Report Title:

Additional Ground Investigation & Remediation Strategy

Project Name:

Hempton Road, Deddington

Report Reference: **BRD3567-OR3-A**

Date: **March 2021**

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REPORT CONTROL SHEET

REPORT TITLE	**ADDITIONAL GROUND INVESTIGATION & REMEDIATION STRATEGY**
PROJECT	**HEMPTON ROAD, DEDDINGTON**
CLIENT	**BURRINGTON ESTATES**

REPORT REFERENCE	ISSUE DETAIL	DATE	PREPARED BY	CHECKED BY
BRD3567-OR3-A	First Issue	12/03/2021	M Morgan	J Brockwell

BRD Environmental Limited

Geotechnical and Environmental Services

- Ground Investigation
- Japanese Knotweed Removal
- Soil, Water and Gas Testing
- Contamination Assessment
- Geotechnical Advice
- Remediation Solutions

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REPORT LAYOUT

This report is divided into the following four sections: Summary Report, Technical Report, Supporting Information and Appendices.

SUMMARY REPORT

This expanded executive summary provides the main findings of the work undertaken in brief non-technical language. This section provides an overview of the key outcomes for the benefit of non-specialists and concludes with the main recommendations. This section should only be relied upon in the context of the whole report and the Technical Report should be referred to with respect to any design decisions.

TECHNICAL REPORT

The main report section is intended to provide the technical detail of the investigation and is intended to provide the level of information required by current guidance documents and practice. The Technical Report is written in a language that, in part, assumes knowledge of subject matter so that it can be written in as concise a form as possible. Its intended audience is peers, regulators and other professionals in related disciplines.

SUPPORTING INFORMATION

This section of the report provides background details of a generic nature together with specific technical approaches adopted by BRD and details of the guidance documents that are commonly referenced in the report. The section also includes explanations of technical terms to assist non-specialist readers in understanding the Technical Report. It should be noted that not all the information within this section is necessarily applicable to this specific report.

APPENDICES

The final section of the report presents the factual data collected and employed as part of the investigation.

APPENDIX 1	**SITE PLANS**	
	Site Location Plan	Ref. BRD3567-OP2-B
	Revised Conceptual Site Model	Ref. BRD3567-OP10-A
	Proposed Development Layout	'Site Plan – As Proposed' drawing ref. 201-P102 Rev. A dated January 2021.
	Exploratory Point Plan	Ref. BRD3567-OD1-B
	Contamination and Remediation Plan	Ref. BRD3567-OD4-A
	Remedial Capping Plan	Ref. BRD3567-OP11-A
APPENDIX 2	**EXPLORATORY HOLE RECORDS**	
	Logs of additional trial pits.	Ref. TP18-TP25
	Photographic records of trial pits.	Ref. BRD3567-OP9-A
APPENDIX 3	**LABORATORY TEST RESULTS**	
	DETS report 21-02154	13 x A4 pages

SUMMARY REPORT - GENERAL INFORMATION

SUBJECT	COMMENTS
CURRENT SITE CONDITION	The site currently comprises two fields with an access track. The southernmost field (Field A) contains a barn in the north east corner and the field is slightly overgrown. The field to the north (Field B) is accessed by a grassy track and was until recently used for growing crops.
PROPOSED DEVELOPMENT	It is proposed that the site will be developed with 21No. residential dwellings and associated roads, driveways, private gardens and a drainage attenuation pond.
HISTORICAL SUMMARY	The earliest available map indicates the south west corner of the site was previously used as an old quarry. The timeline of the backfilling of the quarry is ambiguous as the mapping indicates this has been completed by 1974, but some anecdotal evidence would suggest that it was later. Throughout the 20th Century the site appears to have primarily been used agriculturally. A farm building was constructed by 1974 but subsequently demolished and another building constructed by 1994. The site has remained relatively unchanged since.
PUBLISHED GEOLOGY	The site is shown to be devoid of superficial deposits. The shallowest bedrock unit is shown to be Marlstone Rock Formation in the southern extent of the site and the Whitby Mudstone Formation in the northern extent of the site.
ACTUAL GROUND CONDITIONS	Investigation across the site has proved a large proportion of the site is underlain by backfilled material comprising reworked ironstone to a significant depth. Elsewhere the natural Marlstone Rock Formation was encountered. The affected quarry area was found to be larger than the quarry boundaries identified on the historical maps, however, it should be noted that the reworked ironstone backfill is just the natural overburden soil that was placed back in the quarry following extraction of the rock layer. Beneath the barn and the access track to the south, extensive brick and concrete rubble has been identified which may relate to the historic demolition of the old barn. A layer of buried topsoil was encountered in the fill in the south extreme south western corner of the site, which contained pockets of ash and charcoal fragments.
HYDROGEOLOGY	The underlying bedrock geology is designated a Secondary A Aquifer and the site is not located within a groundwater Source Protection Zone.
HYDROLOGY	The closest water feature to the site is a drainage ditch approximately 270m south west of the site. The site is not in an area indicated to be at risk of flooding.

SUMMARY REPORT – CONTAMINATION ISSUES

SUBJECT	COMMENTS
SOIL RISKS TO HUMAN HEALTH	Following this additional investigation, an additional contamination risk has been identified beneath the barn and access track area where asbestos cement fragments and fibres have been identified in the near surface underlying soils, present to a depth of up to 0.6m bgl. A localised area of lead contamination relating to a buried layer of ash and clinker within the buried topsoil has also been identified in the south western corner of the site, at depths below 0.8m bgl.
LANDFILL GAS	No plausible sources of landfill gas have been identified.
RADON GAS	Full radon gas protection measures are required.
RISKS TO THE WATER ENVIRONMENT	No unacceptable contamination risks to water resources have been identified by this investigation.
RISKS TO BUILDING MATERIALS AND SERVICES	No unacceptable contamination risks to building materials and services have been identified by this investigation.
REMEDIATION	The asbestos impacted soils beneath the barn and driveway are unsuitable to remain at the site and will need to be removed. The visually identifiable asbestos cement fragments should be handpicked, bagged and disposed of. The remaining soils still contain elevated asbestos fibre concentrations and should also be disposed of to a suitably licensed landfill or soil treatment plant. For the area of localised lead contamination, it is currently at a depth where it will have no significant impact to future residents. However, there are likely to be excavations through the area for roads, services and foundations and therefore careful management of the soils is required to ensure that a suitable cover of clean soil remains intact in garden and landscaped areas. A formal remediation strategy is presented within the report.
WASTE SOIL DISPOSAL	Any reworked or natural sub-soils disposed of from the site would be classified as 'non-hazardous waste' and would be characterised for disposal to landfill as 'inert waste'. Following handpicking of any asbestos cement fragments, the asbestos impacted soils should be classified as non-hazardous waste. The picked asbestos would be classified as hazardous waste. The contaminated ashy soils buried in the south western corner will also be classified as hazardous waste due to high concentrations of metals.
RECOMMENDATIONS	It is recommended that this report is submitted to the planning department of the Local Authority, the organisation undertaking the Building Control function, warranty providers confirm that the investigation completed to date and the proposed remediation strategy is satisfactory.

1. INTRODUCTION TO TECHNICAL REPORT

1.1. CONTRACT DETAILS

CLIENT	Burrington Estates (Deddington) Ltd trading as Burrington Estates.
SITE	Land situated north of Hempton Road in the village of Deddington, Oxfordshire.
CLIENT'S ADVISORS	BRD Environmental Limited (BRD) has been commissioned directly by the Client.
REPORT CONTEXT	It is understood that the Client owns the site and intends to develop it for residential housing.
REPORT TYPE	Additional Ground Investigation and Remediation Strategy.
REPORT OBJECTIVES	The site has been subject to a previous desk study and site investigation by BRD referenced as follows: • 'Phase 1 Environmental Desk Study – Hempton Road, Deddington', BRD Environmental Ltd, report ref. BRD2567-OR1-A, dated October 2019. • 'Phase 2 Geo-Environmental Site Investigation - Hempton Road, Deddington', BRD Environmental Ltd, report ref. BRD2567-OR2-A, dated January 2020. The reports identified the vast majority of the site to be uncontaminated, but with one possible hotspot identified in the south western corner that required some additional investigation. It was also recommended to investigate in and around the barn once it was vacant /demolished. The site has been granted outline planning permission for residential development (ref. 18/02147/OUT) and this report, in conjunction with the previous report aims to fully address both Condition 7 (site investigation) and Condition 8 (remediation strategy).

1.2. SCOPE OF WORKS

The agreed scope of works was:

- Mobilisation to site and production of health and safety documentation.
- One day of trial pitting using a mechanical excavator to provide approximately 7-8No. trial pits to a nominal depth of 3m, ground conditions permitting.
- All exploratory points will be logged and sampled in general accordance with BS5930:2015 by supervising Geo-Environmental Consultant.
- A photo-ionisation detector (PID) will be used during the site works to assist in identifying and delineating any volatile organic contamination.
- Determination of the accurate location and level of exploratory points by topographical GPS unit.

- Chemical testing of soil samples with the budget based on the following testing schedule:

    - 6No. Metals Suite - As, Cd, Cr, CrVI, Hg, Pb, Se, Cu, Ni and Zn.
    - 6No. Inorganics Suite – water soluble sulphate, pH, organic matter.
    - 6No. Speciated Polycyclic Aromatic Hydrocarbons (PAH).
    - 2No. Banded aliphatic/aromatic Total Petroleum Hydrocarbons (TPH).
    - 2No. Benzene, Toluene, Ethylbenzene, Xylene (BTEX) and Methyl Tertiary Butyl Ether (MTBE) compounds.
    - 2No. Asbestos screen and quantification (if present).

- Chemical testing of 2No. soil samples for Waste Acceptance Criteria (WAC) to assist in establishing the waste classification of the soil for disposal purposes.

- Provision of an additional investigation report, to include all exploratory point records and test results, as well as an updated Generic Quantitative Contamination Risk Assessment (GQRA), waste classification and a remediation strategy.

1.3. REPORT LIMITATIONS

Any site boundary lines depicted on plans included within this report are approximate only and do not imply legal ownership of land. Any observations of tree species, asbestos containing materials within structures or invasive weeds, does not constitute a formal survey of such features. The identification of such features is therefore tentative only. In the case of Japanese Knotweed, BRD can undertake separate surveys for this plant undertaken by a Property Care Association qualified surveyor.

The report does not consider whether sensitive ecology or archaeology is present as these require consideration by professionals specialising in these matters. It should be recognised that the collection of desk study information may not be exhaustive and that other information pertinent to the site may be available.

The recommendations, interpretations and conclusions of this report are based solely on the ground conditions found at the exploratory holes. Due to the variability in the nature of ground, conditions between exploratory holes can only be interpreted and not defined. The description of the site and the ground conditions is accurate only for the dates of the field works. In particular, groundwater levels can vary due to seasonal and other effects.

The assessment and interpretation of contamination risks is based on the scope of works agreed with the Client together with the budgetary and programme constraints imposed. Further investigation, analysis and assessment of contamination may be required by regulators or other third parties with an interest in the site. An ecological risk assessment of contaminated soils is beyond the scope of this report. This report is concerned with assessing those contamination risks which apply to the future use of the site through the proposed development as part of the planning regime. The assessment does not consider the risk to current site users or continued future use of the site in its current state. If development of the site should occur that differs from that proposed, then the findings of the contamination assessment would need to be re-evaluated.

This report is restricted to a contamination assessment only and does not include any form of geotechnical advice. It should be noted that a geotechnical assessment has been completed in the previous report for this site and this should be referred to.

2. SITE CHARACTERISTICS

2.1. SITE SETTING

SITE ADDRESS AND POST CODE	Land at Hempton Road, Deddington, Oxfordshire, OX15 0QH.
NATIONAL GRID REFERENCE	445970E, 231830N.

2.2. SITE DESCRIPTION

SUBJECT	COMMENTS
CURRENT SITE DESCRIPTION	The site currently comprises two separate areas referred to as Field A and Field B. Field A is located in the south west extent of the site. A barn with a lean-to is located in the north east corner of Field A and is used for storage. The remaining Field A area has not been in use recently and is therefore slightly overgrown. The inside of the barn and its surroundings have recently been cleared of all of the old materials and waste, etc, that had been stored within. Field B forms part of a wider agricultural field extending to the north, with an access track covered in grass along the eastern boundary of Field A. The site boundary is now formed by Heras style fencing.
SURROUNDING LAND USE	The site is set on the western edge of the village of Deddington with fields to the north and west, residential land to the east and a recreation ground to the south.
PROPOSED DEVELOPMENT	It is proposed that the site will be developed with 21No. residential properties, together with associated gardens, access, garages, landscaping and a drainage pond.
HISTORICAL SUMMARY	The earliest available map indicates the south west corner of the site was previously used as a quarry. The timeline of the backfilling of the quarry is ambiguous as the mapping indicates this has been completed by 1974, but some anecdotal evidence would suggest that it was later. Throughout the 20th Century the site appears to have primarily been used agriculturally. A farm building was constructed by 1974, which was later demolished and a new farm building is shown in the north east corner of Field A in 1994. The site has remained relatively unchanged since.
PUBLISHED GEOLOGY	The site is shown to be devoid of superficial deposits. The shallowest bedrock unit is shown to be the Marlstone Rock Formation in the southern extent of the site and the Whitby Mudstone Formation in the northern extent of the site.

SUBJECT	COMMENTS
RADON	Full radon protection measures are required. Public Health England (PHE) recommends that a new building should be subject to an appropriate radon test during the first year of occupation if it is located in a radon-affected area. BRE further recommends radon testing on completion or occupation of all extensions, conversions and building subject to significant alterations. While there is no specific statutory requirement to inspect the radon barrier, BRE strongly recommends that an inspection is carried out prior to covering up the barrier. BRD are of the opinion that such inspections should be independent and undertaken in general accordance with 'Good practice on the testing and verification of gas protection systems for buildings against hazardous ground gases. CIRIA C735'.
HYDROGEOLOGY	The site is situated upon a Secondary A aquifer. The site is not located within a groundwater Source Protection Zone.
HYDROLOGY	The closest water feature to the site is a drainage ditch approximately 270m south west of the site. The nearest river is the River Cherwell located approximately 4km east of the site. The site is not in an area indicated to be at risk of flooding.

2.3. PREVIOUS INVESTIGATIONS

The site has been subject to the following relevant previous contamination assessment reports:

- 'Phase 1 Geo-Environmental Desk Study – Hempton Road, Deddington', BRD Environmental Ltd, ref. BRD3567, dated October 2019.
- 'Phase 2 Geo-Environmental Site Investigation - Hempton Road, Deddington', BRD Environmental Ltd, report ref. BRD2567-OR2-A, dated January 2020.

2.3.1. Phase 1 Geo-Environmental Desk Study

The Desk Study comprised desk based research and site walk over. The primary finding was that part of the site was historically used as an old quarry that has since been backfilled.

The preliminary contamination risk assessment identified that the backfill could contain potentially contaminative material that may pose a possible risk to human health, the water environment, building structures and water pipes. Additionally, it was considered that complications may arise when designing and constructing foundations for the proposed development.

Furthermore, potential limited contamination was identified from the debris observed on the site surface within the vicinity of the barn and through the process of burning of material previously conducted on the site. Elsewhere, the vast majority of site was agricultural and considered unlikely to be significantly contaminated. However the underlying soils were identified to potentially be naturally elevated in arsenic, chromium and nickel.

2.3.2. Phase 2 Geo-Environmental Site Investigation

The investigation comprised the excavation of 17No. trial pits across the site. The investigation identified that a large proportion of the site is underlain by backfilled material comprising reworked ironstone to a significant depth. The affected quarry area was found to be larger than the quarry boundaries identified on the historical maps, however, it should be noted that the reworked ironstone backfill is just the natural overburden soil that was placed back in the quarry following extraction of the rock layer.

Beneath the fill, the Marlstone Rock Formation was identified as the underlying bedrock in majority of the site other than two locations in the southern extent of the site, where the clays of the Dyrham Formation were encountered.

In general, no significant contamination risks were identified. As anticipated, naturally elevated arsenic concentrations were recorded in the soils across the site, but additional testing confirmed the bioavailability of the arsenic was very low and a detailed quantitative human health risk assessment demonstrated a significantly reduced risk to human health.

In TP3 towards the south western corner of the site, a layer of ashy soil was encountered at a depth of 0.8m and this recorded elevated lead concentrations. It was recommended that further sampling should be completed in this area in order to delineate the area of contamination.

Coupled with this, the report identified that investigation beneath the existing barn building should be completed once it has been demolished to establish whether or not there are any contamination risks in this area.

This current report aims to address these two recommendations.

3. GROUND INVESTIGATION

3.1. INVESTIGATION DESIGN

METHODOLOGY	For the additional ground investigation, machine excavated trial pits were chosen as the most appropriate investigation technique in order to expose more soil and provide a more accurate record of the ground conditions. Trial pits in and around the barn were now possible as the barn and Field A area had been vacated by the previous owner.	
DATES OF SITE WORKS	The field works were undertaken on 19th February 2021.	
CONSTRAINTS TO EXPLORATORY HOLE LAYOUT	There were no significant constraints to the investigation. Due to the barn still be in place (but vacant) it was only possible to undertake one trial pit within it, through the floor slab. However, due to the relatively small size of the barn, this is considered to be representative. Coupled with this, three further trial pits were completed in the area surrounding the barn.	
EXPLORATORY HOLE SPACING	Approximately 5m-10m grid (where completed).	
LAYOUT RATIONALE	**SOURCE / FEATURE**	**EXPLORATORY HOLE**
CONTAMINATION SOURCES TARGETED	Previously un-investigated areas in and around the barn.	TP18-TP21
	Delineation of the lead hotspot in the south western corner of the site (around TP3).	TP22-TP25
CONTAMINATION SAMPLING PLAN	In the south western part of the site, the sampling focussed on the soils corresponding with the previously identified contaminated ashy layer at a depth of around 0.8m. In the previously un-investigated area beneath the barn and surroundings, the testing focussed on a combination of soils displaying evidence of contamination as well as the soils most likely to be encountered by future residents i.e. the upper metre.	
ANALYSIS PLAN	Due to the sites history as an agricultural barn and field, BRD scheduled a suite of typically occurring contaminants including asbestos screening and petroleum hydrocarbons. Lead testing, as well as other heavy metals have been analysed in the soils in the south western area where these contaminants were previously identified.	

3.2. BRD FIELDWORK

TRIAL PITS	
REFERENCES	TP18 to TP25.
DEPTH RANGE	From 1.30m to 3.00m.
EXCAVATOR	JCB 3CX style wheeled backactor.
BACKFILL	All the trial pits were backfilled with arisings upon completion and compacted with rams of the excavator bucket.

3.3. LABORATORY TESTING

SOIL CHEMICAL TESTING	
The soil samples for contamination and/or chemical geotechnical testing were forwarded to the laboratory of DETS Ltd and the testing suite is detailed below. The UKAS or MCERTS accreditation of the individual test methods is shown on the laboratory test report included in the Appendices.	
SOIL TESTS	**NUMBER OF SAMPLES TESTED**
Arsenic, Cadmium, Chromium, Chromium VI, Copper, Lead, Mercury, Nickel, Selenium, Zinc	6
Speciated Polycyclic Aromatic Hydrocarbons (PAH)	6
Total Petroleum Hydrocarbons (TPH) with full carbon banding and aliphatic/aromatic split	2
Benzene, Toluene, Ethylbenzene and Xylenes (BTEX) plus Methyl Tert Butyl Ether (MTBE)	2
Organic Matter	6
Asbestos Quantification	2
Asbestos identification	1
Waste Acceptance Criteria (WAC) testing	2

4. GROUND CONDITIONS

4.1. OVERVIEW

The ground conditions encountered during the additional ground investigation were broadly as anticipated from the previous investigations and site history. In the south western corner, the ashy layer was found to be fairly localised and instead was found to be part of a thin layer of buried topsoil present at depth across the wider area. Beneath the barn and its access track, deeper Made Ground in the form of brick and concrete rubble was encountered beneath the surfacing and the upper horizons contained occasional asbestos cement fragments.

Details of the various stratigraphic units are given in the following sections.

4.2. ARTIFICIAL GROUND

4.2.1. Hardstanding

The concrete hardstanding beneath the barn was found to be reinforced and 200mm in thickness.

Some patches of tarmac was evident across the access road, but in some locations the surfacing was just the granular backfill material.

4.2.2. Made Ground – Barn Area

Beneath the barn, Made Ground was encountered beneath the concrete hardstanding and comprised 'clayey gravel and cobbles of brick and concrete' extending down to 0.60m bgl. Rare asbestos cement fragments were encountered and two reinforced concrete girders were present at one end of the pit and these most likely related to the historic barn that was previously present at the site.

Beneath the driveway area similar Made Ground soils were encountered and one of the exploratory holes (TP20) encountered extensive brick rubble extending to 1.5m bgl although the possible asbestos cement fragments were only encountered in a sandy layer in the upper 0.5m.

4.2.3. Made Ground – South Western Section

This area was dominated by the reworked Marlstone Rock Formation as was encountered across most of the site during the previous investigation. The trial pits in this location were targeting a buried ashy layer encountered in the previous trial pit TP3. However, ashy soils were not encountered by these trial pits and instead what appeared to comprise a layer of buried topsoil within the backfill was encountered in three of the holes at depths in the range 0.7m to 1.1m and up to 0.5m thick. This was noted to contain some charcoal in two of the locations. It is therefore surmised that the previous ashy layer was just a pocket of more ashy soils within this buried topsoil layer.

4.3. TOPSOIL AND MADE GROUND TOPSOIL

Reworked topsoil similar to that encountered during the previous investigation was encountered in all 5No. trial pits excavated in the field area (TP21-TP25). This topsoil extended to depths of up to 0.4m and was described as 'brown very gravelly, very clayey sand. Gravel of fine to coarse angular ironstone'.

4.4. SUPERFICIAL DEPOSITS

Superficial deposits were not encountered.

4.5. BEDROCK

The Marlstone Rock Formation was encountered beneath the Made Ground or reworked ironstone fill in most of the trial pits undertaken as part of this additional investigation.

Clayey silt soils from the Dyrham Formation were also encountered in TP22 in the south western corner at a depth of 2.80m bgl.

4.6. CONTAMINATION OBSERVATIONS

Occasional fragments of asbestos cement were identified within the surface layer of the rubbly Made Ground extending to 0.5m-0.6m bgl in TP18 and TP20 in the area of the existing barn and access track.

The previously identified ashy soils in TP3 were not encountered but a layer of buried topsoil containing occasional charcoal fragments was encountered in three of the surrounding trial pits and the previously identified ashy layer is considered to be a pocket within this layer.

4.7. GROUNDWATER BEHAVIOUR

Groundwater was not encountered whilst forwarding the exploratory holes.

5. RISK ESTIMATION – SOILS

5.1. HUMAN HEALTH

The Generic Assessment Criteria (GAC) employed below are for residential land use as this is appropriate to the proposed form of development. These GAC are the same used for the previous investigation report.

CONTAMINANT	UNITS	NUMBER OF TESTS	MAXIMUM CONCENTRATION	GAC	NUMBER EXCEEDING GAC
Arsenic	mg/kg	6	153	37	6
Cadmium	mg/kg	6	0.3	22	0
Chromium (hexavalent)	mg/kg	6	<2	21	0
Chromium (total)	mg/kg	6	235	910	0
Copper	mg/kg	6	147	2,400	0
Lead	mg/kg	6	236	200	1
Mercury	mg/kg	6	1.1	11	0
Nickel	mg/kg	6	89	180	0
Selenium	mg/kg	6	<3	250	0
Zinc	mg/kg	6	297	3,700	0
pH	Units	6	7.8-8.2	<5-10>	0
Naphthalene	mg/kg	6	<0.1	2.3	0
Acenaphthylene	mg/kg	6	<0.1	170	0
Acenaphthene	mg/kg	6	<0.1	210	0
Fluorene	mg/kg	6	<0.1	170	0
Phenanthrene	mg/kg	6	0.61	95	0
Anthracene	mg/kg	6	0.15	2,400	0
Fluoranthene	mg/kg	6	0.79	280	0
Pyrene	mg/kg	6	0.72	620	0
Benzo(a)anthracene	mg/kg	6	0.37	7.2	0
Chrysene	mg/kg	6	0.36	15	0
Benzo(b)fluoranthene	mg/kg	6	0.57	2.6	0
Benzo(k)fluoranthene	mg/kg	6	0.20	77	0
Benzo(a)pyrene	mg/kg	6	0.39	2.2	0
Indeno(1,2,3-cd)pyrene	mg/kg	6	0.23	27	0
Dibenzo(a,h)anthracene	mg/kg	6	<0.1	0.24	0
Benzo(ghi)perylene	mg/kg	6	0.20	320	0
TPH Aliphatic C5-C6	mg/kg	2	< 0.01	42	0
TPH Aliphatic C6-C8	mg/kg	2	< 0.05	100	0
TPH Aliphatic C8-C10	mg/kg	2	< 2	27	0
TPH Aliphatic C10-C12	mg/kg	2	< 2	130	0
TPH Aliphatic C12-C16	mg/kg	2	< 3	1,100	0
TPH Aliphatic C16-C35	mg/kg	2	87	65,000	0

CONTAMINANT	UNITS	NUMBER OF TESTS	MAXIMUM CONCENTRATION	GAC	NUMBER EXCEEDING GAC
TPH Aliphatic C35-C44	mg/kg	2	16	65,000	0
TPH Aromatic C5-C7	mg/kg	2	< 0.01	70	0
TPH Aromatic C7-C8	mg/kg	2	< 0.05	130	0
TPH Aromatic C8-C10	mg/kg	2	< 2	34	0
TPH Aromatic C10-C12	mg/kg	2	< 2	74	0
TPH Aromatic C12-C16	mg/kg	2	< 2	140	0
TPH Aromatic C16-C21	mg/kg	2	5	260	0
TPH Aromatic C21-C35	mg/kg	2	91	1,100	0
TPH Aromatic C35-C44	mg/kg	2	14	1,100	0
Benzene	mg/kg	2	<0.002	0.87	0
Toluene	mg/kg	2	<0.005	130	0
Ethylbenzene	mg/kg	2	<0.002	47	0
Xylene (total of all types)	mg/kg	2	<0.002	56	0
Methyl Tert Butyl Ether (MTBE)	mg/kg	2	<0.005	49	0
Asbestos Quantification	%	2	0.006	LOD*	2
Asbestos Identification	Presence	1	Chrysotile & Crocidolite in cement matrix		1
Hydrocarbon Vapour (PID)	ppm	8	0.0	50	0
*Notes: *Limit of detection*					

RESULTS EXCEEDING HUMAN HEALTH ASSESSMENT CRITERIA	
ARSENIC	All 6No. of the samples analysed recorded elevated arsenic at concentrations in the range 103-153mg/kg. Concentrations of up to 301mg/kg were recorded previously throughout the near surface soils, the reworked backfill and the natural bedrock. As part of the previous contamination assessment, a detailed quantitative human health risk assessment for arsenic was undertaken utilising bioavailability testing. This recorded a worst case bioavailability factor of 1.6% and from this, a site specific human health assessment criterion of 411mg/kg. Therefore it is evident that the additional test results fall below this level and no additional risks are presented at the site.
LEAD	The previous investigation identified an elevated lead concentration of 607mg/kg in a layer of ash and clinker identified in TP3 at a depth of 0.7m-1.3m. This investigation included four trial pits surrounding TP3 (ref. TP22-TP25. Elevated lead was only recorded in one of the four additional trial pits (TP22) in a corresponding layer of buried topsoil present from 1.0m to 1.4m. The lead was recorded at a concentration of 236mg/kg on this occasion, only marginally exceeding the GAC.

RESULTS EXCEEDING HUMAN HEALTH ASSESSMENT CRITERIA	
	In the other three locations (TP23-TP25) lead was recorded at very low concentrations of 46-135mg/kg, and was associated with very little evidence of the ash and clinker layer being present in these locations. Therefore it is considered that that the area of lead impacted soils is restricted to the area of TP3 and TP22 in the south western corner of the site, and only at depths greater than 0.80m bgl.
ASBESTOS	Occasional fragments of suspected asbestos cement were identified in the upper 0.5m-0.6m of hardcore / sub-base present beneath the building and access track. Laboratory identification of the fragments has confirmed that they are asbestos cement containing chrysotile and crocidolite. Whilst asbestos cement is typically dominated by chrysotile, it can contain traces of crocidolite, as is the case here. Testing of the soil for fibre quantification has revealed that this is at very low levels with concentrations in the range 0.002%-0.006%. BRD employed the JIWG 'Decision support tool for the qualitative risk ranking of work activities and receptors involved in or exposed to asbestos in soil and Construction & Demolition materials' (Version 2, February 2017). This confirmed that the risk ranking as being low to medium.

5.2. WATER ENVIRONMENT

It is not appropriate to consider human health assessment criteria for human health in relation to the risk to the water environment, but currently there are no generic soil assessment criteria in respect of the water environment. In the absence of any groundwater sampling data, the soil results are assessed on the basis of professional judgement.

The contaminant concentrations recorded in the soils at the site are not considered to be at such levels that they would present any significant risk to the underlying water environment. This was also the case during the previous investigation.

5.3. BUILDING MATERIALS

As with the previous investigation, the additional investigation has not identified any contaminant concentrations exceeding the assessment criteria for building materials and services.

6. RISK EVALUATION

6.1. REVISED CONCEPTUAL MODEL

The revised conceptual site model plan is presented in the Appendices.

ADDITIONAL POLLUTANT LINKAGES	This investigation has identified additional risks in the location of the barn and access track whereby fragments of cement asbestos and low concentrations of asbestos fibres have been identified in the underlying near surface hardcore material.
INVALID POLLUTANT LINKAGES	Whilst not a completely invalid linkage, the previously identified area of lead contamination at TP3 has been delineated to be a localised area in the south western corner of the site and only present below a depth of at least 0.80m bgl. No contamination has been identified during the additional investigation which poses a risk to either building materials and services, or the water environment.
LIMITATIONS AND UNCERTAINTIES	Following the additional stage of ground investigation beneath the barn and driveway area after the site has been vacated, it is not considered that there are any significant limitations to the contamination assessment.

6.2. UPDATED CONTAMINATION RISK ASSESSMENT

The pollutant linkages identified in the revised conceptual site model will now be evaluated as to their severity:

SOURCES AND CONTAMINANTS	PATHWAYS (REFERENCE FROM MODEL)	RECEPTORS	POTENTIAL RISK
Quarry backfill (SW corner) - Elevated Lead concentrations	Ingestion of dust Dermal contact Inhalation of dust Consumption of home grown produce (1)	Future Residents	Low
Asbestos impacted sub-base / hardcore beneath barn and driveway - Presence of asbestos fragments and fibres in the soil/rubble matrix	Inhalation of dusts (2)	Future Residents	Moderate to low

The contamination risks that are presented to the various receptor groups are discussed further in the following sections:

RISK TO HUMAN HEALTH
A moderate to low risk to future residents from inhalation of fibres has been identified from the asbestos impacted soils / hardcore present beneath the barn and driveway. Lead impacted soils have been identified in the south western corner of the site, however, currently they are at a depth where they won't come into contact with the future residents. However, it is possible that they could be inadvertently mixed with the surface soils at the site if not carefully managed during the redevelopment. As such it is considered that these soils pose a low risk to the future residents.

RISK TO WATER ENVIRONMENT
No risks to the water environment have been identified from the site.

RISK TO BUILDING MATERIALS AND SERVICES
No risks to building materials or services have been identified from the soils at the site.

6.3. RISK MANAGEMENT

6.3.1. Further Contamination Assessment

It is considered that no further ground investigation is required for contamination assessment purposes.

6.3.2. Outline Remediation Strategy

A detailed remediation strategy is presented in the following sections to manage the identified contamination risks.

6.3.3. Recommendations

It is recommended that this report is submitted to the planning department of the Local Authority, the organisation undertaking the Building Control function, warranty providers confirm that the investigation completed to date and the proposed remediation strategy is satisfactory and addresses the requirements of Conditions 7 & 8 of the planning permission.

6.4. WASTE SOIL DISPOSAL

Topsoil should be viewed as a resource rather than a waste. As the topsoil is suitable for residential garden use in terms contamination, the topsoil at the site should be stripped and reused. It should be noted that topsoil, even if uncontaminated, is unlikely to constitute 'inert waste' due to its high organic matter content.

It is considered that any uncontaminated natural and reworked sub-soils disposed of from the site would be classified as 'non-hazardous waste' and would be characterised for disposal to landfill as 'inert waste'. However, the chemical results should be forwarded to the proposed landfill site and the waste classification confirmed prior to disposing of any surplus soils. Waste Acceptance Criteria (WAC) testing of the soils was completed and the results are in the Appendices which confirm the soil tested complies with the inert waste limits. The waste code from the European Waste Catalogue (EWC) 2002 for the soils would be 17 05 04 'Soil and Stones, not containing dangerous substances'.

It is considered that, if excavated, the ashy subsoil encountered in the south western corner of the site (TP3) would be classified as 'hazardous waste'. Such waste will require pre-treatment prior to off-site treatment or disposal e.g. by selective excavation and further testing. Waste Acceptance Criteria (WAC) testing of these soils has been completed and the results are in the appendices. The waste code from the European Waste Catalogue (EWC) 2002 for the soils would be 17 05 03 'Soil and Stones, containing dangerous substances'.

It is considered that the Made Ground soils containing asbestos cement fragments beneath the barn and driveway would be classified as 'non-hazardous waste' but only following removal of any asbestos cement fragments (see Section 8.2.1). The chemical results should be forwarded to the proposed landfill site and the waste classification confirmed prior to disposing of any surplus soils. The waste code from the European Waste Catalogue (EWC) 2002 for the soils would be 17 05 03 'Soil and Stones, containing dangerous substances'.

Any fragments of asbestos cement disposed of from the site would be classified as 'hazardous waste'.

7. REMEDIATION STRATEGY

7.1. INTRODUCTION

The overall aim of a remediation strategy is to design the remediation works necessary to mitigate the potentially unacceptable contamination risks identified through the various desk study and investigation reports. The remediation process begins with development of the remediation objectives and the options appraisal process, although the appraisal process must be proportionate to the degree and extent of remediation required. A verification plan will need to be documented that can be implemented as the remediation works are completed.

The processes of remediation design, implementation and verification comprise:

- Definition of remediation objectives.
- Appraisal of the options for remediation and selection of a preferred strategy.
- Planning and implementation of the preferred strategy.
- Long term monitoring and maintenance.
- Preparation of a verification report.

The risk assessment and conceptual site model as presented in the previous sections has identified all of the unacceptable risks. The remediation strategy must present a clear methodology for managing the risks associated with each pollutant identified in the revised conceptual model.

7.2. IDENTIFIED CONTAMINATION RISKS

From the previous contamination assessment, the following pollutant linkages have been identified:

- Area of asbestos impacted sub-base beneath the barn and driveway extending to a depth of 0.5m-0.6m bgl, containing low concentrations of asbestos fibres and occasional asbestos cement fragments.
- A localised area of soils contaminated with lead in the south western corner present below a depth of 0.8m bgl.

The Revised Conceptual Site Model that illustrates the location of these pollutant linkages is included in Appendix 1.

7.3. OBJECTIVES

On some sites, a range of objectives may be established in response to the different nature of the risks associated with different pollutant linkages. These fall into the following three categories:

- Contamination remediation objectives must be based on the conceptual model for the site and must define the desired end condition. They can be qualitative or quantitative but must always relate to the risk assessment. Contamination related objectives are the most important of the three types of objectives and wherever possible, should drive the selection of a remediation option.

- Engineering related objectives considerer the need for improvement, maintenance or modification of the engineering properties of the physical ground conditions on a site. Improvements in stability of the site or changes in ground levels may be required in order to construct the proposed development.

- Management related objectives often relate to the aspects of the remediation process itself, but also to the site after remediation has been completed. For example, the costs of a particular remediation option may exceed the budget making the project not financially viable or un-sustainable. Programme constraints may conflict with the use of particular remediation technology. On sites where there are existing buildings or structures to be retained, remediation activities will have to be designed and carried out to avoid unnecessary disruption.

Accordingly, all three categories of objectives need to be considered in developing the strategy.

The remediation objectives for this project are as follows:

- To ensure that future residents are not exposed to any of the contaminated soils.

- To complete the remediation works in a timely, sustainable and cost effective manner.

- To conform to current guidance regarding contamination remediation and gain regulatory approval.

7.4. REMEDIATION OPTIONS APPRAISAL

7.4.1. Introduction

Having identified the remediation objectives, an appraisal of potentially suitable remediation options must be carried out. Conceptually, remediation action will involve breaking the pollutant linkage or linkages by use of one or more of the following methods:

- Source control: technical action to either, remove or in some way modify the source(s) of the contamination for example excavation or bioremediation.

- Pathway control: technical action to reduce the ability of the contaminant source to pose a threat to receptors by inhibiting or controlling the pathway for example cover systems or gas membranes.

- Receptor control: non-technical actions or controls that alter the likelihood of receptors coming into contact with the contaminants, for example altering the site layout.

A wide range of different techniques can be used individually or in combination in order to break a pollutant linkage. The options appraisal will consider a technique's effectiveness in dealing with the contaminants of concern but will also give consideration of the wider circumstances of the site.

7.4.2. Mitigation options for risk to human health

7.4.2.1. Asbestos impacted soils

Asbestos cement fragments have been identified in the near surface Made Ground soils beneath the barn and driveway. The asbestos fragments were identified from directly beneath the concrete slab (barn) or ground level (access track) to a maximum depth of 0.6m bgl.

Based on the proposed development layout, the access track section falls within the proposed position of an attenuation pond and will therefore need to be excavated regardless. The position of the barn falls across an area of proposed driveway, garage and houses and garden.

Due to the localised area of contamination, coupled with the fact that the vast majority would be excavated regardless during construction, it is considered that off-site disposal of this material is the most viable option in this instance.

In order to reduce the hazardous waste classification of the soils prior to off-site disposal, visible fragments of asbestos cement should be handpicked and disposed of separately. This should render the resultant soil to be classified as non-hazardous waste. It should be noted that this 'picked' soil is still considered to be contaminated as it contains asbestos fibres. The soil should still be disposed of from site as it still poses a contamination risk. The purpose of the handpicking is solely to address the waste management.

7.4.2.2. Lead impacted soils

The lead impacted soils are present within an ashy later present at depth below 0.8m bgl in the south western corner of the site. The area in question has a proposed road crossing through it with a strip of landscaping to the south west and the property of Plot 2 to the north east.

The proposed finished ground levels in the south western area are similar to the current levels. Therefore it is very unlikely that future residents would come into contact with these contaminated soils at their current depth and as such the risk would be mitigated. Therefore, it is proposed that from a remediation perspective all that is required is the careful management of the soils in this area of the site during construction works to ensure that the contaminated soils are not brought to the surface, or re-used anywhere else on site.

It is likely that there will be excavations for drains / sewers along the road, as well as foundation excavations for Plot 2 which will penetrate this layer. When exposed during such excavations, the contaminated soils will therefore need to be identified and segregated to ensure that they are not re-used elsewhere at the site. These soils are also classified as hazardous waste so need to be segregated from other general muckaway.

However, the continued presence of the soil cover will need to be confirmed as the development is nearing completion. It is proposed that within the future private garden areas, the minimum required thickness of clean capping is 0.6m and within small areas of landscaping such as front gardens and verges, the minimum required thickness of clean capping is 0.3m.

8. PROPOSED REMEDIATION WORKS

8.1. GENERAL

8.1.1. Liaison with Regulatory Authorities

This investigation and strategy shall be agreed with the regulatory authorities prior to commencing the works.

During the remedial works, the appointed consultant will continue to liaise directly with the regulatory authorities. They will be consulted over any deviation from the remediation strategy and their representatives will be welcome to visit the site on any occasion throughout the site works.

8.1.2. Professional Supervision

The remediation works shall be undertaken under the part time supervision of a suitably qualified and experienced environmental consultant. This will involve inspections / supervision during the removal of the asbestos impacted soils, supervision during any excavations through the buried lead impacted soils, inspection of capping layers and inspection of any additional areas of contamination uncovered.

8.1.3. Health and Safety

The remediation and subsequent construction of the new development will fall within the remit of the Construction (Design and Management) Regulations 2015. Adherence to these regulations provides a framework for the management of health and safety during the redevelopment of the site and specific health and safety issues are discussed in the following sections.

8.2. SOIL REMEDIATION

8.2.1. Removal of asbestos impacted soils

The potential for asbestos containing materials (ACM) within Made Ground on previously developed sites is a common occurrence and competent contractors should have procedures for addressing the associated risks.

It proposed that the asbestos impacted soils should be removed immediately following the demolition of the barn and associated floor slab in order to prevent any further cross contamination.

The soils should be slowly excavated and placed in a temporary stockpile for the any asbestos cement fragments to be handpicked. The handpicked fragments should be double bagged and a taped around a ‘swan neck’ and placed in a dedicated asbestos skip. The residual handpicked rubble / soil matrix should be disposed of off-site as non-hazardous waste.

The excavation should encompass the entire surface brick and concrete rubble layer with the occasional asbestos fragments which extends to depths of up to 0.6m bgl. In most areas, the underlying soils are the easily distinguishable reworked ironstone Made Ground and this will form the base of the excavation. In those areas beneath the access track, further Made Ground in the forms of sands, gravels and cobbles extended beneath the surface brick and concrete rubble in some locations, but did not contain any asbestos. In all instances the supervising Environmental Consultant will advise on the limits of the required excavation.

While dealing with the cement bonded asbestos fragments in soils, measures to protect the health and safety of site workers should always be implemented including use of appropriate personal protective equipment, education and good hygiene practices. The JIWG Decision Support Tool for

CAR2012 Work Categories proposes that a low risk to construction workers is posed by the presence of these fragments and suggests that the remedial work as proposed is classified as 'Non-Licensed Work'.

The removal of the asbestos cement fragments should be undertaken in general accordance with HSE Asbestos Essentials A11 "Removing Asbestos Cement (AC) Debris", allowing for the fact that this work is being undertaken outside with the debris within the soil matrix. Personal protective equipment should be worn in accordance with HSE guidance note EM6 – 'Personal Protective Equipment'.

Specifically, when dealing with asbestos impacted soils, EN149 type FFP3 disposable masks as well as Type 5/6 protective coveralls should be worn. Manual/localised dust suppression such as wetting the ground should also be applied and localised and basic personal decontamination facilities should be provided.

Any handpicking of the cement asbestos fragments should be undertaken by operatives trained in Non-Licensed asbestos removal. During the course of the works, should any other forms of more friable disaggregated asbestos be identified, then the works will stop and reassessment of the working methods will be undertaken as a matter of urgency.

8.2.2. Removal of lead contamination and confirmation of capping layers

The area of lead contamination comprises an easily identifiable ashy layer, is localised and is present below a depth of 0.8m in the south western corner of the site. Any excavations through this area will need to be completed under part time supervision of a suitably qualified environmental consultant to ensure that any contaminated soils excavated are suitably segregated and not re-used at the site.

It will also need to be confirmed that there is a suitable cover of uncontaminated soils above any contamination which is left in-site in areas of garden or landscaping. Based on the finished levels proposed to be similar to the existing levels, there is already a 'capping' layer of uncontaminated reworked ironstone of at least 0.8m above the contaminated soils, which will prevent future residents coming into contact with the underlying soil contamination.

The extent of the contaminated area coincides with the proposed landscaping along the south western area together with the front garden sections of Plot 2. The rear private garden of Plot 2 is outside the area of contamination. Therefore it will be necessary to confirm a minimum required thickness of clean capping of 300mm (0.3m) across these areas. In addition, the upper 150mm should comprise topsoil and it is likely that there is sufficient site won topsoil that can be reused for the redevelopment.

If imported soils are to be used for any parts of the capping, it will be a requirement that the topsoil and subsoil are proven to be suitable for a residential setting and samples must be submitted for a general contamination suite.

It is important that the provision of the capping layer is integrated into the construction process so that once the layer is placed, it is not disturbed by subsequent construction actives e.g. digging drainage runs. The installation of the capping layer (if required) will take place after construction of the foundations and services trenched thus minimising the risk of cross contamination.

The Remediation Plan in Appendix 1 shows details of the areas that will require capping as described above.

8.3. PREVIOUSLY UNIDENTIFIED CONTAMINATION

It is considered that the investigations to date have significantly reduced the likelihood of finding any unforeseen contamination. However, there remains the possibility that additional sources of contamination may be identified during the construction phase of the development given the backfilled nature of the majority of the site. Additionally, whilst only asbestos cement has been identified in the impacted soils, additional types of asbestos containing materials, such as asbestos insulating board, may be uncovered which may need to be dealt with separately to the other asbestos contaminated soils.

If the developer uncovers any suspect soils that are not consistent with the known ground conditions, then advice from the appointed environmental consultant should be sought prior to any further disturbance of the suspect soils. Depending on the nature of any additional contamination identified, the remediation strategy may need to be updated / revised. Alternatively, if similar pockets of impacted asbestos soils are uncovered then a similar approach to that detailed above can be adopted.

9. VERIFICATION PLAN

9.1. AREA OF ASBESTOS CONTAMINATION

Following the removal of asbestos impacted soils beneath the barn and access track, it is proposed that the area is visually inspected by a suitable qualified environmental consultant and a series of confirmatory samples are also taken.

Samples should be analysed for Asbestos Quantification and any results above 0.001%, or the visual presence of asbestos fragments, will dictate that further excavation and additional verification is required.

9.2. CAPPING LAYER THICKNESS

The proposed landscaping along the south western area together with the front garden sections of Plot 2 will require that a clean capping layer is maintained.

The thickness of the 300mm capping layer (either comprising of the original clean soils or imported soils) will be verified by an environmental consultant through the excavation of hand dug inspection pits undertaken through the placed soils once this area of the development is nearing completion.

9.3. IMPORTING OF SOILS

Should the need arise to import topsoil or subsoil, they will need to be tested to confirm their suitability for the development. The testing rate should be at a minimum of one test per 50m^3 of imported soil and that at least three results are available for each soil source. Test results should be provided by the soil supplier or alternatively samples taken by the attending Geo-Environmental Consultant to ensure they comply with the Verification Assessment Criteria for the site (Section 9.3.1 below). It is recommended that testing to confirm the suitability of the soil is undertaken prior to the import to site. Sample density may need to be increased depending upon the consistency of the material and nature of the source. Alternatively, if a well-defined greenfield source is adopted then the sample density may be decreased.

Please note it will only be necessary to test imported topsoil for the metals and PAH compounds as it is anticipated that the soils would be from a greenfield source so it is not considered that any TPH or BTEX testing will be required.

Any important topsoil failing to meet the assessment criteria shall be removed from the site.

9.3.1. Imported Soil Assessment Criteria

The following assessment criteria will be adopted to determine the suitability of any topsoil or subsoil imported to the site. These take into account the proposed 'residential with plant uptake' land use.

CONTAMINANT	ASSESSMENT CRITERIA
Arsenic	37
Cadmium	22
Chromium (total)	21
Chromium VI	910
Copper	2,400
Lead	200
Mercury	11

Nickel	180
Selenium	250
Zinc	3,700
pH	<5-10>
Naphthalene	2.3
Acenaphthylene	170
Acenaphthene	210
Fluorene	170
Phenanthrene	95
Anthracene	2,400
Fluoranthene	280
Pyrene	620
Benzo(a)anthracene	7.2
Chrysene	15
Benzo(b)fluoranthene	2.6
Benzo(k)fluoranthene	77
Benzo(a)pyrene	2.2
Indeno(1,2,3-cd)pyrene	27
Dibenzo(a,h)anthracene	0.24
Benzo(ghi)perylene	320

9.4. VERIFICATION REPORT

Upon completion of the remediation works, the supervising environmental consultant shall prepare a remediation verification report. The report will include commentary on the following:

- Details on the handpicking of asbestos fragments from the contaminated Made Ground soils.
- Details and copies of waste tickets for the contaminated soils and materials removed from site.
- Evidence of a suitable capping within landscaped areas and gardens.
- Details of any chemical testing undertaken at the site.
- Details on any deviation from the remediation strategy.
- Confirmation of the suitability of any imported soils, if applicable.
- Photographic records.

The verification report will conclude with a statement confirming the site is fit for its intended use in respect of contamination.

10. HEALTH AND SAFETY FILE INFORMATION

10.1. INTRODUCTION

The aim of the following sections is to present pertinent Health and Safety information that has arisen from the current investigation/survey works discussed in this report. The aim is to identify health and safety controls that may be necessary during any subsequent maintenance, refurbishment, demolition or construction works. The information is not exhaustive and stems only from the aspects identified within the scope of the works undertaken by BRD.

Reports are always forwarded to the Client and they shall be responsible for ensuring this safety information is disseminated to those who need it.

The works undertaken by BRD are detailed in the previous sections of this report.

10.2. HAZARDS

During the course of the BRD works the following noteworthy safety hazards have been identified:

10.2.1. Contamination

Although the naturally occurring arsenic has been demonstrated to present a negligible risk to future residents, construction workers may be at greater risk due to their increased exposure to the soils, although the shorter duration of exposure may result in a decreased risk.

The localised area of ashy soils may present a greater risk to construction workers if they are exposed to it, for example during demolition, utility services work and foundation construction (as discussed in the remediation strategy).

Therefore during the redevelopment of the site, the presence of contaminated soils should be considered within health and safety plans. Measures to protect the health and safety of site workers should be implemented including use of appropriate personal protective equipment, education and good hygiene procedures. If during the redevelopment any anomalous material is encountered that is different to that conditions revealed by this investigation, then expert environmental advice should be sought.

10.2.2. Asbestos

10.2.2.1. Building and surface debris

It is noted that the ground around the barn was previous littered with surface asbestos cement fragments which had broken off from the building. This has now been partially cleared and contained to within the building footprint. However, the building remains clad with asbestos cement sheeting and will need demolishing in a controlled manner. These works should be undertaken in accordance with Health and Safety Executive (HSE) guidance by contractors trained in working with non-licensed asbestos.

10.2.2.2. Soils

Occasional asbestos cement fragments have been encountered in the surface sub-base / hardcore beneath the barn and access track area. Quantification testing of soils from these trial pits recorded maximum asbestos fibre concentration of 0.006%. The JIWG Decision Support Tool for CAR2012 Work Categories proposes that a low risk to construction workers is posed by the presence of these fragments and suggests that remedial work is classified as 'Non-Licensed Work'.

The presence of asbestos within the soils should be considered within health and safety plans.

All below ground operatives would be expected to have asbestos awareness training, so that they can identify any suspected ACM and inform site management so it can be appropriately dealt with.

Any handpicking of any cement asbestos fragments should be undertaken by operatives trained in Non-Licensed asbestos removal. Measures to protect the health and safety of site workers should always be implemented including use of appropriate personal protective equipment, education and good hygiene practices. During removal works disposable masks should be worn. Manual/localised dust suppression such as wetting the ground should also be applied and localised and basic personal decontamination facilities should be provided.

During the course of the works, should any other forms of more friable disaggregated asbestos be identified, then the works will stop and reassessment of the working methods will be undertaken as a matter of urgency.

10.2.3. Other Issues

During the BRD works the following safety hazards were identified:

- There are multiple slip, trip and fall hazards around the site.
- There is a 2m deep concrete tank to the side of the barn without a secure cover and containing water.

10.3. EXISTING STRUCTURES

The roof present on the lean-to of the barn is not intact and parts of the roof may break off, additionally the structural integrity of this part of the building may be weak.

BRD recommend that advice on existing structures is gained from a qualified and experienced Building Surveyor or Structural Engineer.

10.4. HAZARDOUS MATERIALS

BRD did not construct anything with hazardous materials.

Any soils to be imported to the site, in particular topsoil, should be tested to confirm their suitability in the development.

10.5. UTILITY SERVICES

No previously unidentified utility services were encountered during the BRD works. An electricity cable was traced from the south western corner of the barn and along the western boundary of the driveway section to the road. It is likely that the site water feed also follows a similar route but this has not been confirmed.

The utility services plans held by the Client should be referred to.

REPORT SPECIFIC REFERENCES

- 'Phase 1 Geo-Environmental Desk Study – Hempton Road, Deddington', BRD Environmental Ltd, ref. BRD3567, dated October 2019.

- 'Phase 2 Geo-Environmental Site Investigation - Hempton Road, Deddington', BRD Environmental Ltd, report ref. BRD2567-OR2-A, dated January 2020.

SUPPORTING INFORMATION

GROUND INVESTIGATION

Exploratory holes are logged by an experienced Geo-Environmental Consultant in general accordance with 'Code of practice for site investigations' BS5930:2015, British Standards Institution, 2015. Soil samples for chemical and geotechnical analysis are taken from the exploratory holes at intervals dictated by the nature of the soils and the objectives of the investigation.

Where stated on the logs of inspection pits, trial pits or boreholes (where insitu testing has not been undertaken), the relative density of coarse (sand and gravel) soils is tentative only. Such assessments of density are on the basis of visual inspection only taking into consideration such factors as drilling rates, stability of pit side walls, appearance and behaviour under excavation.

Where Chalk strata is encountered it is logged and graded in general accordance with CIRIA guidance 'C574 - Engineering in Chalk'. It should be recognised that where percussive drilling methods are employed, the structure of the Chalk is destroyed and therefore the grading stated on such logs is either tentative or absent where it is not possible to assess the grade.

Hand Dug Inspection Pits

Hand tools are used to forward shallow inspection pits as a cost effective method of describing and sampling near surface soils. The technique is also used where exposure of existing footings is required. The depth reached by such techniques is a function of the nature of the ground and generally does not exceed 1.5m

Trial Pits

Mechanically excavated trial pits allow detailed inspection of near surface ground due to the large volume of soil exposed. A wheeled backhoe loader is the usual machine for digging trial pits that are typically 3 to 4.5m deep, 0.5m wide and 3m long.

Windowless Sampling Boreholes

This type of borehole is formed by a small tracked dynamic percussion drilling rig with samples retrieved in thin plastic liners within the narrow diameter steel sampling tubes. Borehole depths of up to 5m are typical, but in exceptional circumstances up to 15m depth can be achieved. This is the smallest type of rig that is capable of undertaking Standard Penetration Tests (SPTs).

Hand Held Window Sampling

Hand held window sampling is a useful method of drilling narrow diameter boreholes particularly where access is difficult. Hand held mechanical percussive hammers are used to drive the sampling tube into the ground. The soil samples are collected within the hollow metal sampling tubes and inspected via the open window along one side. Window sampling boreholes can be forwarded to depths of 3m to 6m depending upon ground conditions.

Cable Percussive Boreholes

This form of drilling involves repetitive dropping of a tube into the soil under its own weight from a tripod support. The sample is obtained from the clay cutter head in fine soils or a bailer for wet granular soils. As the borehole progresses SPTs can be undertaken and relatively undisturbed samples can be obtained. Typically these boreholes are 15 to 25m deep, but depths of double that can be achieved in soils, but only thin weak rock layers can be penetrated.

Rotary Boreholes

Where competent rock is required to be drilled then rotary drilling techniques are required. The drilling rigs can vary in size from small tracked units to larger units mounted on four wheel drive trucks. Rotary open hole drilling techniques break the rock into small fragments and so recovery of any samples is limited. In contrast, rotary coring retrieves excellent samples. Some rigs also allow windowless sampling to be undertaken through soil layers. There are no practical limits to the depths that this drilling method can achieve.

Gas Monitoring

Gas monitoring is undertaken with a portable gas monitor for oxygen, Methane, Carbon Dioxide, Hydrogen Sulphide and Carbon Monoxide together with recording of atmospheric pressure and any flow rate.

Vapour Monitoring

Headspace tests and monitoring for Volatile Organic Compounds (VOC) or Semi Volatile Organic Compounds (SVOC) is undertaken using a Photo Ionisation Detector (PID). The MiniRAE models used have a 10.6 eV lamp calibrated for isobutylene. The PID is useful tool to indicate the presence of a wide range of volatile compounds, but only provides semi-quantitative data as different compounds provide a different response and thus the reading is not a true reflection of the actual concentration present.

Low PID readings can be recorded in natural uncontaminated organic soils or even as a result of atmospheric pollution. It is generally accepted by consultants and regulators that recorded values in excess 50 parts per million (ppm) represents the presence of organic compound pollutants and in excess of 100 ppm such contamination may be significant.

The headspace test procedure involves the collection of a sample of suspected contaminated soils and placing within a sample bag. A tight seal to the bag is formed with a similar volume of air trapped to that of the soil and the sample is left for fifteen minutes to allow volatilisation of any contaminants. The bag is then pierced by, and sealed around, the sample probe of the PID and a reading taken.

Borehole well monitoring is undertaken by connecting the PID directly to the gas tap on the monitoring well installation.

Groundwater Level Monitoring

Groundwater levels are recorded with an electronic dip meter that has a detector end that is lowered into the borehole well. An audible signal is made when water is reached and the depth recorded from the graduated tape used to lower the detector. Where there is potential for a separate Light Non Aqueous Phase Liquid (LNAPL) to be present floating on the groundwater an oil/water interface meter is used in preference to a conventional dip meter so that any such floating product can be detected.

Contamination Sampling

BRD schedule contamination testing as appropriate to the ground conditions, available budget, potential contaminants and the proposed development. Samples are collected in single use laboratory supplied containers.

Soil samples are retrieved in plastic containers and/or amber glass jars with a lined plastic cap. Contamination samples are indicated by a 'J' on exploratory hole logs.

Water samples are collected in plastic bottles and/or amber glass jars with a lined plastic cap then placed in cool boxes together with freezer packs. Water samples are indicated by a 'W' on exploratory hole records, but generally such samples are not tested as testing from dedicated monitoring wells is preferred for sample quality reasons.

Samples retrieved from the exploratory holes are dispatched to the laboratory by overnight courier. Where samples cannot be transported directly from site they are temporarily stored in the BRD dedicated sample storage facility which includes refrigeration where necessary. The individual accreditation of the test methods is detailed in the laboratory test report.

CONTAMINATION ASSESSMENT METHODOLOGY

UK Policy

The UK Government's policy in relation to land affected by historic contamination is based on a 'suitable for use' approach. The approach recognises that the risks presented by any given level of contamination will vary greatly according to the use of the land and a wide range of other factors, such as the underlying geology of the site. Contamination risks therefore need to be assessed on a site-by-site basis. The 'suitable for use' approach limits requirements for remediation to the work necessary to prevent unacceptable risks to human health or the environment in relation to either the current use or future use of the land.

The three main drivers for contamination assessment and remediation are:

- *Voluntary action.*
- *Development as part of the planning regime.*
- *Regulatory action to mitigate unacceptable risks e.g. Part 2A of the Environmental Protection Act 1990.*

Pollutant Linkages

For a contamination risk to exist there must be a 'pollutant linkage' from the contaminant (source) via a pathway (the route from contaminant to receptor) to a receptor (the entity that could be harmed). The absence of a contaminant, pathway or receptor breaks the pollutant linkage and therefore no contamination risk exists.

Contamination is typically present at a site (in the ground and/or in the underlying groundwater) as a result of a historic or current industrial use, usually as a result of leaks, spills or disposal of residues, wastes and excess raw materials from the industrial processes. Contamination may also be present due to:

- *The deliberate application of chemicals e.g. the spraying of herbicide/pesticide.*
- *Migration of pollutants from adjacent land.*
- *Naturally occurring processes e.g. elevated concentrations of particular heavy metals associated with specific geological strata.*

Conceptual Site Model

The conceptual site model can be defined as a textual or graphical representation of the identified pollutant linkages for a given site. The model forms the basis for designing the investigation as the aim will be to target all of the potential pollutant linkages to determine, through the subsequent phases of risk assessment, whether or not they pose an actual risk.

It is important that the conceptual site model is updated with new information as the various investigation, risk assessment and remediation works are completed.

Technical Guidance

The technical and legal framework for contamination assessment is complex. The process adopted through this report for assessing contamination risks is in general accordance with the following guidance, as listed below:

- *'Investigation of Potentially Contaminated Sites - Code of Practice - BS 10175:2011+A2:2017', The British Standards Institution 2017.*
- *'Model Procedures for the management of Land Contamination - CLR Document No. 11', Environment Agency, 2004.*
- *'Guidance for the safe development of housing on land affected by contamination - R&D66: 2008', NHBC/Environment Agency, 2008.*

Risk Assessment Methodology

In line with the technical guidance, the contamination risk assessment follows a series of phased stages for each particular site:

PHASE	DESCRIPTION	RISK ASSESSMENT STAGE
PHASE1	*Generally limited to desk based research and a site walkover survey to develop an initial conceptual site model and identify what risks, if any, are likely to be presented by the site.*	***Hazard Identification and Assessment*** *A preliminary stage of risk assessment concerned with identifying and characterising the hazards that may be associated with a particular site and identifying potential pollutant linkages.*
PHASE 2	*This phase is concerned with establishing whether contamination is present, usually through intrusive ground investigation, and then evaluating the degree and magnitude of the associated risks.*	***Risk Estimation*** *A stage concerned with estimating the likelihood that receptors will suffer adverse effects if they come into contact with, or are otherwise affected by, a hazardous substance or agent under defined conditions.* ***Risk Evaluation*** *A stage of risk assessment concerned with evaluating the acceptability of estimated risks, taking into account the nature and scale of the risk estimates, any uncertainties associated with the assessment and the broad costs and benefits of taking action to mitigate risks.*
PHASE 3	*The appraisal and selection of remediation techniques, their implementation and verification.*	***Risk Management*** *The process whereby decisions are made to accept a known or assessed risk and/or the implementation of action to reduce the consequences or probabilities of occurrence.*

Risk Classification

The objective of risk assessment is to identify the nature and magnitude of the potential risks and should be based on a consideration of both:

- *The likelihood/probability of an event [taking into account both the presence of the hazard and receptor and the integrity of the pathway].*
- *The severity of the potential consequence [taking into account both the potential severity of the hazard and the sensitivity of the receptor].*

There is a need for a logical, transparent and repeatable system in defining the categories of severity of consequence and likelihood as well as for the risk itself and therefore the following risk rating matrix is employed:

		SEVERITY OF CONSEQUENCE			
		SEVERE	***MEDIUM***	***MILD***	***MINOR***
PROBABILITY	***HIGH LIKELIHOOD***	*Very High Risk*	*High Risk*	*Moderate Risk*	*Moderate/Low Risk*
	LIKELY	*High Risk*	*Moderate Risk*	*Moderate/Low Risk*	*Low Risk*
	LOW LIKELIHOOD	*Moderate Risk*	*Moderate/Low Risk*	*Low Risk*	*Negligible Risk*
	UNLIKELY	*Moderate/Low Risk*	*Low Risk*	*Negligible Risk*	*Negligible Risk*

These risk classifications are defined as follows:

- *Very High Risk - There is a high probability that severe harm could arise to a designated receptor from an identified hazard at the site without appropriate remediation action.*
- *High Risk - Harm is likely to arise to a designated receptor from an identified hazard at the site without appropriate remediation action.*
- *Moderate Risk - It is possible that without appropriate remediation action harm could arise to a designated receptor. It is relatively unlikely that any such harm would be severe, and if any harm were to occur it is more likely that such harm would be relatively mild.*
- *Low Risk - It is possible that harm could arise to a designated receptor from an identified hazard. It is likely that, at worst if any harm was realised any effects would be mild.*
- *Negligible Risk - The presence of an identified hazard does not give rise to the potential to cause harm to a designated receptor.*

This risk assessment matrix and classification system is based on guidance produced by Department for Environment, Food and Rural Affairs (Defra) and the Environment Agency in connection with contaminated land assessment.

RISK ESTIMATION - SOILS

Introduction to Soil Human Health Generic Assessment Criteria (GAC)

The Environment Agency (EA) and Department of Environment Food and Rural Affairs (DEFRA) had previously issued revised guidance following the consultation about the DEFRA publication "Assessing risks from land contamination – a proportionate approach. Soil Guideline Values: the Way Forward". This resulted in a revised version of the Contaminated Land Exposure Model (CLEA) model (version 1.06) and a few of the previously published Soil Guideline Values (SGVs) were revised.

The main legislative driver for dealing with historical land affected by contamination is Part 2A of the Environmental Protection Act 1990. Revised Statutory Guidance to support Part 2A was published in April 2012. This Guidance introduced a new four-category system for classifying land under Part 2A for cases of a Significant Possibility of Significant Harm to human health,1 where Category 1 includes land where the level of risk is clearly unacceptable and Category 4 includes land where the level of risk posed is acceptably low. The impact assessment for the new Statutory Guidance stated "The new statutory guidance will bring about a situation where the current SGVs/GACs are replaced with more pragmatic (but still strongly precautionary) Category 4 screening levels (C4SLs) which will provide a higher simple test for deciding that land is suitable for use and definitely not contaminated land". The C4SLs are still derived using the CLEA model, but adopt a slightly different approach to toxicological assessment and exposure modelling.

In March 2014, the outcome of "SP1010 – Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination - Final Project Report" (CL:AIRE) was published. Due to slightly ambiguous wording within this report, Lord de Mauley, Parliamentary Under Secretary, DEFRA wrote to all local authorities on 3 September 2014 to confirm that the published C4SLs were final and that they can be used in risk assessment undertaken under the planning regime.

Whilst there are proposals for the industry to develop C4SLs for other contaminants, these have yet to produce any new values. BRD do not believe that C4SLs could be developed by a single organisation with sufficient confidence. BRD has therefore employed other, more conservative guidance based on the CLEA model (detailed below) within this assessment for compounds where C4SLs are not available. However, it should be noted that the results of this investigation may need to be reinterpreted as new C4SLs become available.

Due to the limited number of published C4SL values at this time, the Chartered Institute of Environmental health (CIEH) and Land Quality Management Ltd (LQM) have produced Generic Assessment Criteria (GAC) known as Suitable for Use Levels (S4ULs), for use in contaminated land human health risk assessment. These S4ULs (2014) have been derived for a large number of substances using the current CLEA model and are therefore consistent with current guidance. They also incorporate the revised exposure parameters as adopted by the C4SL programme, but have not adopted the revised toxicological approach adopted by the C4SLs and so remain a more conservative assessment criteria. The substances for which SGVs were previously published have also been revised as new S4ULs in light of the new exposure parameters proposed by the C4SL programme, and therefore effectively replace the existing SGVs.

In addition, in December 2009, other GAC for less common substances were produced by the Environmental Industries Commission (EIC), The Association of Geotechnical and Geoenvironmental Specialists (AGS) and Contaminated Land: Applications in Real Environments (CL:AIRE) using the CLEA model. These are referred to as the EIC/AGS/CLAIRE GAC.

In summary, C4SLs have been used where these are available. For those substances where C4SLs have yet to be issued, then the S4ULs have been adopted or in some cases, the EIC/AGS/CLAIRE GAC. All of the previously produced SGVs have now either been withdrawn, or superseded by the respective C4SLs or S4ULs.

The only exception to this approach is the PAH compound benzo(a)pyrene (BaP) where a C4SL guideline value has been produced, whereas BRD has adopted the S4UL value. The C4SL for BaP relates to its use as a surrogate marker compound representing all of the genotoxic PAH compounds as a mixture, rather than this individual compound. BRD has therefore adopted the compound specific S4UL value as the initial screening value, for consistency with the other PAH compounds before then employing the C4SL is necessary.

It should be noted that unless otherwise stated, all the assessment criteria adopted within this report have been derived based on a sandy loam soil at pH 7 and the values quoted are for a conservative soil organic matter content of 1% where applicable (i.e. organic contaminants).

Human Health - Soil Generic Assessment Criteria

The results of the soils analysis have been compared to generic assessment criteria for the default exposure scenarios comprising either residential land with plant uptake, residential land without plant uptake, or commercial/industrial land use. The criteria values selected are listed in the table below and full details on the source are referred to above. Where applicable, the results have also been assessed with reference to the required statistical tests presented within CLAIRE document "Guidance on comparing soil contamination data with a critical concentration".

ANALYSIS	GENERIC ASSESSMENT CRITERIA (mg/kg unless stated)			SOURCE
	RESIDENTIAL WITH PLANT UPTAKE	RESIDENTIAL WITHOUT PLANT UPTAKE	COMMERCIAL / INDUSTRIAL	
Arsenic	37	40	640	C4SL
Cadmium	22	150	410	
Chromium (total)$	910	910	8,600	S4UL
Chromium VI	21	21	49	C4SL
Lead	200	310	2,330	
Mercury*	11	15	320	S4UL
Selenium	250	430	12,000	
Nickel	180	180	980	
Copper	2400	7,100	68,000	
Zinc	3,700	40,000	730,000	
pH	<5 - 10> units			Professional judgement
Naphthalene	2.3	2.3	190	S4UL
Acenaphthylene	170	2,900	83,000	
Acenaphthene	210	3,000	84,000	
Fluorene	170	2,800	63,000	
Phenanthrene	95	1,300	22,000	
Anthracene	2,400	31,000	520,000	
Fluoranthene	280	1,500	23,000	
Pyrene	620	3,700	54,000	
Benzo(a)anthracene	7.2	11	170	
Chrysene	15	30	350	
Benzo(b)fluoranthene	2.6	3.9	44	
Benzo(k)fluoranthene	77	110	1,200	
Benzo(a)pyrene	2.2	3.2	35	
Indeno(1,2,3-cd)pyrene	27	45	500	
Dibenzo(a,h)anthracene	0.24	0.31	3.5	S4UL
Benzo(ghi)perylene	320	360	3,900	
TPH Aliphatic C5-C6	42	42	3,200	
TPH Aliphatic C6-C8	100	100	7,800	
TPH Aliphatic C8-C10	27	27	2,000	
TPH Aliphatic C10-C12	130	130	9,700	
TPH Aliphatic C12-C16	1,100	1,100	59,000	
TPH Aliphatic C16-C35	65,000	65,000	1,600,000	
TPH Aliphatic C35-C44	65,000	65,000	1,600,000	

ANALYSIS	GENERIC ASSESSMENT CRITERIA (mg/kg unless stated)			SOURCE
	RESIDENTIAL WITH PLANT UPTAKE	RESIDENTIAL WITHOUT PLANT UPTAKE	COMMERCIAL / INDUSTRIAL	
TPH Aromatic C5-C7	70	370	26,000	
TPH Aromatic C7-C8	130	860	56,000	
TPH Aromatic C8-C10	34	47	3,500	
TPH Aromatic C10-C12	74	250	16,000	
TPH Aromatic C12-C16	140	1,800	36,000	
TPH Aromatic C16-C21	260	1,900	28,000	
TPH Aromatic C21-C35	1,100	1,900	28,000	
TPH Aromatic C35-C44	1,100	1,900	28,000	
Benzene	0.87	3.3	98	C4SL
Toluene	130	880	56,000	S4UL
Ethylbenzene	47	83	5,700	
Xylene^	56	79	5,900	
MTBE	49	73	7,900	EIC/AGS/CL:AIRE GAC

Notes:
** The S4UL for methyl mercury has been adopted as the worst case mercury compound as generally there is no desk study evidence to suggest the potential for elemental mercury on the majority of sites.*
^ The lowest S4UL of either p-xylene, o-xylene or m-xylene has been adopted for each land use as a conservative measure.
$ S4UL for Chromium III adopted, as in the absence of Chromium VI it is likely that all of the chromium will be in this form as these are the two most common and stable forms of chromium in the soil environment.

Where no GAC is available, any concentrations exceeding the laboratory limit of detection are identified and discussed in more detail.

Water Environment - Soil Generic Assessment Criteria

There are no UK published Generic Assessment Criteria for soil test results in respect of the risk to the water environment and therefore risk estimation is on the basis of the professional judgement and experience of BRD to employ values that are a reasonable concentration above which concern for water resources is valid.

The Total PAH GAC employed is the sum of the 16No. priority PAH compounds regularly tested for in contaminated land analysis (i.e. US EPA 16PAHs). BRD employ a soil screening based upon the total PAH limit for 'inert waste' of 100mg/kg. The rationale is based on PAHs are recognised to be generally of low solubility and the risk to the water environment is correspondingly low.

In respect of Total Petroleum Hydrocarbons, BRD employ a value of 500 mg/kg as a screening value in comparison to the sum of the component aliphatic and aromatic TPH carbon bands. The employed soil screening value is based upon:

- *In common with some other consultants, the professional judgement and experience of BRD suggests that this value is a reasonable concentration above which concern for water resources is valid. The rationale is based on the fact that lower concentrations of fuel based contaminants are more likely to naturally degrade than migrate any great distance.*

- *BRD is aware of regional Environment Agency groundwater and contaminated land teams historically employing 500 mg/kg as a screening value for considering whether or not TPH could represent a risk to water resources.*

- *The value mirrors the mineral oil Waste Acceptance Criteria limits for what is considered 'inert waste'.*

Should elevated contaminants that pose a potential risk to the water environment be identified then site specific assessment criteria should be developed.

Building Materials and Services – Soil Generic Assessment Criteria

Some hydrocarbon compounds are known to both attack and permeate through certain plastic pipe materials, with the primary concern being the degradation and tainting of water supplies. The UK Water Industry Research (UKWIR) has therefore produced a document 'Guidance for the Selection of Water Supply Pipes to be used in Brownfield Sites' (ref. 10/WM/03/21) that specifies threshold criteria for the adoption of 'standard' polythene (PE) or PVC pipes, protective barrier pipe and ductile iron/steel/copper pipes.

The UKWIR threshold assessment criteria from Table 3.1 of this document for standard PE pipes have been employed. It should be noted that the approach taken by UKWIR is very conservative, and both the document and research are flawed. However, it is these values that are being using to specify water pipe materials and therefore it is appropriate to consider them.

The UKWIR guidance is particularly flawed in respect of the chemical analysis it expects as it seeks a limit of detection that is generally below limits that are reasonable or commonly employed in contaminated land assessment. The UKWIR seeks that where a substance is below the limit of detection it should be taken as being present at half this concentration. For the larger suite of chemicals where the limit is against a sum of compounds, this approach would mean that a sample of virgin sub-soil from a greenfield site with absolutely no contamination would actually fail the criteria for using standard PE pipes. To avoid this situation, BRD have adopted the approach of summing only those compounds detected above their respective limits of detection.

In terms of building materials, the primary concern is in respect of concrete as certain commonly occurring natural ground conditions can adversely impact on buried concrete as discussed in 'Special digest 1:2005 Concrete in aggressive ground', BRE, 2005.

ANALYSIS	GENERIC ASSESSMENT CRITERIA	SOURCE
pH	<5.5	BRE Special Digest 1:2005
Sulphate (w/s)	500 mg/l	BRE Special Digest 1:2005
Sum of any VOC above detection limits	0.5 mg/kg	Relevant compounds adapted from UKWIR Table 3.1
Sum of SVOC + Aliphatic TPH >C5-C10 + Aromatic TPH >C5-C10 above detection limits	2 mg/kg	
Sum of Aliphatic TPH >C10-C21 + Aromatic TPH >C10-C21 above detection limits	10 mg/kg	
Sum of Aliphatic TPH >C21-C34 + Aromatic TPH >C10-C35 above detection limits	500 mg/kg	
Sum of BTEX + MTBE above detection limits	0.1 mg/kg	
Phenols	2 mg/kg	
Cresols and chlorinated phenols	2 mg/kg	
Naphthalene	0.5 mg/kg	
Benzo(a)pyrene	0.5 mg/kg	

RISK ESTIMATION – GROUNDWATER

The initial assessment of the contamination risk to groundwater is by comparing dissolved groundwater concentrations with screening values (GAC) that are protective of groundwater resources.

The reference source for the target concentrations is generally the EA's Environmental Quality Standards (EQS) (accessed July 2018: http://evidence.environment-agency.gov.uk/ChemicalStandards/report.aspx?cid=17), the Water Supply (Water Quality) Regulations 2016 and the DW1/DW2 criteria from the Surface Water (Abstraction for drinking water)(classification) Regulations 1996. The target concentrations are outlined in the table below. The 'Petroleum Hydrocarbons in Groundwater: Guidance on assessing petroleum hydrocarbons using existing hydrogeological risk assessment methodologies'. CL:AIRE, 2017 has also been used as reference source for the values.

ANALYSIS	GENERIC ASSESSMENT CRITERIA (GAC)	SOURCE
Arsenic	50 µg/l	DW1 & EQS
Cadmium	5 µg/l	EQS
Chromium (total)	50 µg/l	DW2 & EQS
Copper	50 µg/l	DW1
Nickel	20 µg/l	EQS
Lead	50 µg/l	DW1
Mercury	1 µg/l	WSR
Selenium	10 µg/l	WSR
Zinc	5 mg/l	DW2
Cyanide	50 µg/l	WSR
pH	6 to 9 units	EQS
Benzene	10 µg/l	EQS
Toluene	74 µg/l	EQS
Ethylbenzene	300 µg/l	WHO guideline
Xylene	30 µg/l	EQS
Methyl tert-butyl ether (MTBE)	15 µg/l	Taste and odour threshold.
Naphthalene	2 µg/l	EQS
Benzo(a)pyrene	0.0017 µg/l	EQS – Less than Limit of Detection (LOD)
Total PAH	0.2 µg/l	DW1
TPH Aliphatic C5-C6	15,000 µg/l	World Health Organization (WHO) guide values for TPHCWG fractions in drinking water
TPH Aliphatic C6-C8	15,000 µg/l	
TPH Aliphatic C8-C10	300 µg/l	
TPH Aliphatic C10-C12	300 µg/l	
TPH Aliphatic C12-C16	300 µg/l	
TPH Aromatic C5-C7	10 µg/l	
TPH Aromatic C7-C8	700 µg/l	
TPH Aromatic C8-C10	300 µg/l	
TPH Aromatic C10-C12	90 µg/l	
TPH Aromatic C12-C16	90 µg/l	
TPH Aromatic C16-C21	90 µg/l	
TPH Aromatic C21-C35	90 µg/l	

There are no available generic assessment criteria for some of the analytical parameters which have been scheduled, for example hexavalent chromium, and some VOC compounds. These parameters will be assessed based on professional judgement should they exceed the limit of detection.

RISK ESTIMATION - GROUND GAS

Introduction

A variety of potentially hazardous gases occur in naturally in the ground environment. Microbial decay of organic matter under anaerobic conditions and geological processes can lead to the generation of Methane and Carbon Dioxide, but can also include traces gases such as Hydrogen sulphide and Carbon monoxide.

Methane is a colourless and odourless gas that has the hazardous properties of being flammable and, at certain air/Methane mixtures, explosive. Methane has a low toxicity, but can be a simple asphyxiant due to the displacement of oxygen.

Carbon Dioxide is a colourless, odourless and non-combustible gas that has the hazardous property of being a highly toxic chemical. At concentrations of 3% by volume, shortness of breath and headaches will occur becoming acute by 6%. At levels of above 10% by volume headache, visual distortion, tremors and rapid loss of consciousness occur. Concentrations of Carbon Dioxide above 22% by volume are likely to be fatal. The effects of Carbon Dioxide poisoning are made more severe if there is accompanying reduction in oxygen concentrations.

Hydrogen sulphide is a colourless and flammable gas that has an odour of rotten eggs. It is important to that the sense of smell is over powered at higher concentrations. The gas is toxic and can be an asphyxiant.

Carbon monoxide is a colourless, odourless and explosive gas in air mixtures that has the hazardous property of being a highly toxic chemical.

Radon is a naturally occurring colourless and odourless gas that is radioactive. It is formed by the radioactive decay of radium which in turn is derived from the radioactive decay of uranium, both of which are minerals that can be found in many soil types. Whilst it is recognised that the air inside every building contains radon, some buildings built in certain defined areas of the country might have unacceptably high concentrations and require special precautions to be taken. The maps contained within BRE211:2015 'Radon: guidance on protective measures for new buildings' identify areas where no radon protection measures are necessary or where higher concentrations are present that either basic or full radon protection measures are required to be fitted to all new buildings, extensions or refurbishments.

Basis of Gas Assessment

In order to classify the level of risk and need, if any, for gas protection measures at a site with the potential for a gas problem, consideration of each of the following is necessary:

- *The source of the gas.*
- *The generation potential of the gas.*
- *The location of the source and the geological setting.*
- *Boreholes flow rate and estimated surface emission rate.*
- *The nature of the proposed development.*
- *Confidence in the knowledge of the gas regime.*

The gas assessment is made with reference to 'C665 - Assessing risks posed by hazardous ground gases to buildings', Construction Industry Research and Information Association (CIRIA), 2007 and 'BS8485:2015 – Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings' BSi 2015.

Gas Screening Value

The methods within CIRIA C665 and BS8485 both use the gas concentrations together with the borehole flow rates to define a characteristic situation for a site based on the limiting borehole gas volume flow for Methane and Carbon Dioxide. This limiting borehole gas volume flow is called the Gas Screening Value (GSV) and is expressed below:

Gas Screening Value (l /hr) = borehole flow rate (l/hr) x gas concentration (fraction)

The calculation of GSV is completed for both Methane and Carbon Dioxide and then the 'worse case' maximum values are used in the assessment. The assessment is to determine the gas regime at the site is dependent upon the nature of the development.

Characteristic Gas Situation

The characteristic situation for many sites is determined from evaluation of the Gas Screening Value derived against the criteria in the following table.

Characteristic situation	Hazard potential	Gas Screening Value (CH4 or CO2 l/hr)	Additional factors
CS1	Very low risk	<0.07	Typically Methane ≤1% and/or Carbon Dioxide ≤5%. Otherwise consider an increase to characteristic situation 2.
CS2	Low risk	0.07 to <0.7	Borehole air flow rate not to exceed 70 l/hr. Otherwise consider an increase to characteristic situation 3.
CS3	Moderate risk	0.7 to <3.5	-
CS4	Moderate to high risk	3.5 to <15	-
CS5	High risk	15 to <70	-
CS6	Very high risk	>70	-

Low rise housing with gardens – NHBC 'Traffic Lights'

The NHBC model for low rise housing development considered a typical residential house with a ground floor area of 64m^2, suspended floor and ventilated sub-floor void of height 150mm. Where the proposed development of a site is consistent with this model, the NHBC traffic light situation of the site is determined from evaluation of the Gas Screening Value against the criteria in the following table.

Traffic Lights	Methane		Carbon Dioxide	
	Typical maximum concentrations (%)	Gas Screening Value (l/hr)	Typical maximum concentrations (%)	Gas Screening Value (l/hr)
Green	≤1	≤0.16	≤5	≤0.78
Amber 1	1> to ≤5	>0.16 to ≤0.63	>5 to ≤10	>0.78 to ≤1.56
Amber 2	5> to ≤20	>0.63 to ≤1.56	>10 to ≤30	>1.56 to ≤3.13
Red	>20	>1.56	>30	>3.13

APPENDIX 1

Site Location Plan

Not to scale.

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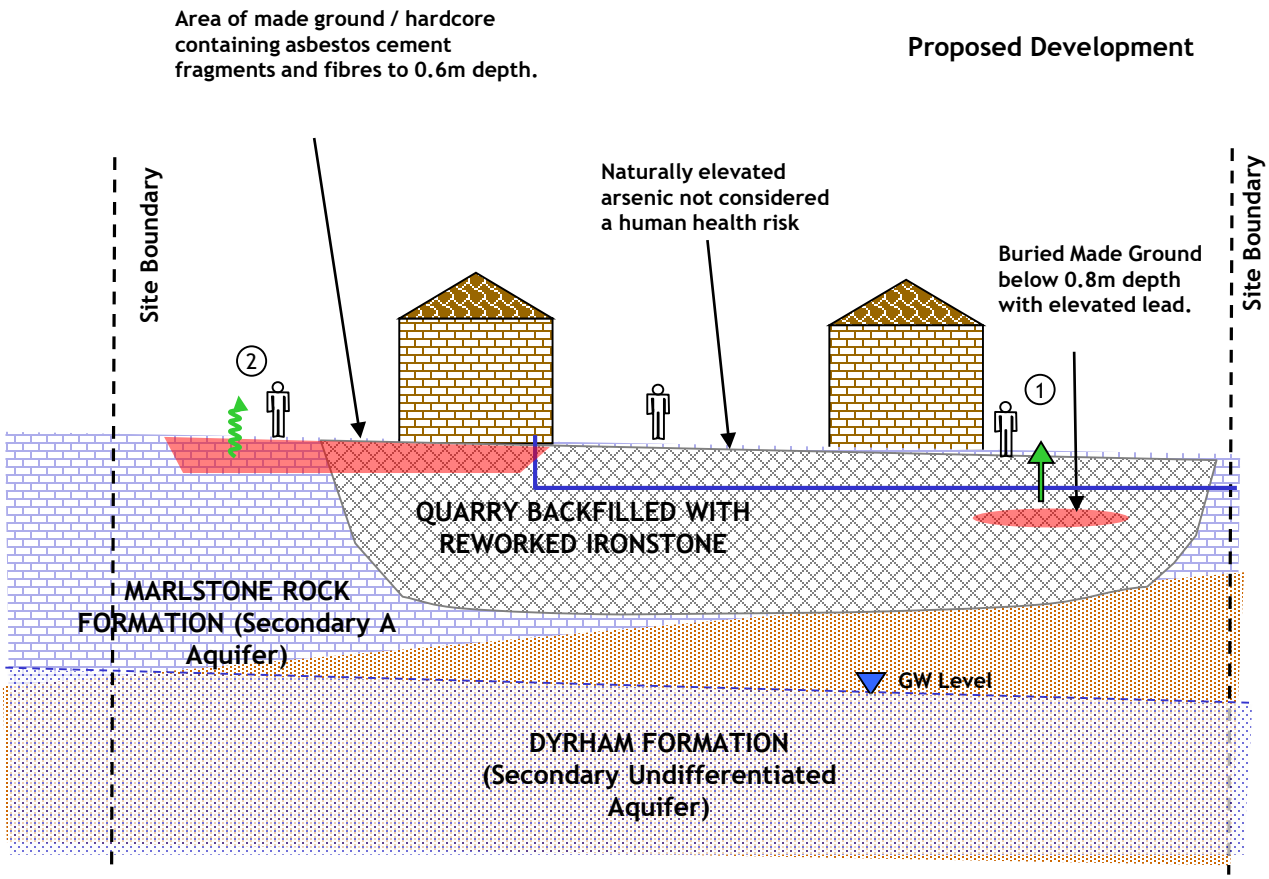
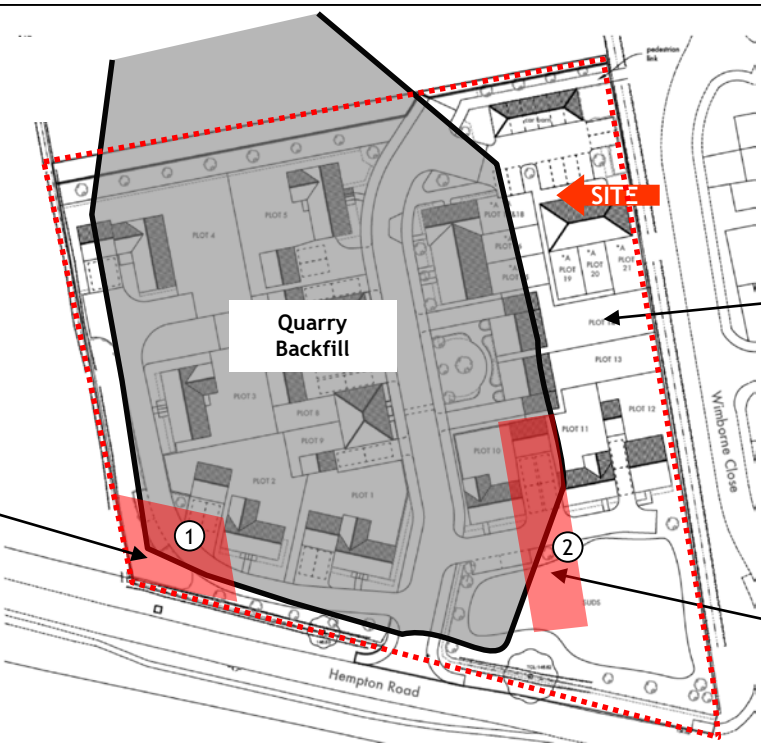
Project Title:	Hempton Road, Deddington
Client:	Burrington Estates
BRD Reference:	BRD3567-OP2-B
Date Issued:	March 2021

BRD
01295 272244
info@brduk.com

Revised Conceptual Model



Proposed Development:



Project Title:	Hempton Road, Deddington.
Client:	Burrington Estates
BRD Reference:	BRD3567-OP10-A
Date Issued:	March 2021

BRD
01295 272244
info@brduk.com

pedestrian link

car barn

PLOT 4

PLOT 5

*A *A PLOT 17&18

*A PLOT 16

*A PLOT 15

*A PLOT 19

*A PLOT 20

*A PLOT 21

PLOT 6

PLOT 7

PLOT 14

PLOT 13

PLOT 3

PLOT 8

PLOT 9

PLOT 12

PLOT 11

PLOT 10

PLOT 2

PLOT 1

SUDS

TCL: 146.83

TCL: 146.62

136.89

Hempton Road

Wimborne Close

19

13

15

5

N

0 5 10 15 20 25m

KEY:

*A - Affordable housing

REV.	DATE	DESCRIPTION
A	JAN 21	Client/LPA comments

CLIENT:
BURRINGTON ESTATES

PROJECT TITLE:
HEMPTON ROAD, DEDDINGTON, PHASE 1

DRAWING TITLE:
SITE PLAN
AS PROPOSED

SCALE:	1:500 @A3	DATE:	January 21
DWG NO.:	201-P102	REVISION:	A

Key:

- BRD Trial Pit Locations (2021)
- BRD Trial Pit Locations (2019)
- Site Boundary (Approximate)

Notes:

All BRD Trial pits are located by Topographical survey.

Drawing reproduced from Greenhatch Group
Drawing Title: Topographical Survey
Drawing No: 29833_T; Rev .0; Dated: 23/03/2018

Revision	Date	Description	Drawn	Approved
B	22/02/21	Second Issue: Additional Trial Pits	DB	JB
A	23/12/19	First Issue: Exploratory Point Plan	DB	BD

Drawing title

EXPLORATORY POINT PLAN

Project title

HEMPTON ROAD, DEDDINGTON

Client

BURRINGTON ESTATES

Scale	Original drg. size/colour	Date
1:750	A3 / C	22/02/2021
Drawn	Checked	Approved
DB	MM	JB

Drawing Number: BRD3567-OD1

Rev: B

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www.brduk.com

Key:

- BRD Trial Pit Locations (2021)
- BRD Trial Pit Locations (2019)
- Lead contamination below 0.80m depth. Soils to be segregated and disposed off-site during any excavations through this area.
- Asbestos contamination to 0.60m depth. Soils to be excavated and disposed off-site following hand picking of visible asbestos fragments.
- Site Boundary (Approximate)

Notes:

All BRD Trial pits are located by Topographical survey.

Drawing reproduced from Greenhatch Group
Drawing Title: Topographical Survey
Drawing No: 29833_T; Rev .0; Dated: 23/03/2018

Revision	Date	Description	Drawn	Approved
A	12/03/21	First Issue.	RM	JB

Drawing title

CONTAMINATION AND REMEDIATION PLAN

Project title

HEMPTON ROAD, DEDDINGTON

Client

BURRINGTON ESTATES

Scale	Original drg. size/colour	Date
1:750	A3 / C	12/03/2021
Drawn	Checked	Approved
RM	MM	JB

Drawing Number: BRD3567-OD4 Rev: A

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www.brduk.com

Remedial Capping Plan

Key:

Site Boundary

Areas of landscaping and front gardens requiring 300mm clean soil capping layer.

Not to scale.

All positions illustrative only.

Reproduced from Expedite Engineering 'Floor Level Plan' drawing ref. ES20.060 01.01 dated Jan 2021.

Project Title:	Hempton Road, Deddington
Client:	Burrington Estates
BRD Reference:	BRD3567-OP11-A
Date Issued:	March 2021

BRD
01295 272244
info@brduk.com

APPENDIX 2

TRIAL PIT RECORD

Client:	Burrington Estates
Project Title:	Hempton Road, Deddington
Project No:	BRD3567
Logged By:	M Morgan
Date Completed:	19/02/2021
Method Used:	180° Backhoe excavator (JCB 3CX type)

Trial Pit No.

TP18

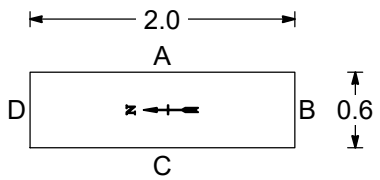
Sheet 1 of 1

Samples & Tests			Description of Strata	Depth / (Level)	Geology	Legend
Depth	Type & No	Value				
			Reinforced CONCRETE.	0.20 ()	MADE GROUND	
0.40	J1		MADE GROUND: Orange brown to red brown, clayey gravel and cobbles of brick and concrete. Occasional metal and rare suspected asbestos cement fragments.			
0.50	PID	0.0 ppm				
0.50	D1		0.50 m: Two reinforced concrete girders crossing pit.	0.60 ()		
			Dense, red brown, sandy, slightly clayey GRAVEL and COBBLES of fine to coarse, tabular ironstone.	1	MRB	
1.10	PID	0.0 ppm				
1.10	J2			1.30 ()		
				2		
				3		
				4		

Pit Stability: Generally stable throughout
Groundwater: Not encountered

Surface Elevation Level:

Plan of Trial Pit:



General Remarks:
Trial pit located within building and terminated at 1.30m bgl due to access restrictions.

All dimensions in metres
Log Scale 1:25

BRD
Telephone: 01295 272244
Email: info@brduk.com

TRIAL PIT RECORD

Client: Burrington Estates
Project Title: Hempton Road, Deddington
Project No: BRD3567
Logged By: M Morgan
Date Completed: 19/02/2021
Method Used: 180° Backhoe excavator (JCB 3CX type)

Trial Pit No.

TP19

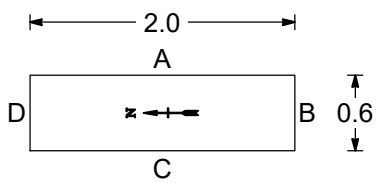
Sheet 1 of 1

Samples & Tests			Description of Strata	Depth / (Level)	Geology	Legend
Depth	Type & No	Value				
0.20 0.20 0.20	PID J1 D1	0.0 ppm	MADE GROUND: Dark grey becoming light brown at 0.10m, clayey, sandy gravel of fine to coarse, angular ironstone. Rare brick and concrete fragments. 0.00 - 0.10 m: Loose tarmac surfacing at southern end of pit.		MADE GROUND	
			MADE GROUND: Brown, slightly clayey, brick, concrete, tarmac and wood rubble.	0.50 ()		
1.30 1.30	PID J2	0.0 ppm	Dense, orange to yellow brown, sandy, silty GRAVEL and COBBLES of fine to coarse, angular, tabular limestone / ironstone.	1 0.95 ()	MRB	
				1.70 ()		
				2		
				3		
				4		

Pit Stability: Generally stable throughout
Groundwater: Not encountered

Surface Elevation Level:

Plan of Trial Pit:



General Remarks:
Trial pit terminated at 1.70m bgl.

All dimensions in metres
Log Scale 1:25

BRD
Telephone: 01295 272244
Email: info@brduk.com

TRIAL PIT RECORD

Client:	Burrington Estates
Project Title:	Hempton Road, Deddington
Project No:	BRD3567
Logged By:	M Morgan
Date Completed:	19/02/2021
Method Used:	180° Backhoe excavator (JCB 3CX type)

Trial Pit No.

TP20

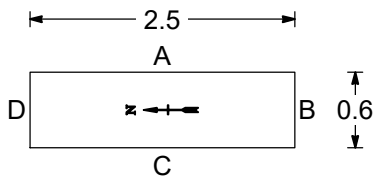
Sheet 1 of 1

Samples & Tests			Description of Strata	Depth / (Level)	Geology	Legend
Depth	Type & No	Value				
0.30	PID	0.0 ppm	MADE GROUND: Brown / yellow brown, clayey, gravelly sand. Gravel of fine to coarse, angular limestone and occasional brick and concrete. Very rare cement asbestos.		MADE GROUND	
0.30	J1					
0.40	D1			0.50 ()		
			MADE GROUND: Brown, sandy, clayey gravel and cobbles of brick and concrete with occasional plastic.			
				0.90 ()		
1.00	PID	0.0 ppm	MADE GROUND: Loose gravel / cobbles and boulders of brick and concrete. Two reinforced concrete girders encountered.	1		
1.00	J2					
				1.50 ()		
			MADE GROUND?: Loose, brown, very sandy gravelly clay. Gravel of fine to coarse, angular limestone.	2		
2.50	J3					
				2.90 ()		
			Dense, orange to yellow brown, sandy, silty GRAVEL and COBBLES of fine to coarse, angular, tabular limestone / ironstone.	3	M	
				3.00 ()		
				4		

Pit Stability: Generally stable throughout
Groundwater: Not encountered

Surface Elevation Level:

Plan of Trial Pit:



General Remarks:
Trial pit terminated at 3.00m bgl.

All dimensions in metres
Log Scale 1:25

BRD
Telephone: 01295 272244
Email: info@brduk.com

TRIAL PIT RECORD

Client:	Burrington Estates
Project Title:	Hempton Road, Deddington
Project No:	BRD3567
Logged By:	M Morgan
Date Completed:	19/02/2021
Method Used:	180° Backhoe excavator (JCB 3CX type)

Trial Pit No.

TP21

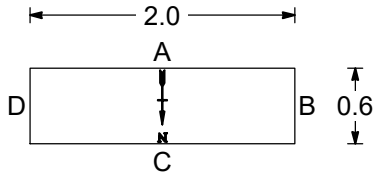
Sheet 1 of 1

Samples & Tests			Description of Strata	Depth / (Level)	Geology	Legend
Depth	Type & No	Value				
0.10 0.10	PID J1	0.0 ppm	MADE GROUND TOPSOIL: Dark brown, very gravelly, sandy clay. Gravel of fine to coarse, angular ironstone.	0.20 ()	MGTS	
0.70 0.70	PID J2	0.0 ppm	MADE GROUND?: Medium dense, brown, clayey, sandy GRAVEL and COBBLES of tabular, angular limestone / ironstone.	1 2 2.00 ()	MADE GROUND	
				3 4		

Pit Stability: See General Remarks
Groundwater: Not encountered

Surface Elevation Level:

Plan of Trial Pit:



General Remarks:
Trial pit terminated at 2.00m bgl.
Pit sides collapsed at 1.50m bgl.

All dimensions in metres
Log Scale 1:25

Telephone: 01295 272244
Email: info@brduk.com

TRIAL PIT RECORD

Client:	Burrington Estates
Project Title:	Hempton Road, Deddington
Project No:	BRD3567
Logged By:	M Morgan
Date Completed:	19/02/2021
Method Used:	180° Backhoe excavator (JCB 3CX type)

Trial Pit No.

TP22

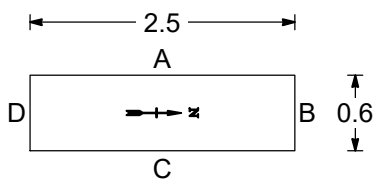
Sheet 1 of 1

Samples & Tests			Description of Strata	Depth / (Level)	Geology	Legend
Depth	Type & No	Value				
			MADE GROUND TOPSOIL: Brown, very gravelly, very clayey sand. Gravel of fine to coarse, angular ironstone.	0.20 ()	MADE GROUND	
0.50	J1		MADE GROUND: Loose, orange brown, sandy, clayey gravel of fine to coarse, angular ironstone and rare brick, plastic and charcoal.	1 1.00 ()		
1.20	J2		MADE GROUND: Firm, dark brown, gravelly, sandy clay. Gravel of fine, angular flint, limestone and charcoal. (Buried topsoil)	1.40 ()		
			MADE GROUND: Loose, orange brown, sandy, clayey gravel of fine to coarse, angular ironstone.	2		
			Stiff, green grey mottled yellow, clayey SILT.	2.80 ()	D.F.	
				3 3.00 ()		
				4		

Pit Stability: Generally stable throughout
Groundwater: Not encountered

Surface Elevation Level:

Plan of Trial Pit:



General Remarks:
Trial pit terminated at 3.00m bgl.

All dimensions in metres
Log Scale 1:25

BRD
Telephone: 01295 272244
Email: info@brduk.com

TRIAL PIT RECORD

Client:	Burrington Estates
Project Title:	Hempton Road, Deddington
Project No:	BRD3567
Logged By:	M Morgan
Date Completed:	19/02/2021
Method Used:	180° Backhoe excavator (JCB 3CX type)

Trial Pit No.

TP23

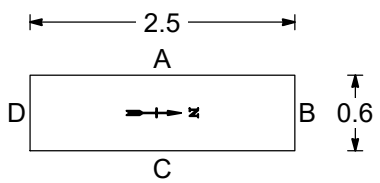
Sheet 1 of 1

Samples & Tests			Description of Strata	Depth / (Level)	Geology	Legend
Depth	Type & No	Value				
			MADE GROUND TOPSOIL: Brown, very gravelly, very clayey sand. Gravel of fine to coarse, angular ironstone.	0.20 ()	MADE GROUND	
0.40	J1		MADE GROUND: Loose, orange brown, sandy, clayey gravel of fine to coarse, angular ironstone and rare brick, plastic and charcoal. Occasional breeze blocks.	1		
			MADE GROUND: Firm, dark brown, gravelly, sandy clay. Gravel of fine, angular flint, limestone and charcoal. (Buried topsoil)	1.10 ()		
1.30	J2		MADE GROUND: Loose, orange brown, sandy, clayey gravel of fine to coarse, angular ironstone.	1.60 ()		
			Dense, brown, sandy, clayey COBBLES and BOULDERS of tabular, angular ironstone.	2 2.00 ()	MRB	
			2.50m: Solid ironstone bedrock encountered.	2.50 () 3 4		

Pit Stability: See General Remarks
Groundwater: Not encountered

Surface Elevation Level:

Plan of Trial Pit:



General Remarks:
Trial pit terminated at 2.50m bgl.
Slight collapse between 1.50m & 2.50m bgl.

All dimensions in metres
Log Scale 1:25

BRD
Telephone: 01295 272244
Email: info@brduk.com

TRIAL PIT RECORD

Client:	Burrington Estates
Project Title:	Hempton Road, Deddington
Project No:	BRD3567
Logged By:	M Morgan
Date Completed:	19/02/2021
Method Used:	180° Backhoe excavator (JCB 3CX type)

Trial Pit No.

TP24

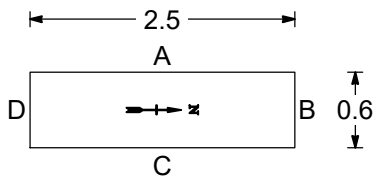
Sheet 1 of 1

Samples & Tests			Description of Strata	Depth / (Level)	Geology	Legend
Depth	Type & No	Value				
			MADE GROUND TOPSOIL: Brown, very gravelly, very clayey sand. Gravel of fine to coarse, angular ironstone.	0.20 ()	MADE GROUND	
0.50	J1		MADE GROUND: Brown, sandy, clayey gravel of fine to coarse, angular ironstone with occasional plastic.	0.70 ()		
0.80	J2		MADE GROUND: Dark brown, sandy, gravelly clay. Gravel of fine to coarse, angular ironstone. (Buried topsoil)	1.00 ()		
			MADE GROUND: Light brown, sandy, clayey gravel and cobbles of fine to coarse, angular ironstone.	2.00 ()		
			Dense, brown, sandy, clayey COBBLES and BOULDERS of tabular, angular ironstone.	2.50 ()	MRB	

Pit Stability: Generally stable throughout
Groundwater: Not encountered

Surface Elevation Level:

Plan of Trial Pit:



General Remarks:
Trial pit terminated at 2.50m bgl.

All dimensions in metres
Log Scale 1:25

BRD
Telephone: 01295 272244
Email: info@brduk.com

TRIAL PIT RECORD

Client:	Burrington Estates
Project Title:	Hempton Road, Deddington
Project No:	BRD3567
Logged By:	M Morgan
Date Completed:	19/02/2021
Method Used:	180° Backhoe excavator (JCB 3CX type)

Trial Pit No.

TP25

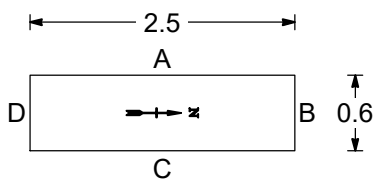
Sheet 1 of 1

Samples & Tests			Description of Strata	Depth / (Level)	Geology	Legend
Depth	Type & No	Value				
0.20	J1		MADE GROUND TOPSOIL: Brown, very gravelly, very clayey sand. Gravel of fine to coarse, angular ironstone.	0.40 ()	MADE GROUND	
0.60	J2		MADE GROUND: Loose, brown to orange brown, very gravelly, fine to coarse sand. Gravel of fine to medium, angular ironstone.	1.00 ()		
			Medium dense, orange brown / yellow brown, sandy, clayey GRAVEL and COBBLES of fine to coarse, subangular to angular ironstone. (Possible MADE GROUND)	2.50 ()	MARLSTONE ROCK FORMATION	

Pit Stability: See General Remarks
Groundwater: Not encountered

Surface Elevation Level:

Plan of Trial Pit:



General Remarks:
Trial pit terminated at 2.50m bgl.
Pit sides collapse between 1.00 & 2.50m bgl.

All dimensions in metres
Log Scale 1:25

BRD
Telephone: 01295 272244
Email: info@brduk.com

Trial Pit Photographs

TP18

Project Title: Hempton Road, Deddington
Client: Burrington Estates
BRD Reference: BRD3567-OP9-A
Date Issued: February 2021

BRD
01295 272244
info@brduk.com

Trial Pit Photographs

TP19

Project Title:	Hempton Road, Deddington
Client:	Burrington Estates
BRD Reference:	BRD3567-OP9-A
Date Issued:	February 2021

BRD
01295 272244
info@brduk.com

Trial Pit Photographs

TP20

Project Title: Hempton Road, Deddington
Client: Burrington Estates
BRD Reference: BRD3567-OP9-A
Date Issued: February 2021

BRD
01295 272244
info@brduk.com

Trial Pit Photographs

TP21

Project Title: Hempton Road, Deddington
Client: Burrington Estates
BRD Reference: BRD3567-OP9-A
Date Issued: February 2021

BRD
01295 272244
info@brduk.com

Trial Pit Photographs

TP22

Project Title: Hempton Road, Deddington
Client: Burrington Estates
BRD Reference: BRD3567-OP9-A
Date Issued: February 2021

BRD
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info@brduk.com

Trial Pit Photographs

TP23

Project Title: Hempton Road, Deddington
Client: Burrington Estates
BRD Reference: BRD3567-OP9-A
Date Issued: February 2021

BRD
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Trial Pit Photographs

TP24

Project Title: Hempton Road, Deddington
Client: Burrington Estates
BRD Reference: BRD3567-OP9-A
Date Issued: February 2021

BRD
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Trial Pit Photographs

TP25

Project Title: Hempton Road, Deddington
Client: Burrington Estates
BRD Reference: BRD3567-OP9-A
Date Issued: February 2021

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APPENDIX 3

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1 Old Parr Road
Banbury
Oxfordshire
OX16 5HT

DETS Ltd
Unit 1
Rose Lane Industrial Estate
Rose Lane
Lenham Heath
Kent
ME17 2JN
t: 01622 850410

DETS Report No: 21-02154

Site Reference:	Hempton Road, Deddington
Project / Job Ref:	BRD3567
Order No:	None Supplied
Sample Receipt Date:	23/02/2021
Sample Scheduled Date:	23/02/2021
Report Issue Number:	1
Reporting Date:	02/03/2021

Authorised by:

[redacted]

Dave Ashworth
Technical Manager

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

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

DETS Ltd
Unit 1, Rose Lane Industrial Estate
Rose Lane
Lenham Heath
Maidstone
Kent ME17 2JN
Tel : 01622 850410

4480

Soil Analysis Certificate						
DETS Report No: 21-02154	Date Sampled	19/02/21	19/02/21	19/02/21	19/02/21	19/02/21
BRD Environmental Ltd	Time Sampled	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Site Reference: Hempton Road, Deddington	TP / BH No	TP18	TP20	TP22	TP23	TP24
Project / Job Ref: BRD3567	Additional Refs	J1	J1	J2	J2	J2
Order No: None Supplied	Depth (m)	0.40	0.30	1.20	1.30	0.80
Reporting Date: 02/03/2021	DETS Sample No	527503	527505	527506	527507	527509

Determinand	Unit	RL	Accreditation					
Asbestos Quantification (S)	%	< 0.001	ISO17025	0.002	0.006			
pH	pH Units	N/a	MCERTS	8.2	8.2	8.0	7.8	7.8
W/S Sulphate as SO_4 (2:1)	mg/l	< 10	MCERTS	1680	171	29	37	11
W/S Sulphate as SO_4 (2:1)	g/l	< 0.01	MCERTS	1.68	0.17	0.03	0.04	0.01
Organic Matter	%	< 0.1	MCERTS	1.6	2	4.5	3.4	3.7
Arsenic (As)	mg/kg	< 2	MCERTS	136	103	107	126	136
Cadmium (Cd)	mg/kg	< 0.2	NONE	< 0.2	< 0.2	0.3	< 0.2	< 0.2
Chromium (Cr)	mg/kg	< 2	MCERTS	218	161	167	189	200
Chromium (hexavalent)	mg/kg	< 2	NONE	< 2	< 2	< 2	< 2	< 2
Copper (Cu)	mg/kg	< 4	MCERTS	9	15	147	51	27
Lead (Pb)	mg/kg	< 3	MCERTS	32	37	236	135	77
Mercury (Hg)	mg/kg	< 1	MCERTS	< 1	< 1	< 1	1.1	< 1
Nickel (Ni)	mg/kg	< 3	MCERTS	79	63	69	75	80
Selenium (Se)	mg/kg	< 2	MCERTS	< 3	< 3	< 3	< 3	< 3
Zinc (Zn)	mg/kg	< 3	MCERTS	297	188	286	353	200

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

DETS Ltd
Unit 1, Rose Lane Industrial Estate
Rose Lane
Lenham Heath
Maidstone
Kent ME17 2JN
Tel : 01622 850410

Soil Analysis Certificate						
DETS Report No: 21-02154	Date Sampled	19/02/21				
BRD Environmental Ltd	Time Sampled	None Supplied				
Site Reference: Hempton Road, Deddington	TP / BH No	TP25				
Project / Job Ref: BRD3567	Additional Refs	J2				
Order No: None Supplied	Depth (m)	0.60				
Reporting Date: 02/03/2021	DETS Sample No	527510				

Determinand	Unit	RL	Accreditation					
Asbestos Quantification (S)	%	< 0.001	ISO17025					
pH	pH Units	N/a	MCERTS	8.0				
W/S Sulphate as SO_4 (2:1)	mg/l	< 10	MCERTS	< 10				
W/S Sulphate as SO_4 (2:1)	g/l	< 0.01	MCERTS	< 0.01				
Organic Matter	%	< 0.1	MCERTS	1.5				
Arsenic (As)	mg/kg	< 2	MCERTS	153				
Cadmium (Cd)	mg/kg	< 0.2	NONE	< 0.2				
Chromium (Cr)	mg/kg	< 2	MCERTS	235				
Chromium (hexavalent)	mg/kg	< 2	NONE	< 2				
Copper (Cu)	mg/kg	< 4	MCERTS	15				
Lead (Pb)	mg/kg	< 3	MCERTS	46				
Mercury (Hg)	mg/kg	< 1	MCERTS	< 1				
Nickel (Ni)	mg/kg	< 3	MCERTS	89				
Selenium (Se)	mg/kg	< 2	MCERTS	< 3				
Zinc (Zn)	mg/kg	< 3	MCERTS	214				

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

DETS Ltd
Unit 1, Rose Lane Industrial Estate
Rose Lane
Lenham Heath
Maidstone
Kent ME17 2JN
Tel : 01622 850410

4480

Soil Analysis Certificate - Speciated PAHs						
DETS Report No: 21-02154	Date Sampled	19/02/21	19/02/21	19/02/21	19/02/21	19/02/21
BRD Environmental Ltd	Time Sampled	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Site Reference: Hempton Road, Deddington	TP / BH No	TP18	TP20	TP22	TP23	TP24
Project / Job Ref: BRD3567	Additional Refs	J1	J1	J2	J2	J2
Order No: None Supplied	Depth (m)	0.40	0.30	1.20	1.30	0.80
Reporting Date: 02/03/2021	DETS Sample No	527503	527505	527506	527507	527509

Determinand	Unit	RL	Accreditation					
Naphthalene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Acenaphthylene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Acenaphthene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Fluorene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Phenanthrene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	0.25	0.33	0.61
Anthracene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	0.15
Fluoranthene	mg/kg	< 0.1	MCERTS	0.18	0.43	0.62	0.79	0.67
Pyrene	mg/kg	< 0.1	MCERTS	0.18	0.43	0.55	0.72	0.56
Benzo(a)anthracene	mg/kg	< 0.1	MCERTS	0.11	0.28	0.25	0.37	0.33
Chrysene	mg/kg	< 0.1	MCERTS	0.16	0.35	0.36	0.50	0.35
Benzo(b)fluoranthene	mg/kg	< 0.1	MCERTS	0.21	0.45	0.37	0.57	0.27
Benzo(k)fluoranthene	mg/kg	< 0.1	MCERTS	< 0.1	0.20	0.12	0.17	< 0.1
Benzo(a)pyrene	mg/kg	< 0.1	MCERTS	0.17	0.37	0.24	0.39	0.19
Indeno(1,2,3-cd)pyrene	mg/kg	< 0.1	MCERTS	< 0.1	0.21	0.14	0.21	< 0.1
Dibenz(a,h)anthracene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(ghi)perylene	mg/kg	< 0.1	MCERTS	< 0.1	0.20	0.13	0.20	< 0.1
Total EPA-16 PAHs	mg/kg	< 1.6	MCERTS	< 1.6	2.9	3	4.2	3.1

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Soil Analysis Certificate - Speciated PAHs						
DETS Report No: 21-02154	Date Sampled	19/02/21				
BRD Environmental Ltd	Time Sampled	None Supplied				
Site Reference: Hempton Road, Deddington	TP / BH No	TP25				
Project / Job Ref: BRD3567	Additional Refs	J2				
Order No: None Supplied	Depth (m)	0.60				
Reporting Date: 02/03/2021	DETS Sample No	527510				

Determinand	Unit	RL	Accreditation				
Naphthalene	mg/kg	< 0.1	MCERTS	< 0.1			
Acenaphthylene	mg/kg	< 0.1	MCERTS	< 0.1			
Acenaphthene	mg/kg	< 0.1	MCERTS	< 0.1			
Fluorene	mg/kg	< 0.1	MCERTS	< 0.1			
Phenanthrene	mg/kg	< 0.1	MCERTS	< 0.1			
Anthracene	mg/kg	< 0.1	MCERTS	< 0.1			
Fluoranthene	mg/kg	< 0.1	MCERTS	< 0.1			
Pyrene	mg/kg	< 0.1	MCERTS	< 0.1			
Benzo(a)anthracene	mg/kg	< 0.1	MCERTS	< 0.1			
Chrysene	mg/kg	< 0.1	MCERTS	< 0.1			
Benzo(b)fluoranthene	mg/kg	< 0.1	MCERTS	< 0.1			
Benzo(k)fluoranthene	mg/kg	< 0.1	MCERTS	< 0.1			
Benzo(a)pyrene	mg/kg	< 0.1	MCERTS	< 0.1			
Indeno(1,2,3-cd)pyrene	mg/kg	< 0.1	MCERTS	< 0.1			
Dibenz(a,h)anthracene	mg/kg	< 0.1	MCERTS	< 0.1			
Benzo(ghi)perylene	mg/kg	< 0.1	MCERTS	< 0.1			
Total EPA-16 PAHs	mg/kg	< 1.6	MCERTS	< 1.6			

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Soil Analysis Certificate - TPH LQM Banded						
DETS Report No: 21-02154	Date Sampled	19/02/21	19/02/21			
BRD Environmental Ltd	Time Sampled	None Supplied	None Supplied			
Site Reference: Hempton Road, Deddington	TP / BH No	TP18	TP20			
Project / Job Ref: BRD3567	Additional Refs	J1	J1			
Order No: None Supplied	Depth (m)	0.40	0.30			
Reporting Date: 02/03/2021	DETS Sample No	527503	527505			

Determinand	Unit	RL	Accreditation					
Aliphatic >C5 - C6	mg/kg	< 0.01	NONE	< 0.01	< 0.01			
Aliphatic >C6 - C8	mg/kg	< 0.05	NONE	< 0.05	< 0.05			
Aliphatic >C8 - C10	mg/kg	< 2	MCERTS	< 2	< 2			
Aliphatic >C10 - C12	mg/kg	< 2	MCERTS	< 2	< 2			
Aliphatic >C12 - C16	mg/kg	< 3	MCERTS	< 3	< 3			
Aliphatic >C16 - C35	mg/kg	< 10	MCERTS	87	< 10			
Aliphatic >C35 - C44	mg/kg	< 10	NONE	16	< 10			
Aliphatic (C5 - C44)	mg/kg	< 30	NONE	104	< 30			
Aromatic >C5 - C7	mg/kg	< 0.01	NONE	< 0.01	< 0.01			
Aromatic >C7 - C8	mg/kg	< 0.05	NONE	< 0.05	< 0.05			
Aromatic >C8 - C10	mg/kg	< 2	MCERTS	< 2	< 2			
Aromatic >C10 - C12	mg/kg	< 2	MCERTS	< 2	< 2			
Aromatic >C12 - C16	mg/kg	< 2	MCERTS	< 2	< 2			
Aromatic >C16 - C21	mg/kg	< 3	MCERTS	5	< 3			
Aromatic >C21 - C35	mg/kg	< 10	MCERTS	91	< 10			
Aromatic >C35 - C44	mg/kg	< 10	NONE	14	< 10			
Aromatic (>C5 - C44)	mg/kg	< 30	NONE	110	< 30			
Total >C5 - C44	mg/kg	< 60	NONE	213	< 60			

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Soil Analysis Certificate - BTEX / MTBE						
DETS Report No: 21-02154	Date Sampled	19/02/21	19/02/21			
BRD Environmental Ltd	Time Sampled	None Supplied	None Supplied			
Site Reference: Hempton Road, Deddington	TP / BH No	TP18	TP20			
Project / Job Ref: BRD3567	Additional Refs	J1	J1			
Order No: None Supplied	Depth (m)	0.40	0.30			
Reporting Date: 02/03/2021	DETS Sample No	527503	527505			

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

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Waste Acceptance Criteria Analytical Certificate - BS EN 12457/3

DETS Report No: 21-02154		Date Sampled	19/02/21				Landfill Waste Acceptance Criteria Limits		
BRD Environmental Ltd		Time Sampled	None Supplied				Inert Waste Landfill	Stable Non-reactive HAZARDOUS waste in non-hazardous Landfill	Hazardous Waste Landfill
Site Reference: Hempton Road, Deddington		TP / BH No	TP22						
Project / Job Ref: BRD3567		Additional Refs	J2						
Order No: None Supplied		Depth (m)	1.20						
Reporting Date: 02/03/2021		DETS Sample No	527506						
Determinand	Unit	MDL							
TOC[MU]	%	< 0.1	2.6				3%	5%	6%
Loss on Ignition	%	< 0.01	10.60				--	--	10%
BTEX[MU]	mg/kg	< 0.05	< 0.05				6	--	--
Sum of PCBs	mg/kg	< 0.1	< 0.1				1	--	--
Mineral Oil[MU]	mg/kg	< 10	< 10				500	--	--
Total PAH[MU]	mg/kg	< 1.7	3				100	--	--
pH[MU]	pH Units	N/a	8.0				--	>6	--
Acid Neutralisation Capacity	mol/kg (+/-)	< 1	1.2				--	To be evaluated	To be evaluated
Eluate Analysis			2:1 mg/l	8:1 mg/l		Cumulative 10:1 mg/kg	Limit values for compliance leaching test using BS EN 12457-3 at L/S 10 l/kg (mg/kg)		
Arsenic[U]			< 0.01	< 0.01		< 0.2	0.5	2	25
Barium[U]			< 0.02	< 0.02		< 0.1	20	100	300
Cadmium[U]			< 0.0005	< 0.0005		< 0.02	0.04	1	5
Chromium[U]			< 0.005	< 0.005		< 0.20	0.5	10	70
Copper[U]			0.01	< 0.01		< 0.5	2	50	100
Mercury[U]			< 0.0005	< 0.0005		< 0.005	0.01	0.2	2
Molybdenum[U]			0.002	0.003		< 0.1	0.5	10	30
Nickel[U]			< 0.007	< 0.007		< 0.2	0.4	10	40
Lead[U]			< 0.005	< 0.005		< 0.2	0.5	10	50
Antimony[U]			< 0.005	< 0.005		< 0.05	0.06	0.7	5
Selenium[U]			< 0.005	< 0.005		< 0.05	0.1	0.5	7
Zinc[U]			0.005	0.008		< 0.2	4	50	200
Chloride[U]			4	3		28	800	15000	25000
Fluoride[U]			< 0.5	< 0.5		< 1	10	150	500
Sulphate[U]			9	3		35	1000	20000	50000
TDS			163	122		1270	4000	60000	100000
Phenol Index			< 0.01	< 0.01		< 0.5	1	-	-
DOC			16.6	10.5		112	500	800	1000
Leach Test Information									
Sample Mass (kg)			0.21						
Dry Matter (%)			83.5						
Moisture (%)			19.8						
Stage 1									
Volume Eluate L2 (litres)			0.32						
Filtered Eluate VE1 (litres)			0.22						

Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than 30°C. The Samples Descriptions page describes if the test is performed on the dried or as-received portion
Stated limits are for guidance only and DETS Ltd cannot be held responsible for any discrepencies with current legislation
M Denotes MCERTS accredited test
U Denotes ISO17025 accredited test

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Waste Acceptance Criteria Analytical Certificate - BS EN 12457/3

DETS Report No: 21-02154		Date Sampled	19/02/21				Landfill Waste Acceptance Criteria Limits		
BRD Environmental Ltd		Time Sampled	None Supplied				Inert Waste Landfill	Stable Non-reactive HAZARDOUS waste in non-hazardous Landfill	Hazardous Waste Landfill
Site Reference: Hempton Road, Deddington		TP / BH No	TP24						
Project / Job Ref: BRD3567		Additional Refs	J1						
Order No: None Supplied		Depth (m)	0.50						
Reporting Date: 02/03/2021		DETS Sample No	527508						
Determinand	Unit	MDL							
TOC[MU]	%	< 0.1	0.7				3%	5%	6%
Loss on Ignition	%	< 0.01	4.82				--	--	10%
BTEX[MU]	mg/kg	< 0.05	< 0.05				6	--	--
Sum of PCBs	mg/kg	< 0.1	< 0.1				1	--	--
Mineral Oil[MU]	mg/kg	< 10	< 10				500	--	--
Total PAH[MU]	mg/kg	< 1.7	< 1.7				100	--	--
pH[MU]	pH Units	N/a	7.9				--	>6	--
Acid Neutralisation Capacity	mol/kg (+/-)	< 1	1.2				--	To be evaluated	To be evaluated
Eluate Analysis			2:1 mg/l	8:1 mg/l		Cumulative 10:1 mg/kg	Limit values for compliance leaching test using BS EN 12457-3 at L/S 10 l/kg (mg/kg)		
Arsenic[U]			< 0.01	< 0.01		< 0.2	0.5	2	25
Barium[U]			< 0.02	< 0.02		< 0.1	20	100	300
Cadmium[U]			< 0.0005	< 0.0005		< 0.02	0.04	1	5
Chromium[U]			< 0.005	< 0.005		< 0.20	0.5	10	70
Copper[U]			0.01	0.01		< 0.5	2	50	100
Mercury[U]			< 0.0005	< 0.0005		< 0.005	0.01	0.2	2
Molybdenum[U]			0.001	0.002		< 0.1	0.5	10	30
Nickel[U]			< 0.007	< 0.007		< 0.2	0.4	10	40
Lead[U]			< 0.005	< 0.005		< 0.2	0.5	10	50
Antimony[U]			< 0.005	< 0.005		< 0.05	0.06	0.7	5
Selenium[U]			< 0.005	< 0.005		< 0.05	0.1	0.5	7
Zinc[U]			0.007	0.009		< 0.2	4	50	200
Chloride[U]			5	6		57	800	15000	25000
Fluoride[U]			0.5	0.6		5.9	10	150	500
Sulphate[U]			6	5		50	1000	20000	50000
TDS			141	114		1171	4000	60000	100000
Phenol Index			< 0.01	< 0.01		< 0.5	1	-	-
DOC			67.8	11.4		179	500	800	1000
Leach Test Information									
Sample Mass (kg)			0.20						
Dry Matter (%)			87						
Moisture (%)			15						
Stage 1									
Volume Eluate L2 (litres)			0.32						
Filtered Eluate VE1 (litres)			0.20						

Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than 30°C. The Samples Descriptions page describes if the test is performed on the dried or as-received portion
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M Denotes MCERTS accredited test
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Bulk Analysis Certificate						
DETS Report No: 21-02154	Date Sampled	19/02/21				
BRD Environmental Ltd	Time Sampled	None Supplied				
Site Reference: Hempton Road, Deddington	TP / BH No	TP18				
Project / Job Ref: BRD3567	Additional Refs	D1				
Order No: None Supplied	Depth (m)	0.50				
Reporting Date: 02/03/2021	DETS Sample No	527504				

Determinand	Unit	RL	Accreditation					
Asbestos Type (S)	PLM Result	N/a	ISO17025	Chrysotile Crocidolite				
Sample Matrix (S)	Material Type	N/a	NONE	Cement				

The samples have been examined to identify the presence of asbestiform minerals by polarising light microscopy and dispersion staining technique to In-House Procedures QTSE600 Determination of Asbestos in Bulk Materials; Asbestos in Soils/Sediments (fibre screening and identification) that is in accordance with the Health and Safety Executive HSG 248 Appendix 2.

This report refers to samples as received, and QTS Environmental Ltd, takes no responsibility for the accuracy or competence of sampling by others.

The material description shall be regarded as tentative and is not included in our scope of UKAS Accreditation.

Opinions and interpretations expressed herein are outside the scope of UKAS Accreditation.

RL: Reporting Limit

Subcontracted analysis (S)

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Soil Analysis Certificate - Sample Descriptions
DETS Report No: 21-02154
BRD Environmental Ltd
Site Reference: Hempton Road, Deddington
Project / Job Ref: BRD3567
Order No: None Supplied
Reporting Date: 02/03/2021

DETS Sample No	TP / BH No	Additional Refs	Depth (m)	Moisture Content (%)	Sample Matrix Description
527503	TP18	J1	0.40	10.5	Brown sandy clay with brick and concrete
527505	TP20	J1	0.30	13.1	Brown sandy clay with stones and brick
527506	TP22	J2	1.20	16.6	Brown sandy clay with stones
527507	TP23	J2	1.30	15.3	Brown sandy clay with stones
527508	TP24	J1	0.50	13	Brown sandy clay with stones
527509	TP24	J2	0.80	14.6	Brown sandy clay with stones
527510	TP25	J2	0.60	12.6	Light brown sandy clay with stones

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

Insufficient Sample I/S

Unsuitable Sample U/S

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mCERTS THE ENVIRONMENT AGENCY'S MONITORING CERTIFICATION SCHEME
UKAS TESTING 4480

Soil Analysis Certificate - Methodology & Miscellaneous Information
DETS Report No: 21-02154
BRD Environmental Ltd
Site Reference: Hempton Road, Deddington
Project / Job Ref: BRD3567
Order No: None Supplied
Reporting Date: 02/03/2021

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

D Dried
AR As Received

Parameter	Matrix Type	Suite Reference	Expanded Uncertainity Measurement	Unit
TOC	Soil	BS EN 12457	13.49	%
Loss on Ignition	Soil	BS EN 12457	17	%
BTEX	Soil	BS EN 12457	14	%
Sum of PCBs	Soil	BS EN 12457	23	%
Mineral Oil	Soil	BS EN 12457	9	%
Total PAH	Soil	BS EN 12457	20	%
pH	Soil	BS EN 12457	0.399	Units
Acid Neutralisation Capacity	Soil	BS EN 12457	18	%
Arsenic	Leachate	BS EN 12457	16.63	%
Barium	Leachate	BS EN 12457	14.29	%
Cadmium	Leachate	BS EN 12457	14.44	%
Chromium	Leachate	BS EN 12457	18.06	%
Copper	Leachate	BS EN 12457	21.27	%
Mercury	Leachate	BS EN 12457	24.13	%
Molybdenum	Leachate	BS EN 12457	12.55	%
Nickel	Leachate	BS EN 12457	20.08	%
Lead	Leachate	BS EN 12457	13.43	%
Antimony	Leachate	BS EN 12457	18.85	%
Selenium	Leachate	BS EN 12457	18.91	%
Zinc	Leachate	BS EN 12457	13.71	%
Chloride	Leachate	BS EN 12457	16	%
Fluoride	Leachate	BS EN 12457	19.4	%
Sulphate	Leachate	BS EN 12457	19.63	%
TDS	Leachate	BS EN 12457	12	%
Phenol Index	Leachate	BS EN 12457	14	%
DOC	Leachate	BS EN 12457	10	%
Clay Content	Soil	BS 3882: 2015	15	%
Silt Content	Soil	BS 3882: 2015	14	%
Sand Content	Soil	BS 3882: 2015	13	%
Loss on Ignition	Soil	BS 3882: 2015	17	%
pH	Soil	BS 3882: 2015	0.399	Units
Carbonate	Soil	BS 3882: 2015	16	%
Total Nitrogen	Soil	BS 3882: 2015	12	%
Phosphorus (Extractable)	Soil	BS 3882: 2015	24	%
Potassium (Extractable)	Soil	BS 3882: 2015	20	%
Magnesium (Extractable)	Soil	BS 3882: 2015	26	%
Zinc	Soil	BS 3882: 2015	14.9	%
Copper	Soil	BS 3882: 2015	16	%
Nickel	Soil	BS 3882: 2015	17.7	%
Available Sodium	Soil	BS 3882: 2015	23	%
Available Calcium	Soil	BS 3882: 2015	23	%
Electrical Conductivity	Soil	BS 3882: 2015	10	%