

CONTAMINATED LAND INTRUSIVE INVESTIGATION

59 Langstone Road
Havant
Hampshire
PO9 1RB



October 2019

Contents

Contact Information	3
Company information	4
1 Introduction and scope of work	5
2 Methodology	7
3 On-site observations	9
4 Results from soil analyses	15
5 Interpretation	24
6 Summary of analyses	28
7 Review of conceptual model and risk assessment	30
8 Summary and recommendations	33
9 Limitations	36
10 References and specified sources of information	37
Appendices	
Laboratory data	38

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1 Introduction and scope of work

Apple Environmental has been appointed to undertake an intrusive soil contamination investigation at 59 Langstone Road, Havant, Hampshire PO9 1RB. The report has been prepared in support of the proposal to rebuild a dwelling that has recently been largely destroyed by fire.

It is understood that Havant Borough Council have identified a potential land contamination concern, due principally to the recent fire damage, for which the contaminants deemed to be potentially present include general inorganics and poly-aromatic hydrocarbons.

An intrusive investigation was subsequently undertaken therefore in order to determine the presence and extent of any such contamination, and to assess the overall risk more fully. The investigation has focussed on all of the garden area associated with the dwelling.

The principal 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 this area, 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 characterise the nature of the sub-surface material at five separate locations across the site down to a depth of 1000mm;

- to collect at least two soil samples from four of the five 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.

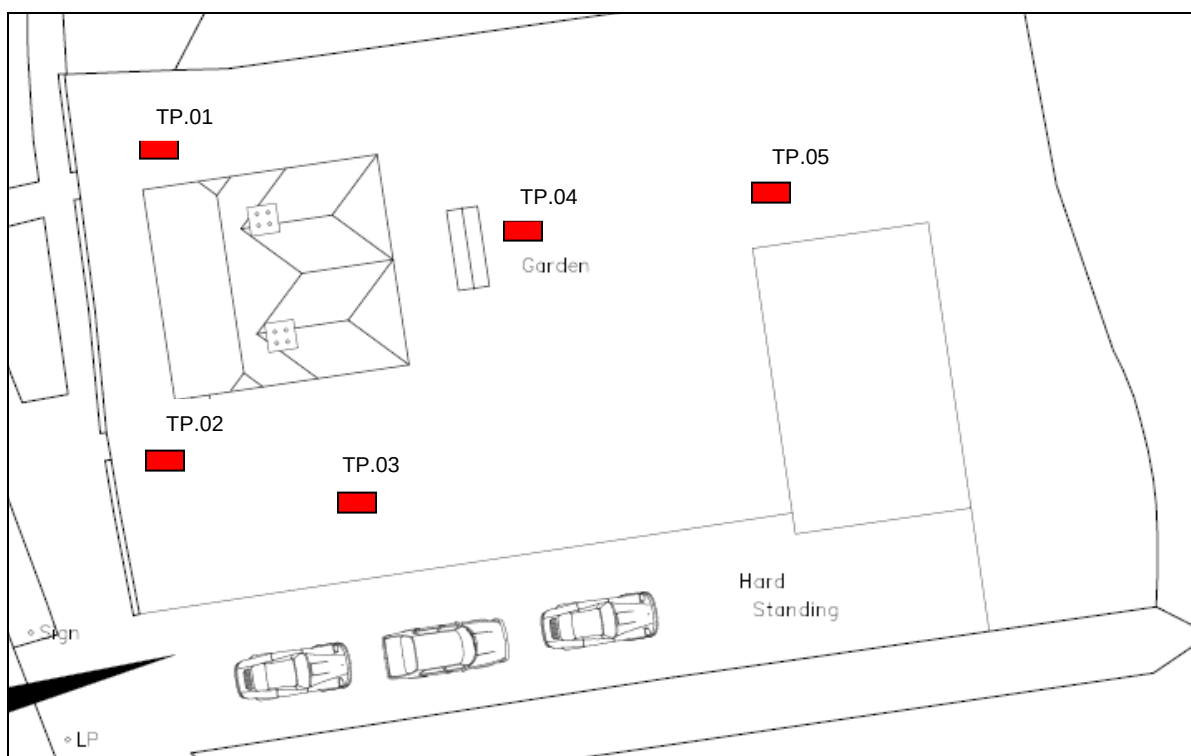
The necessary on-site work was undertaken on the 3rd October 2019.

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 mechanically excavated to a minimum depth of 1000mm, at the approximate locations shown below in Figure 1.

Figure 1 Plan showing the approximate sampling locations



■ Trial pit locations

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

As stated, soil samples were collected from four of the five trial pits representing depths of 100 - 200mm and 500 - 600mm for laboratory analysis. These were trial pits TP.01, TP.03, TP.04 and TP.05.

All of the 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 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. 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

At the time of the investigation the general structure of the dwelling remained, although had been extensively damaged by fire. The ground surface across the site existed as soft landscaping, albeit with some ash residue on the surface in the vicinity of the dwelling.

According to BGS data, the ground upper surface at the site was expected to be characterised by superficial deposits of sand, silt and clay. These were believed to have been observed in all of the trial pit locations.

The superficial deposits are expected to overlie bedrock of the Lewes Nodular Chalk Formation; which was not reached in any of the sampled locations.

In general, the extracted material profiles were characterised by a surface layer of grass, underlain by peaty topsoil, overlying silty sandy clay.

Note that either side of trial pits TP.01 and TP.02, burnt timber and ceramic tiles were present at the surface.

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 - 150	Light-brown sandy clay with rootlets. (Some surface ash).
	150 - 1000	Light-brown sandy silty clay.
Groundwater	800	Groundwater rest level 700mm (bgl).

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 - 20	Grass.
	20 - 280	Dark-brown clayey subsoil with rounded stones (5-30mm diameter). (Some surface ash).
	280 - 1000	Light-brown sandy silty clay with rounded stones (20-50mm diameter).
Groundwater	800	Groundwater rest level 800mm (bgl).

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 - 20	Grass.
	20 - 130	Dark-brown peaty topsoil with rootlets.
	130 - 490	Mid-brown clayey subsoil with rounded stones (10-30mm diameter).
	490 - 1000	Light-brown silty sandy clay with rounded stones (10-40mm diameter).
Groundwater	800	Groundwater rest level 800mm (bgl).

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 - 20	Grass.
	20 - 100	Dark-brown peaty topsoil with rootlets.
	100 - 450	Mid-brown clayey silty subsoil with rounded stones (20-60mm diameter).
	450 - 1000	Light-brown silty sandy clay. (Damp at 950mm).
Groundwater	-	Groundwater rest level 1000mm.

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 - 20	Grass.
	20 - 110	Dark-brown peaty topsoil with made-ground comprising, brick fragments and angular flints (10-80mm diameter).
	110 - 470	Mid-brown clayey silty subsoil.
	470 - 1000	Light-brown silty sandy clay. (Damp at 1000mm).
Groundwater	-	Groundwater was not reached.

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 6 to 11 below. Any determinand detected has been highlighted in **bold** type.

Table 6 Results for specified inorganics in soil - metals

Determinand (mg/kg)	TP.01		TP.03	
	Depth 100-200mm	Depth 500-600mm	Depth 100-200mm	Depth 500-600mm
Arsenic	11	11	14	15
Boron	< 1	< 1	< 1	< 1
Cadmium	0.2	< 0.2	0.5	0.3
Chromium	32	35	26	26
Hexavalent chromium	< 2	< 2	< 2	< 2
Copper	27	21	68	53
Lead	98	88	465	271
Mercury (total)	<0.05	0.07	0.32	0.50
Nickel	28	33	25	24
Selenium	< 3	< 3	< 3	< 3
Zinc	73	66	181	84

Table 6 (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	12	14	12	10
Boron	< 1	< 1	< 1	< 1
Cadmium	0.5	0.3	0.4	0.3
Chromium	22	26	22	23
Hexavalent chromium	< 2	< 2	< 2	< 2
Copper	74	70	61	64
Lead	584	328	285	109
Mercury (total)	0.41	1.10	0.39	0.29
Nickel	19	22	20	20
Selenium	< 3	< 3	< 3	< 3
Zinc	263	134	170	81

Table 7 Results for specified inorganics in soil - non-metals

Determinand (mg/kg)	TP.01		TP.03	
	Depth 100-200mm	Depth 500-600mm	Depth 100-200mm	Depth 500-600mm
Cyanide (total)	<2	<2	<2	<2
Sulphate (total)	<200	<200	551	296
Sulphide	<5	<5	<5	<5
Chloride	26	46	40	18
Asbestos	Not detected	Not detected	Not detected	Not detected
Determinand (mg/kg)	TP.04		TP.05	
	Depth 100-200mm	Depth 500-600mm	Depth 100-200mm	Depth 500-600mm
Cyanide (total)	<2	<2	<2	<2
Sulphate (total)	735	499	531	272
Sulphide	<5	<5	<5	<5
Chloride	22	16	18	16
Asbestos	Not detected	Not detected	Not detected	Not detected

Table 8 Results for specified hydrocarbons in soil

Determinand (mg/kg)	TP.01		TP.03	
	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
Determinand (mg/kg)	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 9 Results for poly-aromatic hydrocarbons in soil

Determinand (mg/kg)	TP.01		TP.03	
	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	0.82	< 0.1
Anthracene	< 0.1	< 0.1	0.12	< 0.1
Fluoranthene	0.33	0.29	3.13	0.31
Pyrene	0.30	0.26	2.94	0.29
Benzo(a)anthracene	0.40	0.38	1.90	0.41
Chrysene	0.13	< 0.1	1.96	0.16
Benzo(b)fluoranthene	0.23	0.21	2.60	0.30
Benzo(k)fluoranthene	< 0.1	< 0.1	0.94	< 0.1
Benzo(a)pyrene	0.15	0.14	1.78	0.18
Indeno(123-cd)pyrene	< 0.1	< 0.1	1.38	< 0.1
Dibenzo(ah)anthracene	< 0.1	< 0.1	0.21	< 0.1
Benzo(ghi)perylene	< 0.1	< 0.1	1.28	< 0.1
Coronene	< 0.1	< 0.1	0.24	< 0.1
Total EPA-16 PAHs	<1.6	<1.6	19.1	1.7

Table 9 (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	1.35	0.30	0.37	< 0.1
Anthracene	0.18	< 0.1	< 0.1	< 0.1
Fluoranthene	4.31	1.11	1.22	< 0.1
Pyrene	3.93	1.0	1.13	< 0.1
Benzo(a)anthracene	2.30	0.81	0.84	< 0.1
Chrysene	2.63	0.67	0.75	< 0.1
Benzo(b)fluoranthene	3.37	0.92	1.01	< 0.1
Benzo(k)fluoranthene	1.19	0.32	0.36	< 0.1
Benzo(a)pyrene	2.46	0.62	0.66	< 0.1
Indeno(123-cd)pyrene	1.72	0.44	0.47	< 0.1
Dibenzo(ah)anthracene	0.26	< 0.1	< 0.1	< 0.1
Benzo(ghi)perylene	1.58	0.37	0.41	< 0.1
Coronene	0.28	< 0.1	< 0.1	< 0.1
Total EPA-16 PAHs	25.3	6.6	7.2	<1.6

Table 10 Results for petroleum hydrocarbons in soil

Determinand (mg/kg)	TP.01		TP.03	
	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
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	6	< 2
Aromatic C16 - C21	< 3	< 3	10	< 3
Aromatic C21 - C35	< 10	< 10	47	< 10
Total aromatic (C5 -35)	< 21	< 21	63	< 21
Total (C5 - 35)	< 42	< 42	63	< 42

Table 10 (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
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	3	< 2	< 2	< 2
Aromatic C16 - C21	11	< 3	< 3	< 3
Aromatic C21 - C35	40	< 10	< 10	< 10
Total aromatic (C5 -35)	54	< 21	< 21	< 21
Total (C5 - 35)	54	< 42	< 42	< 42

Table 11 Non-specified VOCs - measured by means of photo-ionisation detection in-situ

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

5 Interpretation

Tables 12 to 14 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 1.82%; which approximates to 3.1% SOM.

Table 12 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 13 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 14 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. Two soil samples were collected from four of the pits, representing depths of 100 - 200mm and 500 - 600mm for laboratory analysis.

Through reference to Tables 6 to 11 above, it has been shown that there were a number of substances present above their corresponding soil guideline levels; namely lead and poly-aromatic hydrocarbons (PAHs).

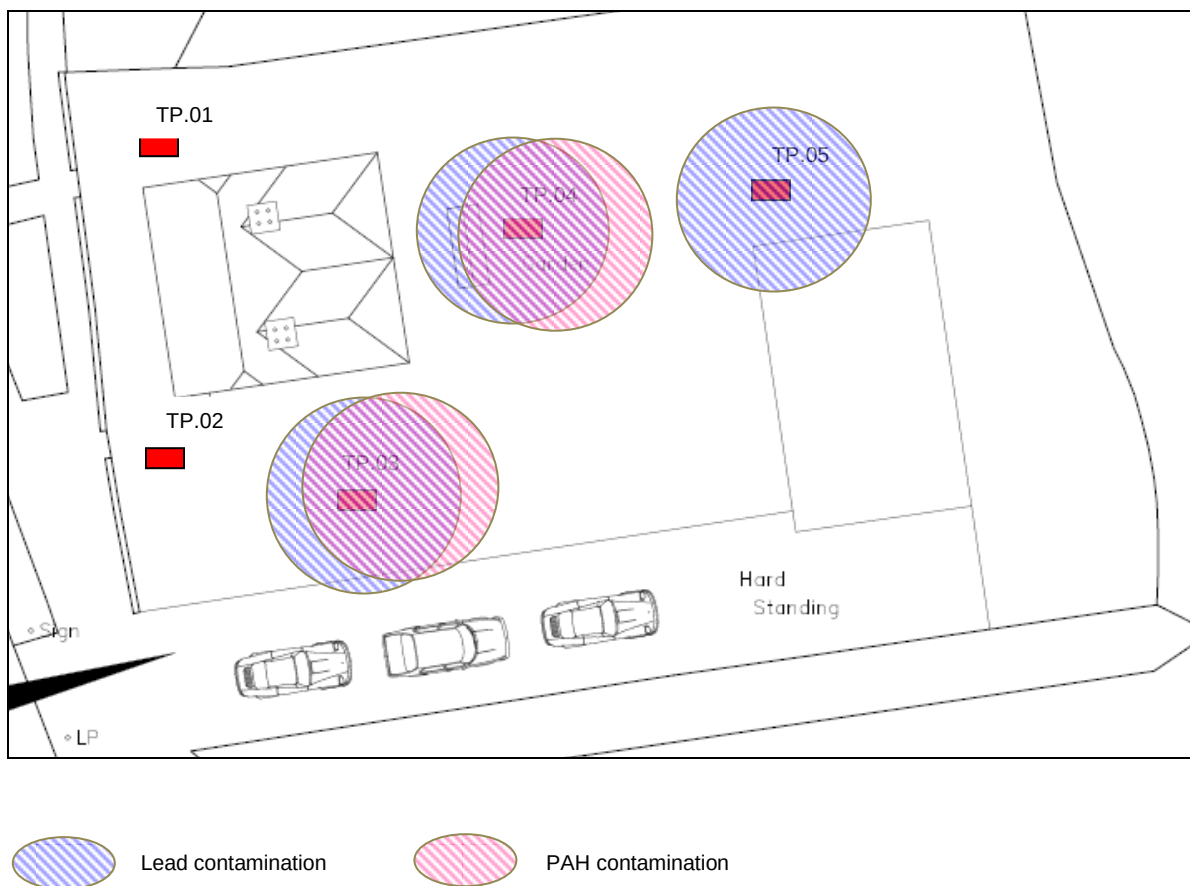
The exceedences have been summarised below in Table 15, and the corresponding areas have been indicated in Figure 2 below.

Table 15 Soil guideline criteria exceedences

Trial pit	Lead	Benzo-(b) fluoranthrene	Benzo-(a) pyrene	Dibenzo-(ah) anthracene
TP.03/01				
TP.03/02				
TP.04/01				
TP.04/02				
TP.05/01				

 Guideline exceedence

Figure 2 Plan showing the indicative extent of ground contamination



The source of this identified contamination can not be precisely determined without knowing the history of the site. However, it may well be associated with the aforementioned fire that recently occurred at the dwelling.

It is quite possible in such instances for the fire-fighting water to run-off across a site dispersing residue from the burning construction materials. It is noted that both lead and PAHs are commonly found within construction materials.

Soil contamination is also frequently associated with made-ground deposits, however in this instance, made-ground was only observed within one area, and therefore unlikely to account for the majority of the contamination identified.

7 Review of conceptual model and risk assessment

Using the sampling results and observations made, a conceptual site model (CSM) can be undertaken.

Table 16 below highlights any perceived pollutant pathway linkages that may be present.

It should be noted that the following assessment of the risk, has been made on the basis that is a soft landscaped recreational garden area associated with the dwelling.

The risk matrix used for this purpose is reproduced below in Figure 3.

Figure 3 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 16 Reviewed comments relating to perceived risk

Contaminants identified	Potential pathways	Perceived level of risk	Comments and reasoning
Lead and PAHs	Digestion of soil or soil-derived dust	12	The likelihood of ingesting soil during construction work or recreation is low. Ingestion is most likely to be limited to trace quantities through unwashed hands or ingesting airborne dusts etc. However, as elevated concentrations of PAHs and lead are known to be present in the garden area, the corresponding risk must be deemed to be moderate-high.
	Dermal contact with soil or soil-derived dust	9	The potential for touching soil during construction work or recreation is high. It is also possible that PAHs could exert a biological effect from absorption through the epidermis, or alternatively be transferred to the mouth. In either instance the extent of uptake is expected to be low, although as elevated concentrations of PAHs and lead are still known to be present in the garden area, the corresponding risk must at least be deemed to be moderate.
	Inhalation of soil or soil-derived dust	8	Uptake from the inhalation of PAHs during the disturbance of soil is expected to be limited to trace quantities only. Conversely, lead is not a volatile substance. Overall the corresponding risk from inhalation is deemed to be low-moderate at worst.

Table 16 (Cont.) Reviewed comments relating to perceived risk

Contaminants identified	Potential pathways	Perceived level of risk	Comments and reasoning
Lead and PAHs	Ingestion of vegetables	8	Considering the identified presence of localised elevated concentrations of PAHs in the soil, there is some potential for ingestion from home-grown vegetables. Despite this, the uptake concentration is expected to be low. Conversely, lead is not generally taken up by vegetables. As such the corresponding risk is deemed to be low-moderate at worst.
	Inhalation and/or ignition of gases and/or vapours	6	Despite the concentration of lead and PAHs exceeding soil guideline values it is not expected for these concentrations (in conjunction with trace petroleum hydrocarbons) to be great enough to generate significant vapours. Similarly the general organic carbon content of the soil is again not deemed to be high enough to produce significant quantities of methane or carbon dioxide. The corresponding risk from each is therefore believed to be low.
	Direct contact with buildings and services	8	PAHs can potentially present a risk to building fabric and underground services. If either of these are to be located in the specified areas where the PAH concentration is elevated then appropriate materials resistant to hydrocarbon attack may need to be used. The corresponding risk in these areas must be deemed to be moderate.

8 Summary and remediation proposal

8.1 Summary

This report has been prepared in support of the proposed redevelopment of a dwelling with associated garden area, following extensive damage caused by a fire.

The report has noted that lead exceeded its corresponding residential guideline concentration within three of the four trial pits, namely; TP.03, TP.04 and TP.05, in addition to which poly-aromatic hydrocarbons (PAHs) exceeded guideline levels in trial pits TP.03 and TP.04.

It is quite possible that the source of this contamination may well be due to the building materials that became burned in the fire, and subsequently dispersed across the site via the fire-fighting run-off water.

Based on the findings of this investigation therefore, the conceptual site model (CSM) has concluded that in its current state the site presents an unacceptable degree of risk to future receptors, on the basis of residential use.

8.2 Recommendations

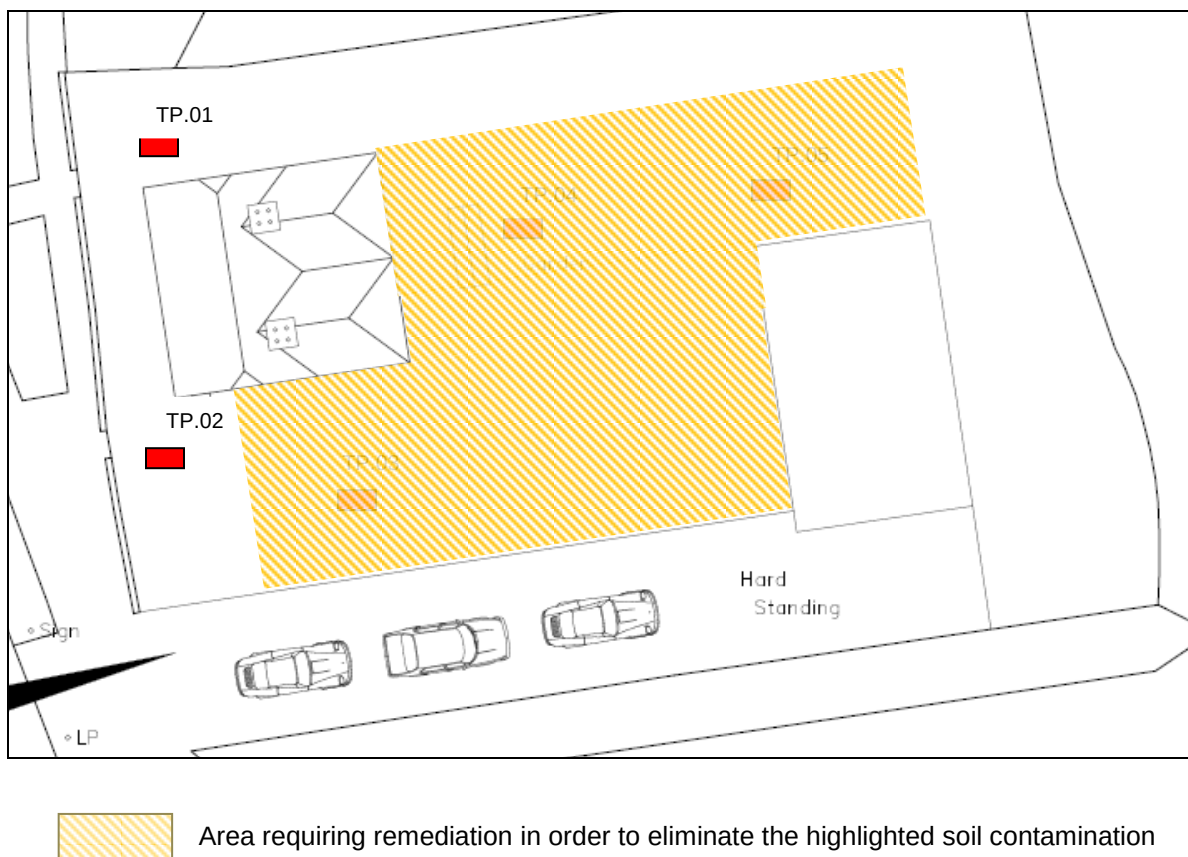
In view of these findings it would be necessary to undertake a programme of remediation in order to bring the risk down to an acceptable level.

On the basis of the information known to-date, remediation would need to be considered for the majority of the garden area in order to ensure that the risk has been fully minimised.

Alternatively however, delineation sampling may wish to be undertaken in order to attempt to determine more precisely the actual extent of lead and PAH contamination within the garden areas; thereby potentially focussing remediation more effectively (and sustainably).

In the absence of undertaking any delineation sampling, the recommended area where ground remediation would be required has been highlighted in Figure 4 below.

Figure 4 Plan showing the recommended area requiring remediation



More specifically, it is suggested that in the first instance the soil in this highlighted area (above) should be excavated to a depth of at least 300mm below the existing ground level, and removed off-site for appropriate disposal or treatment.

Once this stage has been undertaken, it is suggested that soil samples are obtained from the base and sides of the excavated area, and analysed for the presence of lead and PAHs.

In any area where the concentration of lead and/or PAHs in the soil still exceeds guideline criteria then the excavation should extend deeper to a maximum depth of 600mm.

In each area where the excavation has been extended to 600mm, the soil at the base and sides of that excavation will once again need to be sampled and analysed for lead and/or PAHs, depending upon the specific concern in that area.

If either of these contaminants is still present above guideline criteria at this depth then each excavated area would need to be lined with an appropriate barrier membrane to the base and sides, and protected with at least 100mm of clean crushed concrete, and then backfilled with 'clean' soil.

Conversely, if either of these contaminants are no longer present above guideline criteria at this 600mm depth then each excavated area can be directly backfilled with 'clean' soil.

Note that any soil brought onto the site for the purposes of backfilling these excavated areas should arrive 'fit for purpose', and comply with the British Standard BS3882:2015; although this will still need to undergo independent confirmatory laboratory analyses to show that it is free from contamination.

Photographic evidence of all remedial work undertaken should be collated and presented to the planning authority in the form of a post-remediation validation report, along with any waste transfer documentation relating to the off-site disposal of soil, and any receipts or other documentation relating to the importation of 'clean' soil.

With regards to underground service runs, it should again be ensured that all materials used are safe from chemical or physical attack by hydrocarbon residue in the ground. If necessary, consideration may need to be given to the use of appropriate barrier water pipes.

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) - July 2018
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



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ME17 2JN
t: 01622 850410

DETS Report No: 19-14301

Site Reference: None Supplied

Project / Job Ref: CL/2823/LR

Order No: None Supplied

Sample Receipt Date: 07/10/2019

Sample Scheduled Date: 07/10/2019

Report Issue Number: 1

Reporting Date: 16/10/2019

Authorised by:

A handwritten signature in black ink, appearing to read "Ela Mysiara".

Ela Mysiara
Quality Manager

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Soil Analysis Certificate						
DETS Report No: 19-14301	Date Sampled	03/10/19	03/10/19	03/10/19	03/10/19	03/10/19
Apple Environmental Ltd	Time Sampled	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Site Reference: None Supplied	TP / BH No	TP.01/01/2823	TP.01/02/2823	TP.03/01/2823	TP.03/02/2823	TP.04/01/2823
Project / Job Ref: CL/2823/LR	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: 16/10/2019	DETS Sample No	439644	439645	439646	439647	439648

Determinand	Unit	RL	Accreditation					
Asbestos Screen ^(S)	N/a	N/a	ISO17025	Not Detected	Not Detected	Not Detected	Not Detected	Not Detected
pH	pH Units	N/a	MCERTS	7.9	8.0	6.8	7.8	7.3
Total Cyanide	mg/kg	< 2	NONE	< 2	< 2	< 2	< 2	< 2
Total Sulphate as SO ₄	mg/kg	< 200	NONE	< 200	< 200	551	296	735
Total Sulphate as SO ₄	%	< 0.02	NONE	< 0.02	< 0.02	0.06	0.03	0.07
W/S Sulphate as SO ₄ (2:1)	mg/l	< 10	MCERTS	24	19	14	< 10	11
W/S Sulphate as SO ₄ (2:1)	g/l	< 0.01	MCERTS	0.02	0.02	0.01	< 0.01	0.01
Sulphide	mg/kg	< 5	NONE	< 5	< 5	< 5	< 5	< 5
Total Organic Carbon (TOC)	%	< 0.1	MCERTS	0.4	0.4	2.8	1.5	4.3
W/S Chloride (2:1)	mg/kg	< 1	MCERTS	26	46	40	18	22
W/S Chloride (2:1)	mg/l	< 0.5	MCERTS	13.1	22.8	20.1	9	11.1
Arsenic (As)	mg/kg	< 2	MCERTS	11	11	14	15	12
W/S Boron	mg/kg	< 1	NONE	< 1	< 1	< 1	< 1	< 1
Cadmium (Cd)	mg/kg	< 0.2	MCERTS	0.2	< 0.2	0.5	0.3	0.5
Chromium (Cr)	mg/kg	< 2	MCERTS	32	35	26	26	22
Chromium (hexavalent)	mg/kg	< 2	NONE	< 2	< 2	< 2	< 2	< 2
Copper (Cu)	mg/kg	< 4	MCERTS	27	21	68	53	74
Lead (Pb)	mg/kg	< 3	MCERTS	98	88	465	271	584
Mercury (Hg) ^(S)	mg/kg	< 0.05	MCERTS	< 0.05	0.07	0.32	0.50	0.41
Nickel (Ni)	mg/kg	< 3	MCERTS	28	33	25	24	19
Selenium (Se)	mg/kg	< 3	NONE	< 3	< 3	< 3	< 3	< 3
Zinc (Zn)	mg/kg	< 3	MCERTS	73	66	181	84	263
Total Phenols (monohydric)	mg/kg	< 2	NONE	< 2	< 2	< 2	< 2	< 2

Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than 30°C
Subcontracted analysis (S)



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Soil Analysis Certificate						
DETS Report No: 19-14301	Date Sampled	03/10/19	03/10/19	03/10/19		
Apple Environmental Ltd	Time Sampled	None Supplied	None Supplied	None Supplied		
Site Reference: None Supplied	TP / BH No	TP.04/02/2823	TP.05/01/2823	TP.05/02/2823		
Project / Job Ref: CL/2823/LR	Additional Refs	None Supplied	None Supplied	None Supplied		
Order No: None Supplied	Depth (m)	None Supplied	None Supplied	None Supplied		
Reporting Date: 16/10/2019	DETS Sample No	439649	439650	439651		

Determinand	Unit	RL	Accreditation				
Asbestos Screen ^(S)	N/a	N/a	ISO17025	Not Detected	Not Detected	Not Detected	
pH	pH Units	N/a	MCERTS	7.9	7.6	7.9	
Total Cyanide	mg/kg	< 2	NONE	< 2	< 2	< 2	
Total Sulphate as SO ₄	mg/kg	< 200	NONE	499	531	272	
Total Sulphate as SO ₄	%	< 0.02	NONE	0.05	0.05	0.03	
W/S Sulphate as SO ₄ (2:1)	mg/l	< 10	MCERTS	82	< 10	< 10	
W/S Sulphate as SO ₄ (2:1)	g/l	< 0.01	MCERTS	0.08	< 0.01	< 0.01	
Sulphide	mg/kg	< 5	NONE	< 5	< 5	< 5	
Total Organic Carbon (TOC)	%	< 0.1	MCERTS	1.7	2.3	1.2	
W/S Chloride (2:1)	mg/kg	< 1	MCERTS	16	18	16	
W/S Chloride (2:1)	mg/l	< 0.5	MCERTS	7.8	8.8	8.2	
Arsenic (As)	mg/kg	< 2	MCERTS	14	12	10	
W/S Boron	mg/kg	< 1	NONE	< 1	< 1	< 1	
Cadmium (Cd)	mg/kg	< 0.2	MCERTS	0.3	0.4	0.3	
Chromium (Cr)	mg/kg	< 2	MCERTS	26	22	23	
Chromium (hexavalent)	mg/kg	< 2	NONE	< 2	< 2	< 2	
Copper (Cu)	mg/kg	< 4	MCERTS	70	61	64	
Lead (Pb)	mg/kg	< 3	MCERTS	328	285	109	
Mercury (Hg) ^(S)	mg/kg	< 0.05	MCERTS	1.10	0.39	0.29	
Nickel (Ni)	mg/kg	< 3	MCERTS	22	20	20	
Selenium (Se)	mg/kg	< 3	NONE	< 3	< 3	< 3	
Zinc (Zn)	mg/kg	< 3	MCERTS	134	170	81	
Total Phenols (monohydric)	mg/kg	< 2	NONE	< 2	< 2	< 2	

Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than 30°C
Subcontracted analysis (S)



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Soil Analysis Certificate - Speciated PAHs						
DETS Report No: 19-14301	Date Sampled	03/10/19	03/10/19	03/10/19	03/10/19	03/10/19
Apple Environmental Ltd	Time Sampled	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Site Reference: None Supplied	TP / BH No	TP.01/01/2823	TP.01/02/2823	TP.03/01/2823	TP.03/02/2823	TP.04/01/2823
Project / Job Ref: CL/2823/LR	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: 16/10/2019	DETS Sample No	439644	439645	439646	439647	439648

Determinand	Unit	RL	Accreditation					
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	0.82	< 0.1	1.35
Anthracene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	0.12	< 0.1	0.18
Fluoranthene	mg/kg	< 0.1	MCERTS	0.33	0.29	3.13	0.31	4.31
Pyrene	mg/kg	< 0.1	MCERTS	0.30	0.26	2.94	0.29	3.93
Benzo(a)anthracene	mg/kg	< 0.1	MCERTS	0.40	0.38	1.90	0.41	2.30
Chrysene	mg/kg	< 0.1	MCERTS	0.13	< 0.1	1.96	0.16	2.63
Benzo(b)fluoranthene	mg/kg	< 0.1	MCERTS	0.23	0.21	2.60	0.30	3.37
Benzo(k)fluoranthene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	0.94	< 0.1	1.19
Benzo(a)pyrene	mg/kg	< 0.1	MCERTS	0.15	0.14	1.78	0.18	2.46
Indeno(1,2,3-cd)pyrene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	1.38	< 0.1	1.72
Dibenz(a,h)anthracene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	0.21	< 0.1	0.26
Benzo(ghi)perylene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	1.28	< 0.1	1.58
Coronene	mg/kg	< 0.1	NONE	< 0.1	< 0.1	0.24	< 0.1	0.28
Total Oily Waste PAHs	mg/kg	< 1	MCERTS	< 1	< 1	10.8	1.1	13.9
Total Dutch 10 PAHs	mg/kg	< 1	MCERTS	1	< 1	13.3	1.1	17.7
Total EPA-16 PAHs	mg/kg	< 1.6	MCERTS	< 1.6	< 1.6	19.1	1.7	25.3
Total WAC-17 PAHs	mg/kg	< 1.7	NONE	< 1.7	< 1.7	19.3	< 1.7	25.5

Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than 30°C



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Soil Analysis Certificate - Speciated PAHs						
DETS Report No: 19-14301	Date Sampled	03/10/19	03/10/19	03/10/19		
Apple Environmental Ltd	Time Sampled	None Supplied	None Supplied	None Supplied		
Site Reference: None Supplied	TP / BH No	TP.04/02/2823	TP.05/01/2823	TP.05/02/2823		
Project / Job Ref: CL/2823/LR	Additional Refs	None Supplied	None Supplied	None Supplied		
Order No: None Supplied	Depth (m)	None Supplied	None Supplied	None Supplied		
Reporting Date: 16/10/2019	DETS Sample No	439649	439650	439651		

Determinand	Unit	RL	Accreditation					
Naphthalene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1		
Acenaphthylene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1		
Acenaphthene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1		
Fluorene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1		
Phenanthrene	mg/kg	< 0.1	MCERTS	0.30	0.37	< 0.1		
Anthracene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1		
Fluoranthene	mg/kg	< 0.1	MCERTS	1.11	1.22	< 0.1		
Pyrene	mg/kg	< 0.1	MCERTS	1	1.13	< 0.1		
Benzo(a)anthracene	mg/kg	< 0.1	MCERTS	0.81	0.84	< 0.1		
Chrysene	mg/kg	< 0.1	MCERTS	0.67	0.75	< 0.1		
Benzo(b)fluoranthene	mg/kg	< 0.1	MCERTS	0.92	1.01	< 0.1		
Benzo(k)fluoranthene	mg/kg	< 0.1	MCERTS	0.32	0.36	< 0.1		
Benzo(a)pyrene	mg/kg	< 0.1	MCERTS	0.62	0.66	< 0.1		
Indeno(1,2,3-cd)pyrene	mg/kg	< 0.1	MCERTS	0.44	0.47	< 0.1		
Dibenz(a,h)anthracene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1		
Benzo(ghi)perylene	mg/kg	< 0.1	MCERTS	0.37	0.41	< 0.1		
Coronene	mg/kg	< 0.1	NONE	< 0.1	< 0.1	< 0.1		
Total Oily Waste PAHs	mg/kg	< 1	MCERTS	3.8	4.1	< 1		
Total Dutch 10 PAHs	mg/kg	< 1	MCERTS	4.7	5.1	< 1		
Total EPA-16 PAHs	mg/kg	< 1.6	MCERTS	6.6	7.2	< 1.6		
Total WAC-17 PAHs	mg/kg	< 1.7	NONE	6.6	7.2	< 1.7		

Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than 30°C



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Soil Analysis Certificate - TPH CWG Banded

DETS Report No: 19-14301	Date Sampled	03/10/19	03/10/19	03/10/19	03/10/19	03/10/19
Apple Environmental Ltd	Time Sampled	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Site Reference: None Supplied	TP / BH No	TP.01/01/2823	TP.01/02/2823	TP.03/01/2823	TP.03/02/2823	TP.04/01/2823
Project / Job Ref: CL/2823/LR	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: 16/10/2019	DETS Sample No	439644	439645	439646	439647	439648

Determinand	Unit	RL	Accreditation					
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	6	< 2	3
Aromatic >C16 - C21	mg/kg	< 3	MCERTS	< 3	< 3	10	< 3	11
Aromatic >C21 - C35	mg/kg	< 10	MCERTS	< 10	< 10	47	< 10	40
Aromatic (C5 - C35)	mg/kg	< 21	NONE	< 21	< 21	63	< 21	54
Total >C5 - C35	mg/kg	< 42	NONE	< 42	< 42	63	< 42	54

Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than 30°C



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Soil Analysis Certificate - TPH CWG Banded

DETS Report No: 19-14301	Date Sampled	03/10/19	03/10/19	03/10/19		
Apple Environmental Ltd	Time Sampled	None Supplied	None Supplied	None Supplied		
Site Reference: None Supplied	TP / BH No	TP.04/02/2823	TP.05/01/2823	TP.05/02/2823		
Project / Job Ref: CL/2823/LR	Additional Refs	None Supplied	None Supplied	None Supplied		
Order No: None Supplied	Depth (m)	None Supplied	None Supplied	None Supplied		
Reporting Date: 16/10/2019	DETS Sample No	439649	439650	439651		

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

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Soil Analysis Certificate - BTEX / MTBE						
DETS Report No: 19-14301	Date Sampled	03/10/19	03/10/19	03/10/19	03/10/19	03/10/19
Apple Environmental Ltd	Time Sampled	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Site Reference: None Supplied	TP / BH No	TP.01/01/2823	TP.01/02/2823	TP.03/01/2823	TP.03/02/2823	TP.04/01/2823
Project / Job Ref: CL/2823/LR	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: 16/10/2019	DETS Sample No	439644	439645	439646	439647	439648

Determinand	Unit	RL	Accreditation					
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

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Soil Analysis Certificate - BTEX / MTBE						
DETS Report No: 19-14301	Date Sampled	03/10/19	03/10/19	03/10/19		
Apple Environmental Ltd	Time Sampled	None Supplied	None Supplied	None Supplied		
Site Reference: None Supplied	TP / BH No	TP.04/02/2823	TP.05/01/2823	TP.05/02/2823		
Project / Job Ref: CL/2823/LR	Additional Refs	None Supplied	None Supplied	None Supplied		
Order No: None Supplied	Depth (m)	None Supplied	None Supplied	None Supplied		
Reporting Date: 16/10/2019	DETS Sample No	439649	439650	439651		

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

Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than 30°C



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Soil Analysis Certificate - Sample Descriptions

DETS Report No: 19-14301	
Apple Environmental Ltd	
Site Reference: None Supplied	
Project / Job Ref: CL/2823/LR	
Order No: None Supplied	
Reporting Date: 16/10/2019	

DETS Sample No	TP / BH No	Additional Refs	Depth (m)	Moisture Content (%)	Sample Matrix Description
439644	TP.01/01/2823	None Supplied	None Supplied	14.1	Brown clayey sand
439645	TP.01/02/2823	None Supplied	None Supplied	13	Brown clayey sand
439646	TP.03/01/2823	None Supplied	None Supplied	19.3	Brown loamy clay with stones and vegetation
439647	TP.03/02/2823	None Supplied	None Supplied	17.2	Brown clayey sand with stones
439648	TP.04/01/2823	None Supplied	None Supplied	23.8	Brown loamy clay with stones and vegetation
439649	TP.04/02/2823	None Supplied	None Supplied	16.4	Brown clayey sand with vegetation
439650	TP.05/01/2823	None Supplied	None Supplied	18.7	Brown loamy clay with stones and vegetation
439651	TP.05/02/2823	None Supplied	None Supplied	16.4	Brown clayey sand with stones

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

Insufficient Sample ^{1/5}

Unsuitable Sample ^{u/s}



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Soil Analysis Certificate - Methodology & Miscellaneous Information

DETS Report No: 19-14301

Apple Environmental Ltd

Site Reference: None Supplied

Project / Job Ref: CL/2823/LR

Order No: None Supplied

Reporting Date: 16/10/2019

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 diphencylcarbazine 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	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 @ 450°C	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 SO ₄) - Total	Determination of total sulphate by extraction with 10% HCl followed by ICP-OES	E013
Soil	D	Sulphate (as SO ₄) - Water Soluble (2:1)	Determination of sulphate by extraction with water & analysed by ion chromatography	E009
Soil	D	Sulphate (as SO ₄) - 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