MRS L. MURISON

THE WOODYARD
CHURCH STREET, WELDON NN17 3JS

REPORT ON PHASE 2 SITE INVESTIGATION

Contract: 20366

Date: April 2008

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REPORT ON PHASE 2 SITE INVESTIGATION

carried out at

THE WOODYARD

CHURCH STREET, WELDON NN17 3JS

Prepared for

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EXECUTIVE SUMMARY

On the instructions of Philip Evans Architects, on behalf of Mrs L Murison, a site investigation was undertaken to determine ground conditions to enable a contamination risk assessment. It is understood that the proposed development comprises residential housing with gardens

This report follows and should be read in conjunction with our previous Report on Phase I Desk Study, issued under reference 20024 in May 2006.

The site is situated at Weldon, approximately 6 km to the east of the town centre of Corby and may be located by National Grid Reference 492800, 289287. The geological map indicates the site to be partially underlain by superficial deposits of Alluvium, or otherwise directly underlain by the Upper Lincolnshire Limestone.

The site work was carried out on the 4th March 2008. Eight trial pits were dug by mechanical excavator, with representative samples collected for laboratory testing Two soakaway permeability tests were also undertaken. The sequence of the strata encountered during the investigation generally confirms the anticipated geology as interpreted from the geological map.

The suite of chemical analyses has been based upon the findings of the desk study, to investigate the potential sources of contamination identified in the conceptual model. The subsequent assessment identified that a 'source – pathway – receptor' linkage potentially occurs with benzo(a)pyrene impacting upon human health. 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.

In areas that are to be covered by buildings or hard standing, no pathway is likely to exist. In gardens or areas likely to be used for the growing of vegetables/fruit for consumption, a simple capping layer of 'inert' material could be provided to break the pathway between the identified contamination and end users of the site

CONTENTS

1.0 INTRODUCTION

1.1 It is understood that the proposed development comprises residential housing with gardens.

1.2 On the instructions of Mrs L Murison, on behalf of Philip Evans Architects, a site investigation was undertaken to determine ground conditions and enable a contamination risk assessment.

1.3 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.

1.4 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.

1.5 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.

1.6 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.

1.7 This report follows and should be read in conjunction with our previous Report on Phase I Desk Study, issued under reference 20024 in May 2006.

2.0 SITE SETTING

2.1 Site Location

2.1.1 The site is situated at Weldon, approximately 6 km to the east of the town centre of Corby and may be located by National Grid Reference 492800, 289287. It comprises an area adjacent to Church Street, which is reasonably level and has remnants for former structures and concrete hard standing associated with a timber yard. The remainder of the site slopes upwards away from the access on Church Street, with some wooded areas and stockpiled soil.

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

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. 171, ‘Kettering’, solid and drift edition, 1:50000 scale, published 2002.

2.2.2 The geological map indicates the site to be partially underlain by superficial deposits of Alluvium comprising silty clay with gravel lenses.

2.2.3 The superficial deposits are underlain by the Upper Lincolnshire Limestone of the Jurassic, comprising ooidal, peloidal and shell detrital limestone.

2.2.4 The site is within an urban area and, although not indicated as present on the site from the geological maps, the possibility that Made Ground exists on site cannot be discounted.

2.3 Potential Geological Hazards

2.3.1 The following are brief findings relating to factors highlighted in the Phase 1 report that may have a potential impact upon the engineering of the proposed development.

Potential Hazard	Assessed Risk On Site
Compressible ground subsidence	None to Moderate (NW corner)
Ground dissolution subsidence	Very low to low
Gulls and cambering subsidence	None
Swelling clay subsidence	None to Very Low (W)
Landslip subsidence	Very Low
Natural Cavities	None

3.0 SITE WORK

3.1 The site work was carried out on the 4th March 2008. The locations of exploratory holes have been planned, where possible, 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 10175:2001, ref. 8.2, and BS 5930:1999 ref. 8.3.

3.2 Eight trial pits, designated SW1 to SW2 and TP1 to TP6, were dug by mechanical excavator 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 in the trial pit records, Appendix 2, Figures 20366.SW1 to SW2 and TP1 to TP6.

3.3 Representative disturbed samples were taken at the depths shown on the trial pit records and despatched to the laboratory.

3.4 Samples for environmental purposes were collected in amber glass jars and kept in a cool box.

3.5 The ground levels at the trial pit locations were not determined.

3.6 Soakaway permeability tests were carried out in trial pits SW1 and SW2, in line with guidelines given in BRE Digest 365, ref 8.4. The results are included in Figures A2.1 to A2.2.

4.0 LABORATORY TESTS

4.1 Chemical Testing

4.1.1 The suite of chemical analyses has been based upon the findings of the desk study, to investigate the potential sources of contamination identified in the conceptual model. The chemical analyses were carried out on six samples of soil.

4.1.2 **Metals Suite** - arsenic, cadmium, chromium, lead, selenium, copper, nickel and zinc

4.1.3 **Organic Suite -** petroleum hydrocarbons (TPH), polycyclic aromatic hydrocarbons (PAH) – USEPA 16 suite, phenols

4.1.4 **Inorganics Suite** - cyanide (free), sulphate

4.1.5 **Others** - pH, organic matter content

4.1.6 The results of these tests are shown in Appendix 4, Test Report Ref: 08-18049.

5.0 GROUND CONDITIONS ENCOUNTERED

5.1 Sequence

5.1.1 The sequence of the strata encountered during the investigation generally confirms the anticipated geology as interpreted from the geological map.

5.1.2 The sequence and indicative thicknesses of strata are provided below:

Strata Encountered	Depth Encountered (m)		Strata Thickness (m)
	From	To	
Made Ground / Topsoil	0.00	0.00 to 0.50	0.00 to 0.50
Alluvium	0.50	1.60	1.10
Upper Lincolnshire Limestone	0.00 to 1.60	1.60	>3.20
Grantham / Northampton Sand Formations	1.10	>3.20	>2.10

5.2 Made Ground / Topsoil

5.2.1 There was evidence of Made Ground on the site, in the form of existing concrete and brickwork, and also stockpiled material. The majority of the site

however appeared to be covered by topsoil, or directly onto natural ground, especially in areas where archaeological trenches had been excavated.

5.3 Alluvium

5.3.1 Alluvium was encountered as anticipated in SW1, in the most northern corner, also closest to the river. Alluvial deposits extended to 1.60m below ground level, overlying weathered limestone.

5.4 Upper Lincolnshire Limestone

5.4.1 Limestone deposits were encountered in all locations, with the exception of TP1, and generally comprised limestone in various stages of weathering, from cobbles to clay, with some thicker clay layers.

5.5 Grantham / Northampton Sand Formations

5.5.1 TP1, at the lowest point of the site, indicated weathered limestone deposits, underlain by clay of the Grantham Formation, in turn underlain by Northampton Sand, recovered as sand to cobble sized fragments of ironstone. Due to the varying levels across the site, no other pits encountered these deposits.

5.6 Groundwater

5.6.1 Groundwater was not encountered in any of the exploratory holes.

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 hazard identification and hazard assessment have been based upon the Phase 1 Desk Study and formed the conceptual site model, detailed in our report, reference 20024, dated May 2006.

6.3.6 The risk assessment and evaluation stages are presented in this phase 2 interpretive report, after an intrusive ground investigation has taken place.

6.4 Risk Assessment – Human Health

6.4.1 The proposed development consists of residential housing with gardens. The risk assessment has therefore been based on guidelines for a residential with plant uptake end use of the site. Should the proposed development be changed in the future then further risk assessment may be required.

6.4.2 The results of the soil analyses have been compared to the CLEA SGVs where available, or alternatively, Generic Assessment Criteria (GAC), determined by LQM and CIEH in accordance with current legislation and guidance, as detailed in their publication, ref. 8.7.

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 CLR 7, ref 8.8 and CLR 10, ref. 8.9. 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)	Guidelines Adopted
SW1	0.30m	Zinc	400	300	SGV
SW1	0.30m	Benzo(a)pyrene	3.9	1.1	GAC
TP5	0.20m	Benzo(a)pyrene	3.4	1.1	GAC

6.4.5 Where the concentration of any contaminant is above the Guidance Level, further statistical analysis of the results has been conducted in accordance with the CLEA guidance.

6.4.6 The 'mean value test' was applied to the results above. Applying the mean value test to the results gives the upper 95th percentile bound of the samples. This upper bound indicates whether any high concentrations represent a significant possibility of harm to human health.

6.4.7 The output from the mean value tests are provided in Appendix 4, Figure A4.1, and the results is/are tabulated below:

Contaminant	Value of upper 95th percentile (mg/kg)	Guidance Value (mg/kg)	Comments
Zinc	291.7	300	Risk within acceptable limits for proposed use
Benzo(a)pyrene	2.9	1.1	Maximum value test required

6.4.8 The results of the zinc mean value tests determined that the elevated zinc concentration is unlikely to present a significant risk to human health in relation to the proposed site end use and requires no further consideration. However, the elevated benzo(a)pyrene concentrations present a potential risk to human health and require(s) further consideration.

6.4.9 To assess the significance of the contaminants that are above the generic Guideline Value, the 'maximum value test' has been undertaken. This test determines whether the highest recorded contaminant concentrations are from the same population or represent a 'hot spot'.

6.4.10 The calculated maximum value is compared against a critical 'T' value detailed in CLR 7 ref. 8.8. Maximum values below the 'T' value are considered to represent values across the entire site, whilst exceedances are considered to signify an outlier and likely to be a hotspot.

6.4.11 The output from the maximum value tests is provided in Appendix 4, Figure A4.1, and the results is tabulated below:

Contaminant	Result of Maximum Value Test	'T' Critical Value	Distribution
Benzo(a)pyrene	1.1	1.7	Widespread

6.4.12 The result of the benzo(a)pyrene maximum value test indicates that the elevated concentrations are part of the same sample population and are therefore likely to be generally representative of concentrations across the site.

6.5 Protection Of Services

6.5.1 Due to the increasing number of developments being undertaken on potentially contaminated land, the Water Supply Industry has identified the need to protect newly laid water supply pipes. They are likely to impose constraints on the nature of water supply pipes that are to be laid in contaminated land. Guidance on the selection of materials for water pipes is provided by the Water Regulations Advisory Scheme, ref 8.10.

6.6 Risk Evaluation

6.6.1 The conceptual model formed within the Phase 1 Desk Study has been updated to reflect the findings of the contamination risk assessment and the revised conceptual model, detailing the relevant pollutant linkages, is tabulated below:

Source	Potential Pathways	Receptor Group
Benzo(a)pyrene (human health)	• Ingestion of contaminated soil by direct contact. • Ingestion of contaminants	Humans • Site occupants[1] • Site users[1]

Source	Potential Pathways	Receptor Group
	through vegetables. • Entry of contaminants by skin or eye contact with contaminated soils or dust. • Inhalation of contaminated dust.	• Construction workers[2] • Maintenance workers[1] • Neighbouring site users[2]
[1] – Assumes no remediation is undertaken [2] – Pathway exists only during the construction period		

6.7 Summary of Risk Evaluation

6.7.1 The above assessment identifies that the 'source – pathway – receptor' linkage potentially occurs with benzo(a)pyrene 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.

6.7.2 The benzo(a)pyrene contamination appears to be confined to the upper 0.20m of made ground or at the junction between the made ground /topsoil and natural strata at two locations, namely SW1 located on the northern most corner of the site and TP5 located near to the south-eastern boundary of the site.

6.7.3 Whilst all other benzo(a)pyrene results fell below the guideline values, it is considered that these two areas of the site may be treated as localised hotspots.

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. 8.11, 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 benzo(a)pyrene concentrations within the Made Ground and topsoil across the site. Relevant pollutant linkages have been identified, as demonstrated in the updated 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 An important part of the risk management process is identifying and informing all stakeholders with an interest in the outcome of the risk management project. To this end, if the regulators have not yet been contacted with regard to the redevelopment of this site, it is recommended that they be supplied with a copy of both the Phase 1 Desk Study and this Phase 2 Site Investigation reports in order to enable liaison to be undertaken with them.

7.1.6 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.

7.1.7 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.

7.1.8 A number of potential remedial options for dealing with the contamination identified at this site, by removing the contamination source or treating the contamination source, are detailed below:

7.1.9 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.

7.1.10 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. The required thickness of the capping layer could be determined using guidance provided by the BRE, ref 8.12.

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.

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 2001.

8.3 British Standards Institute: BS 5930 'Code of practice for site investigations', BSi 1999.

8.4 Building Research Establishment, Digest 365, Soakaway Design, 2003.

8.5 The Environmental Protection Act, Part IIA, Section 78, 1990.

8.6 Environment Act 1995, Section 57, DoE 1995.CLR 3, 'Documentary research on industrial sites', Report by RPS Consultants Ltd, DoE 1994.

8.7 Generic Assessment Criteria for Human Health Risk Assessment, Nathanial CP, McCaffery C, Ashmore M, Cheng Y, Gillett A, Hooker P and Ogden RC, Land Quality Press, Nottingham, published November 2006.

8.8 CLR 7, 'Assessment of risks to human health from land contamination: an overview of the development of soil guideline values and related research'. DEFRA/EA, March 2002.

8.9 CLR 10, 'The Contaminated Land Exposure Assessment Model (CLEA): Technical basis and algorithms'. DEFRA/EA, March 2002.

8.10 Water Regulations Advisory Scheme, Information and Guidance Note, October 2002, 'The Selection of Materials for Water Supply Pipes to be Laid in Contaminated Land'.

8.11 CLR 11, 'Model Procedures for the Management of Contaminated Land', DEFRA and Environment Agency, 2004.

8.12 BRE Digest 465, 'Cover Systems for Land Regeneration – Thickness Cover Systems for Contaminated Land', 2004

8.13 CLR 2, 'Guidance on preliminary site inspection of contaminated land', Report by Applied Environmental, DoE 1994.

8.14 CLR 3 'Documentary Research on Industrial Sites', Report by RPS Consultants Ltd., DOE, 1994

8.15 CLR 8, 'Potential contaminants for the assessment of contaminated land'. DEFRA/EA, March 2002.

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APPENDIX 1

DRAWINGS

APPENDIX 2

SITE WORK

APPENDIX 2

GENERAL NOTES ON SITE WORKS

A2.1 SAMPLES

B represents large bulk disturbed samples

D represents small disturbed sample

A represents amber jar contamination sample

V represents vial contamination sample

W represents water sample

▽ represents water strike

▼ represents level to which water rose

A2.2 DESCRIPTION OF SOILS

A2.2.1 General

The procedures and principles given in Section 6 of BS 5930, ref. 8.3 have been used in the soil descriptions contained within this report.

APPENDIX 3

CHEMICAL TESTS

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 new legislation has been 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 last remaining guidance document, CLR 11, ref 8.11 was published in 2004.

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 8.13. 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 8.14. The information from these enquiries is presented in a desk study report with recommendations, if necessary, for further work based upon the conceptual model. CLR 8, ref. 8.15, together with specific DoE 'Industry Profiles' provides guidance on the nature of contaminants relating to specific industrial processes.

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 contamination risk assessment 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 5930:1999, ref. 8.3 and BS 10175:2001, ref 8.2.

A4.2.7 The generic contamination risk assessment screens the results of the chemical analysis against generic guidance values. Soils will be compared with the available Soil Guideline Values (SGVs) as published by the Department of Environment Food and Rural Affairs (DEFRA) and The Environment Agency (EA), and developed using the Contaminated Land Exposure Assessment (CLEA) Model.

A4.2.8 Where there are no currently available SGVs for specific soil contaminants, the results of the soil analyses will be compared to Generic Assessment Criteria (GAC), determined by LQM and CIEH in accordance with current legislation and guidance.

A4.2.9 Chemical laboratory test results are processed as follows. A statistical analysis of the results is conducted, as detailed in CLR 7, ref 8.8. Individual concentrations are compared to the selected guideline values to identify concentrations of contaminants that are above the selected screening criteria.

A4.2.10 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. 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'.

A4.2.11 Where the risk estimation identifies significant concentrations of one or more contaminants, a further risk evaluation needs to be undertaken.

A4.2.12 The risk evaluation will address the potential pollutant linkages between an identified source of contamination and the likely receptors both on and off site.

A4.2.13 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

A4.2.14 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

A4.2.15 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

Determinant	Guidance Value (mg/kg)	Source
	Residential with plant uptake	
Arsenic	20	SGV[1]
Benzo(a)pyrene		
1% SOM[3]	1.12	GAC[2]
2.5% SOM[3]	1.08	GAC[2]
5% SOM[3]	1.09	GAC[2]
Dibenzo(a,h)anthracene		
1% SOM[3]	1.14	GAC
2.5% SOM[3]	1.13	GAC
5% SOM[3]	1.10	GAC
Cadmium		
pH 8	8	SGV
Chromium	130	SGV
Copper	111	GAC
Fluorene		
1% SOM[3]	3.84E+01	GAC
2.5% SOM[3]	9.14E+01	GAC
5% SOM[3]	1.84E+02	GAC
Lead	450	SGV
Mercury	8	SGV
Naphthalene		
1% SOM[3]	3.47	GAC
2.5% SOM[3]	8.47	GAC
5% SOM[3]	17.0	GAC

Determinant	Guidance Value (mg/kg)	Source
	Residential with plant uptake	
Nickel	50	SGV
Petroleum hydrocarbons	In separate table	In separate table
Phenol		
1% SOM[3]	78	SGV
2.5% SOM[3]	21900	SGV
5% SOM[3]	21900	SGV
Selenium	35	SGV
Vanadium	140	GAC
Zinc	330	GAC

[1] SGV – Published Authoritative Soil Guideline Values

[2] GAC – LQM CIEH Generic Assessment Criteria for Human Health Risk Assessment, ref. 8.7

[3] SOM – Soil Organic Matter

A4.3.1 Generic Assessment Criteria for Petroleum Hydrocarbons

Residential with Plant Uptake	GAC (mg/kg) 1% SOM	GAC (mg/kg) 2.5% SOM	GAC (mg/kg) 5% SOM
Aliphatic			
EC 5-6	2.11E+00	3.72E+00	6.38E+00
EC >6-8	5.37E+00	1.19E+01	2.27E+01
EC >8-10	1.46E+00	3.55E+00	7.00E+00
EC >10-12	8.53E+00	2.08E+01	4.01E+01
EC >12-16	4.07E+01	9.34E+01	1.63E+02
EC >16-35	1.64E+04	1.64E+04	1.63E+04
EC >35-44	1.64E+04	1.64E+04	1.63E+04
Aromatic			
EC 5-7 (benzene)	5.75E-01	1.33E+00	2.57E+00
EC >7-8 (toluene)	6.24E-01	1.46E+00	2.85E+00
EC >8-10	1.09E+00	2.67E+00	5.30E+00
EC >10-12	1.94E+00	4.76E+00	9.44E+00
EC >12-16	2.19E+00	5.39E+00	1.07E+01
EC >16-21	1.15E+02	1.32E+02	1.33E+02
EC >21-35	1.57E+02	1.61E+02	1.57E+02
EC >35-44	1.57E+02	1.61E+02	1.57E+02
Aliphatic and Aromatic			
EC >44-70	1.74E+02	1.79E+02	1.74E+02

Notes: pH = 7; sandy soil