Acton Gardens, Phase 8

Phase 2 Ground Investigation Report

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Client Name: Countryside Properties (UK) Ltd.

Client Address: 79 Enfield Road | Acton | London | W3 8RB

Site Address: Acton Gardens | Acton | London | W3 8TJ

Curtins Consulting Limited
40 Compton Street
London
EC1V 0BD
Tel: 020 7324 2240
Email: london@curtins.com
www.curtins.com

Rev	Description	Issued by	Checked	Date

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Author	Signature	Date
M Wood MSci (Hons) Geo-Environmental Engineer	[redacted]	April 2020
R Swinnerton BSc (Hons) MSc FGS Geo-Environmental Engineer	[redacted]	June 2020

Reviewed	Signature	Date
W Spraggs BSc (Hons) MSc Senior Geo-Environmental Engineer	[redacted]	June 2020

Authorised	Signature	Date
M Lomas BSc (Hons) MCIWEM C.WEM Associate	[redacted]	April 2020

Executive Summary

Appointment	Curtins were instructed by Countryside Properties (UK) Ltd. to undertake a Phase 2 Ground Investigation at Acton Gardens, Acton, London, W3 8TJ. This ground investigation report has been undertaken in support of the proposed demolition of the existing buildings and the construction of 2 to 10 storey residential buildings with associated access roads, hard-standing and soft landscaping areas (open space and private gardens).
Current Site Status	The development site comprises an irregularly shaped parcel of land, approximately 1.84 Hectares in size and is located at Acton Gardens, London. It is centred around national grid reference (NGR) 520120, 179680. The site is currently occupied by residential developments which consists of 3 No. residential tower blocks, road access, car parking (including garages), soft and hard landscaped areas.
Fieldworks	The ground investigation fieldworks were undertaken in February 2020 and May 2020, comprising five cable percussion boreholes, eight window sample boreholes, six in-situ CBR (TRL-DCP) tests and three return ground gas and ground monitoring visits. The arisings of the boreholes were logged by a suitably qualified Curtins engineer and representative samples of the soil were submitted for environmental and geotechnical laboratory testing.
Ground Conditions	Made Ground deposits were encountered in all exploratory locations to a maximum depth of 2.30m bgl, consisting of either hard-standing or Topsoil at surface, with a granular and cohesive fill encountered thereafter. Anthropogenic material of the Made Ground comprised black ash, flint, brick, concrete, slate, metal, glass, clinker, ceramic and tile. Superficial Deposits included Head Deposits, Lynch Hill Gravel Member and Langley Silt Member. Head Deposits were encountered underlying the Made Ground in the south-west of the site comprising dense to very dense orangish brown slightly clayey SAND and GRAVEL. The Langley Silt Member was encountered underlying the Made Ground in the south of the site; comprising inter-bedded SAND and CLAY. The clay layers consisted of firm to stiff orangish brown and grey silty sandy CLAY with black specks and sand lenses, in the location of CP101 gravel was present towards the base of the deposit. The sand layers consisted of medium dense to dense orange and yellow silty SAND with black specks and shell fragments. This was proven to a maximum depth of 9.00m bgl / 5.00m AOD in the location of CP101. The Lynch Hill Gravel Member was encountered underlying the Made Ground in the northwest of the site; comprising inter-bedded CLAY, SAND and GRAVEL considered to comprise interbedding between the Head Deposits. The clay layers consisted of soft to firm orangish brown silty sandy gravelly CLAY. The sand layers comprised medium dense orangish brown clayey gravelly SAND. The gravel layers consist of medium dense orangish brown clayey very sandy GRAVEL. Thereafter residual soil and bedrock geology of the London Clay Formation was encountered to termination depths of 30.0m bgl (base not encountered) comprising initially a firm to stiff, orange brown, silty CLAY from 0.85m to 4.80m becoming stiff to very stiff grey mottled bluish grey slightly silty CLAY. Perched groundwater was encountered at depths of 0.20m bgl/14.30m AOD (WS104), 0.90m bgl/17.34m AOD (WS105), 1.30m bgl/15.99m AOD (WS108) and 1.30m bgl/15.37m AOD (CP105) during the ground investigation within the Made Ground. Shallow groundwater (likely perched) was encountered at depths of 2.80m bgl/16.87m AOD (WS106) and 1.80m bgl/17.26m AOD (CP104) within the Lynch Hill Gravel Member during the ground investigation. Groundwater was encountered at depths of 4.80m bgl/9.70m AOD (WS104), 2.65m bgl/14.64m AOD (WS108) within the London Clay Formation during the ground investigation. The groundwater encountered in the London Clay is presumed to exist within silty sandy layers within the clay.
Laboratory Testing	Representative samples of the site soils were obtained and submitted to a suitably accredited laboratory for environmental and geotechnical analyses. The environmental chemistry results for soils have been compared with the Tier 1 criteria for soils with respect to human health for a combined Residential (with homegrown produce) use reflecting the proposed end usage (residential properties with gardens and public open space). The geotechnical testing undertaken comprised Atterberg Limits, BRE SD1 Suite, PSD, Sedimentation, undrained tri-axial testing, pH, and water-soluble sulphate.

Generic Quantitative Risk Assessment	**Human Health -** The risk to future site users from impacted site soils is assessed as Moderate with respect to combined end use (Residential with Homegrown Produce). **Controlled Waters –** The risk presented to controlled waters is assessed to be Low. **Ground Gas –** The risk presented by ground gases is assessed as Low with no requirement for ground gas protection measures as part of the proposed development.
Geotechnical Assessment	It is considered that shallow London Clay soils encountered at 0.85m to 2.50m bgl on-site within proposed areas of 2 to 3 storey buildings are likely to achieve bearing capacities of 100kPa. However, given the high plasticity soils and high-volume change potential of such soils a minimum founding depth of 1.00m (outside zone of trees) and 1.50m bgl (within zone of new planting) is adopted in line with NHBC 'Building Near Trees' guidance. It is considered that as a worst case and conservative assessment preliminary pile loads of 900kN would be achievable at a depth of 25.0m bgl, assuming a pile diameter of 600mm. It is considered potentially greater pile loads would be achieved at a shallower depth within the northern portion of the site, based on the London Clay dataset within this area (CP104 and CP105). For the purposes of pavement designed and in accordance with Interim Advice Note 73/06, 2009, a minimum CBR of 2% must be adopted. This guidance indicates that pavements founded on ground with a minimum CBR of 2.5% will not require regular maintenance. As such, where minimal maintenance is required, it is advised that a pavement designer is consulted, and suitable appropriate testing and assessment is undertaken.
Recommendations	It is recommended that the sub-base material on-site containing Asbestos fibres with a thickness of (220mm to 500mm) is removed from areas of proposed soft landscaping. Due to identified potential contaminative risk within private gardens, the following either/or recommendations are provided: It is recommended that in proposed private gardens on-site areas, a 600mm thickness of certified, clean imported soil (of both Topsoil and sub-soil verified at source and on-site) is required in proposed areas of the soft landscaping within residential gardens. It is recommended that the above be detailed within a Remediation Strategy for the development and submitted to the local authority for approval. Or, Given a total of 11 private gardens proposed (as presented in development plans Appendix A) for the development and the marginal exceedances recorded within the Made Ground, consideration should be given to further testing of these areas to determine the presence of any marginal exceedances and requirements or otherwise for clean capping, potentially reducing quantities of import material on-site.

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Appendices

1.0 Introduction

1.1 Project Background

Curtins were instructed by Countryside Properties (UK) Ltd. to undertake a Phase 2 Ground Investigation at Acton Gardens, Acton, London, W3 8TJ.

This geo-environmental assessment report has been undertaken in support of the proposed demolition of the existing buildings and the construction of 2 to 10 storey residential buildings with associated access roads, hard-standing and soft landscaping areas (open space and private gardens). The development layout plans, current at the time of writing, are presented in Appendix A.

Curtins have previously undertaken a Phase 1 Desk Study (1) for the development site as part of an outline planning application for the development site, which recommended for a Phase 2 Ground Investigation to be undertaken to determine potential contaminative risk to environmental receptors and aid the civil/structural design of the proposed development.

1.2 Scope of Works

The investigation was undertaken to provide an assessment of both environmental and geotechnical ground conditions on the subject site with respect to any potential contamination in the underlying soils and or groundwater.

Specifically, the report is intended to determine:

a) If there is a risk of the proposed end user being adversely impacted upon by potential contamination in shallow site soils that may be present on the site due to its known current, recent and historical use.

b) If there is a risk of groundwater and/or surface water being adversely impacted upon by potential contamination that may be present on the site due to its known current, recent and historical use.

c) If there is a risk to the end user from soil gases including methane, carbon dioxide, oxygen, and hydrogen sulphide.

d) Recommendations for the design of foundations and building ground floor slabs.

e) Recommendations for the specification of sub-structure concrete.

2.0 Site Setting

2.1 Current Setting

The Acton Gardens Phase 8 development site comprises an irregularly shaped parcel of land, approximately 1.84 Hectares in size and is located at Acton Gardens, London. It is centred around grid reference 520120, 179680 and is shown in figure 2.1 below. The site is currently occupied by residential developments which consists of 3 No. residential tower blocks, access road, car parking (including garages), soft and hard landscaped areas.

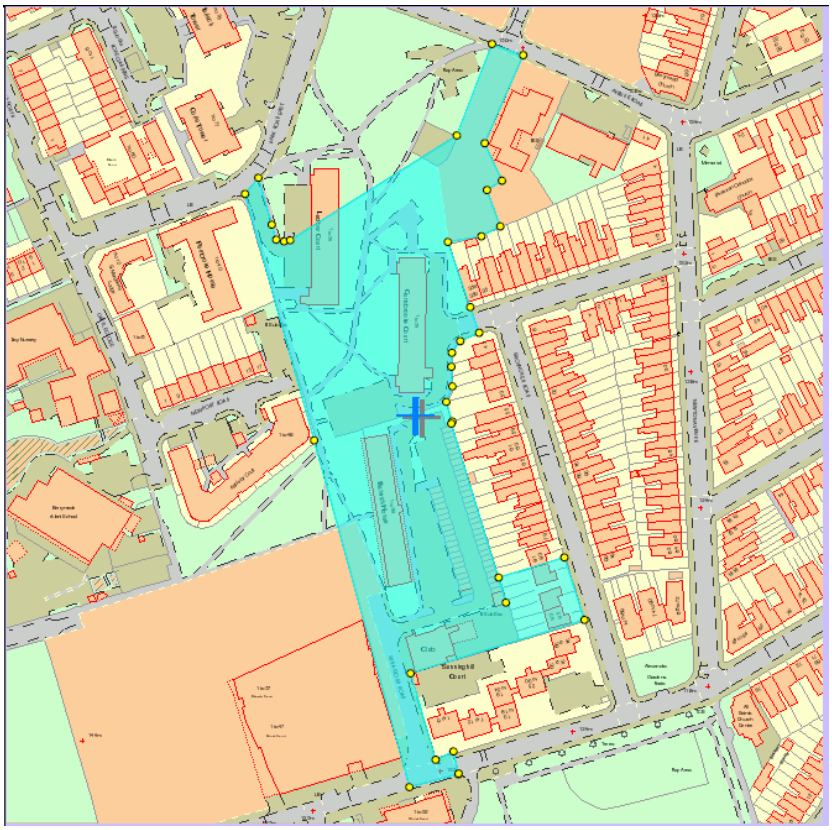

Figure 1 Site Location Plan (site highlighted in blue)

2.2 Phase 1 Desk Study

Curtins have undertaken a Phase 1 Preliminary Risk Assessment (1). This is recommended to be read in conjunction with this reporting to provide a geo-environmental overview in regard to the site geology, hydrogeology, hydrology, historical land use, and landfill.

For continuity, the Preliminary Conceptual Site Model (PCSM) previously completed by Curtins has been included in Section 3.0 of this report.

2.3 Unexploded Ordnance

As part of the Phase 2 investigation, Curtins commissioned 1st Line Defence to undertake a site specific Detailed Unexploded Ordnance (UXO) Risk Assessment in regard to intrusive works on-site. A copy of the full report is presented in Appendix B.

The UXO Assessment concluded there is a Low Risk from items of German aerial delivered UXO and Negligible Risk from Allied UXO across the site. Given this, the following risk mitigation measures were recommended to support the proposed works at the Acton Gardens Phase 8 site:

- UXO Risk Management Plan; and,
- Site Specific UXO Awareness Briefings to all personnel conducting intrusive works.

3.0 Conceptual Site Model and Qualitative Risk Assessment

The Conceptual Site Model (CSM) and Qualitative Risk Assessment (QRA) are presented in the table within this section.

The CSM details the source-pathway-receptor linkages or potential contaminant linkages (PCLs) that have been identified for the site. The QRA details the associated level of risk relating to these PCLs.

The CSM and QRA concern the major risks to human health and controlled waters with additional, more specific risk assessment protocols contained within the main body of this reporting.

The QRA follows the framework outlined within CIRIA C552 which is summarised within Appendix F.

The 'risk rating' within the QRA refers to the risk that the source, pathway, receptor linkage or PCL is complete. Unless specifically stated it does not necessarily refer to an immediate risk and is intended to be used as a tool to assess the necessity for further assessment/investigation.

Under current health and safety legislation, employers are required to carry out their own appropriate risk assessments and mitigation to protect themselves and their employees, other human receptors and the environment from potential contamination. Such risks must be adequately mitigated by law, specifically the Construction Design Management (CDM) Regulations (2015) which require that potential risks to human health and the environment from construction activities are appropriately identified and all necessary steps taken to eliminate / manage that risk. It has been assumed that any future construction works on site will be undertaken in compliance with these requirements and therefore construction workers involved in the building works at the site have been discounted as a human receptor in the conceptual site model.

- The table below represents the first stage in the land quality risk assessment process: The Qualitative Risk Assessment.
- In order for a development site to be deemed 'suitable for use', the level of risk needs to be brought down to acceptable levels, i.e. low to negligible risk. The purpose of each stage of risk assessment is ultimately to establish, if there is a requirement for additional levels of assessment to be made in order to have sufficient confidence to support a risk characterisation or management decision, e.g. remedial action.
- In the absence of specific site data a Generic Quantitative Risk Assessment is invariably recommended.

Conceptual Site Model			Qualitative Risk Assessment			Recommended actions
Potential on-site sources	**Pathway(s)**	**Receptor(s)**	**Consequence**	**Likelihood of occurrence**	**Risk rating**	
ON-SITE SOURCES Contaminants [e.g. asbestos, polycyclic aromatic hydrocarbons (PAH), total petroleum hydrocarbon (TPH) and heavy metals (e.g. lead and arsenic)] associated with Made Ground (non-specific locations)	Direct contact and dermal uptake, soil and dust ingestion, dust & vapour inhalation/ingestion in areas of soft landscaping of the proposed development.	Site end users	Medium	Likely Based on available development proposal options, the majority of the site will be hard standing; however, some soft landscaping area are located surrounding the proposed buildings.	Moderate	Ground investigation including sampling and analysis of Made Ground soil samples. GQRA based on ground investigation findings.
	Ingestion of drinking water impacted via the migration of contaminants into waters supply pipes			Likely Given the likely presence of contaminants such as TPH prone to pipe permeation.		
	Soil and dust ingestion, dust inhalation from migrating dust (indoor & outdoor air)	Neighbouring residents		Low likelihood Standard health and safety precautions adopted by construction workers (e.g. measures to supress dust) are likely to reduce the generation of soil dust.	Moderate/Low	
	Direct contact and dermal uptake, soil and dust ingestion, dust inhalation (outdoor air)	Construction and maintenance workers		Low likelihood Standard health and safety precautions likely adopted to mitigate/reduce risk.		
	Downward migration into underlying secondary aquifer such as the Lynch Hill Gravel Member	Water environment Underlying secondary A aquifer		Likely within the secondary A aquifer located in the superficial deposits.	Moderate	Groundwater should be taken from perched water, if encountered in the Made Ground. If encountered, samples should also be taken from encountered ground water.
ON-SITE SOURCES Chlorinated hydrocarbons such as tetrachloroethylene (PCE), heavy metals, asbestos and petroleum hydrocarbons associated with the Engineering Works, Plating Works, Laundries and Warehouses used to be present to the south-west and north-west respectively. Historical Engineering Works, Plating Works, Laundries, Warehouse that used to be present on-site Free product) lateral migration of contaminants (in particular chlorinated hydrocarbons) from Historical site-use within the Made Ground (on top of the London Clay) underneath the site	Migration of vapours from contaminants prone to vaporisation (e.g. chlorinated hydrocarbons & petroleum hydrocarbons) through ground floor slabs of the proposed buildings and build-up	Site end users	Medium	Likely Based on available development proposal options, the majority of the site will be hard standing; however, some soft landscaping area may remain surrounding the proposed buildings.	Moderate	Ground investigation including sampling and chemical analysis of soil samples. GQRA based on ground investigation findings
	Ingestion of drinking water impacted by the migration of contaminants into waters supply pipes			Likely Given the likely presence of contaminants (e.g. BTEX, chlorinated hydrocarbon & TPH) prone to pipe permeation.		
	Build-up in excavations / confined spaces	Construction and maintenance workers		Low likelihood Standard health and safety precautions adopted by construction workers (e.g. measures to supress dust) are likely to reduce the generation of soil dust.	Moderate/Low	
	Inhalation (indoor & outdoor air)	Adjacent residents		Low likelihood Standard health and safety precautions likely adopted to mitigate/reduce risk.		
	Downward migration into underlying secondary A aquifer (Lynch Hill Gravel Member)	Water environment Underlying secondary A aquifer		Likely within the secondary aquifer located in the superficial deposits.	Moderate	Groundwater should be taken from perched water, if encountered in the Made Ground. If encountered, samples should also be taken from encountered ground water.

Conceptual Site Model			Qualitative Risk Assessment			Recommended Actions
Potential on-site sources	**Pathway(s)**	**Receptor(s)**	**Consequence**	**Likelihood of Occurrence**	**Risk Rating**	
ON-SITE SOURCES Electricity Sub Station that used to be present on site.	Direct contact and dermal uptake, soil and dust ingestion, dust & vapour inhalation/ingestion in areas of soft landscaping of the proposed development.	Site end users	Medium	Likely Based on available development proposal options, the majority of the site will be hard standing; however, some soft landscaping may remain.	Moderate	Ground investigation including ground gas monitoring. GQRA based on ground investigation findings.
	Ingestion of drinking water impacted via the migration of contaminants into waters supply pipes.			Likely Given the likely presence of contaminants (e.g. TPH) prone to pipe permeation.		
	Soil and dust ingestion, dust inhalation from migrating dust (indoor & outdoor air).	Neighbouring residents		Low likelihood Standard health and safety precautions adopted by construction workers (e.g. measures to supress dust) are likely to reduce the generation of soil dust.	Moderate/Low	
	Direct contact and dermal uptake, soil and dust ingestion, dust inhalation (outdoor air).	Construction and maintenance workers		Low likelihood Standard health and safety precautions likely adopted to mitigate/reduce risk.		
	Downward migration into underlying secondary aquifer in the Lynch Hill Gravel Member.	Water environment Underlying secondary A aquifer		Likely within the secondary aquifer located in the superficial deposits.	Moderate	Groundwater should be taken from perched water, if encountered in the Made Ground. If encountered, samples should also be taken from encountered ground water.
Ground gas and vapour from organic and hydrocarbon contaminants generated from contaminants in the Made Ground and organic / putrescible materials in the Made Ground and natural materials (non-specific & specific locations)	Migration through ground floor slabs of the proposed buildings and build-up	Site users	Medium	Likely Based on available development proposal options, the majority of the site will be hard standing; however, some soft landscaping may remain.	Moderate	Ground investigation including ground gas monitoring. GQRA based on ground investigation findings.
	Build-up in confined spaces	Construction and maintenance workers	Medium	Low (as above; in addition, standard health & safety precautions likely to be used by workers)	Low	
	Inhalation (indoor & outdoor air)	Adjacent residents		Unlikely (due to outdoor dilution and dispersion effects)		No further action required.
OFF-SITE SOURCES: Contaminants [e.g. asbestos, polycyclic aromatic hydrocarbons (PAH), total petroleum hydrocarbon (TPH) and heavy metals (e.g. lead and arsenic)] in the Made Ground	Migration of vapours from contaminants prone to vaporisation (e.g. chlorinated hydrocarbons) through ground floor slabs of the proposed buildings and build-up	Site end users / commercial development	Medium	Low (the potential for soil / dusts migration is assessed low)	Moderate/low	Ground investigation including ground gas monitoring. GQRA based on ground investigation findings.
	Build-up in excavations / confined spaces	Construction and maintenance workers		Unlikely (as above; however, standard health & safety precautions likely to be used by workers, reducing the risk further)	Low	
	Inhalation (indoor & outdoor air)	Adjacent residents				
OFF-SITE SOURCES: Railway lines, Brewery, Laundries, Engineering Works, Garage, Works, Depots, Made Ground, Warehouses, Timber Yard,	Migration of vapours from contaminants prone to vaporisation (e.g. chlorinated hydrocarbons) through ground floor slabs of the proposed buildings and build-up	Site end users / commercial development	Medium	Likely Based on available development proposal options, the majority of the site will be hard standing; however, some soft landscaping areas may remain.	Moderate	Ground investigation including ground gas monitoring. GQRA based on ground investigation findings.
	Ingestion of drinking water impacted via the migration of contaminants into waters supply pipes			Low (as above; in addition, standard health & safety precautions likely to be used by workers)	Moderate/Low	
	Build-up in excavations / confined spaces	Construction and maintenance workers	Medium	Unlikely (as above; however, standard health & safety precautions likely to be used by workers, reducing the risk further)	Low	
	Inhalation (indoor & outdoor air)	Adjacent residents	Medium	Unlikely (due to outdoor dilution and dispersion effects)		No further action required.
	Downward migration into underlying secondary aquifer in the Hackney Gravel	Water environment Underlying secondary aquifer	Medium	Likely within the secondary aquifer located in the superficial deposits.	Moderate	Groundwater samples to be taken from perched water & Made Ground if encountered.

4.0 Fieldwork

4.1 General

The ground investigation was undertaken by Curtins in two phases. The first completed in February 2020 with the second completed in May 2020. A summary of the scope and rationale for the intrusive works undertaken is summarised in Table 4.1 below.

The ground investigation was designed by Curtins in relation to the findings of the Phase 1, the proposed development plans and in general accordance with current UK guidance including CLR11 (2), British Standard (BS) 10175 (3), BS5930:2010 (4) and Eurocode 7 (5).

Table 4.1 *Ground Investigation Scope and Rationale*

Activity	Rationale
5 No. cable percussion boreholes (CP101 to CP105) to depths of 30.00m bgl*	• Characterise deeper ground conditions; • Collect soil samples for chemical & geotechnical analysis; • Undertake in-situ testing; • Installation of ground gas and groundwater monitoring; and • Determine geotechnical parameters
8 No. window sample boreholes (WS101 to WS108) to depths of 5.00m bgl	• Confirm shallow ground conditions; • Collect soil samples for chemical & geotechnical analysis; • Undertake in-situ testing; • Installation of ground gas and groundwater monitoring; and • Determine geotechnical parameters.
6 No. TRL-DCP in-situ tests	• To enable preliminary roadway and pavement design.
3 No. return gas and groundwater monitoring visits.	• To determine the ground gas and groundwater level regime;

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Curtins Exploratory Hole Location drawing, records the locations of all exploratory hole locations a copy of which is contained within Appendix A.

4.2 Logging and Sampling (Soil and Groundwater)

Exploratory hole arisings were logged on site by a suitably qualified Curtins engineer in accordance with the requirements of BS5930:2015 (4), including recording observed visual and olfactory indicators of contamination. Copies of the exploratory hole logs are provided in Appendix C, with ground conditions presented in Section 6.1.

Representative soil samples were selected for laboratory chemical analysis, based on field observations and to provide a characterisation of the Made Ground and natural strata encountered.

Representative soil samples were placed in laboratory provided containers and stored in cool boxes prior to being transported to the nominated laboratory under the laboratory's chain of custody documentation. The laboratory selected by Curtins for chemical and geotechnical analysis was i2 Analytical, a UKAS and MCERTS accredited laboratory.

4.3 Monitoring Well Installations

Gas and groundwater monitoring wells (50mm OD) were installed at 8 locations as part of the ground investigation. A bentonite seal was placed above the screened section of the borehole to minimise potential for downward migration of contaminants and the creation of a preferential migratory pathway. A gravel surround was installed in the annulus between the sides of the borehole and the slotted sections of pipe. A summary of the response zones is presented in Table 4.3 below

Table 4.3 *Borehole Response Zones*

Location Reference	Response Zone(s) (m bgl)	Strata Description(s)
CP103	2.00 to 20.00	LONDON CLAY FORMATION (natural soils)
CP104	3.00 to 20.00	LYNCH HILL GRAVEL MEMBER LONDON CLAY FORMATION (natural soils)
CP105	1.00 to 20.00	LONDON CLAY FORMATION (natural soils)
WS102	1.00 to 5.00	Made Ground/LANGLEY SILT MEMBER (natural soils)
WS104	1.00 to 5.00	LONDON CLAY FORMATION (natural soils)
WS106	1.00 to 3.00	LYNCH HILL GRAVEL MEMBER LONDON CLAY FORMATION (natural soils)

Location Reference	Response Zone(s) (m bgl)	Strata Description(s)
WS107	2.00 to 4.00	LONDON CLAY FORMATION (natural soils)
WS108	1.00 to 5.00	LONDON CLAY FORMATION (natural soils)

Copies of borehole logs provided by Curtins can be referred to in Appendix C of this report.

4.4 Post-Investigation Monitoring

4.4.1 Ground Gas and Groundwater Level Monitoring

An initial programme of three gas and groundwater level monitoring visits was proposed in order to confirm the initial ground gas risk assessment and to determine a working groundwater level model for the site. A total of three gas and groundwater monitoring visits have been undertaken on the following occasions: 13 March 2020, 29 April 2020 and 05 May 2020.

5.0 Laboratory and In-Situ Testing

5.1 Environmental Chemical Testing

A programme of environmental chemistry testing was scheduled, with analytical suites developed reflecting the preliminary CSM in Section 3.0 and observations made during the ground investigation.

Given the potential for site wide source of contamination (Made Ground) the sampling positions (boreholes) were generally located in a semi targeted array to give an adequate and representative coverage of the site accounting for the historical site use and immediate environmental setting; along with targeting areas of the proposed development.

5.1.1 Soil Analysis

Soil samples were taken from the shallow (<1.0m) Made Ground soils across the site and tested for the suite listed in Table 5.1.1.

The nature and type of soil contamination potentially present on the site was considered to include, amongst others; ash, hydrocarbons (e.g. fuel oils), heavy metals and asbestos the extent of which is captured by the broad environmental testing suite detailed in Table 5.1.1.

Copies of the environmental chemistry testing certificates can be referred to in Appendix D of this report.

Table 5.1.1 *Environmental Chemistry Analysis Suite: Soils*

Analysis	Limit of Detection (LOD)
Asbestos Screen	N/A
Asbestos Quantification	<0.001%
pH	N/A
Organic Matter	0.1%
Arsenic	1 mg/kg
Boron (water soluble)	0.2 mg/kg
Cadmium	0.2 mg/kg
Chromium	1.2 mg/kg
Chromium VI	1 mg/kg
Copper	1 mg/kg
Lead	1 mg/kg
Mercury	0.3 mg/kg
Nickel	1 mg/kg
Selenium	1 mg/kg
Zinc	1 mg/kg
TPH (Aro/Ali C5-C35)	0.01 to 10 mg/kg
PAH (speciated	<0.05 to <0.1 mg/kg
Phenols (total)	<0.1 mg/kg
Cyanide (total)	1 mg/kg
Sulphate (SO_4)	<1.25 mg/l

5.2 Geotechnical Testing

Soil samples, taken during the ground investigation works were prepared in accordance with BS1377: Part 1:2016.

The following geotechnical in-situ and laboratory testing has been undertaken. The results of the testing are discussed further in Section 6.0 and presented in Appendix D.

Table 5.*2* *Geotechnical Testing*

Test Type	Quantity	Standard
In-Situ Testing & Sampling		
Standard Penetration Testing	78	BS5930:2015, Clause 41
U100	27	BS EN ISO 22475-1:2006
In-situ CBR Testing (using DCP)	6	BS1377-0:1990
Laboratory Testing		
Atterberg Limit	20	*BS 1377:1990, Part 2 (clause 4.5, 5.3 & 5.4)*
Moisture Content	20	*BS 1377:1990, Part 2 (clause 3.2)*
Particle Size Distribution	15	*BS1377:1990 Part 2:9.2*
Sedimentation	3	*BS1377:1990 Part 2:9.4*
Quick Undrained Triaxial (single stage)	20	*BS 1377:1990 Part 7:8*
BRE Special Digest 1 Suite	5	*ISO 17025 MCERTS*

6.0 Ground Conditions

6.1 Encountered Ground Conditions

A summary of the ground conditions encountered during the ground investigations is presented below, with detailed information presented on the exploratory hole logs, Appendix C.

Table 6.1 *Summary of Ground Conditions Encountered*

Stratum	Depth to top of strata (m bgl)		Thickness (m)		General Description
	Min	Max	Min	Max	
Topsoil	0.0	0.0	0.10	0.40	Grass over brown sandy gravelly CLAY or SILT with rootlets and rare cobbles.
Made Ground	0.00	0.40	0.60	2.30	**Granular Fill** (Loose to medium dense) Multicoloured silty gravelly SAND with occasional cobbles and black ash. **Cohesive Fill** (Soft to firm) multicoloured silty slightly sandy gravelly CLAY.
Head Deposits (Superficial Deposits)	0.60	1.20	0.50	1.00	Medium dense to very dense orangish brown slightly clayey slightly silty SAND and GRAVEL. Soft to firm brown-orangish mottled grey silty slightly gravelly CLAY.
Lynch Hill Gravel Member (Superficial Deposits)	1.00	1.70	0.30	2.60	Medium dense brown orange and black clayey SAND and GRAVEL. Interbedded SAND, GRAVEL, and CLAY.
Langley Silt Member (Superficial Deposits)	1.40	1.50	>3.95*	7.60	Interbedded SAND and CLAY. Stiff orangish brown and greyish brown silty slightly sandy CLAY with frequent black specks and occasional flint and sand laminations. Sand is fine to medium. Medium dense to very dense orange mottled yellow very silty SAND with occasional black specks and shell fragments.
London Clay Formation (Residual Soil & Bedrock)	0.85	9.00	>4.60*	>28.25*	Firm to stiff, orangish brown mottled grey, silty CLAY (weathered). Stiff to Very Stiff grey mottled bluish grey slightly silty CLAY with occasional clusters of selenite crystals.

Notes - *Base not encountered.

6.1.1 Topsoil

Topsoil was encountered within the majority of intrusive locations (except WS101 and WS104) to base depths ranging from 0.10m (WS102) to 0.40m bgl (WS103) comprising grass over

brown sandy gravelly CLAY or SILT with rootlets and rare cobbles. Sand is fine to medium. Gravel is angular to subangular fine to coarse flint, tile, brick and concrete.

The anthropogenic material of tile, brick and concrete within the Topsoil is reflective of a 1970s construction Topsoil with such material comprising 'remnants' of the development.

6.1.2 Made Ground

Made Ground was encountered to underlie the hardstanding or the Topsoil. The majority of the Made Ground comprised reworked natural soils (both granular and cohesive) with frequent ash and debris of general building materials.

A minimal thickness (230mm to 320mm) of sub-base was encountered to underly the hardstanding within WS101, WS104 and CP102, comprising dark brown and black silty very gravelly SAND with frequent cobbles and frequent ash.

The Made Ground was encountered to base depth ranging from 0.80m (WS103) to 2.30m bgl (CP103). A general average would be circa 1.50m bgl.

Made Ground – Granular Fill

The granular fill comprised (loose to medium dense) multicoloured silty gravelly SAND with occasional cobbles and black ash. Sand is medium to coarse. Gravel is angular to subangular fine to coarse flint, brick, concrete, slate, metal, glass, clinker, and tile. Typically, the granular fill was underlain by granular superficial deposits.

Made Ground – Cohesive Fill

The cohesive fill comprised (soft to firm) multicoloured silty slightly sandy gravelly CLAY. Sand is medium. Gravel is angular to subangular fine to coarse flint, brick, and concrete. Typically, the cohesive fill was underlain by cohesive superficial deposits.

Made Ground is not considered a suitable founding stratum, as such no laboratory geotechnical testing has been undertaken on this stratum and no design parameters have been derived.

CBR testing (via TRL-DCP method), was undertaken to inform preliminary roadway and pavement design. A summary of the CBR testing results recorded within the Made Ground deposits are presented in Table 6.1.2 below, with discussion presented in Section 9.0. Full details of the geotechnical results can be found in Appendix D.

Table 6.1.2 - *Summary of geotechnical test results from Made Ground Deposits*

Stratum	Parameter	Quantity	Values
	In Situ Test		
Made Ground	CBR Tests (using DCP)	6	Min: 2 Max: 89 Average: 19

The in-situ TRL testing depth range was between 330mm and 820mm and the CBRs values ranged from 2% to 65% in the top 500mm and from 4% to 89% >500mm, with an average of 19 across the full range of depths.

6.1.3 Superficial Deposits

Head Deposits

Head Deposits were encountered underlying the Made Ground at locations WS103, WS107 and CP102, located in the south-west and central portion of the site, to depths ranging between 1.70m bgl (WS107), >1.80m bgl (WS103) – base not encountered due to refusal. Lastly to 1.10m bgl (CP102).

The unit comprised both granular and cohesive material with a dense to very dense orangish brown slightly clayey SAND and GRAVEL recorded in WS103. Sand is medium. Gravel is angular to sub-rounded fine to coarse of flint. The cohesive material comprised a soft to firm orangish brown mottled grey silty slightly gravelly CLAY with occasional orange sand lenses in WS107 and CP102. Gravel is angular to subangular to subrounded and fine to coarse flint.

Within the north-western portion of the site (WS106 & WS107), the Head Deposits appear to be interbedded with the Lynch Hill Gravel Member with a reduction in thickness eastwards.

Langley Silt Member

The Langley Silt Member was encountered underlying the Made Ground in two locations (WS102 & CP101) which are both located in the south of the site; comprising interbedded SAND and CLAY within WS102. Whereas CP101 records a silty CLAY initially which with depth is recorded to contain sand and gravel. The clay layers consisted of firm to firm to stiff consistencies, orangish brown and grey silty sandy CLAY with black specks and sand lenses. The sand layers consisted of medium dense to dense orange and yellow silty SAND with black specks and shell fragments. Sand is fine to medium. Gravel content was typically recorded as subangular to subrounded and fine to coarse of flint. The base of the unit was not proven within WS102. However, the position of CP101 proved the base of the Langley Silt Member to a maximum depth of 9.00m bgl / 5.00m AOD.

Lynch Hill Gravel Member

The Lynch Hill Gravel Member was encountered underlying the Made Ground at CP104, WS105, WS106 and WS107 which are in the northwest portion of the site; comprising inter-bedded CLAY, SAND and GRAVEL. The clay layers consisted of soft to firm orangish brown silty sandy gravelly CLAY. Sand is fine to coarse. Gravel is angular to subangular fine to medium of flint. The sand layers comprised medium dense orangish brown clayey gravelly SAND. Sand

is medium to coarse. Gravel is angular to subangular fine to coarse flint. The gravel layers consist of medium dense orangish brown clayey very sandy GRAVEL. Sand is medium to coarse. Gravel is angular to subangular fine to coarse flint. The base of the unit was between 2.00m bgl / 16.07m AOD (WS107) to 3.60m bgl / 15.56m AOD (WS106)

It is considered the interbedded sands, gravels, and clay in the areas of the north-west is reflective of the strata boundary changes between Lynch Hill Gravel and Head Deposits.

A summary of the geotechnical test results recorded within the superficial deposits for both granular and cohesive are presented in Table 6.1.3a below. Full details of the geotechnical results can be found in Appendix D.

Table 6.1.3a – *Summary of geotechnical test results from Superficial Deposits*

Stratum	Parameter	Quantity	Values
	In Situ Test		
Head Deposits	Standard Penetration Test 'N' Value	3	Min: 7 Max: >50 Average: 29
	Hand Shear Vane Test	1	70 kPa
Lynch Hill Gravel Member	Standard Penetration Test 'N' Value	6	Min: 7 Max: 39 Average: 23
Langley Silt Member	Standard Penetration Test 'N' Value	7	Min: 8 Max: 13 Average: 11
	Hand Shear Vane Test	1	120 kPa
Stratum	Laboratory Test		
Head Deposits	Particle Size Distribution (PSD)	2	Refer to Appendix D
	Sedimentation	1	
Lynch Hill Gravel Member	Particle Size Distribution (PSD)	5	
Langley Silt Member	Particle Size Distribution (PSD)	3	
	Sedimentation	1	

The two PSDs undertaken within WS106 highlight the interbedded gravels, sands and clays with content ranging 0.8 to 4% (gravels), 24 to 47% sands and 51 to 70% (clays). As previously discussed, these are considered to reflect the strata boundary change of Lynch Hill Gravel (sands and gravels) to Head Deposits (clay, silt, sand, and gravel). Due to the variability of soils in this north-western area (WS106 to WS107) the superficial soils in this area are not considered a suitable founding stratum (with potential for differential settlement) and no geotechnical parameters have been derived.

With this borne in mind the granular SPT 'N' values recorded, ranged between 7 to 39, with an average of 23 for Lynch Hill Gravels indicating a relative density ranging from loose to dense. For the Langley Silt Member SPT 'N' values range between 8 and 13 for the Langley Silt Member in the southern portion of the site with an average of 11.

The Angle of Internal Friction for the granular Lynch Hill Gravel Member has been derived from a review of derived parameters from relationship with SPT 'N' values (Tomlinson, 1986) and published values. An Angle of Internal Friction of 33° is deemed suitable for this stratum.

Following a review of published values, a moderately conservative unit weight, ɣ', of 19 kN/m3 has been deemed suitable for the granular Lynch Hill Gravels

These characteristic parameters for the Lynch Hill Gravel and Langley Silt are presented in Table 6.1.3b below.

Table 6.1.3b - *Characteristic Parameters – Granular Soils (Lynch Hill Gravels and Langley Silt)*

Parameter	Characteristic Values	Reference
Unit Weight, ɣ (kN/m^3)	19	Barnes, 2000
Angle of Internal Friction, ϕ' (°)	35 (LHG)	Correlation with SPT 'N' value (Tomlinson, 1986)
	30 (LS)	
Drained Cohesion, c' (kPa)	0	Based on engineering judgement

Notes – Lynch Hill Gravel (LHG) and Langley Silts (LS)

2 No. SPT 'N' values were recorded for cohesive Langley Silts, ranging between 8 and 13. The Undrained Shear Strength (Cu) of the cohesive soils has been determined from the relationship between SPT 'N' values and the Plasticity Indices (PI), after Stroud, 1975, as presented on Equation 1:

$Cu = SPT\ N.F_1$ [Equation 1]

Where:
Cu is the Undrained Shear Strength
N is SPT 'N' value

F_1 is the Stroud Factor

A conservative F_1 value of 4.5 is deemed suitable for the Langley Silt, therefore, for SPT 'N' values between 8 and 13, Undrained Shear Strength values of between 36kPa and 59kPa are calculated. Hand shear vane testing recorded on determined Undrained Shear Strength values of between 120kPa. The aforementioned ranges highlight that the Langley Silt Member comprise low strength to medium strength soils.

These characteristic parameters for the Lynch Hill Gravels and Langley Silt are presented in Table 6.1.3c below.

Table 6.1.3c - *Characteristic Parameters – Cohesive Soils (Langley Silt)*

Parameter	Characteristic Values	Reference
Unit Weight, ɣ' (kN/m^3)	18	Barnes, 2000
Angle of Internal Friction, ϕ' (°)	18	Correlation with Plasticity Index (Gibson, 1953)
Undrained Shear Strength, Cu (kPa)	36 to 120kPa	SPT 'N' correlation with Plasticity Index (Stroud 1997) and Hand Shear Vane Testing

6.1.4 Residual Soil & Bedrock

London Clay Formation

Underlying the superficial deposits was the bedrock geology of the London Clay Formation encountered at depths ranging from 0.85m (WS104) to 9.00m bgl (CP101). The unit was encountered shallower on the eastern portion of the site and deeper within the western and southern portions.

In the majority of the locations, this was encountered initially in its weathered form, comprising a firm to stiff, orangish brown mottled grey, silty CLAY from 0.85m to 4.80m bgl. Thereafter this consisted of stiff grey mottled bluish grey, slightly silty CLAY with occasional clusters of selenite crystals and rare black specks. The clay started becoming hard between 18.0m and 22.0m bgl.

A summary of the geotechnical test results recorded within the bedrock formation are presented in Table 6.1.4a below. Full details of the geotechnical results can be found in Appendix D.

Table 6.1.4a – *Summary of geotechnical testing results – London Clay Formation - Bedrock*

Parameter		Quantity	Values
In Situ Test			
Standard Penetration Test 'N' Value		40	Min: 7 Max: 50 Average: 21
Hand Shear Vane Testing		10	Min: 52 Max: 104 Average: 78
Laboratory Test			
Atterberg Test	Moisture Content (%)	20	Min: 21 Max: 34 Average: 29
	Liquid Limit (%)	20	Min: 60 Max: 78 Average: 70
	Plastic Limit (%)	20	Min: 25 Max: 32 Average: 29
	Plasticity Index (%)	20	Min: 34 Max: 48 Average: 40
Quick Undrained Triaxial Single Stage		20	Min Cu: 37 Max Cu: 167 Average Cu: 117 (kPa)
Particle Size Distribution		5	Refer to Appendix D
Sedimentation		1	
BRE SD1 Suite		7	

53 No. SPT 'N' values were recorded, ranging between 7 and >50 within the residual soil and bedrock of London Clay Formation. In general, the SPT values increased with depth with N values ranging from 8 to 26 between 3m and 10m bgl; 15 to 34 between 10m and 20m bgl; and 35 and 44 between 20m to 30m bgl.

The in-situ hand shear vane testing of the London Clay Formation recorded shear strengths ranging from 52 to 104kPa.

The Undrained Shear Strength (Cu) of the London Clay Formation has been determined from the relationship between SPT 'N' values and the Plasticity Indices (PI), after Stroud, 1975, as presented on Equation 1:

$$Cu = SPT\ N.F_1 \qquad \textbf{[Equation 1]}$$

Where:
Cu is the Undrained Shear Strength
N is SPT 'N' *value*
F_1 is the Stroud Factor

A F_1 value of 4.2 is deemed suitable for the average PI of 40, determined from the Atterberg test results. Therefore, for SPT 'N' values between 7 and >50, Undrained Shear Strength values of between 29.4 kPa and 210 kPa are calculated.

Quick undrained triaxial testing recorded Undrained Shear Strength values of between 37 to 167kPa, however only one value in the range of 37 kPa in CP104 at 4.00 – 4.45m bgl was recorded. All other results calculated as >80 kPa. The value of 37 kPa is will be assumed as an outlier and not used in further calculations. The aforementioned ranges highlight that the London Clay Formation comprise medium strength at the top of the deposit progressing to very high strength soils at greater depths.

The Coefficient of Volume Compressibility (Mv) of cohesive London Clay has been determined from consolidation tests and the relationship between SPT 'N' values and the Plasticity Indices (PI), after Stroud, 1975, as presented in Equation 2:

$$Mv = 1/(SPT\ N.f_2) \quad \textbf{[Equation 2]}$$

Where:
Mv is Coefficient of Volume Compressibility
N is SPT 'N' values
F2 is the Stroud factor

A F_2 value of 0.450 is deemed suitable for the average PI of 40. Therefore, for SPT 'N' values between 7 and >50, Mv values ranging between 0.31 m^2/MN and 0.04 m^2/MN are determined. This aforementioned range highlights very low (over-consolidated clays) at depth to medium compressible (normally consolidated clays) at the top of the deposit associated the with weathered London Clay.

The Angle of Internal Friction (ϕ') for cohesive soils has been derived from the correlation with Plasticity Indices, after Gibson, 1953. A moderately conservative value of 18° is deemed suitable for the cohesive London Clay Formation.

The Atterberg tests results in the London Clay, indicate a **High to Very High** plasticity clay. The Casagrande Graphs are shown in Appendix D.

Bulk Density was determined during triaxial tests. The values ranged between 1.85 Mg/m^3 and 2.03 Mg/m^3. As such, a moderately conservative unit weight, ɣ', of 18 kN/m^3 has been deemed suitable for the London Clay Formation.

The Undrained Stiffness Modulus for the London Clay Formation has been derived from the relationship with SPT 'N' values, after CIRIA 143, as presented in Equation 3:

$$E = SPT\ N \times 1.2 \quad \textbf{[Equation 3]}$$

Where:
Eu is the Undrained Stiffness Modulus
N is SPT 'N' *values*

The results with reference to the range of SPT N values, are 7 to >50, with an average of 21. These are displayed in table 6.1.4b below.

The Drained Stiffness Modulus of the London Clay Formation has been determined from the relationship with SPT 'N' values, after CIRIA 143, as presented in Equation 4:

$$E' = SPT\ 'N'\ \times 1.2 \times 0.73 \qquad \textbf{[Equation 4]}$$

Where:
E' is the Drained Stiffness Modulus
E is the Undrained Stiffness

The results with reference to the range of SPT N values, are 7 to >50, with an average of 21.

Based on the above the geotechnical parameters derived for the London Clay Formation are summarised in Table 6.1.4b.

Table 6.1.4b – *Characteristic Parameters – London Clay Formation*

Parameter	Characteristic Values	Reference
Unit Weight, ɣ' (kN/m^3)	18	Barnes, 2000 and Triaxial Test Results
Angle of Internal Friction, ϕ' (°)	18	Correlation with Plasticity Index (Gibson, 1953)
Undrained Shear Strength, Cu (kPa)	2.0m to 10.0m bgl Cu = 36 to 97 kPa 10.0 to 20.0m bgl Cu = 109 to 160 20.0 to 30.0m bgl Cu= 123 to 225 kPa	SPT 'N' correlation with Plasticity Index (Stroud 1997). Hand shear vane testing and Quick Undrained Triaxials
Coefficient of Volume Compressibility, Mv (m^2/MN)	Mv =0.04 to 0.31	SPT 'N' correlation with Plasticity Index (Stroud 1997)
Undrained Stiffness, Eu (MPa)	3.0m to 10.0m bgl Eu = 9.6 to 31.2 MPa 10.0 to 20.0m bgl Eu = 18 to 40.8 MPa 20.0 to 30.0m bgl Eu = 42 to 52.8 MPa	SPT 'N' correlation (CIRIA 143)
Drained Stiffness, E' (MPa)	3.0m to 10.0m bgl E' = 7 to 22.8 MPa 10.0 to 20.0m bgl E' =	SPT 'N' correlation (CIRIA 143)

Parameter	Characteristic Values	Reference
	13.1 to 29.8 MPa 20.0 to 30.0m bgl E' = 30.7 to 38.5 MPa	
Drained Cohesion, c' (kPa)	0	Based on engineering judgement

6.2 Visual and Olfactory Indicators of Contamination

Weak hydrocarbon odours were detected within the Made Ground at boreholes WS101, WS104, underlying the hardstanding and WS105 within the Made Ground. The suspected source of the indicators is considered to comprise the presence of ash material with this noted in each of the boreholes with reported odours. Environmental samples taken of the suspected source and submitted for environmental testing. The results are presented in Section 7.0.

The perched groundwater within WS104 at 0.2m bgl, possessed an oily sheen with a faint hydrocarbon odour, which is considered to be representative of 'leaching' of the ashy material underlying the hardstanding. **Note –** ground investigation works were undertaken during a period of heavy rainfall.

As part of the investigation former plating works, laundry and engineering works were targeted with locations to determine any potential contamination associated with former industry. However, no visual or olfactory indicators of volatile contamination was encountered within these areas. Consequently, no VOC testing was undertaken based on this.

During the ground investigation, no visual or olfactory indicators of gross contamination were encountered within the superficial deposits or bedrock.

6.3 Groundwater

Groundwater seepages were encountered across the site, within both the Made Ground and natural deposits. A summary of the groundwater strikes encountered during the intrusive investigation are summarised in Table 6.3 below.

Table 6.3 - *Summary of Groundwater Strikes and Seepages During the Investigation*

Exploratory Location	*Groundwater Seepage / Strike Depth (m)*	*Groundwater Level (m AOD)*
Made Ground - Perched Groundwater		
WS104 (East Central)	0.20	14.30
WS105 (Central)	0.90	17.34

Exploratory Location	*Groundwater Seepage / Strike Depth (m)*	*Groundwater Level (m AOD)*
WS108 (North-east)	1.30	15.99
CP105 (North-east)	1.30	15.37
Lynch Hill Gravel Member		
WS106 (North-west)	2.80	16.87
CP104 (North-west)	1.80	17.26
London Clay Formation		
WS104 (East Central)	4.80	9.70
WS108 (North-east)	2.65	14.64

Three return groundwater monitoring visits were completed between March and May 2020. These visits recorded groundwater levels ranging between 0.30m bgl / 14.20m AOD (WS104) to 2.14m bgl / 14.53m AOD (CP105) within superficial and bedrock soils. As such, this suggests partial hydraulic connectivity between the superficial deposits and the weathered zone at the top of the London Clay.

6.4 Aggressive Ground Conditions

The classification of the site in terms of concrete in aggressive ground is based on the guidance provided in the Building Research Establishment (BRE) Special Digest 1 3rd Edition of 2017 (6). A summary of the results obtained during the ground investigation works are summarised in Table 6.4.1. Table 6.4.2 summarises the classification, based on geology.

Table 6.4.1 *Aggressive Chemical Environment for Concrete (ACEC) Site Classification*

Stratum	***Test Type***	***Range***
Made Ground	*pH*	*7.1 to 8.3*
	Water Soluble Sulphate (mg/l)	*22.1 to 486*
Superficial Deposits		
Head Deposits	*pH*	*7.3*
	Water Soluble Sulphate (mg/l)	*150*
	pH	*7.8 to 7.9*

Stratum	Test Type	Range
Lynch Hill Gravel Member	*Water Soluble Sulphate (mg/l)*	*28 to 69*
Langley Silt Member	*pH*	*7.7*
	Water Soluble Sulphate (mg/l)	*3100*
Bedrock		
London Clay Formation	*pH*	*7.5 to 8.5*
	Water Soluble Sulphate (mg/l)	*320 to 2600*

A total of seven samples of bedrock underwent BRE SD1 testing and all samples (with exception of WS104 at 4.50m bgl) recorded oxidizable sulphates >0.3%, as such pyrite is likely to be present within the London Clay soils. The total potential sulphate of the seven samples ranged from 0.76% to 2.12%.

Table 6.4.2 *Aggressive Chemical*

Stratum	Design Sulphate Class	ACEC Class (1)
Made Ground	*DS-1*	*AC-1s*
Superficial Deposits		
Head Deposits	*DS-1*	*AC-1s*
Lynch Hill Gravel Member	*DS-1*	*AC-1s*
Langley Silt Member	*DS-4*	*AC-4*
Bedrock	*DS-4*	*AC-4*

(1) ACEC assessment was based on mobile groundwater condition in a brownfield scheme area.

7.0 Geochemical Ground and Groundwater Risk Assessment

This section of the report includes the assessment of the potential solid contamination, liquid and gas, identified on the subject site which may present a risk to the potential end users, associated utilities and the wider environment.

In guidance published by the Environment Agency, the risk to human health or controlled waters is determined through an assessment of contaminant linkages between a source of contamination (within the ground or groundwater either on or off site) and a sensitive receptor such as end users of the site, building materials, edible plants grown in gardens or groundwater abstracted for drinking. This is termed a source-pathway-receptor relationship. The same model is applied to the assessment of risk arising from ground gases as detailed within BS8576:2013 (7).

These models have a common approach, which is one of a tiered assessment. At each stage of the assessment further detail can be applied to the conceptual site model to provide a detailed interpretation on a site by site basis. As part of the planning process this approach is adopted in order to establish either if the site is 'suitable for use' or whether additional work or else remedial work is required in order for the site to be deemed so.

The sub-sections hereafter therefore incorporate the first tier (Tier 1) of this approach otherwise referred to as the Generic Quantitative Risk Assessment (GQRA). The GQRA builds on the qualitative risk assessment presented in Section 3.0, in conjunction with observations made during the ground investigation and is based solely on the results of the chemical and other testing data obtained as part of Curtins Consulting's ground investigation.

The following sections present more detail on the risk assessment methodology rationale for the main receptors.

7.1 Human Health GQRA

Detailed guidance on human health risk assessment is available within a number of documents, published by both the Environment Agency and DEFRA. Guidance includes Contaminated Land Exposure Assessment (CLEA) v1.07 model (8), Science Report 2 (9) and Science Report 3 (10).

A generic quantitative risk assessment (GQRA) has been carried out for the Potential Contaminant Linkages (PCLs) investigated by screening of soil contamination data against relevant Generic Assessment Criteria (GAC) where available, including:

i) **Soil Guideline Values (SGVs):** These have been published by the Environment Agency and are trigger values for screening out low risk areas of land contamination. SGV's give an indication of representative average concentrations of chemicals in soil, below which long-term health risks are likely to be minimal. SGVs have been published for a number of contaminants including arsenic, cadmium, mercury, nickel, selenium, BTEX, phenols and dioxins, furans and dioxin-like PCB substances for land uses including residential, allotments and commercial. The SGVs have been developed for a sandy loam soil with 1% soil organic matter (SOM) content;

ii) **Supplementary Screening Values:** In addition to the SGVs developed by the EA other third-party organisations have derived GACs for a wider range of contaminants and land uses using the CLEA Model. Curtins have adopted these numbers where applicable, including those developed by Atkins AtriskSoil™, the LQM/CIEH Suitable for Use Levels (S4UL) and EIC/AGS/CL:AIRE published thresholds.

iii) **Category 4 Screening Levels (C4SLs):** In March 2014 Defra published C4SLs for arsenic, benzene, benzo(a)pyrene, cadmium, hexavalent chromium, and lead. These values were derived to support the revised Part 2A Statutory Guidance issued in 2012 (11) in which four categories of contaminated land are included, ranging from Category 1 (significant/high risk) to Category 4 (low risk). C4SLs are not representative of significant possibility of significant harm (SPoSH) and are values of low risk levels. As such, where the C4SLs are not exceeded, land can be demonstrated to be in Category 4 and therefore cannot be determined as contaminated land.

It is understood the proposed scheme is to comprise the demolition of the existing buildings and the construction of 2 to 10 storey residential buildings with associated access roads, hardstanding and soft landscaping areas, comprising both private gardens and areas of open space. The current development layout plans are presented in Appendix A.

As such, this GQRA considers a combination of land use scenario:

- *'Residential with homegrown produce';* and
- *'Public open space near residential housing'*

Details of the GAC's adopted for the GQRA are provided in Appendix E.

7.1.1 Soils

As part of the investigation a total of 10 samples (one natural soil, two Topsoil and eight Made Ground) were submitted for environmental testing, based on a suite presented in Table 5.1.1.

As discussed within the previous section, comparison of the soil analysis results has been undertaken against Generic Assessment Criteria (GAC) for *Residential (with Homegrown Produce)* and *Public open space near residential housing*.

Soil organic matter (SOM) has a strong bearing on the availability of potential contaminants and therefore influences the Tier 1 thresholds. The SOM typically ranged from 0.1% to 6.5%. As such, as part of a conservative assessment the comparison has been made against GACs developed for a sandy soil with a SOM of 1%.

The results of the environmental testing are appended in Appendix D. Copies of the adopted Tier 1 thresholds are contained within Appendix E.

With respect to the potential *Residential with Homegrown Produce* end use of the site, the results of the screening identified several exceedances as highlighted in Table 7.1.1a below.

Table 7.1.1a *Summary of Tier 1 Threshold Exceedances – Residential with Homegrown Produce*

Location	Depth (m bgl)	Strata	Determinant	Concentration (mg/kg)	Tier 1 Threshold (mg/kg)
WS101	0.1	MG	Lead	230	200
WS103	0.2	TS	Lead	240	200
WS104	0.15	MG	Arsenic Lead Benzo(a)pyrene Benzo(b)fluoranthene Dibenz(a,h)anthracene	43 490 3.6 3.8 0.63	37 200 2.2 2.6 0.24
WS105	1.0	MG	Lead Benzo(a)pyrene Dibenz(a,h)anthracene	360 2.3 0.41	200 2.2 0.24
WS106	0.5	MG	Benzo(a)pyrene Dibenz(a,h)anthracene	2.9 0.46	2.2 0.24

Notes – MG Made Ground and TS Topsoil

The results of the Tier 1 screening against the '*Residential with Homegrown Produce'* identified exceedances in five of the samples submitted. The exceedances were recorded for arsenic, lead and speciated PAHs as per Table 7.1.1a.

No mobile phase exceedances (with inhalation of vapour pathways) were recorded within the samples submitted, notably within the sample of potential indicators of contamination. Consequently, the noted indicators are considered to reflect hydrocarbon odours derived from ashy material within the sub-base material and not considered an ongoing vapour source. The testing of the Total Petroleum Hydrocarbons (TPH) is considered sufficient owing to no volatile odours recorded within any of the site soils.

With respect to the potential *Public open space near residential housing* end use of the site, the results of the screening identified several exceedances as highlighted in Table 7.1.1b below.

Table 7.1.1b *Summary of Tier 1 Threshold Exceedances – Public open space near residential housing*

Location	Depth (m bgl)	Strata	Determinant	Concentration (mg/kg)	Tier 1 Threshold (mg/kg)
WS104	0.15	MG	Dibenz(a,h)anthracene	0.63	0.57

Notes – MG Made Ground

The results of the Tier 1 screening against the *'Public open space near residential housing'* identified a single exceedance at WS104 (0.15m bgl) for the PAH, Dibenz(a,h)anthracene.

With reference to the logs (Appendix C), the source of the exceedances is considered to be due to solid phase gravel constituents (i.e. asphalt, ash, brick, concrete etc.) of the Made Ground notably in the sub-base material underlying the hardstanding.

The main contaminant exposure pathways for the identified exceedances are considered to represent, the contact and oral route pathways (i.e. inhalation/ingestion of soil/dust and dermal contact of soil/dust). Given the shallow depth of the majority of the exceedances (<0.50m bgl) there is a potential risk to future site users.

The discussion of the potential risks in relation to identified exceedances are presented in Section 7.2 below.

7.1.2 Asbestos

A total of 10 No. samples were submitted to the laboratory for Asbestos presence screen. The testing concluded that asbestos was positively identified in three of the samples, WS101 at 0.10m, WS104 at 0.15m bgl (sub-base material underlying hardstanding) and CP101 at 0.50m bgl within made ground strata. Following the positive identification of asbestos, the samples underwent further testing to determine the percentage weight of asbestos within the sample (asbestos quantification), presented in Table 7.1.2 below.

Table 7.1.2 *Summary of Asbestos Identification and Quantification*

Location	Depth (m bgl)	Determinant	Mass Quantification (%)
WS101	0.10	Chrysotile – loose fibres	<0.001
WS104	0.15	Chrysotile and amosite - loose fibres	<0.001
CP101	0.50	Amosite – Sheeting / Board Debris	0.006

7.1.3 Groundwater derived Vapours

Perched groundwater was encountered across the site at depths of between 0.20m and 1.30m bgl during the ground investigation. The perched groundwater within WS104 at 0.2m bgl, had an oily sheen with a faint hydrocarbon odour, however as previously discussed this is considered to represent 'leaching' of exposed ashy aggregate material within the hand pit during the ground investigation (undertaken during heavy rainfall). The subsequent environmental testing of the material did not record any vapour pathway contaminant exceedances of the conservative end use.

With this borne in mind and no mobile or gross free phase contamination or volatile odours noted during the ground investigations, groundwater derived vapours are unlikely to present a risk to future site users.

7.2 Discussion of Potential Risk

7.2.1 Risk to Future Site Users – Private Gardens

Inhalation of Fibres

The results of the Asbestos presence screen on the Made Ground samples positively identified three shallow Made Ground samples (WS101 at 0.10m, WS104 at 0.15m bgl and CP101 at 0.50m bgl) containing asbestos. The asbestos was encountered in the form of chrysotile and amosite (white and brown asbestos respectively). Asbestos quantification testing of the samples reported fibres below the hazardous waste threshold (<0.001%) for WS101 and WS104. Both the positive detections of Asbestos relate to the sub-base underlying the hardstanding of WS101 and WS104. The location of CP101 at 0.50m bgl recorded an asbestos concentration of 0.006%. Given the above, and all other samples submitted not recording Asbestos, it is considered likely the sub-base material underlying on hardstanding on-site has the potential presence of Asbestos.

Consequently, it is considered that should the existing sub-base remain within proposed soft landscaping areas on-site it is likely to present a potential inhalation of fibres risk to future site users.

Recommendation: Given the thickness of the material (220mm to 500mm) it is recommended that the existing sub-base material is removed from areas of proposed soft landscaping.

As part of the construction phase, it is recommended that the on-site asbestos risk is managed through appropriate PPE and along with dust suppression measures. The Principal Contractor shall be responsible for ensuring that method statements and risk assessments are in place for the safe handling of excavated soils on-site during construction, in line with their requirements under the CDM Regulation (2015).

Ingestion and dermal contact of soil/vegetables, Inhalation of dust

Environmental samples taken from the Made Ground material on-site recorded slightly marginal exceedances for arsenic, lead and PAHs with respect to the potential '*Residential with Homegrown Produce*' conservative end use of the site, whilst a single lead exceedance was recorded within a Topsoil sample.

The recorded contaminant exceedances are considered to present a risk to future site users through the contaminant pathways for ingestion/direct contact of soils/homegrown produce and inhalation of dust in areas of proposed soft landscaping (private gardens) if both the Topsoil

and Made Ground remain on-site. It is anticipated the source of such exceedances is the gravel constituents of the Made Ground. Three recorded locations (WS101, WS104 and CP101) of exceedances were within the sub-base material and made ground, which has been recommended to be removed from the site. Review of the exceedances following this, indicates predominately marginal exceedances of lead and two PAHs (Benzo(a)pyrene and Dibenz(a,h)anthracene) within shallow Made Ground soils.

However though given the proposed sensitive end use (residential gardens), there is a potential likely risk to future site users should existing Made Ground soils remain at shallow depths in private gardens through the aforementioned contaminant pathway routes. Based on this, the following either/or recommendations are proposed.

Recommendation 1: Based on the above, it is recommended that in proposed private gardens on-site areas, a 600mm thickness of certified, clean imported soil (of both Topsoil and sub-soil verified at source and on-site) is required in proposed areas of the soft landscaping within residential gardens. It is recommended that the above be detailed within a Remediation Strategy for the development and submitted to the local authority for approval.

Recommendation 2: Additionally, given a total of 11 private gardens proposed (as presented in development plans Appendix A) for the development and the marginal exceedances recorded within the Made Ground, consideration should be given to further testing of these areas to determine the presence of any marginal exceedances and requirements or otherwise for clean capping, potentially reducing quantities of import material on-site.

7.2.2 Risk to Future Site Users – Public Open Space near Residential

Ingestion/dermal contact of soil and inhalation of dust

A single exceedance of PAH (Dibenz(a,h)anthracene) within the Made Ground was recorded within in WS104 at 0.15m bgl. The source of the exceedance is the existing sub-base material underlying the hardstanding and as previously stated in Section 7.2.2 due to the presence of Asbestos within this material, is recommended to be removed from areas of soft landscaping on-site.

As such given this, it is considered there is unlikely to be any potential risk to future site users if current site soils remain within areas of public open space. With no recorded exceedances above the Public Open Space screening criteria for existing Topsoil and Made Ground on-site (notwithstanding the sub-base material).

7.3 Controlled Waters – GQRA

The controlled waters GQRA has been designed to assess the risks posed to the identified controlled waters receptors from the potential migration of contaminants originating from site sources as defined within our Phase 1 reporting.

These include: the on-site Secondary (A) Aquifer (Lynch Hill Gravel Member) and the Secondary (undifferentiated) aquifer (Head Deposits) present in the north west and central west parts of the site.

The closest surface water receptor is located 418m north-west if the sites boundary. Groundwater is present beneath the site within the Superficial Deposits (Secondary Aquifers), the Made Ground and within the London Clay Formation (unproductive), however, no active groundwater abstractions are recorded within 750m of the subject site.

The risk to the underlying Secondary A Aquifer (superficial deposits) is considered to be Low owing to; the overall limited nature of mobile contamination revealed on site, marginal exceedances of solid phase contaminants for a conservative land use and no presence of free phase product or gross contamination.

With reference to the foregoing commentary, the risk to controlled waters is assessed as Low and therefore there is no requirement for further action in terms of risk to controlled waters.

7.4 Ground Gas GQRA

The assessment of risk presented by ground gases is assessed with reference to guidance published by CIRIA (Assessing Risks Posed by Hazardous Ground Gases to Buildings, C665 (12), BSI Publication (Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings BS8485:2015 (13), BSI Publication (Guidance on Investigations for Ground Gas-Permanent gases and Volatile Organic Compounds (VOCs) (7) and other broadly accepted references such as the Ground Gas Handbook 2009 (14).

The gas risk assessment adopts a tiered approach. In the first instance, this involves a re-evaluation of the Conceptual Site Model described within the Phase 1 Preliminary Site Assessment (desk study) and thereafter validating this conceptual model with the ground gas data, the semi-quantitative risk assessment.

7.4.1 Asphyxiant, Noxious and Explosive Gases

The Preliminary Conceptual Site Model (PCSM) presented within Section 3.0, noted the potential for gases to arise from uncontrolled deposition of Made Ground on-site. The ground investigation encountered Made Ground to a maximum depth of 2.30m bgl.

In order to characterise the site's gas regime and validate the qualitative assessment of ground gas risk, 8 No. dual gas and groundwater monitoring installations were constructed within boreholes as detailed in Table 4.3 within Section 4.0.

An initial programme of three gas and groundwater monitoring visits were proposed. The gas monitoring programme has been completed with three visits completed between March and May 2020.

With the exception of the second visit, the ground gas monitoring has been undertaken during rising atmospheric pressures with barometric pressure ranging from 1014 to 1019.

A summary of the ground gas monitoring results to date is presented in Table 7.4.1 below and copies of the log sheets presented in Appendix D.

Table 7.4.1 Summary of Soil Gas Monitoring Results

Location	CO_2 Range (% $^{vol}/_{vol}$)	CH_4 Range (% $^{vol}/_{vol}$)	O_2 (% $^{vol}/_{vol}$)	Max Flow Rate (l/hr)	Steady State Flow Rate (l/hr)
CP103	0.9	0.0	18.1	0.0	0.0
CP104	2.1	0.0	19.5	0.0	0.0
CP105	2.4	0.0	14.9	0.0	0.0
WS102	3.5	0.0	16.5	0.0	0.0
WS104(1)	0.1	0.0	20.4	0.0	0.0
WS106	1.1	0.0	19.5	0.0	0.0
WS107	4.9	0.0	14.1	97.0	0.0
WS108(2)	3.8	0.0	17.6	0.0	0.0

Notes – 1. Unable to be accessed during first or second monitoring visit. 2. Unable to be accessed during third and final visit.

Carbon monoxide and hydrogen sulphide were not detected during any of the ground gas monitoring visits.

Maximum concentrations of methane were recorded at <0.1% $^{vol}/_{vol}$. Maximum concentrations of carbon dioxide ranged between 0.1% to 4.9%. With the highest concentration recorded within WS107 on the second visit. All concentrations across the boreholes generally reduced on the third visit with the exception of CP105. These ground gas concentrations are consistent with the on-site ground gas sources, i.e. predominately Made Ground less than 2m in thickness

predominately consisting of inert material (i.e. brick, and concrete) and no organic/putrescible material recorded.

During the monitoring visits, steady state flow rates of <0.1 l/hr were recorded. A peak flow of 97.0 l/hr was recorded within WS107 on the first visit, however, this is considered to represent an artificial 'release' of pressure during the first monitoring visit following rising of groundwater above the response zone in the monitoring well. A steady state flow of <0.1 l/hr was recorded thereafter within WS107.

Considering both a 'worst credible scenario' (maximum 'absolute' flow rate, maximum gas concentration within a single borehole location) and 'worst possible scenario' (maximum 'absolute' flow rate, maximum gas concentration across all borehole locations) the Hazardous Gas Flow Rates (Q_{hg}) for the site are evaluated as 0.0049 (carbon dioxide) and 0.0001 (methane).

In this site situation, the calculated Hazardous Gas Flow Rates (Q_{hg}) are considered to be reflective of a conservative assessment of Gas Screening Values (GSV) with generally very low to negligible flow rates and fairly low concentrations of carbon dioxide and low concentrations of methane recorded.

With reference to CIRIA C665 (12), the above calculated GSV for the development site, indicate a Characteristic Situation (CS) 1 in regard to ground risk. Based on this classification, ground gas protection measures are not recommended for the proposed development.

7.4.2 Radon

The BGS Radon Mapping confirms the site is situated in a Lower probability radon area where less than 1% of homes are above the radon action level. On this basis no radon protection measures are considered necessary in the construction of new dwellings or extensions.

8.0 Revised Conceptual Site Model

The preliminary conceptual site model (PCSM) presented and discussed in Section 3.0 of this report has been revised following the GQRA in Section 7.0 above. The revised Conceptual Site Model (CSM) is presented in the table overleaf.

The CSM details the source-pathway-receptor linkages or potential contaminant linkages (PCL) that have been identified for the site. The GQRA details the associated level of risk relating to these potential contaminant linkages.

The CSM concerns risk to human health, Water and Environment with additional, more specific risk assessment protocols contained within the main body of this reporting as detailed in Section 8.1 below.

The CSM follows the framework outlined within CIRIA C552 which is summarised within Appendix F.

The 'risk rating' within the CSM refers to the risk that the source, pathway, receptor linkage or PCL is complete. Unless specifically stated it does not necessarily refer to an immediate risk and is intended to be used as a tool to assess the necessity for further assessment/investigation.

8.1 Additional Risk Assessments

The following risk assessments, listed below, are not included within the main CSM and GQRA but none-the-less can be of critical importance to the onward development of the site.

- The risk presented by **Radon** is discussed and assessed in Section 7.3.2.

Under current health and safety legislation, employers are required to carry out their own appropriate risk assessments and mitigation to protect themselves and their employees, other human receptors and the environment from potential contamination. Such risks must be adequately mitigated by law, specifically the Construction Design Management (CDM) Regulations, 2015 which require that potential risks to human health and the environment from construction activities are appropriately identified and all necessary steps taken to eliminate / manage that risk. It has been assumed that any future construction works on site will be undertaken in compliance with these requirements and therefore construction workers involved in the building works at the site have been discounted as a human receptor in the conceptual site model. Reference should be given

- The table below represents the first stage in the land quality risk assessment process: The Quantitative Risk Assessment.
- In order for a development site to be deemed 'suitable for use', the level of risk needs to be brought down to acceptable levels, i.e. low to negligible risk. The purpose of each stage of risk assessment is ultimately to establish, if there is a requirement for additional levels of assessment to be made in order to have sufficient confidence to support a risk characterisation or management decision, e.g. remedial action.

Conceptual Site Model			Qualitative Risk Assessment			Action
Source	**Pathway(s)**	**Receptor(s)**	**Consequence (Potential Severity)**	**Likelihood of Occurrence**	**Risk Rating**	
On-site solid phase sources of contamination: Exceedances above the *Residential with homegrown produce* screening criteria within in relation to arsenic, lead, PAHs and Asbestos.	Inhalation of Fibres (Private Gardens and Public Open Space)	**Site end users** Residents, visitors, and trespassers	**Medium**	**Likely** As part of the ground investigation Asbestos fibres was identified in samples sent for laboratory analysis within the existing sub-base soils underlying the hardstanding on-site, with no further detections in Topsoil and Made Ground soils submitted for the sampling. Consequently, there is a likely contaminative risk to future site users on-site through the inhalation of fibres where the impacted sub-base and made ground areas present within proposed soft landscaping areas.	**Moderate**	**Removal of sub-base material (230mm to 500mm thick) within areas of proposed soft landscaping on-site.**
	Ingestion and dermal contact of soil/vegetables, Inhalation of dust (Private Gardens)			**Likely** The environmental testing as part of the ground investigation, recorded marginal exceedances of lead and PAHs within Made Ground soils on-site. The sources of the encountered exceedances are considered to represent the solid phase contaminants within the Made Ground. Consequently, given the marginal exceedances within the shallow soils, there is a potential contaminative risk to future site users within private gardens through the ingestion/dermal contact of soil/vegetables and inhalation of dust pathways.	**Moderate**	**600mm thickness of 'clean' imported soil within areas of proposed private gardens within residential gardens to be detailed within a 'Remediation Strategy' for the development.** **or** **Additional testing of proposed 11 private gardens to determine requirements for clean capping given marginal exceedance.**
	Vertical migration of contaminants within the Made Ground into underlying superficial deposits	**Groundwater** Superficial Deposits - Secondary A Aquifer (Lynch Hill Gravels) Bedrock – Unproductive Aquifer No groundwater abstractions within 750m of the subject site. No surface water features within 250m of the site.		**Unlikely** The risk to the underlying Secondary A Aquifer (superficial deposits) is considered to be Low owing to; the overall limited nature of mobile contamination revealed on site, only marginal exceedances of solid phase contaminants when screened against conservative screening criteria, a large portion of the site consisting of hard-standing and no presence of free phase product or gross contamination.	**Low**	**No further action required.**
Off-site sources of potential contamination: Spillages, leakages and pollution associated with local historic industry. Uncontrolled deposition of Made Ground from unknown sources associated with local development and development.	Horizontal migration through the superficial deposits and air (dust/particulates) Followed by: Direct contact, ingestion, inhalation (dust and vapours)	**Site end users** Residents, visitors and trespassers		**Unlikely** The immediate surrounding off-site land uses comprises predominantly residential properties at present and as such the potential for 'gross contamination' to be present on such sites that could migrate onto the development site is limited. The risk of contamination on site from former industrial land use of the neighbouring land is considered negligible based on no mobile or gross phase contamination encountered on-site. Based on the above, it is considered unlikely that off-site sources of contamination could migrate onto the development site and pose a risk to future site users,	**Low**	**No further action required.**
On and off-site soils with the potential to generate ground gases Made Ground encountered on the site to a depth of 2.30m bgl. No historical landfills within 250m of the subject site	Vertical and horizontal migration through the residual (incl. Made Ground)	**Site end users** Residents, construction workers, visitors	**Medium** Acute health risk, e.g. asphyxiation or risk from explosion	**Unlikely** Based on the results of the three ground gas monitoring visits completed, in regard to ground gas risk assessment the site has been determined to be within a Characteristic Situation 1 (CS1) scenario. Consequently, the ground gas risk for the site is considered to be low.	**Low**	**No ground gas protection measures required as part of the development.**

9.0 Geotechnical Conclusions and Recommendations

The recommendations provided within this section are based on a review of the historical and recent records of ground conditions encountered across the site, along with the proposed development.

9.1 Foundation Recommendation

The proposed development (Appendix A) is to comprise ten 2 to 3 storey buildings and a total of ten 6 to 10 storey apartment buildings. Given this initial foundation recommendations for the proposed developments are outlined in Section 9.1.1 below.

9.1.1 Conventional and Deep Trench Fill

Given the likely high loadings of the 6 to 10 storey buildings, conventional or deep trench fill foundations are unlikely to be suitable. However, such foundations could potentially support loadings (not known at the time of writing) of the proposed 2 to 3 storey buildings.

It is considered that shallow London Clay soils encountered at 0.85m to 2.50m bgl on-site within proposed areas of 2 to 3 storey buildings are likely to achieve bearing capacities of 100kPa. However, given the high plasticity soils and high-volume change potential of such soils a minimum founding depth of 1.00m (outside zone of trees) and 1.50m bgl (within zone of new planting) is adopted in line with NHBC 'Building Near Trees' guidance.

Equally, within the southern portion of the site, it is likely similar bearing capacities would be achieved in the cohesive Langley Silts encountered at 1.50m bgl. If greater loads are required, consideration should be given to mini-piled foundations into underlying London Clay to support loadings for the proposed 2 to 3 storey buildings.

9.1.2 Pile Foundation

As a preliminary consideration, it is recommended that piles be advanced a sufficient thickness into the underlying stiff to very stiff London Clay bedrock encountered from a depth of circa 10.0m to 11.50m bgl (based on geotechnical testing).

It is considered that as a worst case and conservative assessment preliminary pile loads of 900kN would be achievable at a depth of 25.0m bgl, assuming a pile diameter of 600mm. It is considered, potentially, that greater pile loads would be achieved at a shallower depth within the northern portion of the site, based on the London Clay dataset within this area (CP104 and CP105).

Given the evolving nature of pile design and pile technology it is recommended that a specialist contractor is commissioned to undertaken detailed design of the piles. The

following and above commentary is therefore offered as preliminary guidance with respect to their design.

Pile Type: In light of the ground conditions revealed a bored piled solution is considered technically feasible within any proposed development. In general, the adoption of a driven pile solution is not considered feasible given the presence of medium dense to dense granular soils in portions of the site and adjacent residential properties.

Potential Constraints: As part of the enabling works consideration should be given to the presence of below ground obstructions including relic and existing drains and on-site utilities.

Temporary Casing: The presence of Made Ground deposits and granular soils up to 3.60m bgl will likely necessitate temporary casing within some pile locations to ensure pile consistency and prevent 'necking' of the pile.

Piling Platforms: In its current condition, it is unlikely that the shallow soils will be suitable to support the load of a piling rig, with a temporary piling matt to be required.

9.2 Ground Floor Slabs

In general, based on the proposed piled foundation solution as part of a development a suspended floor slab is considered to be suitable. Additionally, given the presence of high plasticity and high-volume change potential of the shallow London Clay soils, a significant thickness of suitably engineered granular fill would be required to underlie any potential ground floor slabs to prevent potential cracking of the slab, along with heave protection in accordance with NHBC guidance.

9.3 Settlement and Heave Considerations

With reference to the proposed piled foundation solution settlement levels should be limited to tolerable levels as agreed with the Structural Engineer.

In addition, if shallow foundations are adopted for the 2 to 3 storey buildings consideration should be given to the potential for differential settlement given the variability of shallow soils (notably Langley Silts in the southern portion).

Consideration should be given to likely potential for ground heave, following the removal of the existing multi-storey buildings and the presence of underlying high plasticity clays, which are recorded to be over consolidated. In addition, heave protection measures will be required in areas of shallow London Clay soils. The proposed buildings should be designed to withstand the potential heave pressures, which may result of the removal of existing structure (existing multi-storey buildings).

9.4 Excavations

It is anticipated that excavations will be required during the enabling works and construction phase, these are likely to be for achieving localised dig and replacement works.

Given the presence of variable Made Ground soils at shallow depths to circa 2.30m any excavations are likely to require ground support. Local instability should be expected where greater proportions of degradable or unsuitable material such as lenses of sand and gravel or made ground are encountered. Where batters are not feasible it is anticipated that some form of temporary earth retaining works would be required. Excavations shallower than 1.2m deep, requiring personnel access, will require closed side support. Attention should be given to limiting the duration over which excavations remain exposed to water ingress as the superficial deposits may undergo rapid loss of strength and possible heave if wetted excessively.

In accordance with Health and Safety Regulations, side support for safety purposes should be provided to all excavations which appear unstable and those more than 1.2m deep. Excavations are likely to be stable at suitable batters.

Shallow groundwater seepage is anticipated based on ground investigation data. Noticeable amounts of standing water encountered within the excavations could result in weakening of the founding soils, as such where encountered, the water should be removed facilitating suitable methods.

General advice on de-watering in accordance with CIRIA Report C750: Groundwater Control (CIRIA, 2016) should be taken into consideration.

9.5 Re-use of Site Soils

It is assumed that re-use of soils will be considered as a part of the development works.

The re-use of site soils is considered viable in terms of an environmental quality perspective providing soils are placed beneath hardstanding. The re-use of soils in proposed soft landscaping for public open space areas is considered suitable, however at this stage re-use of site soils in private gardens is subject to further testing, as discussed in Section 8.0.

The re-use of any material on-site should be discussed with a suitably qualified Geo-Environmental Engineer.

In addition to quality, the re-use of site-won soils is governed by the following principles:

- The geotechnical suitability of the material needs to be confirmed;
- The re-use of the material needs to be covered as part of the planning approval, e.g. site levels maintained within agreed limits;
- The volume of the material being re-used needs to be confirmed and traceable
- Regulatory approval from the relevant authorities should be sought.

These principles are outlined within the CL: AIRE Code of Practice (v2) (15) and if and where the re-use of site-won soils is proposed as part of the development works, it is recommended that a Materials Management Plan is produced in line with the Code of Practice to detail and document the process.

9.6 Roads and Hard-standing Design

In-situ CBR tests were undertaken across the site as a part of the ground investigation (CBR101 - CBR106) using the TRL-DCP method. The testing depth range was between 330mm and 820mm and the CBRs values ranged from 2% to 65% in the top 500mm and from 4% to 89% >500mm, as presented in Appendix D.

For the purposes of pavement designed and in accordance with Interim Advice Note 73/06, 2009 (14) and tested values of the Made Ground soils a minimum CBR of 2% must be adopted at this stage.

This guidance indicates that pavements founded on ground with a minimum CBR of 2.5% will not require regular maintenance. As such, where minimal maintenance is required, it is advised that a pavement designer is consulted, and suitable appropriate testing and assessment is undertaken. Consideration could be given to use of engineered fill or dig/replace of any soft spots within any hard-standing areas.

When designing the roads and hardstanding, it is recommended the variability of potential formation layers (i.e. sands, silts, or clays) is accounted for in design.

9.7 Soakaways

Infiltration testing was not undertaken as part of the ground investigation, however given the ground conditions encountered the majority of the site is unlikely to be suitable for soakaways; owing to the predominately cohesive material on-site, where granular deposits have been encountered within the northern portion the presence of interbedded clays and shallow groundwater are likely to negate viability.

Additionally, consideration would need to be given to the thickness of granular material overlying the London Clay prior to adopting soakaways.

10.0 Geo-Environmental Conclusions and Recommendations

10.1 Geo-environmental Conclusions

A revised tabulated Conceptual Site Model has been derived following the findings of the Generic Quantitative Risk Assessment and is presented in Section 8.0.

10.1.1 Ground and Groundwater Contamination

The environmental chemistry soil results have been compared with the Generic Assessment Criteria (GAC) for soils with respect to human health against '*Residential with Homegrown'* and *'Public Open Space'* thresholds.

With respect to the proposed end-use of the site, GAC thresholds for arsenic, lead and PAHs exceeded within Made Ground, along with the presence of Asbestos. Given the proposed sensitive end use (residential gardens), there is a potential likely risk to future site users should existing Made Ground soils remain at shallow depths through the oral and ingestion contaminant pathway routes.

A review of the ground gas risk highlights that no ground gas protection measures are required for the site.

The BGS Radon Mapping confirms that the site is situated in a lower probability radon area where less than 1% of homes are above the radon action level. On this basis radon protection measures are not considered necessary for the proposed development on the site.

10.1.2 Recommendations

It is recommended that the sub-base and made ground material on-site containing Asbestos material with a thickness of (220mm to 500mm) is removed from areas of proposed soft landscaping.

Due to identified potential contaminative risk within private gardens, the following either/or recommendations are provided:

It is recommended that in proposed private gardens on-site areas, a 600mm thickness of certified, clean imported soil (of both Topsoil and sub-soil verified at source and on-site) is required in proposed areas of the soft landscaping within residential gardens. It is recommended that the above be detailed within a Remediation Strategy for the development and submitted to the local authority for approval.

Or,

Given a total of 11 private gardens proposed (as presented in development plans Appendix A) for the development and the marginal exceedances recorded within the Made Ground,

consideration should be given to further testing of these areas comprising shallow hand pits to determine the presence of any marginal exceedances and requirements or otherwise for clean capping, potentially reducing quantities of import material on-site.

11.0 References

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2. **Environment Agency (EA).** *Model Procedures for the Management of Land Contamination, Contaminated Land Report (CLR) 11.* September 2004.

3. **British Standard Institution (BSI).** *Investigation of Potentially Contaminated Sites (report no. BS10175).* 2011.

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11. **Department of Environment, Food and Rural Affairs (DEFRA).** *Environmental Protection Act 1990: Part 2A Contaminated Land Statutory Guidance (report no.PB13735).* 2014.

12. **CIRIA.** *Assessing Risks Posed by Hazardous Ground Gases to Buildings (report no. C665).* 2007.

13. **British Standards.** *BS 8485, Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings.* June 2015.

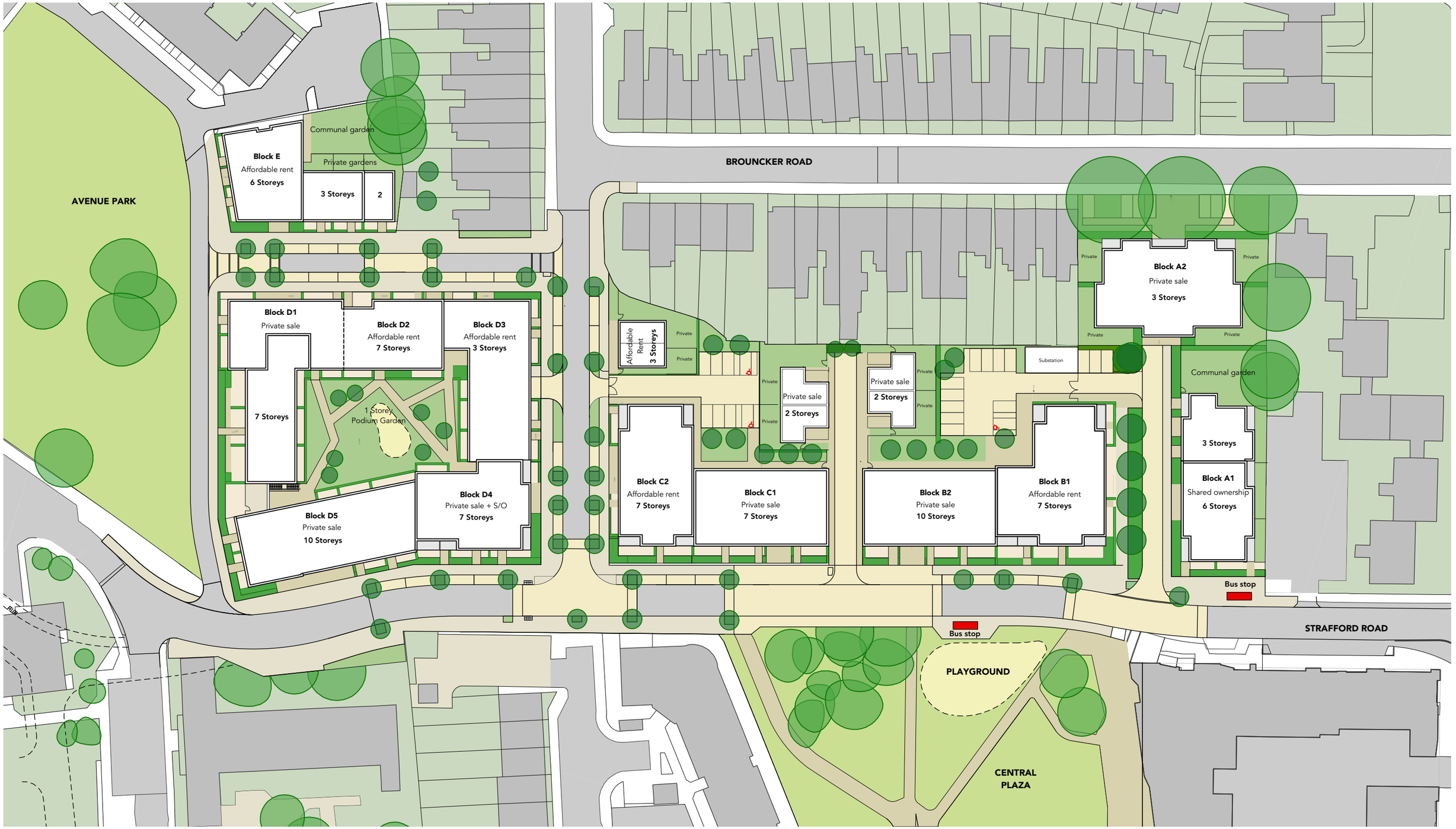
14. **S.Wilson, G.Card and S.Haines.** *Ground Gas Handbook.* 2009.

15. **CIRIA.** *CIRIA Report No C750 Groundwater Control.* 2016.

Appendices

Appendix A Drawings

- Proposed Development Plan; and,
- Exploratory Hole Location Plan.



KEY PLAN

DRAWING NOTES

N

0 10 20 30 M

ISSUE REASON FOR ISSUE DATE

stitch
Architects & Urban Designers
Suite 6, Fusion House, 28 Rochester Place, London, NW1 9DF
www.stitch-studio.co.uk, +44 (0)20 3617 8725

PROJECT
South Acton Phase 8

PROJECT CODE
19193

CLIENT
Countryside Properties

DRAWING TITLE
Phases 8.1 + 8.2
Proposed roof plan

STATUS
S0 - WIP

SCALE
1:750

SHEET
A3

DATE OF FIRST ISSUE
20.11.19

DRAWING NUMBER
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REVISION
-

AVENUE PARK

BROUNCKER ROAD

STRAFFORD ROAD

Block E1

Block D1

Block D2

Block D3

Block D4

Block D5

Under-podium car park

Houses CH

Houses CM

Houses BM

Block C2

Block C1

Block B2

Block B1

Block A1

Block A2

Secure resident's parking court

Secure resident's parking court

Bus stop

Bus stop

PLAYGROUND

CENTRAL PLAZA

KEY PLAN

DRAWING NOTES

N

0 10 20 30 M

Key

- 1 bed 2 person
- 2 bed 3 person
- 2 bed 4 person
- 3 bed 5 person
- 3 bed 6 person
- 4 bed

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Suite 6, Fusion House, 28 Rochester Place, London, NW1 9DF
www.stitch-studio.co.uk, +44 (0)20 3617 8725

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PROJECT CODE
19193

CLIENT
Countryside Properties

DRAWING TITLE
Phases 8.1 + 8.2
Proposed ground floor plan

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S0 - WIP

SCALE
1:750

SHEET
A3

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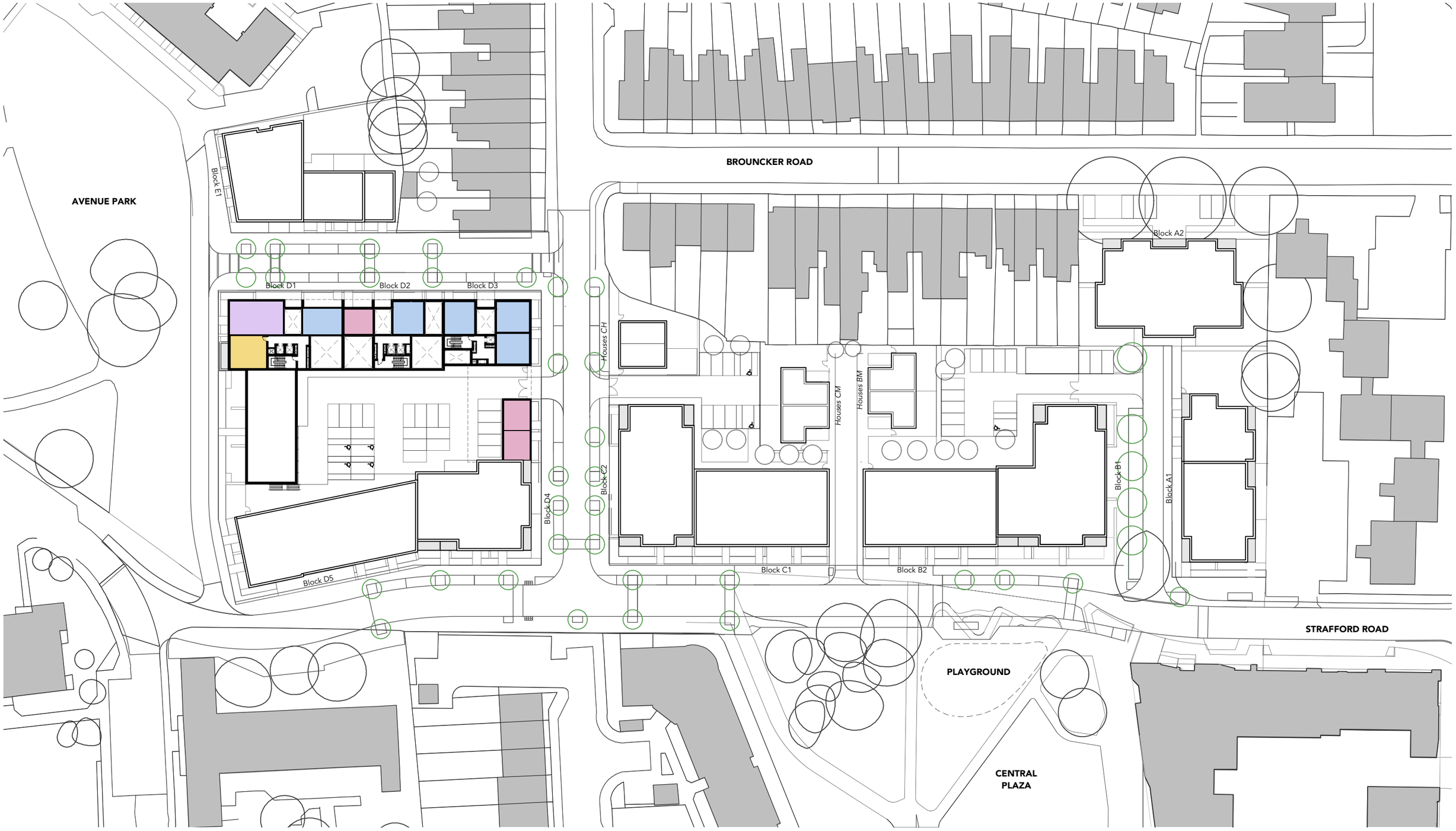

KEY PLAN

DRAWING NOTES

N

0 10 20 30 M

Key

- 1 bed 2 person
- 2 bed 3 person
- 2 bed 4 person
- 3 bed 5 person
- 3 bed 6 person
- 4 bed

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www.stitch-studio.co.uk, +44 (0)20 3617 8725

PROJECT
South Acton Phase 8

PROJECT CODE	CLIENT
19193	Countryside Properties

DRAWING TITLE	STATUS
Phases 8.1 + 8.2 Proposed upper ground	S0 - WIP

SCALE	SHEET	DATE OF FIRST ISSUE
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DRAWING NUMBER	REVISION
19193-SK-0182	-

KEY PLAN

DRAWING NOTES

N

0 10 20 30 M

Key

- 1 bed 2 person
- 2 bed 3 person
- 2 bed 4 person
- 3 bed 5 person
- 3 bed 6 person
- 4 bed

ISSUE	REASON FOR ISSUE	DATE

stitch
Architects & Urban Designers
Suite 6, Fusion House, 28 Rochester Place, London, NW1 9DF
www.stitch-studio.co.uk, +44 (0)20 3617 8725

PROJECT
South Acton Phase 8

PROJECT CODE
19193

CLIENT
Countryside Properties

DRAWING TITLE
Phases 8.1 + 8.2
Proposed first floor plan

STATUS
S0 - WIP

SCALE
1:750

SHEET
A3

DATE OF FIRST ISSUE
20.11.19

DRAWING NUMBER
19193-SK-0183

REVISION
-

KEY PLAN

DRAWING NOTES

N

0 10 20 30 M

Key

- 1 bed 2 person
- 2 bed 3 person
- 2 bed 4 person
- 3 bed 5 person
- 3 bed 6 person
- 4 bed

ISSUE	REASON FOR ISSUE	DATE

stitch
Architects & Urban Designers
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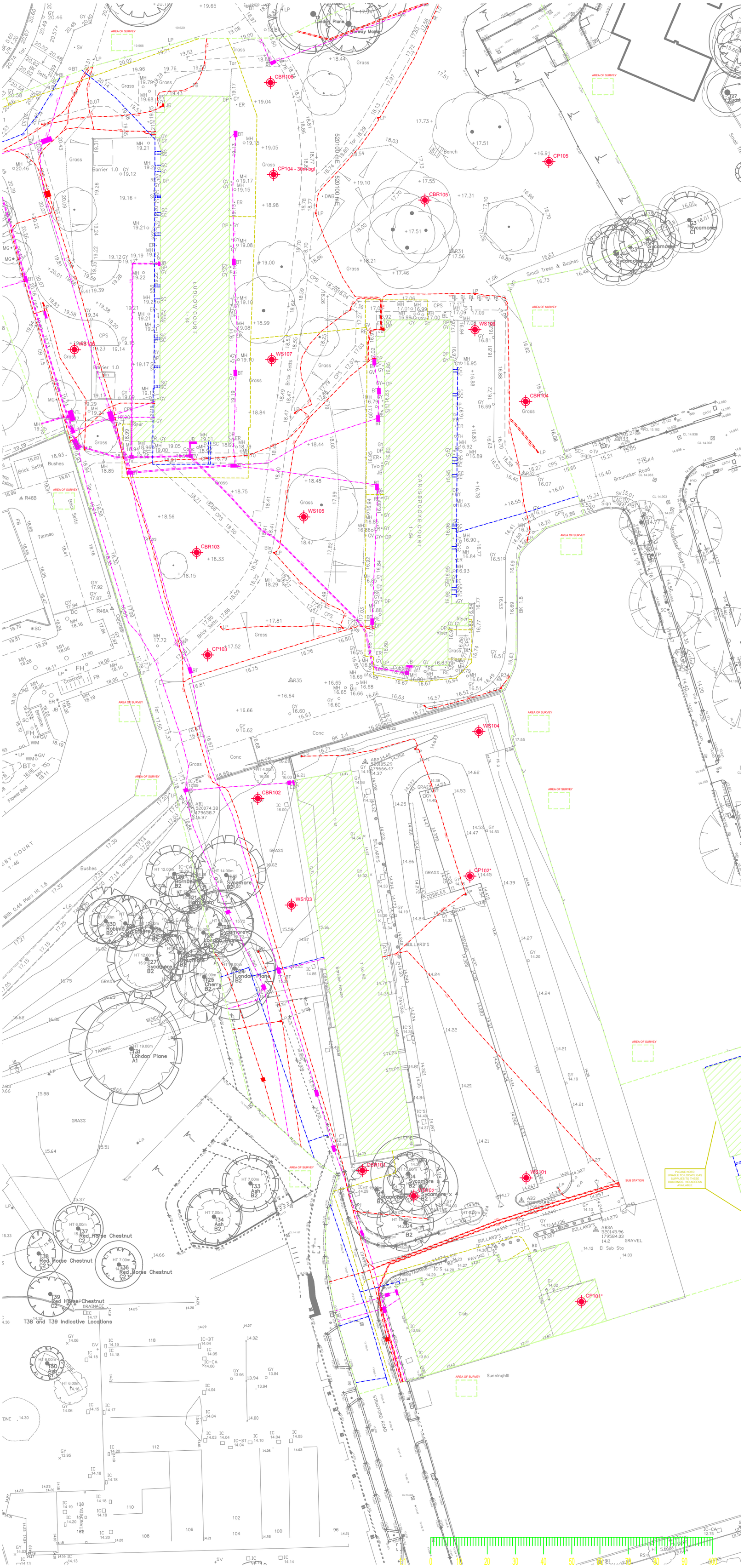
PROJECT
South Acton Phase 8

PROJECT CODE	CLIENT
19193	Countryside Properties

DRAWING TITLE	STATUS
Phases 8.1 + 8.2 Proposed typical floor plan	S0 - WIP

SCALE	SHEET	DATE OF FIRST ISSUE
1:750	A3	20.11.19

DRAWING NUMBER	REVISION
19193-SK-0184	-



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2. DO NOT SCALE THIS DRAWING. ANY AMBIGUITIES, OMISSIONS AND ERRORS ON DRAWINGS SHALL BE BROUGHT TO THE ENGINEERS ATTENTION IMMEDIATELY. ALL DIMENSIONS MUST BE CHECKED / VERIFIED ON SITE.
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Key

- CP — Cable Percussive Borehole
- WS — Window Sample Borehole
- CBR — In-Situ CBR Test

REV	ISSUED	00/00/00	XXX	XXX
Rev:	Description:	Date:	By:	Chkd:

Curtins
40 Compton Street, London, EC1V 0BD
020 7324 2240
london@curtins.com
www.curtins.com

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Project: Acton Gardens Phase 8

Drg Title: Exploratory Hole Location Plan

Size:	Date:	Drawn By:	Designed By:	Checked By:
A2	16/04/2020	WS	WS	ML
Scale: 1:XXX				

Project No:	Originator:	Volume:	Level:	Type:	Role:	Category / Number:	Rev:
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Appendix B Supporting Information

- 1st Line Defence Detailed Unexploded Ordnance Risk Assessment

Detailed Unexploded Ordnance (UXO) Risk Assessment

Project Name	Acton Gardens, Phases 8.1 & 8.2
Client	Curtins
Site Address	Strafford Road, London, W3 8BA
Report Reference	DA9817-00
Date	23rd March 2020
Originator	CB

Find us on Twitter and Facebook

Company No: 7717863 VAT No: 128 8833 79

www.1stlinedefence.co.uk

1st Line Defence Limited

Unit 3, Maple Park, Essex Road, Hoddesdon, Herts. EN11 0EX

Tel: +44 (0)1992 245 020 info@1stlinedefence.co.uk

Executive Summary

Site Location and Description

The site is located in Acton, West London. It is bound to the north by Avenue Road and open grassland, to the east by residential properties situated on Brouncker Road, to the south by Bollo Bridge Road and to the west by residential apartment buildings situated on Hope Gardens, Park Road East, Castle Close, Newport Road and Strafford Road.

Recent aerial photography indicates the boundary to currently comprise residential apartment buildings, hard surfaced roadways, pathways and car parks and open grassland.

The site is approximately centred on the OS grid reference: **TQ 20114 79688**.

Proposed Works

The proposed development is understood to involve the demolition of existing buildings and the construction of 2 to 10 storey residential buildings. Specific intrusive works include:

- Advancement of five cable percussive boreholes (CP101 to CP105) to depths of up to 20m and 30m bgl.
- Advancement of eight window sample boreholes (WS101 to WS108) to depths of up to 5m bgl.
- Six in-situ CBR tests (CBR101 to CBR106) utilising a TRL probe to depths of up to 0.8m bgl.

Geology and Bomb Penetration Depth

The British Geological Survey (BGS) map shows the site area to be underlain by the London Clay Formation – clay and silt, of the Palaeogene Period. Superficial deposits are indicated to comprise the following:

- Langley Silt Member – clay and silt, of the Quaternary Period.
- Head – clay, silt, sand and gravel, of the Quaternary Period.
- Lynch Hill Gravel Member – sand and gravel, of the Quaternary Period.

Site specific geotechnical information was not available to 1st Line Defence at the time of the production of this report. An assessment of maximum bomb penetration depth can be made once such data becomes available, or by a UXO specialist during on-site support.

It should be noted that the maximum depth that a bomb could reach may vary across a site and will be largely dependent on the specific underlying geological strata and its density.

UXO Risk Assessment

1st Line Defence has assessed that there is a **Low Risk** from items of German aerial delivered UXO and Allied UXO across the site. This assessment is based on the following factors:

- During WWII, the site was situated within the Municipal Borough of Acton. Home Office statistics suggest that Acton sustained an overall very-high density of bombing, with an average of 162.6 items of ordnance recorded per 1,000 acres. OS mapping indicates the site to have predominantly comprised a mixture of residential and commercial properties during WWII. Bombing in Acton can primarily be attributed to the borough's proximity to central London as well as Luftwaffe targets, such as the West Middlesex Waterworks located approximately 2.8km south-east of the boundary.
- Consulted bomb census mapping records an incendiary bomb 'shower' over the site boundary on one occasion during WWII. There are no high explosive bombing incidents recorded within the proposed boundary or its immediate vicinity within consulted bomb census mapping or written incident records. The closest recorded high explosive incidents are plotted approximately 60m to the south and west of the boundary; these incidents are referenced in available written records and anecdotal accounts, which are consistent in describing the incidents and subsequent damage caused.
- MCC war damage mapping does not attribute any serious damage to the residential properties on site. However, damage is recorded to the south and west of the boundary; this damage varies from 'seriously damaged; doubtful if repairable' and 'total damage, building to be demolished'. The war damage mapping is corroborated by post-war aerial photography, which indicates the two areas of damage to be in the general vicinity of the recorded incidents mentioned above (60m south and west of the boundary).
- Whilst it should be noted that evacuation protocol may have been initiated following bombing incidents in the immediate vicinity of the site, the wartime access to the residential and commercial properties situated on site is generally considered to have been frequent owing to the lack of recorded damage.

UXO Risk Assessment

- Although open areas, such as the gardens and yards situated throughout the boundary, are generally considered to have been accessed based on the prudency of each resident, the site's urbanised environment and surrounds may have provided such open areas within and around the proposed site with more frequent access than initially anticipated.
- Ground conditions throughout the site boundary are overall considered to have been favourable in the visual detection of UXO; obvious signs of UXO, such as unaccounted damage and entry holes, are thought likely to have been spotted amongst the residential properties. Whilst the open areas of the site, namely the residential gardens, are considered less conducive in comparison, the chance of an item of UXO going unnoticed is considered reduced in this case owing to the small size of the open areas.
- To summarise, records do not indicate any bomb strikes to have occurred directly within the proposed site area. Incidents are recorded in the site's surrounds; however, these are considered too far removed to have been of any effect. Given the lack of positive evidence that suggests the site area experienced bombing, the risk is not considered to be high enough to warrant active risk mitigation measures.
- There is no evidence that the site formerly had any military occupation or usage that could have led to contamination with items of Allied ordnance, such as LSA and SAA. The conditions in which HAA or LAA projectiles may have fallen unnoticed within the site boundary are however analogous to those regarding aerial delivered ordnance.

Recommended Risk Mitigation Measures

The following risk mitigation measures are recommended to support the proposed works at the Acton Gardens Phases 8.1 & 8.2 site:

All Works

- UXO Risk Management Plan
- Site Specific UXO Awareness Briefings to all personnel conducting intrusive works.

Glossary

Abbreviation	Definition
AA	Anti-Aircraft
AFS	Auxiliary Fire Service
AP	Anti-Personnel
ARP	Air Raid Precautions
DA	Delay-action
EOC	Explosive Ordnance Clearance
EOD	Explosive Ordnance Disposal
FP	Fire Pot
GM	G Mine (Parachute mine)
HAA	Heavy Anti-Aircraft
HE	High Explosive
IB	Incendiary Bomb
JSEODOC	Joint Services Explosive Ordnance Disposal Operation Centre
LAA	Light Anti-Aircraft
LCC	London County Council
LRRB	Long Range Rocket Bomb (V-2)
LSA	Land Service Ammunition
NFF	National Filling Factory
OB	Oil Bomb
PAC	Pilotless Aircraft (V-1)
PB	Phosphorous Bomb
PM	Parachute Mine
POW	Prisoner Of War
RAF	Royal Air Force
RCAF	Royal Canadian Air Force
RFC	Royal Flying Corps
RNAS	Royal Naval Air Service
ROF	Royal Ordnance Factory
SA	Small Arms
SAA	Small Arms Ammunition
SD2	Anti-personnel “Butterfly Bomb”
SIP	Self-Igniting Phosphorous
U/C	Unclassified bomb
UP	Unrotated Projectile (rocket)
USAAF	United States Army Air Force
UX	Unexploded
UXAA	Unexploded Anti-Aircraft
UXB	Unexploded Bomb
UXO	Unexploded Ordnance
V-1	Flying Bomb (Doodlebug)
V-2	Long Range Rocket
WAAF	Women’s Auxiliary Air Force
X	Exploded

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1st Line Defence Limited
Detailed Unexploded Ordnance (UXO) Risk Assessment

Site: Acton Gardens Phases 8.1 & 8.2
Client: Curtins

1. Introduction

1.1. Background

1st Line Defence has been commissioned by Curtins to conduct a Detailed Unexploded Ordnance (UXO) Risk Assessment for the works proposed at the Acton Gardens Phases 8.1 & 8.2 site.

Buried UXO can present a significant risk to construction works and development projects. The discovery of a suspect device during works can cause considerable disruption to operations as well as cause unwanted delays and expense.

UXO in the UK can originate from three principal sources:

1. Munitions resulting from wartime activities including German bombing in WWI and WWII, long range shelling, and defensive activities.
2. Munitions deposited as a result of military training and exercises.
3. Munitions lost, burnt, buried or otherwise discarded either deliberately, accidentally, or ineffectively.

This report will assess the potential factors that may contribute to the risk of UXO contamination. If an elevated risk is identified at the site, this report will recommend appropriate mitigation measures, in order to reduce the risk to as low as is reasonably practicable. Detailed analysis and evidence will be provided to ensure an understanding of the basis for the assessed risk level and any recommendations.

This report complies with the guidelines outlined in *CIRIA C681*, 'Unexploded Ordnance (UXO) A Guide for the Construction Industry.'

2. Method Statement

2.1. Report Objectives

The aim of this report is to conduct a comprehensive assessment of the potential risk from UXO at the Acton Gardens Phases 8.1 & 8.2 site. The report will also recommend appropriate site and work-specific risk mitigation measures to reduce the risk from explosive ordnance during the envisaged works to a level that is as low as reasonably practicable.

2.2. Risk Assessment Process

1st Line Defence has undertaken a five-step process for assessing the risk of UXO contamination:

1. The likelihood that the site was contaminated with UXO.
2. The likelihood that UXO remains on the site.
3. The likelihood that UXO may be encountered during the proposed works.
4. The likelihood that UXO may be initiated.
5. The consequences of initiating or encountering UXO.

In order to address the above, 1st Line Defence has taken into consideration the following factors:

- Evidence of WWI and WWII German aerial delivered bombing as well as the legacy of Allied occupation.
- The nature and conditions of the site during WWII.
- The extent of post-war development and UXO clearance operations on site.
- The scope and nature of the proposed works and the maximum assessed bomb penetration depth.
- The nature of ordnance that may have contaminated the proposed site area.

2.3. Sources of Information

Every reasonable effort has been made to ensure that relevant evidence has been consulted and presented in order to produce a thorough and comprehensible report for the client. To achieve this the following, which includes military records and archive material held in the public domain, have been accessed:

- The National Archives, London Metropolitan Archives and Ealing Archives.
- Historical mapping datasets.
- Historic England National Monuments Record.
- Relevant information supplied by Curtins.
- Available material from 33 Engineer Regiment (EOD) Archive (now 28 Regt).
- 1st Line Defence's extensive historical archives, library and UXO geo-datasets.
- Open sources such as published books and internet resources.

Research involved a visit to The National Archives, London Metropolitan Archives and Ealing Archives.

3. Background to Bombing Records

3.1. General Considerations of Historical Research

This desktop assessment is based largely upon analysis of historical evidence. Every reasonable effort has been made to locate and present significant and pertinent information. 1st Line Defence cannot be held accountable for any changes to the assessed risk level or risk mitigation measures, based on documentation or other data that may come to light at a later date, or which was not available to 1st Line Defence during the production of this report.

It is often problematic and sometimes impossible to verify the completeness and accuracy of WWII-era records. Consequently, conclusions as to the exact location and nature of a UXO risk can rarely be quantified and are to a degree subjective. To counter this, a range of sources have been consulted, presented and analysed. The same methodology is applied to each report during the risk assessment process. 1st Line Defence cannot be held responsible for any inaccuracies or the incompleteness in available historical information.

3.2. German Bombing Records

During WWII, bombing records were generally gathered locally by the police, Air Raid Precaution (ARP) wardens and military personnel. These records typically contained information such as the date, the location, the amount of damage caused and the types of bombs that had fallen during an air raid. This information was made either through direct observation or post-raid surveys. The Ministry of Home Security Bomb Census Organisation would then receive this information, which was plotted onto maps, charts, and tracing sheets by regional technical officers. The collective record set (regional bomb census mapping and locally gathered incidents records) would then be processed and summarised into reports by the Ministry of Home Security Research and Experiments Branch. The latter were tasked with providing the government 'a complete picture of air raid patterns, types of weapons used and damage caused- in particular to strategic services and installations such as railways, shipyards, factories and public utilities.'[1]

The quality, detail and nature of record keeping could vary considerably between provincial towns, boroughs and cities. No two areas identically collated or recorded data. While some local authorities maintained records with a methodical approach, sources in certain areas can be considerably more vague, dispersed, and narrower in scope. In addition, the immediate priority was mostly focused on assisting casualties and minimising damage at the time. As a result, some records can be incomplete and contradictory. Furthermore, many records were even damaged or destroyed in subsequent air raids. Records of raids that took place on sparsely or uninhabited areas were often based upon third party or hearsay information and are therefore not always reliable. Whereas records of attacks on military or strategic targets were often maintained separately and have not always survived.

3.3. Allied Records

During WWII considerable areas of land were requisitioned by the War Office for the purpose of defence, training, munitions production and the construction of airfields. Records relating to military features vary and some may remain censored. Within urban environments, datasets will be consulted detailing the location of munition production as well as wartime air and land defences. In rural locations, it may be possible to obtain plans of military establishments, such as airfields, as well as training logs, record books, plans and personal memoirs. As with bombing records, every reasonable effort will be made to access records of, and ascertain any evidence of, military land use. However, there are occasions where such evidence is not available, as records may not be accessible, have been lost/destroyed, or simply were not kept in the first place.

[1] http://www.nationalarchives.gov.uk/help-with-your-research/research-guides/bomb-census-survey-records-1940-1945/.

4. UK Regulatory Environment and Guidelines

4.1. General

There is no formal obligation requiring a UXO risk assessment to be undertaken for construction projects in the UK, nor is there any specific legislation stipulating the management or mitigation of UXO risk. However, it is implicit in the legislation outlined below that those responsible for intrusive works (archaeology, site investigation, drilling, piling, excavation etc.) should undertake a comprehensive and robust assessment of the potential risks to employees and that mitigation measures are implemented to address any identified hazards.

4.2. CDM Regulations 2015

The Construction (Design and Management) Regulations 2015 (CDM 2015) define the responsibilities of parties involved in the construction of temporary or permanent structures.

The CDM 2015 establishes a duty of care extending from clients, principle co-ordinators, designers, and contractors to those working on, or affected by, a project. Those responsible for construction projects may therefore be accountable for the personal or proprietary loss of third parties, if correct health and safety procedure has not been applied.

Although the CDM does not specifically reference UXO, the risk presented by such items is both within the scope and purpose of the legislation. It is therefore implied that there is an obligation on parties to:

- Provide an appropriate assessment of potential UXO risks at the site (or ensure such an assessment is completed by others).
- Put in place appropriate risk mitigation measures if necessary.
- Supply all parties with information relevant to the risks presented by the project.
- Ensure the preparation of a suitably robust emergency response plan.

4.3. The 1974 Health and Safety at Work etc. Act

All employers have a responsibility under the Health and Safety at Work etc. Act 1974 and the Management of Health and Safety at Work Regulations 1999, to ensure the health and safety of their employees and third parties, so far as is reasonably practicable and conduct suitable and sufficient risk assessments.

4.4. CIRIA C681

In 2009, the Construction Industry Research and Information Association (CIRIA) produced a guide to UXO for the UK construction industry (CIRIA C681). CIRIA is a neutral, independent and not-for-profit body, linking organisations with common interests and facilitating a range of collaborative activities that help improve the industry.

The publication provides the UK construction industry with a defined process for the management of risks associated with UXO from WWI and WWII aerial bombardment. It is also broadly applicable to the risks from other forms of UXO that might be encountered. It focuses on construction professionals' needs, particularly if there is a suspected item of UXO on site and covers issues such as what to expect from a UXO specialist. The guidance also helps clients to fulfil their legal duty under CDM 2015 to provide designers and contractors with project specific health and safety information needed to identify hazards and risks associated with the design and construction work. This report conforms to this CIRIA guidance and to the various recommendations for good practice referenced therein. It is recommended that this document is acquired and studied where possible to allow a better understanding of the background to both the risk assessment process and the UXO issue in the UK in general.

4.5. Additional Legislation

In the event of a casualty resulting from the failure of an employer/client to address the risks relating to UXO, the organisation may be criminally liable under the Corporate Manslaughter and Corporate Homicide Act 2007.

5. The Role of Commercial UXO Contractors and The Authorities

5.1. Commercial UXO Specialists

The role of a UXO Specialist (often referred to as UXO Consultant or UXO Contractor) such as 1st Line Defence is defined in CIRIA C681 as the provision of expert knowledge and guidance to the client on the most appropriate and cost-effective approach to UXO risk management at a site.

The principal role of UXO Specialists is to provide the client with an appropriate assessment of the risk posed by UXO for a specific project, and identify and carry out suitable methodology for the mitigation of any identified risks to reduce them to an acceptable level.

The requirement for a UXO Specialist should ideally be identified in the initial stages of a project, and it is recommended that this occur prior to the start of any detailed design. This will enable the client to budget for expenditure that may be required to address the risks from UXO, and may enable the project team to identify appropriate techniques to eliminate or reduce potential risks through considered design, without the need for UXO specific mitigation measures. The UXO Specialist should have suitable qualifications, levels of competency and insurances.

Please note 1st Line Defence has the capability to provide a complete range of required UXO risk mitigation services, in order to reduce a risk to as low as reasonably practicable. This can involve the provision of both ground investigation, and where appropriate, UXO clearance services.

5.2. The Authorities

The police have a responsibility to co-ordinate the emergency services in the event of an ordnance-related incident at a construction site. Upon inspection, they may impose a safety cordon, order an evacuation, and call the military authorities Joint Services Explosive Ordnance Disposal Operation Centre (JSEODOC) to arrange for investigation and/or disposal. Within the Metropolitan Police Operational Area, SO15 EOD will be tasked to any discovery of suspected UXO. The request for Explosive Officer (Expo) support is well understood and practiced by all Metropolitan Boroughs. The requirement for any additional assets will then be coordinated by the Expo if required.

In the absence of a UXO specialist, police officers will usually employ such precautionary safety measures, thereby causing works to cease, and possibly requiring the evacuation of neighbouring businesses and properties.

The priority given to the police request will depend on the EOD teams judgement of the nature of the UXO risk, the location, people and assets at risk, as well as the availability of resources. The speed of response varies; authorities may respond immediately or in some cases, it may take several days for the item of ordnance to be dealt with. Depending on the on-site risk assessment, the item of ordnance may be removed from the site and/or destroyed by a controlled explosion.

Following the removal of an item of UXO, the military authorities will only undertake further investigations or clearances in high-risk situations. If there are regular UXO finds on a site the JSEODOC may not treat each occurrence as an emergency and will recommend the construction company puts in place alternative procedures, such as the appointment of a commercial contractor to manage the situation.

6. The Site

6.1. Site Location

The site is located in Acton, West London. It is bound to the north by Avenue Road and open grassland, to the east by residential properties situated on Brouncker Road, to the south by Bollo Bridge Road and to the west by residential apartment buildings situated on Hope Gardens, Park Road East, Castle Close, Newport Road and Strafford Road.

The site is approximately centred on the OS grid reference: **TQ 20114 79688**.

Site location maps are presented in **Annex A**.

6.2. Site Description

Recent aerial photography indicates the boundary to currently comprise residential apartment buildings, hard surfaced roadways, pathways and car parks and open grassland.

A recent aerial photograph and site plan are presented in **Annex B** and **Annex C** respectively.

7. Scope of the Proposed Works

7.1. General

The proposed development is understood to involve the demolition of existing buildings and the construction of 2 to 10 storey residential buildings. Specific intrusive works include:

- Advancement of five cable percussive boreholes (CP101 to CP105) to depths of up to 20m and 30m bgl.
- Advancement of eight window sample boreholes (WS101 to WS108) to depths of up to 5m bgl.
- Six in-situ CBR tests (CBR101 to CBR106) utilising a TRL probe to depths of up to 0.8m bgl.

8. Ground Conditions

8.1. General Geology

The British Geological Survey (BGS) map shows the site area to be underlain by the London Clay Formation – clay and silt, of the Palaeogene Period. Superficial deposits are indicated to comprise the following:

- Langley Silt Member – clay and silt, of the Quaternary Period.
- Head – clay, silt, sand and gravel, of the Quaternary Period.
- Lynch Hill Gravel Member – sand and gravel, of the Quaternary Period.

8.2. Site Specific Geology

Site-specific geotechnical data was not available during the production of this report.

9. Site History

9.1. Introduction

The purpose of this section is to identify the composition of the site pre and post-WWII. It is important to establish the historical use of the site, as this may indicate the site's relation to potential sources of UXO as well as help with determining factors such as the land use, groundcover, likely frequency of access and signs of bomb damage.

9.2. Ordnance Survey Historical Maps

Relevant historical maps were obtained for this report and are presented in **Annex D.** See below for a summary of the site history shown on acquired mapping.

Pre-WWII		
Date	**Scale**	**Description**
1934 – 1935	1:,2500	This map indicates the site area to have been predominantly occupied by residential properties and associated gardens, with a number of commercial/industrial properties situated sporadically throughout the boundary. *Park Road East* intersects the site area in the north, whilst *Strafford Road* runs along the length of the site's western border. *All Saints Church* is situated to the immediate south of the boundary.

Post-WWII		
Date	**Scale**	**Description**
1954 – 1960	1:2,500	This map indicates that some changes have occurred on site following the war. A *Plating Works* was constructed in the northern section of the site, replacing two pre-war structures. A *Laundry* and a *Warehouse* were constructed in the southern area of the site. The remainder of the boundary is still occupied predominantly by residential properties and associated gardens.

9.3. Historical Photographs of the Site

Historical photographs have been consulted from the Aerofilms collection available from Britain From Above. These photographs provide a view of the site in the 1920s and 1930s (see **Annex E**). See below for a description of each photograph.

Title of Photograph	**Comments**
EPW010774 ENGLAND (1924). All Saints' Church and the Recreation Ground, South Acton, 1924.	This image covers the southern area of the boundary. *All Saints Church* is visible to the immediate south of the boundary. The remainder of the site area visible in this image is defined by residential properties.
EPW059942 – A Cityscape, Acton, 1938.	This image portrays the entire site area from the south-west; a mixture of residential and commercial properties are situated within the site footprint.

10. Introduction to German Aerial Delivered Ordnance

10.1. General

During WWI and WWII, the UK was subjected to bombing which often resulted in extensive damage to city centres, docks, rail infrastructure and industrial areas. The poor accuracy of WWII targeting technology and the nature of bombing techniques often resulted in neighbouring areas to targets sustaining collateral damage.

In addition to raids which concentrated on specific targets, indiscriminate bombing of large areas also took place, this occurred most prominently in the London 'Blitz', though affected many other towns and cities. As discussed in the following sections, a proportion of the bombs dropped on the UK did not detonate as designed. Although extensive efforts were made to locate and deal with these UXBs at the time, many still remain buried and can present a potential risk to construction projects.

The main focus of research for this section of the report will concern German aerial delivered ordnance dropped during WWII, although WWI bombing will also be considered.

10.2. Generic Types of WWII German Aerial Delivered Ordnance

To provide an informed assessment of the hazards posed by any items of unexploded ordnance that may remain in situ on site, the table below provides information on the types of German aerial delivered ordnance most commonly used by the Luftwaffe during WWII. Images and brief summaries of the characteristics of these items of ordnance are listed in **Annex F**.

Generic Types of WWII German Aerial Delivered Ordnance		
Type	**Frequency**	**Likelihood of detection**
High Explosive (HE) bombs	In terms of weight of ordnance dropped, HE bombs were the most frequently deployed by the Luftwaffe during WWII.	Although efforts were made to identify the presence of unexploded ordnance following an air raid, often the damage and destruction caused by detonated bombs made observation of UXB entry holes impossible. The entry hole of an unexploded bomb can be as little as 20cm in diameter and was easily overlooked in certain ground conditions (see **Annex G**). Furthermore, ARP documents describe the danger of assuming that damage, actually caused by a large UXB, was due to an exploded smaller bomb. UXBs therefore present the greatest risk to present–day intrusive works.
1kg Incendiary bombs (IB)	In terms of the number of weapons dropped, small IBs were the most numerous. Millions of these were dropped throughout WWII.	IBs had very limited penetration capability and in urban areas would often have been located in post-raid surveys. If they failed to initiate and fell in water, on soft vegetated ground, or bombed rubble, they could easily go unnoticed.
Large Incendiary bombs (IB)	These were not as common as the 1kg IBs, although they were more frequently deployed than PMs and AP bomblets.	If large IBs did penetrate the ground, complete combustion did not always occur and in such cases they could remain a risk to intrusive works.
Aerial or Parachute mines (PM)	These were deployed less frequently than HE and IBs due to size, cost and the difficulty of deployment.	If functioning correctly, PMs generally would have had a slow rate of descent and were very unlikely to have penetrated the ground. Where the parachute failed, mines would have simply shattered on impact if the main charge failed to explode. There have been extreme cases when these items have been found unexploded. However, in these scenarios, the ground was either extremely soft or the munition fell into water.
Anti-personnel (AP) bomblets	These were not commonly used and are generally considered to pose a low risk to most works in the UK.	SD2 bomblets were packed into containers holding between 6 and 108 submunitions. They had little ground penetration ability and should have been located by the post-raid survey unless they fell into water, dense vegetation or bomb rubble.

10.3. Failure Rate of German Aerial Delivered Ordnance

It has been estimated that 10% of WWII German aerial delivered HE bombs failed to explode as designed. Reasons for why such weapons might have failed to function as designed include:

- Malfunction of the fuze or gain mechanism (manufacturing fault, sabotage by forced labour or faulty installation).
- Many were fitted with a clockwork mechanism that could become immobilised on impact.
- Failure of the bomber aircraft to arm the bombs due to human error or an equipment defect.
- Jettisoning the bomb before it was armed or from a very low altitude. This most likely occurred if the bomber aircraft was under attack or crashing.

From 1940 to 1945, bomb disposal teams reportedly dealt with a total of 50,000 explosive items of 50kg and over, 7,000 anti-aircraft projectiles and 300,000 beach mines. Unexploded ordnance is still regularly encountered across the UK; see press articles in **Annex H1**.

10.4. UXB Ground Penetration

An important consideration when assessing the risk from a UXB is the likely maximum depth of burial. There are several factors which determine the depth that an unexploded bomb will penetrate:

- Mass and shape of bomb.
- Height of release.
- Velocity and angle of bomb.
- Nature of the ground cover.
- Underlying geology.

Geology is perhaps the most important variable. If the ground is soft, there is a greater potential of deeper penetration. For example, peat and alluvium are easier to penetrate than gravel and sand, whereas layers of hard strata will significantly retard and may stop the trajectory of a UXB.

10.4.1. The J-Curve Effect

J-curve is the term used to describe the characteristic curve commonly followed by an aerial delivered bomb dropped from height after it penetrates the ground. Typically, as the bomb is slowed by its passage through underlying soils, its trajectory curves towards the surface. Many UXBs are found with their nose cone pointing upwards as a result of this effect. More importantly however is the resulting horizontal offset from the point of entry. This is typically a distance of about one third of the bomb's penetration depth, but can be higher in certain conditions (see **Annex G**).

10.4.2. WWII UXB Ground Penetration Studies

During WWII, the Ministry of Home Security undertook a major study on actual bomb penetration depths, carrying out statistical analysis on the measured depths of 1,328 bombs as reported by bomb disposal (BD) teams. Conclusions were made as to the likely average and maximum depths of penetration of different sized bombs in different geological strata.

For example, the largest common German bomb (500kg) had a likely concluded penetration depth of 6m in sand or gravel but 11m in clay. The maximum observed depth for a 500kg bomb was 11.4m and for a 1,000kg bomb 12.8m. Theoretical calculations suggested that significantly greater penetration depths were probable.

10.4.3. Site Specific Bomb Penetration Considerations

When considering an assessment of the bomb penetration at the site of proposed works the following parameters have been used:

- WWII geology – London Clay Formation.
- Impact angle and velocity – 10-15° from vertical and 270 metres per second.
- Bomb mass and configuration – The 500kg SC HE bomb, without retarder units or armour piercing nose (this was the largest of the common bombs used against Britain).

It has not been possible to determine maximum bomb penetration capabilities at this stage due to the lack or limitations of site-specific geotechnical information. An assessment can be made once such information becomes available or by an UXO Specialist on-site.

10.5. V-Weapons

Hitler's 'V-weapon' campaign began from mid-1944. It used newly developed unmanned cruise missiles and rockets. The V-1 known as the *flying bomb* or *pilotless aircraft* and the V-2, a long-range rocket, were launched from bases in Germany and occupied Europe. A total of 2,419 V-1s and 517 V-2s were recorded in the London Civil Defence region alone.

Although these weapons caused considerable damage their relatively low numbers allowed accurate records of strikes to be maintained. These records have mostly survived. There is a negligible risk from unexploded V-weapons on land today since even if the 1000kg warhead failed to explode, the weapons are so large that they would have been observed and dealt with at the time. Therefore, V-weapons are referenced in this report not as a viable risk factor, but primarily in order to help account for evidence of damage and clearance reported.

11. The Likelihood of Contamination from German Aerial Delivered UXBs

11.1. World War I

During WWI Britain was targeted and bombed by Zeppelin Airships as well as Gotha and Giant fixed-wing aircraft. An estimated 250 tons of ordnance (high explosive and incendiary bombs) was dropped on Greater London, more than half of which fell on the City of London (see **Annex I** for a WWI bomb plot map of London). This source does not record any WWI bombing incidents to have affected the site.

WWI bombs were generally smaller and dropped from a lower altitude than those used in WWII. This resulted in limited UXB penetration depths. Aerial bombing was often such a novelty at the time that it attracted public interest and even spectators to watch the raids in progress. For these reasons, there is a limited risk that UXBs passed undiscovered in the urban environment. When combined with the relative infrequency of attacks and an overall low bombing density the risk from WWI UXBs is considered low and will not be further addressed in this report.

11.2. World War II Bombing of Acton

The Luftwaffe's main objective for the attacks on Britain was to inhibit the country's economic and military capability. To achieve this they targeted airfields, depots, docks, warehouses, wharves, railway lines, factories, and power stations. As the war progressed the Luftwaffe bombing campaign expanded to include the indiscriminate bombing of civilian areas in an attempt to subvert public morale.

During WWII, the site was located within the Municipal Borough of Acton, which sustained a high density of bombing, as represented by bomb density data figures and maps, see **Annex J**. This was mainly due to its location close to central London and proximity to potential Luftwaffe targets, as identified on Luftwaffe reconnaissance photography. For instance, the West Middlesex Waterworks was situated approximately 2.8km to the south-east of the site (see **Annex K**).

Neighbouring areas would often be affected by the presence of such targets, partly due to the inaccuracies of carpet-bombing and the fact that Luftwaffe bomber aircraft would often deploy any remaining bombs on adjacent areas. Much of the bombing on the region can be attributed to these potential targets in the region and any bombing inflicted upon the civilian population.

Records of bombing incidents in the civilian areas of Acton were typically collected by Air Raid Precautions wardens and collated by Civil Defence personnel. Some other organisations, such as port and railway authorities, maintained separate records. Records would be in the form of typed or hand written incident notes, maps and statistics. Bombing data was carefully analysed, not only due to the requirement to identify those parts of the country most needing assistance, but also in an attempt to find patterns in the Germans' bombing strategy in order to predict where future raids might take place.

Records of bombing incidents for Acton are presented in the following sections.

11.3. WWII Home Office Bombing Statistics

The following table summarises the quantity of German aerial delivered bombs (excluding 1kg incendiaries and anti-personnel bombs) dropped on the Municipal Borough of Acton between 1940 and 1945.

Record of German Ordnance Dropped on the Municipal Borough of Acton		
Area Acreage		**2,318**
Weapons	High Explosive bombs (all types)	328
	Parachute mines	3
	Oil bombs	16
	Phosphorus bombs	23
	Fire pots	0
	Pilotless aircraft (V-1)	7
	Long range rocket bombs (V-2)	0
Total		**377**
Number of Items per 1,000 acres		**162.6**

Source: Home Office Statistics
This table does not include UXO found during or after WWII.

Detailed records of the quantity and locations of the 1kg incendiary and anti-personnel bombs were not routinely maintained by the authorities as they were frequently too numerous to record. Although the risk relating to IBs is lesser than that relating to larger HE bombs, they were similarly designed to inflict damage and injury. Anti-personnel bombs were used in much smaller quantities and are rarely found today but are potentially more dangerous. Although Home Office statistics did not record these types of ordnance, both should not be overlooked when assessing the general risk to personnel and equipment.

11.4. London Civil Defence Region Bomb Census Maps

During WWII, the ARP Department within the Research and Experiments Branch of the Ministry of Home Security produced both consolidated and weekly bomb census maps for the London Civil Defence Region, as well as census mapping of V-1 pilotless aircraft. These maps collectively show the approximate locations of bombs, mines and rockets dropped in the region. The site area was checked on each available map sheet; those showing bomb incidents on and in the immediate vicinity of the site are discussed below and are presented in **Annex L**.

London Consolidated Bomb Census Maps – Annex L1	
Date Range	**Comments**
Night Bombing up to 7th October 1940	There are no incidents recorded within the site footprint or its immediate surrounds.
7th October 1940 to 6th June 1941	There are no incidents recorded within the site footprint or its immediate surrounds.

London Weekly Bomb Census Maps – Annex L2-L3	
Date Range	**Comments**
7th to 14th October 1940	An incendiary bomb 'shower' is recorded approximately 120m west of the boundary. There are no incidents recorded within the site footprint during this week.
14th to 21st April 1941	An incendiary bomb 'shower' is recorded over the northern half of the site footprint during this week.
7th to 23rd May 1943	A 500kg HE bomb is recorded approximately 70m to the west of the boundary on the junction of Park Road East and Park Road North.
21st to 27th February 1944	A 500kg HE bomb is recorded approximately 40m to the south of the boundary on the adjacent side of Bollo Bridge Road.

V-1 Pilotless Aircraft Bomb Census Map – Annex M	
Date Range	**Comments**
1944-45	A V-1 pilotless aircraft strike is recorded approximately 250m to the south-east of the site area in the vicinity of Beaumont Street.

11.5. Acton WWII Incident Reports

Bomb incident records for Acton were obtained from Ealing Archives. This record was compiled by local Air Raid Precaution (ARP) personnel and volunteers during the war. A summary of the associated written records for bombs which fell in the site area is presented in the table below (see **Annex N** for visual examples of this records).

Acton WWII Bomb Incident Report			
Date	**Type of Bomb**	**Location**	**Comments**
4th October 1940	HE	Rear of No. 14 Bollo Bridge Road	**Size and position of crater**: large – in garden at rear of No. 14. **Property wrecked:** none. **Property dangerous and to be demolished**: none. **Property dangerous**: Bollo Bridge Road 10, 12, 14, 16, 18, 22, 24 **Other property uninhabitable**: Leythe Road 2, 4, 6, 8, 10
19th May 1943	HE	Park Road North junction with Park Road East	**Size and position of crater**: none – direct hit on Nos. 63-65 Park Road North **Property demolished by bomb**: Park Road North 63, 65, 67 **Property beyond repair and to be demolished**: Park Road North 61 (Gladstone PH), 69, 40, 42, 44, 46, 48, 34, 36, 71, 73, 38, 50 Park Road East 56, 56A **Other property seriously damaged and uninhabitable:** Park Road East 45, 50, 52, 54 Park Road North 52, 54, 56, 58, 59 St Margaret's Terrace 1, 3, 5, 2, 4, 6, 8, 10, 12, 14, 16, 18, 20 **Property temporarily uninhabitable**: Park Road North 62, 64, 66, 79, 81 Park Road East 42, 44

11.6. Acton Log Book of Air Raid Incident Records

A log book of air raids incidents in Acton, compiled for the County Council of Middlesex was obtained from the London Metropolitan Archives. This record was compiled by local Air Raid Precaution (ARP) personnel and volunteers during the war. A transcript of the associated written records for bombs which fell in the site area is presented in the table below. An example of these entries are presented in **Annex O**.

Acton Log Book of Air Raid Incident Records	
Date Range	**Comments**
19th May 1943	Damage from HE bomb on Park Road East, Avenue Road and Park Road North. Electrical Repairs Ltd. Works destroyed – 2 killed, 55 injured (out of production), Atlas Planting Works (production reduced to 50%), London Fan & Motor Co. (production suspended), Hulbird Patents Ltd. (no interference with production)

11.7. Damage to Property Records

Records regarding damage to properties were obtained from Ealing Archives. References were found to the church to the immediate south of the site area suffering from minor bomb damage. This is considered unlikely to have affected the site area (see **Annex P** for an example of the records).

11.8. Middlesex County Council War Damage Map

Map sheets compiled by Middlesex County Council (MCC) showing the extent of wartime bomb damage over the area of the site were consulted at London Metropolitan Archives. The section showing the area of the site is described in the table below and presented in **Annex Q**.

It should be highlighted that this source only records the following damage categories: 'Total damage, building to be demolished', 'damaged beyond repair' and 'seriously damaged; doubtful if repairable'. The lesser damage categories such as seriously damaged but repairable at cost and general blast damage were not used.

MCC War Damage Map	
Date Range	**Comments**
1940-1945	No properties within the site footprint are recorded as damaged. However, properties to the immediate north-west of the boundary, in the vicinity of Park Road East/Park Road North, and the immediate south of the boundary, in the vicinity of Bollo Bridge Road, are recorded as suffering damage. This damage varies from 'seriously damaged; doubtful if repairable' and 'total damage, building to be demolished'. Both areas of damage are conducive with recorded bombing incidents.

11.9. South Acton Remembered

An anecdotal account of the history of South Acton was compiled by Graham Charles Woodward, and entitled '*South Acton Remembered*'.[2] Relevant passages from within this source have been transcribed below. Any incidents recorded that are in close proximity to the site area have been emboldened.

'Second World War:

1) On the 24 February 1940 a bomb fell in the back gardens of Palmerston Road demolishing houses 1-5 Palmerston Road, number 7 was also made uninhabitable. The bomb made a 20 feet deep hole. Buildings in All Saints Road and Bollo Bridge Road also suffered damage. No-one was killed.

2) 20 September 1940, a landmine descended on a green parachute near Church Path, and there was a lot of damage in Acton Lane and Kent Road.

3) 4 October 1940, bakery was destroyed, and telegraph wires across the road were brought down on Bollo Bridge Road, south side.

4) A bomb fell at the junction of Park Road North and Park Road East on 19 May 1943, killing 4 people. Local people say it was a landmine and that it destroyed the Lord Palmerston pub, a ball bearing factory and a dairy (this incident occurred approximately 60m to the west of the site area).

5) A bomb fell on Fletcher Road on 24 February 1944, leaving 7 houses demolished, and 20 people killed, with damage to many other houses.

6) On 23 June 1944, 20 houses in Fletcher Road were destroyed by a V1 flying bomb. This is the second bomb recorded on this one street.'

[2] *http://ancestors-genealogy.com/woodward/acton.htm*

11.10. WWII-Era Aerial Photography

A high-resolution scan of WWII-era aerial photography for the site area was obtained from the National Monuments Record Office (Historic England). A post-WWII oblique aerial photograph of the site area was also obtained from Britain From Above. These photographs provide a record of the potential composition of the site during the war, as well as its condition immediately following the war (**see Annexes R & S**).

WWII-Era Aerial Photography	
Date/Title	**Description**
29th January 1946	This image shows the site to be predominantly occupied by residential and commercial properties. No obvious evidence of significant structural damage occurring within the boundary is noted in the image; all properties appear to have survived WWII externally structurally intact. However, damage is noted in the site's immediate surrounds. A large area of structural clearance is noted approximately 60m to the south of the boundary on the adjacent side of Bollo Bridge Road. Structural clearance and pre-fabricated properties are also present approximately 60m to the west of the boundary in the vicinity of the junction of Park Road East and Park Road North. Both of these areas of clearance/damage are in the vicinity of bombing incidents recorded in bomb census mapping and written records. An open area is present in the north of the boundary. However, this is known to have been a works yard throughout the war. Furthermore, there is some evidence of potential repairs in sporadic areas within the boundary; however, these are not thought to have been a result of bomb damage occurring based on the evidence available. Further areas of clearance and pre-fabricated housing are visible in the site's wider surrounds (see **Annex R2** for a wider view of the image).
EAW044726 – The London Transport Executive Acton Works and South Acton, Gunnersbury, 1952.	This image portrays the site area and its surrounding environs from the south-west. Structural changes are noted in sporadic areas throughout the boundary as seen in the vertical image. However, these are not thought to have been due to bomb damage occurring.

11.11. Abandoned Bombs

A post air-raid survey of buildings, facilities, and installations would have included a search for evidence of bomb entry holes. If evidence of an entry hole was encountered, Bomb Disposal Officer Teams would normally have been requested to attempt to locate, render safe, and dispose of the bomb. Occasionally, evidence of UXBs was discovered but due to a relatively benign position, access problems, or a shortage of resources the UXB could not be exposed and rendered safe. Such an incident may have been recorded and noted as an 'abandoned bomb'.

Given the inaccuracy of WWII records and the fact that these bombs were 'abandoned', their locations cannot be considered definitive or the lists exhaustive. The MoD states that 'action to make the devices safe would be taken only if it was thought they were unstable'. It should be noted that other than the 'officially' abandoned bombs, there will inevitably be UXBs that were never recorded.

1st Line Defence holds no records of officially registered abandoned bombs at or near the site of the proposed works.

11.12. Bomb Disposal Tasks

The information service from the Explosive Ordnance Disposal (EOD) Archive Information Office at 33 Engineer Regiment (EOD) (now 29 Regt) is currently facing considerable delay. It has therefore not been possible to include any updated official information regarding bomb disposal/clearance tasks with regards to this site. A database of known disposal/clearance tasks has been referred to which does not make reference to such instances occurring within the site of proposed works. If any relevant information is received at a later date, Curtins will be advised.

11.13. Evaluation of German Aerial Delivered UXO Records

Factors	Conclusion
Density of Bombing *It is important to consider the bombing density when assessing the possibility that UXBs remain in an area. High bombing density could allow for error in record keeping due to extreme damage caused to the area.*	During WWII, the site was situated within the Municipal Borough of Acton. Home Office statistics suggest that Acton sustained an overall very-high density of bombing, with an average of 162.6 items of ordnance recorded per 1,000 acres. An incendiary bomb 'shower' is recorded over the site boundary on one occasion during WWII. However, there are no high explosive bombing incidents recorded within the proposed boundary or its immediate vicinity within consulted bomb census mapping or written incident records. The closest recorded incidents are plotted approximately 60m to the south, in the vicinity of Bollo Bridge Road, and 60m to the west, on the junction of Park Road North and Park Road East. These incidents are referenced in available written records and anecdotal accounts.
Damage *If buildings or structures on a site sustained bomb or fire damage any resulting rubble and debris could have obscured the entry holes of unexploded bombs dropped during the same or later raids. Similarly, a high explosive bomb strike in an area of open agricultural land will have caused soil disturbance, increasing the risk that a UXB entry hole would be overlooked.*	MCC war damage mapping does not attribute any serious damage to the residential properties on site; an open area in the northern part of the site is known to have been present at the outset of WWII. However, damage is recorded just south and west of the site boundary; this damage varies from 'seriously damaged; doubtful if repairable' and 'total damage, building to be demolished'. Both areas of damage are corroborated by post-war aerial photography, which displays evidence of structural clearance occurring. It should be noted that there are some minor structural alterations evident between pre- and post-war OS mapping; these are also evident in post-WWII photography. However, there is no evidence to suggest that these changes are a direct result of bombing incidents occurring.
Access Frequency *UXO in locations where access was irregular would have a greater chance of passing unnoticed than at those that were regularly occupied. The importance of a site to the war effort is also an important consideration as such sites are likely to have been both frequently visited and subject to post-raid checks for evidence of UXO.*	The wartime access to the residential and commercial properties situated on site is generally considered to have been frequent. Furthermore, the site's urbanised environment and surrounds may have provided open areas within and around the proposed site, which are generally considered to have been infrequently accessed, with a degree of monitor. Although, it should be noted that evacuation protocol may have been initiated following bombing incidents in the immediate vicinity of the site.
Ground Cover *The nature of the ground cover present during WWII would have a substantial influence on any visual indication that may indicate UXO being present.*	Ground conditions throughout the site boundary are considered to have been conducive to the detection of UXO. Obvious signs of UXO, such as unaccounted for damage and entry holes, are likely to have been easily spotted amongst the properties and in residential garden areas. Although, the discovery of UXO in the rear gardens of properties would generally rely on the vigilance of individual residents.

Bomb Failure Rate	There is no evidence to suggest that the bomb failure rate in the locality of the site would have been dissimilar to the 10% normally used.
Abandoned Bombs	1st Line Defence holds no records of abandoned bombs at or within the site vicinity.
Bombing Decoy sites	1st Line Defence could find no evidence of bombing decoy sites within the site vicinity.
Bomb Disposal Tasks	1st Line Defence could find no evidence of bomb disposal tasks within the site boundary and immediate area.

12. Introduction to Allied Explosive Ordnance

12.1. General

Many areas across the UK may be at risk from Allied UXO because of both wartime and peacetime military use. Typical military activities and uses that may have led to a legacy of military UXO at a site include former minefields, home guard positions, anti-aircraft emplacements, training and firing ranges, military camps, as well as weapons manufacture and storage areas.

Although land formerly used by the military were usually subject to clearance before they returned to civilian use, items of UXO are sometimes discovered and can present a potential risk to construction projects.

It should be highlighted that there is no evidence that the site formerly had any military occupation or usage that could have led to contamination with such items of Allied ordnance. Despite this, urban areas such as the location of the site, can however be at risk from buried unexploded anti-aircraft projectiles fired during WWII – as addressed below.

12.2. Defending the UK From Aerial Attack

During WWII the War Office employed a number of defence tactics against the Luftwaffe from bombing major towns, cities, manufacturing areas, ports and airfields. These can be divided into passive and active defences (examples are provided in the table below).

Active Defences	Passive Defences
• Anti-aircraft gun emplacements to engage enemy aircraft. • Fighter aircraft to act as interceptors. • Rockets and missiles were used later during WWII.	• Blackouts and camouflaging to hinder the identification of Luftwaffe targets. • Decoy sites were located away from targets and used dummy buildings and lighting to replicate urban, military, or industrial areas. • Barrage balloons forced enemy aircraft to greater altitudes. • Searchlights were often used to track and divert adversary bomber crews during night raids.

Active defences such as anti-aircraft artillery present a greater risk of UXO contamination than passive defences. Unexploded ordnance resulting from dogfights and fighter interceptors is rarely encountered and difficult to accurately qualify.

12.2.1. Anti-Aircraft Artillery (AAA)

During WWII three main types of gun sites existed: heavy anti-aircraft (HAA), light anti-aircraft (LAA) and 'Z' batteries (ZAA). If the projectiles and rockets fired from these guns failed to explode or strike an aircraft they would descend back to land. The table below provides further information on the operation and ordnance associated with these type of weapons.

Anti-Aircraft Artillery				
Item	**Description**			
HAA	These large calibre guns such as the 3.7" QF (Quick Firing) were used to engage high flying enemy bombers, They often fired large HE projectiles, which were usually initiated by integral fuzes triggered by impact, area, time delay or a combination of aforementioned mechanisms.			
LAA	These mobile guns were intended to engage fast, low flying aircraft. They were typically rotated between locations on the perimeters of towns and strategically important industrial works. As they could be moved to new positions with relative ease when required, records of their locations are limited. The most numerous of these were the 40mm Bofors gun which could fire up to 120 x 40mm HE projectiles per minute to over 1,800m.			
Variations in HAA and LSA Ammunition	**Gun type**	**Calibre**	**Shell Weight**	**Shell Dimensions**
	3.0 Inch	76mm	7.3kg	76mm x 356mm
	3.7 Inch	94mm	12.7kg	94mm x 438mm
	4.5 Inch	114mm	24.7kg	114mm x 578mm
	40mm	40mm	0.9kg	40mm x 311mm
Z-AA	The three inch unrotated rocket/projectile known as the UP-3 had initially been developed for the Royal Navy. The UP-3 was also used in ground-based single and 128-round launchers known as ''Z'' batteries. The rocket, containing a high explosive warhead was often propelled by cordite.			

The closest recorded HAA to the site was located approximately 1.65km west of the site. However, the range of a projectile can be up to 15km. The site would also have been in range of mobile light anti-aircraft guns.

The conditions in which anti-aircraft projectiles may have fallen unnoticed within a site area are analogous to those regarding aerial delivered ordnance. Unexploded anti-aircraft projectiles could essentially have fallen indiscriminately anywhere within range of the guns. The chance of such items being observed, reported and removed during the war depends on factors such as land use, ground cover, damage and frequency of access – the same factors that govern whether evidence of a UXB is likely to have been noted. More information about these factors with regards to this particular site can be found in the German Aerial Delivered Ordnance section of this report.

Illustrations of Anti-Aircraft artillery, projectiles and rockets are presented at **Annex T**.

13. The Likelihood of Contamination from Allied Ordnance

13.1. Introduction

When undertaking construction work within or immediately adjacent to a site with previous and/or current military use, it is often considered likely to contain an elevated risk of contamination from Allied UXO. This assumption of risk is based on the following reasoning:

- The clearance of ordnance from military camps, depots, storage facilities, ranges and training areas were not always effectively managed, or undertaken to equivalent degrees of certainty. In addition, search and detection equipment used over seventy years ago following WWII has proved ineffective both for certain types of UXO and at depths beyond capability.
- In the vast majority of cases, explosive ordnance would have been stored and available for use at military installations. Ordnance ranged from small arms and land service ammunition to weapons components and larger, aerial delivered items. During periods of heightened activity, ordnance was also frequently lost in transit, particularly between stores and assigned training locations.
- The military generally did not anticipate that their land would be later sold for civilian development, and consequently appropriate ordnance disposal procedure was not always adhered to. It was not uncommon for excess or unwanted ordnance to be buried or burnt within the perimeters of a military establishment as a means of disposal. Records of such practice were rarely kept.

There are several factors that may serve to either affirm, increase, or decrease the level of risk within a site with a history of military usage. Such factors are typically dependent upon the proximity of the proposed area of works to training activities, munition productions and storage, as well as its function across the years.

This section will examine the history of the proposed site and assess to what degree, if any, the site could have become contaminated as a result of the military use of the surrounding area.

13.2. Evaluation of Contamination Risk from Allied UXO

1st Line Defence has considered the following potential sources of Allied ordnance contamination:

Sources of Allied UXO Contamination	Conclusion
Military Camps *Military camps present an elevated risk from ordnance simply due to the large military presence and likelihood of associated live ordnance training.*	1st Line Defence could find no evidence of a military camp within the site.
Anti-Aircraft Defences *Anti-Aircraft defences were employed across the country. Proximity to anti-aircraft defences increases the chance of encountering AA projectiles.*	1st Line Defence could find no evidence of Anti-Aircraft defences such as a HAA or LAA gun emplacement occupying or bordering the site. The closest HAA was located approximately 1.65km west of the site. However, the range of a projectile can be up to 15km. The conditions in which HAA or LAA projectiles may have fallen unnoticed within a site footprint are analogous to those regarding German aerial delivered ordnance.

Home Guard Activity *The Home Guard regularly undertook training and ordnance practice in open areas, as well as burying ordnance as part of anti-invasion defences.*	1st Line Defence has no evidence of any Home Guard activities on the site.
Defensive Positions *Defensive positions suggest the presence of military activity, which is often indicative of ordnance storage, usage or disposal.*	There is no evidence of any defensive features formerly located on or bordering the site footprint.
Training or firing ranges *Areas of ordnance training saw historical ordnance usage in large numbers, often with inadequate disposal of expended and live items. The presence of these ranges significantly impact on the risk of encountering items of ordnance in their vicinity.*	There is no evidence of such features affecting the site.
Defensive Minefields *Minefields were placed in strategic areas to defend the country in the event of a German invasion. Minefields were not always cleared with an appropriate level of vigilance.*	There is no evidence of defensive minefields affecting the site.
Ordnance Manufacture *Ordnance manufacture indicates an increased chance that items of ordnance were stored, or disposed of, within a location.*	No information of ordnance being stored, produced, or disposed of within the proposed site could be found.
Military Related Airfields *Military airfields present an elevated risk from ordnance simply due to the large military presence and likelihood of associated live ordnance training or bombing practice.*	The site was not situated within the perimeters or vicinity of a military airfield.

14. The Likelihood of UXO Contamination Summary

The following table assesses the likelihood that the site was contaminated by items of German aerial delivered and Allied ordnance. Factors such as the risk of UXO initiation, remaining, and encountering will be discussed later in the report.

UXO Contamination Summary	
Quality of the Historical Record	The research has evaluated pre- and post-WWII Ordnance Survey maps, Luftwaffe reconnaissance imagery, pre-war oblique imagery, Home Office bombing statistics, WWII bomb census mapping, incident reports for Acton, MCC incident records, MCC war damage mapping and post-WWII high-resolution aerial imagery. The record set is of generally good quality; several sources are corroborative of one another regarding the location of bombing incidents in the site's surrounds and the damage recorded.
German Aerial Delivered Ordnance	• During WWII, the site was situated within the Municipal Borough of Acton. Home Office statistics suggest that Acton sustained an overall very-high density of bombing, with an average of 162.6 items of ordnance recorded per 1,000 acres. OS mapping indicates the site to have predominantly comprised a mixture of residential and commercial properties during WWII. Bombing in Acton can primarily be attributed to the borough's proximity to central London as well as Luftwaffe targets, such as the West Middlesex Waterworks located approximately 2.8km south-east of the boundary. • Consulted bomb census mapping records an incendiary bomb 'shower' over the site boundary on one occasion during WWII. There are no high explosive bombing incidents recorded within the proposed boundary or its immediate vicinity within consulted bomb census mapping or written incident records. The closest recorded high explosive incidents are plotted approximately 60m to the south and west of the boundary; these incidents are referenced in available written records and anecdotal accounts, which are consistent in describing the incidents and subsequent damage caused. • MCC war damage mapping does not attribute any serious damage to the residential properties on site. However, damage is recorded to the south and west of the boundary; this damage varies from 'seriously damaged; doubtful if repairable' and 'total damage, building to be demolished'. The war damage mapping is corroborated by post-war aerial photography, which indicates the two areas of damage to be in the general vicinity of the recorded incidents mentioned above (60m south and west of the boundary). • Whilst it should be noted that evacuation protocol may have been initiated following bombing incidents in the immediate vicinity of the site, the wartime access to the residential and commercial properties situated on site is generally considered to have been frequent owing to the lack of recorded damage. • Although open areas, such as the gardens and yards situated throughout the boundary, are generally considered to have been accessed based on the prudency of each resident, the site's urbanised environment and surrounds may have provided such open areas within and around the proposed site with more frequent access than initially anticipated. • Ground conditions throughout the site boundary are overall considered to have been favourable in the visual detection of UXO; obvious signs of UXO, such as unaccounted damage and entry holes, are thought likely to have been spotted amongst the residential properties. Whilst the open areas of the site, namely the residential gardens, are considered less conducive in comparison, the chance of an item of UXO going unnoticed is considered reduced in this case owing to the small size of the open areas. • To summarise, records do not indicate any bomb strikes to have occurred directly within the proposed site area. Incidents are recorded in the site's surrounds;

	however, these are considered too far removed to have been of any effect. Given the lack of positive evidence that suggests the site area experienced bombing, the risk is not considered to be high enough to warrant active risk mitigation measures.
Allied Ordnance	• There is no evidence that the site formerly had any military occupation or usage that could have led to contamination with items of Allied ordnance, such as LSA and SAA. The conditions in which HAA or LAA projectiles may have fallen unnoticed within the site boundary are however analogous to those regarding aerial delivered ordnance.

15. The Likelihood that UXO Remains

15.1. Introduction

It is important to consider the extent to which any explosive ordnance clearance (EOC) activities or extensive ground works have occurred on site. This may indicate previous ordnance contamination or reduce the risk that ordnance remains undiscovered.

15.2. UXO Clearance

1st Line Defence has found no evidence in the public domain or within internal records that any official ordnance clearance operations have taken place on site. Note however that we have not received confirmation of this fact from the 33 EOD Regiment Archive (now part of 29 Regt). It should also be noted that in addition to 29 Regt archival information, 1st Line Defence also do not currently have access to data that may be relevant including 5131(BD)SQN Archive, SD Training Technical Advisory Section (TAS) and MACA Records (bomb disposal callouts).

If such information is available at a later date, it is recommended that it be reviewed as it will assist with understanding both levels and types of contamination likely to be present, and may indicate risk reduction in certain areas.

15.3. Post-war Redevelopment

Post-war redevelopment has consisted of the clearance of all surviving wartime structures and the construction of residential apartment buildings in three locations across the boundary. The risk from deep-buried unexploded bombs is only considered mitigated at locations where post war piling or deep foundations have taken place.

16. The Likelihood of UXO Encounter

16.1. Introduction

For UXO to pose a risk at a site, there should be a means by which any potential UXO might be encountered on that site.

The likelihood of encountering UXO on the site of proposed would depend on various factors, such as the type of UXO that might be present and the intrusive works planned on site. In most cases, UXO is more likely to be present below surface (buried) than on surface.

In general, the greater the extent and depth of intrusive works, the greater the risk of encountering. The most likely scenarios under which items of UXO could be encountered during construction works is during piling, drilling operations or bulk excavations for basement levels. The overall risk will depend on the extent of the works, such as the numbers of boreholes/piles (if required) and the volume of the excavations.

16.2. Encountering Aerial Delivered Ordnance

Since an aerial delivered bomb may come to rest at any depth between just below ground level and its maximum penetration depth, there is a chance that such an item (if present) could be encountered during shallow excavations (for services or site investigations) into the original WWII ground level as well as at depth.

17. The Likelihood of UXO Initiation

17.1. Introduction

UXO does not spontaneously explode. Older UXO devices will require an external event/energy to create the conditions for detonation to occur. The likelihood that a device will function can depend on a number of factors including the type of weaponry, its age and the amount of energy it is struck with.

17.2. Initiating Aerial Delivered Ordnance

Unexploded bombs do not spontaneously explode. All high explosive filling requires significant energy to create the conditions for detonation to occur.

In recent decades, there have been a number of incidents in Europe where Allied UXBs have detonated, and incidents where fatalities have resulted (some examples are presented in **Annex H2**). There have been several hypotheses as to the reason why the issue is more prevalent in mainland Europe – reasons could include the significantly greater number of bombs dropped by the Allied forces on occupied Europe, the preferred use by the Allies of mechanical rather than electrical fuzes, and perhaps just good fortune. The risk from UXO in the UK is also being treated very seriously in many sectors of the construction industry, and proactive risk mitigation efforts will also have affected the lack of detonations in the UK.

There are certain construction activities which make initiation more likely, and several potential initiation mechanisms must be considered:

UXB Initiation	
Direct Impact	Unless the fuze or fuze pocket is struck, there needs to be a significant impact e.g. from piling or large and violent mechanical excavation, onto the main body of the weapon to initiate a buried iron bomb. Such violent action can cause the bomb to detonate.
Re- starting the Clock	A small proportion of German WWII bombs employed clockwork fuzes. It is probable that significant corrosion would have taken place within the fuze mechanism over the last 70+ years that would prevent clockwork mechanisms from functioning. Nevertheless, it was reported that the clockwork fuze in a UXB dealt with by 33 EOD Regiment in Surrey in 2002 did re-start.
Friction Impact	The most likely scenario resulting in the detonation of a UXB is friction impact initiating the shock-sensitive fuze explosive. The combined effects of seasonal changes in temperature and general degradation over time can cause explosive compounds to crystallise and extrude out from the main body of the bomb. It may only require a limited amount of energy to initiate the extruded explosive which could detonate the main charge.

18. Consequences of Initiation/Encounter

18.1. Introduction

The repercussions of the inadvertent detonation of UXO during intrusive ground works, or if an item or ordnance is interfered with or disturbed, are potentially profound, both in terms of human and financial cost. A serious risk to life and limb, damage to plant and total site shutdown during follow-up investigations are potential outcomes. However, if appropriate risk mitigation measures are put in place, the chances of initiating an item of UXO during ground works is comparatively low.

The consequences of encountering UXO can be particularly notable in the case of high-profile sites (such as airports and train stations) where it is necessary to evacuate the public from the surrounding area. A site may be closed for anything from a few hours to a week with potentially significant cost in lost time. It should be noted that even the discovery of suspected or possible item of UXO during intrusive works (if handled solely through the authorities), may also involve significant loss of production

18.2. Consequences of Detonation

When considering the potential consequences of a detonation, it is necessary to identify the significant receptors that may be affected. The receptors that may potentially be at risk from a UXO detonation on a construction site will vary depending on the site specific conditions but can be summarised as follows:

- People – site workers, local residents and general public.
- Plant and equipment – construction plant on site.
- Services – subsurface gas, electricity, telecommunications.
- Structures – not only visible damage to above ground buildings, but potentially damage to foundations and the weakening of support structures.
- Environment – introduction of potentially contaminating materials.

19. 1st Line Defence Risk Assessment

19.1. Risk Assessment Stages

Taking into account the quality of the historical evidence, the assessment of the overall risk from unexploded ordnance is based on the following five considerations:

1. That the site was contaminated with unexploded ordnance.
2. That unexploded ordnance remains on site.
3. That such items will be encountered during the proposed works.
4. That ordnance may be initiated by the works operations.
5. The consequences of encountering or initiating ordnance.

19.2. Assessed Risk Level

1st Line Defence has assessed that there is an overall **Low Risk** from German and anti-aircraft unexploded ordnance at the site of proposed works. There is also an assessed **Negligible Risk** from Allied ordnance.

Ordnance Type	Risk Level			
	Negligible	Low	Medium	High
German Unexploded HE Bombs		✓		
German 1kg Incendiary Bombs		✓		
Allied Anti-Aircraft Artillery Projectiles		✓		
Allied Land Service and Small Arms Ammunition	✓			

Please note – although the risk from unexploded ordnance on this site has been assessed as 'Low', this does not mean there is 'no' risk of encountering UXO. This report has been undertaken with due diligence, and all reasonable care has been taken to access and analyse relevant historical information. By necessity, when dealing historical evidence, and when making assessments of UXO risk, various assumptions have to be made which we have discussed and justified throughout this report. Our reports take a common-sense and practical approach to the assessment of risk, and we strive to be reasonable and pragmatic in our conclusions.

It should however be stressed that if any suspect items are encountered during the proposed works, 1st Line Defence should be contacted for advice/assistance, and to re-assess the risk where necessary. The mitigation measures outlined in the next section are recommended as a minimum precaution to alert ground personnel to the history of the site, what to look out for, and what measures to take in the event that a suspect item is encountered. It should also be noted that the conclusions of this report are based on the scope of works outlined in the 'Proposed Works' section of this report. Should the scope of works change or additional works be proposed, 1st Line Defence should be contacted to re-evaluate the risk.

20. Proposed Risk Mitigation Methodology

20.1. General

The following risk mitigation measures are recommended to support the proposed works at the Acton Gardens Phases 8.1 & 8.2 site:

Type of Work	Recommended Mitigation Measure
All Works	• **UXO Risk Management Plan** It is recommended that a site-specific plan for the management of UXO risk be written for this site. This plan should be kept on site and be referred to in the event that a suspect item of UXO is encountered at any stage of the project. It should detail the steps to be taken in the event of such a discovery, considering elements such as communication, raising the alarm, nominated responsible persons etc. Contact 1st Line Defence for help/more information. • **Site Specific UXO Awareness Briefings to all personnel conducting intrusive works.** As a minimum precaution, all personnel working on the site should be briefed on the basic identification of UXO and what to do in the event of encountering a suspect item. This should in the first instance be undertaken by a UXO Specialist. Posters and information on the risk of UXO can be held in the site office for reference.

In making this assessment and recommending these risk mitigation measures, if known, the works outlined in the 'Scope of the Proposed Works' section were considered. Should the planned works be modified or additional intrusive engineering works be considered, 1st Line Defence should be consulted to see if a re-assessment of the risk or mitigation recommendations is necessary.

1st Line Defence Limited **23rd March 2020**

This Report has been produced in compliance with the Construction Industry Research and Information Association (CIRIA) C681 guidelines for the writing of Detailed UXO Risk Assessments.

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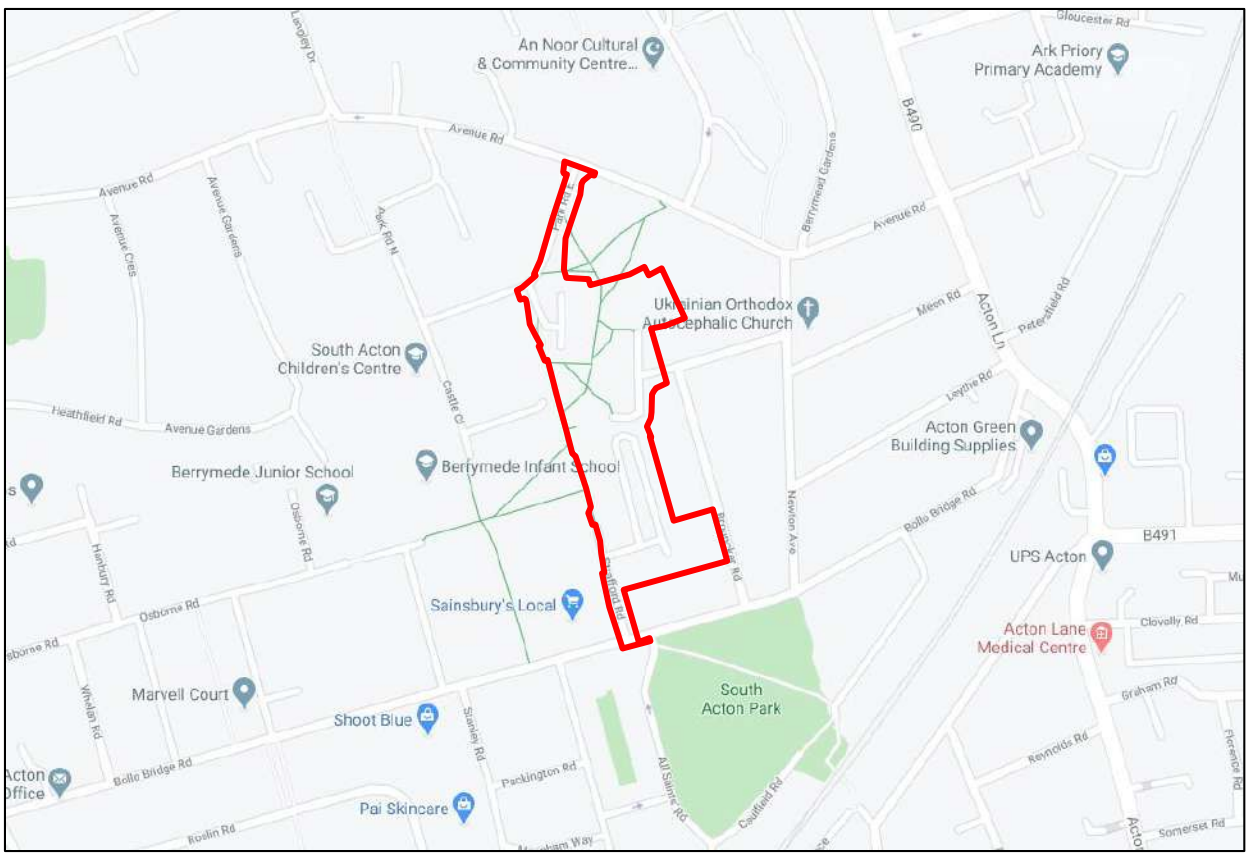
This report has been prepared by 1st Line Defence Limited with all reasonable care and skill. The report contains historical data and information from third party sources. 1st Line Defence Limited has sought to verify the accuracy and comprehensiveness of this information where possible but cannot be held accountable for any inherent errors. Furthermore, whilst every reasonable effort has been made to locate and access all relevant historical information, 1st Line Defence cannot be held responsible for any changes to risk level or mitigation recommendations resulting from documentation or other information which may come to light at a later date.

Site Location Maps

Annex: **A**



1ST LINE DEFENCE

Unit 3, Maple Park
Essex Road, Hoddesdon,
Hertfordshire. EN11 0EX
Email: info@1stlinedefence.co.uk
Tel: +44 (0)1992 245 020

Client: **Curtins**

Approximate site boundary

N

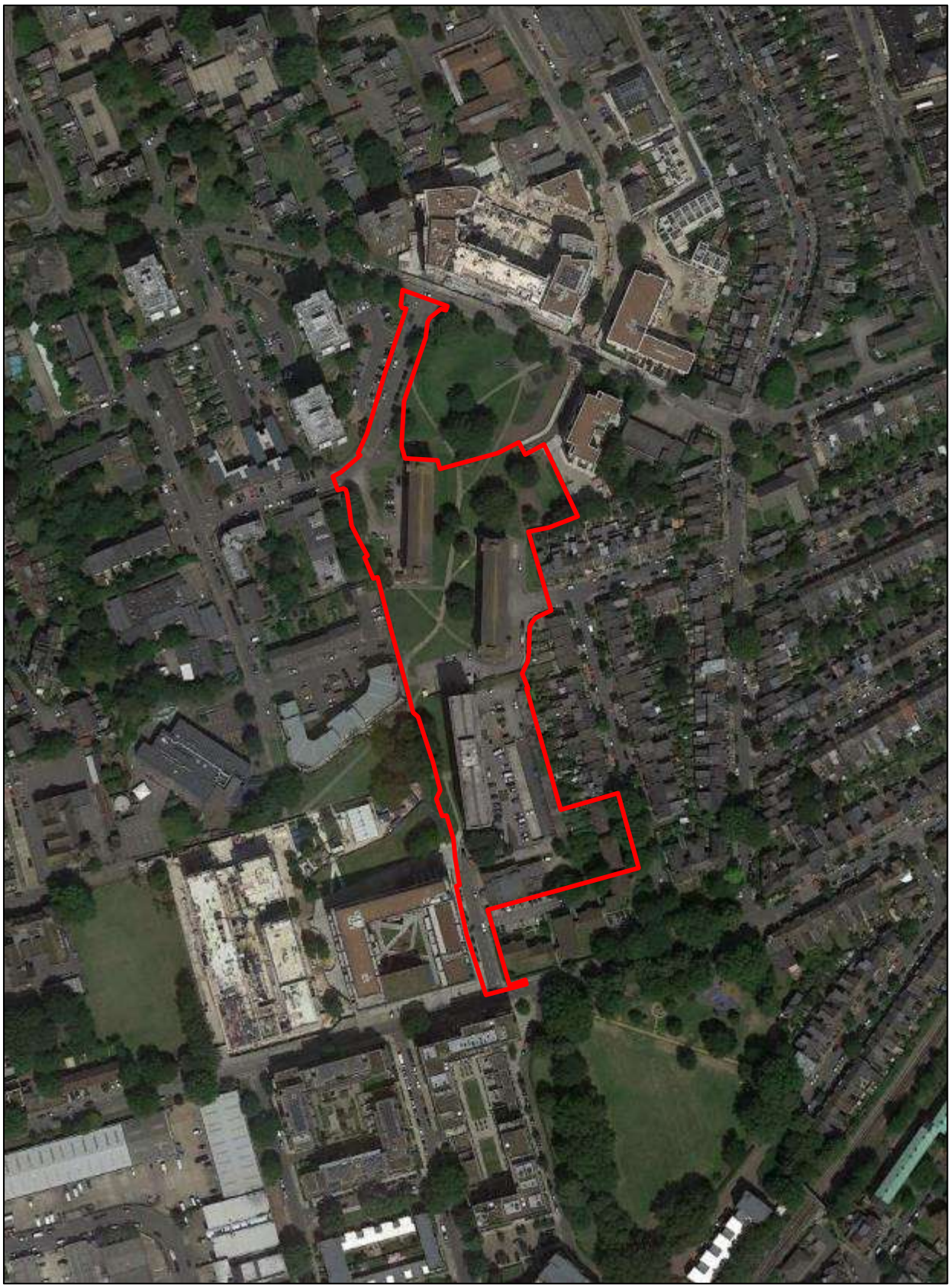
Project: **Acton Gardens Phases 8.1 &.2**

Ref: **DA9817-00**

Source: Google Maps

Recent Aerial Photography

Annex: **B**



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Hertfordshire. EN11 0EX
Email: info@1stlinedefence.co.uk
Tel: +44 (0)1992 245 020

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Project: **Acton Gardens Phases 8.1 &.2**

Ref: **DA9817-00**

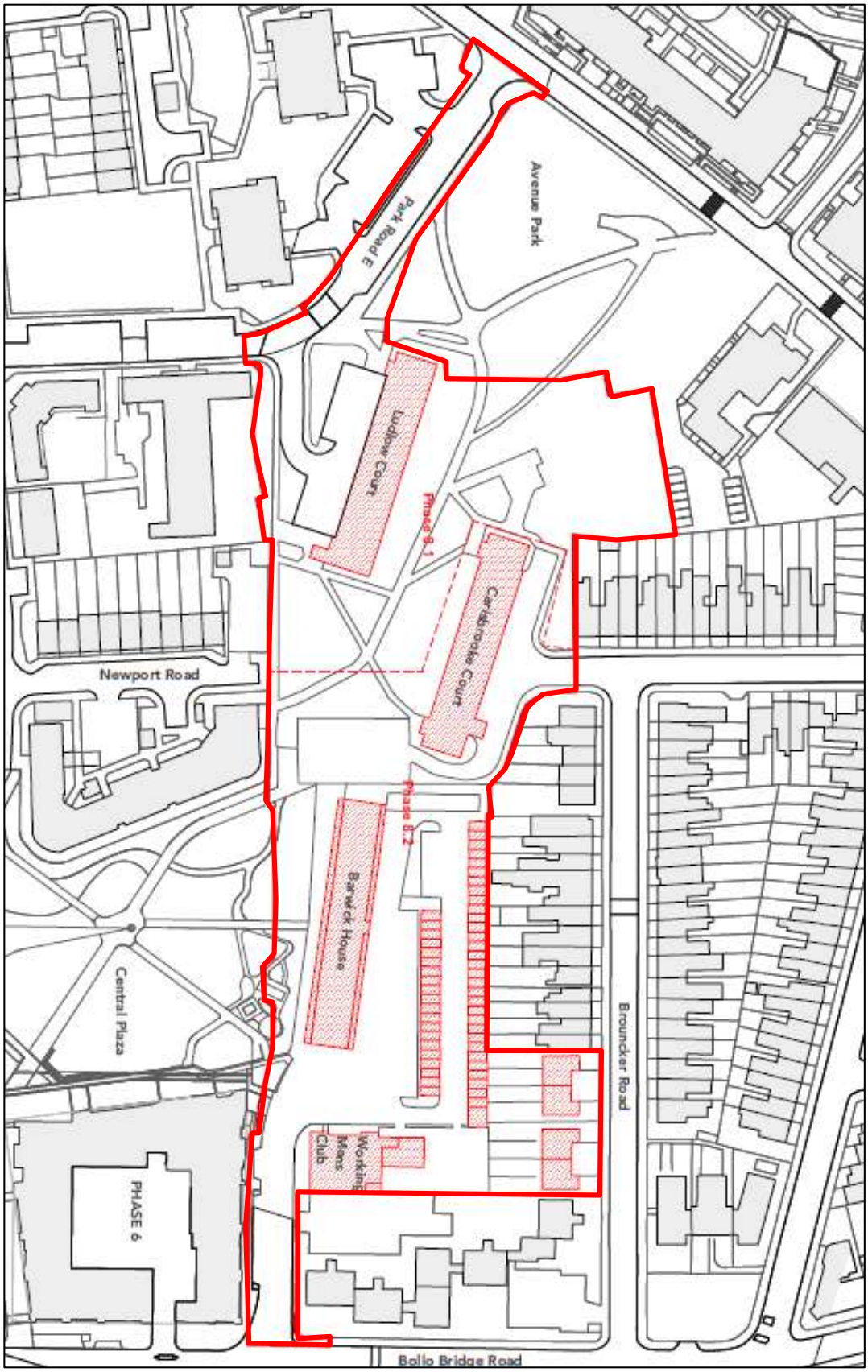
Source: Google Earth ™ Mapping Services

Approximate site boundary

N

Client Provided Site Plan

Annex: C



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Email: info@1stlinedefence.co.uk
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Project: **Acton Gardens Phases 8.1 &.2**

Ref: **DA9817-00**

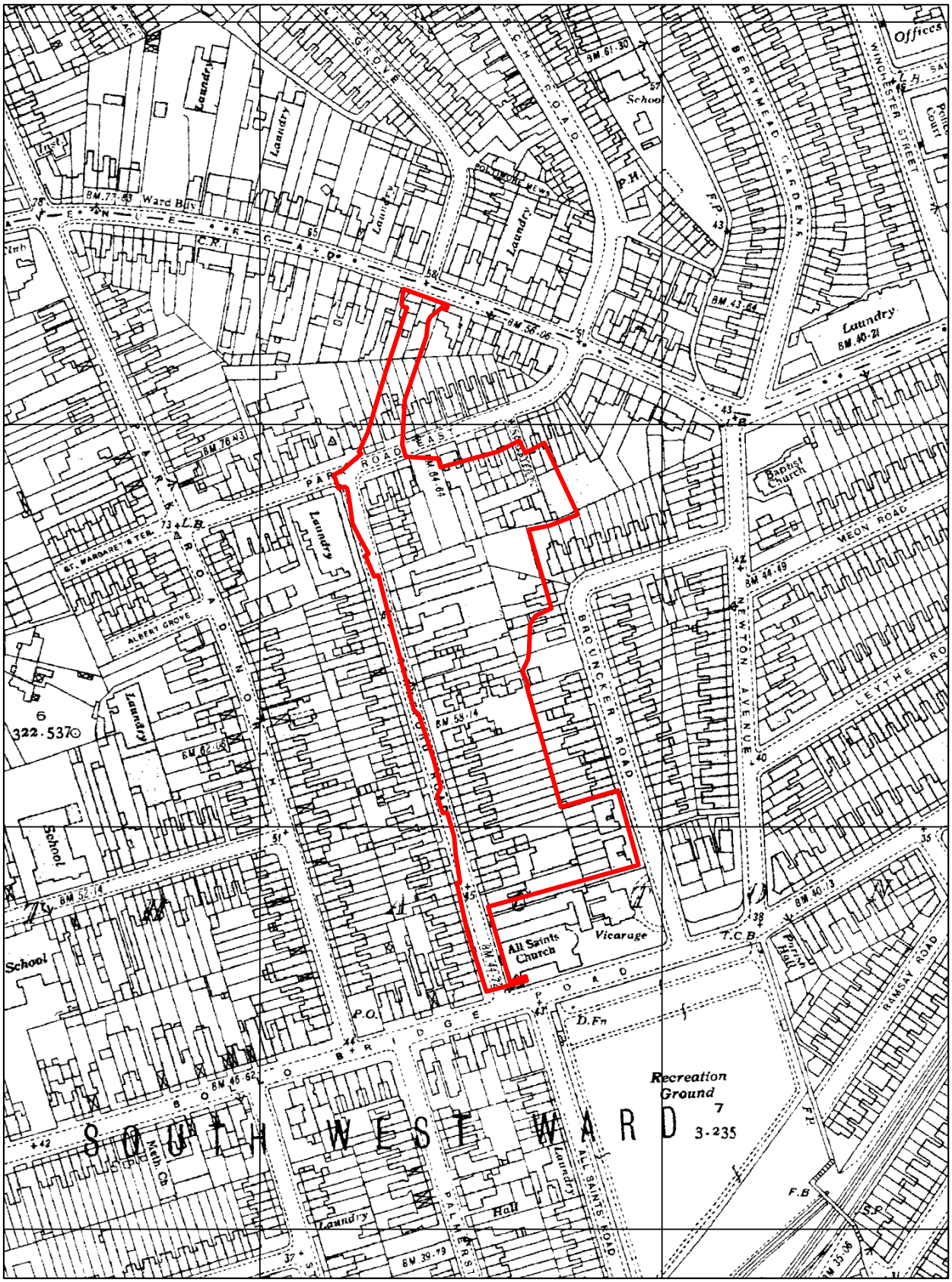
Source: Curtins

Approximate site boundary

N

1934 – 1935 Historical Map

Annex: **D1**



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Hertfordshire. EN11 0EX
Email: info@1stlinedefence.co.uk
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Project: **Acton Gardens Phases 8.1 &.2**

Ref: **DA9817-00**

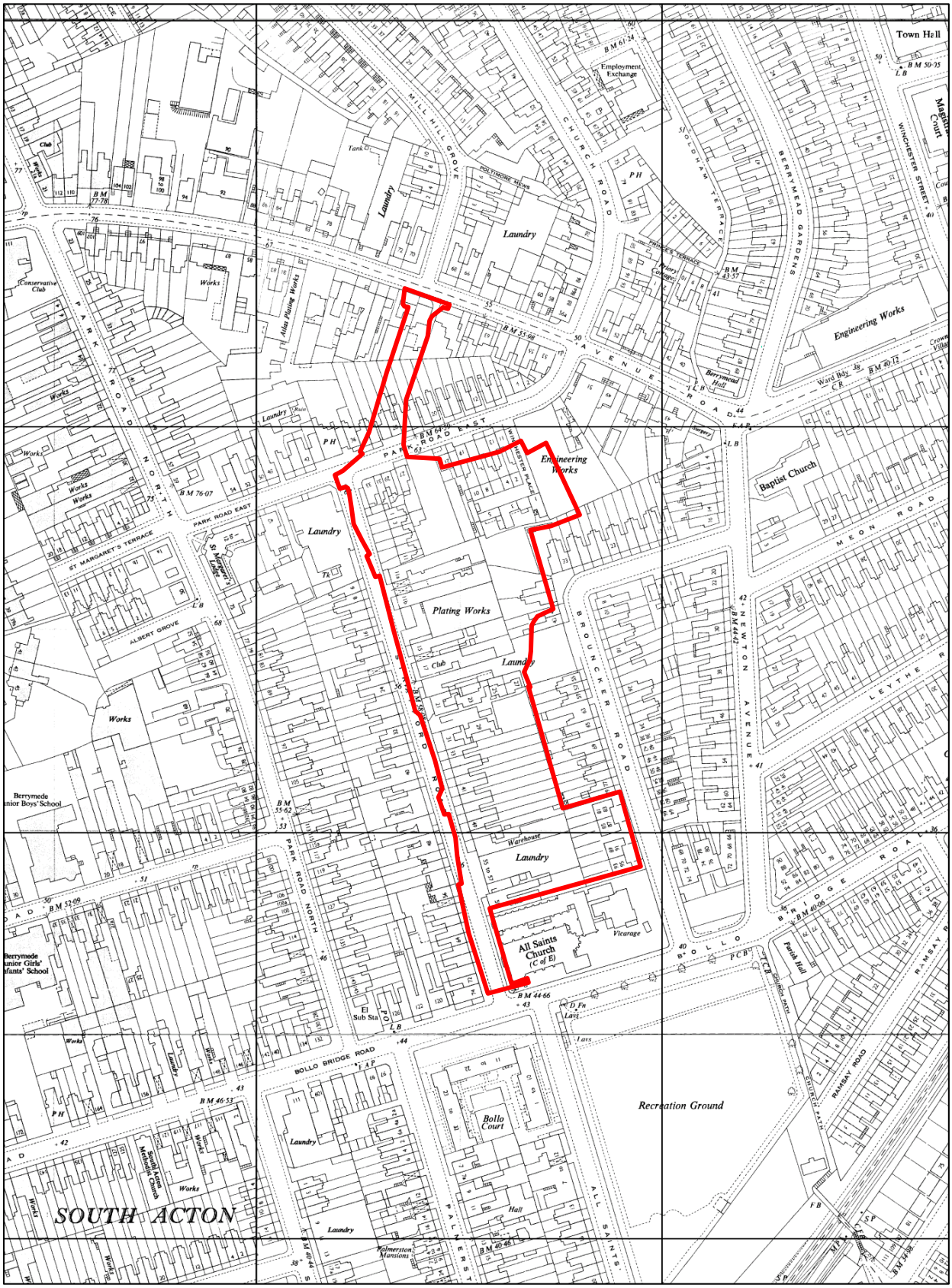
Source: Landmark Maps

Approximate site boundary

N

1954 – 1960 Historical Map

Annex: **D2**



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Unit 3, Maple Park
Essex Road, Hoddesdon,
Hertfordshire. EN11 0EX
Email: info@1stlinedefence.co.uk
Tel: +44 (0)1992 245 020

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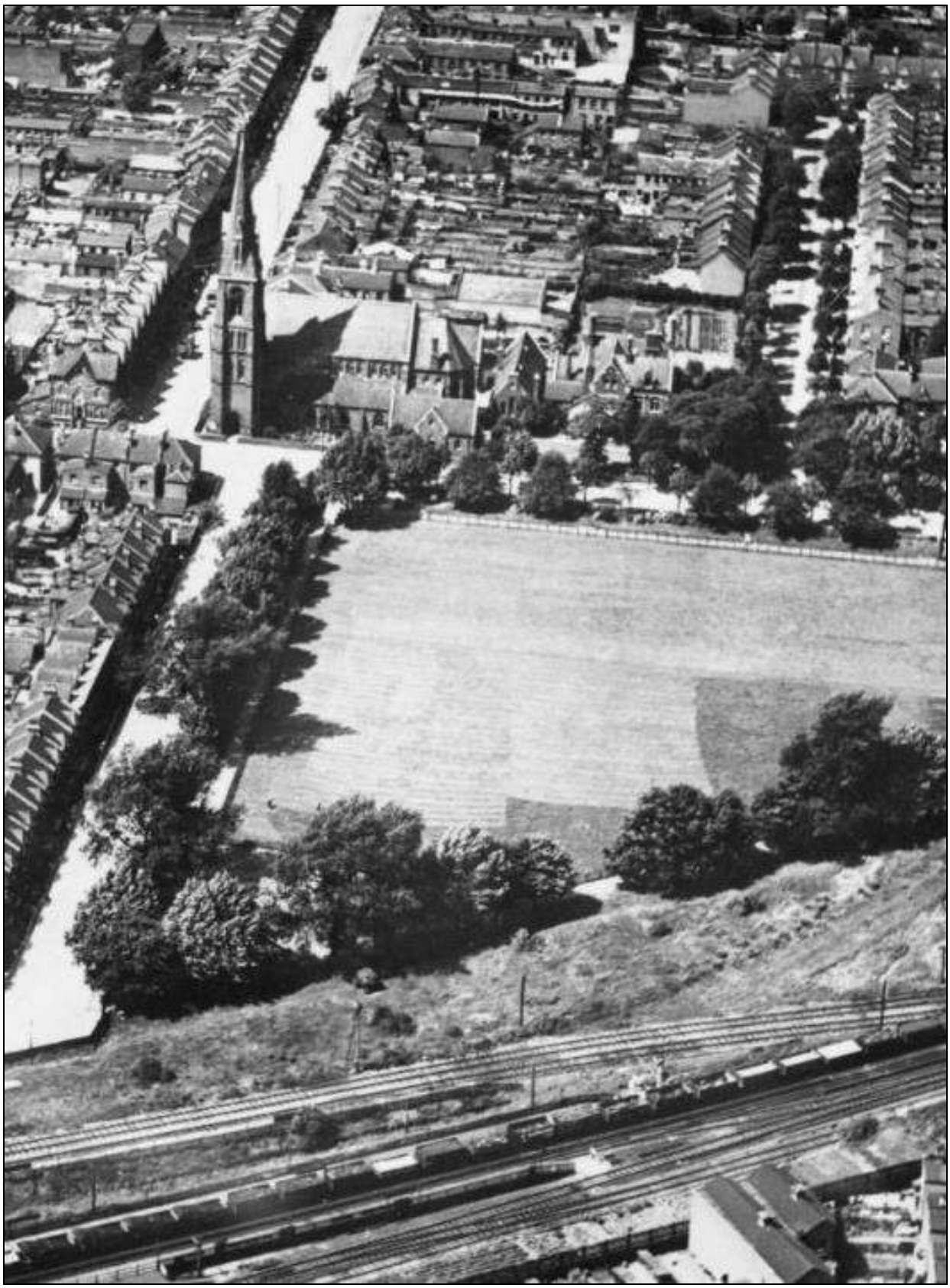
Ref: **DA9817-00**

Source: Landmark Maps

Approximate site boundary

N

EPW010774 ENGLAND (1924). All Saints' Church and the Recreation Ground, South Acton, 1924.



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Hertfordshire. EN11 0EX
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Approximate site boundary

N

Project: **Acton Gardens Phases 8.1 &.2**

Ref: **DA9817-00**

Source: Britain From Above

EPW059942 – A Cityscape, Acton, 1938.

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Unit 3, Maple Park
Essex Road, Hoddesdon,
Hertfordshire. EN11 0EX
Email: info@1stlinedefence.co.uk
Tel: +44 (0)1992 245 020

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Approximate site boundary

Project: **Acton Gardens Phases 8.1 &.2**

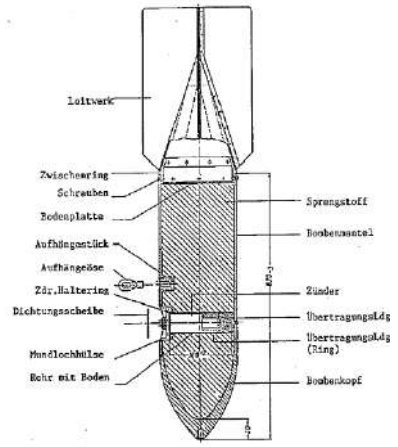
Ref: **DA9817-00**

Source: Britain From Above

Examples of German Air-Delivered Ordnance

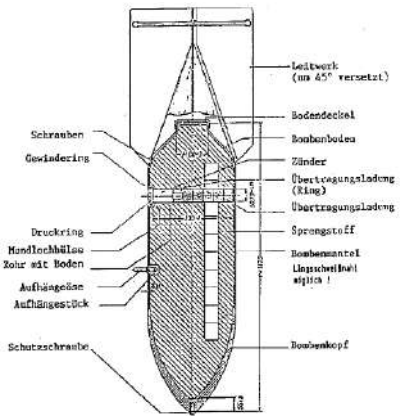
SC 50kg High Explosive Bomb

Bomb Weight	40-54kg (88-119lb)
Explosive Weight	25kg (55lb)
Fuze Type	Impact fuze/electro-mechanical time delay fuze
Bomb Dimensions	1,090 x 280mm (42.9 x 11.0in)
Body Diameter	200mm (7.87in)
Use	Against lightly damageable materials, hangars, railway rolling stock, ammunition depots, light bridges and buildings up to three stories.
Remarks	The smallest and most common conventional German bomb. Nearly 70% of bombs dropped on the UK were 50kg.



SC 250kg High Explosive Bomb

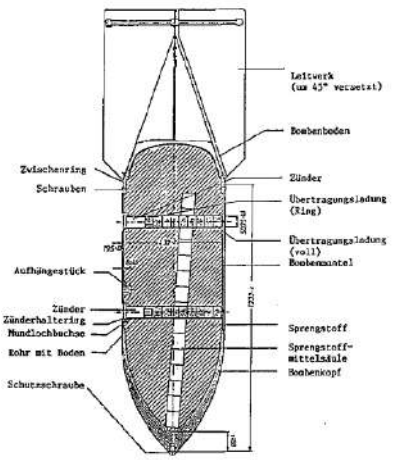
Bomb Weight	245-256kg (540-564lb)
Explosive Weight	125-130kg (276-287lb)
Fuze Type	Electrical impact/mechanical time delay fuze.
Bomb Dimensions	1640 x 512mm (64.57 x 20.16in)
Body Diameter	368mm (14.5in)
Use	Against railway installations, embankments, flyovers, underpasses, large buildings and below-ground installations.
Remarks	It could be carried by almost all German bomber aircraft, and was used to notable effect by the Junkers Ju-87 Stuka (Sturzkampfflugzeug or dive-bomber).

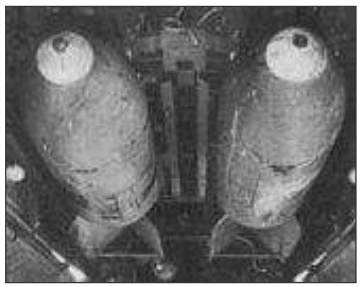


SC250 bomb being loaded onto German bomber

SC 500kg High Explosive Bomb

Bomb Weight	480-520kg (1,058-1,146lb)
Explosive Weight	250-260kg (551-573lb)
Fuze Type	Electrical impact/mechanical time delay fuze.
Bomb Dimensions	1957 x 640mm (77 x 25.2in)
Body Diameter	470mm (18.5in)
Use	Against fixed airfield installations, hangars, assembly halls, flyovers, underpasses, high-rise buildings and below-ground installations.
Remarks	40/60 or 50/50 Amatol TNT, trialene. Bombs recovered with Trialen filling have cylindrical paper wrapped pellets 1-15/16 in. in length and diameter forming





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Essex Road, Hoddesdon,
Hertfordshire. EN11 0EX
Email: info@1stlinedefence.co.uk
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Project: **Acton Gardens Phases 8.1 &.2**

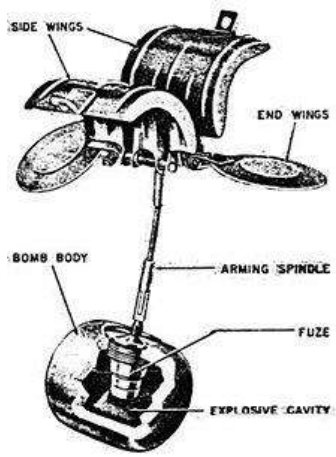
Ref: **DA9817-00**

Source: Various sources

Examples of German Air-Delivered Ordnance

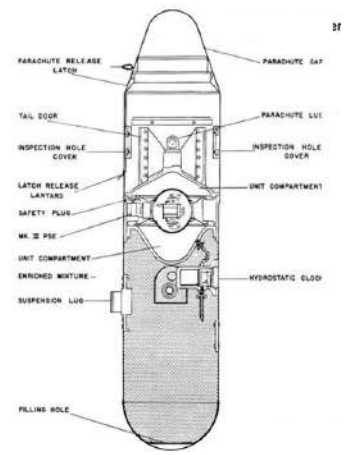
SD2 Anti-Personnel 'Butterfly Bomb'

Bomb Weight	Approx. 2kg (4.41lb)
Explosive Weight	Approx. 7.5oz (225 grams) of Amatol surrounded by a layer of bituminous composition.
Fuze Type	41 fuze (time) , 67 fuze (clockwork time delay) or 70 fuze (anti-handling device)
Body Diameter	3in (7.62 cm) diameter, 3.1in (7.874) long
Use	Designed as an anti-personnel/ fragmentation weapon. They were delivered by air, being dropped in containers of 23-144 sub-munitions that opened at a predetermined height, thus scattering the bombs.
Remarks	Very rare. First used against Ipswich in 1940, but were also dropped on Kingston upon Hull, Grimsby and Cleethorpes in June 1943, amongst various other targets in UK. As the bombs fell the outer case flicked open by springs which caused four light metal drogues with a protruding 5 inch steel cable to deploy in the form of a parachute & wind vane which armed the device as it span.



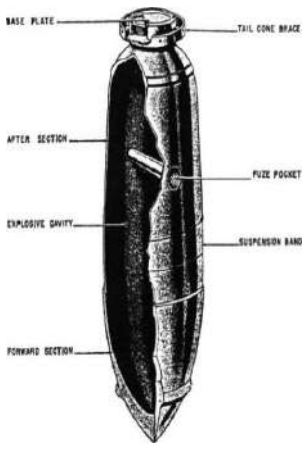
Parachute Mine (Luftmine B / LMB)

Bomb Weight	Approx. 990kg (2176lb)
Explosive Weight	Approx. 705kg (1,554lb)
Fuze Type	Impact/ Time delay / hydrostatic pressure fuze
Dimensions	2.64m x 0.64m (3.04m with parachute housing)
Use	Against civilian, military and industrial targets. Used as blast bombs and designed to detonate above ground level to maximise damage to a wider area.
Remarks	Deployed a parachute when dropped in order to control its descent. Had the potential to cause extensive damage in a 100m radius.



SC 1000kg

Bomb Weight	Approx. 993-1027kg (2,189-2,264lb)
Explosive Weight	Approx. 530-620kg (1168-1367lb)
Fuze Type	Electrical impact/mechanical time delay fuze.
Filling	Mixture of 40% amatol and 60% TNT, but when used as an anti-shipping bomb it was filled with Trialen 105, a mixture of 15% RDX, 70% TNT and 15% aluminium powder.
Bomb Dimensions	2800 x 654mm (110 x 25.8in)
Body Diameter	654mm (18.5in)
Use	SC type bombs are General Purpose Bombs used primarily for general demolition work. Constructed of parallel walls with comparatively heavy noses. They are usually of three piece welded construction



1ST LINE DEFENCE

Unit 3, Maple Park
Essex Road, Hoddesdon,
Hertfordshire. EN11 0EX
Email: info@1stlinedefence.co.uk
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Project: **Acton Gardens Phases 8.1 &.2**

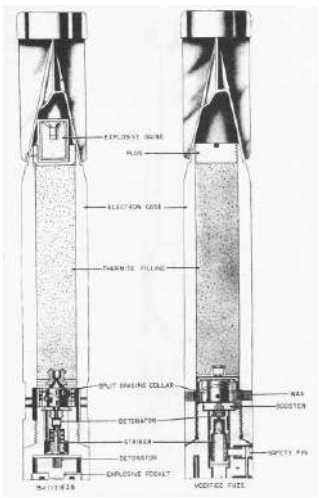
Ref: **DA9817-00**

Source: Various sources

German Incendiary Bombs

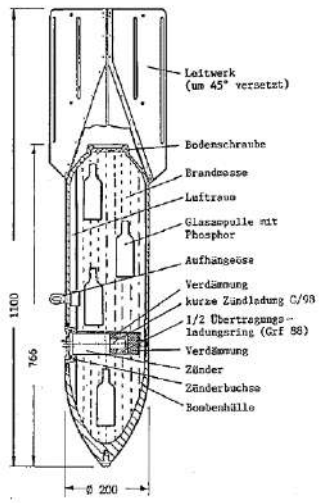
1kg Incendiary Bomb

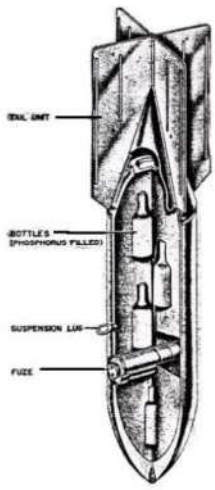
Bomb Weight	Approx. 1.0 - 1.3kg (2.2 and 2.9lb)
Explosive Weight	Approx. 680g (1.5lb) Thermite 8-15gm Explosive Nitropenta
Fuze Type	Impact fuze
Bomb Dimensions	350 x 50mm (13.8 x 1.97in)
Body Diameter	50mm (1.97in)
Use	As incendiary – dropped in clusters on towns and industrial complexes
Remarks	Magnesium alloy case. Sometimes fitted with high explosive charge. The body is a cylindrical alloy casting threaded internally at the nose to receive the fuze holder and fuze.



C50 A Incendiary Bomb

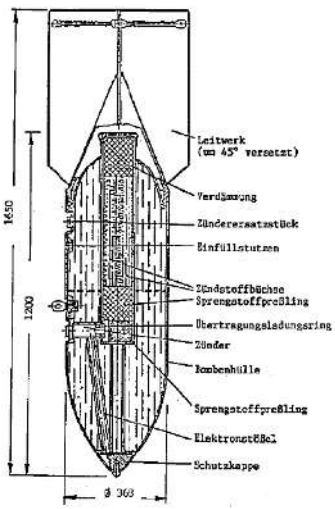
Bomb Weight	Approx. 41kg (90.4lb)
Explosive Weight	Approx. 0.03kg (0.066lb)
Incendiary Filling	12kg (25.5lb) liquid filling with phosphor igniters in glass phials. Benzine 85%; Phosphorus 4%; Pure Rubber 10%
Fuze Type	Electrical impact fuze
Bomb Dimensions	1,100 x 280mm (43.2 x 8in)
Use	Against any targets where an incendiary effect is required
Remarks	Early fill was a phosphorous/carbon disulphide incendiary mixture





Flam C-250 Oil Bomb

Bomb Weight	Approx. 125kg (276lb)
Explosive Weight	Approx. 1kg (2.2lb)
Fuze Type	Super-fast electrical impact fuze
Filling	Mixture of 30% petrol and 70% crude oil
Bomb Dimensions	1,650 x 512.2mm (65 x 20.2in)
Body Diameter	368mm (14.5in)
Use	Often used for surprise attacks on ground troops, against troop barracks and industrial installations. Thin casing – not designed for ground penetration



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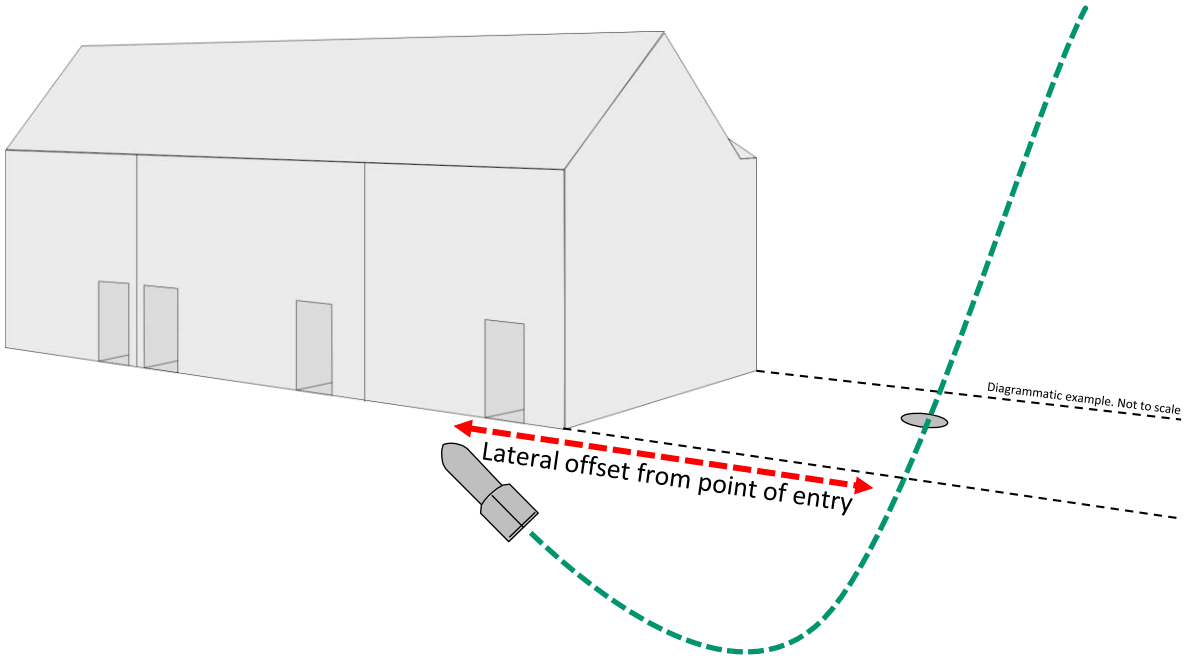
Unit 3, Maple Park
Essex Road, Hoddesdon,
Hertfordshire. EN11 0EX
Email: info@1stlinedefence.co.uk
Tel: +44 (0)1992 245 020

Client: **Curtins**

Project: **Acton Gardens Phases 8.1 &.2**

Ref: **DA9817-00**

Source: Various sources



Top: J-curve Effect - Due to angle of entry, unexploded bombs would often end their trajectory at a lateral offset from point of entry, often ending up beneath adjacent extant structures/sites. The photograph above shows 250kg bomb found in Bermondsey pointing upwards, demonstrating ‘J-curve’

One of the most common scenarios for UXO going unnoticed was when a UXB fell into a ‘bomb site’ (such as the area shown **Top Left**), the entry hole of the bomb obscured by any debris and rubble present. Note that the entry hole of a 50kg UXB could be as little as 20cm in diameter (**Left**).

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Ref: **DA9817-00**

Source: Various sources

Recent Unexploded Bomb Finds, UK

BBC NEWS

Bermondsey bomb: World War Two device safely removed

An unexploded World War Two bomb found in south London has been driven away safely under police and Army escort.

The 500lb (250kg) device was found on a building site in Grange Walk, Bermondsey on Monday.

March 2015

BBC NEWS

Bethnal Green WW2 bomb: Experts remove unexploded device

An unexploded World War Two bomb that prompted the evacuation of 700 people in east London has been made safe and removed by the military.

Families spent the night in a school hall after the 500lb bomb was found in the basement of a building site on Temple Street, in Bethnal Green, on Monday afternoon.

A 200m (650ft) exclusion zone was set up around the device.

August 2016

BBC NEWS

Bath WW2 bomb scare: Device defused, police say

A 500lb World War Two bomb found on the site of a former school in Bath has been defused and made safe.

The discovery of the bomb on Thursday **led to the evacuation of hundreds of homes** and many road closures in the Lansdown area of the city.

A cordon around the site was lifted on Friday evening, more than 24 hours after residents were asked to leave their homes.

May 2016

BBC NEWS

London City Airport reopens after WW2 bomb moved

London City Airport has reopened after an unexploded 500kg World War Two bomb was safely moved from the area.

The device was discovered at the King George V Dock on Sunday during planned work at the east London airport.

All flights were cancelled on Monday after an exclusion zone was put in place, **with the closure affecting up to 16,000 passengers and nearby residents being evacuated from their homes.**

May 2015

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Ref: **DA9817-00**

Source: BBC News

Examples of Unexpected Detonation of WWII Bombs

Annex: H2

BASF has confirmed that an explosive device, most likely a World War II-era bomb, caused the blast that left one person injured Tuesday at a plant construction site in Germany.

The explosion was reported at BASF's Ludwigshafen toluene diisocyanate (TDI) plant, which recently broke ground for a 300,000 metric tons per year TDI production plant and other construction to expand its facilities.

BASF Provides Some Details

Responding to a request from *PaintSquare News* for more information on Wednesday (Feb. 27), BASF's manager of media relations and corporate communications Europe, Ursula von Stetten, wrote in an email, "So here [are] the facts: The detonation took place at 10:00 a.m. One person was injured; the injury is not serious. He will be kept in the hospital for some days.

"Cause of the detonation was an explosive device, presumably a bomb deriving from the Second World War. The device detonated when grounding work was done. No details on [a] delay [are] available. At the moment, the exact circumstances of the incident are [being] evaluated."

1st March 2013

SPIEGEL ONLINE

Blast Kills One

World War II Bomb Explodes on German Motorway

A highway construction worker in Germany accidentally struck an unexploded World War II bomb, causing an explosion which killed him and wrecked several passing cars.

A World War II bomb has exploded during construction work on a German highway, killing one worker and injuring several motorists who were driving past, police said.

The worker had been cutting through the road surface near the south-western town of Aschaffenburg when his machine struck the bomb and triggered it. Police said they weren't sure yet what type of bomb it was. "The explosion seems to have been too small for it to have been an aircraft bomb," a police spokesman said.

23rd October 2006

WWII bomb injures 17 at Hattingen construction site

Seventeen people were injured on Friday when a construction crew unwittingly detonated a buried World War II-era bomb in Hattingen.

An excavator apparently drove over a 250-kilogramme (550 pound) American bomb, damaging surrounding buildings. Most of the injured suffered auditory trauma from the blast, and the excavator operator suffered injuries to his hands, police in the German state of North Rhine-Westphalia said.

"The hole was astoundingly small for such a large bomb full of so many explosives," Armin Gebhard, head of the Arnsberg department for military ordnance removal, told The Local. "But of course it damaged all the surrounding buildings too. We are really happy it wasn't worse."

19th September 2013

BBC NEWS

World War II bomb kills three in Germany

A special commission is investigating the causes of the explosion, while prosecutors are considering whether the team leader should face charges of manslaughter through culpable negligence, the BBC's Oana Lungescu reports from Berlin.

The blast happened an hour before the defusing operation was due to start.

Officials said the three men who died were experienced sappers, or combat engineers, who over 20 years had defused up to 700 bombs.

More than 7,000 people were immediately evacuated when the 500kg bomb was found. Several schools, a kindergarten and local companies remain closed.

2nd June 2010

June 2006

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Essex Road, Hoddesdon,
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Ref: **DA9817-00**

Source: Various news sources

World War Two bomb found in Ealing garden

11:50, 7 JUL 2011 | **UPDATED** 10:56, 30 SEP 2013 | **BY** JAMES GATES

HOMES were evacuated at the weekend when an unexploded bomb was discovered in West Ealing.

SHARES

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HOMES were evacuated at the weekend when an unexploded bomb was discovered in West Ealing.

Police were called after a local gardener reportedly discovered the device, dating back to World War 2, in their back garden in Hessel Road at about 10.21am.

A 50 metre cordon was put in place around the house while an explosives unit arrived and confirmed that the shell was empty. The cordon was lifted at 11.13hrs and residents where allowed to return. No-one was reported injured.

Most R

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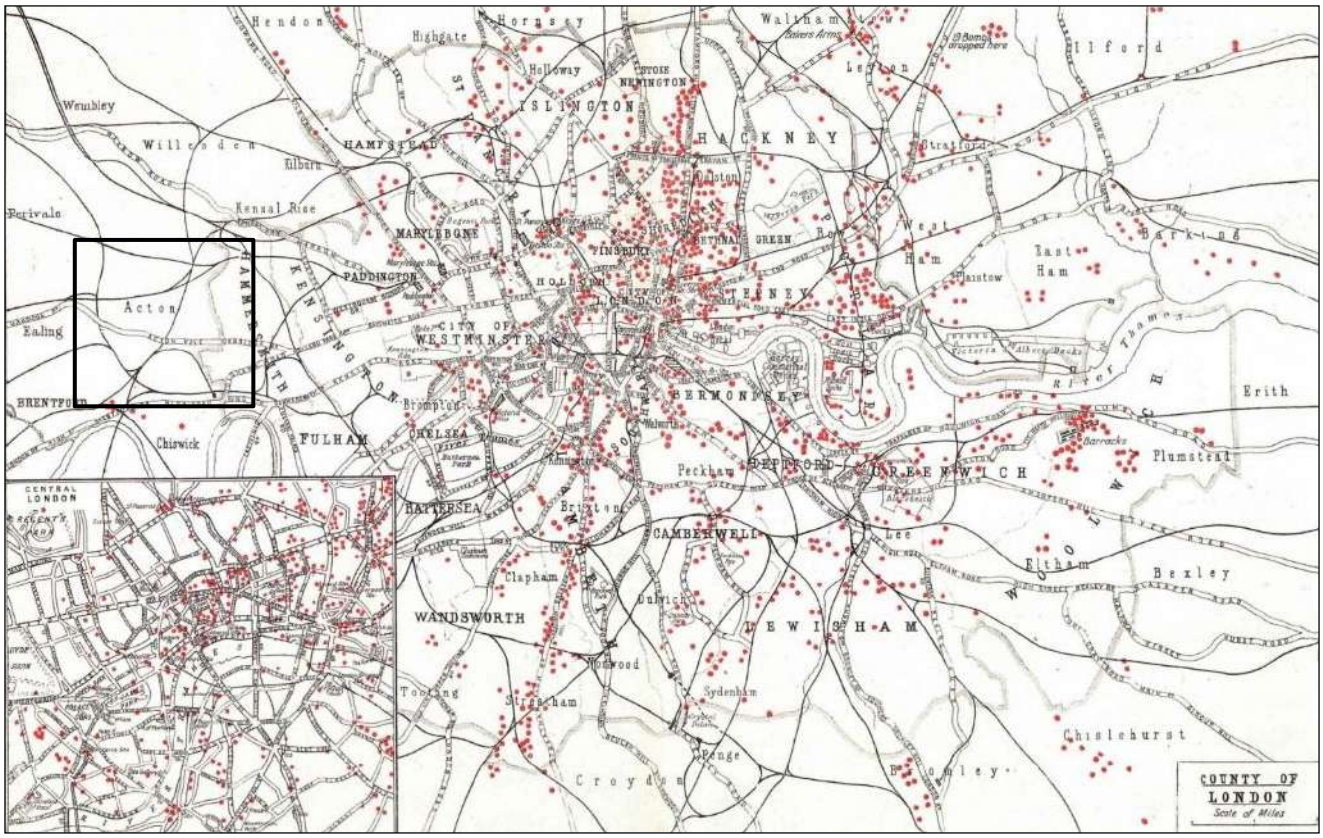
Client: **Curtins**

Project: **Acton Gardens Phases 8.1 &.2**

Ref: **DA9817-00** Source: Local News Source

WWI Bomb Plot Map, London

Annex: I



Examples of 50 and 100kg German WWI bombs

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Project: **Acton Gardens Phases 8.1 &.2**

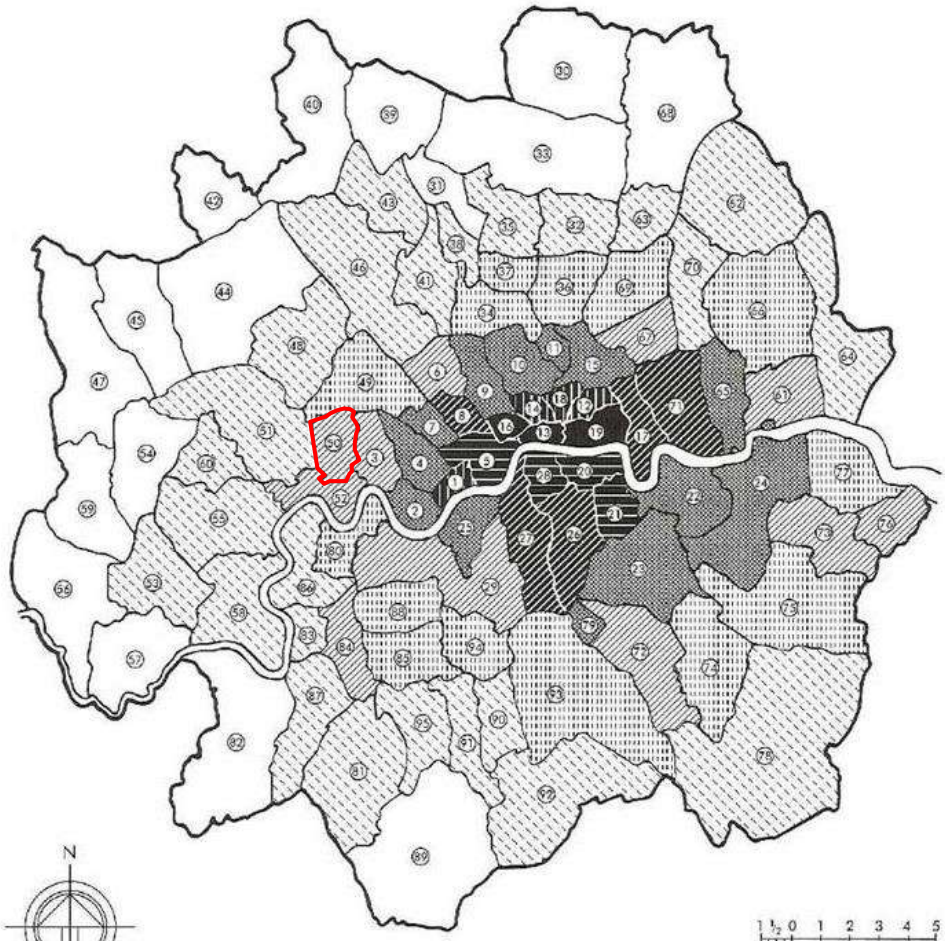
Ref: **DA9817-00**

Source: The National Archives, Kew

N

London WWII Bomb Density Map

Annex: J



No. OF BOMBS PER 1,000 ACRES

OVER 600	300 – 399	100 – 149
500 – 599	200 – 299	50 – 99
400 – 499	150 – 199	UNDER 50

1	Chelsea	25	Battersea	49	Willesden	72	Beckenham
2	Fulham	26	Camberwell	50	Acton	73	Bexley
3	Hammersmith	27	Lambeth	51	Ealing	74	Bromley
4	Kensington	28	Southwark	52	Brentford and Chiswick	75	Chislehurst and Sidcup
5	Westminster	29	Wandsworth	53	Feltham	76	Crayford
6	Hampstead	30	Cheshunt	54	Hayes and Harlington	77	Erith
7	Paddington	31	East Barnet	55	Heston and Isleworth	78	Orpington
8	St. Marylebone	32	Edmonton	56	Staines	79	Penge
9	St. Pancras	33	Enfield	57	Sunbury	80	Barnes
10	Islington	34	Hornsey	58	Twickenham	81	Epsom and Ewell
11	Stoke Newington	35	Southgate	59	Yiewsley and West Drayton	82	Esher
12	Bethnal Green	36	Tottenham			83	Kingston on Thames
13	City of London	37	Wood Green	60	Southall and Norwood	84	Malden and Coombe
14	Finsbury	38	Friern Barnet	61	Barking	85	Merton and Morden
15	Hackney	39	Potters Bar	62	Chigwell	86	Richmond
16	Holborn	40	Elstree	63	Chingford	87	Surbiton
17	Poplar	41	Finchley	64	Dagenham	88	Wimbledon
18	Shoreditch	42	Bushey	65	East Ham	89	Banstead
19	Stepney	43	Barnet U.D.	66	Ilford	90	Beddington and Wallington
20	Bermondsey	44	Harrow	67	Leyton	91	Carshalton
21	Deptford	45	Ruislip and Northwood	68	Waltham Holy Cross	92	Coulsdon and Purley
22	Greenwich	46	Hendon	69	Walthamstow	93	Croydon
23	Lewisham	47	Uxbridge	70	Wanstead and Woodford	94	Mitcham
24	Woolwich	48	Wembley	71	West Ham	95	Sutton and Cheam

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Ref: **DA9817-00**

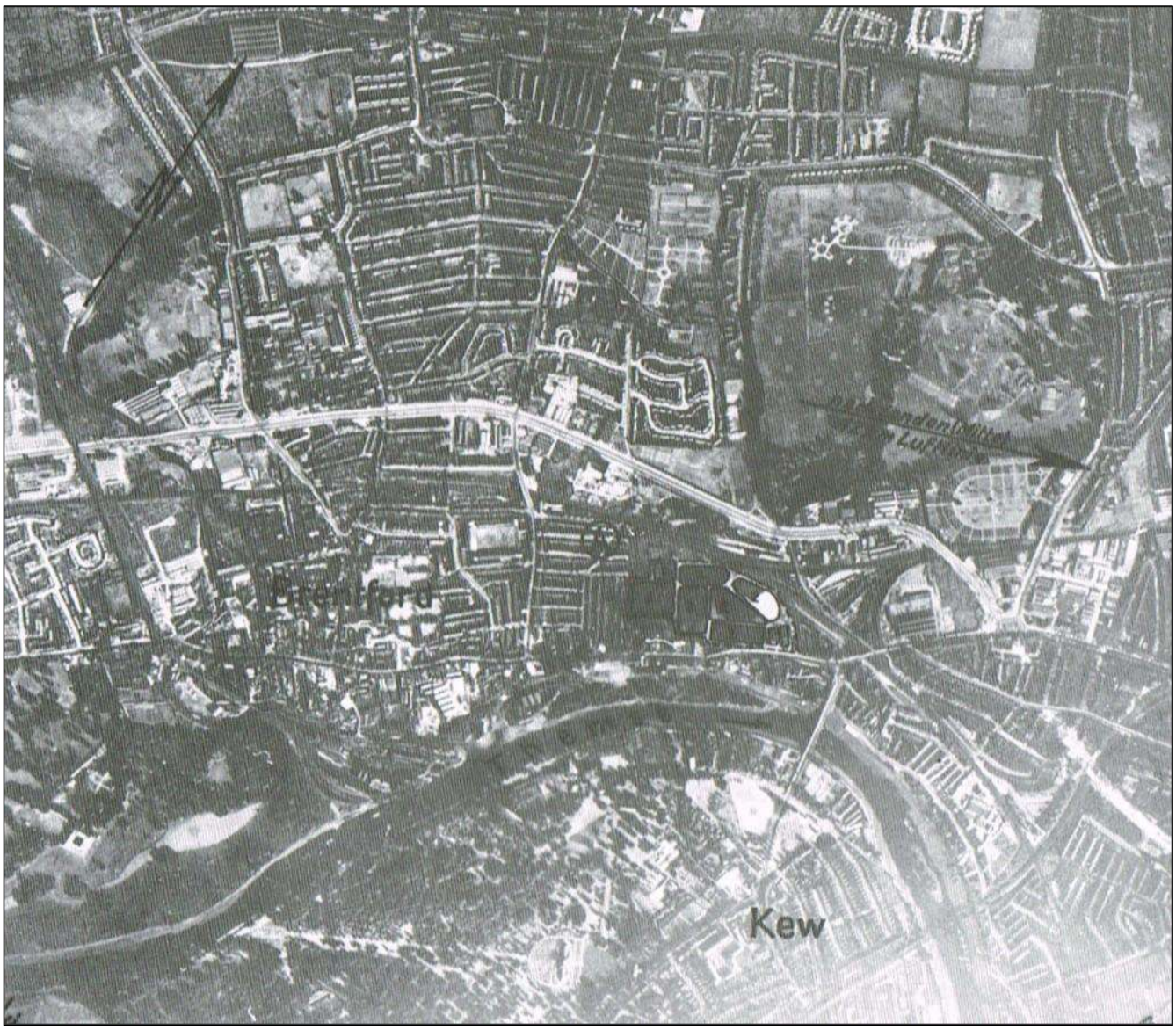
Source: The London Metropolitan Archives

Luftwaffe Photograph, 1st October 1940

London – Barnes

A. West Middlesex Water Works

GB 734 & GB 74100 – Designated Luftwaffe targets

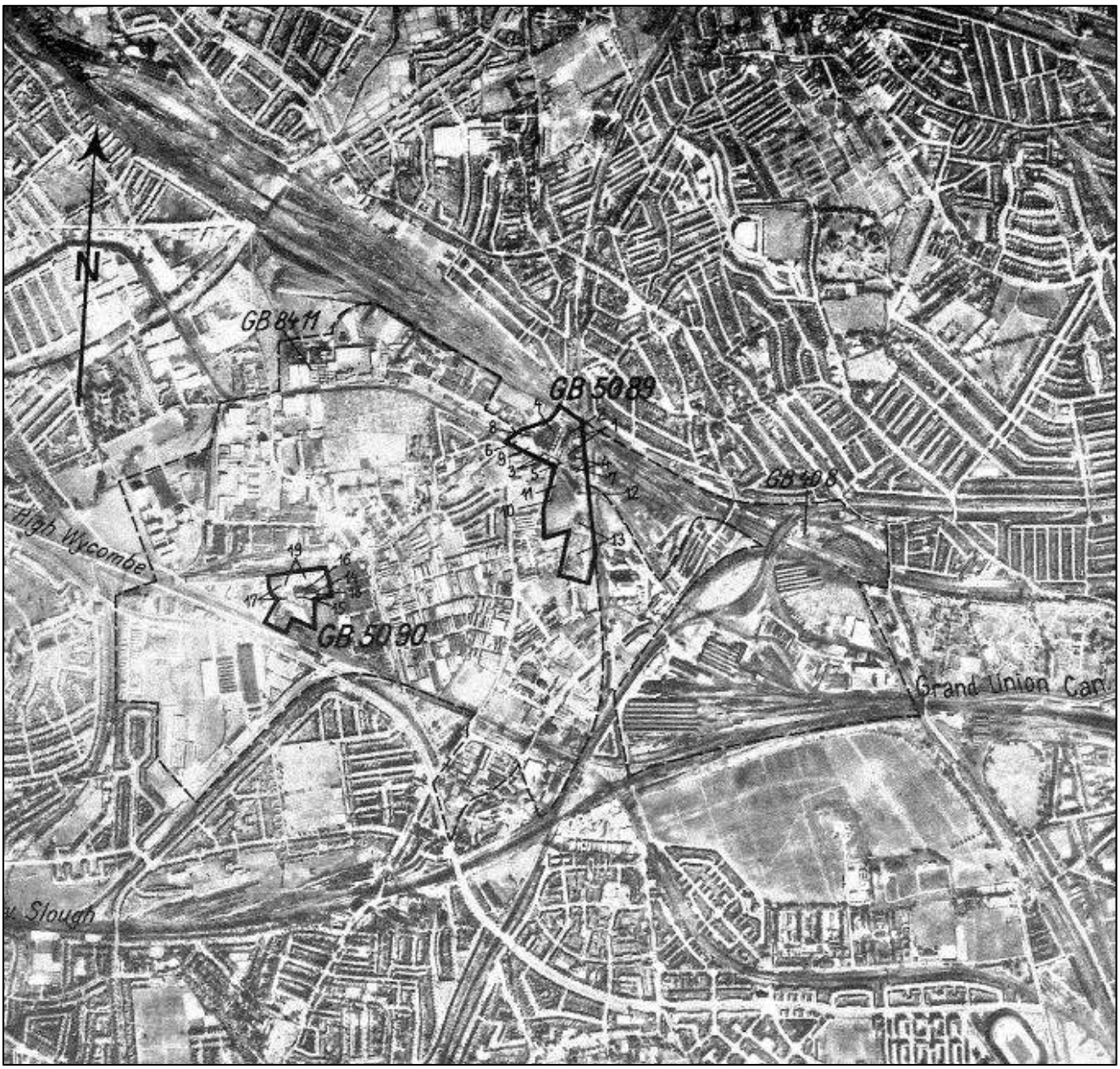


London – Brentford

A. Designated Luftwaffe target

Site area is situated approximately 1.8km north-east of the designated target.

Luftwaffe Photograph, 1st October 1940



London – Willesden

GB 40 8 – railway workshops for GWR
GB 84 11 – industrial area
GB 84 20 – electronics factory
GB 50 90 – power station

Site area is situated approximately 2.6km south of the power station.

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Project: **Acton Gardens Phases 8.1 &.2**

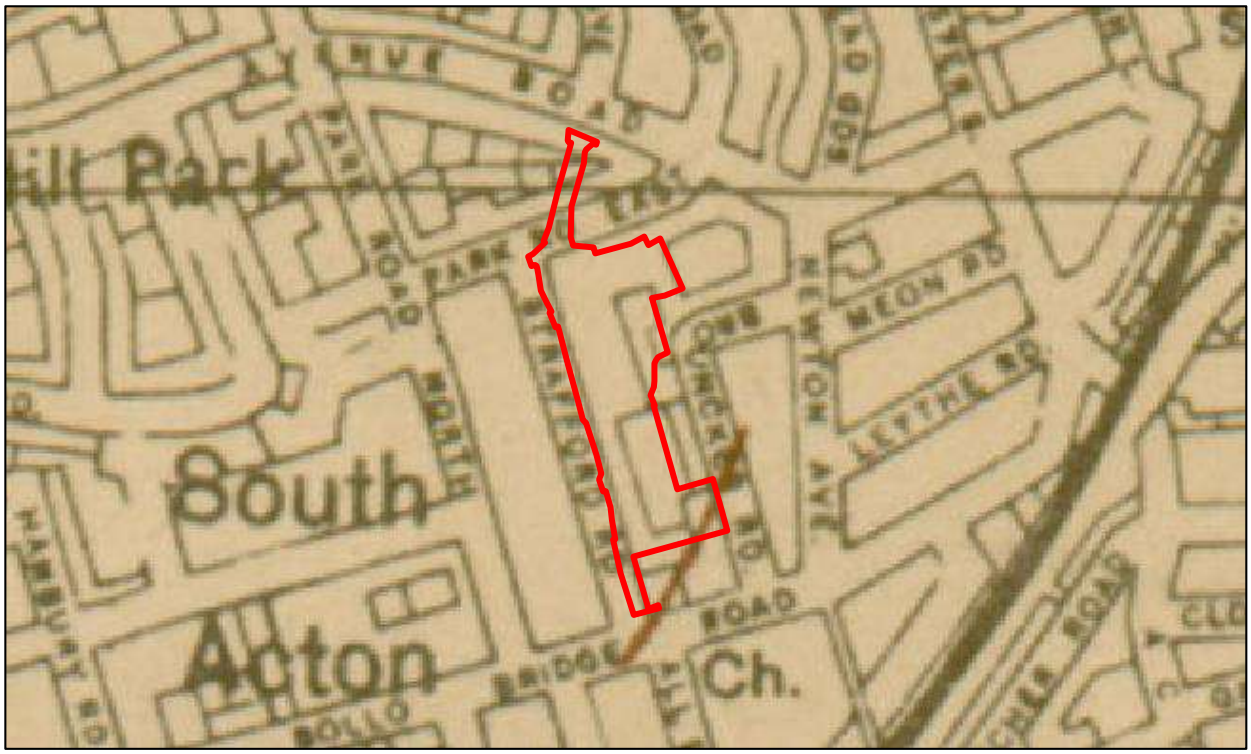
Ref: **DA9817-00**

Source: Nigel J. Clarke, "Adolf Hitler's Home Counties Holiday Snaps"

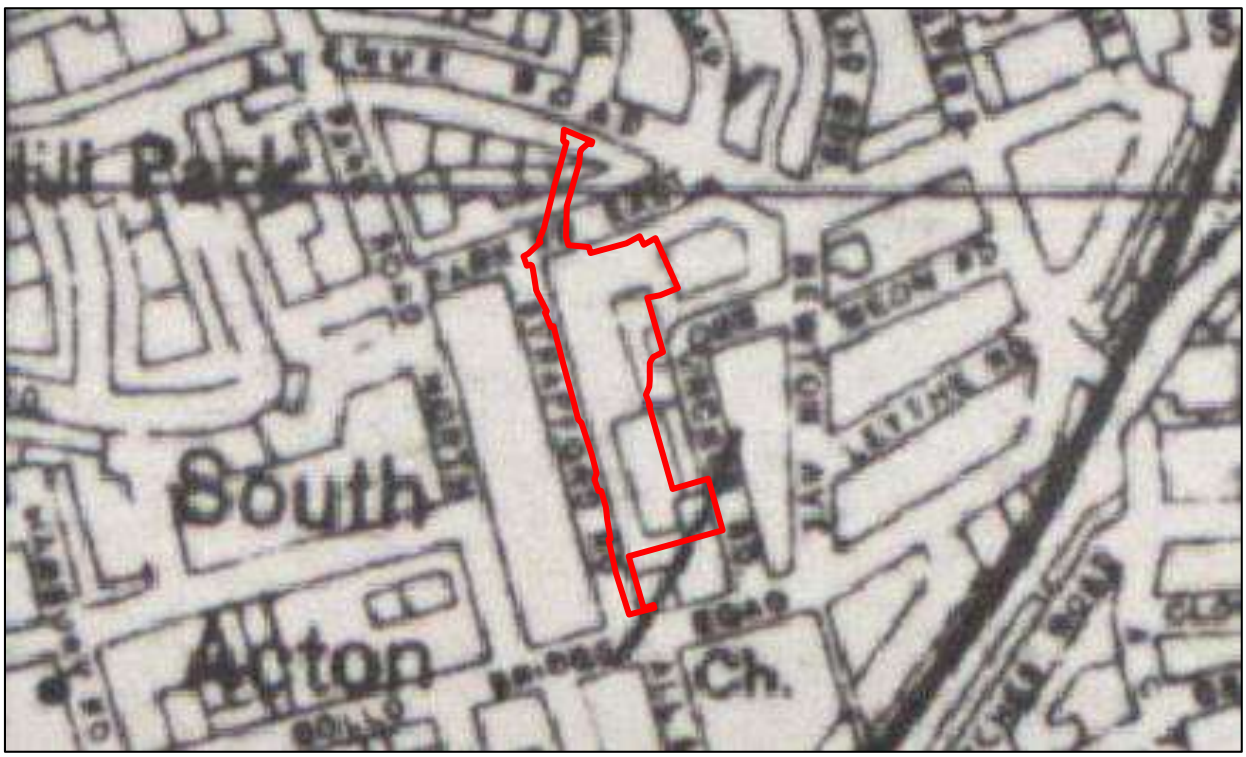
Consolidated London Bomb Census Mapping

Annex: **L1**

Night Bombing up to 7th October 1940



Night Bombing – 7th October 1940 to 28th July 1941



Recorded bomb strike

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Unit 3, Maple Park
Essex Road, Hoddesdon,
Hertfordshire. EN11 0EX
Email: info@1stlinedefence.co.uk
Tel: +44 (0)1992 245 020

Client: **Curtins**

Approximate site boundary

N

Project: **Acton Gardens Phases 8.1 &.2**

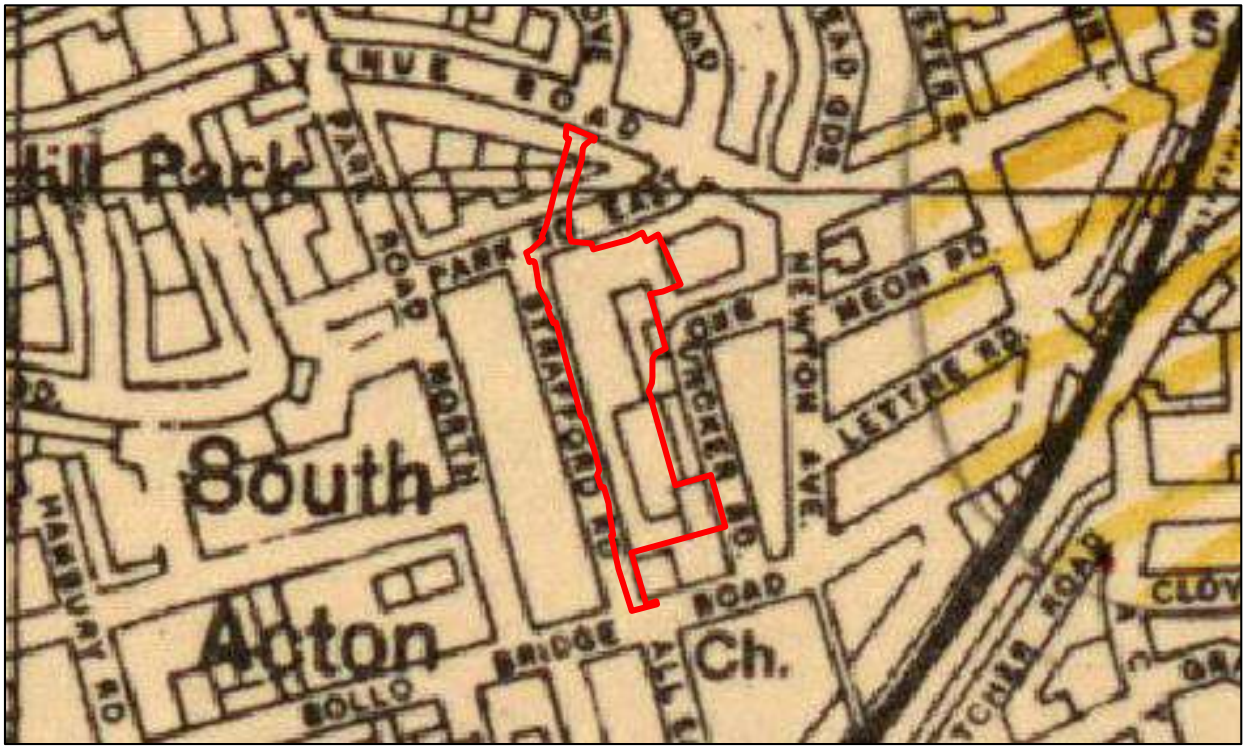
Ref: **DA9817-00**

Source: The National Archives, Kew

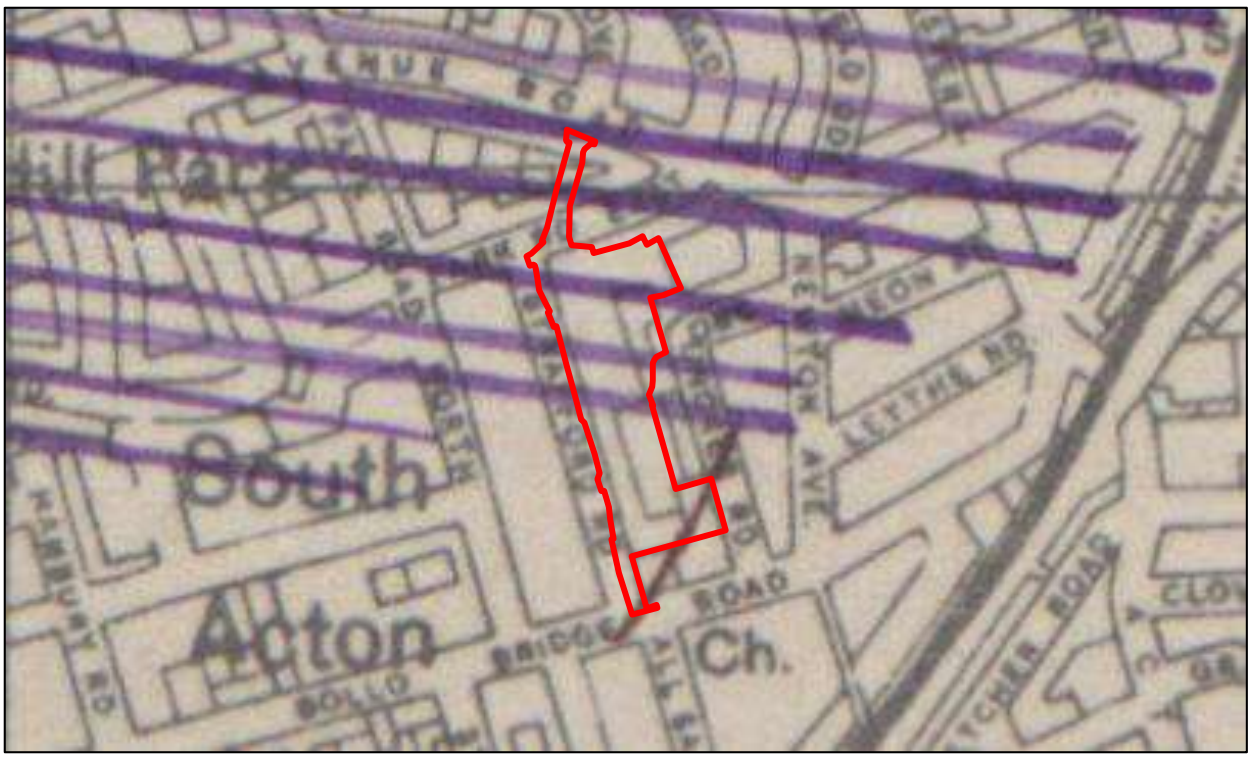
Weekly London Bomb Census Mapping

Annex: **L2**

Night Bombing – 7th to 14th October 1940



Night Bombing – 14th to 21st April 1941



Recorded HE bomb strike

Recorded UXB strike

Recorded incendiary bomb shower

Recorded oil bomb strike

Colour refers to day of the week.

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Tel: +44 (0)1992 245 020

Client: **Curtins**

Project: **Acton Gardens Phases 8.1 &.2**

Ref: **DA9817-00**

Source: The National Archives, Kew

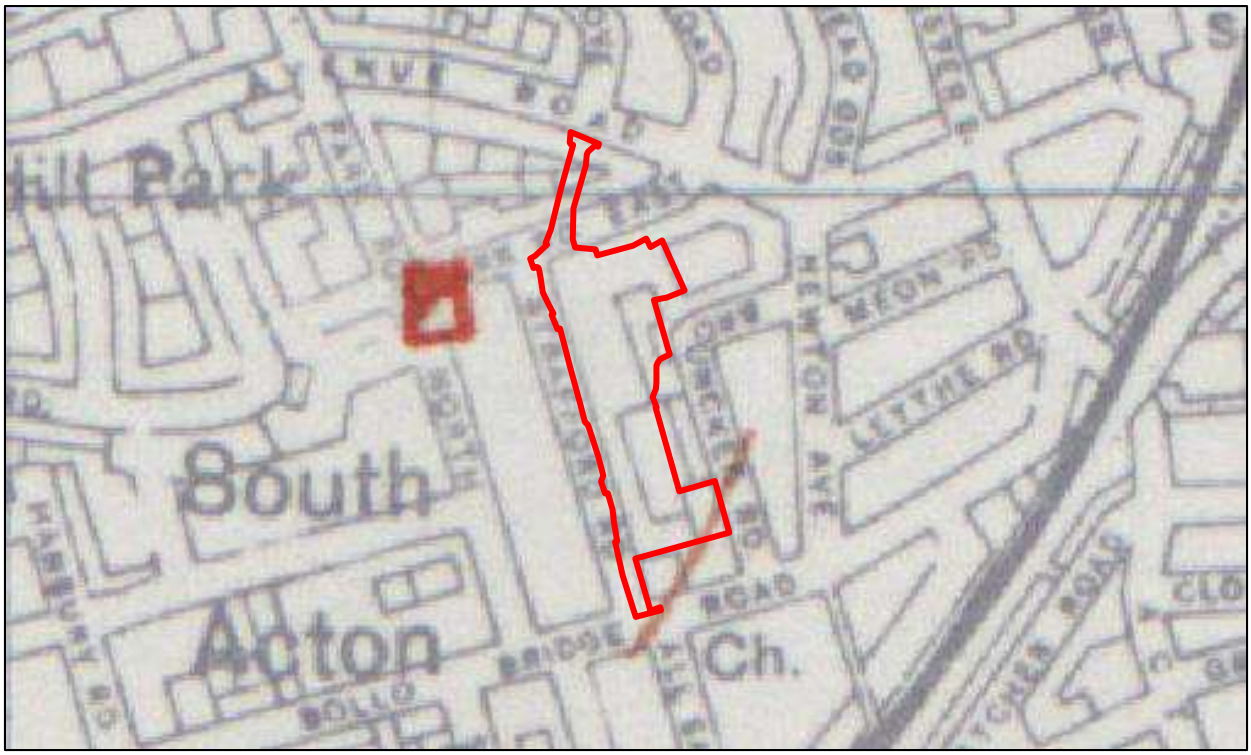
Approximate site boundary

N

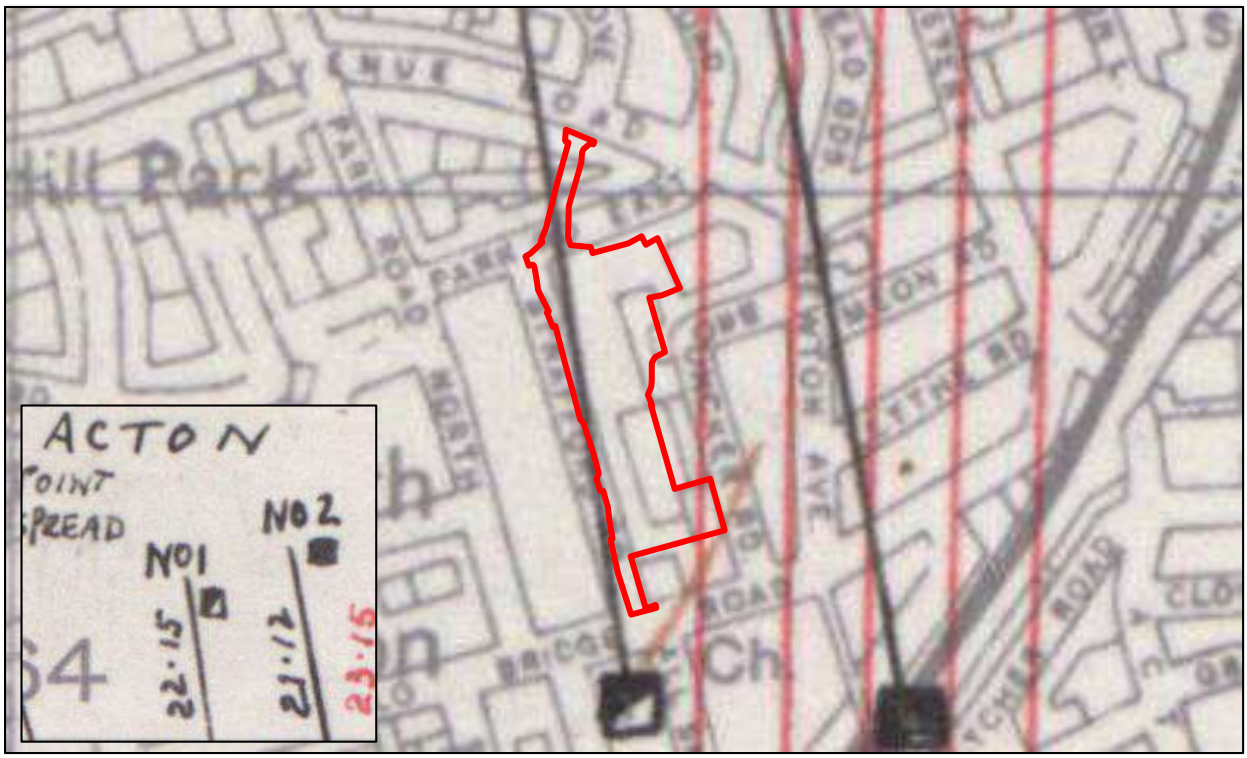
Weekly London Bomb Census Mapping

Annex: **L3**

Night Bombing – 7th to 23rd May 1943



Night Bombing – 21st to 27th February 1944



Recorded HE bomb strike

Recorded UXB strike

Recorded incendiary bomb shower

Recorded oil bomb strike

Colour refers to day of the week.

Recorded 500kg HE bomb strike

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Client: **Curtins**

Project: **Acton Gardens Phases 8.1 &.2**

Ref: **DA9817-00**

Source: The National Archives, Kew

Approximate site boundary

N

London V-1 Flying Bomb Map

Annex: **M**

V-1 flying bomb

1ST LINE DEFENCE

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Tel: +44 (0)1992 245 020

Client: **Curtins**

Project: **Acton Gardens Phases 8.1 &.2**

Ref: **DA9817-00**

Source: The National Archives, Kew

Approximate site boundary

N

Mr. Dyer

SERIOUS DAMAGE TO PROPERTY.

Location... Rear 14 Bella Bridge Rd.

Date 29/9/40 Type of Bomb HE Occurrence No. 3

(a) Size and position of crater. large - in garden at rear of No. 14

(b) Property wrecked. Nos.

(c) Property dangerous and to be demolished (DD). none

(d) Property dangerous (D) Bella Br. Rd. 10, 12, 14, 16, 18, 22, 24

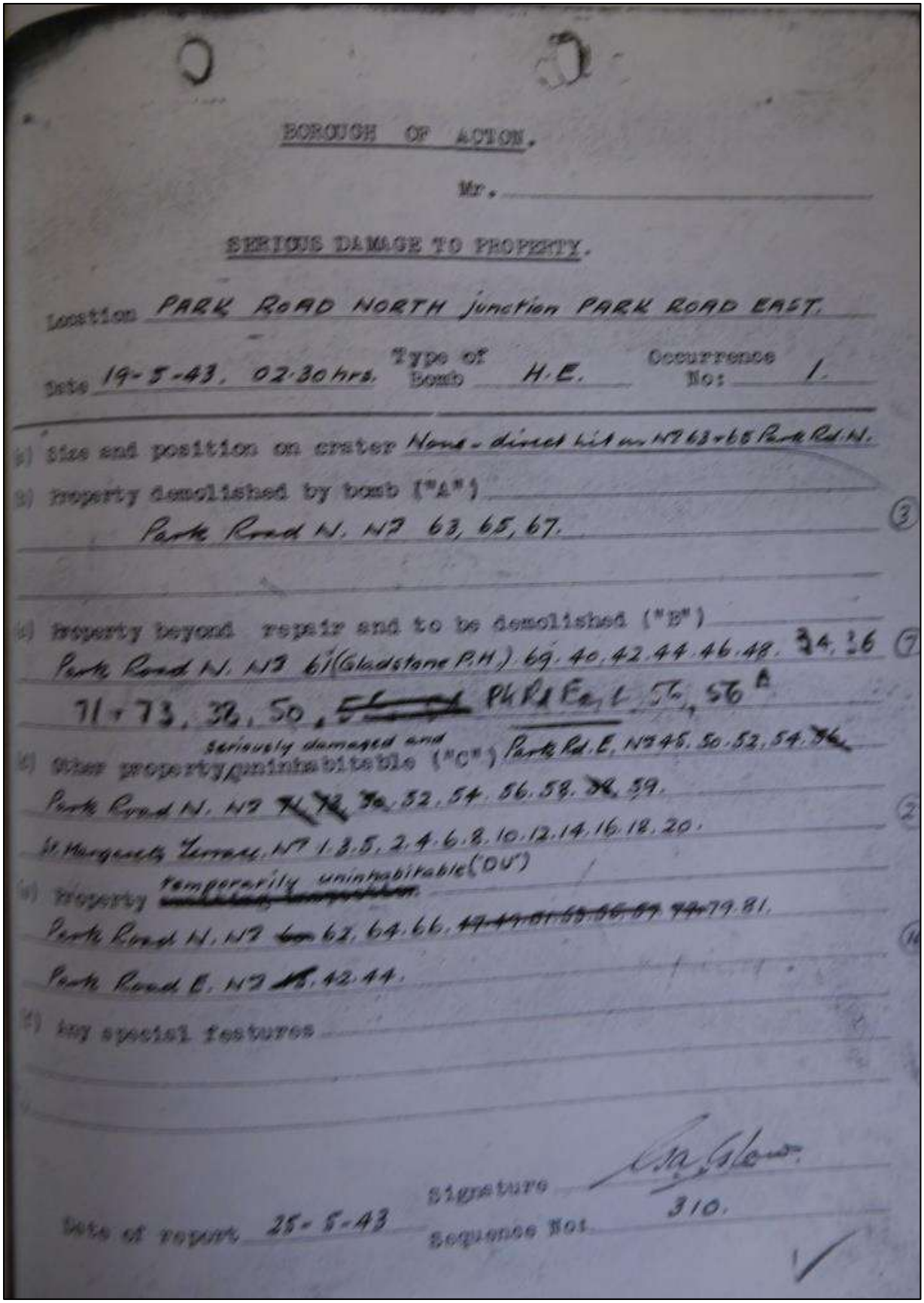
(e) Other property uninhabitable (U). Laythe 2, 4, 6, 8, 10

(f) Property awaiting inspection.

(g) Any special features.

Date of Report..... Signature.....

Sequence No. 121



BOROUGH OF ACTON.

Mr.

SERIOUS DAMAGE TO PROPERTY.

Location PARK ROAD NORTH junction PARK ROAD EAST.

Date 19-5-43. 02.30 hrs. Type of Bomb H.E. Occurrence No: 1.

(a) Size and position on crater None - direct hit on NT 63-65 Park Rd N.

(b) Property demolished by bomb ("A")
Park Road N. NT 63, 65, 67.

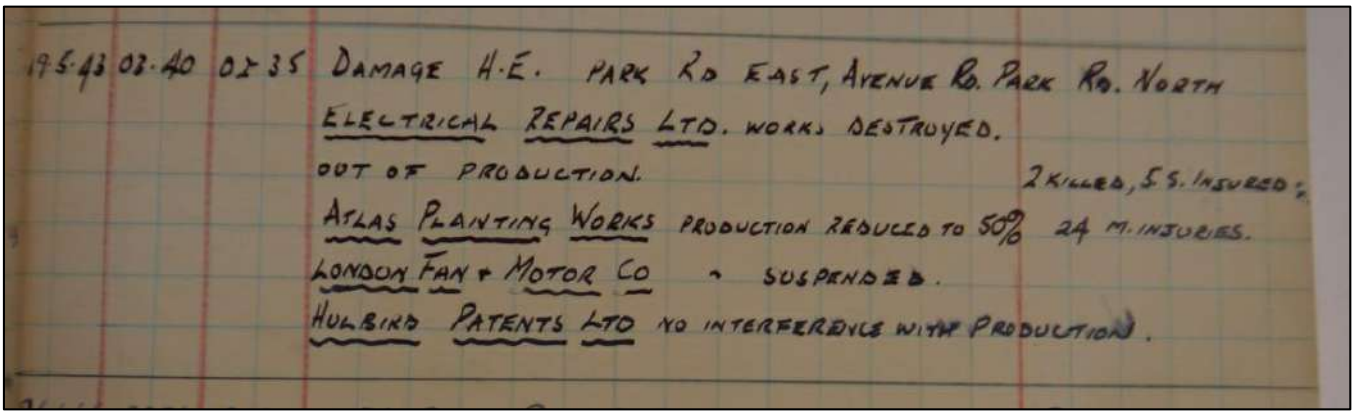
(c) Property beyond repair and to be demolished ("B")
Park Road N. NT 61 (Gladstone P.H.) 69. 40. 42. 44. 46. 48. 34. 36
71. 73. 38. 50. ~~56~~ Pk Rd Ea, L 54, 56A

(d) Other property seriously damaged and uninhabitable ("C") Park Rd E. NT 46. 50. 52. 54. 56
Park Road N. NT ~~74~~ ~~72~~ 30. 32. 34. 36. 38. 39.
St Margarets Terrace NT 1.3.5.2.4.6.8.10.12.14.16.18.20.

(e) Property temporarily uninhabitable (DU')
Park Road N. NT ~~60~~ 62. 64. 66. ~~47-49 51 53 55 57~~ 77-79. 81.
Park Road E. NT ~~38~~. 42. 44.

(f) Any special features

Date of report 25-5-43 Signature [signature] Sequence No: 310.



19·5·43 03·40 01·35 DAMAGE H.E. PARK RD EAST, AVENUE RD. PARK RD. NORTH
ELECTRICAL REPAIRS LTD. WORKS DESTROYED.
OUT OF PRODUCTION. 2 KILLED, 5 S. INJURED;
ATLAS PLANTING WORKS PRODUCTION REDUCED TO 50% 24 M. INJURIES.
LONDON FAN & MOTOR CO " SUSPENDED.
HULBIRD PATENTS LTD NO INTERFERENCE WITH PRODUCTION.

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Project: **Acton Gardens Phases 8.1 &.2**

Ref: **DA9817-00**

Source: London Metropolitan Archives

ALL SAINTS CHURCH, BOLLO BRIDGE RD
Vicar: Revd A.H.ROBERTS

Steeple damaged by bombing	14/04/44//1c
Youth organisations give display	23/06/44//4c
Vicar writes on prayers for our enemy	25/08/44//2e-f
News of services & events	06/10/44//2c
Half to collection at Civic Service to go to church restoration (after bomb damage)	17/11/44//1g
Farewell presentation to Fr. ROBERTS	06/04/45//1c
Last sermon	06/04/45//2b
Annual Meeting	13/04/45//3c
Rev T.A.ROCKLEY as Vicar - photo	13/07/45//1f
Calvary outside re-erected - had been knocked over by flying bomb	20/07/45//4d

Middlesex County Council War Damage Map

Annex: Q

	Category 1 - "Total damage, building to be demolished."
	Category 2 - "Some repairs possible, but could become Cat 1."
	Category 3 - "Border line areas, uncertain whether repairs possible, might have to be demolished."

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Client: **Curtins**

Approximate site boundary

N

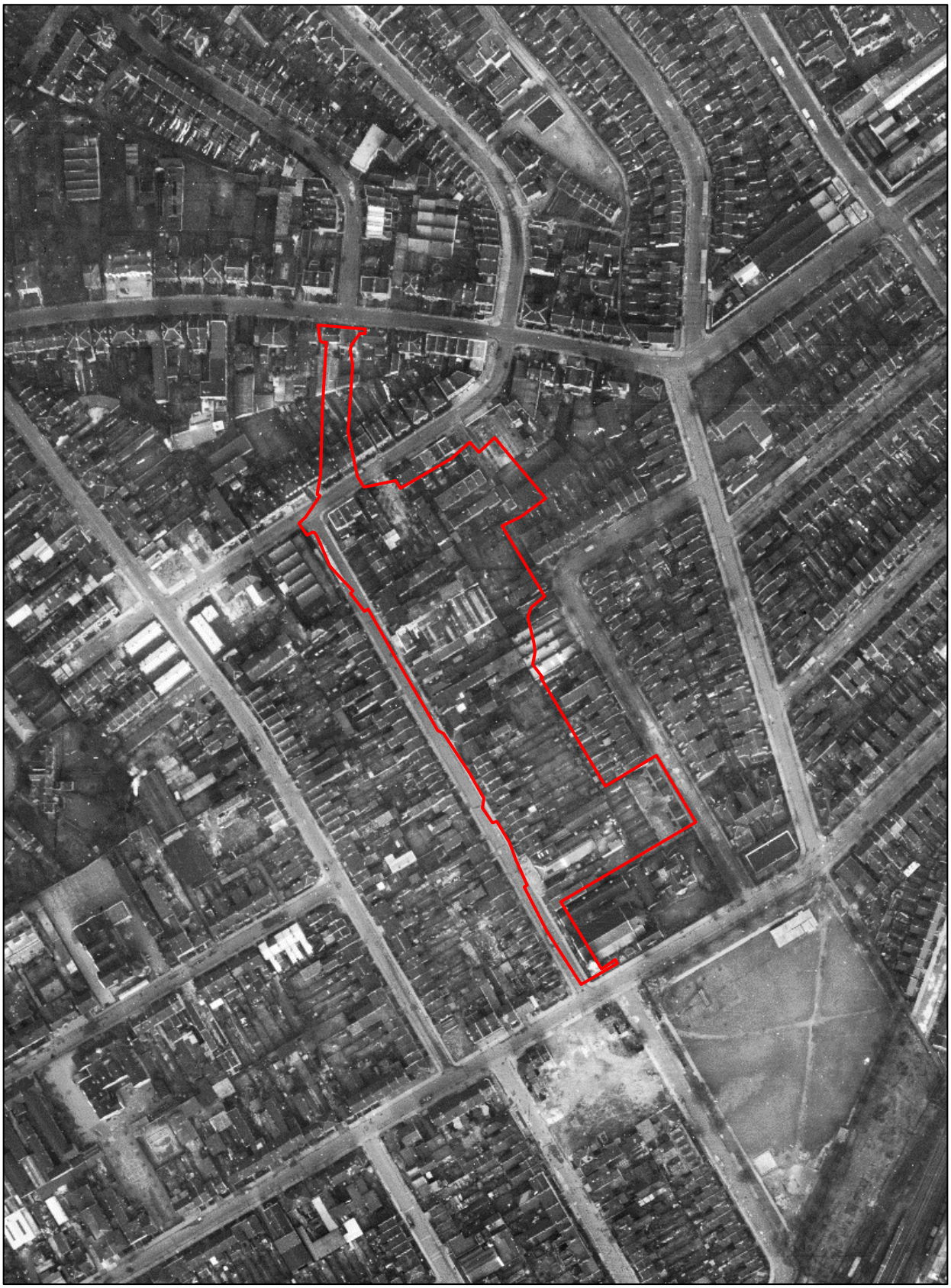
Project: **Acton Gardens Phases 8.1 &.2**

Ref: **DA9817-00**

Source: London Metropolitan Archives

RAF Aerial Photography 29th January 1946

Annex: **R1**



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Approximate site boundary

N

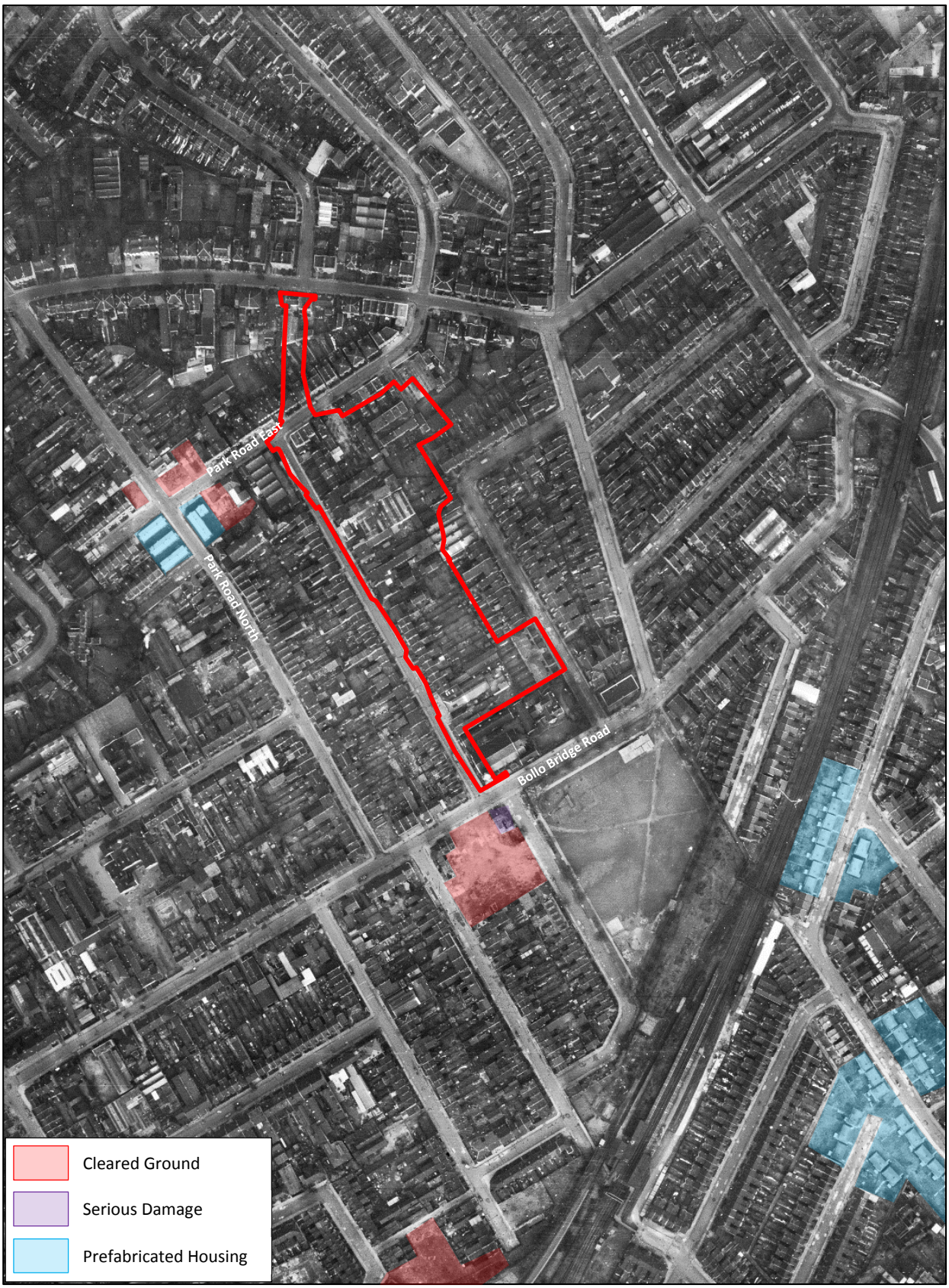
Project: **Acton Gardens Phases 8.1 &.2**

Ref: **DA9817-00**

Source: National Monuments Record Office (Historic England)

RAF Aerial Photography 29th January 1946

Annex: **R2**



1ST LINE DEFENCE

Unit 3, Maple Park
Essex Road, Hoddesdon,
Hertfordshire. EN11 0EX
Email: info@1stlinedefence.co.uk
Tel: +44 (0)1992 245 020

Client: **Curtins**

Approximate site boundary

N

Project: **Acton Gardens Phases 8.1 &.2**

Ref: **DA9817-00**

Source: National Monuments Record Office (Historic England)

EAW044726 – The London Transport Executive Acton Works and South Acton, Gunnersbury, 1952.

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Client: **Curtins**

Project: **Acton Gardens Phases 8.1 &.2**

Ref: **DA9817-00**

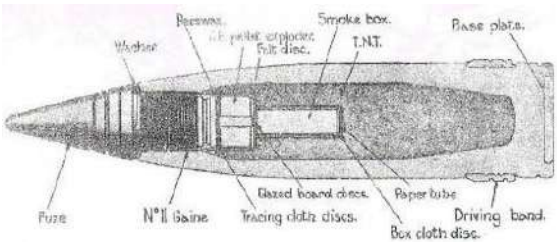
Source: Britain From ABove

Examples of Anti-Aircraft Projectiles

Annex: T

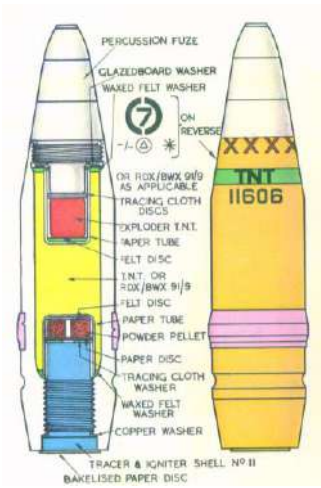
3.7 Inch QF Anti-Aircraft Projectile

Projectile Weight	28lb (12.6 kg)
Explosive Weight	2.52lbs
Fuze Type	Mechanical Time Fuze
Dimensions	3.7in x 14.7in (94mm x 360mm)
Rate of Fire	10 to 20 rounds per minute
Use	The 3.7in AA Mks 1-3 were the standard Heavy Anti-Aircraft guns of the British Army.
Ceiling	30,000ft to 59,000ft



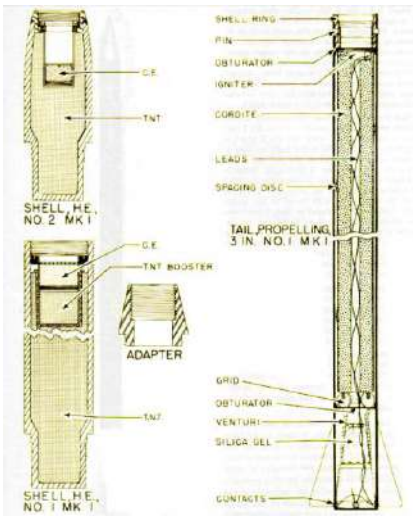
40mm Bofors Projectile

Projectile Weight	1.96lb (0.86kg)
Explosive Weight	300g (0.6lb)
Fuze Type	Impact Fuze
Rate of Fire	120 rounds per minute
Projectile Dimensions	40 x 180mm
Ceiling	23,000ft (7000m)
Remarks	Light quick fire high explosive anti-aircraft projectile. Each projectile fitted with small tracer element. If no target hit, shell would explode when tracer burnt out. Designed to engage aircraft flying below 2,000ft



3in Unrotated Projectile (UP) Anti-Aircraft Rocket ("Z" Battery)

HE Projectile Weight	3.4kg (7.6lb)
Explosive Weight	0.96kg (2.13lb)
Filling	High Explosive – TNT. Fitted with aerial burst fuzing
Dimensions of projectile	236 x 83mm (9.29 x 3.25in)
Remarks	As a short range rocket-firing anti-aircraft weapon developed for the Royal Navy. It was used extensively by British ships during the early days of World War II. The UP was also used in ground-based single and 128-round launchers known as Z Batteries. Shell consists of a steel cylinder reduced in diameter at the base and threaded externally to screw into the shell ring of the rocket motor



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Essex Road, Hoddesdon,
Hertfordshire. EN11 0EX
Email: info@1stlinedefence.co.uk
Tel: +44 (0)1992 245 020

Client: **Curtins**

Project: **Acton Gardens Phases 8.1 &.2**

Ref: **DA9817-00**

Source: Various sources

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Unit 3, Maple Park
Essex Road
Hoddesdon
Hertfordshire
EN11 0EX
Tel: 01992 245020

www.1stlinedefence.co.uk

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Appendix C Exploratory Hole Logs

Borehole Log

Borehole No. **CP101**

Sheet 1 of 2

Project Name: Acton Gardens - Phase 8	Project No. 073270	Co-ords: 520150.00 - 179574.00	Hole Type CP
Location: Brouncker Road, Acton, W3 8BA		Level: 14.00	Scale 1:50
Client: Countryside Properties Ltd.		Dates: 28/05/2020 - 29/05/2020	Logged By WS

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		0.50	ES					Gravel surfacing over dark brown-black slightly silty gravelly SAND. Sand is fine to coarse. Gravel of sub-angular to sub-rounded fine to coarse brick, flint, ceramic and ash MADE GROUND
		0.50 - 1.00	B					
		1.10	D					
		1.20		N=8 (1,2/1,2,2,3)	1.20	12.80		
		1.20 - 1.70	B		1.40	12.60		Soft to firm brown-orange silty CLAY with rare sub-angular brick fragments. MADE GROUND
								Firm brown orange silty CLAY LANGLEY SILT MEMBER
		2.50		N=10 (1,2/2,2,3,3)				
		2.50 - 3.00	B					
		3.00	D					
		3.50 - 3.95	U	Ublow=40				
		4.00	D		4.00	10.00		Firm yellow-orange sandy silty CLAY. Sand is fine. LANGLEY SILT MEMBER
		4.50		N=10 (2,2/2,3,2,3)				
		5.00	D					
		5.50		N=12 (2,2/3,3,3,3)				
		6.00	D					
		7.00	D		7.00	7.00		Firm yellow-orange slightly sandy slightly gravelly silty CLAY. Gravel of sub-angular to sub-rounded fine to coarse flint. Sand is fine. LANGLEY SILT MEMBER
		7.00		N=14 (1,2/3,3,4,4)				
		8.00	D					
		8.50		N=20 (3,3/4,5,5,6)				
		8.50 - 9.00	B					
					9.00	5.00		Stiff dark grey thinly laminated CLAY with frequent mica crystals and occasional pyrite. LONDON CLAY FORMATION
		10.00		N=22 (3,4/5,6,5,6)				

Continued on next sheet

Remarks

Inspection pit hand-dug to 1.2m bgl. No groundwater encountered.

Borehole Log

Borehole No. **CP101**
Sheet 2 of 2

Project Name:	Acton Gardens - Phase 8	Project No. 073270	Co-ords:	520150.00 - 179574.00	Hole Type CP
Location:	Brouncker Road, Acton, W3 8BA		Level:	14.00	Scale 1:50
Client:	Countryside Properties Ltd.		Dates:	28/05/2020 - 29/05/2020	Logged By WS

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		10.50	D					
		11.50 - 11.95	U	Ublow=65				
		12.00	D					
		13.00		N=25 (3,4/5,6,7,7)				
		13.00 - 13.50	B					
		14.00	D					
		14.50 - 14.95	U	Ublow=70				
		15.00	D					
		16.50		N=28 (4,4/6,7,7,8)				
		17.00	D		17.00	-3.00		End of borehole at 17.00 m

11 12 13 14 15 16 17 18 19 20

Remarks
Inspection pit hand-dug to 1.2m bgl. No groundwater encountered.

AGS

Borehole Log

Borehole No. **CP102**

Sheet 1 of 3

Project Name: Acton Gardens - Phase 8	Project No. 073270	Co-ords: 520123.00 - 179652.00	Hole Type CP
Location: Brouncker Road, Acton, W3 8BA		Level: 14.47	Scale 1:50
Client: Countryside Properties Ltd.		Dates: 28/05/2020 - 29/05/2020	Logged By WS

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					0.05	14.42		Tarmac.
					0.30	14.17		MADE GROUND
					0.60	13.87		Dark brown and black silty very gravelly SAND with occasional cobbles, frequent ash, rare yellow sand lenses. Sand is medium to coarse. Gravel is angular to subangular fine to coarse flint, brick, concrete, slate, metal and tile.
		1.00	D		1.10	13.37		MADE GROUND
		1.20		N=14 (1,2/3,3,4,4)				Soft to firm brown-orange slightly gravelly CLAY. Gravel of sub-angular to sub-rounded fine to medium flint and brick.
								MADE GROUND
		2.00	D					Soft to firm brown-orange mottled grey slightly gravelly slightly sandy CLAY. Gravel of sub-rounded fine flint gravel. Sand is fine to medium.
		2.00 - 2.45	U	Ublow=40				HEAD DEPOSITS
								Firm brown mottled grey thinly laminated CLAY. WEATHERED LONDON CLAY FORMATION
		3.00	D		3.00	11.47		Stiff grey thinly laminated CLAY with fine mica crystals and rare shell fragments. LONDON CLAY FORMATION
		3.00		N=17 (3,3/4,4,4,5)				
		4.00 - 4.45	U	Ublow=55				
		5.00	D					
		5.00		N=20 (3,4/4,5,5,6)				
		5.00 - 5.50	B					
		6.00	D					*becoming slightly silty.*
		6.50 - 6.95	U	Ublow=70				
		7.00	D					
		8.00	D					*Frequent mica crystals.*
		8.00		N=25 (4,5/5,6,6,8)				
		9.00	D					
		9.50 - 9.95	U	Ublow=80				
		9.50 - 10.00	B					
		10.00	D					

Continued on next sheet

Remarks

Inspection pit hand-dug to 1.2m bgl. No groundwater encountered.

AGS

Borehole Log

Borehole No. **CP102**
Sheet 2 of 3

Project Name: Acton Gardens - Phase 8	Project No. 073270	Co-ords: 520123.00 - 179652.00	Hole Type CP
Location: Brouncker Road, Acton, W3 8BA		Level: 14.47	Scale 1:50
Client: Countryside Properties Ltd.		Dates: 28/05/2020 - 29/05/2020	Logged By WS

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		11.00 11.00	D	N=29 (4,6/6,7,7,9)					11
		12.00	D						12
		12.50 - 12.95	U	Ublow=75					
		13.00	D						13
		14.00 14.00	D	N=35 (6,6/7,8,10,10)				*Pyrite present.*	14
		15.00	D					*Mudstone gravel present.*	15
		15.50 - 15.95 15.50 - 16.00	U B	Ublow=80					
		16.00	D						16
		17.00 17.00	D	N=45 (7,8/10,10,12,13)					17
		18.00	D						18
		18.50 - 18.95	U	Ublow=120					
		19.00	D						19
		20.00	D						20

Continued on next sheet

Remarks
Inspection pit hand-dug to 1.2m bgl. No groundwater encountered.

AGS

Borehole Log

Borehole No. **CP102**
Sheet 3 of 3

Project Name:	Acton Gardens - Phase 8	Project No. 073270	Co-ords:	520123.00 - 179652.00	Hole Type CP
Location:	Brouncker Road, Acton, W3 8BA		Level:	14.47	Scale 1:50
Client:	Countryside Properties Ltd.		Dates:	28/05/2020 - 29/05/2020	Logged By WS

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		20.00		N=49 (7,9/10,11,13,15)				
		20.00 - 21.00	B					
		21.00	D					
		21.50 - 21.95	U	Ublow=110				
		22.00	D					
		23.00	D					
		23.00		N=50 (7,10/50 for 285mm)				
		24.00	D					
		24.50		N=50 (8,10/50 for 250mm)				
		24.50 - 25.00	B					
		25.00	D		25.00	-10.53		End of borehole at 25.00 m

Remarks
Inspection pit hand-dug to 1.2m bgl. No groundwater encountered.

Borehole Log

Borehole No. **CP103**

Sheet 1 of 4

Project Name: Acton Gardens - Phase 8	Project No. 073270	Co-ords: 520073.97 - 179695.30	Hole Type CP
Location: Brouncker Road, Acton, W3 8BA		Level: 18.00	Scale 1:50
Client: Countryside Properties Ltd.		Dates: 19/02/2020 - 20/02/2020	Logged By MW

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		0.15	ES		0.30	17.70		Grass over brown clayey sandy slightly gravelly SILT with common rootlets and occasional cobbles. Sand is fine to medium. Gravel is angular to subangular fine to coarse flint, tile, brick and concrete. TOPSOIL
		0.40	ES					
		0.90	ES		0.85	17.15		(Loose) dark brown to black silty gravelly SAND with common ash. Sand is fine medium. Gravel is angular to subangular fine to coarse flint and brick. MADE GROUND
		1.00	B					
		1.20		N=153 (4,5/153 for 150mm)				
		1.20 - 1.50	D					
		1.70	D					
		2.00	D		2.30	15.70		(Soft to firm) orange brown and grey mottled very gravelly CLAY. Gravel is angular to subangular fine to coarse flint, concrete, brick, tile and ceramics. MADE GROUND
		2.00		N=12 (4,6/3,4,3,2)				
		2.50	D					*At 1.3m bgl: Concrete slab.*
		3.00		N=8 (2,1/2,2,1,3)				Firm brown mottled bluish grey silty CLAY with common selenite crystals and occasional flint. WEATHERED LONDON CLAY FORMATION
		3.00 - 3.45	D					
		3.50	D					
		4.00 - 4.45	U	Ublow=55				
		4.50	D					
		5.00		N=9 (1,1/2,2,3,2)	4.80	13.20		Firm to stiff grey mottled bluish grey silty CLAY with occasional clusters of selenite crystals. LONDON CLAY FORMATION
		5.00 - 5.45	D					
		5.50	D					
		6.00 - 6.45	U	Ublow=70				
		6.50	D					
		7.00		N=14 (2,2/3,2,4,5)				
		7.00 - 7.45	D					
		7.00 - 7.50	B					*At 7.3m bgl: Clay becomes fissured. Band of clay ironstone.*
		7.50	D					
		8.00 - 8.45	U	Ublow=70				
		8.50	D					
		9.00		N=12 (1,2/3,3,2,4)				
		9.00 - 9.45	D					
		9.50	D					
		10.00 - 10.45	U	Ublow=100				

Continued on next sheet

Remarks

Inspection pit hand-dug to 1.2m bgl. 50mm standpipe installation to 20.0m bgl.

Borehole Log

Borehole No. **CP103**

Sheet 2 of 4

Project Name: Acton Gardens - Phase 8	Project No. 073270	Co-ords: 520073.97 - 179695.30	Hole Type CP
Location: Brouncker Road, Acton, W3 8BA		Level: 18.00	Scale 1:50
Client: Countryside Properties Ltd.		Dates: 19/02/2020 - 20/02/2020	Logged By MW

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		11.00	D						11
		12.00		N=15 (2,3/3,3,4,5)				*At 12.0m bgl: Becoming very stiff.*	12
		12.00 - 12.45	D						
		13.00	D						13
		14.00 - 14.45	U	Ublow=100					14
		15.00	D						15
		16.00		N=18 (2,3/4,4,5,5)					16
		16.00 - 16.45	D						
		17.00	D						17
		18.00 - 18.45	U	Ublow=100					18
		19.00	D						19
		20.00		N=24 (3,4/5,6,6,7)					20

Continued on next sheet

Remarks

Inspection pit hand-dug to 1.2m bgl. 50mm standpipe installation to 20.0m bgl.

Borehole Log

Borehole No. **CP103**

Sheet 3 of 4

Project Name: Acton Gardens - Phase 8	Project No. 073270	Co-ords: 520073.97 - 179695.30	Hole Type CP
Location: Brouncker Road, Acton, W3 8BA		Level: 18.00	Scale 1:50
Client: Countryside Properties Ltd.		Dates: 19/02/2020 - 20/02/2020	Logged By MW

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		20.00 - 20.45	D						
		21.00	D						21
		22.00 - 22.45	U	Ublow=100				At 22.0m bgl: Becoming hard.	22
		23.00	D						23
		24.00		N=35 (4,5/8,8,9,10)					24
		24.00 - 24.45	D						
		25.00	D						25
		26.00 - 26.45	U	Ublow=100					26
		27.00	D						27
		28.00		N=44 (6,6/9,11,12,12)					28
		28.00 - 28.45	D						
		29.00	D						29
		30.00 - 30.45	U	Ublow=100					30

Continued on next sheet

Remarks

Inspection pit hand-dug to 1.2m bgl. 50mm standpipe installation to 20.0m bgl.

AGS

Borehole Log

Borehole No.
CP103
Sheet 4 of 4

Project Name:	Acton Gardens - Phase 8	Project No. 073270	Co-ords: 520073.97 - 179695.30
Location:	Brouncker Road, Acton, W3 8BA		Level: 18.00
Client:	Countryside Properties Ltd.		Dates: 19/02/2020 - 20/02/2020

Hole Type: CP
Scale: 1:50
Logged By: MW

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					30.45	-12.45		End of borehole at 30.45 m

31
32
33
34
35
36
37
38
39
40

Remarks
Inspection pit hand-dug to 1.2m bgl. 50mm standpipe installation to 20.0m bgl.

AGS

Borehole Log

Borehole No. **CP104**

Sheet 1 of 4

Project Name: Acton Gardens - Phase 8	Project No. 073270	Co-ords: 520090.14 - 179768.83	Hole Type CP
Location: Brouncker Road, Acton, W3 8BA		Level: 19.06	Scale 1:50
Client: Countryside Properties Ltd.		Dates: 19/02/2020 - 20/02/2020	Logged By MW

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		0.10	ES		0.20	18.86		Grass over brown clayey sandy slightly gravelly SILT with common rootlets and occasional cobbles. Sand is fine to medium. Gravel is angular to subangular fine to coarse flint, tile, brick and concrete. TOPSOIL
		0.50	ES					
		0.50 - 0.60	D					
		1.00	D		1.00	18.06		(Soft) brown and black sandy gravelly CLAY with ash and occasional charcoal. Sand is fine to medium. Gravel is angular to subrounded fine to coarse flint and brick. MADE GROUND
		1.00	ES					
		1.20		N=33 (6,6/7,8,8,10)	1.30	17.76		
		1.20 - 1.30	D					
	▼	1.50 - 1.60	D					
		2.00		N=34 (4,6/7,8,9,10)				(Medium dense to dense) brown yellow and orange mottled slightly clayey slightly silty very sandy GRAVEL with ash and charcoal. Gravel is angular to subangular fine to coarse brick, flint and nails. MADE GROUND
		2.00 - 2.10	D					
		2.50 - 2.60	D					
		3.00		N=39 (5,7/8,9,10,12)				Dense brown yellow and orange mottled slightly clayey very sandy GRAVEL. Gravel is angular to subangular fine to coarse flint. LYNCH HILL GRAVEL MEMBER
		3.00 - 3.10	D					
		3.50 - 3.60	D		3.50	15.56		Firm to stiff grey mottled bluish grey slightly silty CLAY with occasional clusters of selenite crystals. LONDON CLAY FORMATION
		4.00 - 4.45	B					
		4.00 - 4.45	U	Ublow=75				*From 4.0m bgl: Becoming less silty with depth.*
		5.00		N=12 (2,2/2,3,3,4)				
		5.00 - 5.45	D					
		5.50 - 5.60	D					
		6.00 - 6.45	U	Ublow=76				
		6.50 - 6.60	D					
		7.00		N=15 (2,2/3,3,4,5)				*A 7.0m bgl: Becoming very stiff.*
		7.00 - 7.45	D					
		7.50 - 7.60	D					
		8.00 - 8.45	U	Ublow=75				
		8.50 - 8.60	D					
		9.00		N=22 (4,4/5,5,6,6)				
		9.00 - 9.45	D					
		9.50 - 9.60	D					
		10.00 - 10.45	U	Ublow=80				

Continued on next sheet

Remarks

Inspection pit hand-dug to 1.2m bgl. 50mm standpipe installation to 20.0m bgl.

Borehole Log

Borehole No. **CP104**

Sheet 2 of 4

Project Name: Acton Gardens - Phase 8	Project No. 073270	Co-ords: 520090.14 - 179768.83	Hole Type CP
Location: Brouncker Road, Acton, W3 8BA		Level: 19.06	Scale 1:50
Client: Countryside Properties Ltd.		Dates: 19/02/2020 - 20/02/2020	Logged By MW

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		11.00 - 11.10	D						11
		12.00		N=22 (2,3/4,5,6,7)					12
		12.00 - 12.45	D						
		13.00 - 13.10	D						13
		14.00 - 14.45	U	Ublow=80					14
		15.00 - 15.10	D						15
		16.00		N=28 (3,4/6,6,8,8)					16
		16.00 - 16.45	D						
		17.00 - 17.10	D						17
		18.00 - 18.45	U	Ublow=90				*At 18.0m bgl: Becoming hard*	18
		19.00 - 19.10	D						19
		20.00		N=34 (4,6/7,8,9,10)					20

Continued on next sheet

Remarks

Inspection pit hand-dug to 1.2m bgl. 50mm standpipe installation to 20.0m bgl.

AGS

Borehole Log

Borehole No. **CP104**

Sheet 3 of 4

Project Name: Acton Gardens - Phase 8	Project No. 073270	Co-ords: 520090.14 - 179768.83	Hole Type CP
Location: Brouncker Road, Acton, W3 8BA		Level: 19.06	Scale 1:50
Client: Countryside Properties Ltd.		Dates: 19/02/2020 - 20/02/2020	Logged By MW

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		20.00 - 20.45	D						
		21.00 - 21.10	D						21
		22.00 - 22.45	U	Ublow=92					22
		23.00 - 23.10	D						23
		24.00		N=37 (4,6/8,9,10,10)					24
		24.00 - 24.45	D						
		25.00 - 25.10	D						25
		26.00 - 26.45	U	Ublow=100					26
		27.00 - 27.10	D						27
		28.00		N=35 (4,6/7,9,9,10)					28
		28.00 - 28.45	D						
		29.00 - 29.10	D						29
		30.00 - 30.45	U	Ublow=100					30

Continued on next sheet

Remarks

Inspection pit hand-dug to 1.2m bgl. 50mm standpipe installation to 20.0m bgl.

AGS

Borehole Log

Borehole No.
CP104
Sheet 4 of 4

Project Name:	Acton Gardens - Phase 8	Project No. 073270	Co-ords:	520090.14 - 179768.83	Hole Type CP
Location:	Brouncker Road, Acton, W3 8BA		Level:	19.06	Scale 1:50
Client:	Countryside Properties Ltd.		Dates:	19/02/2020 - 20/02/2020	Logged By MW

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					30.45	-11.40		End of borehole at 30.45 m

31
32
33
34
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36
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Remarks
Inspection pit hand-dug to 1.2m bgl. 50mm standpipe installation to 20.0m bgl.

AGS

Borehole Log

Borehole No. **CP105**

Sheet 1 of 3

Project Name: Acton Gardens - Phase 8	Project No. 073270	Co-ords: 520138.79 - 179771.79	Hole Type CP
Location: Brouncker Road, Acton, W3 8BA		Level: 16.67	Scale 1:50
Client: Countryside Properties Ltd.		Dates: 18/02/2020 - 19/02/2020	Logged By MW

Well	Water Strikes	Samples and In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
		0.10	ES		0.25	16.42		Grass over dark brown silty slightly sandy slightly gravelly CLAY with occasional rootlets with rare cobbles. Sand is medium. Gravel is angular to subrounded fine to coarse flint, brick, concrete, tile and slate. TOPSOIL
		0.30	ES					
		0.50	D					
		0.50 - 0.60	B					
	▼	1.20	D					(Medium dense) brown orange and yellow mottled silty very gravelly SAND with occasional cobbles, clay lenses and ash. Sand is medium to coarse. Gravel is angular to subrounded fine to coarse flint, brick, concrete, glass, slate and clinker. MADE GROUND
		1.20		N=23 (3,4/9,6,4,4)				
		1.50	D					
		2.00		N=16 (2,2/3,4,4,5)				*At 0.5m bgl: 50cm long metal bar.*
		2.00 - 2.45	D		2.20	14.47		*From 1.0m bgl: Becoming more clayey with depth.*
		2.50	D					Stiff to very stiff orangish brown mottled grey slightly silty CLAY with rare flint and black specks. WEATHERED LONDON CLAY FORMATION
		3.00 - 3.45	U	Ublow=75				*From 3.0m bgl: Becoming more stiff and browner with depth.*
		3.50	D					
		4.00		N=17 (3,3/4,4,4,5)				
		4.00 - 4.45	D					
		4.50	D					
		5.00 - 5.45	B		4.80	11.87		Very stiff to hard dark grey CLAY with rare black specks. LONDON CLAY FORMATION
		5.00 - 5.45	U	Ublow=75				
		5.50	D					
		6.00		N=19 (2,3/4,4,5,6)				
		6.00 - 6.45	D					
		6.50	D					
		7.00 - 7.45	U	Ublow=60				
		7.50	D					
		8.00		N=19 (2,3/4,4,5,6)				
		8.00 - 8.45	D					
		8.50	D					
		9.00 - 9.45	U	Ublow=80				
		9.50	D					
		10.00		N=26 (3,5/5,6,7,8)				

Continued on next sheet

Remarks

Inspection pit hand-dug to 1.2m bgl. 50mm standpipe installation to 20.0m bgl.

AGS

Borehole Log

Borehole No. **CP105**

Sheet 2 of 3

Project Name: Acton Gardens - Phase 8	Project No. 073270	Co-ords: 520138.79 - 179771.79	Hole Type CP
Location: Brouncker Road, Acton, W3 8BA		Level: 16.67	Scale 1:50
Client: Countryside Properties Ltd.		Dates: 18/02/2020 - 19/02/2020	Logged By MW

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		10.00 - 10.45	D						
		11.00	D						11
		12.00 - 12.15	U	Ublow=90					12
		13.00	D						13
		14.00		N=26 (3,5/5,6,7,8)					14
		14.00 - 14.45	D						
		15.00	D						15
		16.00 - 16.45	U	Ublow=95					16
		17.00	D						17
		18.00		N=29 (4,6/6,7,8,8)					18
		18.00 - 18.45	D						
		19.00	D					*At 19.0m bgl: Becoming hard.*	19
		20.00 - 20.45	U	Ublow=97					20

Continued on next sheet

Remarks

Inspection pit hand-dug to 1.2m bgl. 50mm standpipe installation to 20.0m bgl.

AGS

Borehole Log

Borehole No.
CP105
Sheet 3 of 3

Project Name:	Acton Gardens - Phase 8	Project No. 073270	Co-ords:	520138.79 - 179771.79	Hole Type CP
Location:	Brouncker Road, Acton, W3 8BA		Level:	16.67	Scale 1:50
Client:	Countryside Properties Ltd.		Dates:	18/02/2020 - 19/02/2020	Logged By MW

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					20.45	-3.78		End of borehole at 20.45 m

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Remarks
Inspection pit hand-dug to 1.2m bgl. 50mm standpipe installation to 20.0m bgl.

AGS

Borehole Log

Borehole No. **WS101**

Sheet 1 of 1

Project Name:	Acton Gardens - Phase 8	Project No. 073270	Co-ords:	520133.39 - 179591.13	Hole Type WS
Location:	Brouncker Road, Acton, W3 8BA		Level:	14.21	Scale 1:25
Client:	Countryside Properties Ltd.		Dates:	20/02/2020 - 20/02/2020	Logged By MW

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		0.10	ES		0.07	14.14		Asphalt.
								MADE GROUND
					0.30	13.90		(Loose) dark brown and black silty very gravel SAND with occasional cobbles, frequent ash, rare yellow sand lenses and a weak hydrocarbon odour. Sand is medium to coarse. Gravel is angular to subangular fine to coarse flint, brick, concrete, slate, metal and tile.
					0.40	13.80		MADE GROUND
		0.50	ES		0.50	13.70		(Loose) black brown and orange mottled silty very gravelly SAND with rare ash. Sand is fine to coarse. Gravel is angular to subrounded fine to coarse flint, brick, concrete, slate, metal and tile.
								MADE GROUND
								(Loose to medium dense) brown sandy very gravelly CLAY with common cobbles of brick and concrete. Sand is fine to coarse. Gravel is angular to subrounded fine to coarse flint, brick, concrete, slate, metal and tile.
								MADE GROUND
								End of borehole at 0.50 m

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Remarks

Concrete obstruction encountered at 0.5m bgl. Hole terminated and backfilled with arisings.

AGS

Borehole Log

Borehole No. **WS102**

Sheet 1 of 2

Project Name: Acton Gardens - Phase 8	Project No. 073270	Co-ords: 520111.00 - 179591.00	Hole Type WS
Location: Brouncker Road, Acton, W3 8BA		Level: 14.20	Scale 1:25
Client: Countryside Properties Ltd.		Dates: 20/02/2020 - 20/02/2020	Logged By MW

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.05	ES		0.10	14.10		Grass over dark brown sandy slightly gravelly SILT with common roots and rootlets. Sand is fine to medium. Gravel is angular to subangular fine to medium flint. TOPSOIL	
		0.50	ES					(Loose) brown sandy slightly gravelly SILT with common roots, rootlets and occasional cobbles. Sand is medium. Gravel is angular to subangular fine to coarse flint, brick, concrete, glass, metal. TOPSOIL	
		0.50 - 2.00	B		0.60	13.60		(Firm) orangish brown silty slightly sandy CLAY with frequent black specks and occasional flint, brick and rootlets. Sand is medium. MADE GROUND	
		1.00	D					*From 1.0m bgl: Becoming firm to stiff with depth.*	1
		1.20		N=9 (1,1/1,2,3,3)					
				HVP=120	1.50	12.70		Firm to stiff orangish brown silty slightly sandy CLAY with frequent black specks and occasional flint and rootlets. Sand is medium. LANGLEY SILT MEMBER	
		2.00		N=13 (2,2/2,3,4,4)				*At 2.0m bgl: Becoming sandier with shell fragments and siltstone.*	2
		2.50 - 3.00	B		2.50	11.70		Medium dense orange mottled yellow very silty SAND with occasional black specks and shell fragments. Sand is fine to medium. LANGLEY SILT MEMBER	
		3.00		N=11 (2,2/2,3,3,3)					3
		3.60	D					*Between 3.5 to 4.0m bgl: Fine laminations of reddish orange and grey fine sand.*	
		4.00		N=13 (2,2/3,3,3,4)				*Between 4.0 to 4.6m bgl: Occasional interbedded light grey clay layers.*	4
					4.60	9.60		Firm light greyish brown with orange mottling silty sandy CLAY with occasional sand laminations. LANGLEY SILT MEMBER	
		4.80	D						
		5.00		N=8 (1,1/2,2,2,2)					5

Continued on next sheet

Remarks

GPS co-ordinates approximate. Levels approximated from topographic survey. Inspection pit hand-dug to 1.2m bgl. 50mm standpipe installation to 5.0m bgl.

AGS

Borehole Log

Borehole No.
WS102
Sheet 2 of 2

Project Name:	Acton Gardens - Phase 8	Project No. 073270	Co-ords:	520111.00 - 179591.00	Hole Type WS
Location:	Brouncker Road, Acton, W3 8BA		Level:	14.20	Scale 1:25
Client:	Countryside Properties Ltd.		Dates:	20/02/2020 - 20/02/2020	Logged By MW

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					5.45	8.75		End of borehole at 5.45 m

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Remarks
GPS co-ordinates approximate. Levels approximated from topographic survey. Inspection pit hand-dug to 1.2m bgl. 50mm standpipe installation to 5.0m bgl.

AGS

Borehole Log

Borehole No. **WS103**

Sheet 1 of 1

Project Name: Acton Gardens - Phase 8	Project No. 073270	Co-ords: 520091.00 - 179633.00	Hole Type WS
Location: Brouncker Road, Acton, W3 8BA		Level: 15.00	Scale 1:25
Client: Countryside Properties Ltd.		Dates: 20/02/2020 - 20/02/2020	Logged By MW

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		0.20	ES		0.10	14.90		Grass over dark brown sandy slightly gravelly SILT with common roots and rootlets. Sand is fine to medium. Gravel is angular to subangular fine to medium flint. TOPSOIL
		0.60	ES		0.40	14.60		Brown sandy slightly gravelly SILT with common roots, rootlets and occasional cobbles. Sand is medium. Gravel is angular to subangular fine to coarse flint, brick, concrete, glass, and metal. TOPSOIL
		1.00	D		0.80	14.20		(Soft to firm) orangish brown silty slightly sandy gravelly CLAY with frequent black specks and occasional flint and rootlets. Sand is medium. Gravel is angular to subangular fine to coarse flint, brick. MADE GROUND
		1.20		N=30 (7,5/5,7,8,10)	1.20	13.80		Dense orangish brown slightly clayey very gravelly SAND. Sand is medium to coarse. Gravel is angular to subrounded fine to coarse flint. HEAD DEPOSITS
		1.30 - 1.60	B					*At 1.1m bgl: Lenses of stiff clay.*
		1.60		N=50 (8,12/50 for 260mm)				Very dense orangish brown slightly silty SAND and GRAVEL. Sand is medium to coarse. Gravel is angular to subangular fine to coarse flint. HEAD DEPOSITS
					1.86	13.14		*At 1.5m bgl: Layer of yellowish brown coarse sand.* End of borehole at 1.86 m

Remarks

GPS co-ordinates approximate. Levels approximated from topographic survey. Inspection pit hand-dug to 1.2m bgl. Refusal at 1.6m bgl. Hole terminated and backfilled with arisings.

Borehole Log

Borehole No. **WS104**

Sheet 1 of 2

Project Name: Acton Gardens - Phase 8	Project No. 073270	Co-ords: 520126.00 - 179672.00	Hole Type WS
Location: Brouncker Road, Acton, W3 8BA		Level: 14.50	Scale 1:25
Client: Countryside Properties Ltd.		Dates: 20/02/2020 - 20/02/2020	Logged By MW

Well	Water Strikes	Samples and In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
		0.15	ES		0.08	14.42		Asphalt. MADE GROUND
		0.60	ES		0.40	14.10		(Loose) dark brown and black silty very gravelly SAND with occasional cobbles, frequent ash, rare yellow sand lenses and a weak hydrocarbon odour. Sand is medium to coarse. Gravel is angular to subangular fine to coarse flint, brick, concrete, slate, metal and tile. MADE GROUND
		0.60 - 0.70	B		0.50	14.00		*Groundwater seepage had an oily sheen.*
		1.00	D		0.85	13.65		(Loose to medium dense) yellowish orange brown with grey mottling silty slightly sandy gravelly CLAY with occasional ash. Sand is medium. Gravel is angular to subangular fine to coarse flint. MADE GROUND
		1.00	ES					
		1.20	D					
		1.20		N=11 (1,2/2,3,3,3) HVP=77				(Loose to medium dense) yellowish orange very clayey sandy GRAVEL with occasional black ash and black concretions, sand and clay lenses. Sand is medium. Gravel is angular to subangular fine to coarse flint. MADE GROUND
		2.00	D		2.00	12.50		Firm to stiff orangish brown silty CLAY with frequent grey veins, black specks, orange fine sand lenses and rare flint. WEATHERED LONDON CLAY FORMATION
		2.00		N=11 (1,2/2,3,3,3) HVP=80				*From 1.2m bgl: Becoming stiffer and more brown in colour with depth.*
		2.50 - 3.00	B					Firm to stiff brown slightly silty CLAY with occasional black specks, grey veins and rare orange and yellow fine sand lenses. WEATHERED LONDON CLAY FORMATION
		3.00	D					
		3.00		N=10 (1,1/2,2,2,4)				
		3.70	D	HVP=83	3.50	11.00		Firm to stiff dark grey CLAY with occasional light grey veins and rare black specks. LONDON CLAY FORMATION
		4.00	D					
		4.00		N=12 (1,2/2,3,3,4)				
		4.60 - 5.00	B	HVP=78				
		5.00	D					

Continued on next sheet

Remarks

GPS co-ordinates approximate. Levels approximated from topographic survey. Inspection pit hand-dug to 1.2m bgl. 50mm standpipe installation to 5.0m bgl.

Borehole Log

Borehole No. **WS104**

Sheet 2 of 2

Project Name:	Acton Gardens - Phase 8	Project No. 073270	Co-ords:	520126.00 - 179672.00	Hole Type WS
Location:	Brouncker Road, Acton, W3 8BA		Level:	14.50	Scale 1:25
Client:	Countryside Properties Ltd.		Dates:	20/02/2020 - 20/02/2020	Logged By MW

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		5.00		N=12 (1,2/3,2,3,4)				
					5.45	9.05		End of borehole at 5.45 m

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Remarks

GPS co-ordinates approximate. Levels approximated from topographic survey. Inspection pit hand-dug to 1.2m bgl. 50mm standpipe installation to 5.0m bgl.

AGS

Borehole Log

Borehole No. **WS105**

Sheet 1 of 2

Project Name: Acton Gardens - Phase 8	Project No. 073270	Co-ords: 520095.65 - 179703.90	Hole Type WS
Location: Brouncker Road, Acton, W3 8BA		Level: 18.24	Scale 1:25
Client: Countryside Properties Ltd.		Dates: 21/02/2020 - 21/02/2020	Logged By MW

Well	Water Strikes	Samples and In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
		0.10	ES					Grass over dark brown clayey slightly sandy slightly gravelly SILT with common roots, rootlets and orangish brown clay pockets. Sand is medium to coarse. Gravel is angular to subrounded fine to coarse plastic, metal.
					0.30	17.94		MADE GROUND
		0.60	ES					(Loose to medium dense) multicoloured silty very gravelly SAND with occasional cobbles, clinker and charcoal. Sand is medium to coarse. Gravel is angular to subrounded fine to coarse brick, concrete, glass, metal and plastic.
	▼				0.90	17.34		MADE GROUND
		1.00	D					(Medium dense) dense black very silty slightly gravelly SAND with abundant ash and a weak hydrocarbon odour. Sand is medium to coarse. Gravel is angular to subangular fine to coarse flint, brick and glass.
		1.00	ES					MADE GROUND
		1.00		N=11 (1,2/2,2,3,4)				
					1.40	16.84		Medium dense brown orange and black very clayey SAND and GRAVEL with frequent black specks and concretions. Sand is medium to coarse. Gravel is angular to subangular fine to coarse flint.
		1.50 - 2.00	B					LYNCH HILL GRAVEL MEMBER
		2.00		N=10 (1,1/2,2,3,3)				
					2.10	16.14		Firm orangish brown with frequent grey veins silty CLAY with occasional orange sand lenses.
		2.50 - 3.00	B					WEATHERED LONDON CLAY FORMATION
				HVP=70				*From 2.5m bgl: Becoming browner with depth.*
		3.00		N=7 (1,0/1,2,1,3)				
		3.40	D		3.40	14.84		Stiff brown with frequent grey veins and grey mottling slightly silty CLAY with occasional orange sand lenses.
				HVP=58				LONDON CLAY FORMATION
								From 3.8m bgl: Becoming more greyish brown with depth.
		4.00		N=13 (2,2/3,3,3,4)				
		4.50	D					*Between 4.6 to 4.9m bgl: Layer of hard orangish brown fine silty sand.*
		5.00		N=14 (1,2/3,3,4,4)				

Continued on next sheet

Remarks

Inspection pit hand-dug to 1.0m bgl. Borehole backfilled with arisings.

AGS

Borehole Log

Borehole No.
WS105
Sheet 2 of 2

Project Name:	Acton Gardens - Phase 8	Project No. 073270	Co-ords:	520095.65 - 179703.90	Hole Type WS
Location:	Brouncker Road, Acton, W3 8BA		Level:	18.24	Scale 1:25
Client:	Countryside Properties Ltd.		Dates:	21/02/2020 - 21/02/2020	Logged By MW

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					5.45	12.79		End of borehole at 5.45 m

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Remarks
Inspection pit hand-dug to 1.0m bgl. Borehole backfilled with arisings.

Borehole Log

Borehole No. **WS106**

Sheet 1 of 1

Project Name: Acton Gardens - Phase 8	Project No. 073270	Co-ords: 520052.45 - 179739.97	Hole Type WS
Location: Brouncker Road, Acton, W3 8BA		Level: 19.67	Scale 1:25
Client: Countryside Properties Ltd.		Dates: 21/02/2020 - 21/02/2020	Logged By MW

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		0.10	ES					Grass over silty slightly sandy slightly gravelly CLAY with roots and rootlets. Sand is fine to medium. Gravel is angular to subangular fine to medium flint, brick and concrete.
					0.30	19.37		TOPSOIL
		0.50	ES					(Medium dense) brown and orange clayey very sandy GRAVEL with occasional ash and charcoal. Sand is medium to coarse. Gravel is angular to subangular fine to coarse flint.
					0.70	18.97		MADE GROUND
		1.00	D		1.00	18.67		(Firm to stiff) orangish brown mottled grey sandy very gravelly CLAY with occasional sandy lenses, black specks and concretions. Gravel is angular to subangular flint.
		1.00		N=8 (1,2/2,2,2,2)				MADE GROUND
		1.50 - 1.80	B					Interbedded SAND and GRAVEL and CLAY - Loose to medium dense orangish brown with dark brown and grey mottling clayey SAND and GRAVEL. Sand is medium to coarse. Gravel is angular to subangular fine to coarse flint. LYNCH HILL GRAVEL MEMBER
		1.80 - 2.40	B		1.80	17.87		Interbedded SAND and GRAVEL and CLAY - medium dense orangish brown clayey slightly gravelly SAND. Sand is medium to coarse. Gravel is angular to subangular fine to coarse flint.
		2.00		N=16 (4,4/4,4,4,4)				LYNCH HILL GRAVEL MEMBER
					2.40	17.27		Interbedded SAND and GRAVEL and CLAY - medium denser orangish brown clayey SAND and GRAVEL. Sand is medium to coarse. Gravel is angular to subangular fine to coarse flint.
					2.70	16.97		LYNCH HILL GRAVEL MEMBER
		2.80	D					Interbedded SAND and GRAVEL and CLAY - orangish brown very sandy CLAY. Sand is medium to coarse.
					2.90	16.77		LYNCH HILL GRAVEL MEMBER
		3.00		N=7 (6,3/2,1,2,2)	3.00	16.67		Interbedded SAND and GRAVEL and CLAY - orangish brown sandy gravelly CLAY. Sand is medium to coarse. Gravel is angular to subangular fine to coarse flint.
								LYNCH HILL GRAVEL MEMBER
					3.60	16.07		Interbedded SAND and GRAVEL and CLAY - loose to medium dense orangish brown clayey very sandy GRAVEL. Sand is medium to coarse. Gravel is angular to subangular fine to coarse flint.
		3.78	D					LYNCH HILL GRAVEL MEMBER
		4.00		N=8 (2,3/2,2,2,2)				Firm to stiff brown mottled orange slightly silty CLAY. WEATHERED LONDON CLAY FORMATION
					4.45	15.22		End of borehole at 4.45 m

Remarks

Inspection pit hand-dug to 1.0m bgl. Hole collapse at 4.0m bgl to 3.30m bgl. 50mm standpipe installation to 3.0m bgl.

Borehole Log

Borehole No. **WS107**

Sheet 1 of 2

Project Name: Acton Gardens - Phase 8	Project No. 073270	Co-ords: 520088.24 - 179738.98	Hole Type WS
Location: Brouncker Road, Acton, W3 8BA		Level: 18.75	Scale 1:25
Client: Countryside Properties Ltd.		Dates: 21/02/2020 - 21/02/2020	Logged By MW

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		0.10	ES					Grass over dark brown silty slightly sandy slightly gravelly CLAY with occasional rootlets, cobbles, ash and concretions. Sand is medium. Gravel is angular to subrounded fine to coarse flint, brick, concrete, tile and slate.
		0.40	ES		0.30	18.45		TOPSOIL
		0.60 - 0.80	B					(Soft) orangish brown clayey slightly sandy gravelly SILT with occasional ash and concretions. Sand is fine to medium. Gravel to angular to subrounded fine to coarse flint and brick.
								MADE GROUND
		1.20	D		1.20	17.55		
		1.20		N=7 (1,2/1,2,2,2)				Soft to firm orangish brown mottled grey silty slightly gravelly CLAY with occasional orange sand lenses. Gravel is angular to subangular fine to coarse flint.
				HVP=70				HEAD DEPOSITS
		1.70 - 1.90	B		1.70	17.05		Orangish brown very clayey sandy GRAVEL. Sand is medium to coarse. Gravel is angular to subangular fine to coarse flint.
		1.90	D					LYNCH HILL GRAVEL MEMBER
		2.00		N=13 (1,2/2,3,4,4)	2.00	16.75		*Between 1.9 to 2.0m bgl: Layer of bluish grey medium to coarse sand.*
								Firm to stiff orangish brown with frequent grey veins and grey mottling silty CLAY with common plant relics.
				HVP=82	2.70	16.05		WEATHERED LONDON CLAY FORMATION
		3.00		N=14 (1,2/3,3,4,4)				Firm to stiff brown and grey mottled with frequent grey veins slightly silty CLAY with occasional orangish yellow sand pockets.
		3.00 - 4.00	B					LONDON CLAY FORMATION
				HVP=104				
		4.00	D					
		4.00		N=18 (2,2/3,4,5,6)				
								Between 4.35 to 4.50m bgl: Layers of orangish brown very silty fine sand.
					4.50	14.25		Firm to stiff dark grey slightly silty CLAY.
								LONDON CLAY FORMATION
		4.90	D					
		5.00		N=11 (1,1/2,3,4)				

Continued on next sheet

Remarks

Inspection pit hand-dug to 1.2m bgl. 50mm standpipe installation to 4.0m bgl.

Borehole Log

Borehole No.
WS107
Sheet 2 of 2

Project Name:	Acton Gardens - Phase 8	Project No. 073270	Co-ords:	520088.24 - 179738.98	Hole Type WS
Location:	Brouncker Road, Acton, W3 8BA		Level:	18.75	Scale 1:25
Client:	Countryside Properties Ltd.		Dates:	21/02/2020 - 21/02/2020	Logged By MW

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					5.45	13.30		End of borehole at 5.45 m

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Remarks
Inspection pit hand-dug to 1.2m bgl. 50mm standpipe installation to 4.0m bgl.

AGS

Borehole Log

Borehole No. **WS108**

Sheet 1 of 2

Project Name: Acton Gardens - Phase 8	Project No. 073270	Co-ords: 520124.41 - 179752.29	Hole Type WS
Location: Brouncker Road, Acton, W3 8BA		Level: 17.29	Scale 1:25
Client: Countryside Properties Ltd.		Dates: 21/02/2020 - 21/02/2020	Logged By MW

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.20	ES		0.30	16.99		Grass over brown silty slightly sandy slightly gravelly CLAY with occasional rootlets, cobbles, ash and concretions. Sand is medium. Gravel is angular to subrounded fine to coarse flint, brick, concrete, tile and slate. TOPSOIL	
		0.40	ES					(Soft to firm) brown and orange very sandy gravelly SILT. Sand is medium. Gravel is angular to subangular fine to coarse flint, brick, concrete, tile and slate. MADE GROUND	
		0.80 - 1.00	B					*At 0.8m bgl: Whole bricks and concrete cobbles.*	
		1.00		N=5 (1,1/2,1,1,1)	1.00	16.29		(Loose) multicoloured very clayey SAND and GRAVEL. Gravel is angular to subangular fine to coarse flint, brick, concrete, tile and slate. MADE GROUND	1
	▼	1.60 - 2.00	B		1.60	15.69		Soft to firm orange brown and grey mottled silty CLAY with occasional black specks, plant relics and rare ironstone nodules. WEATHERED LONDON CLAY FORMATION	
				HVP=78					
		2.00		N=9 (1,1/2,2,2,3)					2
	▼								
		3.00		N=8 (1,1/2,2,2,2)	3.00	14.29		Soft to firm brown and grey slightly silty CLAY. LONDON CLAY FORMATION	3
		3.80	D						
				HVP=85					
		4.00		N=9 (1,1/2,2,2,3)					4
		4.50	D						
				HVP=52					
		5.00		N=10 (1,1/2,3,3)					5
								Continued on next sheet	

Remarks

Inspection pit hand-dug to 1.0m bgl. 50mm standpipe installation to 5.0m bgl.

Borehole Log

Borehole No.
WS108
Sheet 2 of 2

Project Name:	Acton Gardens - Phase 8	Project No. 073270	Co-ords:	520124.41 - 179752.29	Hole Type WS
Location:	Brouncker Road, Acton, W3 8BA		Level:	17.29	Scale 1:25
Client:	Countryside Properties Ltd.		Dates:	21/02/2020 - 21/02/2020	Logged By MW

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					5.45	11.84		End of borehole at 5.45 m

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Remarks
Inspection pit hand-dug to 1.0m bgl. 50mm standpipe installation to 5.0m bgl.

AGS

Appendix D Laboratory and In-Situ Testing Results

- Geo-environmental laboratory results;
- Geotechnical laboratory results;
- CBR (TRL-DCP) In-situ results; and
- Groundwater and ground gas monitoring results

Will Spraggs
Curtins
Rose Wharf
Ground Floor
78-80 East Street
Leeds
LS9 8EE

e: will.spraggs@curtins.com

i2 Analytical Ltd.
7 Woodshots Meadow,
Croxley Green
Business Park,
Watford,
Herts,
WD18 8YS

t: 01923 225404
f: 01923 237404
e: reception@i2analytical.com

Analytical Report Number : 20-12353

Replaces Analytical Report Number : 20-12353, issue no. 1

Additional analysis undertaken.

Project / Site name:	Acton Gardens Phase 8	**Samples received on:**	02/06/2020
Your job number:		**Sample instructed/ Analysis started on:**	02/06/2020
Your order number:	EBL0348	**Analysis completed by:**	17/06/2020
Report Issue Number:	2	**Report issued on:**	17/06/2020
Samples Analysed:	13 soil samples		

Signed: Karolina Marek

Karolina Marek
PL Head of Reporting Team

For & on behalf of i2 Analytical Ltd.

Standard Geotechnical, Asbestos and Chemical Testing Laboratory located at: ul. Pionierów 39, 41 -711 Ruda Śląska, Poland.

Accredited tests are defined within the report, opinions and interpretations expressed herein are outside the scope of accreditation.

Standard sample disposal times, unless otherwise agreed with the laboratory, are :

soils	- 4 weeks from reporting
leachates	- 2 weeks from reporting
waters	- 2 weeks from reporting
asbestos	- 6 months from reporting

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Any assessments of compliance with specifications are based on actual analytical results with no contribution from uncertainty of measurement. Application of uncertainty of measurement would provide a range within which the true result lies. An estimate of measurement uncertainty can be provided on request.

Analytical Report Number: 20-12353

Project / Site name: Acton Gardens Phase 8
Your Order No: EBL0348

Lab Sample Number				1524172	1524173	1524174	1524175	1524176
Sample Reference				CP101	BH1	BH1	BH1	BH1
Sample Number				ES1	D2	D20	D22	D25
Depth (m)				0.50	1.10	10.50	12.00	14.00
Date Sampled				28/05/2020	28/05/2020	28/05/2020	28/05/2020	28/05/2020
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Stone Content	%	0.1	NONE	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Moisture Content	%	N/A	NONE	9.8	8.6	17	17	16
Total mass of sample received	kg	0.001	NONE	1.3	0.85	0.76	0.81	0.82
Asbestos in Soil Screen / Identification Name	Type	N/A	ISO 17025	Amosite	-	-	-	-
Asbestos in Soil	Type	N/A	ISO 17025	Detected	-	-	-	-
Asbestos Quantification (Stage 2)	%	0.001	ISO 17025	0.006	-	-	-	-
Asbestos Quantification Total	%	0.001	ISO 17025	0.006	-	-	-	-
General Inorganics								
pH - Automated	pH Units	N/A	MCERTS	8.4	8.2	8.3	8.4	8.5
Total Sulphate as SO_4	%	0.005	MCERTS	-	-	0.077	0.117	-
Water Soluble Sulphate as SO_4 16hr extraction (2:1)	mg/kg	2.5	MCERTS	870	-	-	-	-
Water Soluble SO4 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	0.44	0.46	0.44	0.42	0.50
Water Soluble SO4 16hr extraction (2:1 Leachate Equivalent)	mg/l	1.25	MCERTS	437	-	441	425	-
Water Soluble Chloride (2:1) (leachate equivalent)	mg/l	0.5	MCERTS	-	-	18	32	-
Total Sulphur	%	0.005	MCERTS	-	-	0.409	0.417	-
Organic Matter	%	0.1	MCERTS	3.0	-	-	-	-
Water Soluble Nitrate (2:1) as N (leachate equivalent)	mg/l	2	NONE	-	-	< 2.0	< 2.0	-
Speciated PAHs								
Naphthalene	mg/kg	0.05	MCERTS	< 0.05	-	-	-	-
Acenaphthylene	mg/kg	0.05	MCERTS	< 0.05	-	-	-	-
Acenaphthene	mg/kg	0.05	MCERTS	< 0.05	-	-	-	-
Fluorene	mg/kg	0.05	MCERTS	< 0.05	-	-	-	-
Phenanthrene	mg/kg	0.05	MCERTS	1.3	-	-	-	-
Anthracene	mg/kg	0.05	MCERTS	0.38	-	-	-	-
Fluoranthene	mg/kg	0.05	MCERTS	3.1	-	-	-	-
Pyrene	mg/kg	0.05	MCERTS	3.1	-	-	-	-
Benzo(a)anthracene	mg/kg	0.05	MCERTS	2.0	-	-	-	-
Chrysene	mg/kg	0.05	MCERTS	1.8	-	-	-	-
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	2.2	-	-	-	-
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	1.4	-	-	-	-
Benzo(a)pyrene	mg/kg	0.05	MCERTS	2.1	-	-	-	-
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	1.4	-	-	-	-
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	0.39	-	-	-	-
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	1.5	-	-	-	-
Total PAH								
Speciated Total EPA-16 PAHs	mg/kg	0.8	MCERTS	20.6	-	-	-	-
Heavy Metals / Metalloids								
Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	34	-	-	-	-
Boron (water soluble)	mg/kg	0.2	MCERTS	2.1	-	-	-	-
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	0.7	-	-	-	-
Chromium (hexavalent)	mg/kg	1.2	MCERTS	< 1.2	-	-	-	-
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	31	-	-	-	-
Copper (aqua regia extractable)	mg/kg	1	MCERTS	250	-	-	-	-
Lead (aqua regia extractable)	mg/kg	1	MCERTS	370	-	-	-	-
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	1.2	-	-	-	-
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	41	-	-	-	-
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	2.3	-	-	-	-
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	270	-	-	-	-
Magnesium (water soluble)	mg/kg	5	NONE	-	-	54	54	-
Magnesium (leachate equivalent)	mg/l	2.5	NONE	-	-	27	27	-

Analytical Report Number: 20-12353

Project / Site name: Acton Gardens Phase 8
Your Order No: EBL0348

Lab Sample Number				1524172	1524173	1524174	1524175	1524176
Sample Reference				CP101	BH1	BH1	BH1	BH1
Sample Number				ES1	D2	D20	D22	D25
Depth (m)				0.50	1.10	10.50	12.00	14.00
Date Sampled				28/05/2020	28/05/2020	28/05/2020	28/05/2020	28/05/2020
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Monoaromatics & Oxygenates								
Benzene	µg/kg	1	MCERTS	< 1.0	-	-	-	-
Toluene	µg/kg	1	MCERTS	< 1.0	-	-	-	-
Ethylbenzene	µg/kg	1	MCERTS	< 1.0	-	-	-	-
p & m-xylene	µg/kg	1	MCERTS	< 1.0	-	-	-	-
o-xylene	µg/kg	1	MCERTS	< 1.0	-	-	-	-
MTBE (Methyl Tertiary Butyl Ether)	µg/kg	1	MCERTS	< 1.0	-	-	-	-
Petroleum Hydrocarbons								
TPH-CWG - Aliphatic >EC5 - EC6	mg/kg	0.001	MCERTS	< 0.001	-	-	-	-
TPH-CWG - Aliphatic >EC6 - EC8	mg/kg	0.001	MCERTS	< 0.001	-	-	-	-
TPH-CWG - Aliphatic >EC8 - EC10	mg/kg	0.001	MCERTS	< 0.001	-	-	-	-
TPH-CWG - Aliphatic >EC10 - EC12	mg/kg	1	MCERTS	< 1.0	-	-	-	-
TPH-CWG - Aliphatic >EC12 - EC16	mg/kg	2	MCERTS	< 2.0	-	-	-	-
TPH-CWG - Aliphatic >EC16 - EC21	mg/kg	8	MCERTS	< 8.0	-	-	-	-
TPH-CWG - Aliphatic >EC21 - EC35	mg/kg	8	MCERTS	< 8.0	-	-	-	-
TPH-CWG - Aliphatic (EC5 - EC35)	mg/kg	10	MCERTS	< 10	-	-	-	-
TPH-CWG - Aromatic >EC5 - EC7	mg/kg	0.001	MCERTS	< 0.001	-	-	-	-
TPH-CWG - Aromatic >EC7 - EC8	mg/kg	0.001	MCERTS	< 0.001	-	-	-	-
TPH-CWG - Aromatic >EC8 - EC10	mg/kg	0.001	MCERTS	< 0.001	-	-	-	-
TPH-CWG - Aromatic >EC10 - EC12	mg/kg	1	MCERTS	< 1.0	-	-	-	-
TPH-CWG - Aromatic >EC12 - EC16	mg/kg	2	MCERTS	< 2.0	-	-	-	-
TPH-CWG - Aromatic >EC16 - EC21	mg/kg	10	MCERTS	11	-	-	-	-
TPH-CWG - Aromatic >EC21 - EC35	mg/kg	10	MCERTS	26	-	-	-	-
TPH-CWG - Aromatic (EC5 - EC35)	mg/kg	10	MCERTS	37	-	-	-	-

Analytical Report Number: 20-12353

Project / Site name: Acton Gardens Phase 8
Your Order No: EBL0348

Lab Sample Number				1524177	1524178	1524179	1524180	1524181
Sample Reference				BH02	BH02	BH02	BH02	BH02
Sample Number				D29	D9	D15	D36	D40
Depth (m)				17.00	5.00	8.00	19.00	21.00
Date Sampled				28/05/2020	28/05/2020	28/05/2020	28/05/2020	28/05/2020
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Stone Content	%	0.1	NONE	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Moisture Content	%	N/A	NONE	16	18	17	19	16
Total mass of sample received	kg	0.001	NONE	0.81	0.76	0.79	0.80	0.83
Asbestos in Soil Screen / Identification Name	Type	N/A	ISO 17025	-	-	-	-	-
Asbestos in Soil	Type	N/A	ISO 17025	-	-	-	-	-
Asbestos Quantification (Stage 2)	%	0.001	ISO 17025	-	-	-	-	-
Asbestos Quantification Total	%	0.001	ISO 17025	-	-	-	-	-
General Inorganics								
pH - Automated	pH Units	N/A	MCERTS	8.4	8.3	8.2	8.9	8.8
Total Sulphate as SO_4	%	0.005	MCERTS	0.101	0.148	-	-	0.094
Water Soluble Sulphate as SO_4 16hr extraction (2:1)	mg/kg	2.5	MCERTS	-	-	-	-	-
Water Soluble SO4 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	0.47	0.72	0.85	0.67	0.42
Water Soluble SO4 16hr extraction (2:1 Leachate Equivalent)	mg/l	1.25	MCERTS	472	720	-	-	417
Water Soluble Chloride (2:1) (leachate equivalent)	mg/l	0.5	MCERTS	30	17	-	-	65
Total Sulphur	%	0.005	MCERTS	0.724	0.429	-	-	0.439
Organic Matter	%	0.1	MCERTS	-	-	-	-	-
Water Soluble Nitrate (2:1) as N (leachate equivalent)	mg/l	2	NONE	< 2.0	< 2.0	-	-	< 2.0
Speciated PAHs								
Naphthalene	mg/kg	0.05	MCERTS	-	-	-	-	-
Acenaphthylene	mg/kg	0.05	MCERTS	-	-	-	-	-
Acenaphthene	mg/kg	0.05	MCERTS	-	-	-	-	-
Fluorene	mg/kg	0.05	MCERTS	-	-	-	-	-
Phenanthrene	mg/kg	0.05	MCERTS	-	-	-	-	-
Anthracene	mg/kg	0.05	MCERTS	-	-	-	-	-
Fluoranthene	mg/kg	0.05	MCERTS	-	-	-	-	-
Pyrene	mg/kg	0.05	MCERTS	-	-	-	-	-
Benzo(a)anthracene	mg/kg	0.05	MCERTS	-	-	-	-	-
Chrysene	mg/kg	0.05	MCERTS	-	-	-	-	-
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	-	-	-	-	-
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	-	-	-	-	-
Benzo(a)pyrene	mg/kg	0.05	MCERTS	-	-	-	-	-
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	-	-	-	-	-
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	-	-	-	-	-
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	-	-	-	-	-
Total PAH								
Speciated Total EPA-16 PAHs	mg/kg	0.8	MCERTS	-	-	-	-	-
Heavy Metals / Metalloids								
Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	-	-	-	-	-
Boron (water soluble)	mg/kg	0.2	MCERTS	-	-	-	-	-
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	-	-	-	-	-
Chromium (hexavalent)	mg/kg	1.2	MCERTS	-	-	-	-	-
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	-	-	-	-	-
Copper (aqua regia extractable)	mg/kg	1	MCERTS	-	-	-	-	-
Lead (aqua regia extractable)	mg/kg	1	MCERTS	-	-	-	-	-
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	-	-	-	-	-
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	-	-	-	-	-
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	-	-	-	-	-
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	-	-	-	-	-
Magnesium (water soluble)	mg/kg	5	NONE	55	140	-	-	43
Magnesium (leachate equivalent)	mg/l	2.5	NONE	28	69	-	-	22

Analytical Report Number: 20-12353

Project / Site name: Acton Gardens Phase 8
Your Order No: EBL0348

Lab Sample Number				1524177	1524178	1524179	1524180	1524181
Sample Reference				BH02	BH02	BH02	BH02	BH02
Sample Number				D29	D9	D15	D36	D40
Depth (m)				17.00	5.00	8.00	19.00	21.00
Date Sampled				28/05/2020	28/05/2020	28/05/2020	28/05/2020	28/05/2020
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Monoaromatics & Oxygenates								
Benzene	µg/kg	1	MCERTS	-	-	-	-	-
Toluene	µg/kg	1	MCERTS	-	-	-	-	-
Ethylbenzene	µg/kg	1	MCERTS	-	-	-	-	-
p & m-xylene	µg/kg	1	MCERTS	-	-	-	-	-
o-xylene	µg/kg	1	MCERTS	-	-	-	-	-
MTBE (Methyl Tertiary Butyl Ether)	µg/kg	1	MCERTS	-	-	-	-	-
Petroleum Hydrocarbons								
TPH-CWG - Aliphatic >EC5 - EC6	mg/kg	0.001	MCERTS	-	-	-	-	-
TPH-CWG - Aliphatic >EC6 - EC8	mg/kg	0.001	MCERTS	-	-	-	-	-
TPH-CWG - Aliphatic >EC8 - EC10	mg/kg	0.001	MCERTS	-	-	-	-	-
TPH-CWG - Aliphatic >EC10 - EC12	mg/kg	1	MCERTS	-	-	-	-	-
TPH-CWG - Aliphatic >EC12 - EC16	mg/kg	2	MCERTS	-	-	-	-	-
TPH-CWG - Aliphatic >EC16 - EC21	mg/kg	8	MCERTS	-	-	-	-	-
TPH-CWG - Aliphatic >EC21 - EC35	mg/kg	8	MCERTS	-	-	-	-	-
TPH-CWG - Aliphatic (EC5 - EC35)	mg/kg	10	MCERTS	-	-	-	-	-
TPH-CWG - Aromatic >EC5 - EC7	mg/kg	0.001	MCERTS	-	-	-	-	-
TPH-CWG - Aromatic >EC7 - EC8	mg/kg	0.001	MCERTS	-	-	-	-	-
TPH-CWG - Aromatic >EC8 - EC10	mg/kg	0.001	MCERTS	-	-	-	-	-
TPH-CWG - Aromatic >EC10 - EC12	mg/kg	1	MCERTS	-	-	-	-	-
TPH-CWG - Aromatic >EC12 - EC16	mg/kg	2	MCERTS	-	-	-	-	-
TPH-CWG - Aromatic >EC16 - EC21	mg/kg	10	MCERTS	-	-	-	-	-
TPH-CWG - Aromatic >EC21 - EC35	mg/kg	10	MCERTS	-	-	-	-	-
TPH-CWG - Aromatic (EC5 - EC35)	mg/kg	10	MCERTS	-	-	-	-	-

Analytical Report Number: 20-12353

Project / Site name: Acton Gardens Phase 8
Your Order No: EBL0348

Lab Sample Number				1524182	1525922	1525923		
Sample Reference				BH02	BH02	BH02		
Sample Number				D43	D3	D26		
Depth (m)				23.00	2.00	14.00		
Date Sampled				28/05/2020	28/05/2020	28/05/2020		
Time Taken				None Supplied	None Supplied	None Supplied		
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Stone Content	%	0.1	NONE	< 0.1	< 0.1	< 0.1		
Moisture Content	%	N/A	NONE	15	21	17		
Total mass of sample received	kg	0.001	NONE	0.83	1.2	0.50		
Asbestos in Soil Screen / Identification Name	Type	N/A	ISO 17025	-	-	-		
Asbestos in Soil	Type	N/A	ISO 17025	-	-	-		
Asbestos Quantification (Stage 2)	%	0.001	ISO 17025	-	-	-		
Asbestos Quantification Total	%	0.001	ISO 17025	-	-	-		
General Inorganics								
pH - Automated	pH Units	N/A	MCERTS	8.5	8.0	8.9		
Total Sulphate as SO_4	%	0.005	MCERTS	-	0.207	0.108		
Water Soluble Sulphate as SO_4 16hr extraction (2:1)	mg/kg	2.5	MCERTS	-	-	-		
Water Soluble SO4 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	0.78	0.23	0.49		
Water Soluble SO4 16hr extraction (2:1 Leachate Equivalent)	mg/l	1.25	MCERTS	-	226	493		
Water Soluble Chloride (2:1) (leachate equivalent)	mg/l	0.5	MCERTS	-	11	39		
Total Sulphur	%	0.005	MCERTS	-	0.084	0.288		
Organic Matter	%	0.1	MCERTS	-	-	-		
Water Soluble Nitrate (2:1) as N (leachate equivalent)	mg/l	2	NONE	-	< 2.0	< 2.0		
Speciated PAHs								
Naphthalene	mg/kg	0.05	MCERTS	-	-	-		
Acenaphthylene	mg/kg	0.05	MCERTS	-	-	-		
Acenaphthene	mg/kg	0.05	MCERTS	-	-	-		
Fluorene	mg/kg	0.05	MCERTS	-	-	-		
Phenanthrene	mg/kg	0.05	MCERTS	-	-	-		
Anthracene	mg/kg	0.05	MCERTS	-	-	-		
Fluoranthene	mg/kg	0.05	MCERTS	-	-	-		
Pyrene	mg/kg	0.05	MCERTS	-	-	-		
Benzo(a)anthracene	mg/kg	0.05	MCERTS	-	-	-		
Chrysene	mg/kg	0.05	MCERTS	-	-	-		
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	-	-	-		
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	-	-	-		
Benzo(a)pyrene	mg/kg	0.05	MCERTS	-	-	-		
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	-	-	-		
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	-	-	-		
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	-	-	-		
Total PAH								
Speciated Total EPA-16 PAHs	mg/kg	0.8	MCERTS	-	-	-		
Heavy Metals / Metalloids								
Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	-	-	-		
Boron (water soluble)	mg/kg	0.2	MCERTS	-	-	-		
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	-	-	-		
Chromium (hexavalent)	mg/kg	1.2	MCERTS	-	-	-		
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	-	-	-		
Copper (aqua regia extractable)	mg/kg	1	MCERTS	-	-	-		
Lead (aqua regia extractable)	mg/kg	1	MCERTS	-	-	-		
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	-	-	-		
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	-	-	-		
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	-	-	-		
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	-	-	-		
Magnesium (water soluble)	mg/kg	5	NONE	-	57	71		
Magnesium (leachate equivalent)	mg/l	2.5	NONE	-	28	35		

Analytical Report Number: 20-12353

Project / Site name: Acton Gardens Phase 8
Your Order No: EBL0348

Lab Sample Number				1524182	1525922	1525923		
Sample Reference				BH02	BH02	BH02		
Sample Number				D43	D3	D26		
Depth (m)				23.00	2.00	14.00		
Date Sampled				28/05/2020	28/05/2020	28/05/2020		
Time Taken				None Supplied	None Supplied	None Supplied		
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Monoaromatics & Oxygenates								
Benzene	µg/kg	1	MCERTS	-	-	-		
Toluene	µg/kg	1	MCERTS	-	-	-		
Ethylbenzene	µg/kg	1	MCERTS	-	-	-		
p & m-xylene	µg/kg	1	MCERTS	-	-	-		
o-xylene	µg/kg	1	MCERTS	-	-	-		
MTBE (Methyl Tertiary Butyl Ether)	µg/kg	1	MCERTS	-	-	-		
Petroleum Hydrocarbons								
TPH-CWG - Aliphatic >EC5 - EC6	mg/kg	0.001	MCERTS	-	-	-		
TPH-CWG - Aliphatic >EC6 - EC8	mg/kg	0.001	MCERTS	-	-	-		
TPH-CWG - Aliphatic >EC8 - EC10	mg/kg	0.001	MCERTS	-	-	-		
TPH-CWG - Aliphatic >EC10 - EC12	mg/kg	1	MCERTS	-	-	-		
TPH-CWG - Aliphatic >EC12 - EC16	mg/kg	2	MCERTS	-	-	-		
TPH-CWG - Aliphatic >EC16 - EC21	mg/kg	8	MCERTS	-	-	-		
TPH-CWG - Aliphatic >EC21 - EC35	mg/kg	8	MCERTS	-	-	-		
TPH-CWG - Aliphatic (EC5 - EC35)	mg/kg	10	MCERTS	-	-	-		
TPH-CWG - Aromatic >EC5 - EC7	mg/kg	0.001	MCERTS	-	-	-		
TPH-CWG - Aromatic >EC7 - EC8	mg/kg	0.001	MCERTS	-	-	-		
TPH-CWG - Aromatic >EC8 - EC10	mg/kg	0.001	MCERTS	-	-	-		
TPH-CWG - Aromatic >EC10 - EC12	mg/kg	1	MCERTS	-	-	-		
TPH-CWG - Aromatic >EC12 - EC16	mg/kg	2	MCERTS	-	-	-		
TPH-CWG - Aromatic >EC16 - EC21	mg/kg	10	MCERTS	-	-	-		
TPH-CWG - Aromatic >EC21 - EC35	mg/kg	10	MCERTS	-	-	-		
TPH-CWG - Aromatic (EC5 - EC35)	mg/kg	10	MCERTS	-	-	-		

Analytical Report Number: 20-12353
Project / Site name: Acton Gardens Phase 8
Your Order No: EBL0348

Certificate of Analysis - Asbestos Quantification

Methods:

Qualitative Analysis

The samples were analysed qualitatively for asbestos by polarising light and dispersion staining as described by the Health and Safety Executive in HSG 248.

Quantitative Analysis

The analysis was carried out using our documented in-house method A006-PL based on HSE Contract Research Report No: 83/1996: Development and Validation of an analytical method to determine the amount of asbestos in soils and loose aggregates (Davies et al, 1996) and HSG 248. Our method includes initial examination of the entire representative sample, then fractionation and detailed analysis of each fraction, with quantification by hand picking and weighing.

The limit of detection (reporting limit) of this method is 0.001 %.

The method has been validated using samples of at least 100 g, results for samples smaller than this should be interpreted with caution.

Both Qualitative and Quantitative Analyses are UKAS accredited.

Sample Number	Sample ID	Sample Depth (m)	Sample Weight (g)	Asbestos Containing Material Types Detected (ACM)	PLM Results	Asbestos by hand picking/weighing (%)	Total % Asbestos in Sample
1524172	CP101	0.50	124	Sheeting/Board Debris	**Amosite**	0.006	**0.006**

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

Analytical Report Number : 20-12353

Project / Site name: Acton Gardens Phase 8

* These descriptions are only intended to act as a cross check if sample identities are questioned. The major constituent of the sample is intended to act with respect to MCERTS validation. The laboratory is accredited for sand, clay and loam (MCERTS) soil types. Data for unaccredited types of solid should be interpreted with care.

Stone content of a sample is calculated as the % weight of the stones not passing a 10 mm sieve. Results are not corrected for stone content.

Lab Sample Number	Sample Reference	Sample Number	Depth (m)	Sample Description *
1524172	CP101	ES1	0.50	Brown loam with gravel and vegetation.
1524173	BH1	D2	1.10	Brown loam with gravel and vegetation.
1524174	BH1	D20	10.50	Brown clay.
1524175	BH1	D22	12.00	Brown clay.
1524176	BH1	D25	14.00	Brown clay.
1524177	BH02	D29	17.00	Brown clay.
1524178	BH02	D9	5.00	Brown clay.
1524179	BH02	D15	8.00	Brown clay.
1524180	BH02	D36	19.00	Brown clay.
1524181	BH02	D40	21.00	Brown clay.
1524182	BH02	D43	23.00	Brown clay.
1525922	BH02	D3	2.00	Brown clay.
1525923	BH02	D26	14.00	Brown clay.

Analytical Report Number : 20-12353

Project / Site name: Acton Gardens Phase 8

Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Water (PrW)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Asbestos identification in soil	Asbestos Identification with the use of polarised light microscopy in conjunction with disperion staining techniques.	In house method based on HSG 248	A001-PL	D	ISO 17025
Asbestos Quantification - Gravimetric	Asbestos quantification by gravimetric method - in house method based on references.	HSE Report No: 83/1996, HSG 248, HSG 264 & SCA Blue Book (draft).	A006-PL	D	ISO 17025
Boron, water soluble, in soil	Determination of water soluble boron in soil by hot water extract followed by ICP-OES.	In-house method based on Second Site Properties version 3	L038-PL	D	MCERTS
BTEX and MTBE in soil (Monoaromatics)	Determination of BTEX in soil by headspace GC-MS.	In-house method based on USEPA8260	L073B-PL	W	MCERTS
Chloride, water soluble, in soil	Determination of Chloride colorimetrically by discrete analyser.	In house method.	L082-PL	D	MCERTS
Hexavalent chromium in soil (Lower Level)	Determination of hexavalent chromium in soil by extraction in water then by acidification, addition of 1,5 diphenylcarbazide followed by colorimetry.	In-house method	L080-PL	W	MCERTS
Magnesium, water soluble, in soil	Determination of water soluble magnesium by extraction with water followed by ICP-OES.	In-house method based on TRL 447	L038-PL	D	NONE
Metals in soil by ICP-OES	Determination of metals in soil by aqua-regia digestion followed by ICP-OES.	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil.	L038-PL	D	MCERTS
Moisture Content	Moisture content, determined gravimetrically. (30 oC)	In house method.	L019-UK/PL	W	NONE
Organic matter (Automated) in soil	Determination of organic matter in soil by oxidising with potassium dichromate followed by titration with iron (II) sulphate.	In house method.	L009-PL	D	MCERTS
pH in soil (automated)	Determination of pH in soil by addition of water followed by automated electrometric measurement.	In house method.	L099-PL	D	MCERTS
Speciated EPA-16 PAHs in soil	Determination of PAH compounds in soil by extraction in dichloromethane and hexane followed by GC-MS with the use of surrogate and internal standards.	In-house method based on USEPA 8270	L064-PL	D	MCERTS
Stones content of soil	Standard preparation for all samples unless otherwise detailed. Gravimetric determination of stone > 10 mm as % dry weight.	In-house method based on British Standard Methods and MCERTS requirements.	L019-UK/PL	D	NONE
Sulphate, water soluble, in soil (16hr extraction)	Determination of water soluble sulphate by ICP-OES. Results reported directly (leachate equivalent) and corrected for extraction ratio (soil equivalent).	In house method.	L038-PL	D	MCERTS
Total Sulphate in soil as %	Determination of total sulphate in soil by extraction with 10% HCl followed by ICP-OES.	In house method.	L038-PL	D	MCERTS
Total Sulphur in soil as %	Determination of total sulphur in soil by extraction with aqua-regia, potassium bromide/bromate followed by ICP-OES.	In house method.	L038-PL	D	MCERTS
TPHCWG (Soil)	Determination of hexane extractable hydrocarbons in soil by GC-MS/GC-FID.	In-house method with silica gel split/clean up.	L088/76-PL	W	MCERTS

Analytical Report Number : 20-12353

Project / Site name: Acton Gardens Phase 8

Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Water (PrW)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Water Soluble Nitrate (2:1) as N in soil	Determination of nitrate by reaction with sodium salicylate and colorimetry.	In-house method based on Examination of Water and Wastewatern & Polish Standard Method PN-82/C-04579.08, 2:1 extraction.	L078-PL	W	NONE

For method numbers ending in 'UK' analysis have been carried out in our laboratory in the United Kingdom.
For method numbers ending in 'PL' analysis have been carried out in our laboratory in Poland.
Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC.

Sample ID	Other_ID	Sample Type	Job	Sample Number	Sample Deviation Code	test_name	test_ref	Test Deviation code
CP101	ES1	S	20-12353	1524172	b	BTEX and MTBE in soil (Monoaromatics)	L073B-PL	b
CP101	ES1	S	20-12353	1524172	b	Speciated EPA-16 PAHs in soil	L064-PL	b
CP101	ES1	S	20-12353	1524172	b	TPHCWG (Soil)	L088/76-PL	b

Key: a - No sampling date b - Incorrect container
c - Holding time d - Headspace e - Temperature

Myfanwy Wood
Curtins
Units 5/6
40 Compton Street
London
EC1V 0BD

e: myfanwy.wood@curtins.com

i2 Analytical Ltd.
7 Woodshots Meadow,
Croxley Green
Business Park,
Watford,
Herts,
WD18 8YS

t: 01923 225404
f: 01923 237404
e: reception@i2analytical.com

Analytical Report Number : 20-89835

Replaces Analytical Report Number : 20-89835, issue no. 1

Additional analysis undertaken.

Project / Site name:	Acton Gardens	**Samples received on:**	25/02/2020
Your job number:	073270	**Samples instructed on:**	28/02/2020
Your order number:	EBLO304	**Analysis completed by:**	16/03/2020
Report Issue Number:	2	**Report issued on:**	16/03/2020
Samples Analysed:	10 soil samples		

Signed:

Rachel Bradley

Deputy Quality Manager
For & on behalf of i2 Analytical Ltd.

Standard Geotechnical, Asbestos and Chemical Testing Laboratory located at: ul. Pionierów 39, 41 -711 Ruda Śląska, Poland.

Accredited tests are defined within the report, opinions and interpretations expressed herein are outside the scope of accreditation.

Standard sample disposal times, unless otherwise agreed with the laboratory, are :

soils	- 4 weeks from reporting
leachates	- 2 weeks from reporting
waters	- 2 weeks from reporting
asbestos	- 6 months from reporting

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Any assessments of compliance with specifications are based on actual analytical results with no contribution from uncertainty of measurement. Application of uncertainty of measurement would provide a range within which the true result lies. An estimate of measurement uncertainty can be provided on request.

Analytical Report Number: 20-89835

Project / Site name: Acton Gardens
Your Order No: EBLO304

Lab Sample Number				1457847	1457848	1457849	1457850	1457852
Sample Reference				WS101	WS103	WS104	CP105	WS105
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.10	0.20	0.15	0.30	1.00
Date Sampled				20/02/2020	20/02/2020	20/02/2020	19/02/2020	21/02/2020
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Stone Content	%	0.1	NONE	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Moisture Content	%	N/A	NONE	10	13	18	8.2	17
Total mass of sample received	kg	0.001	NONE	1.3	1.3	1.3	1.3	1.3
Asbestos in Soil Screen / Identification Name	Type	N/A	ISO 17025	Chrysotile	-	Chrysotile & Amosite	-	-
Asbestos in Soil	Type	N/A	ISO 17025	Detected	Not-detected	Detected	Not-detected	Not-detected
Asbestos Quantification (Stage 2)	%	0.001	ISO 17025	< 0.001	-	< 0.001	-	-
Asbestos Quantification Total	%	0.001	ISO 17025	< 0.001	-	< 0.001	-	-
General Inorganics								
pH - Automated	pH Units	N/A	MCERTS	8.3	7.9	7.7	8.0	7.5
Total Cyanide	mg/kg	1	MCERTS	3	< 1	15	< 1	< 1
Water Soluble Sulphate as SO_4 16hr extraction (2:1)	mg/kg	2.5	MCERTS	340	84	970	44	700
Water Soluble SO4 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	0.17	0.042	0.49	0.022	0.35
Water Soluble SO4 16hr extraction (2:1 Leachate Equivalent)	mg/l	1.25	MCERTS	172	42.2	486	22.1	351
Organic Matter	%	0.1	MCERTS	6.5	2.2	4.3	0.9	4.8
Total Phenols								
Total Phenols (monohydric)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Speciated PAHs								
Naphthalene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Acenaphthylene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Acenaphthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Fluorene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Phenanthrene	mg/kg	0.05	MCERTS	0.34	0.28	1.2	< 0.05	1.3
Anthracene	mg/kg	0.05	MCERTS	0.17	< 0.05	0.42	< 0.05	0.43
Fluoranthene	mg/kg	0.05	MCERTS	1.3	0.71	4.8	0.45	2.5
Pyrene	mg/kg	0.05	MCERTS	1.5	0.70	4.9	0.41	2.5
Benzo(a)anthracene	mg/kg	0.05	MCERTS	0.96	0.36	3.0	< 0.05	1.7
Chrysene	mg/kg	0.05	MCERTS	0.88	0.37	2.4	< 0.05	1.7
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	1.4	0.52	3.8	< 0.05	1.9
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	0.75	0.25	2.2	< 0.05	1.6
Benzo(a)pyrene	mg/kg	0.05	MCERTS	1.4	0.49	3.6	< 0.05	2.3
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	0.74	0.20	1.6	< 0.05	1.2
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	0.63	< 0.05	0.41
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	0.94	0.22	1.8	< 0.05	1.3
Total PAH								
Speciated Total EPA-16 PAHs	mg/kg	0.8	MCERTS	10.4	4.10	30.2	0.86	18.8
Heavy Metals / Metalloids								
Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	25	19	43	12	35
Boron (water soluble)	mg/kg	0.2	MCERTS	0.8	0.9	3.5	0.8	7.9
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	3.1	1.5	16	< 0.2	< 0.2
Chromium (hexavalent)	mg/kg	1.2	MCERTS	< 1.2	< 1.2	< 1.2	< 1.2	< 1.2
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	30	31	55	23	37
Copper (aqua regia extractable)	mg/kg	1	MCERTS	230	150	530	30	150
Lead (aqua regia extractable)	mg/kg	1	MCERTS	230	240	490	95	360
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3	1.0	1.0	< 0.3	2.1
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	63	45	69	20	39
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	360	350	930	100	430

Analytical Report Number: 20-89835

Project / Site name: Acton Gardens
Your Order No: EBLO304

Lab Sample Number				1457847	1457848	1457849	1457850	1457852
Sample Reference				WS101	WS103	WS104	CP105	WS105
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.10	0.20	0.15	0.30	1.00
Date Sampled				20/02/2020	20/02/2020	20/02/2020	19/02/2020	21/02/2020
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Monoaromatics & Oxygenates								
Benzene	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Toluene	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Ethylbenzene	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
p & m-xylene	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
o-xylene	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
MTBE (Methyl Tertiary Butyl Ether)	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Petroleum Hydrocarbons								
TPH-CWG - Aliphatic >EC5 - EC6	mg/kg	0.001	MCERTS	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
TPH-CWG - Aliphatic >EC6 - EC8	mg/kg	0.001	MCERTS	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
TPH-CWG - Aliphatic >EC8 - EC10	mg/kg	0.001	MCERTS	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
TPH-CWG - Aliphatic >EC10 - EC12	mg/kg	1	MCERTS	1.4	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aliphatic >EC12 - EC16	mg/kg	2	MCERTS	5.7	< 2.0	5.1	< 2.0	< 2.0
TPH-CWG - Aliphatic >EC16 - EC21	mg/kg	8	MCERTS	25	< 8.0	29	< 8.0	< 8.0
TPH-CWG - Aliphatic >EC21 - EC35	mg/kg	8	MCERTS	230	< 8.0	330	< 8.0	< 8.0
TPH-CWG - Aliphatic (EC5 - EC35)	mg/kg	10	MCERTS	260	< 10	370	< 10	< 10
TPH-CWG - Aromatic >EC5 - EC7	mg/kg	0.001	MCERTS	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
TPH-CWG - Aromatic >EC7 - EC8	mg/kg	0.001	MCERTS	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
TPH-CWG - Aromatic >EC8 - EC10	mg/kg	0.001	MCERTS	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
TPH-CWG - Aromatic >EC10 - EC12	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aromatic >EC12 - EC16	mg/kg	2	MCERTS	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
TPH-CWG - Aromatic >EC16 - EC21	mg/kg	10	MCERTS	14	< 10	25	< 10	< 10
TPH-CWG - Aromatic >EC21 - EC35	mg/kg	10	MCERTS	230	< 10	340	< 10	21
TPH-CWG - Aromatic (EC5 - EC35)	mg/kg	10	MCERTS	250	< 10	370	< 10	28

Analytical Report Number: 20-89835

Project / Site name: Acton Gardens
Your Order No: EBLO304

Lab Sample Number				1457853	1457854	1457855	1458176	
Sample Reference				WS106	WS107	WS108	CP104	
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	
Depth (m)				0.50	0.60	0.20	1.00	
Date Sampled				21/02/2020	21/02/2020	21/02/2020	19/02/2020	
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Stone Content	%	0.1	NONE	< 0.1	< 0.1	< 0.1	< 0.1	
Moisture Content	%	N/A	NONE	7.9	12	13	5.9	
Total mass of sample received	kg	0.001	NONE	1.3	1.3	1.3	1.3	
Asbestos in Soil Screen / Identification Name	Type	N/A	ISO 17025	-	-	-	-	
Asbestos in Soil	Type	N/A	ISO 17025	Not-detected	Not-detected	Not-detected	Not-detected	
Asbestos Quantification (Stage 2)	%	0.001	ISO 17025	-	-	-	-	
Asbestos Quantification Total	%	0.001	ISO 17025	-	-	-	-	
General Inorganics								
pH - Automated	pH Units	N/A	MCERTS	7.9	7.1	7.9	8.2	
Total Cyanide	mg/kg	1	MCERTS	< 1	< 1	< 1	< 1	
Water Soluble Sulphate as SO_4 16hr extraction (2:1)	mg/kg	2.5	MCERTS	110	94	51	23	
Water Soluble SO4 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	0.054	0.047	0.026	0.012	
Water Soluble SO4 16hr extraction (2:1 Leachate Equivalent)	mg/l	1.25	MCERTS	54.1	47.0	25.5	11.5	
Organic Matter	%	0.1	MCERTS	0.8	1.5	2.3	< 0.1	
Total Phenols								
Total Phenols (monohydric)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	
Speciated PAHs								
Naphthalene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	
Acenaphthylene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	
Acenaphthene	mg/kg	0.05	MCERTS	0.47	< 0.05	< 0.05	< 0.05	
Fluorene	mg/kg	0.05	MCERTS	0.54	< 0.05	< 0.05	< 0.05	
Phenanthrene	mg/kg	0.05	MCERTS	6.4	< 0.05	0.57	< 0.05	
Anthracene	mg/kg	0.05	MCERTS	1.2	< 0.05	0.17	< 0.05	
Fluoranthene	mg/kg	0.05	MCERTS	11	0.39	1.8	< 0.05	
Pyrene	mg/kg	0.05	MCERTS	9.5	0.40	1.7	< 0.05	
Benzo(a)anthracene	mg/kg	0.05	MCERTS	3.9	< 0.05	0.64	< 0.05	
Chrysene	mg/kg	0.05	MCERTS	3.0	< 0.05	0.80	< 0.05	
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	3.2	< 0.05	0.64	< 0.05	
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	1.5	< 0.05	0.57	< 0.05	
Benzo(a)pyrene	mg/kg	0.05	MCERTS	2.9	< 0.05	0.78	< 0.05	
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	1.2	< 0.05	0.38	< 0.05	
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	0.46	< 0.05	< 0.05	< 0.05	
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	1.4	< 0.05	0.37	< 0.05	
Total PAH								
Speciated Total EPA-16 PAHs	mg/kg	0.8	MCERTS	47.1	< 0.80	8.40	< 0.80	
Heavy Metals / Metalloids								
Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	14	8.1	15	8.0	
Boron (water soluble)	mg/kg	0.2	MCERTS	1.0	0.9	1.7	0.3	
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	< 0.2	< 0.2	0.6	< 0.2	
Chromium (hexavalent)	mg/kg	1.2	MCERTS	< 1.2	< 1.2	< 1.2	< 1.2	
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	26	18	40	16	
Copper (aqua regia extractable)	mg/kg	1	MCERTS	22	14	88	6.7	
Lead (aqua regia extractable)	mg/kg	1	MCERTS	77	41	120	7.0	
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	0.6	< 0.3	< 0.3	< 0.3	
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	21	10	25	16	
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	48	41	140	14	

Analytical Report Number: 20-89835

Project / Site name: Acton Gardens
Your Order No: EBLO304

Lab Sample Number				1457853	1457854	1457855	1458176	
Sample Reference				WS106	WS107	WS108	CP104	
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	
Depth (m)				0.50	0.60	0.20	1.00	
Date Sampled				21/02/2020	21/02/2020	21/02/2020	19/02/2020	
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Monoaromatics & Oxygenates								
Benzene	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	
Toluene	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	
Ethylbenzene	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	
p & m-xylene	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	
o-xylene	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	
MTBE (Methyl Tertiary Butyl Ether)	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	

Petroleum Hydrocarbons

TPH-CWG - Aliphatic >EC5 - EC6	mg/kg	0.001	MCERTS	< 0.001	< 0.001	< 0.001	< 0.001	
TPH-CWG - Aliphatic >EC6 - EC8	mg/kg	0.001	MCERTS	< 0.001	< 0.001	< 0.001	< 0.001	
TPH-CWG - Aliphatic >EC8 - EC10	mg/kg	0.001	MCERTS	< 0.001	< 0.001	< 0.001	< 0.001	
TPH-CWG - Aliphatic >EC10 - EC12	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	
TPH-CWG - Aliphatic >EC12 - EC16	mg/kg	2	MCERTS	< 2.0	< 2.0	< 2.0	< 2.0	
TPH-CWG - Aliphatic >EC16 - EC21	mg/kg	8	MCERTS	< 8.0	< 8.0	< 8.0	< 8.0	
TPH-CWG - Aliphatic >EC21 - EC35	mg/kg	8	MCERTS	< 8.0	< 8.0	< 8.0	< 8.0	
TPH-CWG - Aliphatic (EC5 - EC35)	mg/kg	10	MCERTS	< 10	< 10	< 10	< 10	

TPH-CWG - Aromatic >EC5 - EC7	mg/kg	0.001	MCERTS	< 0.001	< 0.001	< 0.001	< 0.001	
TPH-CWG - Aromatic >EC7 - EC8	mg/kg	0.001	MCERTS	< 0.001	< 0.001	< 0.001	< 0.001	
TPH-CWG - Aromatic >EC8 - EC10	mg/kg	0.001	MCERTS	< 0.001	< 0.001	< 0.001	< 0.001	
TPH-CWG - Aromatic >EC10 - EC12	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	
TPH-CWG - Aromatic >EC12 - EC16	mg/kg	2	MCERTS	5.0	< 2.0	< 2.0	< 2.0	
TPH-CWG - Aromatic >EC16 - EC21	mg/kg	10	MCERTS	36	< 10	< 10	< 10	
TPH-CWG - Aromatic >EC21 - EC35	mg/kg	10	MCERTS	32	< 10	< 10	< 10	
TPH-CWG - Aromatic (EC5 - EC35)	mg/kg	10	MCERTS	74	< 10	< 10	< 10	

Analytical Report Number: 20-89835
Project / Site name: Acton Gardens
Your Order No: EBLO304

Certificate of Analysis - Asbestos Quantification

Methods:

Qualitative Analysis

The samples were analysed qualitatively for asbestos by polarising light and dispersion staining as described by the Health and Safety Executive in HSG 248.

Quantitative Analysis

The analysis was carried out using our documented in-house method A006-PL based on HSE Contract Research Report No: 83/1996: Development and Validation of an analytical method to determine the amount of asbestos in soils and loose aggregates (Davies et al, 1996) and HSG 248. Our method includes initial examination of the entire representative sample, then fractionation and detailed analysis of each fraction, with quantification by hand picking and weighing.

The limit of detection (reporting limit) of this method is 0.001 %.

The method has been validated using samples of at least 100 g, results for samples smaller than this should be interpreted with caution.

Both Qualitative and Quantitative Analyses are UKAS accredited.

Sample Number	Sample ID	Sample Depth (m)	Sample Weight (g)	Asbestos Containing Material Types Detected (ACM)	PLM Results	Asbestos by hand picking/weighing (%)	Total % Asbestos in Sample
1457847	WS101	0.10	127	Loose Fibres	**Chrysotile**	< 0.001	**< 0.001**
1457849	WS104	0.15	169	Loose Fibres	**Chrysotile & Amosite**	< 0.001	**< 0.001**

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

Analytical Report Number : 20-89835

Project / Site name: Acton Gardens

* These descriptions are only intended to act as a cross check if sample identities are questioned. The major constituent of the sample is intended to act with respect to MCERTS validation. The laboratory is accredited for sand, clay and loam (MCERTS) soil types. Data for unaccredited types of solid should be interpreted with care.

Stone content of a sample is calculated as the % weight of the stones not passing a 10 mm sieve. Results are not corrected for stone content.

Lab Sample Number	Sample Reference	Sample Number	Depth (m)	Sample Description *
1457847	WS101	None Supplied	0.10	Brown loam and clay with gravel.
1457848	WS103	None Supplied	0.20	Brown clay and loam with gravel and vegetation.
1457849	WS104	None Supplied	0.15	Brown clay and loam with gravel and vegetation.
1457850	CP105	None Supplied	0.30	Brown clay and loam with gravel.
1457852	WS105	None Supplied	1.00	Brown loam and clay with gravel and brick.
1457853	WS106	None Supplied	0.50	Brown clay and loam with gravel and vegetation.
1457854	WS107	None Supplied	0.60	Brown loam and clay with gravel.
1457855	WS108	None Supplied	0.20	Brown loam and clay with gravel.
1458176	CP104	None Supplied	1.00	Brown sand with gravel.

Analytical Report Number : 20-89835

Project / Site name: Acton Gardens

Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Water (PrW)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Asbestos identification in soil	Asbestos Identification with the use of polarised light microscopy in conjunction with disperion staining techniques.	In house method based on HSG 248	A001-PL	D	ISO 17025
Asbestos Quantification - Gravimetric	Asbestos quantification by gravimetric method - in house method based on references.	HSE Report No: 83/1996, HSG 248, HSG 264 & SCA Blue Book (draft).	A006-PL	D	ISO 17025
Boron, water soluble, in soil	Determination of water soluble boron in soil by hot water extract followed by ICP-OES.	In-house method based on Second Site Properties version 3	L038-PL	D	MCERTS
BTEX and MTBE in soil (Monoaromatics)	Determination of BTEX in soil by headspace GC-MS.	In-house method based on USEPA8260	L073B-PL	W	MCERTS
Hexavalent chromium in soil (Lower Level)	Determination of hexavalent chromium in soil by extraction in water then by acidification, addition of 1,5 diphenylcarbazide followed by colorimetry.	In-house method	L080-PL	W	MCERTS
Metals in soil by ICP-OES	Determination of metals in soil by aqua-regia digestion followed by ICP-OES.	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil.	L038-PL	D	MCERTS
Moisture Content	Moisture content, determined gravimetrically. (30 oC)	In house method.	L019-UK/PL	W	NONE
Monohydric phenols in soil	Determination of phenols in soil by extraction with sodium hydroxide followed by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (skalar)	L080-PL	W	MCERTS
Organic matter (Automated) in soil	Determination of organic matter in soil by oxidising with potassium dichromate followed by titration with iron (II) sulphate.	In house method.	L009-PL	D	MCERTS
pH in soil (automated)	Determination of pH in soil by addition of water followed by automated electrometric measurement.	In house method.	L099-PL	D	MCERTS
Speciated EPA-16 PAHs in soil	Determination of PAH compounds in soil by extraction in dichloromethane and hexane followed by GC-MS with the use of surrogate and internal standards.	In-house method based on USEPA 8270	L064-PL	D	MCERTS
Stones content of soil	Standard preparation for all samples unless otherwise detailed. Gravimetric determination of stone > 10 mm as % dry weight.	In-house method based on British Standard Methods and MCERTS requirements.	L019-UK/PL	D	NONE
Sulphate, water soluble, in soil (16hr extraction)	Determination of water soluble sulphate by ICP-OES. Results reported directly (leachate equivalent) and corrected for extraction ratio (soil equivalent).	In house method.	L038-PL	D	MCERTS
Total cyanide in soil	Determination of total cyanide by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (Skalar)	L080-PL	W	MCERTS
TPHCWG (Soil)	Determination of hexane extractable hydrocarbons in soil by GC-MS/GC-FID.	In-house method with silica gel split/clean up.	L088/76-PL	W	MCERTS

For method numbers ending in 'UK' analysis have been carried out in our laboratory in the United Kingdom.
For method numbers ending in 'PL' analysis have been carried out in our laboratory in Poland.
Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC.

Sample ID	Other_ID	Sample Type	Job	Sample Number	Sample Deviation Code	test_name	test_ref	Test Deviation code
CP104		S	20-89835	1458176	c	Total cyanide in soil	L080-PL	c
CP105		S	20-89835	1457850	c	Total cyanide in soil	L080-PL	c
WS101		S	20-89835	1457847	c	Total cyanide in soil	L080-PL	c
WS103		S	20-89835	1457848	c	Total cyanide in soil	L080-PL	c
WS104		S	20-89835	1457849	c	Total cyanide in soil	L080-PL	c
WS105		S	20-89835	1457852	c	Total cyanide in soil	L080-PL	c
WS106		S	20-89835	1457853	c	Total cyanide in soil	L080-PL	c
WS107		S	20-89835	1457854	c	Total cyanide in soil	L080-PL	c
WS108		S	20-89835	1457855	c	Total cyanide in soil	L080-PL	c

Key: a - No sampling date b - Incorrect container
c - Holding time d - Headspace e - Temperature

Myfanwy Wood
Curtins
Units 5/6
40 Compton Street
London
EC1V 0BD

e: myfanwy.wood@curtins.com

i2 Analytical Ltd.
7 Woodshots Meadow,
Croxley Green
Business Park,
Watford,
Herts,
WD18 8YS

t: 01923 225404
f: 01923 237404
e: reception@i2analytical.com

Analytical Report Number : 20-90119

Project / Site name:	Acton Gardens	**Samples received on:**	21/02/2020
Your job number:	073270	**Samples instructed on:**	28/02/2020
Your order number:	EBLO304	**Analysis completed by:**	06/03/2020
Report Issue Number:	1	**Report issued on:**	06/03/2020
Samples Analysed:	1 soil sample		

Signed: A. Czerwińska

Agnieszka Czerwińska

Technical Reviewer (Reporting Team)
For & on behalf of i2 Analytical Ltd.

Standard Geotechnical, Asbestos and Chemical Testing Laboratory located at: ul. Pionierów 39, 41 -711 Ruda Śląska, Poland.

Accredited tests are defined within the report, opinions and interpretations expressed herein are outside the scope of accreditation.

Standard sample disposal times, unless otherwise agreed with the laboratory, are :

soils	- 4 weeks from reporting
leachates	- 2 weeks from reporting
waters	- 2 weeks from reporting
asbestos	- 6 months from reporting

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Any assessments of compliance with specifications are based on actual analytical results with no contribution from uncertainty of measurement. Application of uncertainty of measurement would provide a range within which the true result lies. An estimate of measurement uncertainty can be provided on request.

Analytical Report Number: 20-90119

Project / Site name: Acton Gardens
Your Order No: EBLO304

Lab Sample Number				1459198				
Sample Reference				WS104				
Sample Number				None Supplied				
Depth (m)				1.00				
Date Sampled				20/02/2020				
Time Taken				None Supplied				
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Stone Content	%	0.1	NONE	< 0.1				
Moisture Content	%	N/A	NONE	17				
Total mass of sample received	kg	0.001	NONE	0.68				
Speciated PAHs								
Naphthalene	mg/kg	0.05	MCERTS	< 0.05				
Acenaphthylene	mg/kg	0.05	MCERTS	< 0.05				
Acenaphthene	mg/kg	0.05	MCERTS	< 0.05				
Fluorene	mg/kg	0.05	MCERTS	< 0.05				
Phenanthrene	mg/kg	0.05	MCERTS	< 0.05				
Anthracene	mg/kg	0.05	MCERTS	< 0.05				
Fluoranthene	mg/kg	0.05	MCERTS	< 0.05				
Pyrene	mg/kg	0.05	MCERTS	< 0.05				
Benzo(a)anthracene	mg/kg	0.05	MCERTS	< 0.05				
Chrysene	mg/kg	0.05	MCERTS	< 0.05				
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	< 0.05				
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	< 0.05				
Benzo(a)pyrene	mg/kg	0.05	MCERTS	< 0.05				
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	< 0.05				
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	< 0.05				
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	< 0.05				
Total PAH								
Speciated Total EPA-16 PAHs	mg/kg	0.8	MCERTS	< 0.80				
Petroleum Hydrocarbons								
TPH C10 - C40	mg/kg	10	MCERTS	< 10				

Analytical Report Number : 20-90119

Project / Site name: Acton Gardens

* These descriptions are only intended to act as a cross check if sample identities are questioned. The major constituent of the sample is intended to act with respect to MCERTS validation. The laboratory is accredited for sand, clay and loam (MCERTS) soil types. Data for unaccredited types of solid should be interpreted with care.

Stone content of a sample is calculated as the % weight of the stones not passing a 10 mm sieve. Results are not corrected for stone content.

Lab Sample Number	Sample Reference	Sample Number	Depth (m)	Sample Description *
1459198	WS104	None Supplied	1.00	Brown clay.

The results included within the report are representative of the samples submitted for analysis.

Analytical Report Number : 20-90119

Project / Site name: Acton Gardens

Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Water (PrW)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Moisture Content	Moisture content, determined gravimetrically. (30 oC)	In house method.	L019-UK/PL	W	NONE
Speciated EPA-16 PAHs in soil	Determination of PAH compounds in soil by extraction in dichloromethane and hexane followed by GC-MS with the use of surrogate and internal standards.	In-house method based on USEPA 8270	L064-PL	D	MCERTS
Stones content of soil	Standard preparation for all samples unless otherwise detailed. Gravimetric determination of stone > 10 mm as % dry weight.	In-house method based on British Standard Methods and MCERTS requirements.	L019-UK/PL	D	NONE
TPH Banding in Soil by FID	Determination of hexane extractable hydrocarbons in soil by GC-FID.	In-house method, TPH with carbon banding and silica gel split/cleanup.	L076-PL	W	MCERTS

For method numbers ending in 'UK' analysis have been carried out in our laboratory in the United Kingdom.
For method numbers ending in 'PL' analysis have been carried out in our laboratory in Poland.
Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC.

Sample ID	Other_ID	Sample Type	Job	Sample Number	Sample Deviation Code	test_name	test_ref	Test Deviation code
WS104		S	20-90119	1459198	b	Speciated EPA-16 PAHs in soil	L064-PL	b

Key: a - No sampling date b - Incorrect container
c - Holding time d - Headspace e - Temperature

TEST CERTIFICATE

Liquid and Plastic Limits

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

4041

Tested in Accordance with: BS 1377-2: 1990: Clause 4.3 and 5

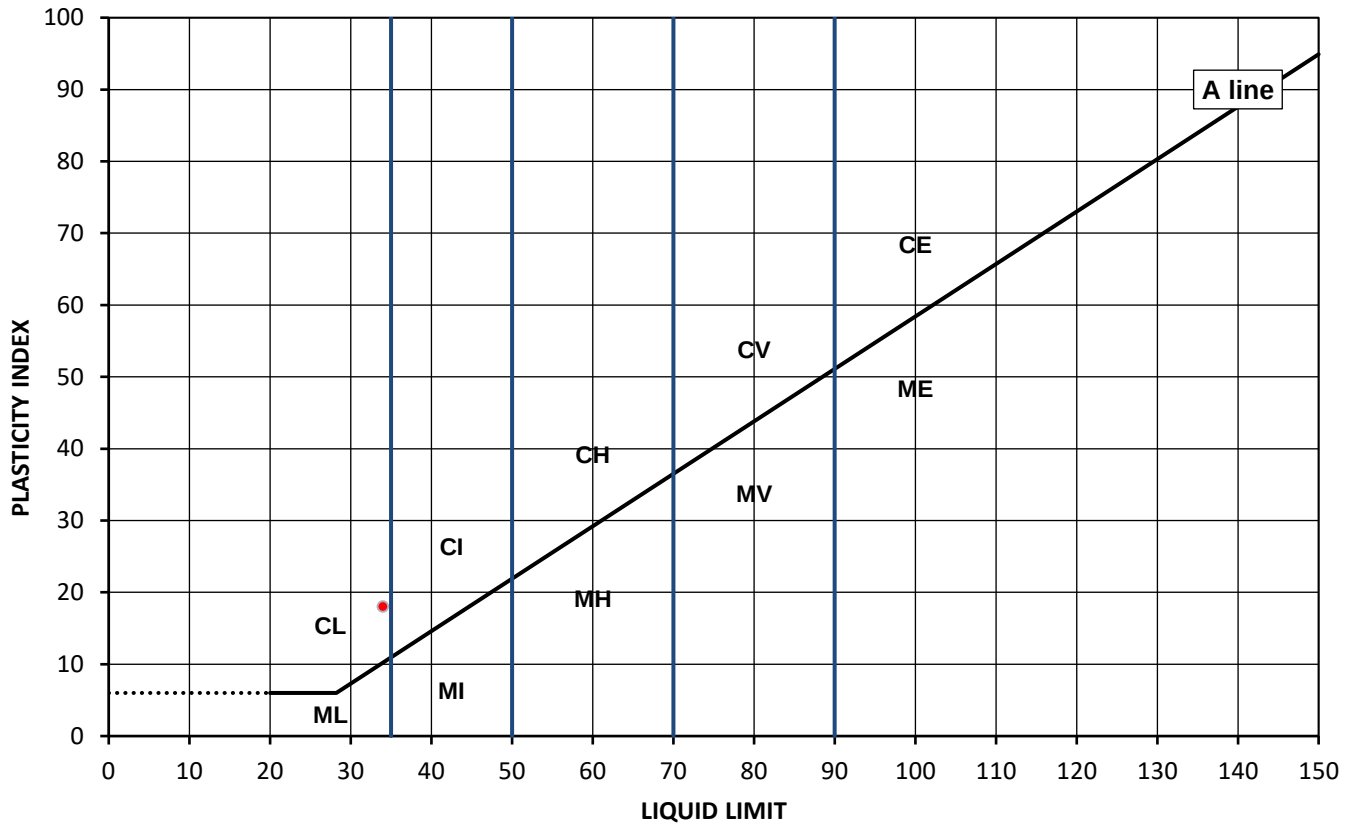
Client:	CURTINS	Client Reference:	20-12595
Client Address:	Rose Wharf, Ground Floor, 78-80 East Street, Leeds, LS9 8EE	Job Number:	20-12595
		Date Sampled:	Not Given
		Date Received:	02/06/2020
Contact:	Will Spraggs	Date Tested:	09/06/2020
Site Address:	Acton Gardens	Sampled By:	Not Given

Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

Test Results:

Laboratory Reference:	1525731	Depth Top [m]:	2.50
Hole No.:	BH01	Depth Base [m]:	3.00
Sample Reference:	B6	Sample Type:	B
Soil Description:	Brown slightly gravelly sandy CLAY		
Sample Preparation:	Tested after >425um removed by hand		

As Received Moisture Content [%]	Liquid Limit [%]	Plastic Limit [%]	Plasticity Index [%]	% Passing 425µm BS Test Sieve
21	34	16	18	95



Legend, based on BS 5930:2015 Code of practice for site investigations

		Plasticity		Liquid Limit
C	Clay	L	Low	below 35
M	Silt	I	Medium	35 to 50
		H	High	50 to 70
		V	Very high	70 to 90
		E	Extremely high	exceeding 90
	Organic	O	append to classification for organic material (eg CHO)	

Note: Moisture Content by BS 1377-2: 1990: Clause 3.2

Remarks:

Signed:

Aleksandra Jurochnik
PL Technical Reviewer
for and on behalf of i2 Analytical Ltd

Date Reported: 16/06/2020

GF 236.9

TEST CERTIFICATE

Liquid and Plastic Limits

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

4041

Tested in Accordance with: BS 1377-2: 1990: Clause 4.3 and 5

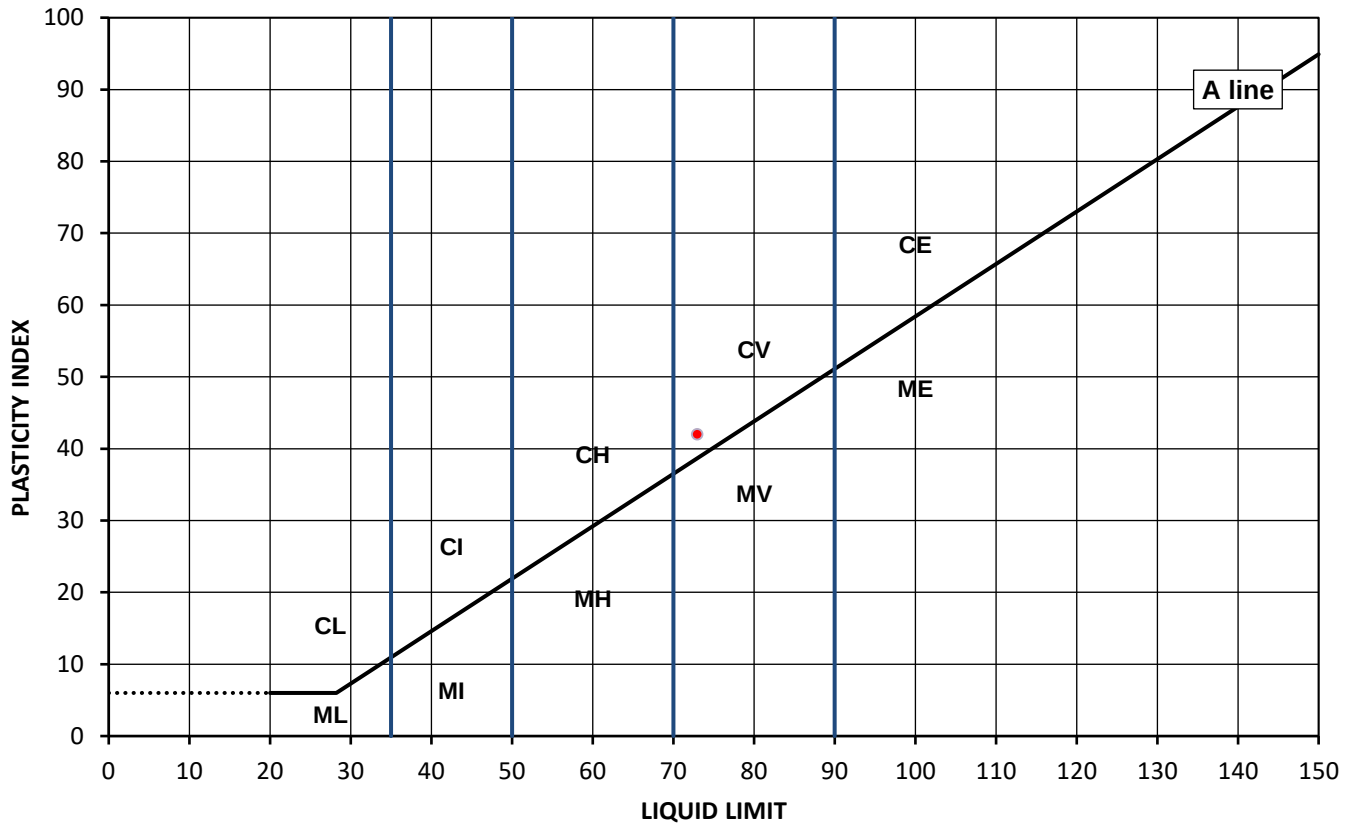
Client:	CURTINS	Client Reference:	20-12595
Client Address:	Rose Wharf, Ground Floor, 78-80 East Street, Leeds, LS9 8EE	Job Number:	20-12595
		Date Sampled:	Not Given
		Date Received:	02/06/2020
Contact:	Will Spraggs	Date Tested:	09/06/2020
Site Address:	Acton Gardens	Sampled By:	Not Given

Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

Test Results:

Laboratory Reference:	1525734	Depth Top [m]:	5.00
Hole No.:	BH02	Depth Base [m]:	5.50
Sample Reference:	B11	Sample Type:	B
Soil Description:	Greyish brown CLAY		
Sample Preparation:	Tested in natural condition		

As Received Moisture Content [%]	Liquid Limit [%]	Plastic Limit [%]	Plasticity Index [%]	% Passing 425µm BS Test Sieve
33	73	31	42	100



Legend, based on BS 5930:2015 Code of practice for site investigations

		Plasticity		Liquid Limit
C	Clay	L	Low	below 35
M	Silt	I	Medium	35 to 50
		H	High	50 to 70
		V	Very high	70 to 90
		E	Extremely high	exceeding 90
	Organic	O	append to classification for organic material (eg CHO)	

Note: Moisture Content by BS 1377-2: 1990: Clause 3.2

Remarks:

Signed:

Aleksandra Jurochnik
PL Technical Reviewer
for and on behalf of i2 Analytical Ltd

Date Reported: 16/06/2020

GF 236.9

TEST CERTIFICATE

Liquid and Plastic Limits

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

4041

Tested in Accordance with: BS 1377-2: 1990: Clause 4.3 and 5

Client:	CURTINS	Client Reference:	20-12595
Client Address:	Rose Wharf, Ground Floor, 78-80 East Street, Leeds, LS9 8EE	Job Number:	20-12595
		Date Sampled:	Not Given
		Date Received:	02/06/2020
Contact:	Will Spraggs	Date Tested:	09/06/2020
Site Address:	Acton Gardens	Sampled By:	Not Given

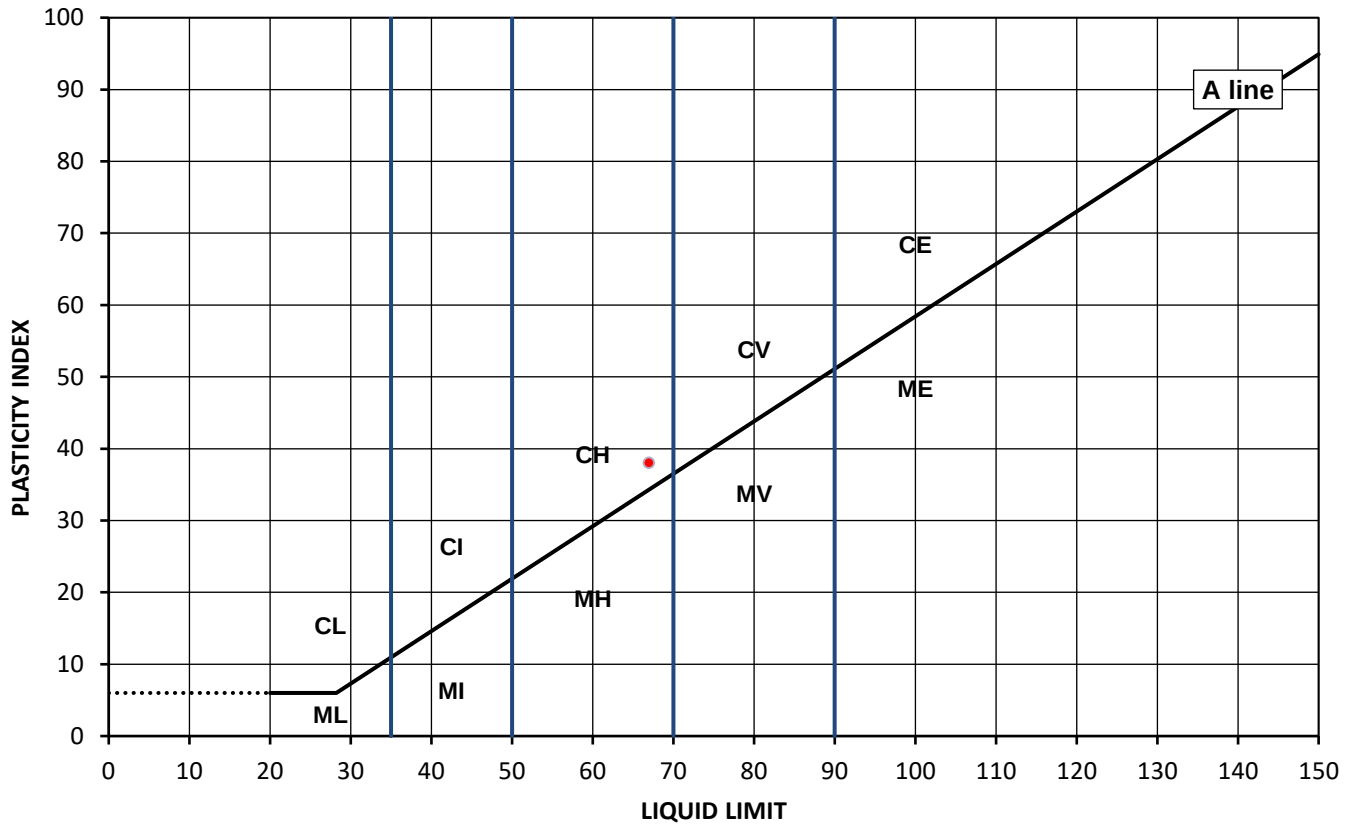
Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

Test Results:

Laboratory Reference:	1525735	Depth Top [m]:	13.00
Hole No.:	BH01	Depth Base [m]:	13.50
Sample Reference:	B1	Sample Type:	B
Soil Description:	Greyish brown CLAY		

Sample Preparation: Tested in natural condition

As Received Moisture Content [%]	Liquid Limit [%]	Plastic Limit [%]	Plasticity Index [%]	% Passing 425µm BS Test Sieve
25	67	29	38	100



Legend, based on BS 5930:2015 Code of practice for site investigations

		Plasticity		Liquid Limit
C	Clay	L	Low	below 35
M	Silt	I	Medium	35 to 50
		H	High	50 to 70
		V	Very high	70 to 90
		E	Extremely high	exceeding 90
	Organic	O	append to classification for organic material (eg CHO)	

Note: Moisture Content by BS 1377-2: 1990: Clause 3.2

Remarks:

Signed:

Aleksandra Jurochnik
PL Technical Reviewer
for and on behalf of i2 Analytical Ltd

Date Reported: 16/06/2020

GF 236.9

TEST CERTIFICATE

Liquid and Plastic Limits

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

4041

Tested in Accordance with: BS 1377-2: 1990: Clause 4.3 and 5

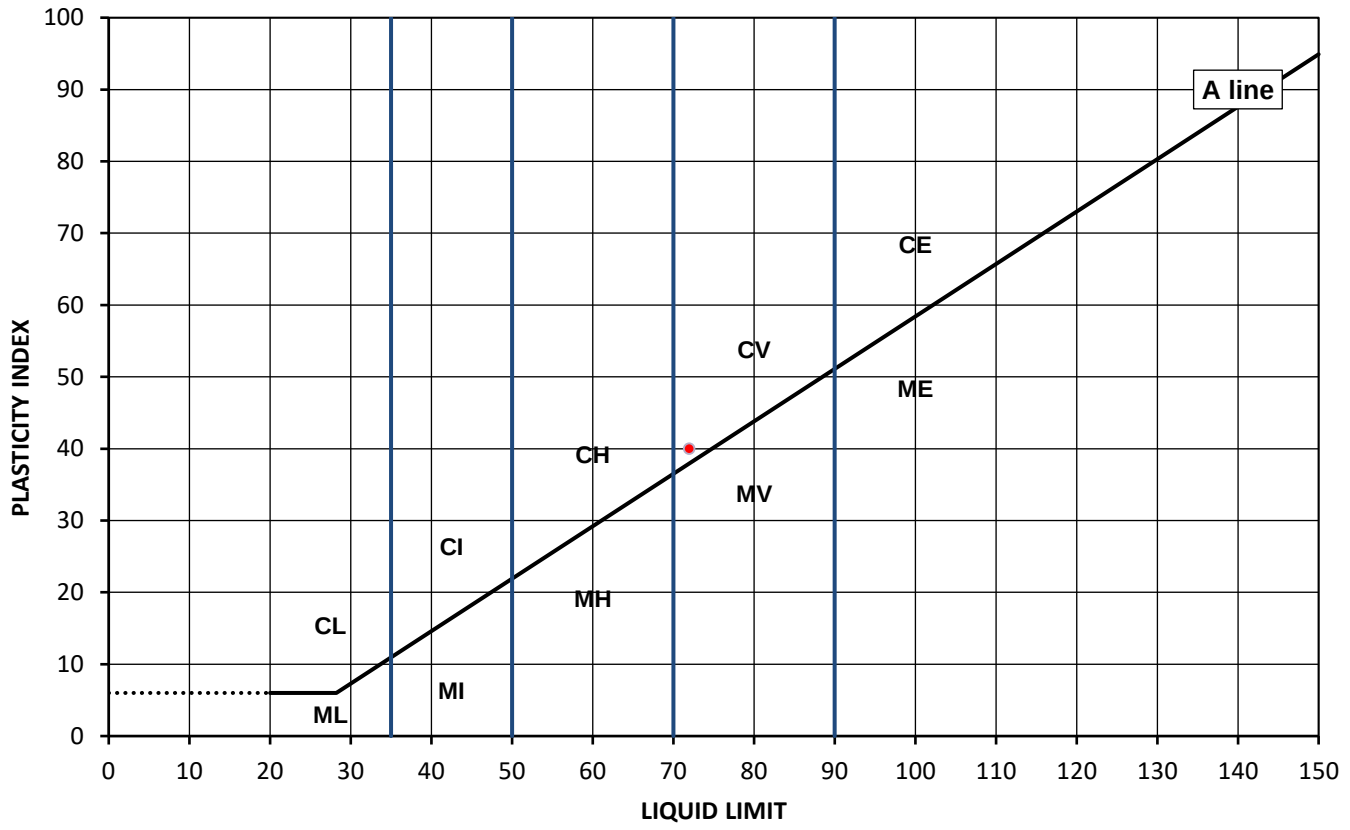
Client:	CURTINS	Client Reference:	20-12595
Client Address:	Rose Wharf, Ground Floor, 78-80 East Street, Leeds, LS9 8EE	Job Number:	20-12595
		Date Sampled:	Not Given
		Date Received:	02/06/2020
Contact:	Will Spraggs	Date Tested:	09/06/2020
Site Address:	Acton Gardens	Sampled By:	Not Given

Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

Test Results:

Laboratory Reference:	1525736	Depth Top [m]:	3.00
Hole No.:	BH02	Depth Base [m]:	Not Given
Sample Reference:	D5	Sample Type:	B
Soil Description:	Greyish brown CLAY		
Sample Preparation:	Tested in natural condition		

As Received Moisture Content [%]	Liquid Limit [%]	Plastic Limit [%]	Plasticity Index [%]	% Passing 425µm BS Test Sieve
28	72	32	40	100



Legend, based on BS 5930:2015 Code of practice for site investigations

		Plasticity		Liquid Limit
C	Clay	L	Low	below 35
M	Silt	I	Medium	35 to 50
		H	High	50 to 70
		V	Very high	70 to 90
		E	Extremely high	exceeding 90
	Organic	O	append to classification for organic material (eg CHO)	

Note: Moisture Content by BS 1377-2: 1990: Clause 3.2

Remarks:

Signed:

Aleksandra Jurochnik
PL Technical Reviewer
for and on behalf of i2 Analytical Ltd

Date Reported: 16/06/2020

GF 236.9

TEST CERTIFICATE

Liquid and Plastic Limits

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

4041

Tested in Accordance with: BS 1377-2: 1990: Clause 4.3 and 5

Client:	CURTINS	Client Reference:	20-12595
Client Address:	Rose Wharf, Ground Floor, 78-80 East Street, Leeds, LS9 8EE	Job Number:	20-12595
		Date Sampled:	Not Given
		Date Received:	02/06/2020
Contact:	Will Spraggs	Date Tested:	09/06/2020
Site Address:	Acton Gardens	Sampled By:	Not Given

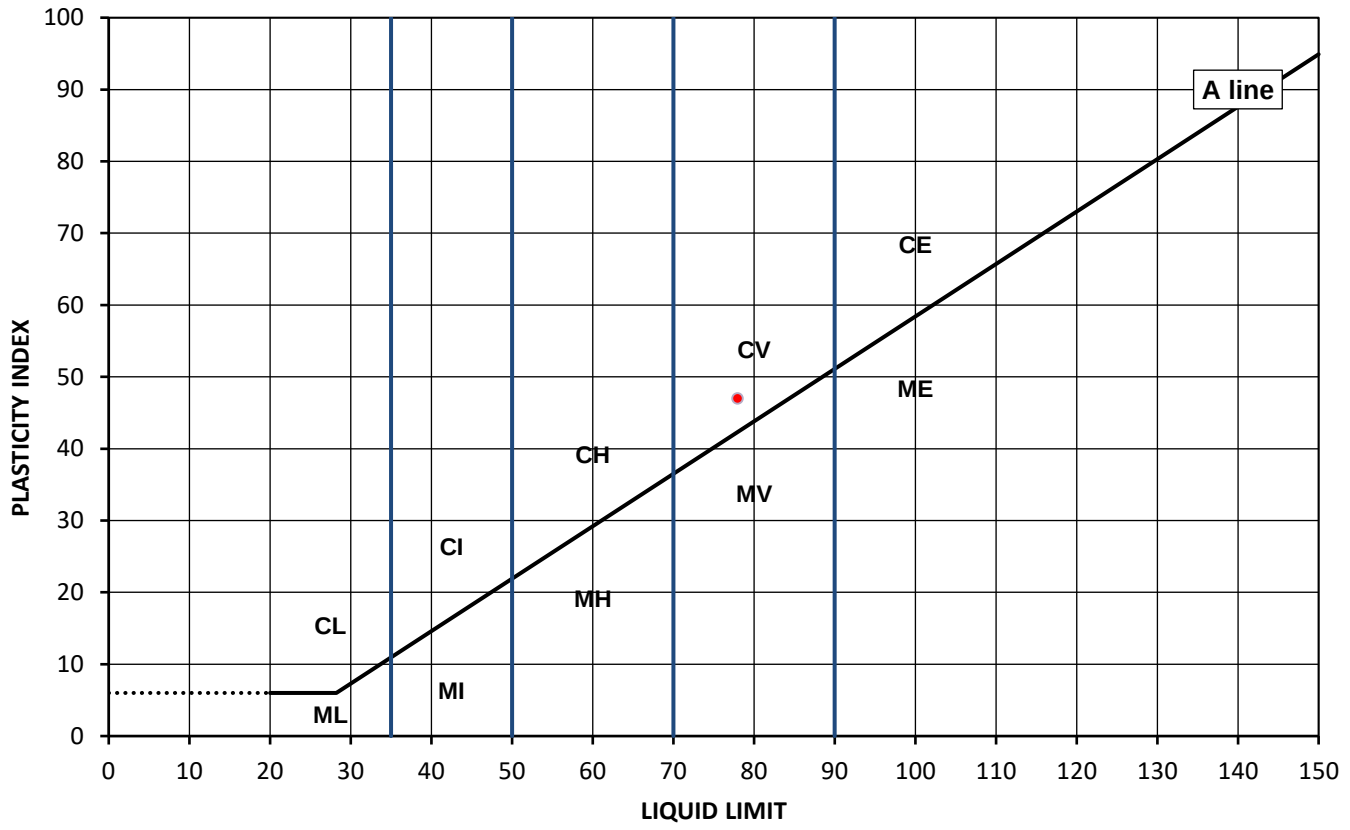
Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

Test Results:

Laboratory Reference:	1525737	Depth Top [m]:	9.00
Hole No.:	BH02	Depth Base [m]:	Not Given
Sample Reference:	Not Given	Sample Type:	B
Soil Description:	Dark brown CLAY		

Sample Preparation: Tested in natural condition

As Received Moisture Content [%]	Liquid Limit [%]	Plastic Limit [%]	Plasticity Index [%]	% Passing 425µm BS Test Sieve
31	78	31	47	100



Legend, based on BS 5930:2015 Code of practice for site investigations

		Plasticity		Liquid Limit
C	Clay	L	Low	below 35
M	Silt	I	Medium	35 to 50
		H	High	50 to 70
		V	Very high	70 to 90
		E	Extremely high	exceeding 90
	Organic	O	append to classification for organic material (eg CHO)	

Note: Moisture Content by BS 1377-2: 1990: Clause 3.2

Remarks:

Signed:

Aleksandra Jurochnik
PL Technical Reviewer
for and on behalf of i2 Analytical Ltd

Date Reported: 16/06/2020

GF 236.9

TEST CERTIFICATE

Liquid and Plastic Limits

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

4041

Tested in Accordance with: BS 1377-2: 1990: Clause 4.3 and 5

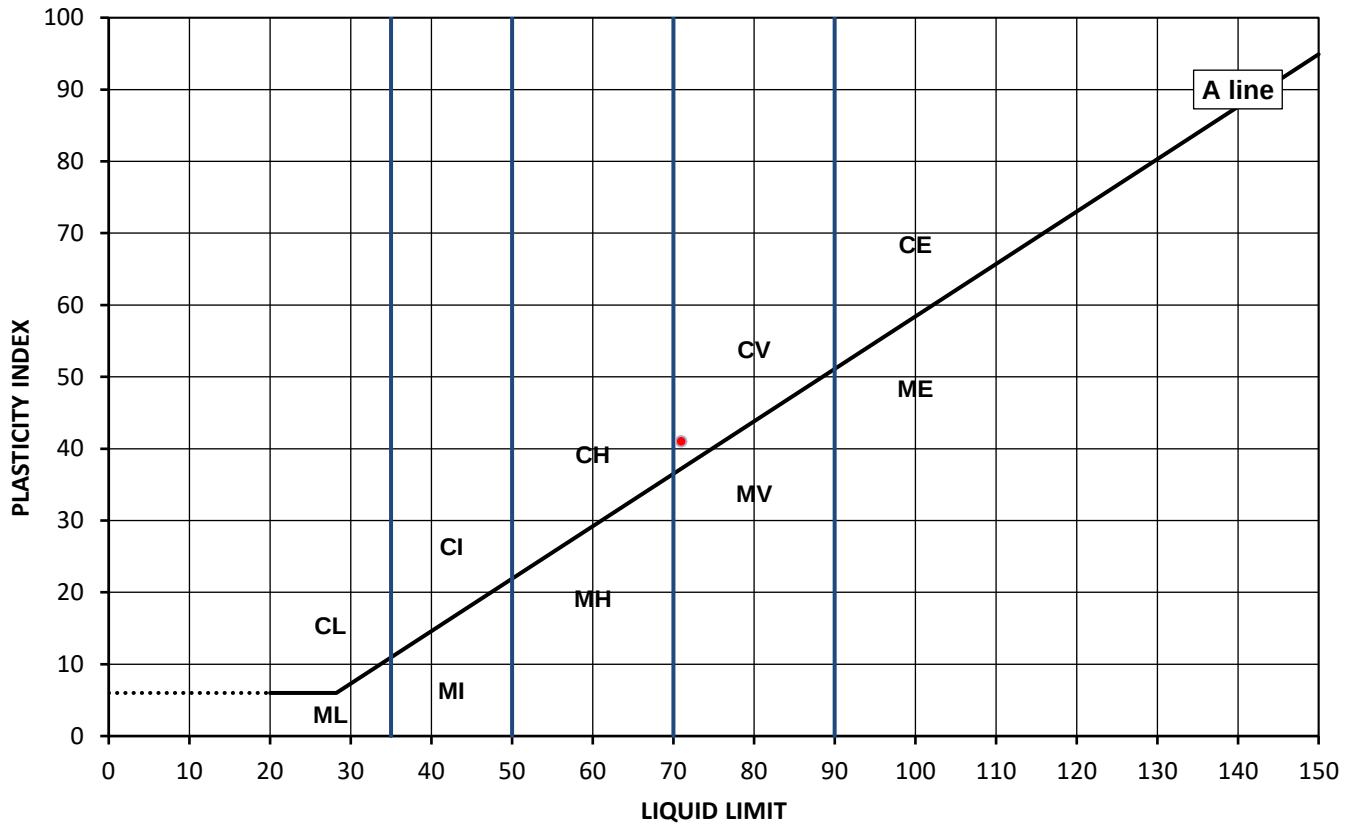
Client:	CURTINS	Client Reference:	20-12595
Client Address:	Rose Wharf, Ground Floor, 78-80 East Street, Leeds, LS9 8EE	Job Number:	20-12595
		Date Sampled:	Not Given
		Date Received:	02/06/2020
Contact:	Will Spraggs	Date Tested:	09/06/2020
Site Address:	Acton Gardens	Sampled By:	Not Given

Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

Test Results:

Laboratory Reference:	1525738	Depth Top [m]:	24.00
Hole No.:	BH02	Depth Base [m]:	Not Given
Sample Reference:	D45	Sample Type:	B
Soil Description:	Greyish brown CLAY		
Sample Preparation:	Tested in natural condition		

As Received Moisture Content [%]	Liquid Limit [%]	Plastic Limit [%]	Plasticity Index [%]	% Passing 425µm BS Test Sieve
26	71	30	41	100



Legend, based on BS 5930:2015 Code of practice for site investigations

		Plasticity		Liquid Limit
C	Clay	L	Low	below 35
M	Silt	I	Medium	35 to 50
		H	High	50 to 70
		V	Very high	70 to 90
		E	Extremely high	exceeding 90
	Organic	O	append to classification for organic material (eg CHO)	

Note: Moisture Content by BS 1377-2: 1990: Clause 3.2

Remarks:

Signed:

Aleksandra Jurochnik
PL Technical Reviewer
for and on behalf of i2 Analytical Ltd

Date Reported: 16/06/2020

GF 236.9

SUMMARY REPORT

Summary of Classification Test Results

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

4041

Tested in Accordance with:

MC by BS 1377-2: 1990: Clause 3.2; WC by BS EN 17892-1: 2014; Atterberg by BS 1377-2: 1990: Clause 4.3, Clause 4.4 and 5; PD by BS 1377-2: 1990: Clause 8.2

Client: CURTINS

Client Address: Rose Wharf, Ground Floor, 78-80 East Street, Leeds, LS9 8EE

Contact: Will Spraggs

Site Address: Acton Gardens

Client Reference: 20-12595
Job Number: 20-12595
Date Sampled: Not Given
Date Received: 02/06/2020
Date Tested: 09/06/2020
Sampled By: Not Given

Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

Test results

Laboratory Reference	Hole No.	Sample				Description	Remarks	MC	WC	Atterberg				Density			Total Porosity#		
		Reference	Depth Top	Depth Base	Type					% Passing 425um	LL	PL	PI	bulk	dry	PD			
			m	m				%	%	%	%	%	%	Mg/m3	Mg/m3	Mg/m3	%		
1525731	BH01	B6	2.50	3.00	B	Brown slightly gravelly sandy CLAY	Atterberg 4 Point	21		95	34	16	18						
1525735	BH01	B1	13.00	13.50	B	Greyish brown CLAY	Atterberg 4 Point	25		100	67	29	38						
1525736	BH02	D5	3.00	Not Given	B	Greyish brown CLAY	Atterberg 4 Point	28		100	72	32	40						
1525734	BH02	B11	5.00	5.50	B	Greyish brown CLAY	Atterberg 4 Point	33		100	73	31	42						
1525737	BH02	Not Given	9.00	Not Given	B	Dark brown CLAY	Atterberg 4 Point	31		100	78	31	47						
1525738	BH02	D45	24.00	Not Given	B	Greyish brown CLAY	Atterberg 4 Point	26		100	71	30	41						

Note: # Non accredited; NP - Non plastic

Comments:

Signed:

Aleksandra Jurochnik
PL Technical Reviewer
for and on behalf of i2 Analytical Ltd

Date Reported: 16/06/2020

GF 238.11

TEST CERTIFICATE

Particle Size Distribution

Tested in Accordance with: BS 1377-2: 1990

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

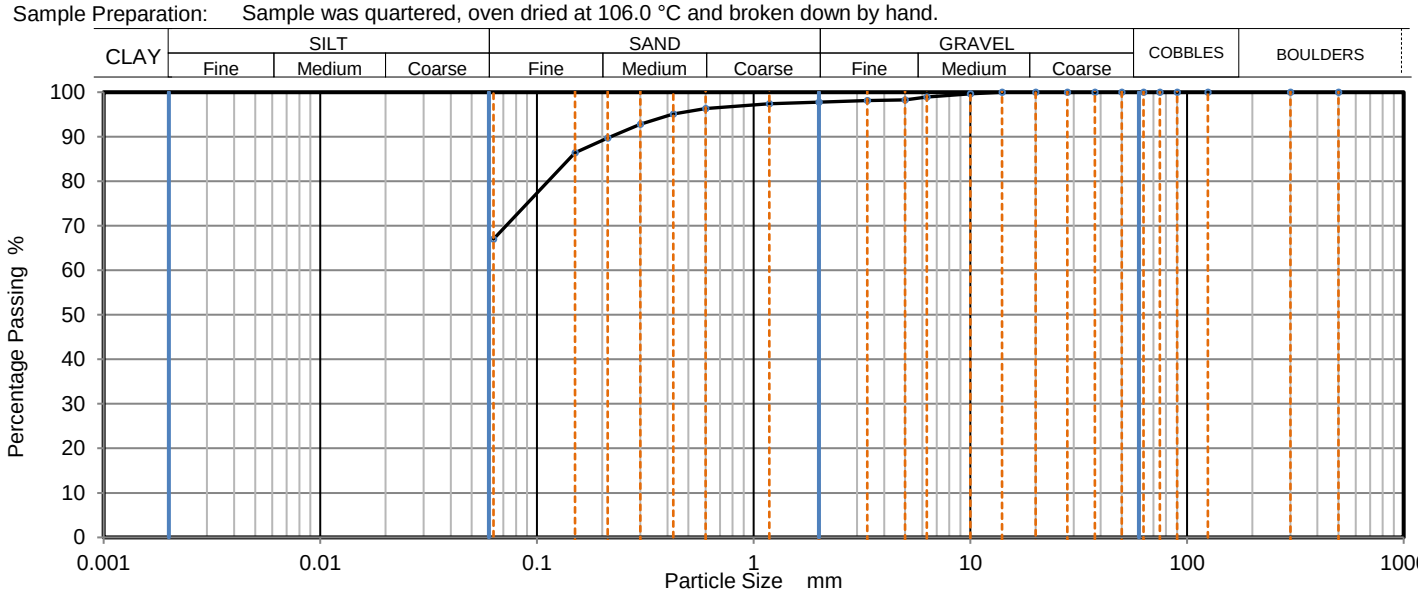
4041

Client:	CURTINS	Client Reference:	20-12595
Client Address:	Rose Wharf, Ground Floor, 78-80 East Street, Leeds, LS9 8EE	Job Number:	20-12595
		Date Sampled:	Not Given
		Date Received:	02/06/2020
Contact:	Will Spraggs	Date Tested:	09/06/2020
Site Address:	Acton Gardens	Sampled By:	Not Given

Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

Test Results:

Laboratory Reference:	1525731	Depth Top [m]:	2.50
Hole No.:	BH01	Depth Base [m]:	3.00
Sample Reference:	B6	Sample Type:	B
Sample Description:	Brown sandy CLAY		
Sample Preparation:	Sample was quartered, oven dried at 106.0 °C and broken down by hand.		



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
500	100		
300	100		
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	100		
14	100		
10	100		
6.3	99		
5	98		
3.35	98		
2	98		
1.18	97		
0.6	96		
0.425	95		
0.3	93		
0.212	90		
0.15	86		
0.063	67		

Sample Proportions	% dry mass
Very coarse	0.00
Gravel	2.20
Sand	30.40
Fines <0.063mm	67.40

Grading Analysis		
D100	mm	14
D60	mm	
D30	mm	
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

Note: Tested in Accordance with BS1377:Part 2:1990, clause 9.2

Remarks:

Signed:

Aleksandra Jurochnik
PL Technical Reviewer
for and on behalf of i2 Analytical Ltd

Date Reported: 16/06/2020

GF 100.18

TEST CERTIFICATE

Particle Size Distribution

Tested in Accordance with: BS 1377-2: 1990

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

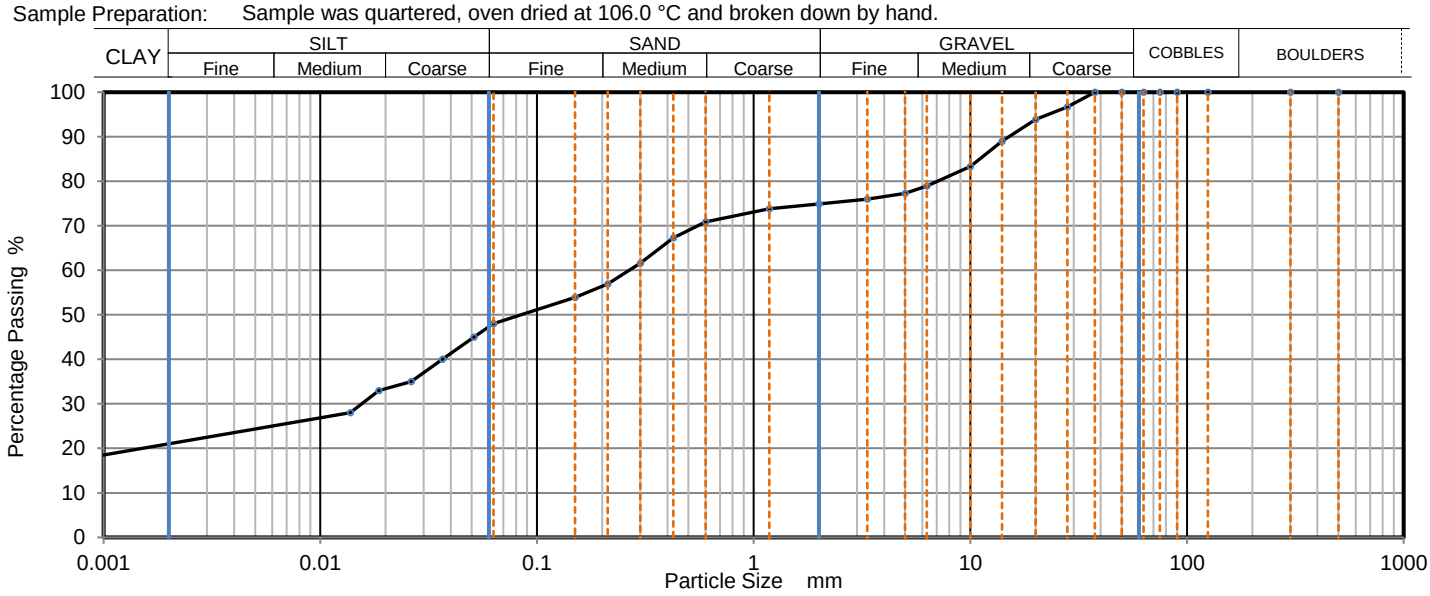
4041

Client:	CURTINS	Client Reference:	20-12595
Client Address:	Rose Wharf, Ground Floor, 78-80 East Street, Leeds, LS9 8EE	Job Number:	20-12595
		Date Sampled:	Not Given
		Date Received:	02/06/2020
Contact:	Will Spraggs	Date Tested:	09/06/2020
Site Address:	Acton Gardens	Sampled By:	Not Given

Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

Test Results:

Laboratory Reference:	1525732	Depth Top [m]:	8.50
Hole No.:	BH01	Depth Base [m]:	9.00
Sample Reference:	B18	Sample Type:	B
Sample Description:	Brown gravelly sandy CLAY		
Sample Preparation:	Sample was quartered, oven dried at 106.0 °C and broken down by hand.		



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
500	100	0.0630	48
300	100	0.0512	45
125	100	0.0367	40
90	100	0.0262	35
75	100	0.0186	33
63	100	0.0138	28
50	100	0.0009	18
37.5	100		
28	97		
20	94		
14	89		
10	83		
6.3	79		
5	77		
3.35	76		
2	75	Particle density	(assumed)
1.18	74	2.65	Mg/m3
0.6	71		
0.425	67		
0.3	62		
0.212	57		
0.15	54		
0.063	48		

Sample Proportions	% dry mass
Very coarse	0.00
Gravel	25.10
Sand	27.00
Silt	27.20
Clay	20.70

Grading Analysis		
D100	mm	37.5
D60	mm	0.266
D30	mm	0.0157
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

Note: Tested in Accordance with BS1377:Part 2:1990, clauses 9.2 and 9.5

Remarks:

Signed:

Aleksandra Jurochnik
PL Technical Reviewer
for and on behalf of i2 Analytical Ltd

Date Reported: 16/06/2020

GF 100.18

TEST CERTIFICATE

Particle Size Distribution

Tested in Accordance with: BS 1377-2: 1990

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

4041

Client:	CURTINS	Client Reference:	20-12595
Client Address:	Rose Wharf, Ground Floor, 78-80 East Street, Leeds, LS9 8EE	Job Number:	20-12595
		Date Sampled:	Not Given
		Date Received:	02/06/2020
Contact:	Will Spraggs	Date Tested:	09/06/2020
Site Address:	Acton Gardens	Sampled By:	Not Given

Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

Test Results:

Laboratory Reference:	1525733	Depth Top [m]:	15.50
Hole No.:	BH02	Depth Base [m]:	16.00
Sample Reference:	Not Given	Sample Type:	B
Sample Description:	Greyish brown slightly sandy very silty CLAY		
Sample Preparation:	Sample was quartered, oven dried at 106.0 °C and broken down by hand.		

Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
500	100	0.0572	91
300	100	0.0413	87
125	100	0.0298	83
90	100	0.0215	79
75	100	0.0155	76
63	100	0.0116	70
50	100	0.0008	40
37.5	100		
28	100		
20	100		
14	100		
10	100		
6.3	100		
5	100		
3.35	100		
2	100	Particle density	(assumed)
1.18	100	2.65	Mg/m3
0.6	99		
0.425	98		
0.3	98		
0.212	97		
0.15	97		
0.063	91		

Sample Proportions	% dry mass
Very coarse	0.00
Gravel	0.30
Sand	9.10
Silt	40.70
Clay	49.90

Grading Analysis		
D100	mm	6.3
D60	mm	0.00485
D30	mm	
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

Note: Tested in Accordance with BS1377:Part 2:1990, clauses 9.2 and 9.5

Remarks:

Signed:

Aleksandra Jurochnik
PL Technical Reviewer
for and on behalf of i2 Analytical Ltd

Date Reported: 16/06/2020

GF 100.18

TEST CERTIFICATE

Unconsolidated Undrained

Triaxial Compression

Tested in Accordance with:
BS 1377-7: 1990: Clause 8

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

UKAS TESTING
4041

Environmental Science

Client:	CURTINS	Client Reference:	20-12595
Client Address:	Rose Wharf, Ground Floor, 78-80 East Street, Leeds, LS9 8EE	Job Number:	20-12595
		Date Sampled:	Not Given
		Date Received:	02/06/2020
Contact:	Will Spraggs	Date Tested:	10/06/2020
Site Address:	Acton Gardens	Sampled By:	Not Given

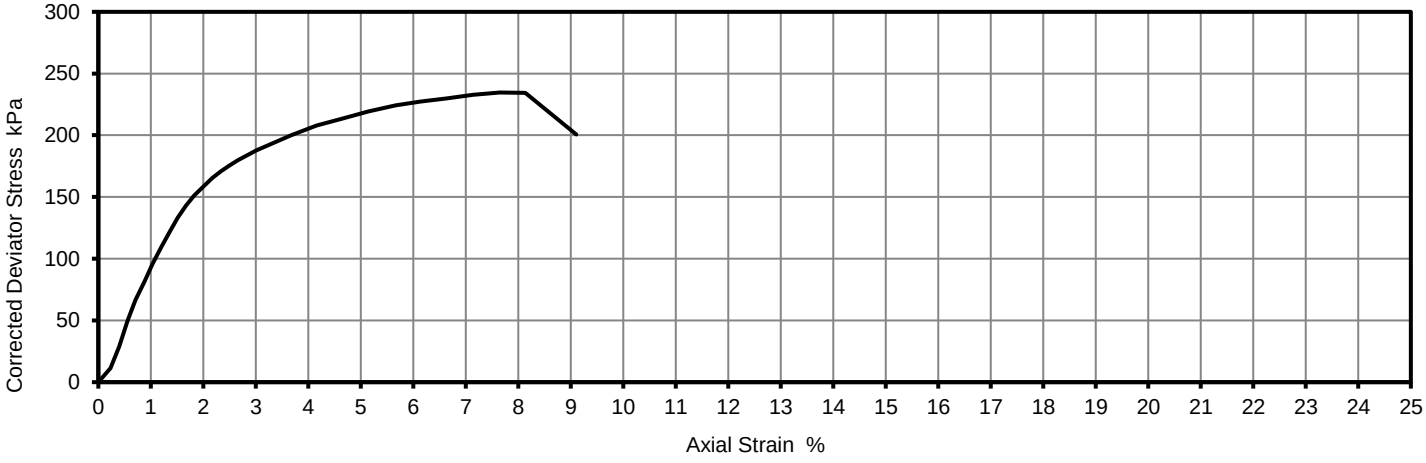
Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

Test Results:

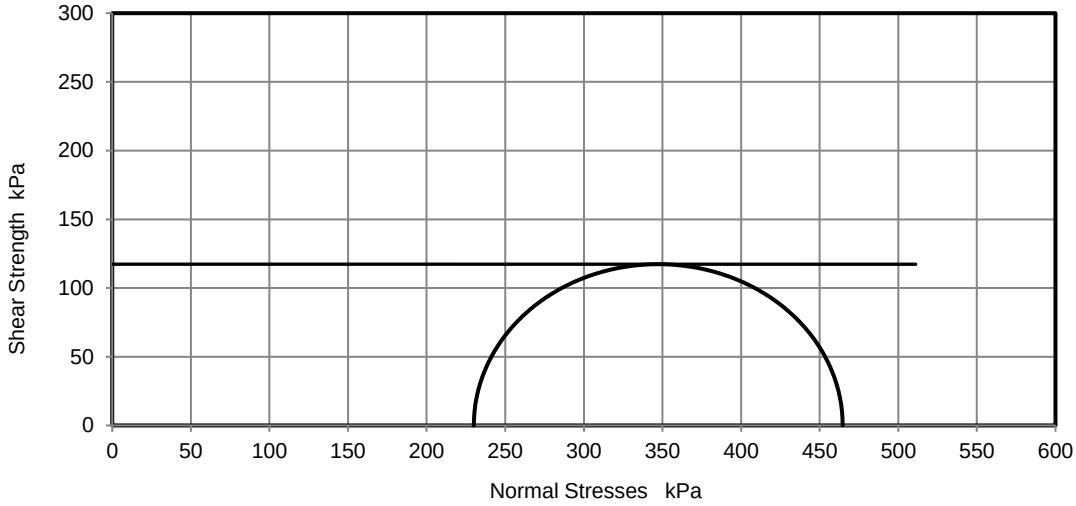
Laboratory Reference:	1525723	Depth Top [m]:	11.50
Hole No.:	BH01	Depth Base [m]:	11.95
Sample Reference:	U21	Sample Type:	U
Sample Description:	Dark brown CLAY		

Test Number	1		Rate of Strain	2.00	%/min	
Length	197.19	mm	Cell Pressure	230	kPa	
Diameter	102.06	mm	Axial Strain at failure	7.6	%	
Bulk Density	1.99	Mg/m3	Deviator Stress, (σ1 - σ3)f	235	kPa	
Moisture Content	27	%	Undrained Shear Strength, cu	117	kPa	½(σ1 - σ3)f
Dry Density	1.57	Mg/m3	Mode of Failure	Brittle		
Membrane Correction	0.40	kPa	Membrane thickness	0.22	mm	

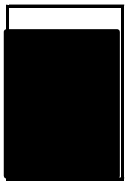
Deviator Stress v Axial Strain



Mohr Circles



Position within sample



Note: Deviator stress corrected for area change and membrane effects. Mohr circles and their interpretation is not covered by BS1377. This is provided for information only.

Remarks:

Signed:

Aleksandra Jurochnik
PL Technical Reviewer
for and on behalf of i2 Analytical Ltd

Date Reported: 16/06/2020

GF 184.11

TEST CERTIFICATE

Unconsolidated Undrained

Triaxial Compression

Tested in Accordance with:
BS 1377-7: 1990: Clause 8

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

UKAS TESTING 4041

Environmental Science

Client:	CURTINS	Client Reference:	20-12595
Client Address:	Rose Wharf, Ground Floor, 78-80 East Street, Leeds, LS9 8EE	Job Number:	20-12595
		Date Sampled:	Not Given
		Date Received:	02/06/2020
Contact:	Will Spraggs	Date Tested:	10/06/2020
Site Address:	Acton Gardens	Sampled By:	Not Given

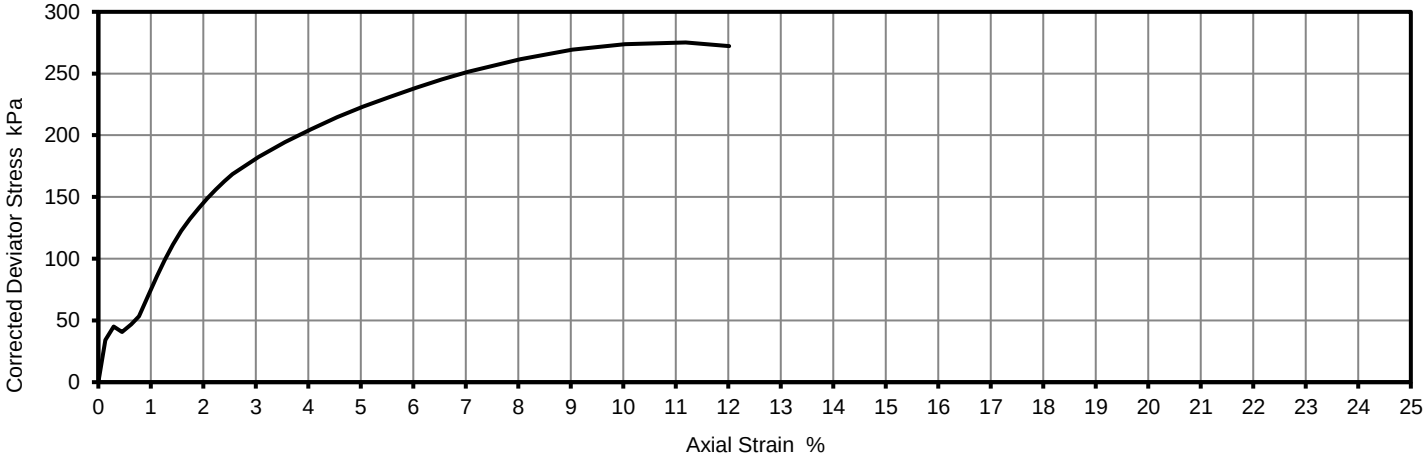
Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

Test Results:

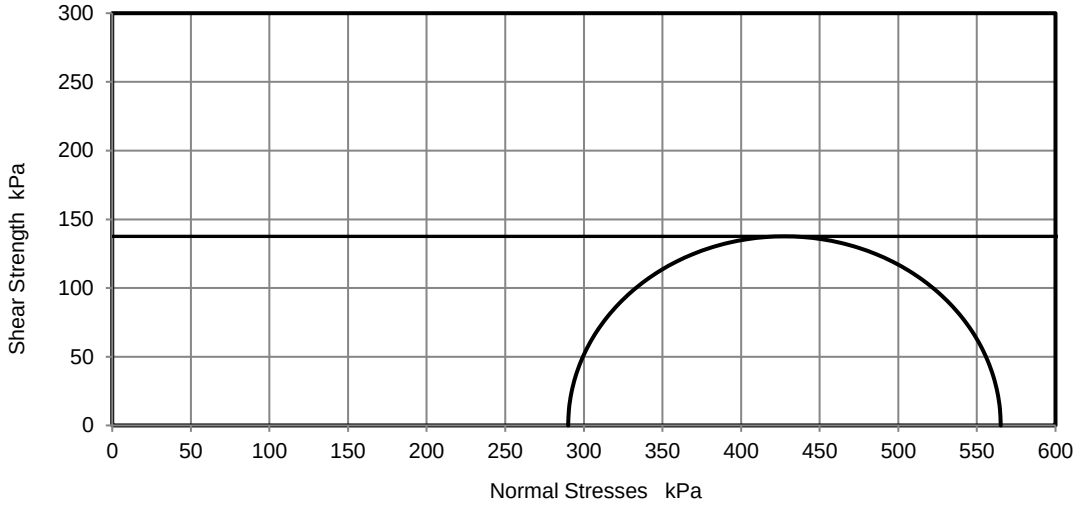
Laboratory Reference:	1525724	Depth Top [m]:	14.50
Hole No.:	BH01	Depth Base [m]:	14.95
Sample Reference:	U26	Sample Type:	U
Sample Description:	Dark brown CLAY		

Test Number	1		Rate of Strain	2.00	%/min	
Length	200.41	mm	Cell Pressure	290	kPa	
Diameter	102.13	mm	Axial Strain at failure	11.2	%	
Bulk Density	2.01	Mg/m3	Deviator Stress, (σ1 - σ3)f	275	kPa	
Moisture Content	29	%	Undrained Shear Strength, cu	138	kPa	½(σ1 - σ3)f
Dry Density	1.56	Mg/m3	Mode of Failure	Compound		
Membrane Correction	0.73	kPa	Membrane thickness	0.31	mm	

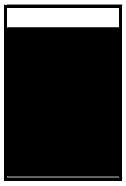
Deviator Stress v Axial Strain



Mohr Circles



Position within sample



Note: Deviator stress corrected for area change and membrane effects. Mohr circles and their interpretation is not covered by BS1377. This is provided for information only.

Remarks:

Signed:

Aleksandra Jurochnik
PL Technical Reviewer
for and on behalf of i2 Analytical Ltd

Date Reported: 16/06/2020

GF 184.11

TEST CERTIFICATE

Unconsolidated Undrained

Triaxial Compression

Tested in Accordance with:
BS 1377-7: 1990: Clause 8

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

UKAS TESTING
4041

Environmental Science

Client:	CURTINS	Client Reference:	20-12595
Client Address:	Rose Wharf, Ground Floor, 78-80 East Street, Leeds, LS9 8EE	Job Number:	20-12595
		Date Sampled:	Not Given
		Date Received:	02/06/2020
Contact:	Will Spraggs	Date Tested:	10/06/2020
Site Address:	Acton Gardens	Sampled By:	Not Given

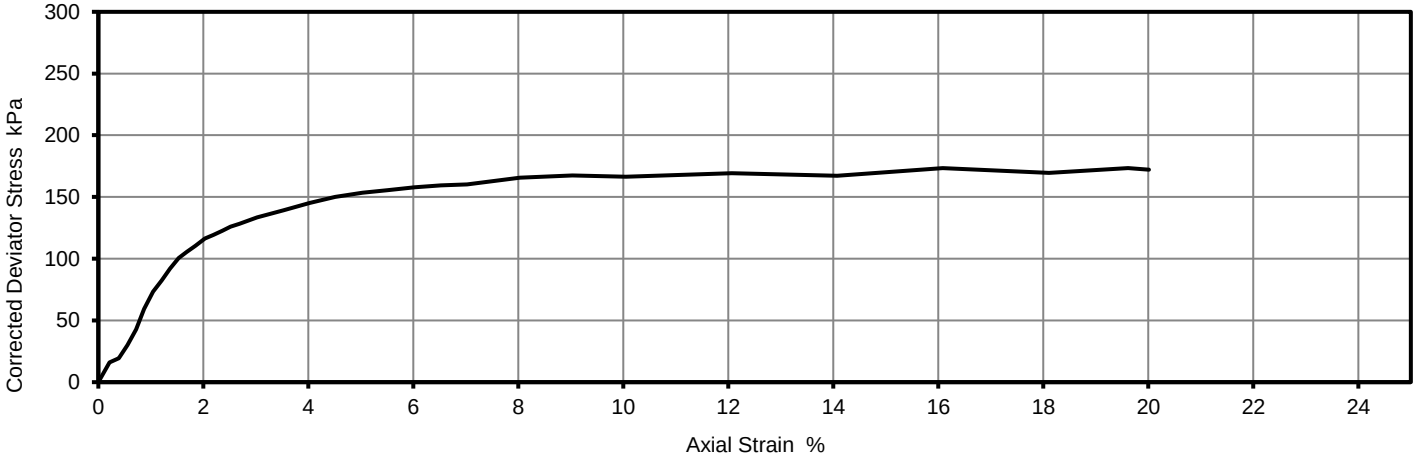
Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

Test Results:

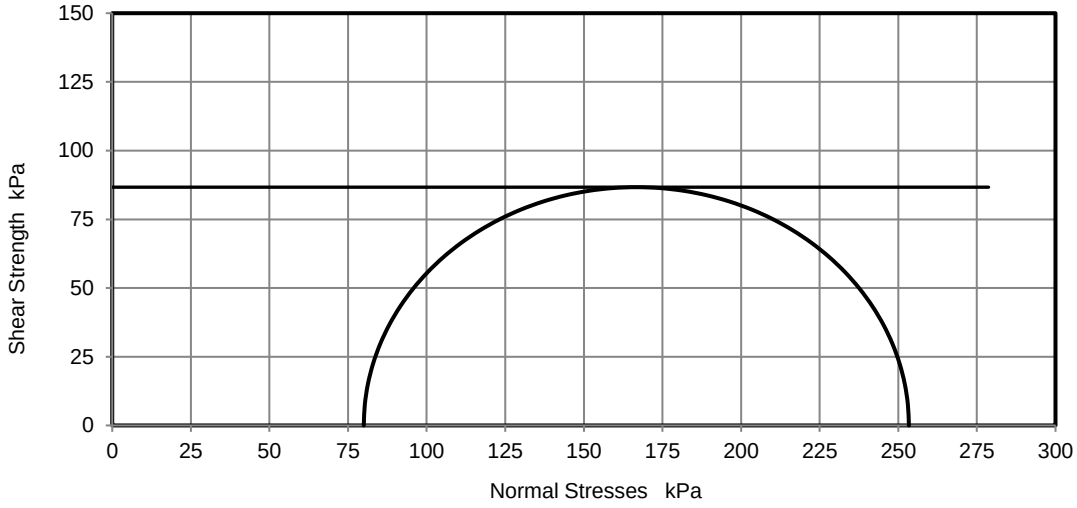
Laboratory Reference:	1525725	Depth Top [m]:	4.00
Hole No.:	BH02	Depth Base [m]:	4.45
Sample Reference:	U8	Sample Type:	U
Sample Description:	Dark brown CLAY		

Test Number	1		Rate of Strain	2.00	%/min	
Length	139.02	mm	Cell Pressure	80	kPa	
Diameter	69.27	mm	Axial Strain at failure	16.1	%	
Bulk Density	1.96	Mg/m3	Deviator Stress, (σ1 - σ3)f	173	kPa	
Moisture Content	31	%	Undrained Shear Strength, cu	87	kPa	½(σ1 - σ3)f
Dry Density	1.50	Mg/m3	Mode of Failure	Compound		
Membrane Correction	1.21	kPa	Membrane thickness	0.26	mm	

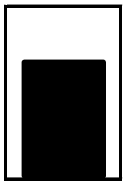
Deviator Stress v Axial Strain



Mohr Circles



Position within sample



Note: Deviator stress corrected for area change and membrane effects. Mohr circles and their interpretation is not covered by BS1377. This is provided for information only.

Remarks:

Signed:

Aleksandra Jurochnik
PL Technical Reviewer
for and on behalf of i2 Analytical Ltd

Date Reported: 16/06/2020

GF 184.11

TEST CERTIFICATE

Unconsolidated Undrained

Triaxial Compression

Tested in Accordance with:
BS 1377-7: 1990: Clause 8

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

UKAS TESTING
4041

Environmental Science

Client:	CURTINS	Client Reference:	20-12595
Client Address:	Rose Wharf, Ground Floor, 78-80 East Street, Leeds, LS9 8EE	Job Number:	20-12595
		Date Sampled:	Not Given
		Date Received:	02/06/2020
Contact:	Will Spraggs	Date Tested:	10/06/2020
Site Address:	Acton Gardens	Sampled By:	Not Given

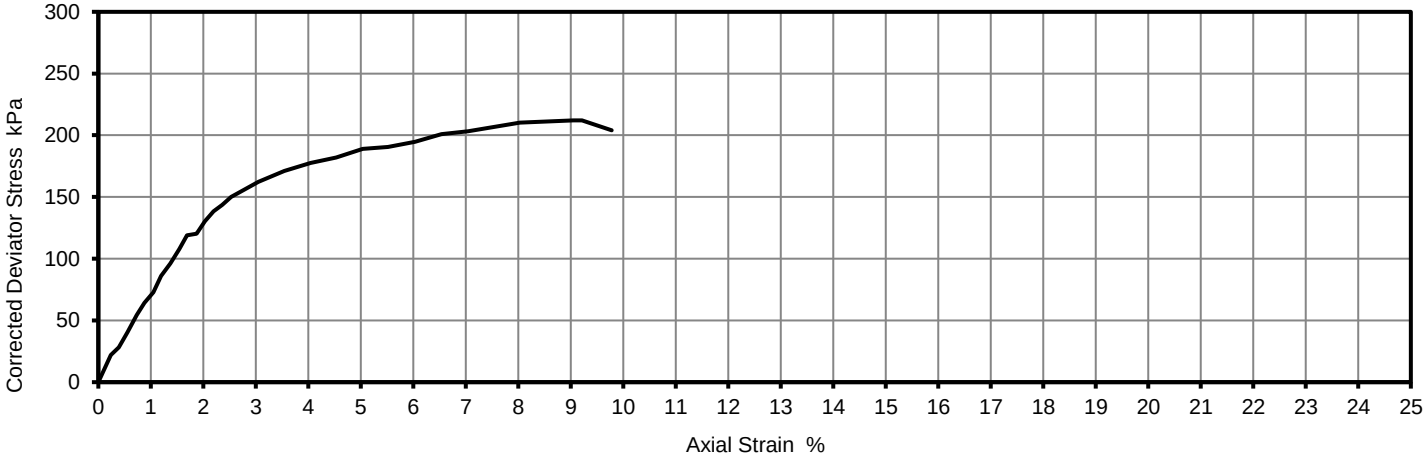
Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

Test Results:

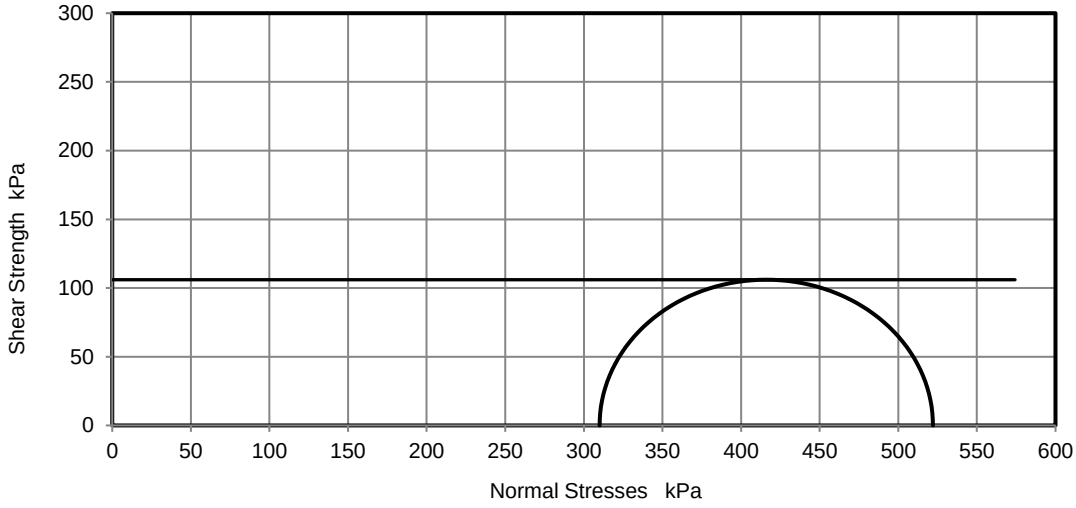
Laboratory Reference:	1525726	Depth Top [m]:	6.50
Hole No.:	BH02	Depth Base [m]:	6.95
Sample Reference:	U13	Sample Type:	U
Sample Description:	Dark brown CLAY		

Test Number	1		Rate of Strain	2.00	%/min	
Length	97.16	mm	Cell Pressure	310	kPa	
Diameter	49.35	mm	Axial Strain at failure	9.2	%	
Bulk Density	2.01	Mg/m3	Deviator Stress, (σ1 - σ3)f	212	kPa	
Moisture Content	26	%	Undrained Shear Strength, cu	106	kPa	½(σ1 - σ3)f
Dry Density	1.60	Mg/m3	Mode of Failure	Brittle		
Membrane Correction	1.11	kPa	Membrane thickness	0.26	mm	

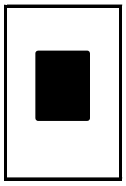
Deviator Stress v Axial Strain



Mohr Circles



Position within sample



Note: Deviator stress corrected for area change and membrane effects. Mohr circles and their interpretation is not covered by BS1377. This is provided for information only.

Remarks:

Signed:

Aleksandra Jurochnik
PL Technical Reviewer
for and on behalf of i2 Analytical Ltd

Date Reported: 16/06/2020

GF 184.11

TEST CERTIFICATE

Unconsolidated Undrained

Triaxial Compression

Tested in Accordance with:
BS 1377-7: 1990: Clause 8

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

UKAS TESTING
4041

Environmental Science

Client:	CURTINS	Client Reference:	20-12595
Client Address:	Rose Wharf, Ground Floor, 78-80 East Street, Leeds, LS9 8EE	Job Number:	20-12595
		Date Sampled:	Not Given
		Date Received:	02/06/2020
Contact:	Will Spraggs	Date Tested:	10/06/2020
Site Address:	Acton Gardens	Sampled By:	Not Given

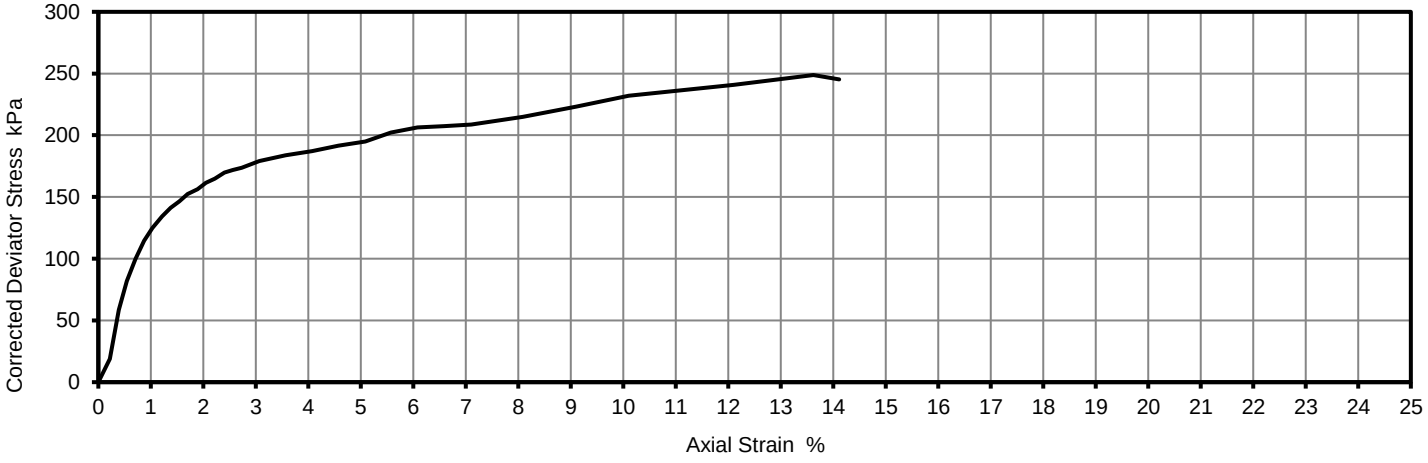
Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

Test Results:

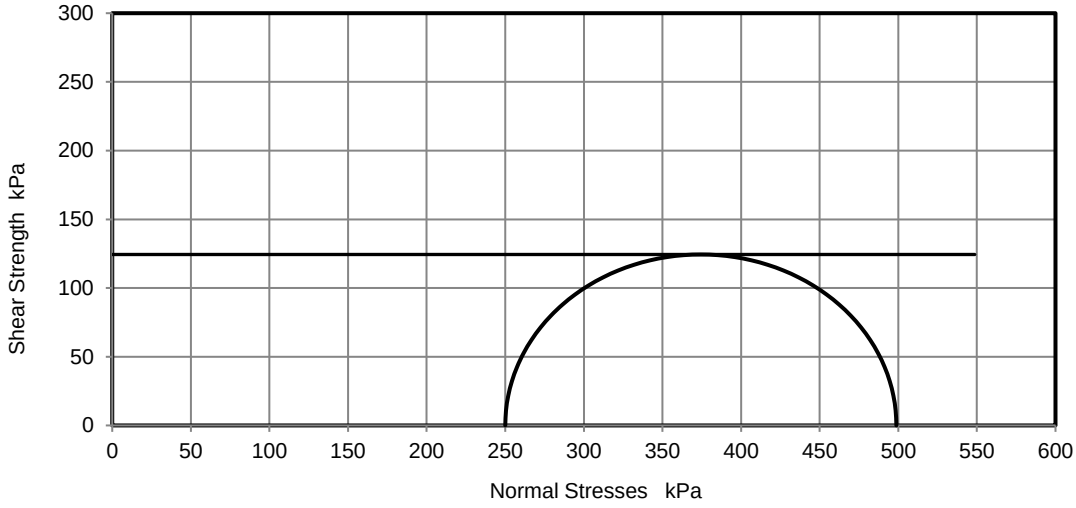
Laboratory Reference:	1525728	Depth Top [m]:	12.50
Hole No.:	BH02	Depth Base [m]:	12.95
Sample Reference:	U24	Sample Type:	U
Sample Description:	Dark brown CLAY		

Test Number	1		Rate of Strain	2.00	%/min	
Length	138.68	mm	Cell Pressure	250	kPa	
Diameter	69.53	mm	Axial Strain at failure	13.6	%	
Bulk Density	1.95	Mg/m3	Deviator Stress, (σ1 - σ3)f	249	kPa	
Moisture Content	30	%	Undrained Shear Strength, cu	124	kPa	½(σ1 - σ3)f
Dry Density	1.50	Mg/m3	Mode of Failure	Brittle		
Membrane Correction	1.25	kPa	Membrane thickness	0.31	mm	

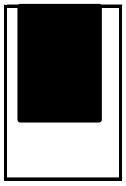
Deviator Stress v Axial Strain



Mohr Circles



Position within sample



Note: Deviator stress corrected for area change and membrane effects. Mohr circles and their interpretation is not covered by BS1377. This is provided for information only.

Remarks:

Signed:

Aleksandra Jurochnik
PL Technical Reviewer
for and on behalf of i2 Analytical Ltd

Date Reported: 16/06/2020

GF 184.11

TEST CERTIFICATE

Unconsolidated Undrained

Triaxial Compression

Tested in Accordance with:
BS 1377-7: 1990: Clause 8

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

4041

Client:	CURTINS	Client Reference:	20-12595
Client Address:	Rose Wharf, Ground Floor, 78-80 East Street, Leeds, LS9 8EE	Job Number:	20-12595
		Date Sampled:	Not Given
		Date Received:	02/06/2020
Contact:	Will Spraggs	Date Tested:	10/06/2020
Site Address:	Acton Gardens	Sampled By:	Not Given

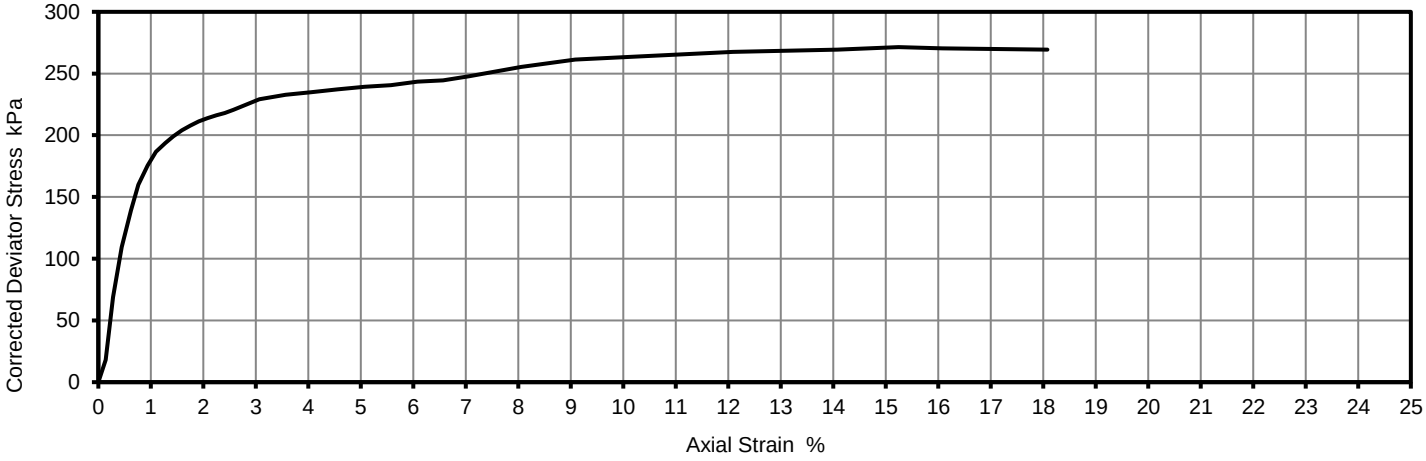
Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

Test Results:

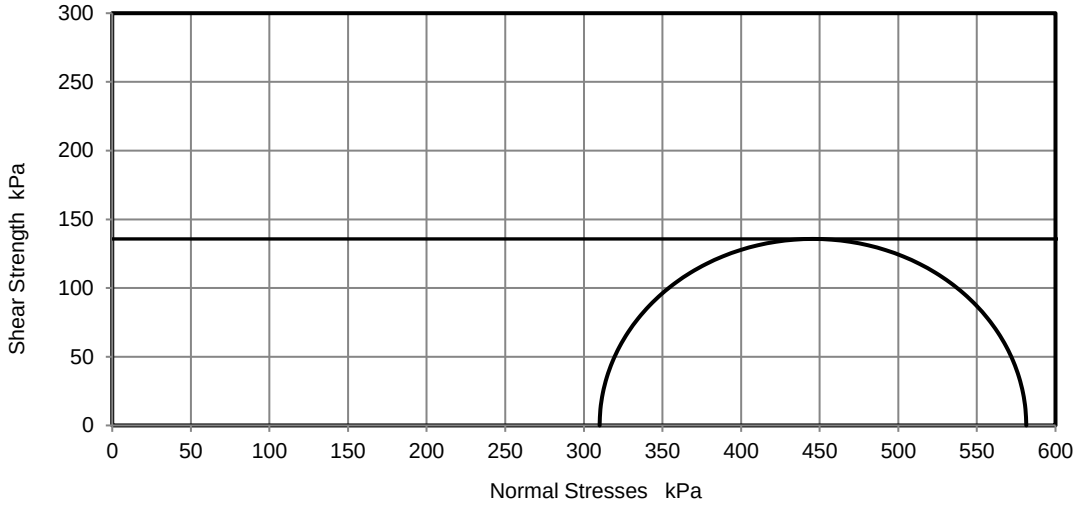
Laboratory Reference:	1525729	Depth Top [m]:	15.50
Hole No.:	BH02	Depth Base [m]:	15.95
Sample Reference:	U29	Sample Type:	U
Sample Description:	Dark brown CLAY		

Test Number	1		Rate of Strain	2.00	%/min	
Length	138.85	mm	Cell Pressure	310	kPa	
Diameter	69.44	mm	Axial Strain at failure	15.2	%	
Bulk Density	2.01	Mg/m3	Deviator Stress, (σ1 - σ3)f	271	kPa	
Moisture Content	24	%	Undrained Shear Strength, cu	136	kPa	½(σ1 - σ3)f
Dry Density	1.62	Mg/m3	Mode of Failure	Brittle		
Membrane Correction	1.20	kPa	Membrane thickness	0.27	mm	

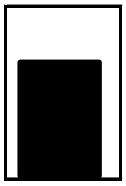
Deviator Stress v Axial Strain



Mohr Circles



Position within sample



Note: Deviator stress corrected for area change and membrane effects. Mohr circles and their interpretation is not covered by BS1377. This is provided for information only.

Remarks:

Signed:

Aleksandra Jurochnik
PL Technical Reviewer
for and on behalf of i2 Analytical Ltd

Date Reported: 16/06/2020

GF 184.11

TEST CERTIFICATE

Unconsolidated Undrained

Triaxial Compression

Tested in Accordance with:
BS 1377-7: 1990: Clause 8

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

UKAS TESTING
4041

Environmental Science

Client:	CURTINS	Client Reference:	20-12595
Client Address:	Rose Wharf, Ground Floor, 78-80 East Street, Leeds, LS9 8EE	Job Number:	20-12595
		Date Sampled:	Not Given
		Date Received:	02/06/2020
Contact:	Will Spraggs	Date Tested:	10/06/2020
Site Address:	Acton Gardens	Sampled By:	Not Given

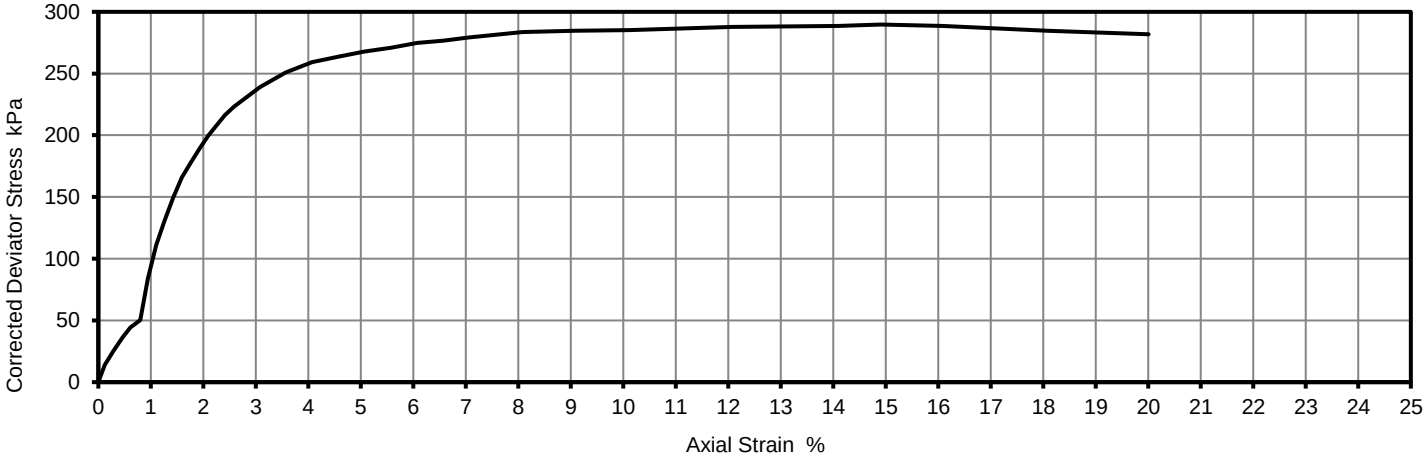
Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

Test Results:

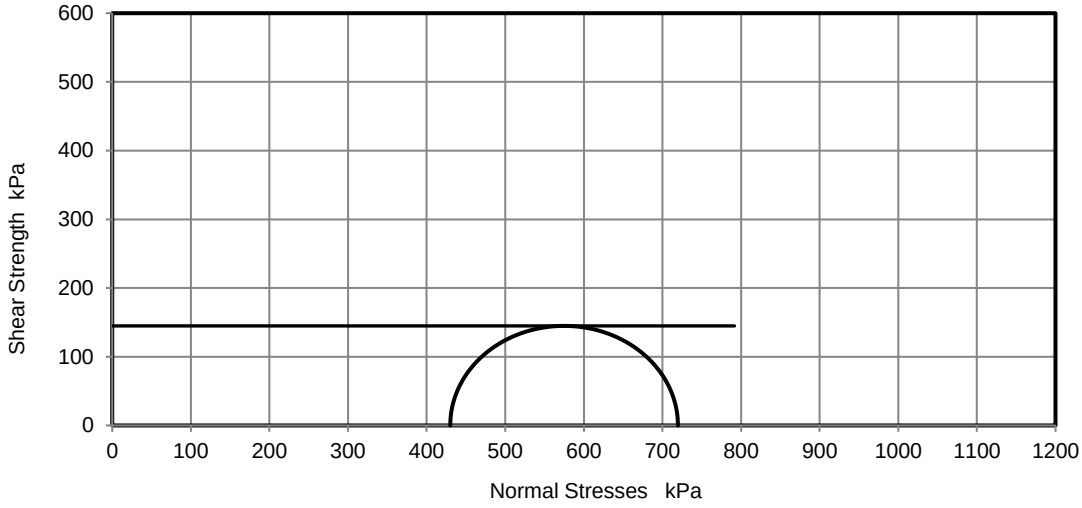
Laboratory Reference:	1525730	Depth Top [m]:	21.50
Hole No.:	BH02	Depth Base [m]:	21.95
Sample Reference:	U41	Sample Type:	U
Sample Description:	Dark brown CLAY		

Test Number	1		Rate of Strain	2.00	%/min	
Length	139.31	mm	Cell Pressure	430	kPa	
Diameter	69.04	mm	Axial Strain at failure	14.9	%	
Bulk Density	2.01	Mg/m3	Deviator Stress, (σ1 - σ3)f	290	kPa	
Moisture Content	26	%	Undrained Shear Strength, cu	145	kPa	½(σ1 - σ3)f
Dry Density	1.59	Mg/m3	Mode of Failure	Brittle		
Membrane Correction	1.27	kPa	Membrane thickness	0.29	mm	

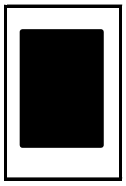
Deviator Stress v Axial Strain



Mohr Circles



Position within sample



Note: Deviator stress corrected for area change and membrane effects. Mohr circles and their interpretation is not covered by BS1377. This is provided for information only.

Remarks:

Signed:

Aleksandra Jurochnik
PL Technical Reviewer
for and on behalf of i2 Analytical Ltd

Date Reported: 16/06/2020

GF 184.11

Myfanwy Wood
Curtins
Units 5/6
40 Compton Street
London
EC1V 0BD

e: myfanwy.wood@curtins.com

i2 Analytical Ltd.
7 Woodshots Meadow,
Croxley Green
Business Park,
Watford,
Herts,
WD18 8YS

t: 01923 225404
f: 01923 237404
e: reception@i2analytical.com

Analytical Report Number : 20-91417

Project / Site name:	Acton Gardens	**Samples received on:**	21/02/2020
Your job number:	073270	**Samples instructed on:**	09/03/2020
Your order number:	EBLO312	**Analysis completed by:**	23/03/2020
Report Issue Number:	1	**Report issued on:**	23/03/2020
Samples Analysed:	2 soil samples		

Signed: Karolina Marek

Karolina Marek
PL Head of Reporting Team

For & on behalf of i2 Analytical Ltd.

Standard Geotechnical, Asbestos and Chemical Testing Laboratory located at: ul. Pionierów 39, 41 -711 Ruda Śląska, Poland.

Accredited tests are defined within the report, opinions and interpretations expressed herein are outside the scope of accreditation.

Standard sample disposal times, unless otherwise agreed with the laboratory, are :

soils	- 4 weeks from reporting
leachates	- 2 weeks from reporting
waters	- 2 weeks from reporting
asbestos	- 6 months from reporting

Excel copies of reports are only valid when accompanied by this PDF certificate.

Any assessments of compliance with specifications are based on actual analytical results with no contribution from uncertainty of measurement. Application of uncertainty of measurement would provide a range within which the true result lies. An estimate of measurement uncertainty can be provided on request.

Analytical Report Number: 20-91417

Project / Site name: Acton Gardens
Your Order No: EBLO312

Lab Sample Number				1466307	1466308			
Sample Reference				WS103	WS102			
Sample Number				None Supplied	None Supplied			
Depth (m)				1.50-1.90	2.50-3.00			
Date Sampled				20/02/2020	20/02/2020			
Time Taken				None Supplied	None Supplied			
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Stone Content	%	0.1	NONE	< 0.1	< 0.1			
Moisture Content	%	N/A	NONE	8.4	20			
Total mass of sample received	kg	0.001	NONE	0.45	2.0			

General Inorganics

pH - Automated	pH Units	N/A	MCERTS	7.3	7.7			
Water Soluble SO4 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	0.15	3.1			
Water Soluble SO4 16hr extraction (2:1 Leachate Equivalent)	mg/l	1.25	MCERTS	147	3110			

Analytical Report Number : 20-91417

Project / Site name: Acton Gardens

* These descriptions are only intended to act as a cross check if sample identities are questioned. The major constituent of the sample is intended to act with respect to MCERTS validation. The laboratory is accredited for sand, clay and loam (MCERTS) soil types. Data for unaccredited types of solid should be interpreted with care.

Stone content of a sample is calculated as the % weight of the stones not passing a 10 mm sieve. Results are not corrected for stone content.

Lab Sample Number	Sample Reference	Sample Number	Depth (m)	Sample Description *
1466307	WS103	None Supplied	1.50-1.90	Light brown sandy clay with gravel.
1466308	WS102	None Supplied	2.50-3.00	Brown clay and sand.

Analytical Report Number : 20-91417

Project / Site name: Acton Gardens

Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Water (PrW)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Moisture Content	Moisture content, determined gravimetrically. (30 oC)	In house method.	L019-UK/PL	W	NONE
pH in soil (automated)	Determination of pH in soil by addition of water followed by automated electrometric measurement.	In house method.	L099-PL	D	MCERTS
Stones content of soil	Standard preparation for all samples unless otherwise detailed. Gravimetric determination of stone > 10 mm as % dry weight.	In-house method based on British Standard Methods and MCERTS requirements.	L019-UK/PL	D	NONE
Sulphate, water soluble, in soil (16hr extraction)	Determination of water soluble sulphate by ICP-OES. Results reported directly (leachate equivalent) and corrected for extraction ratio (soil equivalent).	In house method.	L038-PL	D	MCERTS

For method numbers ending in 'UK' analysis have been carried out in our laboratory in the United Kingdom.
For method numbers ending in 'PL' analysis have been carried out in our laboratory in Poland.
Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC.

TEST CERTIFICATE

Particle Size Distribution

Tested in Accordance with: BS 1377-2: 1990

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

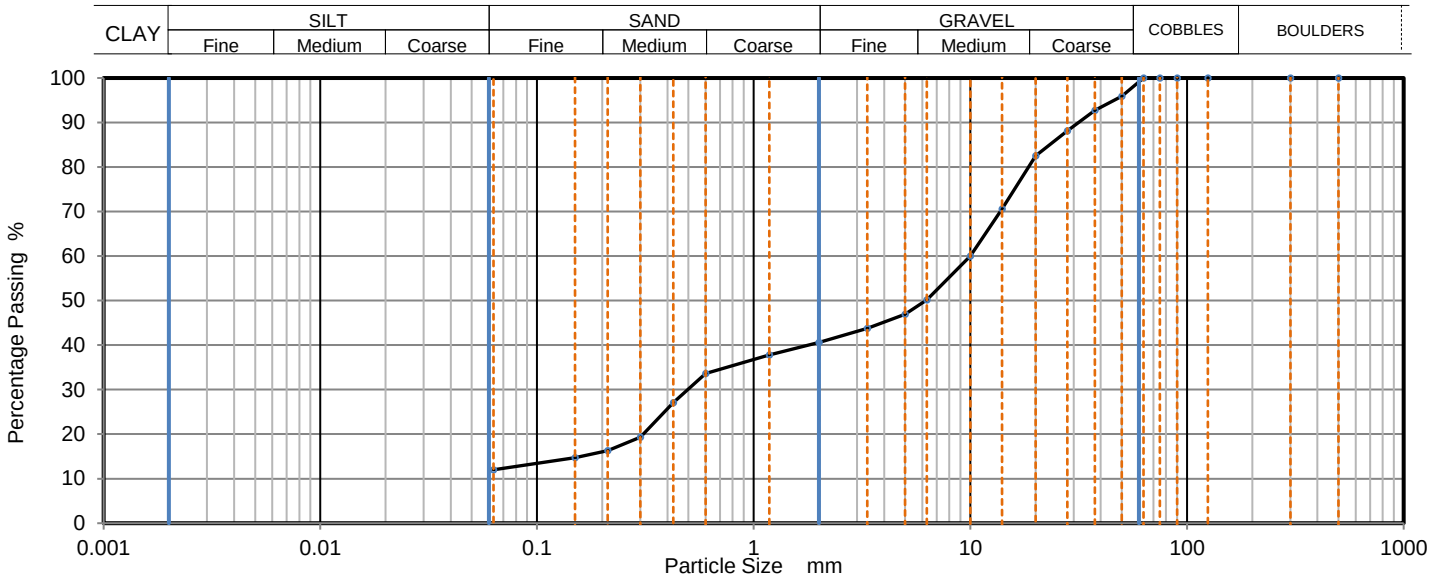
4041

Client:	CURTINS	Client Reference:	73270
Client Address:	Units 5/6, 40 Compton Street, London, EC1V 0BD	Job Number:	20-91392
		Date Sampled:	20/02/2020
		Date Received:	21/02/2020
Contact:	Myfanwy Wood	Date Tested:	19/03/2020
Site Address:	Acton Gardens	Sampled By:	Not Given

Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

Test Results:

Laboratory Reference:	1466221	Depth Top [m]:	1.50
Hole No.:	WS103	Depth Base [m]:	1.90
Sample Reference:	Not Given	Sample Type:	B
Sample Description:	Brown clayey sandy GRAVEL		



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
500	100		
300	100		
125	100		
90	100		
75	100		
63	100		
50	96		
37.5	93		
28	88		
20	83		
14	71		
10	60		
6.3	50		
5	47		
3.35	44		
2	41		
1.18	38		
0.6	34		
0.425	27		
0.3	19		
0.212	16		
0.15	15		
0.063	12.7		

Sample Proportions	% dry mass
Very coarse	0.00
Gravel	59.40
Sand	28.00
Fines <0.063mm	12.70

Grading Analysis		
D100	mm	63
D60	mm	9.99
D30	mm	0.496
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

Note: Tested in Accordance with BS1377:Part 2:1990, clause 9.2

Remarks:

Signed:

Monika Janoszek
PL Deputy Head of Geotechnical Section
for and on behalf of i2 Analytical Ltd

Date Reported: 23/03/2020

GF 100.16

TEST CERTIFICATE

Particle Size Distribution

Tested in Accordance with: BS 1377-2: 1990

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

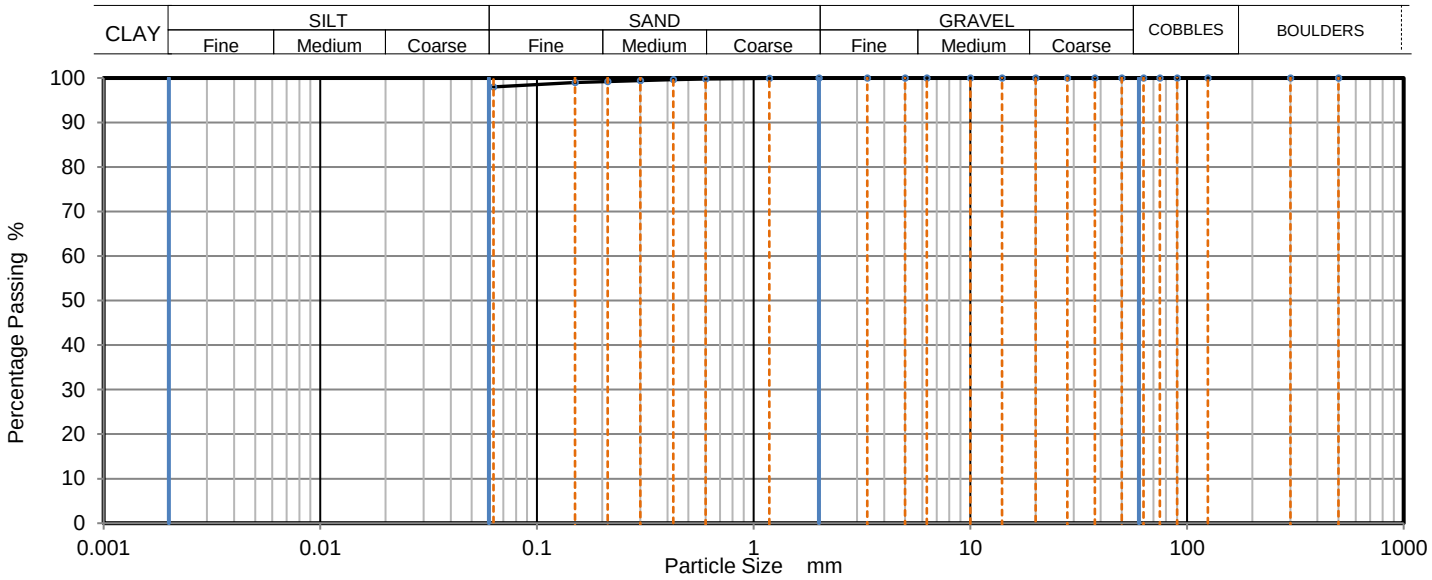
4041

Client:	CURTINS	Client Reference:	73270
Client Address:	Units 5/6, 40 Compton Street, London, EC1V 0BD	Job Number:	20-91392
		Date Sampled:	21/02/2020
		Date Received:	21/02/2020
Contact:	Myfanwy Wood	Date Tested:	19/03/2020
Site Address:	Acton Gardens	Sampled By:	Not Given

Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

Test Results:

Laboratory Reference:	1466222	Depth Top [m]:	3.40
Hole No.:	WS105	Depth Base [m]:	Not Given
Sample Reference:	Not Given	Sample Type:	D
Sample Description:	Brown CLAY		



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
500	100		
300	100		
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	100		
14	100		
10	100		
6.3	100		
5	100		
3.35	100		
2	100		
1.18	100		
0.6	100		
0.425	100		
0.3	99		
0.212	99		
0.15	99		
0.063	98.4		

Sample Proportions	% dry mass
Very coarse	0.00
Gravel	0.00
Sand	1.60
Fines <0.063mm	98.40

Grading Analysis		
D100	mm	3.35
D60	mm	
D30	mm	
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

Note: Tested in Accordance with BS1377:Part 2:1990, clause 9.2

Remarks:

Signed:

Monika Janoszek
PL Deputy Head of Geotechnical Section
for and on behalf of i2 Analytical Ltd

Date Reported: 23/03/2020

GF 100.16

TEST CERTIFICATE

Particle Size Distribution

Tested in Accordance with: BS 1377-2: 1990

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Brackmills Industrial Estate
Northampton NN4 7EB

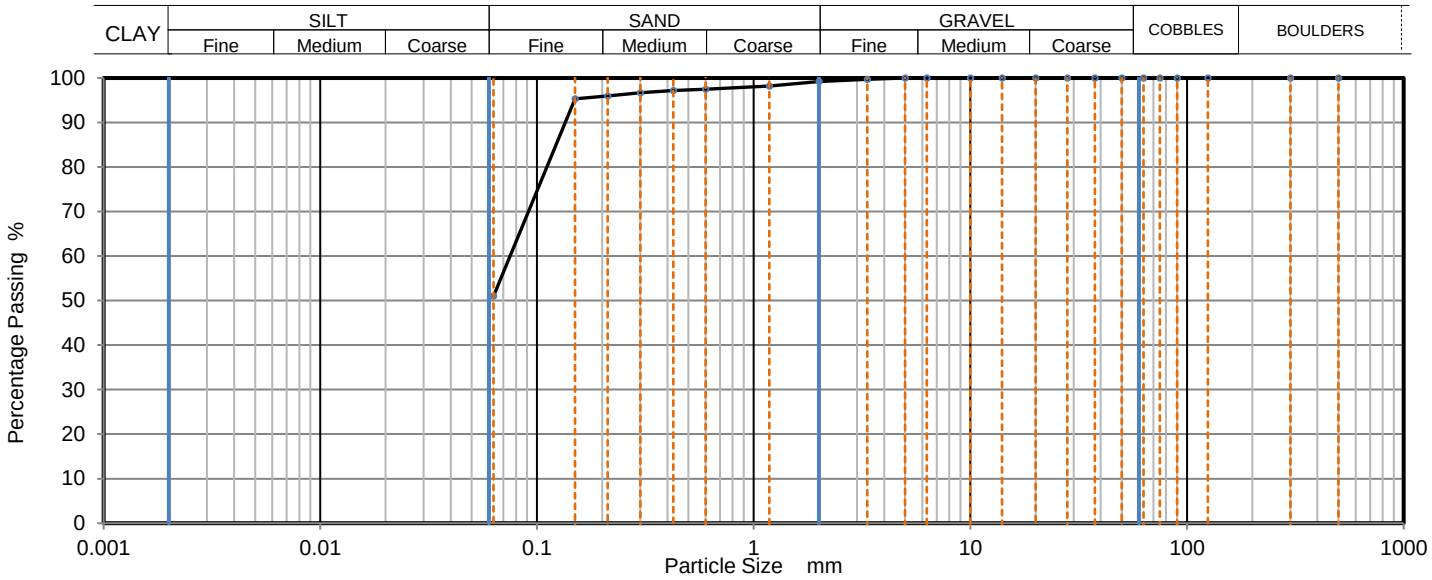
4041

Client:	CURTINS	Client Reference:	73270
Client Address:	Units 5/6, 40 Compton Street, London, EC1V 0BD	Job Number:	20-91392
		Date Sampled:	21/02/2020
		Date Received:	21/02/2020
Contact:	Myfanwy Wood	Date Tested:	19/03/2020
Site Address:	Acton Gardens	Sampled By:	Not Given

Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

Test Results:

Laboratory Reference:	1466224	Depth Top [m]:	3.00
Hole No.:	WS107	Depth Base [m]:	4.00
Sample Reference:	Not Given	Sample Type:	D
Sample Description:	Brown very sandy CLAY		



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
500	100		
300	100		
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	100		
14	100		
10	100		
6.3	100		
5	100		
3.35	100		
2	99		
1.18	98		
0.6	98		
0.425	97		
0.3	97		
0.212	96		
0.15	95		
0.063	51.5		

Sample Proportions	% dry mass
Very coarse	0.00
Gravel	0.80
Sand	47.70
Fines <0.063mm	51.50

Grading Analysis		
D100	mm	5
D60	mm	0.0745
D30	mm	
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

Note: Tested in Accordance with BS1377:Part 2:1990, clause 9.2

Remarks:

Signed:

Monika Janoszek
PL Deputy Head of Geotechnical Section
for and on behalf of i2 Analytical Ltd

Date Reported: 23/03/2020

GF 100.16

TEST CERTIFICATE

Particle Size Distribution

Tested in Accordance with: BS 1377-2: 1990

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

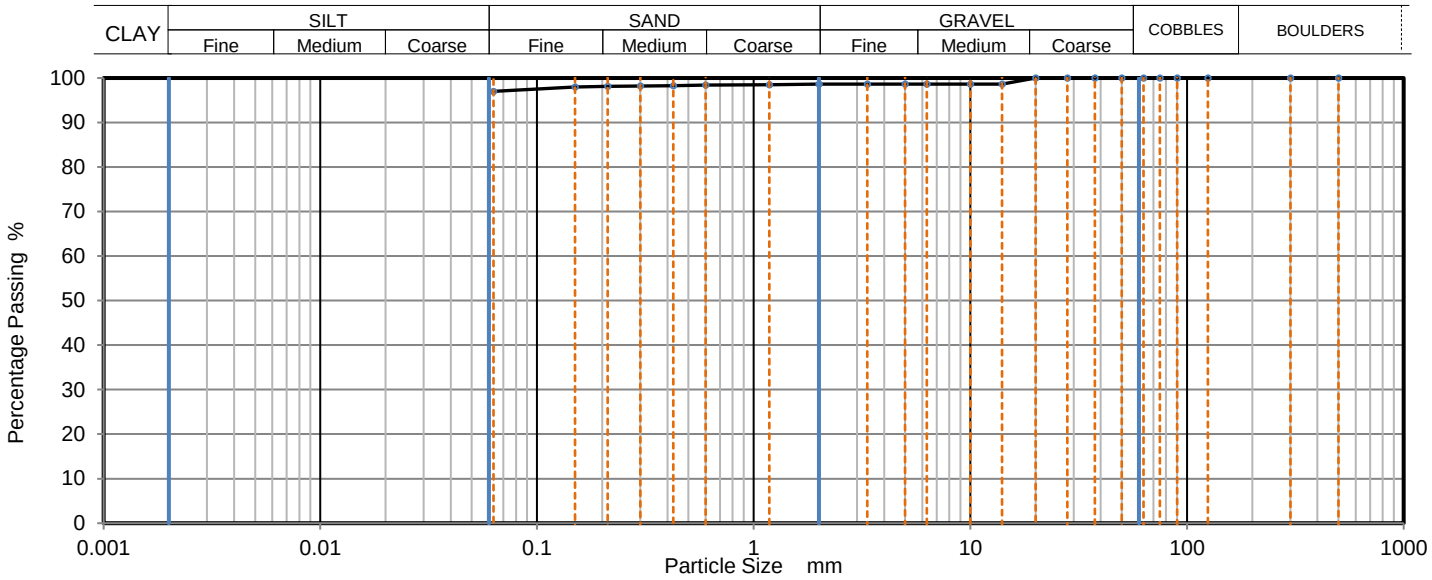
4041

Client:	CURTINS	Client Reference:	73270
Client Address:	Units 5/6, 40 Compton Street, London, EC1V 0BD	Job Number:	20-91392
		Date Sampled:	19/02/2020
		Date Received:	21/02/2020
Contact:	Myfanwy Wood	Date Tested:	19/03/2020
Site Address:	Acton Gardens	Sampled By:	Not Given

Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

Test Results:

Laboratory Reference:	1466225	Depth Top [m]:	5.50
Hole No.:	CP103	Depth Base [m]:	Not Given
Sample Reference:	Not Given	Sample Type:	D
Sample Description:	Dark brown CLAY		



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
500	100		
300	100		
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	100		
14	99		
10	99		
6.3	99		
5	99		
3.35	99		
2	99		
1.18	99		
0.6	98		
0.425	98		
0.3	98		
0.212	98		
0.15	98		
0.063	97.4		

Sample Proportions	% dry mass
Very coarse	0.00
Gravel	1.40
Sand	1.20
Fines <0.063mm	97.40

Grading Analysis		
D100	mm	20
D60	mm	
D30	mm	
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

Note: Tested in Accordance with BS1377:Part 2:1990, clause 9.2

Remarks:

Signed:

Monika Janoszek
PL Deputy Head of Geotechnical Section
for and on behalf of i2 Analytical Ltd

Date Reported: 23/03/2020

GF 100.16

TEST CERTIFICATE

Particle Size Distribution

Tested in Accordance with: BS 1377-2: 1990

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

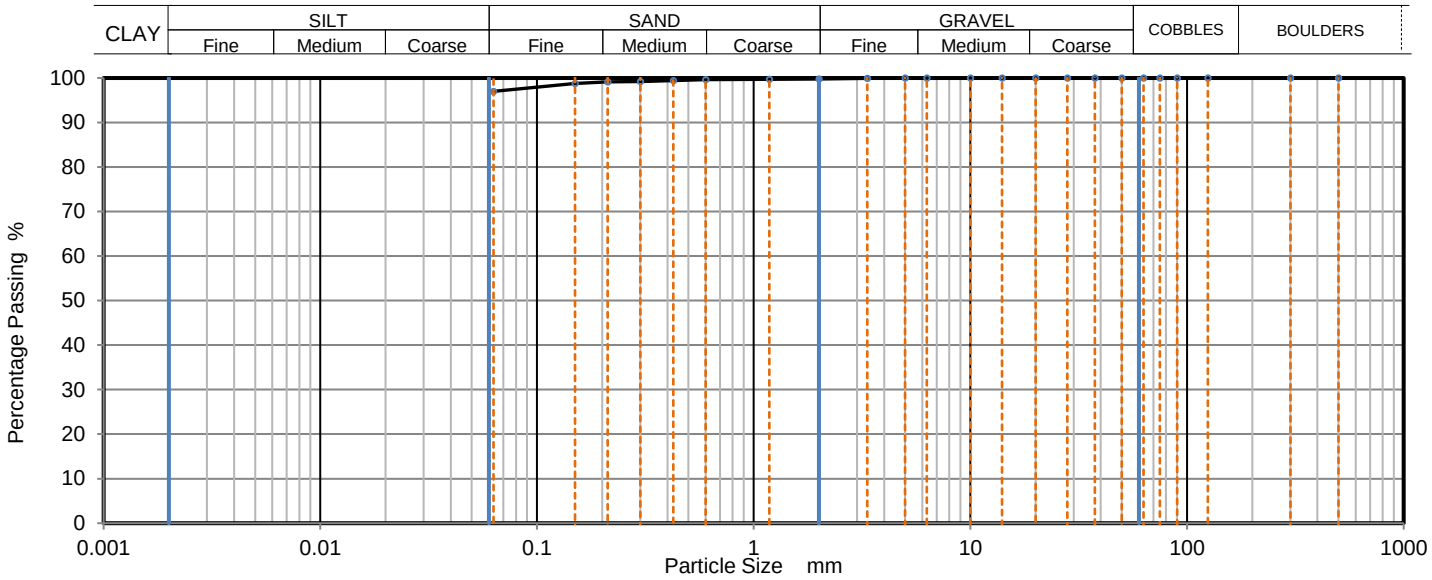
4041

Client:	CURTINS	Client Reference:	73270
Client Address:	Units 5/6, 40 Compton Street, London, EC1V 0BD	Job Number:	20-91392
		Date Sampled:	19/02/2020
		Date Received:	21/02/2020
Contact:	Myfanwy Wood	Date Tested:	19/03/2020
Site Address:	Acton Gardens	Sampled By:	Not Given

Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

Test Results:

Laboratory Reference:	1466226	Depth Top [m]:	5.50
Hole No.:	CP104	Depth Base [m]:	Not Given
Sample Reference:	Not Given	Sample Type:	D
Sample Description:	Dark brown CLAY		



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
500	100		
300	100		
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	100		
14	100		
10	100		
6.3	100		
5	100		
3.35	100		
2	100		
1.18	100		
0.6	100		
0.425	99		
0.3	99		
0.212	99		
0.15	99		
0.063	97.8		

Sample Proportions	% dry mass
Very coarse	0.00
Gravel	0.20
Sand	2.00
Fines <0.063mm	97.80

Grading Analysis		
D100	mm	5
D60	mm	
D30	mm	
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

Note: Tested in Accordance with BS1377:Part 2:1990, clause 9.2

Remarks:

Signed:

Monika Janoszek
PL Deputy Head of Geotechnical Section
for and on behalf of i2 Analytical Ltd

Date Reported: 23/03/2020

GF 100.16

Myfanwy Wood
Curtins
Units 5/6
40 Compton Street
London
EC1V 0BD

e: myfanwy.wood@curtins.com

i2 Analytical Ltd.
7 Woodshots Meadow,
Croxley Green
Business Park,
Watford,
Herts,
WD18 8YS

t: 01923 225404
f: 01923 237404
e: reception@i2analytical.com

Analytical Report Number : 20-89844

Project / Site name:	Acton Gardens	**Samples received on:**	25/02/2020
Your job number:	073270	**Samples instructed on:**	28/02/2020
Your order number:	EBLO305	**Analysis completed by:**	13/03/2020
Report Issue Number:	1	**Report issued on:**	13/03/2020
Samples Analysed:	10 soil samples		

Signed:

Zina Abdul Razzak
Senior Quality Specialist

For & on behalf of i2 Analytical Ltd.

Standard Geotechnical, Asbestos and Chemical Testing Laboratory located at: ul. Pionierów 39, 41 -711 Ruda Śląska, Poland.

Accredited tests are defined within the report, opinions and interpretations expressed herein are outside the scope of accreditation.

Standard sample disposal times, unless otherwise agreed with the laboratory, are :

soils	- 4 weeks from reporting
leachates	- 2 weeks from reporting
waters	- 2 weeks from reporting
asbestos	- 6 months from reporting

Excel copies of reports are only valid when accompanied by this PDF certificate.

Any assessments of compliance with specifications are based on actual analytical results with no contribution from uncertainty of measurement. Application of uncertainty of measurement would provide a range within which the true result lies. An estimate of measurement uncertainty can be provided on request.

Analytical Report Number: 20-89844

Project / Site name: Acton Gardens
Your Order No: EBLO305

Lab Sample Number				1457944	1457945	1457946	1457947	1457948
Sample Reference				CP103	CP103	CP104	CP104	CP105
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				6.50	21.00	9.50	23.00	11.00
Date Sampled				19/02/2020	20/02/2020	19/02/2020	20/02/2020	18/02/2020
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Stone Content	%	0.1	NONE	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Moisture Content	%	N/A	NONE	24	21	20	20	9.9
Total mass of sample received	kg	0.001	NONE	1.4	1.4	1.4	1.4	0.45
General Inorganics								
pH - Automated	pH Units	N/A	MCERTS	8.2	8.4	8.5	8.5	8.3
Total Sulphate as SO_4	%	0.005	MCERTS	0.109	0.094	0.060	0.062	0.117
Water Soluble SO4 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	0.51	0.56	0.34	0.32	0.58
Water Soluble SO4 16hr extraction (2:1 Leachate Equivalent)	mg/l	1.25	MCERTS	-	-	-	-	-
Water Soluble Chloride (2:1) (leachate equivalent)	mg/l	0.5	MCERTS	17	39	16	19	29
Total Sulphur	%	0.005	MCERTS	0.705	0.481	0.254	0.262	0.304
Water Soluble Nitrate (2:1) as N (leachate equivalent)	mg/l	2	NONE	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Heavy Metals / Metalloids								
Magnesium (water soluble)	mg/kg	5	NONE	99	51	50	36	78
Magnesium (leachate equivalent)	mg/l	2.5	NONE	49	25	25	18	39

Analytical Report Number: 20-89844

Project / Site name: Acton Gardens
Your Order No: EBLO305

Lab Sample Number				1457949	1457950	1457951	1457952	1457953
Sample Reference				WS104	WS108	WS105	WS106	WS106
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				5.00	4.50	1.50-2.00	1.50-1.80	1.80-2.40
Date Sampled				20/02/2020	21/02/2020	21/02/2020	21/02/2020	21/02/2020
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Stone Content	%	0.1	NONE	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Moisture Content	%	N/A	NONE	8.7	13	8.0	6.2	14
Total mass of sample received	kg	0.001	NONE	0.40	0.40	0.55	0.55	0.55
General Inorganics								
pH - Automated	pH Units	N/A	MCERTS	8.1	7.5	7.8	7.8	7.9
Total Sulphate as SO_4	%	0.005	MCERTS	0.131	1.95	-	-	-
Water Soluble SO4 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	0.60	2.6	0.069	0.039	0.028
Water Soluble SO4 16hr extraction (2:1 Leachate Equivalent)	mg/l	1.25	MCERTS	-	-	69.2	38.5	28.1
Water Soluble Chloride (2:1) (leachate equivalent)	mg/l	0.5	MCERTS	18	17	-	-	-
Total Sulphur	%	0.005	MCERTS	0.332	0.685	-	-	-
Water Soluble Nitrate (2:1) as N (leachate equivalent)	mg/l	2	NONE	< 2.0	< 2.0	-	-	-
Heavy Metals / Metalloids								
Magnesium (water soluble)	mg/kg	5	NONE	130	460	-	-	-
Magnesium (leachate equivalent)	mg/l	2.5	NONE	66	230	-	-	-

Analytical Report Number : 20-89844

Project / Site name: Acton Gardens

* These descriptions are only intended to act as a cross check if sample identities are questioned. The major constituent of the sample is intended to act with respect to MCERTS validation. The laboratory is accredited for sand, clay and loam (MCERTS) soil types. Data for unaccredited types of solid should be interpreted with care.

Stone content of a sample is calculated as the % weight of the stones not passing a 10 mm sieve. Results are not corrected for stone content.

Lab Sample Number	Sample Reference	Sample Number	Depth (m)	Sample Description *
1457944	CP103	None Supplied	6.50	Brown clay.
1457945	CP103	None Supplied	21.00	Brown clay.
1457946	CP104	None Supplied	9.50	Brown clay.
1457947	CP104	None Supplied	23.00	Brown clay.
1457948	CP105	None Supplied	11.00	Brown clay.
1457949	WS104	None Supplied	5.00	Brown clay.
1457950	WS108	None Supplied	4.50	Brown clay.
1457951	WS105	None Supplied	1.50-2.00	Brown loam and sand with gravel.
1457952	WS106	None Supplied	1.50-1.80	Brown loam and sand with gravel and vegetation.
1457953	WS106	None Supplied	1.80-2.40	Brown loam and sand with gravel and vegetation.

Analytical Report Number : 20-89844

Project / Site name: Acton Gardens

Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Water (PrW)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Chloride, water soluble, in soil	Determination of Chloride colorimetrically by discrete analyser.	In house method.	L082-PL	D	MCERTS
Magnesium, water soluble, in soil	Determination of water soluble magnesium by extraction with water followed by ICP-OES.	In-house method based on TRL 447	L038-PL	D	NONE
Moisture Content	Moisture content, determined gravimetrically. (30 oC)	In house method.	L019-UK/PL	W	NONE
pH in soil (automated)	Determination of pH in soil by addition of water followed by automated electrometric measurement.	In house method.	L099-PL	D	MCERTS
Stones content of soil	Standard preparation for all samples unless otherwise detailed. Gravimetric determination of stone > 10 mm as % dry weight.	In-house method based on British Standard Methods and MCERTS requirements.	L019-UK/PL	D	NONE
Sulphate, water soluble, in soil (16hr extraction)	Determination of water soluble sulphate by ICP-OES. Results reported directly (leachate equivalent) and corrected for extraction ratio (soil equivalent).	In house method.	L038-PL	D	MCERTS
Total Sulphate in soil as %	Determination of total sulphate in soil by extraction with 10% HCl followed by ICP-OES.	In house method.	L038-PL	D	MCERTS
Total Sulphur in soil as %	Determination of total sulphur in soil by extraction with aqua-regia, potassium bromide/bromate followed by ICP-OES.	In house method.	L038-PL	D	MCERTS
Water Soluble Nitrate (2:1) as N in soil	Determination of nitrate by reaction with sodium salicylate and colorimetry.	In-house method based on Examination of Water and Wastewatern & Polish Standard Method PN-82/C-04579.08, 2:1 extraction.	L078-PL	W	NONE

For method numbers ending in 'UK' analysis have been carried out in our laboratory in the United Kingdom.
For method numbers ending in 'PL' analysis have been carried out in our laboratory in Poland.
Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC.

TEST CERTIFICATE

Liquid and Plastic Limits

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

4041

Tested in Accordance with: BS 1377-2: 1990: Clause 4.3 and 5

Client:	CURTINS	Client Reference:	73270
Client Address:	Units 5/6, 40 Compton Street, London, EC1V 0BD	Job Number:	20-89839
		Date Sampled:	20/02/2020
		Date Received:	25/02/2020
Contact:	Myfanwy Wood	Date Tested:	03/03/2020
Site Address:	Acton Gardens	Sampled By:	Not Given

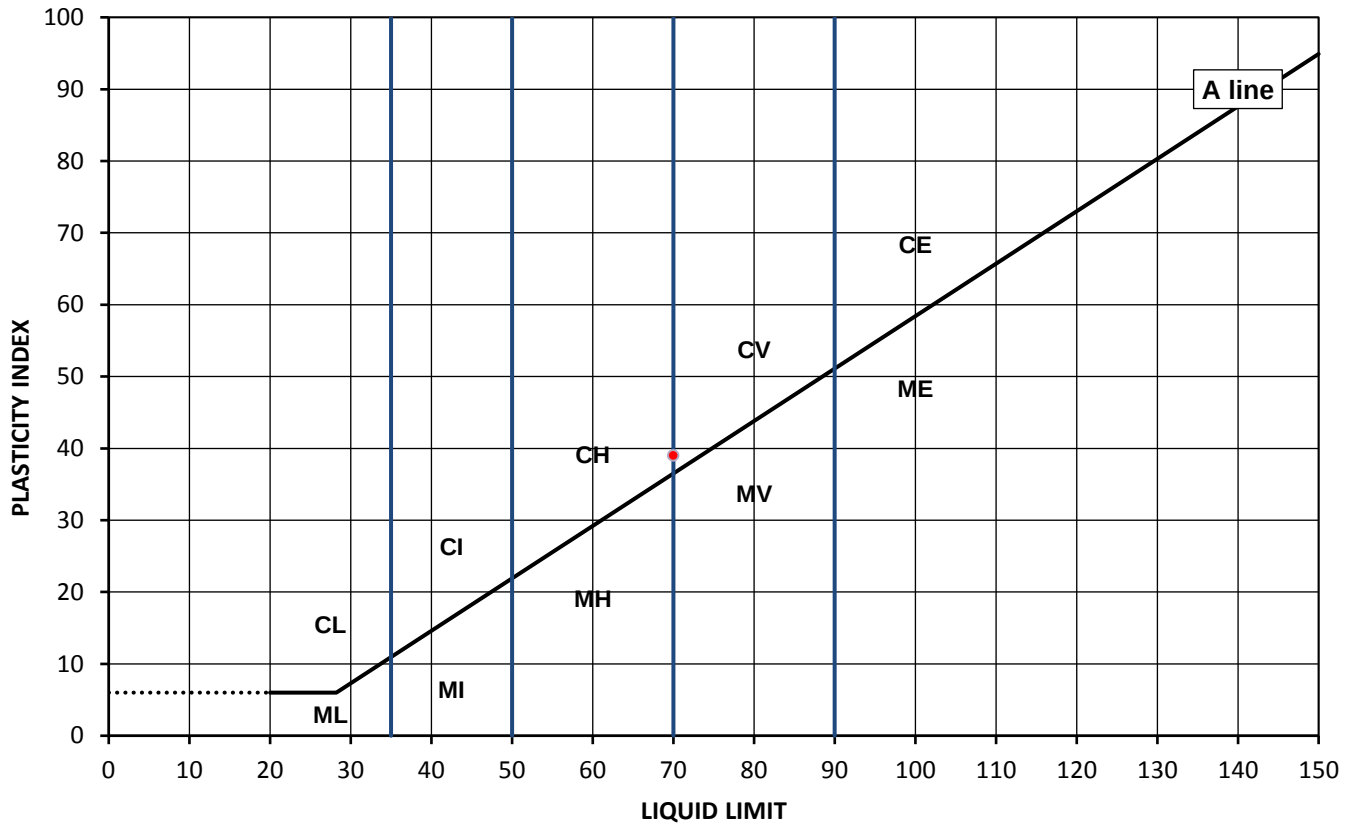
Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

Test Results:

Laboratory Reference:	1457866	Depth Top [m]:	2.00
Hole No.:	WS104	Depth Base [m]:	Not Given
Sample Reference:	Not Given	Sample Type:	D
Soil Description:	Orangish brown CLAY		

Sample Preparation: Tested in natural condition

As Received Moisture Content [%]	Liquid Limit [%]	Plastic Limit [%]	Plasticity Index [%]	% Passing 425µm BS Test Sieve
33	70	31	39	100



Legend, based on BS 5930:2015 Code of practice for site investigations

		Plasticity		Liquid Limit
C	Clay	L	Low	below 35
M	Silt	I	Medium	35 to 50
		H	High	50 to 70
		V	Very high	70 to 90
		E	Extremely high	exceeding 90
	Organic	O	append to classification for organic material (eg CHO)	

Note: Moisture Content by BS 1377-2: 1990: Clause 3.2

Remarks:

Signed:

Monika Janoszek
PL Deputy Head of Geotechnical Section
for and on behalf of i2 Analytical Ltd

Date Reported: 13/03/2020

GF 236.8

TEST CERTIFICATE

Liquid and Plastic Limits

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

4041

Tested in Accordance with: BS 1377-2: 1990: Clause 4.3 and 5

Client:	CURTINS	Client Reference:	73270
Client Address:	Units 5/6, 40 Compton Street, London, EC1V 0BD	Job Number:	20-89839
		Date Sampled:	21/02/2020
		Date Received:	25/02/2020
Contact:	Myfanwy Wood	Date Tested:	03/03/2020
Site Address:	Acton Gardens	Sampled By:	Not Given

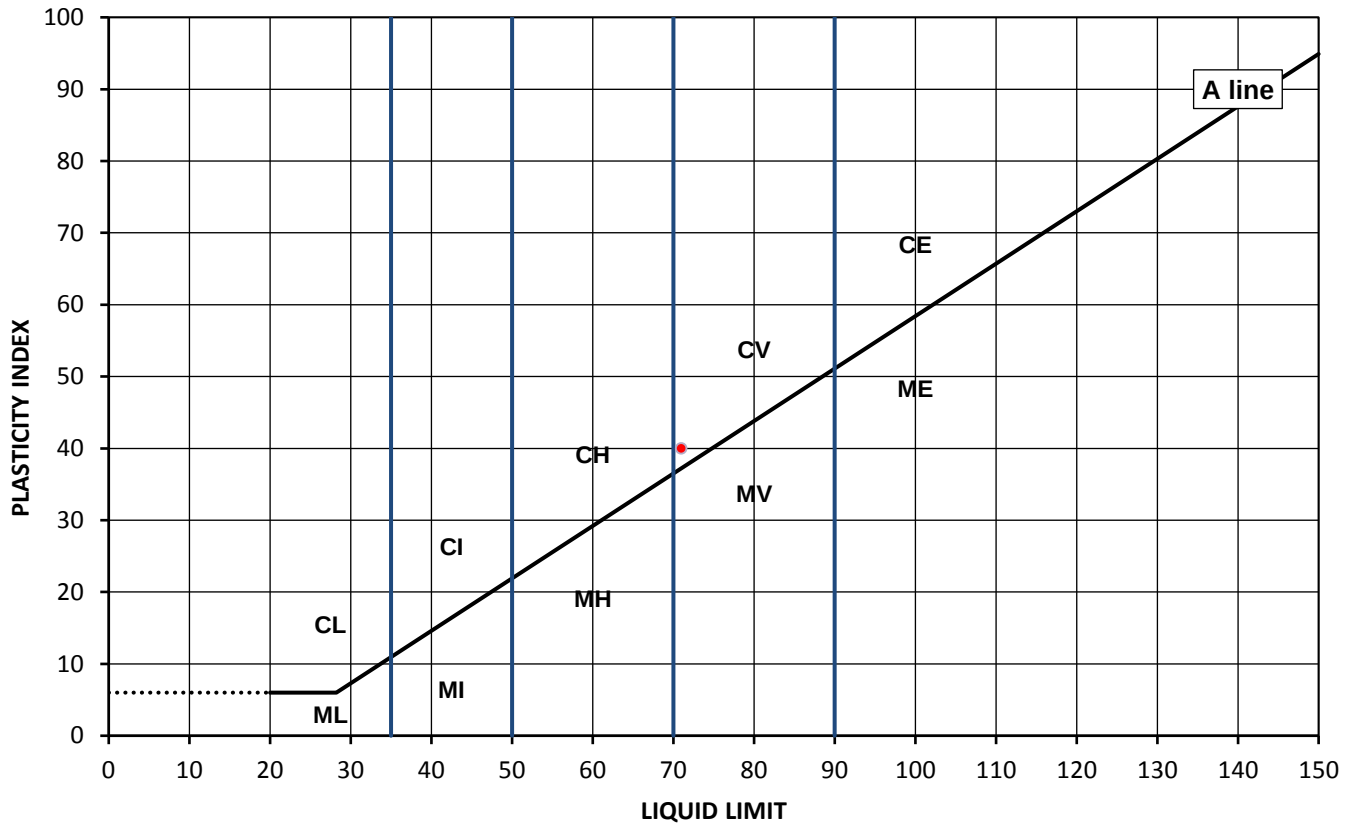
Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

Test Results:

Laboratory Reference:	1457867	Depth Top [m]:	3.40
Hole No.:	WS105	Depth Base [m]:	Not Given
Sample Reference:	Not Given	Sample Type:	D
Soil Description:	Orangish brown CLAY		

Sample Preparation: Tested in natural condition

As Received Moisture Content [%]	Liquid Limit [%]	Plastic Limit [%]	Plasticity Index [%]	% Passing 425µm BS Test Sieve
30	71	31	40	100



Legend, based on BS 5930:2015 Code of practice for site investigations

		Plasticity		Liquid Limit
C	Clay	L	Low	below 35
M	Silt	I	Medium	35 to 50
		H	High	50 to 70
		V	Very high	70 to 90
		E	Extremely high	exceeding 90
	Organic	O	append to classification for organic material (eg CHO)	

Note: Moisture Content by BS 1377-2: 1990: Clause 3.2

Remarks:

Signed:

Monika Janoszek
PL Deputy Head of Geotechnical Section
for and on behalf of i2 Analytical Ltd

Date Reported: 13/03/2020

GF 236.8

TEST CERTIFICATE

Liquid and Plastic Limits

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

4041

Tested in Accordance with: BS 1377-2: 1990: Clause 4.3 and 5

Client:	CURTINS	Client Reference:	73270
Client Address:	Units 5/6, 40 Compton Street, London, EC1V 0BD	Job Number:	20-89839
		Date Sampled:	21/02/2020
		Date Received:	25/02/2020
Contact:	Myfanwy Wood	Date Tested:	03/03/2020
Site Address:	Acton Gardens	Sampled By:	Not Given

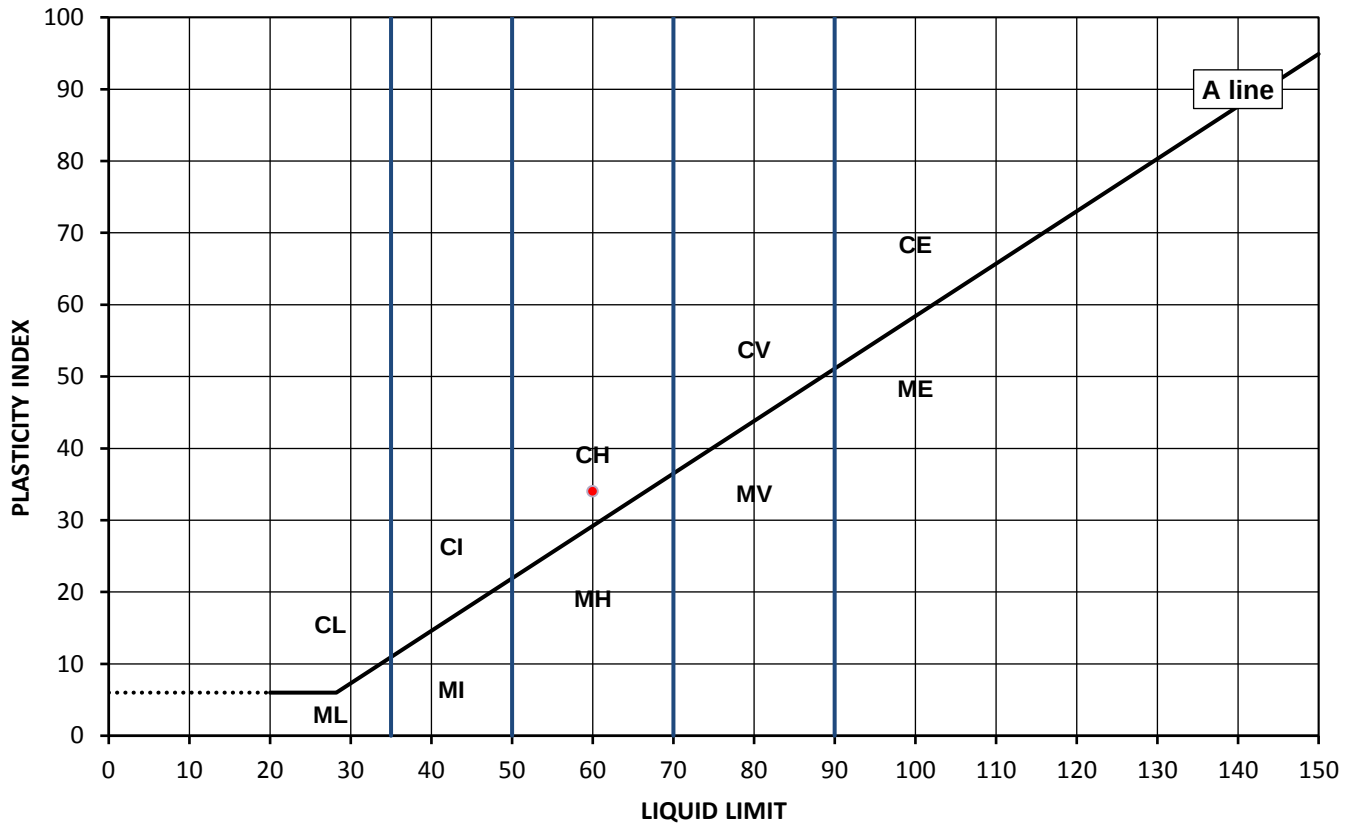
Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

Test Results:

Laboratory Reference:	1457868	Depth Top [m]:	3.80
Hole No.:	WS106	Depth Base [m]:	Not Given
Sample Reference:	Not Given	Sample Type:	D
Soil Description:	Orangish brown slightly gravelly CLAY		

Sample Preparation: Tested after washing to remove >425um

As Received Moisture Content [%]	Liquid Limit [%]	Plastic Limit [%]	Plasticity Index [%]	% Passing 425µm BS Test Sieve
24	60	26	34	95



Legend, based on BS 5930:2015 Code of practice for site investigations

		Plasticity		Liquid Limit
C	Clay	L	Low	below 35
M	Silt	I	Medium	35 to 50
		H	High	50 to 70
		V	Very high	70 to 90
		E	Extremely high	exceeding 90
	Organic	O	append to classification for organic material (eg CHO)	

Note: Moisture Content by BS 1377-2: 1990: Clause 3.2

Remarks:

Signed:

Monika Janoszek
PL Deputy Head of Geotechnical Section
for and on behalf of i2 Analytical Ltd

Date Reported: 13/03/2020

GF 236.8

TEST CERTIFICATE

Liquid and Plastic Limits

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

4041

Tested in Accordance with: BS 1377-2: 1990: Clause 4.3 and 5

Client:	CURTINS	Client Reference:	73270
Client Address:	Units 5/6, 40 Compton Street, London, EC1V 0BD	Job Number:	20-89839
		Date Sampled:	21/02/2020
		Date Received:	25/02/2020
Contact:	Myfanwy Wood	Date Tested:	03/03/2020
Site Address:	Acton Gardens	Sampled By:	Not Given

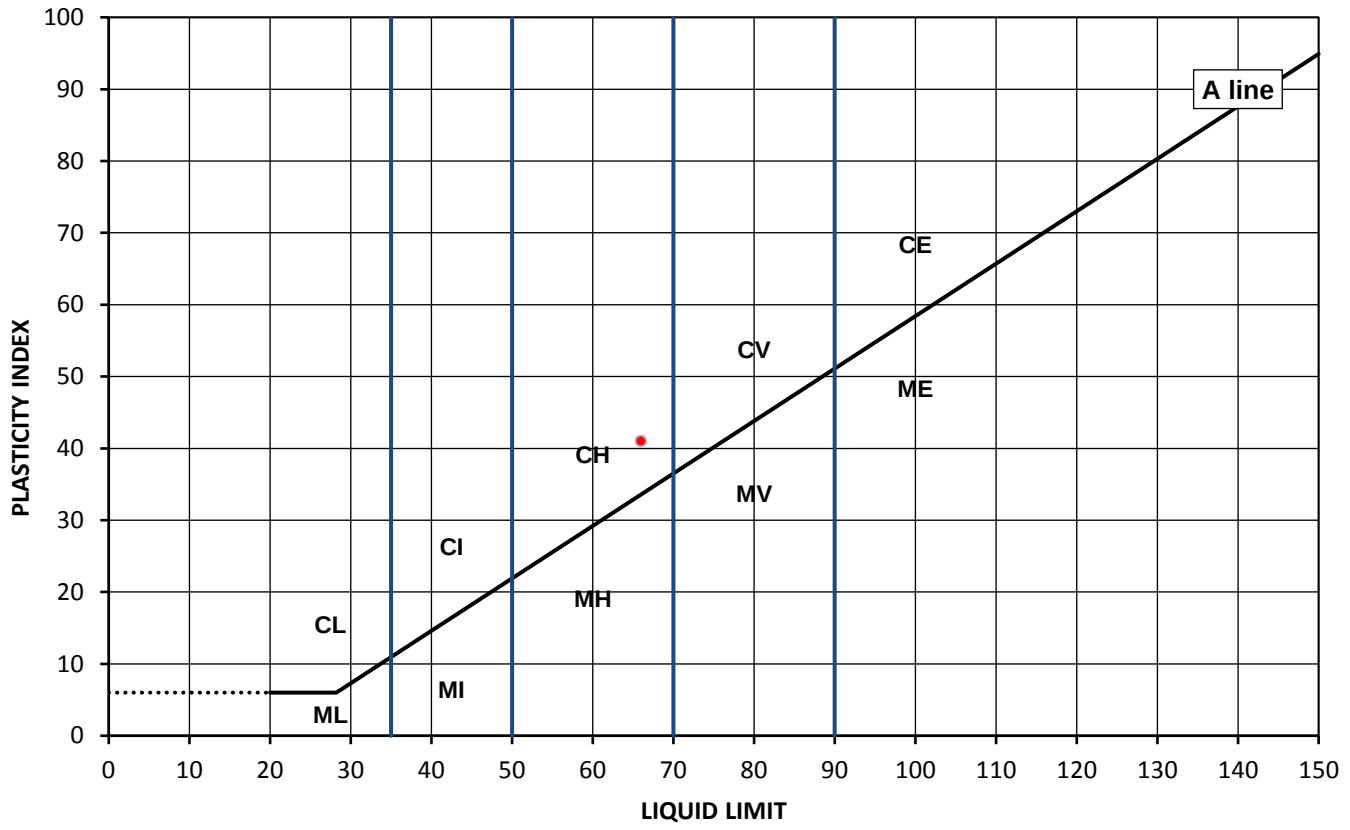
Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

Test Results:

Laboratory Reference:	1457869	Depth Top [m]:	3.00
Hole No.:	WS107	Depth Base [m]:	4.00
Sample Reference:	Not Given	Sample Type:	B
Soil Description:	Brown slightly gravelly CLAY		

Sample Preparation: Tested after washing to remove >425um

As Received Moisture Content [%]	Liquid Limit [%]	Plastic Limit [%]	Plasticity Index [%]	% Passing 425µm BS Test Sieve
25	66	25	41	99



Legend, based on BS 5930:2015 Code of practice for site investigations

		Plasticity		Liquid Limit
C	Clay	L	Low	below 35
M	Silt	I	Medium	35 to 50
		H	High	50 to 70
		V	Very high	70 to 90
		E	Extremely high	exceeding 90
	Organic	O	append to classification for organic material (eg CHO)	

Note: Moisture Content by BS 1377-2: 1990: Clause 3.2

Remarks:

Signed:

Monika Janoszek
PL Deputy Head of Geotechnical Section
for and on behalf of i2 Analytical Ltd

Date Reported: 13/03/2020

GF 236.8

TEST CERTIFICATE

Liquid and Plastic Limits

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

4041

Tested in Accordance with: BS 1377-2: 1990: Clause 4.3 and 5

Client:	CURTINS	Client Reference:	73270
Client Address:	Units 5/6, 40 Compton Street, London, EC1V 0BD	Job Number:	20-89839
		Date Sampled:	21/02/2020
		Date Received:	25/02/2020
Contact:	Myfanwy Wood	Date Tested:	03/03/2020
Site Address:	Acton Gardens	Sampled By:	Not Given

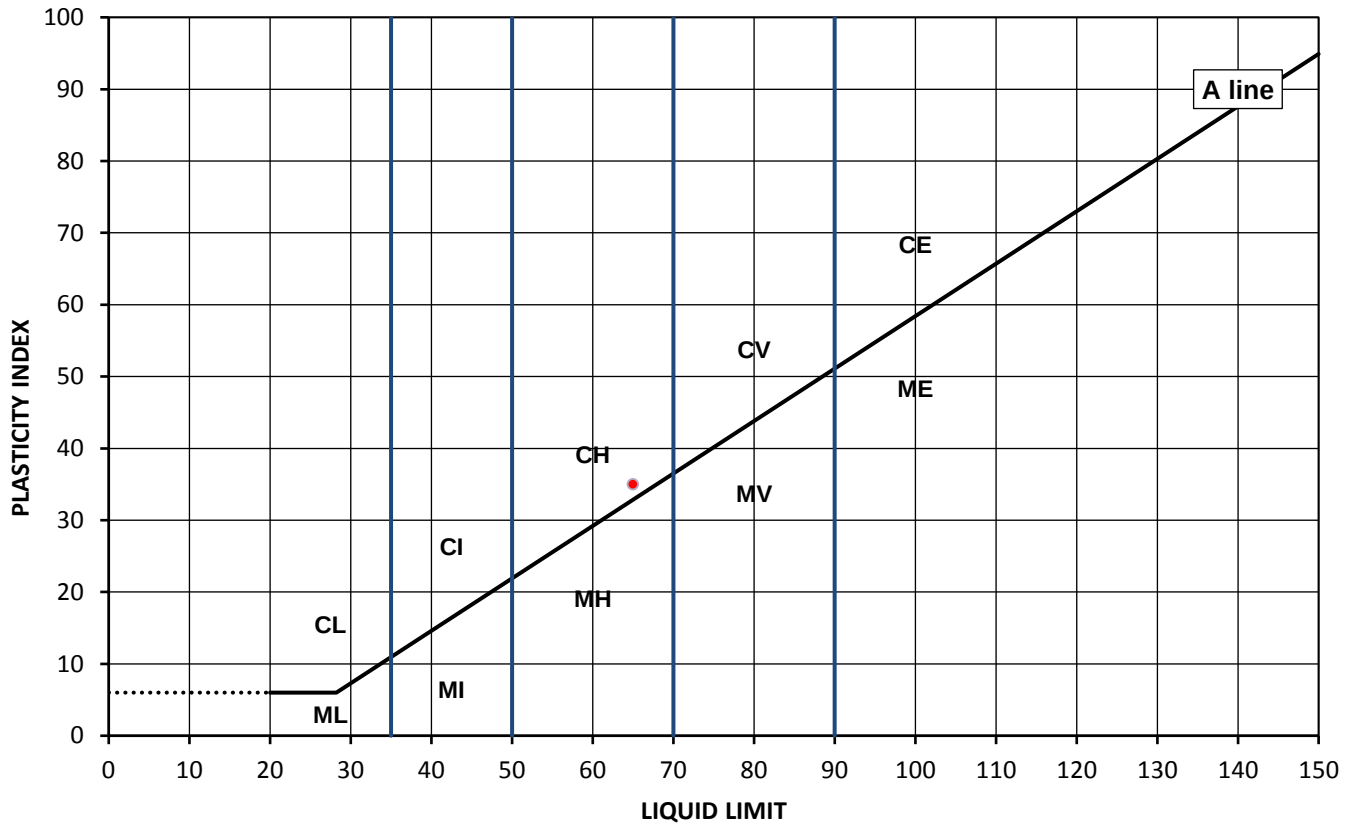
Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

Test Results:

Laboratory Reference:	1457870	Depth Top [m]:	4.90
Hole No.:	WS107	Depth Base [m]:	Not Given
Sample Reference:	Not Given	Sample Type:	D
Soil Description:	Brownish grey CLAY		

Sample Preparation: Tested in natural condition

As Received Moisture Content [%]	Liquid Limit [%]	Plastic Limit [%]	Plasticity Index [%]	% Passing 425µm BS Test Sieve
29	65	30	35	100



Legend, based on BS 5930:2015 Code of practice for site investigations

		Plasticity		Liquid Limit
C	Clay	L	Low	below 35
M	Silt	I	Medium	35 to 50
		H	High	50 to 70
		V	Very high	70 to 90
		E	Extremely high	exceeding 90
	Organic	O	append to classification for organic material (eg CHO)	

Note: Moisture Content by BS 1377-2: 1990: Clause 3.2

Remarks:

Signed:

Monika Janoszek
PL Deputy Head of Geotechnical Section
for and on behalf of i2 Analytical Ltd

Date Reported: 13/03/2020

GF 236.8

TEST CERTIFICATE

Liquid and Plastic Limits

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

4041

Tested in Accordance with: BS 1377-2: 1990: Clause 4.3 and 5

Client:	CURTINS	Client Reference:	73270
Client Address:	Units 5/6, 40 Compton Street, London, EC1V 0BD	Job Number:	20-89839
		Date Sampled:	21/02/2020
		Date Received:	25/02/2020
Contact:	Myfanwy Wood	Date Tested:	03/03/2020
Site Address:	Acton Gardens	Sampled By:	Not Given

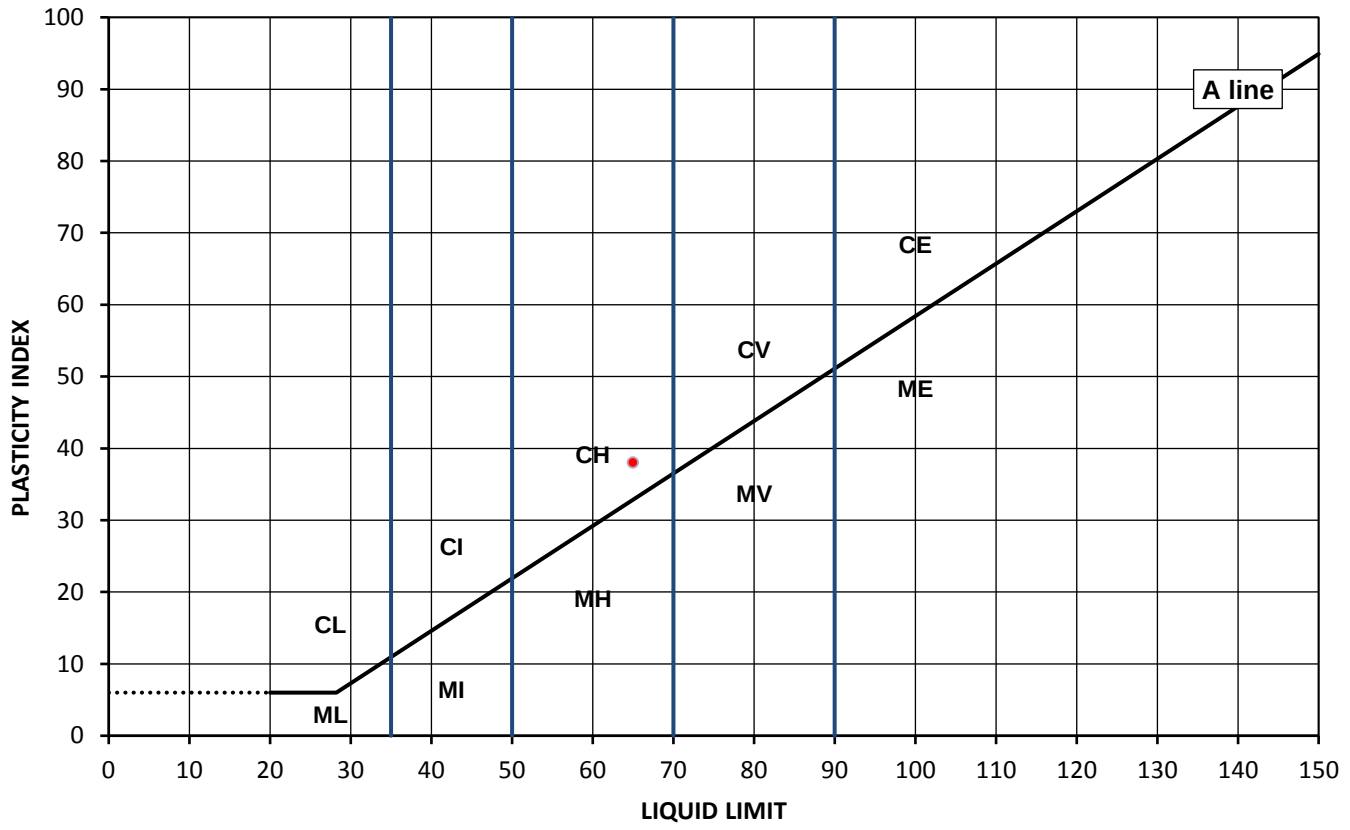
Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

Test Results:

Laboratory Reference:	1457871	Depth Top [m]:	1.60
Hole No.:	WS108	Depth Base [m]:	2.00
Sample Reference:	Not Given	Sample Type:	B
Soil Description:	Brown slightly gravelly CLAY		

Sample Preparation: Tested after washing to remove >425um

As Received Moisture Content [%]	Liquid Limit [%]	Plastic Limit [%]	Plasticity Index [%]	% Passing 425µm BS Test Sieve
21	65	27	38	99



Legend, based on BS 5930:2015 Code of practice for site investigations

		Plasticity		Liquid Limit
C	Clay	L	Low	below 35
M	Silt	I	Medium	35 to 50
		H	High	50 to 70
		V	Very high	70 to 90
		E	Extremely high	exceeding 90
	Organic	O	append to classification for organic material (eg CHO)	

Note: Moisture Content by BS 1377-2: 1990: Clause 3.2

Remarks:

Signed:

Monika Janoszek
PL Deputy Head of Geotechnical Section
for and on behalf of i2 Analytical Ltd

Date Reported: 13/03/2020

GF 236.8

TEST CERTIFICATE

Liquid and Plastic Limits

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

4041

Tested in Accordance with: BS 1377-2: 1990: Clause 4.3 and 5

Client:	CURTINS	Client Reference:	73270
Client Address:	Units 5/6, 40 Compton Street, London, EC1V 0BD	Job Number:	20-89839
		Date Sampled:	19/02/2020
		Date Received:	25/02/2020
Contact:	Myfanwy Wood	Date Tested:	03/03/2020
Site Address:	Acton Gardens	Sampled By:	Not Given

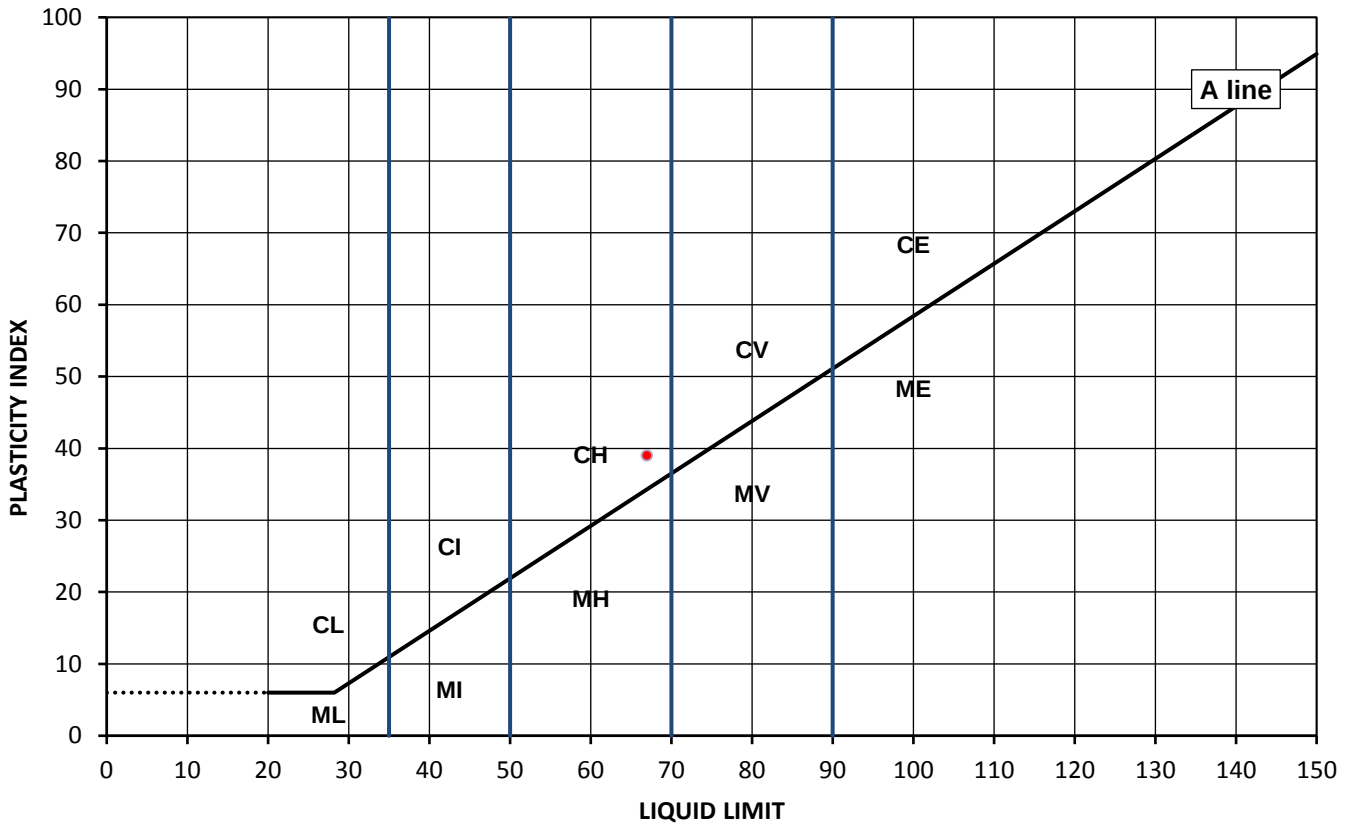
Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

Test Results:

Laboratory Reference:	1457872	Depth Top [m]:	2.50
Hole No.:	CP103	Depth Base [m]:	Not Given
Sample Reference:	Not Given	Sample Type:	D
Soil Description:	Brownish grey CLAY		

Sample Preparation: Tested in natural condition

As Received Moisture Content [%]	Liquid Limit [%]	Plastic Limit [%]	Plasticity Index [%]	% Passing 425µm BS Test Sieve
29	67	28	39	100



Legend, based on BS 5930:2015 Code of practice for site investigations

		Plasticity		Liquid Limit
C	Clay	L	Low	below 35
M	Silt	I	Medium	35 to 50
		H	High	50 to 70
		V	Very high	70 to 90
		E	Extremely high	exceeding 90
	Organic	O	append to classification for organic material (eg CHO)	

Note: Moisture Content by BS 1377-2: 1990: Clause 3.2

Remarks:

Signed:

Monika Janoszek
PL Deputy Head of Geotechnical Section
for and on behalf of i2 Analytical Ltd

Date Reported: 13/03/2020

GF 236.8

TEST CERTIFICATE

Liquid and Plastic Limits

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

4041

Tested in Accordance with: BS 1377-2: 1990: Clause 4.3 and 5

Client:	CURTINS	Client Reference:	73270
Client Address:	Units 5/6, 40 Compton Street, London, EC1V 0BD	Job Number:	20-89839
		Date Sampled:	19/02/2020
		Date Received:	25/02/2020
Contact:	Myfanwy Wood	Date Tested:	03/03/2020
Site Address:	Acton Gardens	Sampled By:	Not Given

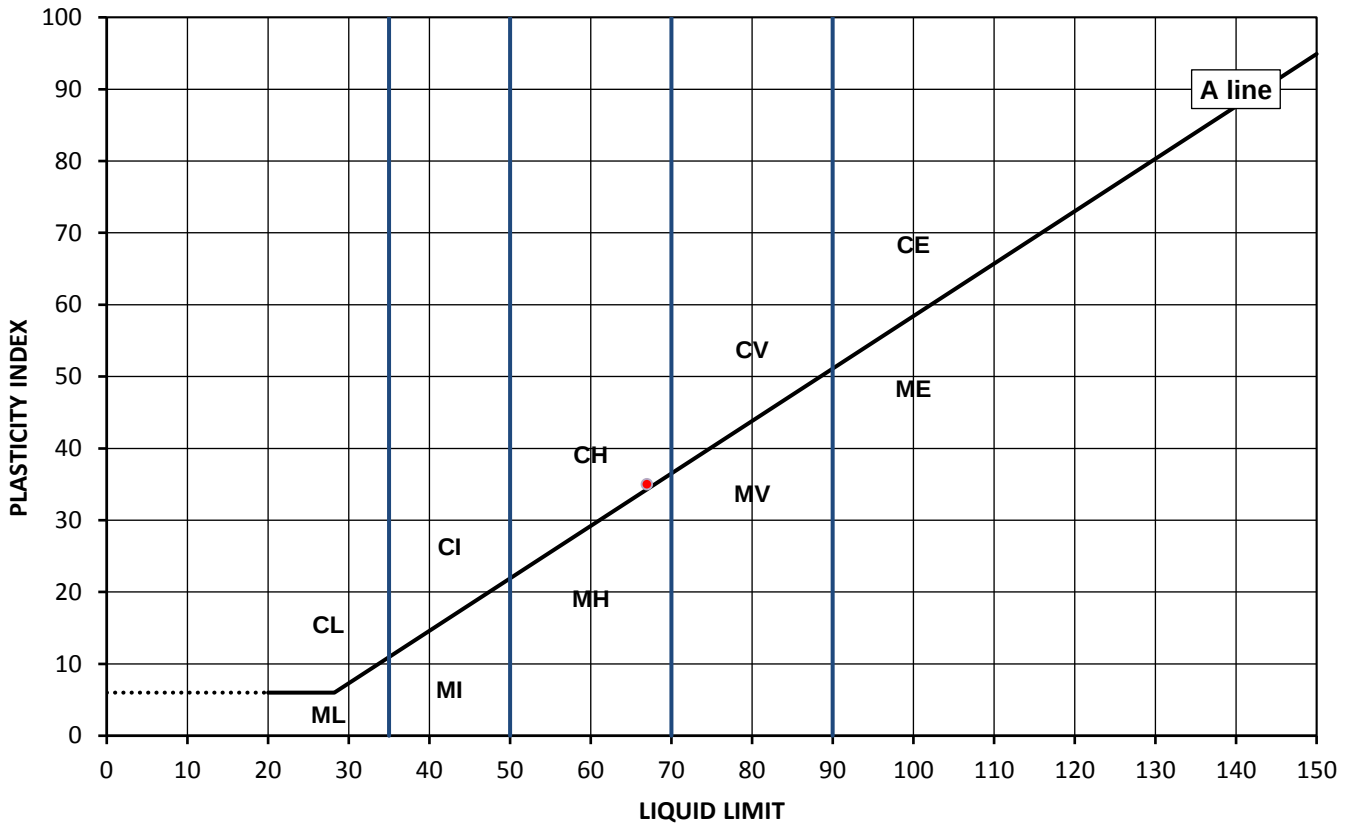
Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

Test Results:

Laboratory Reference:	1457873	Depth Top [m]:	4.50
Hole No.:	CP103	Depth Base [m]:	Not Given
Sample Reference:	Not Given	Sample Type:	D
Soil Description:	Brownish grey CLAY		

Sample Preparation: Tested in natural condition

As Received Moisture Content [%]	Liquid Limit [%]	Plastic Limit [%]	Plasticity Index [%]	% Passing 425µm BS Test Sieve
31	67	32	35	100



Legend, based on BS 5930:2015 Code of practice for site investigations

		Plasticity		Liquid Limit
C	Clay	L	Low	below 35
M	Silt	I	Medium	35 to 50
		H	High	50 to 70
		V	Very high	70 to 90
		E	Extremely high	exceeding 90
	Organic	O	append to classification for organic material (eg CHO)	

Note: Moisture Content by BS 1377-2: 1990: Clause 3.2

Remarks:

Signed:

Monika Janoszek
PL Deputy Head of Geotechnical Section
for and on behalf of i2 Analytical Ltd

Date Reported: 13/03/2020

GF 236.8

TEST CERTIFICATE

Liquid and Plastic Limits

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

4041

Tested in Accordance with: BS 1377-2: 1990: Clause 4.3 and 5

Client:	CURTINS	Client Reference:	73270
Client Address:	Units 5/6, 40 Compton Street, London, EC1V 0BD	Job Number:	20-89839
		Date Sampled:	19/02/2020
		Date Received:	25/02/2020
Contact:	Myfanwy Wood	Date Tested:	03/03/2020
Site Address:	Acton Gardens	Sampled By:	Not Given

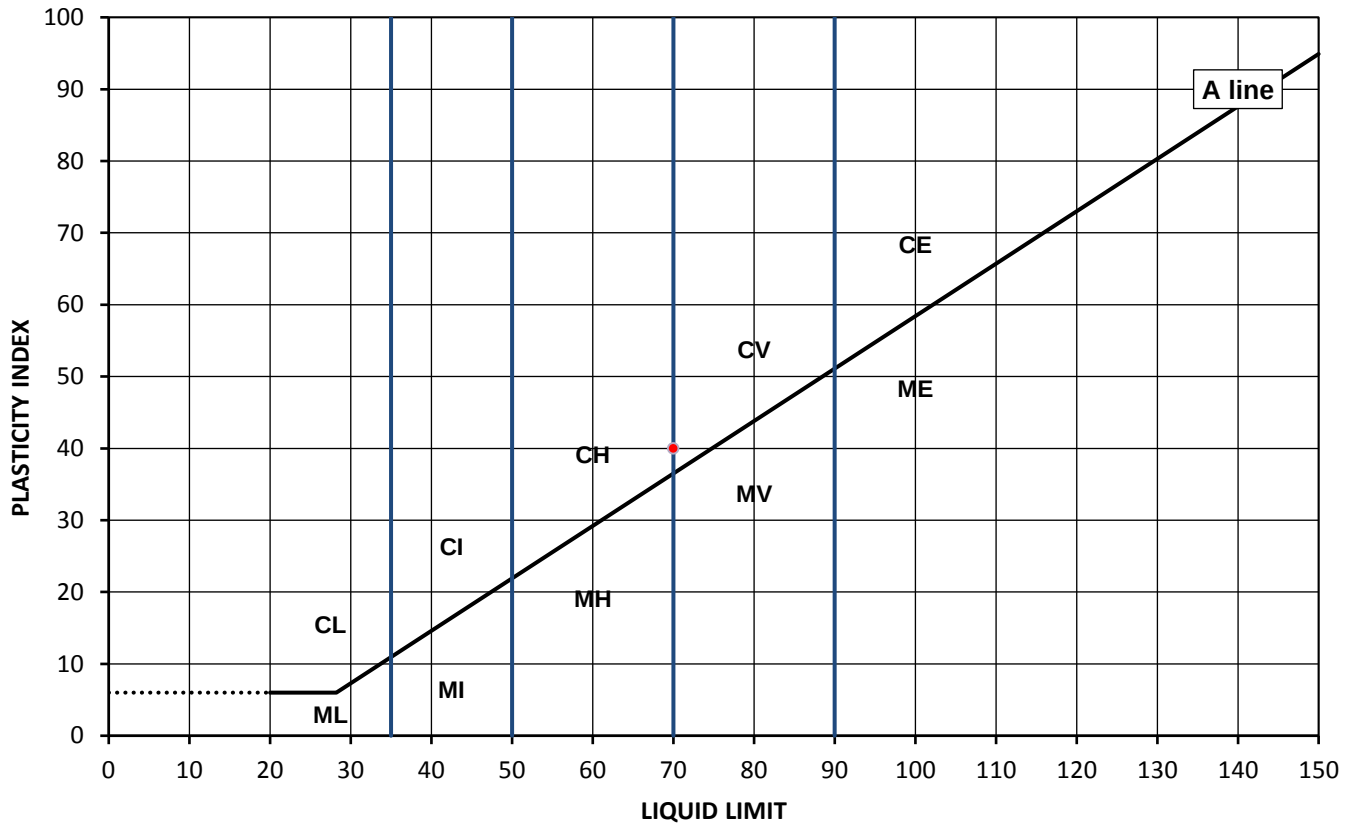
Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

Test Results:

Laboratory Reference:	1457874	Depth Top [m]:	7.50
Hole No.:	CP103	Depth Base [m]:	Not Given
Sample Reference:	Not Given	Sample Type:	D
Soil Description:	Greyish brown CLAY		

Sample Preparation: Tested in natural condition

As Received Moisture Content [%]	Liquid Limit [%]	Plastic Limit [%]	Plasticity Index [%]	% Passing 425µm BS Test Sieve
28	70	30	40	100



Legend, based on BS 5930:2015 Code of practice for site investigations

		Plasticity		Liquid Limit
C	Clay	L	Low	below 35
M	Silt	I	Medium	35 to 50
		H	High	50 to 70
		V	Very high	70 to 90
		E	Extremely high	exceeding 90
	Organic	O	append to classification for organic material (eg CHO)	

Note: Moisture Content by BS 1377-2: 1990: Clause 3.2

Remarks:

Signed:

Monika Janoszek
PL Deputy Head of Geotechnical Section
for and on behalf of i2 Analytical Ltd

Date Reported: 13/03/2020

GF 236.8

TEST CERTIFICATE

Liquid and Plastic Limits

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

4041

Tested in Accordance with: BS 1377-2: 1990: Clause 4.3 and 5

Client:	CURTINS	Client Reference:	73270
Client Address:	Units 5/6, 40 Compton Street, London, EC1V 0BD	Job Number:	20-89839
		Date Sampled:	19/02/2020
		Date Received:	25/02/2020
Contact:	Myfanwy Wood	Date Tested:	09/03/2020
Site Address:	Acton Gardens	Sampled By:	Not Given

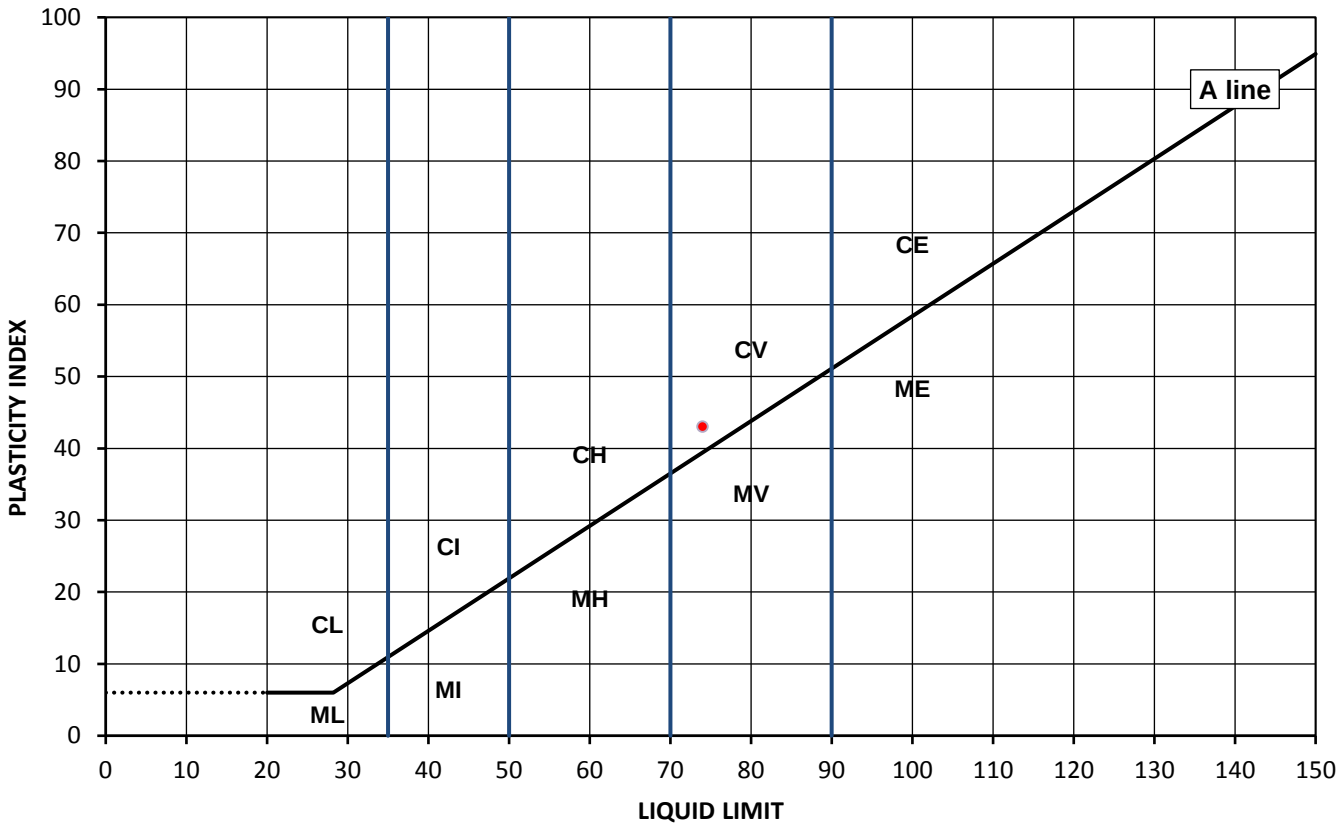
Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

Test Results:

Laboratory Reference:	1457875	Depth Top [m]:	5.50
Hole No.:	CP104	Depth Base [m]:	5.60
Sample Reference:	Not Given	Sample Type:	B
Soil Description:	Brown CLAY		

Sample Preparation: Tested in natural condition

As Received Moisture Content [%]	Liquid Limit [%]	Plastic Limit [%]	Plasticity Index [%]	% Passing 425µm BS Test Sieve
34	74	31	43	100



Legend, based on BS 5930:2015 Code of practice for site investigations

		Plasticity		Liquid Limit
C	Clay	L	Low	below 35
M	Silt	I	Medium	35 to 50
		H	High	50 to 70
		V	Very high	70 to 90
		E	Extremely high	exceeding 90
	Organic	O	append to classification for organic material (eg CHO)	

Note: Moisture Content by BS 1377-2: 1990: Clause 3.2

Remarks:

Signed:

Monika Janoszek
PL Deputy Head of Geotechnical Section
for and on behalf of i2 Analytical Ltd

Date Reported: 13/03/2020

GF 236.8

TEST CERTIFICATE

Liquid and Plastic Limits

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

4041

Tested in Accordance with: BS 1377-2: 1990: Clause 4.3 and 5

Client:	CURTINS	Client Reference:	73270
Client Address:	Units 5/6, 40 Compton Street, London, EC1V 0BD	Job Number:	20-89839
		Date Sampled:	19/02/2020
		Date Received:	25/02/2020
Contact:	Myfanwy Wood	Date Tested:	03/03/2020
Site Address:	Acton Gardens	Sampled By:	Not Given

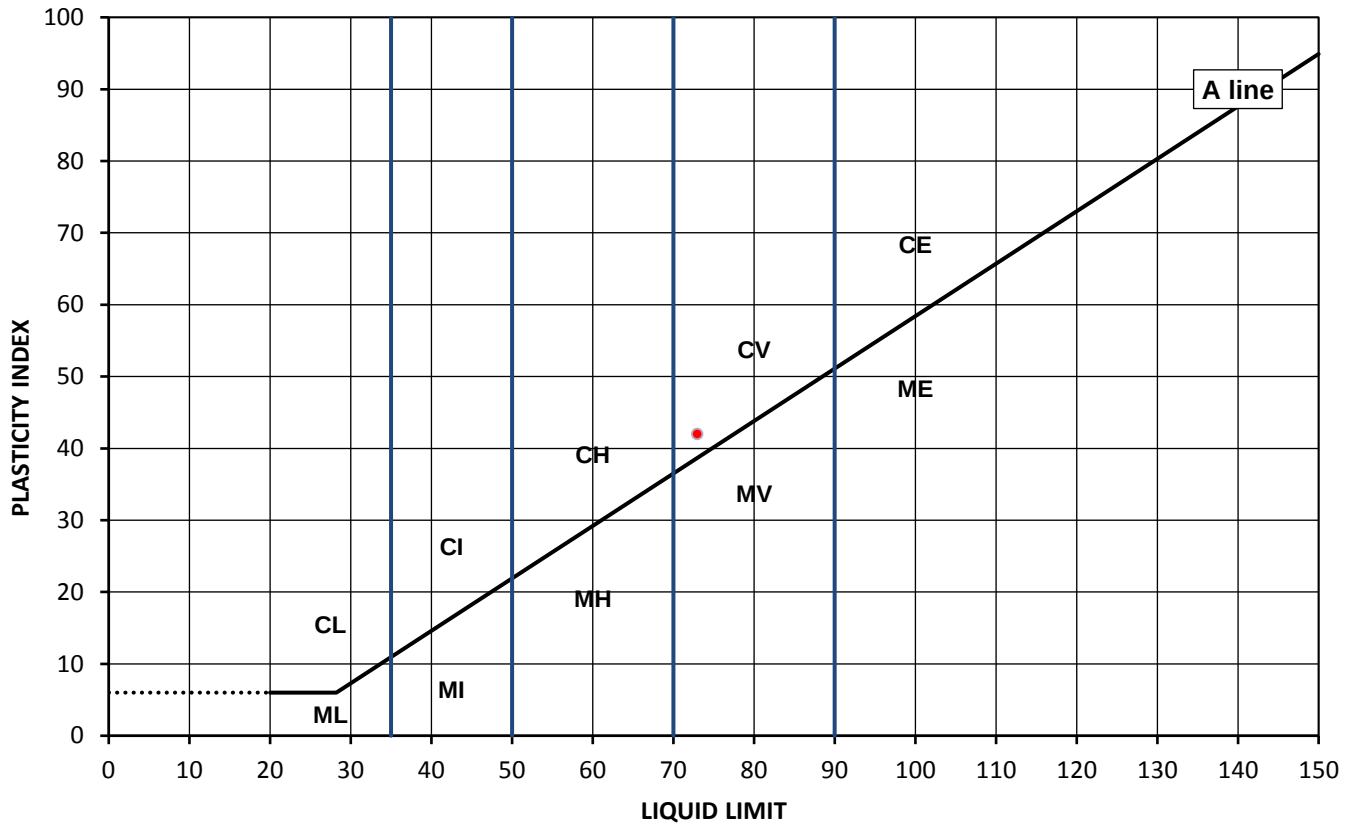
Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

Test Results:

Laboratory Reference:	1457876	Depth Top [m]:	11.00
Hole No.:	CP104	Depth Base [m]:	Not Given
Sample Reference:	Not Given	Sample Type:	D
Soil Description:	Brownish grey CLAY		

Sample Preparation: Tested in natural condition

As Received Moisture Content [%]	Liquid Limit [%]	Plastic Limit [%]	Plasticity Index [%]	% Passing 425µm BS Test Sieve
29	73	31	42	100



Legend, based on BS 5930:2015 Code of practice for site investigations

		Plasticity		Liquid Limit
C	Clay	L	Low	below 35
M	Silt	I	Medium	35 to 50
		H	High	50 to 70
		V	Very high	70 to 90
		E	Extremely high	exceeding 90
	Organic	O	append to classification for organic material (eg CHO)	

Note: Moisture Content by BS 1377-2: 1990: Clause 3.2

Remarks:

Signed:

Monika Janoszek
PL Deputy Head of Geotechnical Section
for and on behalf of i2 Analytical Ltd

Date Reported: 13/03/2020

GF 236.8

TEST CERTIFICATE

Liquid and Plastic Limits

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

4041

Tested in Accordance with: BS 1377-2: 1990: Clause 4.3 and 5

Client:	CURTINS	Client Reference:	73270
Client Address:	Units 5/6, 40 Compton Street, London, EC1V 0BD	Job Number:	20-89839
		Date Sampled:	20/02/2020
		Date Received:	25/02/2020
Contact:	Myfanwy Wood	Date Tested:	09/03/2020
Site Address:	Acton Gardens	Sampled By:	Not Given

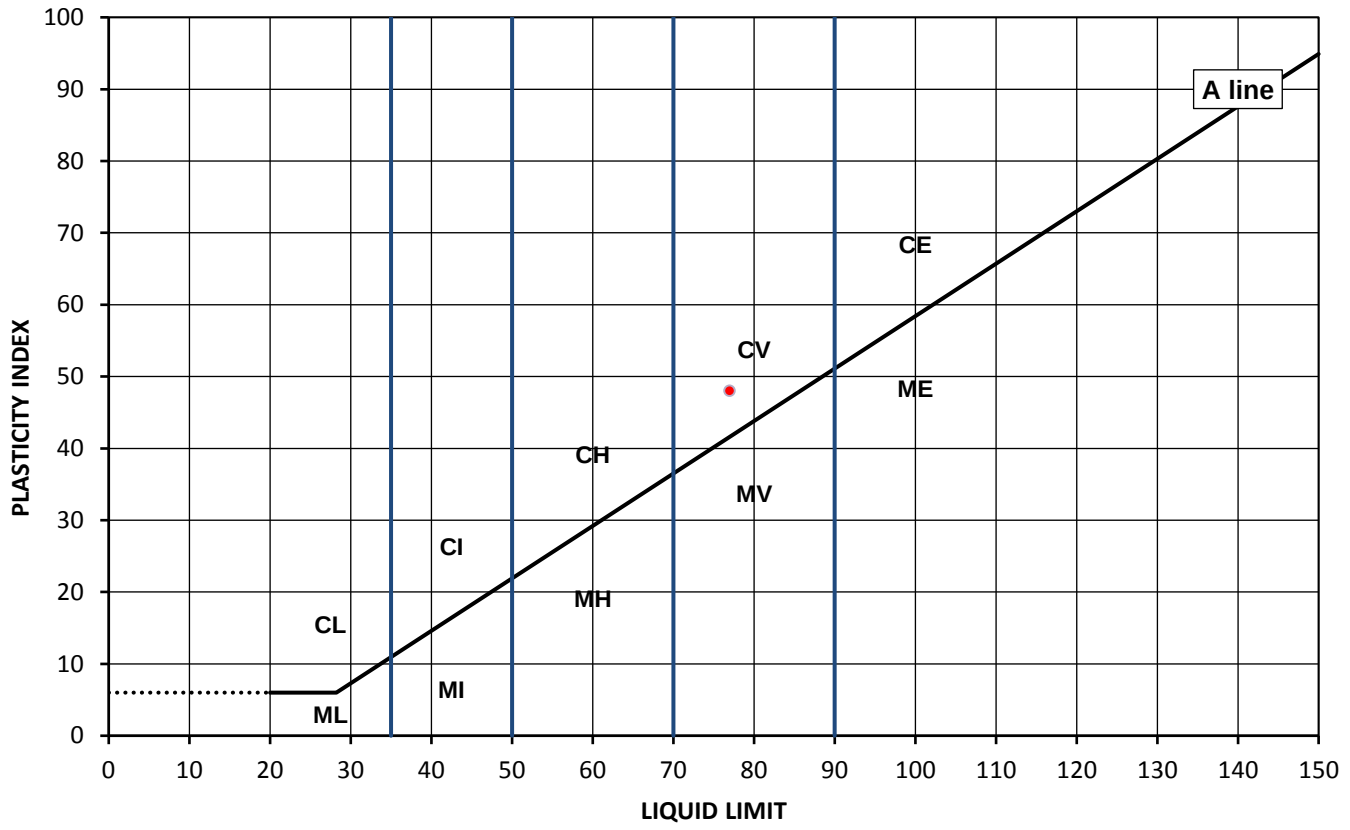
Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

Test Results:

Laboratory Reference:	1457877	Depth Top [m]:	25.00
Hole No.:	CP104	Depth Base [m]:	Not Given
Sample Reference:	Not Given	Sample Type:	D
Soil Description:	Brown CLAY		

Sample Preparation: Tested in natural condition

As Received Moisture Content [%]	Liquid Limit [%]	Plastic Limit [%]	Plasticity Index [%]	% Passing 425µm BS Test Sieve
29	77	29	48	100



Legend, based on BS 5930:2015 Code of practice for site investigations

		Plasticity		Liquid Limit
C	Clay	L	Low	below 35
M	Silt	I	Medium	35 to 50
		H	High	50 to 70
		V	Very high	70 to 90
		E	Extremely high	exceeding 90
	Organic	O	append to classification for organic material (eg CHO)	

Note: Moisture Content by BS 1377-2: 1990: Clause 3.2

Remarks:

Signed:

Monika Janoszek
PL Deputy Head of Geotechnical Section
for and on behalf of i2 Analytical Ltd

Date Reported: 13/03/2020

GF 236.8

TEST CERTIFICATE

Liquid and Plastic Limits

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

4041

Tested in Accordance with: BS 1377-2: 1990: Clause 4.3 and 5

Client:	CURTINS	Client Reference:	73270
Client Address:	Units 5/6, 40 Compton Street, London, EC1V 0BD	Job Number:	20-89839
		Date Sampled:	18/02/2020
		Date Received:	25/02/2020
Contact:	Myfanwy Wood	Date Tested:	03/03/2020
Site Address:	Acton Gardens	Sampled By:	Not Given

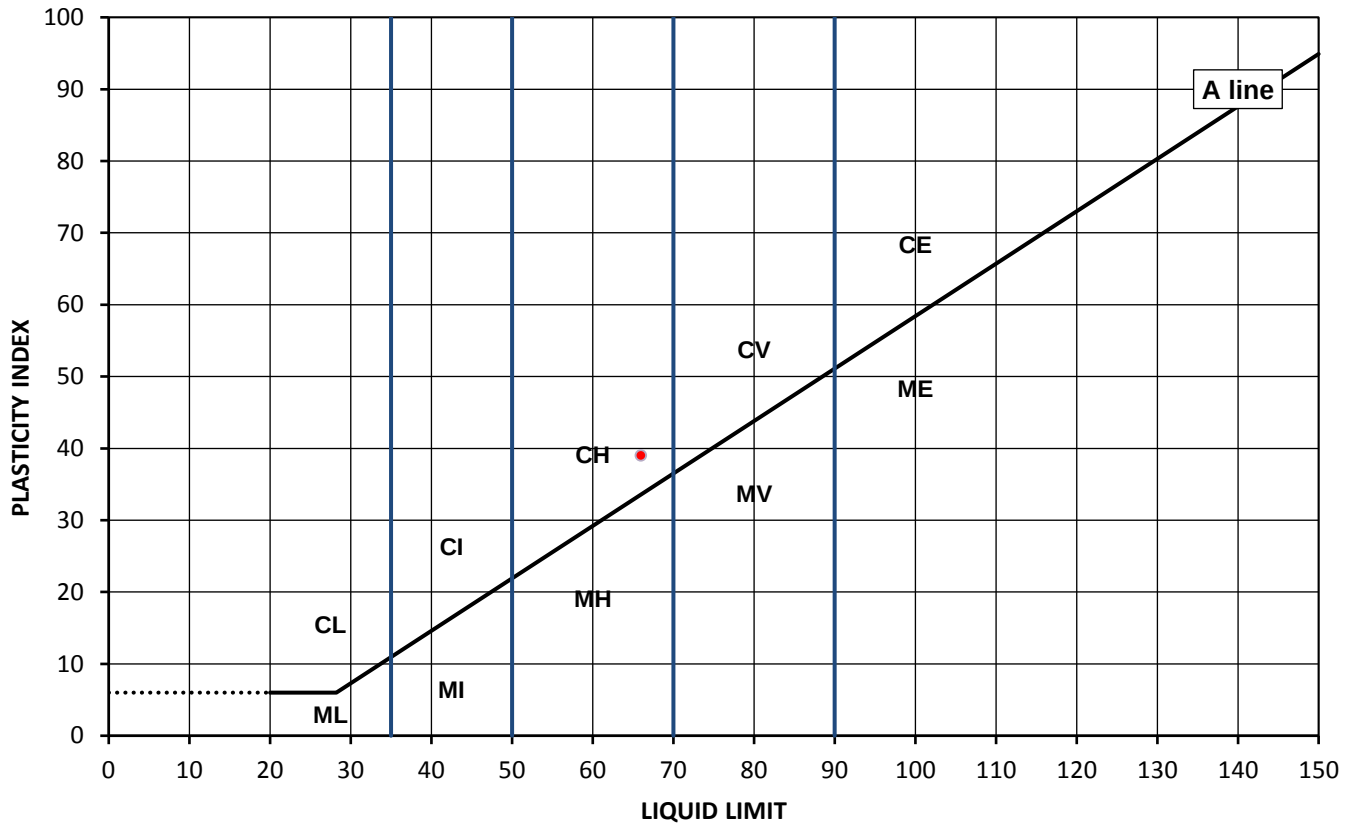
Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

Test Results:

Laboratory Reference:	1457878	Depth Top [m]:	3.50
Hole No.:	CP105	Depth Base [m]:	Not Given
Sample Reference:	Not Given	Sample Type:	D
Soil Description:	Orangish brown to grey CLAY		

Sample Preparation: Tested in natural condition

As Received Moisture Content [%]	Liquid Limit [%]	Plastic Limit [%]	Plasticity Index [%]	% Passing 425µm BS Test Sieve
33	66	27	39	100



Legend, based on BS 5930:2015 Code of practice for site investigations

		Plasticity		Liquid Limit
C	Clay	L	Low	below 35
M	Silt	I	Medium	35 to 50
		H	High	50 to 70
		V	Very high	70 to 90
		E	Extremely high	exceeding 90
	Organic	O	append to classification for organic material (eg CHO)	

Note: Moisture Content by BS 1377-2: 1990: Clause 3.2

Remarks:

Signed:

Monika Janoszek
PL Deputy Head of Geotechnical Section
for and on behalf of i2 Analytical Ltd

Date Reported: 13/03/2020

GF 236.8

TEST CERTIFICATE

Liquid and Plastic Limits

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

4041

Tested in Accordance with: BS 1377-2: 1990: Clause 4.3 and 5

Client:	CURTINS	Client Reference:	73270
Client Address:	Units 5/6, 40 Compton Street, London, EC1V 0BD	Job Number:	20-89839
		Date Sampled:	18/02/2020
		Date Received:	25/02/2020
Contact:	Myfanwy Wood	Date Tested:	03/03/2020
Site Address:	Acton Gardens	Sampled By:	Not Given

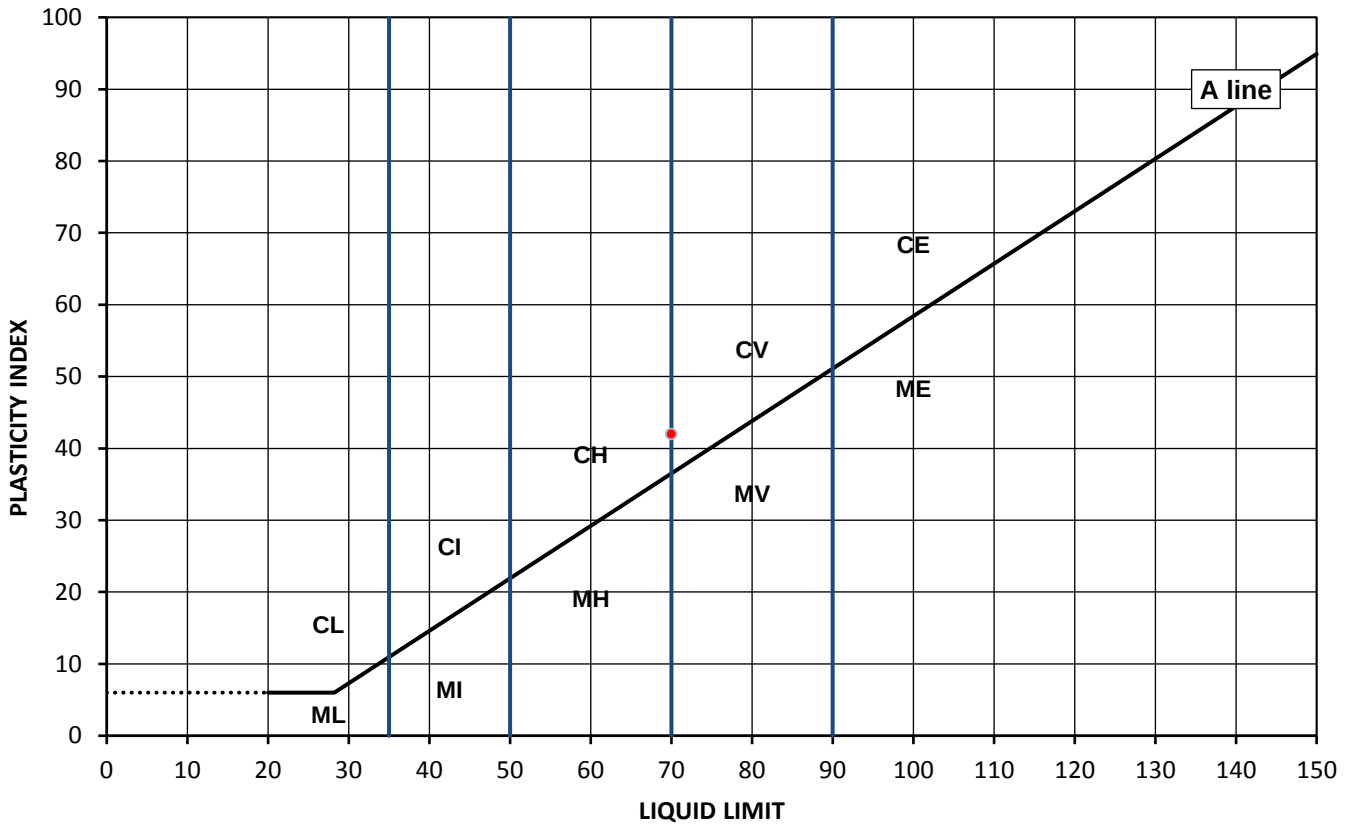
Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

Test Results:

Laboratory Reference:	1457879	Depth Top [m]:	6.50
Hole No.:	CP105	Depth Base [m]:	Not Given
Sample Reference:	Not Given	Sample Type:	D
Soil Description:	Brownish grey CLAY		

Sample Preparation: Tested in natural condition

As Received Moisture Content [%]	Liquid Limit [%]	Plastic Limit [%]	Plasticity Index [%]	% Passing 425µm BS Test Sieve
28	70	28	42	100



Legend, based on BS 5930:2015 Code of practice for site investigations

		Plasticity		Liquid Limit
C	Clay	L	Low	below 35
M	Silt	I	Medium	35 to 50
		H	High	50 to 70
		V	Very high	70 to 90
		E	Extremely high	exceeding 90
	Organic	O	append to classification for organic material (eg CHO)	

Note: Moisture Content by BS 1377-2: 1990: Clause 3.2

Remarks:

Signed:

Monika Janoszek
PL Deputy Head of Geotechnical Section
for and on behalf of i2 Analytical Ltd

Date Reported: 13/03/2020

GF 236.8

TEST CERTIFICATE

Liquid and Plastic Limits

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

4041

Tested in Accordance with: BS 1377-2: 1990: Clause 4.3 and 5

Client:	CURTINS	Client Reference:	73270
Client Address:	Units 5/6, 40 Compton Street, London, EC1V 0BD	Job Number:	20-89839
		Date Sampled:	18/02/2020
		Date Received:	25/02/2020
Contact:	Myfanwy Wood	Date Tested:	09/03/2020
Site Address:	Acton Gardens	Sampled By:	Not Given

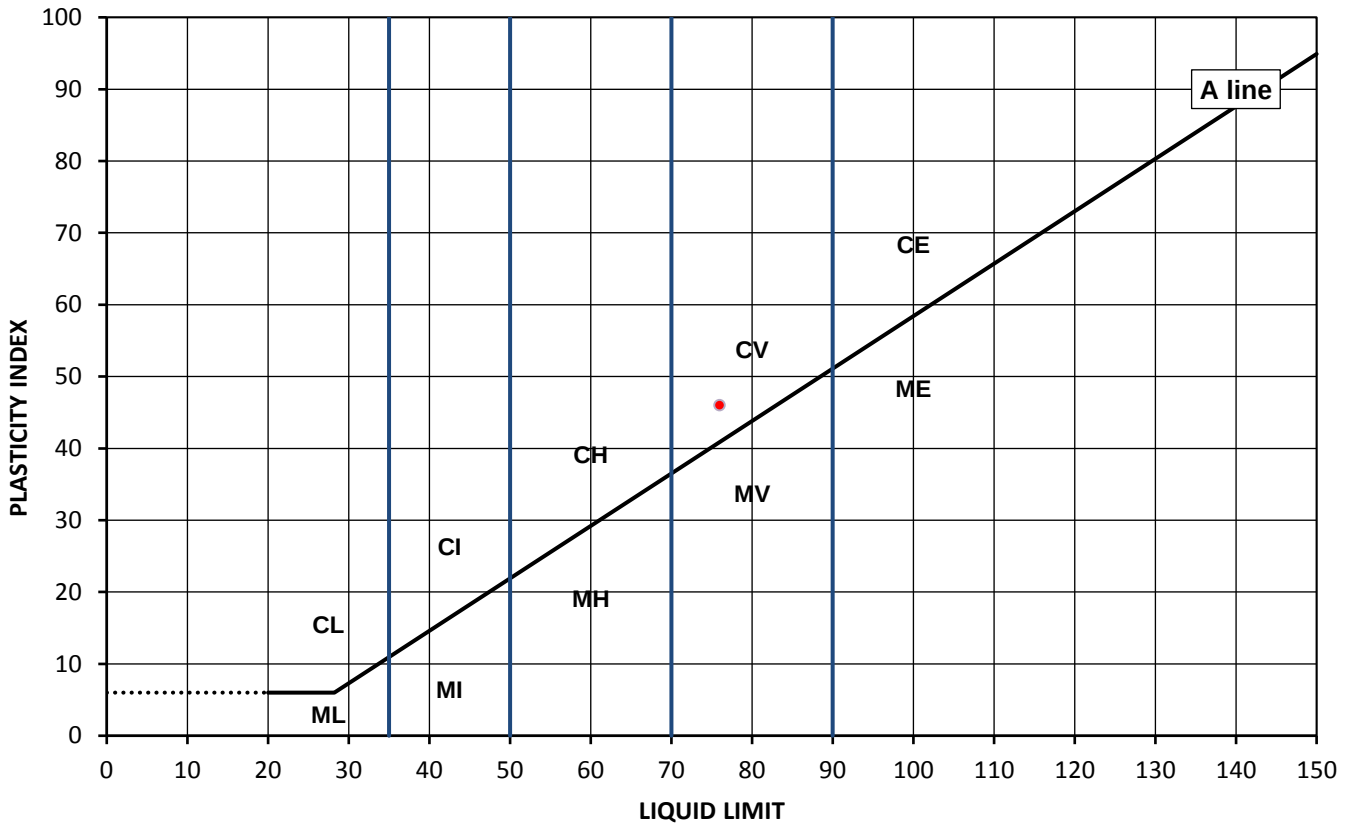
Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

Test Results:

Laboratory Reference:	1457880	Depth Top [m]:	11.00
Hole No.:	CP105	Depth Base [m]:	Not Given
Sample Reference:	Not Given	Sample Type:	D
Soil Description:	Brown CLAY		

Sample Preparation: Tested in natural condition

As Received Moisture Content [%]	Liquid Limit [%]	Plastic Limit [%]	Plasticity Index [%]	% Passing 425µm BS Test Sieve
29	76	30	46	100



Legend, based on BS 5930:2015 Code of practice for site investigations

		Plasticity		Liquid Limit
C	Clay	L	Low	below 35
M	Silt	I	Medium	35 to 50
		H	High	50 to 70
		V	Very high	70 to 90
		E	Extremely high	exceeding 90
	Organic	O	append to classification for organic material (eg CHO)	

Note: Moisture Content by BS 1377-2: 1990: Clause 3.2

Remarks:

Signed:

Monika Janoszek
PL Deputy Head of Geotechnical Section
for and on behalf of i2 Analytical Ltd

Date Reported: 13/03/2020

GF 236.8

SUMMARY REPORT

Summary of Classification Test Results

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

UKAS TESTING 4041

Tested in Accordance with:

MC by BS 1377-2: 1990: Clause 3.2; WC by BS EN 17892-1: 2014; Atterberg by BS 1377-2: 1990: Clause 4.3, Clause 4.4 and 5; PD by BS 1377-2: 1990: Clause 8.2

Client: CURTINS

Client Address: Units 5/6, 40 Compton Street, London, EC1V 0BD

Contact: Myfanwy Wood

Site Address: Acton Gardens

Client Reference: 73270
Job Number: 20-89839
Date Sampled: 18/02 - 20/02/2020
Date Received: 25/02/2020
Date Tested: 03/03 - 09/03/2020
Sampled By: Not Given

Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

Test results

Laboratory Reference	Hole No.	Sample				Description	Remarks	MC	WC	Atterberg				Density			Total Porosity#		
		Reference	Depth Top	Depth Base	Type					% Passing 425um	LL	PL	PI	bulk	dry	PD			
			m	m				%	%	%	%	%	%	Mg/m3	Mg/m3	Mg/m3	%		
1457872	CP103	Not Given	2.50	Not Given	D	Brownish grey CLAY	Atterberg 4 Point	29		100	67	28	39						
1457873	CP103	Not Given	4.50	Not Given	D	Brownish grey CLAY	Atterberg 4 Point	31		100	67	32	35						
1457874	CP103	Not Given	7.50	Not Given	D	Greyish brown CLAY	Atterberg 4 Point	28		100	70	30	40						
1457875	CP104	Not Given	5.50	5.60	B	Brown CLAY	Atterberg 4 Point	34		100	74	31	43						
1457876	CP104	Not Given	11.00	Not Given	D	Brownish grey CLAY	Atterberg 4 Point	29		100	73	31	42						
1457877	CP104	Not Given	25.00	Not Given	D	Brown CLAY	Atterberg 4 Point	29		100	77	29	48						
1457878	CP105	Not Given	3.50	Not Given	D	Orangish brown to grey CLAY	Atterberg 4 Point	33		100	66	27	39						
1457879	CP105	Not Given	6.50	Not Given	D	Brownish grey CLAY	Atterberg 4 Point	28		100	70	28	42						
1457880	CP105	Not Given	11.00	Not Given	D	Brown CLAY	Atterberg 4 Point	29		100	76	30	46						
1457866	WS104	Not Given	2.00	Not Given	D	Orangish brown CLAY	Atterberg 4 Point	33		100	70	31	39						

Note: # Non accredited; NP - Non plastic

Comments:

Signed:

Monika Janoszek
PL Deputy Head of Geotechnical Section
for and on behalf of i2 Analytical Ltd

Date Reported: 13/03/2020

GF 238.10

SUMMARY REPORT

Summary of Classification Test Results

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

4041

Tested in Accordance with:

MC by BS 1377-2: 1990: Clause 3.2; WC by BS EN 17892-1: 2014; Atterberg by BS 1377-2: 1990: Clause 4.3, Clause 4.4 and 5; PD by BS 1377-2: 1990: Clause 8.2

Client: CURTINS

Client Address: Units 5/6, 40 Compton Street, London, EC1V 0BD

Contact: Myfanwy Wood

Site Address: Acton Gardens

Client Reference: 73270
Job Number: 20-89839
Date Sampled: 21/02/2020
Date Received: 25/02/2020
Date Tested: 03/03/2020
Sampled By: Not Given

Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

Test results

Laboratory Reference	Hole No.	Sample				Description	Remarks	MC	WC	Atterberg				Density			Total Porosity#		
		Reference	Depth Top	Depth Base	Type					% Passing 425um	LL	PL	PI	bulk	dry	PD			
			m	m				%	%	%	%	%	%	Mg/m3	Mg/m3	Mg/m3	%		
1457867	WS105	Not Given	3.40	Not Given	D	Orangish brown CLAY	Atterberg 4 Point	30		100	71	31	40						
1457868	WS106	Not Given	3.80	Not Given	D	Orangish brown slightly gravelly CLAY	Atterberg 4 Point	24		95	60	26	34						
1457869	WS107	Not Given	3.00	4.00	B	Brown slightly gravelly CLAY	Atterberg 4 Point	25		99	66	25	41						
1457870	WS107	Not Given	4.90	Not Given	D	Brownish grey CLAY	Atterberg 4 Point	29		100	65	30	35						
1457871	WS108	Not Given	1.60	2.00	B	Brown slightly gravelly CLAY	Atterberg 4 Point	21		99	65	27	38						

Note: # Non accredited; NP - Non plastic

Comments:

Signed:

Monika Janoszek
PL Deputy Head of Geotechnical Section
for and on behalf of i2 Analytical Ltd

Date Reported: 13/03/2020

GF 238.10

TEST CERTIFICATE

Particle Size Distribution

Tested in Accordance with: BS 1377-2: 1990

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

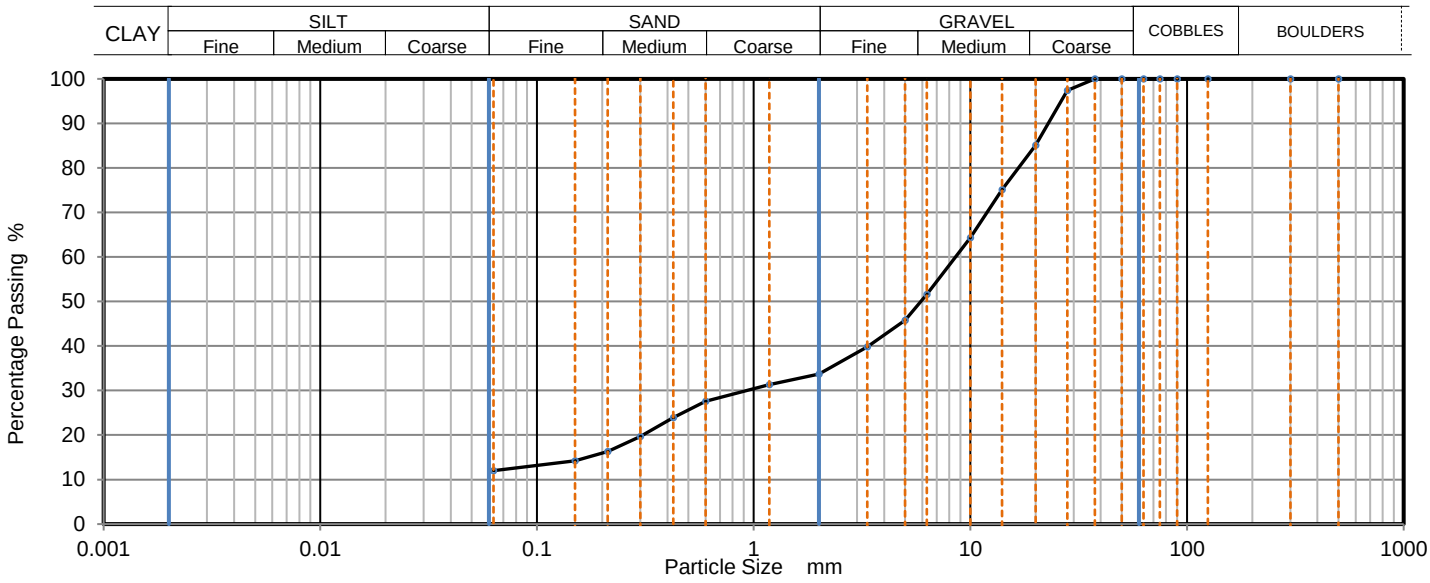
4041

Client:	CURTINS	Client Reference:	73270
Client Address:	Units 5/6, 40 Compton Street, London, EC1V 0BD	Job Number:	20-89839
		Date Sampled:	21/02/2020
		Date Received:	25/02/2020
Contact:	Myfanwy Wood	Date Tested:	03/03/2020
Site Address:	Acton Gardens	Sampled By:	Not Given

Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

Test Results:

Laboratory Reference:	1457881	Depth Top [m]:	1.50
Hole No.:	WS105	Depth Base [m]:	2.00
Sample Reference:	Not Given	Sample Type:	B
Sample Description:	Brown clayey sandy GRAVEL		



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
500	100		
300	100		
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	97		
20	85		
14	75		
10	64		
6.3	52		
5	46		
3.35	40		
2	34		
1.18	31		
0.6	28		
0.425	24		
0.3	20		
0.212	16		
0.15	14		
0.063	12.8		

Sample Proportions	% dry mass
Very coarse	0.00
Gravel	66.30
Sand	20.90
Fines <0.063mm	12.80

Grading Analysis		
D100	mm	37.5
D60	mm	8.56
D30	mm	0.937
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

Note: Tested in Accordance with BS1377:Part 2:1990, clause 9.2

Remarks:

Signed:

Monika Janoszek
PL Deputy Head of Geotechnical Section
for and on behalf of i2 Analytical Ltd

Date Reported: 13/03/2020

GF 100.16

TEST CERTIFICATE

Particle Size Distribution

Tested in Accordance with: BS 1377-2: 1990

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

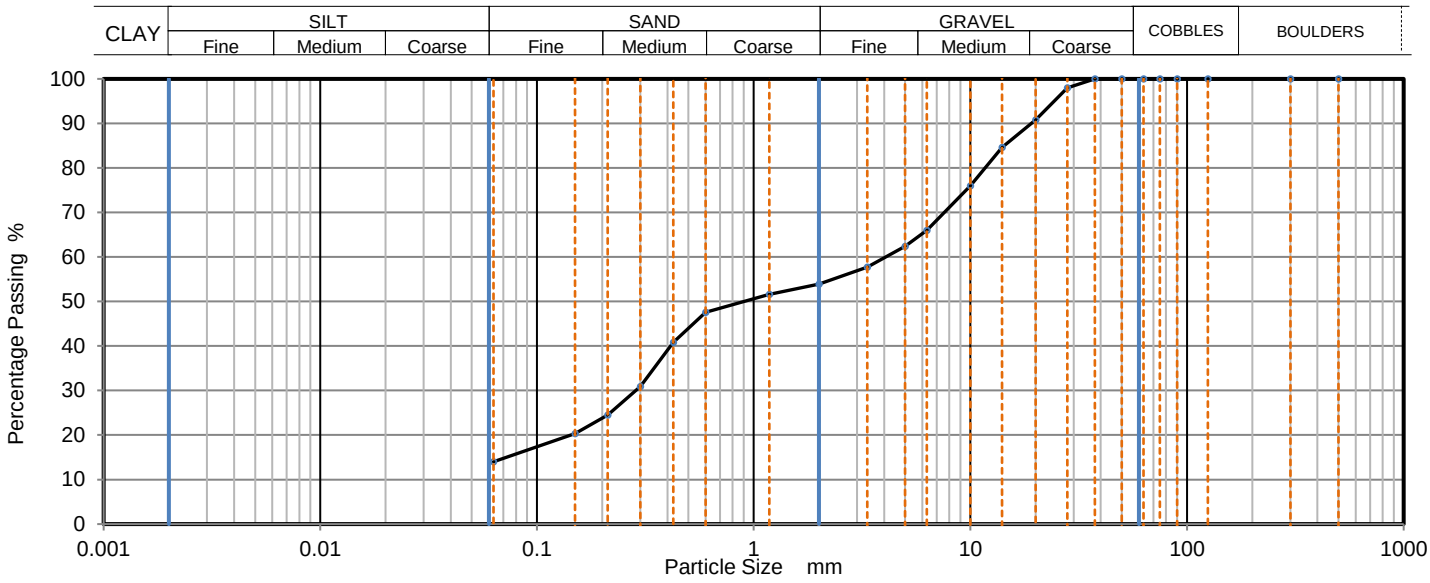
4041

Client:	CURTINS	Client Reference:	73270
Client Address:	Units 5/6, 40 Compton Street, London, EC1V 0BD	Job Number:	20-89839
		Date Sampled:	21/02/2020
		Date Received:	25/02/2020
Contact:	Myfanwy Wood	Date Tested:	03/03/2020
Site Address:	Acton Gardens	Sampled By:	Not Given

Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

Test Results:

Laboratory Reference:	1457882	Depth Top [m]:	1.50
Hole No.:	WS106	Depth Base [m]:	1.80
Sample Reference:	Not Given	Sample Type:	B
Sample Description:	Brown clayey very sandy GRAVEL		



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
500	100		
300	100		
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	98		
20	91		
14	85		
10	76		
6.3	66		
5	62		
3.35	58		
2	54		
1.18	52		
0.6	48		
0.425	41		
0.3	31		
0.212	25		
0.15	20		
0.063	14.3		

Sample Proportions	% dry mass
Very coarse	0.00
Gravel	46.10
Sand	39.70
Fines <0.063mm	14.30

Grading Analysis		
D100	mm	37.5
D60	mm	4.07
D30	mm	0.286
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

Note: Tested in Accordance with BS1377:Part 2:1990, clause 9.2

Remarks:

Signed:

Monika Janoszek
PL Deputy Head of Geotechnical Section
for and on behalf of i2 Analytical Ltd

Date Reported: 13/03/2020

GF 100.16

TEST CERTIFICATE

Particle Size Distribution

Tested in Accordance with: BS 1377-2: 1990

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

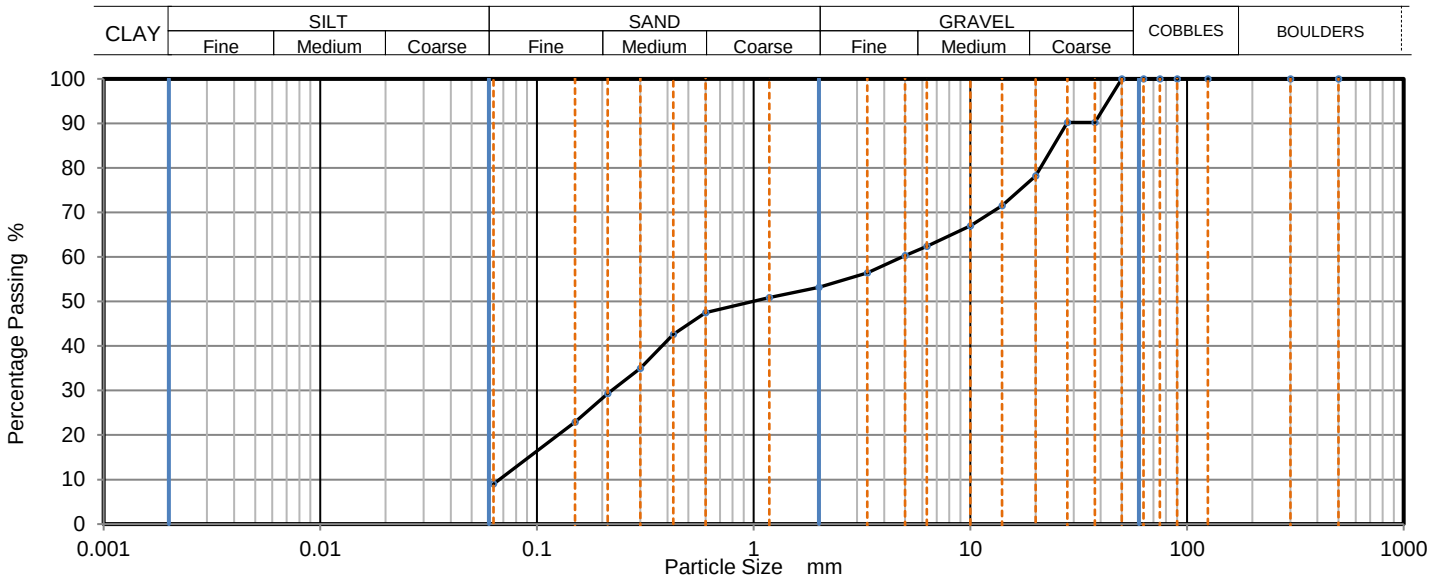
4041

Client:	CURTINS	Client Reference:	73270
Client Address:	Units 5/6, 40 Compton Street, London, EC1V 0BD	Job Number:	20-89839
		Date Sampled:	21/02/2020
		Date Received:	25/02/2020
Contact:	Myfanwy Wood	Date Tested:	03/03/2020
Site Address:	Acton Gardens	Sampled By:	Not Given

Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

Test Results:

Laboratory Reference:	1457883	Depth Top [m]:	1.80
Hole No.:	WS106	Depth Base [m]:	2.40
Sample Reference:	Not Given	Sample Type:	B
Sample Description:	Brown slightly clayey very sandy GRAVEL		



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
500	100		
300	100		
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	90		
28	90		
20	78		
14	72		
10	67		
6.3	62		
5	60		
3.35	56		
2	53		
1.18	51		
0.6	48		
0.425	43		
0.3	35		
0.212	29		
0.15	23		
0.063	9.1		

Sample Proportions	% dry mass
Very coarse	0.00
Gravel	46.80
Sand	44.10
Fines <0.063mm	9.10

Grading Analysis		
D100	mm	50
D60	mm	4.85
D30	mm	0.222
D10	mm	0.0668
Uniformity Coefficient		73
Curvature Coefficient		0.15

Note: Tested in Accordance with BS1377:Part 2:1990, clause 9.2

Remarks:

Signed:

Monika Janoszek
PL Deputy Head of Geotechnical Section
for and on behalf of i2 Analytical Ltd

Date Reported: 13/03/2020

GF 100.16

TEST CERTIFICATE

Particle Size Distribution

Tested in Accordance with: BS 1377-2: 1990

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

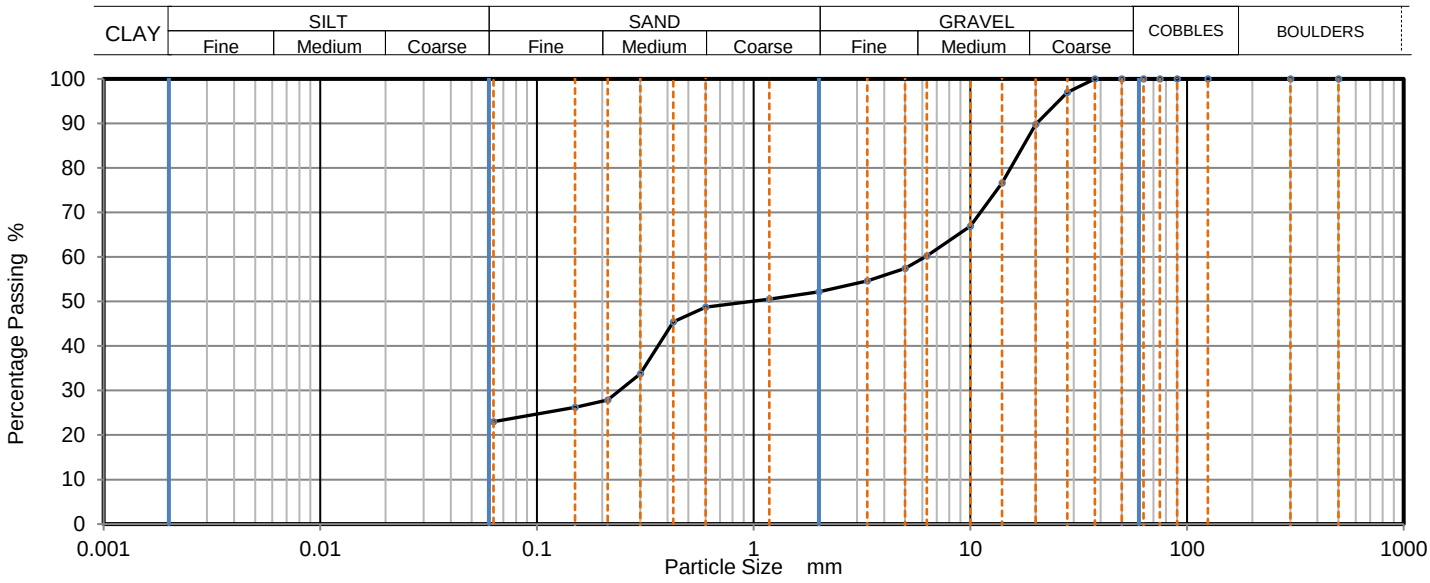
4041

Client:	CURTINS	Client Reference:	73270
Client Address:	Units 5/6, 40 Compton Street, London, EC1V 0BD	Job Number:	20-89839
		Date Sampled:	21/02/2020
		Date Received:	25/02/2020
Contact:	Myfanwy Wood	Date Tested:	03/03/2020
Site Address:	Acton Gardens	Sampled By:	Not Given

Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

Test Results:

Laboratory Reference:	1457884	Depth Top [m]:	1.70
Hole No.:	WS107	Depth Base [m]:	1.90
Sample Reference:	Not Given	Sample Type:	B
Sample Description:	Brown very clayey very sandy GRAVEL		



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
500	100		
300	100		
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	97		
20	90		
14	77		
10	67		
6.3	60		
5	57		
3.35	55		
2	52		
1.18	51		
0.6	49		
0.425	45		
0.3	34		
0.212	28		
0.15	26		
0.063	23.9		

Sample Proportions	% dry mass
Very coarse	0.00
Gravel	47.80
Sand	28.30
Fines <0.063mm	23.90

Grading Analysis		
D100	mm	37.5
D60	mm	6.21
D30	mm	0.24
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

Note: Tested in Accordance with BS1377:Part 2:1990, clause 9.2

Remarks:

Signed:

Monika Janoszek
PL Deputy Head of Geotechnical Section
for and on behalf of i2 Analytical Ltd

Date Reported: 13/03/2020

GF 100.16

TEST CERTIFICATE

Particle Size Distribution

Tested in Accordance with: BS 1377-2: 1990

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

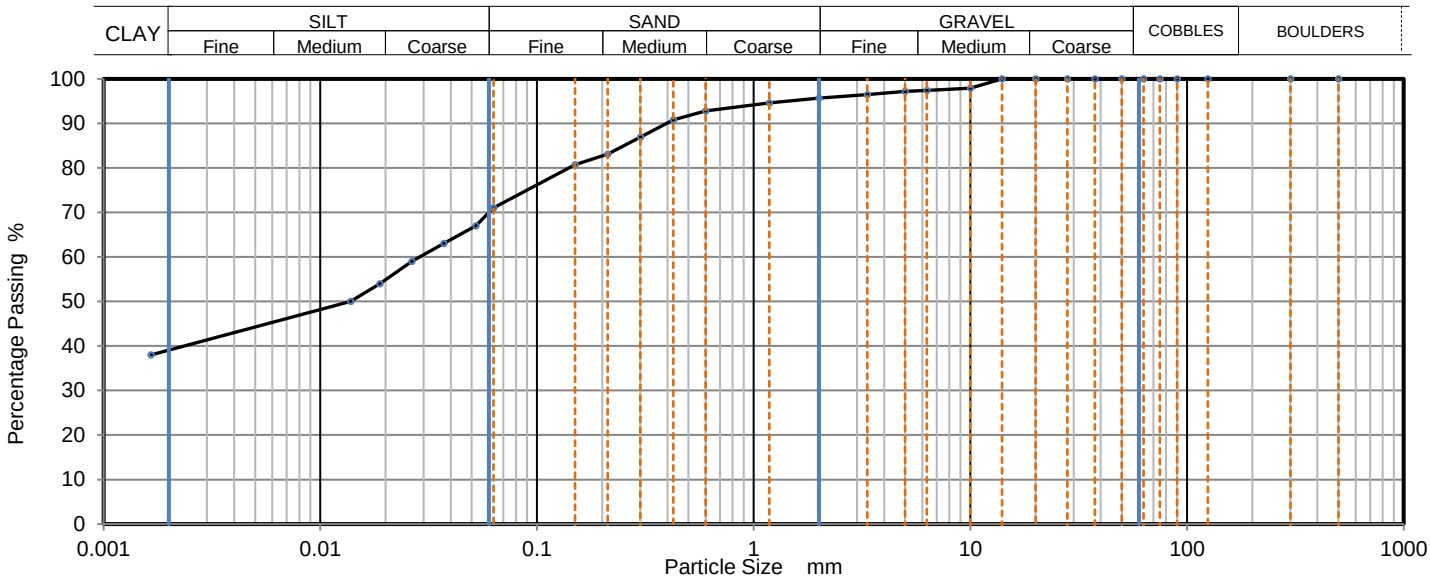
4041

Client:	CURTINS	Client Reference:	73270
Client Address:	Units 5/6, 40 Compton Street, London, EC1V 0BD	Job Number:	20-89839
		Date Sampled:	21/02/2020
		Date Received:	25/02/2020
Contact:	Myfanwy Wood	Date Tested:	09/03/2020
Site Address:	Acton Gardens	Sampled By:	Not Given

Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

Test Results:

Laboratory Reference:	1457885	Depth Top [m]:	1.20
Hole No.:	WS107	Depth Base [m]:	Not Given
Sample Reference:	Not Given	Sample Type:	D
Sample Description:	Orangish brown to grey slightly gravelly very sandy very silty CLAY		



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
500	100	0.0630	71
300	100	0.0522	67
125	100	0.0372	63
90	100	0.0264	59
75	100	0.0188	54
63	100	0.0138	50
50	100	0.0017	38
37.5	100		
28	100		
20	100		
14	100		
10	98		
6.3	97		
5	97		
3.35	97		
2	96	Particle density	(assumed)
1.18	95	2.65	Mg/m3
0.6	93		
0.425	91		
0.3	87		
0.212	83		
0.15	81		
0.063	71.1		

Sample Proportions	% dry mass
Very coarse	0.00
Gravel	4.30
Sand	24.60
Silt	32.30
Clay	38.80

Grading Analysis		
D100	mm	14
D60	mm	0.0297
D30	mm	
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

Note: Tested in Accordance with BS1377:Part 2:1990, clauses 9.2 and 9.5

Remarks:

Signed:

Monika Janoszek
PL Deputy Head of Geotechnical Section
for and on behalf of i2 Analytical Ltd

Date Reported: 13/03/2020

GF 100.16

TEST CERTIFICATE

Particle Size Distribution

Tested in Accordance with: BS 1377-2: 1990

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

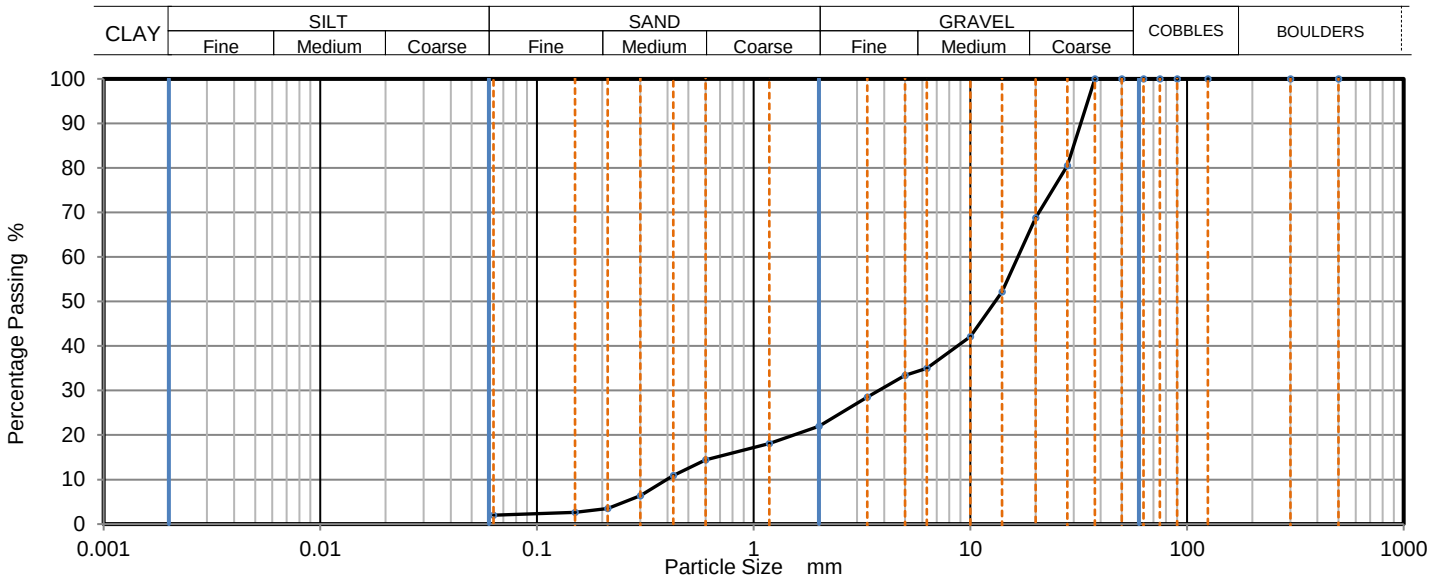
4041

Client:	CURTINS	Client Reference:	73270
Client Address:	Units 5/6, 40 Compton Street, London, EC1V 0BD	Job Number:	20-89839
		Date Sampled:	19/02/2020
		Date Received:	25/02/2020
Contact:	Myfanwy Wood	Date Tested:	09/03/2020
Site Address:	Acton Gardens	Sampled By:	Not Given

Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

Test Results:

Laboratory Reference:	1457886	Depth Top [m]:	2.00
Hole No.:	CP104	Depth Base [m]:	Not Given
Sample Reference:	Not Given	Sample Type:	D
Sample Description:	Orangish brown slightly clayey sandy GRAVEL		



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
500	100		
300	100		
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	81		
20	69		
14	52		
10	42		
6.3	35		
5	33		
3.35	29		
2	22		
1.18	18		
0.6	14		
0.425	11		
0.3	6		
0.212	4		
0.15	3		
0.063	2.0		

Sample Proportions	% dry mass
Very coarse	0.00
Gravel	78.00
Sand	20.00
Fines <0.063mm	2.00

Grading Analysis		
D100	mm	37.5
D60	mm	16.6
D30	mm	3.79
D10	mm	0.396
Uniformity Coefficient		42
Curvature Coefficient		2.2

Note: Tested in Accordance with BS1377:Part 2:1990, clause 9.2

Remarks:

Signed:

Monika Janoszek
PL Deputy Head of Geotechnical Section
for and on behalf of i2 Analytical Ltd

Date Reported: 13/03/2020

GF 100.16

TEST CERTIFICATE

Particle Size Distribution

Tested in Accordance with: BS 1377-2: 1990

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

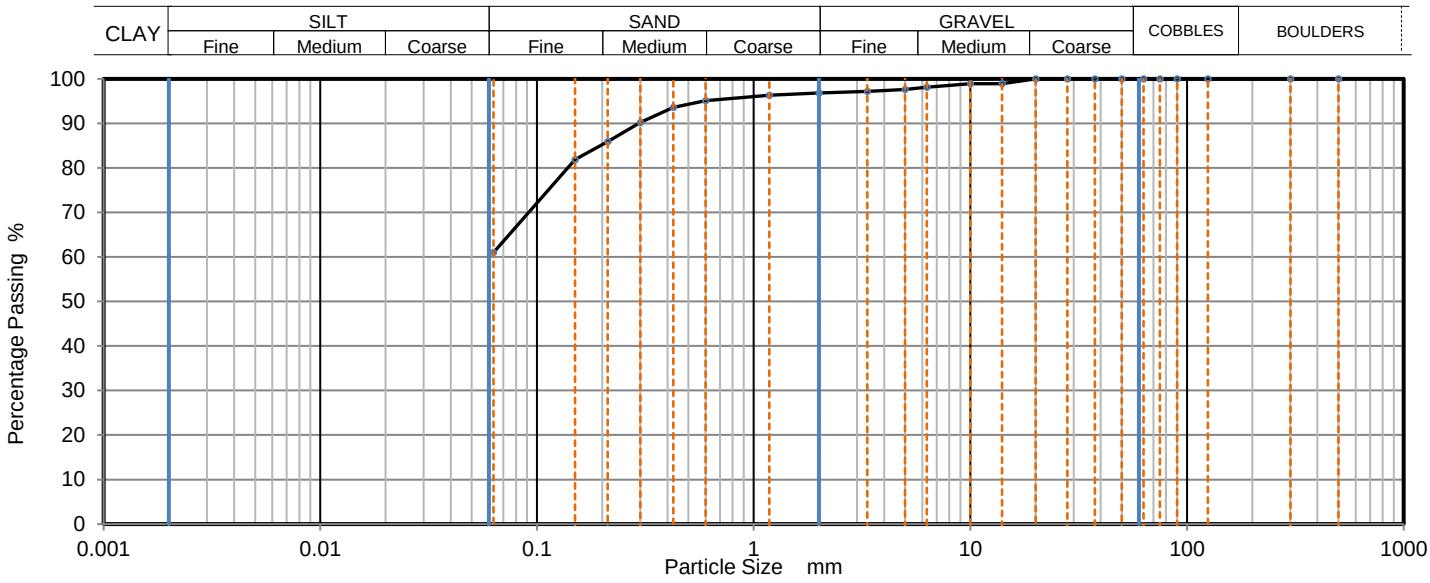
4041

Client:	CURTINS	Client Reference:	73270
Client Address:	Units 5/6, 40 Compton Street, London, EC1V 0BD	Job Number:	20-89839
		Date Sampled:	20/02/2020
		Date Received:	25/02/2020
Contact:	Myfanwy Wood	Date Tested:	03/03/2020
Site Address:	Acton Gardens	Sampled By:	Not Given

Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

Test Results:

Laboratory Reference:	1457887	Depth Top [m]:	2.50
Hole No.:	WS102	Depth Base [m]:	3.00
Sample Reference:	Not Given	Sample Type:	B
Sample Description:	Brown slightly gravelly very sandy CLAY		



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
500	100		
300	100		
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	100		
14	99		
10	99		
6.3	98		
5	98		
3.35	97		
2	97		
1.18	96		
0.6	95		
0.425	94		
0.3	90		
0.212	86		
0.15	82		
0.063	61.4		

Sample Proportions	% dry mass
Very coarse	0.00
Gravel	3.20
Sand	35.40
Fines <0.063mm	61.40

Grading Analysis		
D100	mm	20
D60	mm	
D30	mm	
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

Note: Tested in Accordance with BS1377:Part 2:1990, clause 9.2

Remarks:

Signed:

Monika Janoszek
PL Deputy Head of Geotechnical Section
for and on behalf of i2 Analytical Ltd

Date Reported: 13/03/2020

GF 100.16

TEST CERTIFICATE

Unconsolidated Undrained

Triaxial Compression

Tested in Accordance with:
BS 1377-7: 1990: Clause 8

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

UKAS TESTING 4041

Environmental Science

Client:	CURTINS	Client Reference:	73270
Client Address:	Units 5/6, 40 Compton Street, London, EC1V 0BD	Job Number:	20-89839
		Date Sampled:	19/02/2020
		Date Received:	25/02/2020
Contact:	Rob Allen	Date Tested:	10/03/2020
Site Address:	Acton Gardens	Sampled By:	Not Given

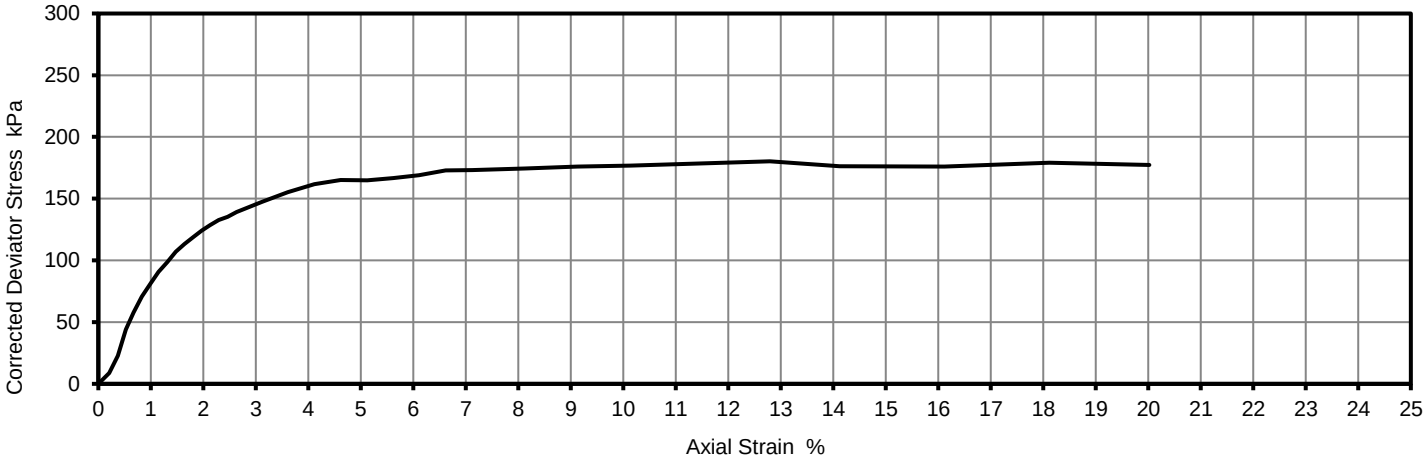
Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

Test Results:

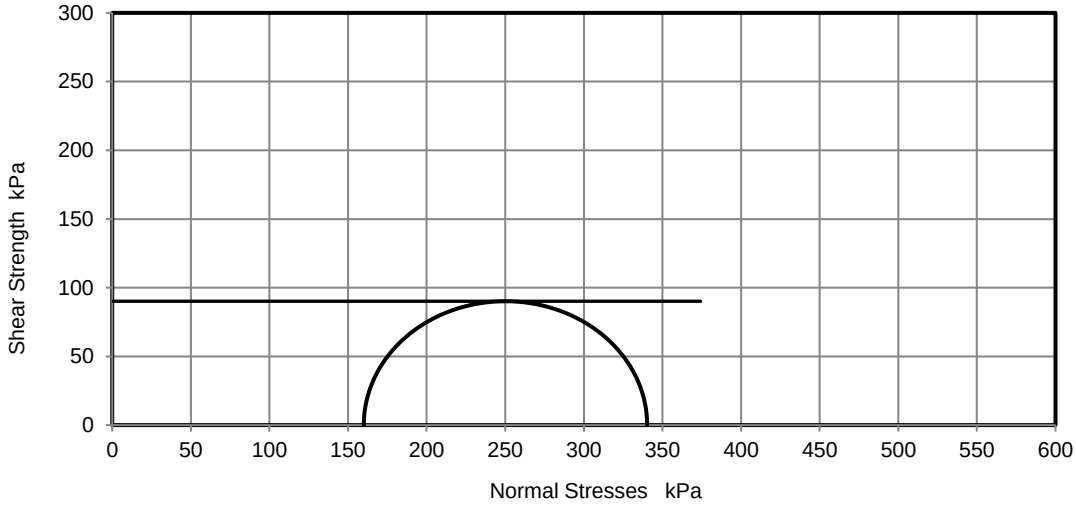
Laboratory Reference:	1457888	Depth Top [m]:	8.00
Hole No.:	CP103	Depth Base [m]:	8.45
Sample Reference:	Not Given	Sample Type:	U
Sample Description:	Brown CLAY		

Test Number	1		Rate of Strain	2.00	%/min	
Length	192.96	mm	Cell Pressure	160	kPa	
Diameter	102.61	mm	Axial Strain at failure	12.8	%	
Bulk Density	1.98	Mg/m3	Deviator Stress, (σ1 - σ3)f	180	kPa	
Moisture Content	30	%	Undrained Shear Strength, cu	90	kPa	½(σ1 - σ3)f
Dry Density	1.51	Mg/m3	Mode of Failure	Brittle		
Membrane Correction	0.60	kPa	Membrane thickness	0.23	mm	

Deviator Stress v Axial Strain



Mohr Circles



Position within sample

Note: Deviator stress corrected for area change and membrane effects. Mohr circles and their interpretation is not covered by BS1377. This is provided for information only.

Remarks:

Signed:

Monika Janoszek
PL Deputy Head of Geotechnical Section
for and on behalf of i2 Analytical Ltd

Date Reported: 13/03/2020

GF 184.10

TEST CERTIFICATE

Unconsolidated Undrained

Triaxial Compression

Tested in Accordance with:
BS 1377-7: 1990: Clause 8

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

UKAS TESTING
4041

Environmental Science

Client:	CURTINS	Client Reference:	73270
Client Address:	Units 5/6, 40 Compton Street, London, EC1V 0BD	Job Number:	20-89839
		Date Sampled:	19/02/2020
		Date Received:	25/02/2020
Contact:	Rob Allen	Date Tested:	05/03/2020
Site Address:	Acton Gardens	Sampled By:	Not Given

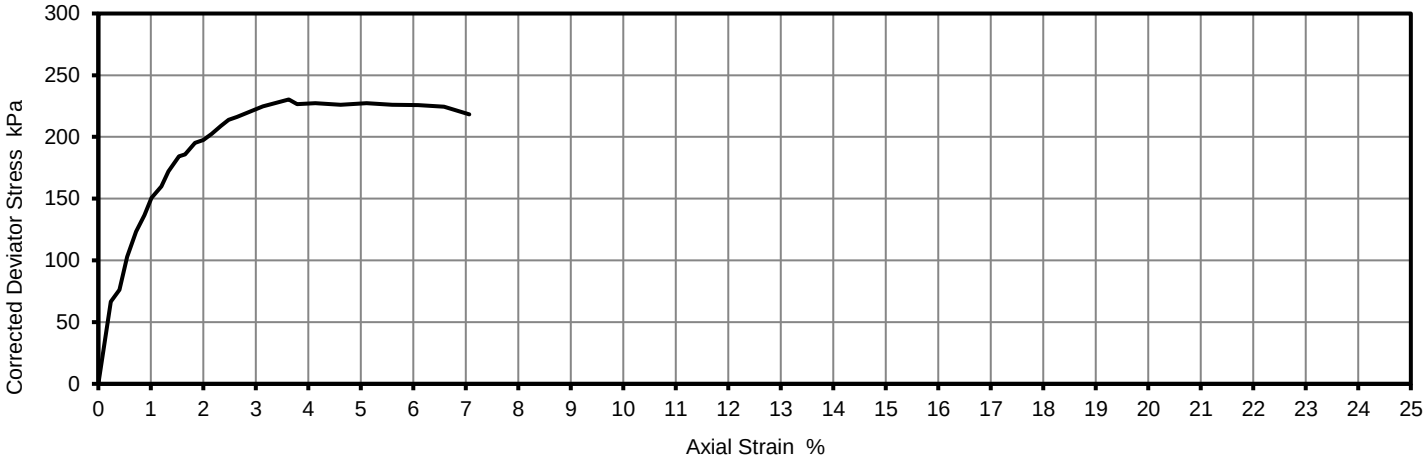
Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

Test Results:

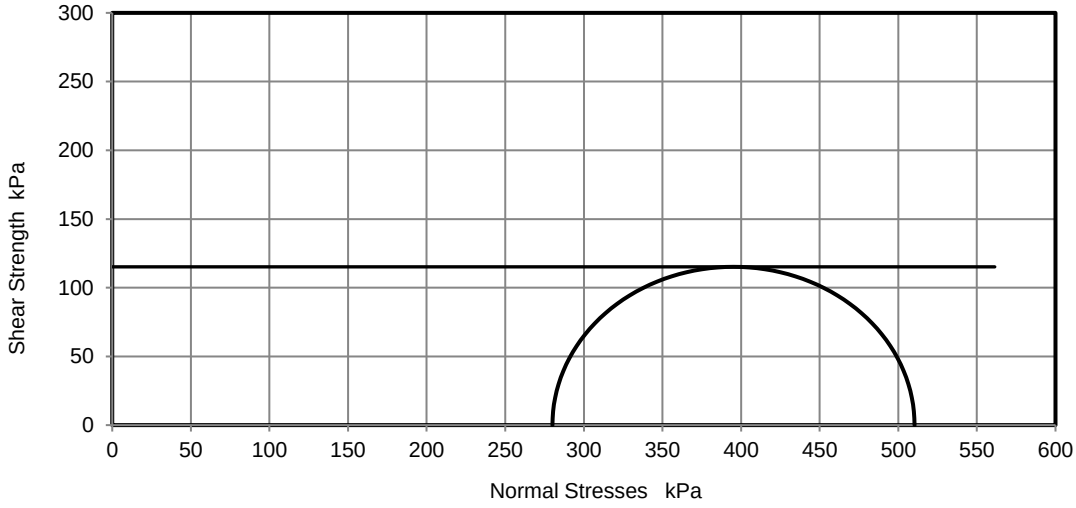
Laboratory Reference:	1457889	Depth Top [m]:	14.00
Hole No.:	CP103	Depth Base [m]:	14.45
Sample Reference:	Not Given	Sample Type:	U
Sample Description:	Brown CLAY		

Test Number	1		Rate of Strain	2.00	%/min	
Length	75.01	mm	Cell Pressure	280	kPa	
Diameter	37.59	mm	Axial Strain at failure	3.6	%	
Bulk Density	1.97	Mg/m3	Deviator Stress, (σ1 - σ3)f	230	kPa	
Moisture Content	27	%	Undrained Shear Strength, cu	115	kPa	½(σ1 - σ3)f
Dry Density	1.56	Mg/m3	Mode of Failure	Compound		
Membrane Correction	0.61	kPa	Membrane thickness	0.23	mm	

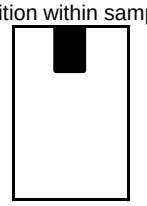
Deviator Stress v Axial Strain



Mohr Circles



Position within sample



Note: Deviator stress corrected for area change and membrane effects. Mohr circles and their interpretation is not covered by BS1377. This is provided for information only.

Remarks:

Signed:

Monika Janoszek
PL Deputy Head of Geotechnical Section
for and on behalf of i2 Analytical Ltd

Date Reported: 13/03/2020

GF 184.10

TEST CERTIFICATE

Unconsolidated Undrained

Triaxial Compression

Tested in Accordance with:
BS 1377-7: 1990: Clause 8

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

UKAS TESTING
4041

Environmental Science

Client:	CURTINS	Client Reference:	73270
Client Address:	Units 5/6, 40 Compton Street, London, EC1V 0BD	Job Number:	20-89839
		Date Sampled:	19/02/2020
		Date Received:	25/02/2020
Contact:	Rob Allen	Date Tested:	05/03/2020
Site Address:	Acton Gardens	Sampled By:	Not Given

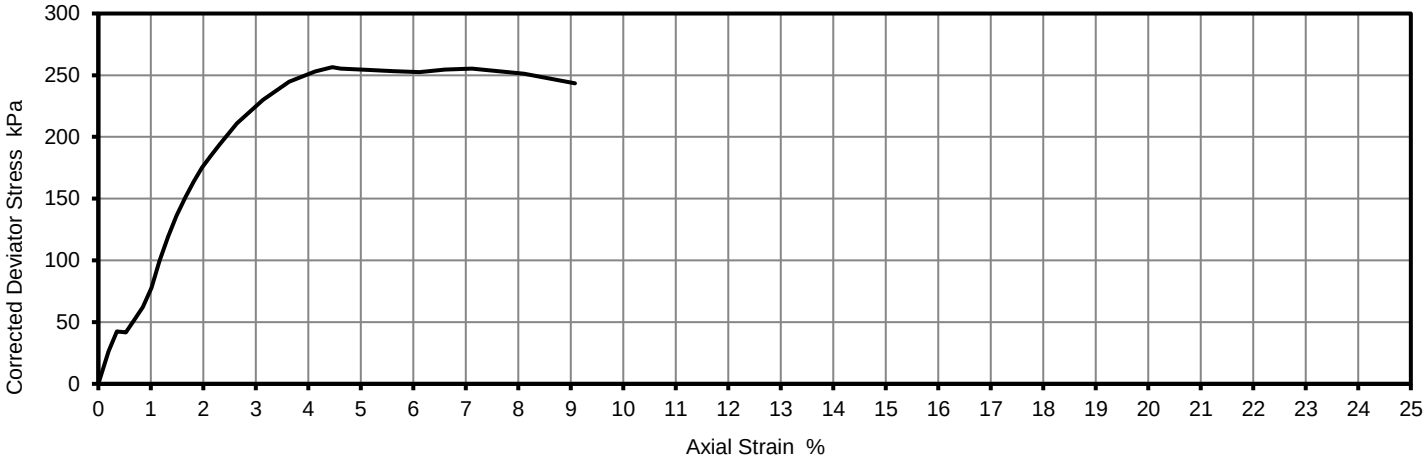
Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

Test Results:

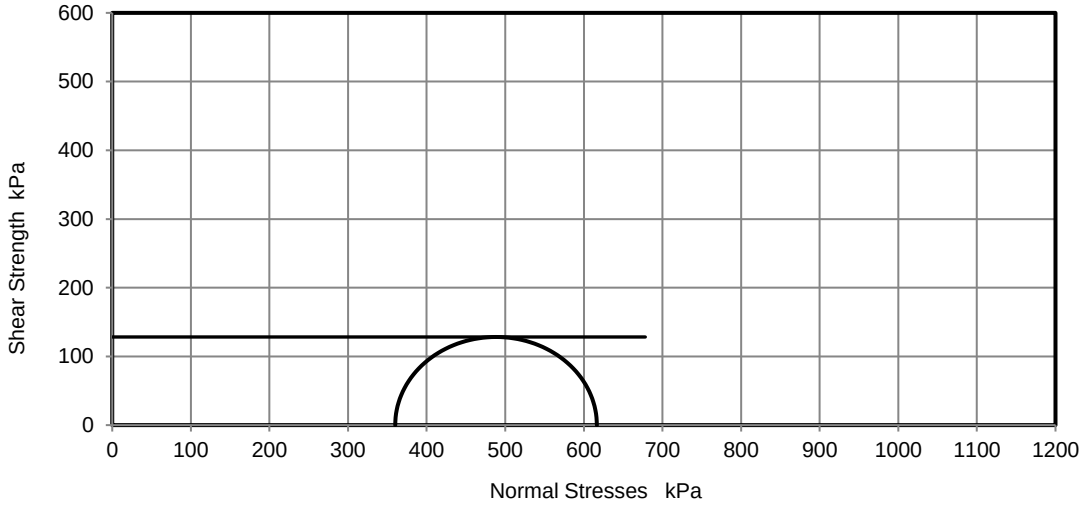
Laboratory Reference:	1457890	Depth Top [m]:	18.00
Hole No.:	CP103	Depth Base [m]:	18.45
Sample Reference:	Not Given	Sample Type:	U
Sample Description:	Brown CLAY		

Test Number	1		Rate of Strain	2.00	%/min	
Length	194.53	mm	Cell Pressure	360	kPa	
Diameter	102.86	mm	Axial Strain at failure	4.5	%	
Bulk Density	2.00	Mg/m3	Deviator Stress, (σ1 - σ3)f	257	kPa	
Moisture Content	24	%	Undrained Shear Strength, cu	128	kPa	½(σ1 - σ3)f
Dry Density	1.61	Mg/m3	Mode of Failure	Brittle		
Membrane Correction	0.25	kPa	Membrane thickness	0.21	mm	

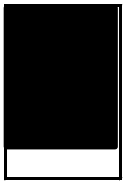
Deviator Stress v Axial Strain



Mohr Circles



Position within sample



Note: Deviator stress corrected for area change and membrane effects. Mohr circles and their interpretation is not covered by BS1377. This is provided for information only.

Remarks:

Signed:

Monika Janoszek
PL Deputy Head of Geotechnical Section
for and on behalf of i2 Analytical Ltd

Date Reported: 13/03/2020

GF 184.10

TEST CERTIFICATE

Unconsolidated Undrained

Triaxial Compression

Tested in Accordance with:
BS 1377-7: 1990: Clause 8

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

UKAS TESTING
4041

Environmental Science

Client:	CURTINS	Client Reference:	73270
Client Address:	Units 5/6, 40 Compton Street, London, EC1V 0BD	Job Number:	20-89839
		Date Sampled:	20/02/2020
		Date Received:	25/02/2020
Contact:	Rob Allen	Date Tested:	05/03/2020
Site Address:	Acton Gardens	Sampled By:	Not Given

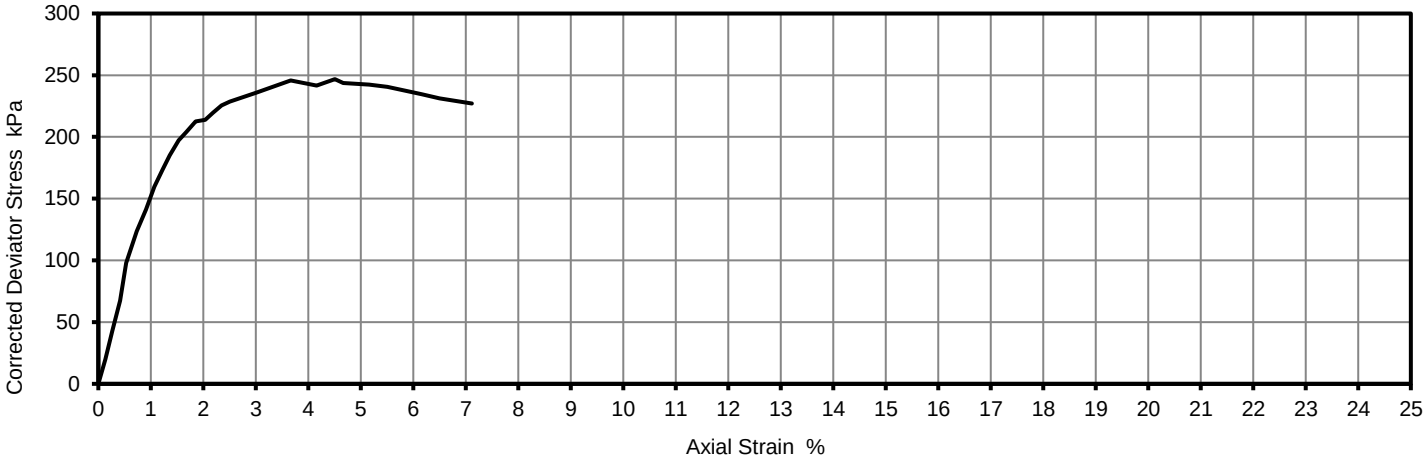
Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

Test Results:

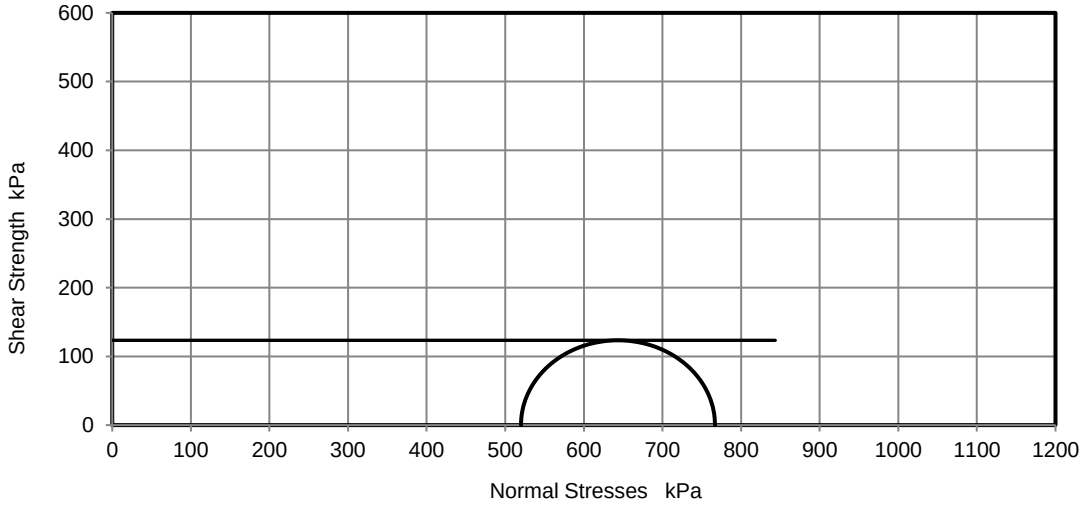
Laboratory Reference:	1457891	Depth Top [m]:	26.00
Hole No.:	CP103	Depth Base [m]:	26.45
Sample Reference:	Not Given	Sample Type:	U
Sample Description:	Dark brown CLAY		

Test Number	1		Rate of Strain	2.00	%/min	
Length	75.05	mm	Cell Pressure	520	kPa	
Diameter	37.55	mm	Axial Strain at failure	4.5	%	
Bulk Density	2.01	Mg/m3	Deviator Stress, (σ1 - σ3)f	247	kPa	
Moisture Content	26	%	Undrained Shear Strength, cu	123	kPa	½(σ1 - σ3)f
Dry Density	1.60	Mg/m3	Mode of Failure	Brittle		
Membrane Correction	0.69	kPa	Membrane thickness	0.21	mm	

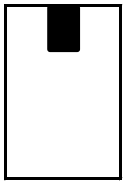
Deviator Stress v Axial Strain



Mohr Circles



Position within sample



Note: Deviator stress corrected for area change and membrane effects. Mohr circles and their interpretation is not covered by BS1377. This is provided for information only.

Remarks:

Signed:

Monika Janoszek
PL Deputy Head of Geotechnical Section
for and on behalf of i2 Analytical Ltd

Date Reported: 13/03/2020

GF 184.10

TEST CERTIFICATE

Unconsolidated Undrained

Triaxial Compression

Tested in Accordance with:
BS 1377-7: 1990: Clause 8

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

UKAS TESTING
4041

Environmental Science

Client:	CURTINS	Client Reference:	73270
Client Address:	Units 5/6, 40 Compton Street, London, EC1V 0BD	Job Number:	20-89839
		Date Sampled:	19/02/2020
		Date Received:	25/02/2020
Contact:	Rob Allen	Date Tested:	03/03/2020
Site Address:	Acton Gardens	Sampled By:	Not Given

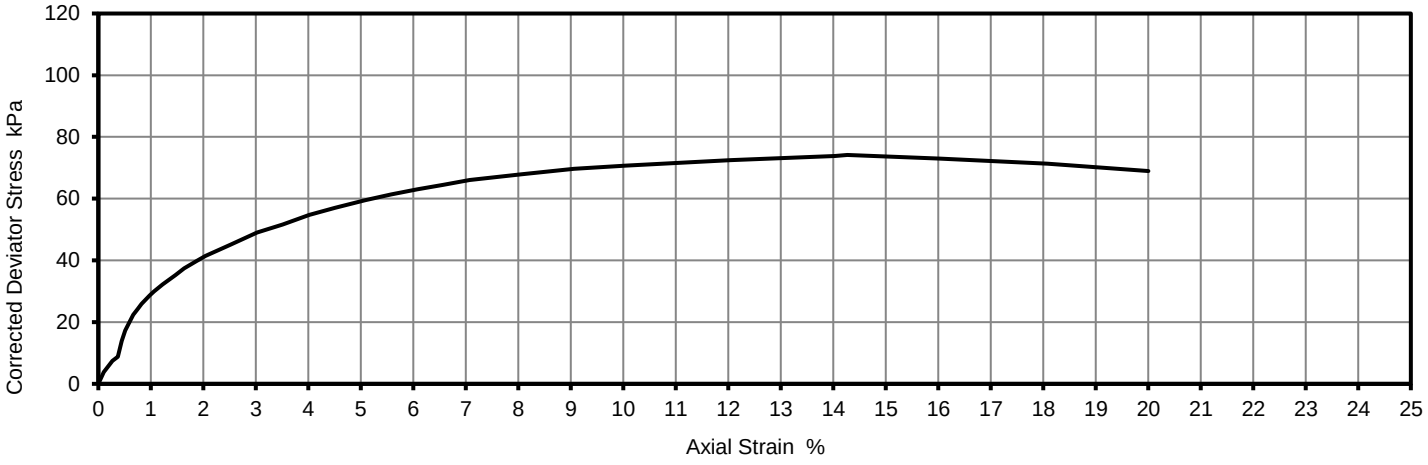
Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

Test Results:

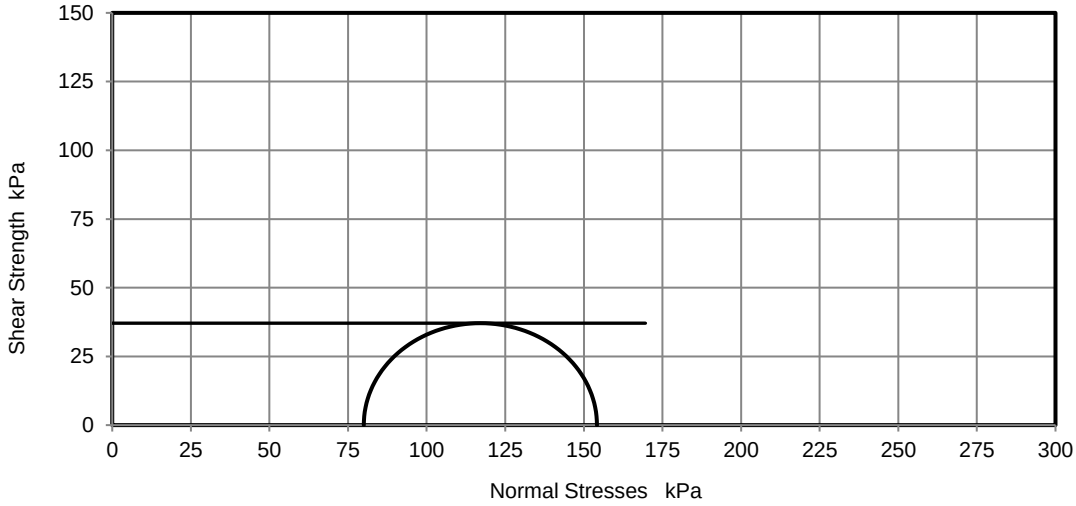
Laboratory Reference:	1457892	Depth Top [m]:	4.00
Hole No.:	CP104	Depth Base [m]:	4.45
Sample Reference:	Not Given	Sample Type:	U
Sample Description:	Greyish brown CLAY		

Test Number	1		Rate of Strain	1.00	%/min	
Length	192.65	mm	Cell Pressure	80	kPa	
Diameter	100.47	mm	Axial Strain at failure	14.3	%	
Bulk Density	1.85	Mg/m3	Deviator Stress, (σ1 - σ3)f	74	kPa	
Moisture Content	37	%	Undrained Shear Strength, cu	37	kPa	½(σ1 - σ3)f
Dry Density	1.35	Mg/m3	Mode of Failure	Compound		
Membrane Correction	0.99	kPa	Membrane thickness	0.34	mm	

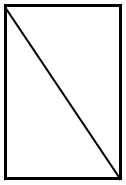
Deviator Stress v Axial Strain



Mohr Circles



Position within sample



Note: Deviator stress corrected for area change and membrane effects. Mohr circles and their interpretation is not covered by BS1377. This is provided for information only.

Remarks: Recompacted at NMC using 2.5kg (light) rammer

Signed:

Monika Janoszek
PL Deputy Head of Geotechnical Section
for and on behalf of i2 Analytical Ltd

Date Reported: 13/03/2020

GF 184.10

TEST CERTIFICATE

Unconsolidated Undrained

Triaxial Compression

Tested in Accordance with:
BS 1377-7: 1990: Clause 8

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

UKAS TESTING
4041

Environmental Science

Client:	CURTINS	Client Reference:	73270
Client Address:	Units 5/6, 40 Compton Street, London, EC1V 0BD	Job Number:	20-89839
		Date Sampled:	20/02/2020
		Date Received:	25/02/2020
Contact:	Rob Allen	Date Tested:	05/03/2020
Site Address:	Acton Gardens	Sampled By:	Not Given

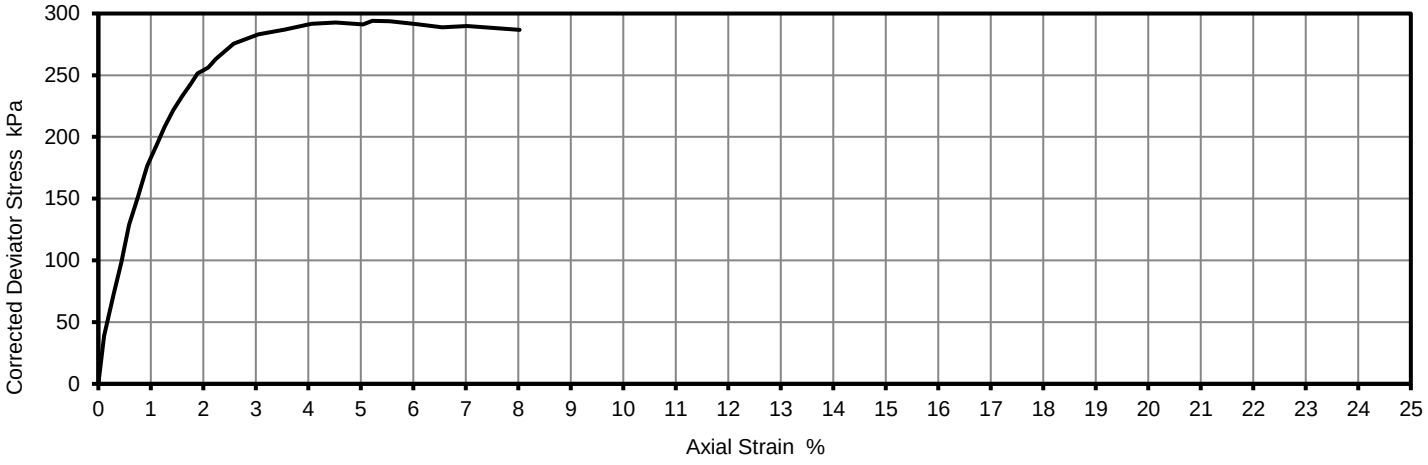
Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

Test Results:

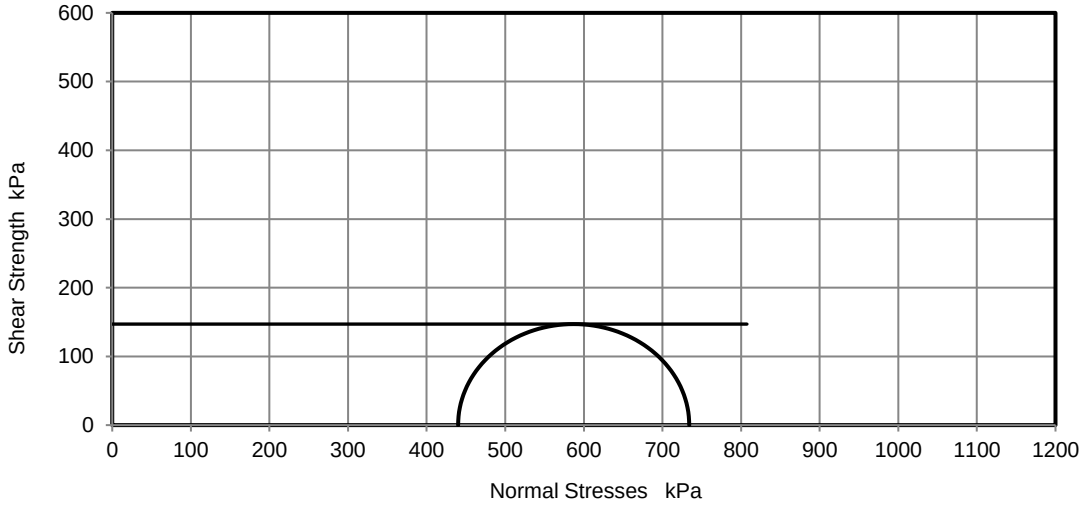
Laboratory Reference:	1457893	Depth Top [m]:	22.00
Hole No.:	CP104	Depth Base [m]:	22.45
Sample Reference:	Not Given	Sample Type:	U
Sample Description:	Brown CLAY		

Test Number	1		Rate of Strain	2.00	%/min	
Length	75.15	mm	Cell Pressure	440	kPa	
Diameter	37.08	mm	Axial Strain at failure	5.2	%	
Bulk Density	2.03	Mg/m3	Deviator Stress, (σ1 - σ3)f	294	kPa	
Moisture Content	26	%	Undrained Shear Strength, cu	147	kPa	½(σ1 - σ3)f
Dry Density	1.61	Mg/m3	Mode of Failure	Brittle		
Membrane Correction	0.86	kPa	Membrane thickness	0.22	mm	

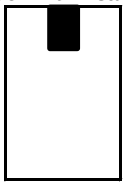
Deviator Stress v Axial Strain



Mohr Circles



Position within sample



Note: Deviator stress corrected for area change and membrane effects. Mohr circles and their interpretation is not covered by BS1377. This is provided for information only.

Remarks:

Signed:

Monika Janoszek
PL Deputy Head of Geotechnical Section
for and on behalf of i2 Analytical Ltd

Date Reported: 13/03/2020

GF 184.10

TEST CERTIFICATE

Unconsolidated Undrained

Triaxial Compression

Tested in Accordance with:
BS 1377-7: 1990: Clause 8

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

UKAS TESTING
4041

Environmental Science

Client:	CURTINS	Client Reference:	73270
Client Address:	Units 5/6, 40 Compton Street, London, EC1V 0BD	Job Number:	20-89839
		Date Sampled:	20/02/2020
		Date Received:	25/02/2020
Contact:	Rob Allen	Date Tested:	05/03/2020
Site Address:	Acton Gardens	Sampled By:	Not Given

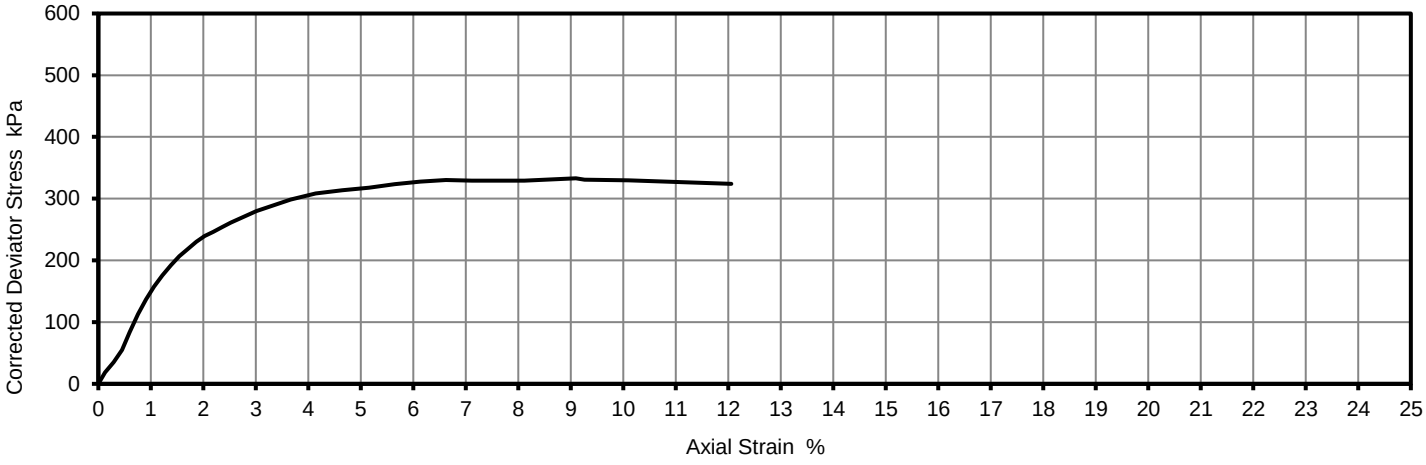
Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

Test Results:

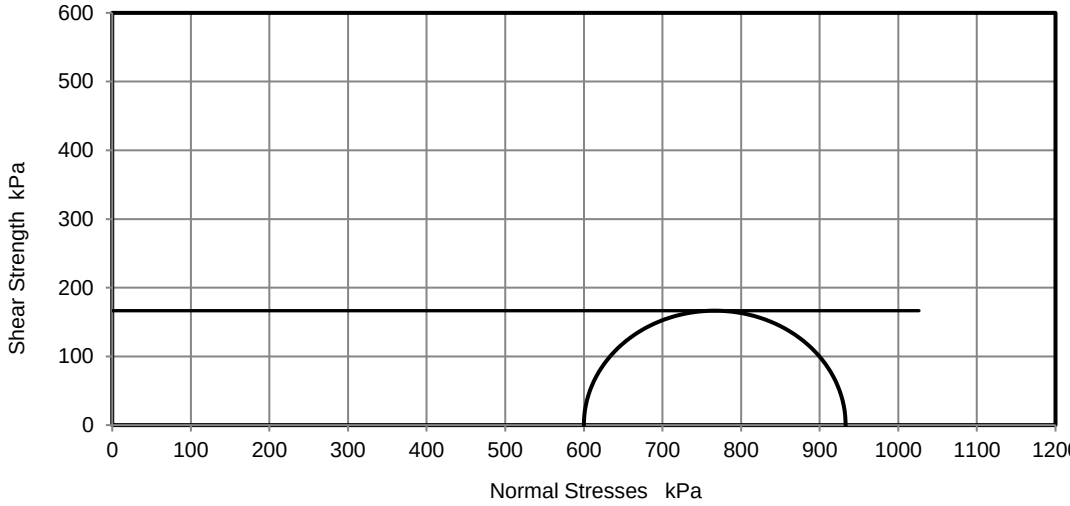
Laboratory Reference:	1457894	Depth Top [m]:	30.00
Hole No.:	CP104	Depth Base [m]:	30.45
Sample Reference:	Not Given	Sample Type:	U
Sample Description:	Brown CLAY		

Test Number	1		Rate of Strain	2.00	%/min	
Length	188.36	mm	Cell Pressure	600	kPa	
Diameter	103.23	mm	Axial Strain at failure	9.1	%	
Bulk Density	2.01	Mg/m3	Deviator Stress, (σ1 - σ3)f	333	kPa	
Moisture Content	26	%	Undrained Shear Strength, cu	167	kPa	½(σ1 - σ3)f
Dry Density	1.59	Mg/m3	Mode of Failure	Brittle		
Membrane Correction	0.42	kPa	Membrane thickness	0.21	mm	

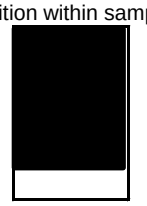
Deviator Stress v Axial Strain



Mohr Circles



Position within sample



Note: Deviator stress corrected for area change and membrane effects. Mohr circles and their interpretation is not covered by BS1377. This is provided for information only.

Remarks:

Signed:

Monika Janoszek
PL Deputy Head of Geotechnical Section
for and on behalf of i2 Analytical Ltd

Date Reported: 13/03/2020

GF 184.10

TEST CERTIFICATE

Unconsolidated Undrained

Triaxial Compression

Tested in Accordance with:
BS 1377-7: 1990: Clause 8

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

UKAS TESTING
4041

Environmental Science

Client:	CURTINS	Client Reference:	73270
Client Address:	Units 5/6, 40 Compton Street, London, EC1V 0BD	Job Number:	20-89839
		Date Sampled:	20/02/2020
		Date Received:	25/02/2020
Contact:	Rob Allen	Date Tested:	05/03/2020
Site Address:	Acton Gardens	Sampled By:	Not Given

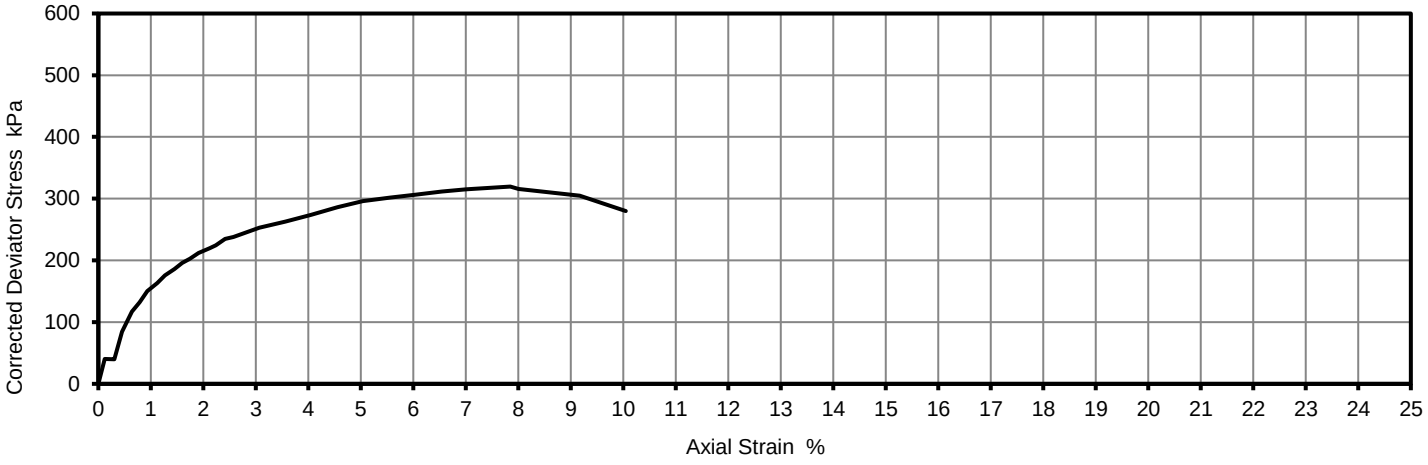
Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

Test Results:

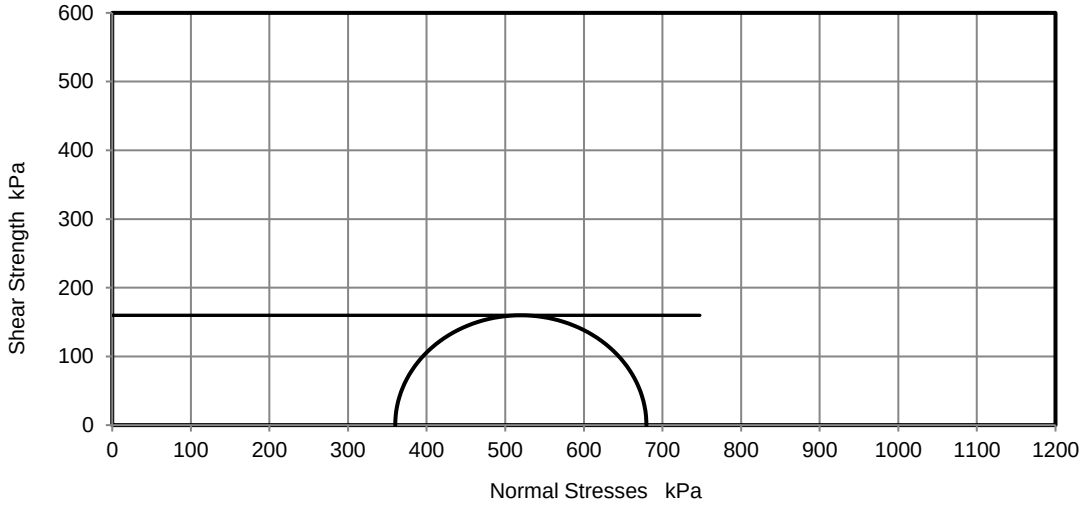
Laboratory Reference:	1457895	Depth Top [m]:	18.00
Hole No.:	CP104	Depth Base [m]:	18.45
Sample Reference:	Not Given	Sample Type:	U
Sample Description:	Brown CLAY		

Test Number	1		Rate of Strain	2.00	%/min	
Length	75.05	mm	Cell Pressure	360	kPa	
Diameter	37.34	mm	Axial Strain at failure	7.8	%	
Bulk Density	2.00	Mg/m3	Deviator Stress, (σ1 - σ3)f	320	kPa	
Moisture Content	27	%	Undrained Shear Strength, cu	160	kPa	½(σ1 - σ3)f
Dry Density	1.57	Mg/m3	Mode of Failure	Compound		
Membrane Correction	1.11	kPa	Membrane thickness	0.22	mm	

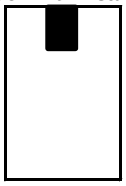
Deviator Stress v Axial Strain



Mohr Circles



Position within sample



Note: Deviator stress corrected for area change and membrane effects. Mohr circles and their interpretation is not covered by BS1377. This is provided for information only.

Remarks:

Signed:

Monika Janoszek
PL Deputy Head of Geotechnical Section
for and on behalf of i2 Analytical Ltd

Date Reported: 13/03/2020

GF 184.10

TEST CERTIFICATE

Unconsolidated Undrained

Triaxial Compression

Tested in Accordance with:
BS 1377-7: 1990: Clause 8

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

UKAS TESTING
4041

Environmental Science

Client:	CURTINS	Client Reference:	73270
Client Address:	Units 5/6, 40 Compton Street, London, EC1V 0BD	Job Number:	20-89839
		Date Sampled:	19/02/2020
		Date Received:	25/02/2020
Contact:	Rob Allen	Date Tested:	10/03/2020
Site Address:	Acton Gardens	Sampled By:	Not Given

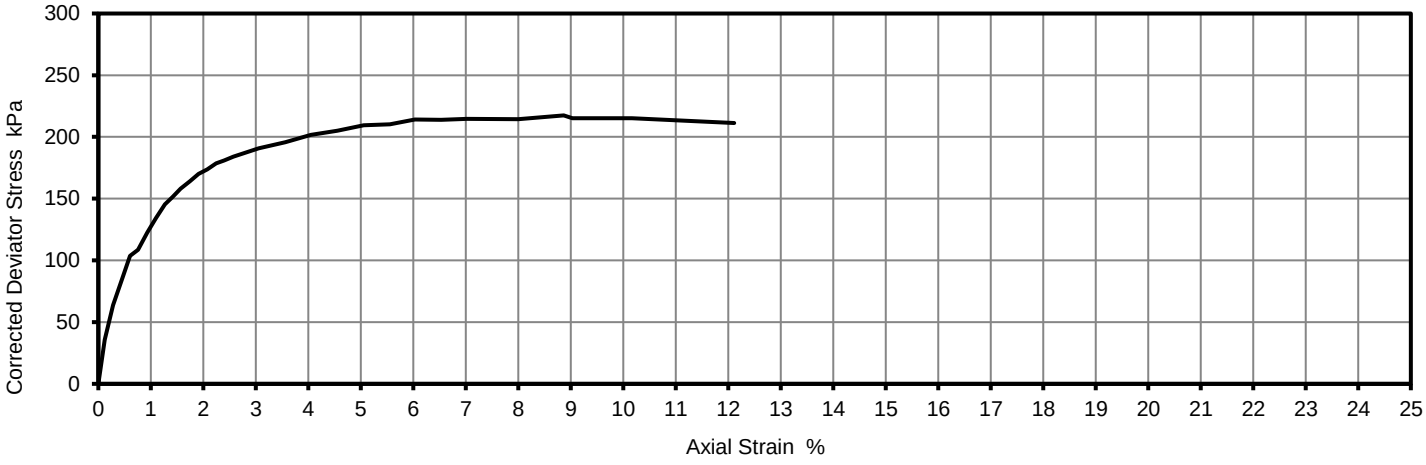
Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

Test Results:

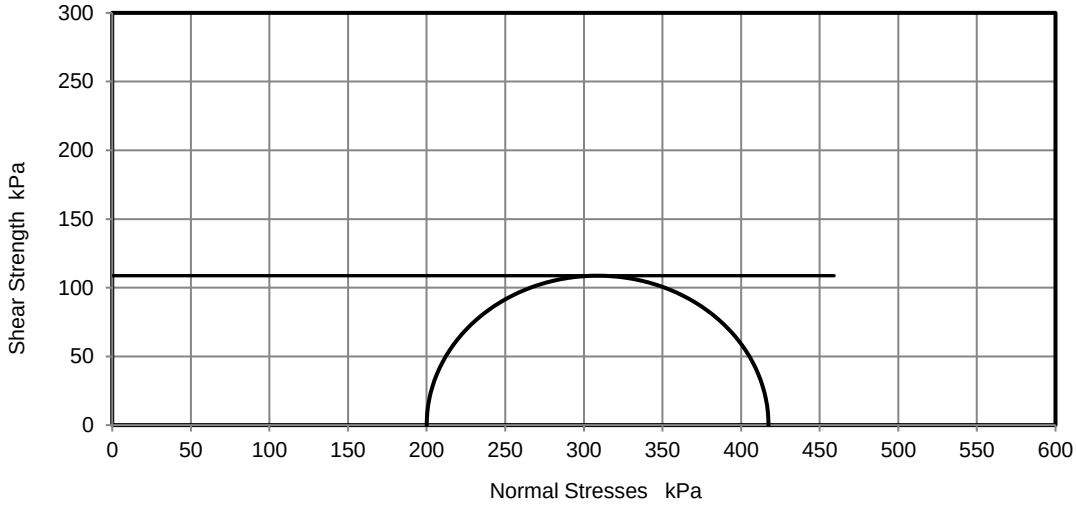
Laboratory Reference:	1457896	Depth Top [m]:	10.00
Hole No.:	CP104	Depth Base [m]:	10.45
Sample Reference:	Not Given	Sample Type:	U
Sample Description:	Brown CLAY		

Test Number	1		Rate of Strain	2.00	%/min	
Length	96.35	mm	Cell Pressure	200	kPa	
Diameter	49.28	mm	Axial Strain at failure	8.9	%	
Bulk Density	2.00	Mg/m3	Deviator Stress, (σ1 - σ3)f	217	kPa	
Moisture Content	27	%	Undrained Shear Strength, cu	109	kPa	½(σ1 - σ3)f
Dry Density	1.57	Mg/m3	Mode of Failure	Brittle		
Membrane Correction	0.91	kPa	Membrane thickness	0.22	mm	

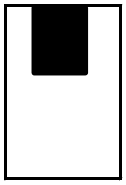
Deviator Stress v Axial Strain



Mohr Circles



Position within sample



Note: Deviator stress corrected for area change and membrane effects. Mohr circles and their interpretation is not covered by BS1377. This is provided for information only.

Remarks:

Signed:

Monika Janoszek
PL Deputy Head of Geotechnical Section
for and on behalf of i2 Analytical Ltd

Date Reported: 13/03/2020

GF 184.10

TEST CERTIFICATE

Unconsolidated Undrained

Triaxial Compression

Tested in Accordance with:
BS 1377-7: 1990: Clause 8

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

UKAS TESTING
4041

Environmental Science

Client:	CURTINS	Client Reference:	73270
Client Address:	Units 5/6, 40 Compton Street, London, EC1V 0BD	Job Number:	20-89839
		Date Sampled:	18/02/2020
		Date Received:	25/02/2020
Contact:	Rob Allen	Date Tested:	05/03/2020
Site Address:	Acton Gardens	Sampled By:	Not Given

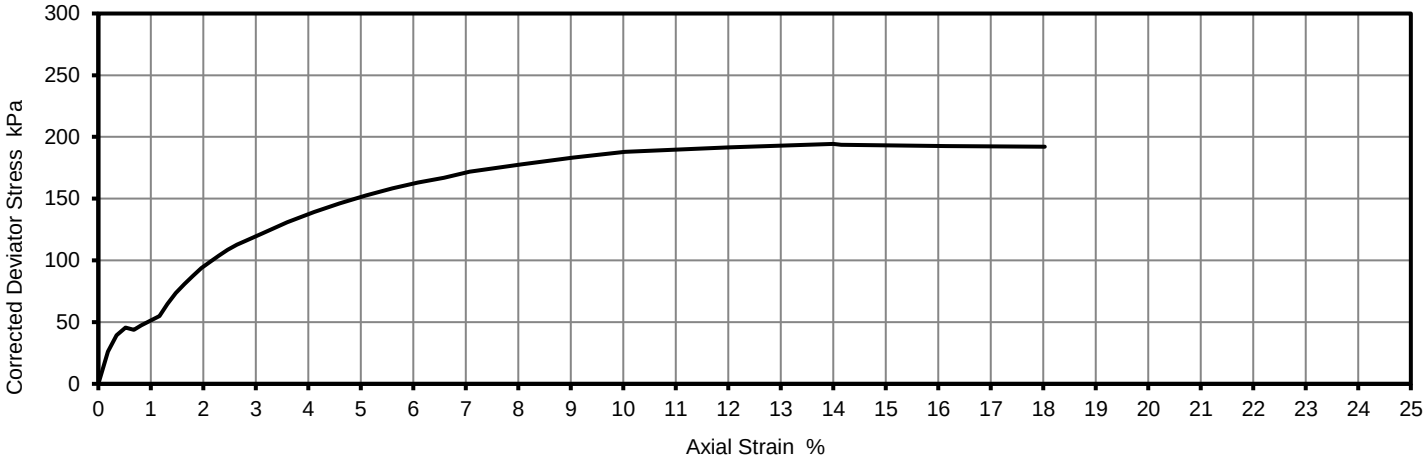
Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

Test Results:

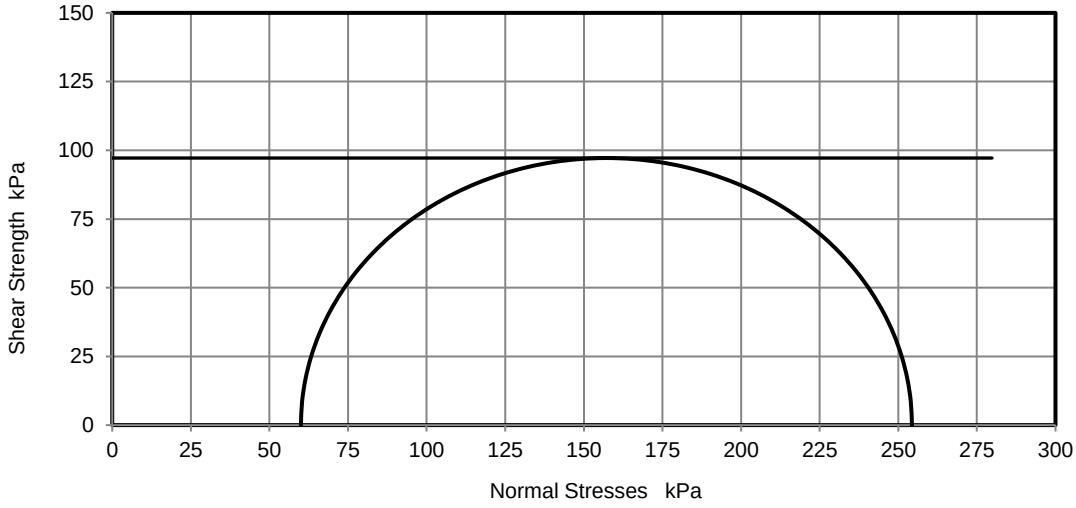
Laboratory Reference:	1457897	Depth Top [m]:	3.00
Hole No.:	CP105	Depth Base [m]:	3.45
Sample Reference:	Not Given	Sample Type:	U
Sample Description:	Brown CLAY		

Test Number	1		Rate of Strain	2.00	%/min	
Length	184.28	mm	Cell Pressure	60	kPa	
Diameter	102.52	mm	Axial Strain at failure	14.0	%	
Bulk Density	1.99	Mg/m3	Deviator Stress, (σ1 - σ3)f	194	kPa	
Moisture Content	29	%	Undrained Shear Strength, cu	97	kPa	½(σ1 - σ3)f
Dry Density	1.54	Mg/m3	Mode of Failure	Compound		
Membrane Correction	0.67	kPa	Membrane thickness	0.24	mm	

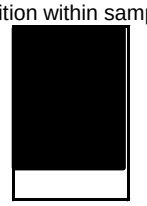
Deviator Stress v Axial Strain



Mohr Circles



Position within sample



Note: Deviator stress corrected for area change and membrane effects. Mohr circles and their interpretation is not covered by BS1377. This is provided for information only.

Remarks:

Signed:

Monika Janoszek
PL Deputy Head of Geotechnical Section
for and on behalf of i2 Analytical Ltd

Date Reported: 13/03/2020

GF 184.10

TEST CERTIFICATE

Unconsolidated Undrained

Triaxial Compression

Tested in Accordance with:
BS 1377-7: 1990: Clause 8

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

UKAS TESTING
4041

Environmental Science

Client:	CURTINS	Client Reference:	73270
Client Address:	Units 5/6, 40 Compton Street, London, EC1V 0BD	Job Number:	20-89839
		Date Sampled:	18/02/2020
		Date Received:	25/02/2020
Contact:	Rob Allen	Date Tested:	05/03/2020
Site Address:	Acton Gardens	Sampled By:	Not Given

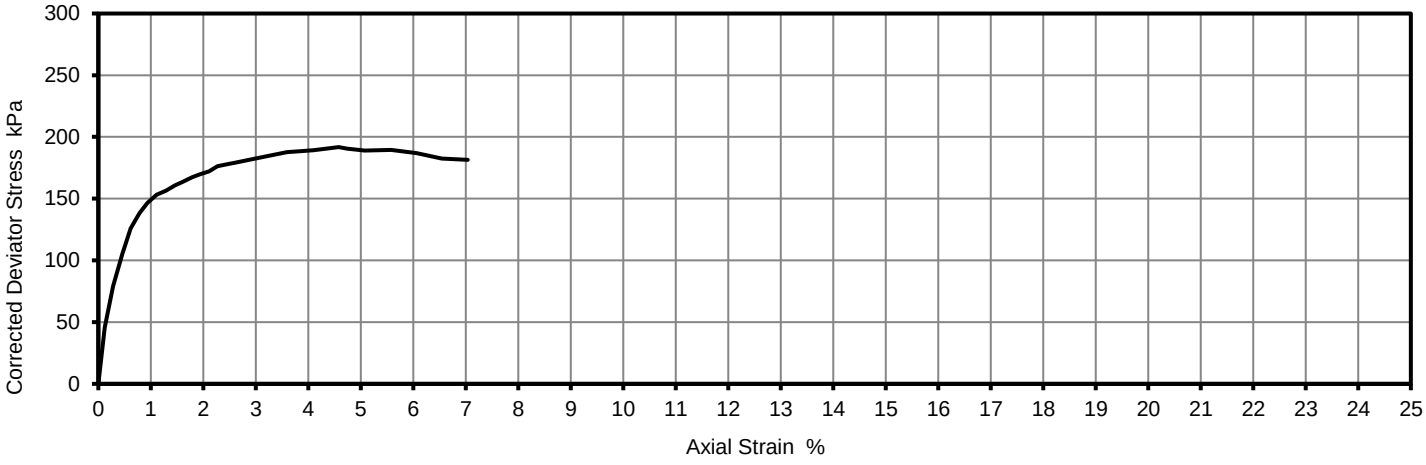
Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

Test Results:

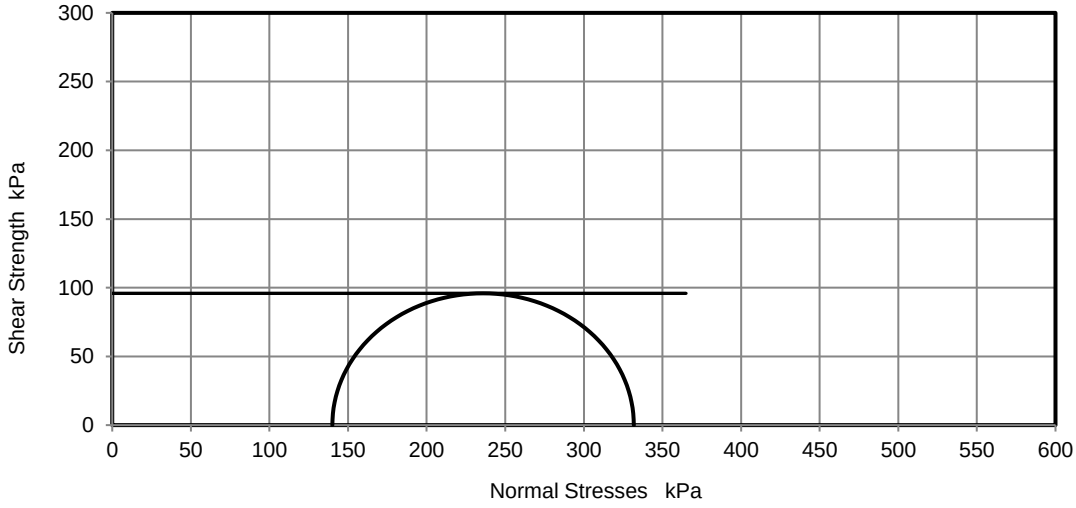
Laboratory Reference:	1457898	Depth Top [m]:	7.00
Hole No.:	CP105	Depth Base [m]:	7.45
Sample Reference:	Not Given	Sample Type:	U
Sample Description:	Brown CLAY		

Test Number	1		Rate of Strain	2.00	%/min	
Length	74.89	mm	Cell Pressure	140	kPa	
Diameter	37.35	mm	Axial Strain at failure	4.6	%	
Bulk Density	2.01	Mg/m3	Deviator Stress, (σ1 - σ3)f	192	kPa	
Moisture Content	25	%	Undrained Shear Strength, cu	96	kPa	½(σ1 - σ3)f
Dry Density	1.61	Mg/m3	Mode of Failure	Brittle		
Membrane Correction	0.70	kPa	Membrane thickness	0.21	mm	

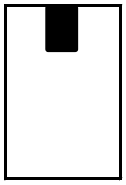
Deviator Stress v Axial Strain



Mohr Circles



Position within sample



Note: Deviator stress corrected for area change and membrane effects. Mohr circles and their interpretation is not covered by BS1377. This is provided for information only.

Remarks:

Signed:

Monika Janoszek
PL Deputy Head of Geotechnical Section
for and on behalf of i2 Analytical Ltd

Date Reported: 13/03/2020

GF 184.10

TEST CERTIFICATE

Unconsolidated Undrained

Triaxial Compression

Tested in Accordance with:
BS 1377-7: 1990: Clause 8

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

UKAS TESTING
4041

Environmental Science

Client:	CURTINS	Client Reference:	73270
Client Address:	Units 5/6, 40 Compton Street, London, EC1V 0BD	Job Number:	20-89839
		Date Sampled:	18/02/2020
		Date Received:	25/02/2020
Contact:	Rob Allen	Date Tested:	10/03/2020
Site Address:	Acton Gardens	Sampled By:	Not Given

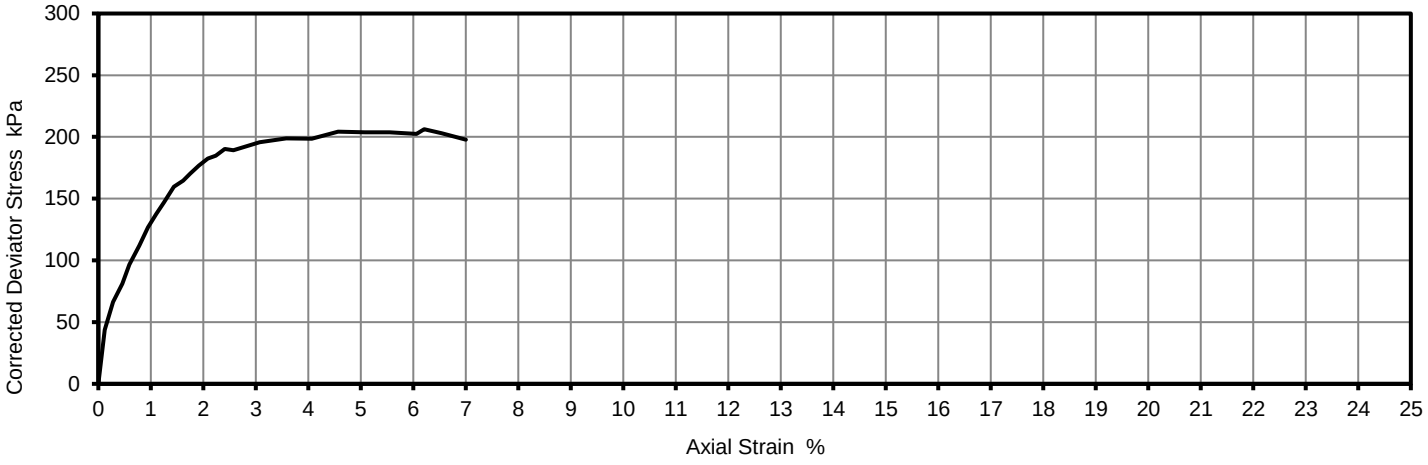
Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

Test Results:

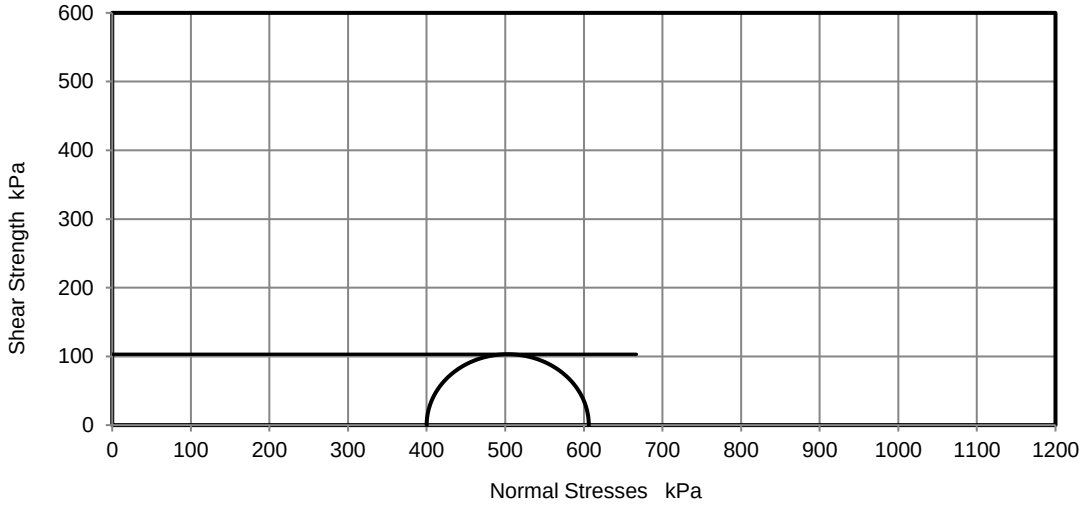
Laboratory Reference:	1457899	Depth Top [m]:	20.00
Hole No.:	CP105	Depth Base [m]:	20.45
Sample Reference:	Not Given	Sample Type:	U
Sample Description:	Brown CLAY		

Test Number	1		Rate of Strain	2.00	%/min	
Length	74.28	mm	Cell Pressure	400	kPa	
Diameter	38.11	mm	Axial Strain at failure	6.2	%	
Bulk Density	1.94	Mg/m3	Deviator Stress, (σ1 - σ3)f	206	kPa	
Moisture Content	25	%	Undrained Shear Strength, cu	103	kPa	½(σ1 - σ3)f
Dry Density	1.55	Mg/m3	Mode of Failure	Brittle		
Membrane Correction	0.93	kPa	Membrane thickness	0.22	mm	

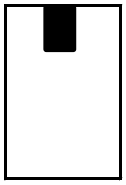
Deviator Stress v Axial Strain



Mohr Circles



Position within sample



Note: Deviator stress corrected for area change and membrane effects. Mohr circles and their interpretation is not covered by BS1377. This is provided for information only.

Remarks:

Signed:

Monika Janoszek
PL Deputy Head of Geotechnical Section
for and on behalf of i2 Analytical Ltd

Date Reported: 13/03/2020

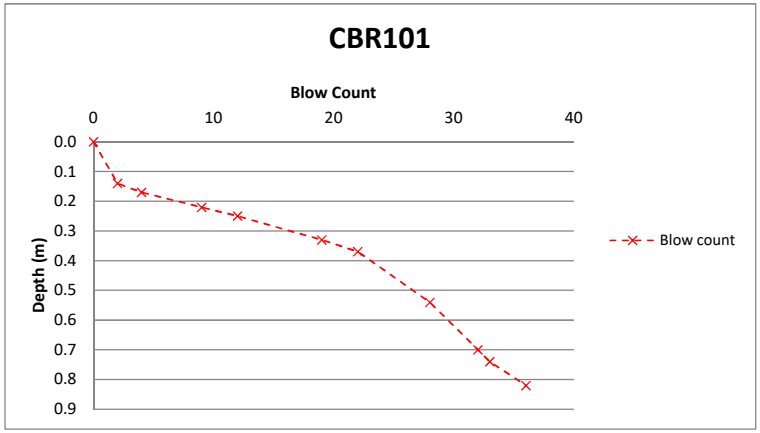
GF 184.10

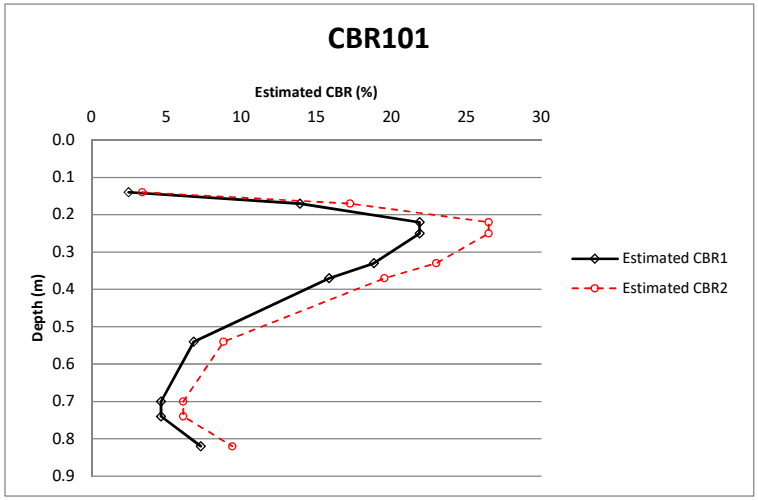
RESULTS OF DYNAMIC CONE PENETROMETER (DCP) TESTING

Project:	Acton Gardens
Project No.	073270
Test No.	CBR101

Date of Test:	19-Feb-20
Operator:	i2
Soil type:	Made ground
Soil condition:	Saturated

Blow count	Penetration (mm)	Penetration (m)	Penetration Index (DPI) mm/blow	Estimated CBR1 (%)[1]	Estimated CBR2 (%)[2]
0	0	0.000			
2	140	0.140	70.0	2	3
4	170	0.170	15.0	14	17
9	220	0.220	10.0	22	26
12	250	0.250	10.0	22	26
19	330	0.330	11.4	19	23
22	370	0.370	13.3	16	20
28	540	0.540	28.3	7	9
32	700	0.700	40.0	4.6	6.1
33	740	0.740	40.0	5	6
36	820	0.820	26.7	7	9
			22.8	9	11





Notes:

1. CBR calculated based on Webster et al, 1992.
2. CBR calculated based on DMRB, 2008.
3. CBR values less than 2.5% highlighted in red and bold. Soils unsuitable in pavements.

Reference: - Webster S, Grau R and Williams T. 1992. Description and Application of Dual Mass Dynamic Cone Penetrometer. Dept of Army Waterways Equipment Station, Instruction rpt GL-92-3.

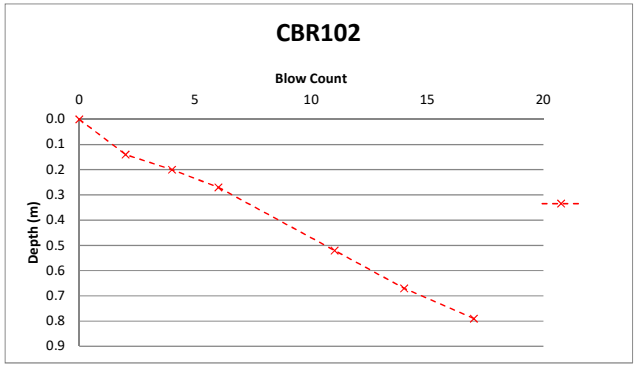
- Highways Agency, 2008. Design Manual for Roads and Bridges (DMRB), Data for Pavement Assessment. HD29/08.

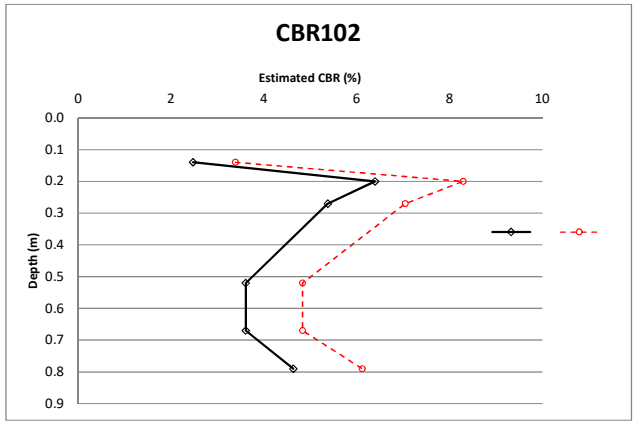
RESULTS OF DYNAMIC CONE PENETROMETER (DCP) TESTING

Project:	Acton Gardens
Project No.	073270
Test No.	CBR102

Date of Test:	19-Feb-20
Operator:	i2
Soil type:	Made ground
Soil condition:	Saturated

Blow count	Penetration (mm)	Penetration (m)	Penetration Index (DPI) mm/blow	Estimated CBR1 (%)[1]	Estimated CBR2 (%)[2]
0	0	0.000			
2	140	0.140	70.0	2	3
4	200	0.200	30.0	6	8
6	270	0.270	35.0	5	7
11	520	0.520	50.0	4	5
14	670	0.670	50.0	4	5
17	790	0.790	40.0	5	6
		0.000	46.5	4	5





Notes:

1. CBR calculated based on Webster et al, 1992.
2. CBR calculated based on DMRB, 2008.
3. CBR values less than 2.5% highlighted in red and bold. Soils unsuitable in pavements.

Reference:

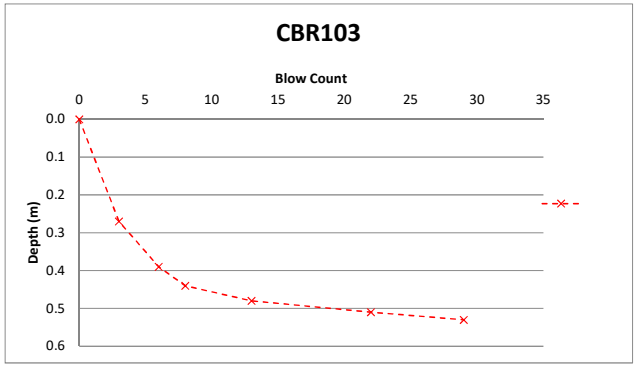
- Webster S, Grau R and Williams T. 1992. Description and Application of Dual Mass Dynamic Cone Penetrometer. Dept of Army Waterways Equipment Station, Instruction rpt GL-92-3.
- Highways Agency, 2008. Design Manual for Roads and Bridges (DMRB), Data for Pavement Assessment. HD29/08.

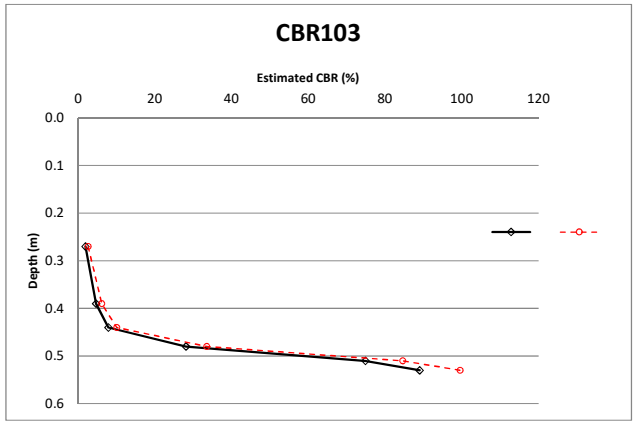
RESULTS OF DYNAMIC CONE PENETROMETER (DCP) TESTING

Project:	Acton Gardens
Project No.	073270
Test No.	CBR103

Date of Test:	19-Feb-20
Operator:	i2
Soil type:	Made ground
Soil condition:	Saturated

Blow count	Penetration (mm)	Penetration (m)	Penetration Index (DPI) mm/blow	Estimated CBR1 (%)[1]	Estimated CBR2 (%)[2]
0	0	0.000			
3	270	0.270	90.0	2	3
6	390	0.390	40.0	5	6
8	440	0.440	25.0	8	10
13	480	0.480	8.0	28	34
22	510	0.510	3.3	75	85
29	530	0.530	2.9	89	100
		0.000	18.3	11	14





Notes:

1. CBR calculated based on Webster et al, 1992.
2. CBR calculated based on DMRB, 2008.
3. CBR values less than 2.5% highlighted in red and bold. Soils unsuitable in pavements.

Reference:

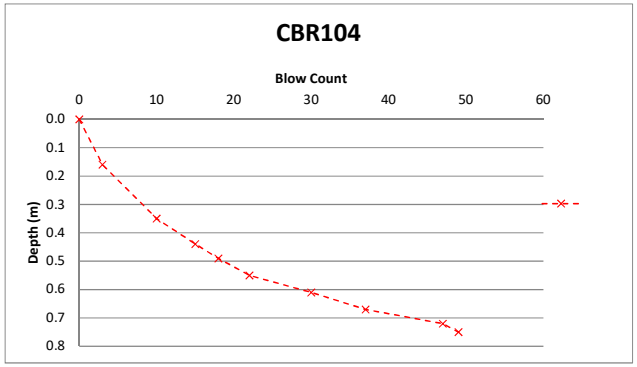
- Webster S, Grau R and Williams T. 1992. Description and Application of Dual Mass Dynamic Cone Penetrometer. Dept of Army Waterways Equipment Station, Instruction rpt GL-92-3.
- Highways Agency, 2008. Design Manual for Roads and Bridges (DMRB), Data for Pavement Assessment. HD29/08.

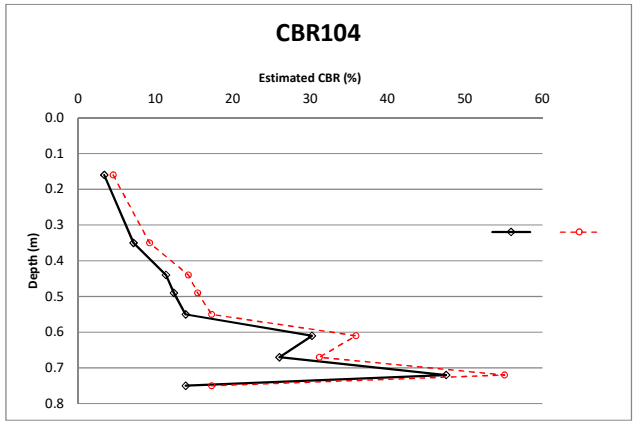
RESULTS OF DYNAMIC CONE PENETROMETER (DCP) TESTING

Project:	Acton Gardens
Project No.	073270
Test No.	CBR104

Date of Test:	19-Feb-20
Operator:	i2
Soil type:	Made ground
Soil condition:	Saturated

Blow count	Penetration (mm)	Penetration (m)	Penetration Index (DPI) mm/blow	Estimated CBR1 (%)[1]	Estimated CBR2 (%)[2]
0	0	0.000			
3	160	0.160	53.3	3	5
10	350	0.350	27.1	7	9
15	440	0.440	18.0	11	14
18	490	0.490	16.7	12	15
22	550	0.550	15.0	14	17
30	610	0.610	7.5	30	36
37	670	0.670	8.6	26	31
47	720	0.720	5.0	47.6	55.1
49	750	0.750	15.0	14	17
		0.000	15.3	14	17





Notes:

1. CBR calculated based on Webster et al, 1992.
2. CBR calculated based on DMRB, 2008.
3. CBR values less than 2.5% highlighted in red and bold. Soils unsuitable in pavements.

Reference:

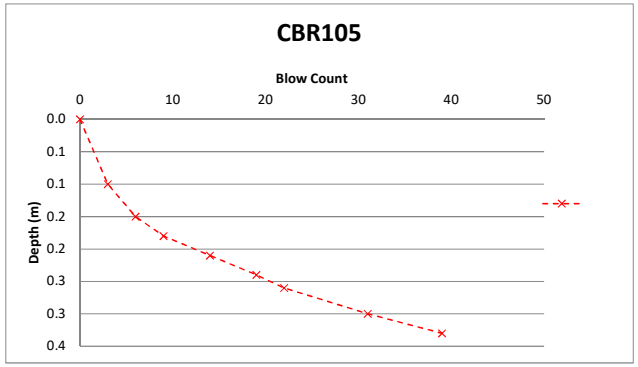
- Webster S, Grau R and Williams T. 1992. Description and Application of Dual Mass Dynamic Cone Penetrometer. Dept of Army Waterways Equipment Station, Instruction rpt GL-92-3.
- Highways Agency, 2008. Design Manual for Roads and Bridges (DMRB), Data for Pavement Assessment. HD29/08.

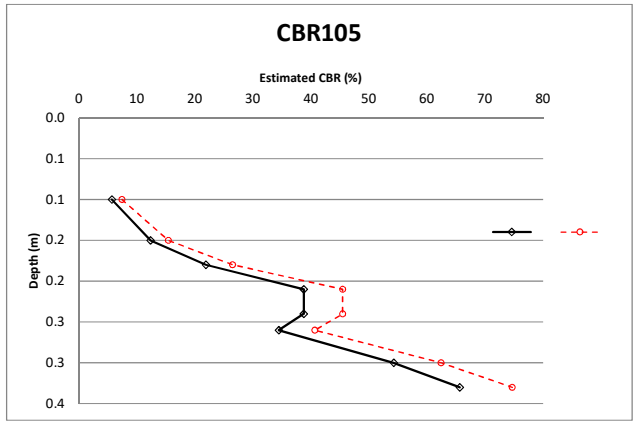
RESULTS OF DYNAMIC CONE PENETROMETER (DCP) TESTING

Project:	Acton Gardens
Project No.	073270
Test No.	CBR105

Date of Test:	19-Feb-20
Operator:	i2
Soil type:	Made ground
Soil condition:	Saturated

Blow count	Penetration (mm)	Penetration (m)	Penetration Index (DPI) mm/blow	Estimated CBR1 (%)[1]	Estimated CBR2 (%)[2]
0	0	0.000			
3	100	0.100	33.3	6	7
6	150	0.150	16.7	12	15
9	180	0.180	10.0	22	26
14	210	0.210	6.0	39	45
19	240	0.240	6.0	39	45
22	260	0.260	6.7	34	41
31	300	0.300	4.4	54	62
39	330	0.330	3.8	65.6	74.7
		0.000	8.5	26	32





Notes:

1. CBR calculated based on Webster et al, 1992.
2. CBR calculated based on DMRB, 2008.
3. CBR values less than 2.5% highlighted in red and bold. Soils unsuitable in pavements.

Reference:

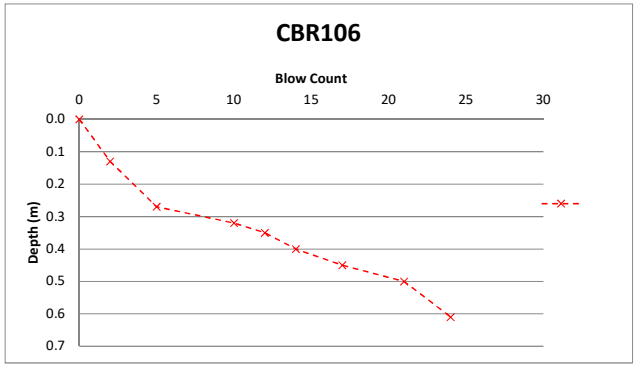
- Webster S, Grau R and Williams T. 1992. Description and Application of Dual Mass Dynamic Cone Penetrometer. Dept of Army Waterways Equipment Station, Instruction rpt GL-92-3.
- Highways Agency, 2008. Design Manual for Roads and Bridges (DMRB), Data for Pavement Assessment. HD29/08.

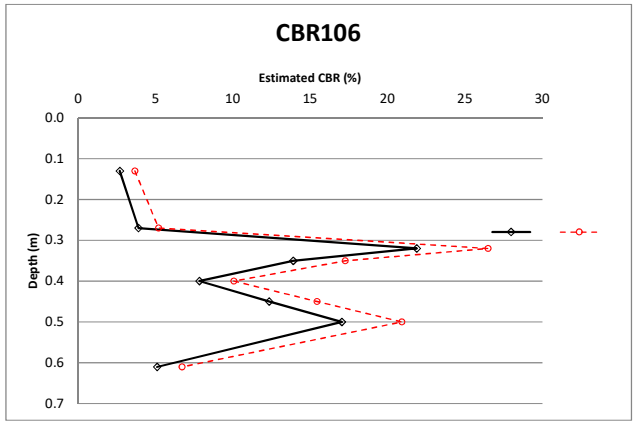
RESULTS OF DYNAMIC CONE PENETROMETER (DCP) TESTING

Project:	Acton Gardens
Project No.	073270
Test No.	CBR106

Date of Test:	19-Feb-20
Operator:	i2
Soil type:	Made ground
Soil condition:	Saturated

Blow count	Penetration (mm)	Penetration (m)	Penetration Index (DPI) mm/blow	Estimated CBR1 (%)[1]	Estimated CBR2 (%)[2]
0	0	0.000			
2	130	0.130	65.0	3	4
5	270	0.270	46.7	4	5
10	320	0.320	10.0	22	26
12	350	0.350	15.0	14	17
14	400	0.400	25.0	8	10
17	450	0.450	16.7	12	15
21	500	0.500	12.5	17	21
24	610	0.610	36.7	5.1	6.7
		0.000	25.4	8	10





Notes:

1. CBR calculated based on Webster et al, 1992.
2. CBR calculated based on DMRB, 2008.
3. CBR values less than 2.5% highlighted in red and bold. Soils unsuitable in pavements.

Reference:

- Webster S, Grau R and Williams T. 1992. Description and Application of Dual Mass Dynamic Cone Penetrometer. Dept of Army Waterways Equipment Station, Instruction rpt GL-92-3.
- Highways Agency, 2008. Design Manual for Roads and Bridges (DMRB), Data for Pavement Assessment. HD29/08.

Curtins
Unit 5/6, Compton Courtyard , 40 Compton Street, EV1C 0BD
Tel: 0207 324 2240

GAS MONITORING LOG SHEET

Project:	Acton Gardens	**Date:**	13/03/2020
Job Number:	73270	**Visit:**	1
Client:	Countryside Properties	**Weather:**	Partly overcast with sunny spells
Barometric State:	Rising	**Ground Conditions:**	Dry

Borehole Reference	Barometric Pressure mb	Flow l/hr		Methane %		Carbon Dioxide %		Oxygen %	Hydrogen Sulphide ppm	Carbon Monoxide ppm	Water Depth m bgl	Water Level m AOD	Note
		Max	SS	Max	SS	Max	SS						
WS102	1015	0.0	0.0	0.0	0.0	0.0	0.0	20.5	0	0	Dry	-	
WS104	-	-	-	-	-	-	-	-	-	-	-	-	1
WS106	1014	0.0	0.0	0.0	0.0	0.0	0.0	20.5	0	0	1.73	17.94	
WS107	1014	97.0	0.0	0.0	0.0	0.0	0.0	20.3	0	0	1.84	16.91	
WS108	1014	0.0	0.0	0.0	0.0	0.0	0.0	20.5	0	0	0.94	16.35	
CP103	1014	0.0	0.0	0.0	0.0	0.0	0.0	20.4	0	0	1.41	16.59	
CP104	1014	0.0	0.0	0.0	0.0	0.0	0.0	20.4	0	0	1.05	18.01	
CP105	1015	0.0	0.0	0.0	0.0	0.0	0.0	20.4	0	0	1.73	14.94	

Notes

1 **No access to the monitoring well due to flytipped material.**

Logged by

MW

1% gas volume = 10,000 ppm

Flow rate, methane and carbon dioxide reported as 'maximum' (max) and 'steady state' (SS) readings.

All other gases recorded at 'steady state' unless otherwise stated

Curtins
Unit 5/6, Compton Courtyard , 40 Compton Street, EV1C 0BD
Tel: 0207 324 2240

GAS MONITORING LOG SHEET

Project:	Acton Gardens	**Date:**	23/04/2020
Job Number:	73270	**Visit:**	2
Client:	Countryside	**Weather:**	Sunny
Barometric State:	Falling	**Ground Conditions:**	Dry

Borehole Reference	Barometric Pressure mb	Flow l/hr		Methane %		Carbon Dioxide %		Oxygen %	Hydrogen Sulphide ppm	Carbon Monoxide ppm	Water Depth m bgl	Water Level m AOD	Note
		Max	SS	Max	SS	Max	SS						
WS102	1019	0.0	0.0	0.0	0.0	3.5	3.5	16.5	0	0	Dry	-	
WS104	-	-	-	-	-	-	-	-	-	-	-	-	1
WS106	1017	0.0	0.0	0.0	0.0	1.1	1.1	20.2	0	0	1.50	18.17	
WS107	1017	0.0	0.0	0.0	0.0	4.9	4.9	14.1	0	0	1.80	16.95	
WS108	1016	0.0	0.0	0.0	0.0	3.8	3.8	17.6	0	0	1.35	15.94	
CP103	1017	0.0	0.0	0.0	0.0	0.9	0.9	20.4	0	0	1.60	16.40	
CP104	1016	0.0	0.0	0.0	0.0	2.1	2.1	19.9	0	0	1.30	17.80	
CP105	1016	0.0	0.0	0.0	0.0	2.1	2.1	14.9	0	0	2.14	14.53	

Notes

1 **No access to the monitoring well due to flytipped material.**

Logged by

WS

1% gas volume = 10,000 ppm
Flow rate, methane and carbon dioxide reported as 'maximum' (max) and 'steady state' (SS) readings.
All other gases recorded at 'steady state' unless otherwise stated

Curtins
Unit 5/6, Compton Courtyard , 40 Compton Street, EV1C 0BD
Tel: 0207 324 2240

GAS MONITORING LOG SHEET

Project:	Acton Gardens	**Date:**	05/05/2020
Job Number:	73270	**Visit:**	3
Client:	Countryside Properties	**Weather:**	Sunny
Barometric State:	Rising	**Ground Conditions:**	Dry

Borehole Reference	Barometric Pressure mb	Flow l/hr		Methane %		Carbon Dioxide %		Oxygen %	Hydrogen Sulphide ppm	Carbon Monoxide ppm	Water Depth m bgl	Water Level m AOD	Note
		Max	SS	Max	SS	Max	SS						
WS102	1018	0.0	0.0	0.0	0.0	3.1	3.1	16.9	0	0	Dry	-	
WS104	1017	0.0	0.0	0.0	0.0	0.1	0.1	20.4	0	0	0.30	14.20	
WS106	1016	0.0	0.0	0.0	0.0	1.1	1.1	19.5	0	0	2.10	17.57	
WS107	1014	0.0	0.0	0.0	0.0	0.2	0.2	20.4	0	0	1.51	17.21	
WS108	-	-	-	-	-	-	-	-	-	-	-	-	1
CP103	1016	0.0	0.0	0.0	0.0	0.9	0.9	18.1	0	0	1.41	16.46	
CP104	1015	0.0	0.0	0.0	0.0	1.1	1.1	19.5	0	0	1.33	17.73	
CP105	1016	0.0	0.0	0.0	0.0	2.4	2.4	15.5	0	0	2.02	14.65	

Notes

1 **No access to the monitoring well due to parked vehicle**

Logged by

WS

1% gas volume = 10,000 ppm

Flow rate, methane and carbon dioxide reported as 'maximum' (max) and 'steady state' (SS) readings.

All other gases recorded at 'steady state' unless otherwise stated

Appendix E Tier 1 Screening Criteria

- Curtins Tier 1 Thresholds.

Adopted Soil Generic Assessment Criteria
Sandy loam with 6% SOM

curtins

Contaminants	Residential with home grown produce	Residential without home grown produce	Allotments	Commercial	Public open space near residential housing POS_{resi}	Public park POS_{park}
Metals						
Beryllium	*1.7*	*1.7*	*35*	*12*	*2.2*	*63*
Boron	*290*	*11,000*	*45*	*240,000*	*21,000*	*46,000*
Cadmium	**10**[13] 22	**85**[13] 150	**1.8** 3.9	**230** 410	*120* 220	*560* 880
Chromium III	*910*	*910*	*18,000*	*8,600*	*1,500*	*33,000*
Chromium VI	*6* 21	*6* 21	*1.8* 170	*33* 49	*7.7* 21	*220* 250
Lead	200	310	80	2,300	630	1,300
Mercury *(elemental)*	**1**	**1**	**26**	**26**	*16*	**26**[8] [*30*]
Mercury (inorganic)	**170**	**240**	**80**	**3600**	*120*	*240*
Nickel	*130*[10]	*180*[10]	*53*[11]	*980*[10]	*230*	*800*
Vanadium	*410*	*1200*	*91*	*9000*	*2000*	*5000*
Copper	*2400*	*7100*	*520*	*68000*	*12000*	*44000*
Zinc	*3700*	*40000*	*620*	*730000*	*81000*	*170000*
Semi-Metals and non-metals						
Arsenic	**32**[12] 37	**35**[12] 40	**43**[12] 49	**640**[12] 640	*79* 79	*170* 170
Antimony		***550***		***7500***	***1500***	***3300***
Selenium	**350**	**600**	**120**	**13000**	*1100*	*1800*
Inorganic chemicals						
Cyanide	34	34	34	34	34	34
Organic contaminants						
Aliphatic risk banded hydrocarbons - TPHCWG method						
$EC_{>5}$ - EC_6	*160*	*160*	*3900*	*12000*	*600000*	*180000*
$EC_{>6}$ - EC_8	*530*	*530*	*13000*	*40000*	*620000*	*320000*
$EC_{>8}$ - EC_{10}	*150*	*150*	*1700*	*11000*	*13000*	*21000*
EC_{10}-EC_{12}	*760*	*770*	*7300*	*47000*	*13000*	*24000*
EC_{12}-EC_{16}	*4300*	*4400*	*13000*	*90000*	*13000*	*26000*
$EC_{>16}$ - EC_{35}	*110000*	*110000*	*270000*	*1800000*	*250000*	*490000*
$EC>_{35}$ - EC_{44}	*110000*	*110000*	*270000*	*1800000*	*250000*	*490000*
Aromatic risk banded hydrocarbons - TPHCWG method						
$EC>_5$ - EC_7	*300*	*1400*	*57*	*86000*	*56000*	*92000*
$EC>_7$ - EC_8	*660*	*3900*	*120*	*180000*	*56000*	*100000*
$EC_{>8}$ - EC_{10}	*190*	*270*	*51*	*17000*	*5000*	*9300*
EC_{10} - EC_{12}	*380*	*1200*	*74*	*34000*	*5000*	*10000*
EC_{12} - EC_{16}	*660*	*2500*	*130*	*38000*	*5000*	*10000*
$EC_{>16}$ - EC_{21}	*930*	*1900*	*260*	*28000*	*3800*	*7800*
$EC_{>21}$ - EC_{35}	*1700*	*1900*	*1600*	*28000*	*3800*	*7900*
$EC>_{35}$ - EC_{44}	*1700*	*1900*	*1600*	*28000*	*3800*	*7900*
Aliph + Arom EC >44-70	*1900*	*1900*	*3000*	*28000*	3800	7900
Aromatic						
Benzene	**0.33** 0.87	**1.0** 3.3	**0.07** 0.18	**95** 98	*73* 140	*110* 230
Ethyl benzene	**350**	**840**	**90**	**2800**[8] [66000]	**2800**[8] [*25000*]	**2800**[8] [*27000*]
Toluene	**610**	**2700**	**120**	**4400**[8] [190000]	**4400**[8] [*56000*]	**4400**[8] [*100000*]
Xylene[9]	**230**	**290**	**160**	**2600**[8] [32000]	**2600**[8] [*43000*]	**2600**[8] [*31000*]
Phenol	**420**	**520**	**280**	**3200**[14] (38000)	**3200**[14] (*10000*)	**3200**[14] (*9300*)
Polycyclic Aromatic Hydrocarbons (PAH)						
Naphthalene	*13*	*13*	*24*	*1100*	*4900*	*3000*
Acenaphthylene	*920*	*6000*	*160*	*100000*	*15000*	*30000*
Acenaphthene	*1100*	*6000*	*200*	*100000*	*15000*	*30000*
Fluorene	*860*	*4500*	*160*	*71000*	*9900*	*20000*
Phenanthrene	*440*	*1500*	*90*	*23000*	*3100*	*6300*
Anthracene	*11000*	*37000*	*2200*	*540000*	*74000*	*150000*
Fluoranthene	*890*	*1600*	*290*	*23000*	*3100*	*6400*
Pyrene	*2000*	*3800*	*620*	*54000*	*7400*	*15000*
Benz(a)anthracene	*13*	*15*	*13*	*180*	*29*	*62*
Chrysene	*27*	*32*	*19*	*350*	*57*	*120*
Benzo(b)fluoranthene	*3.7*	*4.0*	*3.9*	*45*	*7.2*	*16.0*
Benzo(k)fluoranthene	*100*	*110*	*130*	*1200*	*190*	*440*
Benzo(a)pyrene	*3.0* 5.0	*3.2* 5.3	*3.5* 5.7	*36* 77	*5.7* 10	*13* 21
Indeno(123cd)pyrene	*41*	*46*	*39*	*510*	*82*	*180*
Dibenzo(ah)anthracene	*0.3*	*0.32*	*0.43*	*3.6*	*0.58*	*1.4*
Benzo(ghi)perylene	*350*	*360*	*640*	*4000*	*640*	*1600*
Chlorinated Aliphatic Hydrocarbons						
Vinyl chloride	*0.0014*	*0.0015*	*0.0018*	*0.12*	*3.5*	*5.4*
Trichloroethene (TCE)	*0.075*	*0.08*	*0.21*	*5.7*	*120*	*120*
1,1,1,2 Tetrachlorethane	*6.4*	*8.2*	*4.4*	*560*	*1400*	*2100*
Tetrachlorethene (PCE)	*0.90*	*0.92*	*3.6*	*95*	*1400*	*1500*
1,1,1 Trichlorethane	*39*	*40*	*240*	*3000*	*140000*	*100000*

Notes

1. All values above are in mg/kg
2. **Numbers in bold are SGVs or GAC that are derived based on SGV report input parameters**, *numbers in italics are S4ULs*, ***numbers in bold-italics are based on EIC/AGS/CL:AIRE numbers & input parameters*** and underlined numbers are C4SLs
3. Soil organic matter (SOM) is assumed to be 6% - DEFAULT VALUE
4. Soil type is assumed to be sandy loam - DEFAULT SOIL TYPE
5. For residential, the building type is conservatively assumed to be a small terrace house where the development includes bungalows change to more conservative bungalow setting in computer model
6. For commercial, the building type is conservatively assumed to be a pre 1970s office building, where the proposed development comprises houses, flat with living spaces changes setting in model accordingly
7. For classrooms consider increasing the dust loading fator in the 'Soil and Building Data' of the CLEA 1.04 model from 50 to 100µg m^{-3}
8. Based on vapour saturation limt as suggested by EA / [ ] model value
9. Lowest of o-, m- and p-xylene
10. Based on comparison of inhalation exposure with inhalation TDI
11. Based on comparison of oral, dermal, and inhalation exposure with the oral TDI
12. Based on a comparison of oral and dermal soil exposure with oral Index Dose only
13. Averaged over and based on lifetime exposure
14. Based on critical concentration for skin irritation in humans arising from contact with phenol in aqueous solution (number in brackets based on health effects following long term exposure for illustration)
15. NA: Not applicable

Adopted Soil Generic Assessment Criteria
Sandy loam with 2.5% SOM

curtins

Contaminants	Residential with home grown produce	Residential without home grown produce	Allotments	Commercial	Public open space near residential housing POS_{resi}	Public park POS_{park}
Metals						
Beryllium	*1.7*	*1.7*	*35*	*12*	*2.2*	*63*
Boron	*290*	*11,000*	*45*	*240,000*	*21,000*	*46,000*
Cadmium	**10**[13] 22	**85**[13] 150	**1.8** 3.9	**230** 410	*120* 220	*560* 880
Chromium III	*910*	*910*	*18,000*	*8,600*	*1,500*	*33,000*
Chromium VI	*6* 21	*6* 21	*1.8* 170	*33* 49	*7.7* 21	*220* 250
Lead	200	310	80	2,300	630	1,300
Mercury *(elemental)*	**1**	**1**	**26**	**26**	*16*	**26**[8] [*30*]
Mercury (inorganic)	**170**	**240**	**80**	**3600**	*120*	*240*
Nickel	*130*[10]	*180*[10]	*53*[11]	*980*[10]	*230*	*800*
Vanadium	*410*	*1200*	*91*	*9000*	*2000*	*5000*
Copper	*2400*	*7100*	*520*	*68000*	*12000*	*44000*
Zinc	*3700*	*40000*	*620*	*730000*	*81000*	*170000*
Semi-Metals and non-metals						
Arsenic	**32**[12] 37	**35**[12] 40	**43**[12] 49	**640**[12] 640	*79* 79	*170* 170
Antimony		***550***		***7500***	***1500***	***3300***
Selenium	**350**	**600**	**120**	**13000**	*1100*	*1800*
Inorganic chemicals						
Cyanide	34	34	34	34	34	34
Organic contaminants						
Aliphatic risk banded hydrocarbons - TPHCWG method						
$EC_{>5}$ - EC_6	*78*	*78*	*1700*	*5900*	*590000*	*130000*
$EC_{>6}$ - EC_8	*230*	*230*	*5600*	*17000*	*610000*	*220000*
$EC_{>8}$ - EC_{10}	*65*	*65*	*770*	*4800*	*13000*	*18000*
EC_{10}-EC_{12}	*330*	*330*	*4400*	*23000*	*13000*	*23000*
EC_{12}-EC_{16}	*2400*	*2400*	*13000*	*82000*	*13000*	*25000*
$EC_{>16}$ - EC_{35}	*92000*	*92000*	*270000*	*1700000*	*250000*	*480000*
$EC>_{35}$ - EC_{44}	*92000*	*92000*	*270000*	*1700000*	*250000*	*480000*
Aromatic risk banded hydrocarbons - TPHCWG method						
$EC>_5$ - EC_7	*140*	*690*	*27*	*46000*	*56000*	*84000*
$EC>_7$ - EC_8	*290*	*1800*	*51*	*110000*	*56000*	*95000*
$EC_{>8}$ - EC_{10}	*83*	*110*	*21*	*8100*	*5000*	*8500*
EC_{10} - EC_{12}	*180*	*590*	*31*	*28000*	*5000*	*9700*
EC_{12} - EC_{16}	*330*	*2300*	*57*	*37000*	*5100*	*10000*
$EC_{>16}$ - EC_{21}	*540*	*1900*	*110*	*28000*	*3800*	*7700*
$EC_{>21}$ - EC_{35}	*1500*	*1900*	*820*	*28000*	*3800*	*7800*
$EC>_{35}$ - EC_{44}	*1500*	*1900*	*820*	*28000*	*3800*	*7800*
Aliph + Arom EC >44-70	*1800*	*1900*	*2100*	*28000*	3800	7800
Aromatic						
Benzene	**0.16**	**0.49**	**0.035**	**50**	*72*	*100*
Ethyl benzene	**150**	**380**	**39**	**1200**[8] [35000]	**1200**[8] [*24000*]	**1200**[8] [*22000*]
Toluene	**270**	**1300**	**51**	**1900**[8] [110000]	**1900**[8] [*56000*]	**1900**[8] [*95000*]
Xylene[9]	**98**	**120**	**70**	**1200**[8] [14000]	**1200**[8] [*42000*]	**1200**[8] [*23000*]
Phenol	**290**	**420**	**140**	**1500**[14] (35000)	**1500**[14] (*10000*)	**1500**[14] (*8300*)
Polycyclic Aromatic Hydrocarbons (PAH)						
Naphthalene	*5.6*	*5.6*	*10*	*460*	*4900*	*1900*
Acenaphthylene	*420*	*4600*	*69*	*97000*	*15000*	*30000*
Acenaphthene	*510*	*4700*	*85*	*97000*	*15000*	*30000*
Fluorene	*400*	*3800*	*67*	*68000*	*9900*	*20000*
Phenanthrene	*220*	*1500*	*38*	*22000*	*3100*	*6200*
Anthracene	*5400*	*35000*	*950*	*540000*	*74000*	*150000*
Fluoranthene	*560*	*1600*	*130*	*23000*	*3100*	*6300*
Pyrene	*1200*	*3800*	*270*	*54000*	*7400*	*15000*
Benz(a)anthracene	*11*	*14*	*6.5*	*170*	*29*	*56*
Chrysene	*22*	*31*	*9.4*	*350*	*57*	*110*
Benzo(b)fluoranthene	*3.3*	*4.0*	*2.1*	*44*	*7.2*	*15*
Benzo(k)fluoranthene	*93*	*110*	*75*	*1200*	*190*	*410*
Benzo(a)pyrene	*2.7*	*3.2*	*2*	*35*	*5.7*	*12*
Indeno(123cd)pyrene	*36*	*46*	*21*	*510*	*82*	*170*
Dibenzo(ah)anthracene	*0.28*	*0.32*	*0.27*	*3.6*	*0.57*	*1.3*
Benzo(ghi)perylene	*340*	*360*	*470*	*4000*	*640*	*1500*
Chlorinated Aliphatic Hydrocarbons						
Vinyl chloride	*0.00087*	*0.001*	*0.001*	*0.077*	*3.5*	*5*
Trichloroethene (TCE)	*0.034*	*0.036*	*0.091*	*2.6*	*120*	*91*
1,1,1,2 Tetrachlorethane	*2.8*	*3.5*	*1.9*	*250*	*1400*	*1800*
Tetrachlorethene (PCE)	*0.39*	*0.4*	*1.5*	*42*	*1400*	*1100*
1,1,1 Trichlorethane	*18*	*18*	*110*	*1300*	*140000*	*76000*

Notes

1. All values above are in mg/kg
2. **Numbers in bold are SGVs or GAC that are derived based on SGV report input parameters**, *numbers in italics are S4ULs*, ***numbers in bold-italics are based on EIC/AGS/CL:AIRE numbers & input parameters*** and underlined numbers are C4SLs
3. Soil organic matter (SOM) is assumed to be 2.5% - DEFAULT VALUE
4. Soil type is assumed to be sandy loam - DEFAULT SOIL TYPE
5. For residential, the building type is conservatively assumed to be a small terrace house where the development includes bungalows change to more conservative bungalow setting in computer model
6. For commercial, the building type is conservatively assumed to be a pre 1970s office building, where the proposed development comprises houses, flat with living spaces changes setting in model accordingly
7. For classrooms consider increasing the dust loading fator in the 'Soil and Building Data' of the CLEA 1.04 model from 50 to 100µg m^{-3}
8. Based on vapour saturation limt as suggested by EA / [ ] model value
9. Lowest of o-, m- and p-xylene
10. Based on comparison of inhalation exposure with inhalation TDI
11. Based on comparison of oral, dermal, and inhalation exposure with the oral TDI
12. Based on a comparison of oral and dermal soil exposure with oral Index Dose only
13. Averaged over and based on lifetime exposure
14. Based on critical concentration for skin irritation in humans arising from contact with phenol in aqueous solution (number in brackets based on health effects following long term exposure for illustration)
15. NA: Not applicable

Adopted Soil Generic Assessment Criteria
Sandy loam with 1% SOM

curtins

Contaminants	Residential with home grown produce	Residential without home grown produce	Allotments	Commercial	Public open space near residential housing POS_{resi}	Public park POS_{park}
Metals						
Beryllium	*1.7*	*1.7*	*35*	*12*	*2.2*	*63*
Boron	*290*	*11,000*	*45*	*240,000*	*21,000*	*46,000*
Cadmium	**10**[13] 22	**85**[13] 150	**1.8** 3.9	**230** 410	*120* 220	*560* 880
Chromium III	*910*	*910*	*18,000*	*8,600*	*1,500*	*33,000*
Chromium VI	*6* 21	*6* 21	*1.8* 170	*33* 49	*7.7* 21	*220* 250
Lead	200	310	80	2,300	630	1,300
Mercury *(elemental)*	**1**	**1**	**26**	**26**	*16*	**26**[8] *[30]*
Mercury (inorganic)	**170**	**240**	**80**	**3600**	*120*	*240*
Nickel	*130*[10]	*180*[10]	*53*[11]	*980*[10]	*230*	*800*
Vanadium	*410*	*1200*	*91*	*9000*	*2000*	*5000*
Copper	*2400*	*7100*	*520*	*68000*	*12000*	*44000*
Zinc	*3700*	*40000*	*620*	*730000*	*81000*	*170000*
Semi-Metals and non-metals						
Arsenic	**32**[12] 37	**35**[12] 40	**43**[12] 49	**640**[12] 640	*79* 79	*170* 170
Antimony		***550***		***7500***	***1500***	***3300***
Selenium	**350**	**600**	**120**	**13000**	*1100*	*1800*
Inorganic chemicals						
Cyanide	34	34	34	34	34	34
Organic contaminants						
Aliphatic risk banded hydrocarbons - TPHCWG method						
$EC_{>5}$ - EC_6	*42*	*42*	*730*	*3200*	*570000*	*95000*
$EC_{>6}$ - EC_8	*100*	*100*	*2300*	*7800*	*600000*	*150000*
$EC_{>8}$ - EC_{10}	*27*	*27*	*320*	*2000*	*13000*	*14000*
EC_{10}-EC_{12}	*130*	*130*	*2200*	*9700*	*13000*	*21000*
EC_{12}-EC_{16}	*1100*	*1100*	*11000*	*59000*	*13000*	*25000*
$EC_{>16}$ - EC_{35}	*65000*	*65000*	*260000*	*1600000*	*250000*	*450000*
$EC>_{35}$ - EC_{44}	*65000*	*65000*	*260000*	*1600000*	*250000*	*450000*
Aromatic risk banded hydrocarbons - TPHCWG method						
$EC>_5$ - EC_7	*70*	*370*	*13*	*26000*	*56000*	*76000*
$EC>_7$ - EC_8	*130*	*860*	*22*	*56000*	*56000*	*87000*
$EC_{>8}$ - EC_{10}	*34*	*47*	*8.6*	*3500*	*5000*	*7200*
EC_{10} - EC_{12}	*74*	*250*	*13*	*16000*	*5000*	*9200*
EC_{12} - EC_{16}	*140*	*1800*	*23*	*36000*	*5100*	*10000*
$EC_{>16}$ - EC_{21}	*260*	*1900*	*46*	*28000*	*3800*	*7600*
$EC_{>21}$ - EC_{35}	*1100*	*1900*	*370*	*28000*	*3800*	*7800*
$EC>_{35}$ - EC_{44}	*1100*	*1900*	*370*	*28000*	*3800*	*7800*
Aliph + Arom EC >44-70	*1600*	*1900*	*1200*	*28000*	3800	7800
Aromatic						
Benzene	**0.08**	**0.3**	**0.017**	**28**	*72*	*90*
Ethyl benzene	**65**	**170**	**16**	**520**[8] [17000]	**520**[8] *[24000]*	**520**[8] *[17000]*
Toluene	**120**	**610**	**22**	**860**[8] [59000]	**860**[8] *[56000]*	**860**[8] *[87000]*
Xylene[9]	**41**	**53**	**28**	**480**[8] [69000]	**480**[8] *[41000]*	**480**[8] *[17000]*
Phenol	**180**	**310**	**66**	**760**[14] (31000)	**760**[14] *(10000)*	**760**[14] *(7600)*
Polycyclic Aromatic Hydrocarbons (PAH)						
Naphthalene	*2.3*	*2.3*	*4.1*	*190*	*4900*	*1200*
Acenaphthylene	*170*	*2900*	*28*	*83000*	*15000*	*29000*
Acenaphthene	*210*	*3000*	*34*	*84000*	*15000*	*29000*
Fluorene	*170*	*2800*	*27*	*63000*	*9900*	*20000*
Phenanthrene	*95*	*1300*	*15*	*22000*	*3100*	*6200*
Anthracene	*2400*	*31000*	*380*	*520000*	*74000*	*150000*
Fluoranthene	*280*	*1500*	*52*	*23000*	*3100*	*6300*
Pyrene	*620*	*3700*	*110*	*54000*	*7400*	*15000*
Benz(a)anthracene	*7.2*	*11*	*2.9*	*170*	*29*	*49*
Chrysene	*15*	*30*	*4.1*	*350*	*57*	*93*
Benzo(b)fluoranthene	*2.6*	*3.9*	*0.99*	*44*	*7.1*	*13*
Benzo(k)fluoranthene	*77*	*110*	*37*	*1200*	*190*	*370*
Benzo(a)pyrene	*2.2*	*3.2*	*0.97*	*35*	*5.7*	*11*
Indeno(123cd)pyrene	*27*	*45*	*9.5*	*500*	*82*	*150*
Dibenzo(ah)anthracene	*0.24*	*0.31*	*0.14*	*3.5*	*0.57*	*1.1*
Benzo(ghi)perylene	*320*	*360*	*290*	*3900*	*640*	*1400*
Chlorinated Aliphatic Hydrocarbons						
Vinyl chloride	*0.00064*	*0.00077*	*0.00055*	*0.059*	*3.5*	*4.8*
Trichloroethene (TCE)	*0.016*	*0.017*	*0.041*	*1.2*	*120*	*70*
1,1,1,2 Tetrachlorethane	*1.2*	*1.5*	*0.79*	*110*	*1400*	*1500*
Tetrachlorethene (PCE)	*0.18*	*0.18*	*0.65*	*19*	*1400*	*810*
1,1,1 Trichlorethane	*8.8*	*9*	*48*	*660*	*140000*	*57000*

Notes

1. All values above are in mg/kg
2. **Numbers in bold are SGVs or GAC that are derived based on SGV report input parameters**, *numbers in italics are S4ULs*, ***numbers in bold-italics are based on EIC/AGS/CL:AIRE numbers & input parameters*** and underlined numbers are C4SLs
3. Soil organic matter (SOM) is assumed to be 1% - DEFAULT VALUE
4. Soil type is assumed to be sandy loam - DEFAULT SOIL TYPE
5. For residential, the building type is conservatively assumed to be a small terrace house where the development includes bungalows change to more conservative bungalow setting in computer model
6. For commercial, the building type is conservatively assumed to be a pre 1970s office building, where the proposed development comprises houses, flat with living spaces changes setting in model accordingly
7. For classrooms consider increasing the dust loading fator in the 'Soil and Building Data' of the CLEA 1.04 model from 50 to 100µg m^{-3}
8. Based on vapour saturation limt as suggested by EA / [ ] model value
9. Lowest of o-, m- and p-xylene
10. Based on comparison of inhalation exposure with inhalation TDI
11. Based on comparison of oral, dermal, and inhalation exposure with the oral TDI
12. Based on a comparison of oral and dermal soil exposure with oral Index Dose only
13. Averaged over and based on lifetime exposure
14. Based on critical concentration for skin irritation in humans arising from contact with phenol in aqueous solution (number in brackets based on health effects following long term exposure for illustration)
15. NA: Not applicable

Appendix F Risk Assessment Rationale

The site-specific qualitative risk assessment of environmental harm, as detailed in Section 3.0 of this reporting, is summarised in the table presented hereafter; the principle being to establish connecting links between a hazardous source to a potential receptor via an exposure pathway.

The assessment corresponds with the total site area.

Risk assessment is the process of collating known information on a hazard or set of hazards in order to estimate actual or potential risk to receptors. The receptor may be humans, a water resource, a sensitive local ecosystem or future construction materials. Receptors can be connected to the hazardous source by one or several exposure pathways such as direct contact for example. Risks are generally managed by isolating the receptor or intercepting the exposure pathway or by isolating or removing the hazard.

Without the three essential components of a source, pathway and receptor there can be no risk. Therefore the presence of hazard on a site does not necessarily mean there is a risk.

By considering where a viable pathway exists which connects a source with a receptor the risk assessment in Section 3.0 and 8.0 and the table presented hereafter identifies where pollutant linkage exists. If there is no pollutant linkage there is no risk and only where a pollutant linkage is established does the risk assessment consider the level of risk.

The risk assessment considers the likelihood of a particular event taking place (accounting for the presence of the hazard and receptor and the integrity of the exposure pathway) in conjunction with the severity of the potential consequence (accounting for the potential severity of the hazard and the sensitivity of the receptor).

In the risk assessment the consequence of the hazard has been classified as severe or medium or mild or minor and the probability (likelihood) of the circumstances actually occurring classified as high likelihood or likely or low likelihood or unlikely.

The consequences and probabilities are subsequently cross-correlated to give a qualitative estimation of the risk using Department of the Environment risk classifications as detailed in the table below and as referenced in CIRIA C552.

		Consequence			
		Severe	**Medium**	**Mild**	**Minor**
Probability (Likelihood)	**High Likelihood**	Very High Risk	High Risk	Moderate Risk	Negligible Risk
	Likely	High Risk	Moderate Risk	Moderate/Low Risk	Negligible Risk
	Low Likelihood	Moderate Risk	Moderate/Low Risk	Low Risk	Negligible Risk
	Unlikely	Moderate/Low Risk	Low Risk	Negligible Risk	Negligible Risk

In accordance with DoE guidance, the following categorisation of **consequence** has been developed.

Classification	Definition	Examples
Severe	Short-term (acute) risk to human health likely to result in "significant harm" as defined by the Environment Protection Act 1990, Part IIA. Short-term risk of pollution of sensitive water resource. Catastrophic damage to buildings/property. A short-term risk to a particular ecosystem or organisation forming part of such ecosystem.	High concentrations of cyanide on the surface of an informal recreation area. Major spillage of contaminants from site into controlled water. Explosion, causing building collapse (can also equate to a short-term human health risk if buildings are occupied).
Medium	Chronic damage to Human Health. Pollution of sensitive water resources. A significant change in a particular ecosystem or organism forming part of such ecosystem.	Concentration of a contaminant from site exceeds the generic or site-specific assessment criteria. Leaching of contaminants from a site to a Principal or Secondary A aquifer. Death of a species within a designated nature reserve. Lesser toxic and asphyxiate effects
Mild	Pollution of non-sensitive water resources. Significant damage to crops, buildings, structures and services. Damage to sensitive buildings/structures/services or the environment.	Pollution of non-classified groundwater (inc. Secondary B aquifers). Damage to building rendering it unsafe to occupy (e.g. foundation damage resulting in instability).
Minor	Harm, although not necessarily significant harm, which may result in a financial loss or expenditure to resolve. Non-permanent health effects to human health (easily prevented by means such as personal protective clothing, etc). Easily repairable effects of damage to buildings, structures and services.	The presence of contaminants at such concentrations that protective equipment is required during site works. The loss of plants in a landscaping scheme. Discoloration of concrete.

In accordance with DoE guidance, the following categorisation of **probability** has been developed.

Classification	Definition
High Likelihood	There is a pollution linkage and an event that either appears very likely in the short term and almost inevitable over the long term or there is evidence at the receptor of harm or pollution.
Likely	There is a pollution linkage and all the elements are present and in the right place, which means that it is probable that an event will occur. Circumstances are such that an event is not inevitable, but possible in the short term and likely over the long term.
Low Likelihood	There is a pollution linkage and circumstances are possible under which an event could occur. However, it is by no means certain that even over a longer period such event would take place, and is less likely in the shorter term.
Unlikely	There is a pollution linkage but circumstances are such that it is improbable that an event would occur even in the very long term.

In accordance with DoE guidance, the following categorisation of **risk** has been developed.

Classification	Definition
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 further action.
High Risk	*Harm* is *likely to arise* to a designated receptor from an identified hazard at the site without appropriate further action.
Moderate Risk	*It is possible* that without appropriate further 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.

The term ‘risk’ in this instance refers to the risk that the source, pathway, receptor linkage for a given source of contamination is complete. It does not refer to immediate risk to individuals or features present on the site from potential contaminants and is intended to be used as a tool to assess the necessity of further investigation.

Our Locations

Birmingham
2 The Wharf
Bridge Street
Birmingham
B1 2JS
T. 0121 643 4694
birmingham@curtins.com

Bristol
Quayside
40-58 Hotwell Road
Bristol
BS8 4UQ
T. 0117 302 7560
bristol@curtins.com

Cambridge
50 Cambridge Place
Cambridge
CB2 1NS
T. 01223 631 799
cambridge@curtins.com

Cardiff
3 Cwrt-y-Parc
Earlswood Road
Cardiff
CF14 5GH
T. 029 2068 0900
cardiff@curtins.com

Douglas
Varley House
29-31 Duke Street
Douglas
Isle of Man
IM1 2AZ
T. 01624 624 585
douglas@curtins.com

Dublin
39 Fitzwilliam Square
Dublin 2
Ireland
T. 00353 1 507 9447
dublin@curtins.com

Edinburgh
1a Belford Road
Edinburgh
EH4 3BL
T. 0131 225 2175
edinburgh@curtins.com

Glasgow
Queens House
29 St Vincent Place
Glasgow
G1 2DT
T. 0141 319 8777
glasgow@curtins.com

Kendal
28 Lowther Street
Kendal
Cumbria
LA9 4DH
T. 01539 724 823
kendal@curtins.com

Leeds
Rose Wharf
Ground Floor
Leeds
LS9 8EE
T. 0113 274 8509
leeds@curtins.com

Liverpool
51-55 Tithebarn Street
Liverpool
L2 2SB
T. 0151 726 2000
liverpool@curtins.com

London
40 Compton Street
London
EC1V 0BD
T. 020 7324 2240
london@curtins.com

Manchester
Merchant Exchange
17-19 Whitworth Street West
Manchester
M1 5WG
T. 0161 236 2394
manchester@curtins.com

Nottingham
56 The Ropewalk
Nottingham
NG1 5DW
T. 0115 941 5551
nottingham@curtins.com