Alan Wood & Partners

PHASE II GEO-ENVIRONMENTAL ASSESSMENT REPORT

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FOR

MR ABDUL AZIZ

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PROJECT REF:- JMS/DA/37412-Rp001

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COMMERCIAL ROAD, SPALDING

PHASE II GEO-ENVIRONMENTAL INVESTIGATION REPORT

for

MR ABDUL AZIZ.

Project Reference: JS/DA/37412-Rp001

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Signed: ……

Date: 24th December 2015

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Signed: ……

Date: 24th December 2015

Issue	Revision	Revised by	Approved by	Revised Date

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The Appointment of Alan Wood & Partners shall be governed by and construed in all respects in accordance with the laws of England & Wales and each party submits to the exclusive jurisdiction of the Courts of England & Wales

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EXECUTIVE SUMMARY

Site Location & Description

The site is located off Commercial Road, Spalding and is centred at approximate National Grid Reference (NGR) 525476mE, 323384mN.

The site is currently occupied by two single storey dwellings and a former garage now used as a hand car wash with a large concrete forecourt.

Historical Land Use

The earliest maps show the site to be occupied by small terrace houses until c. 1968 when it was redeveloped to contain to larger detached properties in the south and a larger unlabelled structure in the north.

Geology

Superficial deposits are recorded as being Tidal Flat Deposits on site.

The solid geology is recorded as being the Oxford Clay Formation, which underlies the whole site.

Hydrogeology

No information available in regards to aquifer classification.

Mining Assessment

On the basis of available information, risk associated with coal mining is currently considered to be negligible.

Geotechnical Assessment

Made ground soils are site wide and appear to be at their thickest within the rear gardens within the southern portion of the site reaching 1.00m bgl within BH3. The underlying natural strata comprised light brown clayey, silty sand. These underlying granular soils may be described as very loose to medium dense.

Groundwater was proven at 1.65m bgl during the ground investigation.

Given the high water table and granular nature of the near surface deposits running sand conditions are likely to be encountered during excavations, this is likely to be compounded where excavations are left open during prolonged periods of wet weather (e.g. in service trenches).

Environmental Assessment

Several elevated concentrations of metals, metalloids, non-metal inorganic and organics were measured within the on-site soil samples.

Given the low permeability of the underlying clays and Oxford Clay Formation risk to controlled waters (underlying aquifer) receptors is considered to be very low.

No asbestos fibres were identified in the made ground soil samples. Risk to construction workers and site end users are considered to be low.

No radon protective measures will be required.

On the basis of available information it is considered that remediation is required at the site comprising the placement of 600mm of clean capping within all soft landscaped areas.

Any materials imported to site for use in the development will need to be tested at source, prior to importation, to demonstrate that they are suitable for use.

Foundations

It is considered at this stage given the high water table and granular nature of the near surface deposits a piled foundation solution is anticipated to be the best solution. Given the variability of the granular deposits beneath the

site it is anticipated that the piles will need to be taken down to the underlying Glacial Till Deposits which are thought to be around 20.00m bgl shown by a BGS borehole (Ref: TF22SE1/B) located just on the other side of the river to the north west.

Ground Slabs Ground bearing slabs could be used where ground conditions allow and no precautionary measures associated with soft and unstable soils are required.

A suspended floor system incorporating a sub-floor void, such as beam and block, will be required for all structures where the foundations lie within an area with an excess of 600mm of unsuitable material being present below floor slabs following site preparation/regrading.

Precautions near Trees Given that the near surface deposits are predominately granular in nature, precautions near trees are not anticipated.

Drainage Soakaways are unsuitable for use in the disposal of surface water, given the high water table and potential space issues.

Sulphate The on-site soils are not considered to be at risk from containing pyrite. A Design Sulphate classification of DS-1 and an ACEC class of AC-1s should be suitable.

Potable Water Supplies Risk to potable water supply pipes is considered to be low, however, it is recommended that the results of the chemical testing and details of the redevelopment scheme are provided to the appropriate utility companies to determine the necessity for service protection.

Obstruction & Excavations No significant problems with respect to excavations and/or obstructions are anticipated.

Boundary Conditions Should deep excavations be proposed close to site boundaries a risk assessment of the integrity/stability of adjacent structures should be undertaken prior to such works being carried out. Designed and engineered temporary/permanent measures should be adopted to ensure their continued stability.

Roads No *in* situ CBR testing has been carried out to date. A CBR value of less than 2.5% is currently considered for road and pavement design, although it is anticipated that a CBR of 0.5-1.0%, or more, may be achievable.

Further Works Ecological assessment (where required);

In situ CBR testing;

Deep boreholes for foundations design;

Plot specific foundation design (including precautions for trees where required).

NB. The Executive Summary presented above is an overview of the key findings and conclusions of the report. There may be other information contained within the body of the report which puts into context the findings of the Executive Summary. No reliance should therefore be placed on the Executive Summary until the report as a whole has been read in full.

1 INTRODUCTION

1.1 Appointment

1.1.1 Alan Wood and Partners were appointed by Mr Abdul Aziz (the 'Client') to undertake a Phase II geo-environmental investigation of a parcel of land located off Commercial Road, Spalding, Lincolnshire, PE11 2YU.

1.1.2 The report has been prepared for the sole use and reliance of Mr Abdul Aziz no other third party may rely on, reproduce or redistribute any content of this report without the prior written consent of Alan Wood and Partners. Any unauthorised third parties using the information presented in this report do so entirely at their own risk and are duly excluded from any warranty, duty of care or skill.

1.1.3 Although Alan Wood & Partners were not commissioned to undertake a phase I desk top study. A study of readily available information was undertaken in order to develop a preliminary conceptual site model.

1.2 Development Proposals

1.2.1 It is understood that the site is to be developed for a residential end use comprising 19 flats with associated car parking and a large central landscaped area. A proposed preliminary development layout was provided to Alan Wood and Partners, which is appended to this report.

1.3 Objectives of the Investigation

1.3.1 The scope of works undertaken as part of this appraisal was to:

- Carry out a physical inspection of the site (walkover survey):
- Review any pre-existing documentation relating to ground conditions (geotechnical and environmental);
- Investigate the ground conditions present on-site and identify their geotechnical properties in relation to the site's proposed end use;
- Investigate the hydrogeological regime beneath the site wherever possible;

- Identify the nature and concentration of any contamination within the on-site soils and undertake a tiered risk assessment to establish likely risks to sensitive receptors. Defining a Conceptual Site Model of potential pollutant linkages relevant to the proposed redevelopment of the site;

- Carry out a preliminary *in-situ* falling head test to assess the potential for soakaway use at the site;

- Provide preliminary advice in relation to any environmental or geotechnical issues associated with the site including foundation recommendations and other recommendations needed to facilitate the proposed redevelopment, including, where necessary, identifying any additional phases of work or remediation that need to be carried out.

1.4 Site Works

1.4.1 The findings and recommendations given in this report are based on fieldwork undertaken on the 16th November 2015, this comprising the excavation of 4 no. windowless sampler boreholes and 3 no. preliminary *in situ* falling head tests.

1.5 Limitations of Study

1.5.1 This report presents factual and interpretative geotechnical and environmental information, along with provisional construction proposals and recommendations relevant to the objectives of the investigation for the site end-use given above. The report has been prepared for the titled project and Alan Wood and Partners can accept no responsibility or liability for the consequences of the use of this document, wholly or in part, for any other purpose than that for which it was commissioned.

1.5.2 For the purposes of this report and thus defining risk to the proposed development from an environmental point of view, a 'residential with plant uptake' end use scenario has been adopted. Interpretation and recommendations should not be assumed valid for alternate land uses. Where the proposed site usage changes, the findings of this report should be re-assessed to accommodate the change in proposed end-use.

1.5.3 The conclusions and recommendations presented in this report are based on site-specific information obtained during the limited desk study, ground conditions

encountered and laboratory analysis and are considered reasonable on the basis of available information at the time the assessment was carried out. They should not necessarily be relied upon to represent site conditions at a substantially later date.

1.5.4 The findings and opinions provided in this report are given in good faith and are subject to the limitations and constraints imposed by the methods and information sources described. Factual information has been obtained from a variety of sources. Alan Wood and Partners assumes that third party data is reliable, but has not independently confirmed this. The validity and accuracy of this information is therefore outside the control of Alan Wood and Partners. Professional judgement and experience is however used to ensure that uncertainties are reduced to a level appropriate to the site conditions, the purpose of the investigation and the resources devoted to it by the Client.

1.5.5 Whilst every effort has been made to carry out an assessment that enables a realistic characterisation of the geotechnical and environmental parameters at the site, the possibility of significant spatial variation in actual ground, groundwater and environmental (gas and contamination) conditions existing between or beyond exploratory hole locations cannot be discounted. Where information or opinion is given this is for guidance only. Further information, ground investigation, construction activities, change of site use or the passage of time may reveal conditions that were not indicated in the data and therefore could not have been considered in the preparation of this report. Where such information might impact upon stated opinions, Alan Wood and Partners cannot accept responsibility for conditions not encountered and reserves the right to modify or retract the opinions expressed in this report. Where opinions expressed are based on current available guidelines and legislation, no liability can be accepted by AWP for the effects of any future changes to such guidelines and legislation. New information of improved practices and changes in legislation may require reinterpretation of the report as a whole, or in part.

1.5.6 This report does not constitute an archaeological or ecological assessment, nor does it constitute an asbestos inspection. A suitably qualified consultant should be consulted where these aspects of work are required.

1.5.7 A flood risk assessment in accordance with Planning Policy Statement 25, *Development and Flood Risk* (2010) has not been undertaken as part of this commission.

All ground investigation works and soil descriptions were undertaken in general accordance with BS EN ISO 14688-1 'Geotechnical Investigation and Testing – Identification and Classification of Soil' (2002), BS10175 (2011), BS 5930 (2010) and/or BS EN 1997-1:2004 (Part 1, General Rules) and BS EN 1997-2:2007 (Part 2, Ground Investigation and Testing).

2 SITE DETAILS AND DESCRIPTION

2.1 Introduction

2.1.1 Published environmental, geological and historical data relating to the site area has been reviewed, in conjunction with a walkover survey undertaken on 16th November 2015, the findings of which are presented below. The principal considerations of immediate relevance are presented in the following sections.

2.2 Site Location & Description

2.2.1 The site is located off Commercial Road, Spalding and is centred at approximate National Grid Reference (NGR) 525476mE, 323384mN. A site location plan is presented as Figure 37412/001.

2.2.2 The overall site area is recorded as being 0.175 hectares (0.43 acres) in plan. The site may be described as follows:

2.2.3 The site occupies a roughly rectangular shaped piece of land. Access to the site is from Commercial Road which marks the north western boundary.

2.2.4 The site is currently occupied by two single storey dwellings and a former garage now used as a hand car wash with a large concrete forecourt.

2.2.5 The site has a slight incline from the north to the south, with the rear gardens to the dwellings being at a lower level to those at the front with an approximate height difference of 1.5m.

2.2.6 The north western boundary is denoted by Commercial Road while the south eastern boundary is denoted by Barge Close. The north eastern and south western boundaries are denoted by residential properties. Beyond Commercial Road to the north west lies a river running north east – south west.

2.2.7 No evidence of Japanese Knotweed or other invasive plants were noted during the site walkover.

3 GEO-ENVIRONMENTAL SETTING

3.1 Anticipated Geology, Hydrogeology & Mining

3.1.1 A summary of the available published geological and hydrogeological information is provided in Table 3.1 below and overleaf. A review of the following information was undertaken:

- British Geological Survey 1:50,000 scale series, E080 (Kingston Upon Hull), Solid & Drift Edition;
- British Geological Survey on-shore borehole records database;
- Coal Authority database on coal mining reporting areas from the following web pages:
  - http://coal.decc.gov.uk/en/coal/cms/publications/data/map;
  - http://coal.decc.gov.uk/en/coal/cms/services/planning/strategy;
- Environment Agency online aquifer designation database; and
- Environment Agency website.

Table 3.1 - General Geological Information

Made Ground	There were no records with respect to artificial ground.
Superficial and Solid Geology	Superficial deposits are recorded as being Tidal Flat Deposits on site. The solid geology is recorded as being the Oxford Clay Formation, which underlies the whole site. This typically comprises a silicate-mudstone, grey, generally smooth to slightly silty, with sporadic beds of argillaceous limestone nodules. BGS borehole records (TF22SE73 & TF22SE74) indicates the presence of made ground down to 1.70m bgl below this a brown grey slightly fine sandy silt down to a depth of 5.35m bgl. Groundwater was recorded as being encountered between 2.10m and 1.00m bgl.
Hydrogeology	The Environment Agency revised their approach to determining groundwater vulnerability associated with a site. The revised (April 2010) aquifer designation system replaces the old method of classifying aquifers as either Major, Minor or Non-Aquifer (as defined on the 1:100,000 scale Groundwater Vulnerability maps) units. The new approach is in line with the Agency's Groundwater Protection Policy (GP3) and Water Framework Directive (WFD). On this basis, and with respect to site specific information presented on the Environment Agency's website the following has been identified: **Superficial Deposits:** No data available. **Bedrock:** No data available. **Source Protection:** No source protection zones lie within 500m of the site.
Radon and Mine Gas	No radon protective measures will be required. Risk associated with mine gas emission is not anticipated at the

	site.
Coal Mining	***Coal Authority Mining Report*** Information presented on the Coal Authority website (*www.coal.decc.gov.uk*) indicates that the site does not lie within a Coal Mining Reporting area. Risk associated with shallow coal mine workings is considered to be **negligible**.

Table 3.2 - Environmental Data

Pollution Incidents to Controlled Waters	There are no recorded Environment Agency pollution incidents within 500m of the site.
Landfill Sites, Waste Management / Transfer / Treatment and Disposal Sites	No Environment Agency recorded or historic landfills are noted as being within 500m of the site boundary.
Flood	The site is within a Zone 3 Environment Agency Floodplain. There are flood defences within 250m of the boundary however there are no areas benefiting from flood defences within 250m of the boundary.
Groundwater and Surface Water Abstractions	No groundwater, surface water or potable water abstraction licences have been granted within 500m of the site boundary.
Public Register of Contaminated Land: Part 2A (EPA 1990)	There are currently no sites designated as contaminated land under Part 2A of the Environmental Protection Act 1990 within 500m of the site.
Invasive Plant Species	No Japanese Knotweed or other invasive plant species were observed during the site walkover.

4 HISTORICAL LAND USE

4.1.1 A study of readily available online maps has been undertaken to identify any potentially contaminative former land-uses at the site. The main historical features of the site and surrounding area are summarised in the following table

4.1.2 Ordnance Survey map editions may not however be complete and it is possible, therefore, that additional land uses to those presented in the plans have occurred. Alan Wood & Partners Ltd have tried to ascertain the complete record of the site's history, but the possibility that other potentially significant land uses may have taken place cannot be ignored.

4.1.3 A summary of the historical land use and surrounding area is presented in Table 4.1 and Table 4.2 below.

Table 4.1 - Historical Land Use (On site)

Date	Map Scale	Feature
1889	1:2,500	Occupied by several small joining rectangular structures, resembles terraced houses.
1904	1:2,500	No significant changes noted.
1932	1:2,500	
1968	1:2,500	Small joining structures no longer present now replaced by two larger detached structures towards the south with a larger single structure located towards the site.
1956	1:2,500	No significant changes noted.

Table 4.2 - Historical Land Use (Off site)

Date	Map Scale	Feature
1889	1:2,500	The town of Spalding can be found to the south while areas to the north, east and west are predominately occupied by open agricultural land. A gas works is noted to lie off the south western corner of the site.
1904	1:2,500	Extension to the gas works located off the south western corner of the site is the only notable change.
1932	1:2,500	Further extension to the gas works to the south west has been noted along with new residential properties towards the north east.
1946-1951	1:2,500	A residential estate is no located just off the site boundary to the east.
1968	1:2,500	The site is now surrounded by residential properties extending all the way up to the sites boundary.
1980	1:1,250	No significant changes noted.

5 GROUND INVESTIGATION FIELDWORK

5.1 Introduction

5.1.1 The investigation requirements at the site were twofold: to undertake a geotechnical investigation and an environmental investigation. A site-wide ground investigation was therefore carried out to identify geotechnical and environmental liabilities in relation to the proposed development work at the site.

5.1.2 The positions of the exploratory locations are limited to areas of the site, within the site boundary, that were accessible during the works.

5.1.3 Alan Wood and Partners scoped the intrusive investigation on the basis of information submitted in the desk study report and in general accordance with guidance given in BS5930:1999+A2:2010, BS10175:2011+A1:2013 and BS EN 1997:2004 and 2007.

5.2 Site Works

5.2.1 The findings and recommendations given in this report are based on fieldwork undertaken on the 16th November 2015.

5.2.2 The positions of the exploratory holes are shown on the appended ground investigation plan, Figure 37412/002. They were positioned on the basis of the findings of the site conceptual model and distributed in general accordance with the requirements of BS10175:2011+A1:2013 and the working site conditions at the time each phase of investigation was completed.

5.2.3 No specific areas of interest were targeted from either a geotechnical or environmental point of view.

5.3 Geotechnical Investigation

5.3.1 The scope of works undertaken is outlined in Table 5.1 overleaf.

Table 5.1 - Summary of Works

Method of Investigation	No.	Maximum Recorded Depth (m bgl)
Windowless sampler boreholes	4	5.00
Preliminary falling head test*	3	5.00

*Boreholes BH1, 2 & 4 were used to undertake the in-situ falling head tests.

5.3.2 A development-wide geotechnical investigation was carried out to identify liabilities in relation to the proposed construction works at the site and aid the design of appropriate foundation solutions. The following objectives of the ground investigation were therefore to:

- Confirm the lateral and vertical extent of any made ground soils, the nature of the underlying natural ground and the depth to bedrock at selected positions across the area under investigation;
- Determine the depth to groundwater;
- Recover bulk samples for geotechnical testing where necessary;
- Undertake *in situ* Standard Penetration Testing (SPT) in the boreholes to determine soil strength and that of the underlying bedrock;
- Assess the potential for soakaway use as a means of surface water disposal through *in situ* falling head testing.

5.3.3 Standard strata descriptions of the soils encountered are in general compliance with BS EN 1997:2004, BS EN 1997:2007, BS EN ISO 14688:2002, BS EN ISO 14688:2004 and BS EN ISO 14689:2003. The individual strata depths recorded on each borehole log are those from existing ground levels.

5.3.4 Geotechnical laboratory testing was undertaken on a selection of soil samples in accordance with those techniques outlined in BS 1377:1990 'Methods of Test for Soils for Civil Engineering Purposes' at the laboratory of Professional Soils Laboratory in Doncaster. This laboratory is a fully UKAS compliant laboratory.

5.4 Environmental Investigation

5.4.1 The environmental investigation was designed so that site-specific data could be obtained with respect to any potential soil and groundwater contamination associated with the site so that risks could be quantified in relation to the *source-pathway-receptor* scenarios.

5.4.2 Given the potentially historic contaminative nature of the on-site soils, it was considered possible that, when considered within the context of proposed end-use, the on-site soils may present an (albeit low) unacceptable risk to human health and/or the wider environment.

5.4.3 The scope of works undertaken, were therefore to:

- Inspect and identify the general soil conditions that prevail across the site;
- Assess the potential for soil contamination within any made ground, the underlying natural strata or groundwater;
- Recover soil samples to test for heavy metals, metalloids, non-metal inorganics, organics and asbestos fibres;

5.4.4 Representative samples of the on-site soils were therefore recovered from the boreholes that were positioned to provide coverage of the site area under investigation. Sampling was undertaken in accordance with those guidelines prescribed in BS 10175:2011. All environmental samples were collected in 500ml plastic tubs with sealable lids, 250ml glass amber jars or vials (subject to analytical requirements). Care was taken to minimise cross contamination (i.e. wiping of equipment) between sampling. Environmental samples were packed into cool boxes and transported by courier to Chemtest, an MCERTS and UKAS accredited laboratory for analysis and subsequent storage.

5.4.5 The analytical strategy adopted for the environmental investigation was designed to provide an overall assessment of potential contaminants thought to likely be present within the on-site soils. Whilst no specific contaminants of concern were anticipated in significant concentrations, the soil testing undertaken was for a suite of contaminants in general accordance with NHBC Standards Chapter 4.1 ‘Land Quality – Managing Ground Conditions’ and CLR 8 ‘Potential Contaminants for the Assessment of Land’

(withdrawn but used for reference purposes where applicable). The testing of the following analytes was scheduled on selected samples:

- Heavy metals suite (including As, Cd, Cr, Cu, Hg, Pb, Ni, Zn);
- Speciated Polycyclic Aromatic Hydrocarbons;
- Cyanide (free and total) and Thiocyanate;
- Phenol (total);
- Sulphates (Total and Water Soluble);
- Asbestos fibres;
- Sulphide; and
- pH.

6 PHASE II GEOTECHNICAL APPRAISAL

6.1 Ground Conditions

6.1.1 The ground conditions encountered in the exploratory holes completed at the site have been reviewed. A summary of the lithologies encountered is given in the table below, while discussion about each one is given in the following paragraphs.

6.1.2 A copy of the ground investigation logs are presented in Appendix A.

Table 6.1 - Summary of Ground Conditions

Lithology	Exploration Location	Approximate proven depth (m) to base from existing ground level	Approximate Thickness (m)	Allowable Safe Bearing Capacity (kN/m^2)
Made Ground: Granular	All Locations	0.40-1.00		N/A
Loose very silty sand	BH1	2.00	1.25	<20
Soft very clayey, very sandy silt	BH1	3.00	1.00	<20
Firm very sandy clay	BH2	3.40	0.70	75
Very loose to Medium dense very clayey, very silty sand	All Locations	5.00+	Base Not Proven	50
Groundwater	Encountered at 1.40m bgl.			

6.1.3 **Made Ground**: Made ground soils were proven across the site and were noted to be variable. Made ground soils were granular in nature typically comprising sand with brick and concrete gravel down to a maximum depth of 1.00m bgl.

6.1.4 **Natural Strata**: Underlying a layer of made ground the natural strata typically comprised light brown clayey, silty sand.

6.1.5 The sand deposits were considered to be largely medium dense but ranged between very loose and medium dense having an anticipated density index (I_D) of <15% to between 35% and 65%.

6.1.6 **Groundwater**: Groundwater was encountered at 1.65m bgl which rose to 1.40m bgl after 1hr during the investigation.

6.2 Visual & Olfactory Evidence of Contamination

6.2.1 No visual or olfactory evidence of gross contamination, such as hydrocarbons, was recorded during the ground investigation.

6.3 Geotechnical Testing & Material Properties

Standard Penetration Testing

6.3.1 *In situ* standard penetration testing was undertaken within all 4 no. windowless sampler boreholes so that an assessment on material strength and an approximate safe bearing capacity of the ground could be ascertained.

6.3.2 The field test is useful for comparing variability of backfill materials as well as undisturbed natural soils to check for possible differential settlement problems. SPT tests were carried out at 1.0m centres throughout the vertical profile of each borehole.

6.3.3 A summary of the test results is given in the following tables, Table 6.2 below.

Table 6.2 - Summary of *In-Situ* Standard Penetration Test (SPT) Results

Depth in m bgl	Borehole 'N' Value				
	BH1	BH2	BH3	BH4	Average N_{60} Value
1m	0	3	3	4	3
2m	3	8	7	0	5
3m	6	5	16	0	7
4m	13	15	11	3	11
5m	10	16	22	10	15
	N60 = (Er / 60) x N Value = $1.32E_r$ Energy Ratio (72%)				

Contamination and Performance of Building Materials (Cementitious Products)

6.3.4 5 no. soil samples were analysed for a suite of contaminants consistent with BRE Special Digest 1 'Concrete in Aggressive Ground' (2005). A copy of the individual test results is given in the appended laboratory certificates in Appendix C.

6.3.5 The pH values recorded for the soil samples ranged between 8.1 and 8.7 (pH units) with an average of 8.4 indicating slightly alkaline conditions prevail within the on-site soils.

6.3.6 Water soluble sulphate analysis of the soils yielded concentrations between 0.035g/l and 0.28g/l in the samples (0.10g/l on average). An assessment of the data was carried out in accordance with Section C4 '*Site Investigation for Aggressive Ground Conditions'* and the procedure prescribed in Section C5 '*Classification of Site Locations for Chemicals Aggressive to Concrete'* of BRE SD1 (2005) to assess whether ground conditions at the site are potentially aggressive to buried concrete products. The results of the assessment indicate that a Design Sulphate classification of DS-1 may be adopted along with an ACEC class of AC-1s.

6.3.7 Static groundwater conditions have been assumed in this assessment.

7 LABORATORY CHEMICAL TESTING

7.1 Preamble

7.1.1 5 no. representative samples of soil from within the near surface and at depth were analysed for the suite of contaminants outlined in Section 5.4.5 above. This was in order to assess the general degree and nature of contamination within the on-site soils in relation to the site's proposed redevelopment.

7.1.2 A summary of the test results is given in the following tables, whilst a copy of the individual test results is presented in full in Appendix C.

7.2 Guidance for Analytical Results - Assessment Criteria

Soil

7.2.1 With reference to the proposed end use of the site, the results of the chemical testing were assessed as part of an environmental risk assessment against a number of potential receptors, considering risks to human health, environmental quality and the built environment. Such risk assessment comprises the initial comparison of the measured soil concentrations with Generic Assessment Criteria (GAC), which in this instance are considered protective of a *commercial* end use.

7.2.2 Recent changes to UK human health risk assessment has seen the introduction of DEFRAs Category 4 Screening Levels (2014) and the LQM/CIEH Suitable 4 Use Levels (2015). Both set out to provide generic assessment criteria on the basis of updated assumptions relating to the modelling of human exposure to soil contaminants for the standard land uses: residential (with and without home-grown produce), allotments, commercial and public open space.

7.2.3 The general consensus between contaminated land practitioners is that the C4SL values, which are based on the low level of toxicological concern (LLTC), are less cautious than the newly revised GAC values published by LQM/CIEH and may not, therefore, be wholly applicable for use outside the context of Part 2A Statutory Guidance. Although both publications in no way undermine the validity of existing Environment Agency guidance presented in, for example, SR2, SR3 and the existing CLEA software, we are of the mind that the LQM/CIEH S4UL values, which are based on Health Criteria that represents minimal or tolerable levels of risks to health (as

described in the Environment Agency's SR2 guidance) but incorporates the updated exposure assumptions presented in DEFRAs C4SL guidance, provide a better starting point from which to generate generic assessment criteria that can be applied to brownfield development sites and are 'suitable for use' under the planning system.

7.2.4 It should be noted that both approaches are based on sandy loam soil with 6% soil organic matter (SOM). Whilst this does not present a problem for metals, as they are not dependent on soil type or SOM, the algorithms used to model plant uptake and volatilisation for organic contaminants do take account of SOM content in the soil. The GAC values for metals in the standard land uses may therefore be directly applied, whether these are C4SL or S4UL derived, whilst independent GAC values for organics (e.g. PAH, TPH) have been generated using CLEA Version 1.06 and the toxicological updates presented in the aforementioned documents. These have also been adjusted for soil type and are calculated for SOM contents at 1%, 2.5% and 6% for a sandy soil.

7.2.5 A summary of the generic assessment criteria values is presented in Appendix D.

7.3 Test Results

7.3.1 The chemical analysis results and screening criteria are summarised in Tables 7.1 and 7.2 below and overleaf.

Table 7.1 - Summary of Total Soil Concentrations

Contaminant of Concern	GAC* (mg/kg)	Contaminant Concentrations (mg/kg)		No. of Samples Tested	No. of Samples >GAC	Pass/Fail Tier 1 GAC Screen
		Min	Max			
Arsenic (Organic)	**37**	**11**	**58**	**5**	**1**	**FAIL**
Cadmium	22	<0.10	1.3	5	0	PASS
Chromium (III)	910	8.7	45	5	0	PASS
Copper	2,400	10	97	5	0	PASS
Mercury (Inorganic)	40	0.14	1.9	5	0	PASS
Nickle	130	9.4	77	5	0	PASS
Lead	**200**	**100**	**1800**	**5**	**2**	**FAIL**
Selenium	250	<0.20	<0.20	5	0	PASS
Zinc	3,700	28	440	5	0	PASS

* DEFRA (2014). Development of Category 4 Screening Levels (SP1010);
** LQM/CIEH (2015). S4UL for Human Health Risk Assessment.

Table 7.2 - Summary of Chemical Test Results (PAH)

Contaminant of Concern	GAC* (mg/kg)	Contaminant Concentrations (mg/kg)		No. of Samples Tested	No. of Samples >GAC	Pass/Fail Tier 1 GAC Screen
		Min	Max			
Naphthalene	2.3	<0.10	0.38	5	0	PASS
Acenaphthylene	400	<0.10	0.34	5	0	PASS
Acenaphthene	490	<0.10	0.10	5	0	PASS
Fluorene	390	<0.10	0.16	5	0	PASS
Phenanthrene	220	<0.10	2.2	5	0	PASS
Anthracene	5,400	<0.10	0.87	5	0	PASS
Fluoranthene	560	0.25	6.2	5	0	PASS
Pyrene	1,200	0.27	6.2	5	0	PASS
Benzo(a)anthracene	11	<0.10	4.3	5	0	PASS
Chrysene	22	<0.10	4.4	5	0	PASS
Benzo(b)fluoranthene	3.3	**<0.10**	**7.0**	**5**	**1**	**FAIL**
Benzo(k)fluoranthene	93	<0.10	2.9	5	0	PASS
Benzo(a)pyrene	2.7	**<0.10**	**4.9**	**5**	**1**	**FAIL**
Dibenzo(a,h)anthracene	0.28	**<0.10**	**1.1**	**5**	**2**	**FAIL**
Ideno(1,2,3-cd)pyrene	36	<0.10	4.0	5	0	PASS
Benzo(g,h,i)perylene	340	<0.10	3.7	5	0	PASS

* [CLEA/LQM/CIEH, 2015] Calculated for commercial end-use scenario in CLEA v1.06. GAC range for 2.5% SOM used unless stated otherwise. Values will be more conservative for cohesive soils.

Table 7.3 - Summary of Chemical Test Results (TPH & BTEX)

Contaminant of Concern	GAC* (mg/kg)	Contaminant Concentrations (mg/kg)		No. of Samples Tested	No. of Samples >GAC	Pass/Fail Tier 1 GAC Screen
		Min	Max			
TPH	40	<1.00	<1.00	5	0	PASS
Aliphatic TPH >C5-C6						
Aliphatic TPH >C6-C8	110	<1.00	<1.00	5	0	PASS
Aliphatic TPH >C8-C10	30	<1.00	<1.00	5	0	PASS
Aliphatic TPH >C10-C12	150	<1.00	<1.00	5	0	PASS
Aliphatic TPH >C12-C16	1,200	<1.00	<1.00	5	0	PASS

Aliphatic TPH >C16-C35	69,000	<1.00	<1.00	5	0	PASS
Aliphatic TPH >C35-C44	69,000	<1.00	<1.00	5	0	PASS
Aromatic TPH >C5-C7	110	<1.00	<1.00	5	0	PASS
Aromatic TPH >C7-C8	240	<1.00	<1.00	5	0	PASS
Aromatic TPH >C8-C10	50	<1.00	<1.00	5	0	PASS
Aromatic TPH >C10-C12	150	<1.00	<1.00	5	0	PASS
Aromatic TPH >C12-C16	320	<1.00	<1.00	5	0	PASS
Aromatic TPH >C16-C21	540	<1.00	19	5	0	PASS
Aromatic TPH >C21-C35	1,400	<1.00	50	5	0	PASS
Aromatic TPH >C35-C44	1,400	<1.00	8.9	5	0	PASS
BTEX	0.13	<1.00	<1.00	5	0	PASS
Benzene						
Toluene	240	<1.00	<1.00	5	0	PASS
Ethylbenzene	62	<1.00	<1.00	5	0	PASS
M & p-Xylene	140	<1.00	<1.00	5	0	PASS
o-Xylene	70	<1.00	<1.00	5	0	PASS

GAC range for 2.5% SOM used unless stated otherwise. Values will be more conservative for cohesive soils.

Metals, Metalloids and Other Inorganic Analytes

7.3.2 A total of 5 no. soil samples were analysed. Assessment of the soils data indicates that there are several elevated concentrations of potential contaminants of concern that exceed relevant GAC criteria these relate to arsenic which is 0.45 times over its GAC criteria and lead which 4.8 times over its GAC criteria.

7.3.3 Potential unacceptable risk to human health in a residential without plant uptake land use scenario with respect to metals, metalloids and non-metal inorganics is therefore anticipated.

7.3.4 No statistical analysis of the data has been undertaken given the number of samples collected.

Organics (PAH, TPH, and BTEX)

7.3.5 A total of 5 no. soil samples were analysed. Several of the samples analysed for PAH returned concentrations above relevant GAC's. These been related to Benzo(b)fluoranthene which was noted to be 0.75 times over its GAC criteria, Benzo(a)pyrene which was noted to be 0.5 times over its GAC criteria and Dibenzo(a,h)anthracene which was noted to be 2.4 times over it GAC criteria. No elevated concentrations of TPH or BTEX were noted within the samples

7.3.6 Potential unacceptable risk to human health in a residential without plant uptake land use scenario with respect to organic contaminants is therefore anticipated.

Asbestos

7.3.7 A total of 5 no. soil samples were analysed. No asbestos fibres were detected in the samples tested.

7.3.8 Risk associated with asbestos containing materials is therefore not anticipated.

UKWIR

7.3.9 Note that the use of barrier pipe is applicable for all brownfield sites according to the UKWIR guidelines. It is recommended that consultation be held with the water authority at an early stage to confirm any specific requirements they may have.

8 PHASE II ENVIRONMENTAL APPRAISAL

8.1 Introduction

8.1.1 This section presents the initial CSM in light of the ground investigation findings and chemical analysis results presented above.

8.1.2 The conceptual site model has been developed for the proposed future commercial land use. This summarises our understanding of surface and sub-surface features, the potential contaminant sources, transport pathways and receptors assuming that no remediation has been undertaken at the site.

8.2 Ground Conditions - Summary

8.2.1 Made ground soils have been identified across the whole site. These being overlain by a number of hardstanding's comprising either tarmac, concrete and paving slabs. with underlying soil conditions comprising very loose to medium dense very clayey, very silty sand.

8.2.2 Groundwater was proven 1.65m bgl during the ground investigation.

8.2.3 Several elevated concentrations of potential contaminants of concern have been measured within the soil samples in relation to the proposed residential with plant uptake end use of the site therefore significant risk is anticipated.

8.3 Qualitative Contaminated Land Risk Assessment

8.3.1 Current UK legislation on contaminated land is principally contained in Sections 78(A) to (YC) in Part IIA of the Environmental Protection Act 1990, which was retrospectively inserted by Section 57 of the Environment Act 1995. The Contaminated Land Regulations 2000 were amended in 2005. The Environmental Protection Act 1990: Part IIA Contaminated Land, Statutory Guidance, Edition 2, 2006, promulgates the revised statutory guidance with respect to the operation of the Contaminated Land Regime following the implementation of the Contaminated Land Regulations, 2005.

8.3.2 The definition of contaminated land is central to the operation of Part IIA. Legislation adopts the principle of a 'suitable for use' approach for the assessment of contaminated land, the rationale reflected in the site-specific risk assessment and

determination of remedial strategy. Action is only required if unacceptable risks are posed to human health or to the environment, taking into account the current land use and geo-environmental setting.

8.3.3 The legislation places a responsibility on the Local Authority to determine whether the land under its jurisdiction is contaminated by consideration of whether:

- Significant harm is being caused;
- There is a significant possibility of significant harm being caused;
- Significant pollution of controlled waters is being caused or is likely to be caused.

8.4 Assessment Framework

8.4.1 The statutory guidance describes a risk assessment methodology in terms of 'significant pollutants' and 'pollutant linkages', using 'source-pathway-receptor' scenarios for the site. Pollutant linkages are formed when there is a linkage between a contaminant source and a receptor by means of a pathway. Each element has to be present, or no linkage can be formed.

8.4.2 Risk assessment and the procedure of identifying sources, pathways and receptors is recognised as an approach to determine the extent and significance of contamination either within the context of Part IIA (when assessing current site status or when considering the acquisition of an existing development) or the planning process (for the redevelopment of an existing site, or when considering the acquisition of a site for redevelopment purposes). Either way, the 'suitable for use' approach is adopted when assessing risk and the source-pathway-receptor assessment defines the conceptual model for the site.

8.4.3 Within the context of this report therefore, the revised risk assessment has been undertaken on the basis that the 'suitable for use' approach remains aligned with the site being redeveloped for the end use given above.

8.5 Summary of Identified Pollutant Linkages

8.5.1 On the basis of the ground investigation and laboratory test results, it is evident that the on-site soils do contain elevated concentrations of inorganic and/or organic contaminants in excess of the adopted GACs.

8.5.2 Risk to human health, the development and the wider environment, with respect to the identified levels of contaminants within the on-site soils, is therefore anticipated to be significant.

8.5.3 A summary of the risk assessment is given in Table 8.1 overleaf.

Table 8.1 - Summary of Revised Conceptual Site Model & Risk Assessment

Potential Source	Potential Receptor	Plausible Pathway	Probability	Severity	Revised Risk Rating	Solution
Potentially contaminated made ground, near surface natural strata / perched groundwater	Human Health Site end-users, inc. maintenance and site workers (short term risk during construction)	Direct ingestion or dermal contact with soil, dust and/or vapour inhalation	Likely	Mild	**Moderate/Low**	Risk is anticipated. 600mm thick clean capping layer in all soft landscaped areas.
		Direct ingestion and/or dermal contact with liquid contaminants	Unlikely	Mild	**Very Low**	
		Direct ingestion and/or inhalation of asbestos fibres	Unlikely	Severe	**Moderate/Low**	No risk anticipated. R*isk rating cannot be downgraded given severity*
	Construction (Potable Water Supply Pipes)	Direct contact/leaching (tainting)	Low likelihood	Mild	**Low**	No significant risk anticipated. Localised PAH in made ground soils. Excavate and dispose.
	Construction (Foundations)	Direct contact/leaching	Unlikely	Mild	**Very Low**	No risk anticipated. Appropriate concrete specification
	Controlled Waters	Surface run-off / lateral migration	Unlikely	Mild	**Very Low**	No risk anticipated

9 CONCLUSIONS AND RECOMMENDATIONS

9.1 General

9.1.1 This geo-environmental appraisal has been carried out in relation to the redevelopment of land located off Commercial Road, Spalding.

9.1.2 It has been assumed in the production of this report that the site is to be developed for a residential without plant uptake end use.

9.2 Soil Contamination - Risk Evaluation

9.2.1 The Conceptual Site Model confirms that significant potential pollutant linkages exist at the site in relation to existing on-site soils.

Human Health Receptors

9.2.2 Several elevated concentrations of potential contaminants of concern above relevant commercial GAC values were measured within the on-site soils and risk to future end users of the site is therefore anticipated albeit the risk is considered to be low.

9.2.3 Any potential risks to construction workers must be specifically assessed as part of the health and safety evaluation for the works to be performed in accordance with prevailing legislation. Site practices must conform to the specific legislative requirements and follow appropriate guidance (e.g. HSE, 1991; CIRIA, 1996).

Controlled Waters Receptors

9.2.4 Given the low permeability of the underlying clays and Oxford Clay Formation risk to controlled waters (underlying aquifer) receptors is considered to be very low. Some localised excavation and disposal of made ground may be required during construction to alleviate any potential issue that may arise.

Ecological Receptors

9.2.5 There are no ecological receptors at the site.

Utilities

9.2.6 It is recommended that the results of the chemical testing and details of the proposed development of the site are provided to the appropriate utility companies to determine the necessity for service protection.

9.2.7 Risk to potable water supply pipes is considered to be very low.

Ground Gas Risk

9.2.8 Ground gas monitoring was not undertaken as part of these works given the lack of a potentially sauce. Although made ground was encountered on site it is a self-depleting source with no putrescible materials noted.

Asbestos Containing Materials

9.2.9 No asbestos fibres were identified in the samples near surface soils analysed by the laboratory. Risks to construction workers and site end users are considered to be low.

Radon Precautions

9.2.10 No radon protection measures are required in construction.

9.3 Construction - Risk Evaluation

Site Preparation

9.3.1 A significant part of the enabling works will comprise the demolition and removal of the current structures and possible regrading of the site.

9.3.2 It may be that these works will need to be undertaken to an approved earthworks specification.

Sulphate Attack

9.3.3 Soil sulphate concentrations measured during the investigations have been compared to levels within the BRE Special Paper SD1:2005. In considering the sulphate values, the site has been assessed as 'brownfield'.

9.3.4 The on-site soils are not considered to be at risk from containing pyrite.

9.3.5 Design Sulphate classification of DS-1 should be suitable along with an ACEC class of AC-1s. However, this does not make any necessary allowance for the requirements of structural strength, or requirements for durability of concrete. Further consultation should be made with the designing engineer with respect to the site specific sulphate resistant concrete to be used.

Mining Risk

9.3.6 On the basis of readily available information, the potential for there to be shallow mine workings beneath the site is considered to be negligible.

Foundations

9.3.7 Made ground soils of any type are **not** suitable founding stratum given their lateral and vertical variability.

9.3.8 It is considered at this stage given the high water table and granular nature of the near surface deposits a piled foundation solution is anticipated to be the best solution. Given the variability of the granular deposits beneath the site it is anticipated that the piles will need to be taken down to the underlying Glacial Till Deposits which are thought to be around 20.00m bgl shown by a BGS borehole (Ref: TF22SE1/B) located just on the other side of the river to the north west.

Floor Slabs

9.3.9 Ground bearing slabs could be used where ground conditions allow and no precautionary measures associated with soft and unstable soils are required.

9.3.10 A suspended floor system incorporating a sub-floor void, such as beam and block, will be required for all structures where the foundations lie within an area with an excess of

600mm of unsuitable material being present below floor slabs following site preparation/regrading.

9.3.11 Where ground bearing slabs are implemented, care must be taken to ensure that shallow strata do not become heavily disturbed by site clearance/construction activities (especially during inclement weather). Where this occurs, this could result in an increased requirement for suspended floor slabs.

Precautions Near Trees

9.3.12 Given that the near surface deposits are predominately granular in nature, precautions near trees are not anticipated.

Drainage and Soakaways

9.3.13 *A preliminary In situ falling head* test was carried out within BH1, BH2 & BH4. The location of the tests is shown on Figure 37412/002.

9.3.14 The results of the permeability testing is summarised in the table below.

Table 9.1 - Summary of the Preliminary Falling Head Test

Location	Soakage Area Dimensions (average m)	Test Depth (m bcgl)	Test Number	Infiltration Rate (m/sec)	Drainage Characteristics
BH1	0.03	5.00	1	1.8E-07	Practically Impermeable
BH2	0.025	4.00	1	1.2E-06	Very Poor
BH4	0.025	4.00	1	1.4E-06	Very Poor

9.3.15 Given that the underlying groundwater table was recorded at being 1.40m bgl at a worst case scenario and a minimum of 1.00m gap between the top of the water table and the base of the soakaway is required this only leaves a 0.40m as a working space. On this basis and due to the very low infiltration rates it is considered that soakaways are not suitable for use at the site.

Roads and Car Parks

9.3.16 No *in situ* CBR testing has been carried out to date as the final development levels at the site are unknown.

9.3.17 On the basis of visual observation, it is considered that the near surface soils are likely to have a minimum CBR value of around 0.5-1.0%.

9.3.18 Highways Agency document HD25 Interim Advice Note 73/06 Revision 1 (2009) states that where a subgrade has a CBR lower than 2.5%, it is considered unsuitable support for a pavement foundation since it would tend to deform under construction traffic and must be improved. All road design should be discussed with the local authority if highways are to be subject to a Section 38 agreement.

G*round Stability*

9.3.19 Given the high water table and granular nature of the near surface deposits running sand conditions are likely to be encountered during excavations, this is likely to be compounded where excavations are left open during prolonged periods of wet weather (e.g. in service trenches). Allowance for instability should be made where necessary.

9.3.20 An adequate drainage system for surface water may need to be installed by a competent contractor in order to prevent surface water ponding or collection, both during and post construction, as this may lead to deterioration and weakening of the founding stratum.

9.3.21 Where excavations are proposed close to site boundaries and there is the possibility of weak/unstable ground passing across that boundary and beneath adjacent structures, a risk assessment of the integrity/stability should be undertaken prior to such works being carried out. Designed and engineered temporary/permanent measures should be adopted to ensure their continued stability where necessary.

Excavations

9.3.22 Localised obstructions to excavations or shallow hard rock are not anticipated given the geology.

9.3.23 Should remnant foundations or road base construction be encountered, the breaking-out of obstructions for either foundations or other construction requirements should be allowed for. Excavation of the materials encountered should be easily achieved using conventional hydraulic excavation techniques.

9.3.24 No man entry into unsupported excavations should be allowed without an appropriate risk assessment. Reference to CIRIA report 97 (1983) should be made to establish suitable means of support, or battering of excavation sides.

Outline Remediation Requirements

9.3.25 On the basis of available information it is considered that minor remediation is required at the site comprising a 600mm thick clean capping layer within all soft landscaped areas.

9.3.26 Confirmation of the chemical condition of any materials brought to site should be confirmed prior to importation.

Disposal of Soils

9.3.27 Should brightly coloured or odorous soil be encountered during the proposed construction works, Alan Wood and Partners should be notified immediately. An

experienced geo-environmental engineer will visit site for further sampling, analysis and risk assessment, where required.

9.3.28 Any materials removed from site should be undertaken in accordance with the Duty of Care Regulations 1991 and the Hazardous Waste Regulations 2005. There will also be a requirement to classify the waste in accordance with the European Waste Catalogue. The waste should also be subject to Waste Acceptance Criteria (WAC) testing.

10 REGULATORY APPROVAL

10.1.1 The conclusions and recommendations presented in this report are considered reasonable on the basis of available information and the assessment of the site as carried out by Alan Wood and Partners.

10.1.2 It should be noted however that the works undertaken cannot be guaranteed to gain approval by the Regulatory Authorities and your Warranty Provider, so copies of this report should be made available to the relevant organisations (as appropriate) for their comment and approval, prior to undertaking any irrecoverable works associated with the site.

11 INFORMATION SOURCES

In addition to the specific references cited in the text, the following references have been referred to in the production of this report, where relevant to the defined project objectives.

1 BRE *BR211* (2007) *Radon: guidance on protective measures for new dwellings*;

2 BRE GBG 75 (2009), '*Radon Protection For New Large Buildings';*

3 BS5930 (1999), *Code of practice for site investigations*;

4 BS:8576 (2013), *Guidance on Investigations for Ground Gas - Permanent Gases and Volatile Organic Compounds (VOCs)*;

5 BSEN 1997-1 (2004), *Geotechnical Design Part 1 – General Rules*;

6 BSEN 1997-2 (2007), *Geotechnical Design Part 2 – Ground investigation and testing*;

7 Chartered Institute of Environmental Health (CIEH): *Professional Practice Note: Reviewing human health risk assessment reports invoking contaminant oral bioavailability measurements or estimates* (2009);

8 CIRIA C552 (2001), *Contaminated Land Risk Assessment, A Guide to Good Practice*;

9 CIRIA C665 (2007), *Assessing risks posed by hazardous ground gases to buildings*;

10 CL:AIRE / EIC / AGS: *Soil Generic Assessment Criteria for Human Health Risk Assessment* (updated January 2010 version);

11 Coal Authority, *www.coal.decc.gov.uk*;

12 DEFRA SP1010: *Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination - Policy Companion Document*, December 2014;

13 DETR Circular 02/2000 (2000). *Environmental Protection Act 1990 Part IIA. Contaminated Land.* Department of the Environment, Transport and the Regions, Circular 02/2000, Dated 20th March 2000;

14 Environment Agency (EA) & DEFRA: Model Procedures for the Management of Land Contamination – Contaminated Land Report 11 (CLR11) (2004);

15 Environment Agency, *www.environment-agency.org.uk*;

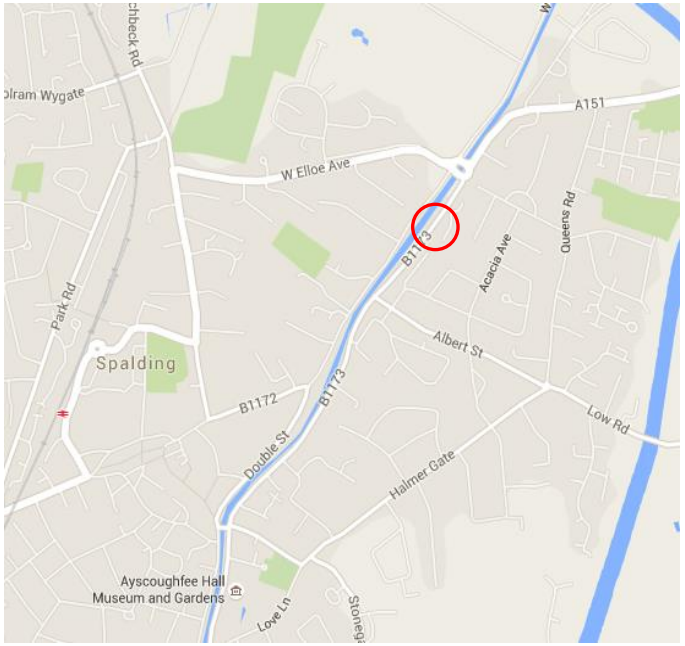
16 Environment Agency (2009). *Human Health Toxicological Assessment of Contaminants in Soil*, Science Report SC050021/SR2;

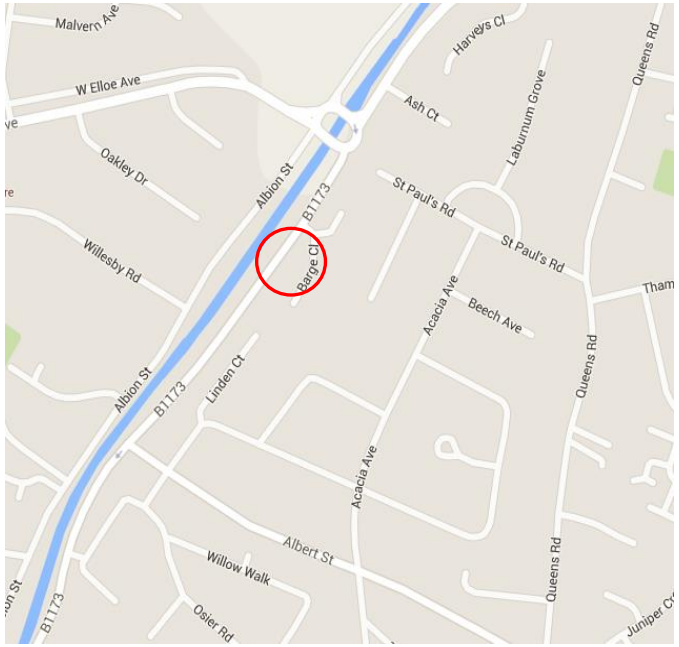
17 Environment Agency (2009).*Updated Technical Background to the CLEA Model*, Science Report SC050021/SR3;

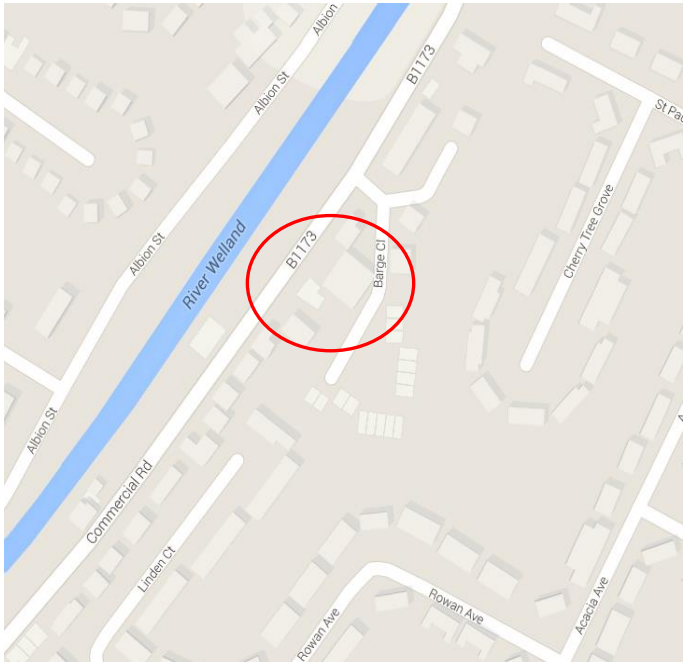
18 Land Quality Management / CIEH: *The LQM/CIEH S4UL's for Human Health Risk Assessment*, Land Quality Press, Nottingham, 2015. Publication Number S4UL3286;

19 NHBC Chapter 4.2 (2003), *Building near trees,* NHBC Publication, July 2007.

FIGURES









DO NOT SCALE

Approximate Site Location

Approximate Red Line Site Boundary

N

Alan Wood & Partners

Client.	**Mr Abdul Aziz**		
Project.	**Commercial Road, Spalding**		
Drawing.	**Site Location Plan**		
Date. **13.11.15**		Scale. **NTS**	
Drawn by. **DA**	Check by. **JS**	Approved by. **JS**	
Status:	**FINAL**		
Job no. **37412**	Fig. no. **001**	Rev.	



Key

Windowless Sampler BH Locations 16th November 2015

Inaccessible area

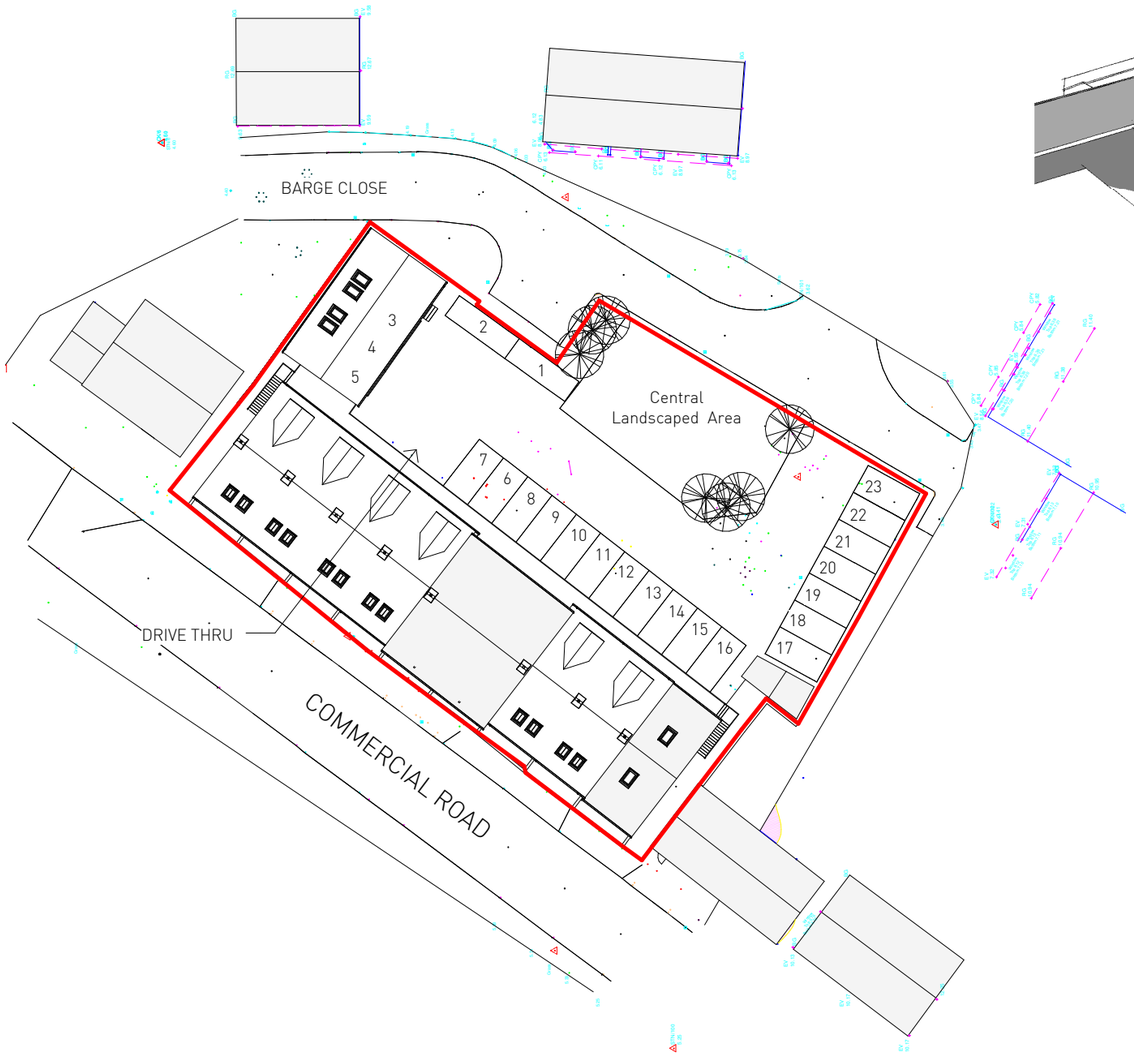
N

DO NOT SCALE

Alan Wood & Partners

Client.	**Mr Abdul Aziz**		
Project.	**Commercial Road, Spalding**		
Drawing.	**Site Features Plan**		
Date. **18.11.15**		Scale. **NTS**	
Drawn by. **DA**	Check by. **JS**	Approved by. **JS**	
Status:	**FINAL**		
Job no. **37412**	Fig. no. **002**	Rev.	

DRAWINGS



PROPOSED SITE PLAN

1 : 500



VIEW 1



VIEW 2

A	Units increased in size	22Oct15
Rev.	Description	Date

PROPOSED SITE PLAN
COMMERCIAL ROAD, SPALDING

Pegasus Urban Design

I T 0113 287 8200 I F 0113 287 8229 I www.pegasuspg.co.uk I Team: NF/CAH I Date: **21Sept15** I Scale @ A3 : **1 : 500** Drawn by: **NF** I drwg: **YOR.2496 - 02** Rev. **A** Client: **M IDREES PROPERTIES**

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APPENDIX A

GROUND INVESTIGATION LOGS

Alan Wood and Partners
Hallamshire House, Hayland Street
Sheffield, South Yorkshire
S9 1BY
Tel: 0114 244 0077

Borehole No
BH1
Sheet 1 of 1

Project Name	Project No.	Co-ords: -	Hole Type
Spalding	37412		WLS
Location: 80 Commercial Road, Spalding		Level: -	Scale 1:50
Client: Mr Abdul Aziz		Dates: 16/11/2015	Logged By DA

Well	Water Strikes	Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description
		Depth (m)	Type	Results				
					0.03			ASPHALT
		0.40-0.60	ES		0.40			MADE GROUND: Dark brown sand and gravel. Gravel is fine, sub-angular and sub-rounded brick, quartzite and mudstone.
					0.70			MADE GROUND: Red gravel. Gravel is medium and coarse, angular and sub-angular brick and sandstone.
					0.75			MADE GROUND: White fine to coarse, angular and sub-angular concrete gravel.
		1.10-1.40	ES					Light brown very silty fine and medium SAND
					2.00			Firm brown very clayey, very sandy SILT.
		2.40-2.80	ES					
					3.00			Soft black very silty, very sandy CLAY with frequent plant matter (organic CLAY).
					3.30			Medium dense light brown very clayey, very silty SAND.
					5.00			End of Borehole at 5.00 m
			Type	Results				

1 2 3 4 5 6 7 8 9

Remarks:

AGS

Alan Wood and Partners
Hallamshire House, Hayland Street
Sheffield, South Yorkshire
S9 1BY
Tel: 0114 244 0077

Borehole No
BH2
Sheet 1 of 1

Project Name	Project No.	Co-ords: -	Hole Type
Spalding	37412		WLS
Location: 80 Commercial Road, Spalding		Level: -	Scale 1:50
Client: Mr Abdul Aziz		Dates: 16/11/2015	Logged By DA

Well	Water Strikes	Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description
		Depth (m)	Type	Results				
		0.20-0.40	ES		0.05			MADE GROUND: Fine and medium, sub-angular and sub-rounded quartzite gravel.
		0.70-0.90	ES		0.50			MADE GROUND: Dark brown, very clayey sand with rare fine brick gravel. Taran layer @ 0.05m
								Medium dense light brown slightly clayey, very silty SAND.
					2.70			Firm brown, very sandy CLAY.
					3.40			Medium dense light brown very clayey, very silty SAND Saturated between 3.4m and 3.7m.
								No longer clayey from 4.5m.
					5.00			End of Borehole at 5.00 m
			Type	Results				

1 2 3 4 5 6 7 8 9

Remarks:

AGS

Alan Wood and Partners
Hallamshire House, Hayland Street
Sheffield, South Yorkshire
S9 1BY
Tel: 0114 244 0077

Borehole No
BH3
Sheet 1 of 1

Project Name	Project No.	Co-ords: -	Hole Type
Spalding	37412		WLS
Location: 80 Commercial Road, Spalding		Level: -	Scale 1:50
Client: Mr Abdul Aziz		Dates: 16/11/2015	Logged By DA

Well	Water Strikes	Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description
		Depth (m)	Type	Results				
					0.10			PAVING SLAB
		0.30-0.40	ES		0.20 0.40 0.50			MADE GROUND: Yellow slightly gravelly sand. Gravel is fine, sub-angular and sub-rounded sandstone.
					0.70			MADE GROUND: Dark brown very clayey sand.
					1.00			MADE GROUND: Concrete gravel. MADE GROUND: Brick gravel. MADE GROUND: Dark brown, very clayey, very gravelly sand. Gravel is fine, sub-angular and sub-rounded brick, sandstone, mudstone, coal and chalk.
		2.00-2.40	ES					Medium dense light brown, very clayey, very silty SAND. Becoming black between 2.0m and 2.3m. No longer clayey from 2.8m.
					5.00			End of Borehole at 5.00 m
		Type	Results					

1 2 3 4 5 6 7 8 9

Remarks:

AGS

Alan Wood and Partners
Hallamshire House, Hayland Street
Sheffield, South Yorkshire
S9 1BY
Tel: 0114 244 0077

Borehole No
BH4
Sheet 1 of 1

Project Name	Project No.	Co-ords: -	Hole Type
Spalding	37412		WLS
Location: 80 Commercial Road, Spalding		Level: -	Scale 1:50
Client: Mr Abdul Aziz		Dates: 16/11/2015	Logged By DA

Well	Water Strikes	Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description
		Depth (m)	Type	Results				
		0.20-0.40	ES		0.20			CONCRETE
					0.30			MADE GROUND: Light brown slightly gravelly sand. Gravel is fine, sub-angular and sub-rounded sandstone.
		0.70-1.00	ES		0.40			MADE GROUND: Dark brown very gravelly sand. Gravel is fine, sub-angular and sub-rounded brick with rare glass and frequent rootlets.
								Medium dense orange slightly silty SAND. Becoming very silty at 1.0m. Becoming saturated from 1.5m. Becoming grey @ 2.0m. Becoming black between 3.6m and 3.8m
					5.00			End of Borehole at 5.00 m
			Type	Results				

1 2 3 4 5 6 7 8 9

Remarks:

AGS

APPENDIX B

LABORATORY TESTS RESULTS: CHEMICAL

Chemtest
The right chemistry to deliver results
Chemtest Ltd.
Depot Road
Newmarket
CB8 0AL
Tel: 01638 606070
Email: info@chemtest.co.uk

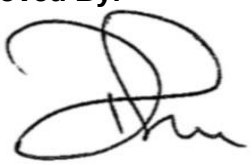
UKAS TESTING
2183

Final Report

Report No.:	15-27233-1
Initial Date of Issue:	25-Nov-2015
Client	Alan Wood & Partners
Client Address:	Hallamshire House Meadow Court Hayland Street Sheffield S9 1BY
Contact(s):	David Ashton
Project	37412 Spalding

Quotation No.:		**Date Received:**	19-Nov-2015
Order No.:	S1365	**Date Instructed:**	19-Nov-2015
No. of Samples:	5	**Target Date:**	25-Nov-2015
Turnaround (Wkdays):	5	**Results Due:**	25-Nov-2015
Date Approved:	25-Nov-2015		

Approved By:



Details: Darrell Hall, Laboratory Director

Chemtest
The right chemistry to deliver results

Results - Soil

Project: 37412 Spalding

Client: Alan Wood & Partners					15-27233	15-27233	15-27233	15-27233	15-27233
Quotation No.:				Chemtest Sample ID.:	221497	221498	221499	221500	221501
Order No.: S1365				Client Sample Ref.:	BH1	BH2	BH3	BH4	BH4
				Client Sample ID.:	E1	E1	E1	E1	E2
				Sample Type:	SOIL	SOIL	SOIL	SOIL	SOIL
				Top Depth (m):	0.4	0.2	0.3	0.2	0.7
				Bottom Depth (m):	0.6	0.4	0.4	0.4	1
				Date Sampled:	16-Nov-2015	16-Nov-2015	16-Nov-2015	16-Nov-2015	16-Nov-2015
Determinand	**Accred.**	**SOP**	**Units**	**LOD**					
ACM Type	U	2192		N/A	-	-	-	-	-
Asbestos Identification	U	2192	%	0.001	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected
Moisture	N	2030	%	0.020	21	13	20	22	17
Soil Colour	N	2040		N/A	Red	Brown	Brown	Brown	Brown
Other Material	N	2040		N/A	Brick	Brick	Stones, Roots	Stones	NONE
Soil Texture	N	2040		N/A	Sand	Loam	Sand	Sand	Sand
pH	M	2010		N/A	8.6	8.1	8.2	8.3	8.7
Boron (Hot Water Soluble)	M	2120	mg/kg	0.40	0.70	0.73	1.2	3.6	1.1
Sulphate (2:1 Water Soluble) as SO4	M	2120	g/l	0.010	0.28	0.042	0.035	0.11	0.057
Cyanide (Free)	M	2300	mg/kg	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Cyanide (Total)	M	2300	mg/kg	0.50	< 0.50	< 0.50	< 0.50	1.2	< 0.50
Thiocyanate	M	2300	mg/kg	5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Sulphide (Easily Liberatable)	M	2325	mg/kg	0.50	1.7	20	3.0	12	1.9
Sulphate (Total)	M	2430	%	0.010	0.35	0.059	0.13	0.36	0.071
Arsenic	M	2450	mg/kg	1.0	32	18	24	58	11
Cadmium	M	2450	mg/kg	0.10	0.15	0.11	1.3	0.37	< 0.10
Chromium	M	2450	mg/kg	1.0	45	8.8	22	28	8.7
Copper	M	2450	mg/kg	0.50	24	42	58	97	10
Mercury	M	2450	mg/kg	0.10	0.93	0.68	0.31	1.9	0.14
Nickel	M	2450	mg/kg	0.50	30	9.4	19	77	9.7
Lead	M	2450	mg/kg	0.50	110	190	340	1800	100
Selenium	M	2450	mg/kg	0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Zinc	M	2450	mg/kg	0.50	51	77	310	440	28
Chromium (Hexavalent)	N	2490	mg/kg	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Organic Matter	M	2625	%	0.40	1.9	2.6	3.1	5.5	1.3
Aliphatic TPH >C5-C6	N	2680	mg/kg	1.0	< 1.0	< 1.0		< 1.0	< 1.0
Aliphatic TPH >C6-C8	N	2680	mg/kg	1.0	< 1.0	< 1.0		< 1.0	< 1.0
Aliphatic TPH >C8-C10	M	2680	mg/kg	1.0	< 1.0	< 1.0		< 1.0	< 1.0
Aliphatic TPH >C10-C12	M	2680	mg/kg	1.0	< 1.0	< 1.0		< 1.0	< 1.0
Aliphatic TPH >C12-C16	M	2680	mg/kg	1.0	< 1.0	< 1.0		< 1.0	< 1.0
Aliphatic TPH >C16-C21	M	2680	mg/kg	1.0	< 1.0	< 1.0		< 1.0	< 1.0
Aliphatic TPH >C21-C35	M	2680	mg/kg	1.0	< 1.0	< 1.0		< 1.0	< 1.0
Aliphatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0	< 1.0		< 1.0	< 1.0
Total Aliphatic Hydrocarbons	M	2680	mg/kg	5.0	< 5.0	< 5.0		< 5.0	< 5.0
Aromatic TPH >C5-C7	N	2680	mg/kg	1.0	< 1.0	< 1.0		< 1.0	< 1.0
Aromatic TPH >C7-C8	N	2680	mg/kg	1.0	< 1.0	< 1.0		< 1.0	< 1.0
Aromatic TPH >C8-C10	M	2680	mg/kg	1.0	< 1.0	< 1.0		< 1.0	< 1.0

Chemtest
The right chemistry to deliver results

Results - Soil

Project: 37412 Spalding

Client: Alan Wood & Partners					15-27233	15-27233	15-27233	15-27233	15-27233
Quotation No.:					221497	221498	221499	221500	221501
Order No.: S1365					BH1	BH2	BH3	BH4	BH4
					E1	E1	E1	E1	E2
					SOIL	SOIL	SOIL	SOIL	SOIL
					0.4	0.2	0.3	0.2	0.7
					0.6	0.4	0.4	0.4	1
					16-Nov-2015	16-Nov-2015	16-Nov-2015	16-Nov-2015	16-Nov-2015
Determinand	**Accred.**	**SOP**	**Units**	**LOD**					
Aromatic TPH >C10-C12	M	2680	mg/kg	1.0	< 1.0	< 1.0		< 1.0	< 1.0
Aromatic TPH >C12-C16	M	2680	mg/kg	1.0	< 1.0	< 1.0		< 1.0	< 1.0
Aromatic TPH >C16-C21	M	2680	mg/kg	1.0	19	13		8.9	< 1.0
Aromatic TPH >C21-C35	M	2680	mg/kg	1.0	50	49		26	< 1.0
Aromatic TPH >C35-C44	N	2680	mg/kg	1.0	2.6	8.9		< 1.0	< 1.0
Total Aromatic Hydrocarbons	M	2680	mg/kg	5.0	72	71		35	< 5.0
Total Petroleum Hydrocarbons	M	2680	mg/kg	10	72	71		35	< 10
Naphthalene	M	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	0.38	< 0.10
Acenaphthylene	M	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	0.34	< 0.10
Acenaphthene	M	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	0.10	< 0.10
Fluorene	M	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	0.16	< 0.10
Phenanthrene	M	2700	mg/kg	0.10	1.1	2.2	0.83	1.6	< 0.10
Anthracene	M	2700	mg/kg	0.10	0.87	0.59	0.18	0.25	< 0.10
Fluoranthene	M	2700	mg/kg	0.10	3.6	6.2	2.2	4.5	0.25
Pyrene	M	2700	mg/kg	0.10	3.1	6.2	2.2	4.1	0.27
Benzo[a]anthracene	M	2700	mg/kg	0.10	1.7	4.3	1.4	2.0	< 0.10
Chrysene	M	2700	mg/kg	0.10	2.0	4.4	1.9	2.7	< 0.10
Benzo[b]fluoranthene	M	2700	mg/kg	0.10	2.2	7.0	1.7	3.1	< 0.10
Benzo[k]fluoranthene	M	2700	mg/kg	0.10	0.92	2.9	0.62	1.3	< 0.10
Benzo[a]pyrene	M	2700	mg/kg	0.10	1.6	4.9	1.1	2.2	< 0.10
Indeno(1,2,3-c,d)Pyrene	M	2700	mg/kg	0.10	1.0	4.0	0.74	1.7	< 0.10
Dibenz(a,h)Anthracene	M	2700	mg/kg	0.10	0.15	1.1	0.17	0.55	< 0.10
Benzo[g,h,i]perylene	M	2700	mg/kg	0.10	1.0	3.7	0.67	1.4	< 0.10
Total Of 16 PAH's	M	2700	mg/kg	2.0	19	48	14	26	< 2.0
Benzene	M	2760	µg/kg	1.0	< 1.0	< 1.0		< 1.0	< 1.0
Toluene	M	2760	µg/kg	1.0	< 1.0	< 1.0		< 1.0	< 1.0
Ethylbenzene	M	2760	µg/kg	1.0	< 1.0	< 1.0		< 1.0	< 1.0
m & p-Xylene	M	2760	µg/kg	1.0	< 1.0	< 1.0		< 1.0	< 1.0
o-Xylene	M	2760	µg/kg	1.0	< 1.0	< 1.0		< 1.0	< 1.0
Total Phenols	M	2920	mg/kg	0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30

Report Information

Key

U	UKAS accredited
M	MCERTS and UKAS accredited
N	Unaccredited
SU	This analysis has been subcontracted to a UKAS accredited laboratory that is accredited for this analysis
SN	This analysis has been subcontracted to a UKAS accredited laboratory that is not accredited for this analysis
T	This analysis has been subcontracted to an unaccredited laboratory
I/S	Insufficient Sample
U/S	Unsuitable Sample
N/E	not evaluated
<	"less than"
>	"greater than"

Comments or interpretations are beyond the scope of UKAS accreditation
The results relate only to the items tested
Uncertainty of measurement for the determinands tested are available upon request
None of the results in this report have been recovery corrected
All results are expressed on a dry weight basis
The following tests were analysed on samples as received and the results subsequently corrected to a dry weight basis TPH, BTEX, VOCs, SVOCs, PCBs, Phenols
For all other tests the samples were dried at < 37°C prior to analysis
All Asbestos testing is performed at our Coventry laboratory
Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1

Sample Deviation Codes

A - Date of sampling not supplied
B - Sample age exceeds stability time (sampling to extraction)
C - Sample not received in appropriate containers
D - Broken Container

Sample Retention and Disposal

All soil samples will be retained for a period of 60 days from the date of receipt
All water samples will be retained for 14 days from the date of receipt
Charges may apply to extended sample storage

If you require extended retention of samples, please email your requirements to:
customerservices@chemtest.co.uk

APPENDIX C

AWP GENERIC ASSESSMENT CRITERIA

Alan Wood & Partners
Generic Assessment Criteria for Soils

Revision Version: V.7 - September 2015

Parameter	Residential		Commercial	Allotment	Public Open Space near Residential land (POS_{resi})	Public Park Land (POS_{park})	Source
	With Plant Uptake	Without Plant Uptake					
	1-6% SOM	1-6% SOM	1-6% SOM	1-6% SOM	1-6% SOM	1-6% SOM	
Metals/Metalloids [a]							
Arsenic (inorganic)	37	40	640	49	79	170	DEFRA C4SL [b]
Beryllium	1.7	1.7	12	35	2.2	63	LQM/CIEH [c]
Boron	290	11,000	240,000	45	21,000	46,000	LQM/CIEH [c]
Cadmium [d]	22	150	410	3.9	220	880	DEFRA C4SL [b]
Chromium (III)	910	910	8,600	18,000	1,500	33,000	LQM/CIEH [c]
Chromium (VI) [e]	21	21	49	170	21	250	DEFRA C4SL [b]
Copper	2,400	7,100	68,000	520	12,000	44,000	LQM/CIEH [c]
Lead [f]	200	310	2,300	80	630	1,300	DEFRA C4SL [b]
Mercury (inorganic)	40	56	1,100	19	120	240	LQM/CIEH [c]
Nickel	130	180	980	53	230	800	LQM/CIEH [c]
Selenium	250	430	12,000	88	1,100	1,800	LQM/CIEH [c]
Vanadium	410	1,200	9,000	91	2,000	5,000	LQM/CIEH [c]
Zinc	3,700	40,000	730,000	620	81,000	170,000	LQM/CIEH [c]
Other Inorganics							
pH	<5	<5	<5	<5	<5	<5	-
Total Sulphate	2400	2400	2400	2400	2400	2400	BRE (2005) [g]
Water-Soluble Sulphate	0.5g/l	0.5g/l	0.5g/l	0.5g/l	0.5g/l	0.5g/l	BRE (2005)

Parameter	Residential						Commercial [i]			Allotment			Public Open Space near Residential land (POS_{resi})			Public Park Land (POS_{park})			Source
	With Plant Uptake			Without Plant Uptake															
	1% SOM	2.5% SOM	6% SOM	1% SOM	2.5% SOM	6% SOM	1% SOM	2.5% SOM	6% SOM	1% SOM	2.5% SOM	6% SOM	1% SOM	2.5% SOM	6% SOM	1% SOM	2.5% SOM	6% SOM	
Organics [h]																			
Acenaphthene	200	490	1,080	2,000	3,600	5,200	75,000	92,000	100,000	34	85	202	Subject to site specific assessment where required			Subject to site specific assessment where required			CLEA/LQM/CIEH
Acenaphthylene	170	400	900	2,000	3,600	5,200	76,000	92,000	100,000	28	68	163							CLEA/LQM/CIEH
Anthracene	2,300	5,400	10,700	30,000	34,000	36,000	520,000	530,000	540,000	380	947	2,230							CLEA/LQM/CIEH
Benzo(a)anthracene	7.5	11	13	12	14	15	170	170	180	2.9	6.5	13							CLEA/LQM/CIEH
Benzo(a)pyrene	2.2	2.7	3	3.2	3.2	3.2	35	35	36	3.6	3.7	3.7							CLEA/LQM/CIEH
Benzo(b)fluoranthene	2.6	3.3	3.7	3.9	4	4	44	45	45	1	2.2	3.9							CLEA/LQM/CIEH
Benzo(g,h,i)perylene	315	340	350	360	360	360	3,900	4,000	4,000	290	480	646							CLEA/LQM/CIEH
Benzo(k)fluoranthene	77	93	100	110	110	110	1,200	1,200	1,200	37	76	129							CLEA/LQM/CIEH
Chrysene	15	22	27	30	31	32	350	350	350	4.1	9.5	19							CLEA/LQM/CIEH
Dibenz(a,h)anthracene	0.24	0.28	0.30	0.31	0.32	0.32	3.5	3.6	3.6	0.14	0.27	0.44							CLEA/LQM/CIEH
Fluoranthene	280	560	890	1,500	1,600	1,600	23,000	23,000	23,000	52	127	288							CLEA/LQM/CIEH
Fluorene	165	390	850	2,200	3,400	4,200	60,000	67,000	70,000	27	67	158							CLEA/LQM/CIEH
Indeno(1,2,3-cd)pyrene	27	36	41	45	46	46	500	510	510	9.5	21	40							CLEA/LQM/CIEH
Naphthalene	1	2.3	5.5	1	2.4	6	100	260	600	4	9.8	23							CLEA/LQM/CIEH
Phenanthrene	95.0	220	440	1,300	1,400	1,500	22,000	22,000	23,000	15	38	90							CLEA/LQM/CIEH
Pyrene	620	1,200	2,000	3,700	3,800	3,800	54,000	54,000	55,000	111	271	620							CLEA/LQM/CIEH
Aliphatic EC 5-6 (benzene)	24	40	80	24	40	80	2,400	4,000	8,000	752	1,730	3,900	Subject to site specific assessment where required			Subject to site specific assessment where required			CLEA/LQM/CIEH
Aliphatic EC >6-8 (toluene)	52	110	250	52	110	250	5,200	11,000	25,000	2,304	5,580	13,000							CLEA/LQM/CIEH
Aliphatic EC >8-10	13	30	70	13	30	70	1,300	3,000	7,000	321	770	1,700							CLEA/LQM/CIEH
Aliphatic EC >10-12	60	150	360	60	150	360	6,000	15,000	32,000	2,153	4,300	7,150							CLEA/LQM/CIEH
Aliphatic EC >12-16	500	1,200	2,600	500	1,200	2,600	42,000	72,000	90,000	10,800	12,400	13,200							CLEA/LQM/CIEH
Aliphatic EC >16-35	41,000	69,000	94,000	41,000	69,000	94,000	140,000	160,000	180,000	240,000	260,000	260,000							CLEA/LQM/CIEH
Aliphatic EC >35-44	41,000	69,000	94,000	41,000	69,000	94,000	140,000	160,000	180,000	240,000	260,000	260,000							CLEA/LQM/CIEH

Alan Wood & Partners
Generic Assessment Criteria for Soils

Revision Version: V.6 - April 2015

Alan Wood & Partners

Parameter	Residential						Commercial [i]			Allotment			Public Open Space near Residential land (POS_{resi})			Public Park Land (POS_{park})			
	With Plant Uptake			Without Plant Uptake															
	1% SOM	2.5% SOM	6% SOM	1% SOM	2.5% SOM	6% SOM	1% SOM	2.5% SOM	6% SOM	1% SOM	2.5% SOM	6% SOM	1% SOM	2.5% SOM	6% SOM	1% SOM	2.5% SOM	6% SOM	
Organics contd./ [h]																			
Aromatic EC >5-7	50	110	240	155	300	630	15,000	28,000	55,000	12	25	57	Subject to site specific assessment where required			Subject to site specific assessment where required			CLEA/LQM/CIEH
Aromatic EC >7-8	100	240	550	370	800	1,800	33,000	68,000	130,000	21	50	117							CLEA/LQM/CIEH
Aromatic EC >8-10	20	50	110	20	53	125	2,000	5,000	120,000	8.6	21	50							CLEA/LQM/CIEH
Aromatic EC >10-12	63	150	340	120	280	650	11,000	22,000	31,000	12.5	31	74							CLEA/LQM/CIEH
Aromatic EC >12-16	140	320	660	1,100	1,900	2,300	35,000	37,000	38,000	23	57	134							CLEA/LQM/CIEH
Aromatic EC >16-21	260	540	930	1,800	1,900	1,900	28,000	28,000	28,000	47	112	260							CLEA/LQM/CIEH
Aromatic EC >21-35	1,100	1,400	1,700	1,900	1,900	1,900	28,000	28,000	28,000	370	820	1,500							CLEA/LQM/CIEH
Aromatic EC >35-44	1,100	1,400	1,700	1,900	1,900	1,900	28,000	28,000	28,000	370	820	1,500							CLEA/LQM/CIEH
Benzene	0.06	0.13	0.30	0.16	0.30	0.64	15	28	57	0.016	0.033	0.073	Subject to site specific assessment where required			Subject to site specific assessment where required			CLEA/LQM/CIEH
Toluene	104	240	550	370	830	1800	33,000	68,000	130,000	22	50	117							CLEA/LQM/CIEH
Ethylbenzene	30	62	150	34	81	190	3,200	7,000	16,000	16	38	91							CLEA/LQM/CIEH
o-xylene	30	70	170	40	90	200	3,700	8,000	19,000	28	67	160							CLEA/LQM/CIEH
m-xylene	30	70	160	34	80	190	3,400	8,000	18,000	30	74	170							CLEA/LQM/CIEH
p-xylene	30	70	160	33	80	180	3,200	8,000	17,000	28	69	160							CLEA/LQM/CIEH

NOTES

- All values are rounded to 1 or 2 significant figures. All values mg/kg unless otherwise stated.

(a) Generic Assessment Criteria presented by DEFRA (2014) and LQM/CIEH (2015) for metals are not sensitive to Soil Organic Matter content and may be applied directly across the SOM range 1-6% for the land uses given.

(b) Final Category 4 Screening Levels given in DEFRA SP1010: Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination - Policy Companion Document, December 2014. Calculated for sandy loam soils with 6% SOM.

(c) Nathanial, C.P., McCaffrey, C., Gillett, A.C., Ogden, R.C. And Nathanial, J.F. (2015). The LQM/CIEH S4ULs for Human Health Risk Assessment. Land Quality Press, Nottingham. Publication Number **S4UL3286**.

(d) GAC for cadmium are calculated for soils with pH values between 6 and 8. Care should be applied when using the GAC values outside this range and particularly below 5.

(e) Additional site specific risk assessment may be required where elevated concentrations of Chromium (VI) are measured on site.

(f) DEFRA (2014) indicate that the BGS have derived 'normal' background lead concentrations for England & Wales. In England normal background concentrations are 180mg/kg for the principal domain, 2400mg/kg for the mineralisation domain and 820mg/kg for the urban domain (DEFRA, 2012). Calculated C4SL values to be adopted for residential, allotment and POS_{resi} are lower therefore than the 'normal' background concentration of lead in urban areas.

(g) BRE (2005) Special Digest 1, 3rd Edition 'Concrete in Aggressive Ground'. GAC is the upper limit for DS-1 sulphate class concrete.

(h) Organic contaminant GAC values calculated using CLEA v1.06 for sandy soil with SOM of 1%, 2.5% and 6%. Sandy soil type is considered to be conservative for the majority of soils, including brownfield soils on (potentially contaminated) sites. Changes made to default CLEA exposure parameters as per updated information given in DEFRA (2014) (C4SL Tables 3.2 and 3.5) and LQM/CIEH (2015).

(i) GAC derived for pre-1970 office buildings using default commercial CLEA model with adjustment to CLEA exposure parameters as per DEFRA (2014) (C4SL Tables 3.2 and 3.5).

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