



Main Investigation Report

at

Cinders Nursery, Cinders Lane, Yapton, West Sussex BN18 0JJ

for

Crayfern Homes

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Prepared by

S J Bevins BSc. (Hons) MSc. CEng, CEnv, MIMMM, FGS
(sb@soilslimited.co.uk)



First check by

Eur Ing R B Higginson BSc, PGDip, CEng, MICE, FGS.



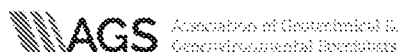
Second check by

N J Lambert BSc (Hons), CEnv, FGS, MIEEnvSci.



This is not a valid document for use in the design of the project unless it is titled Final in the document status box.

Current regulations and good practice were used in the preparation of this report. The recommendations given in this report must be reviewed by an appropriately qualified person at the time of preparation of the scheme design to ensure that any recommendations given remain valid in light of changes in regulation and practice, or additional information obtained regarding the site.



Commission

Soils Limited was commissioned by Crayfern Homes to undertake an intrusive investigation and to prepare a Main Investigation Report on land at Cinders Nursery, Cinders Lane, Yapton, West Sussex BN18 0JJ. The scope of the investigation was outlined in the Soils Limited quotation reference Q20172, dated 18th June 2018.

This document comprises the Main Investigation Report and incorporates the results, discussion and conclusions to this intrusive works.

This Main Investigation Report must be read in conjunction with the Preliminary Investigation (Desk Study) Report undertaken on the above site by Geo-Environmental Services Limited, Report ref: GE16133-DSR-JAN17, dated January 2017.

Standards

The site works, soil descriptions and geotechnical testing was undertaken in accordance with the following standards:

- BS 5930:2015 and BS EN ISO 22476-2 2005+A1:2011
- BS EN 1997-1:2004+A1:2013 Eurocode 7.
- BS EN ISO 14688-1:2002+A1:2013
- BS EN ISO 14688-2:2004+A1:2013
- BS 10175:2011+A1:2013

The geotechnical laboratory testing was performed by GEO Site & Testing Services Ltd (GSTL) in accordance with the methods given in BS 1377:1990 Parts 1 to 8 and their UKAS accredited test methods.

For the preparation of this report, the relevant BS code of practice was adopted for the geotechnical laboratory testing technical specifications, in the absence of the relevant Eurocode specifications (ref: ISO TS 17892).

The chemical analyses were undertaken by I2 Analytical Limited in accordance with their UKAS and MCERTS accredited test methods or their documented in-house testing procedures. This investigation did not comprise an environmental audit of the site or its environs.

Trial hole is a generic term used to describe a method of direct investigation. The term trial pit, borehole or window sample borehole implies the specific technique used to produce a trial hole.

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Section I Introduction

I.1 Objective of Investigation

Soils Limited was commissioned by Crayfern Homes to undertake an intrusive investigation and to prepare a Main Investigation Report to supply the client and their designers with information regarding ground conditions, to assist in preparing a foundation scheme for development that was appropriate to the settings present on the site.

The investigation was to be undertaken to provide comment on appropriate foundation options for the proposed residential development. The investigation was to be made by means of in-situ testing and geotechnical laboratory testing undertaken on soil samples taken from the trial holes.

Soil samples were taken for chemical laboratory testing to enable recommendations for the safe redevelopment of the site and the protection of site workers, end-users and the public from any contamination identified as dictated by the Conceptual Site Model (CSM) in the Preliminary Investigation Report undertaken for the site by Geo-Environmental Services Limited (Report ref: GE16133-DSR-JAN17, dated January 2017) and/or the Revised Conceptual Site Model presented in Appendix C.1.

I.2 Location

The site was located at Cinders Nursery, Cinders Lane, Yapton, West Sussex BN18 0JJ and had an approximate O.S Land Ranger Grid Reference of SU 980 026.

The site location plan is given in Figure 1.

I.3 Site Description

The site was a former nursery comprising industrial greenhouses to the northeast and number of bungalows to the south and southeast. The greenhouses were in poor condition.

Several metal tanks were noted on the site, although their former use was not evident, and there was no sign of material spillages or leaks or odours. A few concrete storage buildings were located to the south of the site, with stockpiles of various construction materials also noted.

The site was generally flat-lying with a mixture of open land, access tracks with gravel and broken tarmac surfacing, and small clusters of mature trees across the site. A ditch was evident along the western site boundary.

The site was surrounded by allotments to the north, farmland to the east and south, and residential land-use to the west.

An aerial photograph has been included in Figure 2.

1.4 Proposed Development

The proposed residential development comprised 51 one to four-bedroom homes including detached and semi-detached houses and a single apartment block. Soft landscaping includes private gardens, informal open space and allotments. Hard landscaping includes access roads, parking and storage areas.

In compiling this report reliance was placed on drawing named Cinders Nursery, Cinders Lane, Yapton, West Sussex, undated and was prepared by Land and Brand New Homes Limited. Any change or deviation from the scheme outlined in the drawing could invalidate the foundation design and remediation recommendations presented within this report. Soils Limited must be notified about any such changes.

Development plan provided by the client is presented in Appendix D.

1.5 Anticipated Geology

The 1:50,000 BGS map showed the site to be located upon the bedrock Lewes Nodular Chalk Formation, Seaford Chalk Formation, Newhaven Chalk Formation, Culver Chalk Formation And Portsdown Chalk Formation (Undifferentiated) (hereafter referred to as White Chalk Subgroup) with overlying superficial deposits of River Terrace Deposits.

1.5.1 River Terrace Deposits

River Terrace Deposits are superficial deposits of Quaternary age that lie along the margins of rivers and are predominantly found in the southern part of West Sussex, along the coastal plain and are typically less than 10m thick. The composition of the River Terrace Gravel varies greatly, depending on the source material available in the river's catchment. Deposits generally consist of sands and gravels of roughly bedded flint or chert gravels commonly in a matrix of silts and clays. In West Sussex the rivers flow mainly south over the Weald Clay, which contains some sandstones and limestone that could be incorporated into the river gravel.

1.5.2 White Chalk Subgroup

The White Chalk Subgroup typically comprises chalk with flints, locally with discrete marl seams, nodular chalk, sponge-rich and flint seams throughout. Typology of flints and incidence of marl seams is important for correlation.

Occasional erosional features, such as pipes, swallow holes and solution cavities, usually in-filled with drift deposits, are found in the chalk. The features sometimes manifest themselves at the surface as shallow circular depressions. Solution features may be reactivated by the concentrated ingress of water from leaking drains or soakaways. Reactivation may lead to surface collapse.

1.6 Limitations and Disclaimers

This Main Investigation Report relates to the site located at Cinders Nursery, Cinders Lane, Yapton, West Sussex BN18 0JJ and was prepared for the sole benefit of Crayfern Homes (The "Client"). The report was prepared solely for the brief described in Section 1.1 of this report.

Soils Limited disclaims any responsibility to the Client and others in respect of any matters outside the scope of the above.

This report has been prepared by Soils Limited, with all reasonable skill, care and diligence within the terms of the Contract with the Client, incorporation of our General Conditions of Contract of Business and taking into account the resources devoted to us by agreement with the Client.

The report is personal and confidential to the Client and Soils Limited accept no responsibility of whatever nature to third parties to whom this report, or any part thereof, is made known. Any such party relies on the report wholly at its own risk.

The Client may not assign the benefit of the report or any part to any third party without the written consent of Soils Limited.

The ground is a product of continuing natural and artificial processes. As a result, the ground will exhibit a variety of characteristics that vary from place to place across a site, and also with time. Whilst a ground investigation will mitigate to a greater or lesser degree against the resulting risk from variation, the risks cannot be eliminated.

The investigation, interpretations, and recommendations given in this report were prepared for the sole benefit of the client in accordance with their brief. As such these do not necessarily address all aspects of ground behaviour at the site.

Current regulations and good practice were used in the preparation of this report. An appropriately qualified person must review the recommendations given in this report at the time of preparation of the scheme design to ensure that any recommendations given remain valid in light of changes in regulation and practice, or additional information obtained regarding the site.

The depth to roots and/or of desiccation may vary from that found during the investigation. The client is responsible for establishing the depth to roots and/or of desiccation on a plot by plot basis prior to the construction of foundations. Supplied site surveys may not include substantial shrubs or bushes and is also unlikely to have data or any trees, bushes or shrubs removed prior to or following the site survey.

Where trees are mentioned in the text this means existing trees, substantial bushes or shrubs, recently removed trees (approximately 20 years to full recovery on cohesive soils) and those planned as part of the site landscaping).

Ownership of land brings with it onerous legal liabilities in respect of harm to the environment. "Contaminated Land" is defined in Section 57 of the Environment Act 1995 as:

"Land which is in such a condition by reason of substances in, on or under the land that significant harm is being caused or that there is a significant possibility of such harm being caused or that pollution of controlled waters is being, or is likely to be caused".

The investigation, analysis or recommendations in respect of contamination are made solely in respect of the prevention of harm to vulnerable receptors, using where possible best practice at the date of preparation of the report. The investigation and report do not address, define or make recommendations in respect of environmental liabilities. A separate environmental audit and liaison with statutory authorities is required to address these issues.

Ownership of copyright of all printed material including reports, laboratory test results, trial pit and borehole log sheets, including drillers log sheets remains with Soils Limited. License is for the sole use of the client and may not be assigned, transferred or given to a third party.

Section 2 Site Works

2.1 Proposed Project Works

The proposed intrusive investigation was designed to provide information on the ground conditions and to aid the design of foundations for the proposed residential development. The intended investigation, as outlined within the Soils Limited quotation (Q20172, dated 18th June 2018), was therefore to comprise the following items:

- 4No 5m deep windowless sampler boreholes;
- 4No 6m deep dynamic probes;
- TRL DCP probes for CBR;
- Well installation for long term groundwater level monitoring;
- Machine excavated trial pits with infiltration testing to BRE365;
- Geotechnical laboratory testing;
- Contamination laboratory testing.

2.1.1 Actual Project Works

The actual project works were undertaken on 3rd July 2018 and comprised:

- 4No. windowless sampler boreholes (WS1 to WS4);
- 4No. dynamic probes (DP1 to DP4);
- Well installation for long term groundwater level monitoring;
- 4No. trial pits (TP1 to TP4) with infiltration testing to BRE365;
- 7No. TRL DCP probes for CBR (DCP1 to DCP3 and DCP7 to DCP10);
- Geotechnical laboratory testing;
- Contamination laboratory testing.

Each of the four windowless sampler boreholes (WS1 to WS4) were backfilled with gravel and bentonite following the installation of monitoring wells. The trial pits were backfilled with arisings upon completion and left slightly proud to accommodate future settlement. All trial hole locations have been presented in Figure 3.

Following completion of site works, soil cores were logged and sub-sampled so that samples could be sent to the laboratory for both contamination and geotechnical testing.

2.2 Ground Conditions

On 3rd July 2018 four windowless sampler boreholes (WS1 to WS4) were drilled, using a Dando Terrier windowless sampler and dynamic probe rig, to a depth of 5.00m below ground level (bgl) at locations selected by Soils Limited using a development plan provided by the client.

Four super heavy dynamic probes, (DP1 to DP4) were driven prior and adjacent to their corresponding windowless sampler borehole to depths ranging between 5.70 and 6.00m

bgl.

Four standpipes were installed within window sample borehole locations (WS1 to WS4) to allow for continued monitoring of groundwater, where present. Four trial pits were machine excavated to depths ranging between 1.30 and 2.95m bgl.

The maximum depths of trial holes have been included in Table 2.1.

All trial holes were scanned with a Cable Avoidance Tool (C.A.T.) and GENNY prior to excavation to ensure the health and safety of the operatives.

Table 2.1 Final Depth of Trial Holes

Trial Hole	Depth (m bgl)	Trial Hole	Depth (m bgl)
WS1	5.00 (w)	DP3	6.00
WS2	5.00 (w)	DP4	6.00
WS3	5.00 (w)	TP1	1.80
WS4	5.00 (w)	TP2	2.95
DPI	6.00	TP3	1.30
DP2	5.70	TP4	2.80

Note: w - well installation

The approximate trial hole locations are shown on Figure 3.

The soil conditions encountered were recorded and soil sampling commensurate with the purposes of the investigation was carried out. The depths given on the trial hole logs and quoted in this report were measured from ground level.

The soils encountered from immediately below ground surface have been described in the following manner. Where the soil incorporated an organic content such as either decomposing leaf litter or roots, or has been identified as part of the in-situ weathering profile, it has been described as Topsoil both on the logs and within this report. Where man has clearly either placed the soil, or the composition altered, with say greater than an estimated 5% of a non-natural constituent, it has been referred to as Made Ground both on the log and within this report.

For more complete information about the soils encountered within the general area of the site reference should be made to the detailed records given within Appendix A, but for the purposes of discussion, the succession of conditions encountered in the trial holes in descending order can be summarised as:

Made Ground/Topsoil (MG/TS)
River Terrace Deposits (RTD)
White Chalk Subgroup (WHCK)

The ground conditions encountered in the trial holes are summarised in Table 2.2.

Table 2.2 Ground Conditions

Strata	Epoch	Depth Encountered (m bgl)		Typical Thickness (m)	Typical Description
		Top	Bottom		
MG/TS	Anthropocene	G.L.	0.15 – 1.10	0.50	TS: Brown slightly gravelly SILT with frequent rootlets. MG: Brown slightly clayey gravelly SAND. Locally with fragments of tarmacadam, clinker, concrete, charcoal and plastic.
RTD	Quaternary	0.15 – 1.10	1.30 ¹ – 4.85	3.00 (where proven)	Firm and stiff brown mottled orangish brown slightly sandy silty CLAY, becoming gravelly with depth. Silty gravelly SAND at depth.
WHCK	Cenomanian to Maastrichtian	2.40 – 4.85	5.00 ¹	Not proven ²	Structureless chalk (Dm) recovered as pale brown and off-white sandy gravelly SILT. Clasts are fine to coarse gravel-sized very weak chalk with occasional flint.

Note: ¹ Final depth of trial hole. ² Base of strata not encountered

2.3 Ground Conditions Encountered in Trial Holes

The ground conditions encountered in trial holes have been described below in descending order. The engineering logs are presented in Appendix A.1.

2.3.1 Made Ground and Topsoil

Soils described as Made Ground were encountered in seven out of the eight trial holes from ground level to depths ranging between 0.20 (TP4) and 1.10m bgl (WS2).

The Made Ground typically comprised brown slightly clayey gravelly SAND. Gravel is fine and medium sub-rounded to sub-angular flint. Locally with fragments of tarmacadam, clinker, concrete, charcoal and plastic.

Soils described as Topsoil were encountered in one trial hole (TP3) from ground level to a depth of 0.15m bgl.

The Topsoil comprised brown slightly gravelly SILT with frequent rootlets. Gravel is fine subangular flint.

The depth of Made Ground/Topsoil has been included in Table 2.3.

Table 2.3 Final Depth of Made Ground/Topsoil

Trial Hole	Strata	Depth (m bgl)
WS/DPI	MG	0.44
WS/DP2	MG	1.10
WS/DP3	MG	0.74
WS/DP4	MG	0.77
TPI	MG	0.25
TP2	MG	0.30
TP3	TS	0.15
TP4	MG	0.20

2.3.2 River Terrace Deposits

The soils of the River Terrace Deposits were encountered directly beneath the Topsoil / Made Ground in each of the eight trial pits to depths ranging between 1.30 (base of TP3) and 4.85m bgl (WS3). Each of the trial pits terminated within the soils of the River Terrace Deposits, so their depth was not confirmed in these locations.

The River Terrace Deposits typically comprised firm and stiff brown mottled orangish brown slightly sandy silty CLAY, becoming gravelly with depth. Horizons of silty gravelly SAND were recorded at depth.

The depth of River Terrace Deposits has been included in Table 2.4.

Table 2.4 Final Depth of River Terrace Deposits

Trial Hole	Depth (m bgl)
WS/DPI	4.84
WS/DP2	2.40
WS/DP3	4.85
WS/DP4	4.52
TPI	1.80 ¹
TP2	2.95 ¹
TP3	1.30 ¹
TP4	2.80 ¹

Note: ¹ Final depth of trial hole.

2.3.3 White Chalk Subgroup

The White Chalk Subgroup was encountered in four of the eight trial holes to the full depth of the investigation at 5.00m bgl (base of WS1 to WS4) and inferred to 6.00m bgl in the dynamic probe holes.

The White Chalk Subgroup typically comprised structureless chalk (Dm) recovered as pale brown and off-white sandy gravelly SILT. Clasts are fine to coarse gravel-sized very weak chalk with occasional flint.

The depth of White Chalk Subgroup has been included in Table 2.5.

Table 2.5 Final Depth of White Chalk Subgroup

Trial Hole	Depth (m bgl)
WS/DPI	5.00 ¹
WS/DP2	5.00 ¹
WS/DP3	5.00 ¹
WS/DP4	5.00 ¹
TP1	Not encountered
TP2	Not encountered
TP3	Not encountered
TP4	Not encountered

Note: ¹ Final depth of trial hole.

2.4 Roots

Roots were encountered in each of the eight trial holes to depths ranging between 0.70 and 2.00m bgl. The depths of root penetration have been included in Table 2.6.

Table 2.6 Depth of Root Penetration

Trial Hole	Depth (m bgl)
WS1	1.80
WS2	0.70
WS3	1.00
WS4	1.43
TP1	1.55
TP2	1.60
TP3	1.30 ¹
TP4	2.00

Note: ¹ Final depth of trial hole.

Roots may be found to greater depth at other locations on the site particularly close to trees and/or trees that may have been removed both within the site and its close environs. Scattered clusters of mature trees were noted within the site area.

It must be emphasised that the probability of determining the maximum depth of roots from a narrow diameter borehole is low. A direct observation such as from within a trial pit is necessary to gain a better indication of the maximum root depth.

2.5 Groundwater

Groundwater was encountered within two trial holes (TP2 and TP4) and was struck depths of 2.90 and 1.60m bgl, respectively. Changes in groundwater level occur for several reasons including seasonal effects and variations in drainage.

The investigation was conducted in July (2018), when groundwater levels should be falling towards their annual minimum (lowest) elevation, which typically occurs around September.

Groundwater monitoring was scheduled for the period August to March, to include the wettest months over winter. At the time of reporting no groundwater monitoring had been undertaken, the report will be updated when monitoring is complete.

Section 3 Discussion of Geotechnical In-Situ and Laboratory Testing

3.1 Dynamic Probe Tests

Dynamic probing (DPSH) was undertaken at four locations (DP1 to DP4) adjacent and prior to the drilling of WS1 to WS4 to depths ranging between 5.70 and 6.00m bgl. The results were converted to equivalent SPT “N60” values based on dynamic energy using commercial computer software (Geostru). The results were then interpreted based on the classifications outlined in Appendix B.1, Table B.1.1 to Table B.1.3.

The SPT “N60” values presented have been corrected in accordance with BS EN 22476 Part 3, to account for the rig efficiency, borehole depth, overburden factors etc. Further correction of the ‘N’ values should therefore not be necessary. Raw field data is archived within the Soils Limited project file and can be provided on request.

The River Terrace Deposits recorded equivalent SPT “N60” values between 1 and 32 within cohesive beds and 14 to 32 in granular beds. The cohesive beds were classified as very to very high strength with an inferred undrained cohesive strength ranging between <10 and 160kPa. The granular beds were classified as having medium dense to dense relative density.

The White Chalk Subgroup recorded equivalent SPT “N60” values between 4 and >50, classifying the beds as structureless (Dm) and (Dc) becoming structured with depth.

A full interpretation of the DPSH tests are outlined in Appendix B.2, Table B.2.1.

3.2 Dynamic Cone Penetrometer Tests

The Transport Research Laboratory (TRL), Dynamic Cone Penetrometer (DCP) was undertaken at seven locations (DCP1 to DCP3 and DCP7 to DCP10). The results were interpreted based on the classification outlined in Appendix B.1. Locations DCP4 to DCP6 were inaccessible.

The results from DCP testing indicated CBR values of between 3% and 382% for the soils encountered in the top 1.00m bgl. The high CBR values encountered were anticipated to be large gravel clasts struck during the test.

Due to hard ground conditions at shallow depth DCP2, DCP3, DCP7, DCP8 and DCP9 refused before a depth of 400mm was achieved.

The DCP results are presented in Appendix B.3.

3.3 Infiltration Tests

Infiltration testing was undertaken in TP1 to TP4 within the River Terrace Deposits following the principles of BRE Digest 365 Soakaway design: 2016. BRE 365 states that

for an accurate infiltration rate to be obtained a soakage pit needs to be filled three times in quick succession. Each test can only be ended once 75% of the water present has drained away.

A single test was carried in TP1 to TP4, although none of them drained sufficiently (to 75% empty) to allow infiltration rates to be calculated in accordance with BRE 365. TP2 was monitored for a period of approximately 30hrs, so the results can be considered the most reliable. However, because the pit did not drain sufficiently, the results cannot be used for soakaway design in accordance with BRE 365.

BRE software BRESOAK was used to calculate extrapolated infiltration rates in TP1 and TP4 and the results outlined in Table 3.1.

Table 3.1 Infiltration Rates

Trial Hole	Test No.	Infiltration Rate (m/s)
TP1	I	6.18E-06*
TP2	I	3.13E-06*
TP3	I	8.14E-06*
TP4	I	1.47E-05*

Notes: *Result extrapolated based on readings taken. The results cannot be relied upon for design in accordance with BRE 365.

3.4 Atterberg Limit Tests

Atterberg Limit tests were performed on four samples obtained from the cohesive soils of the River Terrace Deposits. The results were classified in accordance with BRE Digest 240 and NHBC Standards Chapter 4.2.

The cohesive soils of the River Terrace Deposits were classified as having medium volume change potential in accordance with both BRE Digest 240 and NHBC Standards Chapter 4.2.

A full interpretation of the Atterberg Limit tests are outlined in Table B.2.2, Appendix B.2 and the laboratory report in Appendix B.3.

3.5 Particle Size Distribution Tests

Particle Size Distribution (PSD) tests were performed on two samples from the River Terrace Deposits.

PSD classified the samples taken from the River Terrace Deposits as having a volume change potential in accordance BRE Digest 240 and NHBC Standards Chapter 4.2. Despite the high granular content (42 – 51%), these samples were classified as plastic and therefore having volume change potential.

A full interpretation of the PSD tests are outlined in Table B.2.3, Appendix B.2 and the laboratory report in Appendix B.3.

3.6 Soil Density Tests

Two samples were scheduled for Saturated Moisture Content (SMC) tests but were not suitable for testing as no intact chalk fragments were present, only chalk putty was identified. Soil density tests were undertaken instead, which provide an indication of the material density, but cannot be used in interpretation of the chalk grade, in accordance with Table 3.2, CIRIA Publication, Engineering in Chalk, C574, 2002.

A full interpretation of the density tests are outlined in Table B.2.4, Appendix B.2 and the laboratory report in Appendix B.3.

3.7 Sulphate and pH Tests

Two samples were taken from the River Terrace Deposits for water soluble sulphate (2:1) and pH testing in accordance with Building Research Establishment Special Digest 1, 2005, 'Concrete in Aggressive Ground'.

The tests recorded water soluble sulphate between 11.2mg/l and 15.3mg/l with pH values of 8.6 to 8.8.

The significance of the sulphate and pH Test results are discussed in Section 4.4 and the laboratory report in Appendix B.3.

Section 4 Foundation Design

4.1 General

An engineering appraisal of the soil types encountered during the site investigation and likely to be encountered during the redevelopment of this site is presented. Soil descriptions are based on analysis of disturbed samples taken from the trial holes.

4.1.1 Made Ground and Topsoil

The terms *Fill* and *Made Ground* are used to describe material, which has been placed by man either for a particular purpose e.g. to form an embankment, or to dispose of unwanted material. For the former use, the Fill and/or Made Ground may well have been selected for the purpose and placed and compacted in a controlled manner. With the latter, great variations in material type, thickness and degree of compaction invariably occur and there can be deleterious or harmful matter, as well as potentially methanogenic organic material.

The BSI Code of Practice for Foundations, BS 8004:1986, Clause 2.2.2.3.5 Made Ground and Fill, includes the caveat that '*all Topsoil should be treated as suspect, because of the likelihood of extreme variability*'.

Soils described as Made Ground were encountered in seven out of the eight trial holes from ground level to depths ranging between 0.20 (TP4) and 1.10m bgl (WS2). The Made Ground typically comprised brown slightly clayey gravelly SAND. Gravel is fine and medium subrounded to subangular flint. Locally with fragments of tarmacadam, clinker, concrete, charcoal and plastic.

Soils described as Topsoil were encountered in one trial hole (TP3) from ground level to a depth of 0.15m bgl. The Topsoil comprised brown slightly gravelly SILT with frequent rootlets. Gravel is fine subangular flint.

A result of the inherent variability, particularly of uncontrolled Topsoil, Fill and/or Made Ground is that it is usually unpredictable in terms of bearing capacity and settlement characteristics. Foundations should, therefore, be taken through any Topsoil and/or Made Ground and either into, or onto a suitable underlying natural stratum of adequate bearing characteristics.

4.1.2 River Terrace Deposits

The soils of the River Terrace Deposits were encountered directly beneath the Topsoil / Made Ground in each of the eight trial pits to depths ranging between 1.30 (base of TP3) and 4.85m bgl (WS3). Each of the trial pits terminated within the soils of the River Terrace Deposits, so their depth was not confirmed in these locations. The River Terrace Deposits typically comprised firm and stiff brown mottled orangish brown slightly sandy silty CLAY, becoming gravelly with depth. Horizons of silty gravelly SAND were recorded at depth.

The River Terrace Deposits recorded equivalent SPT “N60” values between 1 and 32 within cohesive beds and 14 to 32 in granular beds. The cohesive beds were classified as **very to very high strength** with an inferred undrained cohesive strength ranging between **<10 and 160kPa**. The granular beds were classified as having **medium dense to dense** relative density.

The cohesive soils of the River Terrace Deposits were classified as having **medium volume change potential** in accordance with both BRE Digest 240 and NHBC Standards Chapter 4.2.

PSD classified the samples taken from the River Terrace Deposits as having a volume change potential in accordance BRE Digest 240 and NHBC Standards Chapter 4.2. Despite the high granular content (42 – 51%), these samples were classified as **plastic and therefore having volume change potential**.

Soils of the River Terrace Deposits encountered on site are predominately cohesive, albeit with high granular content locally. As such, they are expected to display low to moderate bearing capacities with moderate to high settlement characteristics. The soils of the River Terrace Deposits were considered a suitable bearing stratum for the proposed development assuming sufficient bearing capacities can be achieved.

4.1.3 White Chalk Subgroup

The White Chalk Subgroup was encountered in four of the eight trial holes to the full depth of the investigation at 5.00m bgl (base of WS1 to WS4) and inferred to 6.00m bgl in the dynamic probe holes. The White Chalk Subgroup typically comprised structureless chalk (Dm) recovered as pale brown and off-white sandy gravelly SILT. Clasts are fine to coarse gravel-sized very weak chalk with occasional flint.

The White Chalk Subgroup recorded equivalent SPT “N60” values between 4 and >50, classifying the beds as **structureless (Dm) and (Dc) becoming structured with depth**.

Samples were not suitable for Saturated moisture content testing as no intact chalk fragments were present, only chalk putty was identified.

Chalk descriptions from windowless sampler boreholes are not in accordance with CIRIA C574 and are not representative of in-situ chalk. Generally, soils of the White Chalk Subgroup are structureless to weak rock and would possess low to moderate bearing and settlement characteristics. The White Chalk Subgroup would be suitable as a bearing stratum, however given the depths encountered, a piled foundation would be required.

4.1.4 Roots

Roots were encountered in each of the eight trial holes to depths ranging between

0.70 and 2.00m bgl. Roots may be found to greater depth at other locations on the site particularly close to trees and/or trees that may have been removed both within the site and its close environs. Scattered groups of mature trees were noted within the site area.

4.1.5 Groundwater

Groundwater was encountered within two trial holes (TP2 and TP4) and was struck depths of 2.90 and 1.60m bgl, respectively. Changes in groundwater level occur for a number of reasons including seasonal effects and variations in drainage. The investigation was conducted in July (2018), when groundwater levels should be falling towards their annual minimum (lowest) elevation, which typically occurs around September.

Groundwater monitoring was scheduled for the period August to March, to include the wettest months over winter. At the time of reporting no groundwater monitoring had been undertaken: the report will be updated when monitoring is complete.

4.2 Foundation Scheme General

The proposed residential development comprised 51 one to four-bedroom homes including detached and semi-detached houses and a single apartment block. Soft landscaping includes private gardens, informal open space and allotments. Hard landscaping includes access roads, parking and storage areas.

In compiling this report reliance was placed on drawing named Cinders Nursery, Cinders Lane, Yapton, West Sussex, undated and was prepared by Land and Brand New Homes Limited. Any change or deviation from the scheme outlined in the drawing could invalidate the foundation design and remediation recommendations presented within this report. Soils Limited must be notified about any such changes.

Development plans provided by the client are presented in Appendix D.

4.2.1 Guidance on Shrinkable Soils

The Building Research Establishment (BRE) Digests 240, 241 and 242 provide guidance on 'best practice' for the design and construction of foundations on shrinkable soils.

The results from Atterberg Limits Tests showed that the River Terrace Deposits had **medium volume change potential** in accordance with both BRE Digest 240 and NHBC Standards Chapter 4.2.

Medium volume change potential must therefore be adopted where foundations pass through the River Terrace Deposits.

The BRE Digest 241 states: *"An increasingly common, potentially damaging situation is where trees or hedges have been cut down prior to building. The*

subsequent long-term swelling of the zone of clay desiccated by the roots, as moisture slowly returns to the ground, can be substantial. The rate at which the ground recovers is very difficult to predict and if there is any doubt that recovery is complete then bored pile foundations with suspended beams and floors should be used”.

The stated intention of the NHBC is to ensure that shrinkage and swelling of plastic soils does not adversely affect the structural integrity of foundations to such a degree that remedial works would be required to restore the serviceability of the building. It must be borne in mind that adherence to the NHBC tables and design recommendations may not, in all cases, totally prevent foundation movement and cracking of brickwork might occur.

The BRE Digest 240 suggests: *“Two courses of action are open:*

Estimate the potential for swelling or shrinkage and try to avoid large changes in the water content, for example by not planting trees near the foundations.

Accept that swelling or shrinkage will occur and take account of it. The foundations can be designed to resist resulting ground movements or the superstructure can be designed to accommodate movement without damage.”

The design of foundations suitable to withstand movements is presented in BRE Digest 241 “Low-rise buildings on shrinkable clay soils: Part 2”

4.3 Foundation Scheme

Foundations **must not** be constructed within any Made Ground/Topsoil due to the likely variability and potential for large load induced settlements both total and differential.

Given that roots were encountered to depths up to 2.00m bgl, groundwater was noted at depths of up to 1.60m bgl and the dynamic probes recorded low blow counts were recorded to depths of 2.20m in DP4 (0 and 1 blows), a shallow foundation is unlikely to be feasible. In addition, the depth to chalk varied significantly (2.40 to 4.85m bgl).

It is likely therefore that a deep foundation scheme or ground improvement would be required.

Vibro-replacement could be considered, but in view of the ground conditions encountered during the investigation, the ground is likely to be too soft in places for this to be successful. As such, a piled foundation solution is required.

4.3.1 Piled Foundations

If adopted the piled foundations must be taken through any Topsoil/Made Ground and River Terrace Deposits into suitable strength soils of the White Chalk Subgroup.

Further works will be required to inform pile design, comprising 3No. 15m deep cable percussive boreholes, or similar.

The construction of a piled foundation is a specialist job with the actual pile working load depending on the particular type pile and installation method. Prior to finalising the foundation design the advice from a reputable contractor who is familiar with the ground and groundwater conditions present at the site should be sought.

Where piles are to be constructed in groups the bearing value of each individual pile should be reduced by a factor of about 0.8 and a calculation made to check the factor of safety against block failure.

To prevent necking of the green concrete, temporary casing may be required where the pile passes through the Made Ground or River Terrace Deposits and below the groundwater table (if encountered). To achieve the full bearing value a pile should penetrate the bearing stratum by at least five times the pile diameter.

4.3.2 Ground Floor Slab

NHBC Standards 2018, Chapter 5.2, Suspended Ground Floors, states:

- *“Ground floors should be constructed as suspended floors where the depth of fill exceeds 600mm”.*
- *“Suspended slabs should be adopted where the foundation depth dictated by the NHBC Standards 2018, Chapter 4.2, Appendix 4.2-C would exceed 1.5m bgl.”*

The NHBC states that where their Practice notes dictate a foundation depth of 1.5m bgl or greater, then suspended slabs must be adopted.

4.4 Subsurface Concrete

Sulphate concentration measured in 2:1 water/soil extracts fell into Class **DS-1** of the BRE Special Digest 1 2005, *‘Concrete in Aggressive Ground’*. Table C2 of the Digest indicated ACEC (Aggressive Chemical Environment for Concrete) site classifications of **AC-1**. The pH of the soils tested ranged between 8.6 and 8.8. The classification given was determined using the mobile groundwater case, in view of groundwater being encountered. The laboratory results are presented in Appendix B.3.

Concrete to be placed in contact with soil or groundwater must be designed in accordance with the recommendations of Building Research Establishment Special Digest 1 2005, *‘Concrete in Aggressive Ground’* taking into account any possible exposure of potentially pyrite bearing natural ground and the pH of the soils.

4.5 Pavements

The Transport Research Laboratory (TRL), Dynamic Cone Penetrometer (DCP) was undertaken at seven locations (DCP1 to DCP3 and DCP7 to DCP10).

The results from dynamic cone penetrometer tests indicated **CBR values of between 3% and 382%** for the soils encountered in the top 1.00m bgl. The high CBR values encountered were anticipated to be large gravel clasts struck during the test.

Due to hard ground conditions at shallow depth DCP2, DCP3, DCP7, DCP8 and DCP9 refused before a depth of 400mm was achieved.

When removing 400mm of either Made Ground or Topsoil (where tests reached suitable depth) the worst case CBR value was 13% which was considered suitable for design purposes for the majority of the road layout.

As CBR values were highly variable due to changes in moisture content and ground conditions, **in-situ testing must be undertaken** immediately prior to the installation of pavements/roads. Any soft spots at formation level should be dug out and replaced with a suitably compacted granular fill. Prior to construction the formation level should be proof rolled.

The soils of the River Terrace Deposits may be frost susceptible as the plasticity indexes recorded in parts of this stratum were <20%. Therefore, the pavement design should be based on a frost susceptible sub-grade.

4.6 Soakaways

Infiltration testing was undertaken in TP1 to TP4 within the River Terrace Deposits following the principles of BRE Digest 365 Soakaway design: 2016.

A single test was carried in TP1 to TP4, although none of them drained sufficiently (to 50% empty) to allow infiltration rates to be calculated in accordance with BRE 365. Rates between 1.47E-05 (TP4) and 3.13E-06m/s (TP2) were calculated by extrapolation of the data. TP2 was monitored for a period of approximately 30hrs, so the results can be considered the most reliable. However, because the pit did not drain sufficiently, the results cannot be used for soakaway design in accordance with BRE 365.

Occasional erosional features, such as pipes, swallow holes and solution cavities, usually in-filled with drift deposits, are found in the chalk within this area. These features sometimes manifesting themselves at the surface, as shallow circular depressions.

Dissolution features can form due to manmade features such as deneholes. These features can then be reactivated or caused to collapse by the concentrated ingress of water from leaking drains or soakaways.

In line with current guidance (BRE Digest 365, NHBC and CIRIA C574) soakaways

should be located remote from the proposed foundations, ideally greater than 20m away from the face of any existing or proposed footing.

In respect to the control of drainage CIRIA C574, Engineering in Chalk; 2002 states;

- “Concentrated ingress of water into the chalk can initiate new dissolution features, particularly in low-density chalk, and destabilise the loose backfill of existing ones. For this reason, any soakaways should be sited well away from foundations for structures, roads or railways, as indicated below:
- In areas where dissolution features are known to be prevalent, soakaways should be avoided if at all possible but, if unavoidable, should be sited at least 20m away from any foundations;
- Where the chalk is of low density, or its density is not known, soakaways should be sited at least 10m away from any foundations;
- Where the chalk is of medium density (or higher), the closest part of the soakaway should be at least 5m away from any foundations.
- For drainage systems, flexible jointed pipes should be used wherever possible; particular care should be taken for the avoidance of leaks in both water supply and drainage pipework.

As the Chalk is a vitally important aquifer, the Environment Agency and local authority must be consulted when planning soakaway installations where chalk lies below the site even where it is mantled with superficial deposits.

Consultation with the Environment Agency must be sought regarding any use which may have an impact on groundwater resources.

Section 5 Determination of Chemical Analysis

5.1 Site Characterisation and Revised Conceptual Site Model

The Preliminary Investigation (Desk Study) Report undertaken by Geo-Environmental Services Limited (Report ref: GE16133-DSR-JAN17, dated January 2017) identified a very low to moderate/low risk of ground contamination and from previous usage of the site and offsite sources.

It was concluded that the potential for contamination to exist at the site was likely to be limited to the presence of underlying Made Ground from historical development and possible above ground storage of heating oil, although no evidence of leaks or spillages were observed during the walkover or the investigation.

The Main Investigation Report identified Made Ground in seven out of the eight trial holes from ground level to depths ranging between 0.20 (TP4) and 1.10m bgl (WS2). The Made Ground typically comprised brown slightly clayey gravelly SAND. Gravel is fine and medium subrounded to subangular flint. Locally with fragments of tarmacadam, clinker, concrete, charcoal and plastic.

Aside from the secondary constituents listed above, there was not visual (by naked eye) or olfactory indicators of contamination.

Superficial deposits of River Terrace Deposits were encountered underlying the Made Ground. Shallow groundwater was encountered within the River Terrace Deposits. The conceptual site model was updated to take account of the shallow groundwater encountered at the site and presented in Appendix C.1.

5.2 Soil Sampling

A non-targeted sampling strategy is appropriate when there is:

- No adequate information available regarding the likely locations of contamination;
- No sensitive areas where there is a need for a high degree of confidence.

A targeted sampling strategy is appropriate when there is:

- Adequate information available regarding the likely locations of contamination
- Sensitive areas where there is a need for a high degree of confidence.

The CSM identified potential sources and a targeted sampling pattern was adopted as appropriate to these sources. Table 5.1 outlines the sampling undertaken.

Table 5.1 Sampling Strategy

Sample	Strategy	Proposed Use
WS1:0.35	Glasshouses, storage sheds, Made Ground	Residential building
WS2:0.30	Former Works, Made Ground	Roadway / building
WS2:1.10		
WS3:0.50	Former Tank, glass houses, Made Ground	Private rear gardens
WS3:0.80		
WS4:0.15	Made Ground	Private rear gardens
WS4:0.70		

5.3 Determination of Chemical Analysis

The driver for determination of the analysis suite was the information obtained from the Preliminary Investigation Report and Main Investigation Report intrusive investigation. Table 5.2 outlines the specification for each sample tested.

Table 5.2 Chemical Analysis Specification

Substance	Locations: Depths (m bgl)						
	WS1:0.35 ^s	WS2:0.30 ^s	WS2:1.10 ^s	WS3:0.50 ^s	WS3:0.80 ^s	WS4:0.15 ^s	WS4:0.70 ^s
Asbestos Screen	✓	✓	✓	✓	✓	✓	✓
Total Phenols	✓	✓	✓	✓	✓	✓	✓
Total Cyanide	✓	✓	✓	✓	✓	✓	✓
Organic Matter	✓	✓	✓	✓	✓	✓	✓
pH	✓	✓	✓	✓	✓	✓	✓
Metals	✓	✓	✓	✓	✓	✓	✓
Metalloids	✓	✓	✓	✓	✓	✓	✓
Organics	✓	✓	✓	✓	✓	✓	✓
PAHs	✓	✓	✓	✓	✓	✓	✓
TPH-CWG		✓		✓		✓	
BTEX		✓		✓		✓	
Herbicides / pesticides screen	✓						

Notes: **Metals:** Cd, Cr, Pb, Hg, Ni, Se, CN, S, Cu, Zn, Bo, V. **metalloids:** As. **organics:** USEPA 16 speciated PAH, TPH-CWG (speciated TPH), BTEX, VOC/SVOC **Asbestos screening** was undertaken in accordance with HSG 248. ^s = Soil sample

Section 6 Qualitative Risk Assessment

6.1 Assessment Criteria

The assessment criteria used to determine risks to human health are derived and explained within Appendix C.3.

6.2 Representative Contamination Criteria - Soil

The proposed residential development comprised 51 one to four-bedroom homes including detached and semi-detached houses and a single apartment block. Soft landscaping includes private gardens, informal open space and allotments. Hard landscaping includes access roads, parking and storage areas.

In compiling this report reliance was placed on drawing named Cinders Nursery, Cinders Lane, Yapton, West Sussex, undated and was prepared by Land and Brand New Homes Limited. Any change or deviation from the scheme outlined in the drawing could invalidate the foundation design and remediation recommendations presented within this report. Soils Limited must be notified about any such changes.

The chemical laboratory results were compared against the representative contaminants concentration for human health receptor to Soil Guideline Values (SGV), Category 4 Screening Levels (C4SL's) or Suitable 4 Use Level (S4UL) for 'Residential with Plant Uptake' end-use.

Table 6.1 outlines the samples that have exceeded their relevant assessment criteria. The full laboratory report is presented in Appendix C.2.

Table 6.1 Summary of Chemical Analysis of Soils Sample Exceedance

Substance	Sample locations where SGV, C4SL or S4UL adopted were exceeded for the 'Residential with Plant Uptake' land-use scenario
Lead	1200mg/kg against 200mg/kg – WS4:0.15 (C4SL)
PAHs	Benzo(a)anthracene 52mg/kg against 11mg/kg – WS1:0.35 (S4UL)
	Chrysene 48mg/kg against 2mg/kg – WS1:0.35 (S4UL)
	Benzo(b)fluoranthene 56mg/kg against 3.3mg/kg – WS1:0.35 (S4UL)
	Benzo(a)pyrene 55mg/kg against 5mg/kg – WS1:0.35 (C4SL)
	Di-benzo(a,h)anthracene 8.8mg/kg against 0.28mg/kg – WS1:0.35 (S4UL)

The guideline values are assessed against the 'Residential with Plant Uptake' land-use scenario, which was considered the most appropriate land-use scenario, given the type of the proposed redevelopment.

To assess the potential toxicity to the human health receptor from the concentrations of organic compounds tested for, Soil Organic Matter (SOM) tests were undertaken on the samples submitted for chemical testing, which revealed SOM values of between 0.3% and 3.5%. For each soil sample tested, the Soil Organic Matter recorded was used to

derive the appropriate guideline value for organic determinants.

In summary, two of the samples tested showed concentrations in excess of the relevant C4SL / S4UL for a 'Residential with Plant Uptake' land-use scenario:

- In WS4 at 0.15m bgl lead was recorded at a concentration of 1200mg/kg against the 'Residential with Plant Uptake' land-use C4SL of 200mg/kg.
- In WS1 at 0.35m bgl five PAHs were recorded at concentrations above the relevant assessment criteria, as detailed in Table 6.1.

None of the other substances tested recorded concentrations above the 'Residential with Plant Uptake' land-use screening values.

6.2.1 Asbestos

Asbestos Containing Material (ACM) was not detected within any samples tested during the investigation.

It is possible that asbestos is present in other areas of the site. If encountered, care must be taken to ensure any such material is separated and disposed of in an appropriate manner to a licensed waste facility.

6.3 Risk to Groundwater

The risk to groundwater was not directly assessed as part of this investigation. Assessment of the shallow soils has identified exceedances of Lead and several PAHs in two locations. The site is underlain by a Secondary A Aquifer (River Terrace Deposits) and Principal Aquifer (White Chalk Subgroup), although it was not located within a Source Protection Zone (SPZ) and no abstraction were recorded within 1km. Based on this information, a risk to groundwater does exist on the site.

However, the superficial deposits encountered during the investigation were predominately clay, which will have a low permeability and would limit the potential for migration of contaminants to the underlying Principal Aquifer, acting as an aquitard. In addition, site clearance and remedial works relating to the shallow soils will removed much of the source material (Made Ground).

On balance, further assessment may be necessary in conjunction with further testing in areas of proposed soft landscaping, depending on the ground conditions encountered. Should significant Made Ground be recorded in these areas following site clearance, further leachate analysis will be required.

6.4 Tier I Quantitative Risk Assessment

Quantitative risk assessments are undertaken for the soil, groundwater and soil gas. The CSM has been updated to take account of the assessments below and presented in Appendix C.1. The full laboratory chemical report is presented in Appendix D.2.

6.4.1 Soils

Two of the samples tested showed concentrations in excess of the relevant C4SL / S4UL for a 'Residential with Plant Uptake' land-use scenario. In WS4 at 0.15m bgl lead was recorded at a concentration of 1200mg/kg against the 'Residential with Plant Uptake' land-use C4SL of 200mg/kg. In WS1 at 0.35m bgl five PAHs were recorded at concentrations above the relevant assessment criteria, as detailed in Table 6.1.

Asbestos Containing Material (ACM) was not detected within any samples tested during the investigation.

The Tier 1 Quantitative risk assessment therefore established that there was **a risk to the human health receptors** of construction workers or future end-users.

6.4.2 Groundwater

The Groundwater Risk Assessment established that **there was low risk** to the groundwater receptor, which may require further assessment, depending on findings of further investigation works.

6.4.3 Soil Gas

The Preliminary Investigation Report did not identify any significant potential sources of soil gas near the site. A potential risk was identified from possible Made Ground associated with historical redevelopment of the site.

Given that Made Ground was typically recorded to a depth of 0.50m, much of which will be removed during site clearance, that organic content was typically 2.0% and there were no elevated concentrations of hydrocarbons recorded, the risk from soil gas was negligible.

6.5 Remedial Objective

Soil chemical analysis recorded two samples with substance levels over their representative guideline values.

Therefore, there was a risk to the Human Health, Building Structures and Services and Groundwater receptor, which would require a remediation strategy.

The remedial objective for the site is to ensure site clean-up removes any unacceptable risk to the identified receptors of Human Health, Building Structures and Services and Groundwater receptor.

In essence the remedial objective should sever any source-pathway-receptor pollutant linkages that have been established. Once this has been achieved, by whatever means, there can theoretically be no risk.

6.6 Development of Soil Remediation Strategy

Production of a remediation strategy report was not part of the brief for this Main Investigation Report Intrusive Investigation. A number of examples remedial options are outlined below.

6.6.1 Further Chemical Testing and Human Health Risk Assessment

It is **recommended** that further testing is undertaken once the site strip has been completed, targeted to areas of soft landscaping. Leaching testing would also be undertaken at this stage, if necessary.

6.6.2 Adoption of Cover System in Soft Landscaped Areas

The BRE "*Cover Systems For Land Regeneration, Thickness Design of Cover Systems for Contaminated Land, BRE, March 2004*", allows for the design of cover systems to impacted soils where the concentration of substances within the ground does not exceed any of the respective SGV, C4SL or S4UL by more than six times. In such a situation, a maximum cover thickness of 600mm is given. However, the concentration of substances within the certified clean soil/topsoil, which comprises the cover system, determines the overall thickness of the system and can reduce the required thickness markedly below 600mm.

Where the concentration of substances within the ground does exceed any of the respective SGV, C4SL or S4UL by more than six then an engineered capping system would be required.

The concentrations of elevated contaminants outlined in Table 6.1 did show some substances, which were at concentrations greater than six times their respective guideline value.

6.6.3 Excavation of Impacted Soil

It could be proposed to excavate and stockpile the impacted material on the site in preparation for classification and subsequent disposal off-site to a suitable licensed facility.

The initial excavations should be centred on the trial-holes with impacted soil and then extended in all directions, so that the impacted soils can be 'chased' out. Once excavation has been completed validation would be required to prove all impacted soil has been removed. Validation would involve taking a representative number of samples from the sides and base of any excavation and then sent off for appropriate chemical analysis.

The stockpiled soils must be placed on an impermeable liner with raised edges.

During periods of rainfall, the stockpile must be covered over to minimise leaching and run-off into the underlying soils. Covering of the stockpile may be required to prevent fumes impacting receptors off-site.

The remedial works must be inspected and independently validated by a suitable person.

On completion of the development, a Validation and Closure Report must be supplied to both the Local Authority and the NHBC detailing the remediation works undertaken on the site.

Any voids resulting from the removal of impacted soil must be backfilled with a suitable certified clean granular soil.

The developer/groundworker must be made aware of the need to address the risk from asbestos identified in this report; former use of the site and for the potential for additional sources of contamination not identified in the Preliminary Investigation Report or the Main Investigation Report Intrusive Investigation to be found within the site both during demolition and the excavation of trenches for services and foundations.

6.6.4 Excavation of All Made Ground

Made Ground was encountered across the site to depths between 0.20 and 1.10m bgl. Given the proposed development, this option is neither cost-effective or necessary.

6.6.5 Hard Landscape Entire Site

Hard landscaping the entire site could eliminate exposure pathways to contaminated soils for:

- Direct soil and dust ingestion,
- Consumption of home-grown produce,
- Dermal contact,
- Inhalation of dust (indoor and outdoor),
- Migration through permeable soils (direct precipitation, overland flow and through flow).

6.6.6 Engineering Capping System

If an engineering capping system was required it should comprise a geotextile and/or mesh underlying a 200mm thick layer of lightly compacted gap graded crushed concrete (5-75mm) or the like, with geotextile upper cover underlying 450mm thickness of clean certified.

6.6.7 Asbestos

Asbestos-containing soils (ACSs) were not identified at the site.

Asbestos-containing soils (ACSs) do not necessarily require removal or treatment but would require a suitable capping layer to remain in-situ. All future works should have suitable health and safety procedures in place to protect workers from airborne asbestos fibres. If ACSs remain in-situ measures should be put in place to insure the risk of exposures is not increased, such as exposing buried asbestos at the surface. Where ACSs have to be removed from site quantification of the asbestos would be required. Waste containing asbestos will be hazardous waste if it contains more the 0.1% by weight of asbestos, (CIRIA C733, Asbestos in soil and made ground: a guide to understanding and managing risks).

Asbestos quantification would be recommended on soil samples where asbestos was identified, so an assessment can be carried out.

6.7 Duty of Care

Groundworkers must maintain a good standard of personal hygiene including the wearing of overalls, boots, gloves and eye protectors and the use of dust masks during periods of dry weather.

To prevent exposure to airborne dust by both the general public and construction personnel the site should be kept damp during dry weather and at other times when dust is generated as a result of construction activities. The site should be securely fenced at all times to prevent unauthorised access.

Washing facilities should be provided and eating restricted to mess huts.

6.8 Excavated Material

Excavated material as waste must be defined or classified prior to any disposal, transport, recycling or re-use at or by an appropriately licensed or exempt carrier and/or off-site disposal facility. The requirements inherent in both Duty of Care and Health and Safety must also be complied with. In order to determine what is to happen, what is suitable, appropriate and most effective in the disposal of wastes, especially those subject to CDM waste management plan requirements, several factors must be considered and competent advice should always be sought.

The amount, type and nature of the material to be removed will in part determine the amount and type of analysis that may be required to comply with current waste guidance, and thereby allow a competent person to suitably classify the material. Often this data is uncertain or unavailable, especially in the early stages of a project, and therefore further investigation, testing and analysis may be required as additional information regarding the development becomes available.

Wastes must be classified and defined by their solid characteristics to comply with current waste guidance. Existing information and analysis derived for environmental purposes may therefore be suitable for use in this context. Waste Acceptance Criteria

(WAC) report the leachability of materials and therefore cannot be used to classify, characterise or define wastes. The only purpose of a WAC analysis is to determine the suitability of a given material for acceptance at one of the three different types of available licenced landfills (inert, stable non-reactive hazardous or hazardous).

Other options are available that may lead to significant savings against disposal to landfill and expert advice should always be sought from a competent person to advise on their relative costs or benefits and advise on any additional analysis, sampling or investigation that may be required to reduce remaining uncertainties and comply with current guidance. Further consideration of results using HazWasteOnline™ can be undertaken on request to give an indication of potentially hazardous properties in the materials analysed.

6.9 Re-use of Excavated Material On-site

The re-use of on-site soils may be undertaken either under the Environmental Permitting Regulations 2007 (EPR), in which case soils other than uncontaminated soils are classed as waste, or under the CL:AIRE Voluntary Code of Practice (CoP) which was published in September 2008 and is accepted as an alternative regime to the EPR.

Under the EPR, material that is contaminated but otherwise suitable for re-use is also classified as waste and its re-use should be in accordance with the Environmental Permitting Regulations 2007 (EPR). Environmental Permit Exemptions (EPE) are for the re-use of non-hazardous or inert waste only; hazardous waste cannot be re-used under a permit exemption. EPE apply only to imported inert waste materials; inert material arising on site and recovered on site is not classified as waste and does not require an exemption. It is possible that materials arising on-site will be classified as inert and would not need an exemption.

Environmental Permit Exemptions are only allowed for certain activities, placing controls on the quantities that can be stored and re-used. The re-use of waste shall be within areas and levels defined in planning applications and permissions for the development. An EPE requires a site-specific risk assessment for the receptor site to demonstrate that the materials are suitable for use, i.e. that they will not give rise to harm to human health or pollution of the environment.

Under the CL:AIRE voluntary code of practice (CoP) materials excavated on-site are not deemed contaminated if suitable for re-use at specified locations or generally within the site.

Material that may have been classified as hazardous waste under the EPR may be re-used. The CoP regime requires that a 'Qualified Person' as defined under the CoP reviews the development of the Materials Management Plan, including review of Risk Assessments and Remediation Strategy/Design Statement together with documentation relating to Planning and Regulatory issues, and signs a Declaration which is forwarded to the Environment Agency and which confirms compliance with the CoP.

Should it be necessary to import materials from another site where materials are excavated and which is not material from a quarry or produced under a WRAP protocol, then an EPE would be necessary for the imported material whether the work was managed under the CoP or the EPR.

6.10 Imported Material

Any soil, which is to be imported onto the site, must undergo chemical analysis to permit classification prior to its importation and placement in order to ascertain its status with specific regard to contamination, i.e. to prove that it is suitable for the purpose for which it is intended.

6.11 Discovery Strategy

There may be areas of contamination not identified during the course of the investigation. Such occurrences may also be discovered during the demolition and construction phases for the redevelopment of the site.

Care should be taken during excavation works especially to investigate any soils, which appear by eye (e.g. such as fibrous materials, large amounts of ash and unusual discolouration), odour (e.g. fuel, oil and chemical type odours or unusual odours such as sweet odours or fishy odours) or wellbeing (e.g. light headedness and/or nausea, burning of nasal passages and blistering or reddening of skin due to contact with soil) to be contaminated or of unusual and/or different character to standard soils or those analysed.

In the event of any discovery of potentially contaminated soils or materials, this discovery should be quarantined and reported to the most senior member of site staff or the designated responsible person at the site for action. The location, type and quantity must be recorded and the Local Authority, and a competent and appropriate third party Engineer/Environmental consultant notified immediately. An approval from the Local authority must be sought prior to implementing any proposed mitigation action.

The discovery strategy must remain on site at all times and must demonstrate a clear allocation of responsibility for reporting and dealing with contamination. A copy of the strategy must be placed on the health and safety notice board and /or displayed in a prominent area where all site staff are able to take note of and consult the document at any time. Any member of the workforce entering the site to undertake any excavation must be made aware of the potential to discover contamination and the discovery strategy.

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Figure 1 – Site Location Map

Job Number
17034

Client
Crayfern Homes

Project
Cinders Nursery, Cinders Lane, Yapton, West
Sussex BN18 0JJ

Date
August 2018



Figure 2 – Aerial Photograph

Project

Cinders Nursery, Cinders Lane,
Yapton, West Sussex BN18 0JJ

Client

Crayfern Homes

Date

August 2018

Job Number

17034



Figure 3 – Trial Hole Plan

Project

Cinders Nursery, Cinders Lane,
Yapton, West Sussex BN18 0JJ

Client

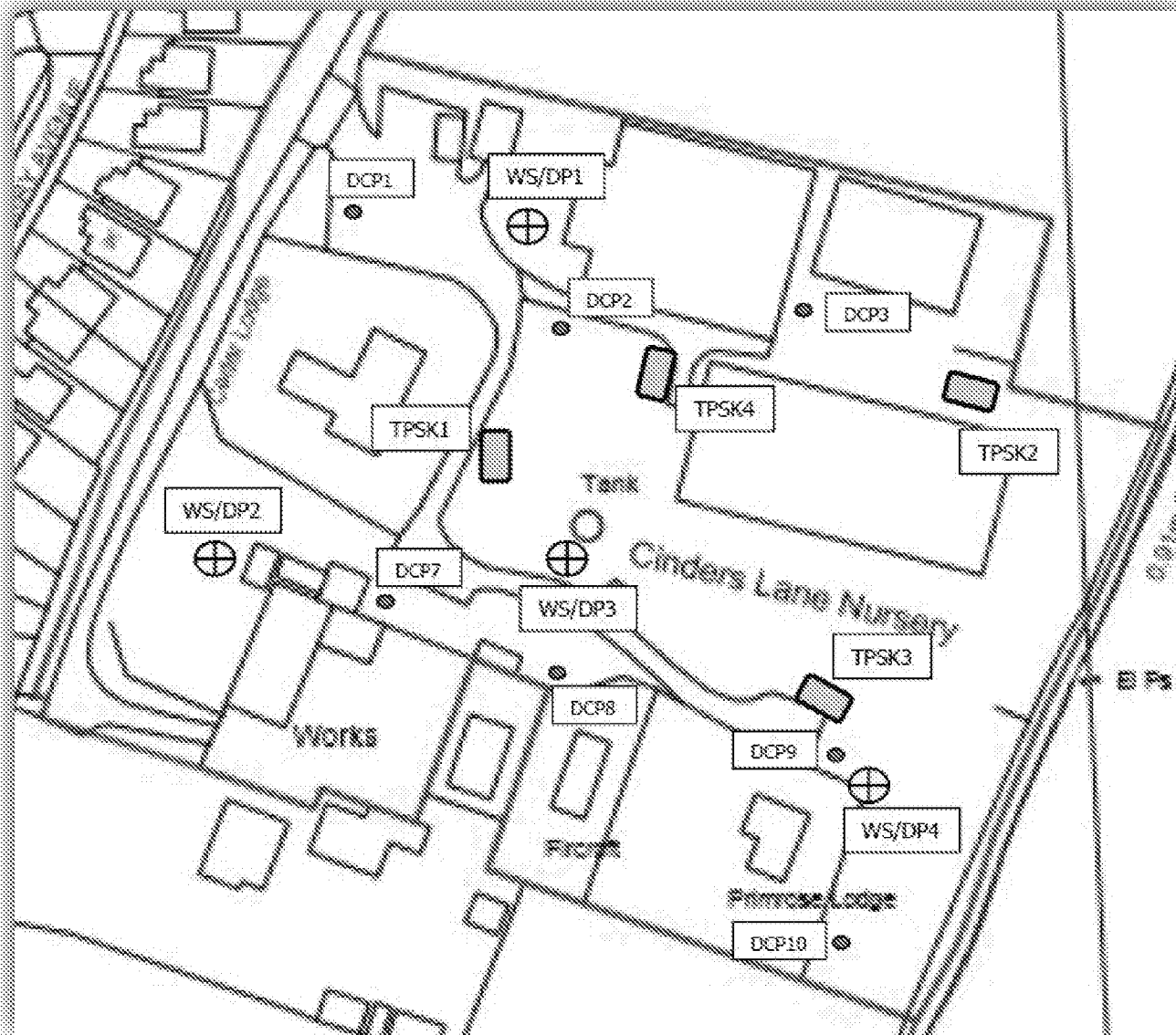
Crayfern Homes

Date

August 2018

Job Number

17034



Appendix A Field Work

Appendix A.1 Engineers Logs

**Soils Limited**

Newton House, Cross Road, Tadworth KT20 5SR

Borehole Log

Borehole No.

WS1

Sheet 1 of 1

Project Name: Cinders Nursery

Project No.: 17034

Co-ords:

Hole Type
WS

Location: Cinders Nursery, Cinders Lane, Yapton

Level:

Scale
1:50

Client: Crayfern Homes

Dates: 03/07/2018

Logged By

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (mAOD)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.15	J+D		0.09			Brown slightly clayey gravelly fine to coarse SAND. Gravel is grey, dark grey, brown and white fine to medium sub-rounded to sub-angular of Flint. Grass and moss vegetation on surface, with weed matting present at 0.04mbgl and 0.09mbgl. MADE GROUND.	
		0.35	J+D		0.20			100% Recovery	
		0.70	J+D		0.44			Brown and grey slightly clayey gravelly fine to coarse SAND. Gravel is dark grey, grey and white fine to coarse rounded to sub-angular of Flint. MADE GROUND.	1
		0.90 - 1.00	D					Brown and red slightly sand slightly gravelly CLAY. Gravel is grey, brown, white, black and red sub-rounded to angular composed of Flint, bitumen / asphalt and brick. Sand is fine to coarse grained. MADE GROUND	
		1.33 - 1.45	D					Stiff brown, and greenish-grey to greyish-brown with reddish-brown iron staining mottling patches slightly gravelly CLAY. Gravel is grey and white fine to medium sub-angular to angular of Flint. Decomposed plant material (roots?) present. SO4 odour present.	
		1.80 - 1.90	D		1.80			100% Recovery	2
		2.20 - 2.30	D		2.00			Very stiff yellowish-brown to brown, with pale grey mottling slightly sandy gravelly CLAY. Gravel is grey, brown and white fine to coarse sub-angular to angular of Flint. Sand is fine to coarse .	
		2.70 - 2.80	D					Stiff mottled orangy-brown and pale grey with black speckling slightly gravelly CLAY. Gravel is white fine to medium sub-angular of Flint. Some signs of iron staining.	
		3.10 - 3.20	D		2.85			100% Recovery	3
		3.40 - 3.50	D		3.40			Firm mottled orangy-brown and pale grey with black speckling slightly gravelly CLAY. Gravel is white fine to medium sub-angular of Flint. Some signs of iron staining.	
		3.90 - 4.00	D		3.82			100% Recovery	4
		4.40 - 4.50	D		3.95			Soft to firm mottled orangy-brown and pale grey with black speckling slightly gravelly CLAY. Gravel is white fine to medium sub-angular of Flint. Some signs of iron staining.	
		4.80 - 4.90	D		4.00			Yellowish-brown slightly gravelly fine to coarse SAND. Gravel is white fine grained sub-angular of Flint .	
					4.15			Soft to firm yellowish-brown sandy gravelly CLAY. Gravel is fine to coarse sub-rounded to sub-angular of Flint. Sand is fine to coarse grained.	
								Yellowish-brown slightly gravelly fine to coarse SAND. Gravel is white fine grained sub-angular of Flint .	
					4.84			55% Recovery	5
					5.00			Firm pale greyish-brown to pale brown sandy gravelly CLAY. Gravel is fine to coarse sub-rounded to sub-angular of Flint and chalk. Sand is fine to coarse grained.	
								Structureless CHALK (Dm), composed pale brown and cream sandy gravelly SILT. Clasts are cream and white fine to coarse gravel sized sub-rounded to sub-angular mainly of very weak low density chalk with occasional Flint. Sand is fine to coarse grained. Matrix is pale brown, cream to creamy grey.	6
								End of Borehole at 5.00m	
									7
									8
									9
									10

General Remarks:

Groundwater Remarks:

Borehole Type
CP: Cable Percussive
WS: Windowless Sampler
RC: Rotary Cored

Sample Types
D: Disturbed
B: Bulk
J: Jar
W: Water
U: Undisturbed

In-Situ Testing
SPT: Split spoon - Standard Penetration Test
CPT: Cone - Standard Penetration Test

Project Name: Cinders Nursery	Project No.: 17034	Co-ords:	Hole Type WS
Location: Cinders Nursery, Cinders Lane, Yapton		Level:	Scale 1:50
Client: Crayfern Homes		Dates: 03/07/2018	Logged By

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (mAOD)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.30	J+D		0.43			Dark brown sandy gravelly CLAY. Gravel is grey, brown, black and cream fine to coarse sub-rounded to sub-angular composed of Flint, bitumen / tarmac, glass and charcoal. Sand is fine to coarse. Roots and Rootlets present. MADE GROUND.	
		0.50	J+D		0.70			100% Recovery Brown Slightly sandy CLAY. Sand is fine to coarse grained. Roots and rootlets present. MADE GROUND.	
		0.80	J+D		0.94			Brown mottled pale grey slightly sandy gravelly CLAY. Gravel is cream to greyish-white fine to coarse sub-rounded to sub-angular composed of Flint. Sand is fine to medium. MADE GROUND.	1
		1.10	J+D		1.10			Brown / orangy-brown mottled pale grey slightly gravelly sandy CLAY. Sand is fine to medium. Gravel is cream to greyish-white fine to medium sub-rounded to sub-angular composed of Flint. MADE GROUND.	
		1.40	J+D		1.50			80% Recovery Brown and orangy-brown slightly sandy gravelly CLAY. Gravel is cream to greyish-white fine to medium sub-rounded to sub-angular composed of Flint and Chalk. Sand is fine to coarse. MADE GROUND.	2
		1.70 - 1.80	D		1.77			Brown with orangy-brown and pale creamy grey/brown mottling slightly sandy clayey GRAVEL. Gravel is cream, white and grey fine to coarse sub-rounded to sub-angular composed of Flint and chalk. Sand is fine to coarse grained. MADE GROUND.	
		2.20 - 2.30	D		2.20			Firm orangy-brown mottled pale grey slightly gravelly sandy CLAY. Sand is fine to coarse grained. Gravel is fine to medium sub-angular of Flint and chalk.	3
		2.50 - 2.60	D		2.40			Firm orangy-brown mottled pale grey slightly gravelly very sandy CLAY. Sand is fine to coarse grained. Gravel is fine to medium sub-angular of Flint and Chalk.	
		3.30 - 3.40	D		3.88			11% Recovery Firm to stiff orangy-brown mottled pale grey gravelly very sandy CLAY. Sand is fine to coarse grained. Gravel is fine to medium sub-rounded to sub-angular of Flint and Chalk.	4
		3.60 - 3.70	D		4.00			Firm to stiff pale grey mottled orangy-brown and brown with black speckling gravelly very sandy CLAY. Sand is fine to coarse grained. Gravel is fine to medium sub-rounded to sub-angular of Flint and Chalk. Orange/brown iron staining present, in matrix and on the chalk clast faces.	
		4.30 - 4.40	D		4.50			Structureless CHALK (Dm), composed pale brown and cream sandy gravelly SILT. Clasts are cream and white fine to coarse gravel sized sub-rounded to sub-angular mainly of very weak low density chalk with occasional Flint. Sand is fine to coarse grained. Matrix is creamy white, pale creamy greyish brown and yellowish brown, with orangy-brown to yellowish orange mottling from iron staining.	5
		4.70 - 4.80	D		5.00			100% Recovery Shattered black Flint band. Very weak to weak, medium density creamy yellow and creamy white CHALK.	
								Structureless CHALK (Dm), composed creamy yellow sandy gravelly SILT. Clasts are cream and white fine to coarse gravel sized sub-rounded to sub-angular of very weak low density chalk and black / dark grey Flint. Sand is fine to coarse grained. Matrix is creamy yellow, with orangy-brown to yellowish orange mottling from iron staining.	6
								100% Recovery Structureless CHALK (Dm), composed creamy white with grey speckling sandy gravelly SILT. Clasts are cream and white fine to coarse gravel sized sub-rounded to sub-angular of very weak low density chalk and black / dark grey Flint. Sand is fine to coarse grained. Matrix is creamy white with creamy yellow mottling, with orange mottling from iron staining.	7
								Shattered black Flint band.	
								End of Borehole at 5.00m	8
									9
									10

General Remarks:

Groundwater Remarks:

Borehole Type
CP: Cable Percussive
WS: Windowless Sampler
RC: Rotary Cored

Sample Types
D: Disturbed
B: Bulk
J: Jar
W: Water
U: Undisturbed

In-Situ Testing
SPT: Split spoon - Standard Penetration Test
CPT: Cone - Standard Penetration Test

**Soils Limited**

Newton House, Cross Road, Tadworth KT20 5SR

Borehole Log

Borehole No.

WS3

Sheet 1 of 1

Project Name: Cinders Nursery

Project No.: 17034

Co-ords:

Hole Type
WS

Location: Cinders Nursery, Cinders Lane, Yapton

Level:

Scale
1:50

Client: Crayfern Homes

Dates: 03/07/2018

Logged By

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (mAOD)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.30	J+D					Brown / greyish brown slightly clayey gravelly fine to coarse SAND with low cobble content. Gravel is grey, dark grey, brown and white fine to coarse sub-rounded to sub-angular of concrete, brick, charcoal / bitumen, sandstone, and Flint. Cobbles are sub-angular composed of sandstone. Grass and moss vegetation on surface. Roots and rootlets present. MADE GROUND.	
		0.50	J+D		0.47				
		0.80	J+D		0.74			100% Recovery	
					1.00			Brown slightly sandy slightly gravelly CLAY. Gravel is white and red fine to coarse sub-angular composed of brick, charcoal / bitumen and Flint. Sand is fine to coarse grained. Rootlets present. MADE GROUND.	1
		1.30 - 1.40	D		1.50			Stiff orangy-brown to brown slightly sandy CLAY. Sand is fine to medium. Rootlets present.	
		1.80 - 1.90	D					Firm to stiff brown mottle pale grey to grey with some black speckling slightly sand CLAY. Sand is fine to coarse grained.	
		2.20 - 2.30	D					100% Recovery	2
		2.70 - 2.80	D		2.60			Firm to stiff brown mottled pale grey to grey with some black speckling slightly sand slightly gravelly CLAY. Gravel is white and grey fine to coarse sub-rounded to sub-angular of flint. Sand is fine to coarse.	
		3.10 - 3.20	D					80% Recovery	
		3.40 - 3.50	D		3.32			Firm to stiff grey mottle orangy-brown with some black speckling slightly sand slightly gravelly CLAY. Gravel is white and grey fine to coarse sub-rounded to sub-angular of flint. Sand is fine to medium.	3
					3.73			84% Recovery	
		4.20 - 4.30	D		4.00			Firm to stiff brown mottled grey and orangy-brown with some black speckling slightly gravelly sandy CLAY. Sand is fine to coarse (predominately fine to medium). Gravel is dark grey, brown and white fine to coarse grained sub-rounded to angular of Flint and Chalk.	4
		4.50 - 4.60	D		4.30			Firm to stiff brown mottled grey and orangy-brown slightly sandy CLAY. Sand is fine to medium.	
		4.75 - 4.85	D		4.54			90% Recovery	
					4.85			Firm to stiff grey mottled orangy-brown slightly gravelly slightly sandy CLAY. Sand is fine to medium. Gravel is dark grey, brown and white fine to coarse grained sub-rounded to angular of Flint and Chalk.	4
					5.00			Brown clayey gravelly fine to coarse SAND. Gravel is dark grey, brown and white fine to coarse grained sub-rounded to angular of Flint and Chalk.	5
								Structureless CHALK (Dm), composed white sandy gravelly SILT. Clasts are cream and white fine to coarse gravel sized sub-rounded to sub-angular of very weak low density chalk and black / dark grey Flint. Sand is fine to coarse of Chalk. Matrix is creamy grey and cream.	
								End of Borehole at 5.00m	6
									7
									8
									9
									10

General Remarks:

Groundwater Remarks:

Borehole Type
CP: Cable Percussive
WS: Windowless Sampler
RC: Rotary Cored

Sample Types
D: Disturbed
B: Bulk
J: Jar
W: Water
U: Undisturbed

In-Situ Testing
SPT: Split spoon - Standard Penetration Test
CPT: Cone - Standard Penetration Test

**Soils Limited**

Newton House, Cross Road, Tadworth KT20 5SR

Borehole Log

Borehole No.

WS4

Sheet 1 of 1

Project Name: Cinders Nursery

Project No.: 17034

Co-ords:

Hole Type
WS

Location: Cinders Nursery, Cinders Lane, Yapton

Level:

Scale
1:50

Client: Crayfern Homes

Dates: 03/07/2018

Logged By

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (mAOD)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.15	J+D		0.27			Brown / greyish brown slightly clayey gravelly fine to coarse SAND with low cobble content. Gravel is grey, dark grey, red, brown and white fine to coarse sub-rounded to angular of concrete, brick, charcoal / bitumen, and Flint. Cobbles are angular composed of concrete. Glass, plastic string also present. Roots and rootlets present. MADE GROUND.	
		0.40	J+D						
		0.70 - 0.80	D		0.77 0.82			100% Recovery	
		1.10 - 1.20	D					Friable brown / yellowish brown slightly sandy CLAY. Sand is fine to coarse, coarse grains are seen to be Flint with trace of brick?. Roots and rootlets present. Potentially MADE GROUND or reworked natural (tilled field).	1
		1.50 - 1.60	D		1.43			Firm to stiff brown / yellowish brown slightly sandy CLAY. Sand is fine to medium. Roots and rootlets present.	
		1.80 - 1.90	D					Firm to stiff brown mottled pale grey and orangy-brown with occasional black speckling slightly sandy CLAY. Sand is fine to medium. Roots and rootlets present.	
		2.20 - 2.30	D		2.00 2.40			60% Recovery	2
								Firm brown with some grey and orangy-brown mottling, with some black speckling slightly sandy slightly gravelly CLAY. Gravel is white/ cream, dark grey and grey fine to coarse sub-angular to sub-rounded of Flint and Chalk. Sand is fine to coarse.	
					3.10 3.24 3.30			Firm brown with some grey and orangy-brown mottling, with some black speckling slightly sandy slightly gravelly CLAY. Gravel is white/ cream, dark grey and grey fine to coarse sub-angular to sub-rounded of Flint and Chalk. Sand is fine to coarse.	
		3.10 - 3.20	D					7% Recovery	3
		3.60 - 3.70	D		4.05			100% Recovery	
								Soft to firm brown with some grey and orangy-brown mottling, with some black speckling slightly sandy slightly gravelly CLAY. Gravel is white/ cream, dark grey and grey fine to coarse sub-angular to sub-rounded of Flint and Chalk. Sand is fine to coarse.	4
		4.10 - 4.20	D		4.52			Soft to firm brown with some grey and orangy-brown mottling, with some black speckling slightly sandy slightly gravelly CLAY. Gravel is white/ cream, dark grey and grey fine to coarse sub-angular to sub-rounded of Flint and Chalk. Sand is fine to coarse.	
		4.60 - 4.70	D					Firm brown mottled pale grey and orangey-brown with some black speckling slightly sandy gravelly CLAY. Gravel is white, cream and dark grey fine to coarse sub-rounded to sub-angular of Chalk and Flint, iron staining observed on some of the Chalk clast faces. Sand is fine to coarse.	5
					5.00			85% Recovery	
								Brown mottled grey and orangy-brown clayey sandy fine to coarse sub-rounded to sub-angular GRAVEL. Gravel is composed of white and cream clasts of Chalk and occasional dark grey and brownish-grey clast of Flint. Sand is fine to coarse.	6
								Structureless CHALK (Dm), composed of white, cream and greyish cream sandy gravelly SILT. Clasts are white and cream with some orangy-brown iron staining fine to coarse sub-angular to angular of Chalk and occasional sub-angular to angular dark grey clasts of Flint. Sand is fine to coarse of Chalk. Matrix is cream, brownish cream greyish cream.	7
								End of Borehole at 5.00m	8
									9
									10

General Remarks:

Groundwater Remarks:

Borehole Type
CP: Cable Percussive
WS: Windowless Sampler
RC: Rotary Cored

Sample Types
D: Disturbed
B: Bulk
J: Jar
W: Water
U: Undisturbed

In-Situ Testing
SPT: Split spoon - Standard Penetration Test
CPT: Cone - Standard Penetration Test



Soils Limited

Newton House, Cross Road, Tadworth KT20 5SR

Probe Log

Probe No.

DP1

Sheet 1 of 1

Project Name:	Cinders Nursery	Project No.	17034	Co-ords:		Hole Type	DP
Location:	Cinders Nursery, Cinders Lane, Yapton	Level:	m AOD			Scale	1:50
Client:	Crayfern Homes	Dates:	03/07/2018			Logged By	

Depth (m)	Blows/100mm				Torque (Nm)
	10	20	30	40	
	8				
	9				
	4				
	3				
	3				
	1				
	2				
1	1				
	1				
	2				
	1				
	2				
	3				
	2				
	3				
2	4				
	3				
	4				
	3				
	2				
	3				
	3				
	3				
	3				
3	2				
	1				
	2				
	2				
	2				
	2				
	2				
	2				
	1				
	2				
4	3				
	4				
	6				
	7				
	5				
	6				
	8				
	9				
	10				
	10				
5	12				
	12				
	8				
	9				
	9				
	10				
	10				
	11				
	9				
	10				
6	12				
	12				
7					
8					
9					
10					
Remarks	Fall Height mm		Cone Base Diameter mm		
	Hammer Weight kg		Final Depth 6m		
	Probe Type		Energy Ratio (Er) %		

Probe Log

Probe No.

DP2

Sheet 1 of 1

Project Name: Cinders Nursery

Project No.
17034

Co-ords:

Hole Type
DP

Location: Cinders Nursery, Cinders Lane, Yapton

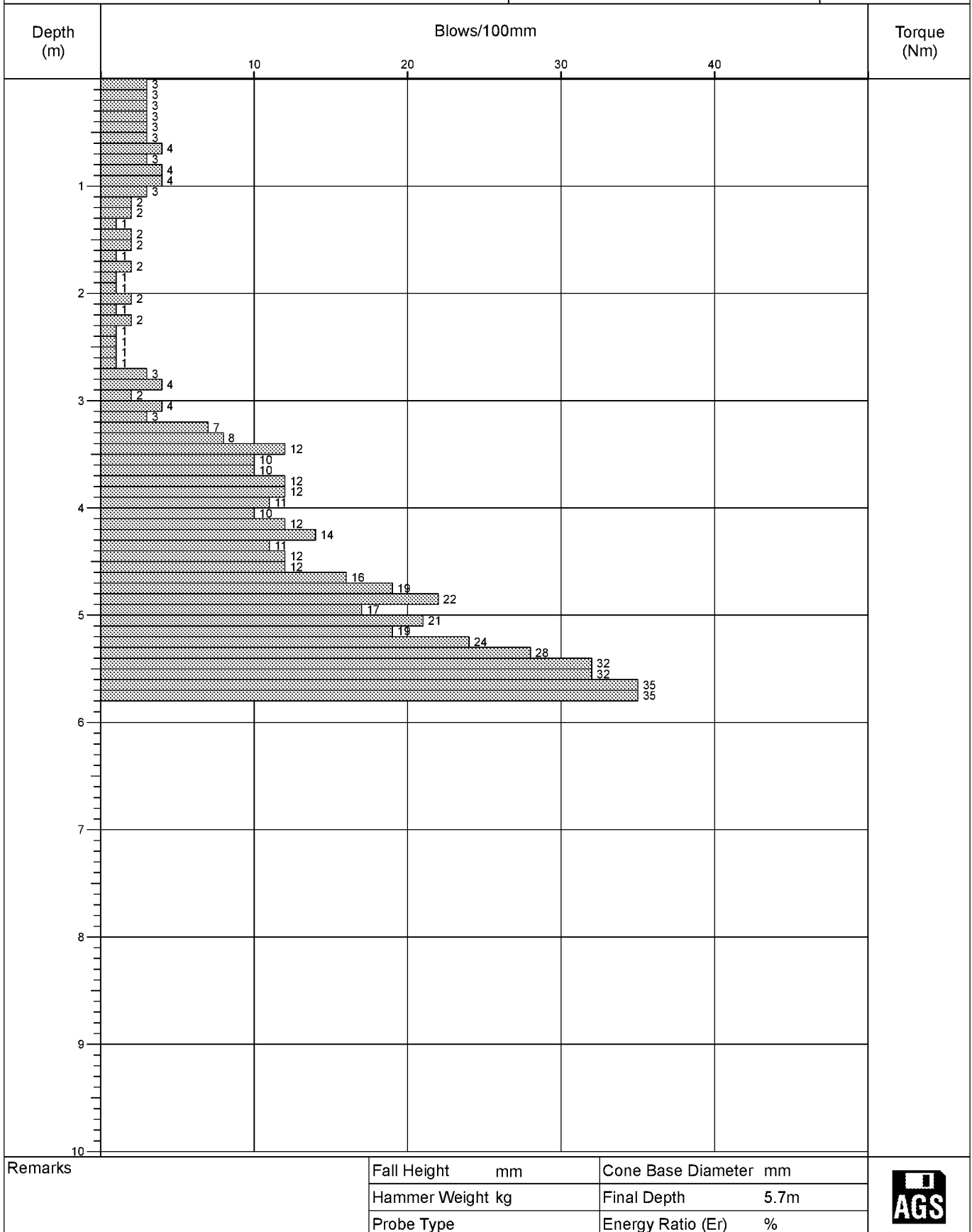
Level: m AOD

Scale
1:50

Client: Crayfern Homes

Dates: 03/07/2018

Logged By





Soils Limited

Newton House, Cross Road, Tadworth KT20 5SR

Probe Log

Probe No.

DP3

Sheet 1 of 1

Project Name:	Cinders Nursery	Project No.	17034	Co-ords:		Hole Type	DP
Location:	Cinders Nursery, Cinders Lane, Yapton	Level:	m AOD			Scale	1:50
Client:	Crayfern Homes	Dates:	03/07/2018			Logged By	

Depth (m)	Blows/100mm				Torque (Nm)
	10	20	30	40	
0.0	3	5	11	14	
0.1	8	7	4	4	
0.2	2	2	1	1	
0.3	1	2	2	1	
0.4	2	3	3	4	
0.5	3	4	3	4	
0.6	3	4	3	4	
0.7	3	4	3	4	
0.8	3	4	3	4	
0.9	3	4	3	4	
1.0	3	4	3	4	
1.1	3	4	3	4	
1.2	3	4	3	4	
1.3	3	4	3	4	
1.4	3	4	3	4	
1.5	3	4	3	4	
1.6	3	4	3	4	
1.7	3	4	3	4	
1.8	3	4	3	4	
1.9	3	4	3	4	
2.0	3	4	3	4	
2.1	3	4	3	4	
2.2	3	4	3	4	
2.3	3	4	3	4	
2.4	3	4	3	4	
2.5	3	4	3	4	
2.6	3	4	3	4	
2.7	3	4	3	4	
2.8	3	4	3	4	
2.9	3	4	3	4	
3.0	3	4	3	4	
3.1	3	4	3	4	
3.2	3	4	3	4	
3.3	3	4	3	4	
3.4	3	4	3	4	
3.5	3	4	3	4	
3.6	3	4	3	4	
3.7	3	4	3	4	
3.8	3	4	3	4	
3.9	3	4	3	4	
4.0	3	4	3	4	
4.1	3	4	3	4	
4.2	3	4	3	4	
4.3	3	4	3	4	
4.4	3	4	3	4	
4.5	3	4	3	4	
4.6	3	4	3	4	
4.7	3	4	3	4	
4.8	3	4	3	4	
4.9	3	4	3	4	
5.0	3	4	3	4	
5.1	3	4	3	4	
5.2	3	4	3	4	
5.3	3	4	3	4	
5.4	3	4	3	4	
5.5	3	4	3	4	
5.6	3	4	3	4	
5.7	3	4	3	4	
5.8	3	4	3	4	
5.9	3	4	3	4	
6.0	3	4	3	4	
6.1	3	4	3	4	
6.2	3	4	3	4	
6.3	3	4	3	4	
6.4	3	4	3	4	
6.5	3	4	3	4	
6.6	3	4	3	4	
6.7	3	4	3	4	
6.8	3	4	3	4	
6.9	3	4	3	4	
7.0	3	4	3	4	
7.1	3	4	3	4	
7.2	3	4	3	4	
7.3	3	4	3	4	
7.4	3	4	3	4	
7.5	3	4	3	4	
7.6	3	4	3	4	
7.7	3	4	3	4	
7.8	3	4	3	4	
7.9	3	4	3	4	
8.0	3	4	3	4	
8.1	3	4	3	4	
8.2	3	4	3	4	
8.3	3	4	3	4	
8.4	3	4	3	4	
8.5	3	4	3	4	
8.6	3	4	3	4	
8.7	3	4	3	4	
8.8	3	4	3	4	
8.9	3	4	3	4	
9.0	3	4	3	4	
9.1	3	4	3	4	
9.2	3	4	3	4	
9.3	3	4	3	4	
9.4	3	4	3	4	
9.5	3	4	3	4	
9.6	3	4	3	4	
9.7	3	4	3	4	
9.8	3	4	3	4	
9.9	3	4	3	4	
10.0	3	4	3	4	
Remarks	Fall Height mm	Cone Base Diameter mm			
	Hammer Weight kg	Final Depth 6m			
	Probe Type	Energy Ratio (Er) %			





Soils Limited

Newton House, Cross Road, Tadworth KT20 5SR

Probe Log

Probe No.

DP4

Sheet 1 of 1

Project Name:	Cinders Nursery	Project No.	17034	Co-ords:		Hole Type	DP
Location:	Cinders Nursery, Cinders Lane, Yapton	Level:	m AOD			Scale	1:50
Client:	Crayfern Homes	Dates:	03/07/2018			Logged By	

Depth (m)	Blows/100mm				Torque (Nm)
	10	20	30	40	
1	5 5 5 6 7 4 5 4 3 3 3				
2	1 2 1 1 0 0 1 2 4 2 3 5 4 3 3 3				
3	5 4 5 5 7 10 10 7 8 8 7 8 9 11 10 9 9 10 12 12 11 9 11 10 10 9				
4	11 10 10 11 11 11 10 10 11 11				
5	11 11				
6					
7					
8					
9					
10					
Remarks	Fall Height mm		Cone Base Diameter mm		
	Hammer Weight kg		Final Depth 6m		
	Probe Type		Energy Ratio (Er) %		

**Soils Limited**

Newton House, Cross Road, Tadworth KT20 5SR

Trial Pit Log

Trial Pit No.

TP01

Sheet 1 of 1

Project Name: Cinders Nursery

Project No.: 17034

Method:

Plant:

Support:

Hole Type

TP

Scale

1:25

Logged By

Location: Cinders Nursery, Cinders Lane, Yapton

Client: Crayfern Homes

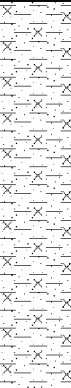
Trial Pit Length: m

Trial Pit Width: m

Dates: 03/07/2018

Level:

Co-ords:

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.20	J D		0.25			Dark grey and black silty gravelly SAND comprising metal, tarmac, flint and clinker. MADE GROUND	
	0.80	D					Firm brown mottled orangish brown slightly sandy slightly silty CLAY with frequent roots and rootlets.	1
	1.20	D						
	1.60	D		1.55			Light brown gravelly CLAY. Gravel fine to medium putty Chanel and subangular flint.	
				1.80			End of Pit at 1.80m	2
								3
								4
								5

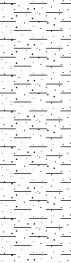
General Remarks:

Sample Type

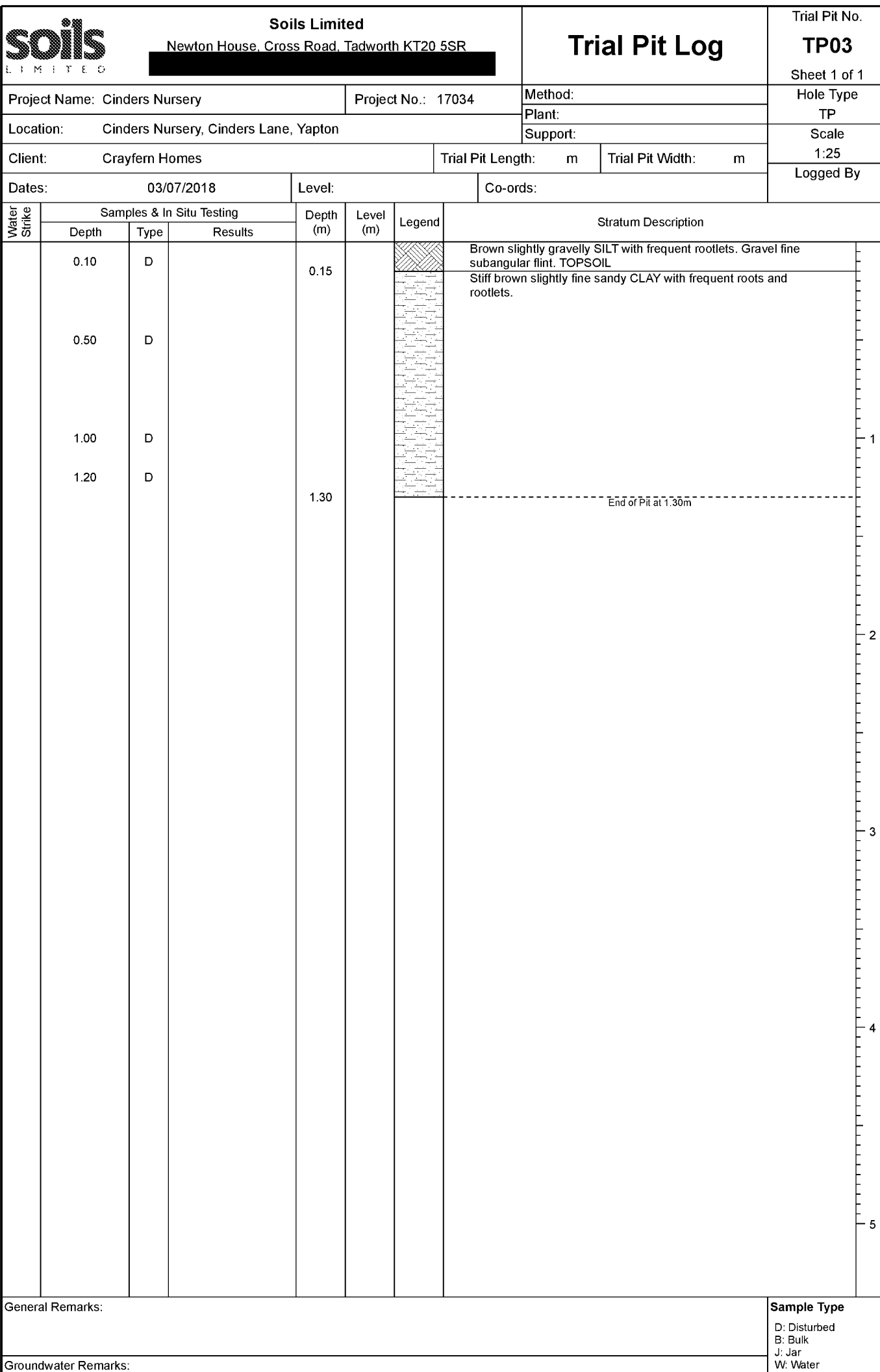
D: Disturbed
B: Bulk
J: Jar
W: Water

Groundwater Remarks:

Project Name: Cinders Nursery		Project No.: 17034		Method:		Hole Type TP
Location: Cinders Nursery, Cinders Lane, Yapton				Plant:		
Client: Crayfern Homes		Trial Pit Length: m		Trial Pit Width: m		
Dates: 03/07/2018		Level:		Co-ords:		Scale 1:25
						Logged By

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.20	D J		0.30			Brown gravelly SILT comprising metal, tile, brick, concrete, plastic and occasional angular fragments of shiny low density metallic material. MADE GROUND	
	0.50	D					Stiff brown slightly fine sandy CLAY with frequent roots and rootlets.	1
	1.00	D		1.20			Firm to stiff slightly gravelly slightly sandy CLAY. Frequent roots, rootlets and potentially dessicated roots. Gravel fine to coarse subangular clasts of flint.	
	1.50	D		1.60			Light yellowish brown gravelly silty SAND with occasional subrounded flint cobbles. Gravel is fine occasionally medium to coarse subangular flint and putty chalk.	2
	1.70	D						
	2.00	D						
	2.50	D						
	2.95	D		2.95			End of Pit at 2.95m	3
								4
								5

General Remarks:	Sample Type D: Disturbed B: Bulk J: Jar W: Water
Groundwater Remarks:	



Project Name: Cinders Nursery		Project No.: 17034		Method:		Hole Type TP
Location: Cinders Nursery, Cinders Lane, Yapton				Plant:		
Client: Crayfern Homes		Trial Pit Length: m		Trial Pit Width: m		
Dates: 03/07/2018		Level:		Co-ords:		Scale 1:25
						Logged By

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.10	J D		0.20			Medium to coarse flint GRAVEL over black membrane and fragmented concrete. MADE GROUND	
							Very stiff brown CLAY with frequent roots and rootlets.	1
	1.00	D						
				1.60			Dark brown mottled grey CLAY with occasional roots and rootlets to 2.00m bgl.	2
	2.00	D						
	2.50	D		2.80				
							End of Pit at 2.80m	3
								4
								5

General Remarks:	Sample Type D: Disturbed B: Bulk J: Jar W: Water
Groundwater Remarks:	

Appendix B Geotechnical In-Situ and Laboratory Testing

Appendix B.1 Classification

Classification based on SPT “N” values:

The inferred undrained strength of the cohesive soils was based on the SPT “N” blow counts, derived from the relationship suggested by Stroud (1974) and classified using Table B.1.1. (Ref: Stroud, M. A. 1974, “The Standard Penetration Test – its application and interpretation”, Proc. ICE Conf. on Penetration Testing in the UK, Birmingham. Thomas Telford, London.).

Table B.1.1 SPT “N” Blow Count Cohesive Classification

Classification	Undrained Cohesive Strength c_u (kPa)
Extremely low	<10
Very low	10 – 20
Low	20 – 40
Medium	40 – 75
High	75 – 150
Very high	150 – 300
Extremely high	> 300

Note: (Ref: BS EN ISO 14688-2:2004+A1:2013 Clause 5.3.)

The relative density of granular soils was classified based of the relationship given in Table B.1.2.

The *UK National Annex to Eurocode 7: Geotechnical design – Part 2: Ground investigation and testing, NA 3.7 SPT test, BS EN 1997-2:2007, Annex F* states “Relative density descriptions on borehole records should also be based on uncorrected SPT N values, unless significantly disturbed, using the density classification in BS 5930:2015, Table 7.

Table B.1.2 SPT “N” Blow Count Granular Classification

Classification	SPT “N” blow count (blows/300mm)
Very loose	0 to 4
Loose	4 to 10
Medium dense	10 to 30
Dense	30 to 50
Very dense	Greater than 50

Note: (Ref: The Standard Penetration Test (SPT): Methods and Use, CIRIA Report 143, 1995)

Chalk samples recovered are disturbed by the sampling process. Therefore, it is difficult to assess an accurate chalk grade for in accordance with CIRIA C574 ‘Engineering in

Chalk'. In the absence of a standardised correlation between SPT "N" values and chalk grade for the most recent chalk classification (CIRIA C574) a broad indication of the in-situ chalk grade can be assessed using a paper by T.R.M. Wakeling from a site in Mundford, Norfolk, which compares SPT "N" values to the old Spink & Norbury chalk classification. From the Spink & Norbury classification it is possible to infer a basic CIRIA Grade (structureless or structured), as outlined in Table B.1.3.

Table B.1.3 Interpretation of SPT "N" Blow Counts in Chalk

SPT "N" Value Range	Spink & Norbury Grade	Inferred CIRIA Grade
<8	VI	Structureless (Dm)
8 – 15	V	Structureless (Dc)
15 – 20	IV	Structured chalk (C5 – A1)
20 - 25	III	Structured chalk (C5 – A1)
25 - 35	II	Structured chalk (C5 – A1)
>35	I	Structured chalk (C5 – A1)

Note:

Classification of DCP results to CBR:

The DCP consists of a cone fixed to the bottom of a 575mm vertical rod. An 8kg weight is repeatedly lifted and dropped onto an anvil at the mid-height of the rod to deliver a 'blow'. A vertical scale alongside the rod is used to measure the depth of penetration of the cone. These measurements are then converted to CBR values using the following equation derived from the DTP Interim Advice Note 73/06 – Design Guidance for Road Pavement Foundations:

$$\text{Log}_{10}(\text{CBR}) = 2.48 - 1.057 \times \text{Log}_{10}(\text{mm/blow})$$

Appendix B.2 Interpretation

Table B.2.1 Interpretation of DPSH Blow Counts

DP	Strata	Equivalent SPT N60 Blow Counts	Inferred Cohesive Strength/Relative Density/Approximate CIRIA Chalk Grade
DPI	RTD 1.00 – 4.00 Gravelly CLAY	5 – 13	Low to medium ($C_u = 25 - 65\text{kPa}$)
	RTD 4.00 – 4.15 Gravelly SAND	14	Medium dense
	RTD 4.15 – 4.84 Sandy gravelly CLAY	21 – 32	High to very high ($C_u = 105 - 160\text{kPa}$)
	WHCK ¹ 4.84 – 6.00 CHALK	30 – 40	Structured chalk (C5 – A1)
DP2	RTD 1.10 – 2.40 Sandy gravelly CLAY	5 – 6	Low ($C_u = 25 - 30\text{kPa}$)
	WHCK ¹ 2.40 – 3.20 CHALK	4 – 12	Structureless (Dm) to structureless (Dc)
	WHCK ¹ 3.20 – 5.70 CHALK	32 – >50	Structured chalk (C5 – A1)
DP3	RTD 1.00 – 1.70 Sandy CLAY	5 – 6	Low ($C_u = 25 - 30\text{kPa}$)
	RTD 1.70 – 3.70 Gravelly CLAY	11 – 13	Medium ($C_u = 55 - 65\text{kPa}$)
	RTD 3.70 – 4.54 Sandy gravelly CLAY	23 – 28	High ($C_u = 115 - 140\text{kPa}$)
	RTD 4.54- 4.85 Clayey gravelly SAND	26 – 29	Medium dense
	WHCK ¹ 4.85 – 6.00 CHALK	30 – 41	Structured chalk (C5 – A1)
DP4	RTD 1.00 – 2.30 Sandy gravelly CLAY	1 - 8	Very low ($C_u = <10 - 40\text{kPa}$)
	RTD 2.30 – 3.60 Sandy gravelly CLAY	11 – 16	Medium to high ($C_u = 55 - 80\text{kPa}$)
	RTD 3.60 – 4.52 Gravelly CLAY / clayey GRAVEL	27 – 32	High to very high / medium dense to dense ($C_u = 135 - 160\text{kPa}$)

DP	Strata	Equivalent SPT N60 Blow Counts	Inferred Cohesive Strength/Relative Density/Approximate CIRIA Chalk Grade
	WHCK ¹ 4.52 – 6.00 CHALK	33 – 41	Structured chalk (C5 – A1)

Note: ¹ Ground conditions inferred past the base of windowless sampler boreholes.

Table B.2.2 Interpretation of Atterberg Limit Tests

Stratum	Moisture Content (%)	Plasticity Index (%)	Passing 425µm Sieve (%)	Modified Plasticity Index (%)	Soil Classification	Volume Change Potential	
						BRE	NHBC
RTD	15 – 23	7 – 20	90 – 100	6.3 – 20	CL - CI	Medium	Medium

Note: BRE Volume Change Potential refers to BRE Digest 240 (based on Atterberg results)

NHBC Volume Change Potential refers to NHBC Standards Chapter 4.2

Soils Classification based on British Soil Classification System

The most common use of the term clay is to describe a soil that contains enough clay-sized material or clay minerals to exhibit cohesive properties. The fraction of clay-sized material required varies, but can be as low as 15%. Unless stated otherwise, this is the sense used in Digest 240. The term can be used to denote the clay minerals. These are specific, naturally occurring chemical compounds, predominately silicates. The term is often used as a particle size descriptor. Soil particles that have a nominal diameter of less than 2 µm are normally considered to be of clay size, but they are not necessarily clay minerals. Some clay minerals are larger than 2 µm and some particles, 'rock flour' for example, can be finer than 2 µm but are not clay minerals.

(The Atterberg Limit Tests were undertaken in accordance with BS 1377:Part 2:1990 Clauses 3.2, 4.3 and 5)

Table B.2.3 Interpretation of PSD Tests

Location	Depth (m bgl)	Soil Description	Volume Change Potential		Passing 63µm Sieve (%)
			BRE	NHBC	
TP2	2.50	Brown fine to coarse gravelly fine to coarse sandy SILT/CLAY	Yes	Yes	58
WS1	3.90	Brown fine to coarse sandy fine to coarse gravelly SILT/CLAY	Yes	Yes	49

Note: BRE 240 states that a soil has a volume change potential when the clay fraction **exceeds 15%**. Only the silt and clay combined fraction are determined by sieving therefore the volume change potential is estimated from the percentage passing the 63µm sieve. NHBC Standards Chapter 4.2 states that a soil is shrinkable if the percentage of silt and clay passing the 63µm sieve is greater than 35% and the Plasticity Index is greater than 10%.

(The Particle Size Distribution Tests were undertaken in accordance with BS 1377: Part 2: 1990 Clause 9)

Table B.2.4 Interpretation of Soil Density Tests

Location	Depth (m bgl)	Bulk Density (Mg/m ³)	Dry Density (Mg/m ³)	Moisture Content (%)
WS2	3.30	1.78	1.50	19
WS4	4.60	2.05	1.69	21

Note: Samples unsuitable for SMC analysis, so density tests using 2.5kg rammer undertaken (BS 1377: Pt2: 7/8:1990)

Appendix B.3 Geotechnical In-Situ and Laboratory Results



Contract Number: 40079

Client Ref: **17034**

Report Date: **02-08-2018**

Client PO: **17034/SB**

Client **Soils Limited**
Newton House
Cross Road
Tadworth
Surrey
KT20 5SR

Contract Title: **Cinders Nursery**
For the attention of: **Sam Bevins**

Date Received: **20-07-2018**
Date Commenced: **20-07-2018**
Date Completed: **02-08-2018**

Test Description	Qty
Moisture Content BS 1377:1990 - Part 2 : 3.2 - * UKAS	4
4 Point Liquid & Plastic Limit (LL/PL) BS 1377:1990 - Part 2 : 4.3 & 5.3 - * UKAS	4
PSD Wet Sieve method BS 1377:1990 - Part 2 : 9.2 - * UKAS	2
Remoulded Bulk/Dry Density on a disturbed sample 1377 : 1990 Part 4 : 4.3/4.4 - * UKAS	2
Disposal of samples for job	1

Notes: Observations and Interpretations are outside the UKAS Accreditation

* - denotes test included in laboratory scope of accreditation

- denotes test carried out by approved contractor

@ - denotes non accredited tests

This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service. The results reported herein relate only to the material supplied to the laboratory. This certificate shall not be reproduced except in full, without the prior written approval of the laboratory.

Approved Signatories:

Alex Wynn (Associate Director) - Ben Sharp (Contracts Manager) - Emma Sharp (Office Manager)

Paul Evans (Quality/Technical Manager) - Richard John (Advanced Testing Manager) - Sean Penn (Administrative/Accounts Assistant)

Wayne Honey (Administrative/Quality Assistant)

GEO Site & Testing Services Ltd

Unit 3-4, Heol Aur, Dafen Ind Estate, Dafen, Llanelli, Carmarthenshire SA14 8QN

LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX (BS 1377 : Part 2 : 1990 Method 5)

[illegible]

Operators	Checked	01/08/2018	Wayne Honey	
RO/MH	Approved	02/08/2018	Ben Sharp	



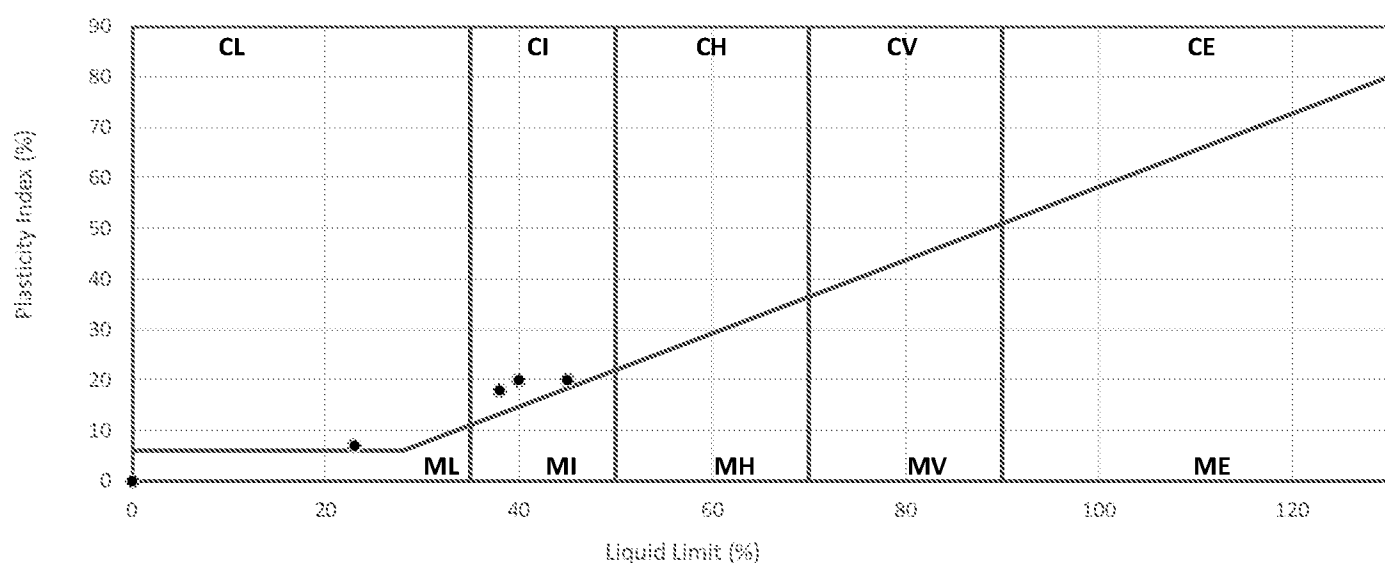
LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX (BS 1377 : Part 2 : 1990 Method 5)

Contract Number	40079	
Site Name	Cinders Nursery	

[illegible]

Symbols: NP : Non Plastic # : Liquid Limit and Plastic Limit Wet Sieved

PLASTICITY CHART FOR CASAGRANDE CLASSIFICATION



Operators	Checked	01/08/2018	Wayne Honey	
DB	Approved	02/08/2018	Ben Sharp	





PARTICLE SIZE DISTRIBUTION
BS 1377 Part 2:1990
Wet Sieve, Clause 9.2

Contract Number

40079

Borehole/Pit No.

TP2

Site Name

Cinders Nursery

Sample No.

Soil Description

Brown fine to coarse gravelly fine to coarse sandy SILT/CLAY

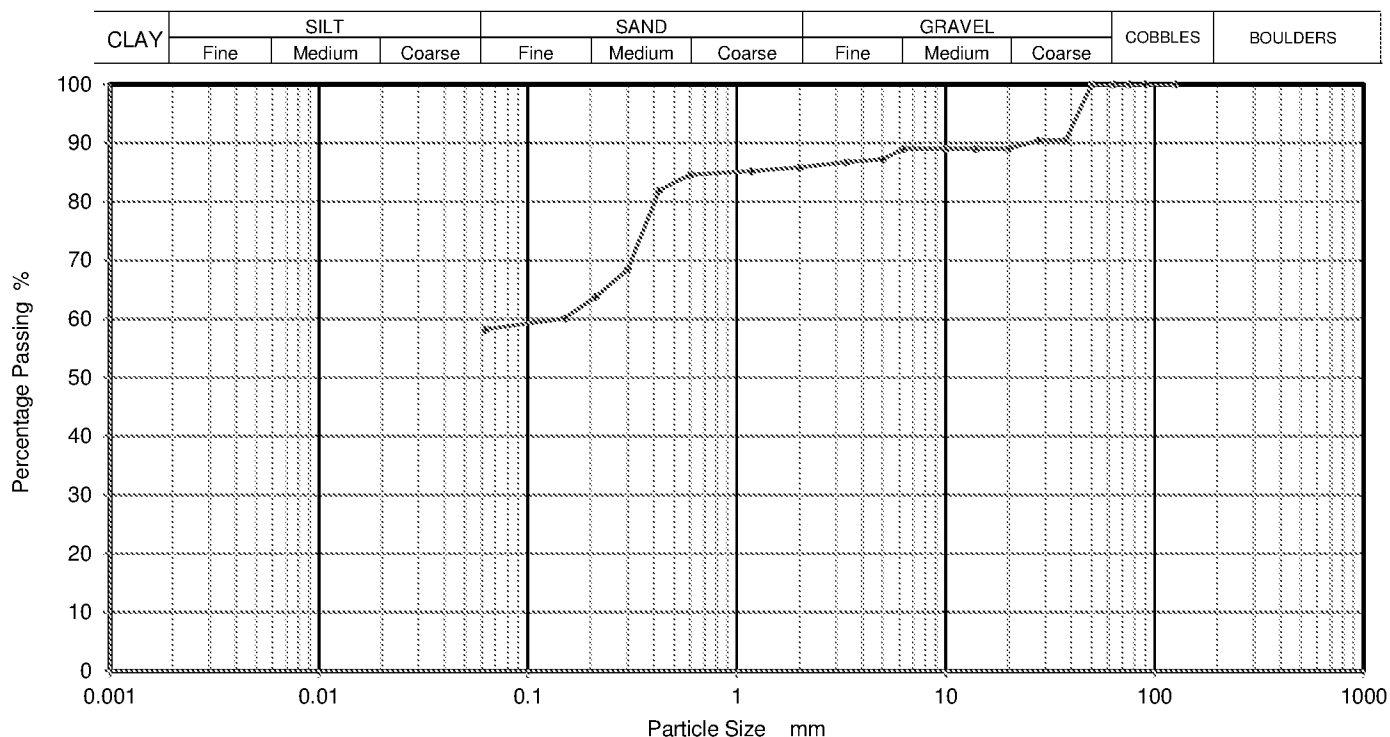
Depth Top

2.50

Depth Base

Sample Type

B/D



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0200	
90	100	0.0060	
75	100	0.0019	
63	100		
50	100		
37.5	90		
28	90		
20	89		
14	89		
10	89		
6.3	89		
5	87		
3.35	87		
2	86		
1.18	85		
0.6	85		
0.425	82		
0.3	68		
0.212	64		
0.15	60		
0.063	58		

Sample Proportions	% dry mass
Cobbles	0
Gravel	14
Sand	28
Silt and Clay	58

Grading Analysis	
Uniformity Coefficient	

Remarks

Preparation and testing in accordance with BS1377 unless noted below

Operators	Checked	01/08/2018	Wayne Honey	
RO/MH	Approved	02/08/2018	Ben Sharp	





PARTICLE SIZE DISTRIBUTION
BS 1377 Part 2:1990
Wet Sieve, Clause 9.2

Contract Number

40079

Borehole/Pit No.

WS1

Site Name

Cinders Nursery

Sample No.

Soil Description

Brown fine to coarse sandy fine to coarse gravelly SILT/CLAY

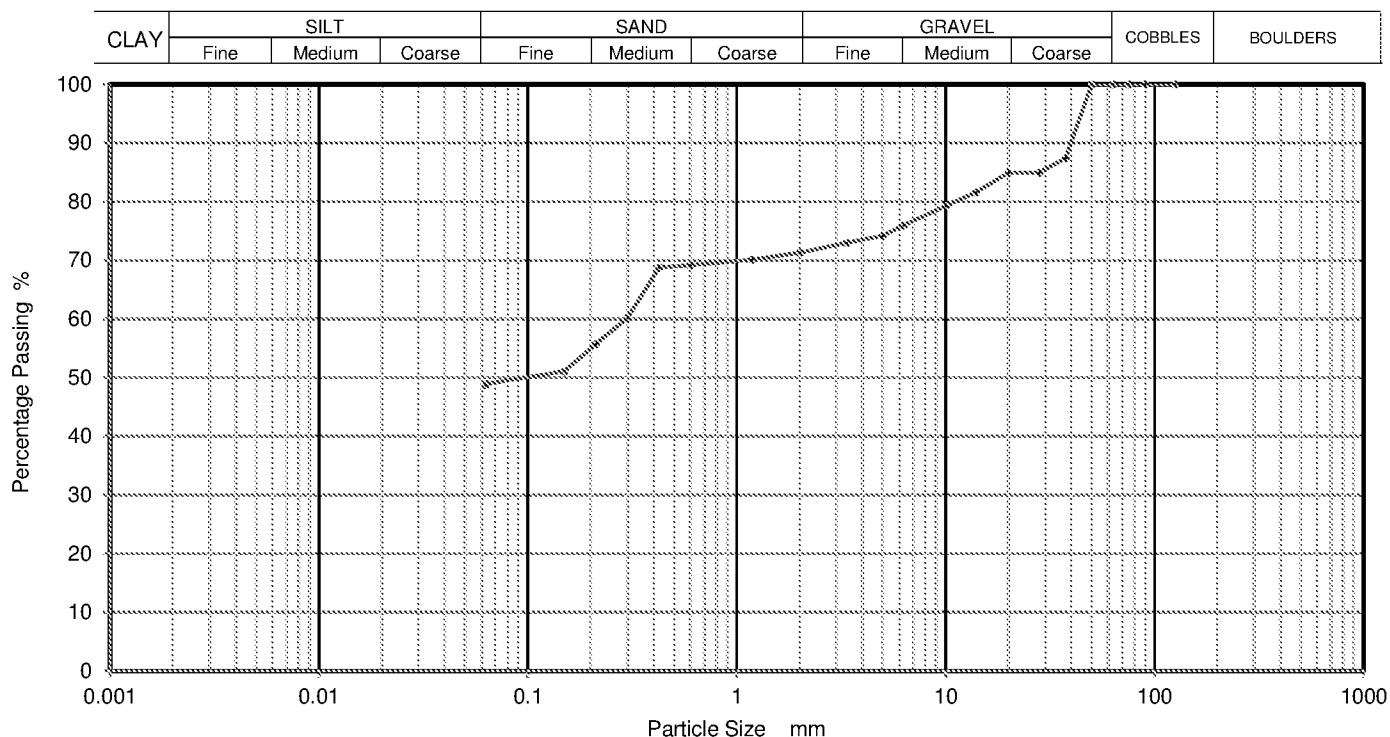
Depth Top

3.90

Depth Base

Sample Type

D



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0200	
90	100	0.0060	
75	100	0.0019	
63	100		
50	100		
37.5	87		
28	85		
20	85		
14	82		
10	79		
6.3	76		
5	74		
3.35	73		
2	71		
1.18	70		
0.6	69		
0.425	69		
0.3	60		
0.212	56		
0.15	51		
0.063	49		

Sample Proportions	% dry mass
Cobbles	0
Gravel	29
Sand	22
Silt and Clay	49

Grading Analysis	
Uniformity Coefficient	

Remarks

Preparation and testing in accordance with BS1377 unless noted below

Operators	Checked	01/08/2018	Wayne Honey	
RO/MH	Approved	02/08/2018	Ben Sharp	





Contract Number

40079

Site Name

Cinders Nursery

Key

Reported As

Operators

Checked

01/08/2018

Wayne Honey

CA/JS

Approved

02/08/2018

Ben Sharp



Appendix C Chemical Laboratory Testing

Appendix C.1 Conceptual Site Model

Table CI.1 CSM Revised Pre Testing

Source	Potential Contaminant	Exposure Pathway	Receptor	Initial Assessment from Preliminary Investigation Report Information			Comments	Proposed Investigation
				Severity	Probability	Risk		
Onsite Source Made Ground, and shallow soils, ASTs	Metals and semi-metals, organic solvents, Asbestos, sulphates, VOCs, TPH, PAH, Pesticides and herbicides	Inhalation of dust	Site Workers/Site Maintenance	Mild	Likely	Low / moderate	Private gardens and amenity areas are proposed	Further investigation required, Chemical Testing Required
			End Users	Mild	Likely	Low / moderate		
			Off-site Users	Mild	Likely	Low / moderate		
	None noted	Inhalation of Vapour/gases (including Radon)	Site Workers/Site Maintenance	Minor	None	None	Limited Made Ground with low organic content, to be largely removed.	
			End Users	Minor	None	None		
			Off-site Users	Minor	None	None		
	Metals and semi-metals, organic solvents, Asbestos, sulphates, VOCs, TPH, PAH, Pesticides and herbicides	Ingestion and absorption via direct contact	Site Workers/Site Maintenance	Mild	Likely	Low / moderate	Private gardens and amenity areas are proposed	
			End Users	Mild	Likely	Low / moderate		
		Migration via surface runoff	Surface Water	Mild	Likely	Low / moderate	Down towards the trainline embankment then to the south at low velocity	Site underlain by Secondary A and Principal Aquifers. No SPZ.
		Migration in solution via groundwater	Surface Water	Mild	Low	Low		
			Shallow Aquifer	Mild	Low	Low		
			Deep Aquifer	Mild	Low	Low		
		Direct contact with construction material	Buried structures	Mild	Low	Low	Possible PAH and TPH contamination.	
			Buried Services	Mild	Low	Low		
	None noted	Migration of gases via permeable soils	Site Workers/Site Maintenance	Minor	None	None	Limited Made Ground with low organic content, to be largely removed.	
			End Users	Minor	None	None		
			Off-site Users	Minor	None	None		
			Building and confined spaces	Minor	None	None		
Off-site Source Allotments	Pesticides and herbicides	Inhalation of dust	Site Workers/Site Maintenance	Mild	Unlikely	Very Low	Private gardens and amenity areas are proposed	Further investigation required, Chemical Testing Required
			End Users	Mild	Unlikely	Very Low		
			Off-site Users	Mild	Unlikely	Very Low		
	None noted	Inhalation of Vapour/gases (including Radon)	Site Workers/Site Maintenance	Minor	None	None	Limited Made Ground with low organic content, to be largely removed.	
			End Users	Minor	None	None		
			Off-site Users	Minor	None	None		
	Pesticides and herbicides	Ingestion and absorption via direct contact	Site Workers/Site Maintenance	Mild	Unlikely	Very Low	Private gardens and amenity areas are proposed	
			End Users	Mild	Unlikely	Very Low		
		Migration via surface runoff	Surface Water	Mild	Unlikely	Very Low	Limited due to variable permeability of the underlying stratum	Limited source. Site underlain by Secondary A and Principal Aquifers. No SPZ.
		Migration in solution via groundwater	Surface Water	Mild	Unlikely	Very Low		
			Shallow Aquifer	Mild	Unlikely	Very Low		
			Deep Aquifer	Mild	Unlikely	Very Low		
		Direct contact with construction material	Buried structures	Minor	None	None	No risk from source type.	
			Buried Services	Minor	None	None		
	None noted	Migration of gases via permeable soils	Site Workers/Site Maintenance	Minor	None	None	Limited Made Ground with low organic content, to be largely removed.	
			End Users	Minor	None	None		
			Off-site Users	Minor	None	None		
			Building and confined spaces	Minor	None	None		

Table CI.2 CSM Revised Post Testing

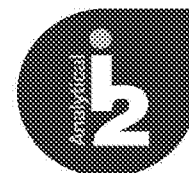
Source	Potential Contaminant	Exposure Pathway	Receptor	Initial Assessment from Preliminary Investigation Report Information			Comments	Proposed Investigation
				Severity	Probability	Risk		
Onsite Source Made Ground, and shallow soils, ASTs	Lead and PAHs	Inhalation of dust	Site Workers/Site Maintenance	Mild	Likely	Low / moderate	Private gardens and amenity areas are proposed	Further investigation required, Further testing / remediation required
			End Users	Mild	Likely	Low / moderate		
			Off-site Users	Mild	Likely	Low / moderate		
	None noted	Inhalation of Vapour/gases (including Radon)	Site Workers/Site Maintenance	Minor	None	None	Limited Made Ground with low organic content, to be largely removed.	
			End Users	Minor	None	None		
			Off-site Users	Minor	None	None		
	Lead and PAHs	Ingestion and absorption via direct contact	Site Workers/Site Maintenance	Mild	Likely	Low / moderate	Private gardens and amenity areas are proposed	
			End Users	Mild	Likely	Low / moderate		
		Migration via surface runoff	Surface Water	Mild	Likely	Low / moderate	Down towards the trainline embankment then to the south at low velocity	
		Migration in solution via groundwater	Surface Water	Mild	Low	Low	Site underlain by Secondary A and Principal Aquifers. No SPZ.	
			Shallow Aquifer	Mild	Low	Low		
			Deep Aquifer	Mild	Low	Low		
		Direct contact with construction material	Buried structures	Mild	Low	Low	Possible PAH and TPH contamination.	
			Buried Services	Mild	Low	Low		
	None noted	Migration of gases via permeable soils	Site Workers/Site Maintenance	Minor	None	None	Limited Made Ground with low organic content, to be largely removed.	
			End Users	Minor	None	None		
			Off-site Users	Minor	None	None		
			Building and confined spaces	Minor	None	None		

Appendix C.2 Chemical Laboratory Results



Sam Bevins

Soils Ltd
The Work Box, PZ 360
St. Mary's Terrace
Penzance
TR18 4DZ



Environmental Science

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

e: sb@soilslimited.co.uk



Combined Report Nos : 18-92946 & 18-93096

Project / Site name:	Cinders Nursery	Samples received on:	17/07/2018
Your job number:	17034	Samples instructed on:	17/07/2018
Your order number:	17034-SB	Analysis completed by:	24/07/2018
Report Issue Number:	1	Report issued on:	25/07/2018
Samples Analysed:	9 soil samples		

Signed:



Jordan Hill
Reporting 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.

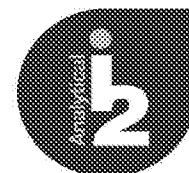
Accredited tests are defined within the report, opinions and interpretations expressed herein are outside the scope of accreditation.

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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Environmental Science

Combined Report Nos : 18-92946 & 18-93096

Project / Site name: Cinders Nursery

Your Order No: 17034-SB

Lab Sample Number	1003362			1003363			1003364			1003365			1003366		
Sample Reference	WS1			WS2			WS2			WS3			WS3		
Sample Number	None Supplied			None Supplied			None Supplied			None Supplied			None Supplied		
Depth (m)	0.35			0.30			1.10			0.50			0.80		
Date Sampled	11/07/2018			11/07/2018			11/07/2018			11/07/2018			11/07/2018		
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		
Moisture Content	%	N/A	NONE	6.6			8.3			11			8.1		
Total mass of sample received	kg	0.001	NONE	0.50			0.45			0.54			0.44		

Asbestos in Soil	Type	N/A	ISO 17025	Not-detected	Not-detected	Not-detected	Not-detected	Not-detected
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General Inorganics

pH - Automated	pH Units	N/A	MCERTS	7.8	7.9	8.4	10.2	8.4
Total Cyanide	mg/kg	1	MCERTS	< 1	< 1	< 1	< 1	< 1
Total Sulphate as SO ₄	mg/kg	50	MCERTS	-	-	-	-	-
Water Soluble SO ₄ 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	0.058	0.018	0.036	0.018	0.050
Water Soluble SO ₄ 16hr extraction (2:1 Leachate Equivalent)	mg/l	1.25	MCERTS	-	-	-	-	-
Sulphide	mg/kg	1	MCERTS	9.7	< 1.0	< 1.0	2.4	< 1.0
Water Soluble Chloride (2:1)	mg/kg	1	MCERTS	-	-	-	-	-
Total Sulphur	mg/kg	50	MCERTS	-	-	-	-	-
Ammonium as NH ₄	mg/kg	0.5	MCERTS	-	-	-	-	-
Organic Matter	%	0.1	MCERTS	3.5	3.5	0.3	2.1	1.3
Total Organic Carbon (TOC)	%	0.1	MCERTS	2.0	2.0	0.1	1.2	0.7
Water Soluble Nitrate (2:1) as N	mg/kg	2	NONE	-	-	-	-	-

Total Phenols

Total Phenols (monohydric)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
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Speciated PAHs

Naphthalene	mg/kg	0.05	MCERTS	1.2	0.42	< 0.05	< 0.05	< 0.05
Acenaphthylene	mg/kg	0.05	MCERTS	1.5	0.33	< 0.05	< 0.05	< 0.05
Acenaphthene	mg/kg	0.05	MCERTS	7.5	0.14	< 0.05	< 0.05	< 0.05
Fluorene	mg/kg	0.05	MCERTS	10	0.13	< 0.05	< 0.05	< 0.05
Phenanthrene	mg/kg	0.05	MCERTS	77	1.5	< 0.05	0.18	< 0.05
Anthracene	mg/kg	0.05	MCERTS	26	0.38	< 0.05	< 0.05	< 0.05
Fluoranthene	mg/kg	0.05	MCERTS	110	4.5	< 0.05	0.48	< 0.05
Pyrene	mg/kg	0.05	MCERTS	95	4.2	< 0.05	0.40	< 0.05
Benzo(a)anthracene	mg/kg	0.05	MCERTS	52	2.1	< 0.05	0.21	< 0.05
Chrysene	mg/kg	0.05	MCERTS	48	2.3	< 0.05	0.31	< 0.05
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	56	2.4	< 0.05	0.30	< 0.05
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	25	1.3	< 0.05	0.20	< 0.05
Benzo(a)pyrene	mg/kg	0.05	MCERTS	55	2.2	< 0.05	0.30	< 0.05
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	33	1.2	< 0.05	< 0.05	< 0.05
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	8.8	0.26	< 0.05	< 0.05	< 0.05
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	40	1.5	< 0.05	< 0.05	< 0.05

Total PAH

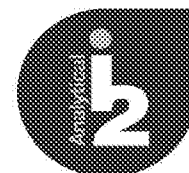
Speciated Total EPA-16 PAHs	mg/kg	0.8	MCERTS	645	24.9	< 0.80	2.38	< 0.80
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Heavy Metals / Metalloids

Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	5.8	8.4	8.2	7.0	7.0
Beryllium (aqua regia extractable)	mg/kg	0.06	MCERTS	0.42	0.71	0.55	0.50	0.60
Boron (water soluble)	mg/kg	0.2	MCERTS	0.6	1.6	0.5	0.9	1.0
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	0.4	0.4	< 0.2	0.2	< 0.2
Chromium (hexavalent)	mg/kg	4	MCERTS	< 4.0	< 4.0	< 4.0	< 4.0	< 4.0
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	15	25	20	180	26
Copper (aqua regia extractable)	mg/kg	1	MCERTS	13	22	11	23	11
Lead (aqua regia extractable)	mg/kg	1	MCERTS	88	81	6.6	45	12
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	13	17	15	14	16
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	3.0	< 1.0
Vanadium (aqua regia extractable)	mg/kg	1	MCERTS	22	33	26	54	33
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	39	170	28	140	41



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Environmental Science

Combined Report Nos : 18-92946 & 18-93096

Project / Site name: Cinders Nursery

Your Order No: 17034-SB

Lab Sample Number	1003362	1003363	1003364	1003365	1003366
Sample Reference	WS1	WS2	WS2	WS3	WS3
Sample Number	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)	0.35	0.30	1.10	0.50	0.80
Date Sampled	11/07/2018	11/07/2018	11/07/2018	11/07/2018	11/07/2018
Time Taken	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status		

Monoaromatics

Benzene	ug/kg	1	MCERTS	-	< 1.0	-	< 1.0	-
Toluene	ug/kg	1	MCERTS	-	< 1.0	-	< 1.0	-
Ethylbenzene	ug/kg	1	MCERTS	-	< 1.0	-	< 1.0	-
p & m-xylene	ug/kg	1	MCERTS	-	< 1.0	-	< 1.0	-
o-xylene	ug/kg	1	MCERTS	-	< 1.0	-	< 1.0	-
MTBE (Methyl Tertiary Butyl Ether)	ug/kg	1	MCERTS	-	< 1.0	-	< 1.0	-

Petroleum Hydrocarbons

TPH-CWG - Aliphatic > EC5 - EC6	mg/kg	0.001	MCERTS	-	< 0.001	-	< 0.001	-
TPH-CWG - Aliphatic > EC6 - EC8	mg/kg	0.001	MCERTS	-	< 0.001	-	< 0.001	-
TPH-CWG - Aliphatic > EC8 - EC10	mg/kg	0.001	MCERTS	-	< 0.001	-	< 0.001	-
TPH-CWG - Aliphatic > EC10 - EC12	mg/kg	1	MCERTS	-	< 1.0	-	< 1.0	-
TPH-CWG - Aliphatic > EC12 - EC16	mg/kg	2	MCERTS	-	< 2.0	-	< 2.0	-
TPH-CWG - Aliphatic > EC16 - EC21	mg/kg	8	MCERTS	-	< 8.0	-	< 8.0	-
TPH-CWG - Aliphatic > EC21 - EC35	mg/kg	8	MCERTS	-	< 8.0	-	< 8.0	-
TPH-CWG - Aliphatic > EC35 - EC44	mg/kg	8.4	NONE	-	< 8.4	-	< 8.4	-
TPH-CWG - Aliphatic (EC5 - EC35)	mg/kg	10	MCERTS	-	< 10	-	< 10	-
TPH-CWG - Aliphatic (EC5 - EC44)	mg/kg	10	NONE	-	< 10	-	< 10	-

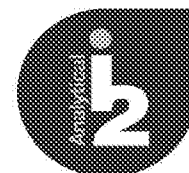
TPH-CWG - Aromatic > EC5 - EC7	mg/kg	0.001	MCERTS	-	< 0.001	-	< 0.001	-
TPH-CWG - Aromatic > EC7 - EC8	mg/kg	0.001	MCERTS	-	< 0.001	-	< 0.001	-
TPH-CWG - Aromatic > EC8 - EC10	mg/kg	0.001	MCERTS	-	< 0.001	-	< 0.001	-
TPH-CWG - Aromatic > EC10 - EC12	mg/kg	1	MCERTS	-	< 1.0	-	< 1.0	-
TPH-CWG - Aromatic > EC12 - EC16	mg/kg	2	MCERTS	-	< 2.0	-	< 2.0	-
TPH-CWG - Aromatic > EC16 - EC21	mg/kg	10	MCERTS	-	11	-	< 10	-
TPH-CWG - Aromatic > EC21 - EC35	mg/kg	10	MCERTS	-	30	-	< 10	-
TPH-CWG - Aromatic > EC35 - EC44	mg/kg	8.4	NONE	-	< 8.4	-	< 8.4	-
TPH-CWG - Aromatic (EC5 - EC35)	mg/kg	10	MCERTS	-	41	-	< 10	-
TPH-CWG - Aromatic (EC5 - EC44)	mg/kg	10	NONE	-	41	-	< 10	-

Pesticide and Herbicide Screen

Pesticides/Herbicides Screen in Soil	P/A	N/A	NONE	Absent	-	-	-	-
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Environmental Science

Combined Report Nos : 18-92946 & 18-93096

Project / Site name: Cinders Nursery

Your Order No: 17034-SB

Lab Sample Number				1004213	1004214	1004215	1004216	
Sample Reference				WS4	WS4	WS1	WS4	
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	
Depth (m)				0.15	0.70	1.80	2.20	
Date Sampled				11/07/2018	11/07/2018	11/07/2018	11/07/2018	
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	5.4	16	12	12	
Total mass of sample received	kg	0.001	NONE	0.44	0.47	1.2	1.3	

Asbestos in Soil	Type	N/A	ISO 17025	Not-detected	Not-detected	-	-	
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General Inorganics

pH - Automated	pH Units	N/A	MCERTS	8.5	8.2	8.6	8.8	
Total Cyanide	mg/kg	1	MCERTS	5	< 1	-	-	
Total Sulphate as SO ₄	mg/kg	50	MCERTS	-	-	320	260	
Water Soluble SO ₄ 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	0.042	0.013	0.015	0.011	
Water Soluble SO ₄ 16hr extraction (2:1 Leachate Equivalent)	mg/l	1.25	MCERTS	-	-	15.3	11.2	
Sulphide	mg/kg	1	MCERTS	28	< 1.0	-	-	
Water Soluble Chloride (2:1)	mg/kg	1	MCERTS	-	-	2.9	4.8	
Total Sulphur	mg/kg	50	MCERTS	-	-	120	91	
Ammonium as NH ₄	mg/kg	0.5	MCERTS	-	-	0.7	< 0.5	
Organic Matter	%	0.1	MCERTS	3.2	0.7	-	-	
Total Organic Carbon (TOC)	%	0.1	MCERTS	1.9	0.4	-	-	
Water Soluble Nitrate (2:1) as N	mg/kg	2	NONE	-	-	< 2.0	< 2.0	

Total Phenols

Total Phenols (monohydric)	mg/kg	1	MCERTS	< 1.0	< 1.0	-	-	
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Speciated PAHs

Naphthalene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	-	-	
Acenaphthylene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	-	-	
Acenaphthene	mg/kg	0.05	MCERTS	0.32	< 0.05	-	-	
Fluorene	mg/kg	0.05	MCERTS	0.22	< 0.05	-	-	
Phenanthrene	mg/kg	0.05	MCERTS	3.1	< 0.05	-	-	
Anthracene	mg/kg	0.05	MCERTS	0.77	< 0.05	-	-	
Fluoranthene	mg/kg	0.05	MCERTS	4.2	< 0.05	-	-	
Pyrene	mg/kg	0.05	MCERTS	4.0	< 0.05	-	-	
Benzo(a)anthracene	mg/kg	0.05	MCERTS	1.8	< 0.05	-	-	
Chrysene	mg/kg	0.05	MCERTS	1.6	< 0.05	-	-	
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	1.7	< 0.05	-	-	
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	0.68	< 0.05	-	-	
Benzo(a)pyrene	mg/kg	0.05	MCERTS	1.6	< 0.05	-	-	
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	0.95	< 0.05	-	-	
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	-	-	
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	1.3	< 0.05	-	-	

Total PAH

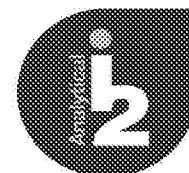
Speciated Total EPA-16 PAHs	mg/kg	0.8	MCERTS	22.1	< 0.80	-	-	
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Heavy Metals / Metalloids

Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	13	11	-	-	
Beryllium (aqua regia extractable)	mg/kg	0.06	MCERTS	0.81	0.75	-	-	
Boron (water soluble)	mg/kg	0.2	MCERTS	1.5	0.7	-	-	
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	0.3	< 0.2	-	-	
Chromium (hexavalent)	mg/kg	4	MCERTS	< 4.0	< 4.0	-	-	
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	26	37	-	-	
Copper (aqua regia extractable)	mg/kg	1	MCERTS	40	12	-	-	
Lead (aqua regia extractable)	mg/kg	1	MCERTS	1200	22	-	-	
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3	< 0.3	-	-	
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	21	14	-	-	
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0	< 1.0	-	-	
Vanadium (aqua regia extractable)	mg/kg	1	MCERTS	32	43	-	-	
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	310	56	-	-	



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Environmental Science

Combined Report Nos : 18-92946 & 18-93096

Project / Site name: Cinders Nursery

Your Order No: 17034-SB

Lab Sample Number				1004213	1004214	1004215	1004216	
Sample Reference				WS4	WS4	WS1	WS4	
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	
Depth (m)				0.15	0.70	1.80	2.20	
Date Sampled				11/07/2018	11/07/2018	11/07/2018	11/07/2018	
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status					

Monoaromatics

Benzene	ug/kg	1	MCERTS	< 1.0	-	-	-	
Toluene	ug/kg	1	MCERTS	< 1.0	-	-	-	
Ethylbenzene	ug/kg	1	MCERTS	< 1.0	-	-	-	
p & m-xylene	ug/kg	1	MCERTS	< 1.0	-	-	-	
o-xylene	ug/kg	1	MCERTS	< 1.0	-	-	-	
MTBE (Methyl Tertiary Butyl Ether)	ug/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 > EC35 - EC44	mg/kg	8.4	NONE	< 8.4	-	-	-	
TPH-CWG - Aliphatic (EC5 - EC35)	mg/kg	10	MCERTS	< 10	-	-	-	
TPH-CWG - Aliphatic (EC5 - EC44)	mg/kg	10	NONE	< 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	13	-	-	-	
TPH-CWG - Aromatic > EC21 - EC35	mg/kg	10	MCERTS	36	-	-	-	
TPH-CWG - Aromatic > EC35 - EC44	mg/kg	8.4	NONE	27	-	-	-	
TPH-CWG - Aromatic (EC5 - EC35)	mg/kg	10	MCERTS	51	-	-	-	
TPH-CWG - Aromatic (EC5 - EC44)	mg/kg	10	NONE	78	-	-	-	

Pesticide and Herbicide Screen

Pesticides/Herbicides Screen in Soil	P/A	N/A	NONE	-	-	-	-	
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Combined Report Nos : 18-92946 & 18-93096

Project / Site name: Cinders Nursery

* 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 *
1003362	WS1	None Supplied	0.35	Brown clay and sand with gravel and brick.
1003363	WS2	None Supplied	0.30	Light brown sandy clay with gravel.
1003364	WS2	None Supplied	1.10	Light brown clay and sand with gravel.
1003365	WS3	None Supplied	0.50	Brown clay and sand with gravel and vegetation.
1003366	WS3	None Supplied	0.80	Light brown clay and sand.
1004213	WS4	None Supplied	0.15	Brown loam and sand with rubble and brick.
1004214	WS4	None Supplied	0.70	Light brown clay and sand.
1004215	WS1	None Supplied	1.80	Light brown clay with gravel.
1004216	WS4	None Supplied	2.20	Light brown clay with gravel.

Combined Report Nos : 18-92946 & 18-93096

Project / Site name: Cinders Nursery

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
Ammonium as NH ₄ in soil	Determination of Ammonium/Ammonia/Ammoniacal Nitrogen by the colorimetric salicylate/nitroprusside method, 10:1 water extraction.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L082-PL	W	MCERTS
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
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 based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests. 2:1 extraction.	L082-PL	D	MCERTS
Hexavalent chromium in soil	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.	In-house method based on BS1377 Part 2, 1990, Chemical and Electrochemical Tests	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.	BS1377 Part 3, 1990, Chemical and Electrochemical Tests [™]	L009-PL	D	MCERTS
Pesticides and Herbicides in soil screening	In-house method	In-house method		W	NONE
pH in soil (automated)	Determination of pH in soil by addition of water followed by automated electrometric measurement.	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests	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 based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests, 2:1 water:soil extraction, analysis by ICP-OES.	L038-PL	D	MCERTS
Sulphide in soil	Determination of sulphide in soil by acidification and heating to liberate hydrogen sulphide, trapped in an alkaline solution then assayed by ion selective electrode.	In-house method	L010-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

Iss No Combined Report 18-92946 & 18-93096 Cinders Nursery 17034

Combined Report Nos : 18-92946 & 18-93096

Project / Site name: Cinders Nursery

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
Total organic carbon (Automated) in soil	Determination of organic matter in soil by oxidising with potassium dichromate followed by titration with iron (II) sulphate.	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests"	L009-PL	D	MCERTS
Total sulphate (as SO ₄ in soil)	Determination of total sulphate in soil by extraction with 10% HCl followed by ICP-OES.	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests	L038-PL	D	MCERTS
Total Sulphur in soil	Determination of total sulphur in soil by extraction with aqua-regia, potassium bromide/bromate followed by ICP-OES.	In-house method based on BS1377 Part 3, 1990, and MEWAM 2006 Methods for the Determination of Metals in Soil	L038-PL	D	MCERTS
TPH in (Soil)	Determination of TPH bands by HS-GC-MS/GC-FID	In-house method, TPH with carbon banding.	L076-PL	D	NONE
TPHCWG (Soil)	Determination of hexane extractable hydrocarbons in soil by GC-MS/GC-FID.	In-house method	L088/76-PL	W	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 Wastewater & Polish Standard Method PN-82/C-04579.08, 2:1 extraction.	L078-PL	D	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 30°C.

Sample Deviation Report



Sample ID	Other ID	Sample Type	Job	Sample Number	Sample Deviation Code	test_name	test_ref	Test Deviation code
WS2		S	18-92946	1003363	b	BTEX and MTBE in soil (Monoaromatics)	L073B-PL	b
WS2		S	18-92946	1003363	b	TPHCWG (Soil)	L088/76-PL	b
WS3		S	18-92946	1003365	b	BTEX and MTBE in soil (Monoaromatics)	L073B-PL	b
WS3		S	18-92946	1003365	b	TPHCWG (Soil)	L088/76-PL	b

Sample Deviation Report



Sample ID	Other ID	Sample Type	Job	Sample Number	Sample Deviation Code	test_name	test_ref	Test Deviation code
WS4		S	18-93096	1004213	c	Total cyanide in soil	L080-PL	c
WS4		S	18-93096	1004214	c	Total cyanide in soil	L080-PL	c

Appendix C.3 General Assessment Criteria

HUMAN HEALTH RISK ASSESSMENT

1.1 Introduction

Human Health Generic Quantitative Risk Assessment (GQRA) involves the comparison of contaminant concentrations measured in soil at the site with Generic Assessment Criteria (GAC).

GAC are conservative values adopted to ensure that they are applicable to the majority of possible contaminated site. These values may be published Contaminated Land Exposure Assessment Model (CLEA) derived GAC derived by a third party or the Environment Agency/ DEFRA. It is imperative to the risk assessor to understand the uncertainties and limitations associated with these GAC to ensure that they are used appropriately. Where the adoption of a GAC is not appropriate, for instance when the intended land-use is at variance the CLEA standard land-uses, then a Detailed Quantitative Risk Assessment (DQRA) may be undertaken to develop site specific values for relevant soil contaminants based on the site specific conditions.

1.2 General Assessment Criteria

The Contaminated Land Regime reflects the UK Government's stated objectives of achieving sustainable development through the 'suitable for use approach'.

1.2.1 Contaminated Land Exposure Assessment Model (CLEA)

Current United Kingdom risk assessment practice is based on the Contaminated Land Exposure Assessment Model (CLEA).

The CLEA Guidance comprises the following documents:

- EA Science Report SC050021/SR2: Human health toxicological assessment of contaminants in soil.
 - EA Science Report SC050021/SR3: Updated technical background to the CLEA model.
 - EA CLEA Bulletin (2009).
 - CLEA software version 1.04 (2009)
 - Toxicological reports and SGV technical notes.
-

The CLEA guidance and tools:

1. do not cover other types of risk to humans, such as fire, suffocation or explosion, or short-term and acute exposures.
 2. do not cover risks to the environment, such as groundwater, ecosystems or buildings.
 3. do not provide a definitive test for telling when human health risks are significant.
 4. are not a legal requirement in assessing land contamination risks. They are not part of the legal regime for Part 2A of the Environmental Protection Act 1990.
-

1.3 Soil Guideline Values (2009)

The EA are publishing a series of SGV reports for a selection of common contaminants relevant to the assessment of land contamination.

SGV's are generic assessment criteria based on CLEA standard land-uses and can be used to simplify the assessment of human health risks from long-term exposure to

chemical contamination in soil. They do not cover short-term exposure (i.e. construction and maintenance workers), acute exposure or other risks such as fire, suffocation or explosion, as might arise from an accumulation of gases such as methane and carbon dioxide, or either odour or aesthetic issues.

SGV's represent 'trigger values', indicators that soil concentrations above the SGV level may pose a possibility of *significant harm* to human health. The converse, where soil concentrations are less than the SGV, is that the long-term human health risks are considered to be tolerable or minimal.

The CLEA guidance derives soil concentrations of contaminants above which (in the opinion of the EA) there may be a concern that warrants further investigation. It does not provide a definitive test for establishing that the risk is significant.

1.4 Ongoing development of CLEA based guidance

The EA is involved in a programme of publishing SGV's and related toxicity data (the TOX reports). As at July 2009 ten SGV's and matching TOX reports had been published. Soil Assessment Criteria (SAC's) may be derived using toxicity data from the updated TOX reports, where these are published, or from the original TOX reports. SGV reports also take account of recent updates for plant uptake and other factors.

-
- GAC's developed by CLEA guidance and given in this report will need to be assessed against updated TOX reports and SGV's when these are published.
-
- SGV reports may give values that differ from the GAC's used in this report.
-
- These variations may materially alter the remediation requirement for the site, requiring either an increase or decrease in the extent, type and cost of remediation.
-

1.5 Phytotoxicity

CLEA guidance only addresses human health toxicity; assessment of plant toxicity (phytotoxicity) is based on threshold trigger values obtained from the following source:

ICRCL 70/90: *Notes on the restoration and aftercare of metalliferous mining sites for pasture and grazing.*

1.6 Other Generic Assessment Criteria

If an SGV is not available for a substance identified in the soil then the range of Generic Assessment Criteria published from a collaborative research by Land Quality Management Limited (LQM) and the Chartered Institute of Environmental Health (CIEH) are used for example. In the case of Lead, Category 4 screening levels (C4SLs) have replaced the AtRisk Soil SSV.

1.6.1 EIC/AGS/CL: AIRE

The report represents the collaborative effort of risk assessors from 26 EIC and AGS member companies to produce generic assessment criteria (GAC) for soils for human health risk assessment. The project involved the collation and review of physico-chemical data, toxicological data and information on background

exposure for 44 contaminants sometimes encountered on land affected by contamination in the UK and the derivation of GAC for 351 of these using the CLEA model (v1.06). The GAC are intended to complement soil guideline values (SGV) produced by the Environment Agency of England and Wales and the 2nd edition GAC produced by LQM and CIEH (Nathanail *et al*, 2009). All three sets of assessment criteria have been derived in general accordance with the Environment Agency of England and Wales Contaminated Land Exposure Assessment (CLEA) guidance and thus the combined efforts of these three groups have resulted in a useful set of screening criteria for the assessment of risks to human health from soil contamination for more than 120 potentially contaminative substances.

1.6.2 Category 4 screening levels (C4SLs) (2014)

A new statutory DEFRA guidance recently (i.e. August 2014) published some GACs with a more pragmatic (but still strongly precautionary) approach in their derivation called the Category 4 screening levels (C4SLs). These values provide a higher simple test for deciding that land is suitable for use and definitely not contaminated land. They are intended as generic screening values, (ii) they describe a level of risk that whilst above 'minimal' is still 'low' and (iii) they provide a 'higher simple test' for deciding that land is suitable for use and definitely not contaminated. These values were derived for four generic land uses: residential, commercial, allotments, and public open space.

1.6.3 LQM/CIEH Suitable 4 Use Level (S4UL) (2015)

The new S4UL's ((Nathanail *et al*, 2015), was developed for around 85 substances and are intended to enable a screening assessment of the risks posed by soil quality on development sites. The updated LQM/CIEH GAC publication was developed to accommodate recent developments in the understanding of chemical, toxicological and routine exposure to soil-based contaminants. The S4ULs were:

- based on Health Criteria Values, updated to reflect changes since 2009
- derived for the standard CLEA land uses and the two public open space scenarios developed by Defra SP1010
- developed for ca 85 substances (those previously covered by the LQM/CIEH GAC and the SGV substances);
- Compliant with SR2 and the long standing principle of 'suitable for use' and reflecting changes to exposure parameters produced by Defra SP1010.

For derivation of these Generic Assessment Criteria reference must be made to: Nathanail, P., McCaffrey, C., Ashmore, M., Cheng, Y., Gillet, A., Ogden, R., Scott, D. *The LQM/CIEH Generic Assessment Criteria for Human Health Risk Assessment (3rd edition)*. **Land Quality Press**. 2015.

1.7 Standard Land-use Scenarios

The standard land-use scenarios used to develop conceptual exposure models are presented in the following sections:

1.7.1 Residential

Generic scenario assumes a typical two-storey house built on a ground bearing slab with a private garden having a lawn, flowerbeds and a small fruit and vegetable patch.

- | |
|--|
| • Critical receptor is a young female child (zero to six years old) |
| • Exposure duration is six years. |
| • Exposure pathways include direct soil and indoor dust ingestion, consumption of home-grown produce and any adhering soil, skin contact with soils and indoor dust and inhalation of indoor and outdoor dust and vapours. |
| • Building type is a two-storey small terraced house. |

A sub-set of this land-use is residential apartments with communal landscaped gardens where the consumption of home grown vegetables will not occur.

1.7.2 Allotments

Provision of open space (about 250sq.m) commonly made available to tenants by the local authority to grow fruit and vegetable for their own consumption.

Typically, there are a number of plots to a site which may have a total area of up to 1 hectare. The tenants are assumed to be adults and that young children make occasional accompanied visits.

Although some allotment holders may choose to keep animals including rabbits, hens, and ducks, potential exposure to contaminated meat and eggs is not considered.

- | |
|--|
| • Critical receptor is a young female child (zero to six years old) |
| • Exposure duration is six years. |
| • Exposure pathways include direct soil ingestion, consumption of homegrown produce and any adhering soil, skin contact with soils and inhalation of outdoor dust and vapours. |
| • There is no building. |

1.7.3 Commercial/Industrial

The generic scenario assumes a typical commercial or light industrial property comprising a three-storey building at which employees spend most time indoors and are involved in office-based or relatively light physical work.

- | |
|--|
| • Critical receptor is a working female adult (aged 16 to 65 years old). |
| • Exposure duration is a working lifetime of 49 years. |
| • Exposure pathways include direct soil and indoor dust ingestion, skin contact with soils and dusts and inhalation of dust and vapours. |
| • Building type is a three-storey office (pre 1970). |

1.7.4 Public Open Space within Residential Area

The generic scenario refers to any grassed area 0.05 ha and that is close to Housing.

-
- Grassed area of up to 0.05 ha and a considerable proportion of this (up to 50%) may be bare soil
-
- Predominantly used by children for playing and may be used for activities such as a football kick about
-
- Sufficiently close proximity to home for tracking back of soil to occur, thus indoor exposure pathways apply
-
- older children as the critical receptor on basis that they will use site most frequently (Age class 4-9)
-
- ingestion rate 75 mg.day^{-1}
-

1.7.5 Public Open Space Park

This generic scenario refers to any public park that is more than 0.5ha in area:

-
- Public park (>0.5 ha), predominantly grassed and may also contain children's play equipment and border areas of soil containing flowers or shrubs (75% cover)
-
- Female child age classes 1-6
-
- Soil ingestion rate of 50 mg.day^{-1}
-
- Occupancy period outdoors = 2 hours.day^{-1}
-
- Exposure frequency of 170 days.year⁻¹ for age classes 2-18 and 85
-
- days.year⁻¹ for age class 1
-
- Outdoor exposure pathways only (no tracking back).
-

1.8 Detailed Quantitative Risk Assessments (DQRA)

Where the adoption of an SGV/GAC is not appropriate, for instance when the intended land-use is at variance the CLEA standard land-uses, then a DQRA may be undertaken to develop site specific values for relevant soil contaminants.

-
- Establishing the plausibility that generic exposure pathways exist in practice by measurement and observation.
-
- Developing more accurate parameters using site data.
-

1.9 Current Criteria

Table 1 presents the current Generic Assessment Criteria and reference should be made to the original publications if needed.

1.10 Statistical Tests

DEFRA R&D Publication CLR 7 (DOE 1994) and Category 4 screening levels (C4SLs) (2014) addressed the statistical treatment of test results and their comparison to Soil Guideline Values.

Consideration must be given to the appropriate area of land to be considered termed the critical averaging area.

For a communal open space or commercial land-use, the critical averaging area will depend on the proposed layout. For a residential use with private gardens the averaging area is the individual plot.

It may be appropriate to compare the upper 95th percentile concentration with the Soil Guideline Value, subject to applying a statistical test to establish that the range of concentrations are reasonably consistent and belonging to the same underlying distribution of data.

The DEFRA discussion paper Assessing risks from land contamination – a proportionate approach ('the way forward') (CLAN06/2006) aimed to increase understanding of the role that statistics can play in quantifying the uncertainty attached to the estimates of the mean concentration of contaminants in soil. In direct response CL:AIRE/CIEH published a joint report, *Guidance in comparing soil contamination data with a critical concentration* (CL:AIRE/CIEH 2008). A software implementation of the statistical techniques given in the report was published by ESI International (2008).

Treatment of Hot-Spots

- A statistical test is applied to establish whether the data is a part of a single set, or whether data outliers are present.
 - Provided that the data is based on random sampling and no distinct contamination source was present at the sampling location, the hot-spot(s) may be excluded and the mean of the remaining data assessed.
-

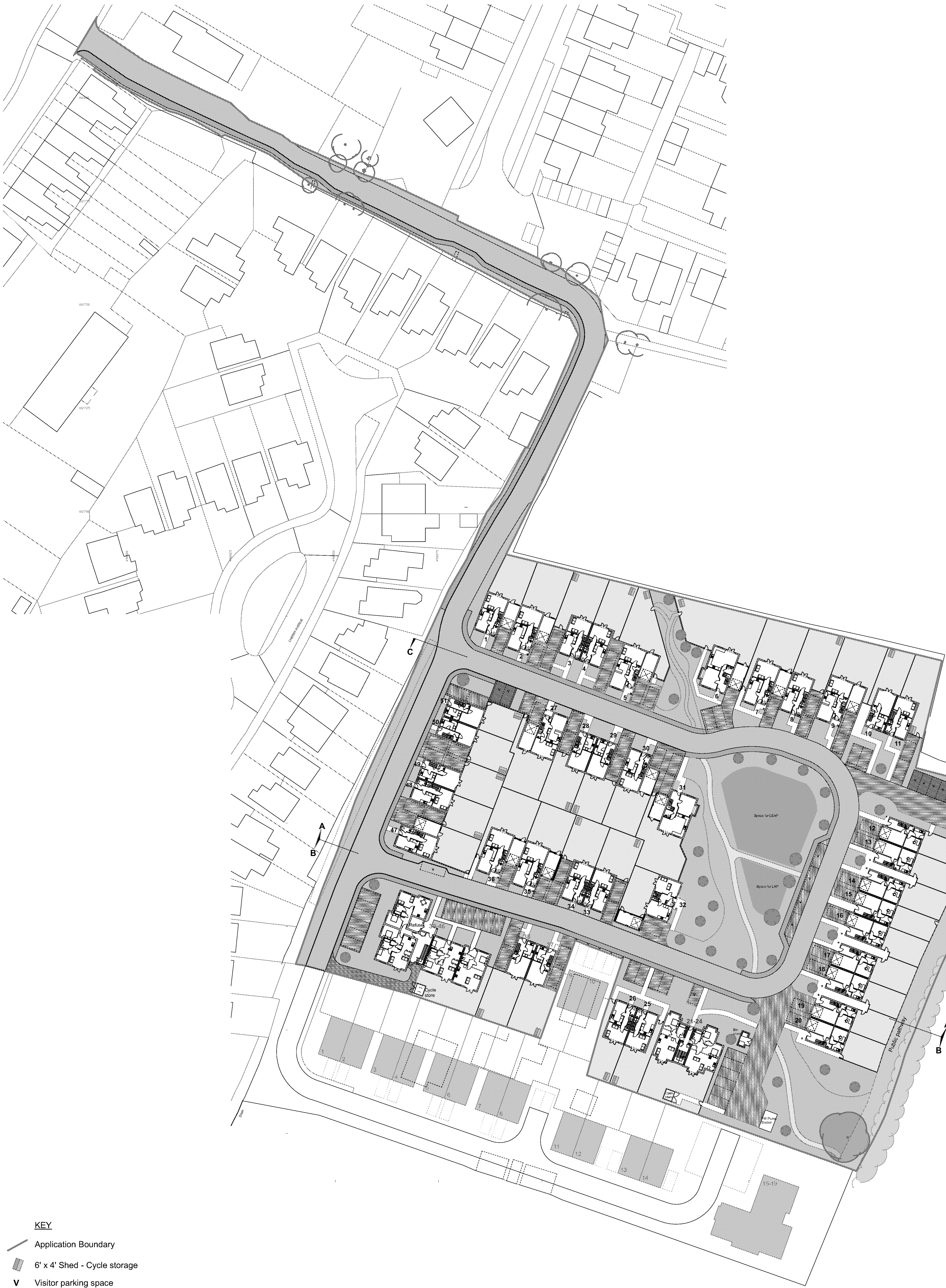
Land Use			Residential With or Without Plant Uptake									Public Open Space (POS)									Name	Authority	Date				
			With			Without			Allotments			Commercial			Residential			Park									
			1.0	2.5	6	1	2.5	6	1	2.5	6	1	2.5	6	1	2.5	6	1	2.5	6							
Type	Contaminants	Species	Year	SGM	1.0	2.5	6	1	2.5	6	1	2.5	6	1	2.5	6	1	2.5	6	1	2.5	6					
Metals	Antimony		2010							550						7500							EIC/AGS/CLAIRE	EIC/AGS/CLAIRE	2010		
	Arsenic		2014				37			40			49			640			79		168		C4SL	DEFRA	2014		
			2015				37			40			40			640			79		170		S4UL	LQM/CIEH	2015		
	Beryllium		2015				1.7			1.7			35			12			2.2		63		S4UL	LQM/CIEH	2015		
	Boron		2015				290			11000			45			240000			21000		46000		S4UL	LQM/CIEH	2015		
	Cadmium		2015				11			85			1.9			190			120		532		S4UL	LQM/CIEH	2015		
			2014				28			149			4.9			410			220		880		C4SL	DEFRA	2014		
	Chromium	III	2015				910			910			18000			8600			1500		33000		S4UL	LQM/CIEH	2015		
		V	2014				21			21			170			49			22		256		C4SL	DEFRA	2014		
		VI	2015				6			6			1.8			33			7.7		220		S4UL	LQM/CIEH	2015		
	Copper		2015				2400			7100			520			68000			12000		44000		S4UL	LQM/CIEH	2015		
	Lead						200			310			80			2330			630		1300		C4SL	DEFRA	2014		
	Mercury	Elemental	2012				1.0			1.0			26			26								SGV	DEFRA	2012	
			2015				1.2			1.2			21			58			16		30		S4UL	LQM/CIEH	2015		
		Inorganic	2012				170			170			80			36000								SGV	DEFRA	2012	
			2015				40			56			19			1100			120		240		S4UL	LQM/CIEH	2015		
		Methyl	2012				11			11			8			410									SGV	DEFRA	2012
			2015				11			15			6			320			40		68		S4UL	LQM/CIEH	2015		
	Nickel		2012				130			130			230			1800								SGV	DEFRA	2012	
			2015				130			180			53			980			230		800		S4UL	LQM/CIEH	2015		
	Selenium		2012				350			350			120			13000								SGV	DEFRA	2012	
			2015				250			430			88			12000			1100		1800		S4UL	LQM/CIEH	2015		
	Vanadium		2015				410			1200			91			9000			2000		5000		S4UL	LQM/CIEH	2015		
	Zinc		2015				3700			40000			620			730000			81000		170000		S4UL	LQM/CIEH	2015		
BTEX & MTBE	Benzene		2012				0.33			0.33			0.07			95							SGV	DEFRA	2012		
			2014				0.87			3.3			0.18			98			140		230		C4SL	DEFRA	2014		
			2015	0.087	0.17	0.37	0.38	0.7	1.4	0.017	0.034	0.075	27	47	90	72	72	73	90	100	110		S4UL	LQM/CIEH	2015		
	Toluene		2012				610			610			120			4400								SGV	DEFRA	2012	
			2015	130	290	660	880	1900	3900	22	51	120	65000	110000	180000	56000	56000	56000	87000	95000	100000		S4UL	LQM/CIEH	2015		
	Ethylbenzene		2012				350			350			90			2800								SGV	DEFRA	2012	
			2015	47	110	260	83	190	440	16	39	91	4700	13000	27000	24000	24000	25000	17000	22000	27000		S4UL	LQM/CIEH	2015		
	Xylenes	o-xylene	2012				250			250			160			2600									SGV	DEFRA	2012
			2015	60	140	330	88	210	480	28	67	160	6600	15000	33000	41000	42000	43000	17000	24000	33000		S4UL	LQM/CIEH	2015		
		m-xylene	2012				240			240			180			3500									SGV	DEFRA	2012
			2015	59	140	320	82	190	450	31	74	170	6200	14000	31000	41000	42000	43000	17000	24000	32000		S4UL	LQM/CIEH	2015		
		p-xylene	2012				230			230			160			3200									SGV	DEFRA	2012
			2015	56	130	310	79	180	310	29	69	160	5900	14000	30000	41000	42000	43000	17000	23000	31000		S4UL	LQM/CIEH	2015		
Petroleum Hydrocarbons Fractions	Aliphatic >C3 - C6		2015	42	78	160	42	78	160	730	1700	3900	3200	5900	12000	570000	590000	600000	95000	130000	180000		S4UL	LQM/CIEH	2015		
	Aliphatic >C6 - C8		2015	100	230	530	100	230	530	2300	5600	13000	7800	17000	40000	600000	610000	620000	150000	220000	320000		S4UL	LQM/CIEH	2015		
	Aliphatic >C8 - C10		2015	27	65	150	27	65	150	320	770	1700	2000	4800	11000	13000	13000	13000	14000	18000	21000		S4UL	LQM/CIEH	2015		
	Aliphatic >C10 - C12		2015	130	330	760	130	330	770	2200	4400	7300	9700	23000	47000	13000	13000	13000	21000	23000	24000		S4UL	LQM/CIEH	2015		
	Aliphatic >C12 - C16		2015	1100	2400	4300	1100	2400	4400	11000	13000	13000	59000	82000	90000	13000	13000	13000	25000	25000	26000		S4UL	LQM/CIEH	2015		
	Aliphatic >C16 - C35		2015	65000	92000	110000	65000	92000	110000	260000	270000	270000	1600000	1700000	1800000	250000	250000	250000	450000	480000	490000		S4UL	LQM/CIEH	2015		
	Aliphatic >C35 - C44		2015	65000	92000	140000	65000	92000	110000	260000	270000	270000	1600000	1700000	1800000	250000	250000	250000	450000	480000	490000		S4UL	LQM/CIEH	2015		
	Aromatic >C3 - C7		2015	70	140	300	370	690	1400	13	27	57	26000	46000	86000	56000	56000	56000	76000	84000	92000		S4UL	LQM/CIEH	2015		
	Aromatic >C7 - C8		2015	130	290	660	860	1800	3900	22	51	120	56000	110000	180000	56000	56000	56000	87000	95000	100000		S4UL	LQM/CIEH	2015		
	Aromatic >C8 - C10		2015	34	83	190	47	110	270	8.6	21	51	3500	8100	17000	5000	5000	5000	7200	8500	9300		S4UL	LQM/CIEH	2015		
	Aromatic >C10 - C12		2015	74	180	380	250	590	1200	13	31	74	16000	28000	34000	5000	5000	5000	9200	9700	10000		S4UL	LQM/CIEH	2015		
	Aromatic >C12 - C16		2015	140	330	660	1800	2300	2500	23	57	130	36000	37000	38000	5100	5100	5000	10000	10000	10000		S4UL	LQM/CIEH	2015		
	Aromatic >C16 - C21		2015	260	540	930	1900	1900	1900	46	110	260	28000	28000	28000	3800	3800	3800	7600	7700	7800		S4UL	LQM/CIEH	2015		

Land Use			Residential With or Without Plant Uptake									Public Open Space (POS)									Media	Authority	Date	
			Allotments						Commercial			Residential						Park						
			With home-grown produce			Without home-grown produce			1	2.5	6	1	2.5	6	1	2.5	6	1	2.5	6				
Type	Contaminants	Species	Year	SOM	1.0	2.5	6	1	2.5	6	1	2.5	6	1	2.5	6	1	2.5	6	1	2.5	6		
	Aromatic >C21 - C35		2015	1100	1500	1700	1900	1900	1900	370	820	1600	28000	28000	28000	3800	3800	3800	7800	7800	7900	S4UL	LQM/CIEH	2015
	Aromatic >C34 - C44		2015	1100	1500	1700	1900	1900	1900	370	820	1600	28000	28000	28000	3800	3800	3800	7800	7800	7900	S4UL	LQM/CIEH	2015
	Aliphatic + Aromatic >C44 - C70			1600	1800	1900	1900	1900	1900	1200	2100	3000	28000	28000	28000	3800	3800	3800	7800	7800	7900	S4UL	LQM/CIEH	2015
Polycyclic Aromatic Hydrocarbons (PAHs) (mg/kg)	Acenaphthene		2015	210	510	1100	3000	4700	6000	34	85	200	84000	97000	100000	15000	15000	15000	29000	30000	30000	S4UL	LQM/CIEH	2015
	Acenaphthylene		2015	170	420	920	2900	4600	6000	28	69	160	83000	97000	100000	15000	15000	15000	29000	30000	30000	S4UL	LQM/CIEH	2015
	Anthracene		2015	2400	5400	11000	31000	35000	37000	380	950	2200	520000	54000	540000	74000	74000	74000	150000	150000	150000	S4UL	LQM/CIEH	2015
	Benzo(a)anthracene		2015	7.2	11	13	11	14	15	2.9	6.5	13	170	170	180	29	29	29	49	56	62	S4UL	LQM/CIEH	2015
	Benzo(a)pyrene		2014			5			5.3			5.7			76			10		21	CASL	DEFRA	2014	
			2015	2.2	2.7	3	3.2	3.2	3.2	0.97	2	3.5	35	35	36	5.7	5.7	5.7	11	12	13	S4UL	LQM/CIEH	2015
	Benzo(b)fluoranthene		2015	2.6	3.3	3.7	3.9	4.0	4.0	0.99	2.1	3.9	44	44	45	7.1	7.2	7.2	13	15	16	S4UL	LQM/CIEH	2015
	Benzo(g,h)perylene		2015	320	340	250	360	360	360	290	470	640	3900	4000	4000	640	640	640	1400	1500	1600	S4UL	LQM/CIEH	2015
	Benzo(k)fluoranthene		2015	77	93	100	110	110	110	37	75	130	1200	1200	1200	190	190	190	370	410	440	S4UL	LQM/CIEH	2015
	Chrysene		2015	15	22	27	30	31	32	4.1	9.4	19	350	350	350	57	57	57	93	110	120	S4UL	LQM/CIEH	2015
	Dibenz(a,h)anthracene		2015	0.24	0.28	0.3	0.31	0.32	0.32	0.14	0.27	0.43	3.5	3.6	3.6	0.57	0.57	0.58	1.1	1.3	1.4	S4UL	LQM/CIEH	2015
	Fluoranthene		2015	280	560	890	1500	1600	1600	52	130	290	23000	23000	23000	3100	3100	3100	6300	6300	6400	S4UL	LQM/CIEH	2015
	Fluorene		2015	170	400	860	2800	3800	4500	27	67	160	63000	68000	71000	9900	9900	9900	20000	20000	20000	S4UL	LQM/CIEH	2015
	Indeno(1,2,3-cd)pyrene		2015	27	36	41	45	46	46	9.5	21	39	500	510	510	82	82	82	150	170	180	S4UL	LQM/CIEH	2015
	Naphthalene		2015	2.3	5.6	13	2.3	5.6	13	4.1	10	24	190	460	1100	4900	4900	4900	1200	1900	3000	S4UL	LQM/CIEH	2015
	Phenanthrene		2015	95	220	440	1300	1500	1500	15	38	90	22000	22000	23000	3100	3100	3100	6200	6200	6300	S4UL	LQM/CIEH	2015
	Pyrene		2015	620	1200	2000	3700	3800	3800	110	270	620	54000	54000	54000	7400	7400	7400	15000	15000	15000	S4UL	LQM/CIEH	2015
	Coal Tar(Bap as surrogate matter)		2015	0.79	0.98	1.1	1.2	1.2	1.2	0.32	0.67	1.2	15	15	15	2.2	2.2	2.2	4.4	4.7	4.8	S4UL	LQM/CIEH	2015
Chloroalkanes & alkenes	1,2 Dichloroethane		2015	0.0071	0.011	0.019	0.0092	0.013	0.023	0.0046	0.0083	0.016	0.67	0.97	1.7	29	29	29	21	24	28	S4UL	LQM/CIEH	2015
	1,1,1 Trichloroethane		2015	8.8	18	39	9	18	40	48	110	240	660	1300	3000	140000	140000	140000	57000	76000	100000	S4UL	LQM/CIEH	2015
	1,1,2,2 Tetrachloroethane		2015	1.6	3.4	7.5	3.9	8	17	0.41	0.89	2	270	550	1100	1400	1400	1400	1800	2100	2300	S4UL	LQM/CIEH	2015
	1,1,1,2 Tetrachloroethane		2015	1.2	2.8	6.4	1.5	3.5	8.2	0.79	1.9	4.4	110	250	560	1400	1400	1400	1500	1800	2100	S4UL	LQM/CIEH	2015
	Tetrachloroethene		2015	0.18	0.39	0.9	0.18	0.4	0.92	0.65	1.5	3.6	19	42	95	1400	1400	1400	810	1100	1500	S4UL	LQM/CIEH	2015
	Tetrachloromethane (Carbon Tetrachloride)		2015	0.026	0.056	0.13	0.026	0.056	0.13	0.45	1	2.4	2.9	6.3	14	890	920	950	190	270	400	S4UL	LQM/CIEH	2015
	Trichloroethene		2015	0.016	0.034	0.075	0.017	0.036	0.08	0.041	0.091	0.21	1.2	2.6	5.7	120	120	120	70	91	120	S4UL	LQM/CIEH	2015
	Trichloromethane		2015	0.91	1.7	3.4	1.2	2.1	4.2	0.42	0.83	1.7	99	170	350	2500	2500	2500	2600	2800	3100	S4UL	LQM/CIEH	2015
	Vinyl Chloride (chloroethene)		2015	0.00064	0.00087	0.0014	0.00077	0.001	0.0015	0.00055	0.001	0.0018	0.059	0.077	0.12	3.5	3.5	3.5	4.8	5	5.4	S4UL	LQM/CIEH	2015
Explosives	2,4,6 Trinitrotoluene		2015	1.6	3.7	8.1	65	66	66	0.24	0.58	1.4	1000	1000	1000	130	130	130	260	270	270	S4UL	LQM/CIEH	2015
	RDX (Hexogen/Cyclonite/1,3,5-trinitro-1,3,5-triazacyclohexane)		2015	120	250	540	13000	13000	13000	17	38	85	210000	210000	210000	26000	26000	27000	49000	51000	53000	S4UL	LQM/CIEH	2015
	HMX (Octogen/1,3,5,7-tetranitro-1,3,5,7-tetrazacyclo-octane)		2015	5.7	13	26	6700	6700	6700	0.86	1.9	3.9	110000	110000	110000	13000	13000	13000	23000	23000	24000	S4UL	LQM/CIEH	2015
Pesticides	Aldrin		2015	5.7	6.6	7.1	7.3	7.4	7.5	3.2	6.1	9.6	170	170	170	18	18	18	30	31	31	S4UL	LQM/CIEH	2015
	Dieldrin		2015	0.97	2	3.5	7	7.3	7.4	0.17	0.41	0.96	170	170	170	18	18	18	30	30	31	S4UL	LQM/CIEH	2015
	Atrazine		2015	3.3	7.6	17.4	610	620	620	0.5	1.2	2.7	9300	9400	9400	1200	1200	1200	2300	2400	2400	S4UL	LQM/CIEH	2015
	Dichlorvos		2015	0.032	0.066	0.14	6.4	6.5	6.6	0.0049	0.01	0.022	140	140	140	16	16	16	26	26	27	S4UL	LQM/CIEH	2015
	Alpha - Endosulfan		2015	7.4	18	41	160	280	410	1.2	2.9	6.8	5600	7400	8400	1200	1200	1200	2400	2400	2500	S4UL	LQM/CIEH	2015
	Beta - Endosulfan		2015	7	17	39	190	320	440	1.1	2.7	6.4	6300	7800	8700	1200	1200	1200	2400	2400	2500	S4UL	LQM/CIEH	2015
	Alpha -Hexachlorocyclohexanes		2015	0.23	0.55	1.2	6.9	9.2	11	0.035	0.087	0.21	170	180	180	24	24	24	47	48	48	S4UL	LQM/CIEH	2015
	Beta -Hexachlorocyclohexanes		2015	0.085	0.2	0.46	3.7	3.8	3.8	0.013	0.032	0.077	65	65	65	8.1	8.1	8.1	15	15	16	S4UL	LQM/CIEH	2015
Chlorobenzenes	Gamma -Hexachlorocyclohexanes		2015	0.06	0.1.																			

Land Use			Residential With or Without Plant Uptake									Public Open Space (POS)									Media	Authority	Date		
			Allotments						Commercial			Residential						Park							
			With home-grown produce			Without home-grown produce																			
Type	Contaminants	Species	Year	SGM	1.0	2.5	6	1	2.5	6	1	2.5	6	1	2.5	6	1	2.5	6	1	2.5	6			
Phenols & Chlorophenols	1,2,3,4,-Tetrachlorobenzene		2015	15	36	78	24	56	120	4.4	11	26	1700	3080	4400	830	830	830	1500	1600	1600	S4UL	LQM/CIEH	2015	
	1,2,3,5,- Tetrachlorobenzene		2015	0.66	1.6	3.7	0.75	1.9	4.3	0.38	0.9	2.2	49	120	240	78	79	79	110	120	130	S4UL	LQM/CIEH	2015	
	1,2,4, 5,- Tetrachlorobenzene		2015	0.33	0.77	1.6	0.73	1.7	3.5	0.06	0.16	0.37	42	72	96	13	13	13	25	26	26	S4UL	LQM/CIEH	2015	
	Pentachlorobenzene		2015	5.8	12	22	19	30	38	1.2	3.1	7	640	770	830	100	100	100	190	190	190	S4UL	LQM/CIEH	2015	
	Hexachlorobenzene		2015	1.8	3.3	4.9	4.1	5.7	6.7	0.47	1.1	2.5	110	120	120	16	16	16	30	30	30	S4UL	LQM/CIEH	2015	
	Phenols		2012			420			420			280			3200							SGV	DEFRA	2012	
			2015	120	200	380	440	690	1200	23	42	83	440	690	1300	440	690	1300	440	690	1300	S4UL	LQM/CIEH	2015	
	Chlorophenols (4 Congeners)		2015	0.87	2	4.5	94	150	210	0.13	0.3	0.7	3500	4000	4300	620	620	620	1100	1100	1100	S4UL	LQM/CIEH	2015	
	Pentachlorophenols		2015	0.22	0.52	1.2	27	29	31	0.03	0.08	0.19	400	400	400	60	60	60	110	120	120	S4UL	LQM/CIEH	2015	
Others																									
	Carbon Disulphide		2015	0.14	0.29	0.62	0.14	0.29	0.62	4.8	10	23	11	22	47	11000	11000	12000	1300	1900	2700	S4UL	LQM/CIEH	2015	
	Hexachloro-1,3-Butadiene		2015	0.29	0.7	1.6	0.32	0.78	1.8	0.25	0.61	1.4	31	66	120	25	25	25	48	50	51	S4UL	LQM/CIEH	2015	
	Sum of PCDD's, PCDF's and dioxin-like PCB's.		2012			8			8			8			240							SGV	DEFRA	2012	

NOTE	
Priority	Guideline (mg kg ⁻¹)
1	Site Specific Assessment Criteria (SSAC) (Soils Limited)
2	2014: Category 4 Screening Level (C4SL) (Contaminated Land: Application in Real Environment (CLARE), 2014)
3	2012: Soil Guideline Value (SGV) (Environment Agency, 2009)
4	2015: Sutable 4 Use Level (S4UL) (Nathanail <i>et al</i> , 2015)
For Generic Risk Assessment, the values in Bold have priority	
Table reviewed February 2018	

Appendix D Information Provided by the Client



Accommodation Schedule				
Plot	Type	Bedrooms	Tenure	Part M Cat. 2 Compliant
Plot 1	House	3 Bed & Garage	Open Market	
Plot 2	House	3 Bed & Garage	Open Market	
Plot 3	House	3 Bed	Open Market	
Plot 4	House	3 Bed	Open Market	
Plot 5	House	4 Bed & Garage	Open Market	
Plot 6	House	4 Bed & Garage	Open Market	
Plot 7	House	3 Bed & Garage	Open Market	
Plot 8	House	3 Bed	Open Market	
Plot 9	House	4 Bed & Garage	Open Market	
Plot 10	House	3 Bed	Open Market	
Plot 11	House	2 Bed	Open Market	YES
Plot 12	House	3 Bed & Garage	Open Market	
Plot 13	House	3 Bed & Garage	Open Market	
Plot 14	House	3 Bed & Garage	Open Market	
Plot 15	House	3 Bed & Garage	Open Market	
Plot 16	House	3 Bed & Garage	Open Market	
Plot 17	House	3 Bed & Garage	Open Market	
Plot 18	House	3 Bed & Garage	Open Market	
Plot 19	House	3 Bed & Garage	Open Market	
Plot 20	House	3 Bed & Garage	Open Market	
Plot 21	Flat	1 Bed	Intermediate	YES
Plot 22	Flat	2 Bed	Intermediate	YES
Plot 23	Flat	1 Bed	Intermediate	YES
Plot 24	Flat	2 Bed	Intermediate	YES
Plot 25	House	3 Bed	Open Market	
Plot 26	House	3 Bed	Open Market	
Plot 27	House	4 Bed & Garage	Open Market	
Plot 28	House	2 Bed	Open Market	YES
Plot 29	House	2 Bed	Open Market	YES
Plot 30	House	3 Bed & Garage	Open Market	
Plot 31	House	4 Bed & Garage	Open Market	
Plot 32	House	3 Bed & Garage	Open Market	
Plot 33	House	3 Bed	Open Market	
Plot 34	House	3 Bed	Open Market	
Plot 35	House	3 Bed & Garage	Open Market	
Plot 36	House	3 Bed & Garage	Open Market	
Plot 37	House	2 Bed	Rented	YES
Plot 38	House	2 Bed	Rented	YES
Plot 39	Flat	1 bed	Rented	
Plot 40	Flat	2 Bed	Rented	
Plot 41	Flat	2 Bed	Rented	
Plot 42	Flat	1 bed	Rented	
Plot 43	Flat	1 bed	Rented	
Plot 44	Flat	1 bed	Rented	
Plot 45	Flat	2 Bed	Rented	
Plot 46	Flat	2 Bed	Rented	
Plot 47	House	3 Bed & Garage	Open Market	
Plot 48	House	2 Bed	Open Market	YES
Plot 49	House	3 Bed	Open Market	
Plot 50	House	2 Bed	Open Market	YES
Plot 51	House	2 Bed	Open Market	YES

	Social	Intermediate	Open Market	Total
1 Bed	4	2		6
2 Bed	6	2	6	14
3 Bed		0	26	26
4 Bed			5	5
Total:	10	4	37	51

KEY

- Application Boundary
- 6' x 4' Shed - Cycle storage
- Visitor parking space
- Retained tree
- Proposed tree - Refer to landscape design for details
- Brick boundary wall (all other plot rear boundaries- Timber closeboard fencing)
- Blockpaving private drives and parking - Charcoal
- Tarmac- Road
- Tarmac- Footpath
- Reinforced Grass - Visitor parking
- Existing public footpath upgraded to multi-user path

U 22.05.19 Minor amendments to reflect landscaping plan
T 15.05.19 Bin & cycle store added to flats
S 10.05.19 Amended layout to reflect planning officers request

Crayfern
HOMES

Victoria House 14 St Johns Road Hedge End Southampton Hampshire SO30 4AB
Tel 01489 773577 * Fax 01489 797111 * E mail sales@crayfernhomes.co.uk

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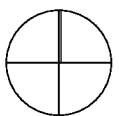
SITE LAYOUT | PROPOSED
DEVELOPMENT AT:
CINDERS LANE
YAPTON
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FOR
CRAYFERN HOMES LIMITED

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Drawing No : 19.14.P101_U

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Soils Limited
Geotechnical & Environmental Consultants

**Newton House
Cross Road, Tadworth
Surrey KT20 5SR**

