

Phase 2 Ground Investigation

LAND OFF EAST STREET, READING



WB04333/R3

STUDIOUS DEVELOPMENT (READING) LTD

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WB04333/R3	05/12/18

Project
Land at East Street, Reading – New Student Apartment Block

Client Name
Studios Development (Reading) Ltd

Issue Date/ Number	Status	Description of Amendments
16 December 2016	Final	-
28 September 2018	Final	Development plans and client name changes.
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EXECUTIVE SUMMARY

Client	Studios Development (Reading) Ltd																												
Site and Location	The site is located in the centre of the town of Reading at approximate National Grid Reference E471870, N173150																												
Proposals	Proposed change of use of existing office car park and development of site for new purpose built 4 storey student accommodation building with basement.																												
History of Site and Surroundings	Site The site has undergone moderate developments since the earliest available maps. Until the 1990s the site was predominantly used as residential gardens for the adjacent houses and shops to the west. In the 1950s a tank appeared in the centre of the site and after 1993 a sub-station appeared. East Street has formed the eastern site edge since the earliest available maps. A small retaining wall lies in the north of the site. Surroundings In the 1950s a printing works was developed immediately north of the site. The site surroundings include a brewery immediately east of the site, as well as industrial developments north of Queen's Road (thus down likely hydraulic gradient)(including a Lead and Zinc works) before being converted to a car park in the 1960s, the change of use of the Royal Brewery in the 1960s to a warehouse and then again the 1990s to a garage. To the west of the site has been occupied by shops for the majority of the site history while to the south of the site was developed in the 1930s to include a 'works' and in the 1970s to include a large factory. 2nr other garages and a print works have lain near the site.																												
Ground Conditions	<table><tr><th rowspan="2">Strata</th><th colspan="2">Depth Encountered (mBGL)</th><th rowspan="2">Typical Thickness (m)</th></tr><tr><th>Top</th><th>Bottom</th></tr><tr><td>Made Ground</td><td>0</td><td>0.90 – 3.80</td><td>2.00</td></tr><tr><td>Kempton Park Gravel (medium dense sandy gravel)</td><td>0.90</td><td>2.20</td><td>1.30</td></tr><tr><td>Taplow Gravel Member (medium dense gravel with some cobbles)</td><td>1.90 – 2.70</td><td>3.10 – 7.00</td><td>2.50</td></tr><tr><td>Weathered Seaford Chalk Formation</td><td>2.20 – 7.00</td><td>7.50 – 15.50</td><td>7.50</td></tr><tr><td>Seaford Chalk Formation</td><td>7.50 – 15.50</td><td colspan="2">Unproven</td></tr></table>	Strata	Depth Encountered (mBGL)		Typical Thickness (m)	Top	Bottom	Made Ground	0	0.90 – 3.80	2.00	Kempton Park Gravel (medium dense sandy gravel)	0.90	2.20	1.30	Taplow Gravel Member (medium dense gravel with some cobbles)	1.90 – 2.70	3.10 – 7.00	2.50	Weathered Seaford Chalk Formation	2.20 – 7.00	7.50 – 15.50	7.50	Seaford Chalk Formation	7.50 – 15.50	Unproven			
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Seaford Chalk Formation	7.50 – 15.50	Unproven																											
Hydrogeology & Hydrology	The nearest surface water is 90m north east. In 1994 groundwater lay at 12m depth but this could be an error and 3-4m was expected. Groundwater has now been found to stand at 4-6m depth The superficial deposits are Secondary (A) aquifers, while the bedrock geology is a Principle aquifer. The site is not located within or significantly near to a Source Protection Zone. A risk of Clearwater Flooding has been highlighted within 50m of the wider site's boundary. The RoFRaS is low.																												
Geotechnical Considerations	UXO specialists suggest no UXO risk on site. A small retaining wall separates BH2 from the rest of the site. The base of the made ground varies from 38-40mOD. Taplow Gravel thickness varied significantly (1.2m to 4.3m) over the short distance between BH4 and 1994 BH4. The surface of the chalk is generally at about 38-39mODm except in 1994 BH4 where the Taplow Gravel cuts deeper into the chalk. The surface of the structured chalk appears to lie at 27-30mOD, except for BH1 where it appears to be much shallower at 34.5mOD.																												

Geotechnical Considerations ...contd	Excavations • Should remain dry. Above standing groundwater level, any water should be controllable by sump pumping; • Temporary excavations in the granular made ground and natural soils may not stand unsupported in the short term at gradients of 1 in 2 and therefore may require shoring. • Should be possible to >2m with conventional earthmoving plant. Breakers are likely to be required to remove existing foundations and masonry obstructions • Granular MG and the natural sands/gravels could be reused as engineered fill. • Assessment of the addition of a basement to the development, has not formed part of this study. Foundations • Based on our experience and a worst case assumption of a reinforced concrete frame, calculations give column loads of up to 3125kN. • The natural gravels are either too thin to provide sufficient bearing, or are absent from 2nr of 5nr locations and thus based on the ground conditions and site proposals, a piled foundation solution is required. • 5nr 300mm diameter or 3nr 600mm diameter, piles should provide the required capacity per column, by about 15.5m and 14m depths respectively. • Assessment of the addition of a basement to the development, has not formed part of this study. Ground Floor Slabs • Ground bearing or suspended floor slabs may be used. Road Pavements • Based on the general characteristics of the Made Ground, the characteristic design value for pavements, parking and hardstanding areas is CBR ~15%, but we recommend 8% until proven otherwise. • The chalk is frost susceptible. Drainage • See separate Clarkebond drainage assessment. Ground Aggressivity to Buried Concrete • Design Sulphate Class DS-1 and ACEC classes AC-1s and AC-1, above and below groundwater respectively.
Environmental Considerations	• Anthropogenic components of the made ground comprise fragments of brick, and occasional ash. • There were no visual or olfactory indications of contamination noted during the site works, nor during monitoring. • No phenol traces were found, compared to the elevated water results of 1994. • This investigation has found no risks from the proposed redevelopment to humans, plants, nor groundwater. • The local water supply company should accept the use of either PVC or PE water supply pipe materials on site. • No protection is required for radon, ground gas and chemical vapours.
Surplus Soils	• There is unlikely to be any scope to reuse soils on site. • Natural soils can most likely be reused on other development/construction sites (subject to a DoWCoP or U1 waste assessment). • Made ground <u>cannot</u> be transferred to other development/construction sites and should ideally go to a soil treatment facility (to avoid Landfill Tax). • The made ground appears to class as Inert waste if disposed of to landfill.
Outline Strategy for Remediation and Risk Reduction	• A watch should be kept for any other unforeseen contamination • Site, landscape and maintenance workers should wear gloves, boots and overalls and wash their hands before eating, drinking and smoking. Excessive dust generation should be avoided.

1.0 INTRODUCTION

1.1 Instruction and Brief

Clarkebond (UK) Limited (CB) was commissioned by Studios Development (Reading) Ltd to undertake a Phase 2 GeoEnvironmental Investigation on a site known as Land off East Street, Reading.

Clarkebond have previously completed two desk studies, one on the site, and one which focussed on the two existing office buildings to the north. They are respectively:

- *Phase 1 Preliminary Risk Assessment, Land at East Street, Reading*, Ref WB04333/R2, By Clarkebond for Studios Development (Reading) Ltd, Dec 2016.
- *Phase 1 Preliminary Risk Assessment, New Century Place*, Ref WB04333/R1, By Clarkebond for Studios Development (Reading) Ltd, Dec 2016.

This Phase 2 GeoEnvironmental Report is aimed at the geotechnical and GeoEnvironmental risks associated with a change of use of existing office car park and development of site for new purpose built student accommodation comprising a four storey building with basement, holding 108 studio bedrooms, plus all ancillary landscaping works. Plans are included as Appendix A.

1.2 Scope of Works

The objectives of the investigation were to determine the sub-surface conditions in respect of:

- Foundations for proposed structures.
- Design guidance for car park construction.
- Parameters for potential pile design
- Floor slabs.
- Contamination assessment to consider potential significant pollutant linkages arising from the historic land uses on and off site.
- Gas monitoring to consider risk of gas migration from made ground and chalk.
- Assessment of near surface materials for waste classification to allow cost prediction for off-site disposal.

Assessment of the additional basement to the development, has not formed part of this study.

1.3 Limitations

This report is provided for the benefit only of Studios Development (Reading) Ltd and Studios Reading Ltd and we do not accept responsibility to any third party for the whole or any part of the contents and we exercise no duty of care in relation to this report to any third party.

Subsoils are inherently variable and by their very nature are hidden from view such that no investigation can be exhaustive to the extent that all soil conditions are revealed. Conditions may therefore be present beneath the site that were not apparent from the data available for review. Similarly, this assessment has been based to some extent on third party data acquired and such data has been taken at face value and has not been subjected to any third party validation.

Unless specifically noted to the contrary, it should be assumed that this report has not been submitted to any regulatory authorities for approval.

2.0 PHASE 1 REVIEW

2.1 Introduction

Historic assessments have already been undertaken on site and reports for them have been provided by the client to CB as follows:

- *Geotechnical Report, Brewery Site Queens Road Reading Berkshire*, on behalf of Fenchurch Estates Limited. Dated August 1994, Ref: 11459.
- *Supplementary Geotechnical Report, Queens Road Reading, Berkshire*, on behalf of Uberior Moninees (Gulliver D.P.D.T) Limited. Dated September 1994, Ref: 11527.

For this site and an adjacent area, 4nr cable percussion boreholes were drilled to 20m depth and 6nr trial pits were excavated to 1.7-4.5m depth. Of these exploratory holes only BH4 was drilled beneath the proposed new student accommodation block.

All reports were for the sole and exclusive use of the named parties and we assume that Studios now have the benefit of such reports. Significant aspects of the reports are summarised in this report.

2.2 Site Location and Description

The site is located in the centre of the town of Reading at approximate National Grid Reference E471870, N173150. A site location plan is presented as Figure 2.1 and the site boundary is shown in red in Appendix E.

The site was visited in August 2016 and the following site description completed. The site comprises a car park which serves the existing two office buildings, north and north east of the site. The car park comprises brick paving with minor landscaping. A substation lies in the north east corner of the site. The weather at the time was overcast.

- The site covers an area of roughly 0.15ha.
- The site is generally level, however the northern strip of the site is roughly 1.5m lower than the rest of the car park to the south, this is facilitated by a small retaining wall.
- No evidence of contamination was noted on site.

This proposed new student apartment block site is bounded as follows:

Table 2.1 – Site Surroundings

North	Two multi-storey office buildings beyond which lies Queen's Road.
West	Car parking (2-3m higher than the site) beyond which are shops and a pub
South	Multi-storey residential buildings, beyond which lies South Street
East	Multi-storey residential buildings, beyond which are industrial units

2.3 Geology

The geology of the site is shown on the maps obtained from the Groundsure report which are extracted from the British Geological Survey Digital Geological Map of Great Britain at 1:50,000 scale.

This indicates that the site is directly underlain by the Taplow Gravel Member (belonging to the Maidenhead Formation) at the southern extremity of the site. This is underlain by the Seaford Chalk Formation of Upper Cretaceous age (solid geology). Gravel appears absent in the north of the site.

The BGS Lexicon describes:

- The **Taplow Gravel Member** as “Sand and gravel, locally with lenses of silt, clay or peat. [Generic description].”
- And the **Seaford Chalk Formation** as “Firm white chalk with conspicuous semi-continuous nodular and tabular flint seams. Hardgrounds and thin marls are known from the lowest beds. Some flint nodules are large to very large.”

2.4 Hydrology, Hydrogeology and Flood Risk

The nearest surface water feature is the River Gunter's, 90m north east. This river is believed to be tributary to the River Kennet which lies, at its closest point, 103m north. Clarkebond undertook a Flood Risk assessment for the proposed development and concluded the sensitivity of fluvial risks to the site is deemed to be **Low**.

In 1994 groundwater was encountered at roughly 12m depth in BH4. Boreholes BH1-BH3 north of the site encountered much shallower groundwater (3-4m). This could indicate 2nr water tables, one in the north associated with the River and (a deeper) one in the south, with groundwater in the north flowing northwards and groundwater in the south flowing southwards. It could also be inaccuracies in BH4 water logging.

Guidance from the Environment Agency indicates that the Taplow Gravel Member is designated as a Secondary (A) Aquifer, while the Seaford Chalk Formation is designated as a Principle Aquifer. As such the groundwater sensitivity is regarded as **high**.

The nearest licensed groundwater abstraction lies 600m north and thus is of **low** sensitivity.

The site is not located within a Source Protection Zone (SPZ), but is 311m NE of a Zone 3.

2.5 Site History

The site has undergone moderate developments since the earliest available maps. Until the 1990s the site was predominantly used as residential gardens for the adjacent houses and shops to the west. In the 1950s a tank appeared in the centre of the site and after 1993 a sub-station appeared. East Street has formed the eastern site edge since the earliest available maps. A small retaining wall lies in the north of the site.

In the 1950s a printing works was developed immediately north of the site. The site surroundings include a brewery immediately east of the site, as well as industrial developments north of Queen's Road (thus down likely hydraulic gradient)(including a **Lead and Zinc works**) before being converted to a car park in the 1960s, the change of use of the Royal Brewery in the 1960s to a warehouse and then again the 1990s to a **garage**. To the west of the site has been occupied by shops for the majority of the site history while to the south of the site was developed in the 1930s to include a '**works**' and in the 1970s to include a **large factory**. 2nr other **garages** and a **print works** have lain near the site.

The local authority supplied the following environmental –type records:

- The tank in the centre of the site was an oil tank, no contamination has been found around it and it was recommended for removal prior to the 1995 development on site.
- The phenol contamination highlighted in the previous site investigation (immediately adjacent to the site (east)) was recommended for remediation via the following method
 - Remove the fill material from this area 3 x 3 x 1 m depth with subsequent testing in the excavation to establish if contamination. It is not known if this took place.

The previous 1994 ground investigation on site found:

- Eight soils samples were taken and no contamination was found.
- A single water sample was taken and recorded a high phenol concentration of 0.08mg/l. These are elevated by today's standards. It is highly likely that the high concentrations of Phenols in the groundwater originate from the off-site brewery.

3.0 PRELIMINARY CONCEPTUAL MODEL & RISK ASSESSMENT

The site characterisation attempts to identify potential previous and existing site sources of contamination. The conceptual model links the identified sources likely to cause significant possibility of significant harm via pathways to identified critical receptors. The conceptual model is therefore based on a number of identified source-pathway-receptor scenarios. For land to be classified as contaminated a significant pollutant linkage will need to be identified which will include each component of the conceptual model. The absence or removal of a source or interception of a pathway will 'break' the pollutant linkage.

The conceptual model is characterised by identification of the following:

- **On-site** sources, which may impact **on-site** receptors via plausible pathways.
- **On-site** sources, which may impact **off-site** receptors via plausible pathways.
- **Off-site** sources, which may impact **on-site** receptors via plausible pathways.

In the event of a change of land use, the planning regime will require assessment of the new site development layout within the context of the sources or risk and introducing new exposure pathways. The assessment is also used to determine if the site, once developed, would class as contaminated land under the definition provided by the Part 2A of the Environment Act 1990 as defined in the Environment Protection Act 1995.

The method used for risk evaluation is qualitative based on interpretation of the available geoenvironmental and geotechnical data in order to provide an overall impression of the potential risks present at the site. This is described in terms of two variables as follows:

- **"Probability"** – being the likelihood that a hazard is present on site or in the surroundings.
- **"Consequence"** – being the potential outcome of the hazard.

The combination of these is used to define the risk. Clearly if a hazard is not present there can be no consequence. Similarly hazards that are potentially present will have different degrees of potential consequence. The combination of the presence of a hazard, and the potential severity of outcome of such a hazard within any event, can be used to manage the approach to management of the risk.

The **probability** (likelihood) of an event can be classified on a four point system using the following terms and definitions based on CIRIA C552:

- **Highly likely:** The event appears very likely in the short term and almost inevitable over the long term, or there is evidence at the receptor of harm or pollution;
- **Likely:** It is probable that an event will occur, or circumstances are such that the event is not inevitable, but possible in the short term and likely over the long term;
- **Low likelihood:** Circumstances are possible under which an event could occur, but it is not certain even in the long term that an event would occur and it is less likely in the short term;
- **Unlikely:** Circumstances are such that it is improbably the event would occur even in the long term.

The **consequence** (severity) can be classified using a similar system also based on CIRIA C552. The terms and definitions relating to consequence are:

- **Severe:** Short term (acute) risk to human health likely to result in 'significant harm'#. Short-term risk of pollution of sensitive water resources. Catastrophic damage to buildings or property. Short term risk to an ecosystem or organism forming part of that ecosystem#;
- **Medium:** Chronic damage to human health ('significant harm'#), pollution of sensitive water resources, significant change in an ecosystem or organism forming part of that ecosystem#;

- **Mild:** Pollution of non-sensitive water resources. Significant damage to crops, buildings, structures and services ('significant harm' #). Damage to sensitive buildings, structures or the environment; and
- **Minor:** Harm, not necessarily significant, but that could result in financial loss or expenditure to resolve. Non-permanent human health effects easily prevented by use of personal protective clothing. Easily repairable damage to buildings, structures and services.

#: Defined in Defra Circular on "Contaminated Land", EPA 1990 Part 2a", 01/2006, September 2006.

Once the probability of an event occurring and its consequence have been classified, a risk category can be assigned as Table 3.1.

Table 3.1 Risk Classification System (CIRIA 552)

		Consequence			
		Severe	Medium	Mild	Minor
Probability	Highly likely	Very high	High	Moderate	Moderate/Low
	Likely	High	Moderate	Moderate/Low	Low
	Low likelihood	Moderate	Moderate/Low	Low	Very Low
	Unlikely	Moderate/Low	Low	Very Low	Very Low

Risk Level	Action
Low to Very Low	None
Moderate to Moderate/Low	Undertake appropriate mitigation measures to reduce the risk level by appropriate on-site practice at little additional cost.
High to Very High	Designers should take such risks into account and avoid or reduce risk level to acceptable levels. Additional resources required.

Tables 3.3 to 3.5 provide a summary of the data reference points, together with an indication of the hazard, probability, consequence and thus degree of risk.

The hazard, consequence and degree of risk all remain as '**potential**' until assessed by intrusive investigation.

In summary the potential sources of risk from Table 3.3 to 3.5 are:

Table 3.2 Potential Risks and Contaminants of Concern

Source of Risk	Contaminants of Concern
Potential liquid/mobile contamination hotspots on site and risk to on-site groundwater and off site water resources	Hydrocarbons from the former tank location. PCBs from sub-station.
Gases/vapours accumulation beneath buildings (risk to humans) originating from potential hydrocarbon hotspots and/or hydrocarbons/organics in the made ground, or phenols (both on and off-site sources).	Hydrocarbons, Organics (e.g. phenols).

Migration risks via groundwater into the site from adjacent sites is unlikely to pose risk due to the likely depth to groundwater (e.g. volatiles from the groundwater). The same applies to hydrocarbon contamination from the off-site garages because they do not immediately abut our site.

Total soil concentrations, hotspots and possible Asbestos containing materials (ACM) in the ground are unlikely to pose significant risk to end –users due to pathways being cut. They do pose a risk to ground workers, but such can be overcome with appropriate PPE.

Planit UXB Ltd were contacted to determine any risks from UXO on site and they confirmed that *In terms of your piling works, there is no bomb risk at all across the site.*

Table 3.3 On-Site to On-Site Source - Pathway - Receptor Model

Source		Pathway	Receptor	Probability	Consequence	Potential Risk? & Ref
General	Hazard					
Total soils concentrations (e.g. heavy metals and hydrocarbons): General impact (made ground) plus from sub-station and tank	Contamination of groundwater	Migration of leachate through unsaturated zone, then Migration through saturated zone/groundwater;	Groundwater	Unlikely (due site's to hard cover)	Medium	Low
		Migration of liquid contaminants (hotspots) #		Low Likelihood	Medium	A1: Low/moderate
	Human health	Ingestion of & dermal contact with soil & household dust; Inhalation of dust (indoor household & outdoor fugitive).	Human beings	Unlikely (due site's to hard cover)	Medium	Low
Gases from degradation of potential petroleum hydrocarbon hotspot at the historic tank location and/or Gases from made ground with organic content, plus chemical vapours (e.g phenols)	Explosion (accumulation of methane and volatiles)	Preferential flow paths into buildings through unsaturated zone , thus Inhalation of indoor vapours/gases and possible explosion.	Human beings	Low Likelihood	Medium	A2: Low/moderate
	Asphyxiation (resulting from elevated levels of carbon dioxide, methane etc).	Preferential flow paths into buildings via piled foundations vibro columns , etc, thus Inhalation of indoor vapours/gases and possible explosion.		Low Likelihood	Medium	A3: Low/moderate
		Inhalation of outdoor vapours/gases.		Unlikely	Medium	Low
Gases originating from the Seaford Chalk Formation (Carbon Dioxide)	Asphyxiation (resulting from elevated levels of carbon dioxide).	Preferential flow paths into buildings via piled foundations	Human beings	Unlikely	Medium	Low
Sub-Station	PCBs & hydrocarbons	Ingestion of and dermal contact	Human beings	Low Likelihood	Medium	A4: Low/moderate

#: Made ground is shallow and thus any contaminated soil is unlikely to lie in the saturated zone and suffer leaching by groundwater.

Table 3.4 On-Site to Off-Site Source - Pathway - Receptor Model

Source		Pathway	Receptor	Probability	Consequence	Potential Risk? & Ref
General	Hazard					
Total soils concentrations (e.g. heavy metals and hydrocarbons): General impact (made ground) from sub-station and tank	Contamination of groundwater	Migration of leachate through saturated zone/groundwater;	Off-site groundwater and/or surface waters, and/or eco-system (i.e. River)	Unlikely (due site's to hard cover)	Medium	Low
	Human health	Inhalation of dust (indoor household & outdoor fugitive).	Adjacent land users	Unlikely (due site's to hard cover)	Medium	Low
Contaminated groundwater due to chemical migration#	Contamination of groundwater	Migration through saturated zone/groundwater	surface waters, and/or eco-system (i.e. River)	Low Likelihood	Medium	B1: Low/moderate
Gases from degradation of potential petroleum hydrocarbon hotspot at the historic tank location and/or Gases from made ground with organic content plus chemical vapours (e.g phenols)	Explosion (accumulation of methane and volatiles)	Preferential flow paths into buildings through unsaturated zone , thus Inhalation of indoor vapours/ gases and possible explosion.	Human beings	Unlikely	Medium	Low
	Asphyxiation (resulting from elevated levels of carbon dioxide, methane etc).	Preferential flow paths into buildings via piled foundations vibro columns , etc, thus Inhalation of indoor vapours/gases and possible explosion.		Unlikely	Medium	Low
		Inhalation of outdoor vapours/gases.		Unlikely	Medium	Low

#: Made ground is shallow and thus any contaminated soil is unlikely to lie in the saturated zone and suffer leaching by groundwater.

Table 3.5

Off-Site to On-Site Source - Pathway - Receptor Model

Source		Pathway	Receptor	Probability	Consequence	Potential Risk? & Ref
General	Hazard					
Phenol (vapours) from adjacent brewery site	Inhalation	Preferential flow paths into buildings through unsaturated zone , thus Inhalation of indoor vapours/gases and possible explosion.	Human beings	Low Likelihood	Medium	C1: Low/moderate
		Preferential flow paths into buildings via piled foundations vibro columns , etc, thus Inhalation of indoor vapours/gases and possible explosion.		Low Likelihood	Medium	C2: Low/moderate
		Inhalation of outdoor vapours/gases.		Unlikely	Medium	Low

4.0 SITE INVESTIGATION

4.1 General

An intrusive site investigation, using cable percussive boreholes was carried out between 5th and 13th November 2016.

The holes are summarised as follows:

Table 4.1 *Exploratory Hole Details*

Exploratory Hole ID	Technique	Hole Depth (mBGL)	Comments & Reasons for Holes
BH1	Cable Percussion	20	Site coverage & installation of monitoring well
BH2		20	Site coverage & installation of monitoring well
BH3		5	Determine the thickness of made round and depth to chalk
BH4		20	Site coverage & installation of monitoring well

A plan showing the exploratory hole locations is presented as Figure 4.1.

Ground levels shown on the logs are estimated from the topographical plans.

4.2 Cable Percussive Boring

4nr boreholes, designated BH1-4 inclusive were advanced to depths between 5m and 20mBGL by a Dando 150 rig between 5th and 13th November 2016. SPTs and representative soil samples were taken at regular intervals for geotechnical and chemical analysis and logged by an onsite engineer.

Detailed log sheets of the cable percussive boreholes are included in Appendix A.

4.3 Backfilling and Installations

On completion holes BH1, BH2 and BH4 were fitted with gas and groundwater monitoring standpipes. The standpipes comprised 50mm diameter UPVC riser pipe with screw connectors. The lower part is slotted to allow the free ingress of water and gas. The annulus between the riser pipe and the borehole wall was filled with pea gravel. The remaining annulus was filled with a cement bentonite grout and a lockable stopcock cover was installed at ground level. Details are shown on the logs.

On completion the remaining holes were backfilled with arisings, as shown on the logs.

4.4 In-Situ Testing and Monitoring

3nr return visits were made to site on the 17, 21 and 29th November 2016. Groundwater levels were measured, as well as gas concentrations. See Appendix B. Groundwater samples were obtained for potential laboratory testing using bailers.

4.5 Sample Collection and Analysis

Samples were submitted for geotechnical laboratory testing to characterise the engineering properties of the soil. The following testing was scheduled:

- Classification tests (Atterberg Limits)
- Moisture Content
- Saturation Moisture Contents

Testing was carried out in accordance with the procedures outlined in BS EN ISO 14688-1:2002, 14688-2:2004 and 14689-1:2003. Geotechnical laboratory test data is presented in Appendix C.

Soil samples were sent for chemical analysis to Chemtest Laboratories to be analysed for:

- **Full suite** comprising arsenic, cadmium, copper, chromium, lead, mercury, nickel, selenium, zinc, Speciated PAH, speciated Total Petroleum Hydrocarbons (TPHCWG), Soil organic matter content (SOM), pH and soluble sulphate.
- **Screen suite** comprising arsenic, cadmium, copper, chromium, lead, mercury, nickel, selenium, zinc, Speciated PAH, speciated Total Petroleum Hydrocarbons (Banded), Soil organic matter content (SOM), pH and soluble sulphate.
- **Full WAC**
- VOC USEPA 624
- 9 Metals
- PCBs
- CrVI
- Total TPH

Water samples were tested for:

- **CB Full Water Suite:** TPHCWG, spec PAH, arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium, zinc, pH, Hardness, sulphate.
- Phenols

Environmental sample collection was carried out in accordance with Clarkebond Standard Operating Procedures and BS EN ISO 22475-1:2006. All soil samples were collected using either clean stainless steel utensils or clean disposable gloves and placed directly into clean containers provided by the laboratory.

The chemical laboratory test results are presented in Appendix D.

5.0 GROUND CONDITIONS

5.1 General

The following table provides a summary of the strata encountered and the depth to the base of each stratum in metres encountered in the exploratory holes.

This section includes the findings of the 1994 BH4 that lies on this site.

Table 5.1 Typical Strata

Strata	Depth Encountered (mBGL)		Typical Thickness (m)	Description & Comments
	Top	Bottom		
Made Ground	0	0.90 – 3.80	2.00	Generally sand or gravel of chert with occasional brick
Kempton Park Gravel (North, BH2 only)	0.90	2.20	1.30	Slightly clayey very sandy gravel of chert and flint.
Taplow Gravel Member (South, BH4 & BH4 1998 only)	1.90 – 2.70	3.10 – 7.00	2.50	Medium to coarse flint gravel. Only found in BH4, in the south of the site.
Weathered Seaford Chalk Formation	2.20 – 7.00	7.50 – 15.50	7.50	Soft to firm putty chalk with flints. Probable grade Dc
Seaford Chalk Formation	7.50 – 15.50	Unproven		Structured chalk with abundant flint nodules

A cross section through the site, from south to north, is given as Figure 5.1.

Groundwater observations are detailed in Section 5.3.

5.2 Strata Encountered

Made Ground

Made ground was encountered across the site, but was thickest in the centre, near BH3; this is shown in Figure 5.1.

Made ground encountered in BH2 comprised only the car park construction (paving stones over building sand over sub base). Elsewhere the material is generally granular in nature and appears to be composed of reworked material deriving from the underlying gravels. Anthropogenic components include only brick. Ash was noted in the 1994 BH4.

Figure 5.1 also shows that the site levels drop at the location of BH2. The increase in site levels across the rest of the site appears to be facilitated by the greater thickness of made ground. The base of the made ground varies from 38-40mOD.

Kempton Park Gravel

The Kempton Park Gravel Formation was only encountered in the north of the site, in BH2; and was recorded as 1.30m thick in this location. The material comprised subrounded very sandy gravel of flint and chert. A single SPT 'N' value for this material is N15 at 1.20m, which classifies the Kempton Park Gravel Formation as medium dense. This is shown in the SPT 'N' vs Level plot contained as Figure 5.2.

Taplow Gravel Formation

The Taplow Gravel Member was only encountered in the south of the site, in BH4, as well as in historic BH4.

It comprises medium to coarse flint gravel with occasional cobbles. SPTs in this material vary little between 23 and 26, and is therefore medium dense.

It was encountered to depths of 3.10m and 7.00m and its thickness varied significantly (1.2m to 4.3m) over the short distance between BH4 and 1994 BH4.

Seaford Chalk Formation

The Seaford Chalk Formation was encountered in all holes beneath the made ground, Taplow Gravel Formation or Kempton Park Gravel Formation.

The surface of the chalk is generally at about 38-39mODm except in 1994 BH4 where the Taplow Gravel cuts deeper into the chalk. The surface of the structured chalk appears to lie at 27-30mOD, except for BH1 where it appears to be much shallower at 34.5mOD.

At shallower depths (of <10.7-11m) the chalk is highly weathered and was recovered as Grade Dc.

Beneath this the chalk was recovered as low density structured chalk (Saturation Moisture content >27.5%, from 3nr tests at 14.5m and 19.55m, see Appendix C), probable Grade B3. This is reflected in the Cable Percussion logs in Appendix A.

5.3 Groundwater

Groundwater observations were as follows:

Table 5.2 Groundwater Observations

Exploratory Hole ID	Ground Level (mOD)	Groundwater during site works		Groundwater post site works					
		Depth, mBGL	Level, mOD	Visit 1		Visit 2		Visit 3	
				Depth, mBGL	Level, mOD	Depth, mBGL	Level, mOD	Depth, mBGL	Level, mOD
BH1	42.00	5.00	37.00	5.84	36.16	5.73	36.27	5.80	36.20
BH2	40.40	4.80	35.60	4.23	36.17	4.14	36.26	4.19	36.21
BH4	42.20	5.00	37.20	5.95	36.25	5.85	36.35	5.89	36.31
BH4 (1994)*	42.20	11.80	30.40						

*Historic Borehole

5.4 Contamination Indications

There were no visual or olfactory indications of contamination noted during the site works, nor during monitoring.

6.0 GEOTECHNICAL ASSESSMENT

6.1 Introduction

The current development proposals are discussed in Section 1.2.

The column loads were requested from the structural engineer but had not been provided by the time of this report.

Based on our experience and a worst case assumption of a reinforced concrete frame, calculations give column loads of up to 3125kN. Assuming piles are required then for:

- 3nr piles per pad this would be ~1100kN/pile.
- 5nr piles per pad this would be ~625kN/pile.

Similarly likely floor slab are unknown, but dead and live loading on the ground floor slabs are likely to be in the order of 12.5kN/m².

6.2 Earthworks

Any areas of particularly poor quality, i.e. wet, soft, loose etc, should be removed from beneath all proposed foundation and hardstanding areas, and the deficit made good with suitable compacted granular fill to an engineering specification. Excavations to 2m depth should be suitable with conventional soil excavating machinery, although pneumatic tools are likely to be required to break out existing foundations and masonry obstructions.

Excavations are likely to be up to 4m depth to facilitate the proposed basement, within which they should encounter primarily granular made ground and/or gravel belonging to the Taplow Gravel Member in the south and Kempton Park Formation in the north.

The made ground is generally granular and if an engineering use can be found on site, then with regulatory approval it may be possible to retain such soil on site. Some soils can be reused on site, but such reuse requires assessment to prove that the soils do not class as “waste” (e.g. a certain, legitimate and pre-determined reuse that does not create new risks), via waste exemption, *Definition of Waste Code of Practice* (DoWCoP) assessment and/or Materials Management Plan. Soils that are “waste” cannot be reused without an exemption or permit (see Section 8.1) and thus must be disposed of to a licensed waste disposal site or a Soil Treatment Hub. It may also be possible to reuse surplus soil on other sites (see Section 8).

It is unlikely that shallow excavations will encounter significant groundwater. Should this happen, excavations can be kept dry by pumping from a conveniently located sump to a nearby sewer. If this is required, a temporary discharge licence will be required from the water authority.

The supplementary investigation completed by Ground Explorations Limited (and reviewed in the Clarkebond desk study) included 3nr trial pits which are approximately in the location of this site. TP2 and TP3 encountered pit side instability and minor spalling within the sand and gravel, believed to belong to the Kempton Park Gravel Formation. Temporary excavations in this formation may thus not stand unsupported in the short term at gradients of 1 in 2 and therefore may require shoring. Excavations below approximately 1m depth will require sheeting and shoring for personnel to enter safely. The stability of all excavations will deteriorate on wetting either from groundwater or surface water. Excavations should therefore be protected from rain and surface water runoff.

Assessment of the addition of a basement to the development, has not formed part of this study.

6.3 Foundation Assessment

The natural gravels are either too thin to provide sufficient bearing (i.e. capacity is driven by the “soft underlying unstructured chalk”), or are absent from 2nr of 5nr locations (thus made ground underlain directly by unstructured chalk) and thus based on the ground conditions and site proposals, a piled foundation solution is required.

Figure 5.1 cross section gives the SPT N values with depth. Based on this, CFA piles of:

- 5nr 300mm diameter driven to 15.5m depth will provide the required 625kN capacity, or
- 3nr 600mm diameter driven to 14m depth will provide the required 1100kN capacity.

See preliminary pile designs as Figure 5.3.

A copy of this report should be provided to suitable piling contractors and they should be asked to demonstrate the suitability of their equipment in these ground conditions. Furthermore, it is recommended that pile integrity and load testing be carried out as part of the quality assurance process.

The guidance should be reviewed if the ground conditions vary significantly from those highlighted in Section 5.

A *Foundation Works Risk Assessment* may also be required for piling works, as may the design for a piling mat.

Assessment of the addition of a basement to the development, has not formed part of this study.

6.4 Floor Slabs

The site is underlain by primarily granular made ground and has been subject to loading for some time. Accordingly, ground bearing or suspended floor slabs may be used.

Any requirements for membranes to be placed within ground floor slabs to protect against ground/landfill gas, chemical vapours, or radon, are discussed in later sections of this report.

6.5 Roads and Pavements

6.5.1 California Bearing Ratio

Based on the general characteristics of the Made Ground, the characteristic design value for pavements, parking and hardstanding areas is CBR ~15%, but until such time as testing confirms then we recommend:

$$\text{CBR}_{(0-1.0\text{mBGL})} = 8\%$$

Further testing carried out when formation level has been reached may increase the design CBR. The results will require confirmation during construction with proof rolling to determine the absence of soft pockets within the formation. In the event that soft pockets are encountered, the soft material should be excavated and replaced with suitable granular material.

6.5.2 Frost Susceptibility

The made ground is primarily granular and thus unlikely to suffer from heave under the action of frost.

Chalk is frost susceptible and will exhibit heave where present at <0.45m below finished ground levels. This is only likely to occur in exposed areas (such as footways).

6.5.3 General

With respect to car parks and lightly trafficked roads that are **not to be adopted**, the Quarry Products Association provides advice for pavement thicknesses under two categories, as indicated in the table overleaf (ref. circular “*Construction and surfacing of parking areas including private drives*”). It is stressed that this advice is tentative, and should be confirmed from local Contractors before being utilised in the works.

Table 6.1 Pavement Design Recommendations (after Quarry Products Association)

		Light Usage e.g. private drives, small office car parks (mm)	Heavier usage e.g. public car parks or areas where risks of indentation, tight turning or on-the- spot power assisted manoeuvring, or stray use of heavier vehicles. (mm)
Sub-base		>75	>75
Road base	Hardcore	150	200
	Dense road base macadam (BS4987)	75	100
Base course	Open graded base course macadam (BS4987)	60	-
	Dense base course macadam (BS4987)	60	60
	Hot rolled asphalt base course (BS4987)	-	60
Wearing course	Fine grained wearing course macadam (BS4987)	20	-
	6mm medium grained macadam (BS4987)	20	-
	6mm dense wearing course (BS4987)	25	-
	10mm open graded macadam (BS4987)	30	-
	Hot rolled asphalt wearing course (BS4987)	-	40
	10mm close graded wearing course macadam (BS4987)	-	30
	6mm dense wearing course macadam (BS4987)	-	25

6.6 Drainage

Soakage testing has not been carried out as part of this investigation, but soakaways could be feasible (subject to testing). Reference should be made to the separate *Drainage Strategy* by Clarkebond.

6.7 Retaining Walls

Retaining walls were not previously considered in the original site investigation scope. Therefore further investigation may be required to carry out the necessary geotechnical testing to provide parameters for basement design.

6.8 BRE Sulphate Analyses

Samples were tested for sulphate suites as outlined in *BRE Special Digest 1, Concrete in Aggressive Ground: 2005*.

The site can be classed as Greenfield¹ and with groundwater lying at 4-6m depth; water conditions are taken to be static above and mobile below.

Soil pH values varying from 7.8 to 9.2 were recorded and from these results a 'Characteristic Value' of 7.8 is derived.

The water-soluble sulphate results were generally <17mg/l but with one result of 450mg/l. The 'Characteristic Value' is therefore 450mg/l and this falls into Design Sulphate Class DS-1 in Table C1 of BRE Special Digest 1 (SD1).

Groundwater pH values were 7.4 and 7.5 and from these results a 'Characteristic Value' of 7.4 is derived.

The groundwater sulphate results were all <100mg/l. The 'Characteristic Value' is therefore 100mg/l and this falls into Design Sulphate Class DS-1 in Table C1.

From the soil and groundwater results the highest sulphate class is DS-1.

The strata on the site are unlikely to be pyritic.

From consideration of the sulphate, pH and groundwater conditions, it is concluded that the Aggressive Chemical Environment for Concrete (ACEC) class is AC-1 where concrete could be contact with groundwater (e.g. below about 4-6m depth) and AC-1s if there is no risk of concrete being in contact with groundwater. The designer should utilise these classifications in order to produce the concrete specification.

¹ The definition of "Brownfield" adopted by SD1 is one that has been *subject to industrial development, storage of chemicals, or deposition of waste, and which may contain aggressive chemicals in residual surface materials or in ground penetrated by leachates*.

7.0 CONTAMINATION ASSESSMENT

7.1 Soil Risks to Humans

The redevelopment is essentially hardcover, therefore the analytical data has initially been compared against the relevant available guidelines for **residential without plant uptake** end-use to identify chemicals of potential concern.

Metals

The following table summarises the results (**Bold** and/or highlight shows exceedances):

Table 7.1 Values for Metals in Soils

Compound	Number of samples	Maximum values (mg/kg)	SGV or GAC (Residential without plant uptake) mg/kg
Arsenic	6	27	40
Cadmium	6	0.87	85
Chromium	6	27	910
Copper	6	33	7100
Lead	6	190	310
Mercury (Inorganic)	6	0.34	56
Nickel	6	28	180
Selenium	6	0.34	430
Zinc	6	90	40000

None of the results exceeded the GAC values for *residential without plant uptake* end-use.

Organics – General

SOM tests were undertaken on 5nr samples. The lowest value has been conservatively taken and a conservative **1% SOM has been adopted** when selecting the Generic Assessment Criteria (GAC) screening values for organics in the following sections.

Organics – TPH

The following table summarises the results (**Bold** and/or highlight shows exceedances):

Table 7.2 Values for Speciated Hydrocarbons in Soils

Compound	Number of samples	Maximum values (mg/kg)	SGV or GAC (1% SOM) mg/kg (Residential without plant uptake)
Aliphatic			
EC 5-6	4	<1.0	42
EC> 6-8	4	<1.0	100
EC> 8-10	4	<1.0	27
EC> 10-12	4	<1.0	130
EC> 12-16	4	<1.0	1100
EC> 16-35	4	<1.0	65000
EC> 35-44	4	<1.0	65000
Aromatic			
EC 5-7(benzene)	4	<1.0	370
EC> 7-8 (toluene)	4	<1.0	860
EC>8-10	4	<1.0	47
EC>10-12	4	<1.0	250
EC>12-16	4	<1.0	1800
EC>16-21	4	<1.0	1900
EC>21-35	4	<1.0	1900
EC>35-44	4	<1.0	1900

None of the results exceeded the GAC values for *residential without plant uptake* end-use.

Organics – PAHs

The following table summarises the results (**Bold** and/or highlight shows exceedances):

Table 7.3 Values for Speciated PAH in Soils

Compound	No. of samples	Maximum values (mg/kg)	GAC (1% SOM) mg/kg (Residential without plant uptake)
Naphthalene	4	<0.10	2.3
Acenaphthylene	4	<0.10	2900
Acenaphthene	4	<0.10	3000
Fluorene	4	<0.10	2800
Phenanthrene	4	<0.10	1300
Anthracene	4	<0.10	31000
Fluoranthene	4	<0.10	1500
Pyrene	4	<0.10	3700
Benzo(a)anthracene	4	<0.10	11
Chrysene	4	<0.10	30
Benzo(b)fluorathene	4	<0.10	3.9
Benzo(k)fluorathene	4	<0.10	110
Benzo(a)pyrene	4	<0.10	3.2
Indeno(123-ed)pyrene	4	<0.10	45
Dibenzo(ah)anthracene	4	<0.10	0.31
Benzo(ghi)perylene	4	<0.10	360

None of the results exceeded the GAC values for *residential without plant uptake* end-use.

Other

PCBs were tested for in 1nr sample (BH2 at 0.5m near sub-station) and the results were below detection limits.

7.2 Soil Risks to Plants (Phytotoxicity)

Copper, nickel and zinc can inhibit plant growth. The GAC for this pollutant linkage (see following table) have been taken from Department of the Environment Publication, *Code of Practice for Agricultural Use of Sewage Sludge*, 1996.

Table 7.4 GAC for Phytotoxic Risks

Compound	Generic Assessment Criteria (mg/kg)			
	pH 5.0 - <5.5	pH 5.5 - <6.0	pH 6.0 - <7.0	pH >7.0
Zinc	200	200	200	300
Copper	80	100	135	200
Nickel	50	60	75	110

The pH results varied from 7.8 to 9.2, as such, concentrations determined of these contaminants did not exceed the stated guidelines for any of the three phytotoxic elements.

7.3 Groundwater Risks to Water Resources

Groundwater samples have been collected from Boreholes BH1 and BH2 and tested for a range of contaminants.

Because the nearest critical receptor is the underlying aquifer and hence current or future nearby water abstractions, then the results of groundwater tests are compared against the UK Drinking Water Standards (DWS), the World Health Organisation (WHO) guidelines and EA publications. The Environmental Quality Standards (EQS) for freshwater systems are also given for reference.

Table 7.5 – Maximum Values for Contaminants in Groundwater

Analyte	Maximum values, or all values exceeding GAC	Freshwater EQS					UK Drinking Water
Hardness (mg/l)	820 to 1800	-					-
Arsenic (ug/l)	3.7	50					10
Cadmium (ug/l) (Hardness=)	<0.080 (1800)	≤0.08	0.08	0.09	0.15	0.25	5
		<40	40-<50	50-<100	100-<200	≥200	
Chromium (total) (ug/l)	11, 9.2	3.4 (assumed CrVI)					50
Copper (ug/l) (Hardness=)	4.9	1	6	10	28		2000
		0-50	50-100	100-250	>250		
Lead (ug/l)	<1.0	7.2					10
Mercury (ug/l)	<0.010	0.05					1
Nickel (ug/l)	20	20					20
Selenium (ug/l)	3.2	-					10
Zinc (ug/l) (Hardness=)	7.0	8	50	75	125		5000
		0-50	50-100	100-250	>250		
Sulphate (mg/l)	93	400					250
Benzene (ug/l)	<0.10	10					1
Toulene (ug/l)	<0.10	50					700
EthylBenzene (ug/l)	<0.10	20					300
Xylene (ug/l)	<0.10	30					500
MTBE (ug/l)	<0.10	-					15
Total Petroleum Hydrocarbons (TPH)(mg/l)	<0.10	0.01					0.01
Phenanthrene (ug/l)	<0.010	3					-
Anthracene (ug/l)	<0.010	0.1					-
Fluoranthene (ug/l)	<0.010	0.1					-
Pyrene (ug/l)	<0.010	0.04					-
Benzo(a)Anthracene (ug/l)	<0.010	0.018					-
Chrysene (ug/l)	<0.010	0.01					-
Benzo(b)fluoranthene (ug/l)	<0.010	0.03					0.1
Benzo(k)fluoranthene (ug/l)	<0.010	0.03					0.1
Benzo(a)Pyrene (ug/l)	<0.010	0.05					0.01
Indeno(123-cd)Pyrene (ug/l)	<0.010	0.002					0.1
Dibenzo(ah)Anthracene (ug/l)	<0.010	0.01					-
Benzo(ghi)Perylene (ug/l)	<0.010	0.002					0.1
Phenol (ug/l)	<0.030	7.7					-

The GAC of 3.4mg/l has been conservatively used for CrVI. CrVI is not a *contaminant of concern* on the site and thus the results from the water tests are unlikely to be CrVI. The CrVI results and also the nickel results are not considered a significant risk to groundwater.

No phenol traces were found compared to the elevated water results of 1994.

7.4 Ground Gas Risks to Humans

In order to assess the significance of potential ground gases at the site measured concentrations (by volume in air) and flow rates have been used to generate Gas Screening Values (GSVs). These have then been compared to CIRIA Report 665. BS8485 has also been referenced.

It is recommended that the gas risk should be assessed by the consideration of pathways to human receptors as follows:

- Gas entering the dwelling through the substructure and building up to hazardous levels.

The following ground gas parameters have been recorded over 3nr gas monitoring rounds (results are contained in Appendix B):

- A maximum 'initial' methane concentration of 0%
- A maximum 'initial' flow rate of 0.2 l/hr;
- A maximum 'steady state' carbon dioxide concentration of 1.6%;
- A maximum 'steady state' flow rate of 0.1 l/hr
- Atmospheric pressures were 987, 990 and 1034mb.

The worst case Gas Screening Values (GSV) for both methane and carbon dioxide have been calculated, in order to see if any gas protective measures are required in the new development.

The GSV for methane is calculated to be 0.0 l/hr and for carbon dioxide it is 0.0 l/hr.

The type of buildings proposed are residential (**not "low-rise"**) or office/commercial/industrial. The site falls into '**Characteristic Situation' 1 (CS1)(very low hazard)**' in Table 8.5 of CIRIA 665. This indicates that no special protection measures are required in the new buildings.

7.5 Radon Risk to Humans

The environmental data sheets state that **No Radon protection** measures are required for new buildings or extensions on site.

7.6 Final Conceptual Model and Risk Assessment

This investigation has found no risks from the proposed redevelopment to humans, plants, nor groundwater.

7.7 Outline Strategy for Risk Reduction & Remediation

Measures to overcome unacceptable risks identified in the previous section are as follows (risk references that follow refer to those in last column of tables).

Water Supply Pipe Risks:

The local water supply company should accept the use of either PVC or PE water supply pipe materials on site. No indications of petrol, diesel, oils etc have been found to date and if such are found during redevelopment works then they would be remediated such that PVC and PE pipe materials would still be acceptable.

Radon, Gas and Vapour Risks to End Users:

No radon protection measures are required for new buildings or extensions on site. No gas or chemical vapour risk have been found

General Risks:

Site, landscape and maintenance workers should wear gloves, boots and overalls and wash their hands before eating, drinking and smoking. Excessive dust generation should be avoided.

The site investigation samples a very small portion of the overall site soils. Given the existence of made ground on the site, vigilance should be maintained during site clearance and construction, in case any areas of suspected contamination are encountered. If areas are found then a suitably qualified person should undertake appropriate sampling, testing and further risk assessment.

Summary of Risk Reduction and Remediation Measures:

Given the existence of made ground on the site, vigilance should be maintained during site clearance and construction, in case any areas of suspected contamination are encountered. If areas are found then a suitably qualified person should undertake appropriate sampling, testing and further risk assessment.

8.0 OTHER ASPECTS

8.1 Waste Assessment

In order to prevent excessive costs and reduce the environmental impact of the development, it is recommended that surplus natural soils be exported for reuse on other development/construction sites and made ground be exported to a soil treatment facility (all which avoid landfill tax and the last resort of landfilling). Clarkebond's DoWCoP *Qualified Persons* can assist with both assessments.

Subject to potential engineering tests, then the made ground and the underlying natural sands and gravels encountered on site should be acceptable for reuse as engineered fill.

Reuse on Site

There is unlikely to be any scope to reuse soils on site.

Some other site-derived construction wastes could also be reused on site by employing a U1 Waste Exemption.

Transfer for Reuse on Another Site

Surplus soils become waste as soon as they leave site, unless they are being transferred to another "development" or "construction" site for reuse (currently only natural soils can be transferred to the former). Such transfer means that such soils do not class as waste, provided that a waste assessment is completed (e.g. by a DoWCoP Qualified Person) to prove compliance within the 4nr factors.

Certain materials may also be reused on other "Construction" sites by employing a *U1 Waste Exemption (use of waste in construction)*.

Natural soils can most likely be reused on another development/construction site (subject to a DoWCoP or U1 waste assessment), but made ground cannot be transferred to other development/construction site.

Soil Treatment Facilities

The made ground and a wide range of hazardous wastes (including waste acceptance criteria (WAC) failing materials), can avoid landfill disposal by being treated at a number of *Soil Treatment Facility* around the UK. Such disposal is exempt from landfill tax.

Disposal to Licensed Waste Sites

To evaluate the various on-site soils for potential off-site disposal, soils are classified in accordance with the Hazardous Waste Directive (HWD) that enables the provision of a European Waste Catalogue (EWC) Code for use during offsite disposal and a Hazardous or Non-Hazardous Classification. Non-Hazardous material is suitable for disposal in a Non-Hazardous landfill; however, disposal to an Inert Landfill requires further Waste Acceptance Criteria (WAC) testing in accordance with BS EN 12457-3. Material classed as Hazardous also requires WAC testing to assign a suitable hazardous classification.

The Landfill Regulations require that all Hazardous and Non-Hazardous solid waste must be treated prior to offsite disposal to landfill. You can define 'treatment' by using the following 'three-point test'. All three criteria must be satisfied for all of the waste to qualify as being treated:

1. It must be a physical, thermal, chemical or biological process including sorting.
2. It must change the characteristics of the waste.

3. It must do so in order to:
- Reduce its volume; or
 - Reduce its hazardous nature; or
 - Facilitate its handling; or
 - Enhance recovery.

Assessment (including WAC) testing has been undertaken on soils broadly representative of the majority of site soils that might require off-site disposal, as follows:

Table 8.1 Waste Classification

Strata Type	Initial Waste Classification (6nr tested)	Final Classifications from WAC Tests (2nr WAC tests)	Landfill Destination	
			If individual strata kept separate	If all strata excavated as one (composite waste)
Made Ground	Not Hazardous^{1,2} (6nr)	Inert (2nr)	Inert	Inert

Notes:

(1): Initial waste classification gives '**potentially hazardous**' due to conservative software assumptions about Chromium. Given the sites past usage Clarkebond consider this unlikely to be Chromium VI, 1nr CrVI result gives <0.5mg/kg and therefore the class is lowered '**not hazardous**'

(2): also defined as **potentially hazardous** due to the potential for flammability risk from the TPH existing in significant volatile fractions, but detailed results show this not to be the case and therefore the sample is **Not Hazardous**.

It should be noted that a site investigation is unable to identify all below ground conditions at a site and therefore, if during construction works soils that require offsite disposal are identified as being different to what has been preliminarily tested in this report, additional testing will be required by a suitably qualified environmental consultant prior to disposal or recovery at a licensed offsite facility.

It is also recommended that prior to offsite disposal or recovery of any waste soils; the receiving licensed treatment/landfill facility should be sent copies of all relevant chemical analysis, **plus exploratory hole logs** showing the engineering descriptions of the soils to which the sample depths relate.

All producers of waste have a **duty of care** to ensure that any waste they produce is handled safely and within the law. They must **check** that anyone they pass waste on to is **authorised** to take it. This includes the authorised site earmarked to handle the waste and any haulier (licensed waste carrier) used to transport the waste between the sites.

All waste holders must act to keep waste safe against:

- Corrosion or wear of waste containers;
- Accidental spilling or leaking or inadvertent leaching from waste unprotected from rainfall;
- Accident or weather breaking open contained waste and allowing it to escape;
- Waste blowing away or falling while stored or transported;
- Scavenging of waste by vandals, thieves, children, trespassers or animals.

Holders should protect waste against the above risks while it is in their possession and they should also protect it for its future handling requirements. Waste should reach not only its next holder but a licensed facility or other appropriate destination without escape. It is recommended that the container used to transport the waste is suitable not only to prevent solid and liquid residues escaping, but also any potentially dangerous vapours or odours associated with the waste.

Segregation of different categories of waste where they are produced may be necessary to prevent the mixing of incompatible wastes. Segregation may assist the disposal of waste to specialist outlets. Where segregation is practiced on sites, the waste holder should ensure that

his employees and anyone else handling waste there are aware of the locations and uses of each segregated waste container.

Waste handed over to another person should be in some sort of container, which might include a skip. The only reasonable exception would be loose material loaded into a vehicle and then covered sufficiently to prevent escape before being moved. Waste containers should suit the material put in them.

A waste transfer note (WTN) is a document that must accompany any transfer of waste between different holders. The purpose of a WTN is to allow other people who handle your waste to know what they are dealing with so that they can manage it safely and properly. A WTN must be created for each load of waste that leaves the site and must contain enough information about the waste to enable anyone coming into contact with it to handle it safely, and either dispose of it or allow it to be recovered within the law. If insufficient information is given on the WTN the responsible party may liable to be prosecuted.

Records of all waste transferred or received must keep for at least two years.

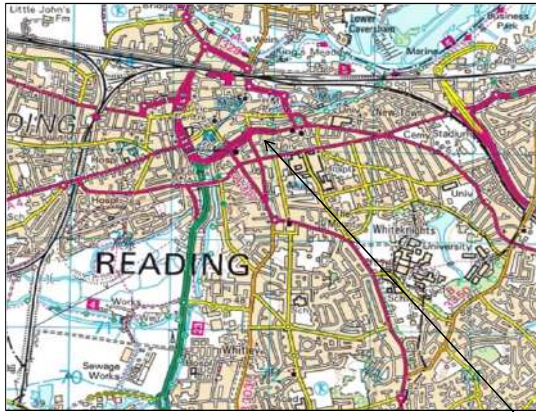
8.2 Abnormal Development Aspects

From the information detailed herein, the following are now confirmed as abnormal development aspects specific to this site:

- Piling.

FIGURES

- 2.1 - Site Location Plan**
- 4.1 - Exploratory Hole Location Plan**
- 5.1 - Site Cross Section**
- 5.2 - SPT 'N' V Depth**
- 5.3 - Preliminary Pile Design Chart**



Site Centre (approximate):

OS X (Eastings) 471870
OS Y (Northings) 173150

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MULTIDISCIPLINARY ENGINEERING CONSULTANTS

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e-mail: bristol@clarkebond.com
web: www.clarkebond.com
Bristol Exeter London

Project:

Land off East St, Reading
Phase I Desk Study

Title:

Site Location Plan

Drawn:

DJ

Scale:

NTS

Checked:

AG

Date:

Aug-16

Status

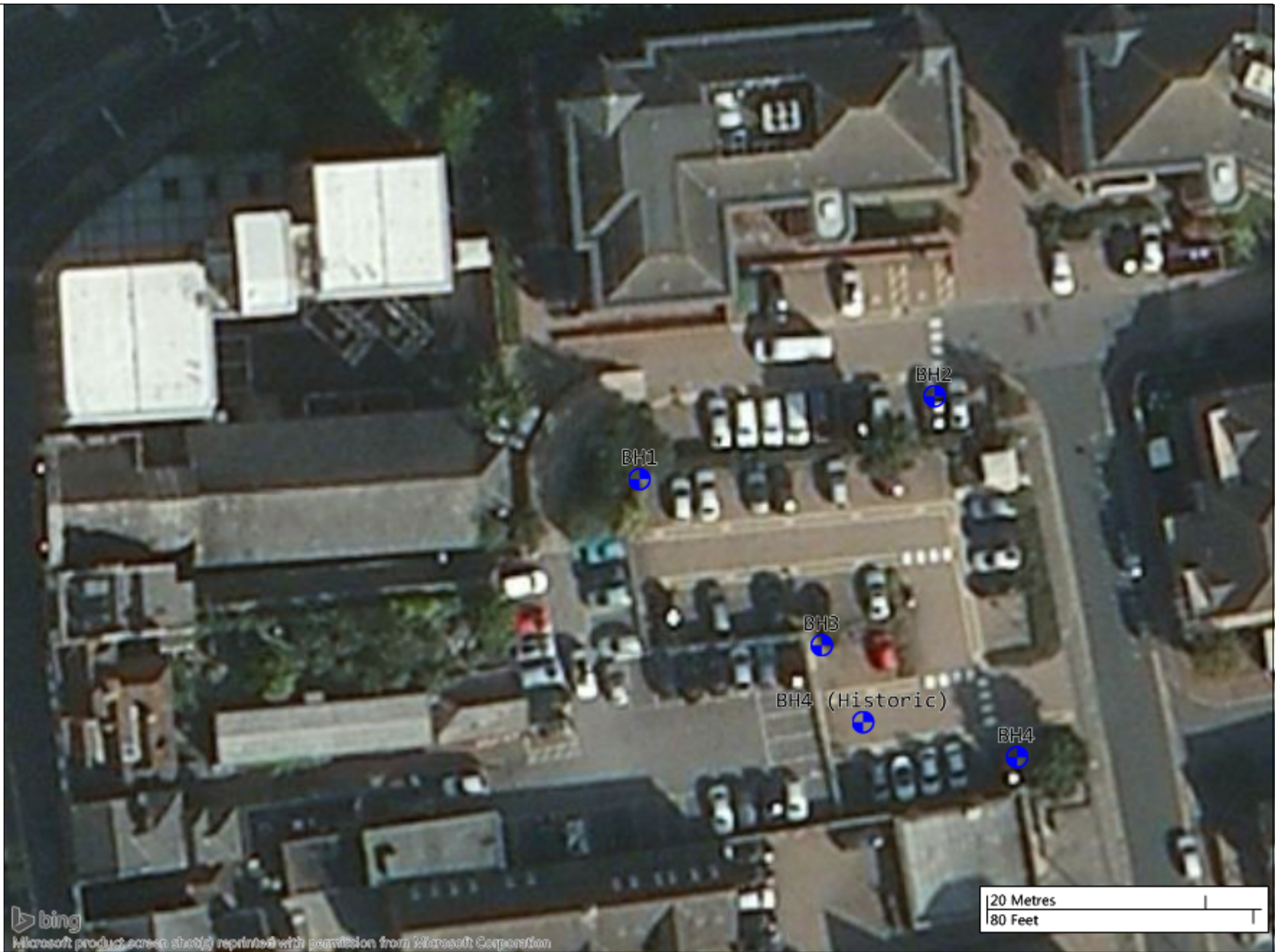
Final Issue

Figure No.
WB04333
Figure 2.1

Rev.
0

Legend Key

- Locations By Type - Empty
- Locations By Type - CP



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Exploratory Hole Location Plan

Project Number: WB04333

Project Name: New Century Place, Reading

Figure:

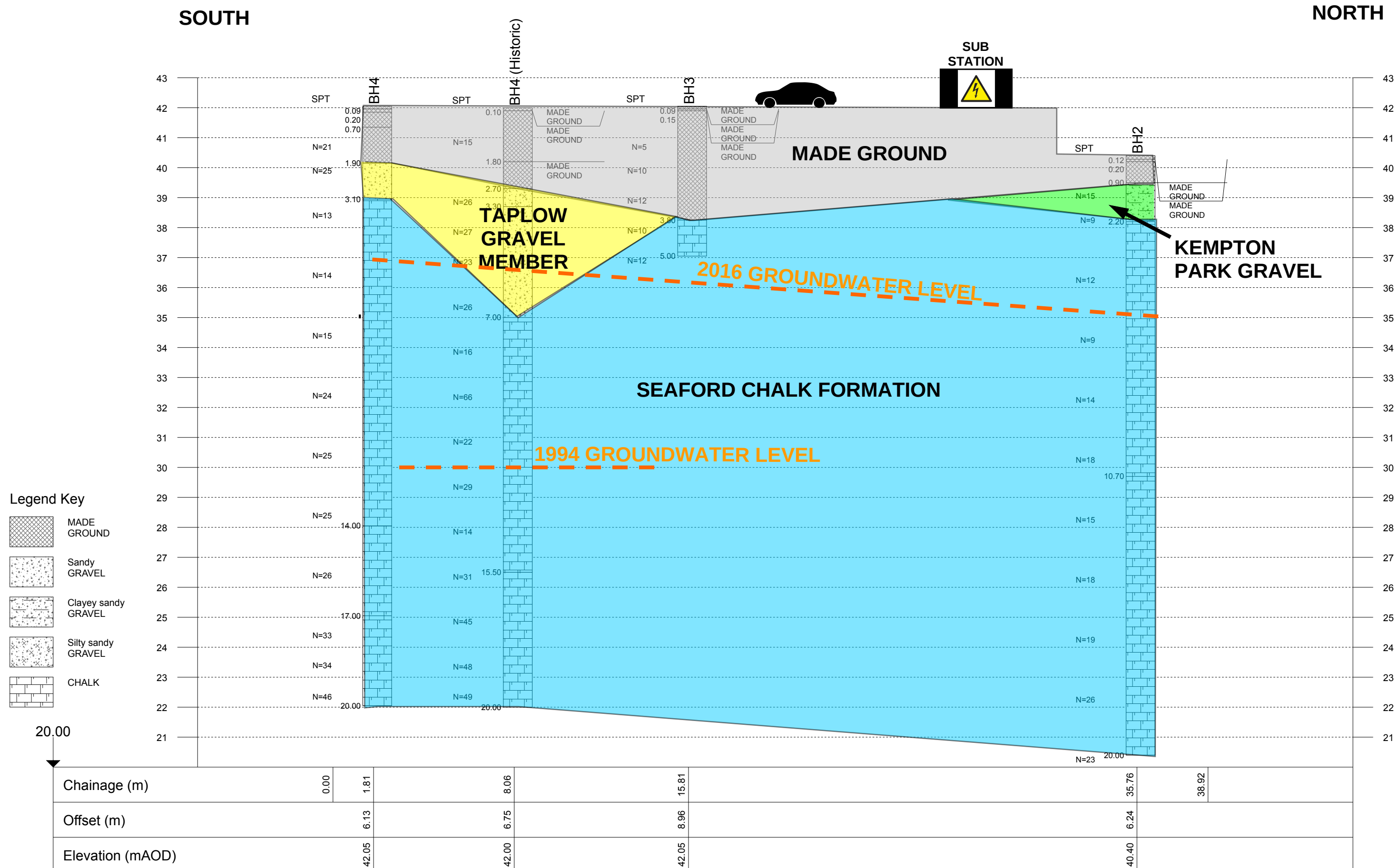
4.1

Client: Studios

Engineer: DJ

Horizontal: 1:160

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SPT N Value vs. Level (m AOD)

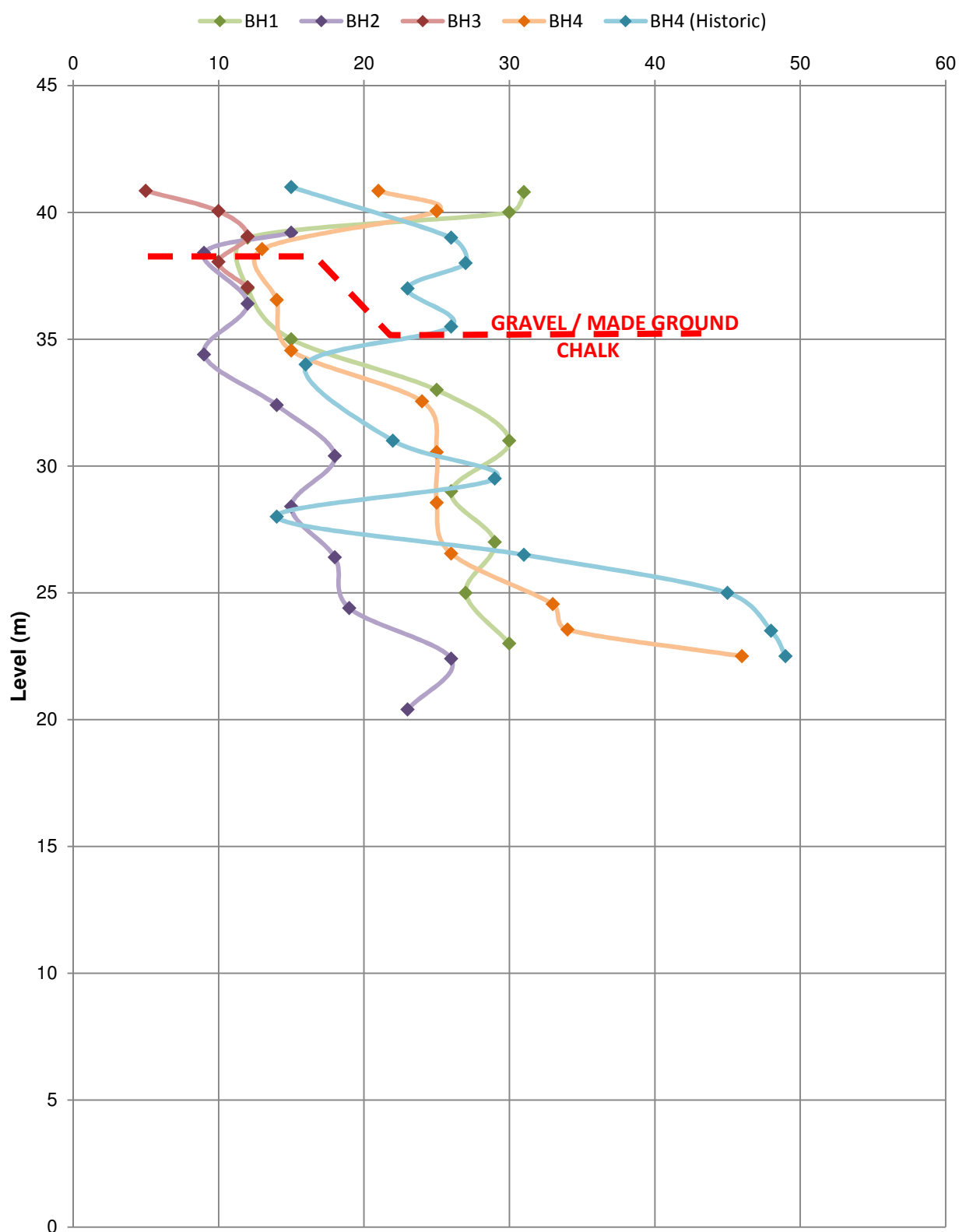
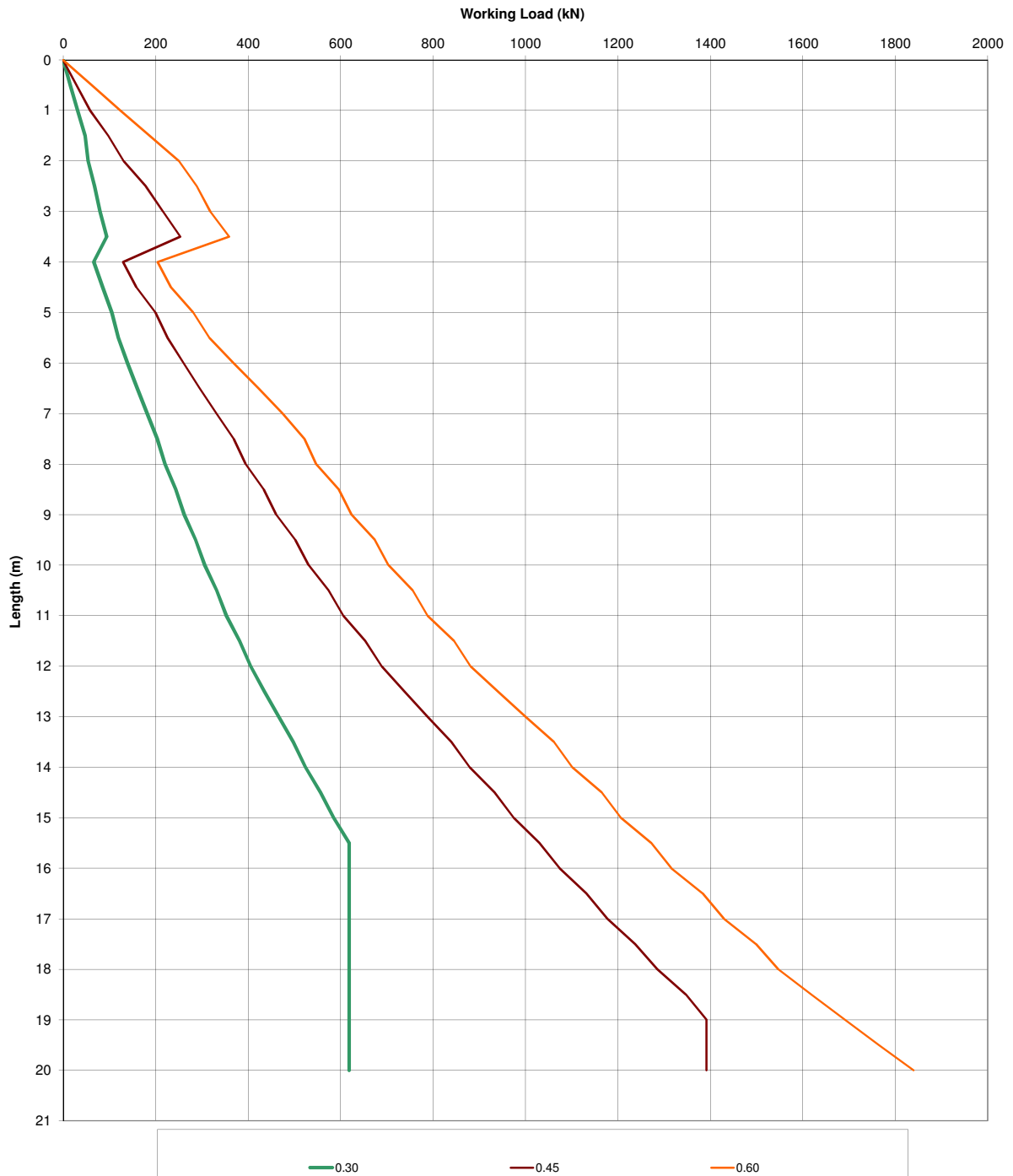
Project ID: **WB04333**Project Title: **New Century Place, Reading**

Figure: 5.2

Date: **01/12/16**Client: **Studios**



NOTES:

- 1) plot lines denote pile diameters in metres
- 2) For parameters and ground model, see report text
- 3) Ground water assumed at 5.0mBGL
- 4) Advice from piling contractor should be obtained for detailed design
- 5) Safety factor of 2.5 applied
- 6) Pile concrete strength of 35MN/m² assumed

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 e-mail: bristol@clarkebond.com
 web: www.clarkebond.co.uk
 Bristol Exeter London

Project:

Land of East St
 Phase 2 Investigation

Title:

Preliminary Pile Design Chart

Drawn:

CS

Scale:

NTS

Checked:

CW

Date:

Dec-16

Status

Final Issue

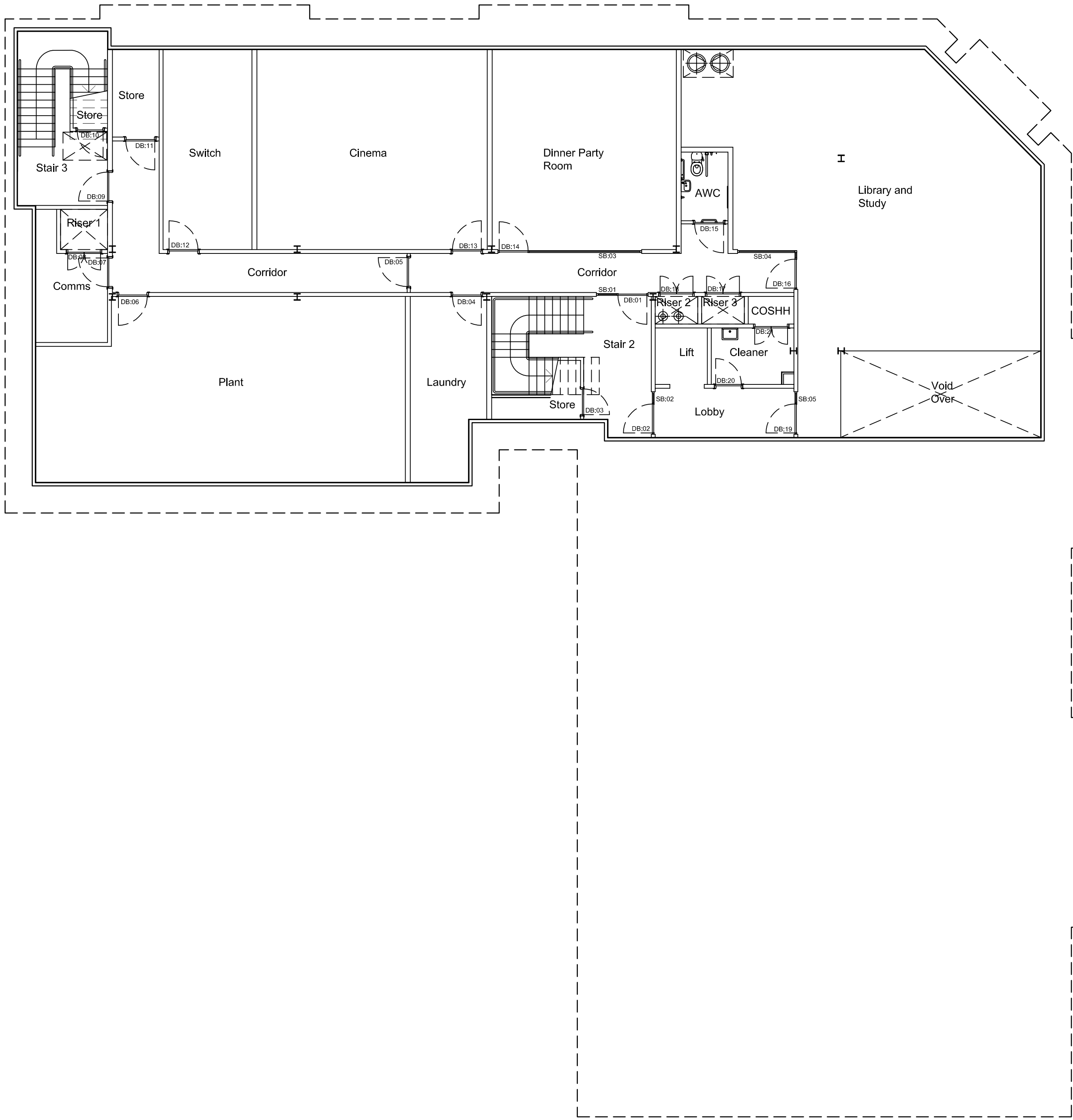
Figure No.
 WB04333/R3
 Figure 5.3

Rev.
 1

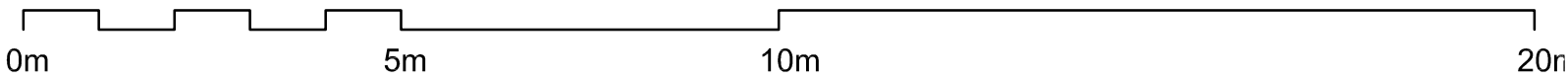
APPENDICES

A - Proposed Site Layout	(2 A4 Sheets)
B - Cable Percussion Logs (inc historic)	(9 A4 Sheets)
C - Monitoring Results	(3 A4 Sheets)
D - Geotechnical Results	(7 A4 Sheets)
E - Chemical Results	(23 A4 Sheets)
F - Site Boundary (in red)	(1 A3 Sheet)
G - Clarkebond Ground Engineering Capabilities	(1 A4 Sheet)

A - Proposed Site Layout (2 A4 Sheets)



18 053 049
BASEMENT LEVEL GENERAL ARRANGEMENT FLOOR PLAN
1:100



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 6. This drawing is to be read in conjunction with the following relevant information:
 - i) All architects, structural and service engineer's drawings and specifications.
 - ii) All CDM Information including designers risk assessments.

-		MMA Planning Issue		P	15/11/2018	MB	-
revision	notes	status	date	author	reviewer		

Unit 4, Woods Pottery, Stepney Bank, Newcastle NE1 2PN
t: (0191) 447 1775 www.greenwelldesign.co.uk

Project: EAST STREET, READING - 4 STOREY

Drawing: BASEMENT LEVEL - GENERAL ARRANGEMENT FLOOR PLAN

Dwg no. 049

Scale 1:100	Job no. 18 053	Rev : -
at size A1	Status Preliminary	



18 053 050
PROPOSED LEVEL 0
1:100

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revision	B	MMA Planning Issue	P	15/11/2018	MB	-
	A	MMA Planning Issue	P	15/11/2018	MB	-
	-	First Issue	P	19/09/2018	MAB	MB
revision	notes	status	date	author	reviewer	

gdlarchitecture

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Project EAST STREET, READING - 4 STOREY

Drawing PROPOSED LEVEL 0 FLOOR PLAN_PLANNING

Dwg no. 050

Scale 1:100	Job no. 18 053	Rev : B
at size A1	Status Preliminary	

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O	REVISED PLANNING APPLICATION ISSUE	P	2017.05.10	MB	-
P	plan updated to reflect elevations	P	2017.05.03	MB	-
N	plan updated to reflect elevations	P	2017.05.03	MB	-
M	plan updated to reflect elevations	P	2017.05.03	MB	-
L	plan updated to reflect elevations	P	2017.05.02	MB	-
K	INFORMAL planning issue for comments	P	2017.04.26	MB	-
J	STAGE 2 TENDER ISSUE	P	2017.03.20	MB	-
H	FF&E layouts omitted from plans	P	2017.03.09	MB	-
G	Window setting out indicated following case officer comments	P	2017.01.19	MB	-
F	PLANNING APPLICATION ISSUE	P	2017.01.02	MB	-
E	plan updated to reflect comments received from client and pre app meeting	P	2016.12.20	MB	-
D	STAGE 3 SIGN OFF PLANS	P	2016.12.05	MB	-
C	plans updated to reflect DC comments received, dinner party replaced with 2no. studios.	P	2016.11.30	MB	-
B	STAGE 3 - client plan sign off issue	P	2016.11.07	MB	-
A	PRE APPLICATION ISSUE	P	2016.10.27	MB	-
-	FIRST ISSUE	P	2016.10.25	MB	-

revision	notes	status	date	author	reviewer
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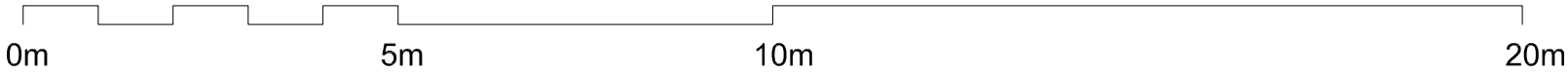
Project **East Street, Reading**

Drawing **PROPOSED PLAN
Levels 1**

Scale 1:100	Job no. 16033	dwg no. 3011	Rev : Q
at size A1	Status Preliminary		

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16033 3011
PROPOSED LEVEL 1
1:100



Refer to Interior Designer plans for room types and FF&E layouts



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P	REVISED PLANNING APPLICATION ISSUE	P	2017.05.10	MB	-
N	plan updated to reflect elevations	P	2017.05.03	MB	-
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L	plan updated to reflect elevations	P	2017.05.03	MB	-
K	plan updated to reflect elevations	P	2017.05.02	MB	-
J	INFORMAL planning issue for comments	P	2017.04.26	MB	-
H	STAGE 2 TENDER ISSUE	P	2017.03.20	MB	-
G	FF&E layouts omitted from plans	P	2017.03.09	MB	-
F	Window setting out indicated following case officer comments	P	2017.01.19	MB	-
E	PLANNING APPLICATION ISSUE	P	2017.01.03	MB	-
D	PLANNING APPLICATION ISSUE	P	2017.01.02	MB	-
C	plan updated to reflect comments received from client and pre app meeting	P	2016.12.20	MB	-
B	STAGE 3 - client plan sign off issue	P	2016.11.30	MB	-
A	PRE APPLICATION ISSUE	P	2016.11.07	MB	-
-	PRE APPLICATION ISSUE	P	2016.10.27	MB	-

revision	notes	status	date	author	reviewer
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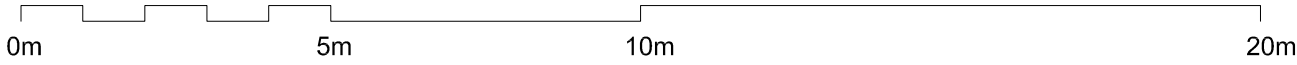
Project **East Street, Reading**

Drawing **PROPOSED PLAN
Level 3**

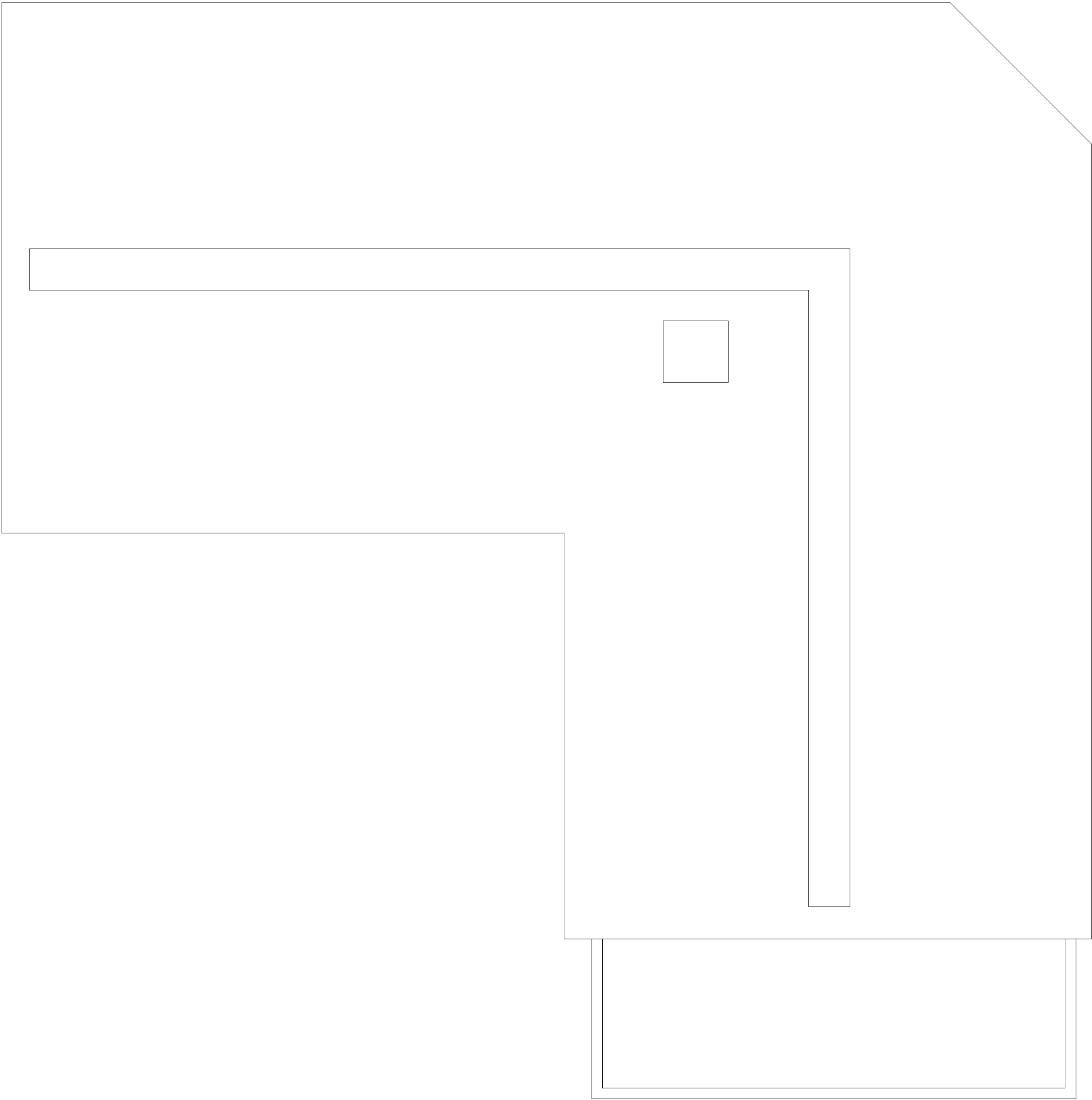
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at size A1	Status Preliminary		

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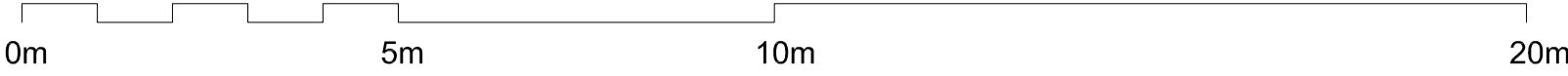
16033 3013
PROPOSED LEVEL 3
1:100



Refer to Interior Designer plans for room types and FF&E layouts



16033 3016
PROPOSED LEVEL ROOF
1:100



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Revision	B	REVISED PLANNING APPLICATION ISSUE	P	2017.05.10	MB	-
	A	STAGE 2 TENDER ISSUE	P	2017.03.20	MB	-
	-	PLANNING APPLICATION ISSUE	P	2017.01.02	MB	-
Notes			Status	Date	Author	Reviewed

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Project **East Street, Reading**

Drawing **PROPOSED PLAN
Level Roof**

Scale 1:100	Job no. 16033	dwg no. 3016	Rev : B
at size A1	Status Preliminary		

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B - Cable Percussion Logs (inc historic)

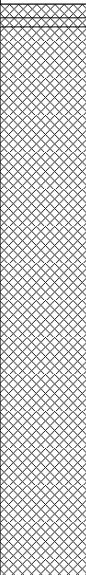
(9 A4 Sheets)

clarkebond			Cable Percussive Borehole Log						Borehole No.: BH1	
Project Name: New Century Place, Reading				Co-Ordinates: 471848.00 E 173172.00 N				Start: 05/11/2016		
Project Number: WB04333				Ground Level: 42.00m OD				End: 05/11/2016		
Samples and In Situ Testing			Casing/ Water Depth	Depth (m)	Level (m OD)	Legend	Stratum Description	Water Strike	Well	
Depth (m)	Type	Results								
0.30	D			0.09	41.91		Brick paving			
0.30	ES			0.12	41.88		MADE GROUND			
0.50	B			0.20	41.80		Yellow fine building sand.			
1.00	ES	N=31					MADE GROUND			
1.20	SPT						Pinkish grey subangular limestone GRAVEL. SUB			
1.20	D						BASE.			
1.50	ES						MADE GROUND			
							Greyish brown slightly clayey sandy GRAVEL. Gravel			
							is subrounded to subangular chert and occasional			
							brick.			
2.00	SPT	N=30								
2.00	D									
2.00	ES									
3.00	SPT	N=12								
3.00	ES									
3.50	SPTLS			3.50	38.50		Soft to firm highly weathered putty CHALK, Grade DC.			

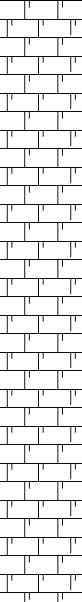
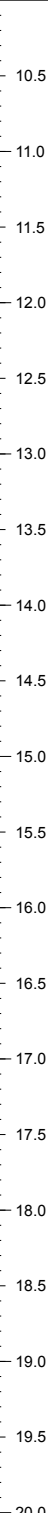
clarkebond		Cable Percussive Borehole Log								Borehole No.: BH1								
Project Name: New Century Place, Reading						Co-Ordinates: 471848.00 E 173172.00 N				Start: 05/11/2016								
Project Number: WB04333						Ground Level: 42.00m OD				End: 05/11/2016								
Samples and In Situ Testing					Casing/ Water Depth	Depth (m)	Level (m OD)	Legend	Stratum Description	Water Strike	Well							
Depth (m)	Type	Results																
11.00 11.00	SPT SPTLS	N=30			12.00	30.00		Medium to firm weathered structured CHALK with occasional flint nodules.										
13.00 13.00	SPT D	N=26						Moderately weak, low-density, white, unstained CHALK with frequent flint nodules. Fractures possibly medium-spaced, probably clean, unstained. (Seaford Chalk Formation, low density, Grade B?3?)										
15.00 15.00	SPT D	N=29																
17.00 17.00	SPT D	N=27																
19.00 19.00	SPT D	N=30																
								20.00			22.00	End of Borehole at 20.00m						
Hole Details		Casing	Chiselling					Water Strikes			General Remarks: Inspection Pit Hand Dug to 1.20m.		Logged By: DJ					
Depth (m)	Diameter (mm)	Depth (m)	Depth From (m)	Depth To (m)				Duration (hh:mm)					Depth Struck (m)	Casing (m)	Depth Sealed (m)	Remarks	Approved By: AG	
20.00	150												0.40	0.00		Slight Seepage	Scale: 1:50	
													5.00	6.50			Method/Plant Used: Dando	
											Sheet 2 of 2							

clarkebond				Cable Percussive Borehole Log						Borehole No.: BH2			
Project Name: New Century Place, Reading						Co-Ordinates: 471875.00 E 173180.00 N				Start: 05/11/2016			
Project Number: WB04333						Ground Level: 40.40m OD				End: 05/11/2016			
Samples and In Situ Testing					Casing/ Water Depth	Depth (m)	Level (m OD)	Legend	Stratum Description	Water Strike	Well		
Depth (m)	Type	Results											
1.20	SPT	N=15				0.12	40.28		Brick paving				
						0.20	40.20						
2.00	SPT	N=9				0.90	39.50		MADE GROUND				
									Fine yellow building SAND.				
4.00	SPT	N=12				2.20	38.20		MADE GROUND				
									Pinkish grey subrounded to subangular limestone GRAVEL.				
6.00	SPT	N=9							Orangish brown slightly clayey very sandy subangular to subrounded GRAVEL. Gravel is chert and flint.				
									Soft to firm putty CHALK with occasional flints. Probable grade DC.				
8.00	SPT	N=14											
10.00	SPT	N=18											
Hole Details		Casing	Chiselling			Water Strikes				General Remarks: Inspection Pit Hand Dug to 1.20m.		Logged By: DJ	
Depth (m)	Diameter (mm)	Depth (m)	Depth From (m)	Depth To (m)	Duration (hh:mm)	Depth Struck (m)	Casing (m)	Depth Sealed (m)	Remarks			Approved By: AG	
												Scale: 1:50	
Method/Plant Used: Dando										Sheet 1 of 2			

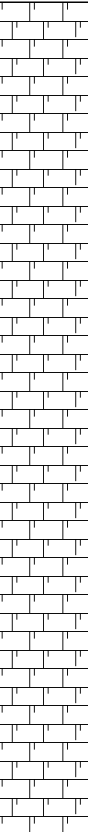
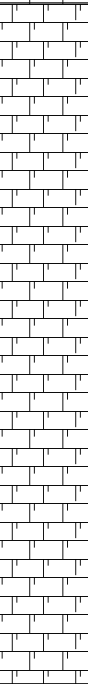
clarkebond		Cable Percussive Borehole Log								Borehole No.: BH2		
Project Name: New Century Place, Reading						Co-Ordinates: 471875.00 E 173180.00 N				Start: 05/11/2016		
Project Number: WB04333						Ground Level: 40.40m OD				End: 05/11/2016		
Samples and In Situ Testing					Casing/ Water Depth	Depth (m)	Level (m OD)	Legend	Stratum Description	Water Strike	Well	
Depth (m)	Type	Results										
12.00	SPT	N=15				10.70	29.70		Soft to firm putty CHALK with occasional flints. Probable grade DC.	10.5		
									Moderately weak, low-density, white, unstained CHALK with frequent flint nodules. Fractures possibly medium-spaced, probably clean, unstained. (Seaford Chalk Formation, low density, Grade B?3?).	11.0		
14.00	SPT	N=18							11.5			
									12.0			
									12.5			
									13.0			
									13.5			
16.00	SPT	N=19							14.0			
									14.5			
									15.0			
									15.5			
									16.0			
18.00	SPT	N=26							16.5			
									17.0			
									17.5			
									18.0			
									18.5			
20.00	SPT	N=23							19.0			
									19.5			
End of Borehole at 20.00m									20.0			
Hole Details		Casing	Chiselling			Water Strikes			General Remarks: Inspection Pit Hand Dug to 1.20m.		Logged By: DJ	
Depth (m)	Diameter (mm)	Depth (m)	Depth From (m)	Depth To (m)	Duration (hh:mm)	Depth Struck (m)	Casing (m)	Depth Sealed (m)			Remarks	Approved By: AG
											Scale: 1:50	
Method/Plant Used: Dando										Sheet 2 of 2		

clarkebond		Cable Percussive Borehole Log								Borehole No.: BH3		
Project Name: New Century Place, Reading						Co-Ordinates: 471865.00 E 173157.00 N				Start: 12/11/2016		
Project Number: WB04333						Ground Level: 42.05m OD				End: 12/11/2016		
Samples and In Situ Testing					Casing/ Water Depth	Depth (m)	Level (m OD)	Legend	Stratum Description	Water Strike	Well	
Depth (m)	Type	Results										
0.30	D	N=5				0.09 0.15	41.96 41.90		MADE GROUND Brick Paving MADE GROUND Fine yellow building SAND. MADE GROUND Brown slightly silty gravelly SAND. Gravel of fine to medium chert and rare red brick.	0.5 1.0 1.5 2.0 2.5 3.0 3.5		
0.50	B											
0.50	D											
1.00	D											
1.20	SPT											
1.20	D	N=10										
1.50	D											
2.00	SPT	N=12										
2.00	D											
3.00	SPT	N=10										
3.00	D											
4.00	SPT	N=12										
4.00	D											
5.00	SPT	N=12										
5.00	D											
									End of Borehole at 5.00m	5.0 5.5 6.0 6.5 7.0 7.5 8.0 8.5 9.0 9.5 10.0		
Hole Details		Casing	Chiselling			Water Strikes				General Remarks:		Logged By:
Depth (m)	Diameter (mm)	Depth (m)	Depth From (m)	Depth To (m)	Duration (hh:mm)	Depth Struck (m)	Casing (m)	Depth Sealed (m)	Remarks	Inspection Pit Hand Dug to 1.20m.		CS
5.00	150											Approved By: AG
											Scale: 1:50	
Method/Plant Used: Dando											Sheet 1 of 1	

clarkebond										Cable Percussive Borehole Log										Borehole No.: BH4	
Project Name: New Century Place, Reading										Co-Ordinates: 471883.00 E 173147.00 N										Start: 12/11/2016	
Project Number: WB04333										Ground Level: 42.05m OD										End: 12/11/2016	
Samples and In Situ Testing						Casing/ Water Depth	Depth (m)	Level (m OD)	Legend	Stratum Description	Water Strike	Well									
Depth (m)		Type	Results																		
0.30 0.50		D B				0.09 0.20	41.96 41.85		Brick paving Fine yellow building SAND												
1.20 1.20		SPT D	N=21			0.70	41.35		Pinkish grey subrounded to subangular limestone GRAVEL Yellow brown slightly sandy GRAVEL of flint and occasional red brick	0.5 1.0 1.5											
2.00 2.00		SPT D	N=25			1.90	40.15		Yellow brown medium to coarse flint GRAVEL with occasional cobbles	2.0 2.5 3.0											
3.50 3.50		SPT SPTLS	N=13			3.10	38.95		Soft to firm putty CHALK with occasional flints. Probable grade DC.	3.5 4.0 4.5 5.0 5.5 6.0 6.5 7.0 7.5 8.0 8.5 9.0 9.5 10.0											
5.50 5.50		SPT SPTLS	N=14																		
7.50 7.50		SPT SPTLS	N=15																		
9.50 9.50		SPT SPTLS	N=24																		
Hole Details		Casing	Chiselling			Water Strikes				General Remarks: Inspection Pit Hand Dug to 1.20m.		Logged By:									
Depth (m)	Diameter (mm)	Depth (m)	Depth From (m)	Depth To (m)	Duration (hh:mm)	Depth Struck (m)	Casing (m)	Depth Sealed (m)	Remarks			CS									
20.00	150					5.00	6.00					Approved By: AG									
										Scale: 1:50		Sheet 1 of 2									
Method/Plant Used: Dando																					

clarkebond						Cable Percussive Borehole Log						Borehole No.: BH4							
Project Name: New Century Place, Reading						Co-Ordinates: 471883.00 E 173147.00 N						Start: 12/11/2016							
Project Number: WB04333						Ground Level: 42.05m OD						End: 12/11/2016							
Samples and In Situ Testing					Casing/ Water Depth	Depth (m)	Level (m OD)	Legend	Stratum Description	Water Strike	Well								
Depth (m)	Type	Results																	
11.50 11.50	SPT SPTLS	N=25			14.00	28.05		Soft to firm putty CHALK with occasional flints. Probable grade DC.											
13.50 13.50	SPT D	N=25																	
15.50 15.50	SPT D	N=26																	
17.50 17.50	SPT SPTLS	N=33																	
18.50 18.50	SPT SPTLS	N=34																	
19.55 19.55	SPT SPTLS	N=46																	
											20.00	22.05		End of Borehole at 20.00m	20.0				
Hole Details		Casing	Chiselling								Water Strikes				General Remarks: Inspection Pit Hand Dug to 1.20m.		Logged By: CS		
Depth (m)	Diameter (mm)	Depth (m)	Depth From (m)	Depth To (m)							Duration (hh:mm)	Depth Struck (m)	Casing (m)	Depth Sealed (m)			Remarks	Approved By: AG	
20.00	150											5.00	6.00					Scale: 1:50	
											Method/Plant Used: Dando		Sheet 2 of 2						

clarkebond		Cable Percussive Borehole Log										Borehole No.: BH4 (Historic)											
Project Name: New Century Place, Reading							Co-Ordinates: 471869.00 E 173150.00 N					Start: 01/07/1994											
Project Number: WB04333							Ground Level: 42.00m OD					End:											
Samples and In Situ Testing						Casing/ Water Depth	Depth (m)	Level (m OD)	Legend	Stratum Description	Water Strike	Well											
Depth (m)	Type	Results																					
1.00	SPT	N=15					0.10	41.90		MADE GROUND Tarmac	0.5												
										MADE GROUND Brick rubble with some flint gravel and some ash.													
							1.80	40.20		MADE GROUND Soft dark brown silty sandy clay with some gravel and some ash.	2.0												
3.00	SPT	N=26					2.70	39.30		Medium dense brown, slightly clayey, silty sandy angular to rounded fine to coarse flint GRAVEL with occasional cobbles. TAPLOW GRAVEL MEMBER.	3.0												
4.00	SPT	N=27					3.30	38.70		Medium dense orange brown slightly sandy angular to rounded fine to coarse flint GRAVEL with occasional cobbles. TAPLOW GRAVEL MEMBER.	3.5												
5.00	SPT	N=23									5.0												
6.50	SPT	N=26									6.0												
							7.00	35.00		White rubbly CHALK with much putty chalk matrix and some flints.	7.0												
8.00	SPT	N=16									7.5												
											8.0												
											8.5												
											9.0												
											9.5												
9.50	SPT	N=66									10.0												
Hole Details										Casing		Chiselling			Water Strikes				General Remarks:		Logged By:		
Depth (m)		Diameter (mm)		Depth (m)		Depth From (m)		Depth To (m)		Duration (hh:mm)		Depth Struck (m)		Casing (m)		Depth Sealed (m)		Remarks				Approved By:	
												11.80		10.50								Scale:	
																						1:50	
																				Method/Plant Used:		Sheet 1 of 2	

clarkebond			Cable Percussive Borehole Log								Borehole No.: BH4 (Historic)	
Project Name: New Century Place, Reading						Co-Ordinates: 471869.00 E 173150.00 N				Start: 01/07/1994		
Project Number: WB04333						Ground Level: 42.00m OD				End:		
Samples and In Situ Testing					Casing/ Water Depth	Depth (m)	Level (m OD)	Legend	Stratum Description	Water Strike	Well	
Depth (m)	Type	Results										
11.00	SPT	N=22				15.50	26.50		White rubbly CHALK with much putty chalk matrix and some flints.			
12.50	SPT	N=29										
14.00	SPT	N=14										
15.50	SPT	N=31										
17.00	SPT	N=45										
18.50	SPT	N=48										
19.50	SPT	N=49										
20.00												
22.00												
End of Borehole at 20.00m												20.0
Hole Details		Casing	Chiselling			Water Strikes				General Remarks:	Logged By:	
Depth (m)	Diameter (mm)	Depth (m)	Depth From (m)	Depth To (m)	Duration (hh:mm)	Depth Struck (m)	Casing (m)	Depth Sealed (m)	Remarks		Approved By:	
						11.80	10.50				Scale: 1:50	
Method/Plant Used:											Sheet 2 of 2	

C - Monitoring Results

(3 A4 Sheets)

GAS MONITORING RESULTS

Date: 17/11/16

Contract No:

Contract Name: Reading

Contract Engineer:

Weather Conditions: Overcast Atmospheric Wind Conditions: ALM Pressure: 993								Equipment used: G501452				Data Collected By: J Reddy				Input Checked by (sign):	
Ground Conditions (eg dry, flooded, frost, snow): Dry					Depth to water (m bgl) (if noted to vary during monitoring then record such)	Well depth (mbgl) Current and [as installed]								Top of Response zone (m bgl)	Notes (eg, samples taken, dual installation, odours, sheens, broken headworks).		
Location	Time		Atmospheric Pressure (mb)	BH Pressure or differential (mb)			Flow (l/hr)	% by volume in air			LEL (%)	(ppm)					
	hours mins	secs						Methane	Carbon Dioxide	Oxygen		H2S	CO			PID	
BH1		0	987	-0.19	0 (initial)	5.84	6.59									Sampled: E/C 553, pH 8.8, Temp 15.2	
					0 (steady state)												
		0						0.0	1.5	19.4	0	0	0	N/A			
		15															
		30															
		60															
		90															
		120															
		180															
		240															
BH2		0	993	-0.15	0 (initial)	4.23	5.17									Sampled: E/C 598, pH 8.6, Temp 14.4	
					0 (steady state)												
		0						0.0	0.2	20.7	0	0	0	N/A			
		15															
		30															
		60															
		90															
		120															
		180															
		240															
BH4		0	993	-0.15	0 (initial)	5.95	6.16									Insufficient to sample	
					0 (steady state)												
		0						0.0	0.2	19.6	0	2	<<<<	N/A			
		15															
		30															
		60															
		90															
		120															
		180															
		240															

GAS MONITORING RESULTS

Date: 29/11/16

Contract No:

Contract Engineer:

Contract Name:

Weather Conditions: Sunny Atmospheric Wind Conditions: Light ALM Pressure: 1034								Equipment used: GM10333				Data Collected By: J Donovan				Input Checked by (sign):	
Ground Conditions (eg dry, flooded, frost, snow): Dry						Depth to water (m bgl) (if noted to vary during monitoring then record such)	Well depth (mbgl) Current and [as installed]								Top of Response zone (m bgl)	Notes (eg, samples taken, dual installation, odours, sheens, broken headworks).	
Location	Time		Atmospheric Pressure (mb)	BH Pressure or differential (mb)	Flow (l/hr)			% by volume in air			LEL (%)	(ppm)					
	hours mins	secs						Methane	Carbon Dioxide	Oxygen		H2S	CO	PID			
BH1		0	1034	-0.74	0.1 (initial)	5.8	6.68										
		30			0 (steady state)												
		0															
	06:57	15					0.0	1.5	19.7	0	0	0	N/A				
	07:00	30					0.0	1.5	19.6	0	0	0	N/A				
	07:01	60					0.0	1.4	19.6	0	0	0	N/A				
	07:03	90					0.0	1.5	19.5	0	0	0	N/A				
	07:06	120					0.0	1.5	19.6	0	0	0	N/A				
	07:09	180					0.0	1.5	19.5	0	0	0	N/A				
	07:13	240					0.0	1.3	19.8	0	0	0	N/A				
BH2		0	1034	-0.64	0 (initial)	4.19	5.2										
		15			0 (steady state)												
		0															
	07:35	15					0.0	0.1	21.5	0	0	0	N/A				
	07:36	30					0.0	0.1	21.6	0	0	0	N/A				
	07:37	60					0.0	0.1	21.6	0	0	0	N/A				
	07:39	90					0.0	0.1	21.4	0	0	0	N/A				
	07:41	120					0.0	0.1	21.6	0	0	0	N/A				
	07:44	180					0.0	0.1	21.6	0	0	0	N/A				
	07:48	240					0.0	0.1	21.5	0	0	0	N/A				
BH4		0	1034	-0.66	0.2 (initial)	5.89	6.2										
		30			0.1 (steady state)												
	0.3020833	0															
	07:16	15					0.0	0.3	17.1	0	0	0	N/A				
	07:18	30					0.0	0.3	17.0	0	0	0	N/A				
	07:19	60					0.0	0.3	17.1	0	0	0	N/A				
	07:22	90					0.0	0.3	17.2	0	0	0	N/A				
	07:25	120					0.0	0.3	17.1	0	0	0	N/A				
	07:28	180					0.0	0.3	17.1	0	0	0	N/A				
	07:33	240					0.0	0.2	17.2	0	0	0	N/A				

GAS MONITORING RESULTS

Date: 21/11/16

Contract No:

Contract Engineer:

Contract Name:

Weather Conditions: Heavy Rain Atmospheric Wind Conditions: 11 ENE ALM Pressure: 990mb								Equipment used: GA 2000+ / GA10111 ATEX GW dip tape				Data Collected By: Jordan Donovan				Input Checked by (sign):	
Ground Conditions (eg dry, flooded, frost, snow): Pooling						Depth to water (m bgl) (if noted to vary during monitoring then record such)	Well depth (mbgl) Current and [as installed]								Top of Response zone (m bgl)	Notes (eg, samples taken, dual installation, odours, sheens, broken headworks).	
Location	Time		Atmospheric Pressure (mb)	BH Pressure or differential (mb)	Flow (l/hr)			% by volume in air			LEL (%)	(ppm)					
	hours mins	secs						Methane	Carbon Dioxide	Oxygen		H2S	CO	PID			
BH1		0	990	-0.61	0.1 (initial)	5.73	6.68										
		120			0 (steady state)												
		0															
	07:26	15					0.0	1.5	20.1	0	0	0	N/A				
	07:28	30					0.0	1.3	19.6	0	0	0	N/A				
	07:30	60					0.0	1.5	19.4	0	0	0	N/A				
	07:33	90					0.0	1.5	19.5	0	0	0	N/A				
	07:35	120					0.0	1.6	19.6	0	0	0	N/A				
	07:39	180					0.0	1.6	19.7	0	0	0	N/A				
	07:43	240					0.0	1.6	19.8	0	0	0	N/A				
BH2		0	990	-0.53	0 (initial)	4.14	5.2										
		180			0 (steady state)												
		0															
	07:59	15					0.0	0.0	21.4	0	0	0	N/A				
	08:00	30					0.0	0.0	21.6	0	0	0	N/A				
	08:02	60					0.0	0.0	21.6	0	0	0	N/A				
	08:04	90					0.0	0.0	21.6	0	0	0	N/A				
	08:07	120					0.0	0.0	21.6	0	0	0	N/A				
	08:11	180					0.0	0.0	21.6	0	0	0	N/A				
	08:15	240					0.0	0.0	21.6	0	0	0	N/A				
BH4		0	990	-0.77	0 (initial)	5.85	6.2										
		240			0 (steady state)												
		0															
	07:46	15					0.0	0.1	18.7	0	1	15	N/A				
	07:47	30					0.0	0.1	17.4	0	2	14	N/A				
	07:48	60					0.0	0.1	18.1	0	2	2	N/A				
	07:49	90					0.0	0.1	18.1	0	2	0	N/A				
	07:51	120					0.0	0.1	18.2	0	2	0	N/A				
	07:54	180					0.0	0.1	18.2	0	2	0	N/A				
	07:58	240					0.0	0.1	18.2	0	2	0	N/A				

D - Geotechnical Results

(7 A4 Sheets)



Saturation Moisture Content - Summary of Results
Tested in accordance with BS1377 : Part 2 : 1990, clause 3.3 unless annotated otherwise.

Job No.	Project Name	Programme	
21999	New Century Place, Reading	Samples received	23/11/2016
		Schedule received	24/11/2016
Project No.	Client	Project started	25/11/2016
WB04333	Clarkebond	Testing Started	07/12/2016

[illegible]

Test Report by K4 SOILS LABORATORY
Unit 8 Olds Close Olds Approach
Watford Herts WD18 9RU
Tel: 01923 711 288
Email: James@k4soils.com

Checked and Approved

Initials J.P

Date: 09/12/2016

2519

Approved Signatories: K.Phaure (Tech.Mgr) J.Phaure (Lab.Mgr)

MSF-5-R18

Summary of Natural Moisture Content, Liquid Limit and Plastic Limit Results

Job No.	Project Name	Programme	
21999	New Century Place, Reading	Samples received	23/11/2016
		Schedule received	24/11/2016
Project No.	Client	Project started	25/11/2016
WB04333	Clarkebond	Testing Started	07/12/2016

[illegible]

Test Methods: BS1377: Part 2: 1990:

Natural Moisture Content : clause 3.2
Atterberg Limits: clause 4.3 and 5.0

Test Report by K4 SOILS LABORATORY
Unit 8 Olds Close Olds Approach
Watford Herts WD18 9RU

Tel: 01923 711 288
Email: James@k4soils.com

Checked and
Approved

Initials J.P

Date: 09/12/2016



STRUCTURAL SOILS LTD

TEST REPORT



Report No. 747988R.01(00)

1774

Date 21-December-2016 Contract New Century Place, Reading

Client Clarkebond (UK) Limited
Address 129 Cumberland Road
Bristol
BS1 6UY

For the Attention of Andre Gilleard

Samples submitted by client	25-November-2016	Client Reference	WB04333
Testing Started	02-December-2016	Client Order No.	None
Testing Completed	21-December-2016	Instruction Type	Written

Tests marked 'Not UKAS Accredited' in this report are not included in the UKAS Accreditation Schedule for our Laboratory.

UKAS Accredited Tests

- 1.01 Moisture Content (oven drying method) BS1377:Part 2:1990:clause 3.2 (superseded)*
- 1.03 Liquid Limit (one point method) & Plastic Limit BS1377:Part 2:1990,clause 4.4/5.3

NON UKAS Accredited Tests

- 10.02 Saturated moisture content of chalk BS1377:Part 2:1990,clause 3.3

* This clause of BS1377 is no longer the most up to date method due to the publication of ISO17892

Please Note: Remaining samples will be retained for a period of one month from today and will then be disposed of .
Test were undertaken on samples 'as received' unless otherwise stated.
Opinions and interpretations expressed in this report are outside the scope of accreditation for this laboratory.

Structural Soils Ltd 1a Princess Street Bedminster Bristol BS3 4AG Tel.0117 9471000. e-mail dimitris.xirouchakis@soils.co.uk

TESTING VERIFICATION CERTIFICATE



1774

The test results included in this report are certified as:-

ISSUE STATUS: **FINAL**

In accordance with the Structural Soils Ltd Laboratory Quality Management System, results sheets and summaries of results issued by the laboratory are checked by an approved signatory. The integrity of the test data and results are ensured by control of the computer system employed by the laboratory as part of the Software Verification Program as detailed in the Laboratory Quality Manual.

This testing verification certificate covers all testing compiled on or before the following datetime: **21/12/2016 12:46:26**.

Testing reported after this date is not covered by this Verification Certificate.

Dimitris Xirouchakis

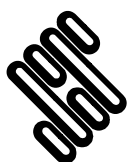
Approved Signatory
Dimitris Xirouchakis (Associate Laboratory Director)

(Head Office)
Bristol Laboratory
Unit 1A, Princess Street
Bedminster
Bristol
BS3 4AG

Castleford Laboratory
The Potteries, Pottery Street
Castleford
West Yorkshire
WF10 1NJ

Hemel Laboratory
18 Frogmore Road
Hemel Hempstead
Hertfordshire
HP3 9RT

Tonbridge Laboratory
Anerley Court, Half Moon Lane
Hildenborough
Tonbridge
TN11 9HU



**STRUCTURAL
SOILS LTD**

Contract:

New Century Place, Reading

Job No:

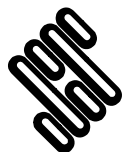
746988



SUMMARY OF SOIL CLASSIFICATION TESTS

In accordance with clauses 3.2,4.3,4.4,5.3,5.4,7.2,8.2,8.3 of BS1377:Part 2:1990

Exploratory Position ID	Sample Ref	Sample Type	Depth (m)	Moisture Content %	Liquid Limit %	Plastic Limit %	Plasticity Index	% <425um	Description of Sample
BH1		D	5.00	27	31	25	6	71	Off white stained brown CHALK
BH1		D	15.00	26	32	25	7	56	Off white CHALK
BH2		D	4.00	30	32	26	6	75	Off white CHALK
BH2		D	10.00	25	32	25	7	73	Off white CHALK
BH2		D	20.00	27	31	23	8	46	Off white CHALK



**STRUCTURAL
SOILS LTD**

Contract:

New Century Place, Reading

Contract Ref:

746988

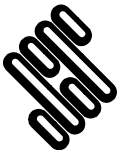


SUMMARY OF SMC (SATURATED MOISTURE CONTENT) TESTS

In accordance with clause 3.3 of BS1377:Part 2:1990

[illegible]

Lab location: B = Bristol (BS3 4AG), C = Castleford (WF10 1NJ), H = Hemel Hempstead (HP3 9RT), T = Tonbridge (TN11 9HU)



STRUCTURAL SOILS
1a Princess Street
Bedminster
Bristol
BS3 4AG

Compiled By

Date _____

Contract Ref:

A. J. Fre

ALAN FROST

21.12.16

Contract:

New Century Place, Reading

746988



E - Contamination Results

(23 A4 Sheet)



Final Report

Report No.: 16-27701-1

Initial Date of Issue: 28-Nov-2016

Client Clarke Bond

Client Address: 129 Cumberland Road
Bristol
Gloucestershire
BS1 6UY

Contact(s): Daniel Jobson
Andre Gilleard

Project WB04333 New Century Place, Reading

Quotation No.: **Date Received:** 14-Nov-2016

Order No.: P06542 **Date Instructed:** 22-Nov-2016

No. of Samples: 13

Turnaround (Wkdays): 5 **Results Due:** 28-Nov-2016

Date Approved: 28-Nov-2016

Approved By:

Details: Robert Monk, Technical Development
Chemist

Results - Soil

Client: Clarke Bond	Chemtest Job No.:				16-27701	16-27702	16-27702	16-27702	16-27926	16-28224	16-28224	16-28224	16-28224
Quotation No.:	Chemtest Sample ID.:				378158	378159	378160	378161	379142	380222	380223	380224	380225
Order No.: P06542	Client Sample Ref.:				BH2								
	Client Sample ID.:				ES	BH1	BH1	BH1	BH1	BH3	BH3	BH3	BH4
	Sample Type:				SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
	Top Depth (m):				0.5	0.30	1.00	1.50	0.50	0.5	1.0	1.5	0.5
	Date Sampled:				05-Nov-2016	05-Nov-2016	06-Nov-2016	05-Nov-2016	05-Nov-2016	12-Nov-2016	12-Nov-2016	12-Nov-2016	12-Nov-2016
Determinand	Accred.	SOP	Units	LOD									
Moisture	N	2030	%	0.020	4.0	4.6	12	7.1	8.7	17	14	13	9.4
Soil Colour	N	2040		N/A	Brown	Orange	Brown			Brown			
Other Material	N	2040		N/A	Stones	Stones	Stones			Stones			
Soil Texture	N	2040		N/A	Sand	Loam	Clay			Clay			
pH	M	2010		N/A	9.2	8.8	8.6			7.8			
Sulphate (2:1 Water Soluble) as SO4	M	2120	g/l	0.010	< 0.010	< 0.010	0.017			0.45			
Arsenic	U	2450	mg/kg	1.0	18	27	25		22	13			15
Cadmium	U	2450	mg/kg	0.10	0.20	0.87	0.47		0.28	0.23			0.15
Chromium	U	2450	mg/kg	1.0	21	12	27		18	15			12
Copper	U	2450	mg/kg	0.50	11	7.7	25		27	33			9.2
Mercury	U	2450	mg/kg	0.10	< 0.10	< 0.10	0.27		0.34	0.28			0.11
Nickel	U	2450	mg/kg	0.50	28	18	26		25	18			18
Lead	U	2450	mg/kg	0.50	10	75	120		140	190			30
Selenium	U	2450	mg/kg	0.20	0.27	< 0.20	< 0.20		0.34	< 0.20			0.21
Zinc	U	2450	mg/kg	0.50	47	78	90		89	73			31
Chromium (Hexavalent)	N	2490	mg/kg	0.50					< 0.50				< 0.50
Organic Matter	M	2625	%	0.40	0.41	0.41	1.2			5.9			
Total TPH >C6-C40	M	2670	mg/kg	10							< 10	< 10	
Aliphatic TPH >C5-C6	N	2680	mg/kg	1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0			< 1.0			
Aliphatic TPH >C6-C8	N	2680	mg/kg	1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0			< 1.0			
Aliphatic TPH >C8-C10	M	2680	mg/kg	1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0			< 1.0			
Aliphatic TPH >C10-C12	M	2680	mg/kg	1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0			< 1.0			
Aliphatic TPH >C12-C16	M	2680	mg/kg	1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0			< 1.0			
Aliphatic TPH >C16-C21	M	2680	mg/kg	1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0			< 1.0			
Aliphatic TPH >C21-C35	M	2680	mg/kg	1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0			< 1.0			
Aliphatic TPH >C35-C44	N	2680	mg/kg	1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0			< 1.0			
Total Aliphatic Hydrocarbons	N	2680	mg/kg	5.0	[B] < 5.0	[B] < 5.0	[B] < 5.0			< 5.0			
Aromatic TPH >C5-C7	N	2680	mg/kg	1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0			< 1.0			
Aromatic TPH >C7-C8	N	2680	mg/kg	1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0			< 1.0			
Aromatic TPH >C8-C10	M	2680	mg/kg	1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0			< 1.0			
Aromatic TPH >C10-C12	M	2680	mg/kg	1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0			< 1.0			
Aromatic TPH >C12-C16	M	2680	mg/kg	1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0			< 1.0			
Aromatic TPH >C16-C21	U	2680	mg/kg	1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0			< 1.0			
Aromatic TPH >C21-C35	M	2680	mg/kg	1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0			< 1.0			
Aromatic TPH >C35-C44	N	2680	mg/kg	1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0			< 1.0			
Total Aromatic Hydrocarbons	N	2680	mg/kg	5.0	[B] < 5.0	[B] < 5.0	[B] < 5.0			< 5.0			
Total Petroleum Hydrocarbons	N	2680	mg/kg	10	[B] < 10	[B] < 10	[B] < 10			< 10			
Naphthalene	M	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10			< 0.10			
Acenaphthylene	M	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10			< 0.10			

Results - Soil

Client: Clarke Bond	Chemtest Job No.:				16-27701	16-27702	16-27702	16-27702	16-27926	16-28224	16-28224	16-28224	16-28224
Quotation No.:	Chemtest Sample ID.:				378158	378159	378160	378161	379142	380222	380223	380224	380225
Order No.: P06542	Client Sample Ref.:				BH2								
	Client Sample ID.:				ES	BH1	BH1	BH1	BH1	BH3	BH3	BH3	BH4
	Sample Type:				SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
	Top Depth (m):				0.5	0.30	1.00	1.50	0.50	0.5	1.0	1.5	0.5
	Date Sampled:				05-Nov-2016	05-Nov-2016	06-Nov-2016	05-Nov-2016	05-Nov-2016	12-Nov-2016	12-Nov-2016	12-Nov-2016	12-Nov-2016
Determinand	Accred.	SOP	Units	LOD									
Acenaphthene	M	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10			< 0.10			
Fluorene	M	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10			< 0.10			
Phenanthrene	M	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10			< 0.10			
Anthracene	M	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10			< 0.10			
Fluoranthene	M	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10			< 0.10			
Pyrene	M	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10			< 0.10			
Benzo[a]anthracene	M	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10			< 0.10			
Chrysene	M	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10			< 0.10			
Benzo[b]fluoranthene	M	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10			< 0.10			
Benzo[k]fluoranthene	M	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10			< 0.10			
Benzo[a]pyrene	M	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10			< 0.10			
Indeno(1,2,3-c,d)Pyrene	M	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10			< 0.10			
Dibenz(a,h)Anthracene	M	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10			< 0.10			
Benzo[g,h,i]perylene	M	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10			< 0.10			
Total Of 16 PAH's	M	2700	mg/kg	2.0	< 2.0	< 2.0	< 2.0			< 2.0			
Dichlorodifluoromethane	U	2760	µg/kg	1.0	[B] < 1.0			[B] < 1.0					
Chloromethane	M	2760	µg/kg	1.0	[B] < 1.0			[B] < 1.0					
Vinyl Chloride	M	2760	µg/kg	1.0	[B] < 1.0			[B] < 1.0					
Bromomethane	M	2760	µg/kg	20	[B] < 20			[B] < 20					
Chloroethane	U	2760	µg/kg	2.0	[B] < 2.0			[B] < 2.0					
Trichlorofluoromethane	M	2760	µg/kg	1.0	[B] < 1.0			[B] < 1.0					
1,1-Dichloroethene	M	2760	µg/kg	1.0	[B] < 1.0			[B] < 1.0					
Trans 1,2-Dichloroethene	M	2760	µg/kg	1.0	[B] < 1.0			[B] < 1.0					
1,1-Dichloroethane	M	2760	µg/kg	1.0	[B] < 1.0			[B] < 1.0					
cis 1,2-Dichloroethene	M	2760	µg/kg	1.0	[B] < 1.0			[B] < 1.0					
Bromochloromethane	U	2760	µg/kg	5.0	[B] < 5.0			[B] < 5.0					
Trichloromethane	M	2760	µg/kg	1.0	[B] < 1.0			[B] < 1.0					
1,1,1-Trichloroethane	M	2760	µg/kg	1.0	[B] < 1.0			[B] < 1.0					
Tetrachloromethane	M	2760	µg/kg	1.0	[B] < 1.0			[B] < 1.0					
1,1-Dichloropropene	U	2760	µg/kg	1.0	[B] < 1.0			[B] < 1.0					
Benzene	M	2760	µg/kg	1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0		< 1.0			
1,2-Dichloroethane	M	2760	µg/kg	2.0	[B] < 2.0			[B] < 2.0					
Trichloroethene	M	2760	µg/kg	1.0	[B] < 1.0			[B] < 1.0					
1,2-Dichloropropane	M	2760	µg/kg	1.0	[B] < 1.0			[B] < 1.0					
Dibromomethane	M	2760	µg/kg	1.0	[B] < 1.0			[B] < 1.0					
Bromodichloromethane	M	2760	µg/kg	5.0	[B] < 5.0			[B] < 5.0					
cis-1,3-Dichloropropene	N	2760	µg/kg	10	[B] < 10			[B] < 10					
Toluene	M	2760	µg/kg	1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0		< 1.0			
Trans-1,3-Dichloropropene	N	2760	µg/kg	10	[B] < 10			[B] < 10					

Results - Soil

Client: Clarke Bond	Chemtest Job No.:				16-27701	16-27702	16-27702	16-27702	16-27926	16-28224	16-28224	16-28224	16-28224
Quotation No.:	Chemtest Sample ID.:				378158	378159	378160	378161	379142	380222	380223	380224	380225
Order No.: P06542	Client Sample Ref.:				BH2								
	Client Sample ID.:				ES	BH1	BH1	BH1	BH1	BH3	BH3	BH3	BH4
	Sample Type:				SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
	Top Depth (m):				0.5	0.30	1.00	1.50	0.50	0.5	1.0	1.5	0.5
	Date Sampled:				05-Nov-2016	05-Nov-2016	06-Nov-2016	05-Nov-2016	05-Nov-2016	12-Nov-2016	12-Nov-2016	12-Nov-2016	12-Nov-2016
Determinand	Accred.	SOP	Units	LOD									
1,1,2-Trichloroethane	M	2760	µg/kg	10	[B] < 10			[B] < 10					
Tetrachloroethene	M	2760	µg/kg	1.0	[B] < 1.0			[B] < 1.0					
1,3-Dichloropropane	U	2760	µg/kg	2.0	[B] < 2.0			[B] < 2.0					
Dibromochloromethane	U	2760	µg/kg	10	[B] < 10			[B] < 10					
1,2-Dibromoethane	M	2760	µg/kg	5.0	[B] < 5.0			[B] < 5.0					
Chlorobenzene	M	2760	µg/kg	1.0	[B] < 1.0			[B] < 1.0					
1,1,1,2-Tetrachloroethane	M	2760	µg/kg	2.0	[B] < 2.0			[B] < 2.0					
Ethylbenzene	M	2760	µg/kg	1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0		< 1.0			
m & p-Xylene	M	2760	µg/kg	1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0		< 1.0			
o-Xylene	M	2760	µg/kg	1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0		< 1.0			
Styrene	M	2760	µg/kg	1.0	[B] < 1.0			[B] < 1.0					
Tribromomethane	U	2760	µg/kg	1.0	[B] < 1.0			[B] < 1.0					
Isopropylbenzene	M	2760	µg/kg	1.0	[B] < 1.0			[B] < 1.0					
Bromobenzene	M	2760	µg/kg	1.0	[B] < 1.0			[B] < 1.0					
1,2,3-Trichloropropane	N	2760	µg/kg	50	[B] < 50			[B] < 50					
N-Propylbenzene	U	2760	µg/kg	1.0	[B] < 1.0			[B] < 1.0					
2-Chlorotoluene	M	2760	µg/kg	1.0	[B] < 1.0			[B] < 1.0					
1,3,5-Trimethylbenzene	M	2760	µg/kg	1.0	[B] < 1.0			[B] < 1.0					
4-Chlorotoluene	U	2760	µg/kg	1.0	[B] < 1.0			[B] < 1.0					
Tert-Butylbenzene	U	2760	µg/kg	1.0	[B] < 1.0			[B] < 1.0					
1,2,4-Trimethylbenzene	M	2760	µg/kg	1.0	[B] < 1.0			[B] < 1.0					
Sec-Butylbenzene	U	2760	µg/kg	1.0	[B] < 1.0			[B] < 1.0					
1,3-Dichlorobenzene	M	2760	µg/kg	1.0	[B] < 1.0			[B] < 1.0					
4-Isopropyltoluene	U	2760	µg/kg	1.0	[B] < 1.0			[B] < 1.0					
1,4-Dichlorobenzene	M	2760	µg/kg	1.0	[B] < 1.0			[B] < 1.0					
N-Butylbenzene	U	2760	µg/kg	1.0	[B] < 1.0			[B] < 1.0					
1,2-Dichlorobenzene	M	2760	µg/kg	1.0	[B] < 1.0			[B] < 1.0					
1,2-Dibromo-3-Chloropropane	U	2760	µg/kg	50	[B] < 50			[B] < 50					
1,2,4-Trichlorobenzene	M	2760	µg/kg	1.0	[B] < 1.0			[B] < 1.0					
Hexachlorobutadiene	U	2760	µg/kg	1.0	[B] < 1.0			[B] < 1.0					
1,2,3-Trichlorobenzene	U	2760	µg/kg	2.0	[B] < 2.0			[B] < 2.0					
Methyl Tert-Butyl Ether	M	2760	µg/kg	1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0		< 1.0			
PCB 28	M	2815	mg/kg	0.010	< 0.010								
PCB 52	M	2815	mg/kg	0.010	< 0.010								
PCB 101	M	2815	mg/kg	0.010	< 0.010								
PCB 118	M	2815	mg/kg	0.010	< 0.010								
PCB 153	M	2815	mg/kg	0.010	< 0.010								
PCB 138	M	2815	mg/kg	0.010	< 0.010								
PCB 180	M	2815	mg/kg	0.010	< 0.010								

Results - Soil

Client: Clarke Bond	Chemtest Job No.:				16-27701	16-27702	16-27702	16-27702	16-27926	16-28224	16-28224	16-28224	16-28224
Quotation No.:	Chemtest Sample ID.:				378158	378159	378160	378161	379142	380222	380223	380224	380225
Order No.: P06542	Client Sample Ref.:				BH2								
	Client Sample ID.:				ES	BH1	BH1	BH1	BH1	BH3	BH3	BH3	BH4
	Sample Type:				SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
	Top Depth (m):				0.5	0.30	1.00	1.50	0.50	0.5	1.0	1.5	0.5
	Date Sampled:				05-Nov-2016	05-Nov-2016	06-Nov-2016	05-Nov-2016	05-Nov-2016	12-Nov-2016	12-Nov-2016	12-Nov-2016	12-Nov-2016
Determinand	Accred.	SOP	Units	LOD									
Total PCBs (7 Congeners)	N	2815	mg/kg	0.10	< 0.10								

Client: Clarke Bond	Chemtest Job No.:				16-28405	16-28405
Quotation No.:	Chemtest Sample ID.:				380954	380955
	Client Sample ID.:				BH1	BH2
	Sample Type:				WATER	WATER
	Date Sampled:				21-Nov-2016	21-Nov-2016
Determinand	Accred.	SOP	Units	LOD		
pH	U	1010		N/A	7.5	7.4
Sulphate	U	1220	mg/l	1.0	93	51
Hardness	U	1415	mg/l	15	1800	820
Arsenic (Dissolved)	U	1450	µg/l	1.0	2.7	3.7
Cadmium (Dissolved)	U	1450	µg/l	0.080	< 0.080	< 0.080
Chromium (Dissolved)	U	1450	µg/l	1.0	9.2	11
Copper (Dissolved)	U	1450	µg/l	1.0	2.3	4.9
Nickel (Dissolved)	U	1450	µg/l	1.0	5.6	20
Lead (Dissolved)	U	1450	µg/l	1.0	< 1.0	< 1.0
Selenium (Dissolved)	U	1450	µg/l	1.0	3.2	2.6
Zinc (Dissolved)	U	1450	µg/l	1.0	5.6	7.0
Mercury Low Level	U	1460	µg/l	0.010	< 0.010	< 0.010
Aliphatic TPH >C5-C6	N	1675	µg/l	0.010	< 0.010	< 0.010
Aliphatic TPH >C6-C8	N	1675	µg/l	0.010	< 0.010	< 0.010
Aliphatic TPH >C8-C10	N	1675	µg/l	0.10	< 0.10	< 0.10
Aliphatic TPH >C10-C12	N	1675	µg/l	0.10	< 0.10	< 0.10
Aliphatic TPH >C12-C16	N	1675	µg/l	0.10	< 0.10	< 0.10
Aliphatic TPH >C16-C21	N	1675	µg/l	0.10	< 0.10	< 0.10
Aliphatic TPH >C21-C35	N	1675	µg/l	0.10	< 0.10	< 0.10
Aliphatic TPH >C35-C44	N	1675	µg/l	0.10	< 0.10	< 0.10
Total Aliphatic Hydrocarbons	N	1675	µg/l	1.0	< 1.0	< 1.0
Aromatic TPH >C5-C7	N	1675	µg/l	0.010	< 0.010	< 0.010
Aromatic TPH >C7-C8	N	1675	µg/l	0.010	< 0.010	< 0.010
Aromatic TPH >C8-C10	N	1675	µg/l	0.10	< 0.10	< 0.10
Aromatic TPH >C10-C12	N	1675	µg/l	0.10	< 0.10	< 0.10
Aromatic TPH >C12-C16	N	1675	µg/l	0.10	< 0.10	< 0.10
Aromatic TPH >C16-C21	N	1675	µg/l	0.10	< 0.10	< 0.10
Aromatic TPH >C21-C35	N	1675	µg/l	0.10	< 0.10	< 0.10
Aromatic TPH >C35-C44	N	1675	µg/l	0.10	< 0.10	< 0.10
Total Aromatic Hydrocarbons	N	1675	µg/l	1.0	< 1.0	< 1.0
Total Petroleum Hydrocarbons	N	1675	µg/l	2.0	< 2.0	< 2.0
Benzene	N	1760	µg/l	0.10	< 0.10	< 0.10
Toluene	N	1760	µg/l	0.10	< 0.10	< 0.10
Ethylbenzene	N	1760	µg/l	0.10	< 0.10	< 0.10
m & p-Xylene	N	1760	µg/l	0.10	< 0.10	< 0.10
o-Xylene	N	1760	µg/l	0.10	< 0.10	< 0.10
Methyl Tert-Butyl Ether	N	1760	µg/l	0.10	< 0.10	< 0.10
Naphthalene	N	1800	µg/l	0.010	< 0.010	< 0.010
Acenaphthylene	N	1800	µg/l	0.010	< 0.010	< 0.010
Acenaphthene	N	1800	µg/l	0.010	< 0.010	< 0.010
Fluorene	N	1800	µg/l	0.010	< 0.010	< 0.010

Results - Water

Client: Clarke Bond	Chemtest Job No.:				16-28405	16-28405
Quotation No.:	Chemtest Sample ID.:				380954	380955
	Client Sample ID.:				BH1	BH2
	Sample Type:				WATER	WATER
	Date Sampled:				21-Nov-2016	21-Nov-2016
Determinand	Accred.	SOP	Units	LOD		
Phenanthrene	N	1800	µg/l	0.010	< 0.010	< 0.010
Anthracene	N	1800	µg/l	0.010	< 0.010	< 0.010
Fluoranthene	N	1800	µg/l	0.010	< 0.010	< 0.010
Pyrene	N	1800	µg/l	0.010	< 0.010	< 0.010
Benzo[a]anthracene	N	1800	µg/l	0.010	< 0.010	< 0.010
Chrysene	N	1800	µg/l	0.010	< 0.010	< 0.010
Benzo[b]fluoranthene	N	1800	µg/l	0.010	< 0.010	< 0.010
Benzo[k]fluoranthene	N	1800	µg/l	0.010	< 0.010	< 0.010
Benzo[a]pyrene	N	1800	µg/l	0.010	< 0.010	< 0.010
Indeno(1,2,3-c,d)Pyrene	N	1800	µg/l	0.010	< 0.010	< 0.010
Dibenz(a,h)Anthracene	N	1800	µg/l	0.010	< 0.010	< 0.010
Benzo[g,h,i]perylene	N	1800	µg/l	0.010	< 0.010	< 0.010
Total Of 16 PAH's	N	1800	µg/l	0.20	< 0.20	< 0.20
Total Phenols	U	1920	mg/l	0.030	< 0.030	< 0.030

Results - 2 Stage WAC

Project: WB04333 New Century Place, Reading

Chemtest Job No: 16-28553 Chemtest Sample ID: 381573 Sample Ref: Sample ID: BH1 Top Depth(m): 0.50 Bottom Depth(m): Sampling Date: 05-Nov-2016							Landfill Waste Acceptance Criteria Limits		
							Inert Waste Landfill	Stable, Non-reactive hazardous waste in non-hazardous Landfill	Hazardous Waste Landfill
Determinand	SOP	Accred.	Units						
Total Organic Carbon	2625	U	%				0.92	3	5
Loss On Ignition	2610	U	%				1.3	--	--
Total BTEX	2760	U	mg/kg				[BC] < 0.010	6	--
Total PCBs (7 Congeners)	2815	U	mg/kg				< 0.10	1	--
TPH Total WAC (Mineral Oil)	2670	U	mg/kg				[BC] < 10	500	--
Total (Of 17) PAH's	2700	N	mg/kg				< 2.0	100	--
pH	2010	U					8.9	--	>6
Acid Neutralisation Capacity	2015	N	mol/kg				0.017	--	To evaluate
Eluate Analysis			2:1 mg/l	8:1 mg/l	2:1 mg/kg	Cumulative mg/kg 10:1	Limit values for compliance leaching test using BS EN 12457-3 at L/S 10 l/kg		
Arsenic	1450	U	0.012	0.0069	< 0.050	0.075	0.5	2	25
Barium	1450	U	0.014	0.0084	< 0.50	< 0.50	20	100	300
Cadmium	1450	U	< 0.00010	< 0.00010	< 0.010	< 0.010	0.04	1	5
Chromium	1450	U	< 0.0010	0.0012	< 0.050	< 0.050	0.5	10	70
Copper	1450	U	0.0027	0.0030	< 0.050	< 0.050	2	50	100
Mercury	1450	U	< 0.00050	< 0.00050	< 0.0010	< 0.0050	0.01	0.2	2
Molybdenum	1450	U	0.0078	0.0016	< 0.050	< 0.050	0.5	10	30
Nickel	1450	U	0.0012	0.0012	< 0.050	< 0.050	0.4	10	40
Lead	1450	U	0.0016	0.0028	< 0.010	0.027	0.5	10	50
Antimony	1450	U	0.0023	< 0.0010	< 0.010	< 0.010	0.06	0.7	5
Selenium	1450	U	0.0095	0.0054	0.019	0.059	0.1	0.5	7
Zinc	1450	U	0.0039	0.0045	< 0.50	< 0.50	4	50	200
Chloride	1220	U	8.2	2.2	16	29	800	15000	25000
Fluoride	1220	U	0.16	0.13	< 1.0	1.3	10	150	500
Sulphate	1220	U	12	3.7	24	47	1000	20000	50000
Total Dissolved Solids	1020	N	110	54	220	610	4000	60000	100000
Phenol Index	1920	U	< 0.030	< 0.030	< 0.30	< 0.50	1	-	-
Dissolved Organic Carbon	1610	U	42	40	84	400	500	800	1000

Soild Information	
Dry mass of test portion/kg	0.175
Moisture (%)	7.4

Leachate Test Information	
Leachant volume 1st extract/l	0.336
Leachant volume 2nd extract/l	1.400
Eluant recovered from 1st extract/l	0.213

Results - 2 Stage WAC

Project: WB04333 New Century Place, Reading

Chemtest Job No: 16-28557							Landfill Waste Acceptance Criteria			
Chemtest Sample ID: 381578							Limits			
Sample Ref:							Inert Waste Landfill	Stable, Non-reactive hazardous waste in non-hazardous Landfill	Hazardous Waste Landfill	
Sample ID: BH4										
Top Depth(m): 0.50										
Bottom Depth(m):										
Sampling Date: 12-Nov-2016										
Determinand	SOP	Accred.	Units							
Total Organic Carbon	2625	U	%				< 0.20	3	5	6
Loss On Ignition	2610	U	%				1.1	--	--	10
Total BTEX	2760	U	mg/kg				[C] < 0.010	6	--	--
Total PCBs (7 Congeners)	2815	U	mg/kg				< 0.10	1	--	--
TPH Total WAC (Mineral Oil)	2670	U	mg/kg				[C] < 10	500	--	--
Total (Of 17) PAH's	2700	N	mg/kg				< 2.0	100	--	--
pH	2010	U					8.0	--	>6	--
Acid Neutralisation Capacity	2015	N	mol/kg				0.015	--	To evaluate	To evaluate
Eluate Analysis			2:1 mg/l	8:1 mg/l	2:1 mg/kg	Cumulative mg/kg 10:1	Limit values for compliance leaching test using BS EN 12457-3 at L/S 10 l/kg			
Arsenic	1450	U	0.0019	0.0020	< 0.050	< 0.050	0.5	2	25	
Barium	1450	U	0.027	0.018	< 0.50	< 0.50	20	100	300	
Cadmium	1450	U	< 0.00010	< 0.00010	< 0.010	< 0.010	0.04	1	5	
Chromium	1450	U	0.0020	< 0.0010	< 0.050	< 0.050	0.5	10	70	
Copper	1450	U	< 0.0010	0.0011	< 0.050	< 0.050	2	50	100	
Mercury	1450	U	< 0.00050	< 0.00050	< 0.0010	< 0.0050	0.01	0.2	2	
Molybdenum	1450	U	0.0062	0.0012	< 0.050	< 0.050	0.5	10	30	
Nickel	1450	U	< 0.0010	< 0.0010	< 0.050	< 0.050	0.4	10	40	
Lead	1450	U	< 0.0010	0.0016	< 0.010	0.014	0.5	10	50	
Antimony	1450	U	< 0.0010	< 0.0010	< 0.010	< 0.010	0.06	0.7	5	
Selenium	1450	U	0.0040	0.0036	< 0.010	0.037	0.1	0.5	7	
Zinc	1450	U	< 0.0010	0.0025	< 0.50	< 0.50	4	50	200	
Chloride	1220	U	1.8	< 1.0	< 10	< 10	800	15000	25000	
Fluoride	1220	U	0.25	0.13	< 1.0	1.5	10	150	500	
Sulphate	1220	U	9.8	1.5	20	28	1000	20000	50000	
Total Dissolved Solids	1020	N	87	43	170	500	4000	60000	100000	
Phenol Index	1920	U	< 0.030	< 0.030	< 0.30	< 0.50	1	-	-	
Dissolved Organic Carbon	1610	U	20	12	< 50	130	500	800	1000	

Soild Information

Dry mass of test portion/kg	0.175
Moisture (%)	8.9

Leachate Test Information

Leachant volume 1st extract/l	0.333
Leachant volume 2nd extract/l	1.400
Eluant recovered from 1st extract/l	0.268

Deviations

In accordance with UKAS Policy on Deviating Samples TPS 63. Chemtest have a procedure to ensure 'upon receipt of each sample a competent laboratory shall assess whether the sample is suitable with regard to the requested test(s)'. This policy and the respective holding times applied, can be supplied upon request. The reason a sample is declared as deviating is detailed below. Where applicable the analysis remains UKAS/MCERTs accredited but the results may be compromised.

Sample ID:	Sample Ref:	Sample ID:	Sampled Date:	Deviation Code(s):	Containers Received:
378158	BH2	ES	05-Nov-2016	B	Amber Glass 250ml
378158	BH2	ES	05-Nov-2016	B	Plastic Tub 500g
378159		BH1	05-Nov-2016	B	Amber Glass 250ml
378159		BH1	05-Nov-2016	B	Amber Glass 60ml
378159		BH1	05-Nov-2016	B	Plastic Tub 500g
378160		BH1	06-Nov-2016	B	Amber Glass 250ml
378160		BH1	06-Nov-2016	B	Amber Glass 60ml
378160		BH1	06-Nov-2016	B	Plastic Tub 500g
378161		BH1	05-Nov-2016	B	Amber Glass 250ml
378161		BH1	05-Nov-2016	B	Amber Glass 60ml
378161		BH1	05-Nov-2016	B	Plastic Tub 500g
381573		BH1	05-Nov-2016	BC	Plastic Bag
381578		BH4	12-Nov-2016	C	Plastic Bag

SOP	Title	Parameters included	Method summary
1010	pH Value of Waters	pH	pH Meter
1020	Electrical Conductivity and Total Dissolved Solids (TDS) in Waters	Electrical Conductivity and Total Dissolved Solids (TDS) in Waters	Conductivity Meter
1220	Anions, Alkalinity & Ammonium in Waters	Fluoride; Chloride; Nitrite; Nitrate; Total; Oxidisable Nitrogen (TON); Sulfate; Phosphate; Alkalinity; Ammonium	Automated colorimetric analysis using 'Aquakem 600' Discrete Analyser.
1415	Cations in Waters by ICP-MS	Sodium; Potassium; Calcium; Magnesium	Direct determination by inductively coupled plasma - mass spectrometry (ICP-MS).
1450	Metals in Waters by ICP-MS	Metals, including: Antimony; Arsenic; Barium; Beryllium; Boron; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Tin; Vanadium; Zinc	Filtration of samples followed by direct determination by inductively coupled plasma mass spectrometry (ICP-MS).
1460	Mercury low-level in Waters by AFS	Mercury	Atomic Fluorescence Spectrometry, with collimated UV source, wavelength 253.7 nm.
1610	Total/Dissolved Organic Carbon in Waters	Organic Carbon	TOC Analyser using Catalytic Oxidation
1675	TPH Aliphatic/Aromatic split in Waters by GC-FID(cf. Texas Method 1006 / TPH CWG)	Aliphatics: >C5–C6, >C6–C8, >C8– C10, >C10–C12, >C12–C16, >C16–C21, >C21–C35, >C35– C44 Aromatics: >C5–C7, >C7–C8, >C8– C10, >C10–C12, >C12–C16, >C16– C21, >C21– C35, >C35– C44	Pentane extraction / GCxGC FID detection
1760	Volatile Organic Compounds (VOCs) in Waters by Headspace GC-MS	Volatile organic compounds, including BTEX and halogenated Aliphatic/Aromatics. (cf. USEPA Method 8260)	Automated headspace gas chromatographic (GC) analysis of water samples with mass spectrometric (MS) detection of volatile organic compounds.
1800	Speciated Polynuclear Aromatic Hydrocarbons (PAH) in Waters by GC-MS	Acenaphthene; Acenaphthylene; Anthracene; Benzo[a]Anthracene; Benzo[a]Pyrene; Benzo[b]Fluoranthene; Benzo[ghi]Perylene; Benzo[k]Fluoranthene; Chrysene; Dibenzo[ah]Anthracene; Fluoranthene; Fluorene; Indeno[123cd]Pyrene; Naphthalene; Phenanthrene; Pyrene	Pentane extraction / GCMS detection
1920	Phenols in Waters by HPLC	Phenolic compounds including: Phenol, Cresols, Xylenols, Trimethylphenols Note: Chlorophenols are excluded.	Determination by High Performance Liquid Chromatography (HPLC) using electrochemical detection.
2010	pH Value of Soils	pH	pH Meter
2015	Acid Neutralisation Capacity	Acid Reserve	Titration
2030	Moisture and Stone Content of Soils(Requirement of MCERTS)	Moisture content	Determination of moisture content of soil as a percentage of its as received mass obtained at <37°C.
2040	Soil Description(Requirement of MCERTS)	Soil description	As received soil is described based upon BS5930
2120	Water Soluble Boron, Sulphate, Magnesium & Chromium	Boron; Sulphate; Magnesium; Chromium	Aqueous extraction / ICP-OES
2450	Acid Soluble Metals in Soils	Metals, including: Arsenic; Barium; Beryllium; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Vanadium; Zinc	Acid digestion followed by determination of metals in extract by ICP-MS.
2490	Hexavalent Chromium in Soils	Chromium [VI]	Soil extracts are prepared by extracting dried and ground soil samples into boiling water. Chromium [VI] is determined by 'Aquakem 600' Discrete Analyser using 1,5-diphenylcarbazide.
2610	Loss on Ignition	loss on ignition (LOI)	Determination of the proportion by mass that is lost from a soil by ignition at 550°C.

SOP	Title	Parameters included	Method summary
2625	Total Organic Carbon in Soils	Total organic Carbon (TOC)	Determined by high temperature combustion under oxygen, using an Eltra elemental analyser.
2670	Total Petroleum Hydrocarbons (TPH) in Soils by GC-FID	TPH (C6–C40); optional carbon banding, e.g. 3-band – GRO, DRO & LRO*TPH C8–C40	Dichloromethane extraction / GC-FID
2680	TPH A/A Split	Aliphatics: >C5–C6, >C6–C8, >C8–C10, >C10–C12, >C12–C16, >C16–C21, >C21–C35, >C35–C44 Aromatics: >C5–C7, >C7–C8, >C8–C10, >C10–C12, >C12–C16, >C16–C21, >C21–C35, >C35–C44	Dichloromethane extraction / GCxGC FID detection
2700	Speciated Polynuclear Aromatic Hydrocarbons (PAH) in Soil by GC-FID	Acenaphthene; Acenaphthylene; Anthracene; Benzo[a]Anthracene; Benzo[a]Pyrene; Benzo[b]Fluoranthene; Benzo[ghi]Perylene; Benzo[k]Fluoranthene; Chrysene; Dibenzo[ah]Anthracene; Fluoranthene; Fluorene; Indeno[123cd]Pyrene; Naphthalene; Phenanthrene; Pyrene	Dichloromethane extraction / GC-FID
2760	Volatile Organic Compounds (VOCs) in Soils by Headspace GC-MS	Volatile organic compounds, including BTEX and halogenated Aliphatic/Aromatics. (cf. USEPA Method 8260)*please refer to UKAS schedule	Automated headspace gas chromatographic (GC) analysis of a soil sample, as received, with mass spectrometric (MS) detection of volatile organic compounds.
2815	Polychlorinated Biphenyls (PCB) ICES7 Congeners in Soils by GC-MS	ICES7 PCB congeners	Acetone/Hexane extraction / GC-MS

Report Information

Key

- U UKAS accredited
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- T This analysis has been subcontracted to an unaccredited laboratory
- I/S Insufficient Sample
- U/S Unsuitable Sample
- N/E not evaluated
- < "less than"
- > "greater than"

Comments or interpretations are beyond the scope of UKAS accreditation

The results relate only to the items tested

Uncertainty of measurement for the determinands tested are available upon request

None of the results in this report have been recovery corrected

All results are expressed on a dry weight basis

The following tests were analysed on samples as received and the results subsequently corrected to a dry weight basis TPH, BTEX, VOCs, SVOCs, PCBs, Phenols

For all other tests the samples were dried at < 37°C prior to analysis

All Asbestos testing is performed at the indicated laboratory

Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1

Sample Deviation Codes

- A - Date of sampling not supplied
- B - Sample age exceeds stability time (sampling to extraction)
- C - Sample not received in appropriate containers
- D - Broken Container

Sample Retention and Disposal

All soil samples will be retained for a period of 45 days from the date of receipt

All water samples will be retained for 14 days from the date of receipt

Charges may apply to extended sample storage

If you require extended retention of samples, please email your requirements to:

customerservices@chemtest.co.uk



2183

Final Report

Report No.: 16-28553-1

Initial Date of Issue: 30-Nov-2016

Client Clarke Bond

Client Address: 129 Cumberland Road
Bristol
Gloucestershire
BS1 6UY

Contact(s): Andre Gilleard
Daniel Jobson

Project WB04333 New Century Place, Reading

Quotation No.: **Date Received:** 22-Nov-2016

Order No.: P06542 **Date Instructed:** 22-Nov-2016

No. of Samples: 1

Turnaround (Wkdays): 7 **Results Due:** 30-Nov-2016

Date Approved: 30-Nov-2016

Approved By:



Details: Robert Monk, Technical Development
Chemist

Results - 2 Stage WAC

Project: WB04333 New Century Place, Reading

Chemtest Job No: 16-28553 Chemtest Sample ID: 381573 Sample Ref: Sample ID: BH1 Top Depth(m): 0.50 Bottom Depth(m): Sampling Date: 05-Nov-2016							Landfill Waste Acceptance Criteria Limits		
							Inert Waste Landfill	Stable, Non-reactive hazardous waste in non-hazardous Landfill	Hazardous Waste Landfill
Determinand	SOP	Accred.	Units						
Total Organic Carbon	2625	U	%				0.92	3	5
Loss On Ignition	2610	U	%				1.3	--	10
Total BTEX	2760	U	mg/kg				[BC] < 0.010	6	--
Total PCBs (7 Congeners)	2815	U	mg/kg				< 0.10	1	--
TPH Total WAC (Mineral Oil)	2670	U	mg/kg				[BC] < 10	500	--
Total (Of 17) PAH's	2700	N	mg/kg				< 2.0	100	--
pH	2010	U					8.9	--	>6
Acid Neutralisation Capacity	2015	N	mol/kg				0.017	--	To evaluate
Eluate Analysis			2:1 mg/l	8:1 mg/l	2:1 mg/kg	Cumulative mg/kg 10:1	Limit values for compliance leaching test using BS EN 12457-3 at L/S 10 l/kg		
Arsenic	1450	U	0.012	0.0069	< 0.050	0.075	0.5	2	25
Barium	1450	U	0.014	0.0084	< 0.50	< 0.50	20	100	300
Cadmium	1450	U	< 0.00010	< 0.00010	< 0.010	< 0.010	0.04	1	5
Chromium	1450	U	< 0.0010	0.0012	< 0.050	< 0.050	0.5	10	70
Copper	1450	U	0.0027	0.0030	< 0.050	< 0.050	2	50	100
Mercury	1450	U	< 0.00050	< 0.00050	< 0.0010	< 0.0050	0.01	0.2	2
Molybdenum	1450	U	0.0078	0.0016	< 0.050	< 0.050	0.5	10	30
Nickel	1450	U	0.0012	0.0012	< 0.050	< 0.050	0.4	10	40
Lead	1450	U	0.0016	0.0028	< 0.010	0.027	0.5	10	50
Antimony	1450	U	0.0023	< 0.0010	< 0.010	< 0.010	0.06	0.7	5
Selenium	1450	U	0.0095	0.0054	0.019	0.059	0.1	0.5	7
Zinc	1450	U	0.0039	0.0045	< 0.50	< 0.50	4	50	200
Chloride	1220	U	8.2	2.2	16	29	800	15000	25000
Fluoride	1220	U	0.16	0.13	< 1.0	1.3	10	150	500
Sulphate	1220	U	12	3.7	24	47	1000	20000	50000
Total Dissolved Solids	1020	N	110	54	220	610	4000	60000	100000
Phenol Index	1920	U	< 0.030	< 0.030	< 0.30	< 0.50	1	-	-
Dissolved Organic Carbon	1610	U	42	40	84	400	500	800	1000

Soild Information

Dry mass of test portion/kg	0.175
Moisture (%)	7.4

Leachate Test Information

Leachant volume 1st extract/l	0.336
Leachant volume 2nd extract/l	1.400
Eluant recovered from 1st extract/l	0.213

Deviations

In accordance with UKAS Policy on Deviating Samples TPS 63. Chemtest have a procedure to ensure 'upon receipt of each sample a competent laboratory shall assess whether the sample is suitable with regard to the requested test(s)'. This policy and the respective holding times applied, can be supplied upon request. The reason a sample is declared as deviating is detailed below. Where applicable the analysis remains UKAS/MCERTs accredited but the results may be compromised.

Sample ID:	Sample Ref:	Sample ID:	Sampled Date:	Deviation Code(s):	Containers Received:
381573		BH1	05-Nov-2016	BC	Plastic Bag

SOP	Title	Parameters included	Method summary
1020	Electrical Conductivity and Total Dissolved Solids (TDS) in Waters	Electrical Conductivity and Total Dissolved Solids (TDS) in Waters	Conductivity Meter
1220	Anions, Alkalinity & Ammonium in Waters	Fluoride; Chloride; Nitrite; Nitrate; Total; Oxidisable Nitrogen (TON); Sulfate; Phosphate; Alkalinity; Ammonium	Automated colorimetric analysis using 'Aquakem 600' Discrete Analyser.
1450	Metals in Waters by ICP-MS	Metals, including: Antimony; Arsenic; Barium; Beryllium; Boron; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Tin; Vanadium; Zinc	Filtration of samples followed by direct determination by inductively coupled plasma mass spectrometry (ICP-MS).
1610	Total/Dissolved Organic Carbon in Waters	Organic Carbon	TOC Analyser using Catalytic Oxidation
1920	Phenols in Waters by HPLC	Phenolic compounds including: Phenol, Cresols, Xylenols, Trimethylphenols Note: Chlorophenols are excluded.	Determination by High Performance Liquid Chromatography (HPLC) using electrochemical detection.
2010	pH Value of Soils	pH	pH Meter
2015	Acid Neutralisation Capacity	Acid Reserve	Titration
2030	Moisture and Stone Content of Soils(Requirement of MCERTS)	Moisture content	Determination of moisture content of soil as a percentage of its as received mass obtained at <37°C.
2610	Loss on Ignition	loss on ignition (LOI)	Determination of the proportion by mass that is lost from a soil by ignition at 550°C.
2625	Total Organic Carbon in Soils	Total organic Carbon (TOC)	Determined by high temperature combustion under oxygen, using an Eltra elemental analyser.
2670	Total Petroleum Hydrocarbons (TPH) in Soils by GC-FID	TPH (C6–C40); optional carbon banding, e.g. 3-band – GRO, DRO & LRO*TPH C8–C40	Dichloromethane extraction / GC-FID
2700	Speciated Polynuclear Aromatic Hydrocarbons (PAH) in Soil by GC-FID	Acenaphthene; Acenaphthylene; Anthracene; Benzo[a]Anthracene; Benzo[a]Pyrene; Benzo[b]Fluoranthene; Benzo[ghi]Perylene; Benzo[k]Fluoranthene; Chrysene; Dibenzo[ah]Anthracene; Fluoranthene; Fluorene; Indeno[123cd]Pyrene; Naphthalene; Phenanthrene; Pyrene	Dichloromethane extraction / GC-FID
2760	Volatile Organic Compounds (VOCs) in Soils by Headspace GC-MS	Volatile organic compounds, including BTEX and halogenated Aliphatic/Aromatics.(cf. USEPA Method 8260)*please refer to UKAS schedule	Automated headspace gas chromatographic (GC) analysis of a soil sample, as received, with mass spectrometric (MS) detection of volatile organic compounds.
2815	Polychlorinated Biphenyls (PCB) ICES7Congeners in Soils by GC-MS	ICES7 PCB congeners	Acetone/Hexane extraction / GC-MS

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- < "less than"
- > "greater than"

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Uncertainty of measurement for the determinands tested are available upon request

None of the results in this report have been recovery corrected

All results are expressed on a dry weight basis

The following tests were analysed on samples as received and the results subsequently corrected to a dry weight basis TPH, BTEX, VOCs, SVOCs, PCBs, Phenols

For all other tests the samples were dried at < 37°C prior to analysis

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Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1

Sample Deviation Codes

- A - Date of sampling not supplied
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- C - Sample not received in appropriate containers
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All soil samples will be retained for a period of 45 days from the date of receipt

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2183

Final Report

Report No.: 16-28557-1

Initial Date of Issue: 30-Nov-2016

Client Clarke Bond

Client Address: 129 Cumberland Road
Bristol
Gloucestershire
BS1 6UY

Contact(s): Andre Gilleard
Daniel Jobson

Project WB04333 New Century Place, Reading

Quotation No.: **Date Received:** 22-Nov-2016

Order No.: P06542 **Date Instructed:** 22-Nov-2016

No. of Samples: 1

Turnaround (Wkdays): 7 **Results Due:** 30-Nov-2016

Date Approved: 30-Nov-2016

Approved By:



Details: Robert Monk, Technical Development
Chemist

Results - 2 Stage WAC

Project: WB04333 New Century Place, Reading

Chemtest Job No: 16-28557							Landfill Waste Acceptance Criteria			
Chemtest Sample ID: 381578							Limits			
Sample Ref:							Inert Waste Landfill	Stable, Non-reactive hazardous waste in non-hazardous Landfill	Hazardous Waste Landfill	
Sample ID: BH4										
Top Depth(m): 0.50										
Bottom Depth(m):										
Sampling Date: 12-Nov-2016										
Determinand	SOP	Accred.	Units							
Total Organic Carbon	2625	U	%				< 0.20	3	5	6
Loss On Ignition	2610	U	%				1.1	--	--	10
Total BTEX	2760	U	mg/kg				[C] < 0.010	6	--	--
Total PCBs (7 Congeners)	2815	U	mg/kg				< 0.10	1	--	--
TPH Total WAC (Mineral Oil)	2670	U	mg/kg				[C] < 10	500	--	--
Total (Of 17) PAH's	2700	N	mg/kg				< 2.0	100	--	--
pH	2010	U					8.0	--	>6	--
Acid Neutralisation Capacity	2015	N	mol/kg				0.015	--	To evaluate	To evaluate
Eluate Analysis			2:1 mg/l	8:1 mg/l	2:1 mg/kg	Cumulative mg/kg 10:1	Limit values for compliance leaching test using BS EN 12457-3 at L/S 10 l/kg			
Arsenic	1450	U	0.0019	0.0020	< 0.050	< 0.050	0.5	2	25	
Barium	1450	U	0.027	0.018	< 0.50	< 0.50	20	100	300	
Cadmium	1450	U	< 0.00010	< 0.00010	< 0.010	< 0.010	0.04	1	5	
Chromium	1450	U	0.0020	< 0.0010	< 0.050	< 0.050	0.5	10	70	
Copper	1450	U	< 0.0010	0.0011	< 0.050	< 0.050	2	50	100	
Mercury	1450	U	< 0.00050	< 0.00050	< 0.0010	< 0.0050	0.01	0.2	2	
Molybdenum	1450	U	0.0062	0.0012	< 0.050	< 0.050	0.5	10	30	
Nickel	1450	U	< 0.0010	< 0.0010	< 0.050	< 0.050	0.4	10	40	
Lead	1450	U	< 0.0010	0.0016	< 0.010	0.014	0.5	10	50	
Antimony	1450	U	< 0.0010	< 0.0010	< 0.010	< 0.010	0.06	0.7	5	
Selenium	1450	U	0.0040	0.0036	< 0.010	0.037	0.1	0.5	7	
Zinc	1450	U	< 0.0010	0.0025	< 0.50	< 0.50	4	50	200	
Chloride	1220	U	1.8	< 1.0	< 10	< 10	800	15000	25000	
Fluoride	1220	U	0.25	0.13	< 1.0	1.5	10	150	500	
Sulphate	1220	U	9.8	1.5	20	28	1000	20000	50000	
Total Dissolved Solids	1020	N	87	43	170	500	4000	60000	100000	
Phenol Index	1920	U	< 0.030	< 0.030	< 0.30	< 0.50	1	-	-	
Dissolved Organic Carbon	1610	U	20	12	< 50	130	500	800	1000	

Soild Information

Dry mass of test portion/kg	0.175
Moisture (%)	8.9

Leachate Test Information

Leachant volume 1st extract/l	0.333
Leachant volume 2nd extract/l	1.400
Eluant recovered from 1st extract/l	0.268

Deviations

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Sample ID:	Sample Ref:	Sample ID:	Sampled Date:	Deviation Code(s):	Containers Received:
381578		BH4	12-Nov-2016	C	Plastic Bag

SOP	Title	Parameters included	Method summary
1020	Electrical Conductivity and Total Dissolved Solids (TDS) in Waters	Electrical Conductivity and Total Dissolved Solids (TDS) in Waters	Conductivity Meter
1220	Anions, Alkalinity & Ammonium in Waters	Fluoride; Chloride; Nitrite; Nitrate; Total; Oxidisable Nitrogen (TON); Sulfate; Phosphate; Alkalinity; Ammonium	Automated colorimetric analysis using 'Aquakem 600' Discrete Analyser.
1450	Metals in Waters by ICP-MS	Metals, including: Antimony; Arsenic; Barium; Beryllium; Boron; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Tin; Vanadium; Zinc	Filtration of samples followed by direct determination by inductively coupled plasma mass spectrometry (ICP-MS).
1610	Total/Dissolved Organic Carbon in Waters	Organic Carbon	TOC Analyser using Catalytic Oxidation
1920	Phenols in Waters by HPLC	Phenolic compounds including: Phenol, Cresols, Xylenols, Trimethylphenols Note: Chlorophenols are excluded.	Determination by High Performance Liquid Chromatography (HPLC) using electrochemical detection.
2010	pH Value of Soils	pH	pH Meter
2015	Acid Neutralisation Capacity	Acid Reserve	Titration
2030	Moisture and Stone Content of Soils(Requirement of MCERTS)	Moisture content	Determination of moisture content of soil as a percentage of its as received mass obtained at <37°C.
2610	Loss on Ignition	loss on ignition (LOI)	Determination of the proportion by mass that is lost from a soil by ignition at 550°C.
2625	Total Organic Carbon in Soils	Total organic Carbon (TOC)	Determined by high temperature combustion under oxygen, using an Eltra elemental analyser.
2670	Total Petroleum Hydrocarbons (TPH) in Soils by GC-FID	TPH (C6–C40); optional carbon banding, e.g. 3-band – GRO, DRO & LRO*TPH C8–C40	Dichloromethane extraction / GC-FID
2700	Speciated Polynuclear Aromatic Hydrocarbons (PAH) in Soil by GC-FID	Acenaphthene; Acenaphthylene; Anthracene; Benzo[a]Anthracene; Benzo[a]Pyrene; Benzo[b]Fluoranthene; Benzo[ghi]Perylene; Benzo[k]Fluoranthene; Chrysene; Dibenzo[ah]Anthracene; Fluoranthene; Fluorene; Indeno[123cd]Pyrene; Naphthalene; Phenanthrene; Pyrene	Dichloromethane extraction / GC-FID
2760	Volatile Organic Compounds (VOCs) in Soils by Headspace GC-MS	Volatile organic compounds, including BTEX and halogenated Aliphatic/Aromatics.(cf. USEPA Method 8260)*please refer to UKAS schedule	Automated headspace gas chromatographic (GC) analysis of a soil sample, as received, with mass spectrometric (MS) detection of volatile organic compounds.
2815	Polychlorinated Biphenyls (PCB) ICES7Congeners in Soils by GC-MS	ICES7 PCB congeners	Acetone/Hexane extraction / GC-MS

Report Information

Key

- U UKAS accredited
- M MCERTS and UKAS accredited
- N Unaccredited
- S This analysis has been subcontracted to a UKAS accredited laboratory that is accredited for this analysis
- SN This analysis has been subcontracted to a UKAS accredited laboratory that is not accredited for this analysis
- T This analysis has been subcontracted to an unaccredited laboratory
- I/S Insufficient Sample
- U/S Unsuitable Sample
- N/E not evaluated
- < "less than"
- > "greater than"

Comments or interpretations are beyond the scope of UKAS accreditation

The results relate only to the items tested

Uncertainty of measurement for the determinands tested are available upon request

None of the results in this report have been recovery corrected

All results are expressed on a dry weight basis

The following tests were analysed on samples as received and the results subsequently corrected to a dry weight basis TPH, BTEX, VOCs, SVOCs, PCBs, Phenols

For all other tests the samples were dried at < 37°C prior to analysis

All Asbestos testing is performed at the indicated laboratory

Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1

Sample Deviation Codes

- A - Date of sampling not supplied
- B - Sample age exceeds stability time (sampling to extraction)
- C - Sample not received in appropriate containers
- D - Broken Container

Sample Retention and Disposal

All soil samples will be retained for a period of 45 days from the date of receipt

All water samples will be retained for 14 days from the date of receipt

Charges may apply to extended sample storage

If you require extended retention of samples, please email your requirements to:

customerservices@chemtest.co.uk

F - Site Boundary (in red)

(1 A3 sheet)

Site Details:

New Century Place, RG1 4AU

Client Ref: 32557
Report Ref: CMAPS-CM-553955-32557-170816HIS
Grid Ref: 471884, 173172

Map Name: National Grid

Map date: 1993

Scale: 1:1,250

Printed at: 1:2,000



Surveyed 1993
Revised N/A
Edition N/A
Copyright 1993
Levelled N/A



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Production date: 17 August 2016

To view map legend click here [Legend](#)



G – Clarkebond Engineering Capabilities

(1 A4 sheet)



clarkebond

ground engineering

Our ground engineering capability covers condition assessment and engineering of the ground, including geotechnics, contamination assessment, geology, hydrology, hydrogeology, and waste soils assessment.

Our development services cover pre-site acquisition, pre- and post-planning stages, validation/verification of any remediation and other risk reduction measures, addressing the aspirations of developers and regulatory bodies (e.g. planning authorities and Environment Agency.)

Our specialist geotechnical and geoenvironmental engineers, apply their skills to the specific challenges of both greenfield and brownfield sites, where comprehensive assessment and investigation is required to identify and define the ground risks and measures to overcome them. Even greenfield sites can contain risks from mining, natural geological hazards, nearby landfills, heavy metals, etc.

services

- Expert Witness.
- Due Diligence reports & Phase 1 desk studies.
- Specialist (e.g. SiLC) independent review of 3rd party reports.
- Design & management of Phase 2 site investigations.
- Quantitative contaminated land risk assessment: soil & water.
- Assessment of risks from landfill gases and chemical vapours.
- Asbestos in Soils: assessment and advice.
- Remediation: strategies/method statements & validation.
- Regulator liaison, pre- and post-planning.
- Earthworks & ground improvement: design, manage, validate.
- Foundation & retaining wall analysis/design & risk assessment.
- Other geotechnical assessment & design (e.g. ground stability).
- Drainage assessment: soakaways, SUDS, foul drainage fields.
- CL:AIRE DoWCoP assessment for inter-site soil transfers/reuse.
- Material Management Plans and classification of waste soils.
- Coal Mining Risk Assessments.
- Crane/piling platform design & validation.

"You always provide a highly professional standard of work that is attentive to our requirements and you take trouble to understand our needs before you act under our instructions. You are first on our list for geotech consultancy and site investigation report work on our projects."

Gary Rumbell, Cavendish & Gloucester Properties

how we add value

- We deliver practical and innovative solutions to complex problems.
- We have a commercial appreciation of our clients' requirements.
- We have a depth of expertise to mitigate risk.
(SiLCs and Qualified Persons)

example projects

- Barnhill Quarry residential development:

We provided a commercially viable solution for this 30m deep quarry infill project by creating a level platform for residential development within 12 weeks of filling completion.

- Bridgwater cellophane landfill site:

We developed innovative solutions to overcome significant ground issues resulting from the historic uses of this contaminated site to enable commercial development of a retail centre.

- civil engineering
- structural engineering
- facade engineering
- geoenvironmental engineering
- environment & sustainability
- engineering management
- resilience & recovery
- infrastructure & drainage
- transport planning
- BIM

For more information please go to **www.clarkebond.com** or call **0117 929 2244**



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