Report Title:

Phase 2 Geo-Environmental Site Investigation

Project Name:

Hempton Road, Deddington

Report Reference: **BRD3567-OR2-A**

Date: **January 2020**

BRD Environmental Ltd
Hawthorne Villa, 1 Old Parr Road,
Banbury, Oxfordshire, OX16 5HT
01295 272244 info@brduk.com
www.brduk.com

REPORT CONTROL SHEET

REPORT TITLE	**PHASE 2 GEO-ENVIRONMENTAL SITE INVESTIGATION**
PROJECT	**HEMPTON ROAD, DEDDINGTON**
CLIENT	**PEMBURY ESTATES LIMITED**

REPORT REFERENCE	ISSUE DETAIL	DATE	PREPARED BY	CHECKED BY
BRD3567-OR2-A	First Issue	31/01/2020	J Hand & A Leon	B Devonshire

BRD Environmental Limited

Geotechnical and Environmental Services

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

Hawthorne Villa, 1 Old Parr Road, Banbury, Oxfordshire. OX16 5HT
T: 01295 272244 www.brduk.com info@brduk.com

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-A
	Revised Conceptual Site Model	Ref. BRD3567-OP7-A
	Proposed Development Layout	AT Architecture, 'Illustrative Concept Plan', ref. A_1807 P100 rev. D, date: 14.05.2019
	Exploratory Point Plan	Ref. BRD3567-OD1-A
	Foundation Zoning Plan	Ref. BRD3576-OD3-A
APPENDIX 2	**EXPLORATORY HOLE**	
	Logs of trial pits	Ref. TP01 - TP17
	Photographic records of trial pits	Ref. BRD3567-OP5-A
	TP12 Cross section	Ref. BRD3567-OD2-A
APPENDIX 3	**LABORATORY TEST RESULTS**	
	DETS reports 19-14862, 19-17332 & 19-17333	18 x A4 pages
	CLEA Model – Arsenic Assessment worksheet	16 x A4 pages
	SPT reports 36020 & 36282	14 x A4 pages

SUMMARY REPORT - GENERAL INFORMATION

SUBJECT	COMMENTS
CURRENT SITE CONDITION	The site currently comprises two fields with an access track. The southern most field (Field A) containing 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 is currently in use agriculturally.
PROPOSED DEVELOPMENT	It is proposed that the site will be developed with 21No. residential properties, together with associated gardens access, garages and landscaping.
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	The investigation has proved a large proportion of the site, underlying the topsoil is backfilled material comprising reworked ironstone to a significant depth. 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.
HYDROGEOLOGY	The underlying bedrock geology is designated 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 site is not in an area indicated to be at risk of flooding.
PREVIOUS GROUND REPORTS	Mewies Engineering Consultants Ltd (M-EC) conducted infiltration tests within two trial pits in the south east corner of the site during June 2018. Additionally, BRD has undertaken geo-environmental desk study research and this has been reported separately.

SUMMARY REPORT - GEOTECHNICAL

SUBJECT	COMMENTS
EXCAVATIONS	It should be possible to forward excavations employing normal equipment. Specific groundwater control unlikely to be required at this site. It is unlikely that requirements of the Party Wall Act will apply to the development.
SLOPE STABILITY	It is considered that slope stability is unlikely to be a concern at this site.
SUB-SURFACE CONCRETE	Design Sulphate Class of DS-1 and Aggressive Chemical Environment for Concrete class of AC-1s applies.
SOAKAWAYS	An infiltration basin is proposed for the south eastern corner. Other forms of soakaways are not suitable for the site.
PAVEMENT DESIGN	A preliminary design California Bearing Ratio (CBR) of less than 2% has been recommended. In areas of deep Made Ground, the use of geo-grid should be used to re-inforce the sub-base
FOUNDATIONS	
LIKELY FOUNDATION TYPE	Extreme South & Eastern site boundaries: these parts of the site should be suitable for the adoption of shallow strip/trench fill footings with foundations taken through Made Ground/topsoil to bear upon the Marlstone Rock Formation and/or Dyrham Formation. Majority of the site: Due to the presence of deep Made Ground across most of the site a foundation solution incorporating piles or ground improvement will be required.
VOLUME CHANGE POTENTIAL	Made Ground: Non shrinkable soils. Marlstone Rock Formation: Non shrinkable soils (assumed as is recorded as a coarse soil). Dyrham Formation: Medium i.e. moderate swelling or shrinking with moisture content changes.
ESTIMATED FOUNDATION DEPTHS	Extreme South & Eastern site boundaries • Marlstone Rock Formation: The minimum foundation depth required is to found below the Topsoil/Made Ground. • Dyrham Formation: the minimum footing depth required is 0.90m, but 1.25m where required to allow for restricted new tree planting. Majority of the site; Pile lengths or ground treatment depths to be determined by specialist piling contractor.
HEAVE PROTECTION	Will be required for a minimum number of plots located in the southern boundary in close proximity to the existing hedge.

SUMMARY REPORT – CONTAMINATION ISSUES

SUBJECT	COMMENTS
SOIL RISKS TO HUMAN HEALTH	No unacceptable contamination in respect of human health has been identified by this investigation. However there is a localised area of buried ashy soils in the south western corner which may present a risk if future residents become exposed to it. In addition, there remains the potential for low levels of contamination beneath the existing building.
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	No remedial works are considered necessary to facilitate the development at this stage. However, subject to the proposed additional investigation, localised remedial measures, such as capping layers, may be required.
ASBESTOS	No asbestos has been detected in the soil samples tested. However, parts of the asbestos cement sheeting on the lean-to structure of the barn was in poor condition and it is anticipated that some asbestos cement fragments may be present on the surface in this area. All asbestos fragments will be required to be removed off-site during the preliminary site clearance works.
WASTE SOIL DISPOSAL	It is considered that the any 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'. A localised area of buried ashy soils in the south western corner of the site will be classified as hazardous waste.

SUMMARY REPORT – KEY RECOMMENDATIONS

RECOMMENDATIONS
It is recommended that this report is submitted to the planning department of the Local Authority, the organisation undertaking the Building Control function and warranty providers to confirm that the investigation completed to date is satisfactory. If required, in order to confirm deeper ground conditions for pile design further ground investigation comprising deep combined rotary cable percussive boreholes is recommended. It is suggested that 2No. boreholes are drilled to depths of 18m. Monitoring wells should be included in the boreholes and at least one post work monitoring visit should be undertaken to record groundwater levels. Insitu Standard Penetration Tests should be conducted during forwarding of the boreholes and collected soil samples submitted for appropriate geotechnical laboratory testing. It is also recommended that additional ground investigation in the form of trial pits is undertaken around the position of TP03 to further assess the extent and depth of the buried ashy material in this location and undertake additional lead testing from the soils to confirm if any risk is presented to future residents. In addition, following the demolition of the existing building, further exploratory holes should be completed in this area to determine whether or not there are any contamination risks.

1. INTRODUCTION TO TECHNICAL REPORT

1.1. CONTRACT DETAILS

CLIENT	Pembury Estates Limited.
SITE	Land situated north of Hempton Road in the village of Deddington, Oxfordshire.
CLIENT'S ADVISORS	BRD Environmental Limited (BRD) has been commissioned by Webb Developments Ltd on behalf of the Client.
REPORT CONTEXT	It is understood that the Client intends to develop the site for residential housing.
REPORT TYPE	Geo-environmental site investigation (i.e. combined geotechnical ground investigation and Phase 2 contamination assessment).
REPORT OBJECTIVES	The purpose of the report is to undertake a Phase 2 contamination assessment to meet the requirements of Condition 6 of the Planning Permission issued by Cherwell District Council referenced 18/2147/OUT. The site has been the subject of a desk study referenced as follows: • 'Phase 1 Environmental Desk Study – Hempton Road, Deddington', BRD Environmental Ltd, report ref. BRD2567-OR1-A, dated October 2019. The purpose of the report is to present the findings of a ground investigation, and to present both geotechnical and contamination assessments of the ground conditions revealed.

1.2. SCOPE OF WORKS

1.2.1. Initial Investigation 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 8-10No. trial pits to a nominal depth of 3m, ground conditions permitting. We have allowed for the provision of a hydraulic breaker to confirm the consistency of any exposed intact bedrock.
- All exploratory points will be logged and sampled in general accordance with BS5930:2015 by supervising Geo-Environmental Consultant. In-situ geotechnical testing of fine soils using a Hand Shear Vane and/or Pocket Penetrometer.
- 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 location of exploratory points by tape measurements or the use of a handheld recreational GPS unit.

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

    - 8No. Metals Suite - As, Cd, Cr, CrVI, Hg, Pb, Se, Cu, Ni and Zn.
    - 6No. Additional As tests (as the geology is naturally elevated in Arsenic).
    - 8No. Inorganics Suite – water soluble sulphate, pH, organic matter.
    - 8No. Speciated Polycyclic Aromatic Hydrocarbons (PAH).
    - 4No. Banded aliphatic/aromatic Total Petroleum Hydrocarbons (TPH).
    - 4No. Benzene, Toluene, Ethylbenzene, Xylene (BTEX) and Methyl Tertiary Butyl Ether (MTBE) compounds.
    - 2No. Semi-Volatile Organic Compounds (SVOC) suite.
    - 4No. Asbestos quantification.

- Geotechnical testing as appropriate to the nature of the ground conditions encountered, but the budget is based on the following testing schedule:

    - 4No. Moisture content.
    - 4No. Plasticity indices.
    - 2No. Particle size distribution by wet sieve.
    - 5No. pH and water soluble sulphate analysis.
    - 5No. Total sulphate and sulphur analysis.

- Provision of a combined factual and interpretative investigation report. Factual findings to include all exploratory point records and test results. Interpretative reporting to include a summary of information from desk study research, a Generic Quantitative Contamination Risk Assessment (GQRA), waste classification and a preliminary Geotechnical Assessment providing comments on pavement design, concrete classification, soakaway feasibility, foundation design recommendations.

1.2.2. Additional Investigation Works

The trial pitting conducted as part of the initial scope identified backfill comprising reworked soils extending to depth across a large proportion of the site and did not fully expose the underlying bedrock. Additionally the site soils were found to be naturally elevated in arsenic due to the underlying Marlstone Rock Formation. To address these outstanding issues a further scope of works was proposed and is outlined below:

- Mobilisation to site and production of health and safety documentation.

- One day of trial pitting using a larger 13T tracked mechanical excavator. The exact number of pits will depend on the depth of backfill and whether any benching of excavations is required or not.

- All exploratory points will be logged and sampled in general accordance with BS5930:2015 by supervising Geo-Environmental Consultant. In-situ geotechnical testing of fine soils using a Hand Shear Vane and/or Pocket Penetrometer.

- Determination of the location of exploratory points by tape measurements or the use of a handheld recreational GPS unit.

- Additional geotechnical testing as appropriate to the nature of the ground conditions encountered, but the budget is based on the following testing schedule:

    - 3No. Moisture content.
    - 3No. Plasticity indices.
    - 2No. pH and water soluble sulphate analysis.
    - 2No. Total sulphate and sulphur analysis.
    - Incorporate findings into main initial investigation report.

- Chemical testing of soil samples with the budget based on the following testing schedule:
    - 2No. BARGE tests to determine arsenic bioavailability.
    - Undertake a bioaccessibility assessment in respect of arsenic to determine site specific assessment criteria (SSAC).
- Incorporate findings into existing investigation report.

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.

At the time of writing, detailed information on the proposed structure, such as detailed layout, loadings and serviceability limits, was not available. Accordingly, where geotechnical design advice is provided it is on the prescriptive basis allowed for by Eurocode 7: employing conventional and conservative design rules. The scope of this investigation excludes a formal slope stability study and any observations made regarding slopes are for information only.

2. SITE CHARACTERISTICS

2.1. SITE SETTING

SITE ADDRESS AND POST CODE	Hempton Road, Deddington, Oxfordshire.
NATIONAL GRID REFERENCE	445970E, 231830N.

2.2. SITE DESCRIPTION

SUBJECT	COMMENTS
CURRENT SITE DESCRIPTION	For the purpose of this report in discerning difference in characteristics, the site has been divided into two areas 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 area has not been in use recently and therefore slightly overgrown. Field B is in use agriculturally and located to the north of Field A, with an access track covered in grass along the eastern boundary of Field A. Field B continues north beyond outlined boundary for planning.
SURROUNDING LAND USE	The site is set in a rural area of agricultural fields but residential areas are present to the south and east.
PROPOSED DEVELOPMENT	It is proposed that the site will be developed with 21No. residential properties, together with associated gardens, access, garages and landscaping.
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.
RADON	Full radon protection measures are required.
HYDROGEOLOGY	The site is situated upon a Secondary A aquifer. The site is not located within a groundwater Source Protection Zone.

SUBJECT	COMMENTS
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

Mewies Engineering Consultants Ltd (M-EC) conducted infiltration testing during June 2018. The site has also been the subject of geo-environmental desk study research by BRD in and this has been reported separately. The relevant investigations are referenced as follows:

- 'Phase 1 Geo-Environmental Desk Study – Hempton Road, Deddington', BRD Environmental Ltd, ref. BRD3567, dated October 2019.
- 'Infiltration Test Results – Hempton Road Deddington Oxfordshire', Mewies Engineering Consultants Ltd, ref. 23933/06-18/6075, date: 18/06/2018.

2.3.1. Phase 1 Geo-Environmental Desk Study – Hempton Road, Deddington

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

At the time of the Desk Study the nature of the fill was unknown, and it was determined that potentially contaminative material may have been present and 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 as a result of the debris observed on the site within the vicinity of the barn and through the process of burning of material previously conducted on the site. The vast majority of site used agriculturally was considered unlikely to be significantly contaminated, however the underlying soils were identified to have potential to be naturally elevated in arsenic, chromium and nickel.

The published geology of the site indicated that there may be a transition in the bedrock in the northern extent of the site from the Marlstone Rock Formation to the Whitby Mudstone Formation.

This current report should be read in conjunction with the previous desk study report.

2.3.2. Infiltration Test Results – Hempton Road, Deddington, Oxfordshire

Mewies Engineering Consultants Ltd (M-EC) conducting infiltration testing in the south east corner of the site during June 2018. The investigation comprised the excavation of two trial pits, SA01 and SA02, to depths of 1.60m and 2.00m respectively. 10No. soakaway tests were completed within the Marlstone Rock Formation, where 3No. tests were undertaken at SA01 and 7No. tests were undertaken at SA02.

The ground conditions recorded from the excavations identified topsoil to a maximum depth of 0.2m bgl comprising reddish brown clayey, gravelly sand with occasional cobble sized pockets of soft brown clay. The topsoil was recorded to be underlain by the Marlstone Rock Formation comprising reddish brown, gravely sand, with an increased gravel component of ironstone cobbles and boulders from 0.6m bgl to the base of the pit.

The investigation identified the Marlstone Rock Formation on the site to be of high permeability with measured rates between 7.77×10^{-4} and 7.35×10^{-3} m/s.

3. GROUND INVESTIGATION

3.1. INVESTIGATION DESIGN

METHODOLOGY	Trial pits were selected as the appropriate technique for the site to expose more of the soils, and as such provide a greater indication of the ground conditions. The trial pits were positioned to determine the nature and extent of the historic quarry. Several trial pits were also undertaken in Field B to identify any naturally occurring elevated metals, and provide geotechnical information of the natural ground in this area. A change in the geological bedrock was anticipated within this area of the site from the desk based research. The initial part of the investigation identified backfill comprising reworked ironstone to depth over a large proportion of the site and failed to expose the bedrock In several locations. To determine the full extent of the backfill and the depth of the underlying bedrock, further trial pitting was conducted with a larger 360º excavator. Where Field B continues north beyond outlined boundary for planning, two trial pits (TP16 & TP17), were conducted to determine if the underlying soils in this area were natural bedrock or reworked ironstone. The trial pits undertaken provided a sufficient number of soil samples to be tested for contamination and geotechnical assessment purposes.	
DATES OF SITE WORKS	The main field works were undertaken on 16th October 2019 and 10th December 2019.	
CONSTRAINTS TO EXPLORATORY HOLE LAYOUT	The storage building is currently located in the north east corner of Field A with hardstanding from the front of the building to the road. No trial pits were conducted in this part of the site.	
EXPLORATORY HOLE SPACING	Approximately 20m spacing.	
LAYOUT RATIONALE	**SOURCE / FEATURE**	**EXPLORATORY HOLE**
CONTAMINATION SOURCES TARGETED	Old quarry	TP01-TP05
	Naturally elevated metals	TP06-TP10
GROUND FEATURES TARGETED	Old quarry	TP01-TP05, TP11-TP17
	Change in bedrock	TP06-TP08

CONTAMINATION SAMPLING PLAN	Based on the proposed end use, the sampling and analysis plan is more positively biased towards near surface and shallow sub-soil samples as these represent the soils most likely to be available to future site users. Where applicable, the sampling has been focussed on soils displaying evidence of contamination as well as soils below or adjacent to such contamination to confirm the degree of migration, if any. The analytical frequency has been increased for samples around the anticipated location of the old quarry as these represent the most likely area for contamination.
ANALYSIS PLAN	Given the history of the site as a quarry within the Phase 1 contamination assessment, testing for a range of contaminants including semi-volatile organic compounds (SVOCs) was undertaken in samples at a range of depths primarily within Field A. As the site has shown to be underlain by the Marlstone Rock Formation associated with elevated arsenic, additional testing for arsenic hase been included to identify any naturally occurring contamination across the area of the site. Furthermore, tests were conducted to assess the bioavailability of the naturally occurring elevated arsenic.

3.2. BRD FIELDWORK

TRIAL PITS	
REFERENCES	TP01 to TP10.
DEPTH RANGE	From 2.30m to 3.10m.
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.

ADDITIONAL TRIAL PITS	
REFERENCES	TP11 to TP17.
DEPTH RANGE	From 2.95m to 3.50m
EXCAVATOR	Tracked 13 Tonne 360° excavator.
BACKFILL	All the trial pits were backfilled with arisings upon completion and compacted by the excavator driving back and forth over the pit locations.

3.3. LABORATORY TESTING

GEOTECHNICAL TESTING	
The soil samples for geotechnical testing were forwarded to the laboratory of Soil Property Testing Ltd with pH and sulphate analysis undertaken at the laboratory of DETS Ltd. The geotechnical testing suite is detailed below. The UKAS accreditation of the individual test methods is shown on the laboratory test report included in the Appendices.	
TEST	**NUMBER OF SAMPLES TESTED**
Moisture content	5
Liquid and plastic limits	5
Particle size distribution by wet sieve	3
pH and Water soluble Sulphate	7
Total Sulphur and Sulphate	7

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	8
Additional Arsenic testing	6
Speciated Polycyclic Aromatic Hydrocarbons (PAH)	8
Total Petroleum Hydrocarbons (TPH) with full carbon banding and aliphatic/aromatic split	4
Benzene, Toluene, Ethylbenzene and Xylenes (BTEX) plus Methyl Tert Butyl Ether (MTBE)	4
Organic Matter, Water soluble Sulphate and pH	8
Asbestos Identification	4
Semi-Volatile Organic Compounds (SVOCs)	2
Arsenic bioavailability	2

4. GROUND CONDITIONS

4.1. OVERVIEW

The published geology indicated that the site was largely underlain by the Marlstone Rock Formation, and an area in the north of the site was underlain directly by the Whitby Mudstone Member. However, the Whitby Mudstone Member was not encountered during the investigation of the site.

Across a large proportion of the site, underlying the topsoil is backfilled material comprising reworked ironstone to a significant depth of typically around 3m. These loose deposits extended further north than anticipated and extending beneath part of the field. Beneath the Made Ground, 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.

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

4.2. ARTIFICIAL GROUND

Hard standing is present at the surface in the eastern area of Field A leading from the access gate to the barn, comprising a concrete drive. No exploratory holes were completed in this area at this time.

A disused water tank is present adjacent to the west of the barn, and is present to a depth of approximately 2m below ground level.

4.3. TOPSOIL

A layer of topsoil or reworked topsoil is present across all of the open field areas of the site and extends to depths in the range 0.20m to 0.35m. It typically comprised 'dark brown sandy, gravelly clay with gravel of fine to coarse limestone and ironstone with frequent rootlets'.

In the south western section of the site the reworked topsoil was noted to be slightly thinner and poorer quality.

4.4. MADE GROUND

In the south western section of the site Made Ground was encountered to depths ranging from 1.2m along the southern boundary to 3.0m in the central and northern area. This soil comprised predominantly reworked ironstone material with typically a clayey upper layer (<1.0m) overlying loose gravel and cobbles of ironstone until the solid bedrock was encountered.

The exception was In TP03 a layer of dark grey to black gravelly sand of ash and clinker was identified from 0.7m to 1.3m bgl including several glass bottles, ceramic and bone.

In the field to the north, loose backfill was also encountered in TP06, TP07 and TP08 to depths of 3.0m. However, given the age of the former quarry, it would seem unlikely that it would have extended to this scale. It is therefore possible that this could be representative of heavily weathered Marlstone Rock, but behaving in the same manner as the backfilled soils elsewhere.

To determine the outer edge of the quarry area a long trial pit (TP12) was undertaken identifying a change from loose reworked ironstone in the west of the pit to layered natural bedrock in the eastern extent of the pit. The transition here from bedrock to the loose Made Ground indicates the edge of the former quarry or loose ground, and at this location, approximately aligns with the eastern boundary of Field A.

4.5. BEDROCK

4.5.1. Marlstone Rock Formation

The Marlstone Rock Formation was encountered at shallow depths in the range 0.30m to 0.7m in the eastern strip of the site. In TP02 towards the south eastern corner it was encountered at 1.20m.

TP11 and TP16 also encountered what is considered to be natural Marlstone but in a loose heavily weathered state and this was encountered at beneath the topsoil.

Elsewhere, the Marlstone was encountered as a layer of competent bedrock at the base of the backfill at depths of 2.90m to 3.0m.

Where encountered at shallow depth in the eastern sections, the Marlstone was described as 'medium dense to dense brown sandy clayey GRAVEL and COBLES of fine to coarse angular tabular ironstone'. With depth the soils became increasingly difficult to excavate. In TP11 and TP16 the soils were similar in makeup but loose and prone to collapse. Increasing boulders were encountered at depth in both cases.

The solid bedrock was not possible to excavate very far, but was described as 'strong light brown ironstone bedrock present as a continuous slab'.

4.5.2. Dyrham Formation

At locations of trial pits TP03 and TP14 within Field A the bedrock encountered was identified as the Dyrham Formation comprising 'firm, greyish brown, slightly gravelly clay' at depths of 1.3m and 3.0m, respectively. This is where the Marlstone Rock Formation thins and the underlying formation is exposed.

4.6. GEOTECHNICAL COMMENTS

The deep Made Ground present across a large part of the site was prone to large scale collapse of the gravel and cobbles of ironstone. In addition, the heavily weathered Marlstone Rock identified in TP11 and TP16 was also noted to be loose and prone to some collapse.

The underlying Marlstone Rock Formation is at depths of approximately 3.0m bgl and greater within the central and northern areas of the site, comprising at depth a strong, ironstone rock slab.

4.7. CONTAMINATION OBSERVATIONS

The layer of Made Ground within TP03 was visibly black in colour containing ash and clinker.

No visual or olfactory evidence of contamination was noted during the forwarding of all other exploratory holes.

4.8. GROUNDWATER BEHAVIOUR

Groundwater was not encountered whilst forwarding the exploratory holes.

5. GEOTECHNICAL PROPERTIES

5.1. COARSE SOIL PARAMETERS

5.1.1. Particle Size Distribution

The grading curves of the three samples of Made Ground subject to PSD determination revealed the soil to be poor graded, clayey, sandy gravel with a fines content ranging from 6% to 16%.

5.2. FINE SOIL PARAMETERS

5.2.1. Index Property Testing

SOIL TYPE	Made Ground.
PLASTICITY INDEX (PI)	Oversize particles present.
MODIFIED PI	7% - 8% (Three samples: Non-shrinkable). 12% (One sample: Low volume change potential).
NHBC CLASS	Non shrinkable soil type.

SOIL TYPE	Dyrham Formation.
PLASTICITY INDEX (PI)	27%
MODIFIED PI	Not applicable – no oversize particles.
NHBC CLASS	Medium volume change potential.

5.3. SULPHATE AND pH

	MADE GROUND AND MARLSTONE ROCK FORMATION			
	Sulphate		pH	
Characteristic Value	100 mg/l		7.6 units	
Justification	Mean of highest 20% results rounded to nearest 100mg/l.		Mean of lowest 20% results.	
	No. of tests	Results Range	No. of tests	Results Range
Soil	15	<10 – 84 mg/l	15	7.3 – 8.0 units
Groundwater	-	N/A	-	N/A
Total Potential Sulphate	7	Not applicable as pyrite unlikely in the samples tested.		

The Dyrham Formation was not tested for sulphate and pH as part of this ground investigation.

6. GEOTECHNICAL ASSESSMENT

6.1. INTRODUCTION

The following advice and recommendations are based on the construction of 21No. residential properties. The proposed development layout plan is included in Appendix 1. From assessment of the nature of the ground conditions and the type of proposed structures, it is considered that the situation falls within EC7 Geotechnical Category 1.

Should the nature of the development be changed then the results of this investigation would need to be reviewed and reassessed.

6.2. EXCAVATIONS

STABILITY	Any excavation requiring man entry should be battered back to a safe angle, supported by an appropriate proprietary trench support system or adequately shored to provide safe working conditions. Shoring to any excavation requiring man entry must be designed by a suitably qualified and experienced engineer. Any support system will require regular inspection as detailed in published guidelines to ensure the excavation support is adequate and appropriate for the ground conditions present. Most of the site has a cover of deep Made Ground and it is anticipated that excavations will be prone to sidewall collapse and will require temporary support to remain open. Excavations within the Marlstone Rock Formation may suffer from the catching of boulders with the excavator bucket then pulling in the trench sides. The presence of rock bands or large boulders within this formation may make it necessary to employ a larger excavator or hydraulic breaker equipment on occasions. Narrow trench excavations in the clay soils of the Dyrham Formation will remain relatively stable and open for short periods, but minor spalling of side walls could still occur.
EQUIPMENT	It should be possible to progress excavations with conventional equipment. The removal of sub-surface structures following demolition will require the use of hydraulic breaking equipment. Rock is present beneath the site at a depth which is envisaged that it will not cause a construction difficulty for excavators grater that 13T in size. If exceptionally deep excavations are required, e.g. for drains, then the use of hydraulic breaking equipment may be required to forward excavations.
GROUNDWATER CONTROL	Specific groundwater control is unlikely to be required at this site. Limited pumping from sumps or bailing out may be required to deal with slight seepages or surface water ingress during periods of inclement weather.
PARTY WALL ISSUES	As there are no nearby third party structures, the Party Wall Act is unlikely to apply to the development.

6.3. SLOPE STABILITY

The site is relatively flat and no significant changes in level as part of the development are anticipated. It is therefore considered that slope stability is unlikely to be a significant concern at this site.

6.4. SUB-SURFACE CONCRETE

ALL ON-SITE SOILS	
SITE / SOIL CATEGORY	Natural ground (Marlstone Rock and Dyrham Formation). Brownfield. (Made Ground)
DESIGN SULPHATE CLASS	DS-1
GROUNDWATER REGIME	Static.
AGGRESSIVE CHEMICAL ENVIRONMENT FOR CONCRETE (ACEC) CLASS	AC-1s
COMMENTS	Static groundwater conditions have been selected as groundwater is expected to be permanently below the lowest level of proposed construction.

6.5. SOAKAWAYS

The majority of the site is unsuitable for private soakaways due to the loose material which could be subject to inundation settlement.

However, the proposed drainage solution is positive drainage into an attenuation pond in the south eastern corner of the site and this is in an area of competent natural strata.

A drainage report was conducted in this part of the site and soakage tests undertaken in the gravelly soils of the Marlstone Rock Formation recorded good permeability rates.

There is the possibility that the western boundary of the proposed pond may be in contact with the deep Made Ground and therefore it will be necessary to ensure that the run-off water percolates only into the natural ground by the installation of a pond liner/membrane across this boundary. This aspect should be inspected by a geo-environmental consultant.

6.6. PAVEMENT CONSTRUCTION

Due to the depth of Made Ground covering the site, it is recommended that a preliminary design California Bearing Ratio (CBR) of less than 2% is assumed at this stage.

Increased road pavement construction thickness should be anticipated where paved areas cross over ground disturbed by the removal of the existing structures. In areas of deep Made Ground, the use of geo-grid should be used to re-inforce the sub-base.

All unsuitable soils, such as topsoil or desiccated soils, should be removed from beneath proposed paved areas. The exposed sub-grade formation should then be proof rolled to reveal any excessively soft or compressible zones and any such features identified also removed by excavation. Where unsuitable materials are removed, the resultant voids should be filled in layers

with appropriately compacted suitable granular fill. To reduce the loss of granular construction materials into the sub-grade, consideration should be given to utilising a geotextile starter layer across the formation level.

6.7. PRELIMINARY FOUNDATION RECOMMENDATIONS

6.7.1. Introduction

The following recommendations are mostly centred on Field A as it is the part of the site which is under planning application, however, because the site investigation has slightly extended into the northern Field B and similar ground conditions have been recorded, the similar recommendations are likely to be applicable.

The site, Field A, it is proposed to be developed with 21No. new residential properties with rear gardens, allocated parking spaces and access roads.

The reworked ironstone Made Ground soils, were noted to be of variable consistency and sometimes noted as being loose in nature with occasional collapse of the trial pit sidewalls encountered. These reworked soils are not usually suitable as bearing strata. Therefore, the location of where these soils extend to a significant depth (>2.50m) is likely that ground improvement or a piled foundation solution will be required as conventional footings would be deemed to be too deep or difficult to construct.

However, for those areas where these deposits are recorded to depths of less than 2.5m, in particular, south and eastern boundaries, it is considered that shallow spread foundations may be adopted for the proposed residential properties emplaced within the Marlstone Rock Formation and/or Dyrham Formation recorded along these areas.

Where footings straddle different soil types, gravel and clay, they will require reinforcement.

6.7.2. Floor Slabs

Due to the depth of Made Ground across the site, fully suspended floor slabs designed and constructed in accordance with NHBC Standards are recommended at this development.

With reference to Section 2.2, the floor construction will have to incorporate full radon gas protection measures.

6.7.3. South and eastern site boundaries

6.7.3.1. Traditional Footings

East and southern boundaries have been recorded with fill thickness of less than 2.5m and then these parts of the site are suitable for the adoption of shallow strip/trench fill footings. Foundations should be taken through Made Ground/topsoil to bear upon the Marlstone Rock Formation and/or Dyrham Formation.

Due to the rapid potential variation in ground conditions likely to be encountered at those areas of the site of the site, steel mesh reinforcement of the footings is generally recommended to guard against the potential for differential settlement.

For eastern boundary and part of the southern boundary when the Marlstone Rock is recorded, a presumed bearing value of 125kN/m^2 is considered appropriate for foundations up to 1m wide bearing upon the gravel and cobbles of ironstone rock. Immediate and long term settlement should be within tolerable limits and take place largely during the construction period.

The minimum foundation depth required is to found below the Topsoil/Made Ground.

For southern boundary a presumed bearing value of 85kN/m^2 is considered appropriate for foundations up to 1m wide bearing upon the clay soils of the Dyrham Formation. Immediate and long term settlement should be within tolerable limits and take place over several years.

The Dyrham Formation clay has been shown to have a medium volume change potential when assessed against NHBC standards and therefore the minimum foundation depth required is 0.90m, but 1.25m where required to allow for restricted new tree planting. Under the NHBC Standards, foundation depths have to be increased if they are within the influence zone of felled trees, existing trees or proposed tree planting. A hedge of coniferous trees was recorded along the southern boundary and foundation depth in that area should consider tree zone of influence of these trees.

It should be noted that where trees are in groups the resulting competition for resources can lead to deeper root systems than allowed for in the NHBC Standards. In any event, foundations should be taken below any roots encountered in foundation trench excavation. Where the required foundation depth varies around a structure, this can be accommodated by forming steps in the foundation as per NHBC Standards.

Where foundation depths exceed 1.50m in clay soils and are within the zone of influence of existing or felled trees or where foundations cut through tree roots, a compressible void former will be required against the internal faces of new foundations in order to accommodate potential long term soil heave. Such precautions against heave should be designed and constructed in accordance with NHBC Standards.

6.7.3.2. General Comments

A number of trees and tree stumps are located along the site boundaries. It will be necessary to remove all unwanted trees, stumps and root structures prior to commencing with the development. Any resultant void should be backfilled accordingly with respect to the preferred foundation design.

Where existing structures are to be demolished it is difficult to predict potential footing depths as the demolition works and foundation removal are likely to disturb the soils and therefore locally over deepened footings should be anticipated in areas of former structures.

During construction, any soft spots found at foundation formation level should be excavated and replaced with lean mix concrete. Foundation excavations should be kept dry and left open for the minimum amount of time possible. Where foundations cannot be completed immediately, a blinding layer of concrete should be placed.

6.7.4. Majority of the site

As mentioned before, most of the site is covered with mostly loose Made Ground and then a different foundation approach should be considered.

6.7.4.1. Ground Improvement

It may be considered more economical to adopt a foundation solution employing ground improvement techniques to improve bearing capacity and also reduce the risk of adverse settlement.

The use of vibro-replacement stone columns would lead to densification of the Made Ground such that shallow reinforced strip footings could then be employed. This solution also had economic benefits and wider sustainable construction gains as the amount of concrete and steel is reduced in comparison to a piled solution.

Discussions with specialist contractors should be held to confirm that their particular technique is suitable for the ground conditions at the site.

Ground improvement techniques such as dynamic compaction, excavation and replacement with suitable engineered fill, and surcharging for to allow the use of shallow spread foundations are not generally accepted by construction warranty providers, e.g. NHBC, and are therefore not discussed.

6.7.4.2. Piling

As an alternative to ground improvement techniques, a piled foundation design could be used due to the depth of the Made Ground and potential for instability of excavations.

In order to confirm deeper ground conditions for pile design further ground investigation is recommended.

6.8. RECOMMENDATIONS FOR FURTHER GEOTECHNICAL WORK

If required, in order to confirm deeper ground conditions for pile or vibro ground improvement design further ground investigation comprising deep combined rotary cable percussive boreholes is recommended. It is suggested that 2No. boreholes are drilled to depths of 18m. Monitoring wells should be included in the boreholes and at least one post work monitoring visit should be undertaken to record groundwater levels. Insitu Standard Penetration Tests should be conducted during forwarding of the boreholes and collected soil samples submitted for appropriate geotechnical laboratory testing.

7. RISK ESTIMATION – SOILS

7.1. HUMAN HEALTH

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

CONTAMINANT	UNITS	NUMBER OF TESTS	MAXIMUM CONCENTRATION	GAC	NUMBER EXCEEDING GAC
Arsenic	mg/kg	14	301	37	14
Cadmium	mg/kg	8	3.1	22	0
Chromium (hexavalent)	mg/kg	8	<2	21	0
Chromium (total)	mg/kg	8	336	910	0
Copper	mg/kg	8	335	2,400	0
Lead	mg/kg	8	607	200	1
Mercury	mg/kg	8	<1	11	0
Nickel	mg/kg	8	106	180	0
Selenium	mg/kg	8	<3	250	0
Zinc	mg/kg	8	3030	3,700	0
pH	Units	13	8	<5-10>	0
Naphthalene	mg/kg	8	0.21	2.3	0
Acenaphthylene	mg/kg	8	<0.1	170	0
Acenaphthene	mg/kg	8	<0.1	210	0
Fluorene	mg/kg	8	<0.1	170	0
Phenanthrene	mg/kg	8	0.76	95	0
Anthracene	mg/kg	8	<0.1	2,400	0
Fluoranthene	mg/kg	8	1.47	280	0
Pyrene	mg/kg	8	1.24	620	0
Benzo(a)anthracene	mg/kg	8	0.67	7.2	0
Chrysene	mg/kg	8	0.79	15	0
Benzo(b)fluoranthene	mg/kg	8	0.84	2.6	0
Benzo(k)fluoranthene	mg/kg	8	0.33	77	0
Benzo(a)pyrene	mg/kg	8	0.47	2.2	0
Indeno(1,2,3-cd)pyrene	mg/kg	8	0.36	27	0
Dibenzo(a,h)anthracene	mg/kg	8	<0.1	0.24	0
Benzo(ghi)perylene	mg/kg	8	0.28	320	0
TPH Aliphatic C5-C6	mg/kg	4	<0.01	42	0
TPH Aliphatic C6-C8	mg/kg	4	<0.05	100	0
TPH Aliphatic C8-C10	mg/kg	4	<2	27	0
TPH Aliphatic C10-C12	mg/kg	4	<2	130	0
TPH Aliphatic C12-C16	mg/kg	4	<3	1,100	0
TPH Aliphatic C16-C35	mg/kg	4	<10	65,000	0
TPH Aliphatic C35-C44	mg/kg	4	<10	65,000	0

CONTAMINANT	UNITS	NUMBER OF TESTS	MAXIMUM CONCENTRATION	GAC	NUMBER EXCEEDING GAC
TPH Aromatic C5-C7	mg/kg	4	<0.01	70	0
TPH Aromatic C7-C8	mg/kg	4	<0.05	130	0
TPH Aromatic C8-C10	mg/kg	4	<2	34	0
TPH Aromatic C10-C12	mg/kg	4	<2	74	0
TPH Aromatic C12-C16	mg/kg	4	<2	140	0
TPH Aromatic C16-C21	mg/kg	4	<3	260	0
TPH Aromatic C21-C35	mg/kg	4	<10	1,100	0
TPH Aromatic C35-C44	mg/kg	4	<10	1,100	0
Benzene	mg/kg	4	<2	0.87	0
Toluene	mg/kg	4	<5	130	0
Ethylbenzene	mg/kg	4	<2	47	0
Xylene (total of all types)	mg/kg	4	<2	56	0
Methyl Tert Butyl Ether (MTBE)	mg/kg	4	<5	49	0
Semi-Volatile Organic Compounds (SVOCs)	mg/kg	2	<LOD	LOD*	0
Asbestos	Presence	4	<0.001	Fibres Present	0
Hydrocarbon Vapour (PID)	ppm	25	0.0	50	0
Notes: *Limit of detection: Given the large amount of compounds in this group, coupled with the lack of GAC for certain compounds, any concentrations above the limit of detection will be highlighted in the first instance.					

RESULTS EXCEEDING HUMAN HEALTH ASSESSMENT CRITERIA	
LEAD	When compared to the generic assessment criteria of 200mg/kg, a single elevated concentration of lead was recorded in the layer of black gravelly sand of ash and clinker at concentrations of 607mg/kg in TP03.
ARSENIC	Elevated arsenic has been identified consistently across the site within the near surface soils, the reworked backfill and the natural bedrock at similar concentrations. There is no discernible difference in soil types between the arsenic distribution and therefore the arsenic is considered to be associated with the natural geochemistry of the iron rich sandy soils (as evidenced by their strong orange coloration), whether they be natural or reworked. Naturally elevated arsenic is common in iron rich soils, such as the Jurassic strata through middle England and glacial and river deposits formed from them. In the case of arsenic it is therefore appropriate to consider all of the samples as being one dataset. Furthermore, 6No. samples tested for arsenic were from the near surface topsoil and the remaining 7No. tests were of samples collected from the reworked ironstone and a single sample was collected from the natural bedrock. These results ranged from 79 mg/kg – 301 mg/kg all, with similar results deriving from the near surface soils and those from the reworked ironstone. Hence, the test results are considered a single dataset of 14No. samples.

RESULTS EXCEEDING HUMAN HEALTH ASSESSMENT CRITERIA	
	A normality plot was undertaken which demonstrated that the arsenic concentrations for the 14No. samples did not approximate to a normal distribution as a result of the value at 301 mg/kg from the deepest sample at 2.5m bgl, however the maximum value test demonstrated that there are unlikely to be any statistical outliers. The mean arsenic concentration was 156 mg/kg and the upper 95th percentile was 181 mg/kg. The risk from the elevated arsenic is considered separately below.

7.1.1. Site Specific Human Health Risk Assessment for Arsenic

7.1.1.1. Arsenic Bioavailability

Whether arsenic in contaminated soils poses a human health risk depends upon the potential of the arsenic to leave the soil and enter the bloodstream. The use of total arsenic concentrations in soil to assess this risk is a conservative approach as it assumes that all the metal content of the soil is available for adsorption by the body.

The Contaminated Land Exposure Assessment (CLEA) model derived Suitable for Use Levels (S4ULs) for arsenic are significantly exceeded by many natural soils in the United Kingdom. It is therefore clear that a practical methodology for taking into account the relative oral bioavailability of arsenic in soil compared to that found in drinking water (the medium upon which the toxicological data is based) is required. The oral bioaccesibility is the fraction of ingested arsenic that can be absorbed into the systemic circulation and therefore available to give rise to toxic effects.

The Bioaccesibility Research Group of Europe (BARGE) developed a Unified Method is an in vitro method for simulating the human digestive system through the use of synthetic digestive fluids. This method provides an indication of the oral bioaccesibility of the arsenic as a measure of its solubility within the gastrointestinal tract.

The test procedure is essentially replicates passage of the soil through the human gastro-intestinal tract through three different compartments: mouth (5 minutes), stomach (1 hour) and small intestine (4 hours), and is undertaken at body temperature. This measure of oral bioaccesibility can therefore be factored into the risk estimation stage as the amount of arsenic that is actually absorbed by the human body will be less than or equal to the amount which is mobilised.

7.1.1.2. Unified BARGE Method Results

The Unified BARGE Method test recorded the total arsenic concentration in 2No. samples of 140 mg/kg and 210 mg/kg and was consistent with the initial results recorded in the other samples by DETS.

The result of the extraction recorded very low values of 1.5% and 1.6%. The worst case relative bioavailability of 1.6% and has been adopted in the risk assessment model.

7.1.1.3. Risk Assessment Model

The current CLEA model (Version 1.07) has been chosen to derive site specific assessment criteria for this assessment. The model incorporates the latest UK legislation is used for derivation of the C4SL values and is therefore considered to be the most appropriate model. The model also allows the user to input bioaccesibility data.

The model has been used with all of the same parameters used to derive the C4SL with the only variable being the oral bioavailability, which has been entered in to the model.

7.1.1.4. Site Specific Assessment Criteria for Arsenic

The Site Specific Assessment Criteria (SSAC) for arsenic has been calculated as 411 mg/kg. The results of the CLEA model assessment are presented in the Appendices.

The maximum recorded total concentration of arsenic was 301 mg/kg. Therefore, the calculated SSAC of 411 mg/kg exceeds the maximum recorded arsenic concentration at the site. In light of this result it is considered that the bioavailability testing confirms there is no significant risk to human health from the elevated arsenic.

7.2. 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.

7.3. BUILDING MATERIALS

CONTAMINANT	UNITS	NUMBER OF TESTS	MAXIMUM CONCENTRATION	GAC	NUMBER EXCEEDING GAC
pH	units	13	7.3	<5.5	0
Sulphate (w/s)	mg/l	13	84	500	0
Sum of any VOC above detection limits	mg/kg	2	Below detection limits	0.5	0
Sum of SVOC + Aliphatic TPH >C5-C10 + Aromatic TPH >C5-C10 above detection limits	mg/kg	2	Below detection limits	2	0
Sum of Aliphatic TPH >C10-C21 + Aromatic TPH >C10-C21 above detection limits	mg/kg	4	Below detection limits	10	0
Sum of Aliphatic TPH >C21-C34 + Aromatic TPH >C10-C35 above detection limits	mg/kg	4	Below detection limits	500	0
Sum of BTEX + MTBE above detection limits	mg/kg	4	Below detection limits	0.1	0
Phenols	mg/kg	2	<0.1	2	0
Cresols and chlorinated phenols	mg/kg	2	<0.15	2	0
Naphthalene	mg/kg	8	0.21	0.5	0
Benzo(a)pyrene	mg/kg	8	0.47	0.5	0

None of the samples record any contaminants at concentrations exceeding their respective assessment criteria.

8. RISK EVALUATION

8.1. REVISED CONCEPTUAL MODEL

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

ADDITIONAL POLLUTANT LINKAGES	During the ground investigation, no additional sources of contamination were identified.
INVALID POLLUTANT LINKAGES	Although the naturally occurring arsenic is at elevated concentrations across the site, the bioavailability of the arsenic is very low and therefore demonstrated to not pose a contamination risk. Within the vicinity of the barn, no asbestos fibres or hydrocarbon contamination above the detection limits were identified. However, parts of the asbestos cement sheeting on the lean-to structure of the barn was in poor condition and it is anticipated that some asbestos cement fragments may be present on the surface in this area. Therefore, all asbestos fragments will be required to be removed off-site during the preliminary site clearance works. The topsoil was found to be uncontaminated, therefore the previously identified bonfires do not pose a contamination risk. The former quarry has been primarily backfilled with reworked ironstone, therefore landfill gases deriving from the degradation of the backfill material are not anticipated on the site due to a lack of any organic material within the backfill. A single elevated lead value is present within a layer of sandy ash within the backfilled material at approximately 0.8m bgl. Given that the elevated lead sample was from a significant depth below the surface and a sample from the same location at a shallower depth of 0.4m did not return as elevated (129mg/kg), lead is not considered to pose a risk to the future residents based on the current situation. However, should site levels be altered the lead could end up closer to the surface. In addition the ashy strata containing the elevated lead may vary in depth across the area. It is not considered that the lead concentration recorded is not significantly elevated to pose a risk to the aquifer or future buried materials and services.
LIMITATIONS AND UNCERTAINTIES	Due to access restrictions, it was not possible to undertake any exploratory holes under the barn floor slab at this stage. Elsewhere, all of the potential contamination sources have been targeted by the exploratory holes and therefore there are no other significant limitations.

8.2. 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
Naturally elevated arsenic in the topsoil, the underlying reworked ironstone, and the bedrock.	Ingestion of dust Dermal contact Inhalation of dust Consumption of home grown produce	Residents	Negligible Risk
Quarry fill	Ingestion of dust Dermal contact Inhalation of dust Consumption of home grown produce (1)	Residents	Low Risk
	Horizontal & vertical migration	Groundwater	Negligible Risk
	Direct Contact	Building materials and services	Negligible Risk
Bonfires	Ingestion of dust Dermal contact Inhalation of dust Consumption of home grown produce	Residents	Negligible Risk
	Horizontal & vertical migration	Groundwater	Negligible Risk
	Direct Contact	Building materials and services	Negligible Risk
Barn	Ingestion of dust Dermal contact Inhalation of dust Consumption of home grown produce (2)	Residents	Negligible Risk*
	Horizontal & vertical migration	Groundwater	Negligible Risk*
	Direct Contact	Building materials and services	Negligible Risk*

Notes: *subject to further investigation

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

RISK TO HUMAN HEALTH
No significant contamination risks to human health have been identified by this investigation. However, there is a localised area of buried ashy Made Ground which contains elevated lead, as well as potential contamination beneath the existing building yet to be investigated.

RISK TO WATER ENVIRONMENT
No significant risks identified, subject to confirming beneath the existing building.

RISK TO BUILDING MATERIALS AND SERVICES
No significant risks identified subject to confirming beneath the existing building.

8.3. RISK MANAGEMENT

8.3.1. Introduction

It is recommended that this report is submitted to the planning department of the Local Authority, the organisation undertaking the Building Control function to confirm that the investigation completed to date is satisfactory.

8.3.2. Further Contamination Assessment

It is recommended that additional ground investigation in the form of trial pits is undertaken around the position of TP03 to further assess the extent and depth of the buried ashy material in this location and undertake additional lead testing from the soils to confirm if any risk is presented to future residents.

In addition, following the demolition of the existing building, further exploratory holes should be completed in this area to determine whether or not there are any contamination risks.

8.3.3. Outline Remediation Strategy

At this stage it has been demonstrated that the vast majority of the site is uncontaminated and does not require any remedial measures. In the south eastern corner the buried ashy materials appear to be at a depth which will not affect future residents, but additional exploratory holes are required to confirm this as well as confirming the finished ground levels. Should the lead concentrations be confirmed to be elevated and the ashy material will be present near surface, then some form of capping layer will likely be required for areas of garden and landscaping in the south western corner of the site.

In the vicinity of the building, there is unlikely to be any significant contamination as other exploratory holes have been completed nearby with no contamination recorded. However, any localised contamination will likely have to be dealt with by either off site removal or additional soil capping.

Any surface asbestos fragments located in the area of the barn should be removed under controlled conditions as part of site clearance activities.

All remediation works should be supervised and verified by an experienced Geo-Environmental Consultant. The remediation works should be documented in a Verification Report.

8.4. 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 the surplus reused on other developments. 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 the any 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'. 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 will also be required where the soil is to be disposed of at a landfill permitted to accept inert waste. 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 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 the soils for disposal will also be required if the soil is to be disposed of to landfill. The waste code from the European Waste Catalogue (EWC) 2002 for the soils would be 17 05 03 'Soil and Stones, containing dangerous substances'.

As discussed above it is recommended that further delineation of this soil is undertaken in order to assess the human health risk and the waste soil classification can also be further confirmed as part of this process.

9. HEALTH AND SAFETY FILE INFORMATION

9.1. 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.

Where BRD has been appointed as a Principal Contractor, then this information shall form the Health and Safety Files as required by the Construction Design and Management (CDM) Regulations 2015.

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.

9.2. HAZARDS

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

9.2.1. 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. Equally, 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. 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.

9.2.2. Asbestos

Materials potentially containing asbestos were noted in the debris surrounding the barn and may pose a risk to those undergoing clearance of the site. All the surface asbestos containing material should be removed from the site as part of site clearance activities prior commencing the development. These works should be undertaken in accordance with Health and Safety Executive (HSE) guidance by contractors trained in working with non-licensed asbestos.

In accordance with Health and Safety Executive (HSE) guidance, a 'Refurbishment Demolition Survey' (RDS) should be undertaken to identify whether or not asbestos containing materials are present in the existing structure(s) prior to demolition or refurbishment. The results of the survey should then be used to plan for the safe management, removal and disposal of asbestos containing materials from the existing buildings and infrastructure should such materials be present.

9.2.3. 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 without a secure cover and containing water.

9.3. 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.

9.4. 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.

9.5. UTILITY SERVICES

No previously unidentified utility services were encountered during the BRD works.

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

The utility service companies should be contacted for records of their own equipment.

REPORT SPECIFIC REFERENCES

- 'Phase 1 Geo-Environmental Desk Study – Hempton Road, Deddington', BRD Environmental Ltd, ref. BRD3567, dated October 2019
- 'Mewies Engineering Consultants Ltd (M-EC), 'Infiltration Test Results', ref. 23933/06-18/6075, date: 18/06/2018.

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.

Dynamic Probing

Dynamic probing comprises a sectional rod with a sacrificial cone at the base of slightly larger diameter than the rod. The rod is driven into the ground by a constant mass falling through a set distance. The number of blows required to forward the rod per 100mm is then recorded and presented in a graph of N_{10} values. The standard applicable to dynamic probing is "BS EN ISO 22476-2:2005 Incorporating corrigendum No. 1, Geotechnical investigation and testing — Field testing — Part 2: Dynamic probing" BSi, February 2007.

Static Cone Penetration Tests

Cone Penetration Tests (CPT) consist of pushing a conical 60° cone into the ground at a constant rate and recording the force required to do this. Sensors in the cone record other information and this data can be correlated to a number of different geotechnical parameters.

Dynamic Penetrometer

The Transport Research Laboratory Dynamic Cone Penetrometer (TRL DCP) uses an 8 kg hammer dropping through a height of 575mm to drive a 60° cone of 20mm maximum diameter into the ground. The depth driven either per blow or per several blows is recorded. The strength of each of the soil layer encountered is then calculated by converting the penetration rate (mm per blow) into an approximate California Bearing Ratio (CBR) value employing the correlation proposed by TRL.

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.

Geotechnical Sampling

BRD schedule a range of geotechnical testing as appropriate to the identified ground conditions, available budget and the proposed development. Different types of soil samples are obtained as appropriate to the ground conditions and planned testing.

SAMPLE TYPE	SYMBOL USED ON LOGS	DESCRIPTION
Disturbed	*D*	*Small disturbed soil samples of about 1 to 2 kg are collected in plastic bags.*
Bulk	*B*	*Large disturbed bulk samples up to about 20 to 30 kg are collected in plastic bags*
Undisturbed	*U*	*'Undisturbed' samples generally collected in plastic or metal tubes within cable percussive boreholes of 100mm diameter for samples of fine soils of firm to stiff consistency. Can also be representative of samples taken by cutting plastic sample liners from windowless sampling drilling methods. It is recognised that such samples do not generally meet Eurocode sample quality requirements for the tests commonly employed. However, given the wealth of experience with these sampling methods this continues to be common in United Kingdom practice particularly for less sensitive developments where more expensive sampling techniques are not economically justifiable.*
Undisturbed	*UT*	*A thin walled steel sampler developed by Archway Engineering called a UT100 in an attempt to gain better quality samples of soft to firm fine soils when using cable percussive drilling methods.*

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.

GEOTECHNICAL ASSESSMENT

Under Eurocode 7 (EC7) the following risk ranking is applied to geotechnical projects:

GEOTECHNICAL CATEGORY	***DESCRIPTION***
1	*Small and relatively simple structures for which it is possible to ensure that the fundamental requirements will be satisfied on the basis of experience and qualitative geotechnical investigations with negligible risk. For example, straightforward ground conditions, local experience, no excavation below the water table unless this will be straight forward.*
2	*Conventional types of structures and foundations. No difficult soil or loading conditions. Quantitative geotechnical data and laboratory testing. Routine procedures for field and laboratory testing. Conventional structures and no exceptional geotechnical risk. For example, spread, raft and piled foundations, retaining walls, bridge piers and abutments, embankments, ground anchors, tunnels and excavations.*
3	*Those structures not in Categories 1 and 2 such as very large or unusual structures, structures involving abnormal risks, or unusual or exceptionally difficult ground or loading conditions. Structures in highly seismic areas. Structures in areas of probable site instability or persistent ground movements that require separate investigation or special measures.*

GEOTECHNICAL PARAMETERS

Soakage Tests

Soakage tests comprise the filling of a test pit with water and recording the time taken for the water to drain away. The tests are undertaken in general accordance with 'Digest DG 365: Soakaway design' BRE, Revised 2016. The test pits are usually gravel filled for safety with a slotted vertical pipe through which water observations are made. Water is generally supplied by a tanker to allow fast filling of the pits with water. Compliant tests are filled and allowed to drain near empty three times.

Standard Penetration Tests

The standard penetration test (SPT) determines the resistance of soils at the base of a borehole to the dynamic penetration of a split barrel sampler and the recovering of disturbed samples for identification purposes. In gravelly soils and some soft rocks a solid cone is used in preference to the sampler.

The basis of the test consists in driving a sampler by dropping a hammer of 63.5 kg mass on from a height of 760 mm. The number of blows (N value) necessary to achieve a penetration of the sampler of 300 mm is recorded. The test is described in 'Geotechnical investigation and testing — Field testing — Part 3: Standard penetration test - BS EN ISO 22476-3:2005 Incorporating corrigendum No. 1', BSi, 2007.

The uncorrected N values of the SPT tests are recorded upon the borehole logs together with a record of blows for each 75mm test portion including the seating blows. Where the full test depth cannot be achieved due to refusal on hard stratum, the number of blows and the distance achieved is recorded and the N value given as >50. The abbreviation SPT(c) is used upon the logs indicates that the test was performed with a solid cone rather than a split spoon sampler.

It is necessary to apply a correction to the N values to account for the effects of energy delivery using the equation: $N_{60} = \frac{E_r}{60} N$ *where* E_r *is the energy ratio of the specific test equipment.*

In the case of tests in sand, for the effects of overburden and rod length the equation is modified to $N_{60} = \frac{E_r}{60} \; x \; \lambda \; x \; C_N \; x \; N$ *where* λ *is the correction factor for energy losses due to the rod length and* C_N *is the correction factor for vertical stress due to overburden of the soil.*

Sulphate

In order to compare the laboratory soil test results with 'Concrete in aggressive ground. BRE Special Digest 1: 2005' (BRE, 2005) laboratory results are converted to SO_4 *mg/l. Laboratory results expressed as* SO_3 *g/l and are multiplied by a factor of 1200 to express the results as* SO_4 *mg/l.*

Index Property Tests

In accordance with National House Building Council (NHBC) Standards Chapter 4.2 – Building near trees, the laboratory plasticity indexes are assessed against their volume change potential. The Modified Plasticity Index is defined as the Plasticity Index of the soil multiplied by the percentage of particles with a nominal diameter of less than 425µm. Whilst the NHBC Standards were developed for residential buildings, the advice is equally applicable to a large number of other types of low rise structures.

Hand Shear Vane

The undrained shear strength of the fine (i.e. clay) soils at the site can be established using hand shear vane apparatus. Usually three readings are taken at every depth tested and the uncorrected results recorded on the exploratory point log. Shear vane readings from depths below 1.2m depth in trial pits are from tests performed on excavated soil. In accordance with Eurocode 7 — Geotechnical design — Part 2: Ground investigation and testing EN 1997-2:2007 the results should be corrected. BRD employ only simple correction methods as the more complex correction methodologies imply undue accuracy to a test that has distinct disadvantages and limitations.

Pocket Penetrometers

The Pocket Penetrometer is a lightweight instrument for use by field personnel to check visual classification of soils. It is a simple test and there is inherent uncertainty related to the small volume of soil being tested and so the results should be used with appropriate caution. Pocket penetrometers are calibrated in terms of unconfined compressive strength and once converted to undrained shear strength (divide by two) the results are further reduced by a factor of 1.5 - 2.0 as the device tends to overestimate strengths.

Instrument Reading (uncompressive strength in kg/cm²)	*Indicative Undrained Shear Strength (kN/m²)*	*Indicative Consistency*	*Indicative strength*
1.0	*25 – 33*	*Soft*	*Low*
1.5	*38 – 50*	*Soft to firm*	*Low to medium*
2.0	*50 - 67*	*Firm*	*Medium*
2.5	*63 – 83*	*Firm to stiff*	*Medium to high*
3.5	*88 – 116*	*Stiff*	*High*
4.5	*113 – 150*	*Stiff to very stiff*	*High to very high*

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)[S]	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	-

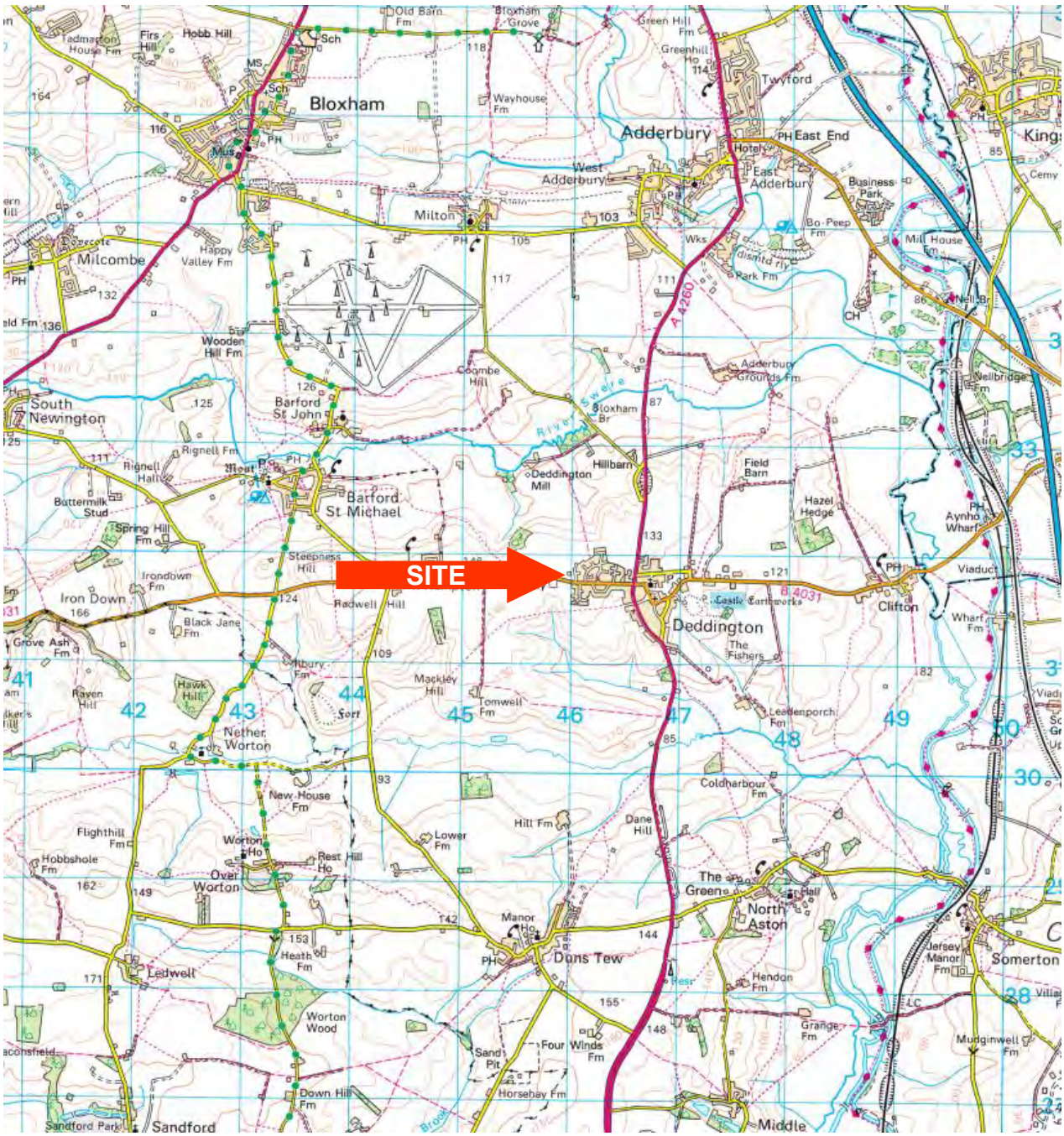
Low rise housing with gardens – NHBC 'Traffic Lights'

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

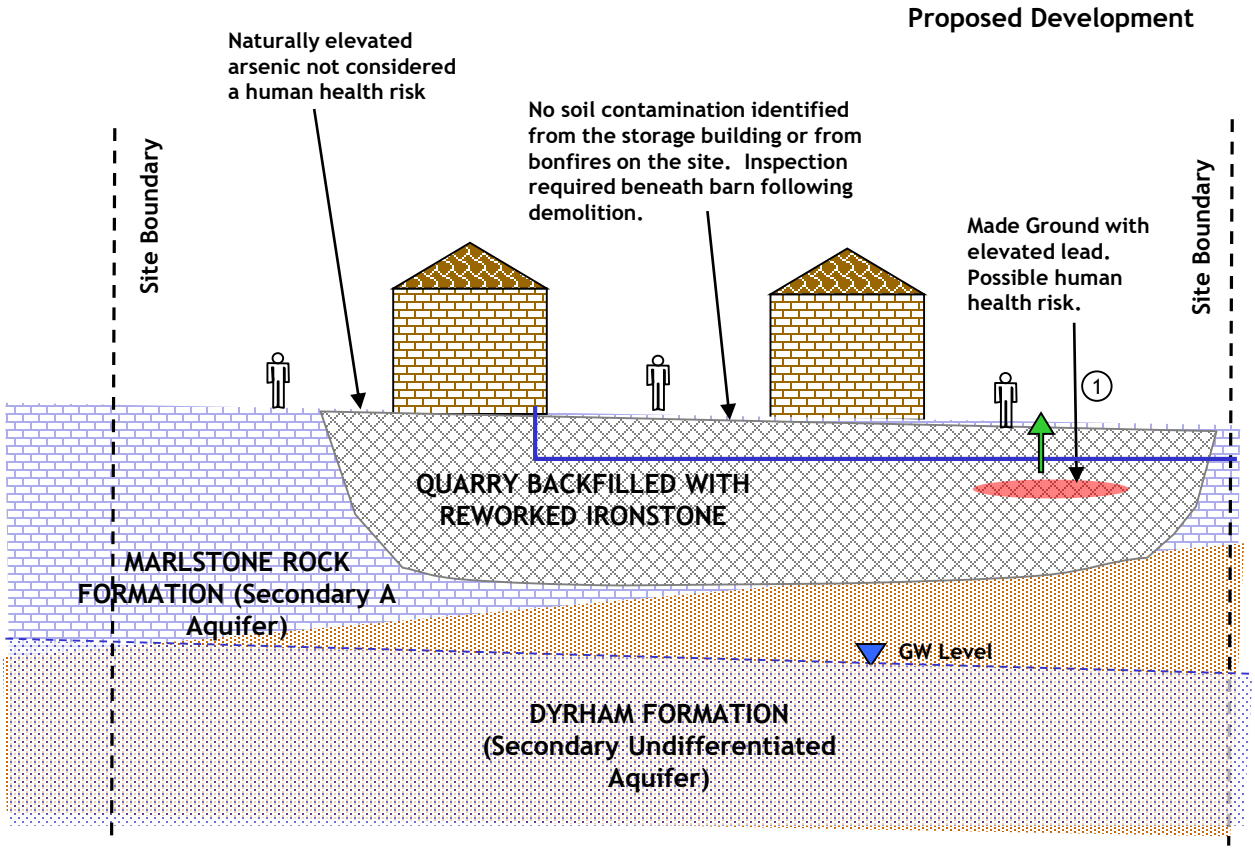


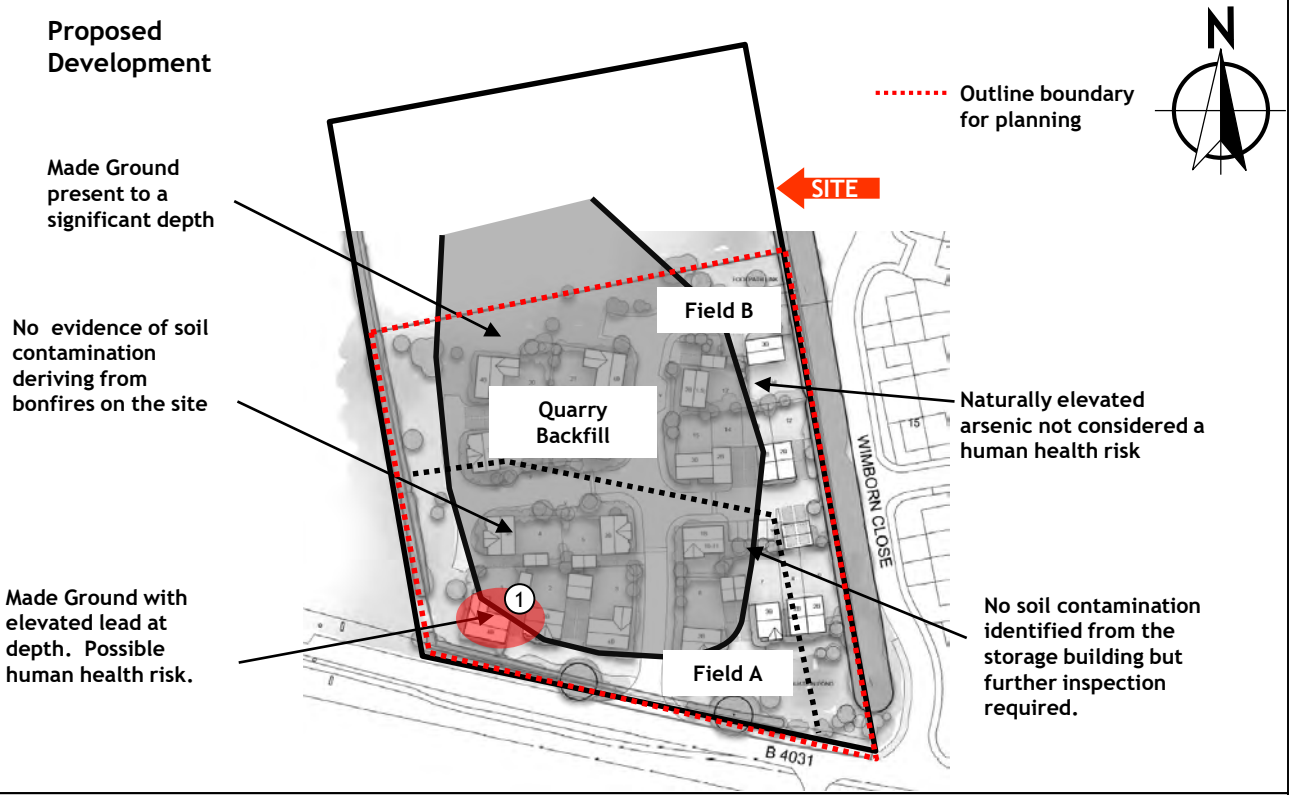
Not to scale.

Project Title:	Hempton Road, Deddington
Client:	Pembury Estates Limited
BRD Reference:	BRD3567-OP2-A
Date Issued:	October 2019

BRD
01295 272244
info@brduk.com

Initial Conceptual Model





Project Title:	Hempton Road, Deddington.
Client:	Pembury Estates Limited
BRD Reference:	BRD3567-OP7-A
Date Issued:	January 2020

BRD
01295 272244
info@brduk.com

NOTES:

AT ARCHITECTURE LIMITED
WWW.ATARCHITECTURELTD.COM
26 THE RIDE, THE GRANGE, DESBOROUGH, NN14 2HZ
ASHLEY.THOMPSON@AT-ARCHITECTURE.UK

NO DIMENSIONS TO BE SCALED FROM DRAWING
ALL DIMENSIONS ARE APPROXIMATE AND TO BE CHECKED ON SITE

THIS DRAWING IS FOR PLANNING PURPOSES ONLY SUBJECT TO BUILDING CONTROL STANDARDS AND COMMENTS

REV:	BY:	DATE:	DETAILS:
D	AJT	14.05.2019	RED LINE AMENDED
C	AJT	26.03.2019	GENERAL AMENDMENTS FOLLOWING COMMENTS FROM LPA
B	AJT	04.03.2019	GENERAL AMENDMENTS FOLLOWING COMMENTS FROM LPA
A	AJT	09.07.2018	GENERAL AMENDMENTS

AT ARCHITECTURE
www.atarchitectureltd.com

PROJECT:
Hempton Road DEDDINGTON

DRAWING TITLE:
Illustrative Concept Plan

SCALE:	STAGE:	DATE:
1:1000 (A3)	Prelim	March 2018

DRAWING NO: **A_1807 P100**
REVISION: **D**

N

Key:

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

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

Drawing title: EXPLORATORY POINT PLAN

Project title: HEMPTON ROAD, DEDDINGTON

Client: PEMBURY ESTATES LIMITED

Scale	Original drg. size/colour	Date
1:750	A3 / C	23/12/2019
Drawn	**Checked**	**Approved**
DB	JH	DB

Drawing Number: BRD3567-OD1 — Rev: A

BRD Environmental Ltd
01295 272244
info@brduk.com
www.brduk.com

Key:

- Shallow strip/trench fill footings
- Piles or Ground Improvement
- BRD Trial Pit Locations
- BRD Site Boundary (Approximate Locations)

Notes:

All BRD Trial pits are located by Topographical survey.

Foundation zones approximate only.

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

Revision	Date	Description	Drawn	Approved

Drawing title

FOUNDATION ZONING PLAN

Project title

HEMPTON ROAD, DEDDINGTON

Client

PEMBURY ESTATES LIMITED

Scale	Original drg. size/colour	Date
1:750	A3 / C	03/02/2020
Drawn	**Checked**	**Approved**
RM	MM	BD

Drawing Number	Rev
BRD3567-OD3	A

BRD Environmental Ltd

01295 272244
info@brduk.com
www.brduk.com

APPENDIX 2

TRIAL PIT RECORD

Client:	Pembury Estates
Project Title:	Hempton Road, Deddington
Project No:	BRD3567
Logged By:	M Morgan
Date Completed:	16/10/2019
Method Used:	180° Backhoe excavator (JCB 3CX type)

Trial Pit No.

TP01

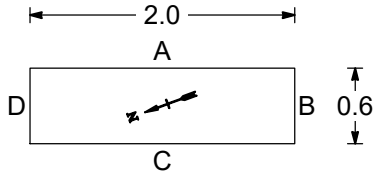
Sheet 1 of 1

Samples & Tests			Description of Strata	Depth / (Level)	Geology	Legend
Depth	Type & No	Value				
0.20	J1		MADE GROUND TOPSOIL: Dark brown, very sandy, very gravelly clay. Gravel of fine to coarse, subangular limestone and ironstone and occasional rootlets.			
			MADE GROUND: Soft, brown, very sandy, gravelly clay. Gravel of fine to coarse, subangular ironstone.	0.30 ()		
0.70	D1					
0.80	J2					
1.00	PID	0.0 ppm	MADE GROUND: Loose, brown to yellow brown, sandy, clayey, fine to coarse, angular gravel of tabular ironstone.	0.90 ()	MADE GROUND	
2.00	PID B1	0.0 ppm				
			2.70m: Large scale collapse of sides.	2.70 ()		

Pit Stability: Pit sides collapsed
Groundwater: Not encountered

Surface Elevation Level:

Plan of Trial Pit:



General Remarks:
Relative density based on visual assessment only.

All dimensions in metres
Log Scale 1:25

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

TRIAL PIT RECORD

Client:	Pembury Estates
Project Title:	Hempton Road, Deddington
Project No:	BRD3567
Logged By:	M Morgan
Date Completed:	16/10/2019
Method Used:	180° Backhoe excavator (JCB 3CX type)

Trial Pit No.

TP02

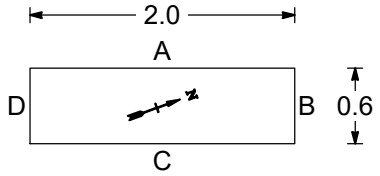
Sheet 1 of 1

Samples & Tests			Description of Strata	Depth / (Level)	Geology	Legend
Depth	Type & No	Value				
0.10	PID J1	0.0 ppm	MADE GROUND TOPSOIL: Dark brown, very sandy, very gravelly clay. Gravel of fine to coarse, subangular limestone and ironstone with occasional rootlets, brick and plastic fragments.			
			MADE GROUND: Medium dense to dense, orange brown to yellow brown, sandy, angular gravel and cobbles of tabular ironstone.	0.40 ()	MADE GROUND	
1.00	PID J2	0.0 ppm		1		
			Medium dense to dense, orange brown to yellow brown, sandy, angular GRAVEL and COBBLES of tabular ironstone.	1.20 ()	MARLSTONE ROCK FM	
2.00	PID D1	0.0 ppm		2		
			2.30m: Limited progress through rock.	2.30 ()		
				3		
				4		

Pit Stability: Generally stable throughout
Groundwater: Not encountered

Surface Elevation Level:

Plan of Trial Pit:



General Remarks:
Relative density based on visual assessment only.

All dimensions in metres
Log Scale 1:25

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

TRIAL PIT RECORD

Client:	Pembury Estates
Project Title:	Hempton Road, Deddington
Project No:	BRD3567
Logged By:	M Morgan
Date Completed:	16/10/2019
Method Used:	180° Backhoe excavator (JCB 3CX type)

Trial Pit No.

TP03

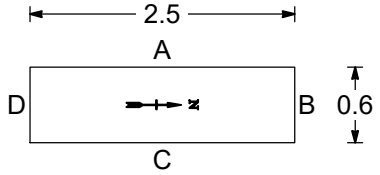
Sheet 1 of 1

Samples & Tests			Description of Strata	Depth / (Level)	Geology	Legend
Depth	Type & No	Value				
			MADE GROUND TOPSOIL: Dark brown, very sandy, very gravelly clay with occasional rootlets. Gravel of fine to coarse, subangular limestone and ironstone.	0.20 ()	MADE GROUND	
0.40	PID J1	0.0 ppm	MADE GROUND: Brown to orange brown, gravelly, sandy clay. Gravel of fine to coarse, subangular ironstone, brick, breezeblock and occasional glass.			
0.80	PID D1 J2	0.0 ppm	MADE GROUND: Dark gray to brown / black gravelly sand of ash and clinker. Gravel of fine to coarse, rounded to subangular glass, ceramic and rare, small, animal bone fragments.	0.70 () 1		
			Firm, light brown, very sandy, gravelly CLAY with increasing gravel with depth. Gravel of subangular, medium to coarse ironstone.	1.30 () 2	DYRHAM FORMATION	
2.20	D2					
2.70	PID J3	0.0 ppm				
				2.90 () 3		
				4		

Pit Stability: See General Remarks
Groundwater: Not encountered

Surface Elevation Level:

Plan of Trial Pit:



General Remarks:
Pit sides collapsed in Made Ground.
Relative density based on visual assessment only.

All dimensions in metres
Log Scale 1:25

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Telephone: 01295 272244
Email: info@brduk.com

TRIAL PIT RECORD

Client: Pembury Estates
Project Title: Hempton Road, Deddington
Project No: BRD3567
Logged By: M Morgan
Date Completed: 16/10/2019
Method Used: 180° Backhoe excavator (JCB 3CX type)

Trial Pit No.

TP04

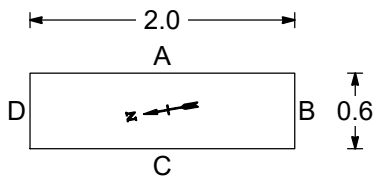
Sheet 1 of 1

Samples & Tests			Description of Strata	Depth / (Level)	Geology	Legend
Depth	Type & No	Value				
0.10	J1		MADE GROUND TOPSOIL: Dark brown, very sandy, very gravelly clay. Gravel of fine to coarse, subangular limestone and ironstone and occasional rootlets.	0.25 ()	MADE GROUND	
			MADE GROUND: Loose, brown, very sandy, clayey gravel and cobbles of angular ironstone.			
0.50	D1					
0.60	J2			0.70 ()		
			MADE GROUND: Medium to dense, slightly sandy gravel and cobbles of angular ironstone.			
1.00	PID	0.0 ppm		1		
			1.40 m: Occasional boulders.			
2.00	PID	0.0 ppm		2		
2.50	D2					
			2.60m: Difficult to excavate due to boulders.	2.60 ()		
				3		
				4		

Pit Stability: See General Remarks
Groundwater: Not encountered

Surface Elevation Level:

Plan of Trial Pit:



General Remarks:
Collapse of pit sides down to 1.8m.
Relative density based on visual assessment only.

All dimensions in metres
Log Scale 1:25

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

TRIAL PIT RECORD

Client:	Pembury Estates
Project Title:	Hempton Road, Deddington
Project No:	BRD3567
Logged By:	M Morgan
Date Completed:	16/10/2019
Method Used:	180° Backhoe excavator (JCB 3CX type)

Trial Pit No.

TP05

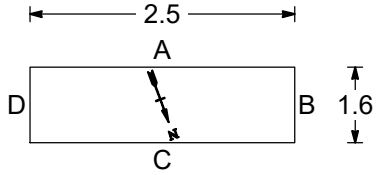
Sheet 1 of 1

Samples & Tests			Description of Strata	Depth / (Level)	Geology	Legend
Depth	Type & No	Value				
0.20	PID J1	0.0 ppm	MADE GROUND TOPSOIL: Dark brown, very sandy, very gravelly clay. Gravel of fine to coarse, subangular limestone and ironstone and occasional rootlets.	0.30 ()	MADE GROUND	
0.70	J2		MADE GROUND: Soft, brown, very sandy, gravelly clay. Gravel of fine to coarse, angular ironstone.			
0.80	PID D1	0.0 ppm		1		
			MADE GROUND: Loose, brown, clayey, sandy gravel, cobbles and boulders of angular ironstone.	1.10 ()		
				2		
2.10	B1					
2.20	PID J3	0.0 ppm				
			Medium dense, brown, clayey, sandy GRAVEL and COBBLES with boulders of angular ironstone.	2.30 ()	MRF	
				2.50 ()		
				3		
				4		

Pit Stability: See General Remarks
Groundwater: Not encountered

Surface Elevation Level:

Plan of Trial Pit:



General Remarks:
Pit sides collapsed in Made Ground.
Relative density based on visual assessment only.

All dimensions in metres
Log Scale 1:25

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

TRIAL PIT RECORD

Client: Pembury Estates
Project Title: Hempton Road, Deddington
Project No: BRD3567
Logged By: M Morgan
Date Completed: 16/10/2019
Method Used: 180° Backhoe excavator (JCB 3CX type)

Trial Pit No.

TP06

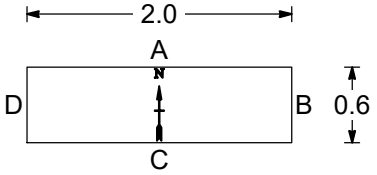
Sheet 1 of 1

Samples & Tests			Description of Strata	Depth / (Level)	Geology	Legend
Depth	Type & No	Value				
0.20	PID J1	0.0 ppm	MADE GROUND TOPSOIL: Loose, dark brown, sandy, slightly gravelly, clay. Gravel of fine to medium, angular ironstone.	0.30 ()	MADE GROUND	
0.60	PID J2	0.0 ppm	MADE GROUND: Firm, orange to brown, sandy, slightly gravelly clay. Gravel of fine to medium, angular ironstone (possible natural).			
0.65	D1		MADE GROUND: Loose to medium dense, yellow brown, sandy, clayey gravel and cobbles of angular ironstone (possible natural).	0.70 ()		
			1.20 m: Occasional boulders.	1		
2.00	PID D2	0.0 ppm		2		
2.30	B1		2.30m: Becoming difficult to excavate due to boulders.	2.30 ()		
				3		
				4		

Pit Stability: Slight spalling of sides
Groundwater: Not encountered

Surface Elevation Level:

Plan of Trial Pit:



General Remarks:
Relative density based on visual assessment only.

All dimensions in metres
Log Scale 1:25

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

TRIAL PIT RECORD

Client: Pembury Estates
Project Title: Hempton Road, Deddington
Project No: BRD3567
Logged By: M Morgan
Date Completed: 16/10/2019
Method Used: 180° Backhoe excavator (JCB 3CX type)

Trial Pit No.

TP07

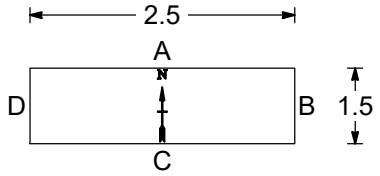
Sheet 1 of 1

Samples & Tests			Description of Strata	Depth / (Level)	Geology	Legend
Depth	Type & No	Value				
0.10	J1		MADE GROUND TOPSOIL: Loose, dark brown, sandy, slightly gravelly, clay. Gravel of fine to medium, angular ironstone.			
			MADE GROUND: Firm, orange to brown, sandy, slightly gravelly clay. Gravel of fine to medium, angular ironstone (possible natural).	0.30 ()		
0.60	D1					
			MADE GROUND: Loose to medium, dense yellow brown, sandy, clayey gravel and cobbles of angular ironstone (possible natrual).	0.70 ()		
0.90	J2					
1.00	PID	0.0 ppm		1	MADE GROUND	
2.00	PID	0.0 ppm		2		
			2.10 m: Large scale collapse of sides.			
				3		
			3.00m: Becoming difficult to excavate due to boulders.	3.00 ()		
				4		

Pit Stability: Pit sides collapsed
Groundwater: Not encountered

Surface Elevation Level:

Plan of Trial Pit:



General Remarks:
Relative density based on visual assessment only.

All dimensions in metres
Log Scale 1:25

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

TRIAL PIT RECORD

Client: Pembury Estates
Project Title: Hempton Road, Deddington
Project No: BRD3567
Logged By: M Morgan
Date Completed: 16/10/2019
Method Used: 180° Backhoe excavator (JCB 3CX type)

Trial Pit No.

TP08

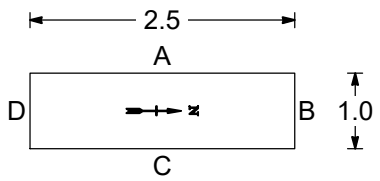
Sheet 1 of 1

Samples & Tests			Description of Strata	Depth / (Level)	Geology	Legend
Depth	Type & No	Value				
0.20	J1		MADE GROUND TOPSOIL: Loose, dark brown, sandy, slightly gravelly, clay. Gravel of fine to medium, angular ironstone.			
			MADE GROUND: Firm, orange to brown, sandy, slightly gravelly clay. Gravel of fine to medium, angular ironstone.	0.30 ()		
0.80	D1					
1.00	PID	0.0 ppm	MADE GROUND: Loose to medium dense, yellow brown, sandy, clayey gravel and cobbles of angular ironstone.	0.90 () 1	MADE GROUND	
			1.20 - 2.80 m: Some collapse of trial pit sides.			
2.00	PID	0.0 ppm		2		
2.50	J2					
2.60	B1					
				2.80 ()		
				3		
				4		

Pit Stability: Pit sides collapsed
Groundwater: Not encountered

Surface Elevation Level:

Plan of Trial Pit:



General Remarks:
Relative density based on visual assessment only.

All dimensions in metres
Log Scale 1:25

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

TRIAL PIT RECORD

Client:	Pembury Estates
Project Title:	Hempton Road, Deddington
Project No:	BRD3567
Logged By:	M Morgan
Date Completed:	16/10/2019
Method Used:	180° Backhoe excavator (JCB 3CX type)

Trial Pit No.

TP09

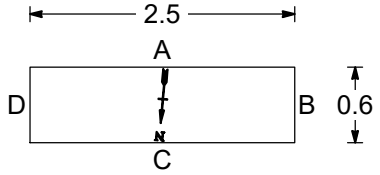
Sheet 1 of 1

Samples & Tests			Description of Strata	Depth / (Level)	Geology	Legend
Depth	Type & No	Value				
			TOPSOIL: Loose, dark brown, sandy, slightly gravelly, clay. Gravel of fine to medium, angular ironstone.	0.30 ()	TS	
			Medium dense to dense, brown, sandy, clayey GRAVEL and COBBLES of fine to coarse, angular and tabular ironstone.		MARLSTONE ROCK FORMATION	
0.80	J1					
0.90	D1					
1.00	PID	0.0 ppm		1		
			1.70 m: Some boulders.			
2.00	PID	0.0 ppm		2		
			2.50 m: Becoming difficult to excavate.			
2.70	J2			3		
				3.10 ()		
				4		

Pit Stability: Slight spalling of sides
Groundwater: Not encountered

Surface Elevation Level:

Plan of Trial Pit:



General Remarks:
Relative density based on visual assessment only.

All dimensions in metres
Log Scale 1:25

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

TRIAL PIT RECORD

Client:	Pembury Estates
Project Title:	Hempton Road, Deddington
Project No:	BRD3567
Logged By:	M Morgan
Date Completed:	16/10/2019
Method Used:	180° Backhoe excavator (JCB 3CX type)

Trial Pit No.

TP10

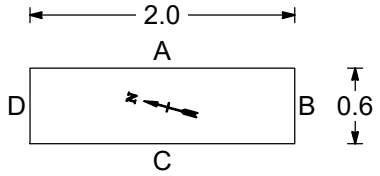
Sheet 1 of 1

Samples & Tests			Description of Strata	Depth / (Level)	Geology	Legend
Depth	Type & No	Value				
0.20	J1		TOPSOIL: Loose, dark brown, sandy, slightly gravelly, clay. Gravel of fine to medium, angular ironstone.	0.30 ()	TS	
0.70	J2		Medium dense, brown, sandy, clayey GRAVEL and COBBLES of angular and tabular ironstone.		MARLSTONE ROCK FORMATION	
0.80	D1					
1.00	PID	0.0 ppm		1		
			1.50 m: Some boulders. 1.50 - 2.80 m: Increasingly difficult to excavate at depth.			
2.00	PID	0.0 ppm		2		
2.70	J3			2.80 ()		
3.00	PID	0.0 ppm		3		
				4		

Pit Stability: Generally stable throughout
Groundwater: Not encountered

Surface Elevation Level:

Plan of Trial Pit:



General Remarks:
Relative density based on visual assessment only.

All dimensions in metres
Log Scale 1:25

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

TRIAL PIT RECORD

Client:	Pembury Estates
Project Title:	Hempton Road, Deddington
Project No:	BRD3567
Logged By:	M Morgan
Date Completed:	10/12/2019
Method Used:	360° Mechanical Excavator

Trial Pit No.

TP11

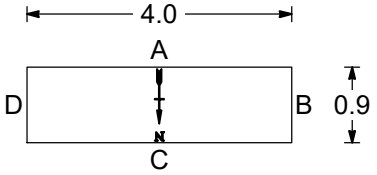
Sheet 1 of 1

Samples & Tests			Description of Strata	Depth / (Level)	Geology	Legend
Depth	Type & No	Value				
0.20	J1		MADE GROUND TOPSOIL: Loose, brown, sandy, slightly gravelly clay. Gravel of fine to medium, subangular to angular ironstone with roots and rootlets.	0.35 ()	MG	
			Loose, orangish brown, slightly sandy, clayey gravel and cobbles of angular tabular ironstone (Possible Made Ground).		MARLSTONE ROCK FORMATION	
0.90	J2		0.80 m: Increasing number of cobbles.	1		
2.00	B1		2.30 m: Increasing number of boulders.	2		
			Strong, light brown, ironstone rock present as a continuous slab.	2.90 () 3 2.95 ()		
				4		

Pit Stability: Slight spalling of sides
Groundwater: Not encountered

Surface Elevation Level:

Plan of Trial Pit:



General Remarks:
Relative density based on visual assessment only.

All dimensions in metres
Log Scale 1:25

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

TRIAL PIT RECORD

Client:	Pembury Estates
Project Title:	Hempton Road, Deddington
Project No:	BRD3567
Logged By:	M Morgan
Date Completed:	10/12/2019
Method Used:	360° Mechanical Excavator

Trial Pit No.

TP12E

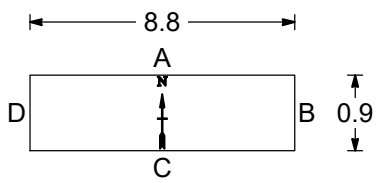
Sheet 1 of 1

Samples & Tests			Description of Strata	Depth / (Level)	Geology	Legend
Depth	Type & No	Value				
			MADE GROUND TOPSOIL: Loose brown sandy, slightly gravelly clay. Gravel of fine to medium, subangular to angular ironstone with roots and rootlets.	0.30 ()	MADE GROUND	
			MADE GROUND: Loose orangish brown sandy gravelly clay. Gravel of fine to coarse, subangular to angular tabular ironstone (possible natural).	0.70 ()		
			Medium dense to dense, yellowish brown, clayey GRAVEL and COBBLES of angular to tabular, layered ironstone.	1.20 ()	MRF	

Pit Stability: Generally stable throughout
Groundwater: Not encountered

Surface Elevation Level:

Plan of Trial Pit:



General Remarks:
Relative density based on visual assessment only.
Eastern end of trial pit TP12.

All dimensions in metres
Log Scale 1:25

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

TRIAL PIT RECORD

Client:	Pembury Estates
Project Title:	Hempton Road, Deddington
Project No:	BRD3567
Logged By:	M Morgan
Date Completed:	10/12/2019
Method Used:	360° Mechanical Excavator

Trial Pit No.

TP12W

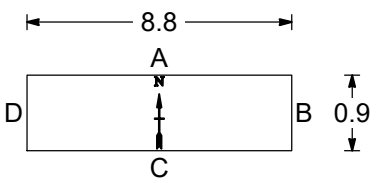
Sheet 1 of 1

Samples & Tests			Description of Strata	Depth / (Level)	Geology	Legend
Depth	Type & No	Value				
			MADE GROUND TOPSOIL: Loose brown sandy, slightly gravelly clay. Gravel of fine to medium, subangular to angular ironstone with roots and rootlets.	0.30 ()	MADE GROUND	
			MADE GROUND: Loose orangish brown sandy gravelly clay. Gravel of fine to coarse, subangular to angular tabular ironstone (possible natrual).	0.70 ()		
			MADE GROUND: Loose, orangish brown, clayey gravel and cobbles of tabular ironstone (possible natural).	1		
			1.30 m: Increasing number of cobbles and boulders with depth. Average boulder size 400mm x 170mm x 300mm.	2		
				3		
			Strong, light brown, ironstone rock present as a continuous slab.	3.00 () 3.05 ()		
				4		

Pit Stability: Slight spalling of sides
Groundwater: Not encountered

Surface Elevation Level:

Plan of Trial Pit:



General Remarks:
Relative density based on visual assessment only.
Western end of trial pit TP12.

All dimensions in metres
Log Scale 1:25

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

TRIAL PIT RECORD

Client:	Pembury Estates
Project Title:	Hempton Road, Deddington
Project No:	BRD3567
Logged By:	M Morgan
Date Completed:	10/12/2019
Method Used:	360° Mechanical Excavator

Trial Pit No.

TP13

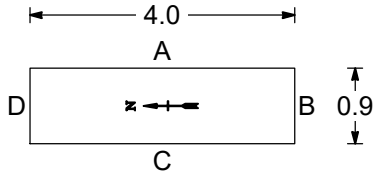
Sheet 1 of 1

Samples & Tests			Description of Strata	Depth / (Level)	Geology	Legend
Depth	Type & No	Value				
			MADE GROUND TOPSOIL: Loose, dark brown, slightly sandy, gravelly clay. Gravel of fine to medium, subangular to angular ironstone and ceramic.	0.30 ()	MADE GROUND	
			MADE GROUND: Loose, orangish brown, sandy, clayey gravel and cobbles of angular tabular ironstone.	1 2		
			Strong, light brown, ironstone rock present as a continuous slab.	2.90 () 3 3.00 ()	M	
				4		

Pit Stability: Slight spalling of sides
Groundwater: Not encountered

Surface Elevation Level:

Plan of Trial Pit:



General Remarks:
Relative density based on visual assessment only.

All dimensions in metres
Log Scale 1:25

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

TRIAL PIT RECORD

Client:	Pembury Estates
Project Title:	Hempton Road, Deddington
Project No:	BRD3567
Logged By:	M Morgan
Date Completed:	10/12/2019
Method Used:	360° Mechanical Excavator

Trial Pit No.

TP14

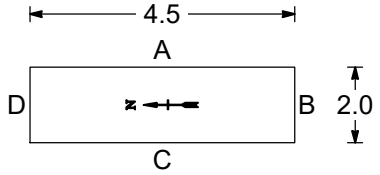
Sheet 1 of 1

Samples & Tests			Description of Strata	Depth / (Level)	Geology	Legend
Depth	Type & No	Value				
			MADE GROUND TOPSOIL: Loose, dark brown, slightly sandy, gravelly clay. Gravel of fine to medium, subangular to angular ironstone and ceramic.	0.30 ()	MADE GROUND	
			MADE GROUND: Loose, orangish brown, sandy, clayey gravel and cobbles of angular tabular ironstone.	1		
			2.00 m: Some collapse of trial pit sides.	2		
				3	3.00 ()	
3.20 3.30	J1 D1		Firm, greyish brown with orange mottling slightly gravelly CLAY. Gravel of fine subrounded to subangular limestone and ironstone.		DYRHAM FM	
				3.50 ()		
				4		

Pit Stability: Pit sides collapsed
Groundwater: Not encountered

Surface Elevation Level:

Plan of Trial Pit:



General Remarks:
Relative density based on visual assessment only.

All dimensions in metres
Log Scale 1:25

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

TRIAL PIT RECORD

Client:	Pembury Estates
Project Title:	Hempton Road, Deddington
Project No:	BRD3567
Logged By:	M Morgan
Date Completed:	10/12/2019
Method Used:	360° Mechanical Excavator

Trial Pit No.

TP15

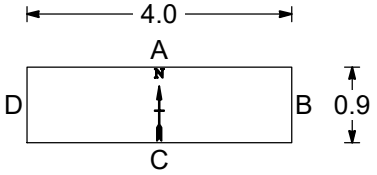
Sheet 1 of 1

Samples & Tests			Description of Strata	Depth / (Level)	Geology	Legend
Depth	Type & No	Value				
			MADE GROUND / TOPSOIL: Loose, brown sandy, slightly gravelly clay. Gravel of fine to medium, subangular to angular ironstone with roots and rootlets.	0.35 ()	MG	
0.60	J1		Loose reddish to orangish brown, slightly sandy, gravelly CLAY. Gravel of medium to coarse, angular ironstone (possible Made Ground).	0.80 ()	MARLSTONE ROCK FORMATION	
			Very weak ironstone, recovered as orangish brown sandy, clayey, angular tabular GRAVEL and COBBLES of ironstone.	1		
			Loose, orangish brown, sandy, clayey GRAVEL and COBBLES of ironstone.	1.20 ()		
			1.50 m: ironstone bedrock extending as slab 1m from wall D.			
			2.00 m: Some collapse of trial pit sides.	2		
				3		
			Strong, light brown, ironstone rock present as a continuous slab.	3.10 () 3.15 ()		
				4		

Pit Stability: Pit sides collapsed
Groundwater: Not encountered

Surface Elevation Level:

Plan of Trial Pit:



General Remarks:
Relative density based on visual assessment only.

All dimensions in metres
Log Scale 1:25

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

TRIAL PIT RECORD

Client:	Pembury Estates
Project Title:	Hempton Road, Deddington
Project No:	BRD3567
Logged By:	M Morgan
Date Completed:	10/12/2019
Method Used:	360° Mechanical Excavator

Trial Pit No.

TP16

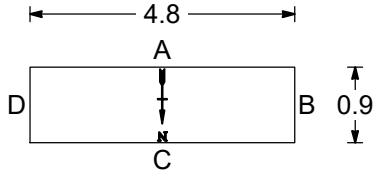
Sheet 1 of 1

Samples & Tests			Description of Strata	Depth / (Level)	Geology	Legend
Depth	Type & No	Value				
			MADE GROUND / TOPSOIL: Loose, brown sandy, slightly gravelly clay. Gravel of fine to medium, subangular to angular ironstone with roots and rootlets.	0.30 ()	MG	
			Loose, orangish brown, slightly sandy, gravelly CLAY. Gravel of subangular to angular medium to coarse ironstone (possible Made Ground).	0.60 ()	MARLSTONE ROCK FORMATION	
			Loose to medium dense, orangish brown, clayey gravel and cobbles of angular tabular ironstone (possible Made Ground).	1		
1.20	D1					
1.50	J1					
				2		
			2.50 m: Becoming hard to dig with medium dense layer of ironstone extending 1m into the pit from from wall D.	3		
			Strong, light brown, ironstone rock present as a continuous slab.	3.40 () 3.45 ()		
				4		

Pit Stability: See General Remarks
Groundwater: Not encountered

Surface Elevation Level:

Plan of Trial Pit:



General Remarks:
Pit sides collapsing in possible Made Ground.
Relative density based on visual assessment only.

All dimensions in metres
Log Scale 1:25

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

TRIAL PIT RECORD

Client:	Pembury Estates
Project Title:	Hempton Road, Deddington
Project No:	BRD3567
Logged By:	M Morgan
Date Completed:	10/12/2019
Method Used:	360° Mechanical Excavator

Trial Pit No.

TP17

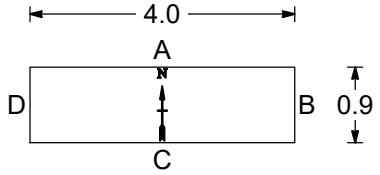
Sheet 1 of 1

Samples & Tests			Description of Strata	Depth / (Level)	Geology	Legend
Depth	Type & No	Value				
			MADE GROUND / TOPSOIL: Loose, brown, sandy, slightly gravelly clay. Gravel of fine to medium, subangular to angular ironstone with roots and rootlets.	0.30 ()	MG	
			Loose, orangish brown, slightly sandy, gravelly CLAY. Gravel of subangular to angular, medium to coarse ironstone (possible Made Ground).	0.90 ()	MARLSTONE ROCK FORMATION	
1.50	D1		Medium dense to dense, orangish brown, sandy, clayey GRAVEL and COBBLES of angular tabular ironstone.	1		
2.00	J1			2		
			Very weak, ironstone rock excavated as orangish brown clayey, gravelly COBBLES AND BOULDERS of angular tabular ironstone.	2.20 ()		
				3		
				3.50 ()		
				4		

Pit Stability: Slight spalling of sides
Groundwater: Not encountered

Surface Elevation Level:

Plan of Trial Pit:



General Remarks:
Relative density based on visual assessment only.

All dimensions in metres
Log Scale 1:25

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

Trial Pit Photographs

TP01

Project Title: Hempton Road, Deddington
Client: Pembury Estates
BRD Reference: BRD2567-OP5-A
Date Issued: October 2019

BRD
01295 272244
info@brduk.com

Trial Pit Photographs

TP02

Project Title: Hempton Road, Deddington
Client: Pembury Estates
BRD Reference: BRD2567-OP5-A
Date Issued: October 2019

BRD
01295 272244
info@brduk.com

Trial Pit Photographs

TP03

Project Title: Hempton Road, Deddington
Client: Pembury Estates
BRD Reference: BRD2567-OP5-A
Date Issued: October 2019

BRD
01295 272244
info@brduk.com

Trial Pit Photographs

TP04

Project Title: Hempton Road, Deddington
Client: Pembury Estates
BRD Reference: BRD2567-OP5-A
Date Issued: October 2019

01295 272244
info@brduk.com

Trial Pit Photographs

TP05

Project Title: Hempton Road, Deddington
Client: Pembury Estates
BRD Reference: BRD2567-OP5-A
Date Issued: October 2019

BRD
01295 272244
info@brduk.com

Trial Pit Photographs

TP06

Project Title: Hempton Road, Deddington
Client: Pembury Estates
BRD Reference: BRD2567-OP5-A
Date Issued: October 2019

BRD
01295 272244
info@brduk.com

Trial Pit Photographs

TP07

Project Title: Hempton Road, Deddington
Client: Pembury Estates
BRD Reference: BRD2567-OP5-A
Date Issued: October 2019

BRD
01295 272244
info@brduk.com

Trial Pit Photographs

TP08

Project Title: Hempton Road, Deddington
Client: Pembury Estates
BRD Reference: BRD2567-OP5-A
Date Issued: October 2019

01295 272244
info@brduk.com

Trial Pit Photographs

TP09

Project Title: Hempton Road, Deddington
Client: Pembury Estates
BRD Reference: BRD2567-OP5-A
Date Issued: October 2019

BRD
01295 272244
info@brduk.com

Trial Pit Photographs

TP10

Project Title: Hempton Road, Deddington
Client: Pembury Estates
BRD Reference: BRD2567-OP5-A
Date Issued: October 2019

BRD
01295 272244
info@brduk.com

Trial Pit Photographs

TP11

Project Title: Hempton Road, Deddington
Client: Pembury Estates
BRD Reference: BRD2567-OP8-A
Date Issued: December 2019

BRD
01295 272244
info@brduk.com

Trial Pit Photographs

TP12

Project Title: Hempton Road, Deddington
Client: Pembury Estates
BRD Reference: BRD2567-OP8-A
Date Issued: December 2019

BRD
01295 272244
info@brduk.com

Trial Pit Photographs

TP13

Project Title: Hempton Road, Deddington
Client: Pembury Estates
BRD Reference: BRD2567-OP8-A
Date Issued: December 2019

BRD
01295 272244
info@brduk.com

Trial Pit Photographs

TP14

Project Title: Hempton Road, Deddington
Client: Pembury Estates
BRD Reference: BRD2567-OP8-A
Date Issued: December 2019

BRD
01295 272244
info@brduk.com

Trial Pit Photographs

TP15

Project Title:	Hempton Road, Deddington
Client:	Pembury Estates
BRD Reference:	BRD2567-OP8-A
Date Issued:	December 2019

BRD
01295 272244
info@brduk.com

Trial Pit Photographs

TP16

Project Title: Hempton Road, Deddington
Client: Pembury Estates
BRD Reference: BRD2567-OP8-A
Date Issued: December 2019

BRD
01295 272244
info@brduk.com

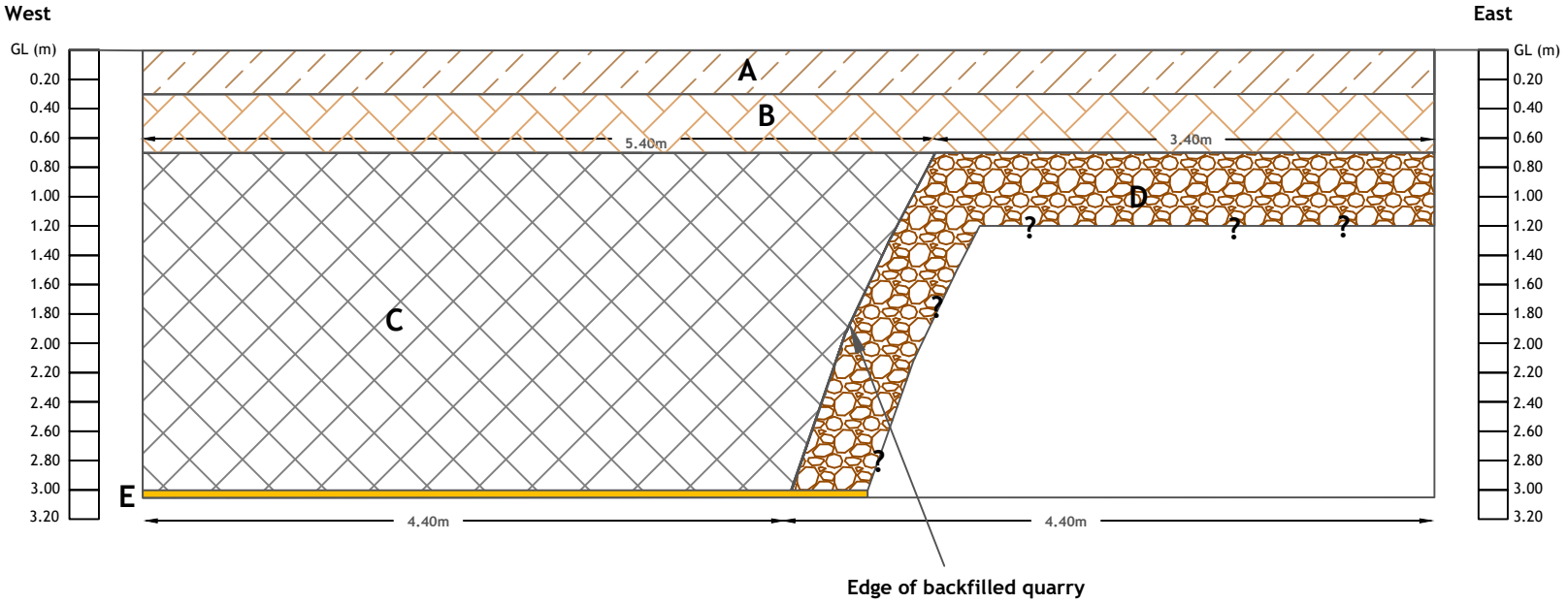
Trial Pit Photographs

TP17

Project Title:	Hempton Road, Deddington
Client:	Pembury Estates
BRD Reference:	BRD2567-OP8-A
Date Issued:	December 2019

BRD
01295 272244
info@brduk.com

TP12 CROSS SECTION FROM WEST TO EAST



A MADE GROUND/TOPSOIL: Loose, brown, sandy, slightly gravelly clay. Gravel of fine to medium, subangular to angular ironstone with roots and rootlets.

B MADE GROUND: Loose, orangish brown, sandy, gravelly clay. Gravel of fine to coarse, subangular to angular, tabular ironstone (possible natural).

C MADE GROUND: Loose, orangish brown, clayey gravel and cobbles of tabular ironstone (possible natural).

D Medium dense to dense, yellowish brown, clayey GRAVEL and COBBLES of angular to tabular, layered ironstone (MARLSTONE ROCK FORMATION).

E Strong, light brown ironstone bedrock presenting as continuous slab (MARLSTONE ROCK FORMATION).

General remarks:
Trial pit terminated at 3.05m bgl due to ironstone bedrock layer.
All dimensions in metres.

Strata Detail: 1.30m: In western section an incresing number of cobbles and boulders with depth. Average boulder size 400mm x 170mm x 300mm

Project title: HEMPTON ROAD, DEDDINGTON			Drawing title: TP12 CROSS SECTION DRAWING	
Client: PEMBURY ESTATE				
Scale: 1:50	Original drg. size/colour: A4 / C	Date: 06/01/2020		
Drawn: DB	Checked: JH	Approved: MM	Drawing Number: BRD3567-OD2	Rev: A

APPENDIX 3

Jessica Hand
BRD Environmental Ltd
Hawthorne Villa
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: 19-14862

Site Reference:	Hempton Road, Deddington
Project / Job Ref:	BRD3567
Order No:	None Supplied
Sample Receipt Date:	18/10/2019
Sample Scheduled Date:	18/10/2019
Report Issue Number:	1
Reporting Date:	29/10/2019

Authorised by:

Dave Ashworth
Technical Manager

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: 19-14862	Date Sampled	16/10/19	16/10/19	16/10/19	16/10/19	16/10/19
BRD Environmental Ltd	Time Sampled	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Site Reference: Hempton Road, Deddington	TP / BH No	TP01	TP01	TP02	TP03	TP03
Project / Job Ref: BRD3567	Additional Refs	J1	J2	J1	J1	J2
Order No: None Supplied	Depth (m)	0.20	0.80	0.10	0.40	0.80
Reporting Date: 29/10/2019	DETS Sample No	442262	442263	442264	442265	442266

Determinand	Unit	RL	Accreditation					
Asbestos Quantification (S)	%	< 0.001	ISO17025		< 0.001		< 0.001	< 0.001
pH	pH Units	N/a	MCERTS	7.9	8.0	7.8	7.8	7.3
Total Sulphate as SO_4	mg/kg	< 200	NONE					
Total Sulphate as SO_4	%	< 0.02	NONE					
W/S Sulphate as SO_4 (2:1)	mg/l	< 10	MCERTS	17	14	< 10	21	84
W/S Sulphate as SO_4 (2:1)	g/l	< 0.01	MCERTS	0.02	0.01	< 0.01	0.02	0.08
Total Sulphur	%	< 0.02	NONE					
Organic Matter	%	< 0.1	MCERTS	4.9	1.9	4.4	4.2	12.4
Arsenic (As)	mg/kg	< 2	MCERTS	148	143	139	108	79
Cadmium (Cd)	mg/kg	< 0.2	MCERTS	2.1	1.9	2.1	1.8	3.1
Chromium (Cr)	mg/kg	< 2	MCERTS	233	252	220	179	77
Chromium (hexavalent)	mg/kg	< 2	NONE	< 2	< 2	< 2	< 2	< 2
Copper (Cu)	mg/kg	< 4	MCERTS	43	22	40	102	335
Lead (Pb)	mg/kg	< 3	MCERTS	140	62	113	129	607
Mercury (Hg)	mg/kg	< 1	NONE	< 1	< 1	< 1	< 1	< 1
Nickel (Ni)	mg/kg	< 3	MCERTS	88	92	86	76	88
Selenium (Se)	mg/kg	< 3	NONE	< 3	< 3	< 3	< 3	< 3
Zinc (Zn)	mg/kg	< 3	MCERTS	234	203	265	397	3030

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Subcontracted analysis (S)

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Soil Analysis Certificate						
DETS Report No: 19-14862	Date Sampled	16/10/19	16/10/19	16/10/19	16/10/19	16/10/19
BRD Environmental Ltd	Time Sampled	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Site Reference: Hempton Road, Deddington	TP / BH No	TP03	TP04	TP04	TP05	TP05
Project / Job Ref: BRD3567	Additional Refs	J3	J1	J2	J1	J2
Order No: None Supplied	Depth (m)	2.70	0.10	0.60	0.20	0.70
Reporting Date: 29/10/2019	DETS Sample No	442267	442268	442269	442270	442271

Determinand	Unit	RL	Accreditation					
Asbestos Quantification (S)	%	< 0.001	ISO17025					
pH	pH Units	N/a	MCERTS	7.9	8.0			8.0
Total Sulphate as SO_4	mg/kg	< 200	NONE	774				529
Total Sulphate as SO_4	%	< 0.02	NONE	0.08				0.05
W/S Sulphate as SO_4 (2:1)	mg/l	< 10	MCERTS	74	< 10			12
W/S Sulphate as SO_4 (2:1)	g/l	< 0.01	MCERTS	0.07	< 0.01			0.01
Total Sulphur	%	< 0.02	NONE	0.04				0.04
Organic Matter	%	< 0.1	MCERTS		1.3			
Arsenic (As)	mg/kg	< 2	MCERTS		136	110	134	
Cadmium (Cd)	mg/kg	< 0.2	MCERTS		1.8			
Chromium (Cr)	mg/kg	< 2	MCERTS		222			
Chromium (hexavalent)	mg/kg	< 2	NONE		< 2			
Copper (Cu)	mg/kg	< 4	MCERTS		15			
Lead (Pb)	mg/kg	< 3	MCERTS		35			
Mercury (Hg)	mg/kg	< 1	NONE		< 1			
Nickel (Ni)	mg/kg	< 3	MCERTS		79			
Selenium (Se)	mg/kg	< 3	NONE		< 3			
Zinc (Zn)	mg/kg	< 3	MCERTS		201			

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Subcontracted analysis (S)

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Soil Analysis Certificate						
DETS Report No: 19-14862	Date Sampled	16/10/19	16/10/19	16/10/19	16/10/19	16/10/19
BRD Environmental Ltd	Time Sampled	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Site Reference: Hempton Road, Deddington	TP / BH No	TP05	TP06	TP07	TP07	TP08
Project / Job Ref: BRD3567	Additional Refs	J3	J2	J1	J2	J1
Order No: None Supplied	Depth (m)	2.20	0.60	0.10	0.90	0.20
Reporting Date: 29/10/2019	DETS Sample No	442272	442273	442274	442275	442276

Determinand	Unit	RL	Accreditation					
Asbestos Quantification (S)	%	< 0.001	ISO17025				< 0.001	
pH	pH Units	N/a	MCERTS	8.0			8.0	7.8
Total Sulphate as SO_4	mg/kg	< 200	NONE	704				
Total Sulphate as SO_4	%	< 0.02	NONE	0.07				
W/S Sulphate as SO_4 (2:1)	mg/l	< 10	MCERTS	26			< 10	< 10
W/S Sulphate as SO_4 (2:1)	g/l	< 0.01	MCERTS	0.03			< 0.01	< 0.01
Total Sulphur	%	< 0.02	NONE	0.03				
Organic Matter	%	< 0.1	MCERTS				1.1	4.4
Arsenic (As)	mg/kg	< 2	MCERTS		152	181	185	178
Cadmium (Cd)	mg/kg	< 0.2	MCERTS				2.5	2.6
Chromium (Cr)	mg/kg	< 2	MCERTS				336	275
Chromium (hexavalent)	mg/kg	< 2	NONE				< 2	< 2
Copper (Cu)	mg/kg	< 4	MCERTS				11	32
Lead (Pb)	mg/kg	< 3	MCERTS				36	90
Mercury (Hg)	mg/kg	< 1	NONE				< 1	< 1
Nickel (Ni)	mg/kg	< 3	MCERTS				105	106
Selenium (Se)	mg/kg	< 3	NONE				< 3	< 3
Zinc (Zn)	mg/kg	< 3	MCERTS				174	243

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Subcontracted analysis (S)

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Soil Analysis Certificate						
DETS Report No: 19-14862	Date Sampled	16/10/19	16/10/19	16/10/19	16/10/19	
BRD Environmental Ltd	Time Sampled	None Supplied	None Supplied	None Supplied	None Supplied	
Site Reference: Hempton Road, Deddington	TP / BH No	TP08	TP09	TP09	TP10	
Project / Job Ref: BRD3567	Additional Refs	J2	J1	J2	J2	
Order No: None Supplied	Depth (m)	2.50	0.80	2.70	0.70	
Reporting Date: 29/10/2019	DETS Sample No	442277	442278	442279	442280	

Determinand	Unit	RL	Accreditation					
Asbestos Quantification (S)	%	< 0.001	ISO17025					
pH	pH Units	N/a	MCERTS			8.0	8.0	
Total Sulphate as SO_4	mg/kg	< 200	NONE			776	784	
Total Sulphate as SO_4	%	< 0.02	NONE			0.08	0.08	
W/S Sulphate as SO_4 (2:1)	mg/l	< 10	MCERTS			< 10	< 10	
W/S Sulphate as SO_4 (2:1)	g/l	< 0.01	MCERTS			< 0.01	< 0.01	
Total Sulphur	%	< 0.02	NONE			0.04	0.04	
Organic Matter	%	< 0.1	MCERTS					
Arsenic (As)	mg/kg	< 2	MCERTS	301	192			
Cadmium (Cd)	mg/kg	< 0.2	MCERTS					
Chromium (Cr)	mg/kg	< 2	MCERTS					
Chromium (hexavalent)	mg/kg	< 2	NONE					
Copper (Cu)	mg/kg	< 4	MCERTS					
Lead (Pb)	mg/kg	< 3	MCERTS					
Mercury (Hg)	mg/kg	< 1	NONE					
Nickel (Ni)	mg/kg	< 3	MCERTS					
Selenium (Se)	mg/kg	< 3	NONE					
Zinc (Zn)	mg/kg	< 3	MCERTS					

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Subcontracted analysis (S)

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Soil Analysis Certificate - Speciated PAHs							
DETS Report No: 19-14862	Date Sampled	16/10/19	16/10/19	16/10/19	16/10/19	16/10/19
BRD Environmental Ltd	Time Sampled	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Site Reference: Hempton Road, Deddington	TP / BH No	TP01	TP01	TP02	TP03	TP03
Project / Job Ref: BRD3567	Additional Refs	J1	J2	J1	J1	J2
Order No: None Supplied	Depth (m)	0.20	0.80	0.10	0.40	0.80
Reporting Date: 29/10/2019	DETS Sample No	442262	442263	442264	442265	442266

Determinand	Unit	RL	Accreditation					
Naphthalene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	0.21
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	0.16	0.27	0.76
Anthracene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Fluoranthene	mg/kg	< 0.1	MCERTS	0.16	< 0.1	0.40	0.75	1.47
Pyrene	mg/kg	< 0.1	MCERTS	0.14	< 0.1	0.36	0.69	1.24
Benzo(a)anthracene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	0.19	0.42	0.67
Chrysene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	0.24	0.45	0.79
Benzo(b)fluoranthene	mg/kg	< 0.1	MCERTS	0.17	< 0.1	0.28	0.59	0.84
Benzo(k)fluoranthene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	0.20	0.33
Benzo(a)pyrene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	0.16	0.36	0.47
Indeno(1,2,3-cd)pyrene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	0.27	0.36
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	< 0.1	< 0.1	0.24	0.28
Total EPA-16 PAHs	mg/kg	< 1.6	MCERTS	< 1.6	< 1.6	1.8	4.2	7.4

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Soil Analysis Certificate - Speciated PAHs							
DETS Report No: 19-14862	Date Sampled	16/10/19	16/10/19	16/10/19		
BRD Environmental Ltd	Time Sampled	None Supplied	None Supplied	None Supplied		
Site Reference: Hempton Road, Deddington	TP / BH No	TP04	TP07	TP08		
Project / Job Ref: BRD3567	Additional Refs	J1	J2	J1		
Order No: None Supplied	Depth (m)	0.10	0.90	0.20		
Reporting Date: 29/10/2019	DETS Sample No	442268	442275	442276		

Determinand	Unit	RL	Accreditation					
Naphthalene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1		
Acenaphthylene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1		
Acenaphthene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1		
Fluorene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1		
Phenanthrene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1		
Anthracene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1		
Fluoranthene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	0.20		
Pyrene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	0.18		
Benzo(a)anthracene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1		
Chrysene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	0.14		
Benzo(b)fluoranthene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	0.22		
Benzo(k)fluoranthene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1		
Benzo(a)pyrene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1		
Indeno(1,2,3-cd)pyrene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1		
Dibenz(a,h)anthracene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1		
Benzo(ghi)perylene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1		
Total EPA-16 PAHs	mg/kg	< 1.6	MCERTS	< 1.6	< 1.6	< 1.6		

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

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Soil Analysis Certificate - TPH LQM Banded						
DETS Report No: 19-14862	Date Sampled	16/10/19	16/10/19	16/10/19	16/10/19	
BRD Environmental Ltd	Time Sampled	None Supplied	None Supplied	None Supplied	None Supplied	
Site Reference: Hempton Road, Deddington	TP / BH No	TP01	TP02	TP03	TP05	
Project / Job Ref: BRD3567	Additional Refs	J2	J1	J2	J2	
Order No: None Supplied	Depth (m)	0.80	0.10	0.80	0.70	
Reporting Date: 29/10/2019	DETS Sample No	442263	442264	442266	442271	

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

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Soil Analysis Certificate - BTEX / MTBE							
DETS Report No: 19-14862	Date Sampled	16/10/19	16/10/19	16/10/19	16/10/19		
BRD Environmental Ltd	Time Sampled	None Supplied	None Supplied	None Supplied	None Supplied		
Site Reference: Hempton Road, Deddington	TP / BH No	TP01	TP02	TP03	TP05		
Project / Job Ref: BRD3567	Additional Refs	J2	J1	J2	J2		
Order No: None Supplied	Depth (m)	0.80	0.10	0.80	0.70		
Reporting Date: 29/10/2019	DETS Sample No	442263	442264	442266	442271		

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

Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than 30^{o}C

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Soil Analysis Certificate - Semi Volatile Organic Compounds (SVOC)						
DETS Report No: 19-14862	Date Sampled	16/10/19	16/10/19			
BRD Environmental Ltd	Time Sampled	None Supplied	None Supplied			
Site Reference: Hempton Road, Deddington	TP / BH No	TP01	TP03			
Project / Job Ref: BRD3567	Additional Refs	J2	J2			
Order No: None Supplied	Depth (m)	0.80	0.80			
Reporting Date: 29/10/2019	DETS Sample No	442263	442266			

Determinand	Unit	RL	Accreditation					
Phenol	mg/kg	< 0.1	NONE	< 0.1	< 0.1			
1,2,4-Trichlorobenzene	mg/kg	< 0.1	ISO17025	< 0.1	< 0.1			
2-Nitrophenol	mg/kg	< 0.1	NONE	< 0.1	< 0.1			
Nitrobenzene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1			
0-Cresol	mg/kg	< 0.1	NONE	< 0.1	< 0.1			
bis(2-chloroethoxy)methane	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1			
bis(2-chloroethyl)ether	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1			
2,4-Dichlorophenol	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1			
2-Chlorophenol	mg/kg	< 0.1	ISO17025	< 0.1	< 0.1			
1,3-Dichlorobenzene	mg/kg	< 0.1	ISO17025	< 0.1	< 0.1			
1,4-Dichlorobenzene	mg/kg	< 0.1	ISO17025	< 0.1	< 0.1			
1,2-Dichlorobenzene	mg/kg	< 0.1	ISO17025	< 0.1	< 0.1			
2,4-Dimethylphenol	mg/kg	< 0.15	ISO17025	< 0.15	< 0.15			
Isophorone	mg/kg	< 0.1	NONE	< 0.1	< 0.1			
Hexachloroethane	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1			
p-Cresol	mg/kg	< 0.15	MCERTS	< 0.15	< 0.15			
2,4,6-Trichlorophenol	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1			
2,4,5-Trichlorophenol	mg/kg	< 0.15	MCERTS	< 0.15	< 0.15			
2-Nitroaniline	mg/kg	< 0.1	NONE	< 0.1	< 0.1			
4-Chloro-3-methylphenol	mg/kg	< 0.1	NONE	< 0.1	< 0.1			
2-Methylnaphthalene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1			
Hexachlorocyclopentadiene	mg/kg	< 0.1	NONE	< 0.1	< 0.1			
Hexachlorobutadiene	mg/kg	< 0.1	ISO17025	< 0.1	< 0.1			
2,6-Dinitrotoluene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1			
Dimethyl phthalate	mg/kg	< 0.1	NONE	< 0.1	< 0.1			
2-Chloronaphthalene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1			
4-Chloroanaline	mg/kg	< 0.15	NONE	< 0.15	< 0.15			
4-Nitrophenol	mg/kg	< 0.1	NONE	< 0.1	< 0.1			
4-Chlorophenyl phenyl ether	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1			
3-Nitroaniline	mg/kg	< 0.1	NONE	< 0.1	< 0.1			
4-Nitroaniline	mg/kg	< 0.1	NONE	< 0.1	< 0.1			
4-Bromophenyl phenyl ether	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1			
Hexachlorobenzene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1			
2,4-Dinitrotoluene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1			
Diethyl phthalate	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1			
Dibenzofuran	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1			
Azobenzene	mg/kg	< 0.1	NONE	< 0.1	< 0.1			
Dibutyl phthalate	mg/kg	< 0.1	ISO17025	< 0.1	< 0.1			
Carbazole	mg/kg	< 0.1	ISO17025	< 0.1	< 0.1			
bis(2-ethylhexyl)phthalate	mg/kg	< 0.15	MCERTS	< 0.15	< 0.15			
Benzyl butyl phthalate	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1			
Di-n-octyl phthalate	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1			

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Soil Analysis Certificate - Sample Descriptions	
DETS Report No: 19-14862	
BRD Environmental Ltd	
Site Reference: Hempton Road, Deddington	
Project / Job Ref: BRD3567	
Order No: None Supplied	
Reporting Date: 29/10/2019	

DETS Sample No	TP / BH No	Additional Refs	Depth (m)	Moisture Content (%)	Sample Matrix Description
442262	TP01	J1	0.20	19	Brown loamy sand with stones and vegetation
442263	TP01	J2	0.80	19.2	Brown sandy clay with stones
442264	TP02	J1	0.10	20.4	Brown sandy clay with stones
442265	TP03	J1	0.40	21.5	Brown loamy sand with stones
442266	TP03	J2	0.80	32.5	Black loamy sand with stones
442267	TP03	J3	2.70	23.3	Brown sandy clay with stones
442268	TP04	J1	0.10	17.1	Brown sandy clay with stones
442269	TP04	J2	0.60	18.7	Brown sandy clay with stones
442270	TP05	J1	0.20	20.2	Brown sandy clay with stones
442271	TP05	J2	0.70	19.7	Brown sandy clay with stones and vegetation
442272	TP05	J3	2.20	18	Brown sandy clay with stones
442273	TP06	J2	0.60	22	Brown sandy clay with stones
442274	TP07	J1	0.10	22.1	Brown loamy sand with stones and vegetation
442275	TP07	J2	0.90	18.3	Brown loamy sand with stones
442276	TP08	J1	0.20	21.5	Brown loamy sand with stones
442277	TP08	J2	2.50	15.7	Brown sandy clay with stones
442278	TP09	J1	0.80	14.1	Brown sandy clay with stones
442279	TP09	J2	2.70	17.3	Brown sandy clay with stones
442280	TP10	J2	0.70	17.5	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

Jessica Hand
BRD Environmental Ltd
Hawthorne Villa
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: 19-17332

Site Reference:	Hempton Road, Deddington
Project / Job Ref:	BRD3567
Order No:	None Supplied
Sample Receipt Date:	13/12/2019
Sample Scheduled Date:	13/12/2019
Report Issue Number:	1
Reporting Date:	19/12/2019

Authorised by:

Dave Ashworth
Technical Manager

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: 19-17332	Date Sampled	10/12/19	10/12/19			
BRD Environmental Ltd	Time Sampled	None Supplied	None Supplied			
Site Reference: Hempton Road, Deddington	TP / BH No	J1	J1			
Project / Job Ref: BRD3567	Additional Refs	TP14	TP16			
Order No: None Supplied	Depth (m)	3.20	1.50			
Reporting Date: 19/12/2019	DETS Sample No	452439	452440			

Determinand	Unit	RL	Accreditation					
pH	pH Units	N/a	MCERTS	7.9	7.8			
Total Sulphate as SO_4	mg/kg	< 200	NONE	< 200	323			
Total Sulphate as SO_4	%	< 0.02	NONE	< 0.02	0.03			
W/S Sulphate as SO_4 (2:1)	mg/l	< 10	MCERTS	44	16			
W/S Sulphate as SO_4 (2:1)	g/l	< 0.01	MCERTS	0.04	0.02			
Total Sulphur	%	< 0.02	NONE	< 0.02	0.02			

Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than 30^{O}C
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 - Sample Descriptions	
DETS Report No: 19-17332	
BRD Environmental Ltd	
Site Reference: Hempton Road, Deddington	
Project / Job Ref: BRD3567	
Order No: None Supplied	
Reporting Date: 19/12/2019	

DETS Sample No	TP / BH No	Additional Refs	Depth (m)	Moisture Content (%)	Sample Matrix Description
452439	J1	TP14	3.20	18.2	Brown clayey sand
452440	J1	TP16	1.50	20.9	Brown clayey sand with stones

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

Insufficient Sample I/S

Unsuitable Sample U/S

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

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

Soil Analysis Certificate - Methodology & Miscellaneous Information
DETS Report No: 19-17332
BRD Environmental Ltd
Site Reference: Hempton Road, Deddington
Project / Job Ref: BRD3567
Order No: None Supplied
Reporting Date: 19/12/2019

Matrix	Analysed On	Determinand	Brief Method Description	Method No
Soil	D	Boron - Water Soluble	Determination of water soluble boron in soil by 2:1 hot water extract followed by ICP-OES	E012
Soil	AR	BTEX	Determination of BTEX by headspace GC-MS	E001
Soil	D	Cations	Determination of cations in soil by aqua-regia digestion followed by ICP-OES	E002
Soil	D	Chloride - Water Soluble (2:1)	Determination of chloride by extraction with water & analysed by ion chromatography	E009
Soil	AR	Chromium - Hexavalent	Determination of hexavalent chromium in soil by extraction in water then by acidification, addition of 1,5 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	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

Certificate of Analysis

Certificate Number	19-25703-1
	08-Jan-20
Client	DETS South Unit 1 Rose Lane Industrial Estate Rose Lane Lenham Heath Maidstone, Kent ME17 2JN
Our Reference	19-25703-1
Client Reference	3567/17333
Order No	(not supplied)
Contract Title	Hempton Road, Deddington
Description	2 Soil samples.
Date Received	16-Dec-19
Date Started	16-Dec-19
Date Completed	08-Jan-20
Test Procedures	Identified by prefix DETSn (details on request).
Notes	**This report supersedes 19-25703, amendments.** 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.

Approved By

Adam Fenwick
Contracts Manager

UKAS TESTING
2139

Summary of Chemical Analysis

Soil Samples

Our Ref 19-25703-1
Client Ref 3567/17333
Contract Title Hempton Road, Deddington

Lab No	1613762	1613763
Sample ID	J1 - TP11	J2 - TP11
Depth	0.20	0.90
Other ID	452441	452442
Sample Type	SOIL	SOIL
Sampling Date	10/12/19	10/12/19
Sampling Time	n/s	n/s

Test	Method	LOD	Units		
Metals					
Arsenic Gastric % Bioaccessible (% of Total As)	DETSC 2400*	0	%	4.2	2.4
Arsenic Gastric mg/kg Bioaccessible	DETSC 2400*	0.5	mg/kg	8.7	3.3
Arsenic Gastro Intestinal % Bioaccessible (% of Total As)	DETSC 2400*	0	%	1.6	1.5
Arsenic Gastro Intestinal mg/kg Bioaccessible	DETSC 2400*	0.5	mg/kg	3.3	2.1
Arsenic	DETSC 2301#	0.2	mg/kg	210	140

Key: * -not accredited. # -MCERTS (accreditation only applies if report carries the MCERTS logo). n/s -not supplied.

Information in Support of the Analytical Results

Our Ref 19-25703-1
Client Ref 3567/17333
Contract Hempton Road, Deddington

Containers Received & Deviating Samples

Lab No	Sample ID	Date Sampled	Containers Received	Holding time exceeded for tests	Inappropriate container for tests
1613762	J1 - TP11 0.20 SOIL	10/12/19	PG		
1613763	J2 - TP11 0.90 SOIL	10/12/19	PG		

Key: P-Plastic G-Bag

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

Soil Analysis Notes

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

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

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

Disposal

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

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

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Report generated	09-Jan-20
Report title	Hempton Road, Deddington
Created by	J Hand at BRD Environmental Ltd

RESULTS

Environment Agency

		Assessment Criterion (mg kg^{-1})			Ratio of ADE to HCV			Saturation Limit (mg kg^{-1})	50% rule?		Top Two applied?	Apply Top 2 Approach to Produce Group						
		oral	inhalation	combined	oral	inhalation	combined		Oral	Inhal		Green vegetables	Root vegetables	Tuber vegetables	Herbaceous fruit	Shrub fruit	Tree fruit
1	Arsenic (C4SL child)	4.11E+02	5.26E+02	NR	1.00	0.78	NR	NR	No	No	Yes	Yes	No	No	No	No	Yes
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Environment Agency

	Assessment Criterion (mg kg^{-1})			Ratio of ADE to HCV			Saturation Limit (mg kg^{-1})	50% rule?		Top Two applied?	Apply Top 2 Approach to Produce Group						
	oral	inhalation	combined	oral	inhalation	combined		Oral	Inhal		Green vegetables	Root vegetables	Tuber vegetables	Herbaceous fruit	Shrub fruit	Tree fruit
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Environment Agency

		Soil Distribution				Media Concentrations													
		Sorbed	Dissolved	Vapour	Total	Soil	Soil gas	Indoor Dust	Outdoor dust at 0.8m	Outdoor dust at 1.6m	Indoor Vapour	Outdoor vapour at 0.8m	Outdoor vapour at 1.6m	Green vegetables	Root vegetables	Tuber vegetables	Herbaceous fruit	Shrub fruit	Tree fruit
		%	%	%	%	mg kg^{-1}	mg m^{-3}	mg kg^{-1}	mg m^{-3}	mg m^{-3}	mg m^{-3}	mg m^{-3}	mg m^{-3}	mg kg^{-1} FW	mg kg^{-1} FW	mg kg^{-1} FW	mg kg^{-1} FW	mg kg^{-1} FW	mg kg^{-1} FW
1	Arsenic (C4SL child)	99.9	0.1	0.0	100.0	4.11E+02	NR	2.05E+02	1.75E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.77E-01	1.64E-01	9.45E-02	1.36E-01	8.21E-02	4.52E-01
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Environment Agency

	Soil Distribution				Media Concentrations													
	Sorbed	Dissolved	Vapour	Total	Soil	Soil gas	Indoor Dust	Outdoor dust at 0.8m	Outdoor dust at 1.6m	Indoor Vapour	Outdoor vapour at 0.8m	Outdoor vapour at 1.6m	Green vegetables	Root vegetables	Tuber vegetables	Herbaceous fruit	Shrub fruit	Tree fruit
	%	%	%	%	mg kg^{-1}	mg m^{-3}	mg kg^{-1}	mg m^{-3}	mg m^{-3}	mg m^{-3}	mg m^{-3}	mg m^{-3}	mg kg^{-1} FW	mg kg^{-1} FW	mg kg^{-1} FW	mg kg^{-1} FW	mg kg^{-1} FW	mg kg^{-1} FW
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Environment Agency

		Average Daily Exposure (mg kg^{-1} bw day^{-1})							Distribution by Pathway (%)							
		Direct soil ingestion	Consumption of homegrown produce and attached soil	Dermal contact with soil and dust	Inhalation of dust	Inhalation of vapour	Background (oral)	Background (inhalation)	Direct soil ingestion	Consumption of homegrown produce and attached soil	Dermal contact with soil and dust	Inhalation of dust	Inhalation of vapour (indoor)	Inhalation of vapour (outdoor)	Background (oral)	Background (inhalation)
1	Arsenic (C4SL child)	4.87E-05	2.11E-04	4.07E-05	6.79E-06	0.00E+00	0.00E+00	0.00E+00	16.25	70.17	13.58	0.00	0.00	0.00	0.00	0.00
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Environment Agency

	Average Daily Exposure (mg kg^{-1} bw day^{-1})							Distribution by Pathway (%)							
	Direct soil ingestion	Consumption of homegrown produce and attached soil	Dermal contact with soil and dust	Inhalation of dust	Inhalation of vapour	Background (oral)	Background (inhalation)	Direct soil ingestion	Consumption of homegrown produce	Dermal contact with soil and dust	Inhalation of dust	Inhalation of vapour (indoor)	Inhalation of vapour (outdoor)	Background (oral)	Background (inhalation)
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Environment Agency

		Oral Health Criteria Value (µg kg^{-1} BW day^{-1})		Inhalation Health Criteria Value (µg kg^{-1} BW day^{-1})		Oral Mean Daily Intake (µg day^{-1})	Inhalation Mean Daily Intake (µg day^{-1})	Air-water partition coefficient (K_{aw}) (cm^3 cm^{-3})	Coefficient of Diffusion in Air (m^2 s^{-1})	Coefficient of Diffusion in Water (m^2 s^{-1})	log K_{oc} (cm^3 g^{-1})	log K_{ow} (dimensionless)	Dermal Absorption Fraction (dimensionless)	Soil-to-dust transport factor (g g^{-1} DW)	Sub-surface soil to indoor air correction factor (dimensionless)	Relative bioavailability via soil ingestion (unitless)	Relative bioavailability via dust inhalation (unitless)
1	Arsenic (C4SL child)	ID	0.3	ID	0.0087	NR	NR	NR	NR	NR	NR	NR	0.03	0.5	1	**0.016**	1
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Environment Agency

	Oral Health Criteria Value (µg kg^{-1} BW day^{-1})	Inhalation Health Criteria Value (µg kg^{-1} BW day^{-1})	Oral Mean Daily Intake (µg day^{-1})	Inhalation Mean Daily Intake (µg day^{-1})	Air-water partition coefficient (K_{aw}) (cm^3 cm^{-3})	Coefficient of Diffusion in Air (m^2 s^{-1})	Coefficient of Diffusion in Water (m^2 s^{-1})	log K_{oc} (cm^3 g^{-1})	log K_{ow} (dimensionless)	Dermal Absorption Fraction (dimensionless)	Soil-to-dust transport factor (g g^{-1} DW)	Sub-surface soil to indoor air correction factor (dimensionless)	Relative bioavailability via soil ingestion (unitless)	Relative bioavailability via dust inhalation (unitless)
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Environment Agency

		Soil-to-water partition coefficient ($cm^3\ g^{-1}$)	Vapour pressure (Pa)	Water solubility ($mg\ L^{-1}$)	Soil-to-plant concentration factor for green vegetables ($mg\ g^{-1}$ plant DW or FW basis over $mg\ g^{-1}$ DW soil)	Soil-to-plant concentration factor for root vegetables ($mg\ g^{-1}$ plant DW or FW basis over $mg\ g^{-1}$ DW soil)	Soil-to-plant concentration factor for tuber vegetables ($mg\ g^{-1}$ plant DW or FW basis over $mg\ g^{-1}$ DW soil)	Soil-to-plant concentration factor for herbaceous fruit ($mg\ g^{-1}$ plant DW or FW basis over $mg\ g^{-1}$ DW soil)	Soil-to-plant concentration factor for shrub fruit ($mg\ g^{-1}$ plant DW or FW basis over $mg\ g^{-1}$ DW soil)	Soil-to-plant concentration factor for tree fruit ($mg\ g^{-1}$ plant DW or FW basis over $mg\ g^{-1}$ DW soil)
1	Arsenic (C4SL child)	5.00E+02	NR	1.25E+06	0.00043 fw	0.0004 fw	0.00023 fw	0.00033 fw	0.0002 fw	0.0011 fw
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Environment Agency

	Soil-to-water partition coefficient ($cm^3 g^{-1}$)	Vapour pressure (Pa)	Water solubility ($mg L^{-1}$)	Soil-to-plant concentration factor for green vegetables (mg g^{-1} plant DW or FW basis over mg g^{-1} DW soil)	Soil-to-plant concentration factor for root vegetables (mg g^{-1} plant DW or FW basis over mg g^{-1} DW soil)	Soil-to-plant concentration factor for tuber vegetables (mg g^{-1} plant DW or FW basis over mg g^{-1} DW soil)	Soil-to-plant concentration factor for herbaceous fruit (mg g^{-1} plant DW or FW basis over mg g^{-1} DW soil)	Soil-to-plant concentration factor for shrub fruit (mg g^{-1} plant DW or FW basis over mg g^{-1} DW soil)	Soil-to-plant concentration factor for tree fruit (mg g^{-1} plant DW or FW basis over mg g^{-1} DW soil)
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Report generated	09/01/2020
Report title	Hempton Road, Deddington
Created by	J Hand at BRD Environmental Ltd

BASIC SETTINGS

Land Use	Residential with produce (C4SL)						
Building	Small terraced house						
Receptor	Female (res C4SL)	Start age class	1	End age class	6	Exposure Duration	6 years
Soil	Sandy loam						

Exposure Pathways

Direct soil and dust ingestion	✓	Dermal contact with indoor dust	✓	Inhalation of indoor dust	✓
Consumption of homegrown produce	✓	Dermal contact with soil	✓	Inhalation of soil dust	✓
Soil attached to homegrown produce	✓			Inhalation of indoor vapour	✓
				Inhalation of outdoor vapour	✓

Land Use Residential with produce (C4SL) **Receptor** Female (res C4SL)

Age Class	Exposure Frequencies (days yr^{-1})						Occupation Periods (hr day^{-1})		Soil to skin adherence factors (mg cm^{2})		Direct soil ingestion rate (g day^{-1})	Body weight (kg)	Body height (m)	Inhalation rate (m^{3} day^{-1})	Max exposed skin factor		Total skin area (m^{2})
	Direct soil ingestion	Consumption of homegrown produce	Dermal contact with indoor dust	Dermal contact with soil	Inhalation of dust and vapour, indoor	Inhalation of dust and vapour, outdoor	Indoors	Outdoors	Indoor	Outdoor					Indoor (m^{2} m^{-2})	Outdoor (m^{2} m^{-2})	
1	180	180	180	170	365	365	23.0	1.0	0.06	0.10	0.10	5.60	0.7	5.4	0.32	0.26	3.43E-01
2	365	365	365	170	365	365	23.0	1.0	0.06	0.10	0.10	9.80	0.8	8.0	0.33	0.26	4.84E-01
3	365	365	365	170	365	365	23.0	1.0	0.06	0.10	0.10	12.70	0.9	8.9	0.32	0.25	5.82E-01
4	365	365	365	170	365	365	23.0	1.0	0.06	0.10	0.10	15.10	0.9	10.1	0.35	0.28	6.36E-01
5	365	365	365	170	365	365	19.0	1.0	0.06	0.10	0.10	16.90	1.0	10.1	0.35	0.28	7.04E-01
6	365	365	365	170	365	365	19.0	1.0	0.06	0.10	0.10	19.70	1.1	10.1	0.33	0.26	7.94E-01
7	0	0	0	0	0	0	0.0	0.0	0.00	0.00	0.00	22.10	1.2	12.0	0.22	0.15	8.73E-01
8	0	0	0	0	0	0	0.0	0.0	0.00	0.00	0.00	25.30	1.2	12.0	0.22	0.15	9.36E-01
9	0	0	0	0	0	0	0.0	0.0	0.00	0.00	0.00	27.50	1.3	12.0	0.22	0.15	1.01E+00
10	0	0	0	0	0	0	0.0	0.0	0.00	0.00	0.00	31.40	1.3	12.0	0.22	0.15	1.08E+00
11	0	0	0	0	0	0	0.0	0.0	0.00	0.00	0.00	35.70	1.4	12.0	0.22	0.14	1.19E+00
12	0	0	0	0	0	0	0.0	0.0	0.00	0.00	0.00	41.30	1.4	15.2	0.22	0.14	1.29E+00
13	0	0	0	0	0	0	0.0	0.0	0.00	0.00	0.00	47.20	1.5	15.2	0.22	0.14	1.42E+00
14	0	0	0	0	0	0	0.0	0.0	0.00	0.00	0.00	51.20	1.6	15.2	0.22	0.14	1.52E+00
15	0	0	0	0	0	0	0.0	0.0	0.00	0.00	0.00	56.70	1.6	15.2	0.21	0.14	1.60E+00
16	0	0	0	0	0	0	0.0	0.0	0.00	0.00	0.00	59.00	1.6	15.2	0.21	0.14	1.63E+00
17	0	0	0	0	0	0	0.0	0.0	0.00	0.00	0.00	70.00	1.6	15.7	0.33	0.27	1.78E+00
18	0	0	0	0	0	0	0.0	0.0	0.00	0.00	0.00	70.90	1.6	13.6	0.33	0.27	1.80E+00

Consumption Rates

Environment Agency

Age Class	Consumption rates (g FW kg^{-1} bodyweight day^{-1}) by Produce Group											
	MEAN RATES						90TH PERCENTILE RATES					
	Green veg	Root veg	Tuber veg	Herb. Fruit	Shrub fruit	Tree fruit	Green veg	Root veg	Tuber veg	Herb. Fruit	Shrub fruit	Tree fruit
1	3.47E+00	5.22E+00	9.22E+00	8.90E-01	1.07E+00	1.87E+00	7.12E+00	1.07E+01	1.60E+01	1.83E+00	2.23E+00	3.82E+00
2	3.34E+00	1.61E+00	3.14E+00	1.93E+00	2.60E-01	5.84E+00	5.87E+00	2.83E+00	6.60E+00	3.39E+00	4.60E-01	1.03E+01
3	3.34E+00	1.61E+00	3.14E+00	1.93E+00	2.60E-01	5.84E+00	5.87E+00	2.83E+00	6.60E+00	3.39E+00	4.60E-01	1.03E+01
4	3.34E+00	1.61E+00	3.14E+00	1.93E+00	2.60E-01	5.84E+00	5.87E+00	2.83E+00	6.60E+00	3.39E+00	4.60E-01	1.03E+01
5	2.54E+00	1.20E+00	2.65E+00	1.25E+00	1.10E-01	2.89E+00	4.53E+00	2.14E+00	4.95E+00	2.24E+00	1.90E-01	5.16E+00
6	2.54E+00	1.20E+00	2.65E+00	1.25E+00	1.10E-01	2.89E+00	4.53E+00	2.14E+00	4.95E+00	2.24E+00	1.90E-01	5.16E+00
7	2.54E+00	1.20E+00	2.65E+00	1.25E+00	1.10E-01	2.89E+00	4.53E+00	2.14E+00	4.95E+00	2.24E+00	1.90E-01	5.16E+00
8	2.54E+00	1.20E+00	2.65E+00	1.25E+00	1.10E-01	2.89E+00	4.53E+00	2.14E+00	4.95E+00	2.24E+00	1.90E-01	5.16E+00
9	2.54E+00	1.20E+00	2.65E+00	1.25E+00	1.10E-01	2.89E+00	4.53E+00	2.14E+00	4.95E+00	2.24E+00	1.90E-01	5.16E+00
10	2.54E+00	1.20E+00	2.65E+00	1.25E+00	1.10E-01	2.89E+00	4.53E+00	2.14E+00	4.95E+00	2.24E+00	1.90E-01	5.16E+00
11	2.54E+00	1.20E+00	2.65E+00	1.25E+00	1.10E-01	2.89E+00	4.53E+00	2.14E+00	4.95E+00	2.24E+00	1.90E-01	5.16E+00
12	1.03E+00	4.90E-01	1.60E+00	5.10E-01	4.00E-02	1.18E+00	1.87E+00	8.90E-01	3.05E+00	9.30E-01	8.00E-02	2.13E+00
13	1.03E+00	4.90E-01	1.60E+00	5.10E-01	4.00E-02	1.18E+00	1.87E+00	8.90E-01	3.05E+00	9.30E-01	8.00E-02	2.13E+00
14	1.03E+00	4.90E-01	1.60E+00	5.10E-01	4.00E-02	1.18E+00	1.87E+00	8.90E-01	3.05E+00	9.30E-01	8.00E-02	2.13E+00
15	1.03E+00	4.90E-01	1.60E+00	5.10E-01	4.00E-02	1.18E+00	1.87E+00	8.90E-01	3.05E+00	9.30E-01	8.00E-02	2.13E+00
16	1.03E+00	4.90E-01	1.60E+00	5.10E-01	4.00E-02	1.18E+00	1.87E+00	8.90E-01	3.05E+00	9.30E-01	8.00E-02	2.13E+00
17	1.26E+00	6.00E-01	1.18E+00	6.90E-01	9.00E-02	1.27E+00	2.36E+00	1.12E+00	2.35E+00	1.29E+00	1.80E-01	2.38E+00
18	1.35E+00	6.40E-01	1.25E+00	7.40E-01	1.00E-01	1.36E+00	2.34E+00	1.12E+00	2.36E+00	1.28E+00	1.80E-01	2.37E+00

Top 2 applied? Yes

Where top 2 method is applied, two produce categories use 90th percentile rates, while the remainder use the mean. Produce categories vary on a chemical-by-chemical basis. Where top 2 method is not used, all produce categories for all chemicals assume 90th percentile rates.

Building Small terraced house

Soil Sandy loam

Building footprint (m^2)	2.80E+01
Living space air exchange rate (hr^{-1})	5.00E-01
Living space height (above ground, m)	4.80E+00
Living space height (below ground, m)	0.00E+00
Pressure difference (soil to enclosed space, Pa)	3.10E+00
Foundation thickness (m)	1.50E-01
Floor crack area (cm^2)	4.23E+02
Dust loading factor ($\mu g\ m^{-3}$)	5.00E+01

Porosity, Total ($cm^3\ cm^{-3}$)	5.30E-01
Porosity, Air-Filled ($cm^3\ cm^{-3}$)	2.00E-01
Porosity, Water-Filled ($cm^3\ cm^{-3}$)	3.30E-01
Residual soil water content ($cm^3\ cm^{-3}$)	1.20E-01
Saturated hydraulic conductivity ($cm\ s^{-1}$)	3.56E-03
van Genuchten shape parameter *m* (dimensionless)	3.20E-01
Bulk density ($g\ cm^{-3}$)	1.21E+00
Threshold value of wind speed at 10m ($m\ s^{-1}$)	7.20E+00
Empirical function (F_x) for dust model (dimensionless)	1.22E+00
Ambient soil temperature (K)	2.83E+02
Soil pH	7.00E+00
Soil Organic Matter content (%)	6.00E+00
Fraction of organic carbon ($g\ g^{-1}$)	3.48E-02
Effective total fluid saturation (unitless)	5.12E-01
Intrinsic soil permeability (cm^2)	4.75E-08
Relative soil air permeability (unitless)	6.42E-01
Effective air permeability (cm^2)	3.05E-08

Soil - Vapour Model

Depth to top of source (no building) (cm)	0
Depth to top of source (beneath building) (cm)	65
Default soil gas ingress rate?	Yes
Soil gas ingress rate ($cm^3\ s^{-1}$)	2.50E+01
Building ventilation rate ($cm^3\ s^{-1}$)	1.87E+04
Averaging time surface emissions (yr)	6
Finite vapour source model?	No
Thickness of contaminated layer (cm)	200

Air Dispersion Model

Mean annual windspeed at 10m ($m\ s^{-1}$)	5.00
Air dispersion factor at height of 0.8m *	2400.00
Air dispersion factor at height of 1.6m *	0.00
Fraction of site cover ($m^2\ m^{-2}$)	0.75

* Air dispersion factor in $g\ m^{-2}\ s^{-1}$ per $kg\ m^{-3}$

Soil - Plant Model

	Dry weight conversion factor	Homegrown fraction		Soil loading factor	Preparation correction factor
		Average	High		
	g DW g^{-1} FW	dimensionless		g g^{-1} DW	dimensionless
Green vegetables	0.096	0.05	0.33	1.00E-03	2.00E-01
Root vegetables	0.103	0.06	0.40	1.00E-03	1.00E+00
Tuber vegetables	0.210	0.02	0.13	1.00E-03	1.00E+00
Herbaceous fruit	0.058	0.06	0.40	1.00E-03	6.00E-01
Shrub fruit	0.166	0.09	0.60	1.00E-03	6.00E-01
Tree fruit	0.157	0.04	0.27	1.00E-03	6.00E-01

Gardener type Average

TEST REPORT

ISSUED BY SOIL PROPERTY TESTING LTD

DATE ISSUED: 05/11/2019

0998

Contract	**Hempton Road, Deddington**
Serial No.	**36020**

Client:

BRD Environmental Ltd

BRD Environmental Ltd
Hawthorne Villa
1 Old Parr Road
Banbury
Oxfordshire
OX16 5HT

Soil Property Testing Ltd

15, 16, 18 Halcyon Court, St Margaret's Way,
Stukeley Meadows, Huntingdon,
Cambridgeshire, PE29 6DG

Tel: 01480 455579
Email: enquiries@soilpropertytesting.com
Website: www.soilpropertytesting.com

Samples Submitted By:

BRD Environmental Ltd

Samples Labelled:

Hempton Road, Deddington

Approved Signatories:

- ☑ **J.C. Garner B.Eng (Hons) FGS** — Technical Director & Quality Manager
- ☐ **S.P. Townend FGS** — Chairman
- ☐ **W. Johnstone** — Materials Lab Manager
- ☐ **D. Sabnis** — Operations Manager

Date Received: 21/10/2019

Samples Tested Between: 21/10/2019 **and** 05/11/2019

Remarks:

For the attention of Jessica Hand
Your Reference No: BRD3567

Notes:

1. All remaining samples or remnants from this contract will be disposed of after 21 days from today, unless we are notified to the contrary.
2. (a) UKAS - United Kingdom Accreditation Service.
   (b) Opinions and interpretations expressed herein are outside the scope of UKAS accreditation.
3. Tests marked "NOT UKAS ACCREDITED" in this test report are not included in the UKAS Accreditation Schedule for this testing laboratory.
4. This test report may not be reproduced other than in full except with the prior written approval of the issuing laboratory.

TEST REPORT

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Contract	**Hempton Road, Deddington**		
Serial No.	**36020**	**Target Date**	01/11/2019
Scheduled By	BRD Environmental Ltd		

SCHEDULE OF LABORATORY TESTS

Schedule Remarks

Bore Hole No.	Type	Sample Ref.	Top Depth	Water Content (BSEN)	Liquid/Plastic Limits	Wet Sieve Preparation	Particle Size Distribution (BS1377)														Sample Remarks
TP01	D	1	0.70	1	1	1															
TP01	B	1	2.00				1														
TP04	D	1	0.50	1	1	1															
TP07	D	1	0.60	1	1	1															
TP08	D	1	0.80	1	1	1															
TP08	B	1	2.60				1														
Totals				**4**	**4**	**4**	**2**														**End of Schedule**

TEST REPORT

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DATE ISSUED: 05/11/2019

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Contract	**Hempton Road, Deddington**
Serial No.	**36020**

SUMMARY OF WATER CONTENT, LIQUID LIMIT, PLASTIC LIMIT, PLASTICITY INDEX AND LIQUIDITY INDEX

Borehole /Pit No.	Depth (m)	Type	Ref.	Water Content (%)	Liquid Limit (%)	Plastic Limit (%)	Plasti-city Index (%)	Liquid-ity Index	SAMPLE PREPARATION				Description	CLASS
									Method	Ret'd 0.425mm (%)	Corr'd W/C <0.425mm	Curing Time (hrs)		
TP01	0.70	D	1	**28.7**	48	33	15	-0.28	Wet Sieved	55 (M)	63.8*	26	Very soft mottled brown and orangish brown slightly gravelly sandy clayey SILT with rare yellowish brown mottling and ironstaining. Gravel brown and orange fine to coarse angular to subrounded ferruginous limestone.	MI
TP04	0.50	D	1	**28.5**	49	29	20	-0.03	Wet Sieved	42 (M)	49.1*	27	Firm orangish brown slightly gravelly sandy clayey SILT with occasional brown mottling, and rare ironstaining. Gravel is brown and orangish brown fine to coarse angular to subrounded ferruginous limestone.	MI
TP07	0.60	D	1	**25.3**	47	32	15	-0.45	Wet Sieved	45 (M)	46.0*	26	Soft orangish brown slightly gravelly sandy clayey SILT with occasional brown mottling, rare ironstaining, and decayed roots. Gravel is orangish brown and brown fine to coarse angular to subrounded limestone.	MI
TP08	0.80	D	1	**25.4**	47	31	16	-0.35	Wet Sieved	54 (M)	55.3*	26	Soft orangish brown slightly gravelly sandy clayey SILT with occasional brown mottling, and rare ironstaining. Gravel is orangish brown and brown fine to coarse angular to subrounded ferruginous limestone.	MI

Method Of Preparation: BS EN ISO: 17892-1: 2014 & BS 1377: Part 2:1990:4.2
Method of Test: BS EN ISO: 17892-1: 2014 & BS 1377: Part 2:1990:3.2, 4.4, 5.3, 5.4
Type of Sample Key: U = Undisturbed, B = Bulk, D = Disturbed, J = Jar, W = Water, SPT = Split Spoon Sample, C = Core Cutter
Comments: *Corrected water content assume material greater than 0.425mm is non-porous. See BS1377: Part 2: 1990 Clause 3 Note 1.

Table Notation: Ret'd 0.425mm: (A) = Assumed, (M) = Measured

TEST REPORT

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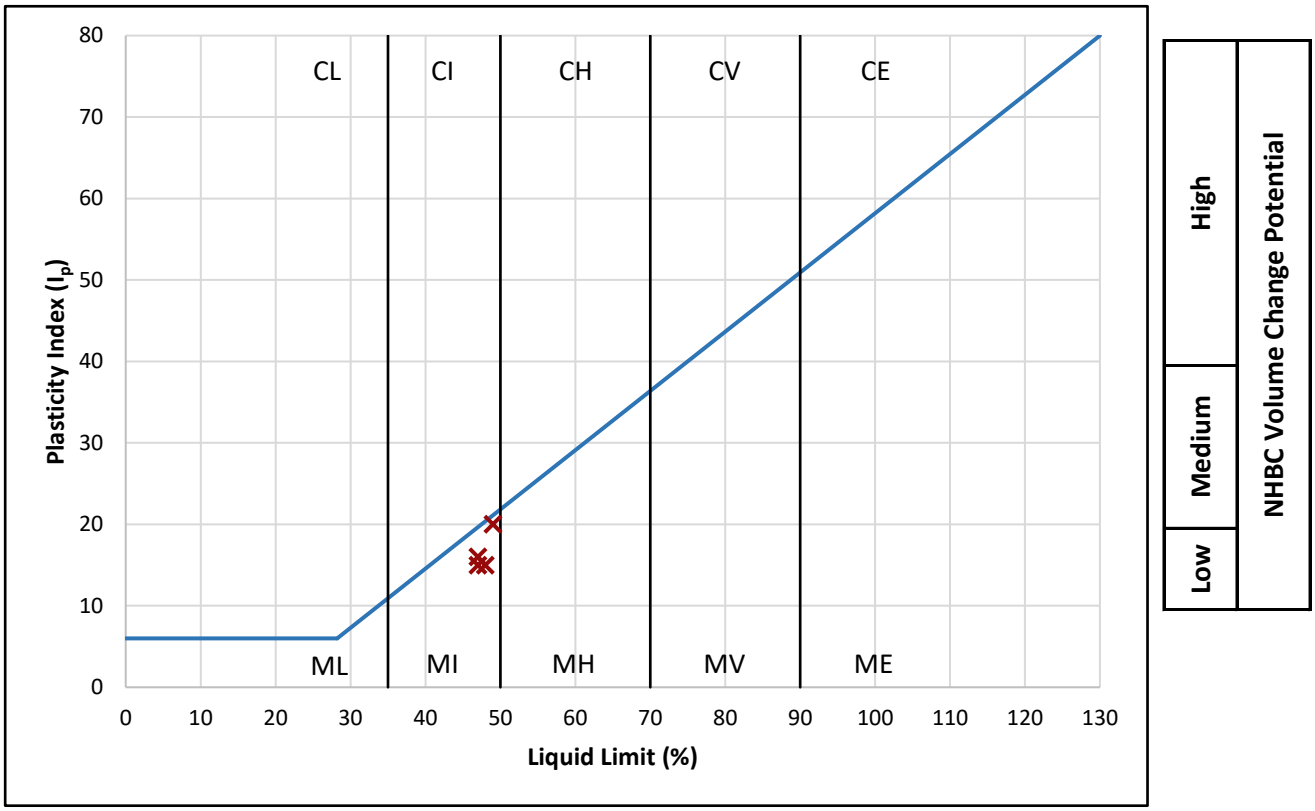
Contract	**Hempton Road, Deddington**
Serial No.	**36020**

PLOT OF PLASTICITY INDEX AGAINST LIQUID LIMIT USING CASAGRANDE CLASSIFICATION CHART

Plasticity				
Low	Medium	High	Very High	Extremely High



Plasticity Chart BS5930: 2015: Figure 8

Method of Preparation:	BS EN ISO: 17892-1: 2014 & BS 1377: Part 2: 1990: 4.2
Method of Test:	BS EN ISO: 17892-1: 2014 & BS1377: Part 2: 3.2, 4.4, 5.3, 5.4
Type of Sample Key:	U = Undisturbed, B = Bulk, D = Disturbed, J = Jar, W = Water, SPT = Split Spoon Sample, C = Core Cutter
Comments:	Volume Change Potential: NHBC Standards Chapter 4.2 Unmodified Plasticity Index

TEST REPORT

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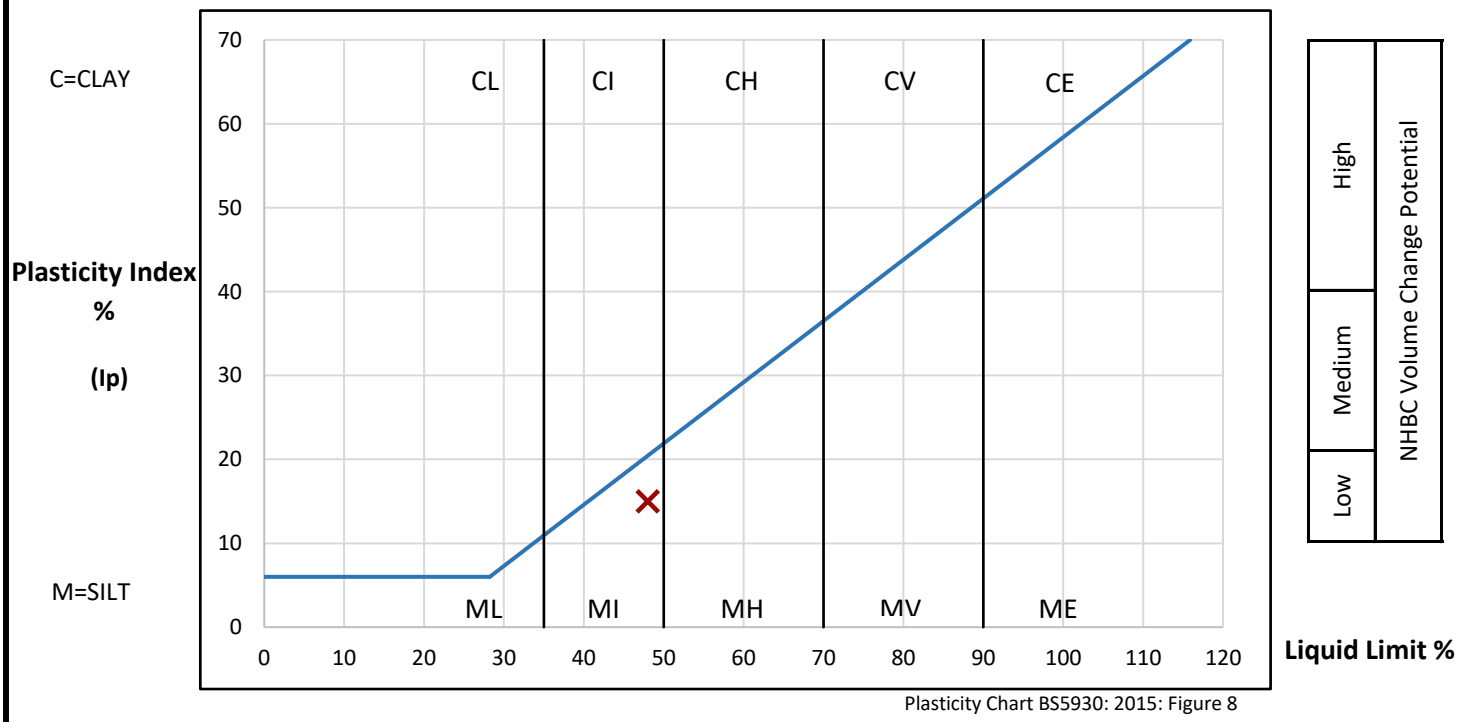
Contract	**Hempton Road, Deddington**
Serial No.	**36020**

DETERMINATION OF WATER CONTENT, LIQUID LIMIT AND PLASTIC LIMIT AND DERIVATION OF PLASTICITY INDEX AND LIQUIDITY INDEX

Borehole / Pit No.	Depth m	Sample Type	Sample Reference	Water Content (W) %	Description	Remarks
TP01	0.70	D	1	28.7	Very soft mottled brown and orangish brown slightly gravelly sandy clayey SILT with rare yellowish brown mottling and ironstaining. Gravel brown and orange fine to coarse angular to subrounded ferruginous limestone.	

PREPARATION			Liquid Limit	48 %
Method of preparation	Wet sieved over 0.425mm sieve		Plastic Limit	33 %
Sample retained 0.425mm sieve	(Measured)	55 %	Plasticity Index	15 %
Corrected water content for material passing 0.425mm		63.8 %	Liquidity Index	-0.28
Sample retained 2mm sieve	(Measured)	34 %	NHBC Modified (I'p)	7 %
Curing time	26 hrs	Clay Content Not analysed	Derived Activity	Not analysed



Plasticity Chart BS5930: 2015: Figure 8

Method of Preparation:	BS EN ISO: 17892-1: 2014 & BS 1377: Part 2: 1990: 4.2
Method of Test:	BS EN ISO: 17892-1: 2014 & BS 1377: Part 2: 1990: 3.2, 4.4, 5.3, 5.4
Type of Sample Key:	U=Undisturbed, B=Bulk, D=Disturbed, J=Jar, W=Water, SPT=Split Spoon Sample, C=Core Cutter
Comments:	Corrected water content assume material greater than 0.425mm non-porous. See BS1377: Part2: 1990 Clause 3 Note 1 Volume Change Potential: NHBC Standards Chapter 4.2 Unmodified Plasticity Index Note: Modified Plasticity Index I'p = Ip x (% less than 425microns/100)

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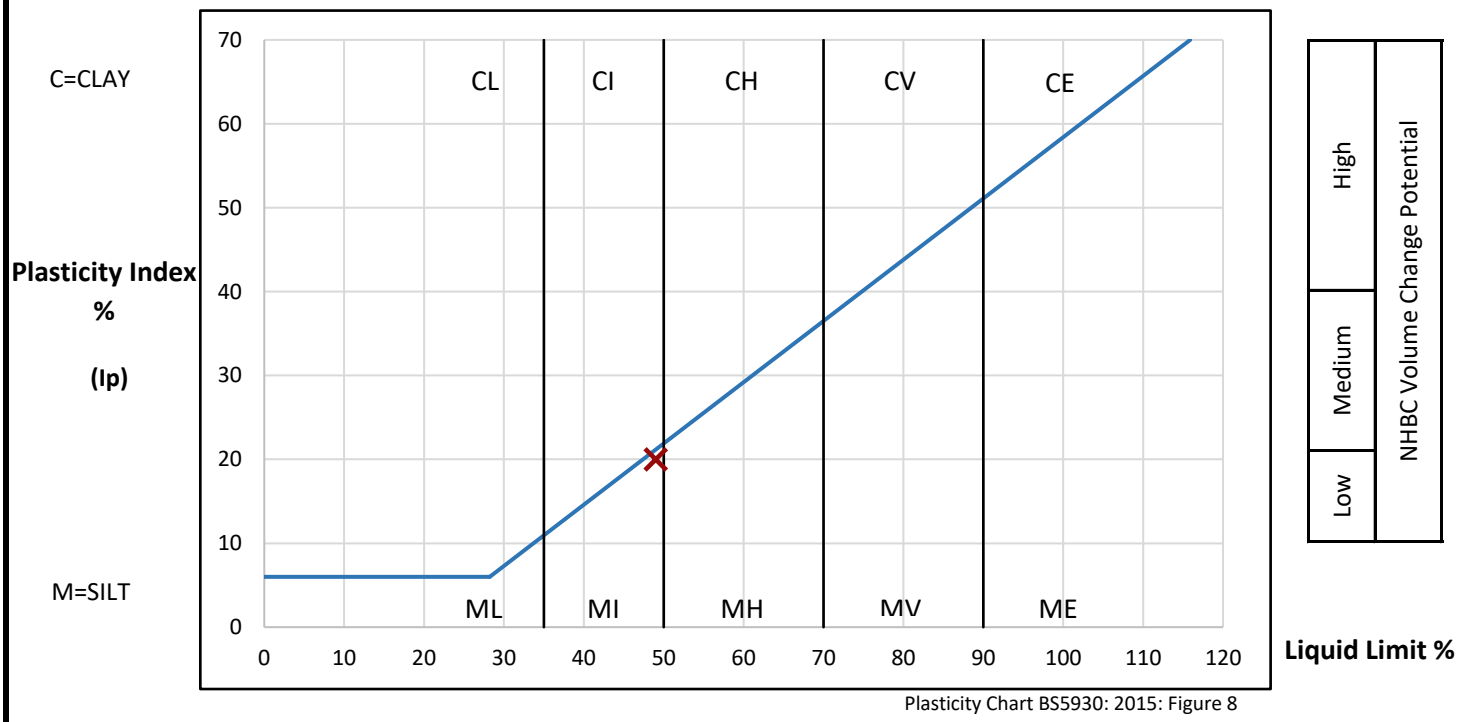
DETERMINATION OF WATER CONTENT, LIQUID LIMIT AND PLASTIC LIMIT AND DERIVATION OF PLASTICITY INDEX AND LIQUIDITY INDEX

Borehole / Pit No.	Depth m	Sample Type	Sample Reference	Water Content (W) %	Description	Remarks
TP04	0.50	D	1	28.5	Firm orangish brown slightly gravelly sandy clayey SILT with occasional brown mottling, and rare ironstaining. Gravel is brown and orangish brown fine to coarse angular to subrounded ferruginous limestone.	

PREPARATION				Liquid Limit	49 %
Method of preparation		Wet sieved over 0.425mm sieve		Plastic Limit	29 %
Sample retained 0.425mm sieve	(Measured)	42 %		Plasticity Index	20 %
Corrected water content for material passing 0.425mm		49.1 %		Liquidity Index	-0.03
Sample retained 2mm sieve	(Measured)	22 %		NHBC Modified (I'p)	12 %
Curing time	27 hrs	Clay Content	Not analysed	Derived Activity	Not analysed



Plasticity Chart BS5930: 2015: Figure 8

Method of Preparation:	BS EN ISO: 17892-1: 2014 & BS 1377: Part 2: 1990: 4.2
Method of Test:	BS EN ISO: 17892-1: 2014 & BS 1377: Part 2: 1990: 3.2, 4.4, 5.3, 5.4
Type of Sample Key:	U=Undisturbed, B=Bulk, D=Disturbed, J=Jar, W=Water, SPT=Split Spoon Sample, C=Core Cutter
Comments:	Corrected water content assume material greater than 0.425mm non-porous. See BS1377: Part2: 1990 Clause 3 Note 1 Volume Change Potential: NHBC Standards Chapter 4.2 Unmodified Plasticity Index Note: Modified Plasticity Index I'p = Ip x (% less than 425microns/100)

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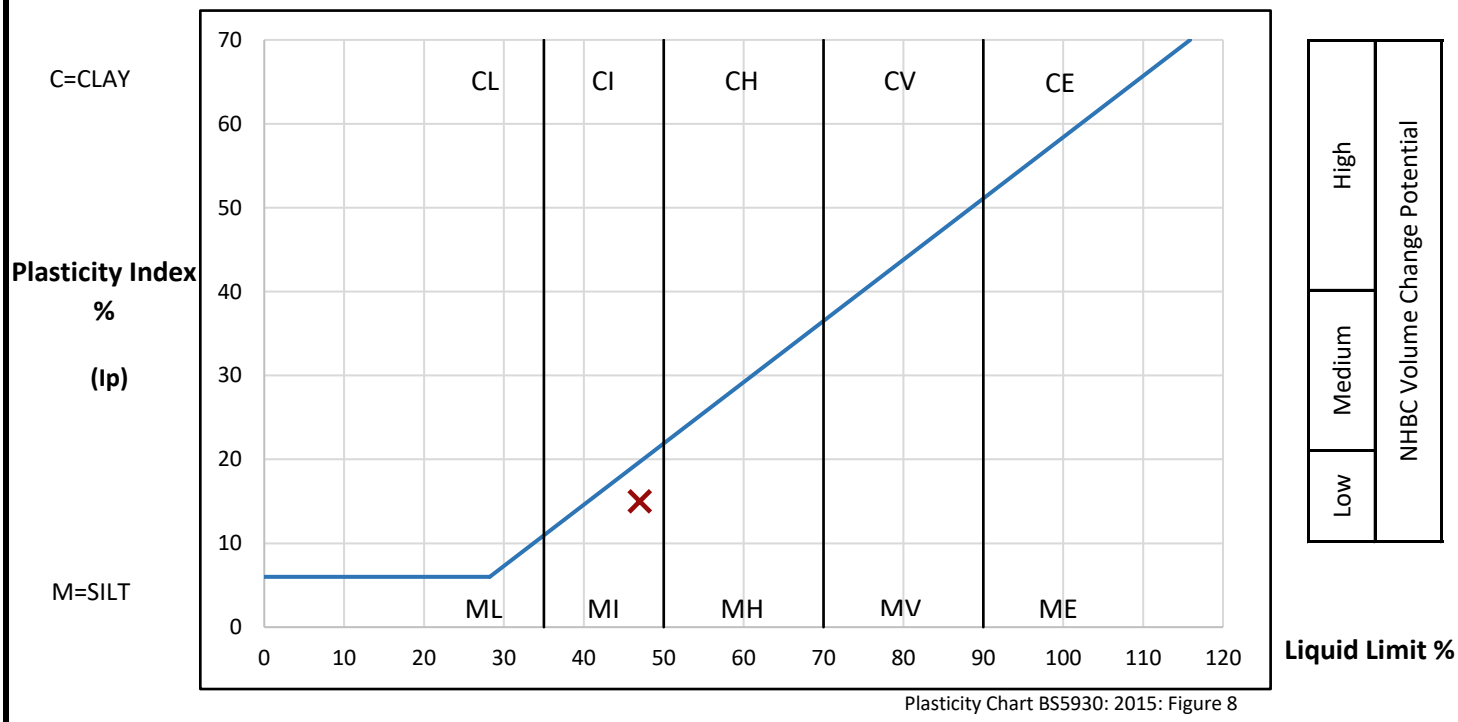
DETERMINATION OF WATER CONTENT, LIQUID LIMIT AND PLASTIC LIMIT AND DERIVATION OF PLASTICITY INDEX AND LIQUIDITY INDEX

Borehole / Pit No.	Depth m	Sample Type	Sample Reference	Water Content (W) %	Description	Remarks
TP07	0.60	D	1	25.3	Soft orangish brown slightly gravelly sandy clayey SILT with occasional brown mottling, rare ironstaining, and decayed roots. Gravel is orangish brown and brown fine to coarse angular to subrounded limestone.	

PREPARATION				Liquid Limit	47 %
Method of preparation		Wet sieved over 0.425mm sieve		Plastic Limit	32 %
Sample retained 0.425mm sieve	(Measured)	45 %		Plasticity Index	15 %
Corrected water content for material passing 0.425mm		46.0 %		Liquidity Index	-0.45
Sample retained 2mm sieve	(Measured)	23 %		NHBC Modified (I'p)	8 %
Curing time	26 hrs	Clay Content	Not analysed	Derived Activity	Not analysed



Plasticity Chart BS5930: 2015: Figure 8

Method of Preparation:	BS EN ISO: 17892-1: 2014 & BS 1377: Part 2: 1990: 4.2
Method of Test:	BS EN ISO: 17892-1: 2014 & BS 1377: Part 2: 1990: 3.2, 4.4, 5.3, 5.4
Type of Sample Key:	U=Undisturbed, B=Bulk, D=Disturbed, J=Jar, W=Water, SPT=Split Spoon Sample, C=Core Cutter
Comments:	Corrected water content assume material greater than 0.425mm non-porous. See BS1377: Part2: 1990 Clause 3 Note 1 Volume Change Potential: NHBC Standards Chapter 4.2 Unmodified Plasticity Index Note: Modified Plasticity Index I'p = Ip x (% less than 425microns/100)

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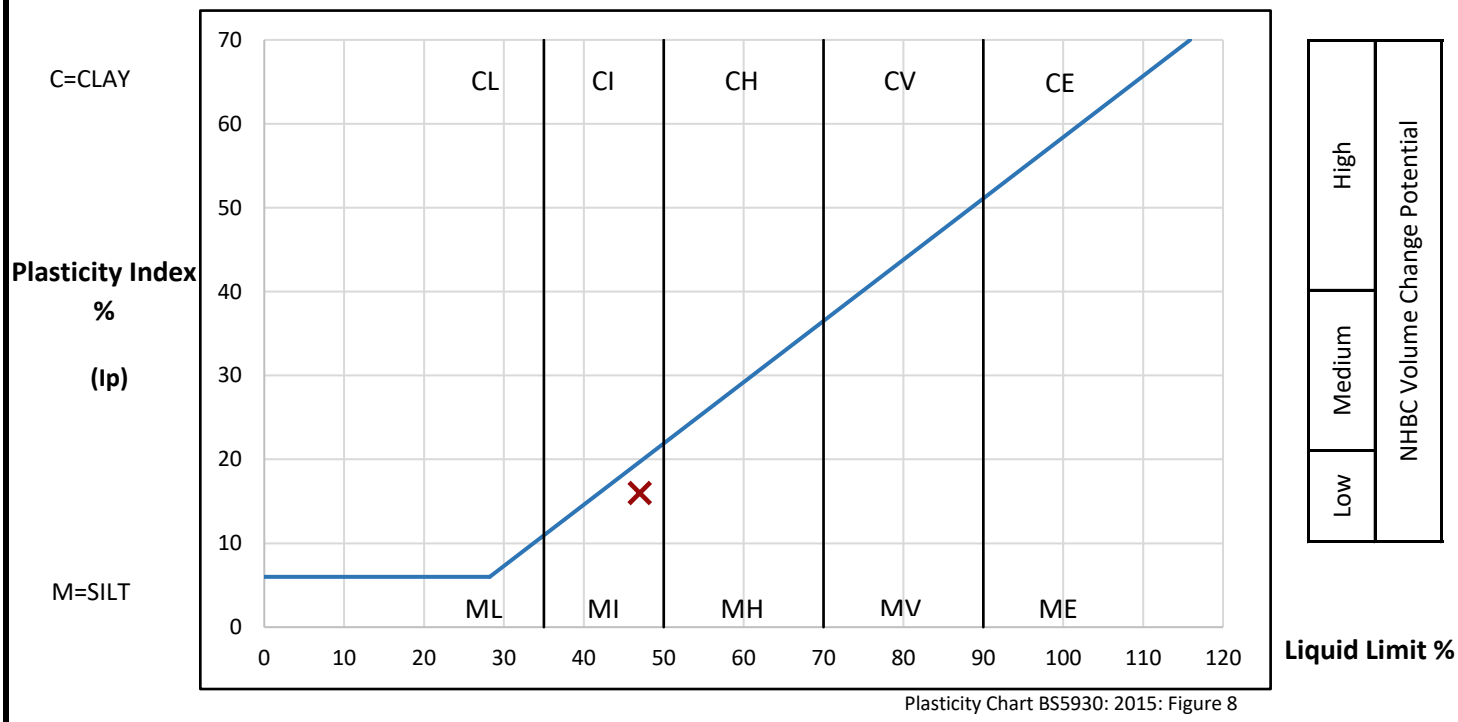
DETERMINATION OF WATER CONTENT, LIQUID LIMIT AND PLASTIC LIMIT AND DERIVATION OF PLASTICITY INDEX AND LIQUIDITY INDEX

Borehole / Pit No.	Depth m	Sample Type	Sample Reference	Water Content (W) %	Description	Remarks
TP08	0.80	D	1	25.4	Soft orangish brown slightly gravelly sandy clayey SILT with occasional brown mottling, and rare ironstaining. Gravel is orangish brown and brown fine to coarse angular to subrounded ferruginous limestone.	

PREPARATION				Liquid Limit	47 %
Method of preparation	Wet sieved over 0.425mm sieve			Plastic Limit	31 %
Sample retained 0.425mm sieve	(Measured)	54 %		Plasticity Index	16 %
Corrected water content for material passing 0.425mm		55.3 %		Liquidity Index	-0.35
Sample retained 2mm sieve	(Measured)	32 %		NHBC Modified (I'p)	7 %
Curing time	26 hrs	Clay Content	Not analysed	Derived Activity	Not analysed



Plasticity Chart BS5930: 2015: Figure 8

Method of Preparation:	BS EN ISO: 17892-1: 2014 & BS 1377: Part 2: 1990: 4.2
Method of Test:	BS EN ISO: 17892-1: 2014 & BS 1377: Part 2: 1990: 3.2, 4.4, 5.3, 5.4
Type of Sample Key:	U=Undisturbed, B=Bulk, D=Disturbed, J=Jar, W=Water, SPT=Split Spoon Sample, C=Core Cutter
Comments:	Corrected water content assume material greater than 0.425mm non-porous. See BS1377: Part2: 1990 Clause 3 Note 1 Volume Change Potential: NHBC Standards Chapter 4.2 Unmodified Plasticity Index Note: Modified Plasticity Index I'p = Ip x (% less than 425microns/100)

TEST REPORT

ISSUED BY SOIL PROPERTY TESTING LTD

DATE ISSUED: 05/11/2019

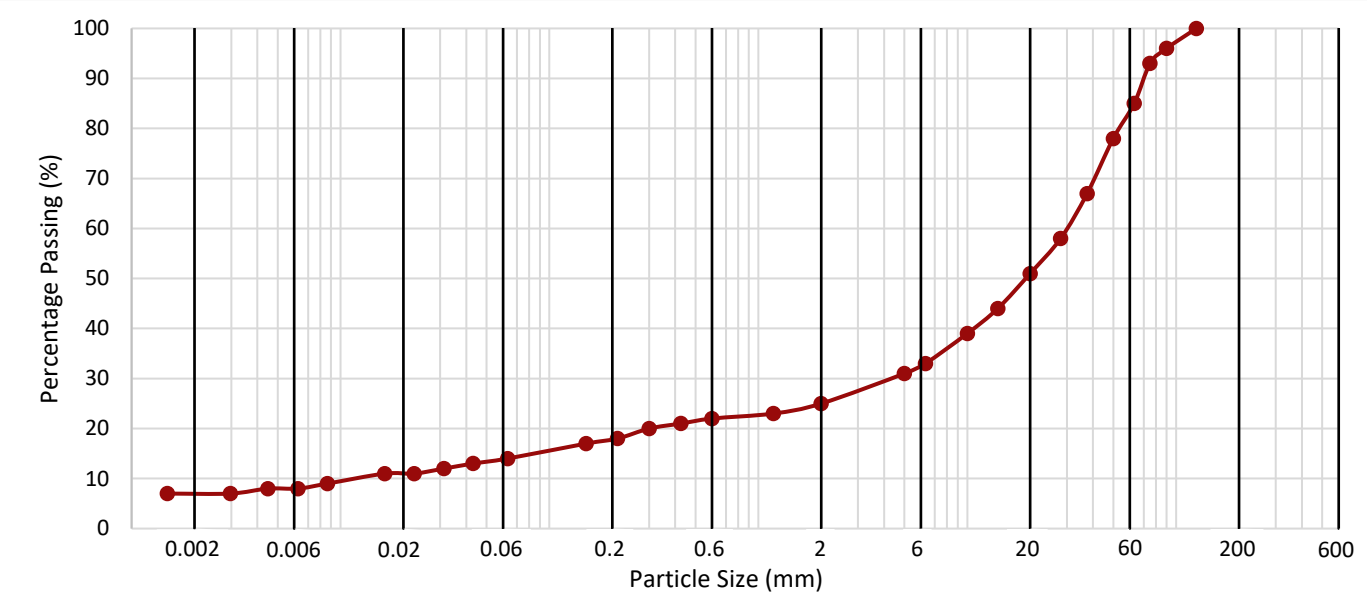
0998

Contract	**Hempton Road, Deddington**
Serial No.	**36020**

DETERMINATION OF PARTICLE SIZE DISTRIBUTION

Borehole / Pit No.	Depth (m)	Sample Type	Sample Reference	Description	Remarks
TP01	2.00	B	1	Reddish brown angular to subrounded ironstone, and orangish brown ferruginous limestone sandy clayey GRAVEL. Clay is orangish brown.	Dry mass of sample required 50kg. Mass of sample submitted 20.511kg. Sample Unrepresentative BS1377:Part 2:1990 Table 3.

Method of Test:	Wet Sieve + Hydrometer	Method of Pretreatment:	Not required



CLAY	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	COBBLES	BOULDERS
	SILT			SAND			GRAVEL				

Hydrometer	Particle Size (mm)	Passing (%)	Silt by Dry Mass (%)	Clay by Dry Mass (%)
	0.0431	13	7	
	0.0313	12		
	0.0225	11		
	0.0163	11		7
	0.0087	9		
	0.0063	8		
	0.0045	8		
	0.0030	7		
	0.0015	7		

Sieve Size (mm)	Passing (%)	Sand By Dry Mass (%)
2.00	25	11
1.18	23	
0.600	22	
0.425	21	
0.300	20	
0.212	18	
0.150	17	
0.063	14	

Fines By Dry Mass (%)	
<0.063mm	14

Sieve Size (mm)	Passing (%)	2mm+ By Dry Mass (%)
300		75
125	100	
90	96	
63	85	
50	78	
37.5	67	
28	58	
20	51	
14	44	
10	39	
6.3	33	
5	31	

Method of Preparation: BS1377: Part 1: 2016: 8.3 & 8.4.5
Method of test: BS1377: Part 2: 1990: 9.2,9.5
Type of Sample Key: U=Undisturbed, B=Bulk, D=Disturbed, J=Jar, W=Water, SPT=Split Spoon Sample, C=Core Cutter
Comments:

TEST REPORT

ISSUED BY SOIL PROPERTY TESTING LTD

DATE ISSUED: 05/11/2019

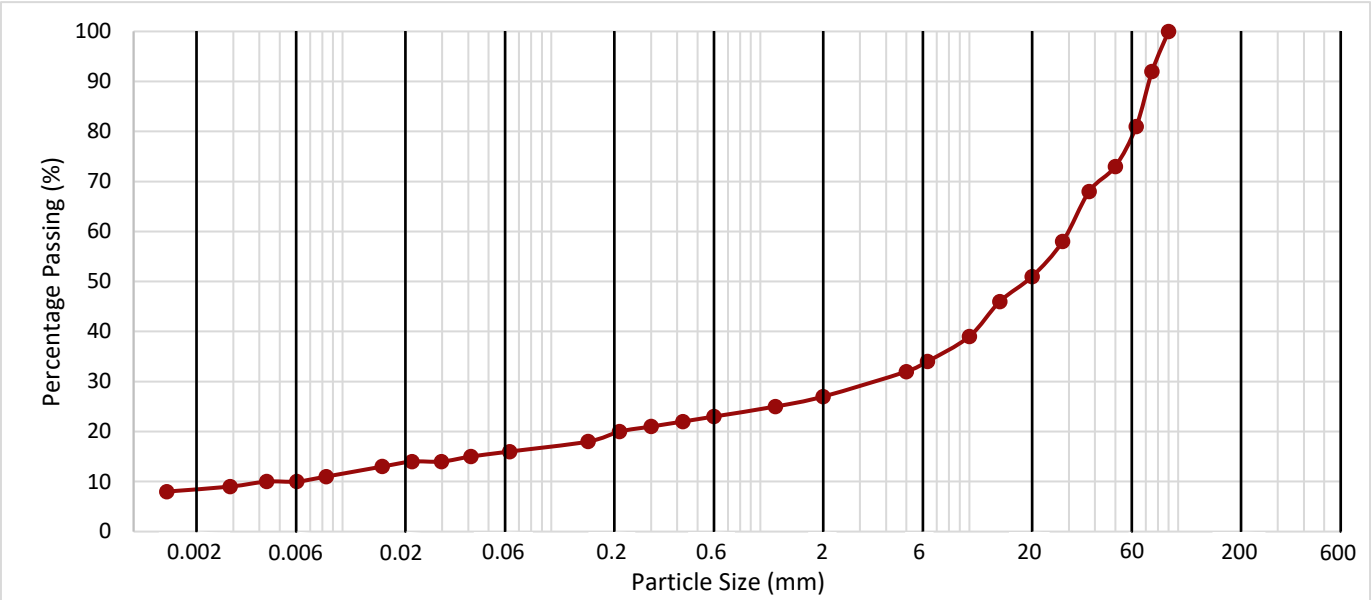
0998

Contract	**Hempton Road, Deddington**
Serial No.	**36020**

DETERMINATION OF PARTICLE SIZE DISTRIBUTION

Borehole / Pit No.	Depth (m)	Sample Type	Sample Reference	Description	Remarks
TP08	2.60	B	1	Reddish brown angular to subrounded ironstone, and orangish brown ferruginous limestone sandy clayey GRAVEL. Clay is orangish brown.	Dry mass of sample required 50kg. Mass of sample submitted 10.294kg. Sample Unrepresentative BS1377:Part 2:1990 Table 3.

Method of Test:	Wet Sieve + Hydrometer	Method of Pretreatment:	Not required



CLAY	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	COBBLES	BOULDERS
	SILT			SAND			GRAVEL				

Hydrometer	Particle Size (mm)	Passing (%)	Silt by Dry Mass (%)	Clay by Dry Mass (%)
	0.0411	15	7	
	0.0298	14		
	0.0215	14		
	0.0155	13		9
	0.0084	11		
	0.0060	10		
	0.0043	10		
	0.0029	9		
	0.0014	8		

Sieve Size (mm)	Passing (%)	Sand By Dry Mass (%)
2.00	27	11
1.18	25	
0.600	23	
0.425	22	
0.300	21	
0.212	20	
0.150	18	
0.063	16	

Fines By Dry Mass (%)	
<0.063mm	16

Sieve Size (mm)	Passing (%)	2mm+ By Dry Mass (%)
300		73
125		
90	100	
63	81	
50	73	
37.5	68	
28	58	
20	51	
14	46	
10	39	
6.3	34	
5	32	

Method of Preparation: BS1377: Part 1: 2016: 8.3 & 8.4.5
Method of test: BS1377: Part 2: 1990: 9.2,9.5
Type of Sample Key: U=Undisturbed, B=Bulk, D=Disturbed, J=Jar, W=Water, SPT=Split Spoon Sample, C=Core Cutter
Comments:

TEST REPORT

ISSUED BY SOIL PROPERTY TESTING LTD

DATE ISSUED: 02/01/2020

0998

Contract	**Hempton Road, Deddington**
Serial No.	**36282**

Client:

BRD Environmental Ltd

BRD Environmental Ltd
Hawthorne Villa
1 Old Parr Road
Banbury
Oxfordshire
OX16 5HT

Soil Property Testing Ltd

15, 16, 18 Halcyon Court, St Margaret's Way,
Stukeley Meadows, Huntingdon,
Cambridgeshire, PE29 6DG

Tel: 01480 455579
Email: enquiries@soilpropertytesting.com
Website: www.soilpropertytesting.com

Samples Submitted By:

BRD Environmental Ltd

Samples Labelled:

Hempton Road, Deddington

Approved Signatories:

- ☑ **J.C. Garner B.Eng (Hons) FGS** — Technical Director & Quality Manager
- ☐ **S.P. Townend FGS** — Chairman
- ☐ **W. Johnstone** — Materials Lab Manager
- ☐ **D. Sabnis** — Operations Manager

Date Received: 23/12/2019

Samples Tested Between: 23/12/2019 **and** 02/01/2020

Remarks:

For the attention of Jessica Hand
Your Reference No: BRD3567

Notes:

1. All remaining samples or remnants from this contract will be disposed of after 21 days from today, unless we are notified to the contrary.
2. (a) UKAS - United Kingdom Accreditation Service.
   (b) Opinions and interpretations expressed herein are outside the scope of UKAS accreditation.
3. Tests marked "NOT UKAS ACCREDITED" in this test report are not included in the UKAS Accreditation Schedule for this testing laboratory.
4. This test report may not be reproduced other than in full except with the prior written approval of the issuing laboratory.

TEST REPORT

ISSUED BY SOIL PROPERTY TESTING LTD

DATE ISSUED: 02/01/2020

0998

Contract	**Hempton Road, Deddington**		
Serial No.	**36282**	**Target Date**	23/12/2019
Scheduled By	BRD Environmental Ltd		

SCHEDULE OF LABORATORY TESTS

Schedule Remarks

Bore Hole No.	Type	Sample Ref.	Top Depth	Particle Size Distribution (BS1377)	Water Content (BSEN)	Liquid/Plastic Limits															Sample Remarks
TP11	B	1	2.00	1																	
TP14	D	1	3.30		1	1															
Totals				**1**	**1**	**1**															**End of Schedule**

TEST REPORT

ISSUED BY SOIL PROPERTY TESTING LTD

DATE ISSUED: 02/01/2020

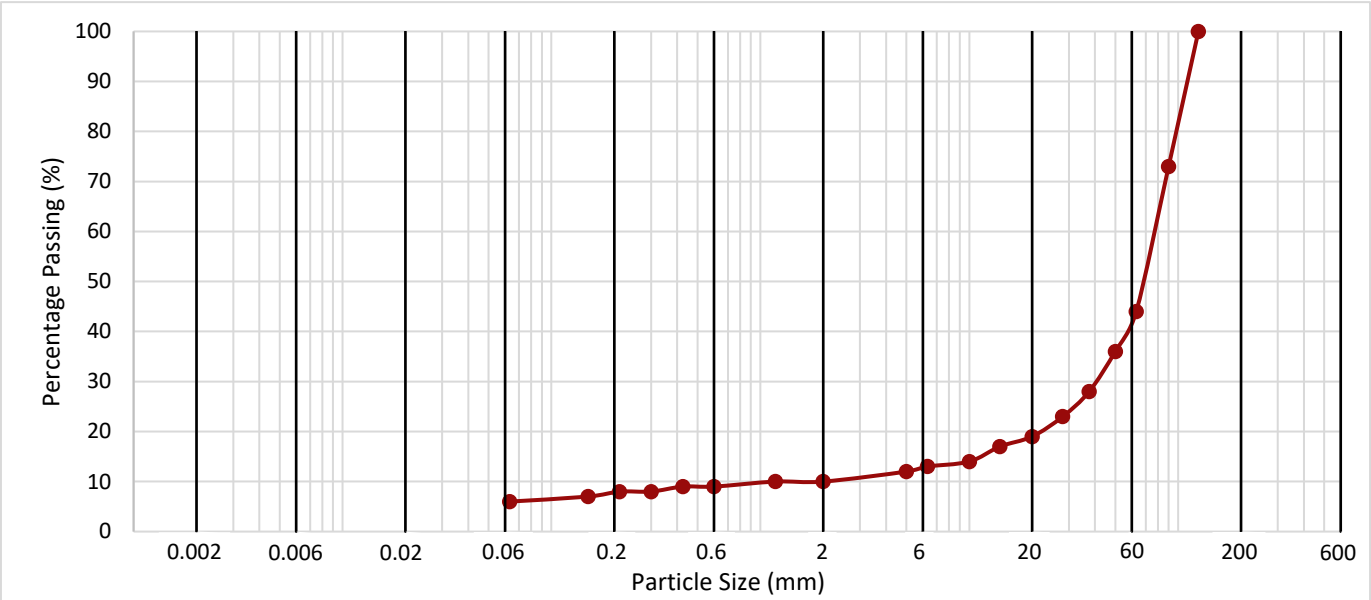
0998

Contract	**Hempton Road, Deddington**
Serial No.	**36282**

DETERMINATION OF PARTICLE SIZE DISTRIBUTION

Borehole / Pit No.	Depth (m)	Sample Type	Sample Reference	Description	Remarks
TP11	2.00	B	1	Orangish brown and reddish brown slightly sandy clayey angular to subrounded ironstone and rare yelllowish brown limestone GRAVEL	

Method of Test:	Wet Sieve	Method of Pretreatment:	Not required



CLAY	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	COBBLES	BOULDERS
	SILT			SAND			GRAVEL				

Hydrometer	Particle Size (mm)	Passing (%)	**Silt by Dry Mass (%)**	**Clay by Dry Mass (%)**

Sieve Size (mm)	Passing (%)	**Sand By Dry Mass (%)**
2.00	10	**4**
1.18	10	
0.600	9	
0.425	9	
0.300	8	
0.212	8	
0.150	7	
0.063	6	

Fines By Dry Mass (%)	
<0.063mm	**6**

Sieve Size (mm)	Passing (%)	**2mm+ By Dry Mass (%)**
300		**90**
125	100	
90	73	
63	44	
50	36	
37.5	28	
28	23	
20	19	
14	17	
10	14	
6.3	13	
5	12	

Method of Preparation: BS1377: Part 1: 2016: 8.3 & 8.4.5
Method of test: BS1377: Part 2: 1990: 9.2
Type of Sample Key: U=Undisturbed, B=Bulk, D=Disturbed, J=Jar, W=Water, SPT=Split Spoon Sample, C=Core Cutter
Comments:

TEST REPORT

ISSUED BY SOIL PROPERTY TESTING LTD

DATE ISSUED: 02/01/2020

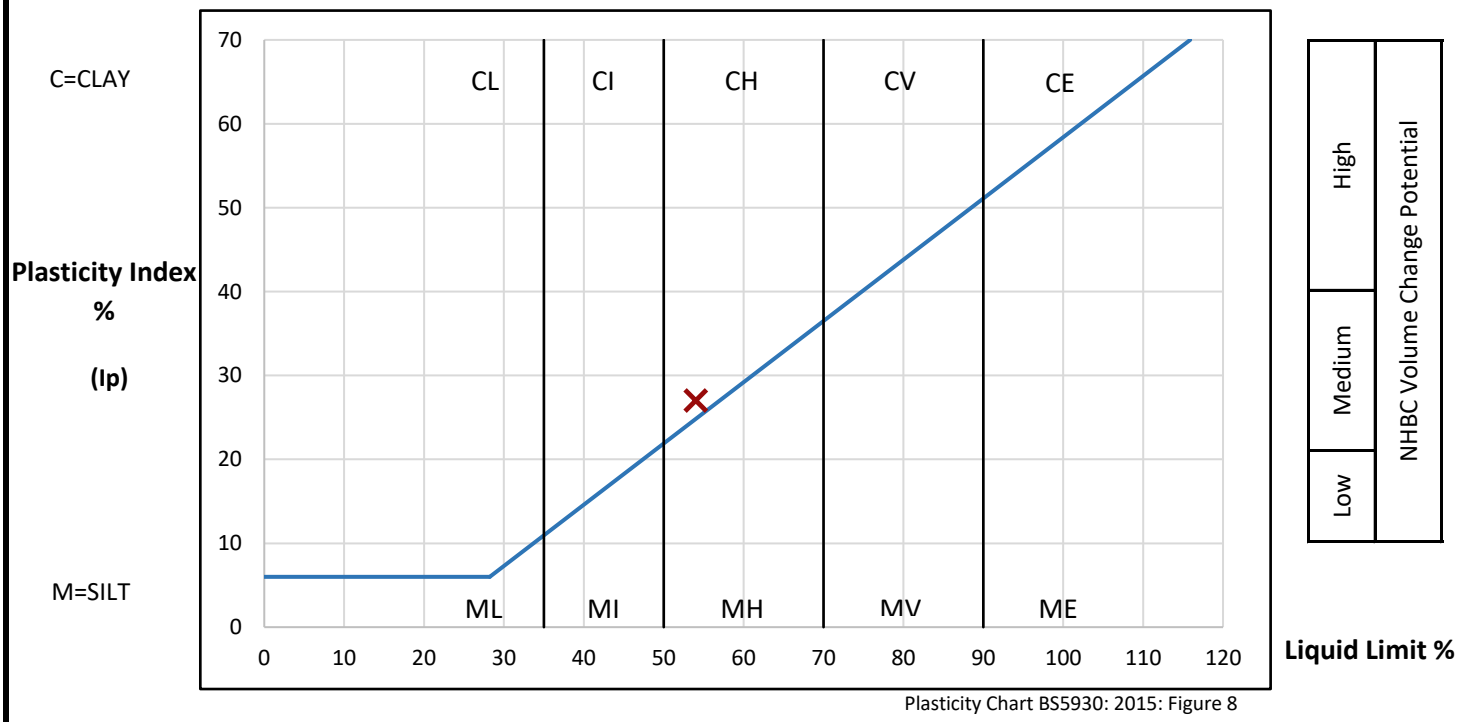
0998

Contract	**Hempton Road, Deddington**
Serial No.	**36282**

DETERMINATION OF WATER CONTENT, LIQUID LIMIT AND PLASTIC LIMIT AND DERIVATION OF PLASTICITY INDEX AND LIQUIDITY INDEX

Borehole / Pit No.	Depth m	Sample Type	Sample Reference	Water Content (W) %	Description	Remarks
TP14	3.30	D	1	27.9	Stiff light olive brown CLAY with rare recently active roots	

PREPARATION			Liquid Limit	54 %
Method of preparation		From natural	Plastic Limit	27 %
Sample retained 0.425mm sieve	(Assumed)	0 %	Plasticity Index	27 %
Corrected water content for material passing 0.425mm			Liquidity Index	0.03
Sample retained 2mm sieve	(Assumed)	0 %	NHBC Modified (I'p)	n/a
Curing time	50 hrs	Clay Content: Not analysed	Derived Activity	Not analysed



Plasticity Chart BS5930: 2015: Figure 8

Method of Preparation: BS EN ISO: 17892-1: 2014 & BS 1377: Part 2: 1990: 4.2

Method of Test: BS EN ISO: 17892-1: 2014 & BS 1377: Part 2: 1990: 3.2, 4.4, 5.3, 5.4

Type of Sample Key: U=Undisturbed, B=Bulk, D=Disturbed, J=Jar, W=Water, SPT=Split Spoon Sample, C=Core Cutter

Comments: