

H. EDWARDS

**PARK FARM,
MINERA**

REPORT ON CONTAMINATION ASSESSMENT

Contract: 41728-V1

Date: August 2015

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REPORT ON CONTAMINATION ASSESSMENT

carried out at

PARK FARM,

MINERA

Prepared for

H. EDWARDS

Park Farm

Minera Mountain Road

Minera

Wrexham

LL11 3DR

Contract No: 41728-V1

Date: August 2015

Issue & Revision Record			
Contract Number:		41728	
Contract Name:		Park Farm, Minera	
Client:		H. Davies	
Engineer:			
Report Title:		Report on Contamination Assessment	
Version	Issue Date	Report / revision details	Distribution
V1	24 th August 2015	Complete report	PDF copy to H. Davies

EXECUTIVE SUMMARY

It is understood that the site is to be re-developed to comprise the demolition of an existing derelict building and the construction of a single detached dwelling.

A planning condition relating to potential contamination has been imposed under Planning Decision Notice Ref. MIN P/2014/0347.

The site is situated at Park Farm, approximately 2km to the west of the village centre of Minera.

Ten hand pits were excavated by hand, samples were obtained and analysed for contaminants related to known lead mining activities on and around the site.

These results have been reviewed to provide a contamination risk assessment for the proposed development.

Soil analysis has indicated significant lead contamination across the site within shallow made ground.

Remediation of the site will be required comprising the placement of a minimum of 600mm of clean cover in garden/landscaped areas.

Validation of the thickness of the imported clean material will need to be carried out and a completion report produced.

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1.0 INTRODUCTION

- 1.1 It is understood that the site is to be re-developed. Development will comprise the demolition of an existing derelict building and the construction of a single detached dwelling.
- 1.2 A planning condition relating to potential contamination has been imposed under Planning Decision Notice Ref. MIN P/2014/0347.
- 1.3 On the instructions of H. Davies samples were obtained and analysed for contaminants related to known lead mining activities on and around the site. These results have been reviewed to provide a contamination risk assessment for the proposed development.
- 1.4 It is recommended that a copy of this report be submitted to the relevant authorities to enable them to carry out their own site assessments and provide any comments.
- 1.5 This report has been prepared for the sole use of the Client for the purpose described and no extended duty of care to any third party is implied or offered. Third parties using any information contained within this report do so at their own risk.
- 1.6 The comments given in this report and the opinions expressed herein are based on the information received, the conditions encountered during site works, and on the results of tests made in the field and laboratory. However, there may be conditions prevailing at the site which have not been disclosed by the investigation and which have not been taken into account in the report.
- 1.7 The comments on groundwater conditions are based on observations made at the time the site work was carried out. It should be noted that groundwater levels vary owing to seasonal or other effects.

2.0 SITE SETTING

2.1 Site Location

2.1.1 The site is situated at Park Farm, approximately 2km to the west of the village centre of Minera and may be located by National Grid Reference 324950, 351531.

2.1.2 A site location plan is included in Appendix 1, Figure A1.1.

2.2 Site Description

2.1.1 At the time of the investigation the site comprised two buildings in a state of disrepair. A house on the east of site which was the subject of heavy fire damage and an old barn which was also in a state of disrepair which was in the west of site. Approximately 10m to the north of the barn temporary accommodation could be found in the form of two static caravans.

2.1.2 The site was fairly open with a combination of stone walls and barbed wire fences surrounding the site.

2.1.3 Overhead electrical services were present on site. An 11kVa overhead electrical mains supply ran parallel to the site access which then fed a smaller 240v house supply which currently supplies electricity to the two static caravans in the north of site.

2.1.4 The site sloped gently down to the east.

2.1.5 Anecdotal evidence from the site owners indicates that two abandoned lead mining investigation pits were located on site, both of which however were unsuccessful for lead mining. Information from documents submitted to Wrexham County Borough Council's planning portal indicates there to be two shafts present on site to the east of the existing building. Furthermore numerous shafts are present to the south of the site with a disused mine being indicated.

2.2 Geological Setting

2.2.1 Details of the geology underlying the site have been obtained from the British Geological Survey map, Sheet No. 121, 'Wrexham', solid and drift edition, 1:50,000 scale, published 1994.

2.2.2 The geological map indicates superficial deposits to be absent. The site is underlain by the Loggerheads Limestone Formation of Carboniferous age.

2.2.3 Although not indicated as present on the site from the geological maps, the possibility that Made Ground exists on site cannot be discounted.

3.0 SITE WORK

- 3.1 The site work was carried out on the 16th July 2015. The locations of exploratory holes were carried out in general accordance with CLR 4, ref. 8.1 and the site work carried out on the basis of the practices set out in BS 10175:2011, ref. 8.2, BS 5930:2010 ref. 8.3 and ISO 1997:2007, ref 8.4.
- 3.2 Ten trial pits, designated HP01 to HP10, were dug by hand at the positions shown on the site plan, Appendix 1, Figure A1.2. The depths of trial pits, descriptions of strata encountered and comments on groundwater conditions are given on the records in Appendix 2.
- 3.3 Samples were collected for environmental purposes in amber glass jars, kept in a cool box and dispatched to the laboratory.
- 3.4 The ground levels and positions of the trial pits were not determined by survey.

4.0 LABORATORY TESTS

4.1 Chemical Testing

- 4.1.1 The chemical analyses were carried out on ten samples of soil. The nature of the analyses is detailed below:
- 4.1.2 **Metals screen** - arsenic, cadmium, chromium (total and hexavalent), lead, mercury, selenium, boron (water soluble), copper, nickel and zinc
- 4.1.3 **Others** - pH, sulphate
- 4.1.4 The results of these tests are shown in Appendix 3, within report 15-40998 (DETS).

5.0 GROUND CONDITIONS ENCOUNTERED

5.1 Made Ground

- 5.1.1 Made ground was encountered at all locations and generally comprised grey brown, slightly gravelly, fine to coarse sand with occasional cobbles of limestone. Gravel encountered included brick, porcelain, limestone, tile and glass. The hand pits were all terminated within the made ground depths of 0.60m.

5.2 Groundwater

- 5.2.1 Groundwater was not encountered in any of the trial pits.

6.0 ENVIRONMENTAL RISK ASSESSMENT IN RELATION TO PROPOSED DEVELOPMENT

6.1 Contaminated Land

6.1.1 The statutory definition of contaminated land is defined in the Environmental Protection Act 1990, ref 8.5, which was introduced by the Environment Act 1995, ref 8.6, as;

- ‘Land which appears to the Local Authority in whose area it is situated to be in such a condition, by reason of substances in, on or under the land, that –
- significant harm is being caused or there is a significant possibility of such harm being caused; or
- significant pollution of controlled waters is being caused, or there is a significant possibility of such pollution being caused.’

6.2 Risk Assessment

6.2.1 The definition of contaminated land is based on the principles of risk assessment. Risk is defined as a combination of:

- The probability, or frequency of exposure to a substance with the potential to cause harm, and:
- The seriousness of the consequence.

6.3 Pollutant Linkage

6.3.1 The basis of an environmental risk assessment involves identifying a ‘source’ of contamination, a ‘pathway’ along which the contamination may migrate and a ‘receptor’ at risk from the contamination.

6.3.2 Current legislation defines the various elements of the pollution linkage as:

- A contaminant is a substance which is in or under the ground and which has the potential to cause harm or to cause pollution of controlled waters.
- A pathway is one or more routes through which a receptor is being exposed to, or affected by, a contaminant, or could be so affected.
- A receptor is either a living organism, an ecological system, a piece of land or property, or controlled water.

6.3.3 A pollutant linkage indicates that all three elements have been identified. The site can only be defined as ‘Contaminated Land’ if a pollutant linkage exists and the contamination meets the criteria in Section 6.1 above.

6.3.4 The guidance proposes a four-stage approach for the assessment of contamination and the associated risks. The four stages are listed below:

- Hazard Identification
- Hazard Assessment
- Risk Assessment
- Risk Evaluation

6.3.5 The area is known to have contamination issues relating to historical lead working. Information from documents submitted to Wrexham Borough County Council's planning portal indicates lead mining activities to be present on and around the site. This report presents an assessment of the risks to the development from soil contamination.

6.4 Risk Assessment – Human Health

6.4.1 The proposed development consists of a residential building with associated garden. The risk assessment has therefore been based on guidelines for a residential end use.

6.4.2 The results of the soil analyses from the current investigation have been compared to CLEA SGVs published in Environment Agency Science Reports SC050021/SR3, ref 8.8 and SC050021, ref 8.9, where available, Generic Assessment Criteria (GAC), determined by LQM and CIEH, ref 8.10, DEFRA C4SL, ref. 8.11 as well as Assessment Criteria (AC) derived in-house using the CLEA Software Version 1.06, ref 8.11. The CLEA AC have been derived by Ian Farmer Associates in accordance with current legislation and guidance.

6.4.3 The guidance values used within this contamination assessment have been tabulated and are detailed within Appendix 4.

6.4.4 The results of chemical analyses have been processed in accordance with recommendations set out in the CIEH and CL:AIRE document 'Guidance on Comparing Soil Contamination Data with a Critical Concentration', ref 8.13. Where the concentrations determined on site are at or below the respective Guidance Level, they are considered not to pose a risk and are removed from further consideration, unless otherwise stated. Those contaminants with observed concentrations above the Guidance Level are detailed below:

Location	Depth (m)	Contaminant	Concentration (mg/kg)	Guidance Level (mg/kg)
HP02	0.40	Lead	4200	200

Location	Depth (m)	Contaminant	Concentration (mg/kg)	Guidance Level (mg/kg)
HP03	0.30	Lead	11000	200
HP04	0.60	Lead	450	200
HP05	0.20	Lead	470	200
HP06	0.30	Lead	1100	200
HP07	0.10	Lead	3800	200
HP08	0.20	Lead	1700	200
HP09	0.40	Lead	2600	200
HP10	0.50	Lead	880	200

6.4.5 Soil analysis has indicated significant lead contamination across the site within shallow made ground.

6.5 Risk Evaluation

6.5.1 The conceptual model formulated to reflect the findings of the contamination risk assessment, detailing the relevant pollutant linkages, is tabulated below:

Source	Potential Pathways	Receptor Group
Lead in soil	• Ingestion of contaminated soil by direct contact. • Ingestion of contaminants through vegetables. • Entry of contaminants by skin or eye contact with contaminated soils or dust. • Inhalation of contaminated dust.	Humans • Site occupants¹ • Site users¹ • Construction workers² • Maintenance workers¹ • Neighbouring site users²
	• Direct uptake and accumulation of contaminants.	Flora and Fauna • Landscaped areas
¹ – Assumes no remediation is undertaken		
² – Pathway exists only during the construction period		

6.6 Summary of Risk Evaluation

6.6.1 The above assessment identifies that the ‘source – pathway – receptor’ linkage potentially occurs with lead impacting upon the identified receptors. Therefore, it would be necessary to manage the risk at this location by either eliminating one of the links or by minimising the potential effects.

- 6.6.2 The lead contamination on site appears to be widespread within the made ground. All of the hand pits were terminated within the made ground at a depth of 0.60m.
- 6.6.3 Due to past historical lead mining known to have been carried out in the local area and the presence of two historical lead mining investigation pits on site, elevated levels of lead may be present in the natural strata.

7.0 MANAGEMENT OF CONTAMINATION

7.1 Remediation and Verification

- 7.1.1 The risk management framework set out in the Model Procedures for the Management of Land Contamination, CLR 11, ref. 8.20, is applicable to the redevelopment of sites that may be affected by contamination.
- 7.1.2 The risk management process set out in the Model Procedures has three main components:
- Risk assessment
 - Options appraisal
 - Implementation
- 7.1.3 This initial risk assessment has identified the presence of elevated lead concentrations within the Made Ground across the site. Relevant pollutant linkages have been identified, as demonstrated in the conceptual model.
- 7.1.4 The remediation strategy will need to review methods of reducing or controlling the identified unacceptable risks. This could be done by removing or treating the source of contamination, removing or modifying the pathways or removing or modifying the behaviour of the receptors, to ensure there is no significant risk of significant harm to either human health or controlled waters from the identified contamination, in relation to the proposed end use.
- 7.1.5 Following liaison with the relevant regulatory bodies, a remediation strategy could be formulated, which should incorporate an options appraisal and summarise in detail the chosen remedial approach, along with the verification proposals. The remediation strategy should then be approved by the relevant regulatory authorities prior to implementation.
- 7.1.6 Where remediation is required, a verification report will need to be formulated following implementation of the remediation strategy, which should provide a complete record of all remedial activities conducted on site and include all the data obtained to support the remedial objectives and demonstrate that the remediation has been effective. Any unexpected conditions encountered during the remedial works should also be detailed within the verification report.
- 7.1.7 In areas that are to be covered by buildings or hard standing, no pathway is likely to exist between any source of contamination and the human receptors by ingestion or dermal contact, therefore no further remedial action is likely to be required.
- 7.1.8 In gardens or areas likely to be used for the growing of vegetables/fruit for consumption, a capping layer of 'inert' material could be provided to break the pathway between the identified contamination and end users of the site.

- 7.1.9 Provision should be made for a minimum of 600mm of clean cover. Depending on final site levels this may be raised from existing site levels or contaminated material may be removed and replaced to retain existing levels.
- 7.1.10 The suitability of imported materials should be confirmed by the suppliers and verified by independent analysis.
- 7.1.11 The thickness of the imported materials should be confirmed by reference to pre and post development survey and / or excavation of shallow trial pits. Records should include photographs, measurements and material movement records.
- 7.1.12 On completion of the works the records should be compiled to form a validation report.
- 7.1.13 All materials removed from site should be disposed of at suitable facilities.

7.2 Management of Unidentified Sources of Contamination

- 7.2.1 There is the possibility that other sources of contamination may be present on the site, which were not detected during the investigation. Should such contamination be identified or suspected during the site clearance or ground works, these should be dealt with accordingly. A number of options are available for handling this material, which include:
- The removal from site and disposal to a suitably licensed tip of all material suspected of being contaminated. The material would need to be classified prior to disposal.
 - Short-term storage of the suspected material while undertaking verification testing for potential contamination. The storage area should be a contained area to ensure that contamination does not migrate and affect other areas of the site. Depending upon the amounts of material under consideration, this could be either a skip or a lined area.
 - Having a suitably experienced environmental engineer either on-call or with a watching brief for the visual and olfactory assessment of the material, and sampling for verification purposes.

7.3 Consultation

7.3.1 During the development of a contaminated site, consultation may be required for a number of reasons with a number of regulatory Authorities. The following provides an indication as to the most likely Authorities with which consultation may be required.

- **Local Authority.** There may be a planning condition regarding contamination and consultation will be required with a designated Contaminated Land Officer within the Environmental Health Department. The Local Authority is generally concerned with human health risks. Some Authorities now require 'Completion Certificates' to be signed off following remediation works.
- **Environment Agency.** Where a site is within a groundwater protection zone or has been designated as a special site, the Environment Agency is likely to be involved to ensure that controlled waters are protected.
- **National House Building Council, NHBC.** Section 4.1 of the NHBC Standards requires land management to be addressed. For a new housing development to be approved by the NHBC, any remediation will require a validation report.

7.3.2 Based on the results of any consultation, there may be specific remediation requirements imposed by one or more of the Authorities.

7.4 Risk Management During Site Works

7.4.1 During ground works, some simple measures may have to be put in place to mitigate the risk of contamination affecting the site workers and the environs. The majority of the proposed measures represent good practice for the construction industry and include:

- Informing the site workers of the contamination on site and the potential health effects from exposure.
- Where appropriate, the provision of suitable Personal Protective Equipment (PPE) for workers who may be potentially impacted by working in areas of the contamination.
- Ensuring good hygiene is enforced on site and washing facilities are maintained on the site. Workers are discouraged from smoking, eating or drinking without washing their hands first.
- Dust monitoring, and if necessary, suppression measures should be put into practice where contamination is becoming airborne.
- Site drainage should be prevented from entering any adjacent watercourse, ref 8.22.

- 7.4.2 Where contaminated materials are being removed from the site they should be disposed of at a suitably licensed landfill, with a 'duty of care' system in place and maintained throughout the disposal operations.

8.0 REFERENCES

- 8.1 CLR 4, 'Sampling strategies for contaminated land'. Report by The Centre for Research into the Built Environment, the Nottingham Trent University, DoE, 1994.
- 8.2 British Standards Institute: BS 10175 'Code of practice for the investigation of potentially contaminated sites', BSI 2011.
- 8.3 BS 5930:1999+A2:2010 '*Code of practice for site investigations*', British Standards Institute, 2010.
- 8.4 ISO 1997, Part 2:2007, 'Eurocode 7 – Geotechnical Design – Part 2, Ground Investigation and Design'
- 8.5 The Environmental Protection Act, Part IIA, Section 78, 1990.
- 8.6 Environment Act 1995, Section 57, DoE 1995.
- 8.7 CLR 3, 'Documentary research on industrial sites', Report by RPS Consultants Ltd, DoE 1994.
- 8.8 Environment Agency Science Report SC050021/SR3, 2008, 'Updated technical background to the CLEA model'
- 8.9 Environment Agency Science Report SC050021, 2009, 'Contaminants in Soil: Updated Collation of Toxicological Data and Intake Values for Humans'
- 8.10 Generic Assessment Criteria for Human Health Risk Assessment (2nd Edition), Nathaniel P, McCaffery C, Ashmore M, Cheng Y, Gillett A, Ogden R, and Scott D, Land Quality Press, Nottingham, published July 2009.
- 8.11 SP1010: Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination – Policy Companion Document. DEFRA. March 2014.
- 8.12 CLEA Software Version 1.06 (downloaded from the Environment Agency website, <http://www.environment-agency.gov.uk>)
- 8.13 'Guidance on Comparing Soil Contamination Data with a Critical Concentration', Chartered Institute of Environmental Health (CIEH) and Contaminated Land: Applications in Real Environments (CL:AIRE) May 2008.
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- 8.15 An Analysis of Variance Test for Normality, Shapiro, S. S. and Wilk, M. B. 1965
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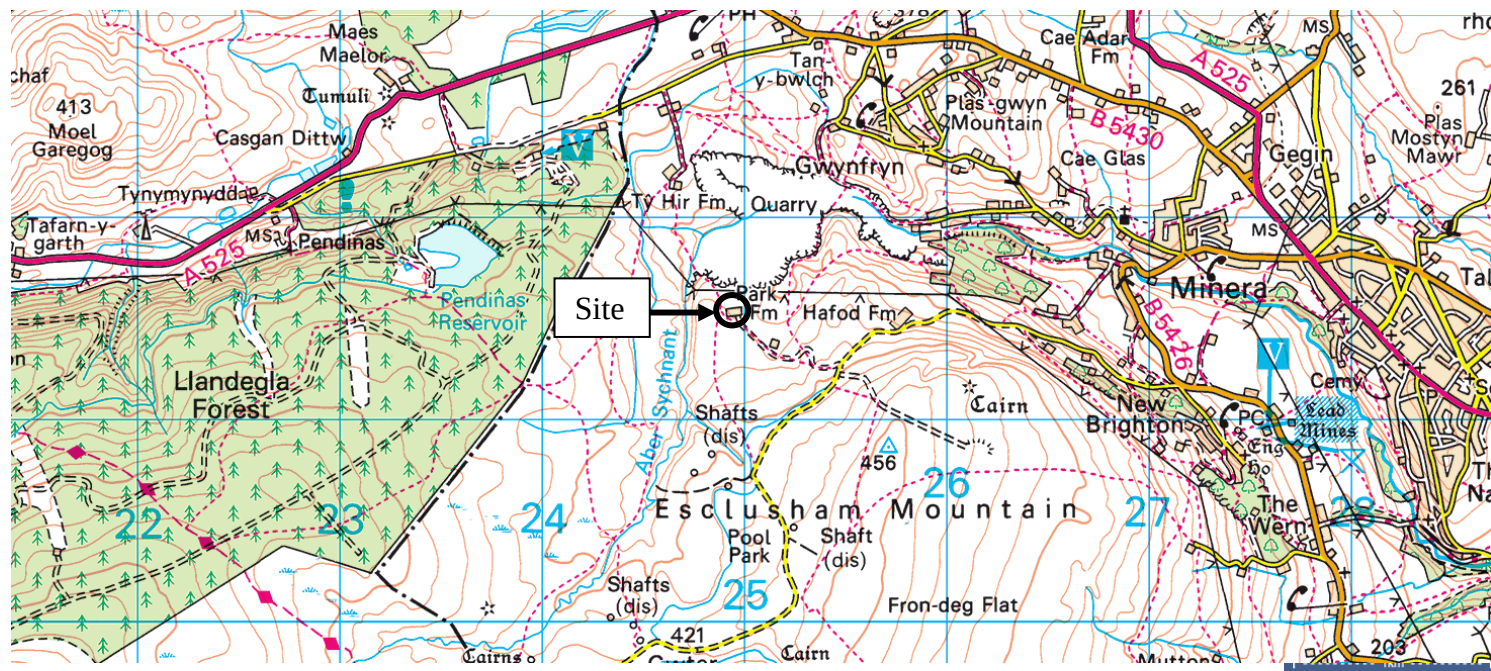
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- 8.18 UK Water Industry Research Ltd, Report 10/WM/03/21, 'Guidance for the Selection of Water Supply Pipes to be used in Brownfield Sites', 2010.
- 8.19 HazWasteOnlinetm, <http://www.hazwasteonline.co.uk>
- 8.20 CLR 11, 'Model Procedures for the Management of Contaminated Land', DEFRA and Environment Agency, 2004.
- 8.21 BRE Digest 465, 'Cover Systems for Land Regeneration – Thickness Cover Systems for Contaminated Land', 2004
- 8.22 Environment Agency / SEPA Pollution Prevention Guidelines, PPG5, 'Works In, Near, or Liable to Affect Watercourses'.
- 8.23 CLR 2, 'Guidance on preliminary site inspection of contaminated land', Report by Applied Environmental, DoE 1994.
- 8.24 Environment Agency, 2008, 'Review of the Fate and Transport of Selected Contaminants in the Soil Environment'. Draft Technical Report P5-079/TR1. Bristol: Environment Agency

For and on behalf of Ian Farmer Associates (1998) Limited

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Principal Engineering Geologist

APPENDIX 1
DRAWINGS



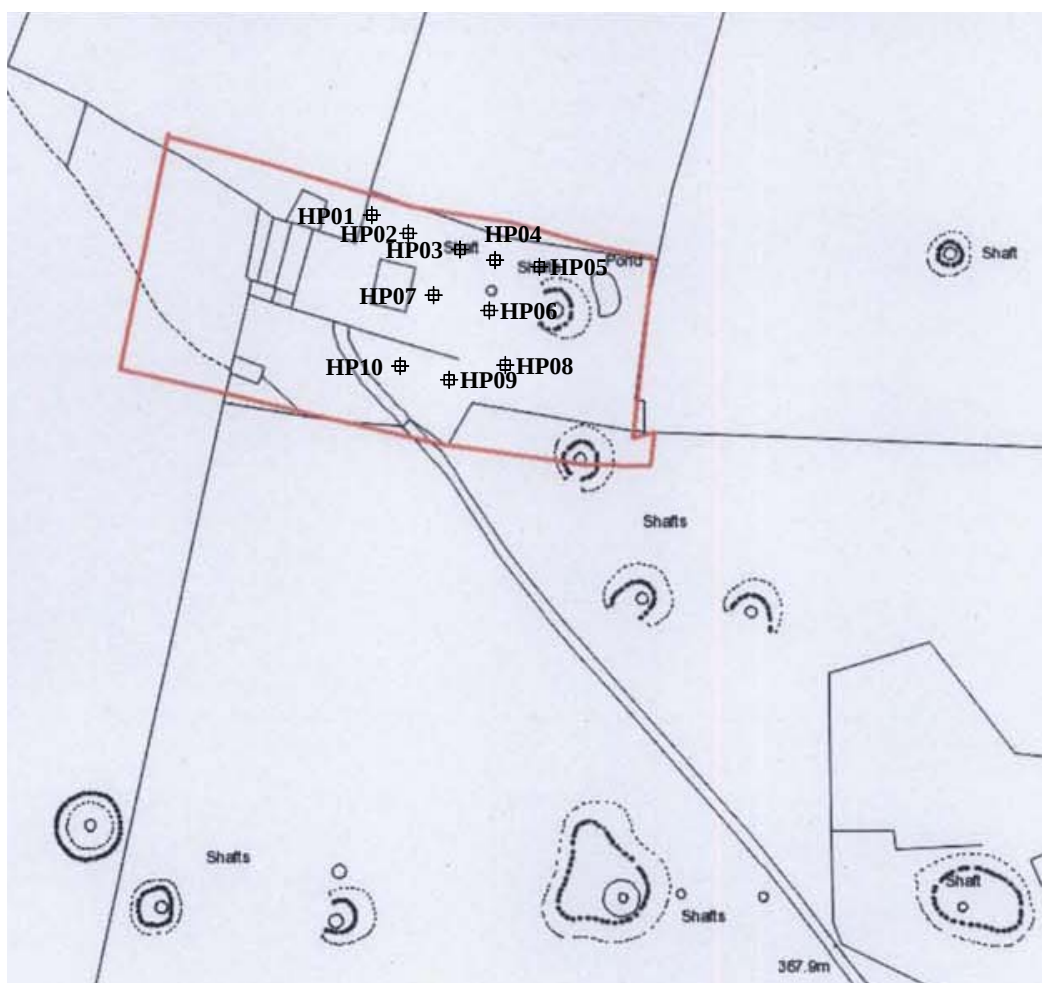
PROJECT: Park Farm, Minera

FIGURE No. A1.1.

SCALE: As Indicated

TITLE: Site Location Plan

IAN FARMER ASSOCIATES
Geotechnical & Environmental Specialists



PROJECT: Park Farm, Minera

FIGURE No. A1.2.

SCALE: As Indicated

TITLE: Site Plan

IAN FARMER ASSOCIATES
Geotechnical & Environmental Specialists

APPENDIX 2

SITE WORK

APPENDIX 2

GENERAL NOTES ON SITE WORKS

A2.1 SITE WORK

A2.1.1 General

Site work is carried out in general accordance with the guidelines given in ISO 1997, 8.4 and BS 5930, ref 8.3.

A2.1.2 Trial Pits

Shallow trial pits are generally dug by mechanical excavator, however, in difficult access locations or adjacent to structures, such pits may be hand dug. Pits are best used where the ground will stand unsupported and generally, the maximum depth of machine dug pits is 4m to 5m. Where personnel are required to enter pits, it is essential that side support is provided. Entry by personnel into unsupported pits deeper than 1.2m is not allowed for health and safety reasons.

Trial pits allow the in-situ condition of the ground to be examined both laterally and vertically and also allow discontinuities to be recorded. The field record should give the orientation of the pit with details of which face was logged, assessment of stability of sides of pit and groundwater as well as the strata encountered. Photographs of the pit should also be taken.

In-situ testing, such as hand penetrometer, hand vane, Macintosh probe, or similar, can be undertaken in the sides or base of pits while both disturbed and undisturbed samples recovered.

It is generally advisable to backfill the pits as soon as possible, open pits should not be left unattended.

A2.2 SAMPLES

B represents large bulk disturbed samples

D represents small disturbed sample

E represents environmental sample

W represents water sample

 represents water strike

 represents level to which water rose

A2.3 DESCRIPTION OF SOILS

A2.3.1 General

The procedures and principles given in ISO 14688 Parts 1 and 2, supplemented by section 6 of BS 5930, ref. 8.3 have been used in the soil descriptions contained within this report.



**IAN FARMER
ASSOCIATES**

Site

Park Farm, Minera, Wrexham

**Trial Pit
Number**

HP01

Excavation Method

Hand excavated

Dimensions

0.30m x 0.30m x 0.60m

Ground Level (mOD)

Client

H.Edwards/R.Davies

**Job
Number**

41728

Location

Dates

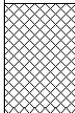
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Engineer

H.Edwards/R.Davies

Sheet

1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
0.10	E1				(0.60)	MADE GROUND: Grass over, grey brown, slightly gravelly, fine to coarse SAND. Gravel is angular to subangular, fine to coarse including porcelain, brick and limestone with occasional cobble content of limestone. At 0.30m: light brown.		
0.40	E2				0.60	Complete at 0.60m		
0.60	E3							

Plan

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Remarks

Hand pit remained dry and stable during excavation.

Scale (approx)

1:40

Logged By

DD

Figure No.

41728.HP01



**IAN FARMER
ASSOCIATES**

Site

Park Farm, Minera, Wrexham

**Trial Pit
Number**

HP02

Excavation Method

Hand excavated

Dimensions

0.30m x 0.30m x 0.60m

Ground Level (mOD)

Client

H.Edwards/R.Davies

**Job
Number**

41728

Location

Dates

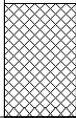
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Engineer

H.Edwards/R.Davies

Sheet

1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
0.20	E1				(0.60)	MADE GROUND: Grass over, grey brown, slightly gravelly, fine to coarse SAND. Gravel is angular to subangular, fine to coarse including tile, brick, limestone and glass. At 0.30m: light brown.		
0.40	E2				0.60	Complete at 0.60m		

Plan

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Remarks

Hand pit remained dry and stable during excavation.

Scale (approx)

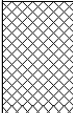
1:40

Logged By

DD

Figure No.

41728.HP02

 IAN FARMER ASSOCIATES						Site Park Farm, Minera, Wrexham		Trial Pit Number HP03		
Excavation Method Hand excavated		Dimensions 0.30m x 0.30m x 0.60m		Ground Level (mOD)		Client H.Edwards/R.Davies		Job Number 41728		
		Location		Dates 16/07/2015		Engineer H.Edwards/R.Davies		Sheet 1/1		
Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description		Legend	Water	
0.30	E1				(0.60)	MADE GROUND: Grass over, grey brown, slightly gravelly, fine to coarse SAND. Gravel is angular to subangular, fine to coarse including brick and limestone with occasional cobbles of subangular limestone. At 0.35m: light brown.				
0.50	E2				0.60	Complete at 0.60m				
Plan						Remarks				
.						Hand pit remained dry and stable during excavation.				
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.										
.						Scale (approx)		Logged By		Figure No.
						1:40		DD		41728.HP03

 IAN FARMER ASSOCIATES						Site Park Farm, Minera, Wrexham		Trial Pit Number HP04		
Excavation Method Hand excavated		Dimensions 0.30m x 0.30m x 0.60m		Ground Level (mOD)		Client H.Edwards/R.Davies		Job Number 41728		
		Location				Dates 16/07/2015		Engineer H.Edwards/R.Davies		Sheet 1/1
Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description		Legend	Water	
0.10	E1				(0.60)	MADE GROUND: Grass over, grey brown, slightly gravelly, fine to coarse SAND. Gravel is angular to subangular, fine to coarse including glass, brick and limestone, with occasional cobbles of angular limestone. At 0.30m: light brown.				
0.60	E2				0.60	Complete at 0.60m				
Plan						Remarks				
.						Hand pit remained dry and stable during excavation.				
.										
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.										
.						Scale (approx) 1:40		Logged By DD		Figure No. 41728.HP04



**IAN FARMER
ASSOCIATES**

Site

Park Farm, Minera, Wrexham

**Trial Pit
Number**

HP05

Excavation Method

Hand excavated

Dimensions

0.30m x 0.30m x 0.60m

Ground Level (mOD)

Client

H.Edwards/R.Davies

**Job
Number**

41728

Location

Dates

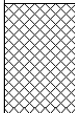
16/07/2015

Engineer

H.Edwards/R.Davies

Sheet

1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
0.20	E1				(0.60)	MADE GROUND: Grass over, grey brown, slightly gravelly, fine to coarse SAND. Gravel is angular to subangular, fine to coarse including limestone and glass, with occasional cobbles of angular limestone blocks. At 0.30m: light brown.		
0.50	E2				0.60	Complete at 0.60m		

Plan

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Remarks

Hand pit remained dry and stable during excavation.

Scale (approx)

1:40

Logged By

DD

Figure No.

41728.HP05



**IAN FARMER
ASSOCIATES**

Site

Park Farm, Minera, Wrexham

**Trial Pit
Number**

HP06

Excavation Method

Hand excavated

Dimensions

0.30m x 0.30m x 0.60m

Ground Level (mOD)

Client

H.Edwards/R.Davies

**Job
Number**

41728

Location

Dates

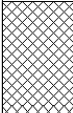
16/07/2015

Engineer

H.Edwards/R.Davies

Sheet

1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
0.30	E1				(0.60)	MADE GROUND: Grass over, grey brown, slightly gravelly, fine to coarse SAND. Gravel is angular to subangular, fine to coarse including limestone with occasional cobbles of limestone.		
0.60	E2				0.60	Complete at 0.60m		

Plan

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Remarks

Hand pit remained dry and stable during excavation.

Scale (approx)

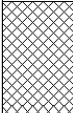
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Logged By

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Figure No.

41728.HP06

 IAN FARMER ASSOCIATES						Site Park Farm, Minera, Wrexham		Trial Pit Number HP07	
Excavation Method Hand excavated		Dimensions 0.30m x 0.30m x 0.60m		Ground Level (mOD)		Client H.Edwards/R.Davies		Job Number 41728	
		Location		Dates 16/07/2015		Engineer H.Edwards/R.Davies		Sheet 1/1	
Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description		Legend	Water
0.10	E1				(0.60)	MADE GROUND: Grass over, brown, slightly gravelly, fine to coarse SAND. Gravel is angular to subangular, fine to coarse including porcelain and limestone. At 0.30m: light brown.			
0.50	E2				0.60	Complete at 0.60m			
Plan						Remarks			
.						Hand pit remained dry and stable during excavation.			
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						Scale (approx) 1:40	Logged By DD	Figure No. 41728.HP07	



Park Farm, Minera, Wrexham

**Trial Pit
Number**
HP08

Hand excavated

0.30m x 0.30m x 0.60m

Dates	16/07/2015
--------------	------------

H. Edwards/R. Davies

**Job
Number**
41728

H. Edwards/R. Davies

Sheet
1/1

Depth
(m)

Sample / Tests

Water
Depth
(m)

Field Records

Level
(mOD)Depth
(m)
(Thickness)

Description

Legend

Water

0.20

E1

0.40

E2

(0.60)

0.60

MADE GROUND: Grass over, brown, slightly gravelly, fine to coarse SAND. Gravel is angular to subangular, fine to coarse including limestone and glass.

At 0.40m: light brown.

Complete at 0.60m

Plan

Remarks

Hand pit remained dry and stable during excavation.

Scale (approx)

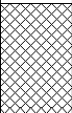
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Figure No.

41728.HP08

 IAN FARMER ASSOCIATES						Site Park Farm, Minera, Wrexham		Trial Pit Number HP09		
Excavation Method Hand excavated		Dimensions 0.30m x 0.30m x 0.60m		Ground Level (mOD)		Client H.Edwards/R.Davies		Job Number 41728		
		Location				Dates 16/07/2015		Engineer H.Edwards/R.Davies		Sheet 1/1
Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description		Legend	Water	
0.20	E1				(0.60)	MADE GROUND: Grass over, brown, slightly gravelly, fine to coarse SAND. Gravel is angular to subangular, fine to coarse including brick and limestone.				
0.40	E2				0.60	Complete at 0.60m				
Plan						Remarks				
.						Hand pit remained dry and stable during excavation.				
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.						Scale (approx)		Logged By		Figure No.
						1:40		DD		41728.HP09



IAN FARMER
ASSOCIATES

Site

Park Farm, Minera, Wrexham

Trial Pit
Number

HP10

Excavation Method

Hand excavated

Dimensions

0.30m x 0.30m x 0.60m

Ground Level (mOD)

Client

H.Edwards/R.Davies

Job
Number

41728

Location

Dates

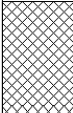
16/07/2015

Engineer

H.Edwards/R.Davies

Sheet

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Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
0.20	E1				(0.60)	MADE GROUND: Grass over, brown, slightly gravelly, fine to coarse SAND. Gravel is angular to subangular, fine to coarse including limestone.		
0.50	E2				0.60	At 0.50m: slightly clayey. Complete at 0.60m		

Plan

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Remarks

Hand pit remained dry and stable during excavation.

Scale (approx)

1:40

Logged By

DD

Figure No.

41728.HP10

APPENDIX 3
CHEMICAL TESTS



Certificate of Analysis

Certificate Number 15-40998

30-Jul-15

Client Ian Farmer Associates
17 Rivington Court
Hardwick Grange
Woolston
Warrington
Cheshire
WA1 4RT

Our Reference 15-40998

Client Reference 41728

Contract Title Park Farm, Minera

Description 10 Soil samples.

Date Received 23-Jul-15

Date Started 24-Jul-15

Date Completed 30-Jul-15

Test Procedures Identified by prefix DETSn (details on request).

Notes Opinions and interpretations are outside the scope of UKAS 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. Observations and interpretations are outside the scope of ISO 17025. This certificate shall not be reproduced except in full, without the prior written approval of the laboratory.

Approved By

A handwritten signature in black ink, appearing to read 'Mark Hughes'.

Mark Hughes
Operations Manager



Summary of Chemical Analysis

Matrix Descriptions

Our Ref 15-40998

Client Ref 41728

Contract Title Park Farm, Minera

Sample ID	Depth	Lab No	Completed	Matrix Description
HP01	0.1	843381	30/07/2015	Brown, gravelly, very sandy CLAY including odd rootlets
HP02	0.4	843382	30/07/2015	Brown, gravelly, very sandy CLAY including odd rootlets
HP03	0.3	843383	30/07/2015	Brown, gravelly, very sandy CLAY including odd rootlets
HP04	0.6	843384	30/07/2015	Brown, gravelly, very sandy CLAY including odd rootlets
HP05	0.2	843385	30/07/2015	Brown, gravelly, very sandy CLAY including odd rootlets
HP06	0.3	843386	30/07/2015	Brown, gravelly, very sandy CLAY including odd rootlets
HP07	0.1	843387	30/07/2015	Brown, gravelly, very sandy CLAY including odd rootlets
HP08	0.2	843388	30/07/2015	Brown, gravelly, very sandy CLAY including odd rootlets
HP09	0.4	843389	30/07/2015	Brown, gravelly, very sandy CLAY including odd rootlets
HP10	0.5	843390	30/07/2015	Brown, gravelly, very sandy CLAY including odd rootlets

Summary of Chemical Analysis Soil Samples

Our Ref 15-40998

Client Ref 41728

Contract Title Park Farm, Minera

Lab No	843381	843382	843383	843384	843385	843386	843387	843388	843389	843390
Sample ID	HP01	HP02	HP03	HP04	HP05	HP06	HP07	HP08	HP09	HP10
Depth	0.10	0.40	0.30	0.60	0.20	0.30	0.10	0.20	0.40	0.50
Other ID										
Sample Type	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
Sampling Date	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s
Sampling Time	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s

Test	Method	LOD	Units										
Metals													
Arsenic	DETSC 2301#	0.2	mg/kg	15	11	11	11	6.6	11	10	7.4	11	11
Boron (water soluble)	DETSC 2123#	0.2	mg/kg	1.5	1.9	1.5	1.2	1.0	1.5	1.5	1.2	1.8	1.3
Cadmium	DETSC 2301#	0.1	mg/kg	13	18	23	1.8	4.5	3.9	5.5	3.7	5.3	6.4
Chromium	DETSC 2301#	0.15	mg/kg	24	15	14	25	19	30	27	16	26	29
Hexavalent Chromium	DETSC 2204*	1	mg/kg	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Copper	DETSC 2301#	0.2	mg/kg	41	27	32	16	13	25	24	16	26	26
Lead	DETSC 2301#	0.3	mg/kg	17	4200	11000	450	470	1100	3800	1700	2600	880
Mercury	DETSC 2325#	0.05	mg/kg	1.4	0.90	0.75	0.07	0.07	0.20	0.25	0.17	0.19	0.24
Nickel	DETSC 2301#	1	mg/kg	20	12	13	23	13	24	23	12	24	30
Selenium	DETSC 2301#	0.5	mg/kg	< 0.5	0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Zinc	DETSC 2301#	1	mg/kg	1900	2600	3600	270	770	610	910	600	810	920
Inorganics													
pH	DETSC 2008#			7.4	7.6	7.7	7.7	7.7	7.0	7.4	7.2	7.1	7.5
Total Sulphate as SO4	DETSC 2321#	0.01	%	0.12	0.21	0.20	0.05	0.08	0.10	0.12	0.08	0.12	0.07

Information in Support of the Analytical Results

Our Ref 15-40998
 Client Ref 41728
 Contract Park Farm, Minera

Containers Received & Deviating Samples

Lab No	Sample ID	Date Sampled	Containers Received	Holding time exceeded for tests	Inappropriate container for tests
843381	HP01 0.10 SOIL		GJ 250ml, GJ 60ml, PT 1L	Sample date not supplied	
843382	HP02 0.40 SOIL		GJ 250ml, GJ 60ml, PT 1L	Sample date not supplied	
843383	HP03 0.30 SOIL		GJ 250ml, GJ 60ml, PT 1L	Sample date not supplied	
843384	HP04 0.60 SOIL		GJ 250ml, GJ 60ml, PT 1L	Sample date not supplied	
843385	HP05 0.20 SOIL		GJ 250ml, GJ 60ml, PT 1L	Sample date not supplied	
843386	HP06 0.30 SOIL		GJ 250ml, GJ 60ml, PT 1L	Sample date not supplied	
843387	HP07 0.10 SOIL		GJ 250ml, GJ 60ml, PT 1L	Sample date not supplied	
843388	HP08 0.20 SOIL		GJ 250ml, GJ 60ml, PT 1L	Sample date not supplied	
843389	HP09 0.40 SOIL		GJ 250ml, GJ 60ml, PT 1L	Sample date not supplied	
843390	HP10 0.50 SOIL		GJ 250ml, GJ 60ml, PT 1L	Sample date not supplied	

Key: G-Glass P-Plastic J-Jar T-Tub

DETS cannot be held responsible for the integrity of samples received whereby the laboratory did not undertake the sampling. In this instance samples received may be deviating. Deviating Sample criteria are based on British and International standards and laboratory trials in conjunction with the UKAS note 'Guidance on Deviating Samples'. All samples received are listed above. However, those samples that have additional comments in relation to hold time and/or inappropriate containers are deviating due to the reasons stated. This means that the analysis is accredited where applicable, but results may be compromised due to sample deviations. If no sampled date (soils) or date+time (waters) has been supplied then samples are deviating. However, if you are able to supply a sampled date (and time for waters) this will prevent samples being reported as deviating where specific hold times are not exceeded and where the container supplied is suitable.

Soil Analysis Notes

Inorganic soil analysis was carried out on a dried sample, crushed to pass a 425µm sieve, in accordance with BS1377.

Organic soil analysis was carried out on an 'as received' sample. Organics results are corrected for moisture and expressed on a dry weight basis.

The Loss on Drying, used to express organics analysis on an air dried basis, is carried out at a temperature of 28°C +/-2°C.

Disposal

From the issue date of this test certificate, samples will be held for the following times prior to disposal :-

Soils - 1 month, Liquids - 2 weeks, Asbestos (test portion) - 6 months

Appendix A - Details of Analysis

Method	Parameter	Units	Limit of Detection	Sample Preparation	Sub-Contracted	UKAS	MCERTS
DETS 2002	Organic matter	%	0.1	Air Dried	No	Yes	Yes
DETS 2003	Loss on ignition	%	0.01	Air Dried	No	Yes	Yes
DETS 2008	pH	pH Units	1	Air Dried	No	Yes	Yes
DETS 2024	Sulphide	mg/kg	10	Air Dried	No	Yes	Yes
DETS 2076	Sulphate Aqueous Extract as SO ₄	mg/l	10	Air Dried	No	Yes	Yes
DETS 2084	Total Carbon	%	0.5	Air Dried	No	Yes	Yes
DETS 2084	Total Organic Carbon	%	0.5	Air Dried	No	Yes	Yes
DETS 2119	Ammoniacal Nitrogen as N	mg/kg	0.5	Air Dried	No	Yes	Yes
DETS 2130	Cyanide free	mg/kg	0.1	Air Dried	No	Yes	Yes
DETS 2130	Cyanide total	mg/kg	0.1	Air Dried	No	Yes	Yes
DETS 2130	Phenol - Monohydric	mg/kg	0.3	Air Dried	No	Yes	Yes
DETS 2130	Thiocyanate	mg/kg	0.6	Air Dried	No	Yes	Yes
DETS 2321	Total Sulphate as SO ₄	%	0.01	Air Dried	No	Yes	Yes
DETS 2325	Mercury	mg/kg	0.05	Air Dried	No	Yes	Yes
DETS 3049	Sulphur (free)	mg/kg	0.75	Air Dried	No	Yes	Yes
DETS 2123	Boron (water soluble)	mg/kg	0.2	Air Dried	No	Yes	Yes
DETS 2301	Arsenic	mg/kg	0.2	Air Dried	No	Yes	Yes
DETS 2301	Barium	mg/kg	1.5	Air Dried	No	Yes	Yes
DETS 2301	Beryllium	mg/kg	0.2	Air Dried	No	Yes	Yes
DETS 2301	Cadmium Available	mg/kg	0.1	Air Dried	No	Yes	Yes
DETS 2301	Cadmium	mg/kg	0.1	Air Dried	No	Yes	Yes
DETS 2301	Cobalt	mg/kg	0.7	Air Dried	No	Yes	Yes
DETS 2301	Chromium	mg/kg	0.15	Air Dried	No	Yes	Yes
DETS 2301	Copper	mg/kg	0.2	Air Dried	No	Yes	Yes
DETS 2301	Manganese	mg/kg	20	Air Dried	No	Yes	Yes
DETS 2301	Molybdenum	mg/kg	0.4	Air Dried	No	Yes	Yes
DETS 2301	Nickel	mg/kg	1	Air Dried	No	Yes	Yes
DETS 2301	Lead	mg/kg	0.3	Air Dried	No	Yes	Yes
DETS 2301	Selenium	mg/kg	0.5	Air Dried	No	Yes	Yes
DETS 2301	Zinc	mg/kg	1	Air Dried	No	Yes	Yes
DETS 3072	Ali/Aro C10-C35	mg/kg	10	As Received	No	Yes	Yes
DETS 3072	Aliphatic C10-C12	mg/kg	1.5	As Received	No	Yes	Yes
DETS 3072	Aliphatic C10-C12	mg/kg	10	As Received	No	Yes	Yes
DETS 3072	Aliphatic C10-C35	mg/kg	10	As Received	No	Yes	Yes
DETS 3072	Aliphatic C12-C16	mg/kg	1.2	As Received	No	Yes	Yes
DETS 3072	Aliphatic C12-C16	mg/kg	10	As Received	No	Yes	Yes
DETS 3072	Aliphatic C16-C21	mg/kg	1.5	As Received	No	Yes	Yes
DETS 3072	Aliphatic C16-C21	mg/kg	10	As Received	No	Yes	Yes
DETS 3072	Aliphatic C21-C35	mg/kg	3.4	As Received	No	Yes	Yes
DETS 3072	Aliphatic C21-C35	mg/kg	3.4	As Received	No	Yes	Yes
DETS 3072	Aromatic C10-C12	mg/kg	0.9	As Received	No	Yes	Yes
DETS 3072	Aromatic C10-C12	mg/kg	10	As Received	No	Yes	Yes
DETS 3072	Aromatic C10-C35	mg/kg	10	As Received	No	Yes	Yes
DETS 3072	Aromatic C12-C16	mg/kg	0.5	As Received	No	Yes	Yes
DETS 3072	Aromatic C12-C16	mg/kg	10	As Received	No	Yes	Yes
DETS 3072	Aromatic C16-C21	mg/kg	0.6	As Received	No	Yes	Yes
DETS 3072	Aromatic C16-C21	mg/kg	10	As Received	No	Yes	Yes
DETS 3072	Aromatic C21-C35	mg/kg	1.4	As Received	No	Yes	Yes
DETS 3072	Aromatic C21-C35	mg/kg	1.4	As Received	No	Yes	Yes
DETS 062	Benzene	mg/kg	0.01	As Received	No	Yes	Yes
DETS 062	Ethylbenzene	mg/kg	0.01	As Received	No	Yes	Yes
DETS 062	Toluene	mg/kg	0.01	As Received	No	Yes	Yes
DETS 062	Xylene	mg/kg	0.01	As Received	No	Yes	Yes
DETS 062	m+p Xylene	mg/kg	0.01	As Received	No	Yes	Yes
DETS 062	o Xylene	mg/kg	0.01	As Received	No	Yes	Yes
DETS 3311	C10-C24 Diesel Range Organics (DRO)	mg/kg	10	As Received	No	Yes	Yes
DETS 3311	C24-C40 Lube Oil Range Organics (LORO)	mg/kg	10	As Received	No	Yes	Yes
DETS 3311	EPH (C10-C40)	mg/kg	10	As Received	No	Yes	Yes

Appendix A - Details of Analysis

Method	Parameter	Units	Limit of Detection	Sample Preparation	Sub-Contracted	UKAS	MCERTS
DETS 3303	Acenaphthene	mg/kg	0.03	As Received	No	Yes	Yes
DETS 3303	Acenaphthylene	mg/kg	0.03	As Received	No	Yes	Yes
DETS 3303	Benzo(a)pyrene	mg/kg	0.03	As Received	No	Yes	Yes
DETS 3303	Benzo(a)anthracene	mg/kg	0.03	As Received	No	Yes	Yes
DETS 3303	Benzo(b)fluoranthene	mg/kg	0.03	As Received	No	Yes	Yes
DETS 3303	Benzo(k)fluoranthene	mg/kg	0.03	As Received	No	Yes	Yes
DETS 3303	Benzo(g,h,i)perylene	mg/kg	0.03	As Received	No	Yes	Yes
DETS 3303	Dibenzo(a,h)anthracene	mg/kg	0.03	As Received	No	Yes	Yes
DETS 3303	Fluoranthene	mg/kg	0.03	As Received	No	Yes	Yes
DETS 3303	Indeno(1,2,3-c,d)pyrene	mg/kg	0.03	As Received	No	Yes	Yes
DETS 3303	Naphthalene	mg/kg	0.03	As Received	No	Yes	Yes
DETS 3303	Phenanthrene	mg/kg	0.03	As Received	No	Yes	Yes
DETS 3303	Pyrene	mg/kg	0.03	As Received	No	Yes	Yes
DETS 3401	PCB 28 + PCB 31	mg/kg	0.01	As Received	No	Yes	Yes
DETS 3401	PCB 52	mg/kg	0.01	As Received	No	Yes	Yes
DETS 3401	PCB 101	mg/kg	0.01	As Received	No	Yes	Yes
DETS 3401	PCB 118	mg/kg	0.01	As Received	No	Yes	Yes
DETS 3401	PCB 153	mg/kg	0.01	As Received	No	Yes	Yes
DETS 3401	PCB 138	mg/kg	0.01	As Received	No	Yes	Yes
DETS 3401	PCB 180	mg/kg	0.01	As Received	No	Yes	Yes
DETS 3401	PCB Total	mg/kg	0.01	As Received	No	Yes	Yes

Method details are shown only for those determinands listed in Annex A of the MCERTS standard. Anything not included on this list falls outside the scope of MCERTS. No Recovery Factors are used in the determination of results. Results reported assume 100% recovery. Full method statements are available on request.

APPENDIX 4
CONTAMINATION ASSESSMENT

APPENDIX 4

GENERAL NOTES ON CONTAMINATION ASSESSMENT

A4.1 STATUTORY FRAMEWORK AND DEFINITIONS

A4.1.1 The statutory definition of contaminated land is defined in the Environmental Protection Act 1990, ref 8.5, which was introduced by the Environment Act 1995, ref 8.6;

‘Land which appears to the local authority in whose area it is situated to be in such a condition, by reason of substances in, on or under the land, that –

(a) significant harm is being caused or there is a significant possibility of such harm being caused; or

(b) pollution of controlled waters is being, or is likely to be, caused.’

A4.1.2 The UK guidance on the assessment of contaminated has developed as a direct result of the introduction of these two Acts. The technical guidance supporting the legislation was originally summarised in a number of key documents collectively known as the Contaminated Land Reports (CLRs), a proposed series of twelve documents. Seven were originally published in March 1994, four more were published in April 2002, while the final guidance document, CLR 11, ref 8.20 was published in 2004. CLR7 to 10 were withdrawn in 2008, with CLR 9 and 10 effectively replaced by the Environment Agency in the form of Science Reports SR2, ref 8.16 and SR3, ref 8.8. CLR11 remains valid and sets out the framework of the investigation process.

A4.1.3 In establishing whether a site fulfils the statutory definition of ‘contaminated land’ it is necessary to identify, whether a pollutant linkage exists in respect of the land in question and whether the pollutant linkage:

- is resulting in significant harm being caused to the receptor in the pollutant linkage,
- presents a significant possibility of significant harm being caused to that receptor,
- is resulting in the pollution of the controlled waters which constitute the receptor, or
- is likely to result in such pollution.

A4.1.4 A ‘pollutant linkage’ may be defined as the link between a contaminant ‘source’ and a ‘receptor’ by means of a ‘pathway’.

A4.2 ASSESSMENT METHODOLOGY

A4.2.1 The guidance proposes a four-stage assessment process for identifying potential pollutant linkages on a site. These stages are set out in the table below:

No.	Process	Description
1	Hazard Identification	Establishing contaminant sources, pathways and receptors (the conceptual model).
2	Hazard Assessment	Analysing the potential for unacceptable risks (what linkages could be present, what could be the effects).
3	Risk Estimation	Trying to establish the magnitude and probability of the possible consequences (what degree of harm might result and to what receptors, and how likely is it).
4	Risk Evaluation	Deciding whether the risk is unacceptable.

- A4.2.2 Stages 1 and 2 develop a '*conceptual model*' based upon information collated from desk based studies, and frequently a walkover of the site. The walkover survey should be conducted in general accordance with CLR 2, ref 8.23. The formation of a conceptual model is an iterative process and as such, it should be updated and refined throughout each stage of the project to reflect any additional information obtained.
- A4.2.3 The extent of the desk studies and enquiries to be conducted should be in general accordance with CLR 3, ref 8.7. The information from these enquiries is presented in a desk study report with recommendations, if necessary, for further work based upon the conceptual model. In the absence of specific information on contamination anticipated to be encountered, specific DoE 'Industry Profiles' provide guidance on the nature of contaminants relating to a variety of industrial processes and should be used as the basis for determining which contaminants are more likely to be present on a site.
- A4.2.4 If potential pollutant linkages are identified within the conceptual model, a Phase 2 site investigation and report will be recommended. The investigation should be planned in general accordance with CLR 4, ref 8.1. The number of exploratory holes and samples collected for analysis should be consistent with the size of the site and the level of risk envisaged. This will enable a generic quantitative risk assessment (GQRA) to be conducted, at which point the conceptual model can be updated and relevant pollutant linkages can be identified.
- A4.2.5 A two-stage investigation may be more appropriate where time constraints are less of an issue. The first stage investigation being conducted as an initial assessment for the presence of potential sources, a second being a more refined investigation to delineate wherever possible the extent of the identified contamination.
- A4.2.6 All site works should be in general accordance with the British Standards, BS 5930:2010, ref. 8.3, ISO 1997, ref 8.4 and BS 10175:2011, ref 8.2.
- A4.2.7 The GQRA screens the results of the chemical analysis against generic guidance values, appropriate to the end-use of the site. Soils will be compared to Soil Guideline Values (SGV) where published, Generic Assessment Criteria (GAC) developed by LQM/CIEH, ref 8.10, or internal screening values generated using the Contaminated Land Exposure Assessment (CLEA) Software, Version 1.06, ref 8.11. Toxicological and physico-chemical/fate and transport data used to generate the AC has been derived from a hierarchy of data sources as follows:
1. Environment Agency or Department of Environment Food and Rural Affairs
(DEFRA) documents;
 2. Other documents produced by UK Government or state organisations;
 3. European institution documents;
 4. International organisation documents;
 5. Foreign government institutions.
- A4.2.8 For many of the contaminants considered, input data has been drawn from the relevant SGV where available, or existing toxicological reports published by the Environment Agency which have not yet been withdrawn/replaced. Fate and transport data has been derived in the first instance from Environment Agency (2008), ref 8.24.

- A4.2.9 Recommendations for tolerable intakes of lead are based on evaluation of the relationship between exposure and blood lead levels. The existing toxicological report for lead considers a health criteria value based on an uptake dose, whereas the CLEA model estimates exposure in terms of an intake dose. At present, the CLEA model is not considered appropriate for determining a screening value for lead. In the absence of a current published assessment criterion, the SGV for lead reported in R&D Publication CLR 10 ref 8.17 have been used in this assessment. This will be updated in due course in light of any further published information.
- A4.2.10 Chemical laboratory test results are processed as follows. A statistical analysis of the results is conducted, as detailed in CIEH and CL:AIRE 'Guidance on Comparing Soil Contamination Data with a Critical Concentration', ref 8.13. Individual concentrations are compared to the selected guideline values to identify concentrations of contaminants that are above the selected screening criteria.
- A4.2.11 Initially the distribution of the data set is tested using the Shapiro-Wilk normality test, ref 8.15 to determine if the data set is, or is not, normally distributed. Where the distribution of the data is shown to be normal, the mean value test is applied to determine whether the mean characteristics of the selected soil unit present a significant possibility of significant harm to human health. Where the data is not normally distributed a method based on the Chebychev Theorem can be applied to test the same hypothesis. The significance of the data is further tested using the maximum value test. This determines whether the highest recorded contaminant concentrations are from the same statistical distribution or whether they may represent a 'hot spot'.
- A4.2.12 Where the risk estimation identifies significant concentrations of one or more contaminants, a further risk evaluation needs to be undertaken.
- A4.2.13 The risk evaluation will address the potential pollutant linkages between an identified source of contamination and the likely receptors both on and off site.
- A4.2.14 The potential receptors include:
- 1) Humans – current site occupants, construction workers, future site users and neighbouring site users.
 - 2) Controlled Waters – surface water and groundwater resources
 - 3) Plants – current and future site vegetation
 - 4) Building materials
- A4.2.15 The potential hazards to be considered in relation to contamination are:
- a) Ingestion and inhalation.
 - b) Uptake of contaminants via cultivated vegetables.
 - c) Dermal contact
 - d) Phytotoxicity (the prevention or inhibition of plant growth)
 - e) Contamination of water resources
 - f) Chemical attack on building materials and services
 - g) Fire and explosion
- A4.2.16 Dependent on the outcome of the initial, generic contamination risk assessment, further detailed assessment of the identified risks may be required.

A4.3 Generic Guidance Values Used Within Contamination Risk Assessment

Residential End Use

	Determinant	Guidance Value (mg/kg)	Guidance Value (mg/kg)	Guidance Value (mg/kg)	Primary Data Source
		1% SOM	2.5% SOM	6% SOM	
PAH	Acenaphthene	210	480	1000	LQM CIEH GAC (*DEFRA C4SL)
	Acenaphthylene	170	400	850	
	Anthracene	2300	4900	9200	
	Benz(a)anthracene	3.1	4.7	5.9	
	Benzo(a)pyrene			5*	
	Benzo(b)fluoranthene	5.6	6.5	7	
	Benzo(ghi)perylene	44	46	47	
	Benzo(k)fluoranthene	8.5	9.6	10	
	Chrysene	6	8	9.3	
	Dibenzo(ah)anthracene	0.76	0.86	0.90	
	Fluoranthene	260	460	670	
	Fluorene	160	380	780	
	Indeno(123-cd)pyrene	3.2	3.9	4.2	
	Napthalene	1.5	3.7	8.7	
	Phenanthrene	92	200	380	
	Pyrene	560	1000	1600	
Other Organics	Phenol	210	390	780	LQM CIEH GAC
Metals	Arsenic	37			DEFRA C4SL
	Beryllium	51			LQM CIEH GAC
	Boron	291			LQM CIEH GAC
	Cadmium	26			DEFRA C4SL
	Chromium (III)	3000			LQM CIEH GAC
	Chromium (VI)	21			DEFRA C4SL
	Copper	2330			LQM CIEH GAC
	Lead	200			DEFRA C4SL
	Inorganic Mercury	169			EA 2009
	Nickel	130			EA 2009
	Selenium	350			EA 2009
	Vanadium	75			LQM CIEH GAC
	Zinc	3750			LQM CIEH GAC

¹ SOM – Soil Organic Matter