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PHASE 2: GROUND INVESTIGATION REPORT

THIRTEEN GROUP

PROPOSED RESIDENTIAL DEVELOPMENT

LAND AT AMBERLEY STREET & HARROGATE STREET

HENDON

SUNDERLAND

SR2 8ES

Project No: 20-794

Prepared By:

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Date: 23/07/2021 Rev. 28/04/22

Checked By:

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Date: 23/07/2021

The information and/or advice contained in this Phase 2: Ground Investigation Report is based solely on, and is limited to, the boundaries of the site, the immediate area around the site, and the historical use(s) unless otherwise stated. This 'Report' has been prepared in order to collate information relating to the physical, environmental and industrial setting of the site, and to highlight, where possible, the likely problems that might be encountered when considering the future development of this site for the proposed end use. All comments, opinions, diagrams, cross sections and/or sketches contained within the report, and/or any configuration of the findings is conjectural and given for guidance only and confirmation of the anticipated ground conditions should be considered before development proceeds. Agreement for the use or copying of this report by any Third Party must be obtained in writing from Arc Environmental Limited (ARC). If a change in the proposed land use is envisaged, then a reassessment of the site should be carried out.

CONTENTS

APPENDICES

1.0 Introduction

July 2021

As requested by Engie Regeneration, on behalf of Thirteen Group, and in conjunction with a Phase 1: Desk Top Study & Coal Mining Risk Assessment Report completed for this site by Arc Environmental Ltd (Ref. No. 20-794, March 2021), Phase 2: Ground Investigation works have been carried out on land located at Amberley Street & Harrogate Street, Sunderland, where proposals have been made to redevelop the site for residential use comprising the construction of c.103 residential dwellings with private gardens and areas of hardstanding.

The intrusive investigation works comprised the sinking of 10 no. windowless sampling boreholes (WS01 to WS10) including 3 no. ground gas / groundwater monitoring standpipes (WS01, WS04 & WS07), the excavation of 22 no. mechanically excavated trial pits (TP01 to TP22), the excavation of 3 no. mechanically excavated trial trenches (TT01 to TT03) and 3 no. Dynamic Cone Penetrometer (DCP) tests (TPA/DCPA to TPC/DCPC). The positions of the investigation locations can be seen on the Borehole and Trial Pit Location Plan, a copy of which can be seen in Appendix II. It should be noted that this plan is for orientating purposes only, as the positions shown are approximate and the plan is not to a standard scale.

2.0 Site Details

Table 2.1

N = north, S = south, E = east, W = west

Site Name & Address:	Amberley Street & Harrogate Street, Hendon, Sunderland, SR2 8ES.
National Grid Reference:	440230, 5562520 – representative for the centre of the site.
Description of Location:	The site is located off Mowbray Road within the Hendon area of Sunderland.
Site Boundaries:	N= Residential dwellings, E= Medical Centre and carpark, S = Ward Court with residential properties beyond, W = Salem Street with residential properties beyond.
Site Shape & Area:	The site is irregular in shape and occupies an approximate area of c.3.1 Hectares.
Proposed Development Details:	Proposals involve the construction c.103 residential dwellings with private gardens and areas of hardstanding.
General Topography:	No topographical survey was available at the time of writing this report. The reconnaissance (walkover) indicated that the site displays a slight fall in gradient to the south-east.
Site surfacing:	The site is mainly covered in grass surfacing although the current road / footpath infrastructure remains.
Above Ground Structures:	None present on site.
Below Ground Structures:	Relic foundations / floor slabs may be present across the site associated with the former residential dwellings recorded on site. In addition, services (i.e. drains, water, electric, gas, etc.) may be present associated with the former dwellings.

3.0 Scope of Works

Table 3.1

Client:	Thirteen Group.
Project type:	Proposed Residential Development.
Site Location plan:	See Appendix I.
Aerial Photograph:	See Appendix I.
Layout plans (existing):	See Appendix I.
Layout plans (proposed):	See Appendix I.
Investigation Works:	10 no. windowless sampling boreholes (WS01 to WS10). 3 no. ground gas / groundwater monitoring standpipes (WS01, WS04 & WS07). 22 no. mechanically excavated trial pits (TP01 to TP22). 3 no. mechanically excavated trial trenches (TT01 to TT03). 3 no. Dynamic Cone Penetrometer (DCP) tests (TPA/DCPA to TPC/DCPC)
Laboratory Testing:	Geotechnical & Ground Contamination.
CLEA End-Use Classification:	Level 1 GQRA – *Residential With Home Grown Produce.*

3.0 Scope of Works (Cont'd)

The information contained in this report is limited to the area of the proposed development, as indicated on the Existing Site Layout Plan shown in Appendix I, and to those areas accessible during the ground investigation. When considering the full scope of the development any features and / or issues not specifically mentioned in this report cannot be assumed to have been covered.

3.1 Investigation Rationale: -

This ground investigation has been designed to provide information on the general ground and groundwater conditions where access would allow, in the area of the proposed development. The boreholes and trial pits were created primarily for geotechnical purposes to assist in the design of new foundations for the proposed development with contamination screening undertaken to aid in assessing the risks to Human Health, Controlled Waters and for off site disposal. The rationale behind the location of each exploratory hole is summarised in Table 3.2 below.

Table 3.2

Potential issue	Exploratory Hole
Determine the nature of the underlying ground conditions, including shallow groundwater.	WS01 – WS10 TP01 – TP22
Determine the sites ground gas regime.	WS01, WS04 & WS07
Determine the insitu strength / density of the underlying deposits to provide characteristic design CBR values.	TPA/DCPA to TPC/DCPC
Locate potential fault on site.	TT01 to TT03
Determine the levels of contamination present within the initial deposits with a view to determining the risks posed towards the future site end-users and Controlled Waters.	WS01 – WS10 TP01 – TP22

3.2 Sampling & Site Protocols: -

All works associated with this ground contamination assessment and investigations have generally been completed in accordance with BS10175:2011 + A2:2017: British Standard Code of Practice for the Investigation of Potentially Contaminated Sites (2011) & Environment Agency (EA) Land Contamination Risk Management (LCRM), October 2020, which superseded CLR11, with the following precautions specific to this project.

3.2.1 Contamination Sampling: -

Samples were recovered by a representative of ARC Environmental Ltd. during the intrusive investigation works. All samples were stored at approximately 2°C - 8°C using cool boxes and ice packs prior to delivery to a UKAS / MCERTS accredited laboratory. Sampling was carried out in accordance with 'Technical Policy Statement 63: UKAS Policy on Deviating Samples'.

3.2.2 Onsite Health & Safety Requirements: -

All site representatives wore relevant and appropriate PPE including (where appropriate) safety footwear, high visibility jacket/vest, hard hat, eye protection and overalls. In addition, disposable latex gloves were used when handling any potentially contaminated materials and when rinsing all sampling tools. Each site vehicle contained a suitable First Aid kit with hand wash station/cleansing products (i.e. sanitary wipes).

3.2.3 Avoiding Cross-Contamination between Sample Locations: -

To avoid cross-contamination of materials between soil horizons, drill casing was used to seal off the made ground. In addition, disposable plastic liners were used to collect samples from the windowless sampling boreholes carried out. With regards to the trial pits, the samples were recovered manually using dedicated

disposable plastic gloves, replaced between each sample recovery with the equipment being cleaned between each investigation position.

4.0 Ground Conditions

For an accurate description of the ground conditions encountered at each investigation position, reference should be made to the borehole and trial pit logs in Appendix II. It should be noted that there is always the possibility of variation in the ground conditions around and between the excavation locations. A UXO engineer was present during the investigation works to monitor all exploratory holes across the site.

4.1 Soil Profile: -

A summary of the soil profile for this site can be found in Table 4.1 below.

Table 4.1 bgl = Below ground level.

Type of Strata	Depths Recorded (BGL)	Description & General Comments
MADE GROUND (1 Layer Recorded):	From 0.00m up to c.0.80m and c.2.30m.	Made ground materials were encountered across the site and comprised grass overlying dark brown sandy gravelly clayey soil (Layer A). Anthropogenic debris (i.e. brick, concrete, metal, etc.) was noted throughout the made ground materials.
DRIFT GEOLOGY: (Glaciolacustrine Deposits)	From 0.80m and c.2.30m to c.1.30m to c.>5.00m..	Comprising firm and stiff (medium and high strength) sandy gravelly CLAY were encountered within TP's 01 –09, 13 – 14, 16, 21, 22 and WS's 01 – 04, 06 – 08 & 10. Occasional thin bands of sand were also recorded. The remaining positions encountered solid deposits directly below the made ground materials.
SOLID GEOLOGY: (Roker Formation)	From c.1.30m to c.>3.50m	Weathered LIMESTONE becoming less weathered with depth and recovered as sandy clayey limestone gravel.

As anticipated from the historic land uses highlighted in the Phase 1: Desk Top Study & Coal Mining Risk Assessment Report produced for the site, made ground was encountered to a depth of between c.0.80m and c.2.30m and comprised 1 layer as detailed in Table 4.1 above.

There was no visual or olfactory evidence of significant or 'gross' contamination (fuel, oils or asbestos) noted on or below the site during the ground investigation works. However, occasional fragments of ash were recorded within the made ground present on site.

Based on the Trial Trenches carried out, although there was evidence of variable thicknesses to limestone deposits and variable quality of limestone potentially associated with a fault, no evidence of dissolution, fracturing, voiding or fault re-activation was noted in the area of the fault across the north eastern margin of the site. Notwithstanding, it is deemed prudent to incorporate structural measures within proposed foundations across this area.

4.2 Groundwater and Stability: -

During the investigation works, no water ingresses were noted within any of the excavations undertaken on site. Combined ground gas & groundwater monitoring wells were installed at the locations of WS01, WS04 & WS07 in order to carry out a subsequent programme of gas and groundwater monitoring. The results are discussed further in Section 5.4

However, it would be prudent to allow for the introduction of adequate groundwater control techniques, to take care of any surface water ingresses and pockets of trapped surface drainage within the made ground and natural deposits during the construction period, especially during the wetter periods of the year.

Owing to the nature of the made ground and natural drift deposits present across the development area, adequate lateral trench support will be required for excavations, to prevent trench wall collapse or over excavations, as well as to create a safe working environment, and any excavations on this site should remain open for as short a period as possible, since some of these materials may be susceptible to deterioration, if left open to the natural elements for any significant period of time. Reference to CIRIA 97 'Trenching Practice'

would be beneficial to establish a suitable means of support or battering of excavation sides during construction.

5.0 Insitu Testing

5.1 Insitu Hand Shear Vane Tests: -

Insitu hand vane tests were carried out using a portable hand vane tester (upper limit 120kN/m^2) on the natural clays encountered in the boreholes. The insitu hand vane tester takes direct readings of shear strength. Three vane sizes allow for the direct determination of undrained shear strength of extremely low to high strength clays.

The peak vane value is determined by a calibrated scale ring built into the head assembly. The cross handle/dial is used both to push the vane to the desired test depth and apply the shearing torque. The results are summarised in Table 5.1 below and can also be found adjacent to the appropriate sample level, on the graphic borehole & trial pit record sheets in Appendix II.

Table 5.1

Type of Strata	Range of Shear Strength Values (kN/m^2)	Result Details
SANDY GRAVELLY CLAY	40kN/m^2 to 120kN/m^2	Medium & high strength deposits

5.2 Insitu Standard Penetration Tests: -

Insitu standard penetration tests (SPT's) were carried out on the natural drift and solid geological deposits encountered within the boreholes, to determine their density / relative strength using a normal split spoon sampler. The results are shown as uncorrected 'N' values on the graphic borehole record sheets (Appendix II), adjacent to the appropriate sample level, and are also summarised in Tables 5.2 below.

Table 5.2

Type of strata	Range of SPT 'N' Values	Density / Strength
DRIFT GEOLOGY: (Glaciolacustrine Deposits)	5 - 14	Indicative of firm and stiff deposits.
SOLID GEOLOGY: (Roker Formation)	17 & 50 - 75 Blows for limited penetration	Indicative of medium dense and dense deposits.

5.3 Insitu TRL Dynamic Cone Penetrometer Tests: -

In total, 3 no. Dynamic Cone Penetrometer (DCP) tests were undertaken directly below the existing access roads to determine the insitu strength / density of the underlying deposits to provide characteristic design CBR values.

The DCP uses an 8kg hammer dropping through a height of 575mm to penetrate a 60° cone (20mm Ø) into the underlying ground. Readings are taken following a set number of blows or change in strength / density to determine the penetration of the cone. The DCP field results are analysed using the UK DCP 3.1 software package to calculate the thickness and strength / density of differing layers. The calculated results provided comprise penetration rates (mm/blow) and CBR values (%). The DCP test results, including a graphical representation, can be seen within the DCP test reports attached, and a summary of the results of the tests undertaken can be seen in Table 5.3 below.

Table 5.3 Bcgl's = Below current ground levels, MG = Made Ground, NS = Natural Strata.

Position	Strata	Depth to base of test (mm bcgl's) / Layer Thickness (mm)	Penetration Indices (mm/blow)	CBR Value over test depth (%)
DCPA	MG	350 / 110	2.69	106
DCPA	NS	970 / 530	35.00 – 77.50	3 – 7
DCPB	MG	875 / 655	1.20 – 14.64	18 – 249

DCPC	MG	495 / 215	15.00 – 35.00	1 – 17
DCPC	NS	770 / 275	1.18 – 4.55	61 – 253

5.0 Insitu Testing (Cont'd)

5.3 Insitu TRL Dynamic Cone Penetrometer Tests (Cont'd): -

A summary of the DCP tests results is as follows: -

- CBR values ranging from 1% to 249% have been recorded for the initial made ground.
- CBR values ranging from 3% to 253% have been recorded for the initial made ground

When considering the higher CBR values noted, it is felt that these have been influenced by the coarse nature of the materials tested and occasional presence of cobbles. Therefore, if the existing road infrastructure is to be used within the proposed development a conservative design CBR value of 4% should be taken the existing subbase whilst a design CBR value of 4% taken for the initial natural drift deposits.

5.4 Insitu Gas & Water Monitoring: -

When considering the areas of infilled land within a plausible distance to the site (as identified within the Phase 1: Desk Top Study previously completed for this site), ground gas & water monitoring standpipes were installed within WS01, WS04 & WS07, primarily to check for the possible presence of hazardous ground gases, and to monitor any shallow water levels. A standard 50mm diameter HDPE standpipe, with gravel and geo-wrap surround, bentonite seal, gas valve cap and security cover, was installed within each borehole, and ground gas and water levels were allowed to reach equilibrium, prior to the first monitoring visit. Monitoring was undertaken using a Gas Data GFM series soil gas analysers, with integral flow meter, and a Geotechnical Instruments electronic dipmeter. The response zones were designed to target any ground gas from on and off site sources.

Based on the DTS and findings of the intrusive investigation works, in accordance with CIRIA Report C665, November 2007, Report Edition No. 04, March 2007 and BS8485:2015+A1 2019 – Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings, it is felt that an adequate risk assessment can be undertaken based on the following limiting factors:

- The development has been considered as **high sensitivity** i.e. residential type development (Tables 5.5a & 5.5b – Typical/Idealised frequency and period of monitoring, after Wilson et al, 2005).
- The risk associated with the generation potential of a source is considered as **very low** (Based on the findings of intrusive works).
- Monitoring over a **minimum** of **three months** with **six recorded** readings (Tables 5.5a & 5.5b – Typical /idealised frequency and period of monitoring after Wilson et al, 2005).
- **Negligible** flow rates are recorded during the monitoring period (Table 8.5 – Modified Wilson & Card classification).
- A targeted and phased programme of gas monitoring will be completed, which will obtain gas monitoring readings during varying atmospheric conditions, which covers the 'worst case' scenario for ground gas emissions to occur, particularly during rapid falls in atmospheric pressure (i.e. from c.1020mb and c.1010mb), and also during low atmospheric pressure events (i.e. c.1000mb and below).

For this site, the monitoring visits undertaken to date were taken during variable atmospheric pressure trends. Proposed monitoring visits will also be undertaken at variable atmospheric pressure trends to correlate with differing conditions. Monitoring of the weather conditions and predicated atmospheric pressures (Met Office Surface Pressure Charts) will be carried out up to 72 hours in advance of proposed monitoring visits, in order that a reasonable period of data is obtained to determine atmospheric trends, and also to target the 'worst case' scenario.

5.0 Insitu Testing (Cont'd)

5.4 Insitu Gas & Water Monitoring (Cont'd): -

A summary of the results for the visits undertaken to date, compared with the 'inert' background gas levels is presented in Table 5.4 below, whilst a copy of the monitoring certificate is attached in Appendix III. A further three monitoring visits have been scheduled and the results along with the final recommendations will be issued as an addendum report.

Table 5.3

Position	Date	Atmospheric Pressure (mbar)	Water (m bgl)	CH4 (%v/v)	LEL (%v/v)	CO2 (%v/v)	O2 (%v/v)	Flow Rate (l/hr)
Background				0	0	0	21.0	<0.1
WS01	02/06/21	997 Falling	Dry	0.0	0.0	1.8	17.8	<0.1
WS04			Dry	0.0	0.0	0.4	18.4	<0.1
WS07			Dry	0.0	0.0	3.1	17.9	<0.1
WS01	16/06/21	999 Steady	Dry	0.0	0.0	2.8	16.7	<0.1
WS04			Dry	0.0	0.0	1.2	17.5	<0.1
WS07			Dry	0.0	0.0	3.4	18.5	<0.1
WS01	09/07/21	1011 Rising	Dry	0.0	0.0	2.9	15.1	<0.1
WS04			Dry	0.0	0.0	0.9	17.6	<0.1
WS07			Dry	0.0	0.0	3.8	16.5	<0.1
3 no. outstanding visits to be completed – results to follow as Addendum Letter Report.								

* Note – Atmospheric trend taken from www.weatheronline.co.uk for Newcastle International. Airport.

From the results undertaken to date, no levels of Methane (CH_4) have been recorded during the monitoring period. However, detectible concentrations of Carbon Dioxide (CO_2) have been recorded, up to a maximum recorded level of 3.8% *v/v*, with associated oxygen (O_2) concentrations (minimum 15.1% *v/v)*. A negligible flow rate of <0.1l/hr has been recorded during the monitoring period undertaken to date.

Based on the results undertaken to date, in accordance with CIRIA Report C665, an initial risk assessment has been completed for this site, by converting the results in Table 5.3 above to a gas screening value (GSV), calculated by multiplying the typical maximum gas concentrations with the recorded maximum positive flow rates (after Wilson & Card). Using the maximum values recorded, as no increased levels of Methane have been recorded, the GSV for Carbon Dioxide only has been calculated, the results of which are shown below:

Carbon Dioxide GSV = 0.038 (3.8%) x 0.1 = 0.0038 l/hr

When considering these results, in accordance with CIRIA C665, and considering the NHBC Traffic light system (low rise housing with ventilated underfloor void), the GSV value for CO_2 is below the assessment GSV of 0.78 l/hr (Green classification), resulting in no gas protection measures being required. Alternatively, if the proposed development were to comprise ground bearing floor slabs within the structures, in accordance with CIRIA C665, the GSV for CO_2 would also fall below the lower target concentration of 0.07l/hr and would equate to a Characteristic Situation 1 (CS1) site classification, resulting in no gas protective measures being required for the proposed development.

However, following completion of the remaining 3 no. gas monitoring visits, a final assessment of these results and recommendations will follow as an addendum to this report.

No water levels have been recorded within the monitoring wells installed on site.

Notwithstanding, it is considered prudent to allow for the introduction of temporary groundwater control techniques (i.e. pumping equipment), in order to take care of any localised ingresses of surface water which

may occur, during the construction period, especially if construction takes place during the wetter periods of the year.

6.0 Laboratory Testing

All geotechnical testing was carried out in accordance with BS1377:1990: Parts 1-9 by Professional Soils Laboratory Limited (PSL) of Doncaster, South Yorkshire (UKAS accredited). Ground contamination was undertaken by Chemtech Environmental of Stanley, Co. Durham (UKAS & MCERTS accredited).

6.1 Determination of pH & SO_4: -

Forty-two samples including samples of the made ground and natural material recovered from the investigation were tested to determine their pH value and soluble sulphate (SO_4) levels. The results are shown in Table 6.1 below, and are also contained in the Chemtech Environmental Limited Analytical Report (ref. no.: 96936(1)), a copy of which can be seen in Appendix IV.

Table 6.1

Position	Depth (m)	Strata	SO_4 (mg/l)	pH value	Design SO_4 Class	ACEC Class
TP01	0.80	MG	100	8.0	DS-1	AC-1
TP01	2.40	NS	124	8.0	DS-1	AC-1
TP02	0.60	MG	87	8.2	DS-1	AC-1
TP03	0.50	MG	356	8.1	DS-1	AC-1
TP03	1.00	NS	167	8.0	DS-1	AC-1
TP04	1.00	MG	108	8.0	DS-1	AC-1
TP05	0.75	MG	31	8.4	DS-1	AC-1
TP06	0.60	MG	44	8.6	DS-1	AC-1
TP07	0.90	MG	591	9.1	DS-2	AC-2
TP07	2.50	NS	190	8.3	DS-1	AC-1
TP08	1.20	MG	1230	8.5	DS-2	AC-2
TP08	1.80	NS	581	8.1	DS-2	AC-2
TP09	1.00	MG	1601	7.9	DS-3	AC-3
TP10	0.80	MG	361	8.4	DS-1	AC-1
TP11	0.30	MG	96	8.5	DS-1	AC-1
TP11	1.30	NS	90	8.8	DS-1	AC-1
TP12	1.50	MG	1643	8.2	DS-3	AC-3
TP13	0.60	MG	106	8.4	DS-1	AC-1
TP14	0.30	MG	21	8.1	DS-1	AC-1
TP14	1.50	NS	81	8.8	DS-1	AC-1
TP15	1.00	MG	220	8.6	DS-1	AC-1
TP16	0.30-0.50	MG	1600	8.2	DS-3	AC-3
TP17	0.80-1.00	MG	370	8.5	DS-1	AC-1
TP17	2.00-2.20	NS	557	8.6	DS-2	AC-2
TP18	0.60-0.80	MG	73	8.3	DS-1	AC-1
TP18	1.40-1.60	NS	13	8.5	DS-1	AC-1
TP19	0.00-0.25	MG	56	8.5	DS-1	AC-1
TP20	0.70-0.90	MG	529	8.2	DS-2	AC-2
TP20	1.30-1.50	NS	70	8.7	DS-1	AC-1
TP21	0.70	MG	119	8.2	DS-1	AC-1
TP22	0.60	MG	66	8.2	DS-1	AC-1
TT01	1.00	MG	1495	8.0	DS-2	AC-2
TT02	0.75	MG	1646	8.0	DS-3	AC-3
WS02	1.05-1.20	NS	206	8.3	DS-1	AC-1
WS04	2.00-2.75	NS	368	8.6	DS-1	AC-1
WS05	1.40	NS	155	8.5	DS-1	AC-1
WS06	1.02-1.20	NS	192	8.5	DS-1	AC-1
WS07	1.50-2.00	NS	158	8.6	DS-1	AC-1
WS08	0.21-0.47	MG	1623	8.1	DS-3	AC-3
WS08	0.85-1.30	NS	1581	8.1	DS-3	AC-3

WS09	1.30	NS	139	8.7	DS-1	AC-1
WS10	1.90-2.41	NS	36	8.9	DS-1	AC-1

MG = Made Ground, NS = Natural Strata, ACEC = Aggressive Chemical Environment for Concrete site classification

6.0 Laboratory Testing (Cont'd)

6.1 Determination of pH & SO_4 (Cont'd): -

Based on the results obtained, and based on the mean of the highest 20% results, the site should be given a classification of Class DS-3, in accordance with BRE Special Digest 1: 2005 (3rd Edition) and the procedures for determining Sulphate Classification for brownfield locations. When considering the pH values of the materials tested, and assuming potentially mobile groundwater, the assessment of the Aggressive Chemical Environment for Concrete (ACEC) for the site is AC-3.

6.2 Determination of Liquid & Plastic Limits: -

Seven representative samples of the natural clay deposits recovered from across the site, were tested in order to determine their liquid and plastic limits, so these materials could be classified. The results can be seen in Table 6.2 below, and are also contained in the PSL Report no. PSL21/4520, a copy of which can be found in Appendix IV.

Table 6.2

Position	Depth (m)	M/C	LL	PL	PI	Class	% Passing 425µm Sieve
WS01	1.20-1.40	21	40	20	20	CI	92
WS06	1.40	19	46	22	24	CI	94
WS10	1.20	21	45	22	23	CI	93
TP05	1.80	20	47	23	24	CI	93
TP16	1.00-1.20	15	37	18	19	CI	94
TP21	1.50	18	43	21	22	CI	94
TP22	1.50	20	41	20	21	CI	93

M/C = Moisture Content (%), LL = Liquid Limit (%), PL = Plastic Limit (%), PI = Plasticity Index (%), CI = Clay Intermediate.

From these results the deposits tested are inorganic in nature, and when plotted on the plasticity chart, falls within the intermediate plasticity range, and from the resulting plasticity indices, have a low to moderate volume change potential, when taking into account the amount passing the 425µm sieve. Subsequently, the natural materials may undergo some changes in volume, if large changes in their natural moisture content were to occur due to seasonal variations or the like, and if new foundations were to be based within these materials, they would need to be taken down to a minimum depth of 0.90m below finished ground levels.

When considering the above, an increase in this minimum depth will be required where increased depths of made ground/fill and variable strength natural deposits are identified below the site. In addition, should the proposed building extend close to existing vegetation, an increase in the minimum foundation depth may also be required, even if trees are to be removed, to ensure no additional future shrinkage and swelling of these materials occurs. Reference should be made to BS5837:2012, "Trees in relation to design, demolition and construction" along with the NHBC Standards, 'Building near trees'.

6.3 Determination of Particle Size Distribution: -

Representative samples of the natural coarse deposits were tested in order to determine their particle size distribution (PSD) so that these materials can be classified. The results of the tests are represented both numerically and graphically on the analytical result sheets (Ref. PSL21/4520), copies of which are attached in Appendix IV and are also summarised in Table 6.3 below.

Table 6.3 Particle fractions expressed as %

Position	Depth (m)	Clay / Silt Fraction	Sand Fraction	Gravel Fraction	Cobble Fraction	Grading Characteristics	Brief Soil Description

WS04	1.20-2.00	4	5	91	0	Poorly	Sandy silty GRAVEL
TP06	2.00	24	60	16	0	Poorly	Gravelly clayey silty SAND
TP15	2.20	22	7	41	30	Poorly	Sandy silty cobbly GRAVEL

6.0 Laboratory Testing (Cont'd)

6.3 Determination of Particle Size Distribution (Cont'd): -

From the results of the grading analysis, it can be seen that the samples tested are generally poorly graded with the laboratory results/descriptions generally corresponding with the field descriptions of this material.

6.4 Contamination Screening: -

Representative samples (25 no.) of the 1 layer of made ground materials encountered within the trial pits and boreholes were passed onto Chemtech Environmental Ltd of Stanley, Co. Durham so that soil contamination screening could be carried out. The results of all the testing can be found in the Chemtech Analytical Report (ref. no.: 96936(1)), a copy of which can be found in Appendix IV.

Representative samples were screened using a standard generic contamination suite (based on the current CLEA SGV listed analytes with historical additions) which is used to assess typical made ground (disturbed natural strata mixed with anthropogenic debris) of an unknown source.

Although no olfactory or visual evidence of gross contamination was encountered during the site investigation works, given the historic uses across the site and the occasional fragments of ash noted within the made ground, for completeness, speciated PAH, speciated TPH, BTEX and asbestos testing was also undertaken.

No visual evidence of PCB contamination was noted in the exploratory holes around the existing substation on the northern portion of the site therefore, PCB testing was not undertaken.

Owing to the lack of water ingresses during the investigation works within the exploratory holes undertaken on site, eight soil samples have also been subjected to leachate testing.

The contamination results have been used to carryout Level 1 Quantitative Human Health and Controlled Waters Risk Assessment for the ground contamination present and are discussed in Section 7.0.

The total analysis carried out is summarised below:

6.4.1 Soils: -

- 25 no. soil samples screened for a generic (metals and inorganics) soil suite which includes the following determinants; Arsenic, Cadmium, Chromium (III & VI), Copper, Lead, Mercury, Nickel, Selenium, Zinc, Cyanide, pH, and Total Organic Carbon (TOC).
- 25 no. soil samples screened for Speciated Polycyclic Aromatic Hydrocarbons (PAH's) – based on the current USEPA 16 PAH's + Benzo(j)fluoranthene.
- 25 no. soil samples screened for Speciated Total Petroleum Hydrocarbons (Aliphatic / Aromatic + BTEX).
- 25 no. soil samples for asbestos.

6.4.2 Leachate: -

- 8 no. soil samples screened for a generic (metals and inorganics) soil suite which includes the following determinants; Arsenic, Cadmium, Chromium (III & VI), Copper, Lead, Mercury, Nickel, Selenium, Zinc, Cyanide, pH, and Total Organic Carbon (TOC).
- 8 no. soil samples screened for speciated Polycyclic Aromatic Hydrocarbons (PAH's) – based on the current USEPA 16.

- 8 no. soil samples screened for speciated Total Petroleum Hydrocarbons (Aliphatic / Aromatic + BTEX).

7.0 Ground Contamination Risk Assessment

7.1 Methodology: -

Following completion of the contamination screening undertaken on various samples recovered from the boreholes and trial pits, a Level 1 generic quantitative ground contamination risk assessment has been undertaken, generally in accordance with Environment Agency (EA) Land Contamination Risk Management (LCRM), October 2020, which superseded CLR11: Model Procedures for the Management of Land.

This quantitative ground contamination risk assessment uses the current UK practice for assessing the risks from land contamination, which is based on the established *source-pathway-receptor* pollutant linkage methodology and 'suitable for use' approach (Part IIA, EPA 1990 - inserted through Section 57 EA 1995).

Based on the Revised Conceptual Site Model (CSM) for this site (described further in the following Section 7.2), a site-specific screening strategy for the site has been developed (see Section 7.3) and the risks from potential contaminants has been assessed for Human Health and Controlled Waters. The results of the risk assessments can be found in Sections 7.4 (Human Health) and 7.5 (Controlled Waters).

7.2 Revised Conceptual Site Model (CSM): -

Following the results of the intrusive investigation works, a Revised Conceptual Site Model (CSM) has been developed for this site, and is represented graphically in Appendix V. In addition, Table 7.1 below summarises the *source(s)*, *pathways* and potentially sensitive *receptors* for this site, assuming no remediation, additional protection measures and/or removal of the sources contamination takes place.

Table 7.2

	Sources (S)		***Pathways (P)***		***Receptors (R)***
S1	Made ground deposits associated with the construction and demolition of the previous buildings on site and also historical site use – **Recorded to a depth of between c.0.80m and c.2.30m.**	P1	Ingestion & Dermal Contact	R1	Human health (End users and construction workforce)
		P2	Air – Inhalation of Vapour and Direct Contact with Dust	R2	Groundwater anticipated at depth within the solid geology (Principal Aquifer).
S2	Potential for localised 'hot spots' of PCB contamination associated with the electricity Substation on the northern portion of the site – **No visible evidence of PCB contamination recorded.**	P3	Plant Uptake & attached soil	R3	Building materials & protection of water pipes*.
		P4	Migration through services	R4	Adjacent sites
S3	Potential hazardous ground gas migration associated with off-site sources (infilled land) – **No elevated readings recorded to date**	P5	Surface runoff & Infiltration	R5	Flora and fauna
		P6	Direct contact with building materials		

* = Not included in the Human Health & Controlled Waters Risk Assessment

7.2.1 Sources: -

The investigation and this model have identified the potential for land contamination to exist on this site, comprising made ground materials. One layer of made ground has been encountered across the site as detailed in Table 7.1 below;

Table 7.1

Made Ground Layer	**Encountered**

	TP	WS	TT
A: Grass overlying dark brown sandy gravelly clayey soil with anthropogenic debris noted throughout (Layer A).	01 - 22	01 - 10	01 - 03

7.0 Ground Contamination Risk Assessment (Cont'd)

7.2 Revised Conceptual Site Model (CSM) (Cont'd): -

7.2.2 Pathways: -

When considering the proposed end use (*Residential With Home Grown Produce*), and without considering treatment, removal or protection measures, there are some potential plausible pathways available for direct contact, dermal contact, ingestion, inhalation, wind (dust / particulate), volatilization, and vertical and lateral transportation below the site.

Within the CLEA Risk Assessment Model for Human Health, there are 3 exposure mediums considered for on site receptors, comprising ingestion of soil containing contaminants, inhalation of contaminated dust/vapours and dermal contact, with up to 10 no. exposure pathways considered, as shown below.

1. Ingestion of soil and indoor dust 2. Consumption of home-grown produce and attached soil 3. Dermal contact (indoor) 4. Dermal contact (outdoor) 5. Inhalation of dust (indoor) 6. Inhalation of dust (outdoor) 7. Inhalation of vapour (indoor) 8. Inhalation of vapour (outdoor) 9. Oral background intake 10. Inhalation background intake.

Where the future site has hard cover and below new structures, a number of these pathways may not be available. In addition, when considering the potential pathways for leachate migration, where either hard cover and/or future surface water drainage systems are present, the potential effects of surface infiltration or contaminated surface water runoff will be greatly reduced.

Similarly, when considering the construction work force, exposure pathways through direct contact, ingestion and dust inhalation will be available during part of the construction process, and therefore adequate PPE should be provided to protect the work force during this period.

7.2.3 Receptors: -

Within the CLEA Risk Assessment Model for Human Health, the potential receptors are assessed initially on site end use, followed by a delineation of age category (i.e. child or adult), with default settings for *Residential, Allotment* and *Public Open Space (Park)* end uses based on a child aged 0 to 6 years, *Public Open Space (Residential)* based on a child aged 3 to 9 and *Commercial* end uses based upon an adult working exposure period of up to 49 years (i.e. age 16 to age 65).

Key generic assumptions for *Residential* and *Public Open Space (Residential)* are based upon a typical residential property, consisting of a two-storey small terraced house, with private garden, and a *Commercial* end use based upon a typical commercial or light industrial property, consisting of a three-storey office building (pre-1970). No buildings are anticipated for *Allotment* or *Public Open Space (Park)* end uses.

Within the CLEA Risk Assessment Model for Human Health there are 6 no. generic end use categories presently in use, as follows;

1) Residential - with home grown produce, 2) Residential - without home grown produce, 3) Allotments, 4) Commercial 5) Public Open Space – Residential, 6) Public Open Space - Park

When considering the proposed end use of this site, the Level 1 Risk Assessment has taken as:

1) Residential - with home grown produce

For Controlled Waters and assuming a worst case scenario, the primary receptor for this Level 1 Risk Assessment is potential deep groundwater within the underlying solid deposits designated as a Principal Aquifer.

7.0 Ground Contamination Risk Assessment (Cont'd)

7.3 Screening Strategy: -

Representative samples of the recorded layer of made ground from across the site were screened using a standard generic contamination suite (metals, metalloids and in-organics), which is used to assess typical made ground (disturbed natural strata mixed with anthropogenic debris) of an unknown source. This made ground layer is detailed in Section 7.2.1.

There was no visual, olfactory or analytical evidence of significant heavy or gross contamination, such as waste oils, fuels, etc. or the like found across the site. However, owing to the history of the site and the occasional presence of ash within the made ground, for completeness the samples have also been screened for speciated PAH, speciated TPH, BTEX and asbestos.

No visual evidence of PCB contamination was noted in the exploratory holes around the existing substation on the northern portion of the site, so PCB testing was not undertaken.

As no olfactory or visual evidence of hydrocarbon solvent type contamination was identified across the site during the completion of the fieldworks, it was not considered necessary to undertake a Photoionization Detector meter (PID) for the presence of hydrocarbons or laboratory screening for volatile organic compounds (VOC's) or semi-volatile organic compounds (SVOC's).

To assess the risk posed from the made ground materials to Controlled Waters owing to the lack of water ingresses during the investigation works, representative soil samples of the recorded layer of made ground across the site have also been screened using a standard generic contamination leachate suite and targeted for leachable speciated PAH's & leachable speciated TPH's and BTEX.

7.4 Level 1 Generic Quantitative Risk Assessment - Human Health: -

The soil screening results from across the site have been assessed by comparing the maximum values recorded for each analyte to the critical concentration values adopted for this site i.e. based on a residential end use with home grown produce. The results of the testing are contained in Appendix IV, and the risk assessment has been summarised in Table 7.3 below and continued on the following page.

Table 7.3

Analyte	Critical Conc. (C_C)	No. of Samples Screened	Max. Conc. (C_M) Recorded	No. of Samples > C_C
Arsenic	37(1)	25	22	0
Cadmium	11(1)	25	0.6	0
Chromium III	910(1)	25	70	0
Chromium VI	6(1)	25	<1	0
Copper	2400(1)	25	72	0
Lead	200(2)	25	**843**	**11**
Mercury	40(1)	25	1.2	0
Nickel	180(1)	25	42	0
Selenium	250(1)	25	1.6	0
Zinc	3700(1)	25	260	0
Cyanide	34(3)	25	<1	0
Speciated PAH's				
Acenaphthene	510(1)	25	0.15	0
Acenaphthylene	420(1)	25	0.12	0

Anthracene	5400[1]	25	0.49	0
Benzo(a)anthracene	11[1]	25	1.15	0
Benzo(a)pyrene	2.7[1]	25	1.33	0
Benzo(b)fluoranthene	3.3[1]	25	1.63	0

[1] = LQM CIEH Suitable 4 Use Levels (S4UL Nov 2014 (Revised August 2015)) – *Residential with home grown produce* – 2.5% SOM, [2] = C4SL Values (*Residential with home grown produce*), [3] = ATRISK^{SOIL} SSV. NAD = No Asbestos Detected, **Bold** = result exceeds critical concentration, Note = All units are mg/kg.

7.0 Ground Contamination Risk Assessment (Cont'd)

7.4 Level 1 Generic Quantitative Risk Assessment - Human Health (Cont'd): -

Table 7.3 (Cont'd)

Analyte	Critical Conc. (C_C)	No. of Samples Screened	Max. Conc. (C_M) Recorded	No. of Samples > C_C
Benzo(ghi)perylene	340[1]	25	1.06	0
Benzo(k)fluoranthene	93[1]	25	0.56	0
Chrysene	22[1]	25	1.11	0
Dibenz(ah)anthracene	0.28[1]	25	0.26	0
Fluoranthene	560[1]	25	2.12	0
Fluorene	400[1]	25	0.31	0
Indeno(123cd)pyrene	36[1]	25	1.15	0
Naphthalene	5.6[1]	25	1.11	0
Phenanthrene	220[1]	25	1.69	0
Pyrene	1200[1]	25	1.76	0
Asbestos	Presence	25	NAD	0
BTEX				
Benzene	0.17(1)	25	<0.01	0
Toluene	290(1)	25	<0.01	0
Ethylbenzene	110(1)	25	<0.01	0
m & p-Xylene	130(1)	25	<0.02	0
o-Xylene	140(1)	25	<0.01	0
Speciated TPH's				
VPH Aliphatic (>C5-C6)	78(1)	25	<0.1	0
VPH Aliphatic (>C6-C8)	230(1)	25	<0.1	0
VPH Aliphatic (>C8-C10)	65(1)	25	<0.1	0
EPH Aliphatic (>C10-C12)	330(1)	25	5	0
EPH Aliphatic (>C12-C16)	2400(1)	25	7	0
EPH Aliphatic (>C16-C35)	92000(1)	25	119	0
EPH Aliphatic (>C35-C44)	92000(1)	25	92	0
VPH Aromatic (>EC5-EC7)	140(1)	25	<0.01	0
VPH Aromatic (>EC7-EC8)	290(1)	25	<0.01	0
VPH Aromatic (>EC8-EC10)	83(1)	25	<0.01	0
EPH Aromatic (>EC10-EC12)	180(1)	25	2	0
EPH Aromatic (>EC12-EC16)	330(1)	25	<1	0
EPH Aromatic (>EC16-EC21)	540(1)	25	7	0
EPH Aromatic (>EC21-EC35)	1500(1)	25	8	0
EPH Aromatic (>EC35-EC44)	1500(1)	25	2	0

[1] = LQM CIEH Suitable 4 Use Levels (S4UL Nov 2014 (Revised August 2015)) – *Residential with home grown produce* – 2.5% SOM, [2] = C4SL Values (*Residential with home grown produce*), [3] = ATRISK^{SOIL} SSV. NAD = No Asbestos Detected, **Bold** = result exceeds critical concentration, Note = All units are mg/kg.

The results have identified the following:

- The C_M value for lead exceeds the C_C value for this site at 11 locations across the site.
- When considering these results, the made ground across the site represents a potential risk to the proposed end users and therefore either treatment, removal, protection measures and / or further risk assessment will be required.

7.5 Level 1 Generic Quantitative Risk Assessment – Controlled Waters: -

Eight soil samples from the made ground, were subjected to leachable screening for metals, metalloids, inorganics, speciated PAH, speciated TPH & BTEX. The results have been used to complete a Level 1 Risk Assessment for the potential impact on Controlled Waters. The results are summarised in Table 7.4 on the following page.

7.0 Ground Contamination Risk Assessment (Cont'd)

7.5 Level 1 Generic Quantitative Risk Assessment – Controlled Waters (Cont'd): -

Table 7.4

Analyte	Target Conc. (C_T) (µg/l)	No. of Samples Screened	Max. Conc. (C_M) recorded	No. of Samples > C_T
Arsenic	10(1)	8	5.71	0
Boron	1000(1)	8	58	0
Cadmium	5(1)	8	<0.07	0
Chromium	50(1)	8	14.7	0
Copper	2000(1)	8	6.1	0
Lead	25-10(1)	8	14.8	0
Mercury	1(1)	8	0.039	0
Nickel	20(1)	8	<0.5	0
Selenium	10(1)	8	0.64	0
Zinc	5000(1)	8	4	0
Sulphate	250mg/l(1)	8	**1099**	**1**
Cyanide	50(1)	8	<20	0
Speciated PAH's				
Acenaphthene	0.1(1)	8	**0.9**	**8**
Acenaphthylene	0.1(1)	8	<0.1	0
Anthracene	0.1(1)	8	**0.5**	**7**
Benzo(a)anthracene	0.1(1)	8	**0.3**	**1**
Benzo(a)pyrene	0.01(1)	8	<0.1	0
Benzo(b)fluoranthene	0.1(1)	8	<0.1	0
Benzo(ghi)perylene	0.1(1)	8	<0.1	0
Benzo(k)fluoranthene	0.1(1)	8	<0.1	0
Chrysene	0.1(1)	8	0.1	0
Dibenz(ah)anthracene	0.1(1)	8	<0.1	0
Fluoranthene	0.1(1)	8	**0.2**	**5**
Fluorene	0.1(1)	8	**1.0**	**8**
Indeno(123cd)pyrene	0.1(1)	8	<0.1	0
Naphthalene	0.1(1)	8	0.5	0
Phenanthrene	0.1(1)	8	**2.4**	**8**
Pyrene	0.1(1)	8	**0.2**	**1**
BTEX				
Benzene	1(1)	8	<1	0
Toluene	50(2)	8	<1	0
Ethylbenzene	300(3)	8	<1	0
m & p-Xylene	30(2)	8	<1	0
o-Xylene	30(2)	8	<1	0
Speciated TPH's				
VPH Aliphatic (>C5-C6)	10(1)	8	<1	0
VPH Aliphatic (>C6-C8)	10(1)	8	<1	0
VPH Aliphatic (>C8-C10)	10(1)	8	<1	0
EPH Aliphatic (>C10-C12)	10(1)	8	<1	0
EPH Aliphatic (>C12-C16)	10(1)	8	3	0
EPH Aliphatic (>C16-C35)	10(1)	8	**29**	**8**
EPH Aliphatic (>C35-C44)	10(1)	8	<1	0
VPH Aromatic (>EC5-EC7)	10(1)	8	<1	0
VPH Aromatic (>EC7-EC8)	10(1)	8	<1	0
VPH Aromatic (>EC8-EC10)	10(1)	8	<1	0
EPH Aromatic (>EC10-EC12)	10(1)	8	1	0
EPH Aromatic (>EC12-EC16)	10(1)	8	3	0

EPH Aromatic (>EC16-EC21)	10(1)	8	4	0
EPH Aromatic (>EC21-EC35)	10(1)	8	<1	0
EPH Aromatic (>EC35-EC44)	10(1)	8	<1	0

(1) = UK Drinking Standard, (2) = EQS Freshwater, (3) = WHO Health. **Bold** = result exceeds target concentration, Note = All units are µg/l unless stated.

7.0 Ground Contamination Risk Assessment (Cont'd)

7.5 Level 1 Generic Quantitative Risk Assessment – Controlled Waters (Cont'd): -

The results have identified the following:

- The Maximum Concentration (C_M) values for sulphate, several speciated PAHs and TPH Aliphatic (C16-C35) are recorded to slightly exceed the Target Concentration (C_T) values taken for this site.

The following hydrogeological and hydrological issues have been taken into consideration when assessing the risks towards the Controlled Waters;

- A continuous groundwater surface (water table) is anticipated at depth within the solid deposits.
- There are no Source Protection Zones (SPZs) recorded on or within 1km of the site.
- There are no Water Abstractions recorded on site or within 500m of the site.
- There are no surface water features within c.250m of the site.

When taking into account the above, the site setting, the proposed end use and based on the leachate screening results, the risk to Controlled Waters is deemed to be negligible and therefore no further risk assessment is required in this regard. Furthermore, remedial works across the site will further reduce the risk.

7.6 Waste Disposal Classification: -

The made ground materials encountered on this site, and which may have to be discarded as a waste to landfill, have been assessed using Technical Guidance WM3 'Guidance on the classification and assessment of Waste' (Version 1.1), in conjunction with the on-line waste classification software tool HazWasteOnline™. Each sample has been assessed separately in order to determine whether all the made ground can be considered as a single waste stream or whether different areas of the made ground represent separate waste streams.

Based on the physical (visual and olfactory) inspection of the all the samples, the made ground has been initially assessed as either 17 05 03 (waste soil and stones containing hazardous substances) or 17 05 04 (waste soil and stones other than those mentioned in 17 05 03) from the WM3 List of Waste (LoW).

In order to determine which waste code applies to each sample, the results of the laboratory testing have been assessed using the HazWasteOnline™ software. The results of this assessment are summarised in Table 7.5 on below and continued on the following page, with the full Waste Classification Report attached in Appendix VI.

Table 7.5

Position	Depth (m)	WM3 Waste Classification	Waste Code
TP01	0.80	Non-Hazardous	17 05 04
TP02	0.60	Non-Hazardous	17 05 04
TP03	0.50	Non-Hazardous	17 05 04
TP04	1.00	Non-Hazardous	17 05 04
TP05	0.75	Non-Hazardous	17 05 04
TP06	0.60	Non-Hazardous	17 05 04
TP07	0.90	Non-Hazardous	17 05 04

TP08	1.20	Non-Hazardous	17 05 04
TP09	1.00	Non-Hazardous	17 05 04
TP10	0.80	Non-Hazardous	17 05 04
TP11	0.30	Non-Hazardous	17 05 04

7.0 Ground Contamination Risk Assessment (Cont'd)

7.6 Waste Disposal Classification (Cont'd): -

Table 7.5 (Cont'd)

Position	Depth (m)	WM3 Waste Classification	Waste Code
TP12	1.50	Non-Hazardous	17 05 04
TP13	0.60	Non-Hazardous	17 05 04
TP14	0.30	Non-Hazardous	17 05 04
TP15	1.00	Non-Hazardous	17 05 04
TP16	0.30-0.50	Non-Hazardous	17 05 04
TP17	0.80-1.00	Non-Hazardous	17 05 04
TP18	0.60-0.80	Non-Hazardous	17 05 04
TP19	0.00-0.25	Non-Hazardous	17 05 04
TP20	0.70-0.90	Non-Hazardous	17 05 04
TP21	0.70	Non-Hazardous	17 05 04
TP22	0.60	Non-Hazardous	17 05 04
TT01	1.00	Non-Hazardous	17 05 04
TT02	0.75	Non-Hazardous	17 05 04
WS08	0.21-0.47	Non-Hazardous	17 05 04

The results of this assessment have identified that the made ground analysed can be classified as Non-Hazardous (waste code 17 05 04).

When considering the values of Total Organic Carbon (TOC) recorded for the majority of the made ground, this is unlikely to meet the Inert Waste criteria, and if these soils are to be removed from site as a waste, they are likely to have to be disposed of at a Non-Hazardous Landfill.

8.0 Conclusions & Recommendations

8.1 Ground Conditions: -

One distinct layer of made ground was identified across the site and comprised grass overlying dark brown sandy gravelly clayey soil (Layer A) with anthropogenic debris noted throughout the made ground materials to a depth of between c.0.80m and c.2.30m.

Drift deposits generally comprising firm and stiff (medium and high strength) sandy gravelly clay were encountered within TP's 01 –09, 13 – 14, 16, 21, 22 and WS's 01 – 04, 06 – 08 & 10 to a depth of between c.1.30m and c.>5.00m. Occasional thin bands of sand were also recorded. The remaining positions encountered solid deposits directly below the made ground materials.

Solid deposits comprising weathered limestone becoming less weathered with depth and recovered as sandy clayey limestone gravel were encountered from a depth of c.1.30m to in excess of c.3.50m.

8.2 Groundwater & Stability: -

During the investigation works, no water ingresses were noted within any of the excavations undertaken across the site. Furthermore, no water levels have been recorded within the monitoring wells installed on site during the monitoring visits undertaken to date.

Notwithstanding, pockets of trapped surface water should be anticipated within the made ground materials and natural drift deposits below the site and it would be prudent to allow for the introduction of suitable groundwater control measures, to take care of any water ingresses within the made ground and natural strata, particularly during the wetter periods of the year.

8.0 Conclusions & Recommendations (Cont'd)

8.2 Groundwater & Stability (Cont'd): -

Owing to the nature of the made ground and natural deposits present across the site, adequate lateral trench support will be required for excavations, to prevent trench wall collapse or over excavations, as well as to create a safe working environment, and any excavations on this site should remain open for as short a period as possible, since some of these materials may be susceptible to deterioration, if left open to the natural elements for any significant period of time. Reference to CIRIA 97 'Trenching Practice' would be beneficial to establish a suitable means of support or battering of excavation sides during construction.

8.3 Foundation Options: -

When considering the ground conditions recorded and proposed development, Table 8.1 below details the varying foundations deemed acceptable for the proposed units on site.

Table 8.1

Units	Foundation Type	Bearing strata / Depth bcgl	ABP (kN/m^2)	Comments
1-13	Traditional strip foundations and mass trench fill	Limestone / c.1.30m to c.2.00m	250	~
14-19	Traditional shallow strip foundations	Clay / c.0.90m to c.1.20m	140	~
20-34	Traditional strip foundations and mass trench fill	Limestone / c.1.10m to c.1.60m	250	Note: Additional reinforcement and a reduced bearing pressure of 150 is required for units 31 & 32 due to inferred line of structural fault
35 & 36	Traditional shallow strip foundations	Limestone / c.0.90m to c.1.00m	150	Note: Additional reinforcement is required due to inferred line of structural fault
37-68	Traditional strip foundations and mass trench fill	Limestone / c.1.05m to c.2.30m	250	Note: Additional reinforcement and a reduced bearing pressure of 150 is required for units 65 & 66 due to inferred line of structural fault
69-76	Traditional shallow strip foundations	Clay / c.0.90m to c.1.20m	80	Note: Foundation for units 69 to 72 should be widened and reinforced to consider the shallow sand layers.
77-89	Traditional strip foundations and mass trench fill	Clay / c.0.90m to c.1.60m	100	~
90-98	Traditional shallow strip foundations	Clay / Sand / 1.00m to 1.20m	75	Note: Foundation for units 90 to 98 should be widened and reinforced to consider the shallow sand layers
99-103	Traditional shallow strip foundations	Thin clay layer / 1.30m to 1.50m	150	~

From the results of the pH and soluble sulphate testing carried out, future foundations and buried concrete should be constructed using a concrete design class of DS-3 and ACEC class of AC-3.

If the existing road infrastructure is to be utilised within the proposed development, then based upon the results of these intrusive works a design CBR value of 10.0% is recommended for the existing sub-base materials where these are to be used as an undisturbed subgrade.

If any new access roads, areas of hardstanding, car parking, etc., or ground bearing slabs are to be considered without any ground improvement taking place, then based upon the results of these intrusive works a design CBR value of 2.0% is recommended for the shallow deposits where these are to be used as an undisturbed subgrade.

8.0 Conclusions & Recommendations (Cont'd)

8.3 Foundation Options (Cont'd): -

Furthermore, it is recommended that the sub-grade materials are 'proof rolled' to identify any potential 'soft spots' below this development area, and these can be dealt with by introducing an increased thickness of compacted sub-base and/or a geotextile reinforcement. In addition, it may also be prudent to allow for an engineer to attend site during the development works, to confirm the design CBR value of the materials to be utilised prior to construction (e.g. plate bearing tests or similar).

8.4 Hazardous Ground Gas Risk Assessment: -

When considering these results detailed in Section 5.4, in accordance with CIRIA C665, and considering the NHBC Traffic light system (low rise housing with ventilated underfloor void), the GSV value for CO_2 is below the assessment GSV of 0.78 l/hr (Green classification), resulting in no gas protection measures being required. Alternatively, if the proposed development were to comprise ground bearing floor slabs within the structures, in accordance with CIRIA C665, the GSV for CO_2 would also fall below the lower target concentration of 0.07l/hr and would equate to a Characteristic Situation 1 (CS1) site classification, resulting in no gas protective measures being required for the proposed development.

However, following completion of the remaining 3 no. gas monitoring visits, a final assessment of these results and recommendations will follow as an addendum to this report.

8.5 Ground Contamination: -

8.5.1 Made Ground

From the results of the contamination screening, elevated levels of Lead have been recorded within the made ground at shallow depths within eleven locations across the site. Therefore, the made ground represents a potential risk to future end users, where exposure pathways are available. As a result, it is recommended that either treatment, removal, protection measures and / or further detailed quantitative risk assessment is required, potential remedial measures available are discussed further in Section 8.6.

No asbestos fibres have been identified within the samples screened. Consequently, there is no requirement for removal, treatment, protection measures and/or further risk assessment to protect the existing end users (i.e. no risk to Human Health) from potential asbestos fibres.

8.5.2 Controlled Waters

When considering the contamination results, the levels of contaminants in the samples screened are not considered to represent a significant risk to controlled waters or adjacent sites, and as such no further treatment, removal, protection measures and/or DQRA is considered necessary in this regard.

8.5.3 General

When considering the risks to the construction workforce, adequate PPE will be required to provide protection against the levels of contaminants recorded during these investigation works. Similarly, the results can also be used by the Main Contractor / Project Coordinator, when devising an adequate Site Health & Safety Plan, in accordance with current CDM Regulations.

8.0 Conclusions & Recommendations (Cont'd)

8.6 Preliminary Remediation Statement: -

From the results of the contamination screening, elevated levels of Lead have been recorded within the made ground at shallow depths within eleven locations across the site. Therefore, the made ground on site (Layer A) represents a potential risk to future end users, where exposure pathways are available.

In this instance, depending on finished ground levels, the simplest and most expedient remedial options would be to either install a robust clean cover system below all areas of soft landscaping or to fully remove the made ground from all areas of soft landscaping.

If a robust clean cover system is the preferred remedial option, this typically comprises 600mm layer of 'clean' materials comprising 150mm topsoil and 450mm subsoil. This should be placed in all gardens and soft landscaped areas.

Where buildings and areas of hardstanding are proposed then the source-pathway-receptor pollutant linkage will not exist and the made ground can remain in-situ with no requirement to incorporate clean cover materials.

In addition, it is recommended that a 'watching brief' is put in place by the Main Contractor to ensure that any unknown or unforeseen ground contamination that might be present on this site is dealt with appropriately.

Where future remediation works are undertaken, as well as completion of the 'watching brief', confirmatory validation works should be undertaken, i.e. sampling, screening and photographic evidence, etc., and submitted to the Local Authority on completion. Similarly, if remediation works are carried out, it is recommended that a Remediation Statement / Strategy is prepared and agreed with the LA, and validated by a suitably qualified Geo-environmental Engineer to ensure that all works are completed in strict accordance with the agreed Remediation Statement / Strategy.

8.7 General Comments: -

The Phase 1: Desk Top Study Report concluded that the site is not at risk from coal mining or coal mine related activities.

For future site works, adequate lateral trench support will be required for excavations, to prevent trench wall collapse or over excavations, as well as to create a safe working environment, and any excavations on this site should remain open for as short a period as possible, since some of these materials may be susceptible to deterioration, if left open to the natural elements for any significant period of time.

With regard to asbestos in soil, where we have sampled and tested for asbestos this is discussed in the report. Whilst we would target any asbestos sampling and testing in accordance with a Conceptual Site Model and site findings, there is always the possibility, along with other contamination, that undiscovered asbestos exists

between sample locations and the possibility of unknown asbestos exists on all sites, particularly brownfield sites where previous buildings have been demolished, there were previous features that were infilled (old hollows, pits etc) or where significant quantities of materials such as demolition and brick rubble exist. It is not uncommon for historical asbestos wastes to be deliberately buried on derelict sites, or imported old demolition rubble which could contain asbestos to be imported for use as hardstanding/hardcore. Unless otherwise stated we have not assessed any above or below ground features such as existing buildings, service ducts, basements, culverts, partly demolished or dilapidated structures, spoil heaps, fly tipped materials, security bunds, etc.

8.0 Conclusions & Recommendations (Cont'd)

8.7 General Comments (Cont'd): -

It is also recommended for the development of this site, adequate surface drainage should be designed and installed by a competent contractor, to prevent surface water 'ponding' or collection, during and post construction, particularly where the existing surface drainage system is disrupted or damaged.

In addition, for deeper excavations, drainage, service runs or the like that may pass close to or beneath any existing or proposed new foundations, these should be undertaken with care and completed prior to the preparation of any new foundations, so as not to allow any loose or granular material to move or 'flow', thus causing settlement to occur to any new or adjacent old foundation based at a higher level.

An "observational technique" can be applied to the design and construction of this site, and where ground conditions seem to vary from that indicated from the conceptual ground model derived from works to date, then advice from a suitably qualified Engineer should be sought.

END OF REPORT

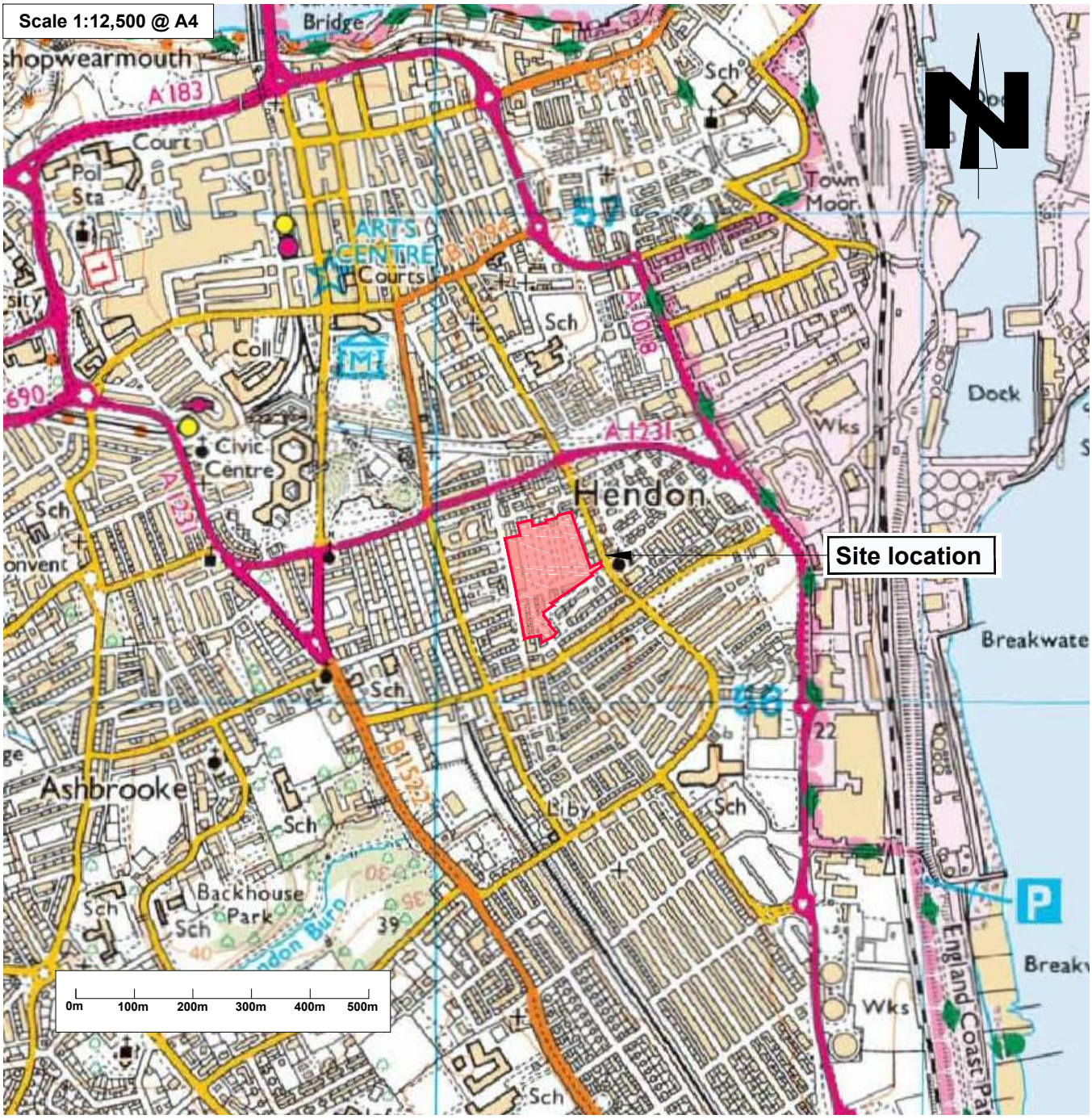
APPENDIX I

Site Location Plan

Aerial Photograph

Existing Site Layout Plan

Proposed Site Layout Plan



Client:

ENGIE REGENERATION

Project Title:	Drawing Title:
Proposed Residential Development Land at Amberley Street & Harrogate Street, Hendon, SR2 8ES	Location Plan

rev.	date	amendments	drawn	chckd

Job Reference:	Drawing Number:	Revision:
20-794	–	–

Drawn by:	Date:	Scale at A4:
P.D	30.03.21	As Shown

Checked by:	Approved by:	
D.M	D.M	The contractor shall check all dimensions on site before commencement of any works. No dimensions to be scaled off this drawing.

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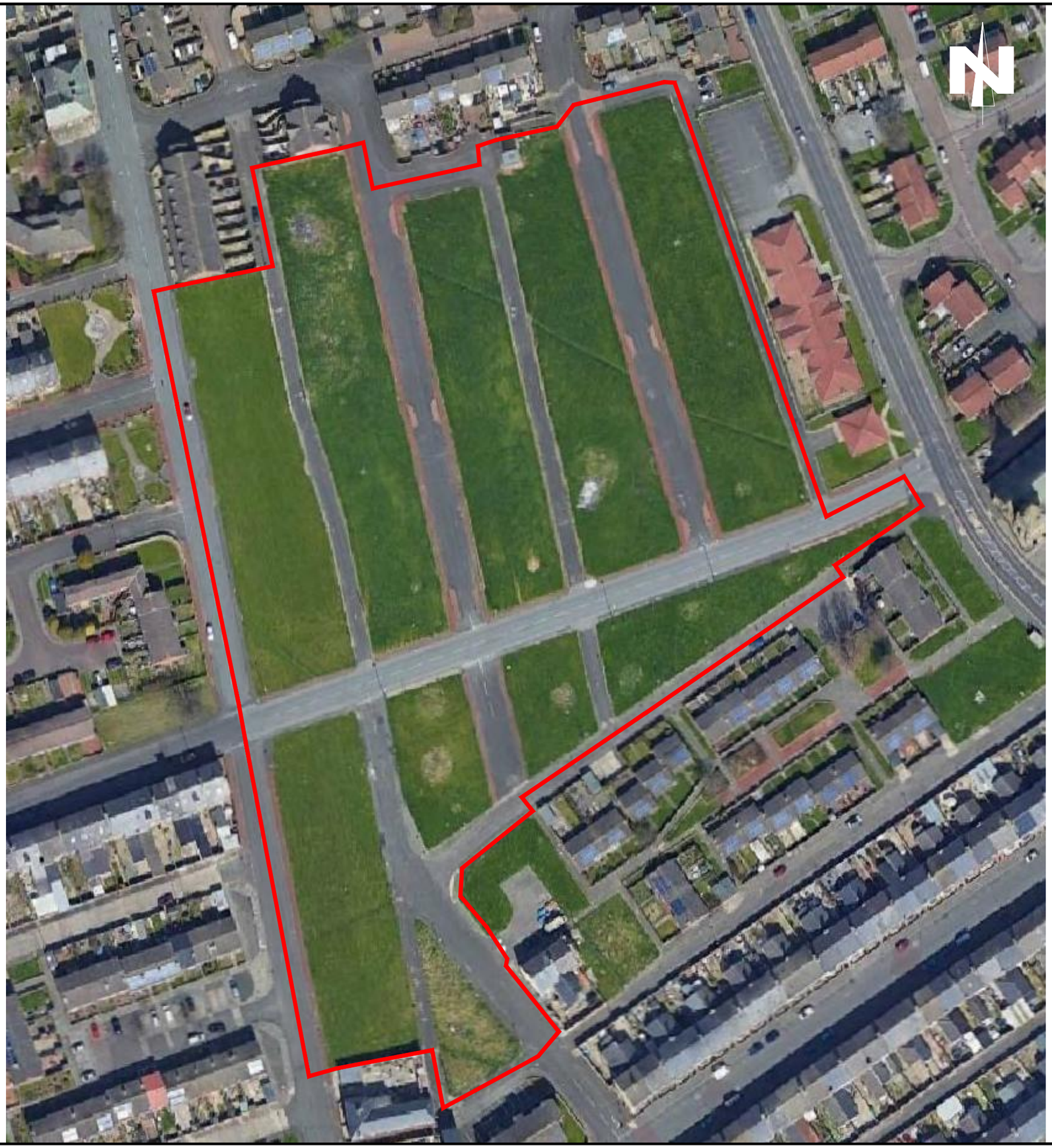

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LEGEND

	APPROXIMATE SITE BOUNDARY

rev.	date	amendments	drawn	chckd

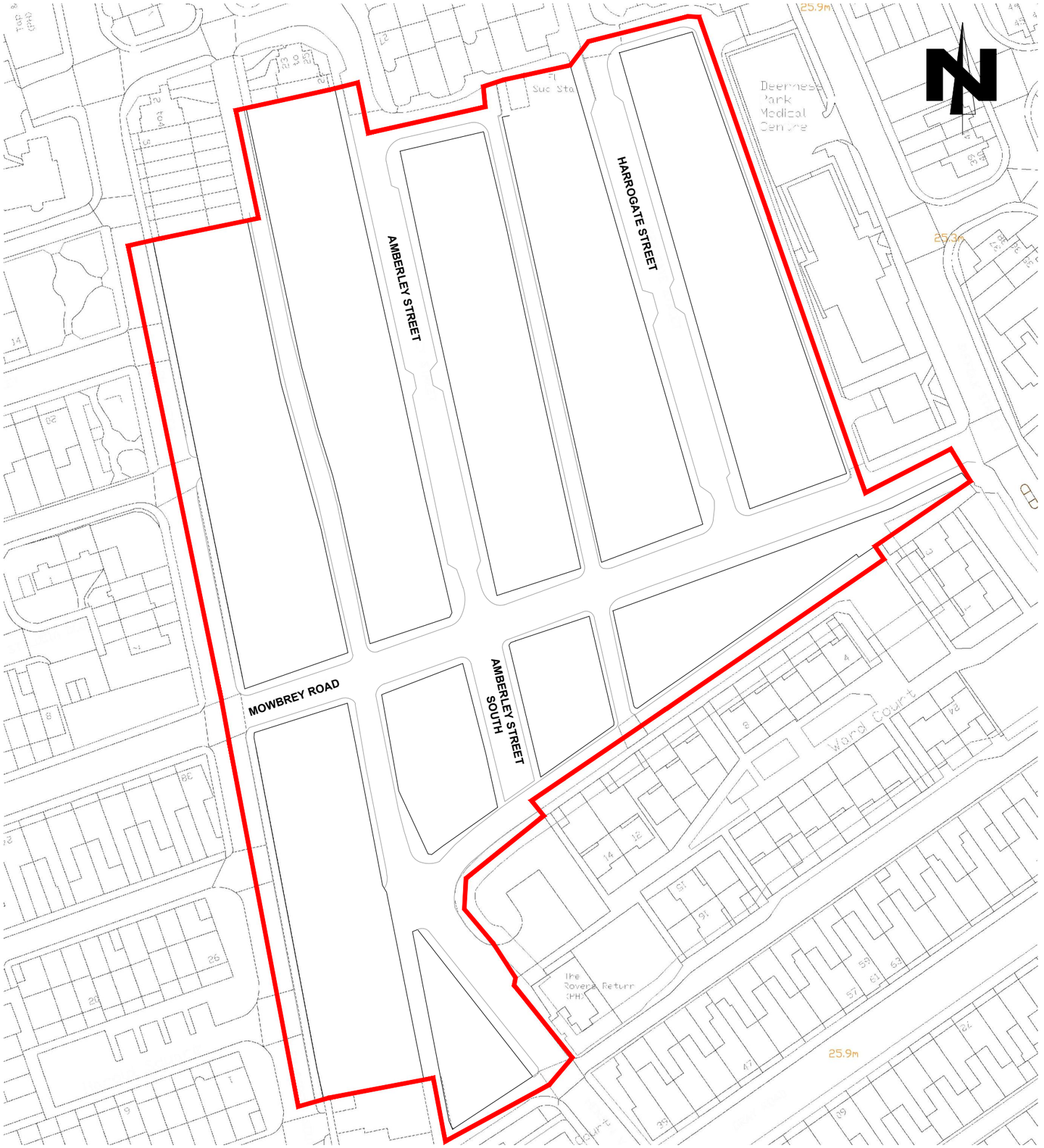
Client:
ENGIE REGENERATION

Project Title:
Proposed Residential Development
Land at Amberley Street & Harrogate Street
Hendon, Sunderland, SR2 8ES

Drawing Title:
Aerial Photograph

Scale at A3:	Date:	Drawn by:	Approved by:
NTS @ A3	30.03.21	P.D	D.M

Job Ref:	Drg no:	Rev:
20-794	–	–



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LEGEND

	APPROXIMATE SITE BOUNDARY

rev.	date	amendments	drawn	chckd

Client:
ENGIE REGENERATION

Project Title:
Proposed Residential Development
Land at Amberley Street & Harrogate Street
Hendon, Sunderland, SR2 8ES

Drawing Title:
Existing Site Layout Plan

Scale at A3:	Date:	Drawn by:	Approved by:
NTS @ A3	30.03.21	P.D	D.M

Job Ref:	Drg no:	Rev:
20-794	–	–

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LEGEND	
	APPROXIMATE SITE BOUNDARY

rev.	date	amendments	drawn	chckd
01	28.04.22	Updated Proposed Layout Added	P.D	L.J

Client:
ENGIE REGENERATION

Project Title:
Proposed Residential Development
Land at Amberley Street & Harrogate Street
Hendon, Sunderland, SR2 8ES

Drawing Title:
Proposed Development Layout Plan

Scale at A3:	Date:	Drawn by:	Approved by:
NTS @ A3	30.03.21	P.D	D.M

Job Ref:	Drg no:	Rev:
20-794	–	01

APPENDIX II

Borehole & Trial Pit Location Plan (Existing & Proposed)

Borehole & Trial Pit Record Sheets

DCP Test Reports

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LEGEND

	APPROXIMATE SITE BOUNDARY
	MECHANICALLY EXCAVATED TRIAL PIT POSITION
	WINDOWLESS SAMPLING BOREHOLE LOCATION
TT02	TRIAL TRENCH POSITION TO TARGET POTENTIAL FAULT ON SITE

rev.	date	amendments	drawn	chckd

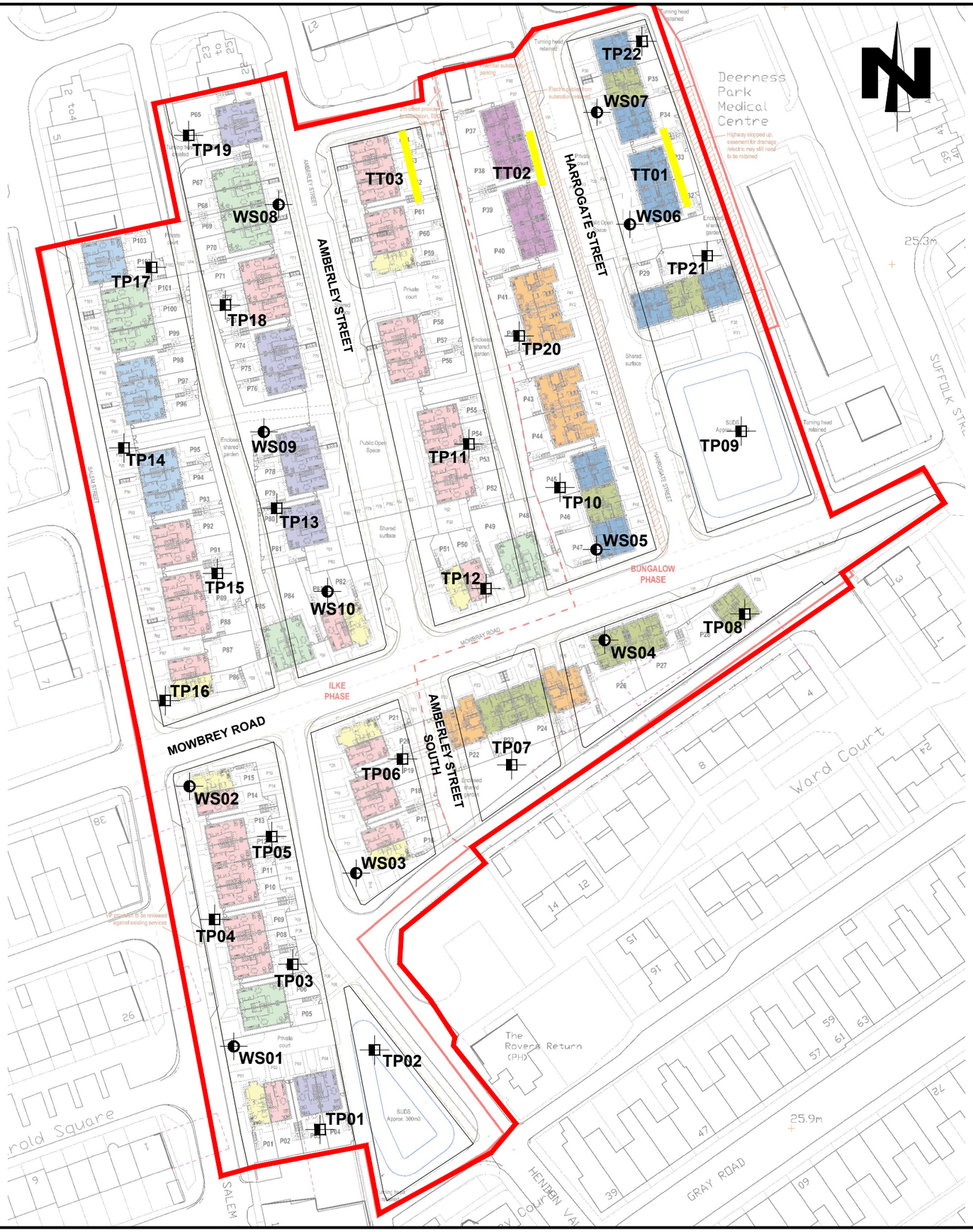
Client:
ENGIE REGENERATION

Project Title:
Proposed Residential Development
Land at Amberley Street & Harrogate Street
Hendon, Sunderland, SR2 8ES

Drawing Title:
Exploratory Hole Location Plan (Aerial)

Scale at A3:	Date:	Drawn by:	Approved by:
NTS @ A3	30.03.21	P.D	D.M

Job Ref:	Drg no:	Rev:
20-794	–	–



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LEGEND

	APPROXIMATE SITE BOUNDARY
	MECHANICALLY EXCAVATED TRIAL PIT POSITION
	WINDOWLESS SAMPLING BOREHOLE LOCATION
TT02	TRIAL TRENCH POSITION TO TARGET POTENTIAL FAULT ON SITE

rev.	date	amendments	drawn	chckd
01	28.04.22	Updated Proposed Layout Added	P.D	L.J

Client:
ENGIE REGENERATION

Project Title:
Proposed Residential Development
Land at Amberley Street & Harrogate Street
Hendon, Sunderland, SR2 8ES

Drawing Title:
Exploratory Hole Location Plan (Proposed)

Scale at A3:	Date:	Drawn by:	Approved by:
NTS @ A3	30.03.21	P.D	D.M

Job Ref:	Drg no:	Rev:
20-794	–	01

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BOREHOLE LOG

Project				BOREHOLE No
Proposed Development, Harrogate Street, Hendon				**WS01**
Job No	Date	Ground Level (m)	Co-Ordinates ()	
20-794	19-05-21			
Contractor				Sheet
Arc Environmental Limited				1 of 1

SAMPLES & TESTS			Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION		
0.00-0.35	B						Grass overlying dark brown sandy gravelly clayey soil with brick, coal, slate and some glass and wood noted (MADE GROUND).		
0.35-0.90	B					(1.20)			
0.90-1.20	B					1.20			
1.20-1.40	B						Firm grey and brown silty sandy CLAY with some fine gravel (GLACIOLACUSTRINE DEPOSITS).		
1.20-1.65	SPT	N=7				1.40			
1.40	B						Stiff (high strength) brown and grey sandy gravelly CLAY. Gravels comprise medium to coarse limestone (GLACIOLACUSTRINE DEPOSITS).		
1.60	V	76kN/m^2							
1.70-2.00	B								
2.00	V	100kN/m^2							
3.00	B								
3.00	V	120kN/m^2				(3.60)			
4.00	B								
4.00	V	120kN/m^2							
						5.00			
5.00	B						Borehole terminated at 5.00m.		
5.00	V	100kN/m^2							

Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Date	Time	Depth	Casing Depth	Casing Dia. mm	Water Dpt	From	To	Hours	From	To	Borehole remained dry on completion.

All dimensions in metres Scale 1:37.5	Client Engie	Method/ Plant Used Windowless Sampling	Logged By SW

AGS3 UK BH WS LOGS.GPJ AGS3_ALL.GDT 20/7/21

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BOREHOLE LOG

Project				BOREHOLE No
Proposed Development, Harrogate Street, Hendon				**WS02**
Job No	Date	Ground Level (m)	Co-Ordinates ()	
20-794	19-05-21			
Contractor				Sheet
Arc Environmental Limited				1 of 1

SAMPLES & TESTS			Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION		
0.00-1.05	B					(1.05) 1.05	Grass overlying dark brown sandy gravelly clayey soil with brick, concrete, limestone, coal, slate and some glass, pottery and wood noted (MADE GROUND).		
1.05-1.20	B					(0.95) 2.00	Firm brown and grey very sandy CLAY with some fine to coarse gravel (GLACIOLACUSTRINE DEPOSITS).		
1.20-1.65	SPT	N=9							
1.50	B		1						
2.00	B					(0.40) 2.40	Stiff (high strength) brown and grey sandy gravelly CLAY. Gravels comprise medium to coarse limestone (GLACIOLACUSTRINE DEPOSITS).		
2.00-2.45	SPT	N=8							
2.40-2.80	B		2			(0.40) 2.80	Firm light brown and brown silty sandy CLAY with some fine gravel of limestone (GLACIOLACUSTRINE DEPOSITS).		
2.80-3.00	B					(0.66) 3.46	Stiff brown and grey sandy gravelly CLAY. Gravels comprise medium to coarse limestone (GLACIOLACUSTRINE DEPOSITS).		
3.00-3.40	B		3						
3.00	V	78kN/m^2							
3.40-3.46	SPT	75 Blows					Borehole terminated at 3.46m due to refusal on possible cobble or limestone bedrock.		

Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Date	Time	Depth	Casing Depth	Casing Dia. mm	Water Dpt	From	To	Hours	From	To	
											Borehole remained dry on completion.

All dimensions in metres Scale 1:37.5	Client Engie	Method/ Plant Used Windowless Sampling	Logged By SW

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BOREHOLE LOG

Project				BOREHOLE No
Proposed Development, Harrogate Street, Hendon				**WS03**
Job No	Date	Ground Level (m)	Co-Ordinates ()	
20-794	19-05-21			
Contractor				Sheet
Arc Environmental Limited				1 of 1

SAMPLES & TESTS			Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION		
0.10-0.56	B					(1.00)	Grass over dark brown sandy gravelly clayey soil with fragments of concrete brick and limestone with some pottery wood and glass noted (MADE GROUND).		
0.56-1.00	B					1.00			
1.00-1.20	B					(0.70)	Firm becoming stiff brown and grey sandy CLAY with some fine to coarse gravel (GLACIOLACUSTRINE DEPOSITS).		
1.20-1.65	SPT	N=7							
1.30	B					1.70			
1.70-2.00	B					(2.95)	Stiff brown and grey sandy gravelly CLAY. Gravels comprise medium to coarse limestone (GLACIOLACUSTRINE DEPOSITS).		
2.00	V	120kN/m^2							
3.00	B								
3.00	V	120kN/m^2							
3.90-4.00	B								
4.00-4.20	B								
4.00	V	110kN/m^2				4.65			
4.65	B						Borehole terminated at 4.65m due to refusal on possible cobble or limestone bedrock.		
4.65-4.65	SPT	50 Blows							

Boring Progress and Water Observations					
Date	Time	Depth	Casing Depth	Casing Dia. mm	Water Dpt

Chiselling			Water Added	
From	To	Hours	From	To

GENERAL REMARKS

Borehole remained dry on completion.

All dimensions in metres Scale 1:37.5	Client Engie	Method/ Plant Used Windowless Sampling	Logged By SW

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BOREHOLE LOG

Project				BOREHOLE No
Proposed Development, Harrogate Street, Hendon				**WS04**
Job No	Date	Ground Level (m)	Co-Ordinates ()	
20-794	19-05-21			
Contractor				Sheet
Arc Environmental Limited				1 of 1

SAMPLES & TESTS			Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION		
0.11-0.97	B					(1.30)	Grass over dark brown sandy gravelly clayey soil with fragments of concrete brick and limestone with some wood ash and glass noted (MADE GROUND).		
0.77-1.30	B					1.30			
1.25-1.70	SPT	N=8				(0.30)	Stiff dark brown sandy gravelly CLAY. Gravels comprise medium to coarse limestone (GLACIOLACUSTRINE DEPOSITS).		
1.30-1.60	B					1.60			
1.60-2.00	B					(1.31)	Medium dense becoming dense light brown sandy GRAVEL of limestone. Possible highly weathered limestone.		
2.00-2.70	B								
2.00-2.45	SPT	N=17							
2.70-2.91	SPT	75 Blows				2.91			
							Borehole terminated at 2.91m due to refusal.		

Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Date	Time	Depth	Casing Depth	Casing Dia. mm	Water Dpt	From	To	Hours	From	To	Borehole remained dry on completion.

All dimensions in metres Scale 1:37.5	Client Engie	Method/ Plant Used Windowless Sampling	Logged By SW

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BOREHOLE LOG

Project				BOREHOLE No
Proposed Development, Harrogate Street, Hendon				**WS05**
Job No	Date	Ground Level (m)	Co-Ordinates ()	
20-794	20-05-21			
Contractor				Sheet
Arc Environmental Limited				1 of 1

SAMPLES & TESTS			Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION		
0.22-0.88	B					(1.40)	Grass over dark brown sandy gravelly clayey soil with concrete brick and ash and some wood pottery coal and glass noted (MADE GROUND).		
0.88-1.20	B								
1.20-1.65	SPT	N=8				1.40			
1.40	B					(0.99)	Buff LIMESTONE with honeycomb weathering and occasional clay infilling (ROKER FORMATION)		
2.00	B								
2.00-2.39	SPT	75 Blows				2.39			
							Borehole terminated at 2.39m due to refusal.		

Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Date	Time	Depth	Casing Depth	Casing Dia. mm	Water Dpt	From	To	Hours	From	To	Borehole remained dry on completion.

All dimensions in metres Scale 1:37.5	Client Engie	Method/ Plant Used Windowless Sampling	Logged By SW

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BOREHOLE LOG

Project				BOREHOLE No
Proposed Development, Harrogate Street, Hendon				**WS06**
Job No	Date	Ground Level (m)	Co-Ordinates ()	
20-794	20-05-21			
Contractor				Sheet
Arc Environmental Limited				1 of 1

SAMPLES & TESTS			Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION		
0.28-0.71	B					(1.02)	Grass over dark brown sandy gravelly clayey soil with brick coal sandstone and concrete and some wood and glass noted (MADE GROUND).		
0.71-1.02	B					1.02			
1.02-1.20	B						Firm becoming stiff (high strength) brown and grey sandy gravelly CLAY. Gravels comprise medium to coarse limestone (GLACIOLACUSTRINE DEPOSITS).		
1.20-1.65	SPT	N=14							
1.40	B								
1.60	V	77kN/m^2				(1.38)			
2.00	B								
2.00	V	81kN/m^2				2.40			
2.40-2.65	B					2.65	Dense light brown sandy GRAVEL of limestone. Possible highly weathered limestone.		
2.65-2.65	SPT	50 Blows					Borehole terminated at 2.65m due to refusal.		

Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Date	Time	Depth	Casing Depth	Casing Dia. mm	Water Dpt	From	To	Hours	From	To	Borehole remained dry on completion.

All dimensions in metres Scale 1:37.5	Client Engie	Method/ Plant Used Windowless Sampling	Logged By SW

AGS3 UK BH WS LOGS.GPJ AGS3_ALL.GDT 20/7/21

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BOREHOLE LOG

Project				BOREHOLE No
Proposed Development, Harrogate Street, Hendon				**WS07**
Job No	Date	Ground Level (m)	Co-Ordinates ()	
20-794	20-05-21			
Contractor				Sheet
Arc Environmental Limited				1 of 1

SAMPLES & TESTS			Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION		
0.00-0.43	B						Grass over dark brown sandy gravelly clayey soil with brick ash and concrete and some wood slate pottery and coal noted (MADE GROUND).		
0.43-0.78	B					(1.20)			
0.78-1.20	B					1.20			
1.20-1.50	B						Firm dark brown sandy CLAY with some fine gravel (GLACIOLACUSTRINE DEPOSITS).		
1.20-1.65	SPT	N=5				(0.30)			
1.50-2.00	B					1.50	Loose light brown fine SAND (GLACIOLACUSTRINE DEPOSITS).		
2.00-2.45	SPT	N=9				(0.75)			
2.25-2.40	B					2.25	Firm becoming stiff (high strength) brown and grey sandy gravelly CLAY. Gravels comprise medium to coarse limestone (GLACIOLACUSTRINE DEPOSITS).		
2.40	B								
2.70	V	110kN/m^2							
3.00	B								
3.00	V	120kN/m^2				(2.35)			
3.70	B								
3.70	V	120kN/m^2							
4.20	B								
4.20-4.60	SPT	75 Blows				4.60			
							Borehole terminated at 4.60m due to refusal.		

Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Date	Time	Depth	Casing Depth	Casing Dia. mm	Water Dpt	From	To	Hours	From	To	Borehole remained dry on completion.

All dimensions in metres Scale 1:37.5	Client Engie	Method/ Plant Used Windowless Sampling	Logged By SW

AGS3 UK BH WS LOGS.GPJ AGS3_ALL.GDT 20/7/21

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BOREHOLE LOG

Project				BOREHOLE No
Proposed Development, Harrogate Street, Hendon				**WS08**
Job No	Date	Ground Level (m)	Co-Ordinates ()	
20-794	20-05-21			
Contractor				Sheet
Arc Environmental Limited				1 of 1

SAMPLES & TESTS			Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION		
0.21-0.47	J/D					(0.47) 0.47	Grass over dark brown sandy gravelly clayey soil with brick concrete and some wood noted (MADE GROUND).		
0.47-0.85	B					(0.38) 0.85	Firm dark brown very sandy CLAY with some fine gravel (GLACIOLACUSTRINE DEPOSITS).		
0.85-1.30	B								
0.90-1.29	SPT	75 Blows				(0.45) 1.30	Dense light brown sandy GRAVEL of limestone. Possible highly weathered limestone.		
1.30-1.38	SPT	75 Blows	1				Borehole terminated at 1.30m due to refusal.		

Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Date	Time	Depth	Casing Depth	Casing Dia. mm	Water Dpt	From	To	Hours	From	To	Borehole remained dry on completion.

All dimensions in metres Scale 1:37.5	Client Engie	Method/ Plant Used Windowless Sampling	Logged By SW

AGS3 UK BH WS LOGS.GPJ AGS3_ALL.GDT 20/7/21

Solum House, Unit 1 Elliott Court
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BOREHOLE LOG

Project				BOREHOLE No
Proposed Development, Harrogate Street, Hendon				**WS09**
Job No	Date	Ground Level (m)	Co-Ordinates ()	
20-794	20-05-21			
Contractor				Sheet
Arc Environmental Limited				1 of 1

SAMPLES & TESTS			Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION		
0.00-0.40	B						Grass over dark brown sandy gravelly clayey soil with brick concrete slate and some glass ash and coal noted (MADE GROUND).		
0.40-1.00	B					(1.30)			
1.00-1.30	B								
1.00-1.45	SPT	N=12				1.30			
1.30	B						Buff LIMESTONE with honeycomb weathering and occasional clay infilling (ROKER FORMATION)		
						(1.10)			
2.00	B								
2.00-2.40	SPT	75 Blows				2.40			
							Borehole terminated at 2.40m due to refusal.		

Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Date	Time	Depth	Casing Depth	Casing Dia. mm	Water Dpt	From	To	Hours	From	To	
											Borehole remained dry on completion.

All dimensions in metres Scale 1:37.5	Client Engie	Method/ Plant Used Windowless Sampling	Logged By SW

AGS3 UK BH WS LOGS.GPJ AGS3_ALL.GDT 20/7/21

Solum House, Unit 1 Elliott Court
St Johns Road, Meadowfield
Durham, DH7 8PN
Telephone: 01913786380

BOREHOLE LOG

Project				BOREHOLE No
Proposed Development, Harrogate Street, Hendon				**WS10**
Job No	Date	Ground Level (m)	Co-Ordinates ()	
20-794	20-05-21			
Contractor				Sheet
Arc Environmental Limited				1 of 1

SAMPLES & TESTS			Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION		
0.00-0.37	B					(1.20) 1.20	Grass over dark brown sandy gravelly clayey soil with concrete slate and brick and some glass wood and coal noted (MADE GROUND).		
0.37-0.70	B								
0.70-1.20	B								
1.00-1.45	SPT	N=7							
1.20	B					(0.70) 1.90	Stiff brown and grey sandy gravelly CLAY. Gravels comprise medium to coarse limestone (GLACIOLACUSTRINE DEPOSITS).		
1.65-1.90	B								
1.90-2.41	B					(0.51) 2.41	Buff LIMESTONE with honeycomb weathering and occasional clay infilling (ROKER FORMATION)		
2.00-2.41	SPT	75 Blows							
							Borehole terminated at 2.40m due to refusal.		

Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Date	Time	Depth	Casing Depth	Casing Dia. mm	Water Dpt	From	To	Hours	From	To	Borehole remained dry on completion.

All dimensions in metres Scale 1:37.5	Client Engie	Method/ Plant Used Windowless Sampling	Logged By SW

AGS3 UK BH WS LOGS.GPJ AGS3_ALL.GDT 20/7/21

Solum House, Unit 1 Elliott Court
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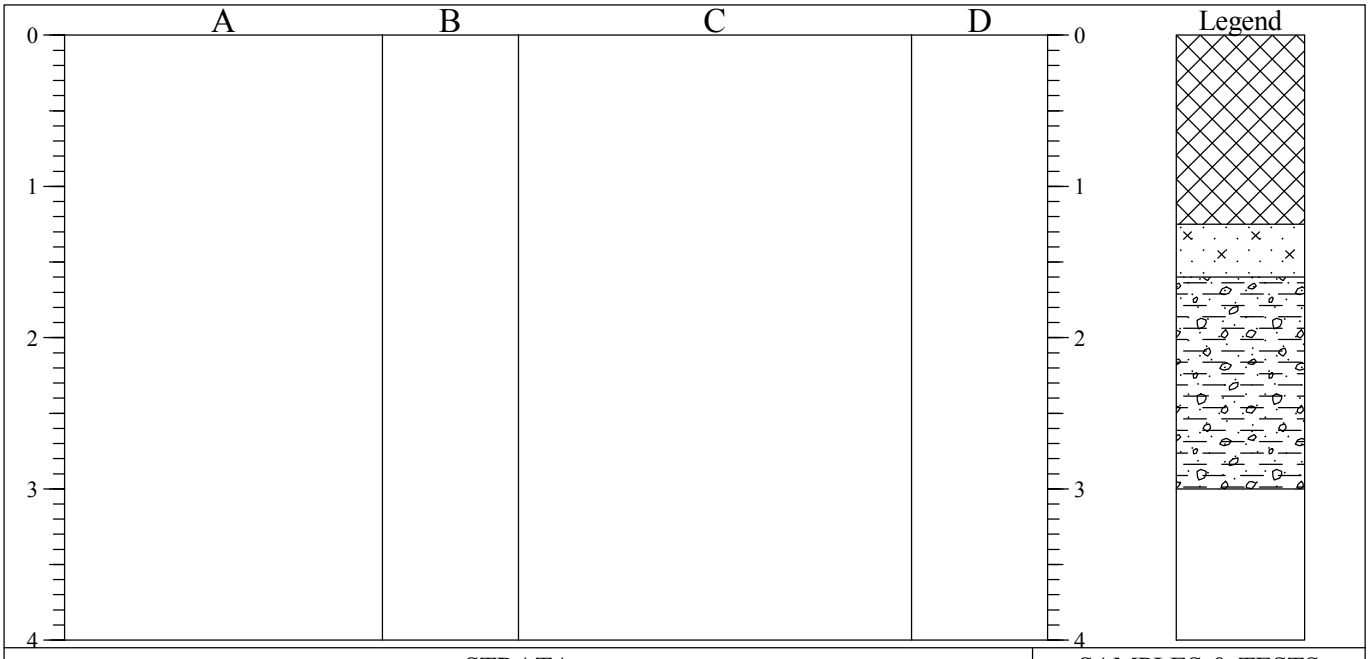
Telephone: 01913786380

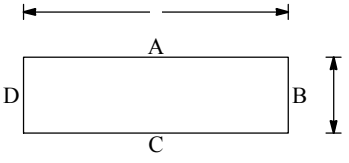
TRIAL PIT LOG

Project				TRIAL PIT No
Proposed Development, Harrogate Street				TP01
Job No	Date	Ground Level (m)	Co-Ordinates ()	
20-794	19-05-21			
Contractor				Sheet
Arc Environmental Limited				1 of 1



STRATA			SAMPLES & TESTS		
Depth	No	DESCRIPTION	Depth	No	Remarks/Tests
0.00-1.25		Grass overlying dark brown sandy gravelly clayey soil with broken bricks, timber, insulation and ceramic tile fragments (MADE GROUND)	0.20-0.30	B	
			0.80	J/D	
1.25-1.60		Orangish brown very clayey slightly silty SAND (GLACIOLACUSTRINE DEPOSITS)			
1.60-3.00		Stiff (high strength) brown and grey mottled slightly sandy slightly gravelly CLAY. Gravels comprise medium to coarse subangular sandstone (GLACIOLACUSTRINE DEPOSITS)	1.50	B	
			1.80	V	120kN/m^2
2.50		Recovered as a friable gravel from 2.50m	2.40	B	

Shoring/Support:
Stability:



GENERAL REMARKS

Trial pit remained dry and stable on completion.

All dimensions in metres Scale 1:50	Client Engie	Method/ Plant Used JCB 3CX	Logged By LJ

AGS3 UK TP 20-794 BH & TP LOGS.GPJ AGS3_ALL.GDT 20/7/21

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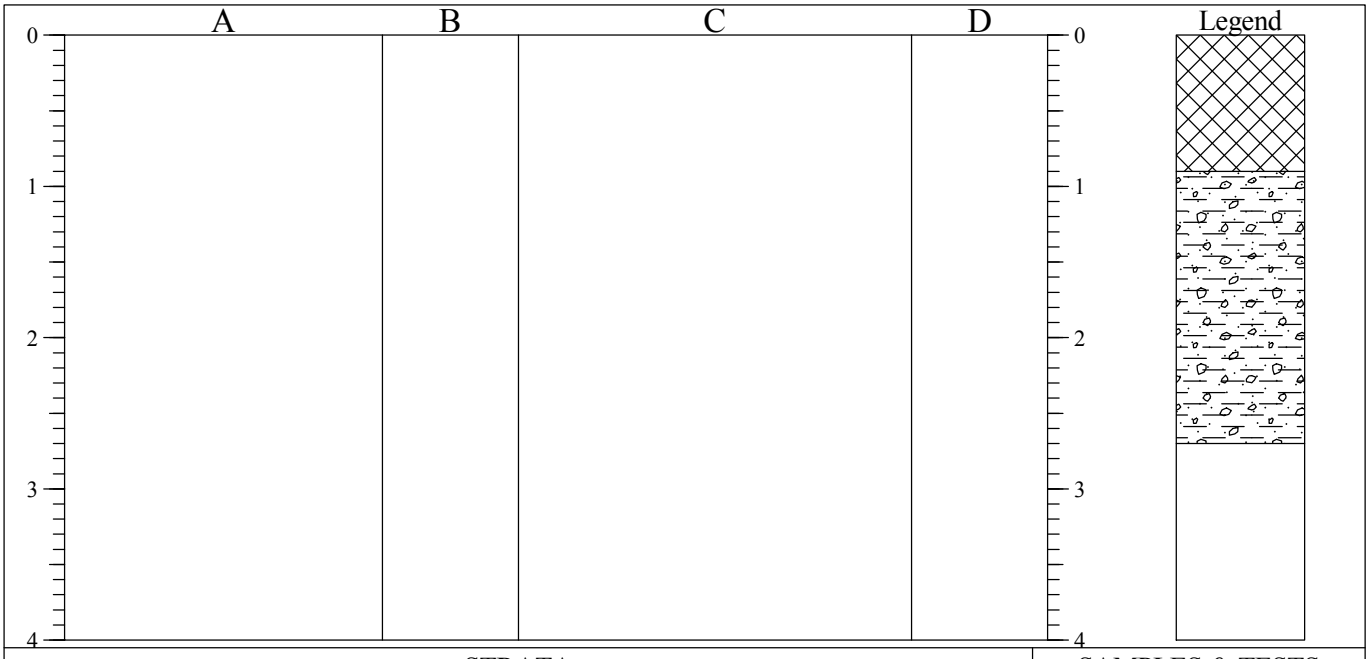
St Johns Road, Meadowfield
Durham, DH7 8PN
Telephone: 01913786380

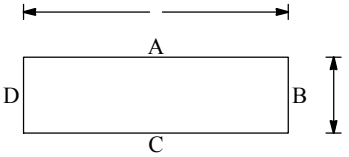
TRIAL PIT LOG

Project				TRIAL PIT No
Proposed Development, Harrogate Street				TP02
Job No	Date	Ground Level (m)	Co-Ordinates ()	
20-794	19-05-21			
Contractor				Sheet
Arc Environmental Limited				1 of 1



STRATA			SAMPLES & TESTS		
Depth	No	DESCRIPTION	Depth	No	Remarks/Tests
0.00-0.90		Grass overlying dark brown sandy gravelly clayey soil with broken bricks and timber (MADE GROUND)	0.30-0.50	B	
			0.60	J/D	
0.90-2.70		Stiff (high strength) brown and grey mottled slightly sandy slightly gravelly CLAY. Gravels comprise medium to coarse subangular sandstone (GLACIOLACUSTRINE DEPOSITS)	1.00	V	78kN/m^2
1.40		Bricks extend to 1.40m in eastern face of trial pit			
			2.00	B	

Shoring/Support:
Stability:



GENERAL REMARKS

Trial pit remained dry and stable on completion.

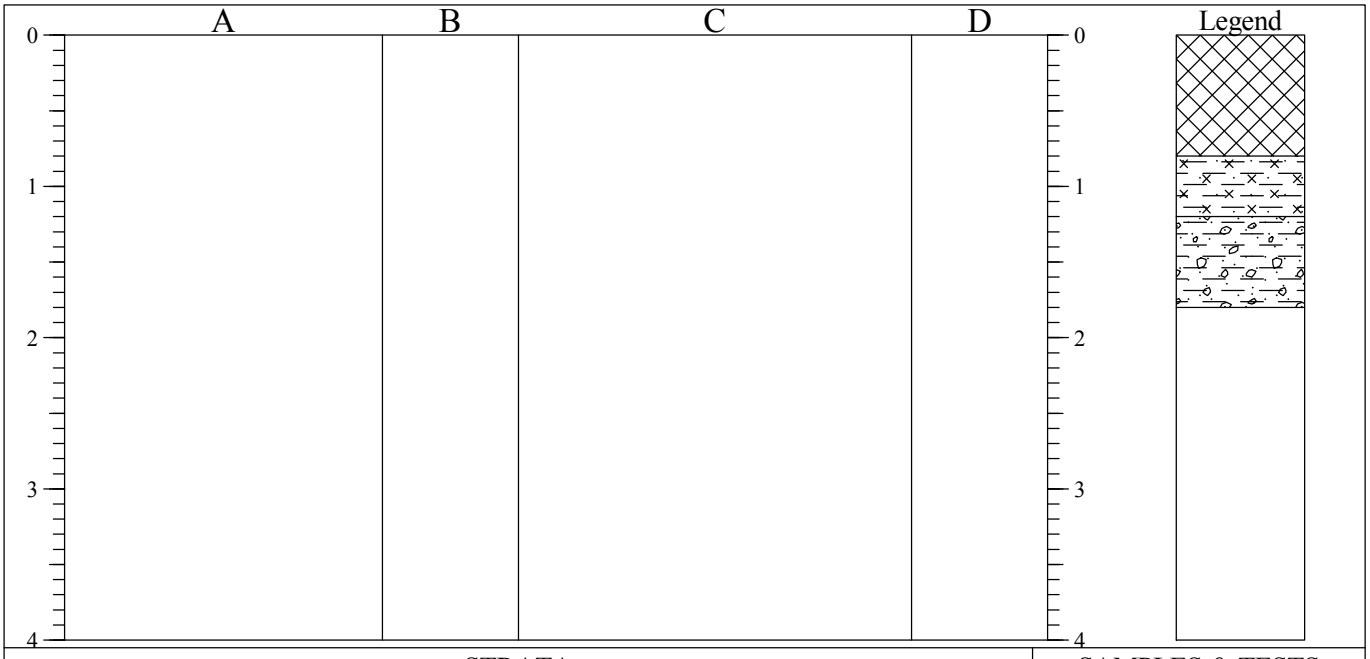
All dimensions in metres Scale 1:50	Client Engie	Method/ Plant Used JCB 3CX	Logged By LJ

AGS3 UK TP 20-794 BH & TP LOGS.GPJ AGS3_ALL.GDT 20/7/21

Solum House, Unit 1 Elliott Court
St Johns Road, Meadowfield
Durham, DH7 8PN
Telephone: 01913786380

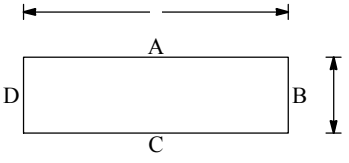
TRIAL PIT LOG

Project				TRIAL PIT No
Proposed Development, Harrogate Street				TP03
Job No	Date	Ground Level (m)	Co-Ordinates ()	
20-794	19-05-21			
Contractor				Sheet
Arc Environmental Limited				1 of 1



STRATA			SAMPLES & TESTS		
Depth	No	DESCRIPTION	Depth	No	Remarks/Tests
0.00-0.80		Grass overlying dark brown sandy gravelly clayey soil with broken bricks and timber (MADE GROUND)	0.30-0.50 0.50	B J/D	
0.80-1.20		Firm orangish / greyish brown very sandy slightly silty CLAY (GLACIOLACUSTRINE DEPOSITS)	1.00	B	
1.20-1.80		Stiff (high strength) brown and grey mottled slightly sandy gravelly CLAY. Gravels comprise medium to coarse subangular sandstone (GLACIOLACUSTRINE DEPOSITS)	1.50 1.60	V B	100kN/m^2
1.80		Trial pit terminated at 1.80m due to water ingress from possible relic drain			

Shoring/Support:
Stability:



GENERAL REMARKS

Slight water ingress from possible relic drain. Trial pit remained stable on completion.

All dimensions in metres Scale 1:50	Client Engie	Method/ Plant Used JCB 3CX	Logged By LJ

AGS3 UK TP 20-794 BH & TP LOGS.GPJ AGS3_ALL.GDT 20/7/21

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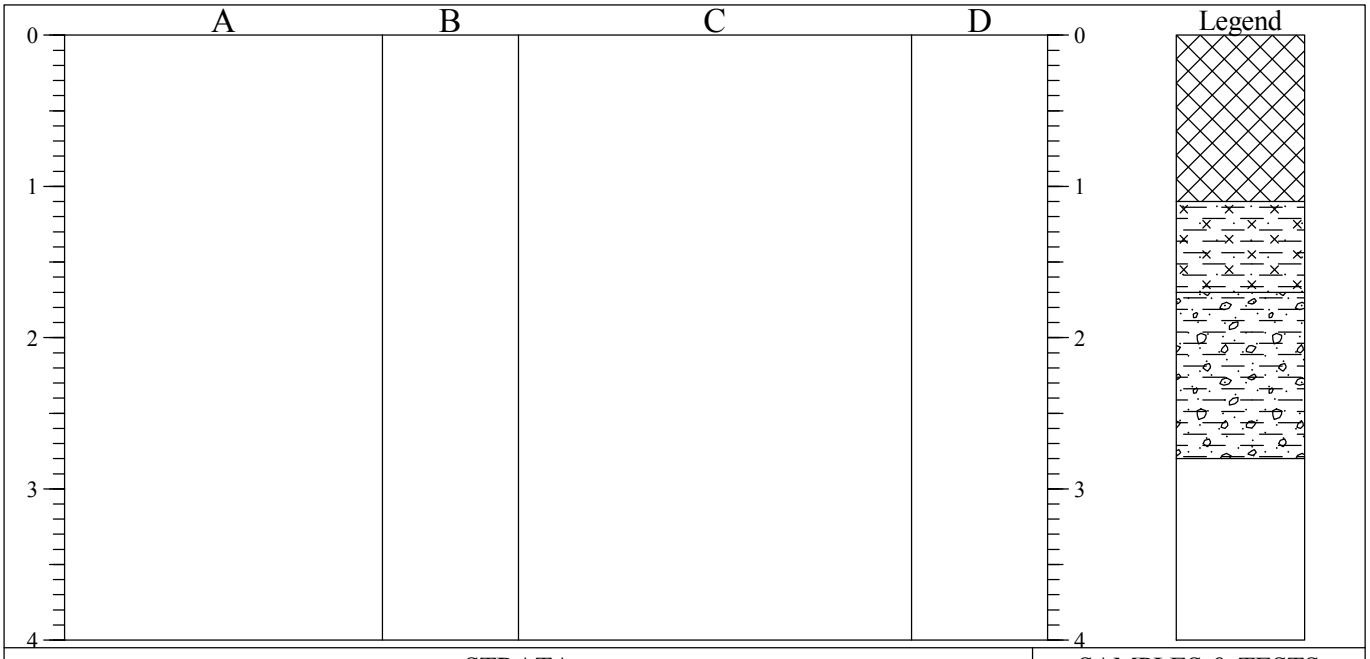
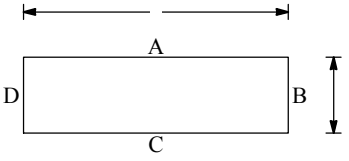
TRIAL PIT LOG

Project				TRIAL PIT No
Proposed Development, Harrogate Street				TP04
Job No	Date	Ground Level (m)	Co-Ordinates ()	
20-794	19-05-21			
Contractor				Sheet
Arc Environmental Limited				1 of 1



STRATA			SAMPLES & TESTS		
Depth	No	DESCRIPTION	Depth	No	Remarks/Tests
0.00-1.10		Grass overlying dark brown sandy gravelly clayey soil with broken bricks and timber (MADE GROUND)			
1.10-1.70		Firm (medium strength) orangish / greyish brown slightly sandy slightly silty CLAY (GLACIOLACUSTRINE DEPOSITS)	1.00	J/D	
			1.50	B	
1.70-2.80		Stiff (high strength) brown and grey mottled slightly sandy slightly gravelly CLAY. Gravels comprise medium to coarse subangular sandstone (GLACIOLACUSTRINE DEPOSITS)	1.50	V	70kN/m^2
			2.00	V	>120kN/m^2
			2.50	B	

Shoring/Support:
Stability:



GENERAL REMARKS

Trial pit remained dry and stable on completion.

All dimensions in metres Scale 1:50	Client Engie	Method/ Plant Used JCB 3CX	Logged By LJ

AGS3 UK TP 20-794 BH & TP LOGS.GPJ AGS3_ALL.GDT 20/7/21

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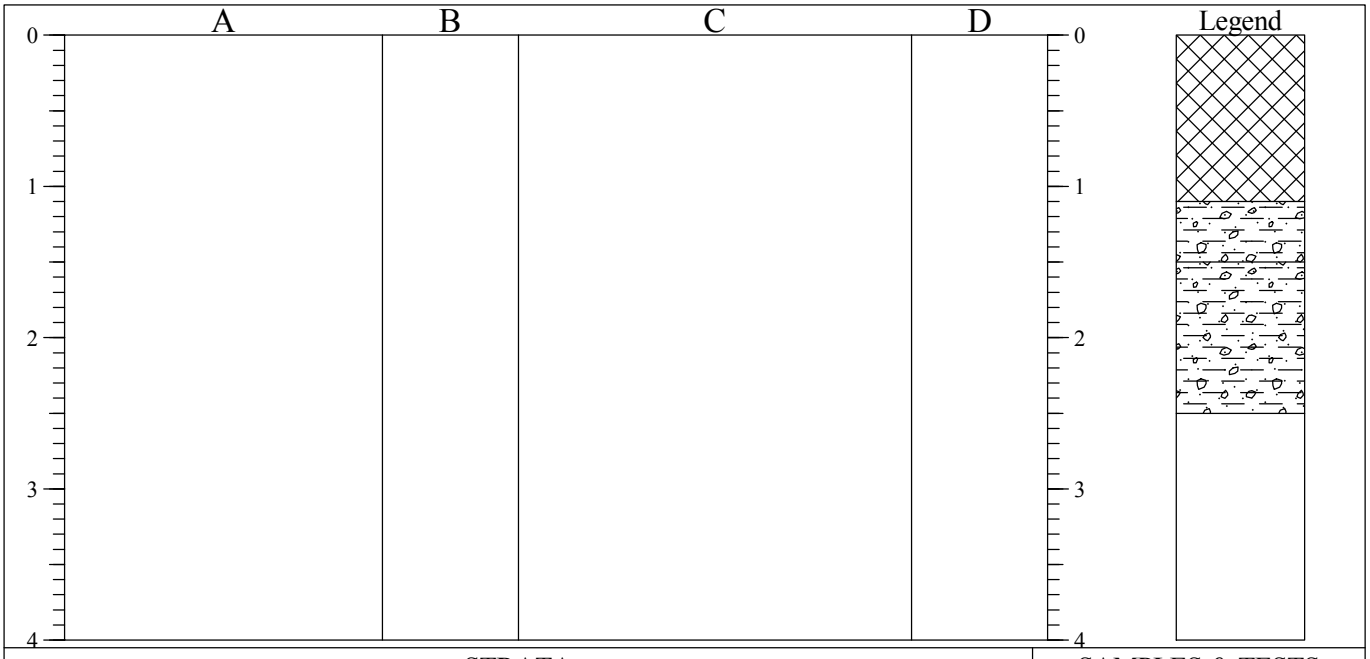
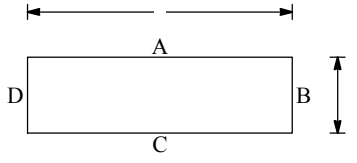
TRIAL PIT LOG

Project				TRIAL PIT No
Proposed Development, Harrogate Street				TP05
Job No	Date	Ground Level (m)	Co-Ordinates ()	
20-794	19-05-21			
Contractor				Sheet
Arc Environmental Limited				1 of 1



STRATA			SAMPLES & TESTS		
Depth	No	DESCRIPTION	Depth	No	Remarks/Tests
0.00-1.10		Grass overlying dark brown sandy gravelly clayey soil with broken bricks, timber and coal fragments (MADE GROUND)	0.75	J/D	
1.10-1.50		Soft locally firm (medium strength) orangish brown very sandy slightly gravelly CLAY. Gravels comprise medium to coarse subangular sandstone with occasional sandstone cobbles (GLACIOLACUSTRINE DEPOSITS)	1.20	B	
			1.40	V	40kN/m^2
1.50-2.50		Stiff (high strength) brown and grey mottled slightly sandy slightly gravelly CLAY. Gravels comprise medium to coarse subangular sandstone (GLACIOLACUSTRINE DEPOSITS)	1.80	B	
			2.00	V	>120kN/m^2

Shoring/Support:
Stability:



GENERAL REMARKS

Trial pit remained dry and stable on completion.

All dimensions in metres Scale 1:50	Client Engie	Method/ Plant Used JCB 3CX	Logged By LJ

AGS3 UK TP 20-794 BH & TP LOGS.GPJ AGS3_ALL.GDT 20/7/21

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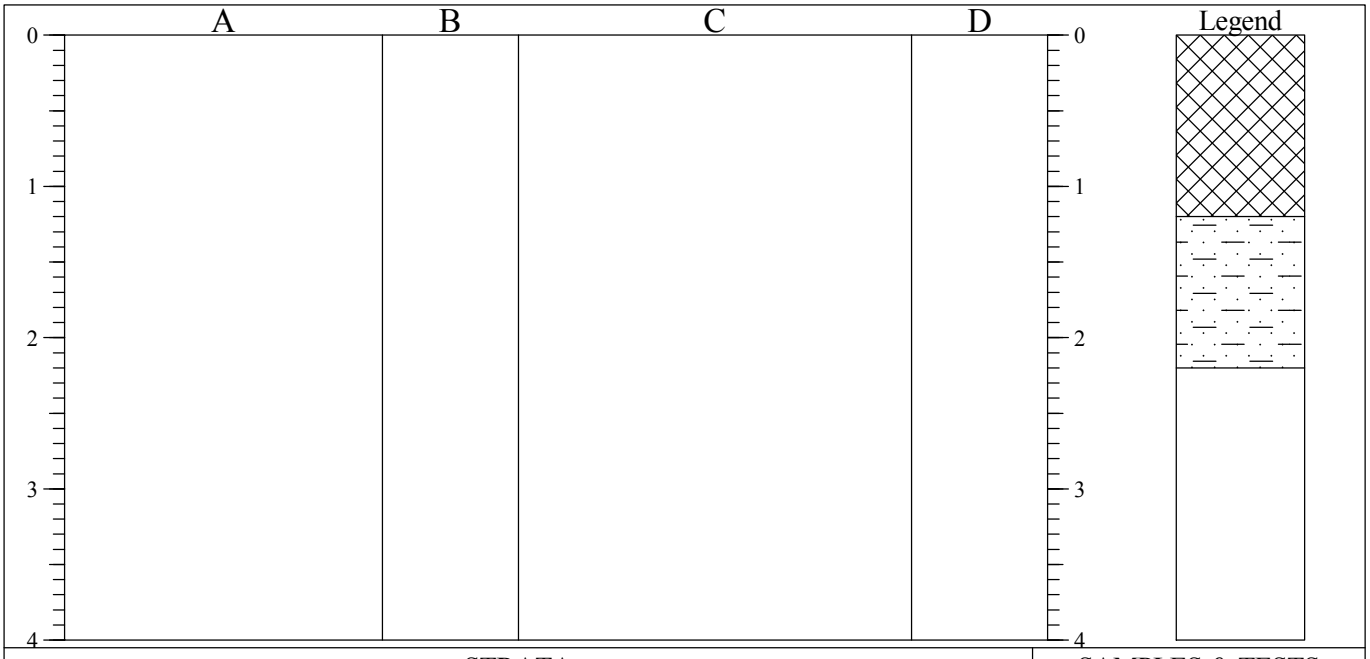
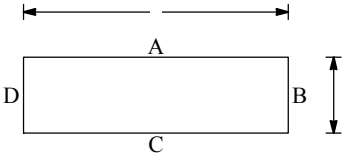
TRIAL PIT LOG

Project				TRIAL PIT No
Proposed Development, Harrogate Street				TP06
Job No	Date	Ground Level (m)	Co-Ordinates ()	
20-794	19-05-21			
Contractor				Sheet
Arc Environmental Limited				1 of 1



STRATA			SAMPLES & TESTS		
Depth	No	DESCRIPTION	Depth	No	Remarks/Tests
0.00-1.20		Grass overlying dark brown sandy gravelly clayey soil with broken bricks, concrete, timber, relic services and coal fragments (MADE GROUND)	0.60	J/D	
1.20-2.20		Orangish brown slightly gravelly very clayey SAND with pockets of soft very sandy clay. Gravels comprise medium to coarse subangular sandstone with occasional sandstone cobbles (GLACIOLACUSTRINE DEPOSITS)	2.00	B	

Shoring/Support:
Stability:



GENERAL REMARKS

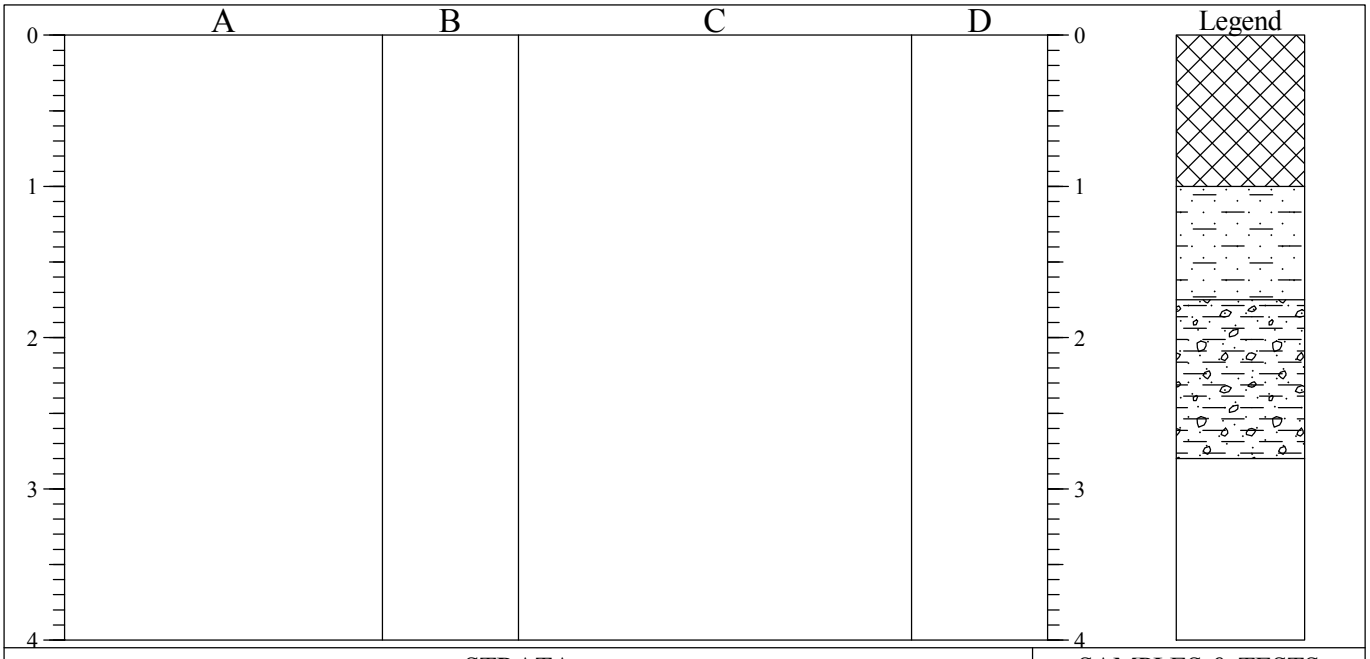
Trial pit remained dry and stable on completion.

All dimensions in metres Scale 1:50	Client Engie	Method/ Plant Used JCB 3CX	Logged By LJ

Solum House, Unit 1 Elliott Court
St Johns Road, Meadowfield
Durham, DH7 8PN
Telephone: 01913786380

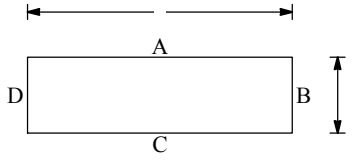
TRIAL PIT LOG

Project				TRIAL PIT No
Proposed Development, Harrogate Street				TP07
Job No	Date	Ground Level (m)	Co-Ordinates ()	
20-794	19-05-21			
Contractor				Sheet
Arc Environmental Limited				1 of 1



STRATA			SAMPLES & TESTS		
Depth	No	DESCRIPTION	Depth	No	Remarks/Tests
0.00-1.00		Grass overlying dark brown sandy gravelly clayey soil with broken bricks, concrete, timber and coal fragments (MADE GROUND)			
1.00-1.75		Orangish brown slightly gravelly very clayey SAND with pockets of soft very sandy clay. Gravels comprise medium to coarse subangular sandstone with occasional sandstone cobbles (GLACIOLACUSTRINE DEPOSITS)	0.90	J/D	
1.75-2.80		Stiff (high strength) greyish brown slightly sandy slightly gravelly CLAY with occasional coal fragments. Gravels comprise medium to coarse subangular sandstone (GLACIOLACUSTRINE DEPOSITS)	2.00	V	>120kN/m^2
			2.50	B	

Shoring/Support:
Stability:



GENERAL REMARKS

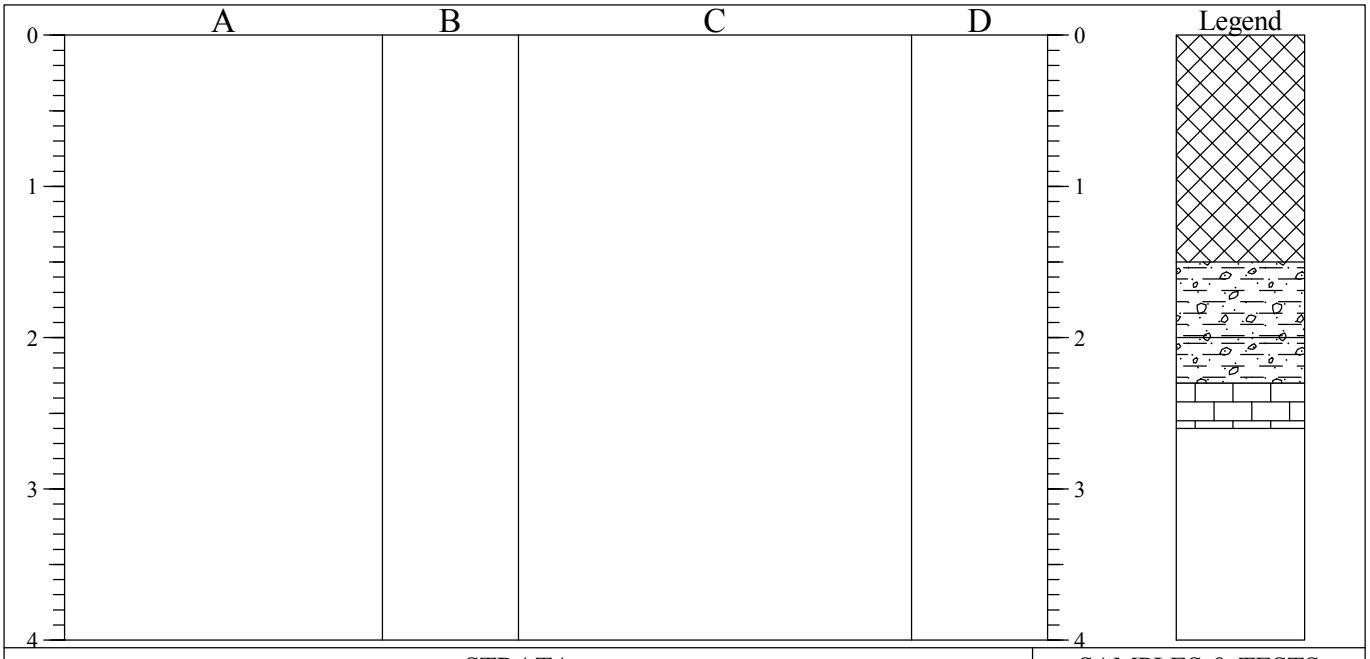
Trial pit remained dry and stable on completion.

All dimensions in metres Scale 1:50	Client Engie	Method/ Plant Used JCB 3CX	Logged By LJ

Solum House, Unit 1 Elliott Court
St Johns Road, Meadowfield
Durham, DH7 8PN
Telephone: 01913786380

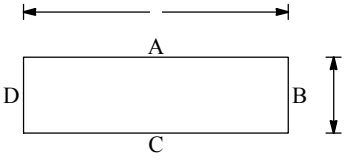
TRIAL PIT LOG

Project				TRIAL PIT No
Proposed Development, Harrogate Street				TP08
Job No	Date	Ground Level (m)	Co-Ordinates ()	
20-794	19-05-21			
Contractor				Sheet
Arc Environmental Limited				1 of 1



STRATA			SAMPLES & TESTS		
Depth	No	DESCRIPTION	Depth	No	Remarks/Tests
0.00-1.50		Grass overlying dark brown sandy gravelly clayey soil with whole bricks, large timber beams and plastic fragments (MADE GROUND)	1.20	J/D	
1.50-2.00		Stiff (high strength) greyish brown slightly sandy slightly gravelly CLAY with occasional coal fragments and pockets of very clayey sand. Gravels comprise medium to coarse subangular sandstone (GLACIOLACUSTRINE DEPOSITS)	1.80	B	
2.00-2.30		Stiff (high strength) brown slightly sandy slightly gravelly CLAY. Gravels comprise medium to coarse subangular sandstone (GLACIOLACUSTRINE DEPOSITS)	1.80	V	80kN/m^2
2.30-2.60		Completely weathered LIMESTONE recovered as a buff very sandy clayey gravel. Gravels comprise medium to coarse limestone with occasional subrounded limestone cobbles (ROKER FORMATION)	2.20	V	>120kN/m^2
			2.50	B	

Shoring/Support:
Stability:



GENERAL REMARKS

Trial pit remained dry and stable on completion.

All dimensions in metres Scale 1:50	Client Engie	Method/ Plant Used JCB 3CX	Logged By LJ

AGS3 UK TP 20-794 BH & TP LOGS.GPJ AGS3_ALL.GDT 20/7/21

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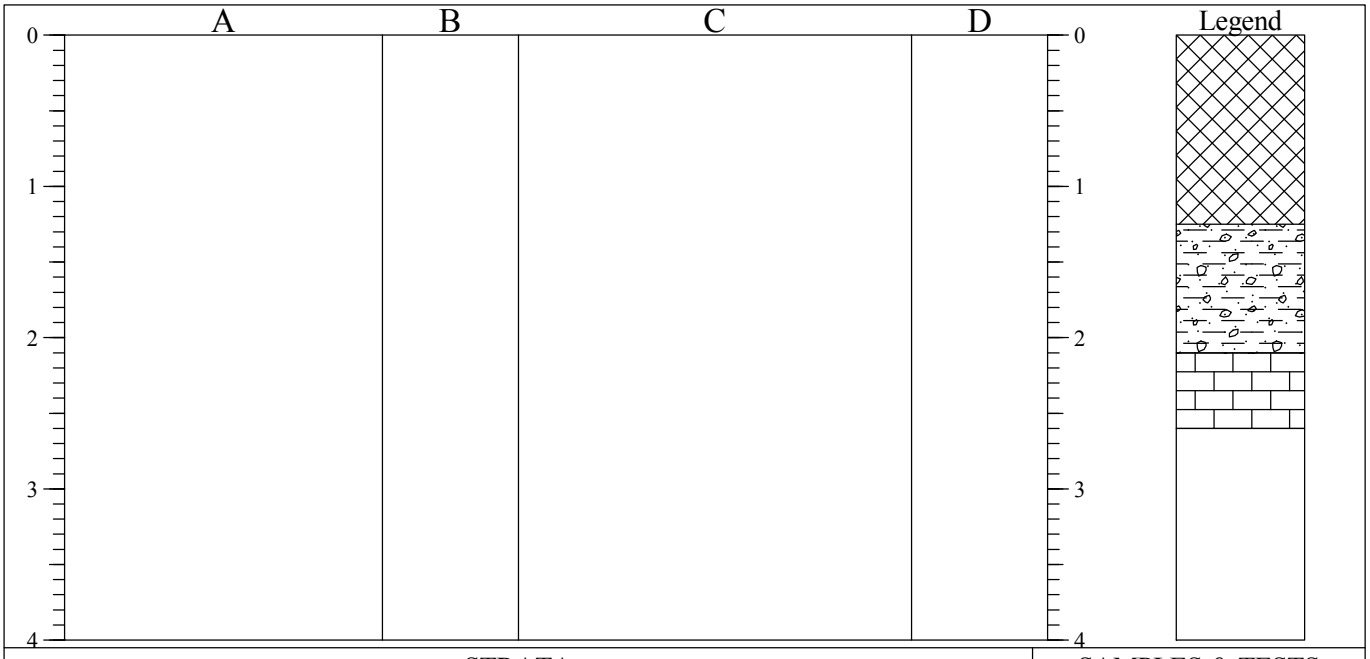
St Johns Road, Meadowfield
Durham, DH7 8PN
Telephone: 01913786380

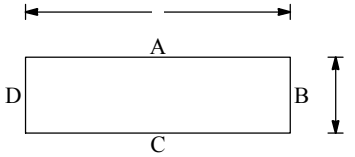
TRIAL PIT LOG

Project				TRIAL PIT No
Proposed Development, Harrogate Street				TP09
Job No	Date	Ground Level (m)	Co-Ordinates ()	
20-794	19-05-21			
Contractor				Sheet
Arc Environmental Limited				1 of 1



STRATA			SAMPLES & TESTS		
Depth	No	DESCRIPTION	Depth	No	Remarks/Tests
0.00-1.25		Grass overlying dark brown sandy gravelly clayey soil with broken bricks and timber (MADE GROUND)			
			1.00	J/D	
1.25-2.10		Stiff (high strength) greyish brown slightly sandy slightly gravelly CLAY with occasional coal fragments and pockets of very clayey sand. Gravels comprise medium to coarse subangular sandstone (GLACIOLACUSTRINE DEPOSITS)			
			2.00	V	95kN/m^2
2.10-2.60		Completely weathered LIMESTONE recovered as a buff sandy gravel. Gravels comprise medium to coarse limestone with occasional subrounded limestone cobbles (ROKER FORMATION)	2.20	B	

Shoring/Support:
Stability:



GENERAL REMARKS

Trial pit remained dry and stable on completion.

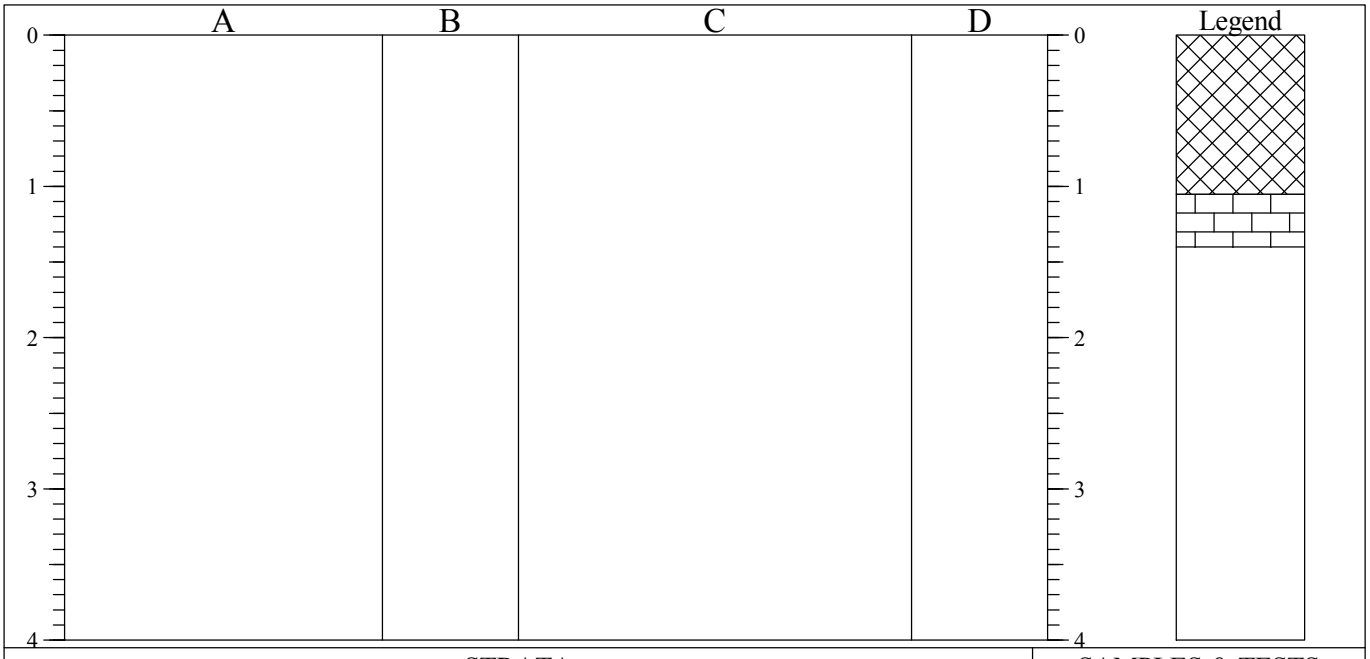
All dimensions in metres Scale 1:50	Client Engie	Method/ Plant Used JCB 3CX	Logged By LJ

AGS3 UK TP 20-794 BH & TP LOGS.GPJ AGS3_ALL.GDT 20/7/21

Solum House, Unit 1 Elliott Court
St Johns Road, Meadowfield
Durham, DH7 8PN
Telephone: 01913786380

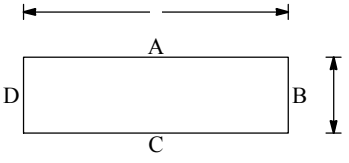
TRIAL PIT LOG

Project				TRIAL PIT No
Proposed Development, Harrogate Street				**TP10**
Job No	Date	Ground Level (m)	Co-Ordinates ()	
20-794	19-05-21			
Contractor				Sheet
Arc Environmental Limited				1 of 1



STRATA			SAMPLES & TESTS		
Depth	No	DESCRIPTION	Depth	No	Remarks/Tests
0.00-1.05		Grass overlying dark brown sandy gravelly clayey soil with broken bricks, timber, large concrete blocks, metal fragments and coal fragments (MADE GROUND)	0.80	J/D	
1.05-1.40		Buff LIMESTONE with honeycomb weathering and occasional clay infilling (ROKER FORMATION)	1.20	B	

Shoring/Support:
Stability:



GENERAL REMARKS

Trial pit remained dry and stable on completion.

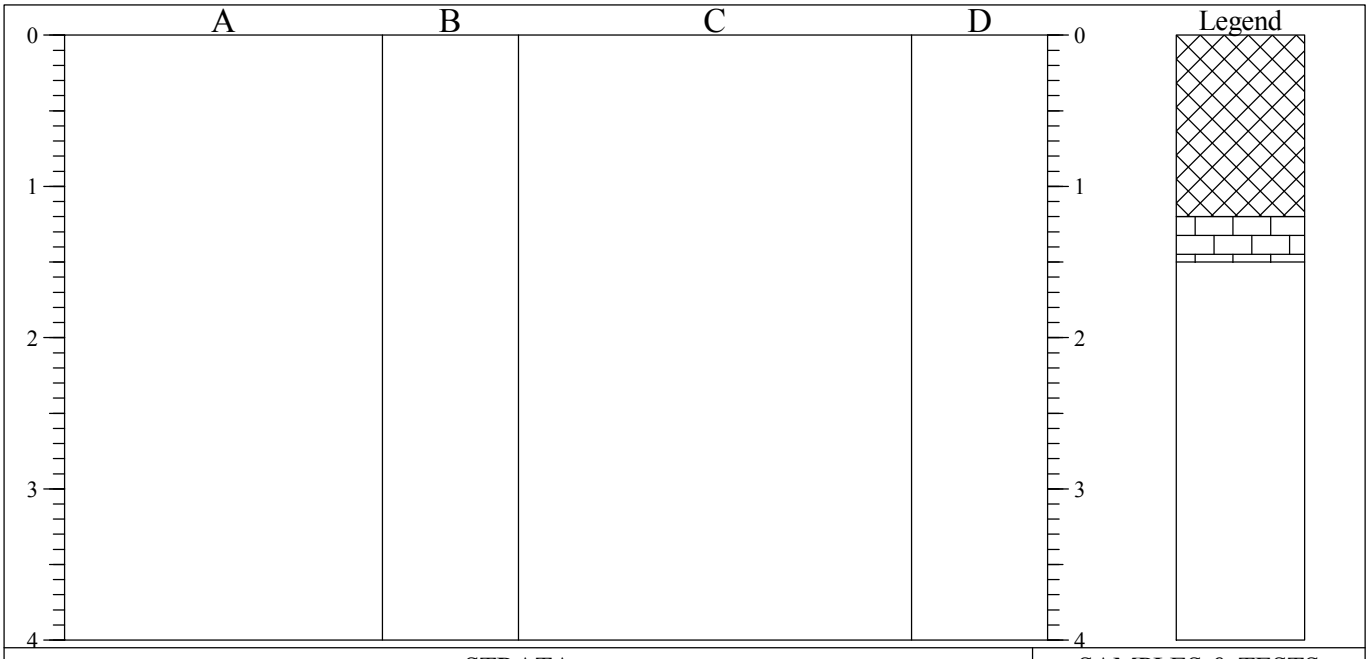
All dimensions in metres Scale 1:50	Client Engie	Method/ Plant Used JCB 3CX	Logged By LJ

AGS3 UK TP 20-794 BH & TP LOGS.GPJ AGS3_ALL.GDT 20/7/21

Solum House, Unit 1 Elliott Court
St Johns Road, Meadowfield
Durham, DH7 8PN
Telephone: 01913786380

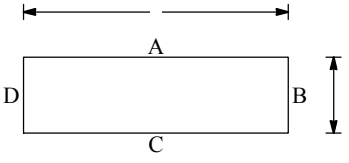
TRIAL PIT LOG

Project				TRIAL PIT No
Proposed Development, Harrogate Street				TP11
Job No	Date	Ground Level (m)	Co-Ordinates ()	
20-794	19-05-21			
Contractor				Sheet
Arc Environmental Limited				1 of 1



STRATA			SAMPLES & TESTS		
Depth	No	DESCRIPTION	Depth	No	Remarks/Tests
0.00-1.20		Grass overlying dark brown sandy gravelly clayey soil with occasional brick and sandstone fragments, ceramic tiles and concrete (MADE GROUND)	0.30	J/D	
1.20-1.50		Buff LIMESTONE with honeycomb weathering and occasional clay infilling (ROKER FORMATION)	1.30	B	

Shoring/Support:
Stability:



GENERAL REMARKS

Trial pit remained dry and stable on completion.

All dimensions in metres Scale 1:50	Client Engie	Method/ Plant Used JCB 3CX	Logged By LJ

AGS3 UK TP 20-794 BH & TP LOGS.GPJ AGS3_ALL.GDT 20/7/21

Solum House, Unit 1 Elliott Court
St Johns Road, Meadowfield
Durham, DH7 8PN
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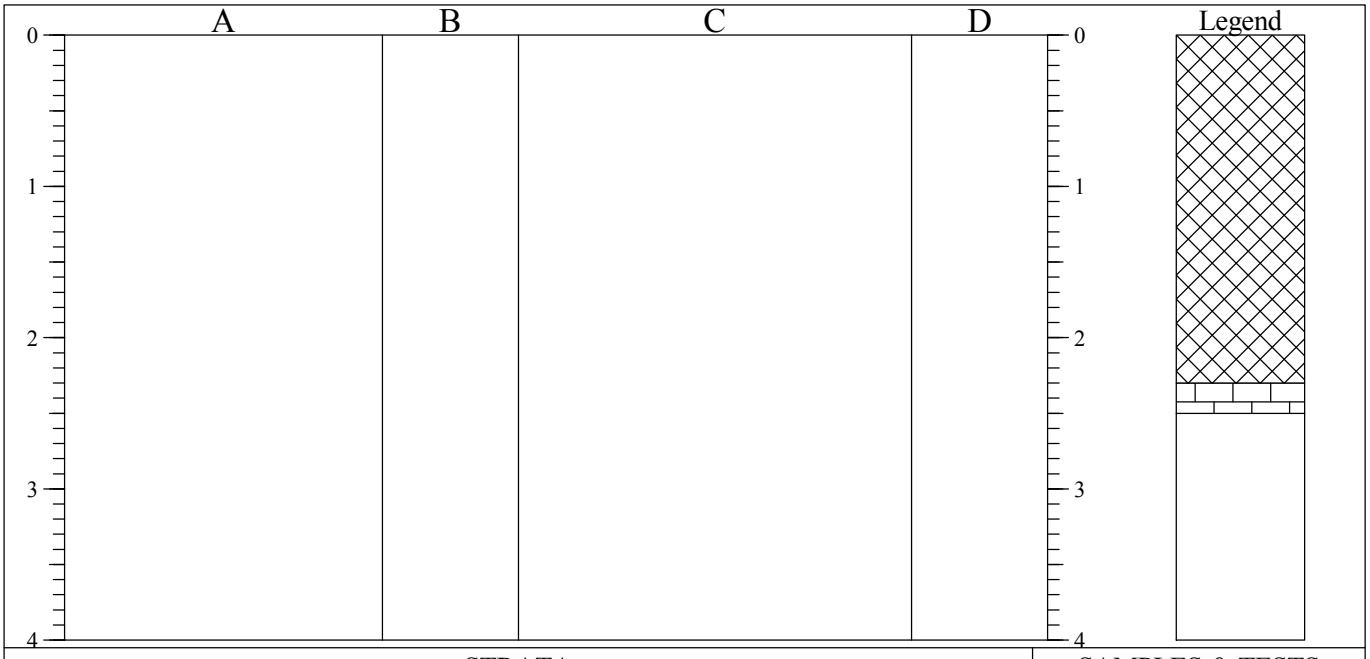
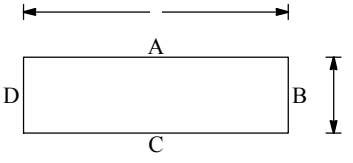
TRIAL PIT LOG

Project				TRIAL PIT No
Proposed Development, Harrogate Street				TP12
Job No	Date	Ground Level (m)	Co-Ordinates ()	
20-794	19-05-21			
Contractor				Sheet
Arc Environmental Limited				1 of 1



STRATA			SAMPLES & TESTS		
Depth	No	DESCRIPTION	Depth	No	Remarks/Tests
0.00-2.30		Grass overlying dark brown sandy gravelly clayey soil with broken bricks, concrete, timber, relic services and coal fragments (MADE GROUND)	1.50	J/D	
2.30-2.50		Buff LIMESTONE with honeycomb weathering and occasional clay infilling (ROKER FORMATION)			

Shoring/Support:
Stability:



GENERAL REMARKS

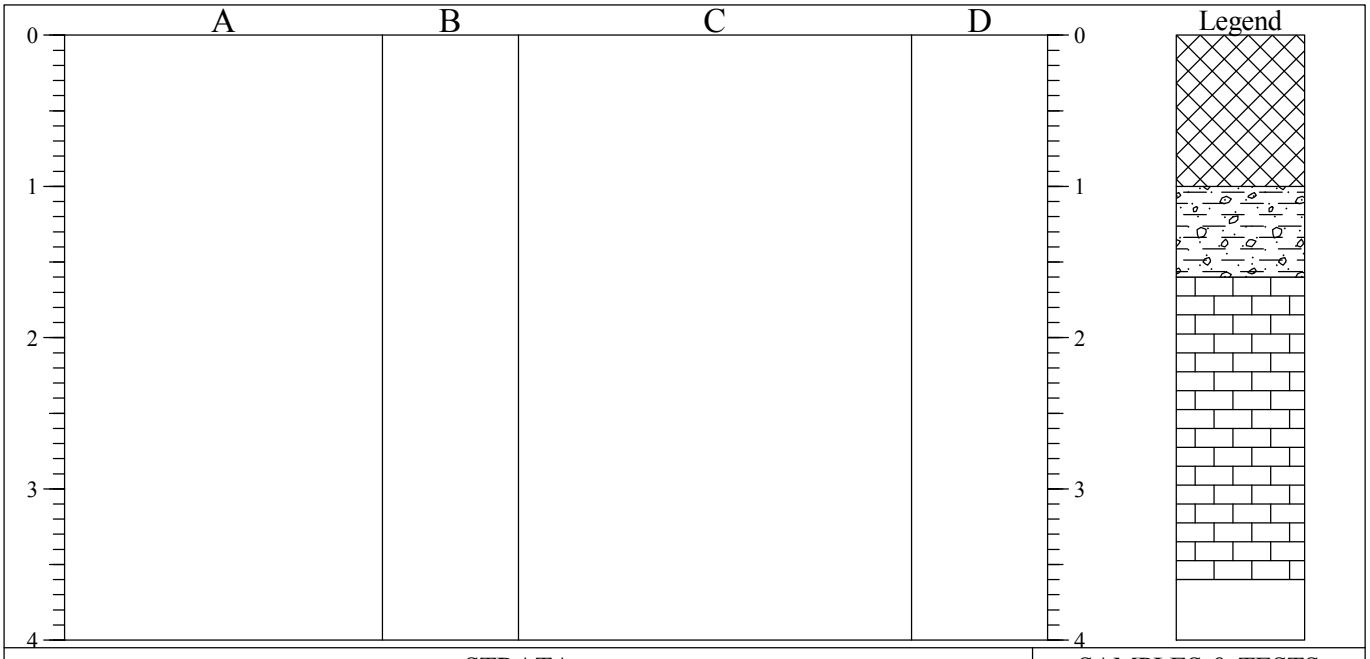
Trial pit remained dry on completion. Unstable and partially collapsing within the made ground materials.

All dimensions in metres Scale 1:50	Client Engie	Method/ Plant Used JCB 3CX	Logged By LJ

Solum House, Unit 1 Elliott Court
St Johns Road, Meadowfield
Durham, DH7 8PN
Telephone: 01913786380

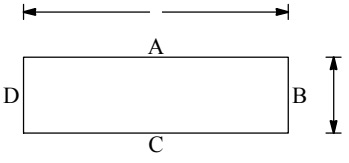
TRIAL PIT LOG

Project				TRIAL PIT No
Proposed Development, Harrogate Street				TP13
Job No	Date	Ground Level (m)	Co-Ordinates ()	
20-794	19-05-21			
Contractor				Sheet
Arc Environmental Limited				1 of 1



STRATA			SAMPLES & TESTS		
Depth	No	DESCRIPTION	Depth	No	Remarks/Tests
0.00-1.00		Grass overlying dark brown sandy gravelly clayey soil with broken bricks, concrete, timber and metal (MADE GROUND)	0.60	J/D	
1.00-1.60		Firm (medium strength) dark brown sandy slightly gravelly CLAY. Gravels comprise medium to coarse subangular sandstone (GLACIOLACUSTRINE DEPOSITS)	1.20	V	70kN/m^2
1.60-3.60		Completely weathered LIMESTONE recovered as a buff slightly clayey sandy gravel. Gravels comprise medium to coarse limestone with occasional subrounded limestone cobbles (ROKER FORMATION)	3.00	B	

Shoring/Support:
Stability:



GENERAL REMARKS

Trial pit remained dry and stable on completion.

All dimensions in metres Scale 1:50	Client Engie	Method/ Plant Used JCB 3CX	Logged By LJ

AGS3 UK TP 20-794 BH & TP LOGS.GPJ AGS3_ALL.GDT 20/7/21

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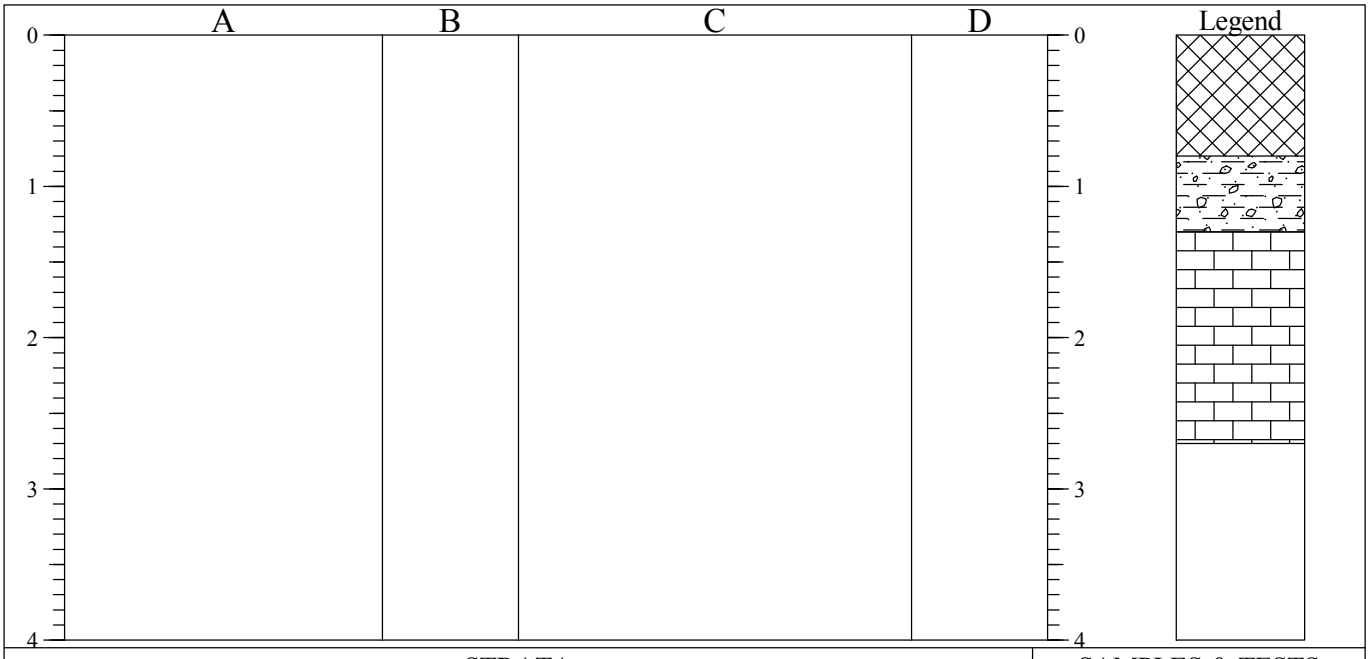
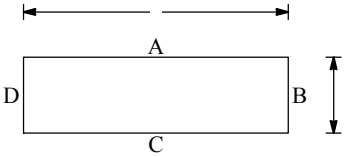
TRIAL PIT LOG

Project				TRIAL PIT No
Proposed Development, Harrogate Street				TP14
Job No	Date	Ground Level (m)	Co-Ordinates ()	
20-794	19-05-21			
Contractor				Sheet
Arc Environmental Limited				1 of 1



STRATA			SAMPLES & TESTS		
Depth	No	DESCRIPTION	Depth	No	Remarks/Tests
0.00-0.80		Grass overlying dark brown sandy gravelly clayey soil with sandy dolostone gravel (MADE GROUND)	0.30	J/D	
0.80-1.30		Firm dark brown sandy gravelly CLAY. Gravels comprise medium to coarse subangular sandstone (GLACIOLACUSTRINE DEPOSITS)			
1.20		Brick foundation to 1.20m in south face of trial pit			
1.30-2.70		Completely weathered LIMESTONE recovered as a buff slightly clayey sandy gravel. Gravels comprise medium to coarse limestone with occasional subrounded limestone cobbles (ROKER FORMATION)	1.50	J/D	
2.70		Limestone becoming more competant at base of trial pit			

Shoring/Support:
Stability:



GENERAL REMARKS

Trial pit remained dry and stable on completion.

All dimensions in metres Scale 1:50	Client Engie	Method/ Plant Used JCB 3CX	Logged By LJ

AGS3 UK TP 20-794 BH & TP LOGS.GPJ AGS3_ALL.GDT 20/7/21

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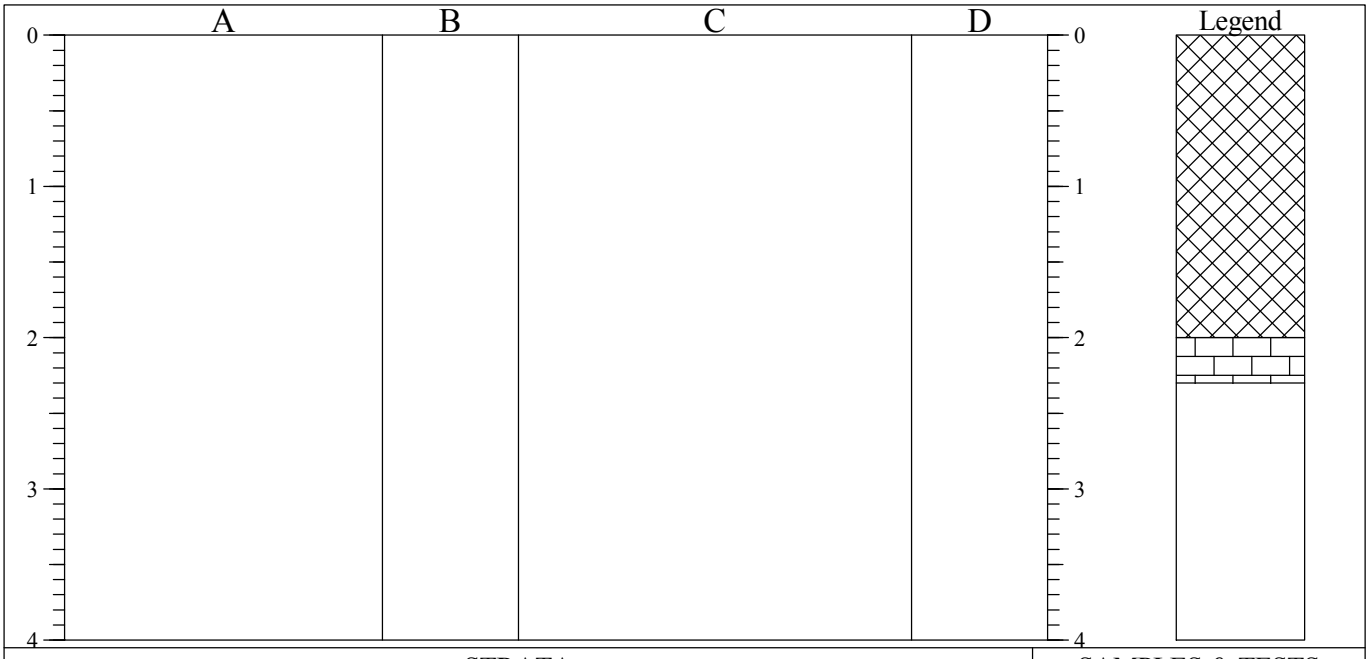
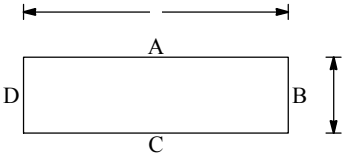
TRIAL PIT LOG

Project				TRIAL PIT No
Proposed Development, Harrogate Street				TP15
Job No	Date	Ground Level (m)	Co-Ordinates ()	
20-794	19-05-21			
Contractor				Sheet
Arc Environmental Limited				1 of 1



STRATA			SAMPLES & TESTS		
Depth	No	DESCRIPTION	Depth	No	Remarks/Tests
0.00-2.00		Grass overlying brown sandy gravelly clayey soil with broken bricks, concrete, timber, metal and pockets of sandy gravelly reworked clay (MADE GROUND)	1.00	J/D	
2.00-2.30		Completely weathered LIMESTONE recovered as a buff slightly clayey sandy gravel. Gravels comprise medium to coarse limestone with occasional subrounded limestone cobbles (ROKER FORMATION)	2.20	B	

Shoring/Support:
Stability:



GENERAL REMARKS

Trial pit remained dry and stable on completion.

All dimensions in metres Scale 1:50	Client Engie	Method/ Plant Used JCB 3CX	Logged By LJ

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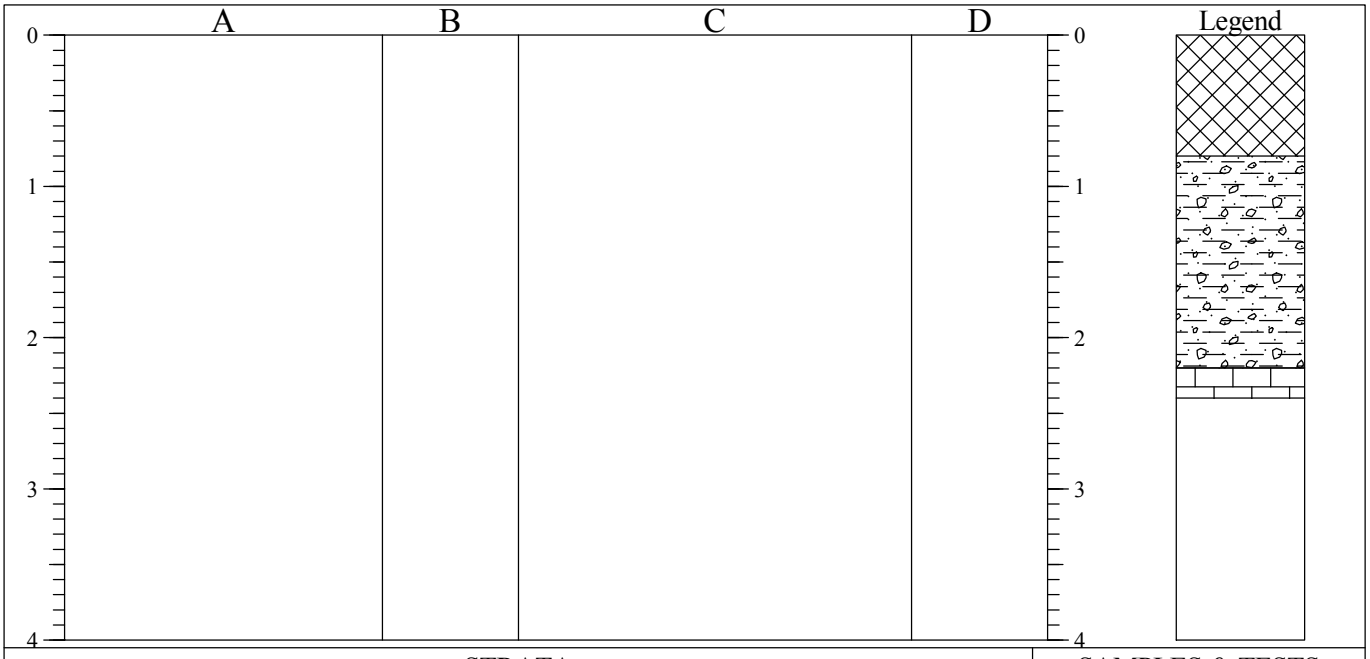
Telephone: 01913786380

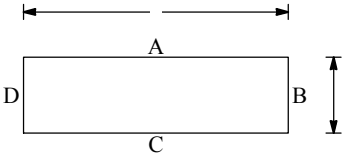
TRIAL PIT LOG

Project				TRIAL PIT No
Proposed Development, Harrogate Street				TP16
Job No	Date	Ground Level (m)	Co-Ordinates ()	
20-794	20-05-21			
Contractor				Sheet
Arc Environmental Limited				1 of 1



STRATA			SAMPLES & TESTS		
Depth	No	DESCRIPTION	Depth	No	Remarks/Tests
0.00-0.80		Grass overlying dark brown sandy gravelly clayey soil with broken bricks and concrete. Relic wall noted on western face of trial pit (MADE GROUND)	0.30-0.50	J/D	
0.80-2.20		Stiff (medium & high strength) brown and grey mottled slightly sandy slightly gravelly CLAY. Gravels comprise medium to coarse subangular limestone (GLACIOLACUSTRINE DEPOSITS)	1.00-1.20 1.00	B V	68kN/m^2
			1.80-2.00 1.80	B V	112kN/m^2
2.20-2.40		Buff weathered clayey LIMESTONE (ROKER FORMATION)	2.20-2.40	B	

Shoring/Support:
Stability:



GENERAL REMARKS

Trial pit remained dry and stable on completion.

All dimensions in metres Scale 1:50	Client Engie	Method/ Plant Used JCB 3CX	Logged By DMC

AGS3 UK TP 20-794 BH & TP LOGS.GPJ AGS3_ALL.GDT 20/7/21

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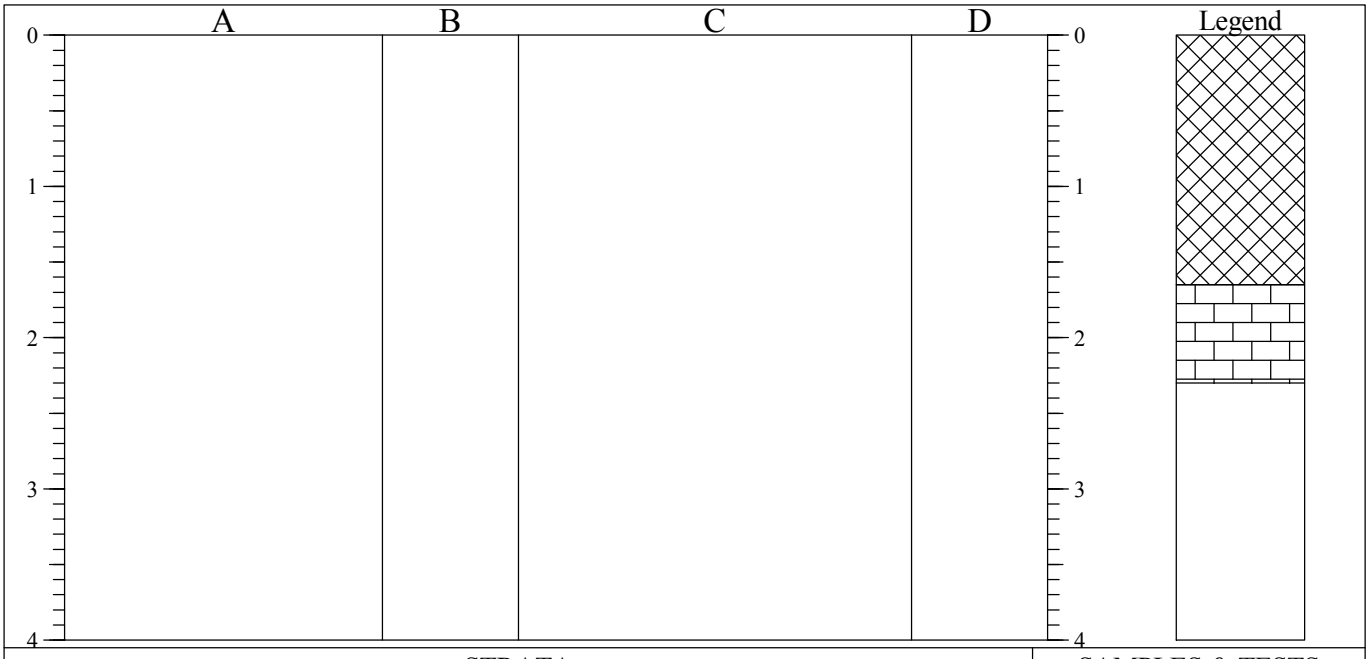
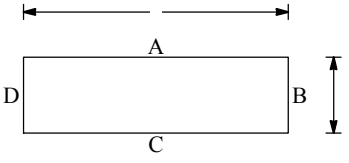
TRIAL PIT LOG

Project				TRIAL PIT No
Proposed Development, Harrogate Street				TP17
Job No	Date	Ground Level (m)	Co-Ordinates ()	
20-794	20-05-21			
Contractor				Sheet
Arc Environmental Limited				1 of 1



STRATA			SAMPLES & TESTS		
Depth	No	DESCRIPTION	Depth	No	Remarks/Tests
0.00-1.65		Grass overlying dark brown sandy gravelly clayey soil with broken bricks, concrete and timber (MADE GROUND)	0.20-0.20	J/D	
			0.80-1.00	J/D	
			1.40-1.60	J/D	
1.65-2.30		Buff weathered LIMESTONE (ROKER FORMATION)	2.00-2.20	B	

Shoring/Support:
Stability:



GENERAL REMARKS

Trial pit dry. Collapse of trial pit walls noted.

All dimensions in metres Scale 1:50	Client Engie	Method/ Plant Used JCB 3CX	Logged By DMC

AGS3 UK TP 20-794 BH & TP LOGS.GPJ AGS3_ALL.GDT 20/7/21

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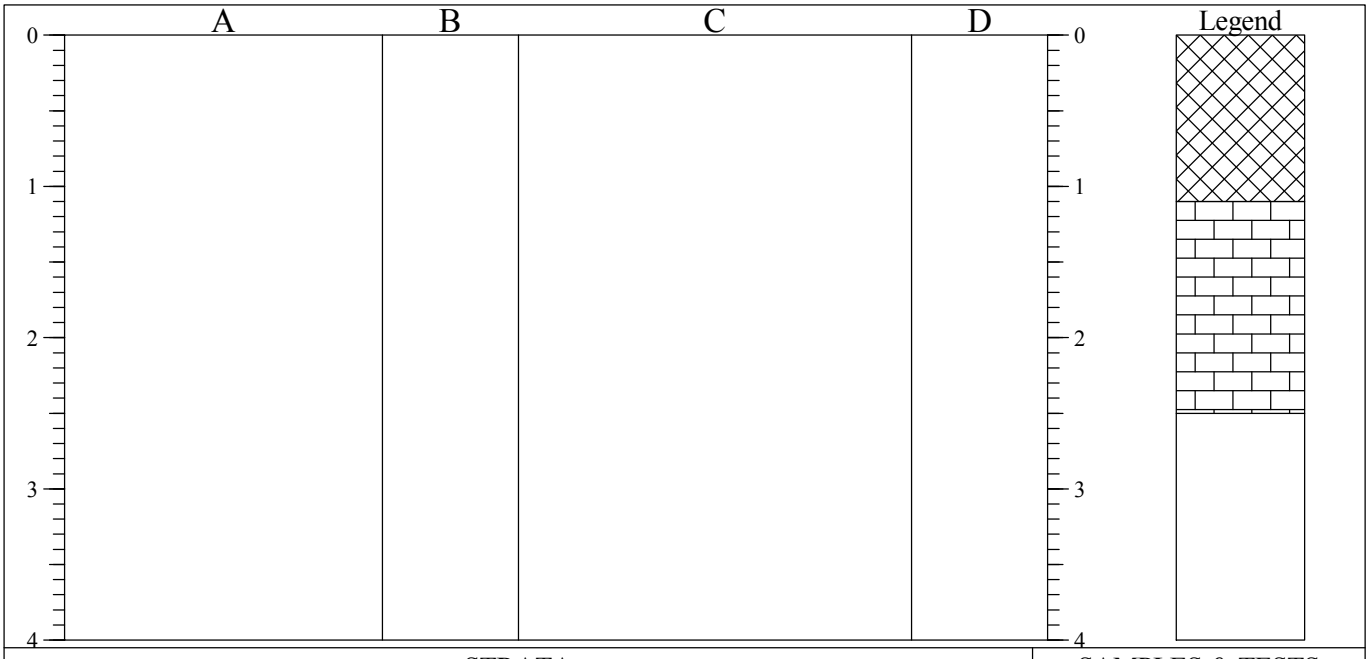
St Johns Road, Meadowfield
Durham, DH7 8PN
Telephone: 01913786380

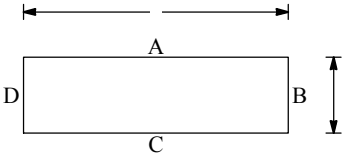
TRIAL PIT LOG

Project				TRIAL PIT No
Proposed Development, Harrogate Street				TP18
Job No	Date	Ground Level (m)	Co-Ordinates ()	
20-794	20-05-21			
Contractor				Sheet
Arc Environmental Limited				1 of 1



STRATA			SAMPLES & TESTS		
Depth	No	DESCRIPTION	Depth	No	Remarks/Tests
0.00-1.10		Grass overlying dark brown sandy gravelly clayey soil with broken bricks and timber (MADE GROUND)	0.00-0.20	J/D	
0.40		Concrete noted on southern portion of trial pit c.0.40m to c.0.60m. Possible relic floor slab / foundation.	0.60-0.80	J/D	
1.10-2.50		Buff completely weathered LIMESTONE recovered as very sandy clayey gravel. Gravels comprise medium to coarse limestone with occasional subrounded limestone cobbles (ROKER FORMATION)	1.40-1.60	B	

Shoring/Support:
Stability:



GENERAL REMARKS

Trial pit remained dry and stable on completion.

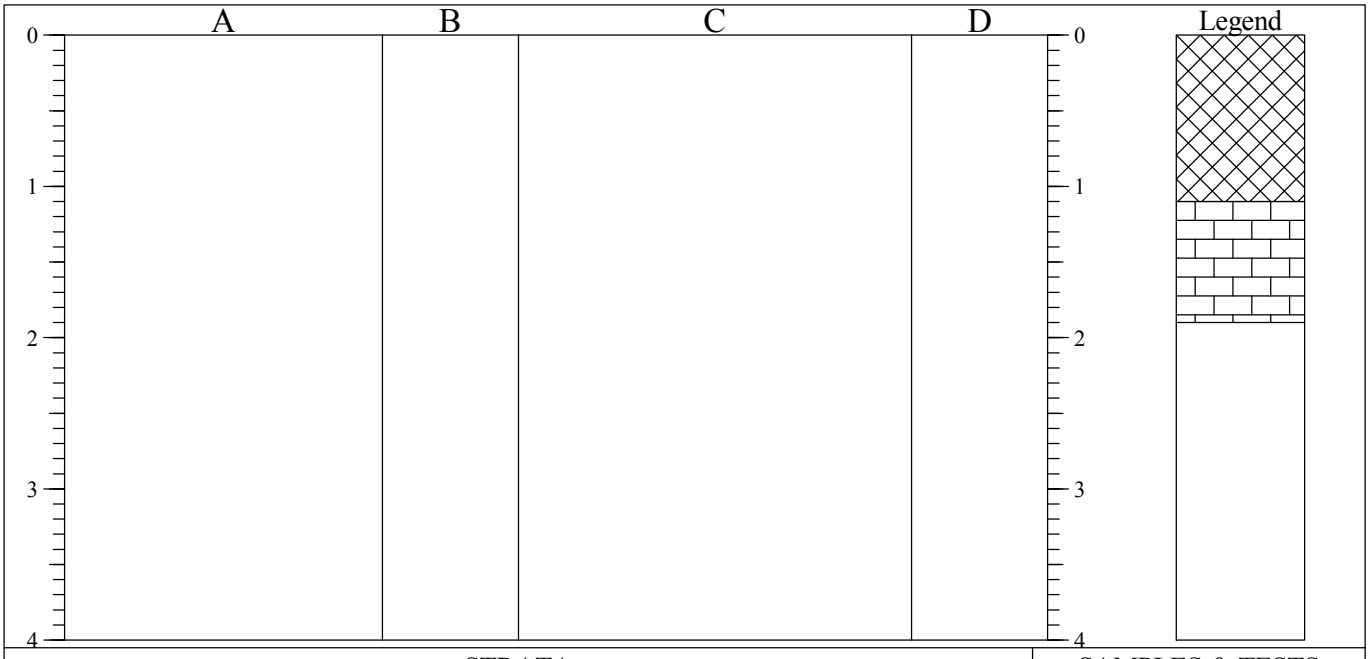
All dimensions in metres Scale 1:50	Client Engie	Method/ Plant Used JCB 3CX	Logged By DMC

AGS3 UK TP 20-794 BH & TP LOGS.GPJ AGS3_ALL.GDT 20/7/21

Solum House, Unit 1 Elliott Court
St Johns Road, Meadowfield
Durham, DH7 8PN
Telephone: 01913786380

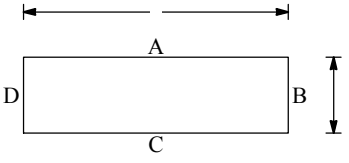
TRIAL PIT LOG

Project				TRIAL PIT No
Proposed Development, Harrogate Street				TP19
Job No	Date	Ground Level (m)	Co-Ordinates ()	
20-794	20-05-21			
Contractor				Sheet
Arc Environmental Limited				1 of 1



STRATA			SAMPLES & TESTS		
Depth	No	DESCRIPTION	Depth	No	Remarks/Tests
0.00-1.10		Grass overlying dark brown sandy gravelly clayey soil with broken bricks, wire and fragments of limestone (MADE GROUND)	0.00-0.25	J/D	
			0.80-1.00	J/D	
1.00		Black cable (electric) noted c.1.00m bgl.			
1.10-1.90		Buff highly weathered LIMESTONE. Becoming more competent with depth (ROKER FORMATION)			
			1.50-1.70	B	

Shoring/Support:
Stability:



GENERAL REMARKS

Trial pit remained dry and stable on completion.

All dimensions in metres Scale 1:50	Client Engie	Method/ Plant Used JCB 3CX	Logged By DMC

AGS3 UK TP 20-794 BH & TP LOGS.GPJ AGS3_ALL.GDT 20/7/21

Solum House, Unit 1 Elliott Court
St Johns Road, Meadowfield
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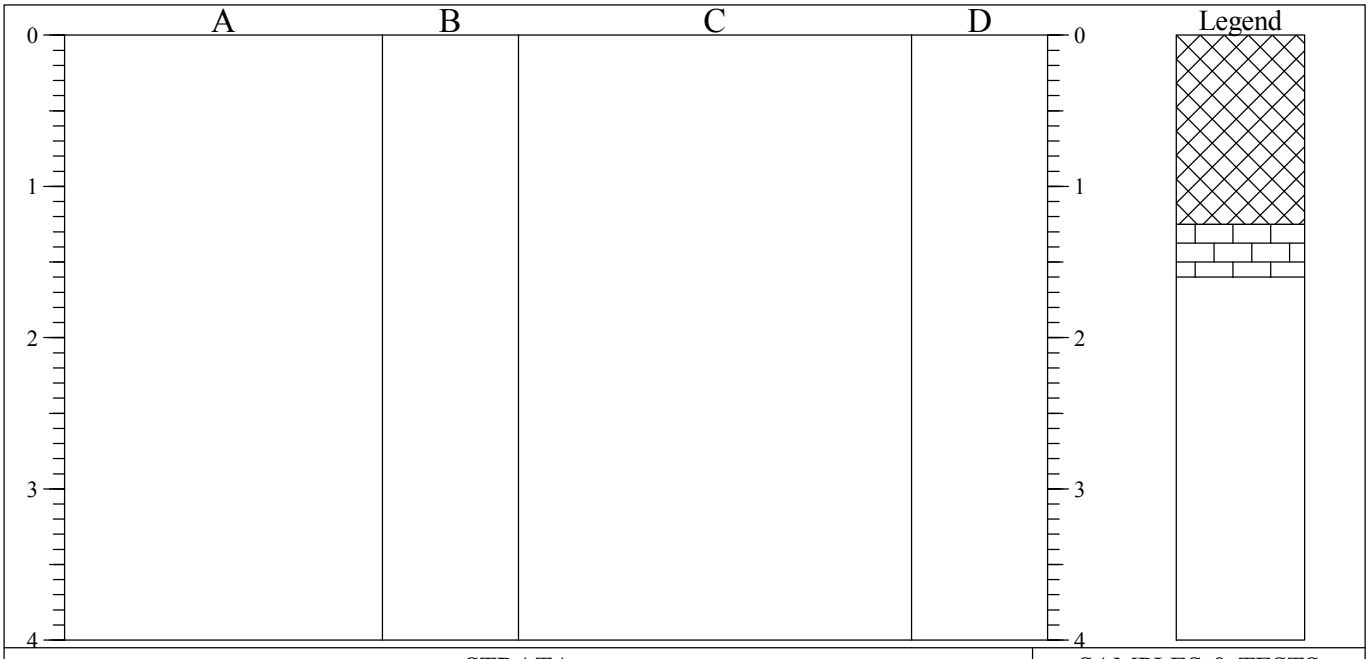
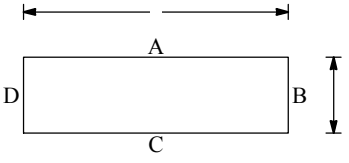
TRIAL PIT LOG

Project				TRIAL PIT No
Proposed Development, Harrogate Street				TP20
Job No	Date	Ground Level (m)	Co-Ordinates ()	
20-794	20-05-21			
Contractor				Sheet
Arc Environmental Limited				1 of 1



STRATA			SAMPLES & TESTS		
Depth	No	DESCRIPTION	Depth	No	Remarks/Tests
0.00-1.25		Grass overlying dark brown sandy gravelly clayey soil with broken bricks, slate and concrete (MADE GROUND)	0.00-0.30	J/D	
			0.70-0.90	J/D	
1.25-1.60		Buff weathered LIMESTONE (ROKER FORMATION)	1.30-1.50	B	

Shoring/Support:
Stability:



GENERAL REMARKS

Trial pit remained dry and stable on completion.

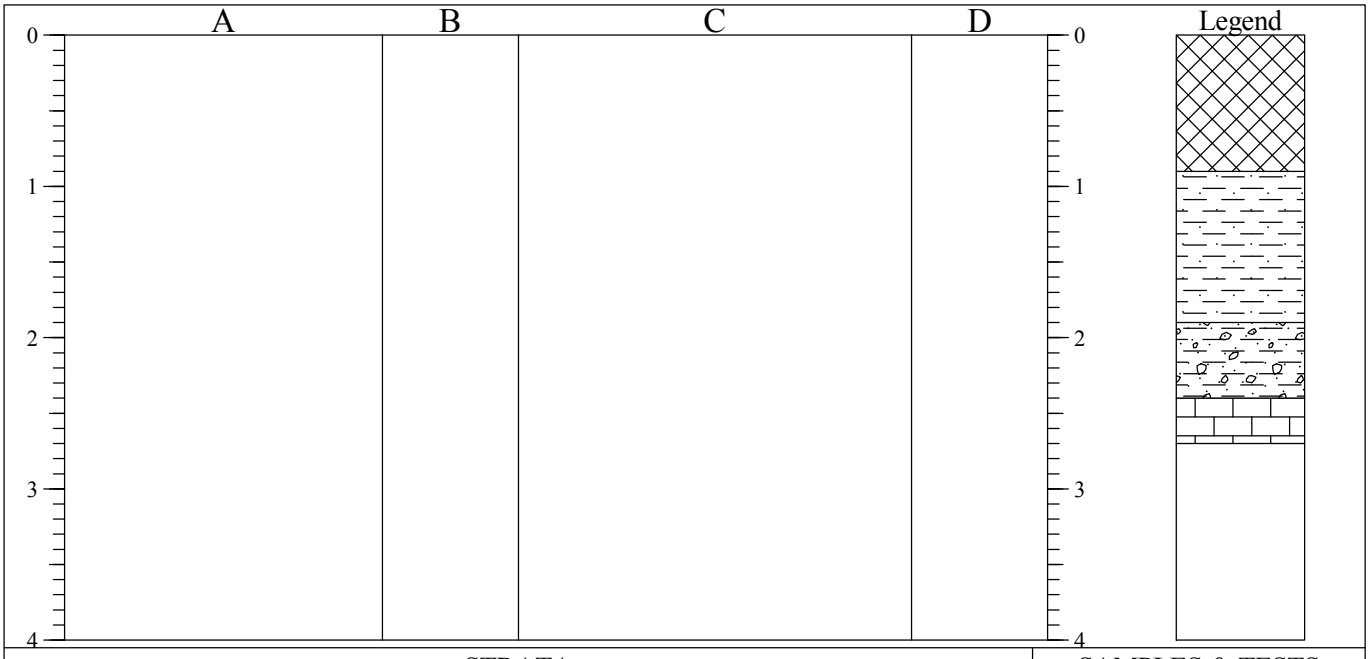
All dimensions in metres Scale 1:50	Client Engie	Method/ Plant Used JCB 3CX	Logged By DMC

AGS3 UK TP 20-794 BH & TP LOGS.GPJ AGS3_ALL.GDT 20/7/21

Solum House, Unit 1 Elliott Court
St Johns Road, Meadowfield
Durham, DH7 8PN
Telephone: 01913786380

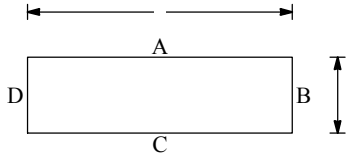
TRIAL PIT LOG

Project				TRIAL PIT No
Proposed Development, Harrogate Street				TP21
Job No	Date	Ground Level (m)	Co-Ordinates ()	
20-794	19-05-21			
Contractor				Sheet
Arc Environmental Limited				1 of 1



STRATA			SAMPLES & TESTS		
Depth	No	DESCRIPTION	Depth	No	Remarks/Tests
0.00-0.90		Grass overlying dark brown sandy gravelly clayey soil broken bricks, concrete, timber and metal (MADE GROUND)			
			0.70	J/D	
0.90-1.90		Firm (medium strength) yellowish brown very sandy CLAY with pockets of very clayey sand (GLACIOLACUSTRINE DEPOSITS)			
			1.20	V	44kN/m^2
			1.50	B	
1.90-2.40		Stiff brown sandy gravelly CLAY. Gravels comprise medium to coarse subangular sandstone (GLACIOLACUSTRINE DEPOSITS)			
			2.20	B	
2.40-2.70		Completely weathered LIMESTONE recovered as a buff slightly clayey sandy gravel. Gravels comprise medium to coarse limestone with occasional subrounded limestone cobbles (ROKER FORMATION)	2.50	B	

Shoring/Support:
Stability:



GENERAL REMARKS

Trial pit remained dry and stable on completion.

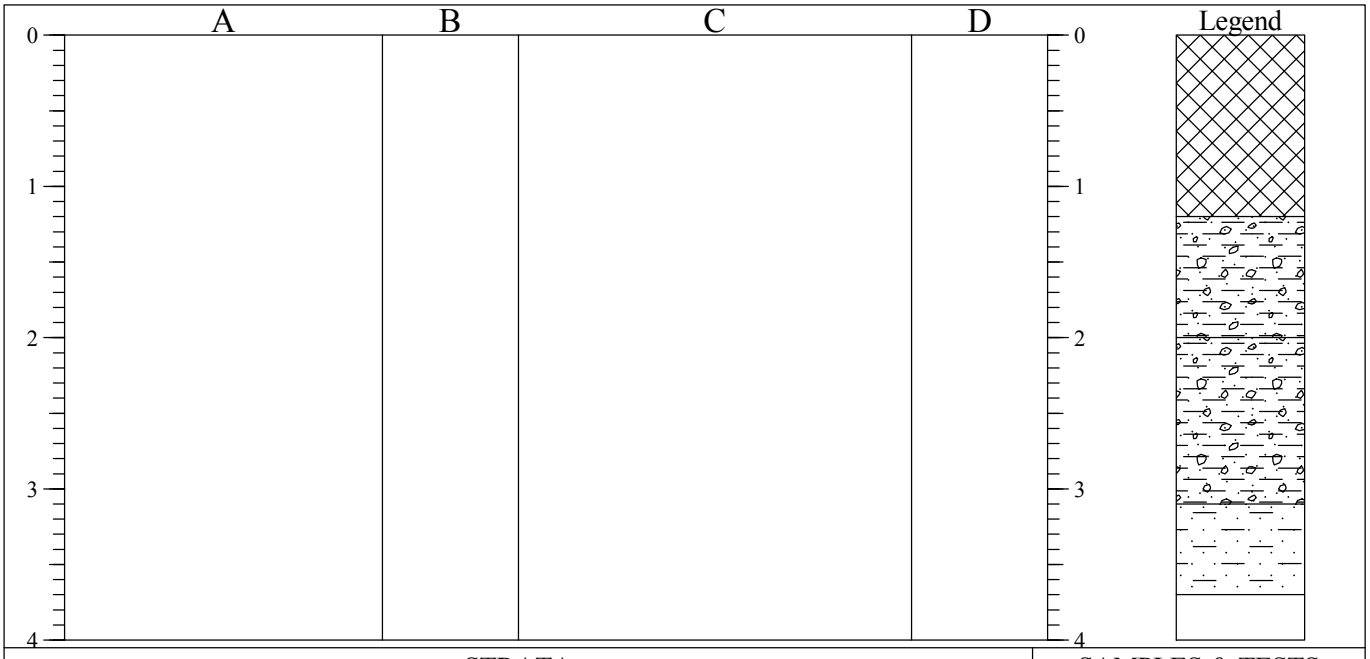
All dimensions in metres Scale 1:50	Client Engie	Method/ Plant Used JCB 3CX	Logged By LJ

AGS3 UK TP 20-794 BH & TP LOGS.GPJ AGS3_ALL.GDT 20/7/21

Solum House, Unit 1 Elliott Court
St Johns Road, Meadowfield
Durham, DH7 8PN
Telephone: 01913786380

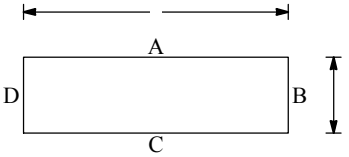
TRIAL PIT LOG

Project				TRIAL PIT No
Proposed Development, Harrogate Street				TP22
Job No	Date	Ground Level (m)	Co-Ordinates ()	
20-794	19-05-21			
Contractor				Sheet
Arc Environmental Limited				1 of 1



STRATA			SAMPLES & TESTS		
Depth	No	DESCRIPTION	Depth	No	Remarks/Tests
0.00-1.20		Grass overlying dark brown sandy gravelly clayey soil with broken bricks, concrete, timber and metal (MADE GROUND)	0.60	J/D	
			1.00	J/D	
1.20-2.00		Stiff (high strength) orangish brown sandy gravelly CLAY with occasional pockets of very clayey sand and coal fragments. Gravels comprise medium to coarse limestone with occasional subrounded limestone cobbles (GLACIOLACUSTRINE DEPOSITS)	1.50 1.50	B V	 80kN/m^2
2.00-3.10		Stiff (high strength) greyish brown slightly sandy gravelly CLAY with occasional coal fragments. Gravels comprise medium to coarse limestone with occasional subrounded limestone cobbles (GLACIOLACUSTRINE DEPOSITS)	2.50 2.50	B V	 >120kN/m^2
3.10-3.70		Light brown very clayey fine to medium SAND with laminations of stiff dark grey very sandy clay (GLACIOLACUSTRINE DEPOSITS)	3.50	B	

Shoring/Support:
Stability:



GENERAL REMARKS

Trial pit remained dry and stable on completion.

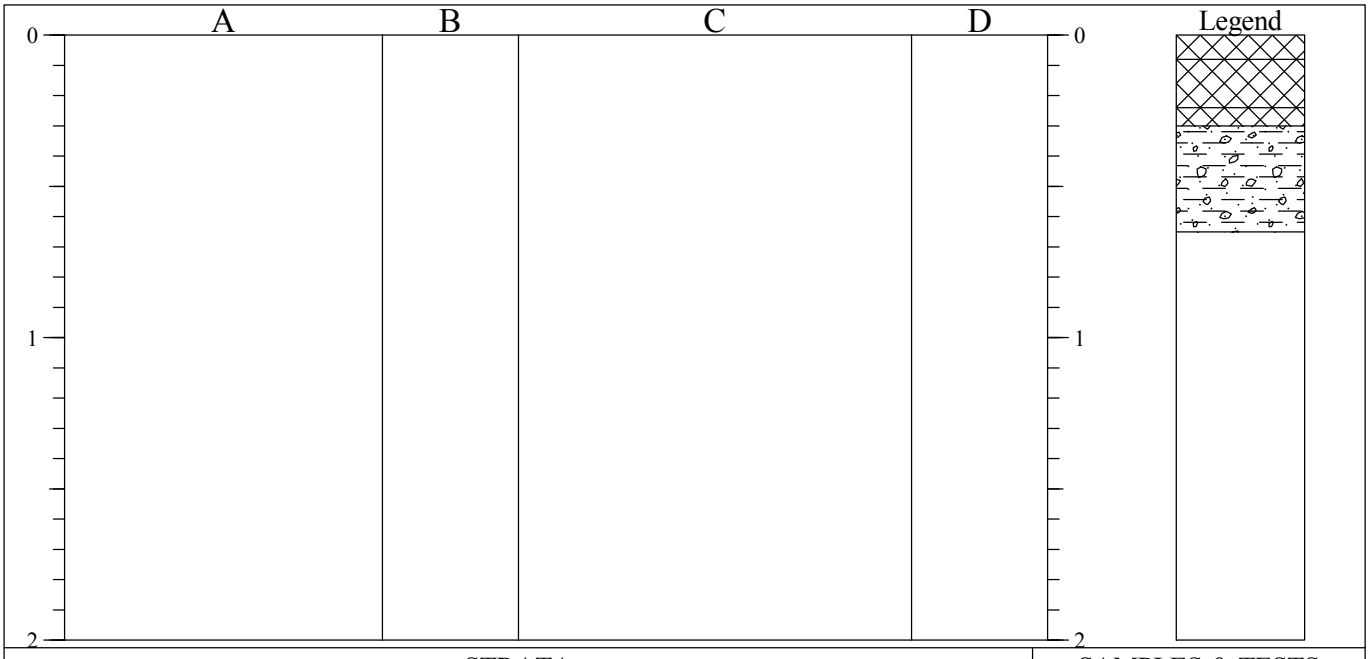
All dimensions in metres Scale 1:50	Client Engie	Method/ Plant Used JCB 3CX	Logged By LJ

AGS3 UK TP 20-794 BH & TP LOGS.GPJ AGS3_ALL.GDT 20/7/21

Solum House, Unit 1 Elliott Court
St Johns Road, Meadowfield
Durham, DH7 8PN
Telephone: 01913786380

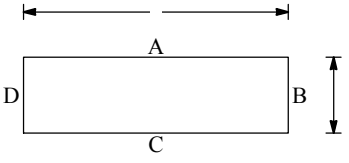
TRIAL PIT LOG

Project				TRIAL PIT No
Proposed Development, Harrogate Street				TPA
Job No	Date	Ground Level (m)	Co-Ordinates ()	
20-794	20-05-21			
Contractor				Sheet
Arc Environmental Limited				1 of 1



STRATA			SAMPLES & TESTS		
Depth	No	DESCRIPTION	Depth	No	Remarks/Tests
0.00-0.08		Black asphalt (MADE GROUND)			
0.08-0.24		Dark grey granite cobbles, remnant cobbled road (MADE GROUND)			
0.24-0.30		Yellowish brown sandy dolostone gravel sub base (MADE GROUND)	0.20-0.30	B	
0.30-0.65		Firm dark brown sandy gravelly CLAY. Gravels comprise medium to coarse subangular sandstone (GLACIOLACUSTRINE DEPOSITS)			
0.52		Trial pit terminated at c.0.52m in natural deposits.			

Shoring/Support:
Stability:



GENERAL REMARKS

WATER: Trial pit remained dry and stable during exploratory period.

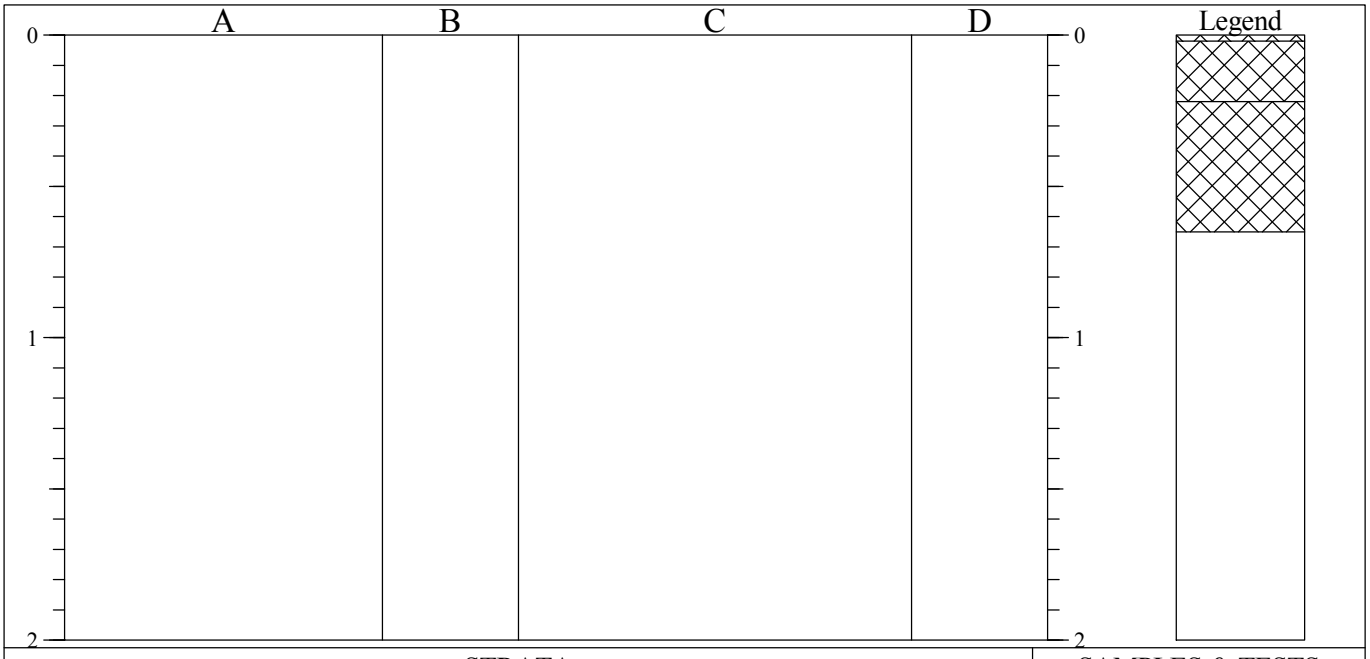
All dimensions in metres Scale 1:25	Client Engie	Method/ Plant Used Manually Excavated	Logged By AB

AGS3 UK TP 20-794 BH & TP LOGS.GPJ AGS3_ALL.GDT 20/7/21

Solum House, Unit 1 Elliott Court
St Johns Road, Meadowfield
Durham, DH7 8PN
Telephone: 01913786380

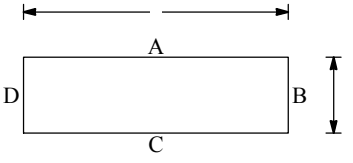
TRIAL PIT LOG

Project				TRIAL PIT No
Proposed Development, Harrogate Street				TPB
Job No	Date	Ground Level (m)	Co-Ordinates ()	
20-794	20-05-21			
Contractor				Sheet
Arc Environmental Limited				1 of 1



STRATA			SAMPLES & TESTS		
Depth	No	DESCRIPTION	Depth	No	Remarks/Tests
0.00-0.02 0.02-0.22		Black asphalt (MADE GROUND) Grey concrete (MADE GROUND)			
0.22-0.65		Yellowish brown sandy dolostone gravel sub base (MADE GROUND)	0.30-0.50	B	
0.65		Trial pit terminated at c.0.65m due to sidewall collapse.			

Shoring/Support:
Stability:



GENERAL REMARKS

WATER: Trial pit remained dry, sidewalls collapsing below c.0.25m bgl.

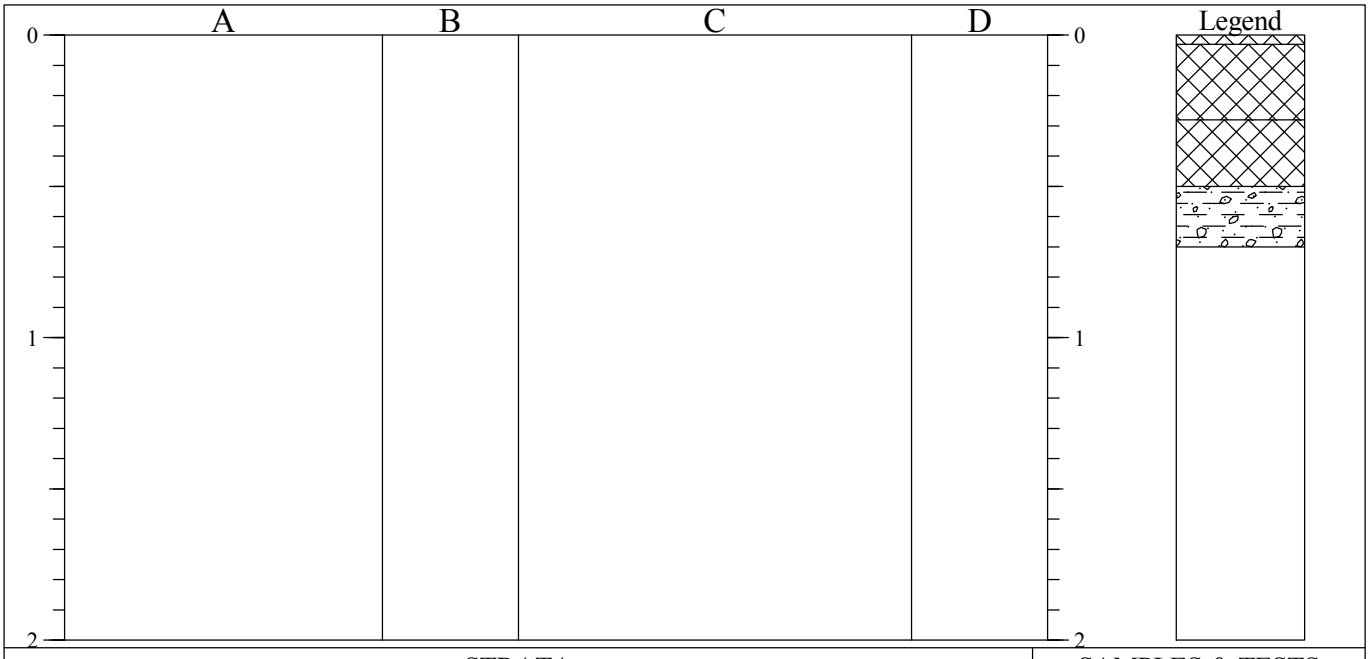
All dimensions in metres Scale 1:25	Client Engie	Method/ Plant Used Manually Excavated	Logged By AB

AGS3 UK TP 20-794 BH & TP LOGS.GPJ AGS3_ALL.GDT 20/7/21

Solum House, Unit 1 Elliott Court
St Johns Road, Meadowfield
Durham, DH7 8PN
Telephone: 01913786380

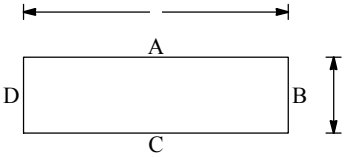
TRIAL PIT LOG

Project				TRIAL PIT No
Proposed Development, Harrogate Street				TPC
Job No	Date	Ground Level (m)	Co-Ordinates ()	
20-794	20-05-21			
Contractor				Sheet
Arc Environmental Limited				1 of 1



STRATA			SAMPLES & TESTS		
Depth	No	DESCRIPTION	Depth	No	Remarks/Tests
0.00-0.03		Black asphalt (MADE GROUND)			
0.03-0.28		Grey concrete (MADE GROUND)			
0.28-0.50		Yellowish brown sandy dolostone gravel sub base (MADE GROUND)	0.30-0.50	B	
0.50-0.70		Firm dark brown sandy gravelly CLAY. Gravels comprise medium to coarse subangular sandstone (GLACIOLACUSTRINE DEPOSITS)			
0.70		Trial pit terminated at c.0.70m in natural deposits.			

Shoring/Support:
Stability:



GENERAL REMARKS

WATER: Trial pit remained dry, sidewalls collapsing below c.0.30m bgl.

All dimensions in metres Scale 1:25	Client Engie	Method/ Plant Used Manually Excavated	Logged By AB

AGS3 UK TP 20-794 BH & TP LOGS.GPJ AGS3_ALL.GDT 20/7/21

Solum House, Unit 1 Elliott Court
St Johns Road, Meadowfield
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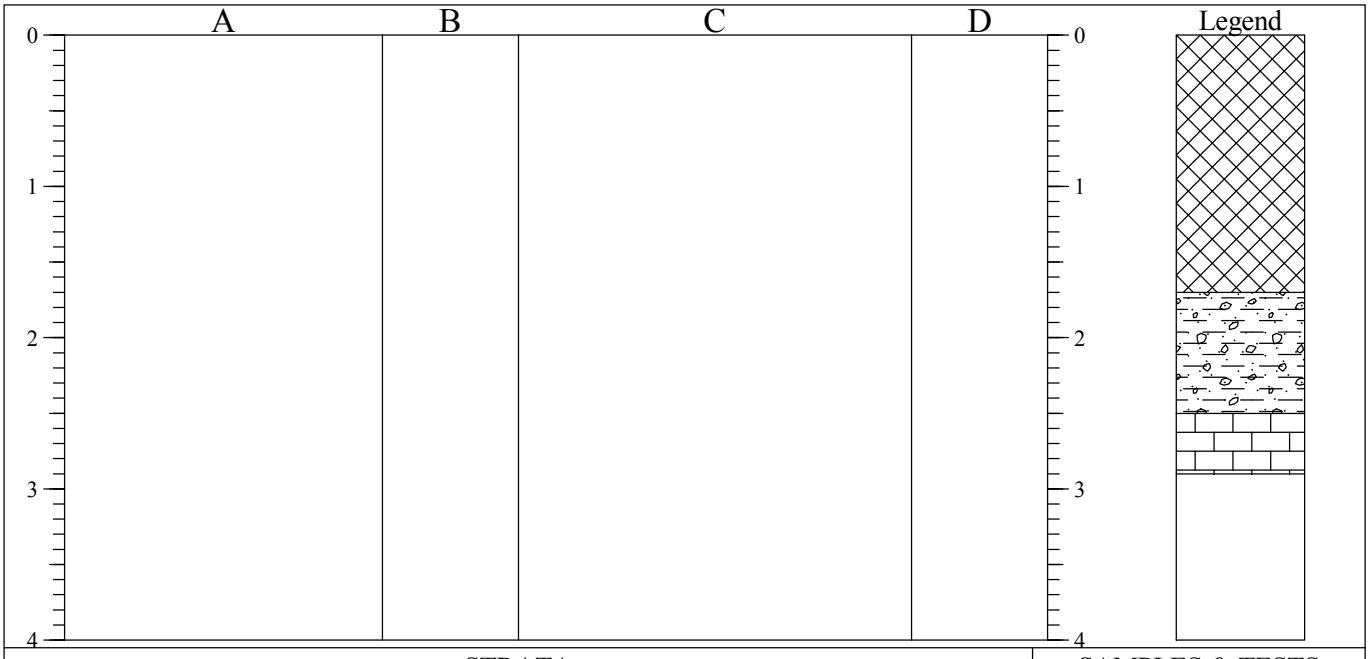
Telephone: 01913786380

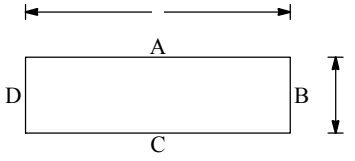
TRIAL PIT LOG

Project				TRIAL PIT No
Proposed Development, Harrogate Street				TT01
Job No	Date	Ground Level (m)	Co-Ordinates ()	
20-794	19-05-21			
Contractor				Sheet
Arc Environmental Limited				1 of 1



STRATA			SAMPLES & TESTS		
Depth	No	DESCRIPTION	Depth	No	Remarks/Tests
0.00-1.70		Grass overlying dark brown sandy gravelly clayey soil with broken bricks, concrete, timber and metal (MADE GROUND)			
			1.00	J/D	
1.30		Brick foundation to 1.30m in northern 5m of trial trench			
1.70-2.50		Stiff (high strength) orangish brown sandy gravelly CLAY with occasional pockets of very clayey sand. Gravels comprise medium to coarse limestone with occasional subrounded limestone cobbles (GLACIOLACUSTRINE DEPOSITS)	1.60	B	
			2.00	B	
			2.00	V	100kN/m^2
2.50-2.90		Buff LIMESTONE with honeycomb weathering and occasional clay infilling (ROKER FORMATION)			

Shoring/Support:
Stability:



GENERAL REMARKS

Trial trench remained dry and stable on completion.

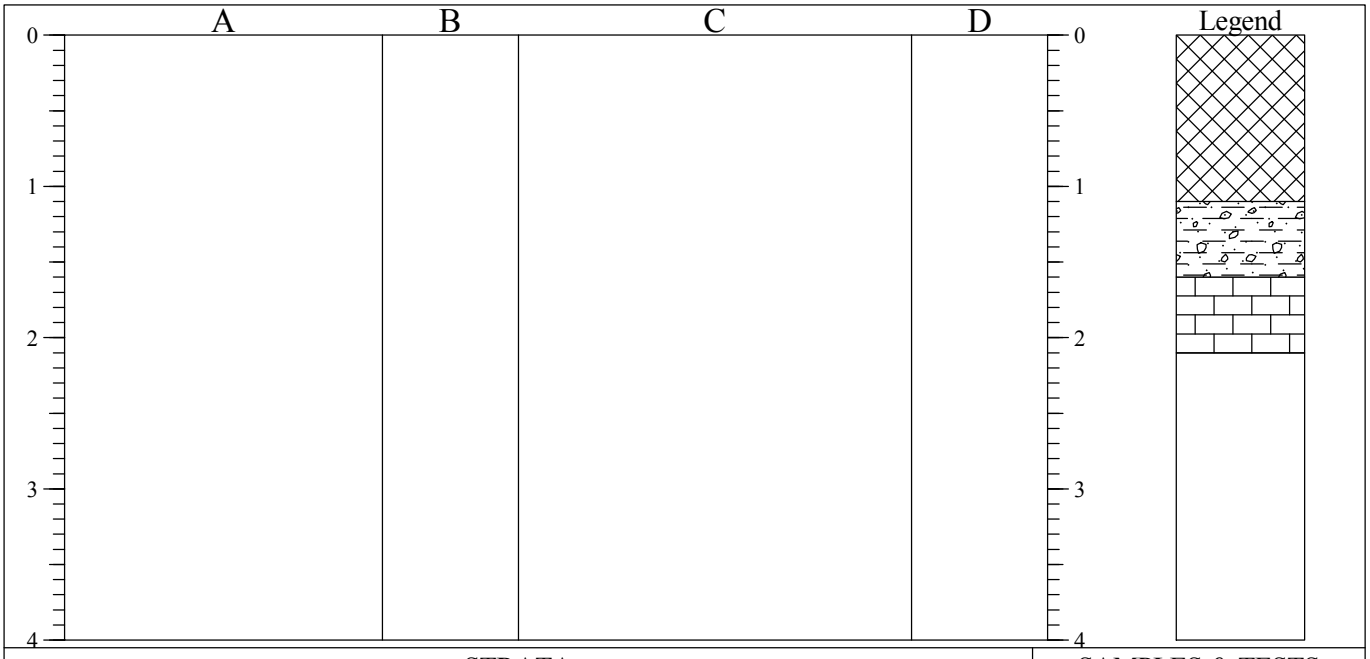
All dimensions in metres Scale 1:50	Client Engie	Method/ Plant Used JCB 3CX	Logged By LJ

AGS3 UK TP 20-794 BH & TP LOGS.GPJ AGS3_ALL.GDT 20/7/21

Solum House, Unit 1 Elliott Court
St Johns Road, Meadowfield
Durham, DH7 8PN
Telephone: 01913786380

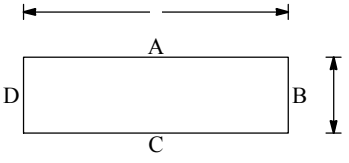
TRIAL PIT LOG

Project				TRIAL PIT No
Proposed Development, Harrogate Street				TT02
Job No	Date	Ground Level (m)	Co-Ordinates ()	
20-794	19-05-21			
Contractor				Sheet
Arc Environmental Limited				1 of 1



STRATA			SAMPLES & TESTS		
Depth	No	DESCRIPTION	Depth	No	Remarks/Tests
0.00-1.10		Grass overlying dark brown sandy gravelly clayey soil with broken bricks, concrete, timber and metal (MADE GROUND)	0.75	J/D	
1.10-1.60		Firm (locally soft) orangish brown very sandy slightly gravelly CLAY with pockets of very clayey sand. Gravels comprise medium to coarse subangular sandstone (GLACIOLACUSTRINE DEPOSITS)	1.20	B	
1.60-2.10		Buff LIMESTONE with honeycomb weathering and occasional clay infilling (ROKER FORMATION)	2.00	B	

Shoring/Support:
Stability:



GENERAL REMARKS

Trial trench remained dry and stable on completion.

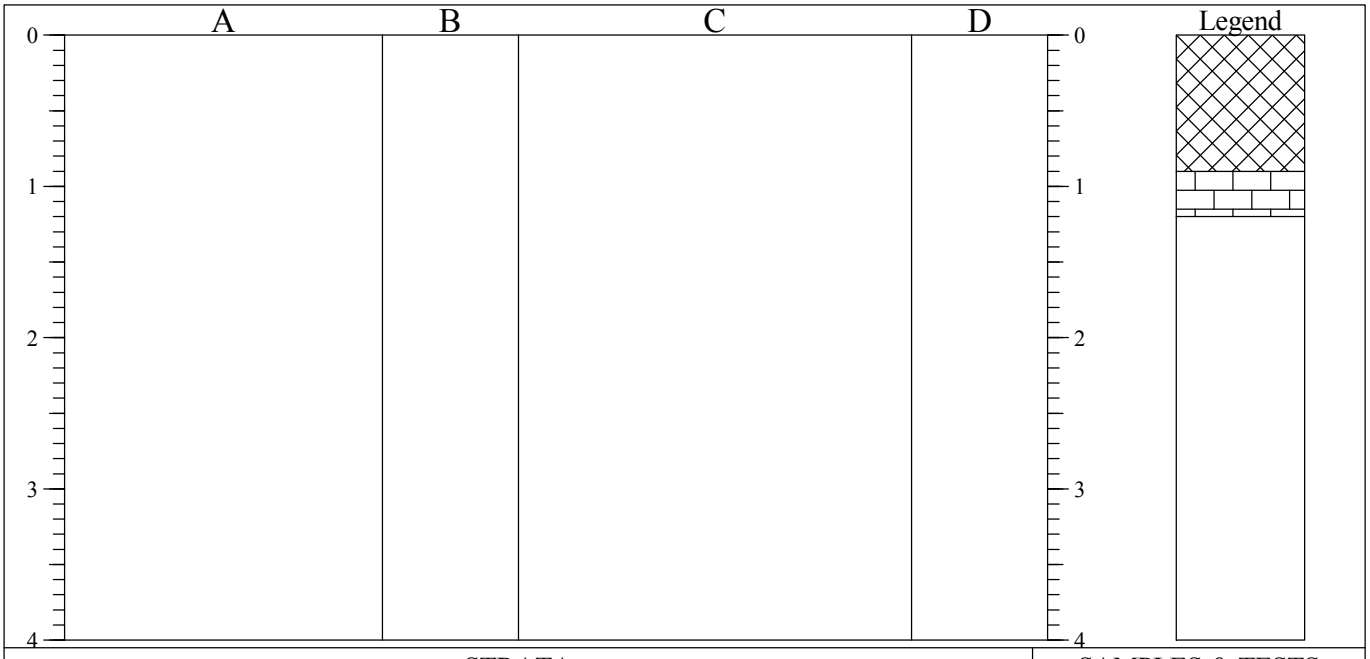
All dimensions in metres Scale 1:50	Client Engie	Method/ Plant Used JCB 3CX	Logged By LJ

AGS3 UK TP 20-794 BH & TP LOGS.GPJ AGS3_ALL.GDT 20/7/21

Solum House, Unit 1 Elliott Court
St Johns Road, Meadowfield
Durham, DH7 8PN
Telephone: 01913786380

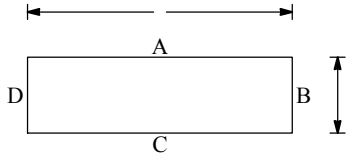
TRIAL PIT LOG

Project				TRIAL PIT No
Proposed Development, Harrogate Street				TT03
Job No	Date	Ground Level (m)	Co-Ordinates ()	
20-794	20-05-21			
Contractor				Sheet
Arc Environmental Limited				1 of 1



STRATA			SAMPLES & TESTS		
Depth	No	DESCRIPTION	Depth	No	Remarks/Tests
0.00-0.90		Grass overlying dark brown sandy gravelly clayey soil with broken bricks and occasional large concrete boulders (MADE GROUND)			
0.90-1.20		Buff weathered LIMESTONE (ROKER FORMATION)			

Shoring/Support:
Stability:



GENERAL REMARKS

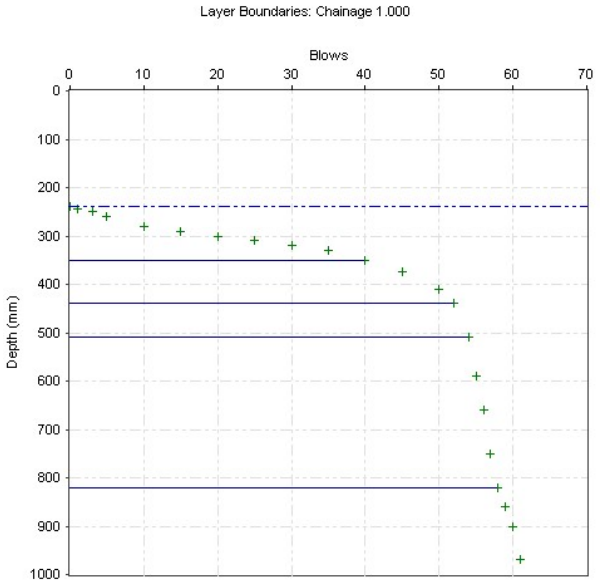
Trial pit remained dry and stable on completion.

All dimensions in metres Scale 1:50	Client Engie	Method/ Plant Used JCB 3CX	Logged By DMC

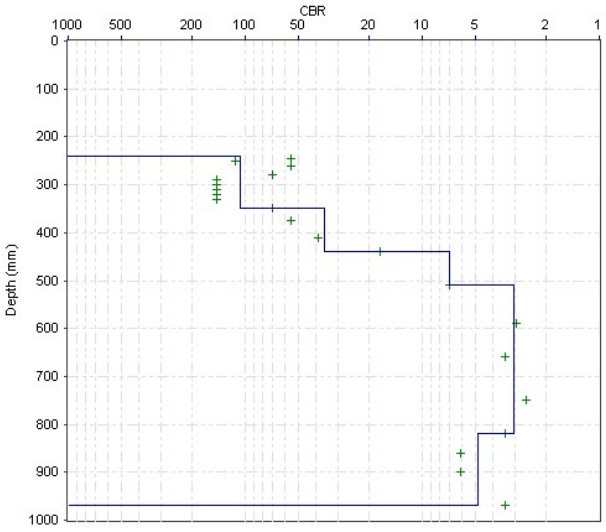
DCP Layer Strength Analysis Report

Project Name: 20-794 Harrogate Street DCPs

Chainage (km):	TPA/DCPA	Surface Type:	Hot Mixed Asphalt
Direction:		Thickness (mm):	240
Location/Offset:	Lay-by / other	Strength Coeff.:	0.40
Cone Angle:	60 degrees	Base Type:	
Zero Error (mm):	0	Thickness (mm):	
Test Date:	19/05/2021	Strength Coeff.:	



Layer Boundaries Chart



CBR Chart

Layer Properties

No.	Penetration Rate (mm/blow)	CBR (%)	Thickness (mm)	Depth to layer bottom (mm)
1	2.69	106	110	350
2	7.50	36	90	440
3	35.00	7	70	510
4	77.50	3	310	820
5	50.00	5	150	970

CBR Relationship:

TRL equation: $\log_{10}(CBR) = 2.48 - 1.057 \times \log_{10}(Strength)$

Report produced by .....