting Date: 19/04/2021	DETS Sample No	536864	536868			

Determinand	Unit	RL	Accreditation			
Aldrin	mg/kg	< 0.02	NONE	< 0.02	< 0.02	
alpha-HCH	mg/kg	< 0.02	NONE	< 0.02	< 0.02	
beta-HCH	mg/kg	< 0.02	NONE	< 0.02	< 0.02	
cis-chlordane	mg/kg	< 0.02	NONE	< 0.02	< 0.02	
delta-HCH	mg/kg	< 0.02	NONE	< 0.02	< 0.02	
Dieldrin	mg/kg	< 0.02	NONE	< 0.02	< 0.02	
Endosulfan A	mg/kg	< 0.02	NONE	< 0.02	< 0.02	
Endosulfan B	mg/kg	< 0.02	NONE	< 0.02	< 0.02	
Endrin	mg/kg	< 0.02	NONE	< 0.02	< 0.02	
gamma-HCH (Lindane)	mg/kg	< 0.02	NONE	< 0.02	< 0.02	
Heptachlor	mg/kg	< 0.02	NONE	< 0.02	< 0.02	
Heptachlor epoxide	mg/kg	< 0.02	NONE	< 0.02	< 0.02	
Hexachlorobenzene (HCB)	mg/kg	< 0.02	NONE	< 0.02	< 0.02	
Isodrin	mg/kg	< 0.02	NONE	< 0.02	< 0.02	
Methoxychlor	mg/kg	< 0.02	NONE	< 0.02	< 0.02	
o,p' - DDD	mg/kg	< 0.02	NONE	< 0.02	< 0.02	
o,p' - DDE	mg/kg	< 0.02	NONE	< 0.02	< 0.02	
o,p' - DDT	mg/kg	< 0.02	NONE	< 0.02	< 0.02	
p,p' - DDD	mg/kg	< 0.02	NONE	< 0.02	< 0.02	
p,p' - DDE	mg/kg	< 0.02	NONE	< 0.02	< 0.02	
p,p' - DDT	mg/kg	< 0.02	NONE	< 0.02	< 0.02	
trans-chlordane	mg/kg	< 0.02	NONE	< 0.02	< 0.02	
Trifluralin	mg/kg	< 0.02	NONE	< 0.02	< 0.02	



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Soil Analysis Certificate - Sample Descriptions

DETS Report No: 21-04608	
Apple Environmental Ltd	
Site Reference: None Supplied	
Project / Job Ref: CL/3153/OAK	
Order No: None Supplied	
Reporting Date: 19/04/2021	

DETS Sample No	TP / BH No	Additional Refs	Depth (m)	Moisture Content (%)	Sample Matrix Description
536862	TP.01/01/3153	None Supplied	None Supplied	10.5	Light brown sandy clay with chalk
536863	TP.01/02/3153	None Supplied	None Supplied	17.4	White chalk
536864	TP.02/01/3153	None Supplied	None Supplied	18.5	Light brown sandy clay with chalk
536865	TP.02/02/3153	None Supplied	None Supplied	13.6	Light brown sandy clay with chalk
536866	TP.03/01/3153	None Supplied	None Supplied	13.9	Light brown sandy clay with chalk
536867	TP.03/02/3153	None Supplied	None Supplied	14.2	Light brown sandy clay with chalk
536868	TP.04/01/3153	None Supplied	None Supplied	12.7	Light brown sandy clay with stones
536869	TP.04/02/3153	None Supplied	None Supplied	13.1	Light brown sandy clay with stones
536870	TP.05/01/3153	None Supplied	None Supplied	16.8	White chalk
536871	TP.05/02/3153	None Supplied	None Supplied	16.2	White chalk

Moisture content is part of procedure E003 & is not an accredited test

Insufficient Sample ^{U/S}

Unsuitable Sample ^{U/S}



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Soil Analysis Certificate - Methodology & Miscellaneous Information

DETS Report No: 21-04608

Apple Environmental Ltd

Site Reference: None Supplied

Project / Job Ref: CL/3153/OAK

Order No: None Supplied

Reporting Date: 19/04/2021

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

D Dried
AR As Received

CALIBRATION CERTIFICATE NO: 68225

ISSUED BY: SHAWCITY LIMITED
DATE: 29-Apr-20
APPROVED SIGNATORY: 
NAME: Jack Cheshire
CUSTOMER: Apple Environmental Ltd
INSTRUMENT: Tiger Select
SERIAL NUMBER: T-113211
CALIBRATION METHOD: CM03
AMBIENT CONDITIONS: 20°C ± 2°C and 50% (± 20%) RH

Prior to calibration the instrument was allowed to stabilise in the laboratory for at least 30 minutes.
The instrument was calibrated by exposing the sensor to known values of gas concentrations.
All gases were sampled through the complete probe and in line filter, where applicable.
The reference value is that generated by the certified source and the indicated value is that measured by the instrument.

CALIBRATION RESULTS

GAS	LOT No	REF. VALUE	INDICATED VALUE
Isobutylene	wo248886-20	100 ppm	100ppm
Isobutylene	56853/1219	1000 ppm	1000ppm
Benzene	WO244908-3	5ppm	5ppm

COMMENTS:

The reported uncertainty is based on a standard uncertainty multiplied by a coverage factor of $k=2$.
This provides a level of confidence of uncertainty of approximately 95%.
The uncertainty of measurement is $\pm 2\%$
The results indicate that the instrument conforms to the applicable parts of the published specification.

HEALTH & SAFETY, OCCUPATIONAL HYGIENE AND ENVIRONMENTAL MONITORING INSTRUMENTS

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