

Norwest Holst Soil Engineering Ltd.						Borehole No. 7	
BOREHOLE LOG				Sheet <u>1</u> of <u>1</u>			
Contract No. <u>F4403</u>				Chainage <u>8.35</u> m.A.O.D.			
Location <u>Littlehampton</u>				Ground Level <u>8.35</u> m.A.O.D.			
Client <u>Arun District Council</u>				Date <u>10/11/79</u>			
Method of Boring <u>Percussion</u>				Diameter of Borehole <u>150 mm</u>			

Description of Strata	Legend	Depth Below G.L. (m)	O.D. Level (m)	Casing Depth at Sampling	Sampling and Coring	"N"/ R.O.D. %	Daily Progress
TOPSOIL		0.20	8.2				
MADEGROUND: Clay		0.40	8.0				
MADEGROUND: Loose brick and domestic refuse.							
		2.40	6.0				
Firm to stiff brown silty very sandy CLAY.		3.00	5.4				
Brown fine to medium SAND with medium to coarse subangular and rounded chert gravel.		5.00	3.4				

Type of Sample	Remarks (Observations of Ground Water etc.)
☒ S.P.T. ☐ Undisturbed ☐ C.P.T. ☐ Vane ☐ Jar ☐ Water ☐ Bulk ☐ Piezometer	Borehole dry.

(2) 3 5 5 0 1710

Norwest Holst Soil Engineering Ltd.

Borehole No. **8**

BOREHOLE LOG

Contract No. F4403 Sheet 1 of 1

Location Littlehampton Chainage

Client Arun District Council Ground Level 5.35 m.A.O.D.

Method of Boring Percussion Date 11/11/79

Diameter of Borehole 150 mm

Description of Strata	Legend	Depth Below G.L. (m)	G.D. Level (m)	Casing Depth at Sampling	Sampling and Coring	"W" / R.O.D. %	Daily Progress
TOPSOIL		0.30	5.1				
MADEGROUND: Loose brick wood and domestic refuse.		2.60	5.8				
Firm to stiff friable brown silty clay very sandy CLAY with pockets of orange clayey medium sand.		4.10	4.3				
Cremy-white structureless CHALK - lumps up to 30 mm, in soft brown chalky clay matrix (grade V)		5.00	3.4				

Type of Sample

☒ S.P.T. ☒ Undisturbed

☒ C.P.T. ☒ Vane

☐ Jar ☐ Water

☒ Bulk ☒ Piezometer

Remarks (Observations of Ground Water etc.)

Borehole dry.

Norwest Holst Soil Engineering Ltd.				Borehole No. 9	
BOREHOLE LOG				Sheet 1 of 1	
Contract No. <u>F4403</u>		Location <u>Littlehampton</u>		Chainage <u>0329.0225</u>	
Client <u>Arun District Council</u>		Method of Boring <u>Percussion</u>		Ground Level <u>8.64</u> m.A.O.D.	
Diameter of Borehole <u>150mm</u>		Date <u>10/11/78</u>		Deny Progress	

Description of Strata	Legend	Depth Below G.L. (m)	O.D. Level (m)	Casing Depth at Sampling	Sampling and Coring	"N" / R.O.D. %
TOPSOIL		0.30	8.3			
MADEGROUND: Sandy clay		0.90	8.1			
MADEGROUND: Brown silty clay with domestic refuse and stones		2.60	6.0			
Firm to stiff friable brown silty very sandy CLAY with patches of sand		5.00	3.6			

Type of Sample	Remarks (Observations of Ground Water etc.)
☒ S.P.T. ☐ C.P.T. ☐ Jar ☐ Bulk ☒ Undisturbed ☒ Vane ☐ Water ☐ Piezometer	Borehole dry

Norwest Holst Soil Engineering Ltd.						Borehole No. 10	
BOREHOLE LOG				Sheet 1 of 1			
Contract No. F4483				Ground Level 8.24 m.A.D.D.			
Location Littlehampton				Date 9/11/28 - 10/11/28			
Client Arun District Council				Chairs			
Method of Boring Percussion							
Diameter of Borehole 150mm							

Description of Strata	Legend	Depth Below G.L. (m)	O.D. Level (m)	Casing Depth at Sampling	Sampling and Coring	"N"/ R.Q.D.%	Daily Progress
TOPSOIL	[Symbol]	0.30	7.9				
MADEGROUND: Soft brown silty clay with domestic refuse	[Symbol]	2.50	8.7				
Firm to stiff friable brown silty sandy CLAY	[Symbol]	5.00	9.2				

Type of Sample S.P.T. [Symbol] Undisturbed C.P.T. [Symbol] Vane Jar [Symbol] Water Bulk [Symbol] Piezometer	Remarks (Observations of Ground Water etc.) Borehole dry
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Norwest Holst Soil Engineering Ltd.						Borehole No. 11	
BOREHOLE LOG				Contract No. F4403			
Location Littlehampton				Sheet 1 of 1			
Client Arun District Council				Chainage			
Method of Boring Percussion				Ground Level 8.03 m.A.O.D.			
Diameter of Borehole 150mm				Date 10/11/78			
Description of Strata	Legend	Depth Below G.L. (m)	O.D. Level (m)	Casing Depth at Sampling	Sampling and Coring	"R"/P.O.D.S	Bathy Program
Topsoil		0.25	7.7				
MADEGROUND: Clay with ash		0.50	7.5				
MADEGROUND: loose ash and domestic refuse							
		3.00	5.0				
Firm friable brown very silty very sandy CLAY with occasional angular chert gravel		3.60	4.4				
Stiff brown silty sandy CLAY with sand pockets and gravel		4.85	3.0				
Greyish-white CHALK							

Type of Sample

☒ S.P.T. ☒ Undisturbed
☒ C.P.T. ☒ Vane
☒ Jar ☒ Water
☒ Bulk ☒ Piezometer

Remarks (Observations of Ground Water etc.)

Borehole dry

Norwest Holst Soil Engineering Ltd.				Borehole No. 12	
BOREHOLE LOG				Sheet 1 of 1	
Contract No. F4403				Chainage 0341 0324	
Location Littlehampton				Ground Level 2.85 m.A.O.D.	
Client Arun District Council				Date 8/11/79	
Method of Boring Percussion					
Diameter of Borehole 150mm					

Description of Strata	Legend	Depth Below G.L. (m)	O.D. Level (m)	Casing Depth at Sampling	Sampling and Coring	"N"/ R.O.D. %	Daily Progress
TOPSOIL		0.25	2.8				
MADEGROUND: Soft brown silty clay with domestic refuse and stones					0.50 1.50 2.50	3 3	
Firm brown very silty very fine sandy CLAY with occasional medium and coarse subangular chert gravel		2.50	5.4		2.50		
		3.80	4.1		4.00	40	
Grayish-white structureless CHALK - lumps up to 50mm with a clayey matrix (grade VI) Lumps increase in size with depth					5.50 7.00 8.50 9.50	35 32	
		10.00	-2.1				

Type of Sample ☒ S.P.T. ☐ C.P.T. ☐ Jar ☒ Bulk ☐ Undisturbed ☒ Vane ☐ Water ☐ Piezometer	Remarks (Observations of Ground Water etc.) Slight seepage at 9.00m
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22

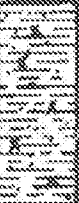
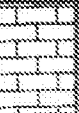
TQ 00SW

201

Norwest Holst Soil Engineering Ltd.				Borehole No.			
Contract No. F4403				13A			
BOREHOLE LOG				Sheet..... of.....			
Location Littlehampton				Chainage.....			
Client Arun District Council				Ground Level..... m.A.O.D.			
Method of Boring Percussion				Date 2/11/79			
Diameter of Borehole 150mm							
Description of Strata	Legend	Depth Below G.L. (m)	O.D. Level (m)	Casing Depth at Sampling	Sampling and Coring	"R"/ R.Q.D.S	Daily Progress
TOPSOIL		0.25	8.3				
MADEGROUND: clay		0.50	7.9				
MADEGROUND: Loose domestic refuse with stones					1.50	4	
		2.50	5.8		2.50		
Soft brown silty very fine sandy CLAY							
		3.70	4.7		3.70	35	
Creamy-yellow structureless CHALK lumps up to 70mm in a firm clayey chalky matrix (Grade V)					5.20		
					6.70	38	
					8.20		
					9.50	37	
		10.00	-1.6				

Type of Sample	Remarks (Observations of Ground Water etc.)
☒ S.P.T. ☐ Undisturbed ☐ C.P.T. ☐ Vane ☐ Jar ☐ Water ☐ Bulk ☐ Piezometer	Borehole dry

Norwest Holst Soil Engineering Ltd.						Borehole No. 14	
BOREHOLE LOG				Sheet <u>1</u> of <u>1</u>			
Contract No. <u>F4403</u> Location <u>Littlehampton</u> Client <u>Arun District Council</u> Method of Boring <u>Percussion</u> Diameter of Borehole <u>150 mm</u>				Chainage <u> </u> Ground Level <u>8.80</u> m.A.O.D. Date <u>10/11/79</u>			
Description of Strata	Legend	Depth Below G.L. (m)	O.D. Level (m)	Casing Depth at Sampling	Sampling and Coring	"N"/ W.O.D. %	Daily Progress
TOPSOIL		1.25	2.7				
MADEGROUND: Clay		0.40	2.6				
MADEGROUND: Loose ash and domestic refuse.		2.40	5.6				
Firm to stiff friable brown silty sandy CLAY.		4.00	4.8				
Pale brown structureless CHALK lumps to 50 mm in a pale brown chalky clayey matrix (grade V)		5.00	3.0				
Type of Sample ☒ S.P.T. ☐ Undisturbed ☒ C.P.T. ☐ Vane ☐ Jar ☐ Water ☒ Bulk ☐ Piezometer		Remarks (Observations of Ground Water etc.) Borehole dry.					

Norwest Holst Soil Engineering Ltd.						Borehole No. 15	
BOREHOLE LOG						Sheet <u>1</u> of <u>1</u>	
Contract No. <u>F4403</u> Location <u>Littlehampton</u> Client <u>Arun District Council</u> Method of Boring <u>Permeation</u> Diameter of Borehole <u>150 mm</u>				Chainage <u> </u> Ground Level <u>7.85</u> m.A.O.D. Date <u>11/11/78</u>			
Description of Strata	Legend	Depth Below G.L. (m)	O.D. Level (m)	Casing Depth at Sampling	Sampling and Coring	"W" / R.O.D. %	Daily Progress
TOPSOIL		0.25	7.6				
MADEGROUND: Loose clay and ash with domestic refuse.		2.50	5.4				
Firm brown silty sandy CLAY with occasional gravel.		4.10	3.6				
Greyish-white structureless CHALK lumps in chalky matrix (grade V)		5.00	2.9				

Type of Sample ☒ S.P.T. ☐ Undisturbed ☒ C.P.T. ☐ Vane ☐ Jar ☐ Water ☒ Bulk ☐ Piezometer	Remarks (Observations of Ground Water etc.) Borehole dry.
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Norwest Holst Soil Engineering Ltd.

TQ00SW 204

Borehole No.
16

Contract No. P4403
 Location: LITTLEHAMPTON
 Client: ARUN DISTRICT COUNCIL
 Method of Boring: Percussion
 Diameter of Borehole: 150mm

BOREHOLE LOG

Sheet: 1 of 1
 Chainage: 0341-0320
 Ground Level: 7.35 m.A.O.D.
 Date:

Description of Strata	Legend	Depth Below G.L. (m)	G.D. Level (m)	Casing Depth or Sampling	Sampling and Coring	"W" / R.G.D. %	Daily Progress
IDEOSITY: MADEGROUND: Very loose domestic refuse with stones and a cavity between 1.80m and 2.80m		0.25	7.1				
Firm yellow-brown slightly silty CLAY with occasional coarse sand		3.00	4.4				
Greyish-white CHALK		4.80	2.4				
		5.00	2.4				

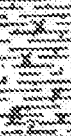
Type of Sample

- ☒ S.P.T. ☒ Undisturbed
☒ C.P.T. ☒ Vane
☐ Jar ☐ Water
☐ Bulk ☐ Piezometer

Remarks (Observations of Ground Water etc.)

Borehole dry

Water levels are subject to seasonal or tidal variations and should not be taken as permanent.

Norwest Holst Soil Engineering Ltd.						Borehole No. 17	
BOREHOLE LOG						Sheet <u>1</u> of <u>1</u>	
Contract No. <u>F4403</u> Location <u>Littlehampton</u> Client <u>Arun District Council</u> Method of Boring <u>Percussion</u> Diameter of Borehole <u>150mm</u>						Chainage <u> </u> Ground Level <u>8.35</u> m.A.O.D. Date <u>11/11/20</u>	
Description of Strata	Legend	Depth Below G.L. (m)	O.D. Level (m)	Casing Depth at Sampling	Sampling and Coring	"R"/ R.O.D. %	Daily Progress
TOPSOIL		0.20	8.2				
MADEGROUND: sandy clay with ash		0.50	7.9				
MADEGROUND: Loose domestic refuse with stones		2.00	8.4				
Firm friable yellow-brown silty fine sandy CLAY		3.20	8.2				
Brown fine SAND and medium to coarse subangular chert GRAVEL Traces of chalk at 5.00m		5.00	8.4				
Remarks (Observations of Ground Water etc.) Type of Sample ☒ S.P.T. ☐ Undisturbed ☒ C.P.T. ☐ Vane ☐ Jar ☐ Water ☐ Bulk ☐ Piezometer Borehole dry							

• R. COSW 206

Norwest Holst Soil Engineering Ltd.

Borehole No. **18**

BOREHOLE LOG

Contract No. E4403 Sheet 1 of 1

Location Littlehampton Chainage 0244 0325

Client Arun District Council

Method of Boring Percussion Ground Level 7.73 m.A.D.D.

Diameter of Borehole 150mm Date 11/11/73

Description of Strata	Legend	Depth Below G.L. (m)	O.D. Level (m)	Casing Depth at Sampling	Sampling and Coring	"W" / R.O.D. %	Daily Progress
TOPSOIL		0.25	7.4				
MADEGROUND: clay with brick fragments		1.10	6.6				
Soft to firm brown silty CLAY		2.40	5.3				
Soft brown very sandy silty CLAY with pockets of fine and medium sand and occasional fine gravel		3.70	4.0				
Grayish-white CHALK		5.00	2.7				

Type of Sample

☒ S.P.T. ☒ Undisturbed

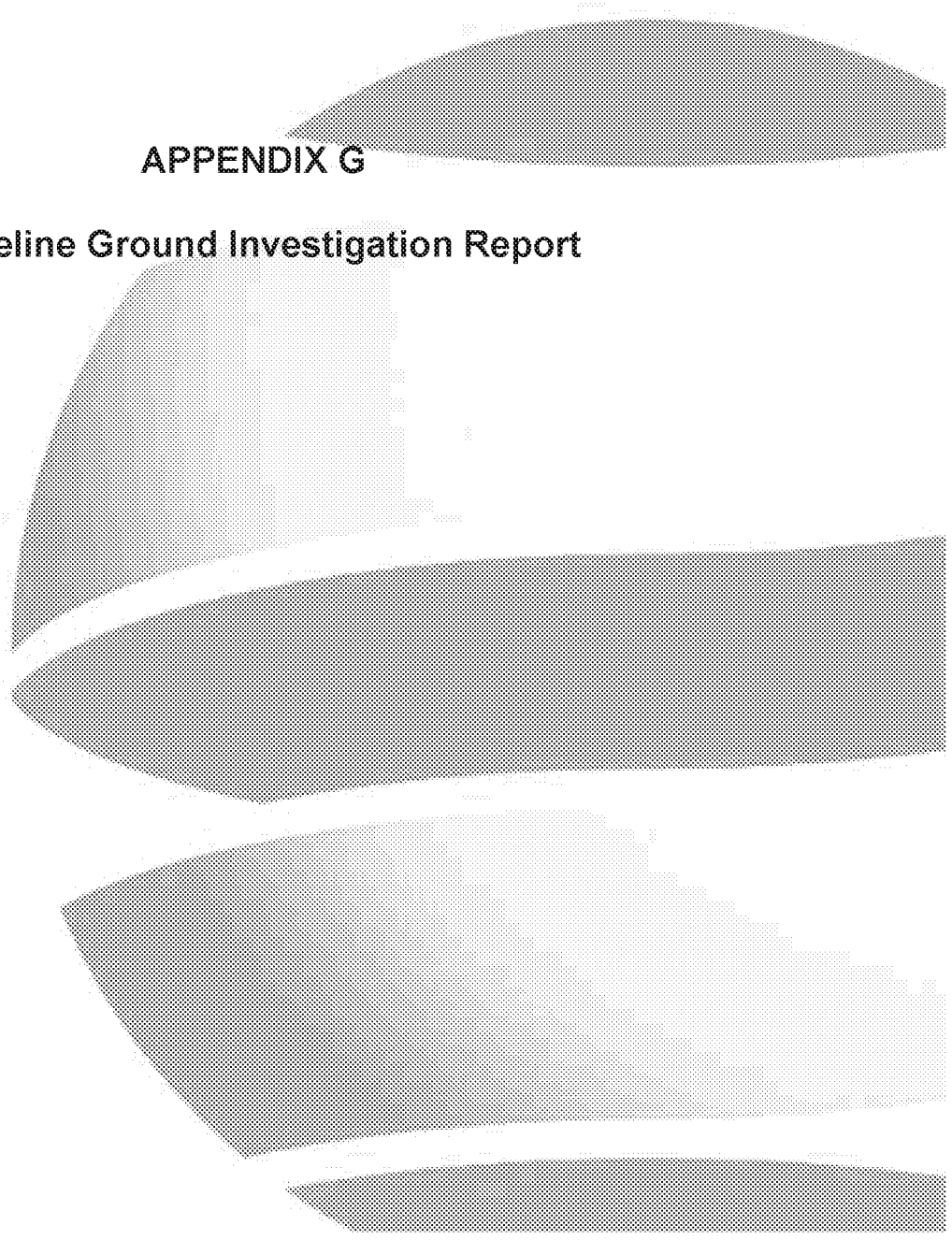
☒ C.P.T. ☒ Vane

☐ Jar ☐ Water

☒ Bulk ☒ Piezometer

Remarks (Observations of Ground Water etc.)

Borehole dry



APPENDIX G

Baseline Ground Investigation Report



Geo-Environmental

BASELINE GROUND INVESTIGATION REPORT

for the land at

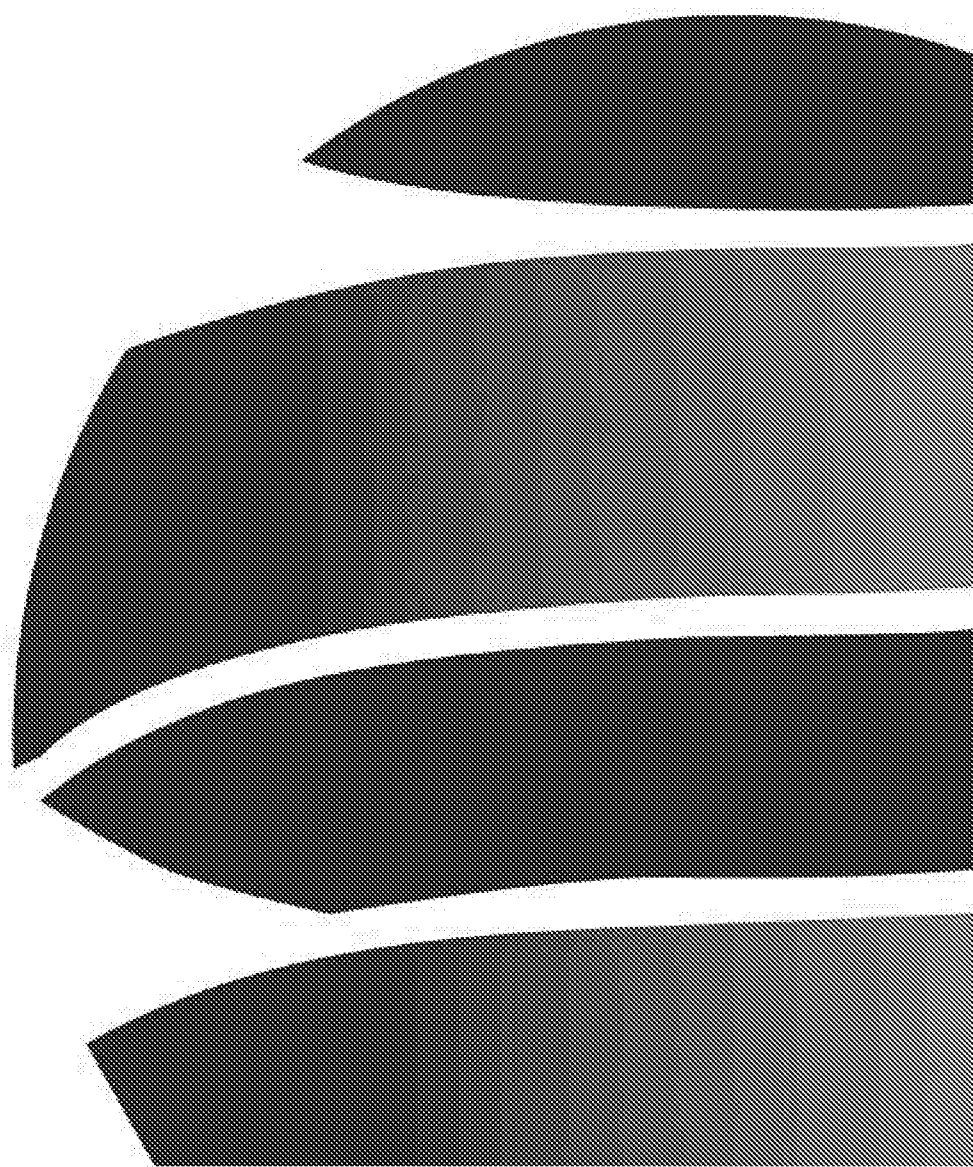
DAISYFIELDS TOURING PARK, CORNFIELD CLOSE,

WICK, LITTLEHAMPTON, WEST SUSSEX

BN17 6LD

on behalf of

THAKEHAM CLIENT



Report:	BASELINE GROUND INVESTIGATION REPORT
Site:	DAISYFIELDS TOURING PARK, CORNFIELD CLOSE, WICK, LITTLEHAM PTON, WEST SUSSEX, BN17 6LD
Client:	THAKEHAM CLIENT
Date:	18/01/2018
Reference:	GE16903BGIR-JAN18
Version:	1.0
Prepared by:	[REDACTED]
&	ANTHONY POTTER BSc (Hons), M Sc, FGS SENIOR ENGINEER
Reviewed by:	[REDACTED]
	GLYN EVANS BSc., M Sc, FGS PG Dip., M I Env Sc TECHNICAL DIRECTOR

Geo-Environmental Services Limited

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AMENDMENT RECORD

Revision ref.	Date	Reasons for amendment	Author's initials
1.0	18/01/218	First issue of the report	AP



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FIGURES

FIGURE 1	Site Location Plan
FIGURE 2	Exploratory Hole Location Plan
FIGURE 3	Conceptual Site Model (Long Term Development)

APPENDICES

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APPENDIX B	Geotechnical Laboratory Test Results
APPENDIX C	Geochemical Laboratory Test Results (soil and GW)
APPENDIX D	CLEA Assessment Outputs – Development of SSAC's
APPENDIX E	Ground Gas Monitoring

EXECUTIVE SUMMARY		
Site Details	Site Address	Daisyfields Touring Park, Cornfield Close, Littlehampton, West Sussex, BN17 6LD
	National Grid Reference	503370, 103260
	Site Area	2.71 Ha
	Form of Development	The proposed development was to comprise the construction of 64 residential houses, 21 residential apartments, private and communal gardens, car parking, access roads and associated infrastructure.
Encountered Conditions	Scope of works	The investigation included intrusive investigations (following previous desk study undertaken by Geo-Environmental for the site), and laboratory testing to inform a geotechnical and geo-environmental assessment.
	Ground Conditions	Made Ground in the form of landfilled material was encountered within all locations to depths of between 1.80m and 2.70m bgl and was of a mixed composition of sandy clay and silty sand with brick, glass, plastics, metal, china, ash, coal, concrete, black organic matter, shoes, fabric, timber, car tyres, and flint gravel. An organic odour was generally noted from the fill material. However, a strong hydrocarbon malodour was noted within TP2 at depths of between 1.00m and 2.50m bgl. It should also be noted that TP6 refused at a depth of 2.00m bgl upon a brick floor (possible former kiln floor). Underlying the Made Ground, River Terrace Deposits were encountered within all locations with the exception of TP6 and generally comprised medium dense brown sand with rare flint gravel becoming sand and gravel at depth, brown and grey friable clay and stiff grey silty clay with black organic matter and brown very clayey sand. Underlying the River Terrace Deposits, the chalk was encountered within BH1 only at a depth of 6.50m and proven to a depth of 15.00m bgl (maximum depth of the investigation) and was generally recovered as weak, medium dense white and off-white unstained chalk, closely spaced fractures, in a white comminuted chalk matrix.
	Groundwater	Groundwater was encountered within BH1 only at a depth of 4.30m bgl and rose to 3.80m bgl after twenty minutes during the intrusive investigation. A return groundwater monitoring visit was undertaken on 7th December 2017. A dual monitoring well was installed within BH1, with a well installed at a depth of 2.0m bgl (MW1a) and further well at a depth of 15m bgl (MW1b). MW1a was recorded as being dry, whilst MW1b had standing water at a depth of 6.64m bgl.
Geotechnical Considerations	Foundations	Piled foundations are recommended, please refer to section 5.1 for pile design preliminary bearing values.
	Floor Slabs	Suspended floor slabs are recommended due to the depth of Made Ground and shrinkable soils encountered across the site.
	Excavations	Excavations within deep Made Ground are likely to be highly unstable and are likely to require some form of support. Excavations within the more granular sand and gravel of the River Terrace Deposits on site are likely be marginally stable in the short term, becoming highly unstable when exposed to water and as such may also require support in the short to medium term or where they are left open for prolonged periods. As such, an allowance for shuttering or possibly sacrificial support may be prudent.



Environmental Considerations	Pavements	CBR testing was outside the scope of the investigation works undertaken for the site. The Made Ground encountered across the site was noted to be of mixed and variable composition. The engineering characteristics of such soils are variable and unpredictable and for which a CBR value of Made Ground would not predict the overall settlements that may occur in such materials. As such, in-situ testing at regular intervals along any road alignment may be required along with treatment of soft/hard spots and additional road construction to account for the presence of poor quality ground. There is likely to be significant long term settlement associated the presence of organic material and the potential for voids within the Made Ground and pavements and services should be designed to accommodate such settlements. As mentioned in Section 5.1, there is likely to be a requirement for soil stabilisation and or compaction, to provide a suitable engineering platform for the proposed development. It is recommended that Made Ground be deemed frost susceptible throughout thus a minimum pavement thickness of 450mm would be appropriate.
	Drainage	Soakage testing was outside the scope of the investigation works undertaken on the site, however based on the depth and composition of the Made Ground, conventional soakaways would be deemed unsuitable and another form of stormwater drainage should be used. Note should be made of the depth to groundwater and the presence of a principal aquifer when considering designs for stormwater disposal. Borehole soakaways may not be viable due to the requirement for a 5.0m unsaturated zone for the chalk aquifer.
	Buried Concrete	The results of the water soluble sulphate and pH analyses indicate that buried concrete within the River Terrace Deposits and Chalk should be designed in accordance with Class DS-1 of BRE Special Digest 1, with an AOEC class of AC-1. The advice of this publication should be taken for the design and specification of all sub surface concrete. Further sampling of the Made Ground is recommended to provide suitable parameters for the design of sub-surface concrete within this medium.
	Human Health	The statistical analysis has found that for all of the determinands tested the null hypothesis can be rejected with >95% confidence with the exception of Arsenic, Lead, Nickel, Vanadium and Benzo(a)pyrene. Additional testing was undertaken for Asbestos and speciated TPH, no asbestos was identified within the samples tested whilst the results of the speciated TPH were within normal limits. At this stage, contamination has been identified however, it is recommended that a more detailed investigation be undertaken to provide a more robust assessment for the site. It should be noted that based on the initial findings, remediation will be required in the form of a cover system and/or possible soil stabilisation techniques.
	Groundwater	Based on the results of the groundwater analysis, PAH and TPH contamination has been identified within the groundwater. However, this is based on one sample from one location. It is recommended that longer term groundwater monitoring is undertaken with additional samples from across the site to provide parameters for a P20 Groundwater Risk Assessment and to determine if remediation is required.
	Ground Gases	A part of the investigation, an allowance was made for an initial ground gas monitoring visit to be made. Dual monitoring wells were installed within BH1 comprising a well to 2.0m (MW1a) and a further well to 15.0m (MW1b). A monitoring visit was made on 7 th December 2017.



		The results of the return monitoring visit revealed no abnormal ground gas concentrations however, the previously undertaken long term spot monitoring identified elevated concentrations of Methane and Carbon Dioxide. It is recommended that additional monitoring wells be installed across the site with continuous ground gas monitoring undertaken to provide a more robust assessment of the ground gas regime within the landfill.
	Radon Gas	No radon protection measures are required.
	Built Environment	The ground conditions encountered across the site include deep areas of Made Ground. As such it is considered the use of barrier pipe as a minimum is likely to be required for potable water supplies installed on the site within areas where Made Ground and infilled ground has been identified. However, this would be subject to confirmation for the water utility company.
	Waste Disposal	CatWaste Soil analysis was undertaken on the soils analysed. The results were classified as being non-hazardous and hazardous. During further investigation, WAC testing should be undertaken for further classification.
Further Action: • Further site wide ground investigation. • Additional ground gas monitoring wells across the site with continuous ground gas monitoring. • Further geochemical analysis of soil and groundwater across the site. • Further geotechnical analysis across the site. • WAC testing of soils		
<i>This Executive Summary is intended to provide a brief summary of the main findings and conclusions of the investigation. For detailed information, the reader is referred to the main report ref. GE16903/GIR JAN18.</i>		

1.0 INTRODUCTION

1.1 General

Geo-Environmental Services Limited (Geo-Environmental) was instructed by Thakeham Client, to undertake baseline investigation works to assess the geotechnical and geo-environmental factors pertaining to proposed development at Daisyfields Touring Park, Cornfield Close, Wick, Littlehampton, West Sussex, BN17 6LD herein referred to as 'the site'. Geo-Environmental had previously undertaken a desk study for the site ref: GE16903/DSR/DEC17. The site's location is presented in Figure 1.

1.2 Form of Development

The proposed development was to comprise the construction of 64 residential houses, 21 residential apartments, private and communal gardens, car parking, access roads and associated infrastructure.

1.3 Objectives

The data from the geotechnical investigation was to form the basis of an interpretation with respect to foundation design, pavement construction, concrete specification, excavation stability and other pertinent construction issues.

Geo-Environmental has previously undertaken a desk study for the site. A Preliminary Risk Assessment (PRA) was undertaken as part of the desk study in accordance with CLR11 which has been updated as part of this assessment. The objective of the further assessment was to undertake phases of further risk assessments in order to evaluate the risks posed to the proposed redevelopment, adjacent land uses and the wider environment, in the context of likely planning requirements, immediate liabilities under the Environmental Protection Act 1990 and risks posed to Controlled Waters under the Water Resources Act from the current status of the site and in line with the proposed redevelopment.

1.4 Standards and References

Where practicable, the ground investigation and subsequent geotechnical and environmental assessments were undertaken in accordance with the following documents and guidance.

- National Planning Policy Framework – March 2012
- Planning Policy Statement 23 – Planning and Pollution Control (Replaced by NPPF but still considered relevant);
- Model Procedures for the Management of Contaminated Land, CLR11, DEFRA and Environment Agency 2004;
- Environment Agency Guidance on Requirements for Land Contamination Reports, Version 1 dated July 2005;
- BS10175:2011+A1:2013 - Investigation of Potentially Contaminated Sites - Code of Practice, BSI 2013;
- BS5930: 2015 - Code of Practice for Site Investigations, BSI 2015;
- EN ISO 14688 Geotechnical Investigation and Testing Part 1-2002 and Part 2-2004;
- BS1377: 1990 - Soils for Civil Engineering Purposes, BSI 1990;
- NHBC Standards Chapter 4.1 Land Quality - Managing Ground Conditions;
- NHBC Standards Chapter 4.2 Building Near Trees;
- CIRIA C665 – Assessing risks posed by hazardous ground gases to buildings (2007);
- NHBC 10627-R01(04)- Guidance on evaluation of development proposals on sites where methane and carbon dioxide are present (2007);

- BS8485:2015 Code of practice for the characterisation and remediation from ground gas in affected developments.

1.5 Conditions

This report does not purport to be a "Geotechnical Design Report" as defined in Clause 2.8 of Eurocode 7 (Geotechnical Design BS EN 1997-1:2004) and some of the data used to support this preliminary geotechnical assessment may not be fully compliant with that design code. It is considered possible that further detailed ground investigations could be required to facilitate the detailed geotechnical design process and should be carried out on a structure specific basis if necessary.

The data collected from the investigations have been used to provide an interpretation of the geotechnical and/or environmental conditions pertaining to the site. The recommendations and opinions expressed in this report are based on the data obtained. Geo-Environmental takes no responsibility for conditions that either have not been revealed in the available records, or that occur between or under points of physical investigation. Whilst every effort has been made to interpret the conditions, such information is only indicative and liability cannot be accepted for its accuracy.

It should be noted that in particular the concentrations and levels of mobile liquid and gaseous materials are likely to vary with time. The results obtained may therefore only be representative of the conditions at the time of sampling. This report should not be taken as any guarantee that a site is free of hazardous or potentially contaminative materials.

Information contained in this report is intended for the use of the Client and Geo-Environmental can take no responsibility for the use of this information by any party for uses other than that described in this report. Geo-Environmental makes no warranty or representation whatsoever express or implied with respect to the use of this information by any third party. Geo-Environmental does not indemnify the Client or any third parties against any dispute or claim arising from any finding or other result of this investigation report or any consequential losses.

Assessment criteria or other parameters developed for the evaluation of contamination on this site are based on a number of assumptions regarding exposure and toxicology. Exposure to contaminants and levels of adverse effects may therefore vary. Whilst reasonable care and expertise has been employed in the development of such criteria, no liability is accepted in this respect. Other criteria or guidance on the development of assessment criteria may be published in the future and no liability is accepted in this respect.

2.0 DESK STUDY

A desk study has previously been undertaken for the site by Geo-Environmental (GE16903/DSF/DEC17). As part of the current assessment a review was undertaken of the previous desk study for the site together with an updated preliminary risk assessment. Pertinent information from the previous report is included as part of assessment present below, however the previous report should be referred to for more detail.

The site has historically been utilised as a brickfield and then subsequently for landfilling and more recently the site was utilised as a caravan park. At the time of the first phase of the investigation works on site, the site was still occupied by the caravan park.

Comments made in the following sections regarding possible ground conditions on the site are based purely on a findings of the desk study previously undertaken.

2.1 Site Description

The site comprised an approximately square shaped parcel, which was noted to be generally flat and level. The site was located at NGR503370, 103260 and extended to c. 2.71Ha.

At the time of the site walkover survey, the site comprised a caravan park. The northernmost portion included accommodation for the owner, a reception/shop, caravan plots and a wash block. The central and southern portions comprised caravan plots and recreation space. The site was bounded by cattle fencing and mature trees.

The surrounding area comprised residential properties to the north and east, and two separate schools to the south and west. Site access was via Cornfield Close to the north.

2.2 Geology

British Geological Survey (BGS) geological mapping indicated the geology underlying the site to comprise sand and gravel of the River Terrace Deposits over the White Chalk Sub-Group. Whilst no worked or Made Ground was marked on the British Geological Survey mapping for the site, it was understood that part of the site had formerly been subject to landfilling and as such areas of Made Ground were expected to be present overlying natural strata.

It was understood that the Made was formed of Household waste including glass, metal, household rubbish and organic matter.

The rivers of the south of England have been subject to at least three changes of level since Pleistocene times. One result has been the formation of a complex series of **River Terrace Deposits**. The deposits are generally found at an elevation close to or higher than that of the existing rivers, and generally comprise sand and gravel of roughly bedded flint or chert.

The **White Chalk Subgroup** is a soft white friable microporous limestone composed of coccolith biomicrites with a varying proportion of larger shell fragments. Flint characterises the White Chalk Subgroup, occurring as nodular courses, tabular beds and linings to fractures.

At various levels clay sized material occurs as marl seams and partings. Close to the surface the upper few metres are invariably discoloured brown, due to leaching from the overlying strata. The interface with any overlying stratum is invariably extremely irregular as a result of localised weathering and general solution. Weathering by frost action may extend to a depth of several metres.

Occasional erosional features, such as pipes, swallow holes and solution cavities, usually infilled with drift deposits,

are found in the chalk, sometimes manifesting 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.

Within the Chalk outcrop on the south coast of England the traditional three-fold division into Lower, Middle and Upper Chalk is impractical for mapping purposes and only two divisions are mapped, these being the Grey Chalk Subgroup (formerly known as the Lower Chalk) and the White Chalk Subgroup (formerly the undivided Middle & Upper Chalk).

2.3 Hydrogeology

With reference to Envirocheck data, the superficial deposits (River Terrace Deposits) were classified as a Secondary 'A' Aquifer. Whilst the Bedrock geology (Chalk) was classified as a Principal Aquifer.

Secondary 'A' aquifers comprise permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers.

Principal Aquifers are layers of rock or drift deposits that have high intergranular and/or fracture permeability - meaning they usually provide a high level of water storage. They may support water supply and/or river base flow on a strategic scale. In most cases, principal aquifers are aquifers previously designated as major aquifer.

The soil cover across the site was classified as being of intermediate leaching potential (I1) and high leaching potential (U), as soil information for restored mineral workings and urban areas is based on fewer observations than other areas and as such as worst case vulnerability classification of (H) is assumed until proved otherwise.

According to information provided from the Environment Agency the site was indicated to be outside of any Source Protection Zone with regard to the protection of groundwater for potable supply.

2.4 Hydrology

The closest surface water feature (58m NW) comprised an unknown feature (possible pond or stream).

The Envirocheck data indicated the subject site to be outside of any areas at risk from fluvial or coastal flood and from surface water flooding. The site was however identified as being located within an area susceptible to groundwater flooding, where there is the potential for groundwater flooding to occur at surface and to property situated below ground level.

2.5 Sensitive Land Uses

The site is not indicated to be within a sensitive land use area.

2.6 Radon

The Envirocheck report states that the site lies in an area where less than 1% of homes are above the Action Level as defined by Public Health England. The BGS record states that no radon protective measures are necessary in the construction of the new dwellings.

2.7 Landfill and Waste Management Facilities

Information provided within the Envirocheck report identified the presence of historic landfilling on the site. The site was recorded to have accepted wastes including household waste.

2.8 Historic Land Uses

Historic mapping from 1876 has shown that the site formed part of a field network, prior to forming a brick field c.1911. The site was developed as a caravan site c.1980. The most recent mapping layout appeared to be consistent with the layout observed during the site walkover survey.

The land in the immediate vicinity of the site appeared to have formed field's c.1876 with the north-western area forming part of the brick field c.1911 to c.1932. From c.1932 to date the surrounding area was developed for a mixture of residential and educational uses.

2.9 Previous Ground Investigations

An environmental search request was sent to Arun District Council asking for any information they made hold for the site, and in particular any information held on the landfill.

Records held for the site comprised a landfill gas monitoring report which it is believed to have been prepared in 1995 although no date or reference were provided. The monitoring based on the standards at that time comprised eleven standpipes being installed and monitored over a two year period, initially the visits were weekly for the first four months before becoming monthly. Methane was recorded within the range of 0.1% v/v to 7.8% v/v with the higher readings recorded within position SP9 only. Carbon Dioxide levels ranged between 0.0% v/v and 13.6% v/v. It was recommended that further monitoring be undertaken until Carbon Dioxide concentrations dropped and to install further monitoring wells adjacent to wells SP6, SP9 and SP10. In addition, it was recommended that a gas barrier in the form of a trench be installed with venting along with the installation of continuous gas monitoring equipment.

The BGS Geology of Britain Viewer borehole scan records identified eighteen shallow boreholes undertaken across the site, these were drilled in November 1978 by Norwest Holst Soil Engineering Ltd. Samples identified Made Ground to depths of between 1.10m and 3.30m bgl. The Made Ground generally comprised friable brown silty sandy gravelly clay overlying brown silty clay with domestic refuse with brick, wood, concrete and ash. Underlying the Made Ground, River Terrace Deposits were encountered to depths of between 3.70m and 6.35m bgl and generally comprised orange brown silty fine sandy clay with chert gravel, clayey sand and gravel and brown sand. Underlying the Made Ground and River Terrace Deposits, Chalk was encountered within ten locations to depths of between 5.00m and 10.00m bgl (maximum depth of the investigation). The chalk was described as greyish-white structureless chalk within a chalky clayey matrix.

2.10 Potential Contamination

The site's previous uses have included a former brickfield which has subsequently been infilled as a landfill including household waste. A summary of potential contaminants associated with this land use are covered by the National House Building Council (NHBC), Environment Agency (EA) and Chartered Institute of Environmental Health (CIEH) publication '*Guidance for the Safe Development of Housing on Land Affected by Contamination*' (2008), which provides a summary of industrial profiles (1995 - 1996) published by the former Department of the Environment (DoE) (now part of the Department for Environment, Food and Rural Affairs [DEFRA]). Under the use of Waste Disposal, treatment and disposal sites; landfills and other waste treatment or waste disposal sites.



The guidance has identified the potential for the following contaminants of concern to be present on the site associated with the historical land uses, metals and semi metals (including As, Ba, Cd, Cr, Pb, Ni, Zn), inorganic chemical (including cyanide, NO₃, sulphates, asbestos, elevated pH, oil/fuel hydrocarbons, PAHs, chlorinated aliphatic hydrocarbons, chlorinated aromatic hydrocarbons, PCBs, dioxins and furans.

Where identified Made Ground or shallow soils may contain contaminants of concern, including metals, non-metal, in organic pollutants, organic pollutants (including PAH/TPH) and asbestos.

In addition it is possible that the surrounding land uses may have resulted in the deposition of airborne contaminants on the surface and shallow soils on site including heavy metals, organic pollutants such as Polyaromatic hydrocarbons (PAH), petroleum hydrocarbons/oils), inorganic compounds.

2.11 Ground Gas and Vapour Summary

The desk study has identified the presence of a thickness of Made Ground/infilled ground on the site associated with the infilling of a former brick field, records from which suggest that household and potentially biodegradable waste was accepted. As such, these materials are considered to represent a potential source of degrading materials for the generation of ground gases and vapours. Information reviewed as part of the desk study indicated that the waste body did not benefit from any in-ground engineering or barriers and thus would presumably be a 'dilute and disperse' type body.

3.0 PRELIMINARY ASSESSMENT

Based on the findings of the desk study previously undertaken for the site, the following sections summarise the anticipated geotechnical and environmental factors likely to impact the site.

3.1 Potential Geotechnical Issues

The following factors that might impact the geotechnical condition of the site were identified as part of the previous desk study for the site:

- The presence of Made Ground (e.g. varying depth and/or composition) which will affect the foundation design and construction.
- The presence of laterally and vertically variable strata and the impact these could have on further construction.
- The suitability of shallow soils as a bearing stratum for conventional foundations.
- Consideration of the volume change potential of any cohesive soils and the affect this could have on foundations.
- The possible presence of aggressive ground conditions (sulphates) which may affect the foundation design and construction.
- The possible presence of perched and shallow groundwater beneath the site.

3.2 Preliminary Environmental Conceptual Site Model & Risk Assessment

3.2.1 Methodology

A Preliminary Risk Assessment ('PRA') and Conceptual Site Model ('CSM') have been prepared in accordance with CLR11 based on information obtained as part of the desk study. Possible risks associated with potential sources of contamination and sensitive receptors identified have been qualitatively assessed following a source-pathway-receptor ('Pollutant Linkage') approach in accordance with current UK protocols.

A risk of harm may only exist where a plausible pollutant linkage is present, and where the quantity or concentration of a contaminant is sufficient so as to pose harm. Under the statutory definition, "Contamination" may only strictly exist where contaminants pose a risk of harm to a receptor. The risk classification has been assessed in accordance with CIRIA C552 (Rudland et al., 2001). A summary of how the risks are derived and their definitions are presented in Tables 3.1 and 3.2.

		Consequence			
		Severe	Medium	Mild	Minor
Probability	High Likelihood	Very high risk	High risk	Moderate risk	Moderate/low risk
	Likely	High risk	Moderate risk	Moderate/low risk	Low risk
	Low Likelihood	Moderate risk	Moderate/low risk	Low risk	Very low risk
	Unlikely	Moderate/low risk	Low risk	Very low risk	Very low risk

Table 3.1 Risk Ratings Matrix

Risk Rating	Definitions
Very high risk	There is a high probability that severe harm could arise to a designated receptor from an identified hazard, OR, there is evidence that severe harm to a designated receptor is currently happening. This risk, if realised, is likely to result in a substantial liability. Urgent investigation (if not already undertaken) and remediation are likely to be required.
High risk	Harm is likely to arise to a designated receptor from an identified hazard Realisation of the risk is likely to present a substantial liability. Urgent investigation (if not already undertaken) is required and remediation works may be necessary in the short term and are likely over the longer term.
Moderate risk	It is possible that harm could arise to a designated receptor from an identified hazard. However, it is either relatively unlikely that any such harm would be severe, or if any harm were to occur it is more likely that the harm would be relatively mild.
Moderate to low risk	It is possible that harm could arise to a designated receptor from an identified hazard. However, it is unlikely that any such harm would be severe, or if any harm were to occur it is probable that the harm would be relatively mild.
Low risk	It is possible that harm could arise to a designated receptor from an identified hazard, but it is likely that this harm, if realised, would at worst normally be mild.
Very low risk	There is low possibility that harm could arise to a receptor. In the event of such harm being realised it is not likely to be severe.

Table 3.2 Risk Rating Definitions

3.2.2 Summary of Plausible Sources

Possible sources of contamination identified from the desk study previously undertaken for the site and the updated preliminary risk assessment are summarised in Table 3.3.

Source	Description	Contaminants
Shallow soils/shallow Made Ground (excluding infilled areas)	The general quality of shallow soils and shallow Made Ground and shallow soils could be impacted by the presence of contamination given the previous use of the site. In addition airborne deposition of contamination may have occurred within the shallow soils on the site.	Possible elevated concentrations of metals, metalloids, TPH and PAH compounds, sulphate and asbestos in Made Ground (if present).
Deeper Made Ground and/or Infilled Ground	The site has been identified as comprising former Brick field which has subsequently been infilled. As such there is the potential that historic land uses may have resulted in the introduction of waste materials to the site, which may have contained contaminants and/or may have resulted in a potential impact to soils and groundwater beneath the site.	Possible elevated concentrations of metals, metalloids, possible elevated organic pollutants such as TPH and PAH compounds, sulphate, asbestos, cyanide, ammonia, SVOC and VOCs, PCBs.
Ground gases/vapours	In view of the possible presence of Made Ground/infilled ground located within the site (to include possible former household waste and potentially biodegradable matter) there is the potential for ground gases and vapours to be present.	Methane, carbon dioxide, hydrogen sulphide, depleted oxygen, volatile organic compounds and trace gases.

Table 3.3 Possible Sources of Contamination

3.2.3 Summary of Plausible Pathways

The plausible pathways are summarised in Table 3.4. These pathways are based on the likely proposed end use, including private gardens, soft landscaping and public open space.

Pathway	Description
Direct Contact	Ingestion of soil particles (and bioaccumulation), inhalation of soil derived dust (including tracked back dust), dermal contact.
Inhalation	Inhalation of soil dust both inside and outside of buildings. Inhalation of ground gas/vapours within buildings.
Vertical & Lateral Migration	Contaminant movement both vertically through leaching/gravity and horizontally along preferential pathways, e.g. services trenches, or with groundwater and/or surface water.
Shallow Groundwater	Shallow groundwater or perched water may be present within the Made Ground and River Terrace Deposits (where present) which could result in the vertical and lateral migration of contaminants.
Chemical Attack	Attack of buried plastics and concrete by aggressive ground conditions.
Flooding	The Envirocheck reports state the site is not within an area at risk of fluvial or coastal flooding. However, the site has been identified as being in an area susceptible to groundwater flooding which could result in the migration of contaminants from the site to potential receptors.

Table 3.4 Possible contamination pathways

3.2.4 Summary of Plausible Receptors

Potential receptors associated with the site and its development are summarised in Table 3.5.

Receptor	Description	Comments
End Users	Residents/occupants of the potential future development and users of public open space	The potential long term future use is likely to comprise residential development with private and communal landscaping.
Soft Landscaping	Possible areas of private gardens, planting including lawns, shrubs, trees and public open space proposed.	Soft landscaped areas are likely to be part of any proposed development to comprise private gardens, communal landscaping, shrub borders.
Built Environment	Buried concrete for foundations and plastics for potable water supply pipes may be laid in contact with contaminated soils.	Aggressive ground conditions and depths of Made Ground may be present beneath parts or all of the site.
Adjacent Land Users	Sensitive land uses identified within the immediate vicinity.	Adjacent land use currently comprises a mix of residential and educational facilities.
Groundwater	Controlled waters contained within the aquifer(s) beneath the site.	The site overlies a Principal Aquifer and Secondary 'A' Aquifer and is outside of any SPZ.
Surface Water	Controlled Waters within lakes, rivers, and ponds, etc., or coastal waters.	An unknown feature was identified 58m from the site boundary.
Ecological Receptors	Sensitive areas of ecological significance.	No significantly sensitive land uses have been identified within 500m of the site. As such, these have not been considered further as part of this assessment.

Table 3.5 Possible Receptors of Contamination

Site workers involved in the preparation and construction of the development have not been considered further in this assessment as the Principal Contractor is duty bound under the current CDM Regulations to undertake their own risk assessments with respect to their employees.

Whilst the above sources and receptors have been identified, Table 3.6 summarises the identified plausible pollution linkages and a qualitative assessment of the risks based on the desk study research.



Potential Source/ media	Potential Receptors	Potential Pathways	Likelihood	Severity	Risk and Justification
Contaminants of Concern (Shallow soils and shallow Made Ground)	End users	Direct contact	Likely	Medium	Moderate End users are likely to come into contact with soils via direct contact in areas of soft landscaping (include private gardens) within the residential areas. However should contaminants of concern be identified landscaping would be completed within uncontaminated soils in the near surface root zone.
	Soft Landscaping	Root Uptake	Likely	Medium	Moderate Areas of soft landscaping are proposed. However landscaping would be completed within uncontaminated soils in the near surface root zone and no clear evidence of harm to existing vegetation as evident.
	Adjacent land users	Direct or indirect contact	Likely	Mild	Moderate to Low Adjacent site users may come into contact with soils, subject to the final proposed development on the site/surrounding land which is currently proposed to include landscaping. Landscaping would be completed within uncontaminated soils in the near surface root zone.
	Water supply pipes	Direct contact	Likely	Mild	Moderate to Low Water supply pipes could come into contact with impacted soils depending upon depth of installation and extent of soil impact.
	Buildings and infrastructure	Direct contact	Likely	Minor	Low Foundations and utilities will be placed within potentially aggressive soils (e.g. sulphate).



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Potential Source/ media	Potential Receptors	Potential Pathways	Likelihood	Severity	Risk and Justification
Contaminants of Concern (Deeper Made Ground/ Infilled Ground)	Groundwater	Vertical migration	Likely	Minor	Low Shallow groundwater (<5m bgl) may be present at the site within the River Terrace Deposits, although in places this may represent perched water due to the more cohesive bands beneath the site. The strata beneath the site is classified as a Principal Aquifer and Secondary 'A' Aquifer. The site is located outside of any SPZ.
	Surface Water	Lateral Migration	Likely	Mild	Moderate to Low An unknown feature was identified 58m from the site boundary. As such where contaminants are identified within the shallow soils on the site, leaching and lateral migration of the contaminants may occur.
	End users	Direct contact	Likely	Medium	Moderate End users are likely to come into contact with soils via direct contact in areas of soft landscaping (potentially to include private gardens). However should contaminants of concern be identified landscaping would be completed within uncontaminated soils in the near surface root zone.
	Soft Landscaping	Root Uptake	Likely	Medium	Moderate Areas of soft landscaping and public open space are proposed. However landscaping would be completed within uncontaminated soils in the near surface root zone and no clear evidence of harm to existing vegetation as evident.
	Adjacent land users	Direct or indirect contact	Likely	Mild	Moderate to Low Adjacent site users may come into contact with soils, subject to the final proposed development on the site/surrounding land. Landscaping would be completed within uncontaminated soils in the near surface root zone.



Ground Investigation Report

Potential Source/ media	Potential Receptors	Potential Pathways	Likelihood	Severity	Risk and Justification
	Water supply pipes	Direct contact	Likely	Mild	Moderate to Low Water supply pipes could come into contact with impacted soils depending upon depth of installation and extent of soil impact.
	Buildings and infrastructure	Direct contact	Likely	Mild	Moderate to Low Foundations and utilities will be placed within potentially aggressive soils (e.g. sulphate).
	Groundwater	Vertical migration	Likely	Mild	Moderate to Low Shallow groundwater (<5m bgl) may be present at the site within the River Terrace Deposits, although in places this may represent perched water due to the more cohesive bands beneath the site. The stratum beneath the site is classified as a Principal Aquifer and Secondary 'A' Aquifer. The site is located outside of any SPZ.
	Surface Water	Lateral Migration	Likely	Mild	Moderate to Low An unknown feature was identified 58m from the site boundary. As such where contaminants are identified within the shallow soils on the site, leaching and lateral migration of the contaminants may occur.
Ground Gases and Vapours	End users	Inhalation	Likely	Medium	Moderate Ingress of hazardous ground gas into buildings on or in proximity to any landfilled area or ground gas/vapour source could occur and could result in significant harm where ground gases are identified on site. Incorporation of gas protection measures could mitigate the risk of harm.
	Soft Landscaping	Root Uptake	Low	Mild	Low Private gardens, soft landscaping and public open space may be proposed.



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Potential Source/ media	Potential Receptors	Potential Pathways	Likelihood	Severity	Risk and Justification
	Adjacent land users	Inhalation	Low	Medium	Moderate to Low It is considered to be unlikely and a low probability that adjacent land users will come into contact with ground gases and vapours originating on site. Should ground gases and vapours be identified on-site service routes should be constructed in line with best practice to prevent the creation of preferential pathways off site.
Naturally occurring aggressive ground conditions	End users	Direct contact and inhalation / ingestion of soil derived dust	Unlikely	Minor	Very Low No naturally occurring potential sources which could harm human health have been identified.
	Soft Landscaping	Root Uptake	Unlikely	Minor	Very Low Gardens, soft landscaping and public open space are proposed but are unlikely to be affected by naturally occurring aggressive ground conditions. Current vegetation around the site appeared in good condition.
	Adjacent land users	Direct contact	Unlikely	Minor	Very Low No potential sources which could harm human health have been identified.
	Water supply pipes	Direct contact	Unlikely	Minor	Very Low Utilities will be constructed in/through Made Ground soils (if present). However the consequence is anticipated to be minor subject to appropriate design.



Potential Source/ media	Potential Receptors	Potential Pathways	Likelihood	Severity	Risk and Justification
	Buildings and infrastructure	Direct contact	Likely	Minor	Low Foundations and utilities will be constructed in through Made Ground soils (if present). However the consequence is anticipated to be minor subject to appropriate design.
	Groundwater	Vertical migration	Likely	Minor	Low Shallow groundwater (<5m bgl) may be present at the site within the River Terrace Deposits, although in places this may represent perched water due to the more cohesive bands beneath the site. The stratum beneath the site is classified as a Principal Aquifer and Secondary 'A' Aquifer. The site is located outside of any SPZ
	Surface Water	Lateral Migration	Low	Mild	Low An unknown feature was identified 58m from the site boundary. As such where contaminants are identified within the shallow soils on the site, leaching and lateral migration of the contaminants may occur.

Table 3.6 Plausible Pollutant Linkages & Qualitative Risk Assessment

3.3 Preliminary Risk Assessment Summary

The potential pollutant linkages established within this preliminary risk assessment are not considered to prevent development on the subject site, but could require investigation and assessment to support further characterisation, calibration of the CSM and where/if necessary determine a remedial strategy to reduce, remove or otherwise control any risk within the site to key receptors.

3.4 Scope of Works

In summary, the following scope of works for the intrusive investigation was agreed with the Client.

- Attendance of a Geo-Environmental/Geotechnical Engineer to set out and supervise the intrusive investigation. On site logging and sampling of soils recovered from exploratory holes.
- The construction of 1No. cable percussion borehole to depths of 15.0m bgl, dependent on drilling conditions, with in-situ testing and sampling to assess the relative strength and density of the soils.
- The excavation of 8No. machine dug trial pits to depths of up to 3m bgl.
- Installation of combined groundwater and ground gas monitoring well within the borehole. A dual monitoring well was installed, this being a 2.0m standpipe installed to target the Made Ground and a 15.0m standpipe installed to target the soils and groundwater beneath the Made Ground.
- An initial return gas and groundwater monitoring visit to assess the potential for ground gases on the site associated with the former land uses.
- Geotechnical laboratory testing on soil samples recovered from the exploratory holes to support the geotechnical assessment.
- Geochemical testing on selected soil and groundwater samples to clarify the findings of the preliminary risk assessment and identify possible remediation requirements.
- Provision of a baseline Ground Investigation Report.

3.5 Investigation Strategy

The positioning of exploratory holes was determined on site to provide general coverage. Table 3.7 sets out the investigation strategy adopted.

Area of Concern	Investigation	Positions
General ground conditions	Exploratory holes located across the site, coupled with sampling and laboratory analysis.	All
Geology at Depth	Cable Percussion borehole, coupled with in-situ testing, sampling and laboratory analysis.	BH1
Potential contamination of near surface soils	Exploratory holes located to provide coverage of the site, coupled with sampling and laboratory analysis.	All
Potential waste materials within former landfill	Targeted exploratory holes located across the site, coupled with sampling and laboratory analysis.	All
General gassing regime and groundwater levels	Spot monitoring within well	BH1

Table 3.7 Summary of the Investigation Strategy

Soil samples were collected and placed into amber jars and cool boxes on site for transit to the office, where they were stored under chilled conditions (<4°C) prior to final transportation in cool boxes to the laboratory by their in-house courier. Both the geotechnical and contamination testing were undertaken by UKAS accredited laboratories. Contamination testing of soil samples was also undertaken in accordance with accredited MCERTS protocols. Samples were stored in temperature controlled conditions from sampling until receipt at the laboratory



from which time sample preparation and storage was determined by testing requirements and in line with laboratory's protocols.



4.0 ENCOUNTERED CONDITIONS

A factual record of the conditions encountered during the physical investigation of the site is presented in the following sections.

For further details of the ground conditions, reference should be made to the exploratory hole logs presented in Appendix B, the geotechnical testing results in Appendix C, geochemical testing results in Appendix D and the ground gas monitoring results in Appendix E.

The physical ground investigation works were undertaken on the 27th November 2017.

Unless stated otherwise, all depths are reported as metres below ground level (m bgl).

4.1 Soils

According to the British Geological Survey, the ground conditions were anticipated to comprise Made Ground, River Terrace Deposits overlying the White Chalk Sub-Group.

Made Ground in the form of landfilled material was encountered within all locations to depths of between 1.80m and 2.70m bgl and was of a mixed composition of sandy clay and silty sand with brick, glass, plastics, metal, china, ash, coal, concrete, black organic matter, shoes, fabric, timber, car tyres, and flint gravel. An organic odour was generally noted from the fill material. However, a strong hydrocarbon malodour was noted within TP2 at depths of between 1.00m and 2.50m bgl. It should also be noted that TP6 refused at a depth of 2.00m bgl upon a brick floor (possible former kiln floor).

Underlying the Made Ground, River Terrace Deposits were encountered within all locations with the exception of TP6 and generally comprised medium dense brown sand with rare flint gravel becoming sand and gravel at depth, brown and grey friable clay and stiff grey silty clay with black organic matter and brown very clayey sand.

Underlying the River Terrace Deposits, the chalk was encountered within BH1 only at a depth of 6.50m and proven to a depth of 15.00m bgl (maximum depth of the investigation) and was generally recovered as weak, medium dense white and off-white unstained chalk, closely spaced fractures, in a white comminuted chalk matrix.

For more detailed descriptions at specific locations, reference should be made to the exploratory hole logs presented in Appendix B.

4.2 Groundwater

Groundwater was encountered within BH1 only at a depth of 4.30m bgl and rose to 3.80m bgl after twenty minutes during the intrusive investigation.

A return groundwater monitoring visit was undertaken on 7th December 2017. A dual monitoring well was installed within BH1, with a well installed at a depth of 2.0m bgl (MW1a) and further well at a depth of 15m bgl (MW1b). MW1a was recorded as being dry, whilst MW1b had standing water at a depth of 6.64m bgl.

It should also be noted that changes in groundwater levels do occur for a number of reasons including seasonal effects and variations in drainage. Such fluctuations may only be recorded by the measurement of the groundwater level within a series of standpipes or piezometers installed within appropriate response zones.



4.3 Obstructions

Artificial obstructions were only encountered within the exploratory hole WS6 which refused at a depth of 2.0m bgl on a brick floor. Based on the location of WS6 when compared against historical mapping, it is possible that the brick floor may have formed part of a former kiln.

Given the nature and history of the site the presence of obstructions elsewhere on the site cannot be discounted.

4.4 Geotechnical Testing

Geotechnical laboratory tests were undertaken on selected samples of the River Terrace Deposits and Chalk encountered on this site. The results are summarised in Table 4.2 below.

Parameter	River Terrace Deposits
Natural Moisture Content (%)	18-20
Liquid Limit (%)	33-37
Plastic Limit (%)	17-18
Plasticity Index Ip (%)	15-20
Modified Plasticity Index Ip' (%)	14.55-19.6
Soil grading Passing <0.063mm (%)	4-81.6
pH	7.4-7.7
Water soluble sulphate (g/l)	0.11-0.18
SPT N Value	17-20

Table 4.2 Summary of Geotechnical Laboratory Test Results

Parameter	Chalk
Saturation Moisture Content (%)	13
Natural Moisture Content (%)	12
Bulk Density (Mg/m ³)	2.24-2.26
Dry Density (Mg/m ³)	2.01
pH	7.5-7.7
Water soluble sulphate (g/l)	0.18-0.21
SPT N Value	29-57

Table 4.3 Summary of Geotechnical Laboratory Test Results

4.5 Chemical Analysis

The testing rationale comprised a baseline analysis of six samples of the Made Ground from across the site. Testing was undertaken for a broad range of commonly occurring contaminants associated with the former land uses including metals and metalloids (including As, Ba, Cd, Cr, Pb, Ni, Zn), inorganic chemicals, sulphates, asbestos, elevated pH, oil/fuel hydrocarbons and PAHs.

4.6 Ground Gases and Vapours

A single ground gas monitoring visit was undertaken to provide initial information regarding ground gases. A dual monitoring well was installed within BH1 which comprised a 2.0m bgl well (MW1a) installed to monitor for gases within the Made Ground, and a 15.0m bgl well (MW1b) installed to monitor for gases within the natural underlying soils. A monitoring visit was made on 7th December 2017, no Methane was detected whilst Carbon Dioxide concentrations ranged between 0.1-3.5% v/v. Oxygen concentrations ranged between 20.6-16.3% v/v. Flow ranged between 0.0 to -2.3 l/hr and VOC concentrations ranged between 0.1-4.2ppm. Pressure was recorded at 1013mb.

5.0 ENGINEERING CONSIDERATIONS

Subsequent to intrusive investigation of the site and receipt of the laboratory test results, the following geotechnical assessments have been made.

5.1 Foundations

It is considered that conventional shallow foundations would be unsuitable for the proposed development based on the depths and engineering characteristics of the Made Ground encountered in the trial holes across the site. It is therefore recommended that an alternate foundation scheme be adopted, such as piles.

In order to provide a suitable sustainable engineering platform for the development, there is likely to be the requirement of ground improvement works over most of the site. These works will be required to maintain potential long term settlements to within tolerable limits and may take the form of soil stabilisation or compaction or a combination of the two. Advice from a specialist contractor should be sought in this respect.

The construction of a piled foundation is a specialist job and the advice of a reputable contractor familiar with the type of ground and groundwater conditions encountered on this site should be sought prior to finalising the design. The actual working load for proposed piles will depend on the particular type of pile and method of installation adopted. Piles should be taken at least five times the pile diameter into the founding strata.

The site overlies a Secondary 'A' and Principal Aquifer and as such the foundation solution adopted should not introduce migration pathways for potential mobile contaminants. The Environment Agency has a preference for CFA piles undertaken within geology designated as an aquifer, as this method prevents the formation of contamination pathways into protected water resources. Should a piled foundation solution be adopted on site, it is possible that the Environment Agency will require a Foundation Works Risk Assessment to be undertaken prior to any foundation works being undertaken. Liaison with the Environment Agency will be required in this respect.

Preliminary load capacities calculated for varying diameters of CFA piles taken through the Made Ground and into the River Terrace Deposits and Chalk are given on the table below. The design should be used for preliminary purposes only as the actual working load is dependent on the type of pile and method of installation.

Table 5.1

Preliminary Pile Design

Pile Type	Diameter (mm)	Depth (m bgl)	Working Load (kN)
CFA	300	10	170
	450	10	320
	600	10	530
CFA	300	12	200
	450	12	380
	600	12	610

These working loads have been calculated on the basis of the ground and groundwater conditions encountered within the borehole and assume the following parameters:

- The contribution to the working load on the upper 3.00m has been ignored.
- A factor of safety of 3 was used on the skin friction and end bearing working loads respectively.



The bearing values given are applicable to single vertically loaded piles. Where groups of piles are to be constructed, the bearing value of each individual pile should be reduced by a factor of 0.8 and a calculation made to check for the factor of safety against block failure.

The piling contractor should be aware that the borehole were cased to a depth of 9.00m to prevent collapse as drilling progressed and that obstructions were encountered within exploratory holes and thus could be present at pile locations.

5.2 Floor Slabs

Given presence of Made Ground in excess of 2.70m deep beneath the site and the presence of shrinkage soils at shallow depth in places, it is recommended that suspended floor slabs be utilised throughout the development.

5.3 Excavations

Excavations within deep Made Ground are likely to be highly unstable and are likely to require some form of support. Excavations within the more granular sand and gravel of the River Terrace Deposits on site are likely be marginally stable in the short term, becoming highly unstable when exposed to water and as such may also require support in the short to medium term or where they are left open for prolonged periods. As such, an allowance for shuttering or possibly sacrificial support may be prudent.

Ground works should be designed in such a manner to avoid any requirement for construction or maintenance personnel to enter into or work within excavations. If such work cannot be avoided, then it should only be permitted once a safe system of work, supported by a robust risk assessment, has been determined and implemented.

5.4 Pavements

CBR testing was outside the scope of the investigation works undertaken for the site. The Made Ground encountered across the site was noted to be of mixed and variable composition. The engineering characteristics of such soils are variable and unpredictable and for which a CBR value of Made Ground would not predict the overall settlements that may occur in such materials. As such, in-situ testing at regular intervals along any road alignment may be required along with treatment of soft/hard spots and additional road construction to account for the presence of poor quality ground.

There is likely to be significant long term settlement associated the presence of organic material and the potential for voids within the Made Ground and pavements and services should be designed to accommodate such settlements. As mentioned in Section 5.1, there is likely to be a requirement for soil stabilisation and or compaction, to provide a suitable engineering platform for the proposed development.

It is recommended that Made Ground be deemed frost susceptible throughout thus a minimum pavement thickness of 450mm would be appropriate.

Any hard or soft spots in the formation level may induce reflective cracking in the pavement and allowance should be made for removing hard or soft spots that may be present.

5.5 Sub-Surface Concrete

The results of the water soluble sulphate and pH analyses indicate that buried concrete within the River Terrace Deposits and Chalk should be designed in accordance with Class DS-1 of BRE Special Digest 1, with an ACEC class of AC-1. The advice of this publication should be taken for the design and specification of all sub surface concrete.



Further sampling of the Made Ground is recommended to provide suitable parameters for the design of sub-surface concrete within this medium.

5.6 Soakaways

Soakage testing was outside the scope of the investigation works undertaken on the site, however based on the depth and composition of the Made Ground, conventional soakaways would be deemed unsuitable and another form of stormwater drainage should be used. Note should be made of the depth to groundwater and the presence of a principal aquifer when considering designs for stormwater disposal. Borehole soakaways may not be viable due to the requirement for a 5.0m unsaturated zone for the chalk aquifer.

6.0 ENVIRONMENTAL CONSIDERATIONS

A Generic Quantitative Risk Assessment (GQRA) incorporating the results of the previous desk study, updated preliminary risk assessment and intrusive ground investigation was undertaken, the findings of which are presented in the following sections.

As stated in Section 3, site workers involved in the preparation and construction of the development have not been considered further in this assessment as the Principal Contractor is duty bound under the current CDM Regulations to undertake their own risk assessments with respect to their employees.

6.1 Outline Risk Assessment

A number of plausible pollutant linkages were identified as part of the original desk study undertaken for the site and the updated preliminary risk assessment. The investigation did not encounter conditions that warranted a revision of the preliminary Conceptual Site Model. However, further testing and monitoring is recommended to provide a more robust assessment in this respect.

6.2 Ground Gases vs. End Users

A part of the investigation, an allowance was made for an initial ground gas monitoring visit to be made. Dual monitoring wells were installed within BH1 comprising a well to 2.0m (MW1a) and a further well to 15.0m (MW1b). A monitoring visit was made on 7th December 2017.

The results of the return monitoring visit revealed no abnormal ground gas concentrations however, the previously undertaken long term spot monitoring identified elevated concentrations of Methane and Carbon Dioxide. It is recommended that additional monitoring wells be installed across the site with continuous ground gas monitoring undertaken to provide a more robust assessment of the ground gas regime within the landfill.

6.3 Soil Contamination vs. End Users

The presence of a possible contaminant does not necessarily imply that a site or area is contaminated or that there is any unacceptable risk to human health. A Preliminary Quantitative Risk Assessment has been undertaken in order to evaluate any unacceptable risks posed to human health with respect to the proposed redevelopment. It should be noted that this assessment is protective of the chronic long-term effects of contaminants, which is also likely to be protective of any possible immediate acute effects.

A quantitative risk assessment has been undertaken by comparing the results of the laboratory chemical testing of shallow soils against Site Specific Assessment Criteria (SSAC) generated using the Contaminated Land Exposure Assessment (CLEA) model v1.07 published by the Environment Agency, or against the Category 4 Screening Levels (C4SLs) published by DEFRA, or against the Suitable for Use Levels (S4ULs) published by LQM. Although the C4SLs were released for Part 2A use, the associated policy companion document for the C4SLs indicated that they may also be used for planning. Although the C4SLs represent a marginally higher risk level than the SSACs (low risk rather than minimal risk) it is considered that the risk levels remain very low. Therefore, the final C4SLs are considered to be suitable to assess soils under the planning regime.

Assumptions				Comments
Land Use	Residential With home grown produce			Commensurate with proposed redevelopment.
Receptor	Female (res C4SL)			A conservative assumption using the most sensitive possible receptor.
Receptor Age	1 to 6			Critical receptor age from birth to age 6.
Building	Terraced house			A conservative assumption of the private residence use proposed.
Soil Type	Silty Loam	pH 8.2	SOM 6.9%	Based on an average of the chemical laboratory results.
Exposure Pathways	Oral	Direct soil & dust ingestion; consumption of home grown produce; soil attached to home grown produce		Default setting for land use.
	Dermal	Indoor & outdoor		Default setting for land use.
	Inhalation	Indoor & outdoor dust & vapour		Default setting for land use.
Occupancy	days/year	hours/day (Indoors)	hour/day (outdoors)	Default settings for the critical receptor.
	180 - 365	19 - 23	1	

Table 6.1 Assumptions for SSAC Calculation (CLEA v1.07 Software)

Statistical analysis of the non-targeted samples within the dataset has been undertaken in accordance with guidance contained in the CIEH/CL:AIRE report 'Comparing Soil Contamination Data with a Critical Concentration' (May 2008). If the contamination status of the soils is considered in a planning context, the null hypothesis tested by the analysis is whether the true mean concentration is equal to or greater than the critical concentration for a given determinand, with the critical concentration being the relevant SSAC or GAC (the soil screening value) for that determinand in the context of the intended end use of the site. If the analysis shows that the true mean concentration is less than the critical concentration the null hypothesis can be rejected. The guidance recommends that for the null hypothesis to be rejected the analysis should show that there is a 95% (or higher) likelihood that the true mean concentration is below the critical concentration. Where this is the case the site is considered to be acceptable for the planned end use without further remediation.

The results of the statistical analysis for the Made Ground are summarised in the table below:

Table 6.2

Summary of Statistical Analysis

Determinand	Soil Screening Value (mg/ kg)	Sample Mean (mg/ kg)	Upper Confidence Limit (mg/ kg)	Evidence Level (%)	Reject null hypothesis?
Arsenic	37	30.75	90.20	17	No
Cadmium	26	1.01	1.55	100	Yes
Chromium	3010	34.61	50.25	100	Yes
Lead	200	276.76	484.33	24	No
Mercury	169	0.89	2.52	100	Yes
Nickel	127	48.43	130.27	95	No
Copper	5200	112.11	340.33	100	Yes
Zinc	19400	632.33	1149.84	100	Yes
Selenium	350	0.71	1.66	100	Yes



Chromium VI	21	0.4	0.4	100	Yes
Barium	1330	344.16	562.60	100	Yes
Beryllium	41.2	2.6	9.44	100	Yes
Vanadium	107	51.93	120.00	93	No
Benzo(a)pyrene	5	3.26	10.31	53	No
Phenol	437	3	3	100	Yes

Benzo(a)pyrene has been used in the assessment as a surrogate marker for PAH contamination.

The statistical analysis has found that for all of the determinands tested the null hypothesis can be rejected with >95% confidence with the exception of Arsenic, Lead, Nickel, Vanadium and Benzo(a)pyrene.

Additional testing was undertaken for Asbestos and speciated TPH, no asbestos was identified within the samples tested whilst the results of the speciated TPH were within normal limits.

At this stage, contamination has been identified however, it is recommended that a more detailed investigation be undertaken to provide a more robust assessment for the site. It should be noted that based on the initial findings, remediation will be required in the form of a cover system and/or possible soil stabilisation techniques.

6.4 Soil Contamination vs. Soft Landscaping

British Standard BS3882:2015 *Specification for topsoil and requirements for use* provides assessment criteria for a number of potentially phytotoxic contaminants in terms of new planting.

The results of the chemical analysis for determinants known to pose a potential phytotoxic risk to plant growth are summarised in Table 6.3 together with the respective adopted Generic Assessment Criteria (GAC) for plant growth. The compliance criteria set out in BS3882:2015 are pH dependent and thus the GAC used relate to the pH range measured on samples recovered from the site.

Determinant	Phytotoxicity GAC (mg/kg)			GAC Exceedances	Geology
	pH <6.0	pH 6.0-7.0	pH >7.0		
Zinc	200	200	300	Yes	Made Ground
Copper	100	135	200	Yes	Made Ground
Nickel	60	75	110	Yes	Made Ground

Table 6.3 Summary of Plant Phytotoxicity Assessment

The phytotoxicity assessment has identified contaminants of concern above the respective phytotoxicity thresholds within the Made Ground. As such it is considered that remedial measures would be required in this respect.

6.5 Soil Contamination vs. Built Environment

Recommendations with respect to pH and sulphate in relation to buried concrete are made in Section 5.5.

The ground conditions encountered across the site include deep areas of Made Ground.

As such it is considered the use of barrier pipe as a minimum is likely to be required for potable water supplies installed on the site within areas where Made Ground and infilled ground has been identified. However, this would be subject to confirmation for the water utility company.

As such, the utility company should be consulted in order to confirm their specific requirements in this respect, at this time subject to further confirmation it should be assumed that barrier pipe will be required. As a matter of good practice and to maximise the protection to maintenance workers, it is recommended that clean, granular backfill is used in service runs and that marker tapes are used for all buried services.

6.6 Soil Contamination vs. Adjacent Land Users

At present, contamination has been identified within the site. Once the extent and all forms of contamination have been identified, remediation can be undertaken. All remedial measures will prevent exposure to adjacent land users.

6.7 Soil Contamination vs. Groundwater

A single groundwater sample was obtained from MW1b within BH1. The results of the groundwater analyses undertaken to were compared against the Environmental Quality Standards for freshwater (EQS), Water Framework Directive and the Water Supply (Water Quality) Regulations 2000. A summary of contaminant concentrations encountered above the respective EQS, WFD and DWS guideline values, where values are set is presented in Table 6.4 below.

Contaminant	BH1 (Concentration ug/l)
Benzo(a)pyrene	0.71
Benzo(b)fluoranthene	0.50
Benzo(k)fluoranthene	0.56
Benzo(g,h,i)perylene	0.38
Indeno(1,2,3cd)pyrene	0.37
Anthracene	0.17
Fluoranthene	1.31
PAH (Sum of four)	2.52
TPH C12-C16 Ali	-
TPH C12-C16 Ali	-
TPH C16-C21 Ali	85.2
TPH C21-C35 Ali	3710
TPH C35-C40 Ali	285
TPH C8-C10 Aro	-
TPH C10-C12 Aro	-
TPH C12-C16 Aro	10.6
TPH C16-C21 Aro	48.0
TPH C21-C35 Aro	1860
TPH C35-C40 Aro	122

Table 6.4 Contaminant exceedances within Groundwater (ug/l)

The results of the speciated groundwater analyses undertaken identified low concentrations of PAH and the presence of TPH compounds.

Currently there are no UK quality standards for the individual TPH fractions. However there are a range of potential quality standards for hydrocarbons/mineral oil as outlined in Table 6.5 below, which could be adopted to allow for the assessment of risk posed by individual speciated fractions on-site. Assessment Criteria for the key Polyaromatic Hydrocarbons identified (for which standards are available) within the groundwater beneath the site are also presented in Table 6.5.



Contaminant	Target Value µg/l		
	Drinking Water ^(a)	EQS ^(b)	UKTAG ^(c)
Hydrocarbon (Dissolved or Emulsified)	10 (Revoked)		
Mineral Oil	10 (Revoked)		
Benzene	1	30	0.5
Toluene		50	350
Ethylbenzene		20	
Xylene		30	
Anthracene		0.02	0.05
Naphthalene		10.0	
Fluoranthene		0.02	
Benzo(a)pyrene	0.01	0.03	0.005
Benzo(b)fluoranthene			0.05
Benzo(g,h,i)perylene			0.05
Benzo(k)fluoranthene			0.05
Indeno(1,2,3cd)pyrene			0.05
PAH (Sum of Benzo(b)fluoranthene, Benzo(k)fluoranthene, indeno(123-cd)pyrene and benzo(ghi)perylene)	0.01		

(a) Water Supply (Water Quality) Regulations 1989.

(b) Environmental Quality Standards (freshwater)

(c) UK Technical Advisory Group to Water Framework Directive (as an annual mean)

Table 6.5 Summary of Compliance Standards

Based on the results of the groundwater analysis, PAH and TPH contamination has been identified within the groundwater. However, this is based on one sample from one location. It is recommended that longer term groundwater monitoring is undertaken with additional samples from across the site to provide parameters for a P20 Groundwater Risk Assessment and to determine if remediation is required.

6.8 Groundwater Contamination vs. Human Health

End users are considered unlikely to come in to contact with groundwater given the depth that groundwater was encountered within the intrusive investigation works and during the return monitoring visits.

6.9 Groundwater Contamination vs. Soft Landscaping

Groundwater was encountered within the intrusive investigation and subsequent groundwater monitoring undertaken on the site within November and December at depths generally greater than 1.0m bgl. In addition groundwater identified was generally noted to be discontinuous at shallow depth. As such given the depth of the groundwater encountered beneath the site, groundwater was considered to be outside of the root zone of influence for the soft landscaping on the site. Furthermore, the vegetation on and around the site showed no evidence of stress. As such, it is considered that no specific action is warranted with respect to soft landscaping.

6.10 Groundwater Contamination vs. Built Environment

Based on the depth of the groundwater, it is unlikely that groundwater contamination would affect the built environment.

6.11 Groundwater Contamination vs. Controlled Waters

Water resources receptors refers to the potential for impact to occur to a controlled water. 'Controlled Water' as



detailed in s.104 of the Water Resources Act 1991 includes the majority of natural waters in England and Wales and includes coastal waters, inland fresh waters and water contained within underground strata (groundwater).

Consideration is given to the resource value and to the resource utilisation of identified groundwater and surface water receptors that may be at risk from the migration of metals and PAH contaminants identified within the soils within the Made Ground and locally impacted groundwater located within the River Terrace Deposits and Chalk beneath the site.

It is recommended that further groundwater analysis be undertaken to determine the impact of the overlying Made Ground on the underlying groundwater across the site.

6.12 Waste Disposal

In addition CatWaste Soil analysis was undertaken on the soils analysed. The results were classified as being non-hazardous and hazardous. During further investigation, WAC testing should be undertaken for further classification.

It is recommended that the results of the testing be passed onto the landfill operator for final approval.

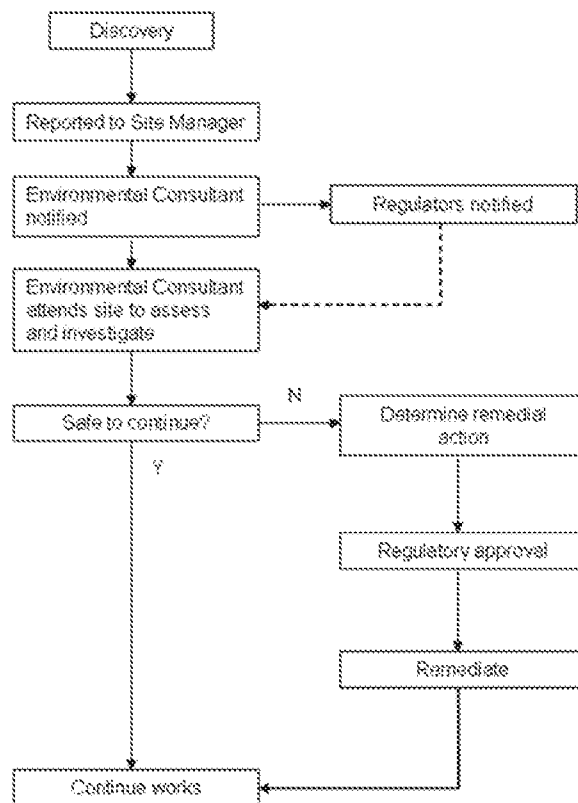
6.13 Discovery Strategy

Whilst several phases of investigation works have been undertaken on the site, it remains possible that unexpected soil conditions may be encountered during the process of site demolition, clearance and construction.

Examples may include oily pockets within the soil, pockets of cement boarding or fibrous materials within the soil, black ashy materials, soils exhibiting strong odours, brightly coloured materials and former structures or brickwork.

Should previously undiscovered contamination be encountered during construction by the ground workers, this should be reported to the Site Manager immediately in order that any necessary inspection may be made. Records should be kept and samples submitted for analysis where conditions encountered are not as anticipated. The results of any such testing should be sent to the authorities for consultation.

The process is shown below.



Discovery Strategy Process

A copy of the discovery strategy should be lodged on site and provisions made to ensure that all workers are made aware of their responsibility to observe, report and act on any potentially suspicious or contaminated materials they may encounter.

FIGURE 1

Site Location Plan

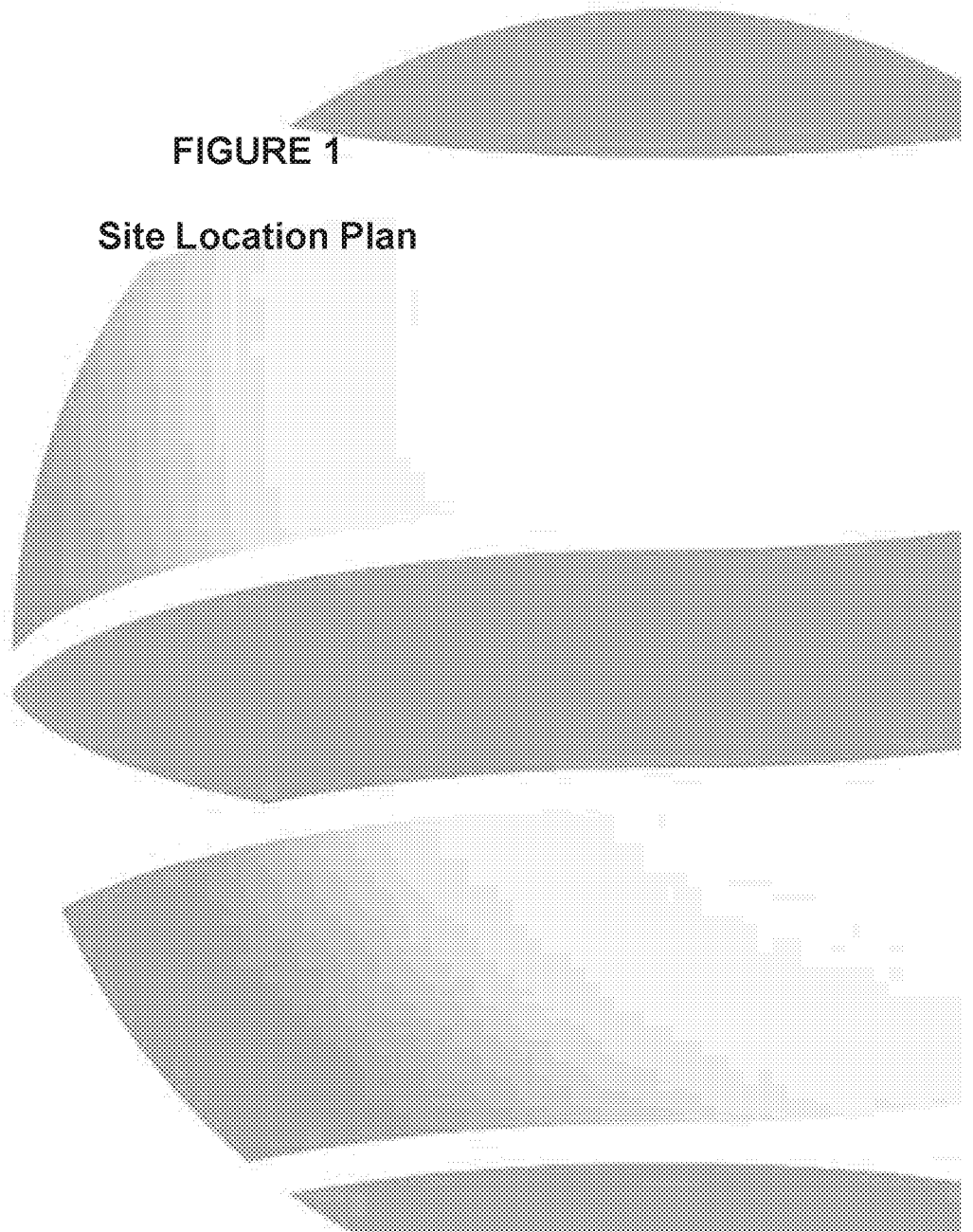
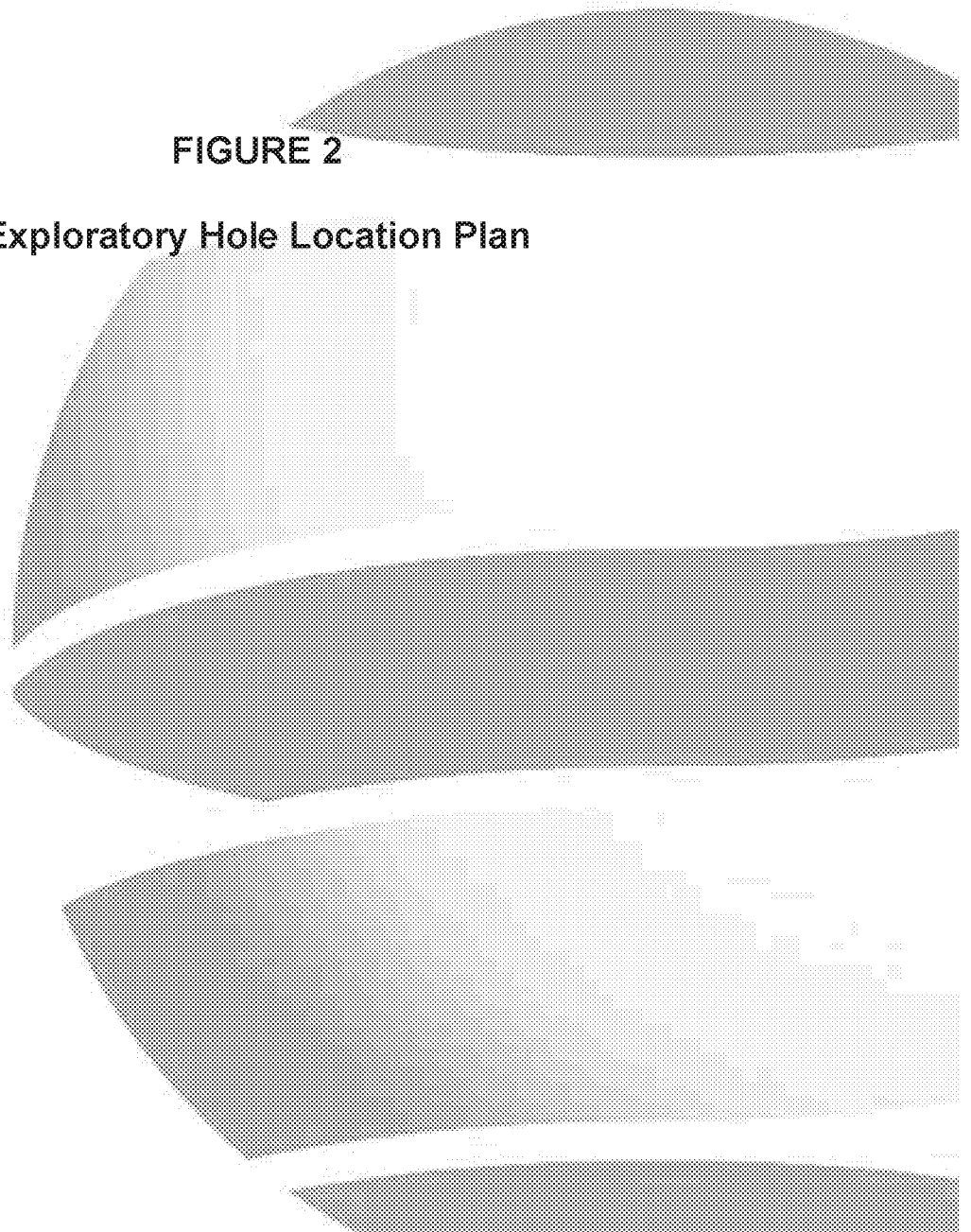
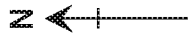


FIGURE 2

Exploratory Hole Location Plan

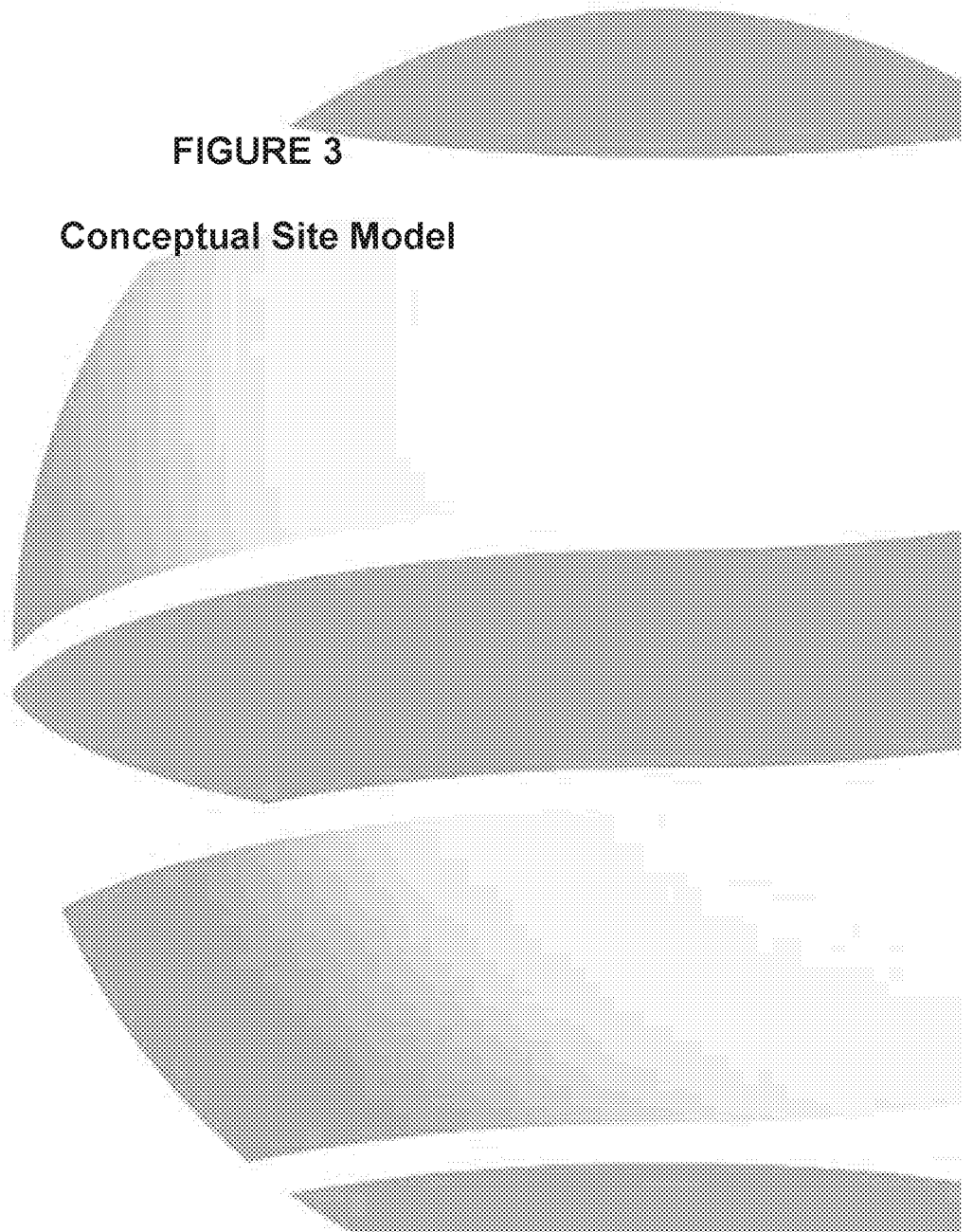


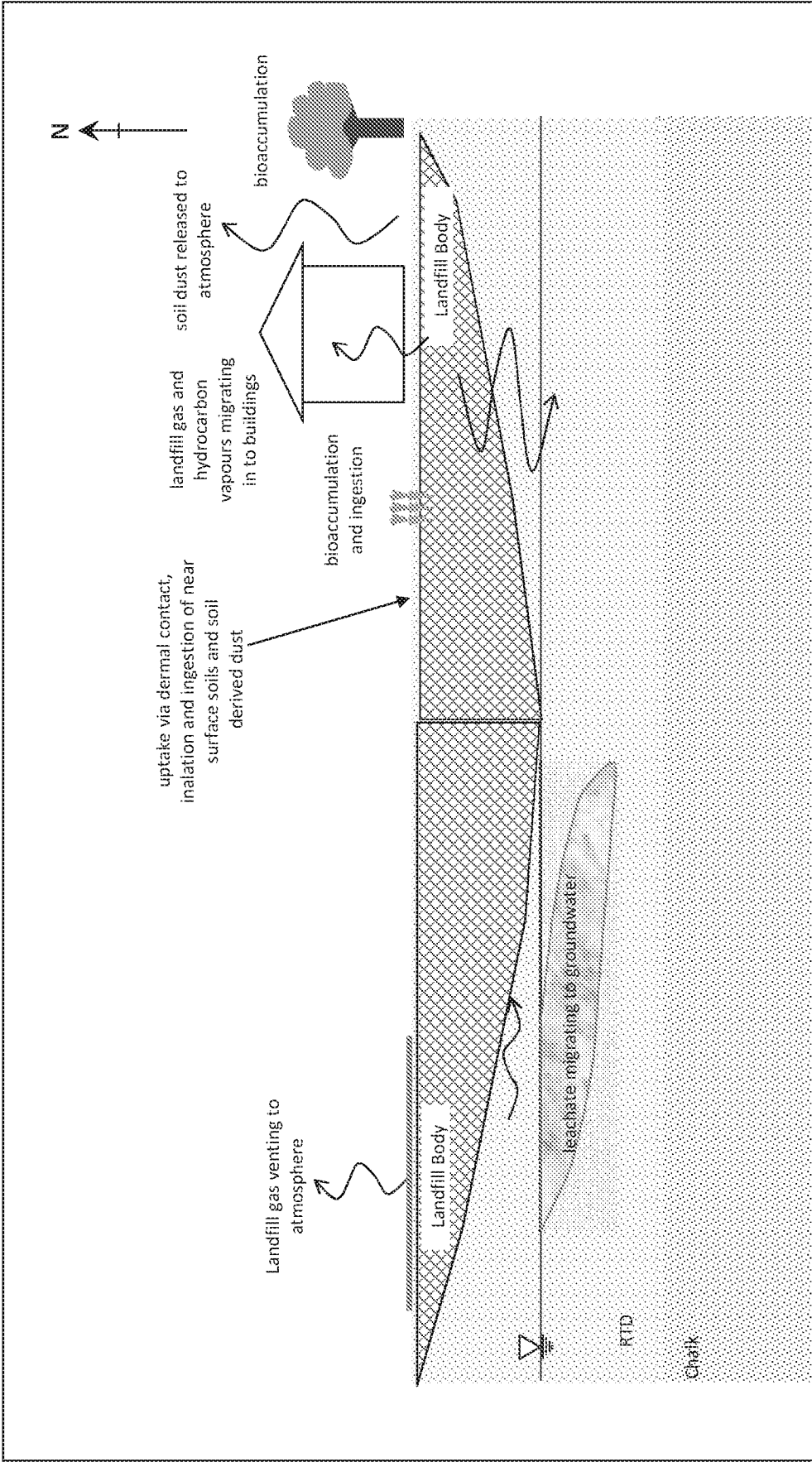


Project:	Cornfield Close, Littlehampton			Title	Site Investigation Plan
Client:	Thakeham Client			Geo-Environmental Services Ltd	
Ref No:	GE16903	Revision:	v1	Unit 7 Danworth Farm, Cuckfield Road	
Drawn:	AP	Date:	14/11/2017	Hurstpierpoint, West Sussex BN6 9GL	
Figure:	2	Scale:	Not To Scale	+44(0)1273 832972 www.gesl.net	
				 Geo-Environmental	

FIGURE 3

Conceptual Site Model





Project:	Daisyfields, Cornfield Close, Littlehampton			Title	Conceptual Site Model
Client:	Thakeham Client			Geo-Environmental Services Ltd	
Ref No:	GE16903	Revision:	v1	Unit 7 Danworth Farm, Cuckfield Road	
Drawn:	AP	Date:	22/12/2017	Hurstpierpoint, West Sussex BN6 9GL	
Figure:	3	Scale:	Not To Scale	+44(0)1273 832972 www.gesl.net	
				 Geo-Environmental	

APPENDIX A

Exploratory Hole Logs



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Unit 7, Danworth Farm
Hurstpierpoint
BN6 9GL

Borehole Log

Borehole No.

BH1

Sheet 1 of 2

Project Name: Cornfield Close

Project No.
GE16903

Co-ords: 503374E - 103242N

Hole Type
CP

Location: Littlehampton, West Sussex

Level: 8.10

Scale
1:50

Client: Thakeham Client

Dates: 27/11/2017

Logged By
PL

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.15			0.15	7.95		Grass overlying brown sandy silt. MADE GROUND	
		0.50 - 1.00	B					Brown sandy clay with brick, glass and wood. MADE GROUND	
		1.10	D		0.80	7.30		Firm brown silty clay. MADE GROUND	1
		1.50 - 2.00	B	Ublow=50					
		1.50 - 2.00	U						
		2.00	D		2.10	6.00			2
		2.50 - 3.00	B					Medium dense brown coarse SAND. RIVER TERRACE DEPOSITS	
		3.00	S	N=17 (2,3/4,4,4,5)					3
		3.45	D		3.50	4.60			
		4.00	D					Medium dense brown medium to coarse SAND and fine to coarse sub-angular to sub-rounded flint GRAVEL RIVER TERRACE DEPOSITS	4
		4.50 - 4.95	B	N=18 (3,3/4,4,5,5)					
		4.50	C						5
		5.50	D						
		6.00 - 6.45	B	N=20 (3,3/4,5,6,5)					
		6.00	C		6.50	1.60			6
		7.00	D					Recovered as weak, medium dense white and off- white unstained CHALK, closely spaced fractures, in white comminuted chalk matrix CHALK	7
		7.50	S	N=29 (5,5/6,8,7,8)					
		7.95	D						8
		8.50	D						
		9.00	S	N=37 (6,6/8,9,10,10)					9
		9.45	D						
		10.00	D						10
Continued on Next Sheet									
Casing		Water Strikes (mbgl)		Chiselling (mbgl)		Remarks			
Diameter	Depth (m)	Depth Strike	Rose to	Depth from	Depth to				
		4.30	3.80			Groundwater struck at 4.3m bgl, rose to 3.8m bgl after twenty minutes. Dual standpipes installed to 2.0m and 15m bgl.			



Geo-Environmental www.gesi.net

Unit 7, Danworth Farm
Hurstpierpoint
BN6 9GL

Borehole Log

Borehole No.

BH1

Sheet 2 of 2

Project Name: Cornfield Close

Project No.
GE16903

Co-ords: 503374E - 103242N

Hole Type
CP

Location: Littlehampton, West Sussex

Level: 8.10

Scale
1:50

Client: Thakeham Client

Dates: 27/11/2017

Logged By
PL

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		10.50	S	N=46 (7,7/10,11,12,13)					
		10.95	D						11
		11.50	D						
		12.00	S	N=57 (7,8/12,13,15,17)					12
		12.45	D						13
		13.50	D						
		14.00	S	N=47 (6,6/10,11,12,14)					14
		14.45	D						
					15.00	-6.90		End of Borehole at 15.00m	15
									16
									17
									18
									19
									20
Casing		Water Strikes (mbgl)		Chiselling (mbgl)		Remarks			
Diameter	Depth (m)	Depth Strike	Rose to	Depth from	Depth to				
		4.30	3.80			Groundwater struck at 4.3m bgl, rose to 3.8m bgl after twenty minutes. Dual standpipes installed to 2.0m and 15m bgl.			



Trial Pit Log

TrialPit No

TP1

Sheet 1 of 1

Project Name: Cornfield Close

Project No.
GE16903

Co-ords: 503384.36 - 103311.73
Level: 7.71

Date
27/11/2017

Location: Littlehampton, West Sussex

Dimensions
(m):

Scale
1:25

Client: Thakeham Client

Depth
3.00

Logged
AP

[illegible]

Remarks

Groundwater not encountered, some instability noted within the Made Ground.

Stability





Unit 7, Danworth Farm
Hurstpierpoint
BN6 9GL

Geo-Environmental/www.gesl.net

Trial Pit Log

Trial Pit No

TP2

Sheet 1 of 1

Project Name: Cornfield Close

Project No.
GE16903

Co-ords: 503318.36 - 103270.49
Level: 8.23

Date
27/11/2017

Location: Littlehampton, West Sussex

Dimensions
(m):

Scale
1:25

Client: Thakeham Client

Depth
3.00

Logged
AP

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.20	ES		0.20	8.03		Grass overlying brown sandy silt with brick and concrete fragments. MADE GROUND	
	0.50	ES					Brown very sandy clay with brick, concrete and flint gravel. MADE GROUND	
	1.00	ES		1.00	7.23		Grey organic clayey sand with brick, glass, china, ash, coal, fabric, clay tile, glass, plastic, timber and a strong hydrocarbon malodour. MADE GROUND	1
	1.50	ES						
	2.00	ES						2
	2.50 2.50	D ES		2.50	5.73		Light brown medium SAND with rare sub-angular medium to coarse flint gravel. RIVER TERRACE DEPOSITS	
	3.00	D		3.00	5.23		End of Pit at 3.00m	3
								4
								5

Remarks

Groundwater not encountered, some instability noted within the Made Ground.

Stability





Unit 7, Danworth Farm
Hurstpierpoint
BN6 9GL

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Trial Pit Log

Trial Pit No

TP3

Sheet 1 of 1

Project Name: Cornfield Close

Project No.
GE16903

Co-ords: 503392.36 - 103264.12
Level: 8.24

Date
27/11/2017

Location: Littlehampton, West Sussex

Dimensions
(m):

Scale
1:25

Client: Thakeham Client

Depth
3.00

Logged
AP

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.20	ES		0.15	8.09		Grass overlying brown silty sand. MADE GROUND	
	0.50	ES		0.60	7.64		Brown clayey sand with rare ash and coal. MADE GROUND	
	1.00	ES					Grey silty sand with household waste including metal, brick, glass, plastics, china, ash, coal, concrete, black organic matter, shoes, fabric, timber and an organic odour. MADE GROUND	1
	1.50	ES						
	2.00	ES		1.90	6.34		Brown friable CLAY. RIVER TERRACE DEPOSITS	2
	2.50 2.50	D PP	PP=2.6kg/cm2					
				2.80	5.44		Stiff grey silty CLAY with black organic matter. RIVER TERRACE DEPOSITS	
	3.00 3.00	D PP	PP=2.2kg/cm2	3.00	5.24		End of Pit at 3.00m	3
								4
								5
Remarks		Groundwater not encountered, some instability noted within the Made Ground.						
Stability								



Trial Pit Log

TrialPit No

TP4

Sheet 1 of 1

Project Name: Cornfield Close

Project No.
GE16903

Co-ords: 503323.15 - 103232.45
Level: 8.05

Date
27/11/2017

Location: Littlehampton, West Sussex

Dimensions
(m):

Scale
1:25

Client: Thakeham Client

Depth
3.00

Logged
AP

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.20	ES		0.30	7.75		Grass overlying brown sandy silt with brick and concrete fragments and rare fine to coarse sub-angular flint gravel. MADE GROUND	1
	0.50	ES		0.60	7.45		Brown clayey sand with rare brick and concrete fragments and rare flint gravel.# MADE GROUND	
	1.00	ES					Brown silty sand with household waste including metal, brick, glass, plastics, china, ash, coal, concrete, black organic matter, shoes, fabric, timber and an organic odour. MADE GROUND	
	1.50	ES						
	2.00	D	PP=2.5kg/cm2	1.80	6.25		Brown mottled friable CLAY. RIVER TERRACE DEPOSITS	2
	2.00	ES		1.90	6.15		Grey very sandy friable CLAY with a hydrocarbon malodour. RIVER TERRACE DEPOSITS	
	2.50	D	PP=2.5kg/cm2	2.30	5.75		Grey and brown mottled sandy CLAY. RIVER TERRACE DEPOSITS	3
	2.50	PP						
	3.00	D	PP=2kg/cm2	3.00	5.05		End of Pit at 3.00m	4
	3.00	PP						
								5
Remarks		Groundwater not encountered, some instability noted within the Made Ground.						
Stability								



Unit 7, Danworth Farm
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BN6 9GL

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Trial Pit Log

Trial Pit No

TP5

Sheet 1 of 1

Project Name: Cornfield Close

Project No.
GE16903

Co-ords: 503330.75 - 103197.66
Level: 8.04

Date
27/11/2017

Location: Littlehampton, West Sussex

Dimensions
(m):

Scale
1:25

Client: Thakeham Client

Depth
3.00

Logged
AP

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.20	ES		0.20	7.84		Grass over brown sandy silt. MADE GROUND	
	0.50	ES		0.50	7.54		Brown slightly silty sand with rare brick, concrete and flint gravel. MADE GROUND	
	1.00	ES					Yellow and brown silty sand with glass, organic matter, plastic, brick, concrete, timber, metal, shoes and fabric. MADE GROUND	1
	1.50	ES						
				1.70	6.34		Brown sandy clay. MADE GROUND	
	2.00	ES		1.80	6.24		Grey sandy clay with rare ash. MADE GROUND	2
	2.00	PP	PP=3.5kg/cm2					
				2.30	5.74		Brown very clayey SAND. RIVER TERRACE DEPOSITS	
	2.50	D						
	3.00	D		3.00	5.04		End of Pit at 3.00m	3
								4
								5
Remarks		Groundwater not encountered, some instability noted within the Made Ground.						
Stability								





Unit 7, Danworth Farm
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Trial Pit Log

Trial Pit No

TP6

Sheet 1 of 1

Project Name: Cornfield Close

Project No.
GE16903

Co-ords: 503346.18 - 103297.43
Level: 7.99

Date
27/11/2017

Location: Littlehampton, West Sussex

Dimensions
(m):

Scale
1:25

Client: Thakeham Client

Depth
2.00

Logged
AP

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.20	ES		0.20	7.79		Grass overlying brown sandy silt with rare ash. MADE GROUND	
	0.50	ES					Brown silty sand with household waste including metal, brick, glass, plastics, china, ash, coal, concrete, black organic matter, shoes, fabric, timbers and an organic odour. Refused on brick floor at 2.0mbgl. MADE GROUND	
	1.00	ES						1
	1.50	ES						
	2.00	ES		2.00	5.99		End of Pit at 2.00m	2
								3
								4
								5
Remarks		Groundwater not encountered, some instability noted within the Made Ground. refused on brick floor at 2.00mbgl.						
Stability								





Unit 7, Danworth Farm
Hurstpierpoint
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Trial Pit Log

Trial Pit No

TP7

Sheet 1 of 1

Project Name: Cornfield Close

Project No.
GE16903

Co-ords: 503396.76 - 103194.18
Level: 7.68

Date
27/11/2017

Location: Littlehampton, West Sussex

Dimensions
(m):

Scale
1:25

Client: Thakeham Client

Depth
3.00

Logged
AP

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.20	ES		0.20	7.48		Grass overlying brown clayey silty sand with occasional flint gravel, brick and concrete fragments. MADE GROUND	
	0.50	ES					Grey silty sand with household waste including metal, brick, glass, plastics, china, ash, coal, concrete, black organic matter, shoes, fabric, timber and an organic odour. MADE GROUND	
	1.00	ES						1
	1.50	ES						
	2.00	ES		1.80	5.88		Grey very sandy clay with black organic matter. MADE GROUND	2
	2.00	PP	PP=2.8kg/cm2	2.20	5.48			
	2.50	D					Very stiff brown sandy CLAY. RIVER TERRACE DEPOSITS	
	2.50	PP	PP=3.5kg/cm2					
	3.00	D		3.00	4.68		End of Pit at 3.00m	3
	3.00	PP	PP=3.2kg/cm2					
								4
								5
Remarks		Groundwater not encountered, some instability noted within the Made Ground.						
Stability								





Unit 7, Danworth Farm
Hurstpierpoint
BN6 9GL

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Trial Pit Log

Trial Pit No

TP8

Sheet 1 of 1

Project Name: Cornfield Close

Project No.
GE16903

Co-ords: 503435.11 - 103238.92
Level: 8.04

Date
27/11/2017

Location: Littlehampton, West Sussex

Dimensions
(m):

Scale
1:25

Client: Thakeham Client

Depth
3.00

Logged
AP

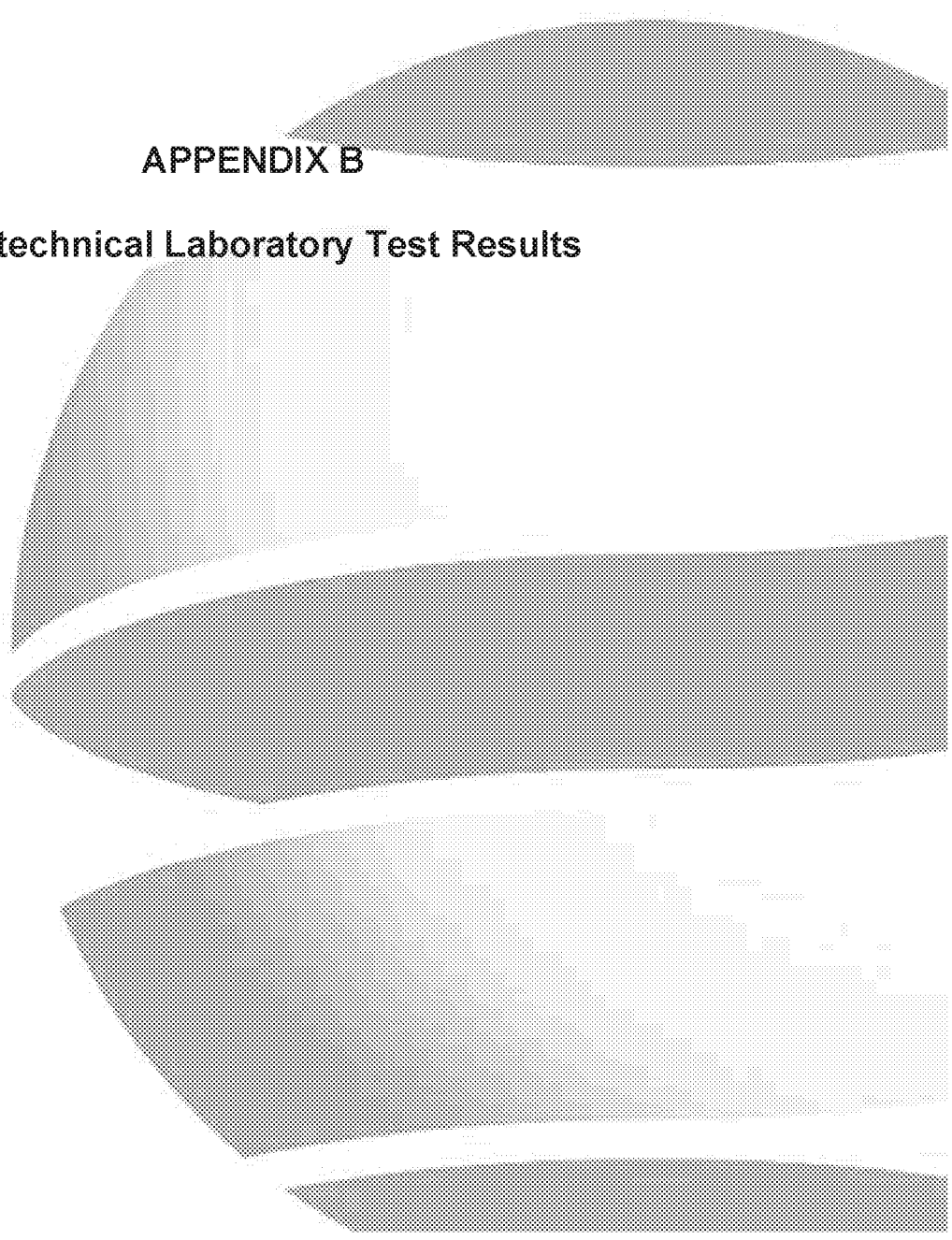
Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.20	ES		0.20	7.84		Grass overlying brown clayey silty sand. MADE GROUND	
	0.50	ES		0.60	7.44		Brown sandy silt. MADE GROUND	
	1.00	ES					Brown mottled friable clay with organic matter, glass, brick, concrete, paper, timber, plastic, rubber, ash and coal. MADE GROUND	1
	1.50	ES						
	2.00	ES						2
	2.50	D		2.70	5.34		Yellow medium SAND. RIVER TERRACE DEPOSITS	
	3.00	D		3.00	5.04		End of Pit at 3.00m	3
								4
								5

Remarks

Groundwater not encountered, some instability noted within the Made Ground.

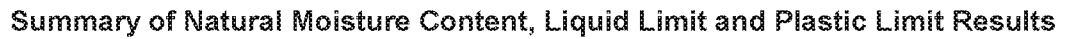
Stability





APPENDIX B

Geotechnical Laboratory Test Results

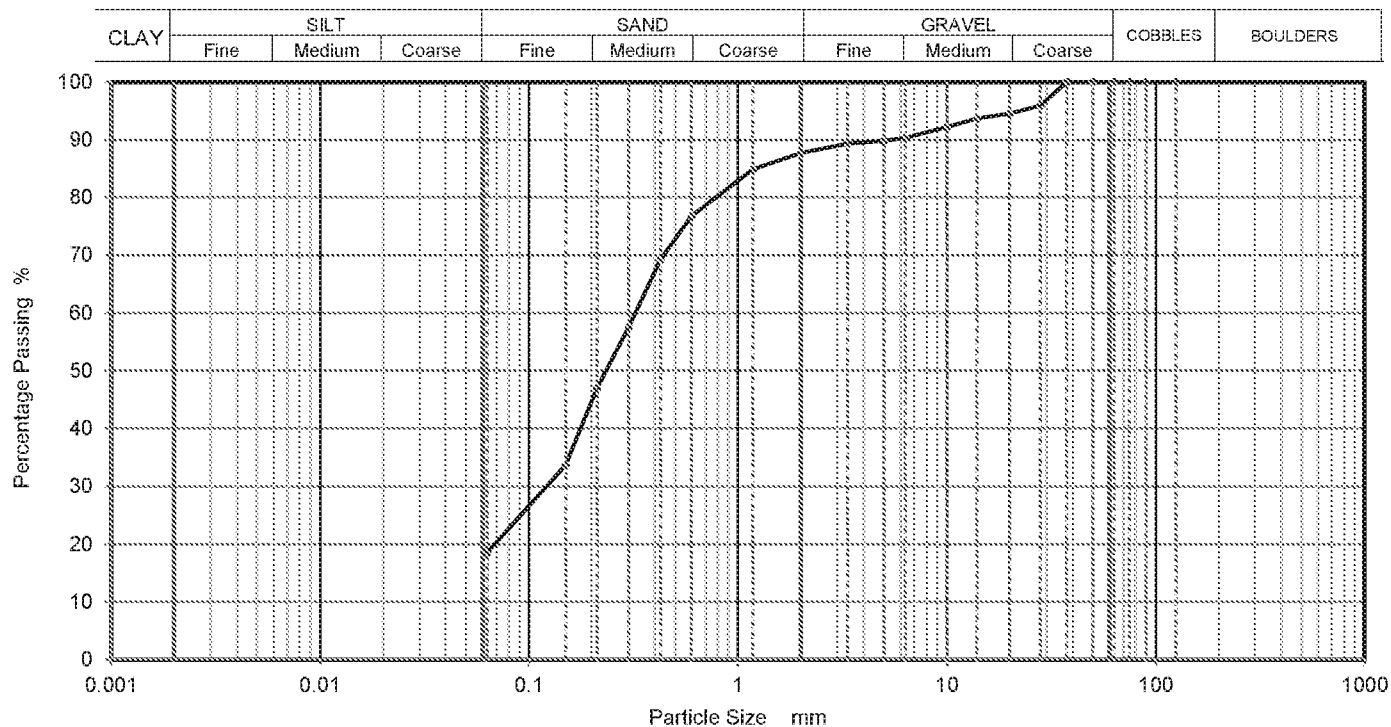
ARUN DISTRICT COUNCIL LU/330/18/PL



PARTICLE SIZE DISTRIBUTION

Job Ref	23749
Borehole/Pit No.	BH1
Sample No.	19
Depth Top	2.50 m
Depth Base	- m
Sample Type	B
Samples received	29/11/2017
Schedules received	29/11/2017
Project started	30/11/2017
Date tested	13/12/2017

Site Name	Cornfield Close		
Project No.	GE16903	Client	GESL
Soil Description	Greyish brown gravelly clayey SAND (gravel is fmc and sub-angular to sub-rounded)		
Test Method	BS1377:Part 2: 1990, clause 9.0		



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	96		
20	95		
14	94		
10	92		
6.3	90		
5	90		
3.35	89		
2	88		
1.18	85		
0.6	77		
0.425	69		
0.3	58		
0.212	47		
0.15	34		
0.063	19		

Dry Mass of sample, g 1067

Sample Proportions	% dry mass
Very coarse	0.0
Gravel	12.3
Sand	69.2
Fines <0.063mm	18.5

Grading Analysis	
D100	mm
D60	mm
D30	mm
D10	mm
Uniformity Coefficient	
Curvature Coefficient	

Remarks
Preparation and testing in accordance with BS1377 unless noted below



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Unit 8, Olds Close, Watford, Herts, WD18 9BU

Checked and Approved

Initials: JP

Date: 14/12/2017

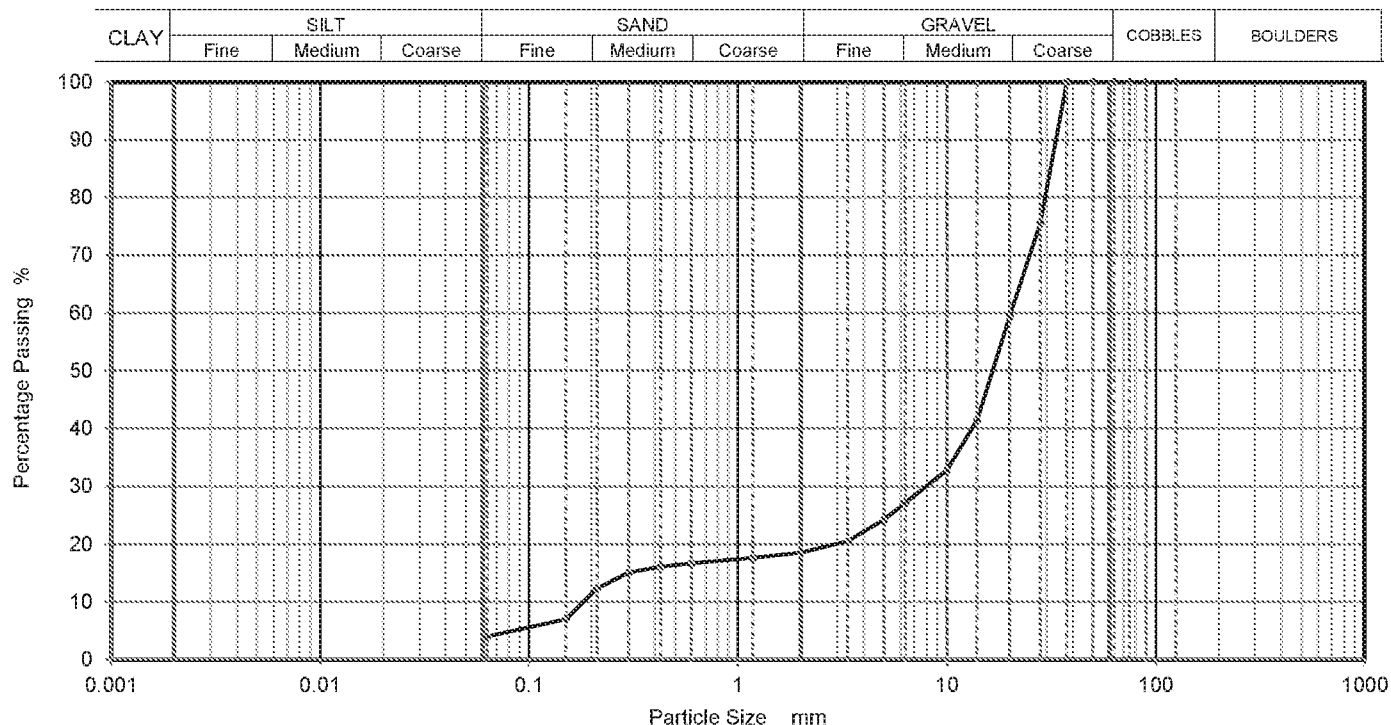
MSF-5-P3



PARTICLE SIZE DISTRIBUTION

Job Ref	23749
Borehole/Pit No.	BH1
Sample No.	5
Depth Top	5.50 m
Depth Base	- m
Sample Type	D
Samples received	29/11/2017
Schedules received	29/11/2017
Project started	30/11/2017
Date tested	13/12/2017

Site Name	Cornfield Close		
Project No.	GE16903	Client	GESL
Soil Description	Orangish brown slightly clayey sandy GRAVEL (gravel is fmc and sub-angular to sub-rounded)		
Test Method	BS1377:Part 2: 1990, clause 9.0		



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	76		
20	59		
14	42		
10	33		
6.3	27		
5	24		
3.35	21		
2	19		
1.18	18		
0.6	17		
0.425	16		
0.3	15		
0.212	12		
0.15	7		
0.063	4		

Dry Mass of sample, g 645

Sample Proportions	% dry mass
Very coarse	0.0
Gravel	81.5
Sand	14.5
Fines <0.063mm	4.0

Grading Analysis	
D100	mm
D60	mm
D30	mm
D10	mm
Uniformity Coefficient	110
Curvature Coefficient	17

Remarks

Preparation and testing in accordance with BS1377 unless noted below



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Initials: JP

Date: 14/12/2017

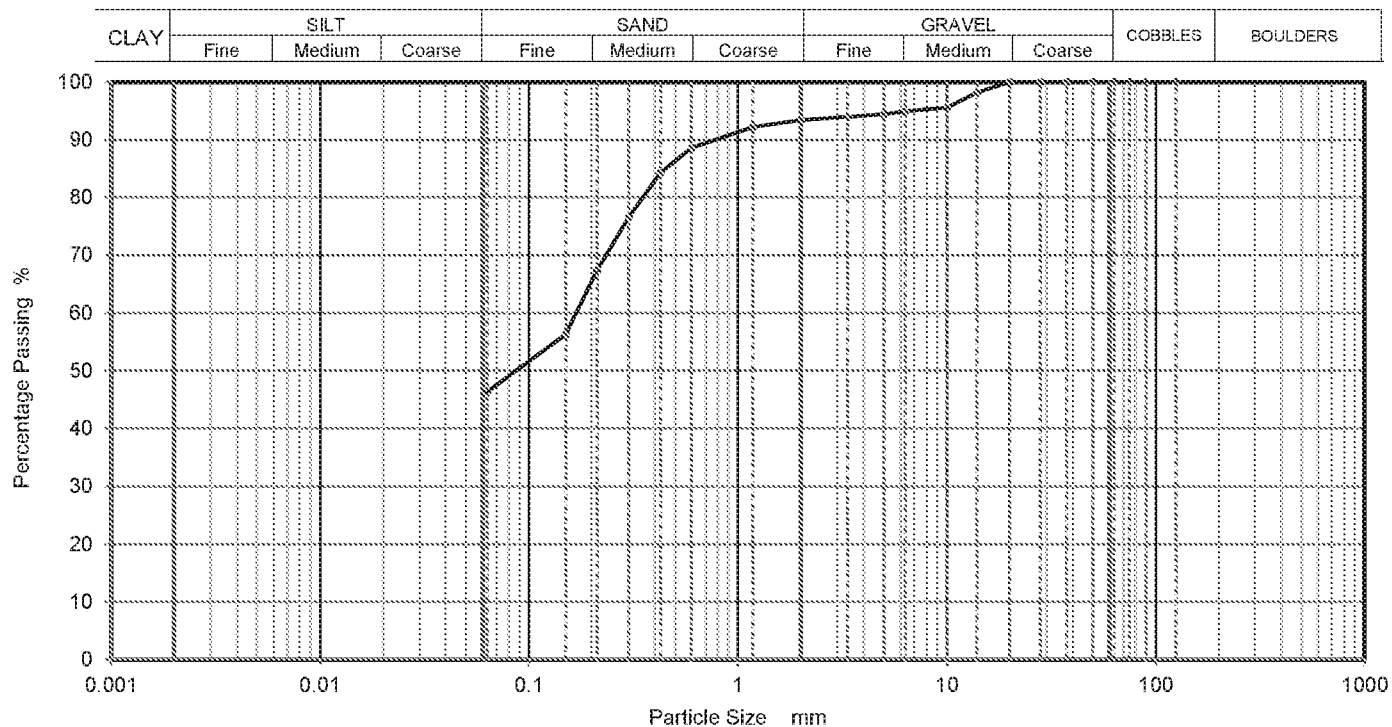
MSF-5-P3



PARTICLE SIZE DISTRIBUTION

Job Ref	23749
Borehole/Pit No.	TP1
Sample No.	7
Depth Top	2.50 m
Depth Base	- m
Sample Type	D
Samples received	29/11/2017
Schedules received	29/11/2017
Project started	30/11/2017
Date tested	13/12/2017

Site Name	Cornfield Close		
Project No.	GE16903	Client	GESL
Soil Description	Orangish brown slightly gravelly silty sandy CLAY (gravel is fm and sub-angular to sub-rounded)		
Test Method	BS1377:Part 2: 1990, clause 9.0		



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	100		
14	98		
10	96		
6.3	95		
5	94		
3.35	94		
2	93		
1.18	92		
0.6	89		
0.425	84		
0.3	77		
0.212	67		
0.15	56		
0.063	46		

Dry Mass of sample, g 1175

Sample Proportions	% dry mass
Very coarse	0.0
Gravel	6.6
Sand	47.0
Fines <0.063mm	46.3

Grading Analysis	
D100	mm
D60	mm
D30	mm
D10	mm
Uniformity Coefficient	
Curvature Coefficient	

Remarks
Preparation and testing in accordance with BS1377 unless noted below



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Initials: JP

Date: 14/12/2017

MSF-5-P3



PARTICLE SIZE DISTRIBUTION

Job Ref 23749

Borehole/Pit No. TP2

Site Name Cornfield Close

Sample No. 8

Project No. GE16903

Client

GESL

Depth Top 3.00 m

Soil Description

Orangish brown slightly gravelly clayey SAND (gravel is fm and sub-angular)

Depth Base - m

Sample Type D

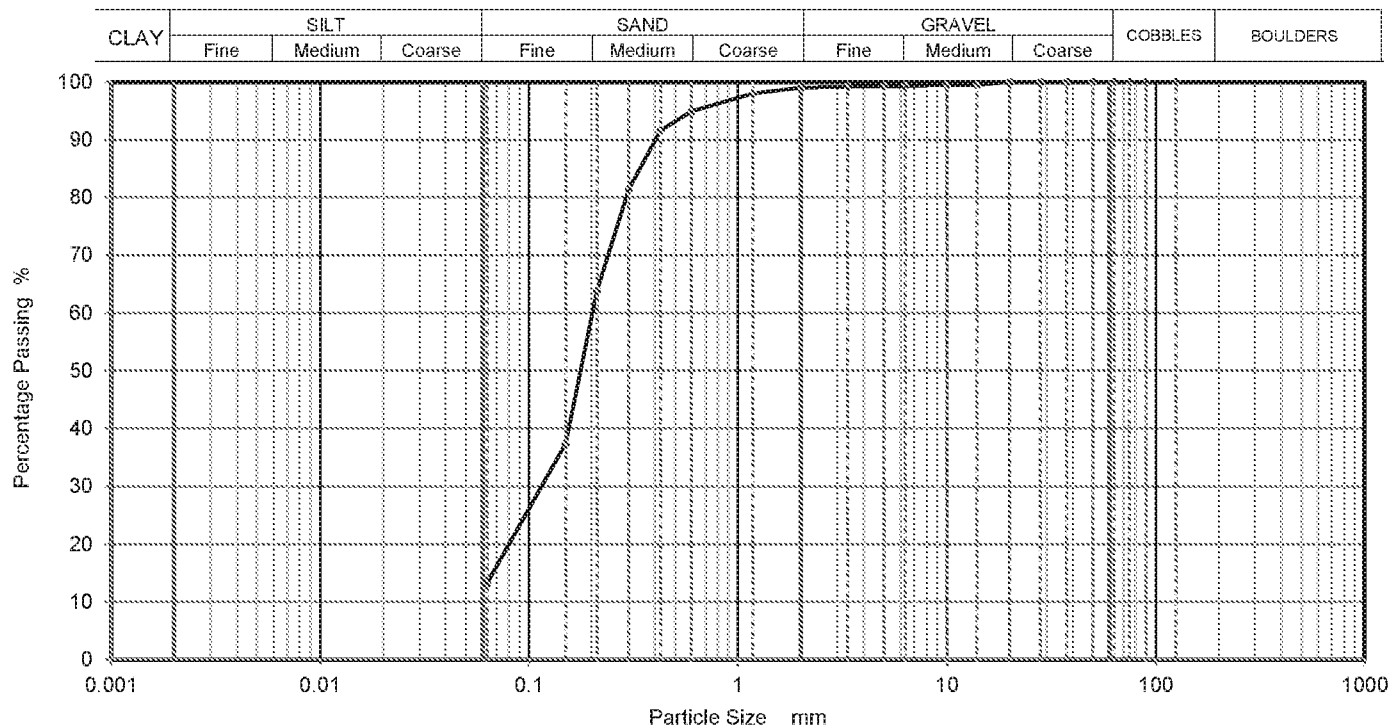
Samples received 29/11/2017

Schedules received 29/11/2017

Test Method BS1377:Part 2: 1990, clause 9.0

Project started 30/11/2017

Date tested 13/12/2017



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	100		
14	100		
10	100		
6.3	99		
5	99		
3.35	99		
2	99		
1.18	98		
0.6	95		
0.425	92		
0.3	81		
0.212	64		
0.15	37		
0.063	13		

Dry Mass of sample, g

722

Sample Proportions	% dry mass
Very coarse	0.0
Gravel	1.0
Sand	85.7
Fines <0.063mm	13.2

Grading Analysis	
D100	mm
D60	mm 0.201
D30	mm 0.115
D10	mm
Uniformity Coefficient	
Curvature Coefficient	

Remarks

Preparation and testing in accordance with BS1377 unless noted below



K4 Soils Laboratory

Unit 8, Olds Close, Watford, Herts, WD18 9RU

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Date: 14/12/2017

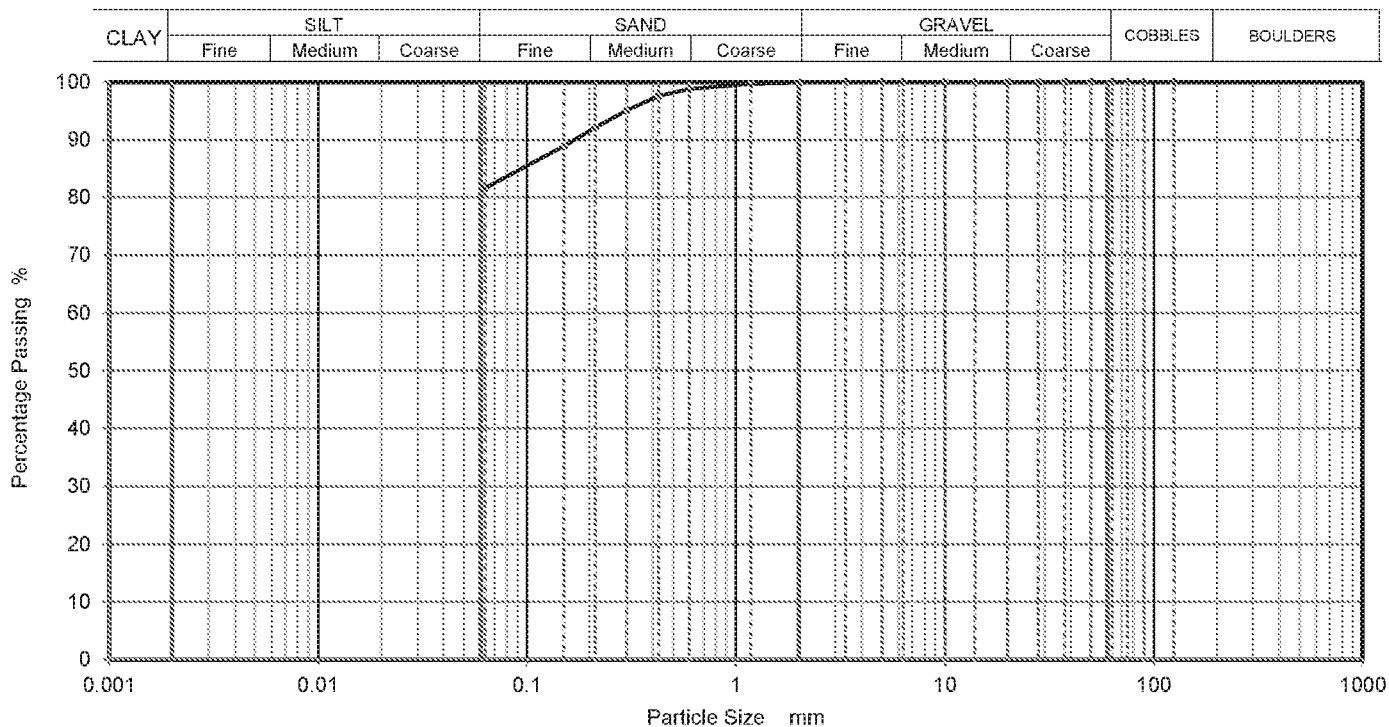
MSF-5-P3



PARTICLE SIZE DISTRIBUTION

Job Ref	23749
Borehole/Pit No.	TP5
Sample No.	6
Depth Top	2.50 m
Depth Base	- m
Sample Type	D
Samples received	29/11/2017
Schedules received	29/11/2017
Project started	30/11/2017
Date tested	13/12/2017

Site Name	Cornfield Close		
Project No.	GE16903	Client	GESL
Soil Description	Brown and orangish brown slightly sandy silty CLAY		
Test Method	BS1377:Part 2: 1990, clause 9.0		



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	100		
14	100		
10	100		
6.3	100		
5	100		
3.35	100		
2	100		
1.18	100		
0.6	99		
0.425	98		
0.3	95		
0.212	92		
0.15	89		
0.063	82		

Dry Mass of sample, g 106

Sample Proportions	% dry mass
Very coarse	0.0
Gravel	0.1
Sand	18.3
Fines <0.063mm	81.6

Grading Analysis	
D100	mm
D60	mm
D30	mm
D10	mm
Uniformity Coefficient	
Curvature Coefficient	

Remarks
Preparation and testing in accordance with BS1377 unless noted below



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Unit 8, Olds Close, Watford, Herts, WD18 9RU

Checked and Approved

Initials: JP

Date: 14/12/2017

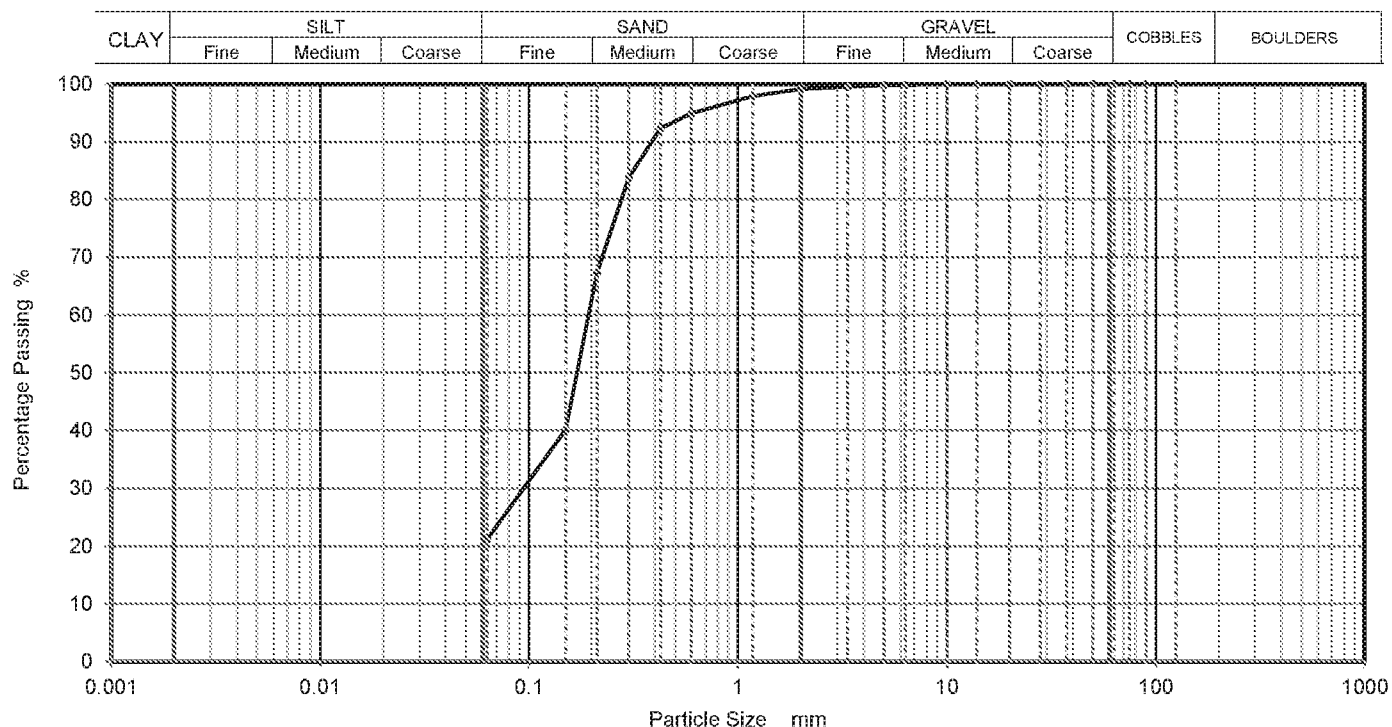
MSF-5-P3



PARTICLE SIZE DISTRIBUTION

Job Ref	23749
Borehole/Pit No.	TP8
Sample No.	7
Depth Top	3.00 m
Depth Base	- m
Sample Type	D
Samples received	29/11/2017
Schedules received	29/11/2017
Project started	30/11/2017
Date tested	13/12/2017

Site Name	Cornfield Close		
Project No.	GE16903	Client	GESL
Soil Description	Orange brown very clayey SAND with rare fine gravel		
Test Method	BS1377:Part 2: 1990, clause 9.0		



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	100		
14	100		
10	100		
6.3	100		
5	100		
3.35	100		
2	99		
1.18	98		
0.6	95		
0.425	92		
0.3	84		
0.212	67		
0.15	40		
0.063	21		

Dry Mass of sample, g

549

Sample Proportions	% dry mass
Very coarse	0.0
Gravel	0.9
Sand	77.9
Fines <0.063mm	21.1

Grading Analysis	
D100	mm
D60	mm
D30	mm
D10	mm
Uniformity Coefficient	
Curvature Coefficient	

Remarks

Preparation and testing in accordance with BS1377 unless noted below



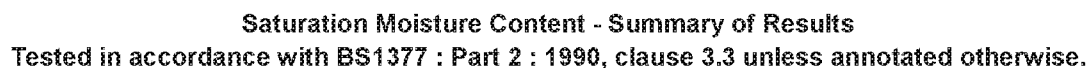
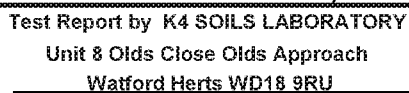
K4 Soils Laboratory
Unit 8, Olds Close, Watford, Herts, WD18 9RU

Checked and Approved

Initials: JP

Date: 14/12/2017

MSF-5-P3

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Checked and Approved

Initials J.P

Date: 14/12/2017

2519

Approved Signatories: K.Phaure (

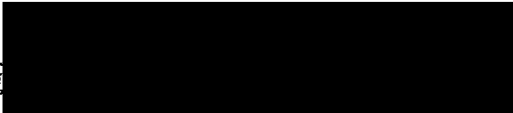
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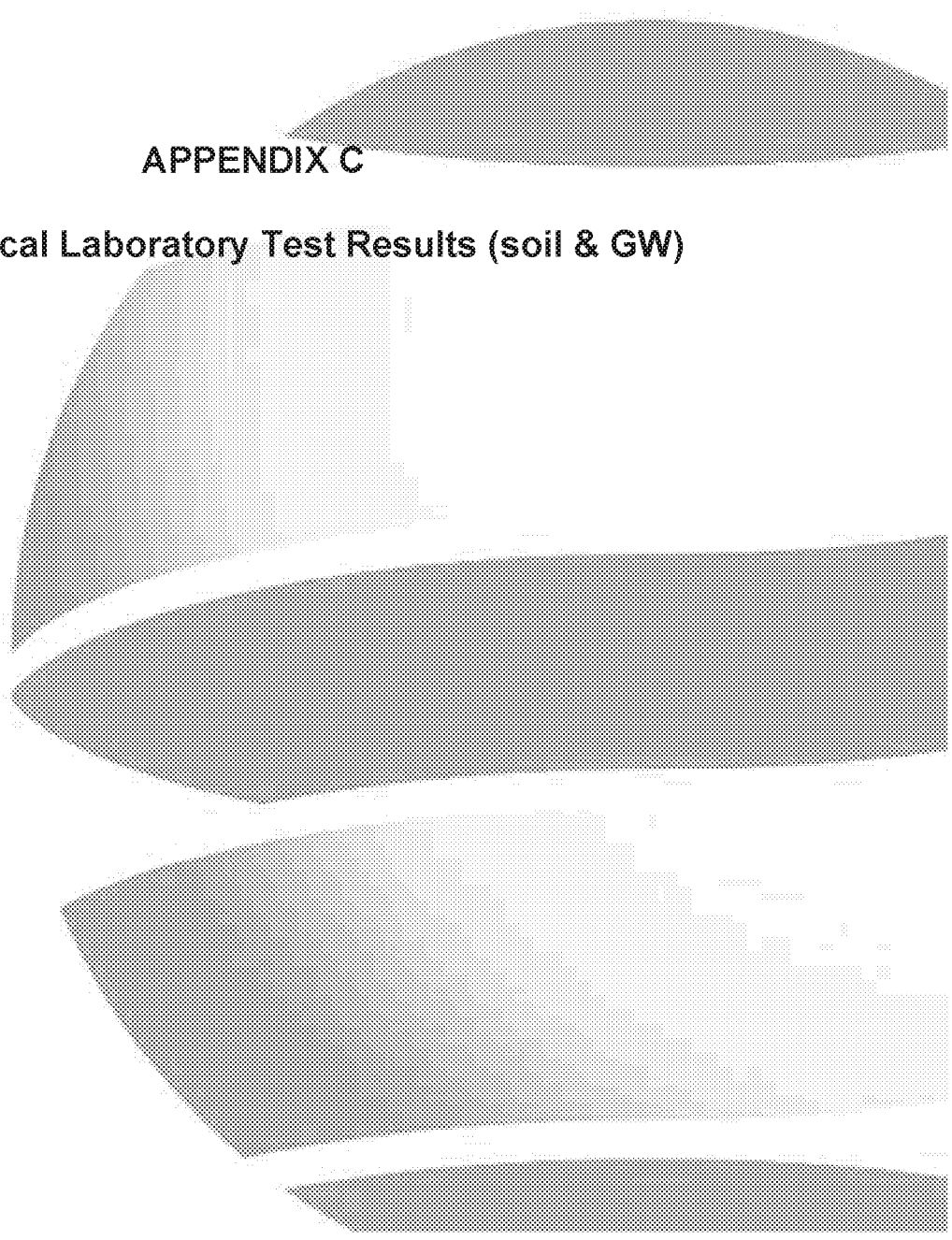


Sulphate Content (Gravimetric Method) for 2:1 Soil: Water Extract and pH Value - Summary of Results
Tested in accordance with BS1377 : Part 3 : 1990, clause 5.3 and clause 9

Job No. 23749	Project Name Comfield Close	Programme	
		Samples received	29/11/2017
Project No. GE16903	Client GESL	Schedule received	29/11/2017
		Project started	30/11/2017
		Testing Started	08/12/2017

Hole No.	Sample				Soil description	Dry Mass passing 2mm %	SO3 Content g/l	SO4 Content g/l	pH	Remarks
	Ref	Top m	Base m	Type						
BH1	19	2.50	-	B	Greyish brown gravelly clayey SAND (gravel is fmc and sub-angular to sub-rounded)	88	0.15	0.18	7.70	
BH1	10	10.00	-	D	Fmc intact CHALK fragments	52	0.17	0.21	7.70	
BH1	15	14.45	-	D	Off white putty CHALK with occasional fm intact chalk fragments	74	0.15	0.18	7.50	
TP1	7	2.50	-	D	Orangish brown slightly gravelly silty sandy CLAY (gravel is fm and sub-angular to sub-rounded)	93	0.15	0.18	7.40	
TP3	6	2.50	-	D	Brown slightly gravelly sandy silty CLAY with traces of decayed roots (gravel is fine and sub-angular)	99	0.14	0.17	7.50	
TP7	6	2.50	-	D	Brown slightly gravelly slightly sandy silty CLAY (gravel is fine and sub-angular)	99	0.09	0.11	7.63	

 2519	Test Report by K4 SOILS LABORATORY Unit 8 Olds Close Olds Approach Watford Herts WD18 9RU								Checked and Approved Initials J.P Date: 14/12/2017
	Approved Signator 								MSF-5-R29



APPENDIX C

Geochemical Laboratory Test Results (soil & GW)



Unit A2
Windmill Road
Ponswood Industrial Estate
St Leonards on Sea
East Sussex
TN38 9BY

THE ENVIRONMENTAL LABORATORY LTD

Analytical Report Number: 17-15134

Issue: 1

Date of Issue: 05/12/2017

Contact: Anthony Potter

Customer Details: GESL
Unit 7
Danworth Farm
Hurstpierpoint
West Sussex BN6 9GL

Quotation No: Q14-00021

Order No: Not Supplied

Customer Reference: GE16903

Date Received: 28/11/2017

Date Approved: 05/12/2017

Details: Cornfield Close, Littlehampton

Approved by:

John Wilson, Operations Manager

Any comments, opinions or interpretations expressed herein are outside the scope of UKAS accreditation (Accreditation Number 2683)

Sample Summary

Report No.: 17-15134

Elab No.	Client's Ref.	Date Sampled	Date Scheduled	Description	Deviations
119353	TP1 1.00	27/11/2017	28/11/2017	Silty loam	
119354	TP2 1.50	27/11/2017	28/11/2017	Silty loam	
119355	TP3 0.50	27/11/2017	28/11/2017	Silty loam	
119356	TP4 1.00	27/11/2017	28/11/2017	Silty loam	
119357	TP6 0.50	27/11/2017	28/11/2017	Silty loam	
119358	TP7 1.00	27/11/2017	28/11/2017	Silty loam	
119359	TP1 0.20	27/11/2017	28/11/2017		
119360	TP1 0.50	27/11/2017	28/11/2017		
119361	TP1 1.50	27/11/2017	28/11/2017		
119362	TP1 2.00	27/11/2017	28/11/2017		
119363	TP2 0.20	27/11/2017	28/11/2017		
119364	TP2 0.50	27/11/2017	28/11/2017		
119365	TP2 1.00	27/11/2017	28/11/2017		
119366	TP2 2.00	27/11/2017	28/11/2017		
119367	TP2 2.50	27/11/2017	28/11/2017		
119368	TP3 0.20	27/11/2017	28/11/2017		
119369	TP3 1.00	27/11/2017	28/11/2017		
119370	TP3 2.00	27/11/2017	28/11/2017		
119371	TP3 1.50	27/11/2017	28/11/2017		
119372	TP4 0.20	27/11/2017	28/11/2017		
119373	TP4 0.50	27/11/2017	28/11/2017		
119374	TP4 1.50	27/11/2017	28/11/2017		
119375	TP4 2.00	27/11/2017	28/11/2017		
119376	TP5 0.20	27/11/2017	28/11/2017		
119377	TP5 0.50	27/11/2017	28/11/2017		
119378	TP5 1.00	27/11/2017	28/11/2017		
119379	TP5 1.50	27/11/2017	28/11/2017		
119380	TP5 2.00	27/11/2017	28/11/2017		
119381	TP6 0.20	27/11/2017	28/11/2017		
119382	TP6 1.00	27/11/2017	28/11/2017		
119383	TP6 1.50	27/11/2017	28/11/2017		
119384	TP6 2.00	27/11/2017	28/11/2017		
119385	TP7 0.20	27/11/2017	28/11/2017		
119386	TP7 0.50	27/11/2017	28/11/2017		
119387	TP7 1.50	27/11/2017	28/11/2017		
119388	TP7 2.00	27/11/2017	28/11/2017		
119389	TP8 0.20	27/11/2017	28/11/2017		
119390	TP8 0.50	27/11/2017	28/11/2017		
119391	TP8 1.00	27/11/2017	28/11/2017		
119392	TP8 1.50	27/11/2017	28/11/2017		
119393	TP8 2.00	27/11/2017	28/11/2017		

Results Summary

Report No.: 17-15134

ELAB Reference				119353	119354	119355	119356	119357	119358
Customer Reference									
Sample ID									
Sample Type				SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
Sample Location				TP1	TP2	TP3	TP4	TP6	TP7
Sample Depth (m)				1.00	1.50	0.50	1.00	0.50	1.00
Sampling Date				27/11/2017	27/11/2017	27/11/2017	27/11/2017	27/11/2017	27/11/2017
Determinand	Codes	Units	LOD						
Metals									
Arsenic	M	mg/kg	1	21.2	11.8	11.1	13.4	97.4	29.6
Barium	U	mg/kg	10	606	120	159	164	746	270
Beryllium	U	mg/kg	1	1.2	< 1.0	1.4	< 1.0	10.4	1.6
Cadmium	M	mg/kg	0.5	1.0	< 0.5	< 0.5	1.2	1.6	1.8
Chromium	M	mg/kg	5	33.9	22.8	25.2	17.5	70.3	38.0
Copper	M	mg/kg	5	72.3	27.3	22.2	83.9	366	101
Lead	M	mg/kg	5	206	56.9	97.7	124	677	499
Mercury	M	mg/kg	0.5	< 0.5	< 0.5	< 0.5	0.5	1.8	2.3
Nickel	M	mg/kg	5	26.3	17.7	15.7	18.5	122	90.4
Selenium	M	mg/kg	1	< 1.0	< 1.0	< 1.0	< 1.0	1.8	< 1.0
Vanadium	M	mg/kg	5	43.8	32.1	39.1	26.9	129	40.7
Zinc	M	mg/kg	5	589	131	122	1810	759	383
Anions									
Water Soluble Chloride	M	mg/kg	40	< 40	55	51	< 40	56	83
Water Soluble Sulphate	M	g/l	0.02	0.09	0.07	0.23	0.08	0.18	0.08
Inorganics									
Elemental Sulphur	N	mg/kg	20	< 20	269	133	< 20	33	< 20
Hexavalent Chromium	N	mg/kg	0.8	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8
Total Sulphide	N	mg/kg	2	10	3	< 2	< 2	< 2	< 2
Total Cyanide	M	mg/kg	1	< 1.0	< 1.0	< 1.0	16.9	13.4	< 1.0
Acid Soluble Sulphate (SO4)	U	%	0.02	0.12	0.07	0.21	0.05	0.30	0.13
Water Soluble Boron	N	mg/kg	0.5	0.7	1.2	0.6	0.5	2.2	0.8
Miscellaneous									
pH	M	pH units	0.1	8.1	8.0	9.6	8.1	7.6	8.1
Total Organic Carbon	N	%	0.01	1.9	1.4	1.6	0.94	15	3.5
Phenols									
Total Phenols	N	mg/kg	6	< 6	< 6	< 6	< 6	< 6	< 6
Polyaromatic hydrocarbons									
Naphthalene	M	mg/kg	0.1	0.3	0.4	< 0.1	< 0.1	< 0.1	< 0.1
Acenaphthylene	M	mg/kg	0.1	0.3	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Acenaphthene	M	mg/kg	0.1	0.8	0.5	< 0.1	< 0.1	< 0.1	< 0.1
Fluorene	M	mg/kg	0.1	0.8	0.4	< 0.1	< 0.1	< 0.1	< 0.1
Phenanthrene	M	mg/kg	0.1	6.4	2.3	1.0	0.3	< 0.1	0.8
Anthracene	M	mg/kg	0.1	2.0	0.7	0.4	0.2	< 0.1	0.2
Fluoranthene	M	mg/kg	0.1	15.6	4.2	3.8	1.0	0.2	2.0
Pyrene	M	mg/kg	0.1	13.8	4.0	3.8	0.9	0.3	1.8
Benzo(a)anthracene	M	mg/kg	0.1	9.1	2.7	2.6	0.6	0.2	1.2
Chrysene	M	mg/kg	0.1	10.0	2.7	2.6	0.8	0.3	1.3
Benzo (b) fluoranthene	M	mg/kg	0.1	10.8	3.0	3.0	0.8	0.4	1.5
Benzo(k)fluoranthene	M	mg/kg	0.1	10.5	4.0	3.4	1.6	0.9	1.8
Benzo (a) pyrene	M	mg/kg	0.1	11.0	3.1	3.0	0.7	0.3	1.5
Indeno (1,2,3-cd) pyrene	M	mg/kg	0.1	10.1	2.6	2.4	1.0	0.4	1.4
Dibenzo(a,h)anthracene	M	mg/kg	0.1	2.3	0.5	0.6	0.2	0.1	0.3
Benzo[g,h,i]perylene	M	mg/kg	0.1	9.4	2.1	2.3	0.9	0.2	1.2
Total PAH(16)	M	mg/kg	0.4	113	33.3	29.0	9.4	3.4	15.0

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Results Summary

Report No.: 17-15134

ELAB Reference				119353	119354	119355	119356	119357	119358
Customer Reference									
Sample ID									
Sample Type				SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
Sample Location				TP1	TP2	TP3	TP4	TP6	TP7
Sample Depth (m)				1.00	1.50	0.50	1.00	0.50	1.00
Sampling Date				27/11/2017	27/11/2017	27/11/2017	27/11/2017	27/11/2017	27/11/2017
Determinand	Codes	Units	LOD						
BTEX									
Benzene	M	ug/kg	10	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0
Toluene	M	ug/kg	10	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0
Ethylbenzene	M	ug/kg	10	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0
Xylenes	M	ug/kg	10	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0
TPH CWG									
>C5-C6 Aliphatic	N	mg/kg	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
>C6-C8 Aliphatic	N	mg/kg	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
>C8-C10 Aliphatic	N	mg/kg	1	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
>C10-C12 Aliphatic	N	mg/kg	1	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
>C12-C16 Aliphatic	N	mg/kg	1	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
>C16-C21 Aliphatic	N	mg/kg	1	1.8	3.1	4.3	1.7	1.5	< 1.0
>C21-C35 Aliphatic	N	mg/kg	1	14.2	11.5	68.3	49.2	39.2	11.4
>C35-C40 Aliphatic	N	mg/kg	1	1.6	2.8	25.6	14.4	10.7	3.9
>C5-C7 Aromatic	N	mg/kg	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
>C7-C8 Aromatic	N	mg/kg	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
>C8-C10 Aromatic	N	mg/kg	1	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
>C10-C12 Aromatic	N	mg/kg	1	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
>C12-C16 Aromatic	N	mg/kg	1	< 1.0	1.2	< 1.0	< 1.0	< 1.0	< 1.0
>C16-C21 Aromatic	N	mg/kg	1	4.4	6.8	3.3	< 1.0	< 1.0	2.2
>C21-C35 Aromatic	N	mg/kg	1	40.3	16.8	63.3	19.0	17.8	27.0
>C35-C40 Aromatic	N	mg/kg	1	5.4	1.6	19.3	8.5	4.8	3.9
Total (>C5-C40) Ali/Aro	N	mg/kg	1	67.7	43.8	184	92.7	73.9	48.4

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Results Summary

Report No.: 17-15134

ELAB Reference	119356	119357
Customer Reference		
Sample ID		
Sample Type	SOIL	SOIL
Sample Location	TP4	TP6
Sample Depth (m)	1.00	0.50
Sampling Date	27/11/2017	27/11/2017

Determinand	Codes	Units	LOD		
Metals					
Arsenic	N	ug/l	5	< 5	< 5
Barium	N	ug/l	5	31	64
Beryllium	N	ug/l	5	< 5	< 5
Boron	N	ug/l	5	34	92
Cadmium	N	ug/l	1	< 1	< 1
Chromium	N	ug/l	5	< 5	< 5
Copper	N	ug/l	5	5	< 5
Lead	N	ug/l	5	< 5	< 5
Mercury	N	ug/l	0.1	< 0.1	< 0.1
Nickel	N	ug/l	5	< 5	< 5
Selenium	N	ug/l	5	< 5	< 5
Vanadium	N	ug/l	5	< 5	< 5
Zinc	N	ug/l	5	5	6
Anions					
Chloride	N	mg/l	1	1	1
Sulphate	N	mg/l	1	4	22
Inorganics					
Hexavalent chromium	N	ug/l	100	< 100	< 100
Elemental Sulphur	N	mg/l	0.1	< 0.1	< 0.1
Sulphide	N	mg/l	0.1	0.2	0.2
Total Cyanide	N	ug/l	5	< 5	< 5
Miscellaneous					
Dissolved organic carbon	N	mg/l	1.5	4.4	3.3
pH	N	pH units	0.1	7.5	7.2
Phenols					
Total Phenols	N	ug/l	6	< 6	< 6
Polyaromatic hydrocarbons					
Naphthalene Leachate GCMS	N	ug/l	0.01	0.05	0.08
Acenaphthylene Leachate GCMS	N	ug/l	0.01	< 0.01	< 0.01
Acenaphthene Leachate GCMS	N	ug/l	0.01	< 0.01	0.01
Fluorene Leachate GCMS	N	ug/l	0.01	< 0.01	< 0.01
Phenanthrene Leachate GCMS	N	ug/l	0.01	0.03	0.04
Anthracene Leachate GCMS	N	ug/l	0.01	0.01	< 0.01
Fluoranthene Leachate GCMS	N	ug/l	0.01	0.02	0.02
Pyrene Leachate GCMS	N	ug/l	0.01	0.01	0.02
Benzo (a) anthracene Leachate GCMS	N	ug/l	0.01	< 0.01	< 0.01
Chrysene Leachate GCMS	N	ug/l	0.01	< 0.01	< 0.01
Benzo (b) fluoranthene Leachate GCMS	N	ug/l	0.01	< 0.01	0.01
Benzo (k) fluoranthene Leachate GCMS	N	ug/l	0.01	< 0.01	0.01
Benzo (a) pyrene Leachate GCMS	N	ug/l	0.01	< 0.01	0.01
Indeno (1,2,3-cd) pyrene Leachate GCMS	N	ug/l	0.01	< 0.01	< 0.01
Dibenzo(a,h)anthracene Leachate GCMS	N	ug/l	0.01	< 0.01	< 0.01
Benzo(ghi)perylene Leachate GCMS	N	ug/l	0.01	< 0.01	< 0.01
Total PAH(16) Leachate GCMS	N	ug/l	0.01	0.19	0.26

Tests marked N are not UKAS accredited.

The Environmental Laboratory Ltd. Reg. No. 3882193



Results Summary

Report No.: 17-15134

ELAB Reference	119356	119357
Customer Reference		
Sample ID		
Sample Type	SOIL	SOIL
Sample Location	TP4	TP6
Sample Depth (m)	1.00	0.50
Sampling Date	27/11/2017	27/11/2017

Determinand	Codes	Units	LOD		
BTEX					
Benzene	N	ug/l	1	< 1.00	< 1.00
Toluene	N	ug/l	1	< 1.00	< 1.00
Ethylbenzene	N	ug/l	1	< 1.00	< 1.00
Xylenes	N	ug/l	1	< 1.00	< 1.00
TPH CWG					
>C5-C6 Aliphatic in Leachate	N	ug/l	1	< 1.0	< 1.0
>C6-C8 Aliphatic in Leachate	N	ug/l	1	< 1.0	< 1.0
>C8-C10 Aliphatic Leachate	N	ug/l	5	< 5.0	< 5.0
>C10-C12 Aliphatic Leachate	N	ug/l	5	< 5.0	< 5.0
>C12-C16 Aliphatic Leachate	N	ug/l	5	27.7	< 5.0
>C16-C21 Aliphatic Leachate	N	ug/l	5	11.6	< 5.0
>C21-C35 Aliphatic Leachate	N	ug/l	5	< 5.0	< 5.0
>C35-C40 Aliphatic Leachate	N	ug/l	5	< 5.0	< 5.0
Total (>C5-C40) Aliphatic Leachate	N	ug/l	5	39.2	< 5.0
>C5-C7 Aromatic in Leachate	N	ug/l	1	< 1.0	< 1.0
>C7-C8 Aromatic in Leachate	N	ug/l	1	< 1.0	< 1.0
>C8-C10 Aromatic Leachate	N	ug/l	5	< 5.0	< 5.0
>C10-C12 Aromatic Leachate	N	ug/l	5	< 5.0	< 5.0
>C12-C16 Aromatic Leachate	N	ug/l	5	22.1	< 5.0
>C16-C21 Aromatic Leachate	N	ug/l	5	< 5.0	< 5.0
>C21-C35 Aromatic Leachate	N	ug/l	5	< 5.0	< 5.0
>C35-C40 Aromatic Leachate	N	ug/l	5	< 5.0	< 5.0
Total (>C5-C40) Aromatic Leachate	N	ug/l	5	22.1	< 5.0
Total (>C5-C40) Ali/Aro Leachate	N	ug/l	5	61.3	< 5.0

Tests marked N are not UKAS accredited.

The Environmental Laboratory Ltd. Reg. No. 3882193

Results Summary

Report No.: 17-15134

Asbestos Results

Analytical result only applies to the sample as submitted by the client. Any comments, opinions or interpretations (marked #)
in this report are outside UKAS accreditation (Accreditation No2683). They are subjective comments only which must be verified by the client

Elab No	Depth (m)	Clients Reference	Description of Sample Matrix #	Asbestos Identification	Gravimetric Analysis Total (%)	Gravimetric Analysis by ACM Type (%)	Free Fibre Analysis (%)	Total Asbestos (%)
119353	1.00	TP1	Brown soil, Stones, tarmac	No asbestos detected	n/l	n/l	n/l	n/l
119354	1.50	TP2	Brown soil, Stones	No asbestos detected	n/l	n/l	n/l	n/l
119355	0.50	TP3	Brown soil, Tarmac, Stones	No asbestos detected	n/l	n/l	n/l	n/l
119356	1.00	TP4	Brown soil, Stones, Glass	No asbestos detected	n/l	n/l	n/l	n/l
119357	0.50	TP6	Brown soil, Stones, clinker	No asbestos detected	n/l	n/l	n/l	n/l
119358	1.00	TP7	Brown soil, Stones	No asbestos detected	n/l	n/l	n/l	n/l

Method Summary

Report No.: 17-15134

Parameter	Codes	Analysis Undertaken On	Date Tested	Method Number	Technique
Soil					
Aliphatic hydrocarbons in leachate	N		04/12/2017		GC-FID
Aliphatic/Aromatic hydrocarbons in leach	N		05/12/2017		GC-FID
Anions in leachates	N		01/12/2017		Ion Chromatography
Aromatic hydrocarbons in leachate	N		05/12/2017		GC-FID
Carbon in leachates	N		01/12/2017		IR
Cyanide (L) in solids in leachates	N		01/12/2017		Colorimetry
Elemental Sulphur by HPLC in leachates	N	On prepared leachate	01/12/2017		HPLC
Metals by ICP in leachates	N		01/12/2017		ICPMS
Phenols in leachates	N		01/12/2017		HPLC
Sulphide in solids in leachates	N		01/12/2017		Colorimetry
pH of leachates	N		01/12/2017		Electromeric
Sulphide	N	As submitted sample	01/12/2017	109	Colorimetry
Hexavalent chromium	N	As submitted sample	30/11/2017	110	Colorimetry
pH	M	Air dried sample	30/11/2017	113	Electromeric
Acid Soluble Sulphate	U	Air dried sample	01/12/2017	115	Ion Chromatography
Aqua regia extractable metals	M	Air dried sample	30/11/2017	118	ICPMS
Phenols in solids	N	As submitted sample	30/11/2017	121	HPLC
Elemental Sulphur	N	Air dried sample	30/11/2017	122	HPLC
PAH (GC-FID)	M	As submitted sample	29/11/2017	133	GC-FID
PAHs and/or PCBs in leachates	N		04/12/2017	135	GC-MS
Water soluble anions	M	Air dried sample	30/11/2017	172	Ion Chromatography
BTEX in solids	M	As submitted sample	01/12/2017	181A	GC-MS
BTEX in leachates	N		05/12/2017	200A	GC-MS
Water soluble boron	N	Air dried sample	30/11/2017	202	Colorimetry
Total cyanide	M	As submitted sample	30/11/2017	204	Colorimetry
Total organic carbon/Total sulphur	N	Air dried sample	01/12/2017	210	IR
Aliphatic hydrocarbons in soil	N	As submitted sample	29/11/2017	214	GC-FID
Aliphatic/Aromatic hydrocarbons in soil	N	As submitted sample	01/12/2017	214	GC-FID
Aromatic hydrocarbons in soil	N	As submitted sample	29/11/2017	214	GC-FID
Low range Aliphatic hydrocarbons leachat	N		05/12/2017	214	GC-MS
Low range Aliphatic hydrocarbons soil	N	As submitted sample	01/12/2017	214	GC-MS
Low range Aromatic hydrocarbons leachate	N		05/12/2017	214	GC-MS
Low range Aromatic hydrocarbons soil	N	As submitted sample	01/12/2017	214	GC-MS
Asbestos identification	U	As submitted sample	30/11/2017	PMAN	Microscopy

Tests marked N are not UKAS accredited



Report Information

Report No.: 17-15134

Key

U	hold UKAS accreditation
M	hold MCERTS and UKAS accreditation
N	do not currently hold UKAS accreditation
^	MCERTS accreditation not applicable for sample matrix
*	UKAS accreditation not applicable for sample matrix
S	Subcontracted to approved laboratory UKAS Accredited for the test
SM	Subcontracted to approved laboratory MCERTS/UKAS Accredited for the test
I/S	Insufficient Sample
U/S	Unsuitable sample
n/t	Not tested
<	means "less than"
>	means "greater than"

Soil sample results are expressed on an air dried basis (dried at < 30°C)

Comments or interpretations are beyond the scope of UKAS accreditation

The results relate only to the items tested

PCB congener results may include any coeluting PCBs

Uncertainty of measurement for the determinands tested are available upon request

Deviation Codes

-
- | | |
|---|--|
| a | No date of sampling supplied |
| b | No time of sampling supplied (Waters Only) |
| c | Sample not received in appropriate containers |
| d | Sample not received in cooled condition |
| e | The container has been incorrectly filled |
| f | Sample age exceeds stability time (sampling to receipt) |
| g | Sample age exceeds stability time (sampling to analysis) |

Where a sample has a deviation code, the applicable test result may be invalid.

Sample Retention and Disposal

All soil samples will be retained for a period of one month

All water samples will be retained for 7 days following the date of the test report

Charges may apply to extended sample storage



Unit A2
Windmill Road
Ponswood Industrial Estate
St Leonards on Sea
East Sussex
TN38 9BY

THE ENVIRONMENTAL LABORATORY LTD

Analytical Report Number: 17-15387

Issue: 1

Date of Issue: 18/12/2017

Contact: Anthony Potter

Customer Details: GESL
Unit 7
Danworth Farm
Hurstpierpoint
West Sussex BN6 9GL

Quotation No: Q14-00021

Order No: Not Supplied

Customer Reference: GE16903

Date Received: 08/12/2017

Date Approved: 18/12/2017

Details: Cornfield Close, Littlehampton

Approved by:

Mike Varley, Technical Manager

Any comments, opinions or interpretations expressed herein are outside the scope of UKAS accreditation (Accreditation Number 2683)



Sample Summary

Report No.: 17-15387

Elab No.	Client's Ref.	Date Sampled	Date Scheduled	Description	Deviations
121207	BH1 6.64	07/12/2017	11/12/2017		



2683

Results Summary

Report No.: 17-15387

ELAB Reference	121207
Customer Reference	6.64
Sample ID	BH1
Sample Type	WATER
Sample Location	BH1
Sample Depth (m)	
Sampling Date	07/12/2017

Determinand	Codes	Units	LOD	
Dissolved Metals				
Arsenic	U	ug/l	5	< 5
Boron	N	ug/l	5	311
Barium	U	ug/l	5	28
Beryllium	U	ug/l	5	< 5
Cadmium	U	ug/l	1	< 1
Chromium	U	ug/l	5	< 5
Copper	U	ug/l	5	< 5
Mercury	U	ug/l	0.1	< 0.1
Nickel	U	ug/l	5	< 5
Lead	U	ug/l	1	< 1
Selenium	U	ug/l	5	< 5
Vanadium	N	ug/l	5	< 5
Zinc	U	ug/l	5	< 5
Anions				
Chloride	U	mg/l	0.5	32.6
Sulphate	U	mg/l	0.5	167
Inorganics				
Elemental Sulphur	N	mg/l	0.1	< 0.1
Hexavalent Chromium	U	ug/l	100	< 100
Sulphide	N	mg/l	0.1	0.2
Miscellaneous				
Dissolved organic carbon	U	mg/l	1.5	5.5
pH	U	pH units	0.1	7.8
Phenols				
Phenol	N	ug/l	1	< 1
M.P-Cresol	N	ug/l	1	< 1
O-Cresol	N	ug/l	1	< 1
3,4-Dimethylphenol	N	ug/l	1	< 1
2,3-Dimethylphenol	N	ug/l	1	< 1
2,3,5-trimethylphenol	N	ug/l	1	< 1
Total Monohydric Phenols	N	ug/l	1	< 1
Polyaromatic hydrocarbons				
Naphthalene GCMS	N	ug/l	0.01	0.05
Acenaphthylene GCMS	N	ug/l	0.01	0.06
Acenaphthene GCMS	N	ug/l	0.01	0.04
Fluorene GCMS	N	ug/l	0.01	0.04
Phenanthrene GCMS	N	ug/l	0.01	0.51
Anthracene GCMS	N	ug/l	0.01	0.17
Fluoranthene GCMS	N	ug/l	0.01	1.31
Pyrene GCMS	N	ug/l	0.01	1.09
Benzo (a) anthracene GCMS	N	ug/l	0.01	0.68
Chrysene GCMS	N	ug/l	0.01	0.55
Benzo (b) fluoranthene GCMS	N	ug/l	0.01	0.50
Benzo (k) fluoranthene GCMS	N	ug/l	0.01	0.56
Benzo (a) pyrene GCMS	N	ug/l	0.01	0.71
Indeno (1,2,3-cd) pyrene GCMS	N	ug/l	0.01	0.37
Dibenzo(a,h)anthracene GCMS	N	ug/l	0.01	0.14
Benzo(ghi)perylene GCMS	N	ug/l	0.01	0.38
Total PAH(16) GCMS	N	ug/l	0.01	7.16
TPH CWG				
>C5-C8 Aliphatic	N	ug/l	1	< 1.0

Tests marked N are not UKAS accredited.

The Environmental Laboratory Ltd. Reg. No. 3882193



2683

Results Summary

Report No.: 17-15387

ELAB Reference	121207
Customer Reference	6.64
Sample ID	BH1
Sample Type	WATER
Sample Location	BH1
Sample Depth (m)	
Sampling Date	07/12/2017

Determinand	Codes	Units	LOD	
>C6-C8 Aliphatic	N	ug/l	1	< 1.0
>C8-C10 Aliphatic	N	ug/l	5	< 5.0
>C10-C12 Aliphatic	N	ug/l	5	< 5.0
>C12-C16 Aliphatic	N	ug/l	5	< 5.0
>C16-C21 Aliphatic	N	ug/l	5	85.2
>C21-C35 Aliphatic	N	ug/l	5	3710
>C35-C40 Aliphatic	N	ug/l	5	285
Total (>C5-C40) Aliphatic	N	ug/l	5	4080
>C5-C7 Aromatic	N	ug/l	1	< 1.0
>C7-C8 Aromatic	N	ug/l	1	< 1.0
>C8-C10 Aromatic	N	ug/l	5	< 5.0
>C10-C12 Aromatic	N	ug/l	5	< 5.0
>C12-C16 Aromatic	N	ug/l	5	10.6
>C16-C21 Aromatic	N	ug/l	5	48.0
>C21-C35 Aromatic	N	ug/l	5	1860
>C35-C40 Aromatic	N	ug/l	5	122
Total (>C5-C40) Aromatic	N	ug/l	5	2040
Total (>C5-C40) Ali/Aro	N	ug/l	5	6120

Method Summary

Report No.: 17-15387

Parameter	Codes	Analysis Undertaken On	Date Tested	Method Number	Technique
Water					
Aliphatic/Aromatic hydrocarbons in water	N		15/12/2017		GC-FID
Aromatic hydrocarbons in water	N		15/12/2017		GC-FID
Phenols in waters	N		13/12/2017		HPLC
Dissolved metals by ICP in waters	U		13/12/2017	101	ICPMS
Dissolved organic carbon	U		14/12/2017	102	IR
pH of waters	U		13/12/2017	113	Electromeric
Chromium Hexavalent in waters	U		14/12/2017	123	Colorimetry
Anions	U		13/12/2017	131	Ion Chromatography
PAHs and/or PCBs in waters	N		13/12/2017	135	GC-MS
Elemental Sulphur by HPLC in waters	N	As submitted sample	14/12/2017	206	HPLC
Aliphatic hydrocarbons in water	N		13/12/2017	215	GC-FID
Aromatic hydrocarbons in water	N		13/12/2017	215	GC-FID
Low range Aliphatic hydrocarbons water	N		13/12/2017	215	GC-MS
Low range Aromatic hydrocarbons water	N		13/12/2017	215	GC-MS

Tests marked N are not UKAS accredited



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Report Information

Report No.: 17-15387

Key

U	hold UKAS accreditation
M	hold MCERTS and UKAS accreditation
N	do not currently hold UKAS accreditation
^	MCERTS accreditation not applicable for sample matrix
*	UKAS accreditation not applicable for sample matrix
S	Subcontracted to approved laboratory UKAS Accredited for the test
SM	Subcontracted to approved laboratory MCERTS/UKAS Accredited for the test
I/S	Insufficient Sample
U/S	Unsuitable sample
n/t	Not tested
<	means "less than"
>	means "greater than"

Soil sample results are expressed on an air dried basis (dried at < 30°C)

Comments or interpretations are beyond the scope of UKAS accreditation

The results relate only to the items tested

PCB congener results may include any coeluting PCBs

Uncertainty of measurement for the determinands tested are available upon request

Deviation Codes

-
- | | |
|---|--|
| a | No date of sampling supplied |
| b | No time of sampling supplied (Waters Only) |
| c | Sample not received in appropriate containers |
| d | Sample not received in cooled condition |
| e | The container has been incorrectly filled |
| f | Sample age exceeds stability time (sampling to receipt) |
| g | Sample age exceeds stability time (sampling to analysis) |

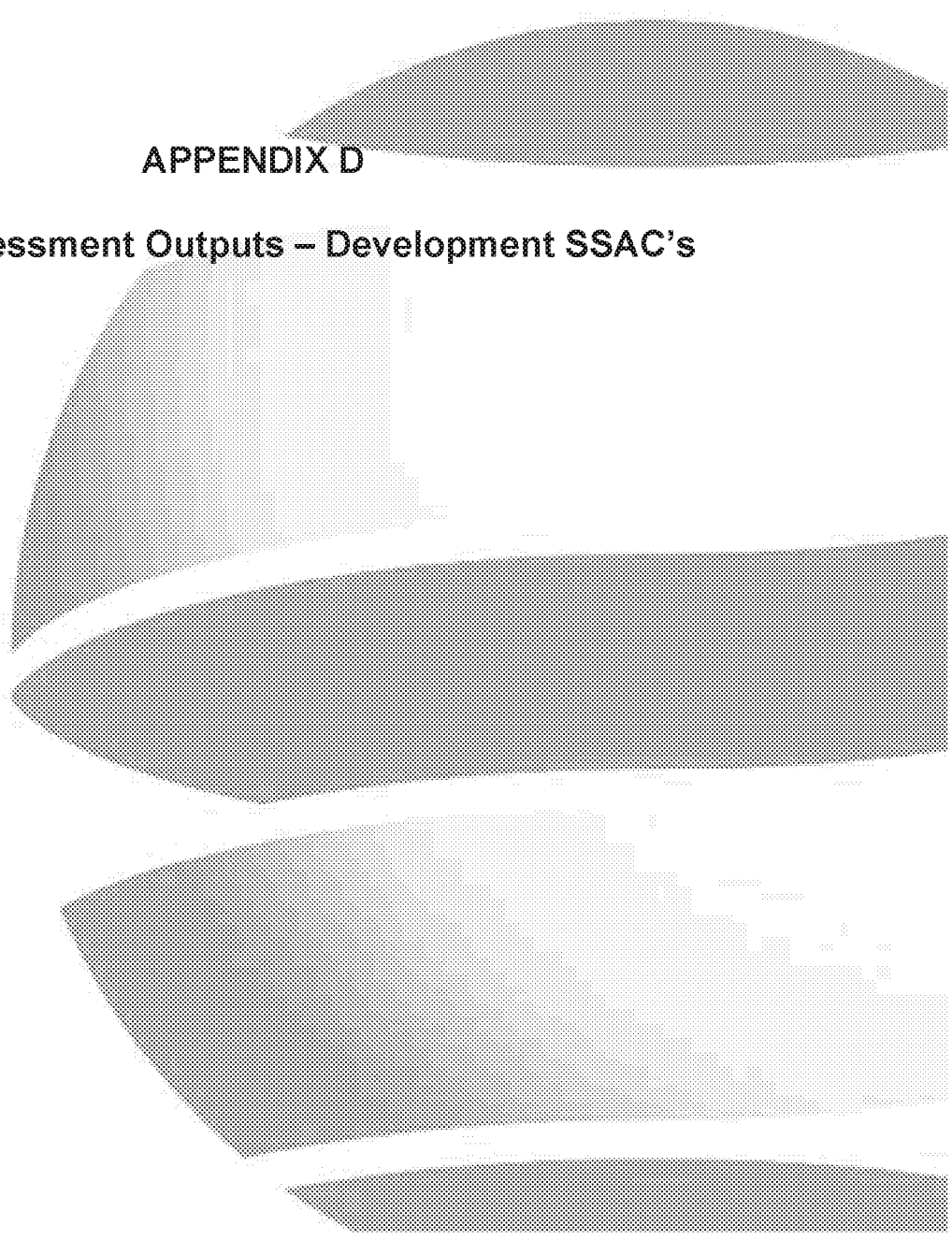
Where a sample has a deviation code, the applicable test result may be invalid.

Sample Retention and Disposal

All soil samples will be retained for a period of one month

All water samples will be retained for 7 days following the date of the test report

Charges may apply to extended sample storage

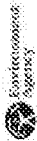


APPENDIX D

CLEA Assessment Outputs – Development SSAC's



	Assessment Criterion (mg kg ⁻¹)			Ratio of ADE to HCV			Saturation Limit (mg kg ⁻¹)		50% rule?	
	oral	inhalation	combined	oral	inhalation	combined			Oral	Inhal
1 Arsenic	3.23E+01	8.50E+01	NR	1.00	0.38	NR		NR	No	No
2 Cadmium	5.45E+00	3.97E+01	5.17E+00	0.91	0.10	1.00		NR	Yes	Yes
3 Chromium III	1.95E+04	2.55E+03	3.01E+03	0.15	0.85	1.00		NR	No	No
4 Mercury inorganic	1.81E+03	2.55E+02	1.88E+02	0.93	0.07	1.00		NR	No	No
5 Nickel	5.31E+02	1.77E+02	NR	0.14	1.00	NR		NR	Yes	Yes
8 Copper	7.81E+03	1.04E+04	5.20E+03	0.50	0.50	1.00		NR	Yes	No
7 Zinc	1.94E+04	2.55E+07	1.94E+04	1.00	0.00	1.00		NR	Yes	No
8 Selenium	3.50E+02	NR	NR	1.00	NR	NR		NR	Yes	No
9 Chromium VI	4.89E+01	NR	NR	1.00	NR	NR		NR	Yes	No
10 Barium	1.53E+03	NR	NR	1.00	NR	NR		NR	Yes	No
11 Beryllium	1.48E+02	5.10E+01	4.32E+01	0.19	0.81	1.00		NR	Yes	No
12 Vanadium	1.18E+02	5.08E+02	1.37E+02	0.90	0.10	1.00		NR	Yes	Yes
13 Phenol	2.32E+03	5.19E+02	4.37E+02	0.18	0.82	1.00		2.06E+05 (vap)	No	No
14 Acenaphthylene	8.87E+02	2.08E+04	9.51E+02	0.95	0.05	1.00		5.82E+02 (sol)	No	No
15 Acenaphthene	1.18E+03	2.43E+04	1.13E+03	0.95	0.05	1.00		3.87E+02 (sol)	No	No
16 Fluorene	8.88E+02	2.54E+04	8.88E+02	0.97	0.03	1.00		2.11E+02 (sol)	No	No
17 Phenanthrene	4.14E+03	5.05E+04	3.89E+03	0.68	0.02	1.00		2.47E+02 (sol)	No	No
18 Anthracene	3.01E+04	5.05E+02	3.88E+03	0.99	0.01	1.00		8.01E+00 (vap)	No	No
19 Fluoranthene	7.88E+02	1.37E+05	7.88E+02	0.99	0.01	1.00		1.30E+02 (vap)	No	No
20 Pyrene	7.84E+03	3.32E+05	1.63E+03	0.99	0.01	1.00		1.51E+01 (vap)	No	No



	Assessment Criterion (mg kg ⁻¹)		Ratio of ADE to HCV		Saturation Limit (mg kg ⁻¹)		50% rule?	
	oral	Inhalation	oral	Inhalation	combined	combined	Oral	Inhal
21	Benz(a)anthracene	1.02E+01	1.30E+03	5.90E+00	0.58	0.42	1.00	No
22	Chrysene	3.33E+01	3.73E+03	8.38E+00	0.66	0.34	1.00	No
23	Benzo(b)fluoranthene	1.08E+01	2.09E+03	7.09E+00	0.66	0.34	1.00	No
24	Benzo(k)fluoranthene	1.04E+01	2.09E+03	1.81E+00	0.65	0.35	1.00	No
25	Benzo(e)pyrene	1.51E+01	2.50E+03	1.00E+00	0.65	0.35	1.00	No
26	Indeno(1,2,3-cd)pyrene	8.43E+00	1.29E+03	4.29E+00	0.66	0.34	1.00	No
27	Dibenz(a,h)anthracene	1.40E+01	2.57E+03	9.98E+00	0.65	0.35	1.00	No
28	Benzo(ghi)perylene	7.20E+01	1.31E+02	1.18E+00	0.65	0.35	1.00	No
29								
30								

		Assessment Criteria (mg kg ⁻¹)			Ratio of ADE to HCV			Saturation Limit (mg kg ⁻¹)		50% rule?	
		oral	inhalation	combined	oral	inhalation	combined			Oral	Inhal
1	AI>EC5-EC7	4.40E+02	3.80E+03	3.34E+02	0.90	0.10	1.00	5.56E+01 (sol)	No	No	No
2	AI>EC7-EC8	8.74E+02	3.80E+03	6.13E+02	0.63	0.07	1.00	5.06E+03 (vap)	No	No	No
3	AI>EC8-EC10	3.19E+02	8.89E+02	2.74E+02	0.75	0.25	1.00	4.12E+03 (vap)	Yes	Yes	Yes
4	AI>EC10-EC12	4.32E+02	3.98E+02	4.18E+02	0.94	0.06	1.00	2.47E+03 (sol)	Yes	Yes	Yes
5	AI>EC12-EC16	8.58E+02	3.28E+04	6.54E+02	0.99	0.01	1.00	1.66E+03 (sol)	Yes	Yes	Yes
6	AI>EC16-EC21	8.04E+02	NR	NR	1.00	NR	NR	3.69E+02 (vap)	Yes	No	No
7	AI>EC21-EC35	1.24E+03	NR	NR	1.00	NR	NR	3.33E+01 (sol)	Yes	No	No
8	AI>EC35-EC44	1.24E+03	NR	NR	1.00	NR	NR	3.33E+01 (sol)	Yes	No	No
9	AI>EC44-EC48	2.64E+03	3.93E+02	3.81E+02	0.01	0.99	1.00	1.28E+03 (sol)	Yes	Yes	Yes
10	AI>EC48-EC8	2.64E+03	3.93E+02	3.81E+02	0.01	0.99	1.00	8.38E+02 (sol)	Yes	Yes	Yes
11	AI>EC8-EC9	3.21E+03	3.93E+02	3.81E+02	0.06	0.94	1.00	5.17E+02 (vap)	Yes	Yes	Yes
12	AI>EC10-EC12	4.29E+02	3.98E+02	4.18E+02	0.25	0.75	1.00	3.26E+02 (vap)	Yes	Yes	Yes
13	AI>EC12-EC16	8.74E+02	3.80E+03	6.13E+02	0.85	0.14	1.00	1.63E+02 (sol)	Yes	Yes	Yes
14	AI>EC16-EC35	8.04E+04	NR	NR	1.00	NR	NR	5.85E+01 (sol)	Yes	No	No
15	AI>EC35-EC44	8.04E+04	NR	NR	1.00	NR	NR	5.85E+01 (sol)	Yes	No	No
16											
17											
18											
19											
20											

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[Go to normality test](#)
[Show individual summary](#)

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Classification Assessment Tool of Soil Wastes - Hazard Summary Sheet

Site Name	Cornfield Close, Littlehampton
Location	Littlehampton
Site ID	Cornfield Close
Job Number	GE16903
Date	1/3/2018
User Name	anthony.potter@gesl.net
Company Name	Geo-Environmental Services Limited

Hole ID	Sample Depth	Hazardous Waste Y/N	HP1	HP2	HP3	HP4	HP5	HP6	HP7	HP8	HP9
---------	--------------	---------------------	-----	-----	-----	-----	-----	-----	-----	-----	-----

ATKINS CatWasteSol

Site Name	Cornfield Close, Littlehampton
Location	Littlehampton
Site ID	Cornfield Close
Job Number	GE16903
Date	1/3/2018
User Name	anthony.potter@gesl.net
Company Name	Geo-Environmental Services Limited

[illegible]

[illegible]

[illegible]

[illegible]

ATKINS CatWasteSoil

Site Name	Comfield Close, Littlehampton
Location	Littlehampton
Site ID	Comfield Close
Job Number	GE16903
Date	1/3/2018
User Name	anthony.potter@gesl.net
Company Name	Geo-Environmental Services Limited

Hole ID	Sample Depth	Hazardous Waste Y/N	HP10	HP11	HP12	HP13	HP14	HP15	HP16
---------	--------------	---------------------	------	------	------	------	------	------	------

[illegible]

[illegible]

[illegible]

ATKINS CatWasteSoil

Site Name	Comfield Close, Littlehampton
Location	Littlehampton
Site ID	Comfield Close
Job Number	GE16903
Date	1/3/2018
User Name	anthony.potter@gesl.net
Company Name	Geo-Environmental Services Limited

Hole ID	Sample Depth	Hazardous Waste Y/N
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APPENDIX E

Ground Gas Monitoring Results

Project: Cornfield Close, Littlehampton
 Ref: GE16903
 Client: Thakeham Client



Location	Date	Time (sec)	CH ₄ (%)	CO ₂ (%)	O ₂ (%)	Flow (l/hr)	VOC (ppm)	Pressure (mb)	GWL (m bgl)	GSV/Gbgs		Characteristic Situation BS5445 & G665			CS1 Limiting Value Check			NHBC				
										CH ₄	CO ₂	CH ₄	CO ₂	CS1	Flow	CH ₄	CO ₂	CH ₄		CS1		
																		GSV	Conc.	GSV	Conc.	
MW1a	07/12/17	10	0.0	0.1	20.6	0.0	0.1	1013	DRY	0.000	0.000	CS1	CS1	CS1	NO	NO	NO	NO	GREEN	GREEN	GREEN	GREEN
MW1a	07/12/17	20	0.0	0.2	20.5	0.0	0.10	1013	DRY	0.000	0.000	CS1	CS1	CS1	NO	NO	NO	NO	GREEN	GREEN	GREEN	GREEN
MW1a	07/12/17	30	0.0	0.3	20.4	0.0	0.10	1013	DRY	0.000	0.000	CS1	CS1	CS1	NO	NO	NO	NO	GREEN	GREEN	GREEN	GREEN
MW1a	07/12/17	60	0.0	0.5	20.3	0.0	0.10	1013	DRY	0.000	0.000	CS1	CS1	CS1	NO	NO	NO	NO	GREEN	GREEN	GREEN	GREEN
MW1a	07/12/17	120	0.0	0.5	20.4	0.0	0.10	1013	DRY	0.000	0.000	CS1	CS1	CS1	NO	NO	NO	NO	GREEN	GREEN	GREEN	GREEN
MW1b	07/12/17	10	0.0	1.4	20.2	-2.3	4.2	1013	6.64	0.000	-0.032	CS1	CS1	CS1	NO	NO	NO	NO	GREEN	GREEN	GREEN	GREEN
MW1b	07/12/17	20	0.0	3.3	18.1	-2.3	4.20	1013	6.64	0.000	-0.076	CS1	CS1	CS1	NO	NO	NO	NO	GREEN	GREEN	GREEN	GREEN
MW1b	07/12/17	30	0.0	3.4	17.0	-2.3	4.20	1013	6.64	0.000	-0.078	CS1	CS1	CS1	NO	NO	NO	NO	GREEN	GREEN	GREEN	GREEN
MW1b	07/12/17	60	0.0	3.5	16.4	-2.3	4.20	1013	6.64	0.000	-0.081	CS1	CS1	CS1	NO	NO	NO	NO	GREEN	GREEN	GREEN	GREEN
MW1b	07/12/17	120	0.0	3.5	16.3	-2.3	4.20	1013	6.64	0.000	-0.081	CS1	CS1	CS1	NO	NO	NO	NO	GREEN	GREEN	GREEN	GREEN

APPENDIX H

Preliminary Soakage Testing Letter Report April 2018

13th April 2018

Our ref: GE17106/AP01/180413

Mark Wild
Thakeham Homes Ltd
Thakeham House
Summers Place
Stane Street
Billingshurst
West Sussex
RH14 9GN



Dear Mark,

Daisyfields Caravan Park, Cornfield Close, Littlehampton, BN17 6LD – Soakage Testing

Geo-Environmental were instructed to complete preliminary BRE365 trial pit soakage testing and indicative falling head soakage tests within the natural soils within the above named site on 11th April 2018.

At the time of the investigation, the site was a closed caravan park although still occupied by the park tenants.

Encountered Conditions

The ground conditions recorded within the trial pits and boreholes comprised a mantle of Topsoil overlying the Made Ground of the Landfill with River Terrace Deposits and Chalk at depth.

Topsoil was encountered within WS1 to WS4 to depths of between 0.10m and 0.20m and generally comprised brown silty clay and brown sandy clay.

Underlying the Topsoil, Made Ground was encountered within all locations to depths of between 1.50m and 2.30m and was of a mixed composition comprising sandy clays, silty clays, clayey sands and sand with various consistence's of ash, organic material, plastic, glass, metal, fabric and roots.

Beneath the Made Ground, the River Terrace Deposits were encountered within all locations to depths of between 2.90m and 4.00m bgl and comprised soft to stiff sandy clays, becoming sandier at depth.

Underling the River Terrace Deposits within WS2 only, White Chalk Subgroup was encountered to a depth of 4.00m bgl and comprised white structureless chalk with very weak and weak chalk clasts, within a white silt grade matrix.

Preliminary Infiltration Tests

Soakage testing and falling head tests were undertaken within all locations with the exception of TP103, which was inundated with perched water from within the Made Ground. It should be noted that no infiltration tests were undertaken within the Landfill material, all tests were undertaken within the River Terrace Deposits and Chalk only.

The results of the tests indicated relatively poor soakage potential, albeit with some variation in soakage rates between the trial pits and boreholes.

Location	Depth of Made Ground (mbgl)	Depth of Trial Pit/Borehole (mbgl)	Calculated Soakage rate (m/s)
TP101	1.50	2.90	6.21×10^{-7}

Geo-Environmental Services Ltd
Unit 7 Danworth Farm, Cuckfield Road, Hurstpierpoint, West Sussex BN6 9GL
+44(0)1273 832972 www.geol.net

Environmental Consultants | Geotechnical Engineers | Site Investigations

Geo-Environmental Services Ltd incorporated in England number 3214980 VAT number 679544479



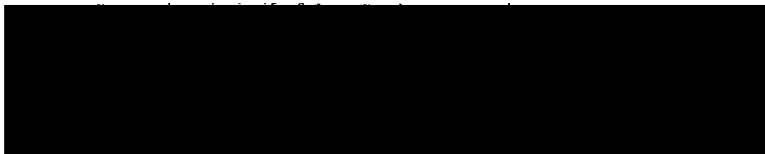
TP102	2.10	3.00	1.74×10^{-6}
WS1 (Test run 1)	2.10	4.00	1.61×10^{-7}
WS1 (Test run 2)		4.00	8.47×10^{-8}
WS1 (Test run 3)		4.00	2.61×10^{-7}
WS2	1.80	4.00	7.26×10^{-8}
WS3	2.10	4.00	3.1×10^{-8}
WS4	2.00	4.00	7×10^{-8}
WS5	2.30	4.00	2.6×10^{-8}

Soakage rates were generally poor within the superficial deposits due to the clay content of the River Terrace Gravel. In addition, poor soakage rates were also recorded within the White Chalk Sub-group and this is likely to be as a result of the smearing of the hole sides due to the drilling process together with the clayey silty nature of chalk (weathering) at shallow depth.

However, as it has been proved that some soakage potential exists within the superficial deposits, it has been agreed in principle with the EA (ref e-mail 24/03/18) that consideration would be given to a proposal to disperse storm water via a chamber/crate system within the area of infilled ground, provided the construction can demonstrate that discharge will be vertical only into the superficial natural uncontaminated soils. The proposed location of the soakaway is indicated on the attached plan. Further investigation is proposed on the site, which will include leachate testing to provide a more robust risk assessment in respect of controlled waters.

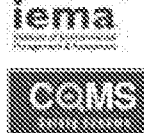
We trust that the information provided is sufficient for your present requirements, please do not hesitate to contact us should you require any further information.

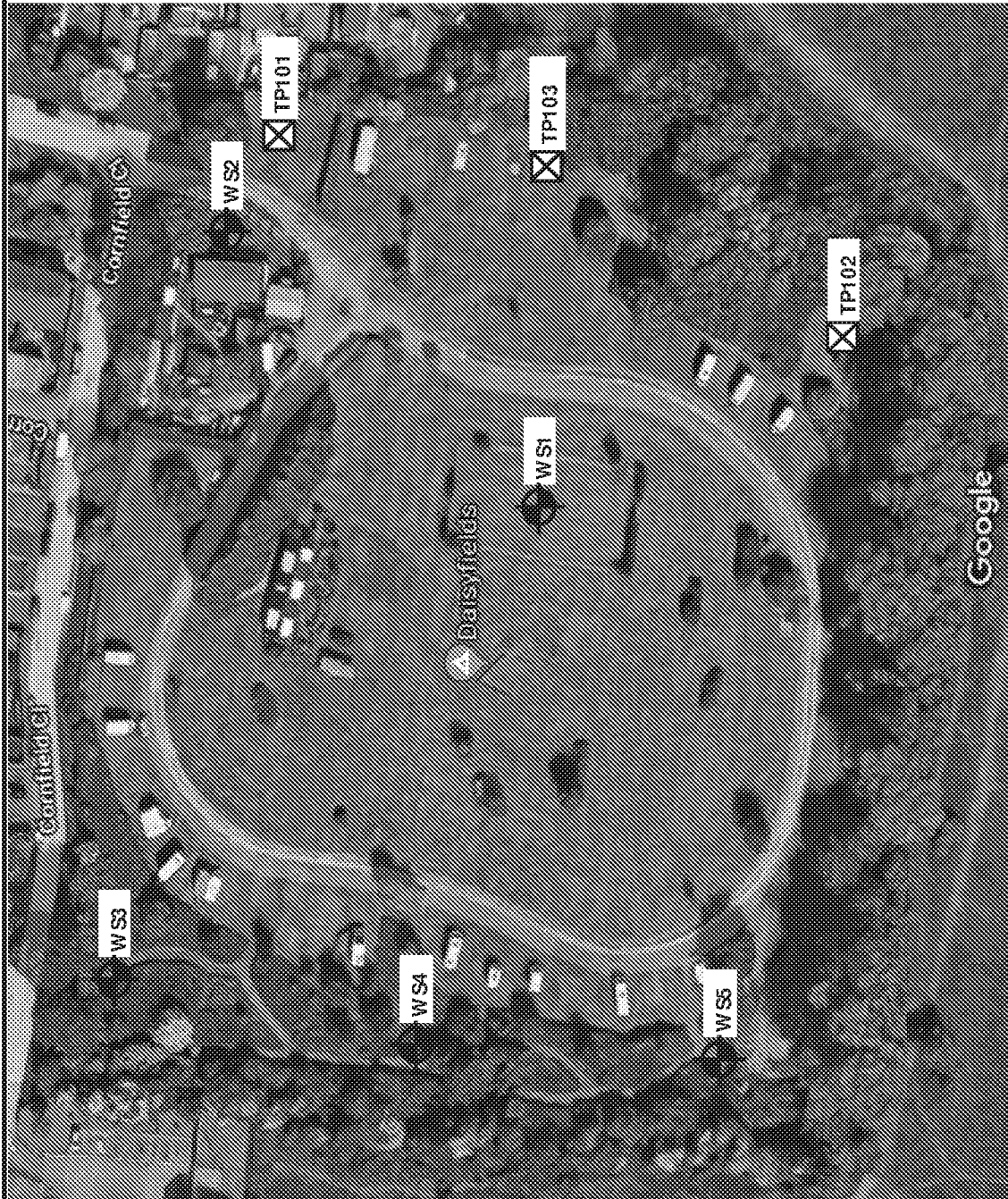
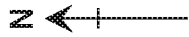
Yours sincerely



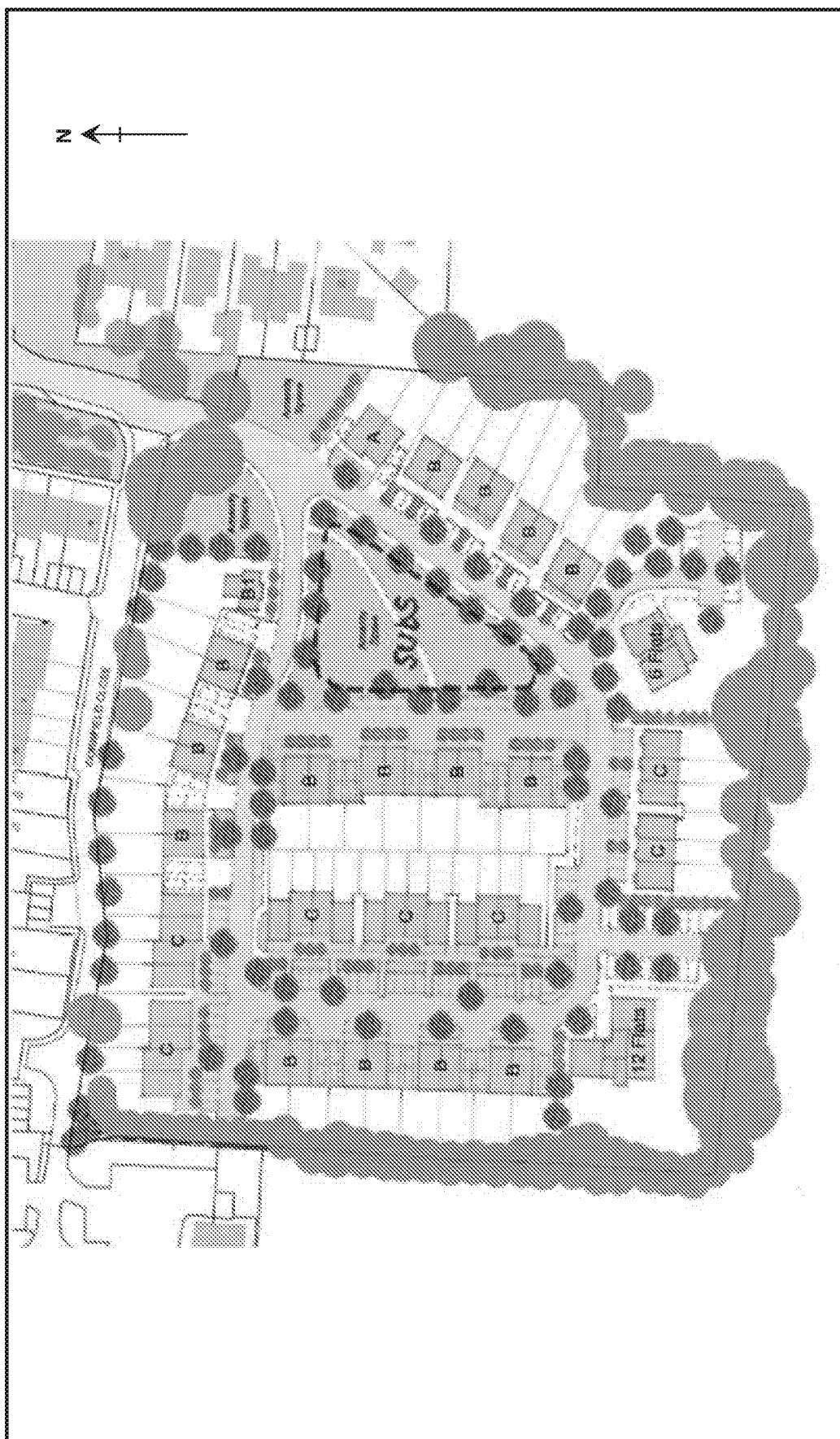
ANTHONY POTTER B.Sc. (Hons), M.Sc. FGS
Senior Engineer anthony@gesl.net

Encs - Site Investigation Plan
- Trial Hole Logs
Proposed soakaway Location





Project:	Daisyfields, Cornfield Close, Littlehampton			Title	Proposed Investigation Plan
Client:	Thakeham Client			Geo-Environmental Services Ltd	
Ref No:	GE17106	Revision:	v3	Unit 7 Danworth Farm, Cuckfield Road	
Drawn:	AP	Date:	10/04/2018	Hurstpierpoint, West Sussex BN6 9GL	
Figure:	2	Scale:	Not To Scale	+44(0)1273 832972 www.gesl.net	
				 Geo-Environmental	



Project: Cornfield Close, Littlehampton		Title		Proposed SUDS Area	
Client: Thakeham Client				Geo-Environmental Services Ltd	
Ref No: GE17106		Revision: v1		Unit 7 Danworth Farm, Cuckfield Road	
Drawn: AP		Date: 13/04/2018		Hurstpierpoint, West Sussex BN6 9GL	
Figure: 2		Scale: Not To Scale		+44(0)1273 832972 www.gesl.net	



Geo-Environmental



Unit 7, Danworth Farm
Hurstpierpoint
BN6 9GL

Geo-Environmental www.gesl.net

Trial Pit Log

Trial Pit No

TP101

Sheet 1 of 1

Project Name: Cornfield Close, Littlehampton

Project No.
GE17106

Co-ords: 503457.00 - 103291.00
Level:

Date
12/04/2018

Location: Littlehampton, West Sussex

Dimensions (m): 2.40

Depth
2.90

0.50

Scale
1:25

Logged
WH

Client: Thakeham Client

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
				0.70			Turf over soft brown slightly sandy slightly gravelly silt with abundant rootlets (to 0.2m). Gravel is fine to coarse fragments of flint, brick, glass, nail, concrete, and tiles MADE GROUND	
				1.50			LANDFILL: Dark brown to black including sand, fragments of brick and concrete, metal, fabric, glass bottles and plastic. With frequent roots. MADE GROUND	1
				2.40			Brownish yellow slightly silty gravelly SAND. Gravel is fine to medium rounded to sub-angular flint. RIVER TERRACE DEPOSITS	2
				2.90			Soft to firm brownish yellow and orange mottled slightly gravelly sandy CLAY. Gravel is fine to medium rounded to sub-angular flint. RIVER TERRACE DEPOSITS	3
							End of Pit at 2.90m	4
								5
Remarks			Groundwater not encountered. Soakage test carried out within natural material					
Stability			Unstable within the landfill					



Trial Pit Log

TrialPit No

TP102

Sheet 1 of 1

Project Name: Cornfield Close, Littlehampton

Project No.
GE17106

Co-ords: 503422.00 - 103179.00
Level:

Date
12/04/2018

Location: Littlehampton, West Sussex

Dimensions (m): 2.30

Scale
1:25

Client: Thakeham Client

Depth
3.00

0.50

2.30

Logged
WH

[illegible]

Trial Pit Log

TrialPit No

TP103

Sheet 1 of 1

Project Name: Cornfield Close, Littlehampton

Project No.
GE17106

Co-ords: 503450.00 - 103224.00
Level:

Date
12/04/2018

Location: Littlehampton, West Sussex

Dimensions (m):

Scale
1:25

Client: Thakeham Client

Depth
3.00

0.50

2.50

Logged
WH

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
				0.25		 Turf over brown gravelly slightly sandy clay with frequent rootlets. Gravel is fine to medium rounded to sub-angular flint. MADE GROUND	1
				2.30		 Orange and yellow clayey slightly gravelly SAND. Gravel is fine to medium rounded to sub-angular flint. RIVER TERRACE DEPOSITS	2
				3.00		 End of Pit at 3.00m	3
							4
							5

1.90

2.50

Remarks Black malodorous water encountered at 1.9m bgl. Filled pit to 2.5m bgl after 60 minutes. Soakage test abandoned due to perched water

Stability Unstable within the landfill





Geo-Environmental www.gesi.net

Unit 7, Danworth Farm
Hurstpierpoint
BN6 9GL

Borehole Log

Borehole No.

WS1

Sheet 1 of 1

Project Name: Cornfield Close, Littlehampton

Project No.
GE17106

Co-ords: 503394E - 103237N

Hole Type
WLS

Location: Littlehampton, West Sussex

Level:

Scale
1:25

Client: Thakeham Client

Dates: 11/04/2018

Logged By
AP

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.10			Grass overlying brown silty clay TOPSOIL	
		0.50	PP	2.0kg/cm2				Brown sandy clay with rare medium to coarse sub-angular flint and chalk gravel. MADE GROUND	
					0.95			Dark grey silty clay and clayey sand with frequent ash, plastic, polystyrene, organic material, glass and metal. MADE GROUND	1
		1.50	PP	0.3kg/cm2					
		2.00	PP	1.8kg/cm2	2.10			Stiff brown sandy CLAY with occasional medium sand bands RIVER TERRACE DEPOSITS	2
		2.50	PP	3.0kg/cm2					
		3.00	PP	2.5kg/cm2					3
		3.50	PP	3.0kg/cm2					
					3.70			Brown medium to coarse SAND. RIVER TERRACE DEPOSITS	
					4.00			End of Borehole at 4.00m	4
									5
Casing		Water Strikes (mbgl)		Chiselling (mbgl)		Remarks			
Diameter	Depth (m)	Depth Strike	Rose to	Depth from	Depth to				
100	3.00					Groundwater not encountered.			





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Unit 7, Danworth Farm
Hurstpierpoint
BN6 9GL

Borehole Log

Borehole No.

WS2

Sheet 1 of 1

Project Name: Cornfield Close, Littlehampton

Project No.
GE17106

Co-ords: 503440E - 103303N

Hole Type
WLS

Location: Littlehampton, West Sussex

Level:

Scale
1:25

Client: Thakeham Client

Dates: 11/04/2018

Logged By
AP

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.10			Grass overlying dark brown sandy clay. TOPSOIL	
					0.40			Brown sandy clay with rare medium to coarse sub-angular flint gravel. MADE GROUND	
								Black clayey sand with ash, glass and organic material. MADE GROUND	
		1.50	PP	4.5kg/cm2					1
					1.80				
								Stiff brown sandy CLAY. RIVER TERRACE DEPOSITS	2
		2.50	PP	2.0kg/cm2					
		3.00	PP	2.5kg/cm2	3.00			...becoming chalky clay from 2.95m bgl. Recovered as white, structureless CHALK, very weak and weak chalk clasts within a white silt grade matrix. CHALK	3
					4.00			End of Borehole at 4.00m	4
									5
Casing		Water Strikes (mbgl)		Chiselling (mbgl)		Remarks			
Diameter	Depth (m)	Depth Strike	Rose to	Depth from	Depth to				
						Groundwater not encountered.			





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Unit 7, Danworth Farm
Hurstpierpoint
BN6 9GL

Borehole Log

Borehole No.

WS3

Sheet 1 of 1

Project Name: Cornfield Close, Littlehampton

Project No.
GE17106

Co-ords: 503310E - 103322N

Hole Type
WLS

Location: Littlehampton, West Sussex

Level:

Scale
1:25

Client: Thakeham Client

Dates: 11/04/2018

Logged By
AP

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		0.10			0.10			Grass overlying brown silty clay TOPSOIL
		0.50	PP	3.0kg/cm2				Dark grey silty clay and clayey sand with frequent ash, plastic, organic material, glass and metal. MADE GROUND
		2.00	PP	2.0kg/cm2	2.10			Stiff brown sandy CLAY with occasional medium sand bands RIVER TERRACE DEPOSITS
		2.50	PP	2.0kg/cm2	4.00			End of Borehole at 4.00m
Casing		Water Strikes (mbgl)		Chiselling (mbgl)		Remarks Groundwater not encountered.		
Diameter	Depth (m)	Depth Strike	Rose to	Depth from	Depth to			



 Unit 7, Danworth Farm Hurstpierpoint BN6 9GL www.gesi.net		Borehole Log				Borehole No. WS4 Sheet 1 of 1	
Project Name: Cornfield Close, Littlehampton		Project No. GE17106		Co-ords: 503297E - 103274N		Hole Type WLS	
Location: Littlehampton, West Sussex				Level:		Scale 1:25	
Client: Thakeham Client				Dates: 11/04/2018		Logged By AP	

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.20			Grass overlying brown sandy clay with rootlets. TOPSOIL	
					0.20			Light brown medium sand. MADE GROUND	
		0.50	PP	2.2kg/cm2				Brown mottled sandy clay with rare brick fragments. MADE GROUND	
		1.00	PP	0.5kg/cm2	1.00			Dark grey silty clay and clayey sand with frequent ash, plastic, organic material, glass and metal. MADE GROUND	1
		1.50	PP	1.5kg/cm2					
		2.00	PP	4.0kg/cm2	2.00			Stiff becoming soft brown sandy CLAY with occasional medium sand bands and rare medium to coarse sub-angular flint gravel. RIVER TERRACE DEPOSITS	2
		2.50	PP	1.5kg/cm2					
		3.00	PP	0.5kg/cm2	3.00		Brown medium to coarse SAND. RIVER TERRACE DEPOSITS	3	
					4.00				
								End of Borehole at 4.00m	4
									5

Casing		Water Strikes (mbgl)		Chiselling (mbgl)		Remarks
Diameter	Depth (m)	Depth Strike	Rose to	Depth from	Depth to	
						Groundwater not encountered.



 Unit 7, Danworth Farm Hurstpierpoint BN6 9GL www.gesi.net		Borehole Log				Borehole No. WS5 Sheet 1 of 1	
Project Name: Cornfield Close, Littlehampton		Project No. GE17106		Co-ords: 503297E - 103274N		Hole Type WLS	
Location: Littlehampton, West Sussex				Level:		Scale 1:25	
Client: Thakeham Client				Dates: 11/04/2018		Logged By AP	

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.20			Grass overlying brown sandy clay with rare ash. MADE GROUND	
								Brown sandy CLAY. MADE GROUND	
		0.50	PP	3.0kg/cm2	0.50			Concrete. MADE GROUND	
		1.00	PP	2.0kg/cm2	0.90			Dark grey silty clay and clayey sand with frequent ash, plastic, organic material, glass and metal. MADE GROUND	
		1.50	PP	2.0kg/cm2					
		2.00	PP	0.2kg/cm2	2.30				
		2.50	PP	2.0kg/cm2				Soft becoming stiff brown sandy CLAY. RIVER TERRACE DEPOSITS	
		3.00	PP	1.8kg/cm2	3.00			Stiff brown and grey mottled sandy CLAY. RIVER TERRACE DEPOSITS	
		3.50	PP	1.5kg/cm2					
		4.00	PP	1.8kg/cm2	4.00			End of Borehole at 4.00m	

Casing		Water Strikes (mbgl)		Chiselling (mbgl)		Remarks
Diameter	Depth (m)	Depth Strike	Rose to	Depth from	Depth to	
						Groundwater not encountered.

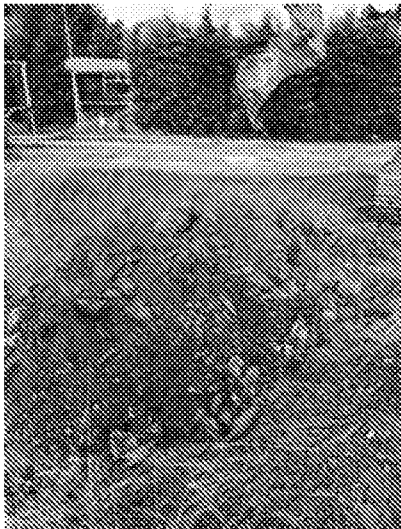


APPENDIX I

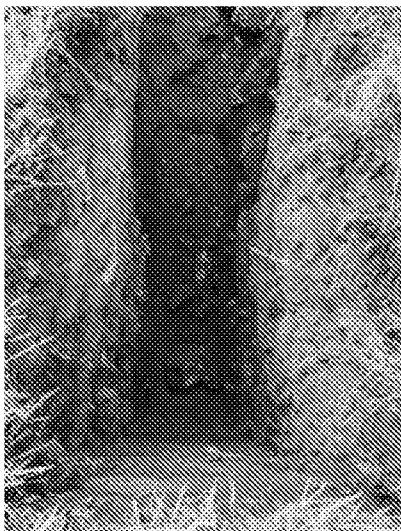
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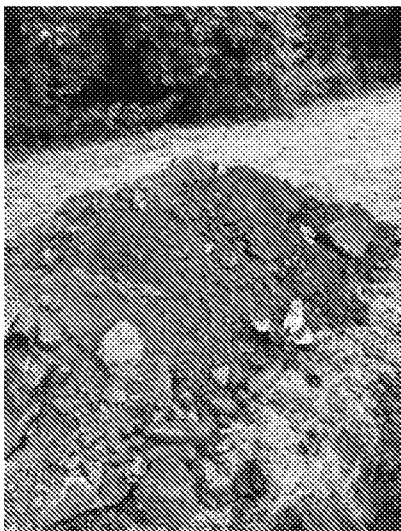
1 TP204



2 TP204 Spoil



3 TP208



4 TP208 Spoil



5 TP209



6 TP209