

WINVIC CONSTRUCTION LIMITED

MAYLANDS GATEWAY, HEMEL HEMPSTEAD, HERTFORDSHIRE

PHASE II SUPPLEMENTARY GROUND INVESTIGATION REPORT

DRAFT

The Granary
White Hall Farm
Long Itchington
Warwickshire
CV47 9PU

December 2017
Report No. CCL02935.CF12

Tel: 01926 815678
Fax: 01926 815222
mail@crossfield-consulting.co.uk

CONTENTS

1.	INTRODUCTION
2.	THE SITE
3.	PUBLISHED GEOLOGY
4.	DESK STUDY ENQUIRIES
5.	GROUND CONDITIONS AND GEOLOGICAL MODEL
6.	PROPOSED DEVELOPMENT
7.	ASSESSMENT OF POTENTIAL CONTAMINATION AND GROUND GASES
8.	ASSESSMENT OF MINING, QUARRYING AND OVERALL GROUND STABILITY
9.	FOUNDATION RECOMMENDATIONS
10.	TEMPORARY WORKS
11.	ROAD PAVEMENTS
12.	ASSESSMENT OF MATERIALS FOR WASTE DISPOSAL
13.	RECOMMENDED SUPERVISION AND MONITORING
14.	SUMMARY
	REFERENCES
	GENERAL NOTES
TABLE 1	- Conceptual Site Model
TABLE 2	- Summary of Analytical Test Data: Soils – Potential Risks to Human Health
TABLE 3	- Assessment of Pollutant Linkages
FIGURE 1	- Site Location Plan
FIGURE 2	- Topographical Site Survey
FIGURE 3	- Proposed Development Plan
FIGURE 4	- Cut & Fill Contours Plan
APPENDIX I	- Phase II Supplementary Ground Investigation
APPENDIX II	- Basis of Geotechnical Assessment for Foundations

1. INTRODUCTION

It is proposed to develop a site identified as 'Maylands Gateway', Hemel Hempstead, Hertfordshire, for commercial purposes. Areas within the site have been previously used as a caravan park, stables, a tennis court and sport fields. It is understood that the proposed development comprises seven warehouse units together with associated access roads, service yards, car parking areas, an attenuation pond and areas of managed landscaping.

RPS Group PLC produced a Phase I Environmental Liability Review (February 2016) and a Phase II Geoenvironmental Site Investigation and Risk Assessment Report (April 2016) for the site. Crossfield Consulting Limited undertook supplementary ground investigation works in March 2017 and the findings of that investigation, together with a summary of the works undertaken by RPS are presented in the Supplementary Ground Investigation Report (CCL02935.CD47) that was produced in April 2017. The report recommended that additional ground investigation works be undertaken to confirm ground conditions within inaccessible areas of the site. Further ground investigation was also recommended in areas where deep Made Ground and hydrocarbon-impacted materials were encountered beneath the eastern part of the site.

An Earthworks Specification Report (CCL02935.CD48) and a Remediation Statement (CCL02935.CF01) have also been produced by Crossfield Consulting Limited and those documents should be read in conjunction with this report.

Crossfield Consulting Limited has been commissioned to undertake a phase II supplementary ground investigation at the site to identify potential constraints to redevelopment relating to the ground conditions and including a risk-based environmental assessment and recommendations for remediation works, foundations and road pavement design and general construction advice in the context of the above development proposals.

This report presents a summary of the information obtained from the desk study and previous ground investigations together with the information obtained from the phase II supplementary ground investigation. Sections 2 to 5 of the report (and corresponding sections of the previous reports), together with the associated Figures and Appendices, provides a Ground Investigation Report (GIR), as defined in BS EN 1997-1:2004 and BS EN 1997-2:2007. The report also includes information required to form a Geotechnical Design Report as defined in BS EN 1997-1:2004.

A risk-based assessment of potential contamination is included in Section 7 of the report. This assessment makes reference to the desk study, the various phases of ground investigation and a Conceptual Site Model. It is considered that the report complies with National Planning Policy Framework and is in general accordance with guidance published by the Environment Agency.

It is considered that the report is suitable for submission in support of a planning application and the report is appropriate to assist in an appraisal of development solutions and costs, together with the preparation of engineering designs for the development. The report also complies with the published guidance relating to the requirements of a Building Control authority.

2. THE SITE

2.1 Location

The site is located within an area referred to as 'Maylands Gateway', approximately 2.7 km east of Hemel Hempstead town centre, as shown on Figure 1. The National Grid Reference for the site is TL 0835 0770. The site is bounded by Breakspears Way to the south, Buncefield Lane to the east, Wood Lane End along with

residential properties to the north and commercial units to the west. A petrol station is located adjacent to the southeast site boundary. Further north, beyond Wood Lane End is Hemel Hempstead industrial estate with commercial units. An oil storage terminal known as Buncefield Terminal is located approximately 200 m to the northeast.

2.2 Site Description

This site description is based on observations made during the March 2017 and October 2017 ground investigations by Crossfield Consulting Limited. Reference should also be made to the topographical survey, presented as Figure 2.

The site is irregularly shaped and up to 400 m wide by 470 m long. The site levels fall from approximately 137.0 m O.D. in the northeast corner to 125.9 m O.D. in the southwest corner. Mature trees, hedgerows and fencing are present around the perimeter of the site. There are three site entrances via padlocked gates: two along Buncefield Way and one along Wood Lane End. Public footpaths cross the site.

The site can be split into three zones (denoted as Zone A, B and C on Figure 2) that are separated by hedgerows with dense vegetation and wooden fencing.

2.2.1 Zone A

This area of the site is occupied by a large field with areas of overgrown dense vegetation around the boundaries. At the time of the October 2017 ground investigation, the majority of Zone A had been stripped of topsoil, as part of ongoing archaeological works. As a result of archaeological works, stockpiles containing topsoil, Made Ground materials and natural strata had been formed within the western area of Zone A.

The eastern part of the field slopes down towards the west whereas, the remainder of the field slopes gently towards the south. An area of gravel surfacing and a concrete slab (associated with a former building) are present within the western margin of Zone A and a man-made bund is present to the east of the slab and gravel-covered area. The southern part of Zone A is occupied by a former running track, which is surrounded by steep embankments. Metal railings are present within the running track.

2.2.2 Zone B

Zone B is predominantly occupied by a field that was used as equine grazing land/horse paddock. Areas of overgrown dense vegetation are present around the boundaries. In the western and northwestern parts of Zone B lie areas of tarmac and concrete surfacing including a disused tennis court. To the south of the former tennis court lies an area of grass that is understood to have been previously used as a bowling green. At the time of the March 2017 ground investigation, small areas of fly-tipped materials and evidence of fires were present within the northwestern corner of the larger field.

2.2.3 Zone C

Zone C comprises a former caravan park and is predominantly covered by grass with isolated areas of overgrown vegetation and mature deciduous trees. Areas of overgrown dense vegetation are present around the boundaries and a bund is present around the southern margin. A circular tarmac-surfaced track is present in the former caravan park and the former caravan pitches comprise areas of gravel that are separated by hedgerows. Concrete slabs are present in the southern part of Zone C in the area of former buildings.

2.3 Site History

Details of the site history are presented in the April 2017 Supplementary Ground Investigation Report. In summary, the plan dated 1877/78 show the site was undeveloped land and the surrounding area was predominantly used as fields.

By 1982 sports pitches and a running track had been developed within the northeastern and southwestern areas of the site and small buildings (pavilions) were constructed within the western and northern site boundary. It is evident that earthworks had taken place within the site boundary to form the sports pitches. By this time, a caravan park was also present within the southeastern corner of the site. Tennis courts are shown within the northwestern corner of the site on the 1991 plan.

The plans dated 2010 and 2014 indicate that no significant changes had occurred within the site. However, aerial images available on the internet show that by 2006 the site was no longer used as a sport ground and that the caravan park has been vacant since 2011.

3. PUBLISHED GEOLOGY

Geological map data published by the British Geological Survey (BGS) online and in print, on 1:50,000 scale Sheet No.238 (Aylesbury) indicate that superficial deposits comprising Clay-with-Flints strata underlie the majority of the site but are shown to be absent in the northern part of the site and locally in the northwestern-most and southern parts of the site.

The solid strata beneath the northwestern-most and northeastern parts of the site are indicated to comprise Lambeth Group strata, which consist of clays, silts and sands. Upper Chalk strata of the Cretaceous System (Lewes Nodular Chalk and Seaford Chalk Formation) are shown to be present beneath the site below either the Clay-with-Flints or Lambeth Group strata.

4. DESK STUDY ENQUIRIES

Detailed desk study information is included in the RPS Phase I Environmental Liability Review (February 2016). The main points are summarised below.

Hydrogeological information indicates that the Clay-with-Flints strata underlying the majority of the site are classed as 'Unproductive' (i.e. non-aquifer) strata. Where present, the Lambeth Group strata are classed as a 'Secondary A' aquifer. The Upper Chalk is classified as a 'Principal' aquifer. The site is located within a Zone 3 – Total Catchment Source Protection Zone (SPZ).

Information in the GroundSure database indicates that a facility approximately 250 m northeast of the site is associated with a pollution incident dated December 2007. This incident has been identified as a significant impact (Category 2) to land and air and a minor impact (Category 3) to water. Available information indicates that this recorded incident is likely to be related to the 'Buncefield Fire' at the Hertfordshire Oil Storage Terminal, which took place in December 2005.

A Geolinsight report, (presented within the RPS report) indicates that the risk of dissolution features varies across the site from low to moderate to high risk, depending on the underlying geology. A solution pipe has been recorded approximately 40 m to the northwest of the site within Hales Park Close and 6 no. solution pipes have been recorded approximately 635 m to the west.

Available information indicates that features associated with historical surface workings are present locally within the western margin of the site. The surface workings on site appear to be related to earthworks but could be indicative of localised chalk excavation. The GeolInsight report indicates that the risk of non-coal mining is unlikely (small scale mining may have occurred but restricted in extent) to highly unlikely (rare and localised small scale chalk mining may have occurred).

BRE Document BR 211 – Radon: *Guidance on Protective Measures for New Buildings* (2015) indicates that the site is not within an area where radon precautions are required in new buildings.

5. GROUND CONDITIONS AND GEOLOGICAL MODEL

5.1 Ground Investigation

A ground investigation was undertaken by RPS Group in February 2016 and a supplementary ground investigation was undertaken by Crossfield Consulting Limited in March 2017. The relevant factual records from those investigations are presented in the Supplementary Ground Investigation Report.

Additional investigation was undertaken in October 2017 to confirm the extent and depth of the Made Ground recorded beneath the eastern part of the site, to further investigate 'anomalous' ground conditions encountered during the March 2017 investigation and to confirm the ground conditions within areas that were previously inaccessible. Details of the rationale and scope of this ground investigation and laboratory testing, together with exploratory hole logs and laboratory test results, are presented in Appendix I.

The ground investigations have identified the following beneath the site.

5.2 Buried Foundations and Services

Based on the site's history, buried obstructions and/or foundations, associated with former structures, may be present within the northern, southeastern and western site boundaries.

A surface water sewer and a foul water sewer, trending northeast to southwest, are recorded to cross the central-eastern part of the site and man holes are present along the line of the sewers. There is also a BT line indicated within the southeast site boundary in the southern part of the former caravan park. It is understood that there is a fibre optic cable running along the eastern site boundary.

During the March 2017 ground investigation a manhole cover was encountered beneath the grass at the eastern end of the former running track. Unrecorded services should be anticipated in this area.

5.3 Strata Encountered

Topsoil

Topsoil is present across majority of the site and typically comprises soft to firm consistency slightly gravelly silty clay with an abundance of roots and rootlets. The topsoil was typically encountered to depths of between approximately 0.2 m and 0.4 m.

Made Ground

Made Ground has been recorded across the western half of Zone A and locally beneath Zones B and C. Across the western half of Zone A and where present beneath Zone C, the Made Ground generally comprises reworked natural strata with occasional brick fragments. The Made Ground in these areas has been recorded to depths of between 0.6 m and 3.0 m. Undrained shear strengths of between 30 kN/m² and 124 kN/m² have been recorded in these materials.

Coarse-grained Made Ground with ash, clinker and cinder fragments were encountered to depths of approximately 0.5 m beneath the gravel-surfaced area in the western part of Zone A, beneath the former running track in Zone A and below the former bowling green and tennis courts within northwestern corner of Zone B.

Across the western part of Zone B (former tennis court) and across Zone C there are areas of concrete and/or tarmac surfacing underlain by a gravel sub-base. Beneath the former tennis courts, Made Ground has been recorded to 2.4 m depth. These materials initially comprise firm consistency, greenish grey, gravelly clay with brick fragments to 0.6 m depth. Below this, sandy gravel comprising concrete and brick has been identified to 2.1 m depth. These materials are then underlain by reworked natural strata with brick fragments. Below the northwestern corner of Zone B, the Made Ground typically comprises firm consistency, greenish grey, gravelly silty clay with some brick fragments and ashy deposits. These materials were recorded to depths of up to 3.5 m and slight organic and hydrocarbon odours were noted.

Beneath the central part of Zone B, deep Made Ground has been encountered to depths of between 2.3 m and 4.5 m. These materials generally comprise soft to firm consistency, brownish grey and orangish brown, gravelly clay with abundant scrap metal materials, tar fragments, brick fragments, wood, slag material, asbestos containing materials (ACMs) and clinker/cinder fragments. Localised hydrocarbon odours and black staining were identified within the Made Ground. During an archaeological investigation undertaken for RPS Group in 2016, buried steel drums and localised hydrocarbon impaction were recorded locally within this area. Undrained shear strengths of between 30 kN/m² and 90 kN/m² have been recorded in these materials.

No significant Made Ground was recorded across the remainder of the site (i.e. the eastern half of Zone A and the majority of Zones B and C).

Clay-with-Flints

Clay-with-Flints strata have been recorded across the site beneath the topsoil and/or Made Ground. These strata typically comprise firm to very stiff consistency, orangish brown mottled grey, gravelly silty clay with cobbles and boulders of flint. Undrained shear strengths typically between 50 kN/m² and 110 kN/m² have been recorded in the Clay-with-Flints. Where Standard Penetration Tests (SPTs) were undertaken within the Clay-with-Flints strata, SPT 'N' values of between 13 and 30 have been recorded.

Based on the borehole and trial pit records, the depth to the base of the Clay-with-Flints strata varies between approximately 0.7 m and 8.5 m. From the static cone penetration test (CPT) data, the Clay-with-Flints strata could extend to 11.5 m depth in the northern part of Zone A.

Lambeth Group

Lambeth Group strata are recorded to underlie the site on the available BGS data. However, no materials considered to be Lambeth Group strata have been identified during the ground investigations.

Upper Chalk

The Upper Chalk strata predominantly comprise structureless weathered chalk gravel in a clay/silt matrix with very weak to moderately weak, low to medium density clasts (Grade Dc). Locally, the structureless weathered chalk consists of firm to stiff consistency gravelly silty clay with extremely weak, low density clasts of chalk (Grade Dm). Flint gravels are present within the chalk strata.

Where Standard Penetration Tests (SPTs) were undertaken within the Upper Chalk strata, SPT 'N' values are typically around 15 in the shallow strata and increase to around 30 with depth.

Anomalous Ground

During the March 2017 ground investigation, dense, coarse-grained strata were identified within the western site boundary at depths of between 3.5 m and 6.0 m. A trial pit (TP CCL10) was undertaken in the CPT location but the trial pit was unable to extend deep enough to inspect the coarse-grained materials.

During the October 2017 ground investigation, the 'anomalous ground' recorded within the western site boundary was identified as stiff to very stiff consistency, very gravelly clay with abundant flint cobbles and boulders. These materials were encountered between approximately 2.4 m to 4.8 m depth.

5.4 Groundwater

Groundwater strikes were not encountered in any of the exploratory holes during the ground investigations.

RPS Group installed monitoring standpipes within twenty four window sample holes at the site and groundwater monitoring was undertaken. Water was encountered within twelve of the monitoring standpipes at variable depths, ranging between approximately 1.4 m and 5.5 m. However, it should be noted that the RPS data is conflicting as some of the recorded water depths have been recorded at depths deeper than the associated window sample holes and monitoring standpipes.

The groundwater conditions are based on observations made at the time of the fieldwork. It should be noted that groundwater levels may vary due to seasonal and other effects.

5.5 Ground Gases

RPS Group installed monitoring standpipes within twenty four window sample holes at the site and ground gas monitoring was undertaken on six occasions by RPS Group over a two month period.

A maximum carbon dioxide concentration of 9.6% was recorded (in the western part of Zone A) and a maximum methane concentration of 7.1% was recorded (in the centre of Zone B). Ground gas flow rates of up to 12 l/hr were recorded but values were typically much lower and often negligible (<0.1 l/hr).

It is noted that methane was only recorded in one location during the second monitoring visit and all other methane concentrations were below the detection limits of the monitoring equipment used. It is also noted that the ground gas flow rates recorded in the earlier visits were much larger than the ground gas flow rates recorded in the final three visits which were typically below the detection limits of the monitoring equipment used.

6. PROPOSED DEVELOPMENT

A proposed development plan is presented as Figure 3. The proposed development includes the construction of seven warehouse units together with associated access roads, service yards, car parking areas, an attenuation pond and areas of managed landscaping.

To enable the construction of the proposed development, earthworks are required at the site. Up to 3.0 m cut and 4.4 m fill is proposed, as shown on Figure 4. To accommodate the changes in levels, retaining structures are also proposed at the site.

An attenuation pond, up to 3.0 m deep and approximately 100 m long by up to 30 m wide, is proposed adjacent to the southwest boundary of the site.

7. ASSESSMENT OF POTENTIAL CONTAMINATION AND GROUND GASES

7.1 Assessment Criteria

Assessment of potential contamination and ground gases has been undertaken using a risk assessment based approach, as recommended within the Environmental Protection Act (1990), CLR11 (2004), CLEA Model (2004-2009), BS 10175:2011+A1:2013, CIRIA C552 (2001) and NHBC R&D Report 66 (2008). This approach considers the likely source of contamination, given the history and location of the site, and the possible migration pathways by which these potentially hazardous substances may reach likely receptors, such as end users of the site, controlled waters or the wider environment, in the context of the proposed development.

Part IIA of the Environmental Protection Act (1990) states that

“Contaminated Land is any land which appears to the local authority in whose area it is situated to be in such a condition, by reason of substances in, on or under the land, that –

- (a) significant harm is being caused or there is a significant possibility of such harm being caused; or
- (b) significant pollution of controlled waters is being caused or there is significant possibility of such pollution being caused;”

All risk assessments carried out as part of this investigation have been carried out with respect to the definition of “contaminated land” within Part IIA of the Environmental Protection Act (1990) and have considered the site both before and on completion of the development. The basis of the risk assessment is the Conceptual Site Model, which is derived from the desk study and initial information and identifies potential pollutant linkages that could affect receptors relevant to the site and the wider environment. The Conceptual Site Model is presented in Table 1.

An environmental assessment based on the previous RPS and Crossfield Consulting Limited investigation reports is presented in the Crossfield Consulting Limited, Supplementary Ground Investigation Report (CCL02935.CD47) together with all relevant factual data from those investigations. The October 2017 ground investigation works were designed to obtain additional information across the site to further assess the identified pollutant linkages. Where relevant, this included the recovery of representative samples and subsequent analytical laboratory testing. The rationale for the sampling and testing is set out in Appendix I. The results of the analytical testing undertaken as part of the October 2017 investigation are presented in Appendix I and summarised in Table 2 (together with the data from the previous ground investigations undertaken by RPS and Crossfield Consulting Limited). On the basis of the conceptual site model and the results of the analytical laboratory testing, an assessment of the identified pollutant linkages is presented in Table 3.

7.2 Potential Sources of Contamination

Historical information indicates that the site was undeveloped land until the 1970s when earthworks were undertaken to form sports grounds in the western and northeastern parts of the site and a caravan park was constructed in the southeastern part of the site. The site was no longer used as sport grounds by 2006 and the caravan park became disused from 2011. It is understood that the northeastern area of the site was used as a horse paddock with stables.

The ground conditions beneath the site typically comprise topsoil overlying Clay-with-Flints strata over Upper Chalk strata. Across the western half of the site, extensive Made Ground, comprising reworked natural strata, is present to depths of between 0.6 m and 3.0 m. Across the southern and western area of Zone A and the northwestern area of Zone B, thin horizons of ashy Made Ground were encountered to depths of between 0.2 m and 0.5 m. An area of Made Ground with localised hydrocarbon impaction and fragments of tar and

asbestos containing materials (ACMs) has been encountered across the central area of Zone B to depths of up to 4.5 m.

Table 2 provides a summary of the analytical testing undertaken on the soil samples recovered from the site from all phases of ground investigation and compares the results with human health generic assessment criteria (GAC) that are relevant for the proposed development type (commercial). The results show that polyaromatic hydrocarbons (PAHs) have been recorded at concentrations above the GAC within the northwestern corner of Zone B (former tennis courts). Elevated concentrations of petroleum hydrocarbons (Aromatic C₂₁ – C₃₅) have been recorded above the GAC within the central area of Zone B where tar fragments have been recorded. Loose fibres of asbestos have been identified within the ashy Made Ground in the western part of Zone A. Loose fibres of asbestos and asbestos cement sheeting have been identified in an area of deeper Made Ground Zone B.

No adverse sulphate conditions have been identified. Potential contaminants have been recorded at very low to negligible concentrations within the Made Ground materials. The risk and implications to buried concrete and potable water supply pipe materials are discussed in Section 7.3.2.

Concentrations of phytotoxic metals have been recorded locally within the Made Ground across the site that may be considered a risk to healthy plant growth, based on BS 3882:2015 for topsoil. Further assessment is outlined in Section 7.3.3.

Based on available information, the organic contaminants identified are typically of low mobility and solubility. Groundwater monitoring/sampling was undertaken in 2016 by RPS Group and the factual data is presented in the Supplementary Ground Investigation Report. Groundwater sampling was undertaken locally within the perched water and has recorded zinc and chromium at concentrations marginally above the relevant quality standards. Following development, large areas of hardstanding surfacing will be present across the site and will inhibit rainwater infiltration. In soft landscaped areas, the presence of low permeability reworked natural strata, Clay-with-Flints strata and weathered Upper Chalk strata between the Made Ground and groundwater at depth would prevent significant vertical migration. On this basis, there appears to be no valid pollutant linkage from shallow soils in relation to controlled waters.

The site is not within an area where radon precautions are required and there are no recorded landfills within the surrounding area. However, putrescible materials may be present locally within the Made Ground beneath the site. Ground gas monitoring was undertaken by RPS Group and an assessment of the monitoring data is outlined in the Supplementary Ground Investigation Report. In summary, a maximum carbon dioxide concentration of 9.6% and a maximum methane concentration of 7.1% were recorded. Ground gas flow rates of up to 12 l/hr were recorded but values were typically much lower and often negligible (<0.1 l/hr). As detailed in the Supplementary Ground Investigation Report, it is recommended that an allowance be made to provide ground gas precautions that are compatible with a Characteristic Gas Situation 2 (CS 2) site. However, it should be noted that earthworks are required to form the development levels and as part of the works all Made Ground materials will be removed from beneath the proposed building footprints and be replaced with Engineered Fill. As detailed in the Specification for Earthworks, organic/putrescible materials will not be permitted within the Engineered Fill materials. Once the proposed earthworks have been completed, consideration could be given to additional plot-specific ground gas monitoring to confirm whether ground gas precautions are still required. If additional monitoring is not undertaken, ground gas precautions, compatible with CS 2, should be installed.

7.3 Pollutant Linkages – Solids and Liquids

Based on the Conceptual Site Model, consideration is given below to identified pollutant linkages and a risk evaluation is undertaken of each possible source-pathway-receptor linkage that may occur at the site. The risk evaluation considers the potential consequences and probability of occurrence in accordance with CIRIA

C552 (2001). Where risks are identified as “negligible”, then by implication such risks are within normally accepted levels for the proposed development, and the further reduction of such risks by remediation works is considered unnecessary. Where risks are identified that are “low” as defined in CIRIA C552 (2001), or worse, then consideration is given to the management of the identified risks, with appropriate recommended actions that may include engineering solutions / remediation works as described in the following sections.

7.3.1 Human Health

During earlier investigations, PAHs have been recorded at concentrations above the GAC for a commercial development beneath the northwestern corner of Zone B. It is considered that the elevated PAHs are likely to be associated with the surface materials across the former tennis courts. It is noted that the October 2017 ground investigation undertaken within the former tennis courts did not identify elevated concentrations of PAHs above the GAC for a commercial development.

Elevated concentrations of petroleum hydrocarbons (Aromatic C₂₁ – C₃₅) have been recorded above the GAC at one location below the central area of Zone B. Organic materials and visible ACMs were also encountered locally in this area. The elevated hydrocarbons appear to relate to tar fragments within the Made Ground. For geotechnical reasons, it is recommended that the Made Ground in this area be dug out and replaced with Engineered Fill during the earthworks. Any hydrocarbon impacted soils encountered should be stockpiled on plastic sheeting for further testing to confirm suitability for re-use and/or waste classification (if required). It will be necessary to segregate the impacted Made Ground from materials that could potentially be reused during earthworks below external areas and/or the proposed units, as outlined in the Specification for Earthworks. Any tar fragments or oil drums should be segregated from the soils and removed off-site for disposal.

Loose fibres of asbestos have been identified within the Made Ground at four locations across the site. Traces of chrysotile, crocidolite and amosite, up to 0.001% in concentration, have been recorded within ashy Made Ground in the western part of Zone A. Loose fibres of asbestos (recorded at concentrations of <0.001%) and fragments of asbestos cement sheeting have been recorded in an area of deeper Made Ground Zone B.

During the October 2017 ground investigation, fragments of ACMs were visibly identified beneath the central area of Zone B. It is recommended that any visible ACMs encountered during construction works should be hand-picked for disposal. All hand-picked ACMs should be stored appropriately and disposed of off-site, as outlined in Section 12.

In the event that other impacted materials are encountered beneath the site, a geoenvironmental specialist should be notified and the area investigated.

It is recommended that appropriate personal protective equipment (PPE) be worn and high levels of personal hygiene be maintained by groundworkers during any development works. To prevent dust from the shallow soils, especially those impacted by loose asbestos fibres, migrating off site via aerial migration pathways and subsequently becoming a risk or nuisance to neighbours or the general public, it is recommended that soil dampening techniques be implemented when earth-moving operations are being undertaken during construction.

With respect to end users, the proposed development includes large areas of hardstanding, which will provide an effective barrier between the end users and the existing ground such that there would be no realistic exposure pathways in these areas following development. Earthworks are required at the site to form the required levels. Such operations could be managed/ designed such that the ashy Made Ground materials are incorporated into the works and are buried/capped beneath a thickness of reworked natural strata. If, following the earthworks, ashy Made Ground materials are present at the surface in areas of proposed soft landscaping, additional testing may be required and/or there may be a requirement to provide a thickness of

appropriate capping materials to form an effective barrier between the end users of the site and the Made Ground.

7.3.2 Durability of Buried Structures and Services

In view of the low soluble sulphate content and near-neutral soil conditions, there are no special precautions required for the protection of good quality buried foundation concrete. Based on guidance within *BRE Special Digest 1* (2005), the specified DC Class of concrete for buried structures and foundations should be suitable for an ACEC site classification of AC-1.

It should be noted that earthworks are required at the site and that the selection of pipe materials should be compatible with the materials present along the line of proposed water pipes following completion of the earthworks.

The site has not been associated with past fuel and/or chemical storage and there are no such storage facilities in close proximity. Therefore, the site would not be considered to be 'brownfield' under the definition provided by UKWIR (2010) with respect to the assessment of ground for water supply pipes. However, hydrocarbon-impacted materials have been identified locally in the central part of Zone B. If these materials remain in-situ in areas of potable water supply pipes, it may not be suitable to use conventional plastic materials for potable water supply pipes without further testing. Alternatively, multi-layer barrier pipe could be used in this area of the site. It is considered that conventional plastic materials are likely to be suitable for potable water supply pipes in other areas of the development.

It should be noted that individual water companies may have in-house requirements for the assessment of ground conditions for potable water supply pipes and these requirements may be in addition to, or may contradict, the guidance provided by UKWIR. Therefore, it is recommended that the relevant water supply company be consulted prior to finalising the potable water supply design.

7.3.3 Landscape Areas

The proposed development includes limited areas of managed soft landscaping. Earthworks are required at the site to form the required levels and, following completion of the earthworks, there will be a requirement to place topsoil in areas of managed soft landscaping.

If Made Ground materials are present at the surface in areas of proposed soft landscaping following the earthworks, additional testing may be required and/or there may be a requirement to provide a thickness of topsoil to form a suitable growing medium.

7.4 Recommended Remedial Works

On the basis of the available information, an allowance should be made for the following:

- It is recommended that a Discovery Strategy be put in place during site development works, such that any unidentified contamination encountered is reported to a geoenvironmental specialist and further investigation undertaken.
- If visible asbestos-containing materials (ACMs) are identified, such materials should be hand-picked for disposal off site.
- A capping layer may be required in proposed landscaped areas if impacted materials remain at the surface following the proposed earthworks.
- Barrier pipes may be required in areas of hydrocarbon-impacted soils, if they are not removed during the earthworks.

- If additional, post-earthworks, ground gas monitoring is not undertaken, allowance should be made to provide ground gas precautions that are compatible with CS 2.
- For geotechnical reasons, it is recommended that the Made Ground below the central area of Zone B be dug out and replaced with Engineered Fill. It will be necessary to segregate the impacted Made Ground from materials that could potentially be reused during earthworks. Any tar fragments or oil drums should be removed for off-site disposal.

It is considered that there are no other requirements for remedial works in order for the development to commence.

A Remediation Statement was produced in September 2017 and details the work to be undertaken. Following the Phase II works, it is considered that the Remediation Statement is still valid. A Remediation Verification Report will be required to demonstrate that the risks to receptors have been effectively negated. The preparation of these documents would meet the normal requirements of a local planning authority.

7.5 Potential Liabilities

Based on available data, it is considered that there should be no environmental liabilities associated with site ownership and this should not change following completion of the development providing any necessary remedial works are implemented.

8. ASSESSMENT OF MINING, QUARRYING AND OVERALL GROUND STABILITY

The desk study information indicates that features associated with historical surface workings are present within the western-most part of the site. The historical surface workings appear to be related to earthworks but could be indicative of localised chalk excavation. The risk of dissolution features varies across the site from low to moderate to high risk, depending on the underlying geology. However, on the basis that the Lambeth Group was not encountered on site the risk of dissolution features is likely to be low. A solution pipe has been recorded approximately 40 m to the northwest of the site within Hales Park Close and 6 no. solution pipes have been recorded approximately 635 m to the west.

Based on observations made during all of the ground investigations, there is no evidence of chalk mining on site, nor is there any evidence of loose or voided strata associated with potential solution features. The anomalous ground recorded within the western site boundary during the March 2017 ground investigation has been identified as Clay-with-Flints strata with abundant cobbles and boulders of flint.

As expected, the depth to the top of the Upper Chalk strata is highly variable across the site from 0.7 m to 11.5 m depth. However, due to the depth of the chalk strata in the northern part of Zone A, additional investigation is recommended in this area, when access is available.

To assess the potential for unrecorded mine workings and/or solution features to be present beneath the site, it is recommended that the Made Ground materials beneath proposed building footprints be removed and replaced with Engineered Fill. An inspection of the formation strata following the removal of Made Ground and prior to the placement of Engineered Fill should be made by a suitably qualified Geotechnical Engineer. If unrecorded mine workings and/or solution features are identified, the foundation arrangements should be reviewed.

With reference to published information provided by the British Geological Survey, and in the context of the low sensitivity of the proposed structure to very minor background seismic events recorded in the UK, it is considered that the foundation solution should not be constrained by potential ground vibrations from natural sources and that more detailed assessment is not necessary.

9. FOUNDATION RECOMMENDATIONS

9.1 Design Approach

In compliance with the requirements of the National Annex of BS EN 1997-1:2004 the geotechnical design assessment is based on Design Approach 1 (as defined in BS EN 1997-1:2004). As the structural loads for the proposed building are well defined, uncertainty and risks of potential unfavourable conditions (or deviations from characteristic values) are primarily associated with the ground conditions.

Consideration is given to the assessment of ultimate limit state (ULS) conditions, where full collapse or failure conditions are considered, and relevant design information is presented in Appendix II in this regard. In addition, the assessment considers serviceability limit states (SLS), to ensure that the recommended design parameters are compatible with an acceptably low risk of serviceability criteria being exceeded during the standard design life of the structure. It is noted that the SLS has a greater influence on the design parameters in comparison to ULS conditions and this is considered in the following assessment.

9.2 Proposed Structural Loadings and Serviceability Criteria

Details of imposed foundation loads (i.e. actions imposed by the building structure) and serviceability limit values are not currently available for the proposed structures. The geotechnical assessment presented in the report has considered generic values for the proposed development type, which is considered appropriate for the appraisal of engineering solutions and preliminary design, and these are listed below:

Imposed Load on Foundations:	Column loads up to 1350 kN
Imposed Load from Floor Slab:	up to 50 kN/m ² (time averaged load of 35 kN/m ² used for settlement assessments)

Serviceability Limit Values (Columns)

Maximum Total Settlement:	25 mm
---------------------------	-------

Maximum Differential Settlement:	15 mm
----------------------------------	-------

Serviceability Limit Values (Floor Slab)

Angular Distortion:	1/500
---------------------	-------

If loads are significantly different to these stated above, additional assessment will be required.

9.3 Geotechnical Category of Proposed Structures

In view of the nature of the proposed structures and with reference to the indicated ground conditions, as outlined in Section 5, it is considered that the development is compatible with Geotechnical Category 2, as defined in BS EN 1997-1:2004, and the necessary information relating to the Ground Investigation and Geotechnical Design Reports has been obtained and assessed on this basis.

9.4 Assessment of Foundation Solutions

With reference to the recorded ground conditions and corresponding Geological Model presented in Section 5, characteristic values relating to the geotechnical properties of the strata within influencing distance of the proposed structures are presented in Appendix II.

The Made Ground and low strength natural strata are considered unsuitable as founding strata due to the unpredictable settlements that may occur in these materials. Based on the ground conditions, it is considered that pad foundations should be possible at this site but such foundations should be placed in either high strength Engineered Fill, medium to high strength Clay-with-Flints or the underlying Upper Chalk strata.

Historical surface workings have been recorded locally within the western margin of the site and immediately outside of the site boundary to the north, east and south. The surface workings on site appear to be related to earthworks but could be indicative of localised chalk excavation. If mining-related ground conditions are encountered during the earthworks, additional investigation, and potentially alternative foundation solutions, may be required. To minimise the potential for unrecorded workings to remain beneath proposed buildings, it is recommended that, as part of the earthworks, all Made Ground be removed from beneath building footprints and replaced with Engineered Fill.

Below are development-specific assessments of ground conditions and foundation recommendations for each unit. An assessment of earthworks is presented in the April 2017 Supplementary Ground Investigation Report. The earthworks should be undertaken in accordance with the Specification for Earthworks.

9.4.1 Unit 1

Based on the available information, the ground conditions below the majority of Unit 1 are expected to comprise medium to high strength Clay-with-Flints strata to approximately 2.5 m and 3.0 m depth. These deposits are underlain by competent Upper Chalk strata. Below the southern-most part of the proposed Unit 1 building footprint, Made Ground has been encountered to depths of up to around 4.5 m. On this basis, there will be a requirement to excavate and replace these materials with high strength Engineered Fill.

Based on the cut/fill drawing provided, Unit 1 lies in an area of proposed cut with up to 1.9 m cut proposed. However, where Made Ground extends beneath the Unit 1 building footprint, additional earthworks will be required, as outlined above. Following earthworks, the proposed Unit will be underlain by either high strength Engineered Fill and/or medium to high strength Clay-with-Flints strata. On this basis, it should be suitable to support the building on shallow pad foundations within the natural strata or Engineered Fill.

Consideration could also be given to ground treatment using vibro-replacement techniques (stone columns). The suitability of ground treatment will require confirmation by a specialist ground treatment contractor and acceptance by the Environment Agency.

9.4.2 Unit 2/3

Based on the latest information, the ground conditions below Unit 2/3 are expected to comprise Made Ground to depths of up to 3.5 m over high strength Clay-with-Flints strata. The deepest Made Ground is anticipated beneath the western part of the proposed footprint.

Based on the cut/fill drawing provided, up to 1.2 m of cut is proposed beneath the northern part of the Unit and up to 1.7 m of fill below the southern section. There will be a requirement to excavate any Made Ground materials and/or low strength strata and replace these materials with high strength Engineered Fill. Following earthworks, the proposed Unit will be underlain by either high strength Engineered Fill and/or medium to high strength Clay-with-Flints. On this basis, it should be possible to support the proposed building on shallow pad foundations within the natural strata or Engineered Fill.

As an alternative to earthworks, it may be possible to treat the Made Ground using vibro-replacement techniques (stone columns), but this will require confirmation by a specialist ground treatment contractor and acceptance by the Environment Agency.

9.4.3 Unit 4

Based on the available information, the ground conditions below the majority of Unit 4 are expected to comprise medium to high strength Clay-with-Flints to approximate depths of between 2.0 m and 3.0 m over Upper Chalk strata. Beneath the southeastern part of the building, Made Ground is expected to be present to approximately 1.0 m depth over medium to high strength Clay-with-Flints and Upper Chalk strata.

Based on the cut/fill drawing provided, up to 1.6 m of cut is proposed beneath the northern part of Unit 4 and up to 2.5 m of fill below southern part. There will be a requirement to excavate any Made Ground materials and/or low strength strata and replace these materials with high strength Engineered Fill. Following earthworks, the proposed Unit will be underlain by either high strength Engineered Fill and/or medium to high strength Clay-with-Flints strata. On this basis, it should be possible to support the proposed building on shallow pad foundations within the natural strata or Engineered Fill.

9.4.4 Unit 5

Based on the available information, the ground conditions below majority of Unit 5 are expected to comprise medium to high strength Clay-with-Flints strata to approximate depths of between 0.6 m and 3.0 m over Upper Chalk strata.

To the northwest of the proposed unit, Made Ground has been encountered to approximately 1.2 m depth and Made Ground is expected to extend locally beneath the building footprint. Where Made Ground is present beneath the building footprint, there will be a requirement to excavate and replace these materials with high strength Engineered Fill.

It should be noted that the cut and fill contour plan presented as Figure 4 does not reflect the latest development layout for Unit 5, as shown on Figure 3. Based on the available information, it is understood that up to approximately 1.4 m of cut is proposed beneath the northeast corner of Unit 5 and up to approximately 3.5 m of fill is proposed below the southwestern corner of Unit 5. Following the earthworks, the proposed Unit will be underlain by either high strength Engineered Fill, medium to high strength Clay-with-Flints strata and/or Upper Chalk strata. On this basis, it should be possible to support the building on shallow pad foundations within the natural strata or Engineered Fill.

9.4.5 Unit 6

Based on the available information, the ground conditions below Unit 6 are expected to comprise a significant thickness of Made Ground (predominantly reworked natural strata) to approximately 3.0 m depth. Below the Made Ground, medium to high strength Clay-with-Flints strata are present and Upper Chalk strata underlie the Clay-with-Flints. It should be noted that ashy Made Ground is present beneath the southern part of the Unit 6 building footprint to approximately 0.3 m depth.

Based on the cut/fill drawing provided, to 3.7 m of fill is proposed beneath this Unit. There will be a requirement to excavate any Made Ground materials and/or low strength strata and replace these materials with high strength Engineered Fill. Following earthworks, the proposed Unit 6 building footprint will be underlain by high strength Engineered Fill. On this basis, it should be possible to support the building on shallow pad foundations within the Engineered Fill or natural strata (if present at shallow depth following the earthworks).

As an alternative to earthworks, it may be possible to treat the Made Ground using vibro-replacement techniques (stone columns), but this will require confirmation by a specialist ground treatment contractor and accepted by the Environment Agency.

If ground treatment is proposed, it is recommended that in-situ probing be undertaken around the footprint of the proposed Unit prior to any ground treatment.

9.4.6 Unit 7

Based on the available information, the ground conditions below the majority of Unit 7 are expected to comprise medium to high strength Clay-with-Flints strata to approximate depths of 6.0 m over Upper Chalk strata. Beneath the southern part of the building, Made Ground is present to approximately 0.6 m depth followed by medium to high strength Clay-with-Flints strata and Upper Chalk strata.

With reference to the cut/fill drawing provided, up to 1.5 m of cut is proposed beneath the western part of Unit 7 and up to 1.1 m of fill is proposed below the eastern part. There will be a requirement to excavate any Made Ground materials and/or low strength strata and replace these materials with high strength Engineered Fill. Following earthworks, the proposed Unit will be underlain by either high strength Engineered Fill and/or medium to high strength Clay-with-Flints strata. On this basis, it should be possible to support the building on shallow pad foundations within the natural strata or Engineered Fill.

Due to the variable depth to chalk beneath Unit 7, it is recommended that additional ground investigation be undertaken in this area. The findings of the additional investigation may alter the recommendations made above.

9.5 Recommended Foundation Design Parameters

As outlined above, it is considered that following the earthworks pad foundations should provide the most appropriate foundation solution for the majority of the proposed units. On the basis of the ground conditions and structures described in the report, the recommended parameters for the foundation design are as follows:

<i>Foundation Strata :</i>	High strength Engineered Fill or; Medium to high strength Clay-with-Flints strata or; Upper Chalk strata
<i>Foundation Depth :</i>	Minimum 1.0 m, deepened within influence of trees, as required.
<i>Foundation Width/Size:</i>	Up to 3.0 m wide (pads)
<i>Nett Allowable Bearing Pressure:</i>	150 kN/m ²

It is considered that total settlement of foundations designed on the above basis should be less than the normal serviceability limit state for this development (i.e. total settlements of 25 mm) as outlined in the assessment presented in Appendix II.

Laboratory testing results, presented in the Supplementary Ground Investigation Report, indicate the clayey horizons at the site comprise 'medium and high volume change' potential soils, as defined in NHBC Standards (2017). Within the influence zones of existing or proposed trees, suitable foundation precautions should be adopted, as outlined in NHBC Standards (2017). There is a potential for desiccated materials to be present in the vicinity of exiting trees, such materials should be dug out and replaced with Engineered Fill.

Based on guidance published within BRE Special Digest 1 (2005), the specified DC Class of concrete for buried structures and foundations should be suitable for an ACEC site classification of AC-1.

9.6 Floor Slab Recommendations

On the basis that floor slab loads of up to 50 kN/m² (UDL) are proposed, it is considered that the existing Made Ground will not be suitable in its current condition to support ground bearing floor slabs. On this basis, there will be a requirement to remove the Made Ground materials and replace them with Engineered Fill, as outlined in the Specification for Earthworks.

As an alternative it may be possible to treat the Made Ground using vibro-replacement techniques (stone columns) to support ground-bearing floor slabs. This solution will require confirmation by a specialist ground treatment contractor and acceptance by the Environment Agency.

There is a potential for desiccated materials to be present in the vicinity of existing trees, such materials should be dug out and replaced with Engineered Fill.

9.7 General Construction Advice

All formations should be cleaned, and subsequently inspected by a suitably qualified engineer prior to placing concrete. Should any soft, compressible or otherwise unsuitable materials be encountered they should be removed and replaced by blinding concrete.

Foundation concrete, or alternatively, a blinding layer of concrete, should be placed immediately after excavation and inspection in order to protect the formation against softening and disturbance.

Generally, all formations should be placed wholly within the same material type, unless specific geotechnical inspection and assessment have been undertaken.

Care should be taken to ensure that any field drains encountered are carefully and satisfactorily blocked to prevent water seeping through the drains and into any excavations.

The locations of any trial pits undertaken should be accurately surveyed in order that their precise locations are known and that appropriate precautions can be taken when building over or near to these locations.

10. TEMPORARY WORKS

Conventional plant is considered appropriate for the excavation works at this site.

Shallow excavations should remain stable in the short term. However, instability should be anticipated in excavations left open for extended periods of time. Support should be provided, or the sides battered back, in any excavations requiring man entry.

Shallow groundwater is not anticipated but localised perched water may be present. If perched water seepages are encountered during the works, it is considered that such seepages should be controllable using conventional sump pumping techniques.

If vibro-replacement ground treatment is proposed, it will be necessary to install a working platform for the tracked plant to be used in the proposed foundation works. The platform should be designed by a geotechnical specialist in accordance with the requirements of the Federation of Piling Specialists (FPS) and

with reference to BRE 470. The piling platform may form part of the temporary works or be incorporated into the final levels.

11. ROAD PAVEMENTS

Road Pavement design should be based on the materials that are present at subgrade following the earthworks. However, based on examination of the soils present beneath the site, and the guidance of IAN73/06 and TRRL Report LR1132, it is considered that an equilibrium design CBR value of 3% may be used for preliminary pavement design at the site.

The majority of the materials beneath the site are likely to be non-frost susceptible. However, if, following the proposed earthworks, chalk strata are present at formation depth, such materials could be frost susceptible.

Design CBR values greater than 15% should be possible if stabilisation is undertaken, subject to material suitability.

12. ASSESSMENT OF MATERIALS FOR WASTE DISPOSAL

There is no requirement to remove soils from site to permit development and, therefore, development levels should be set such that soils can be retained and reused on site where possible. Providing development levels are set to accommodate soil arisings (for example, from foundation excavations), such materials would not be classified as waste if retained and re-used on site. However, if materials are excess to requirements, they should be taken to an appropriately permitted waste facility.

If material is identified for removal to a waste facility, it will be necessary to provide a description of the material and laboratory test data to the receiving facility. This information is included in Appendix I of this report and Appendix I and II of the Supplementary Ground Investigation Report. It should be noted that additional analytical laboratory testing may be required.

The available analytical laboratory test data have been used to provide preliminary waste disposal advice. It should be noted that these test results may not specifically relate to materials that are, or will be, scheduled for removal from site. However, the results are appropriate for preliminary guidance and costing purposes.

HazWasteOnline™ has been used to assess materials on site in accordance with the Environment Agency's document Guidance on the Classification and Assessment of Waste WM3 (2015). Additional assessment is made by direct reference to WM3. The assessment indicates that the following preliminary waste classification advice would be appropriate.

The topsoil is likely to be classified as 'non-hazardous' waste if taken to a landfill due to the organic content of such materials. Alternatively, these materials could be taken to a recycling facility.

Asbestos has been recorded within ashy Made Ground in the western part of Zone A and below the area of deeper Made Ground within the central part of Zone B. The recorded concentrations are <0.001%. The detected asbestos is below 0.1% therefore these materials should be classified as 'non-hazardous' and could be disposed of at a non-hazardous landfill. Asbestos cement fragments have been identified in an area of deeper Made Ground in Zone B. As outlined in Section 7.3.1, any visible ACMs encountered during the works should be hand-picked for disposal. All hand-picked asbestos-containing materials should be bagged, placed in a lidded skip/bin only for asbestos and disposed of off-site as 'hazardous' waste.

Based on the available information, the majority of Made Ground materials encountered beneath the site comprise reworked natural strata and are likely to be classified as 'inert' waste if taken off site but Waste Acceptance Criteria (WAC) testing will be required to confirm this assessment. Some of the Made Ground within the central area of Zone B could be classified as 'hazardous' waste due to the recorded concentrations of metals, BTEX and TPH. The ashy Made Ground located in the former tennis courts and beneath the former running track may be classified as 'non-hazardous' waste due to the recorded concentrations of TPH. It is recommended that, prior to removal from site, materials be segregated and further analytical laboratory testing be undertaken to confirm waste classification and landfill acceptance.

If taken off site, the natural strata should be classified as 'inert' waste (providing they are not visibly impacted by potential contaminants). As these materials comprise natural strata, no analytical laboratory testing should be required on these materials to confirm waste classification.

Waste requires pre-treatment prior to disposal at landfill and this may take the form of physical or chemical treatment to reduce hazards and/or waste volumes. The segregation and screening of waste soils into separate, and appropriately classified, waste streams would satisfy the pre-treatment criteria by ensuring that volumes of each waste category are minimised. Segregation of waste streams is also important to prevent materials being classified within a worse-case category and, therefore, incurring higher disposal costs. Mixing of different waste streams to dilute hazardous properties is not permitted.

It should be noted that the above assessment is provided in accordance with current waste disposal and environmental permitting legislation and guidance documents. However, individual landfills and other waste disposal facilities may have variances in their permit that differs from standard guidance. Waste facilities may also make decisions with respect to accepting waste on a commercial basis. Therefore, landfills or other waste facilities should be approached to confirm that they will accept waste materials prior to finalising waste disposal proposals.

13. RECOMMENDED SUPERVISION AND MONITORING

In compliance with the requirements in BS EN 1997-1:2004 and BE EN 1997-2:2007, construction and workmanship of the engineering solutions recommended in this report shall be supervised. In particular, issues listed in Section 9.7 General Construction Advice shall be considered in the implementation of the works and design of any necessary temporary works set out in Section 10.

In relation to the foundation solution and ground floor slab recommendations in Section 9, the following supervision and monitoring is recommended.

- Inspection of formation strata following the removal of topsoil (and Made Ground beneath proposed building footprints) and prior to placement of Engineered Fill
- Verification testing required ensuring earthworks operations are in accordance within the Specification for Earthworks
- Inspection of formation strata in excavations for pad footings
- If undertaken, verification testing is required following vibro-replacement ground treatment

14. SUMMARY

It is proposed to develop a site identified as 'Maylands Gateway', Hemel Hempstead, Hertfordshire, for commercial purposes. Areas within the site have been previously used as a caravan park, stables, a tennis court and sport fields. The proposed development is understood to comprise seven warehouse units together with associated access roads, service yards, car parking areas, an attenuation pond and areas of managed landscaping. Earthworks are required to form the proposed development levels at the site.

Ground conditions beneath the site typically comprise topsoil overlying Clay-with-Flints strata over Upper Chalk strata. However, Made Ground has been recorded across the western half of Zone A and locally beneath Zones B and C. Across the western half of Zone A and where present beneath Zone C, the Made Ground generally comprise reworked natural strata with occasional brick fragments to depths of up to 3.0 m. Coarse-grained ashy Made Ground were encountered to depths of approximately 0.3 m in the western and southern parts of Zone A. Within the western part of Zone B (former tennis court) and across Zone C there are areas of concrete and/or tarmac surfacing and these areas are generally underlain by coarse-grained Made Ground materials. Deep Made Ground that is locally impacted by hydrocarbons has been recorded to depths of up to 4.4 m beneath the central part of Zone B.

Polyaromatic hydrocarbons (PAHs) have previously been recorded at concentrations above the GAC beneath the northwestern corner of Zone B. The elevated PAHs are likely to be associated with the surface materials across the former tennis courts. Recent ground investigations undertaken by Crossfield Consulting Limited did not identify elevated concentrations of PAHs within this area.

Petroleum hydrocarbons (Aromatic C₂₁ – C₃₅) have been identified at one location below the central area of Zone B, and is likely to be associated with tar fragments within the Made Ground. For geotechnical reasons, it is recommended that the Made Ground in this area is dug out and replaced with Engineered Fill during earthworks. During this work it is recommended that any hydrocarbon-impacted soils, tar fragments and oil drums are segregated from the soils for testing and off-site disposal, where required.

Loose fibres of asbestos have been identified within the ashy Made Ground in the western part of Zone A. Loose fibres of asbestos and asbestos cement fragments have been identified in an area of deeper Made Ground Zone B. It is recommended that any visible asbestos-containing materials (ACMs) encountered during the works should be hand-picked for disposal. All hand-picked ACMs should be stored appropriately and disposed of off-site.

A capping layer may be required in proposed landscaped areas if impacted materials remain at the surface following the proposed earthworks.

No unacceptable risks to controlled waters have been identified.

If additional, post-earthworks, ground gas monitoring is not undertaken, allowance should be made to provide ground gas precautions.

It is recommended that a Discovery Strategy be put in place during site development works, such that any unidentified contamination encountered is reported to a geoenvironmental specialist and further investigation undertaken.

To assess the potential for unrecorded mine workings and/or solution features to be present beneath the site, it is recommended that the Made Ground materials beneath proposed building footprints are removed and replaced with Engineered Fill. The formation strata should be inspected following the removal of Made Ground and prior to the placement of Engineered Fill. If unrecorded mine workings and/or solution features are identified, the foundation arrangements should be reviewed.

Earthworks are required at the site to create the required development platforms. Details of the proposed earthworks are presented within the Supplementary Ground Investigation Report (CCL02935.CD47). The Engineered Fill materials should be placed in accordance with a suitable Specification (CCL02935.CD48). As detailed in the Specification, it is recommended that all Made Ground materials be excavated from beneath the proposed building footprints and replaced with Engineered Fill.

The Made Ground and low strength natural strata are considered unsuitable founding strata due to the unpredictable settlements that may occur in these materials. Any Made Ground materials (including reworked natural strata) and/or low strength strata encountered below the proposed buildings should be excavated and replaced with high strength Engineered Fill. This will also minimise the potential for unrecorded mine workings and/or solution features to remain beneath proposed buildings. Following the removal and replacement of the Made Ground, it is considered that pad foundations should be possible at this site with foundations placed in either high strength Engineered Fill, medium to high strength Clay-with-Flints or the underlying Upper Chalk strata.

Consideration could be given to ground treatment using vibro-replacement techniques (stone columns) for proposed Units 1, 2/3 and 6. However, the suitability of ground treatment will require confirmation by a specialist ground treatment contractor and acceptance by the Environment Agency.

On the basis that Made Ground materials will be excavated and replaced with Engineered Fill and/or the Made Ground is treated using vibro-replacement techniques (stone columns), ground-bearing floor slabs should be suitable.

REFERENCES

Site Specific References

RPS Group PLC (February 2016) *Maylands Gateway, Hemel Hempstead, Phase 1: Environmental Liability Review* Report Ref: RCEL38874-00 R

RPS Group PLC (April 2016) *Maylands Gateway, Hemel Hempstead, Phase 2: Geoenvironmental Site Investigation and Risk Assessment* Report Ref: RCEI39093-003 R

Crossfield Consulting Limited (April 2017) *Maylands Gateway, Hemel Hempstead, Hertfordshire – Supplementary Ground Investigation Report*. Report No. CCL02935.CD47

Crossfield Consulting Limited (April 2017) *Maylands Gateway, Hemel Hempstead, Hertfordshire – Earthworks Specification*. Report No. CCL02935.CD48

Crossfield Consulting Limited (September 2017) *Maylands Gateway, Hemel Hempstead, Hertfordshire – Remediation Statement*. Report No. CCL02935.CF01

Technical References

BRE (2005) *Special Digest 1 – Concrete in aggressive ground*, CRC Ltd

BRE (2015) *BR211 – Radon: Guidance on protective measures for new buildings* BRE Press

BRE (2004) *BR470: Working Platforms for Tracked Plant: Good Practice guide to design*. Building Research Establishment

BSI (2015) *BS 5930:2015 Code of Practice for Ground Investigations* British Standards Institution

BSI (2015) *BS 3882:2015 Specification for topsoil and requirements for use* British Standards Institution

BSI (2015) *BS 8485:2015 Code of Practice for the Design of Protective Measures for Methane and Carbon Dioxide Ground Gases for New Buildings* British Standards Institution

BSI (2013) *BS 8576:2013 Guidance of Investigations for Ground Gas – Permanent Gases and Volatile Organic Compounds (VOCs)* British Standards Institution

BSI (2013) *BS 10175:2011+A1:2013 Code of Practice for Investigation of Potentially Contaminated Sites* British Standards Institution

BSI (2004) *BS EN1997-1:2004 Eurocode 7: Geotechnical Design – Part 1: General Rules* British Standards Institution

BSI (2007) *BS EN1997-2:2007 Eurocode 7: Geotechnical Design – Part 2: Ground Investigation and Testing* British Standards Institution

CIRIA (2002) *CIRIA C574 – Engineering in Chalk* Construction Industry Research Association

CIRIA (2001) *CIRIA C552 – Contaminated Land Risk Assessment: A Guide to Good Practice* Construction Industry Research Association

CIRIA (2007) *CIRIA C665 – Assessing Risks posed by Hazardous Ground Gases to Buildings* Construction Industry Research Association

DoE (1990) *The Environmental Protection Act* Department of The Environment HMSO

Department for Communities and Local Government (2012) *National Planning Policy Framework*

Environment Agency (2004) *Model Procedures for the Management of Land Contamination CLR11* EA

Environment Agency (2005) *Environment Agency Guidance on Requirements for Land Contamination Reports* EA

Environment Agency (2009) *CLEA Software (Version 1.05) Handbook Science Report SC050021/SR4* EA

Environment Agency (2009) *Updated Technical Background to the CLEA Model Science Report SC050021/SR3* EA

Environment Agency (2015) *Waste Classification: Guidance on the Classification and Assessment of Waste (1st Edition) – Technical Guidance WM3* EA

FPS (2002) *Notes on the design, installation and maintenance of working platforms for plant and specialist foundation and geotechnical works* Federation of Piling Specialists

Highways Agency (2009) *Interim Advice Note 73/06 Revision 1 – Design Guidance for Road Pavements (Draft HD25)* HA

LQM/CIEH (2015) *The LQM/CIEH S4ULs for Human Health Risk Assessment* Land Quality Press, Nottingham

NHBC and Environment Agency (2008) *Guidance for the Safe Development of Housing on Land Affected by Contamination R&D Publication 66: 2008*

NHBC (2017) *Standards* National House Building Council

TRRL (1989) *LR1132 – The Design of Bituminous Road Pavements* Transport and Road Research Laboratory

UKWIR (2010) *Guidance for the Selection of Water Supply Pipes to be used in Brownfield Sites Report Ref. No. 10/WM/03/21* UK Water Industry Research

DRAFT

GENERAL NOTES

1. This report is provided in the context of the stated development proposals and should not be used in a different context.
2. The accuracy of map extracts cannot be guaranteed and it should be recognised that different conditions on site may have existed between and subsequent to the various map surveys.
3. Any borehole data from the British Geological Survey sources are included on the following basis: "The British Geological Survey accept no responsibility for omissions or misinterpretation of the data from their Data Bank as this may be old or obtained from non-BGS sources and may not represent current interpretation.
4. Where any data supplied by the Client or by other external sources, including previous site investigation data, have been used it has been assumed that the information is correct unless otherwise stated. No responsibility can be accepted by Crossfield Consulting Limited for inaccuracies within the data supplied by others.
5. Exploratory hole locations provided in the report are generally established by tape measurement from existing features or boundaries. Hole locations are not accurately surveyed and ground levels at these locations are not obtained unless specifically requested.
6. Any assessments made in this report are based on the ground conditions indicated by the trial pits and/or boreholes, together with the results of any field or laboratory testing undertaken and, where appropriate, other relevant site data which may have been obtained for the site. Variations in ground conditions may occur between exploratory hole locations and there may be special conditions appertaining to the site which have not been revealed by the investigation and which have not been taken into account in the report. The assessment may be subject to amendment in the light of additional information becoming available.
7. The report is provided for the sole use by the Client or its assignees and is confidential to the Client's professional advisers. No responsibility whatsoever for the contents of this report will be accepted to any person other than the Client or its assignees.
8. New information, improved practices and legislation may necessitate an alteration to the report in whole, or in part, after its submission. Therefore with any change in circumstances or after the expiry of one year from the date of the report, the report should be referred to Crossfield Consulting Limited for re-assessment and, if necessary, re-appraisal.

DRAFT

TABLES

TABLE 1

CONCEPTUAL SITE MODEL

Potential Contaminant Source	Potential Migration Routes	Receptors and Assessed Pollutant Linkage
<p>Solids <i>Toxic metals:</i> Potential minor source associated with Made Ground. <i>Phytotoxic metals:</i> Potential minor source associated with Made Ground. <i>Polyaromatic hydrocarbons:</i> Potential minor source associated with Made Ground. <i>Petroleum Hydrocarbons:</i> Potential minor source associated with Made Ground. <i>Asbestos:</i> Potential sources associated with the demolition of former buildings (pavilions) and Made Ground. <i>Off-site source:</i> No source identified</p> <p>Liquids No known current source</p> <p>Ground Gases <i>Ground Gases:</i> Potential minor source associated with the presence of Made Ground containing organic materials. <i>Radon:</i> No significant sources</p>	<p>Movement of Solids Direct dermal contact, ingestion of soil and inhalation of dust are all viable pathways during construction. Dust exposure pathways may be present in proposed soft landscaping following development but new building and hardstanding will provide effective barrier to negate dermal, ingestion and inhalation pathways across the majority of the site.</p> <p>Release into Liquid Phase Metal solubility generally low at typical soil temperature and pH. Low possibility of metal uptake by plants. Polyaromatic hydrocarbons typically of low solubility and mobility. Weathered petroleum hydrocarbons generally low solubility.</p> <p>Release into Vapour Phase Not applicable (no source)</p> <p>Movement of Liquids Not applicable (no source)</p> <p>Movement of Gases Potential for migration through Made Ground.</p>	<p>Human Health <i>End Users:</i> Possible pollutant linkage <i>Construction Workers:</i> Possible pollutant linkage during development <i>Adjacent Properties:</i> Possible pollutant linkage during development</p> <p>Buried Structures & Services <i>Plastic pipes for potable water:</i> Possible pollutant linkage <i>Buried concrete:</i> No pollutant linkage <i>Other structures and services:</i> No pollutant linkage</p> <p>Landscape Areas Possible pollutant linkage</p> <p>Controlled Waters <i>Groundwater:</i> No pollutant linkage <i>Surface Water:</i> No pollutant linkage</p> <p>Human Health Possible pollutant linkage</p>

NOTES

1. The above conceptual model is based on CIRIA C552 (2001) and BS 10175:2011+A1:2013.
2. The Conceptual Site Model is prepared from available desk study information. Where a site walkover or ground investigation identifies information that was not known at the desk study stage, such information is used to modify the Model.
3. Where a pollutant linkage is identified, any subsequent ground investigation is designed to obtain relevant information to assess the pollutant linkage. See Table 3 for a summary of pollutant linkage assessments.

TABLE 2
(Page 1 of 2)

SUMMARY OF ANALYTICAL TEST DATA: SOILS
POTENTIAL RISKS TO HUMAN HEALTH

Determinand	Units	No of Tests ⁶	Concentration (mg/kg)		Generic Assessment Criteria (mg/kg) Commercial		Category 4 Screening Level (mg/kg) Commercial	
			Min	Max	Value	No>GAC	Value	No>C4SL
Arsenic	mg/kg	40	<0.1	78	640 ¹	0	640 ⁴	0
Cadmium	mg/kg	40	<0.1	1.8	190 ¹	0	410 ⁴	0
Chromium (Total) ⁵	mg/kg	40	13	330	8600 ¹	0	-	-
Chromium (VI)	mg/kg	40	<1.0	<4.0	33 ¹	0	49 ⁴	0
Lead	mg/kg	40	5.2	210	1200 ²	0	2330 ⁴	0
Inorganic Mercury	mg/kg	40	<0.05	1.9	1100 ¹	0	-	-
Nickel	mg/kg	40	3.5	610	980 ¹	0	-	-
Selenium	mg/kg	40	<0.5	5.1	12,000 ¹	0	-	-
Copper	mg/kg	40	3.3	1100	68,000 ¹	0	-	-
Zinc	mg/kg	40	24	530	730,000 ¹	0	-	-
Phenols	mg/kg	17	<1.0	15	440 ¹	0	-	-
Petroleum Hydrocarbons								
Aliphatics C ₅ – C ₆	mg/kg	41	<0.001	<0.1	5900 ¹	0	-	-
Aliphatics C ₆ – C ₈	mg/kg	41	<0.001	<0.1	17,000 ¹	0	-	-
Aliphatics C ₈ – C ₁₀	mg/kg	41	<0.001	23	4800 ¹	0	-	-
Aliphatics C ₁₀ – C ₁₂	mg/kg	41	<1.0	1500	23,000 ¹	0	-	-
Aliphatics C ₁₂ – C ₁₆	mg/kg	41	<1.2	4000	82,000 ¹	0	-	-
Aliphatics C ₁₆ – C ₃₅	mg/kg	41	<1.5	54,000	1,000,000 ¹	0	-	-
Aromatics C ₆ – C ₇	mg/kg	41	<0.001	0.006	46,000 ¹	0	-	-
Aromatics C ₇ – C ₈	mg/kg	41	<0.001	0.018	110,000 ¹	0	-	-
Aromatics C ₈ – C ₁₀	mg/kg	41	<0.001	4.5	8100 ¹	0	-	-
Aromatics C ₁₀ – C ₁₂	mg/kg	41	<0.9	620	28,000 ¹	0	-	-
Aromatics C ₁₂ – C ₁₆	mg/kg	41	<0.5	1700	37,000 ¹	0	-	-
Aromatics C ₁₆ – C ₂₁	mg/kg	41	<0.6	12,000	28,000 ¹	0	-	-
Aromatics C ₂₁ – C ₃₅	mg/kg	41	<1.4	37,000	28,000 ¹	1	-	-
VOCs								
Benzene	mg/kg	41	<0.01	0.006	47 ¹	0	98 ⁴	0
Toluene	mg/kg	41	<0.01	0.018	110,000 ¹	0	-	-
Ethylbenzene	mg/kg	41	<0.01	0.17	13,000 ¹	0	-	-
Xylene	mg/kg	41	<0.01	1.31	14,000 ¹	0	-	-
MTBE	mg/kg	41	<0.01	<0.01	13,000 ³	0	-	-

TABLE 2
(Page 2 of 2)

Determinand	Units	No of Tests ⁶	Concentration (mg/kg)		Generic Assessment Criteria (mg/kg) Commercial		Category 4 Screening Level (mg/kg) Commercial	
			Min	Max	Value	No>GAC	Value	No>C4SL
PAHs								
Naphthalene	mg/kg	41	<0.05	8.4	460 ¹	0	-	-
Acenaphthylene	mg/kg	41	<0.05	6.0	97,000 ¹	0	-	-
Acenaphthene	mg/kg	41	<0.05	6.7	97,000 ¹	0	-	-
Fluorene	mg/kg	41	<0.05	7.5	680,000 ¹	0	-	-
Phenanthrene	mg/kg	41	<0.05	38	22,000 ¹	0	-	-
Anthracene	mg/kg	41	<0.05	15	540,000 ¹	0	-	-
Fluoranthene	mg/kg	41	<0.05	57	23,000 ¹	0	-	-
Pyrene	mg/kg	41	<0.05	63	54,000 ¹	0	-	-
Benz(a)anthracene	mg/kg	41	<0.05	35	170 ¹	0	-	-
Chrysene	mg/kg	41	<0.05	39	350 ¹	0	-	-
Benzo(b)fluoranthene	mg/kg	41	<0.05	41	44 ¹	0	-	-
Benzo(k)fluoranthene	mg/kg	41	<0.05	23	1200 ¹	0	-	-
Benzo(a)pyrene	mg/kg	41	<0.05	56	35 ¹	1	76 ⁴	0
Indeno(123cd)pyrene	mg/kg	41	<0.05	39	510 ¹	0	-	-
Dibenzo(ah)anthracene	mg/kg	41	<0.05	7.8	3.6 ¹	1	-	-
Benzo(ghi)perylene	mg/kg	41	<0.05	35	4000 ¹	0	-	-

NOTES

1. Suitable for Use Level (S4UL) published by LQM/CIEH, 2015 – Commercial landuse. S4UL assumptions comprise 2.5% soil organic matter, soil pH of 7 and sandy loam soil type. Where S4UL presented by LQM is greater than 100%, the S4UL for this assessment has been capped at 1,000,000 mg/kg. S4ULs are copyright © Land Quality Management Limited reproduced with permission; Publication Number S4UL3133.
2. Generic assessment criteria (GAC) for lead calculated using CLEA Software version 1.06 (Environment Agency, 2009) with a lead intake based on a target blood level of 3.5 µg/dL. Other model assumptions comprise 2.5% soil organic matter, soil pH of 7 and sandy loam soil type.
3. Soil GAC for Human Health Risk Assessment produced by CL:AIRE (2010) – Commercial. Assumption of 2.5% soil organic matter.
4. Category 4 Screening Level (C4SL), Department for Environment Food and Rural Affairs (March 2014)
5. In the absence of desk study or historical map evidence indicating a potential source of chromium (VI) usage at or in the near vicinity of the site, total chromium concentrations have been compared to the GAC for chromium (III).
6. Includes analytical test data from Appendix I together with results from the 2016 Phase II Geoenvironmental Site Investigation by RPS Group PLC and the supplementary ground investigation (March 2017) by Crossfield Consulting Ltd (data presented in the Supplementary Ground Investigation Report)

TABLE 3

ASSESSMENT OF POLLUTANT LINKAGES

- NOTES:
- Pollutant linkage validity assessed following qualitative or semi-quantitative risk assessment.
 - Pollutant linkage assessed following detailed quantitative risk assessment or assuming the recommended remediation or mitigation measures are in place

		Consequence (C)			
		Severe	Medium	Mild	Minor
Probability (P)	High likelihood (HL)	Very High Risk	High Risk	Moderate Risk	Moderate/Low Risk
	Likely (L)	High Risk	Moderate Risk	Moderate/Low Risk	Low Risk
	Low likelihood (LL)	Moderate Risk	Moderate/Low Risk	Low Risk	Very Low Risk
	Unlikely (UL)	Moderate/Low Risk	Low Risk	Very Low Risk	Very Low Risk

All terminology in accordance with the definitions provided in CIRIA C552 (2001)

Pollutant Linkage			Assessment of Pollutant Linkage following Ground Investigation	Pollutant Linkage Valid? ¹	Risk Rating			Quantitative Risk Assessment	Recommended Remediation/Mitigation (See Section 7 for further details)	Recommended Work Verified?	Pollutant Linkage Valid? ²
Source	Pathway	Receptor			C	P	Risk				
Toxic Metals Petroleum Hydrocarbons PAHs Asbestos	Dermal Contact (dust), Ingestion (dust)	End Users	Localised PAHs (benzo(a)pyrene and dibenzo(an)anthracene) and petroleum hydrocarbons (aromatic C ₂₁ – C ₃₅) are elevated above the GAC.	Yes	Med	LL	Mod/Low	Not applicable	The commercial proposed development will include a large area of hardstanding/buildings that will potential inhibit any pathway for contaminants following development. A capping layer may be required in proposed landscaped areas if impacted materials remain at the surface following earthworks. Any visible ACMs fragments should be hand-picked and bagged before being removed from site in a skip/bin with a lid. Any tar fragments or oil drums should be removed for off-site disposal.	To be confirmed during construction phase	No
			Loose fibres of chrysotile and amosite asbestos were identified at several locations across the site with maximum concentrations of 0.001%. Cemented asbestos fragments identified below the central area of Zone B.	Yes	Sev	UL	Mod/Low				
Toxic Metals Petroleum Hydrocarbons PAHs Asbestos	Dermal Contact (dust), Ingestion (dust)	Construction Workers	All test below concentrations considered to be short term (acute) risk. No further assessment required.	No	n/a	n/a	n/a	Not applicable	Not applicable but standard personal protective equipment is recommended as good practice. Any visible ACMs fragments should be hand-picked and bagged before being removed from site in a skip/bin with a lid. Dust suppression measures to be adopted when undertaking ground works.	To be confirmed during construction phase	No
			Loose fibres of chrysotile and amosite asbestos were identified at several locations across the site with maximum concentrations of 0.001%. Cemented asbestos fragments identified below the central area of Zone B.	Yes	Sev	UL	Mod/Low				
Toxic Metals Petroleum Hydrocarbons PAHs Asbestos	Dermal Contact (dust), Ingestion (dust)	Neighbours/general public	Localised PAHs (benzo(a)pyrene and dibenzo(an)anthracene) and petroleum hydrocarbons (aromatic C ₂₁ – C ₃₅) are elevated above the GAC.	Yes	Med	UL	Low	Not applicable	Conventional dust control to be used during construction.	To be confirmed during construction phase	No
			Loose fibres of chrysotile and amosite asbestos were identified at several locations across the site with maximum concentrations of 0.001%. Cemented asbestos fragments identified below the central area of Zone B.	Yes	Sev	UL	Mod/Low				
Phytotoxic Metals	Plant uptake	Landscape planting	Phytotoxic metals (nickel, zinc and copper) recorded at elevated levels in the Made Ground which may be detritus to healthy plant growth across the site.	Yes	Mild	LL	Low	Not applicable	A thickness of subsoil/ topsoil may be required to act as a growing medium for the proposed plants. It should be possible to reuse the topsoil across the site	To be confirmed during construction phase	No
Heavy Metals Petroleum hydrocarbons	Migration through shallow strata	Controlled waters	Concentrations of metals generally below EQS with small volume of zinc and chromium marginally above the EQS.	No	n/a	n/a	n/a	Not applicable.	Not applicable	Not applicable	No

DRAFT

FIGURES

FIGURE 1



SITE LOCATION PLAN

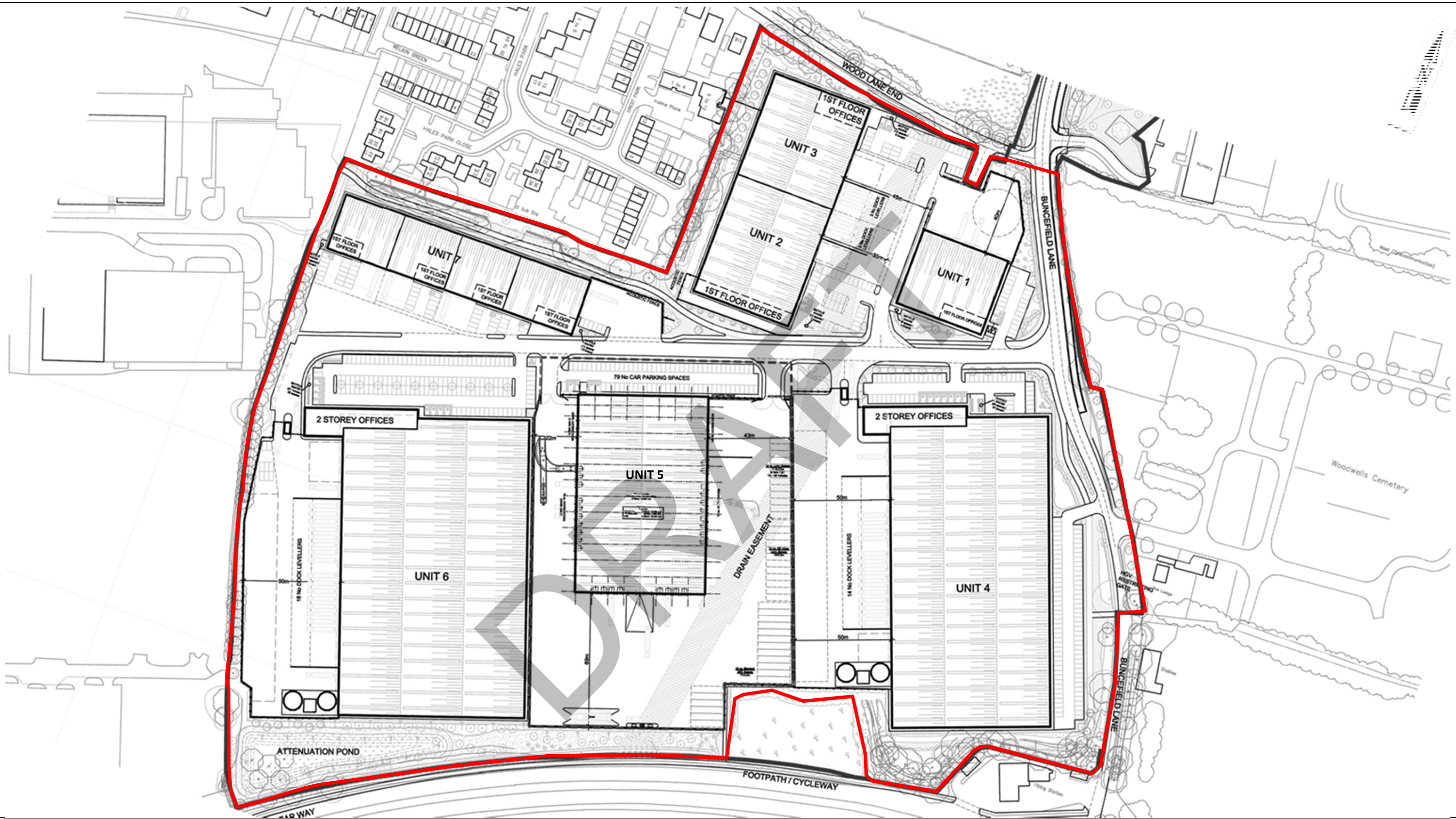
Scale 1: 50,000

Reproduced from the 2013, 1:50,000 Ordnance Survey map with the permission of Ordnance Survey on behalf of The Controller of Her Majesty's Stationery Office, © Crown copyright. Licence No.100014660



TOPOGRAPHICAL SITE SURVEY
Scale 1:2000

Plan based on the Topographical Survey drawing by Greenhatch Group, dated January 2016. Drawing No. 22846_T. Rev. 1

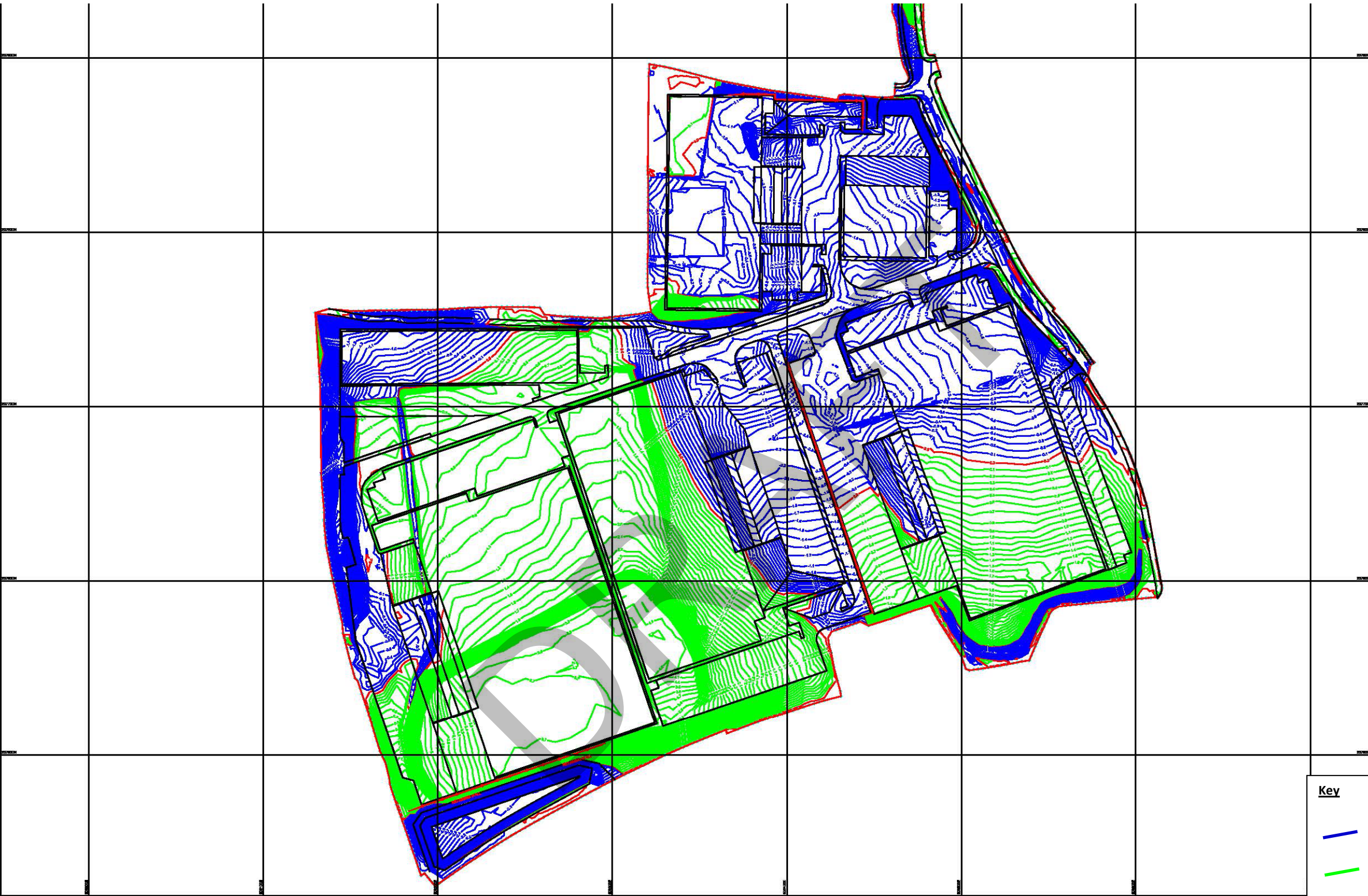


PROPOSED DEVELOPMENT PLAN

Scale 1:2000

Plan based on Drg No. 30830-Fe-71-F by Michael Sparks Associates, dated Feb 2017

FIGURE 4



Note
This drawing does not reflect the latest development layout for Unit 5, as shown on Figure 3

Key
— Cut Contours (0.1 m intervals)
— Fill Contours (0.1 m intervals)

CUT & FILL CONTOURS PLAN
Scale 1:2500

Reproduced from the Cut & Fill Contours Plan (NK18226-RPS-SI-XX-DR-C-SK-0202) drawing, dated February 2017. Drawing No. 9051b

DRAFT

APPENDIX I

APPENDIX I – PHASE II SUPPLEMENTARY GROUND INVESTIGATION

Introduction

This Appendix, together with Sections 2 to 5 of the report (and the Supplementary Ground Investigation Report), forms the Ground Investigation Report for the development described in the report, in compliance with the requirements of BS 5930:2015, BS EN1997-1:2004(2007) and BS EN1997-2:2007(2007).

The site operations were carried out between Monday 2nd October and Tuesday 3rd October 2017 under the supervision of a geoenvironmental engineer from Crossfield Consulting Limited. The scope and rationale for the design of the investigation is presented in Table I-1.

The ground investigation was designed and supervised by qualified and experienced geoenvironmental specialists from Crossfield Consulting Limited. Where appropriate, and as outlined below, specialist drilling/sampling equipment was procured together with trained and experienced operators. Unless otherwise indicated, sampling and logging remained the responsibility of trained staff from Crossfield Consulting Limited and field records were prepared on site, during or immediately following drilling/sampling.

An exploratory hole location plan is presented as Figure I-1.

Trial Pits

Seventeen trial pits, denoted as TP101 to TP117, were excavated by a Volvo EC220 excavator between Monday 2nd October and Tuesday 3rd October 2017. The trial pit records from the investigation are presented in this Appendix and these records include the descriptions and depths of the strata encountered, together with sample depths, groundwater observations and other pertinent comments.

Soil Samples

All samples for analytical testing were collected in appropriate containers, stored in cool boxes (where appropriate) and sent to the testing laboratory overnight. The sample containers, storage and handling procedures were all compatible with the relevant recommendations of the UKAS accredited testing laboratory for the specific testing proposed.

Analytical Laboratory Testing

The rationale for the analytical testing is set out in Table I-2.

Selected samples of the soils encountered were submitted for screening analysis of the following determinands:

- Arsenic (Total)
- Chromium (Total)
- Lead (Total)
- Nickel (Total)
- Selenium (Total)
- Cyanide (Total)
- Sulphate (Water soluble)
- pH
- Asbestos (Fibres & ACM)
- Sulphur (Total)
- Cadmium (Total)
- Copper (Total)
- Mercury (Total)
- Zinc (Total)
- Boron (Water soluble)
- Sulphide (Total)
- Phenols (Total-monohydric)
- Total Organic Carbon
- Asbestos (Quantification)

Note: Total determinands are based on an aqua-regia extract.

Selected samples of the soils encountered were submitted for analysis of the following determinands:

- Total Petroleum Hydrocarbons – aromatic/aliphatic split and carbon number banding, using GC-FID techniques
- BTEX and MTBE – using GC-MS techniques
- Polyaromatic Hydrocarbons – using GC-MS techniques

The analyses were carried out by i2 Analytical, a UKAS accredited laboratory, and the results are presented in this Appendix. Soil testing was undertaken in accordance with the Environment Agency's Monitoring Certification Scheme (MCERTS).

DRAFT

RATIONALE FOR THE DESIGN OF THE GROUND INVESTIGATION

The scope of the ground investigation was designed with reference to the published geology and ground conditions indicated in the desk study information. In addition, reference was also made to the factual records and recommendations contained within the Supplementary Ground Investigation Report (CCL02935.CD47). It is noted that the investigation works were constrained by access restrictions, in particular within Zone A where archaeological works were being undertaken.

In compliance with the guidance published in BS EN 1997-2:2007, the ground investigation was designed to verify the ground model and to characterise the ground conditions within influencing distance of the proposed structures. In this regard, the exploratory holes were targeted within relevant areas of the site to provide information on the strata profile down to competent materials.

In compliance with the guidance published in BS 10175:2011+A1:2013 and BS 5930:2015, the layout of the exploratory holes and sampling regime also considers the Conceptual Site Model and potential pollutant linkages, such that the spatial arrangement of the investigation provides the necessary information to support a risk assessment of the identified potential pollutant linkages.

Exploratory Hole and Technique	Rationale for Hole Location	Depth (m)	Sampling/In Situ Testing and Monitoring
TPCCL101 – TPCCL109	Trial pits were located within accessible areas of the site to investigate anomalous ground conditions recorded during the March 2017 ground investigation.	Between 3.0 m and 4.8 m	None undertaken.
TPCCL110 – TPCCL114 and TPCCL117	Trial pits were located to confirm the extent and depth of the Made Ground recorded across the central area of Zone B during the March 2017 ground investigation.	Up to 4.5 m	Soil samples were recovered for analytical laboratory testing.
TPCCL115 and TPCCL116	Trial pits were located to investigate areas that were previously inaccessible (i.e. former tennis courts) during the March 2017 ground investigation.	Up to 3.5 m	Soil samples were recovered for analytical laboratory testing.

Key

TP X Machine dug trial pit

RATIONALE FOR THE ANALYTICAL TESTING SUITE

Exploratory Hole and Samples	Selection Criteria	Analytical Tests
TPCCCL112: 1.8 – 2.0 m TPCCCL113: 1.4 – 1.5 m TPCCCL113: 2.3 – 2.5 m TPCCCL114: 0.8 – 1.0 m TPCCCL115: 0.0 – 0.2 m TPCCCL115: 1.5 – 1.8 m TPCCCL116: 0.3 – 0.6 m	Samples were recovered from Made Ground to assess the presence of potential contaminants associated with the site's history.	Metal and metalloids, cyanide (total), pH, phenol, sulphate (water and acid soluble), sulphide, sulphur (total), TOC and Asbestos. Petroleum Hydrocarbons Polyaromatic Hydrocarbons (PAHs) BTEX & MTBE

DRAFT

TRIAL PIT RECORDS

KEY

	J	Disturbed Jar Sample	} Category B Samples
	G	Soil Sample in Glass Container	
	g	Soil Sample in Glass Vial	
	B	Disturbed Bulk Sample	
	C	"Undisturbed" CBR Mould Sample (denoted Category A: OS-TK/W in BS EN 22475-1:2006)	
	W	Water Sample	
FVT	{	c_{fv}	Undrained Shear Strength (from hand vane shear vane test)
		c_{rv}	Undrained Remoulded Shear Strength (from hand vane shear vane test)
		c_{fv}^*	Undrained Shear Strength from Hand Vane Shear Strength Test on block sample dug from pit by excavator

Notes:

1. All measurement values on record sheets are uncorrected, unless otherwise indicated.
2. For corrected test values, refer to report.
3. Identification and classification of strata is based on the guidance published in the current edition of BS5930 together with BS EN ISO 14688-1:2002, BS EN ISO 14688-2:2004, BS EN ISO 14689-1:2003
4. Consistency (soft, firm, stiff etc.) relates to a manual test/inspection on site (in compliance with BS EN ISO 14688-1:2002 Section 5.14)
5. Undrained shear strength (low, medium, high etc.) relates to in situ or laboratory test data and the associated assessed strength of a stratum (in compliance with BS EN ISO 14688-2:2004 Section 5.3 and Table 5).
6. The density of coarse-grained soils is based on SPT N values (or equivalent Dynamic Probe test or CPT data) as outlined in BS5930 and BS EN ISO 14688-2:2004.
7. Rock strength (weak, strong etc.) is based on field identification (and/or strength test data), as outlined in BS EN ISO 14689-1:2003 Table 5.


Trial Pit Record Sheet

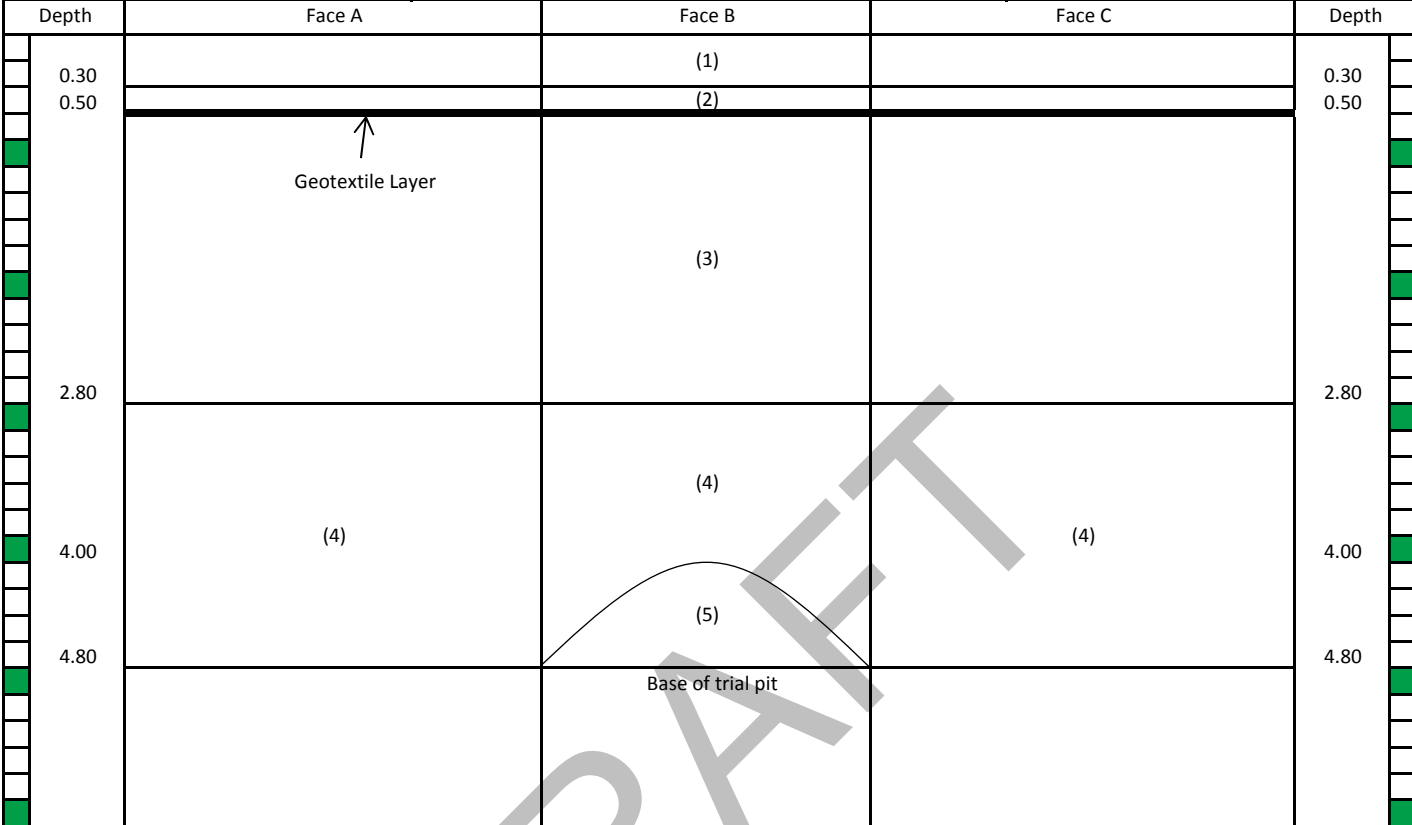
Hole Ref. **TPCCL101**

Project Maylands Gateway, Hemel Hempstead
Date 02/10/2017

Sheet 1 of 1
Job No. CCL02935

Bearing: North
Plant Volvo EC 220 EL
Trial Pit Plan
Shoring None used
Stability Trial Pit remained stable throughout excavation.
Water Groundwater not encountered.

Ground Level 129.36 m OD
Co-ordinates 508208 207567
Logged by SR Logged on site during excavation
Checked by 



Sampling **Strata**

Sample/Test Depth	Type	Strength (kN/m ²)	Ref. No.	Strata Depth	Description
			1	0.00 - 0.30	Vegetation over black slightly sandy fine to coarse angular to subangular gravel with abundant rootlets, concrete fragments, clinker/cinder and occasional flint (MADE GROUND)
			2	0.30 - 0.50	Firm consistency grey very gravelly clay with occasional rootlets and ashy deposits. Gravel is fine to coarse angular to subangular with flint (MADE GROUND) ...black geotextile at 0.5 m
			3	0.50 - 2.80	Firm consistency orangish brown mottled grey gravelly silty CLAY. Gravel is fine to coarse angular to subangular of flint (CLAY-WITH-FLINTS) ...becoming stiff consistency below 1.0 m ...becoming friable below 2.0 m
			4	2.80 - 4.00/4.80	Very stiff consistency orangish brown mottled grey very gravelly silty CLAY. Gravel is fine to coarse angular to subangular of flint. Cobbles and boulders of flint (CLAY-WITH-FLINTS)
			5	4.00 - 4.80	Structureless CHALK composed of white silty fine to coarse angular GRAVEL. Clasts are extremely weak low density (UPPER CHALK: GRADE Dc)

Remarks **Notes**
 1. All logging and sampling in accordance with BS 5930:2015
 2. Symbols and abbreviations are explained on the accompanying key
 3. All linear dimensions are in metres unless otherwise stated

Trial Pit Record Sheet

Hole Ref. **TPCCL102**

Project Maylands Gateway, Hemel Hempstead
Date 02/10/2017

Sheet 1 of 1
Job No. CCL02935

Bearing: West

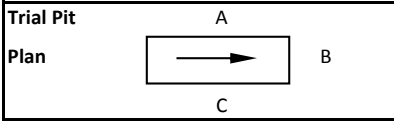
Shoring None used

Ground Level 128.96 m OD

Plant Volvo EC 220 EL

Stability Trial Pit remained stable throughout excavation.

Co-ordinates 508208 207572



Water Groundwater not encountered.

Logged by SR Logged on site during excavation
Checked by *[Signature]*

Depth	Face A	Face B	Face C	Depth
0.20		(1)		0.20
0.40		(2)		0.40
2.30		(3)		2.30
3.60		(4)		3.60
		Base of trial pit		

Sampling **Strata**

Sample/Test Depth	Type	Strength (kN/m ²)	Ref. No.	Strata Depth	Description
			1	0.00 - 0.20	Grass over firm consistency brown slightly gravelly silty clay with rootlets. Gravel is fine to coarse angular to subangular with flint (TOPSOIL)
			2	0.20 - 0.40	Firm consistency orangish brown gravelly clay with occasional rootlets. Gravel is fine to coarse angular to subangular of flint (MADE GROUND)
			3	0.40 - 2.30	Firm consistency brownish grey gravelly clay with rootlets/roots. Gravel is fine to coarse angular to subangular with abundant flint and occasional brick and ash deposits (MADE GROUND)
			4	2.30 - 3.60	Very stiff consistency orangish brown mottled grey slightly gravelly CLAY. Gravel is fine to coarse angular to subangular of flint (CLAY-WITH-FLINTS) ...cobbles and boulders of flint below 3.0 m

Remarks

Notes
1. All logging and sampling in accordance with BS 5930:2015
2. Symbols and abbreviations are explained on the accompanying key
3. All linear dimensions are in metres unless otherwise stated

Trial Pit Record Sheet

Hole Ref. **TPCCL103**

Project Maylands Gateway, Hemel Hempstead
Date 02/10/2017

Sheet 1 of 1
Job No. CCL02935

Bearing: South

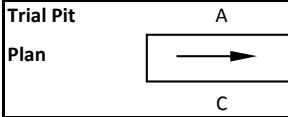
Shoring None used

Ground Level 129.75 m OD

Plant Volvo EC 220 EL

Stability Trial Pit remained stable throughout excavation.

Co-ordinates 508170 207613



Water Groundwater not encountered.

Logged by SR Logged on site during excavation
Checked by *[Signature]*

Depth	Face A	Face B	Face C	Depth
0.20		(1)		0.20
3.80		(2)		3.80
4.00		(3) Base of trial pit		4.00

Sampling			Strata		
Sample/Test Depth	Type	Strength (kN/m ²)	Ref. No.	Strata Depth	Description
			1	0.00 - 0.20	Vegetation over black slightly sandy fine to coarse angular to subangular gravel with rootlets and clinker/cinder (MADE GROUND) ...black geotextile at 0.2 m
			2	0.20 - 3.80	Stiff consistency orangish brown mottled grey gravelly silty CLAY. Gravel is fine to coarse angular to subangular of flint (CLAY-WITH-FLINTS) ...becoming very stiff consistency below 2.0 m ...becoming friable below 2.5 m
			3	3.80 - 4.00	Structureless CHALK composed of white silty fine to coarse angular GRAVEL. Clasts are extremely weak low density (UPPER CHALK: GRADE Dc)

Remarks	Notes 1. All logging and sampling in accordance with BS 5930:2015 2. Symbols and abbreviations are explained on the accompanying key 3. All linear dimensions are in metres unless otherwise stated
----------------	---

Trial Pit Record Sheet

Hole Ref. **TPCCL104**

Project Maylands Gateway, Hemel Hempstead
Date 02/10/2017

Sheet 1 of 1
Job No. CCL02935

Bearing: Southwest

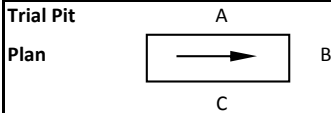
Shoring None used

Ground Level 130.40 m OD

Plant Volvo EC 220 EL

Stability Trial Pit remained stable throughout excavation.

Co-ordinates 508220 207517



Water Groundwater not encountered.

Logged by SR Logged on site during excavation
Checked by *[Signature]*

Depth	Face A	Face B	Face C	Depth
0.30		(1)		0.30
2.50		(2)		2.50
3.20		(3)		3.20
		Base of trial pit		

Sampling **Strata**

Sample/Test Depth	Type	Strength (kN/m ²)	Ref. No.	Strata Depth	Description
			1	0.00 - 0.30	Grass over firm consistency brown slightly gravelly silty clay with rootlets. Gravel is fine to coarse angular to subangular with flint (TOPSOIL)
			2	0.30 - 2.50	Firm consistency orangish brown mottled grey gravelly silty CLAY. Gravel is fine to coarse angular to subangular of flint (CLAY-WITH-FLINTS) ...becoming stiff consistency below 2.0 m
			3	2.50 - 3.20	Very stiff consistency reddish orange very gravelly silty friable CLAY. Gravel is fine to coarse angular to subangular of flint (CLAY-WITH-FLINTS) ...cobbles and boulders of flint below 2.8 m

Remarks

Notes
1. All logging and sampling in accordance with BS 5930:2015
2. Symbols and abbreviations are explained on the accompanying key
3. All linear dimensions are in metres unless otherwise stated

Trial Pit Record Sheet

Hole Ref. **TPCCL105**

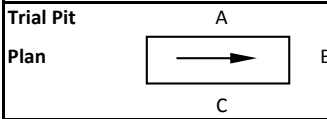
Project Maylands Gateway, Hemel Hempstead
Date 02/10/2017

Sheet 1 of 1
Job No. CCL02935

Bearing: East
Plant Volvo EC 220 EL

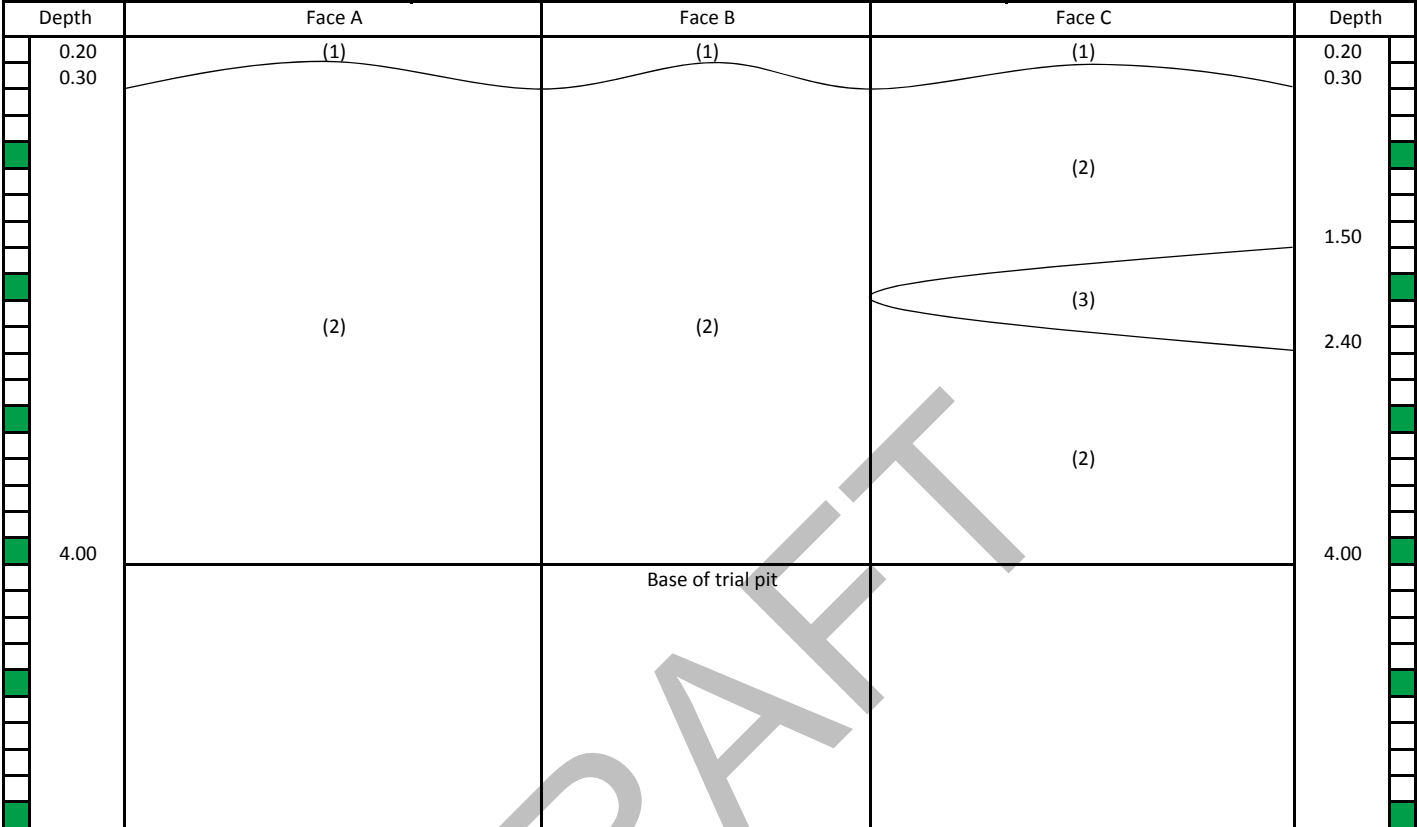
Shoring None used
Stability Trial Pit remained stable throughout excavation.

Ground Level 131.66 m OD
Co-ordinates 508172 207728



Water Groundwater not encountered.

Logged by SR Logged on site during excavation
Checked by *[Signature]*



Sampling **Strata**

Sample/Test Depth	Type	Strength (kN/m ²)	Ref. No.	Strata Depth	Description
			1	0.00 - 0.20/0.30	Grass over brown gravelly silty sand with rootlets and roots. Gravel is fine to coarse angular to subangular with flint (TOPSOIL)
			2	0.30 - 1.50/4.00	Firm consistency orangish brown mottled grey slightly gravelly silty CLAY with rootlets to 1.0 m. Gravel is fine to coarse angular to subangular of flint (CLAY-WITH-FLINTS) ...becoming very gravelly below 2.0 m ...becoming very stiff consistency and friable below 2.5 m ...cobbles and boulders of flint below 2.8 m
			3	1.50 - 2.40	Light brown slightly gravelly sandy SILT. Gravel is fine to coarse angular to subangular of flint (CLAY-WITH-FLINTS)

Remarks **Notes**
 1. All logging and sampling in accordance with BS 5930:2015
 2. Symbols and abbreviations are explained on the accompanying key
 3. All linear dimensions are in metres unless otherwise stated

Trial Pit Record Sheet

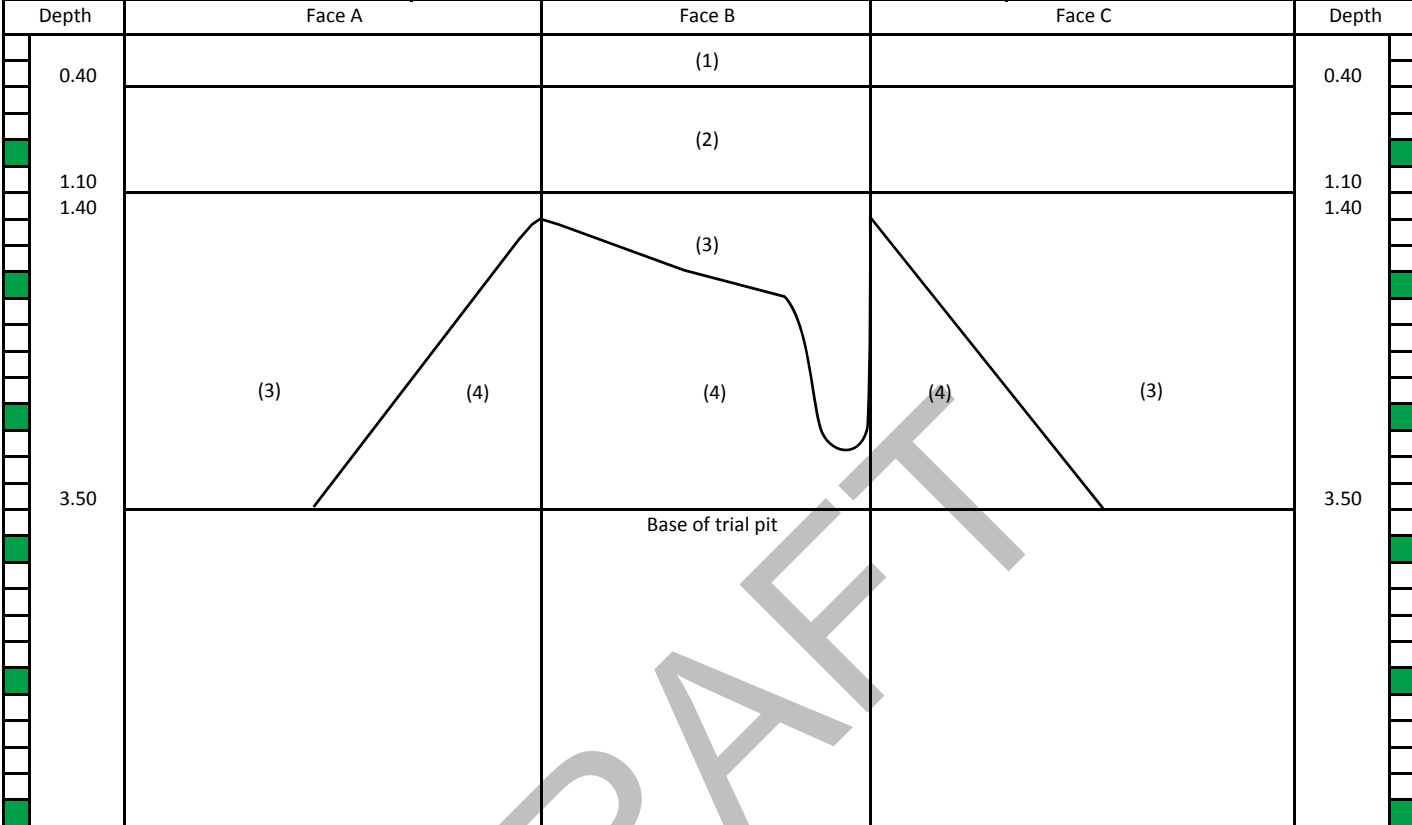
Hole Ref. **TPCCL106**

Project Maylands Gateway, Hemel Hempstead
Date 02/10/2017

Sheet 1 of 1
Job No. CCL02935

Bearing: North
Plant Volvo EC 220 EL
Trial Pit Plan
Shoring None used
Stability Trial Pit remained stable throughout excavation.
Water Groundwater not encountered.

Ground Level 128.82 m OD
Co-ordinates 508344 207585
Logged by SR Logged on site during excavation
Checked by *CB*



Sampling **Strata**

Sample/Test Depth	Type	Strength (kN/m ²)	Ref. No.	Strata Depth	Description
			1	0.00 - 0.40	Grass over firm consistency brown slightly gravelly silty clay with rootlets. Gravel is fine to coarse angular to subangular with flint (TOPSOIL)
			2	0.40 - 1.10	Stiff consistency reddish brown mottled grey very gravelly CLAY. Gravel is fine to coarse angular to subangular of flint. Occasional cobbles and boulders of flint (CLAY-WITH-FLINTS) ...flint band encountered at 0.8 m
			3	1.10 - 1.40/3.50	Very stiff consistency reddish orange mottled greenish grey gravelly silty CLAY. Gravel is fine to coarse angular to subangular of flint (CLAY-WITH-FLINTS) ...cobbles and boulders of flint below 3.0 m
			4	1.40 - 3.50	Structureless CHALK composed of white silty fine to coarse angular GRAVEL. Clasts are weak low density (UPPER CHALK: GRADE Dc)

Remarks **Notes**
1. All logging and sampling in accordance with BS 5930:2015
2. Symbols and abbreviations are explained on the accompanying key
3. All linear dimensions are in metres unless otherwise stated

Trial Pit Record Sheet

Hole Ref. **TPCCL107**

Project Maylands Gateway, Hemel Hempstead
Date 02/10/2017

Sheet 1 of 1
Job No. CCL02935

Bearing: West

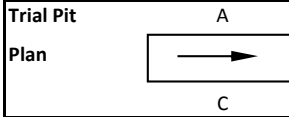
Shoring None used

Ground Level 129.10 m OD

Plant Volvo EC 220 EL

Stability Trial Pit remained stable throughout excavation.

Co-ordinates 508342 207608



Water Groundwater not encountered.

Logged by SR Logged on site during excavation
Checked by *CB*

Depth	Face A	Face B	Face C	Depth
0.20		(1)		0.20
0.50		(2)		0.50
1.40		(3)		1.40
3.00		(4)		3.00
		Base of trial pit		

Sampling			Strata		
Sample/Test Depth	Type	Strength (kN/m ²)	Ref. No.	Strata Depth	Description
			1	0.00 - 0.20	Grass over firm consistency slightly gravelly silty CLAY with rootlets. Gravel is fine to coarse angular to subangular with flint (TOPSOIL)
			2	0.20 - 0.50	Firm consistency orangish brown mottled grey gravelly silty CLAY with rootlets. Gravel is fine to coarse angular to subangular of flint (SUBSOIL)
			3	0.50 - 1.40	Stiff consistency orangish brown mottled reddish orange gravelly silty CLAY. Gravel is fine to coarse angular to subangular of flint (CLAY-WITH-FLINTS) ...black mottling below 1.0 m
			4	1.40 - 3.00	Structureless CHALK composed of white silty fine to coarse angular GRAVEL. Clasts are extremely weak low density (UPPER CHALK: GRADE Dc)

Remarks Topsoil has been stripped down to 0.20 m. Description obtained from exposed side wall.	Notes 1. All logging and sampling in accordance with BS 5930:2015 2. Symbols and abbreviations are explained on the accompanying key 3. All linear dimensions are in metres unless otherwise stated
--	---

Trial Pit Record Sheet

Hole Ref. **TPCCL108**

Project Maylands Gateway, Hemel Hempstead
Date 02/10/2017

Sheet 1 of 1
Job No. CCL02935

Bearing: West

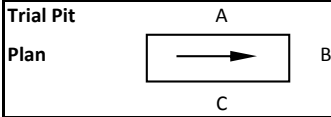
Shoring None used

Ground Level 129.55 m OD

Plant Volvo EC 220 EL

Stability Trial Pit remained stable throughout excavation.

Co-ordinates 508353 207612



Water Groundwater not encountered.

Logged by SR Logged on site during excavation
Checked by *[Signature]*

Depth	Face A	Face B	Face C	Depth
0.30		(1)		0.30
0.60		(2)		0.60
3.50		(3)		3.50
		Base of trial pit		

Sampling			Strata		
Sample/Test Depth	Type	Strength (kN/m ²)	Ref. No.	Strata Depth	Description
			1	0.00 - 0.30	Grass over firm consistency slightly gravelly silty clay with rootlets. Gravel is fine to coarse angular to subangular with flint. Occasional ashy deposits (MADE GROUND)
			2	0.30 - 0.60	Stiff consistency orangish brown gravelly silty CLAY with occasional rootlets. Gravel is fine to coarse angular to subangular of flint (CLAY-WITH-FLINTS)
			3	0.60 - 3.50	Structureless CHALK composed of white and yellow brown silty fine to coarse angular GRAVEL. Clasts are extremely weak low density (UPPER CHALK: GRADE Dc) ...becoming weak below 2.0 m

Remarks Topsoil has been stripped down to 0.30 m. Description obtained from exposed side wall.	Notes 1. All logging and sampling in accordance with BS 5930:2015 2. Symbols and abbreviations are explained on the accompanying key 3. All linear dimensions are in metres unless otherwise stated
--	---

Trial Pit Record Sheet

Hole Ref.

TPCCL109

Project

Maylands Gateway, Hemel Hempstead

Sheet

1 of 1

Date

02/10/2017

Job No.

CCL02935

Bearing: South

Shoring

None used

Ground Level

128.67 m OD

Plant Volvo EC 220 EL

Stability

Trial Pit remained stable throughout excavation.

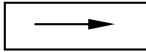
Co-ordinates

508315 207617

Trial Pit

A

Plan



C

Water

Groundwater not encountered.

Logged by

SR

Logged on site during excavation

Checked by

Depth	Face A	Face B	Face C	Depth
0.20		(1)		0.20
0.30		(2)		0.30
0.60		(3)		0.60
0.80		(4)		0.80
2.00		(5)		2.00
3.10	Base of trial pit			3.10

Sampling **Strata**

Sample/Test Depth	Type	Strength (kN/m ²)	Ref. No.	Strata Depth	Description
			1	0.00 - 0.20/0.30	Grass over firm consistency brown slightly gravelly silty clay with rootlets. Gravel is fine to coarse angular to subangular with abundant flint and occasional brick fragments (MADE GROUND)
			2	0.20/0.30 - 0.60	Stiff consistency orangish brown mottled reddish brown slightly gravelly clay with rootlets. Gravel is fine to coarse angular to subangular with flint and occasional chalk (MADE GROUND)
			3	0.60 - 0.80	Stiff consistency brownish grey gravelly clay with occasional ashy deposits and rootlets. Gravel is fine to coarse angular to subangular with flint and occasional brick fragments (MADE GROUND)
			4	0.80 - 2.00	Stiff consistency orangish brown and reddish orange mottled grey slightly gravelly silty CLAY. Gravel is fine to coarse angular to subangular of flint (CLAY-WITH-FLINTS) ...black mottling below 1.5 m
			5	2.00 - 3.10	Structureless CHALK composed of white silty fine to coarse angular GRAVEL. Clasts are weak low density (UPPER CHALK: GRADE Dc)

Remarks	Notes 1. All logging and sampling in accordance with BS 5930:2015 2. Symbols and abbreviations are explained on the accompanying key 3. All linear dimensions are in metres unless otherwise stated
----------------	---

Trial Pit Record Sheet

Hole Ref. **TPCCL110**

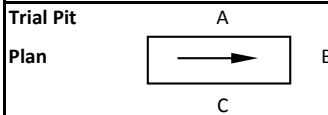
Project Maylands Gateway, Hemel Hempstead
Date 03/10/2017

Sheet 1 of 1
Job No. CCL02935

Bearing: East
Plant Volvo EC 220 EL

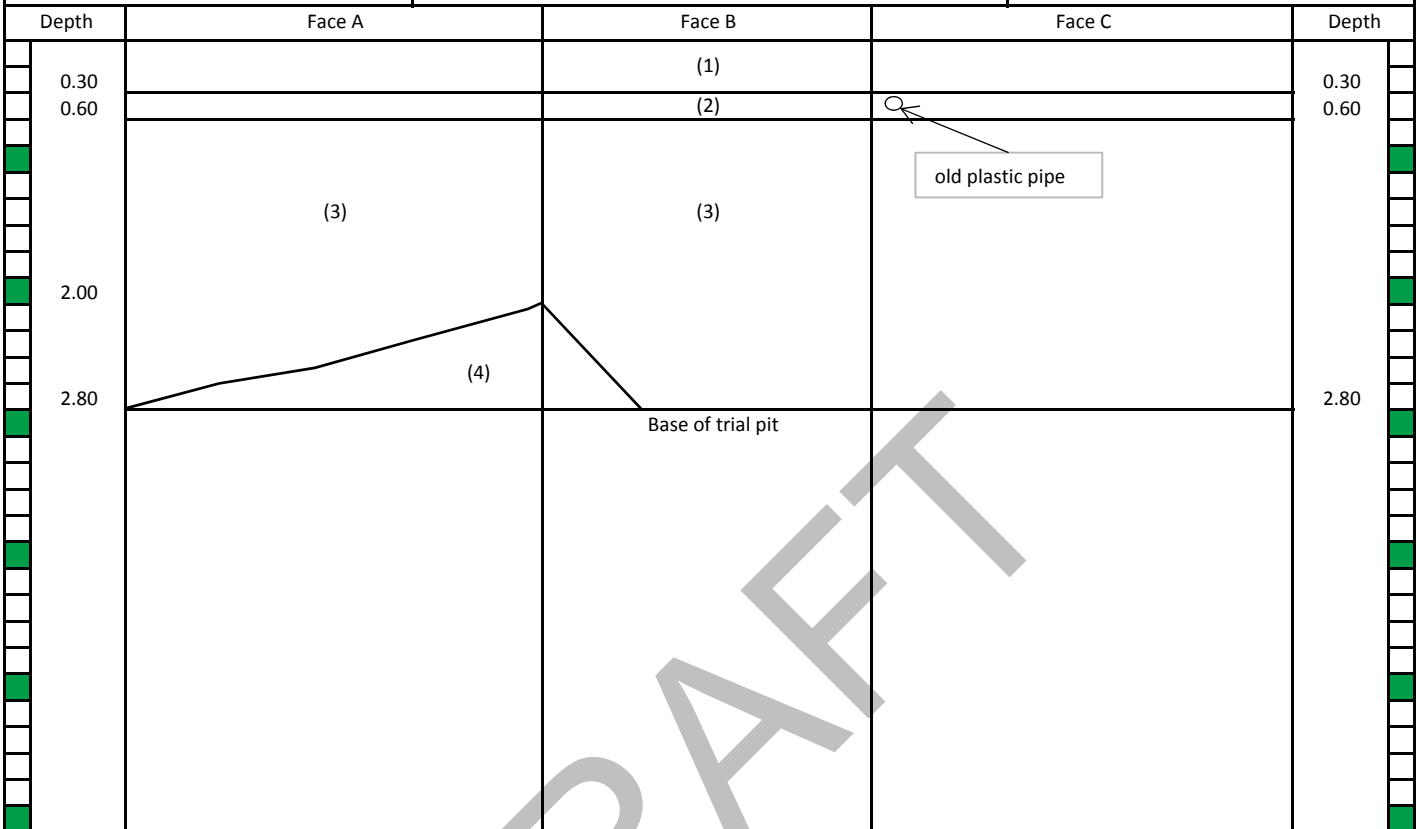
Shoring None used
Stability Trial Pit remained stable throughout excavation.

Ground Level 135.22 m OD
Co-ordinates 508475 207750



Water Groundwater not encountered.

Logged by SR Logged on site during excavation
Checked by *SR*



Sampling			Strata		
Sample/Test Depth	Type	Strength (kN/m ²)	Ref. No.	Strata Depth	Description
			1	0.00 - 0.30	Grass over brown clayey gravelly sand with rootlets. Gravel is fine to coarse angular to subangular with flint and occasional brick fragments (MADE GROUND)
			2	0.30 - 0.60	Firm consistency grey and brown gravelly clay with occasional rootlets. Gravel is fine to coarse angular to subangular with flint and brick fragments. (MADE GROUND) ...old plastic pipe at 0.5 m
			3	0.60 - 2.00/2.80	Stiff consistency orangish brown mottled grey slightly gravelly silty CLAY. Gravel is fine to coarse angular to subangular of flint (CLAY-WITH-FLINTS)
			4	2.00 - 2.80	Structureless CHALK composed of silty fine to coarse angular GRAVEL. Clasts are extremely weak low density (UPPER CHALK: GRADE Dc)

Remarks
Topsoil has been stripped down to 0.30 m. Description obtained from exposed side wall.

Notes
1. All logging and sampling in accordance with BS 5930:2015
2. Symbols and abbreviations are explained on the accompanying key
3. All linear dimensions are in metres unless otherwise stated

Trial Pit Record Sheet

Hole Ref. **TPCCL111**

Project Maylands Gateway, Hemel Hempstead
Date 03/10/2017

Sheet 1 of 1
Job No. CCL02935

Bearing: North

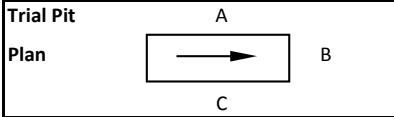
Shoring None used

Ground Level 135.92 m OD

Plant Volvo EC 220 EL

Stability Trial Pit remained stable throughout excavation.

Co-ordinates 508502 207756



Water Groundwater not encountered.

Logged by SR Logged on site during excavation
Checked by *[Signature]*

Depth	Face A	Face B	Face C	Depth
0.30		(1)		0.30
3.00		(2)		3.00
		Base of trial pit		

Sampling **Strata**

Sample/Test Depth	Type	Strength (kN/m ²)	Ref. No.	Strata Depth	Description
			1	0.00 - 0.30	Grass over firm consistency brown slightly gravelly sandy clay with rootlets. Gravel is fine to coarse angular to subangular with flint (TOPSOIL)
			2	0.30 - 3.00	Firm consistency orangish brown mottled grey gravelly CLAY with rootlets down to 2.0 m. Gravel is fine to coarse angular to subangular of flint (CLAY-WITH-FLINTS) ...becoming stiff consistency below 1.0 m ...becoming very stiff consistency and friable below 2.5 m ...cobble and boulders of flint below 2.5 m

Remarks	Notes 1. All logging and sampling in accordance with BS 5930:2015 2. Symbols and abbreviations are explained on the accompanying key 3. All linear dimensions are in metres unless otherwise stated
----------------	---

Trial Pit Record Sheet

Hole Ref. **TPCCL112**

Project Maylands Gateway, Hemel Hempstead
Date 03/10/2017

Sheet 1 of 1
Job No. CCL02935

Bearing: North

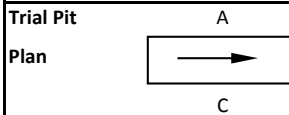
Shoring None used

Ground Level 135.68 m OD

Plant Volvo EC 220 EL

Stability Face A collapsed in from 1.3 m to 2.0 m.

Co-ordinates 508482 207782



Water Groundwater not encountered.

Logged by SR Logged on site during excavation
Checked by *[Signature]*

Depth	Face A	Face B	Face C	Depth
0.20		(1)		0.20
0.30		(2)		0.30
1.30	(3)	(3)	(3)	
2.00	(4)			2.00
4.20		(5)		4.20
4.50		(6)		4.50
		Base of trial pit		

Sampling			Strata		
Sample/Test Depth	Type	Strength (kN/m ²)	Ref. No.	Strata Depth	Description
1.80 - 2.00	JGg		1	0.00 - 0.20	Grass over firm consistency dark brown slightly gravelly sandy clay with rootlets. Gravel is fine to coarse angular to subangular with flint, occasional brick fragments and clinker/cinder (MADE GROUND)
			2	0.20 - 0.30	Grey and black slightly sandy fine to medium angular to subangular gravel with clinker/cinder (MADE GROUND)
			3	0.30 - 1.30/2.00	Firm consistency orangish brown and brown mottled grey gravelly silty clay with occasional rootlets. Gravel is fine to coarse angular to subangular with flint, brick, metal, tarmac fragments and clinker/cinder (MADE GROUND)
			4	1.30 - 2.00	Firm consistency orangish brown locally stained black slightly gravelly clay. Gravel is fine to coarse angular to subangular with flint, brick and abundant metal pipes/sheeting/drums (MADE GROUND) ...cobbles and boulders of flint below 1.5 m
			5	2.00 - 4.20	Firm consistency greenish grey and black gravelly silty clay with occasional roots. Gravel is fine to coarse angular to subangular with flint, brick and metal fragments. Slight organic odour (MADE GROUND)
			6	4.20 - 4.50	Very stiff consistency orangish brown mottled grey slightly gravelly silty CLAY. Gravel is fine to coarse angular to subangular of flint (CLAY-WITH-FLINTS)

Remarks	Notes 1. All logging and sampling in accordance with BS 5930:2015 2. Symbols and abbreviations are explained on the accompanying key 3. All linear dimensions are in metres unless otherwise stated
----------------	---


Trial Pit Record Sheet

Hole Ref. **TPCCL113**

Project Maylands Gateway, Hemel Hempstead
Date 03/10/2017

Sheet 1 of 1
Job No. CCL02935

Bearing: North
Plant Volvo EC 220 EL
Trial Pit Plan
Shoring None used
Stability Trial Pit remained stable throughout excavation.
Water Groundwater not encountered.

Ground Level 135.66 m OD
Co-ordinates 508458 207785
Logged by SR Logged on site during excavation
Checked by 

Depth	Face A	Face B	Face C	Depth
0.20		(1)		0.20
1.40		(2)		1.40
1.70		(3)		1.70
2.20		(4)		2.20
4.40		(5)		4.40
5.00		Base of trial pit		5.00

Sampling **Strata**

Sample/Test Depth	Type	Strength (kN/m ²)	Ref. No.	Strata Depth	Description
			1	0.00 - 0.20	Grass over firm consistency dark brown slightly gravelly sandy clay with rootlets. Gravel is fine to coarse angular to subangular with flint and ashy deposits (MADE GROUND)
1.40 - 1.50	JGg		2	0.20 - 1.40/1.70	Stiff consistency orangish brown mottled grey gravelly friable clay with occasional rootlets. Gravel is fine to coarse angular to subangular with flint, brick and porcelain fragments (MADE GROUND) ...old broken porcelain pipe at 0.5 m
			3	1.40 - 2.20	Firm consistency dark grey and black very gravelly sandy clay. Gravel is fine to coarse angular to subangular with metal, brick, tar fragments and occasional flint and chalk fragments. Hydrocarbon odour (MADE GROUND)
2.30 - 2.50	JGg		4	1.70/2.20 - 4.40	Soft to firm consistency greenish grey and black very gravelly clay with wood fragments. Gravel is fine to coarse angular to subangular with metal, asbestos cement fragments, porcelain, textile and chalk fragments. Organic odour (MADE GROUND)
			5	4.40 - 5.00	Very stiff consistency orangish brown mottled grey gravelly silty friable CLAY. Gravel is fine to coarse angular to subangular of flint (CLAY-WITH-FLINTS)

Remarks **Notes**
1. All logging and sampling in accordance with BS 5930:2015
2. Symbols and abbreviations are explained on the accompanying key
3. All linear dimensions are in metres unless otherwise stated


Trial Pit Record Sheet

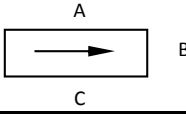
Hole Ref. **TPCCL114**

Project Maylands Gateway, Hemel Hempstead
Date 03/10/2017

Sheet 1 of 1
Job No. CCL02935

Bearing: North
Plant Volvo EC 220 EL
Trial Pit Plan
Shoring None used
Stability Trial Pit remained stable throughout excavation.
Water Groundwater not encountered.

Ground Level 135.22 m OD
Co-ordinates 508440 207782
Logged by SR Logged on site during excavation
Checked by 



Depth	Face A	Face B	Face C	Depth
0.20		(1)		0.20
1.50		(2)		1.50
2.30		(3)		2.30
3.30		(4)		3.30
3.50		(5)		3.50
		Base of trial pit		

Sampling **Strata**

Sample/Test Depth	Type	Strength (kN/m ²)	Ref. No.	Strata Depth	Description
0.80 - 1.00	JGg		1	0.00 - 0.20	Grass over firm consistency brown slightly gravelly sandy clay with rootlets. Gravel is fine to coarse angular to subangular with flint, occasional brick and ashy deposits (MADE GROUND)
			2	0.20 - 1.50	Firm consistency brown and orangish brown very gravelly clay with occasional rootlets. Gravel is fine to coarse angular to subangular with flint, brick, porcelain, asbestos cement fragments, abundant metal sheeting and pipes and tar fragments. Hydrocarbon odour (MADE GROUND)
			3	1.50 - 2.30	Soft to firm consistency greenish grey and black very gravelly clay with wood fragments. Gravel is fine to coarse angular to subangular with flint, brick and metal fragments. Slight organic odour (MADE GROUND)
			4	2.30 - 3.30	Stiff consistency orangish brown mottled grey gravelly silty friable CLAY. Gravel is fine to coarse angular to subangular with abundant chalk fragments and flint (CLAY-WITH-FLINTS)
			5	3.30 - 3.50	Structureless CHALK composed of white silty fine to coarse subangular GRAVEL with occasional flint. Clasts are extremely weak to weak low density (UPPER CHALK: GRADE Dc)

Remarks **Notes**
 1. All logging and sampling in accordance with BS 5930:2015
 2. Symbols and abbreviations are explained on the accompanying key
 3. All linear dimensions are in metres unless otherwise stated

Trial Pit Record Sheet

Hole Ref. **TPCCL115**

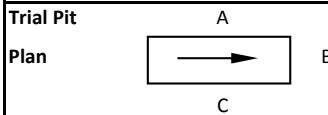
Project Maylands Gateway, Hemel Hempstead
Date 03/10/2017

Sheet 1 of 1
Job No. CCL02935

Bearing: East
Plant Volvo EC 220 EL

Shoring None used
Stability Trial Pit remained stable throughout excavation.

Ground Level 134.23 m OD
Co-ordinates 508333 207817



Water Groundwater not encountered.

Logged by SR Logged on site during excavation
Checked by *[Signature]*

Depth	Face A	Face B	Face C	Depth
0.40		(1)		0.40
1.50		(2)		1.50
2.40		(3)		2.40
2.50		(4)		2.50
3.50		(5)		3.50
4.00		(6)		4.00
		Base of trial pit		

Sampling			Strata		
Sample/Test Depth	Type	Strength (kN/m ²)	Ref. No.	Strata Depth	Description
0.00 - 0.20	JGg		1	0.00 - 0.40	Grass over dark brown and black very gravelly sand with rootlets and ashy deposits. Gravel is fine to coarse angular to subangular (MADE GROUND)
1.50 - 1.80	JGg		2	0.40 - 1.50	Firm consistency orangish brown and brown gravelly silty clay with occasional rootlets. Gravel is fine to coarse angular to subangular with flint, brick fragments, porcelain and occasional metal (MADE GROUND)
			3	1.50 - 2.40	Firm consistency greenish grey mottled black slightly gravelly silty clay with occasional wood fragments. Gravel is fine to coarse angular to subangular with flint, brick, porcelain, ashy deposits and metal pipes (MADE GROUND)
			4	2.40 - 2.50	Firm consistency orangish brown and brown gravelly silty clay. Gravel is fine to coarse angular to subangular with flint, brick fragments and porcelain (MADE GROUND)
			5	2.50 - 3.50	Firm consistency greenish grey mottled black slightly gravelly silty clay. Gravel is fine to coarse angular to subangular with flint, brick, porcelain and ashy deposits (MADE GROUND)
			6	3.50 - 4.00	Stiff to very stiff consistency orangish brown mottled grey gravelly silty CLAY. Gravel is fine to coarse angular to subangular of flint (CLAY-WITH-FLINTS)

Remarks	Notes 1. All logging and sampling in accordance with BS 5930:2015 2. Symbols and abbreviations are explained on the accompanying key 3. All linear dimensions are in metres unless otherwise stated
----------------	---

Trial Pit Record Sheet

Hole Ref. **TPCCL116**

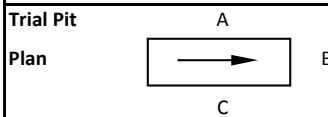
Project Maylands Gateway, Hemel Hempstead
Date 03/10/2017

Sheet 1 of 1
Job No. CCL02935

Bearing: East
Plant Volvo EC 220 EL

Shoring None used
Stability Trial Pit remained stable throughout excavation.

Ground Level 133.81 m OD
Co-ordinates 508327 207862



Water Groundwater not encountered.

Logged by SR Logged on site during excavation
Checked by *SR*

Depth	Face A	Face B	Face C	Depth
0.10		(1)		0.10
0.30		(2)		0.30
0.60		(3)		0.60
		(4)		
2.10		(5)		2.10
2.40		(6)		2.40
3.00		Base of trial pit		3.00

Sampling			Strata		
Sample/Test Depth	Type	Strength (kN/m ²)	Ref. No.	Strata Depth	Description
0.30 - 0.60	JGg		1	0.00 - 0.10	Tarmac surfacing (MADE GROUND)
			2	0.10 - 0.30	Grey and black fine to coarse angular to subangular gravel with ashy deposits and tarmac fragments (MADE GROUND)
			3	0.30 - 0.60	Firm consistency greenish grey and black gravelly clay with ashy deposits. Gravel is fine to coarse angular to subangular with brick fragments, concrete, tarmac and occasional metal fragments (MADE GROUND)
			4	0.60 - 2.10	Grey and brown sandy fine to coarse angular to subangular gravel with concrete, metal rebar, brick fragments and metal columns (MADE GROUND)
			5	2.10 - 2.40	Stiff consistency orangish brown and brown gravelly silty clay. Gravel is fine to coarse angular to subangular with brick, concrete and occasional porcelain (MADE GROUND)
			6	2.40 - 3.00	Very stiff consistency orangish brown mottled grey gravelly silty friable CLAY. Gravel is fine to coarse angular to subangular of flint (CLAY-WITH-FLINTS)

Remarks	Notes 1. All logging and sampling in accordance with BS 5930:2015 2. Symbols and abbreviations are explained on the accompanying key 3. All linear dimensions are in metres unless otherwise stated
----------------	---

Trial Pit Record Sheet

Hole Ref.

TPCCL117

Project

Maylands Gateway, Hemel Hempstead

Sheet

1 of 1

Date

03/10/2017

Job No.

CCL02935

Bearing: North

Shoring

None used

Ground Level

135.70 m OD

Plant Volvo EC 220 EL

Stability

Trial Pit remained stable throughout excavation.

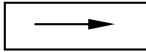
Co-ordinates

508447 207815

Trial Pit

A

Plan



B

C

Water

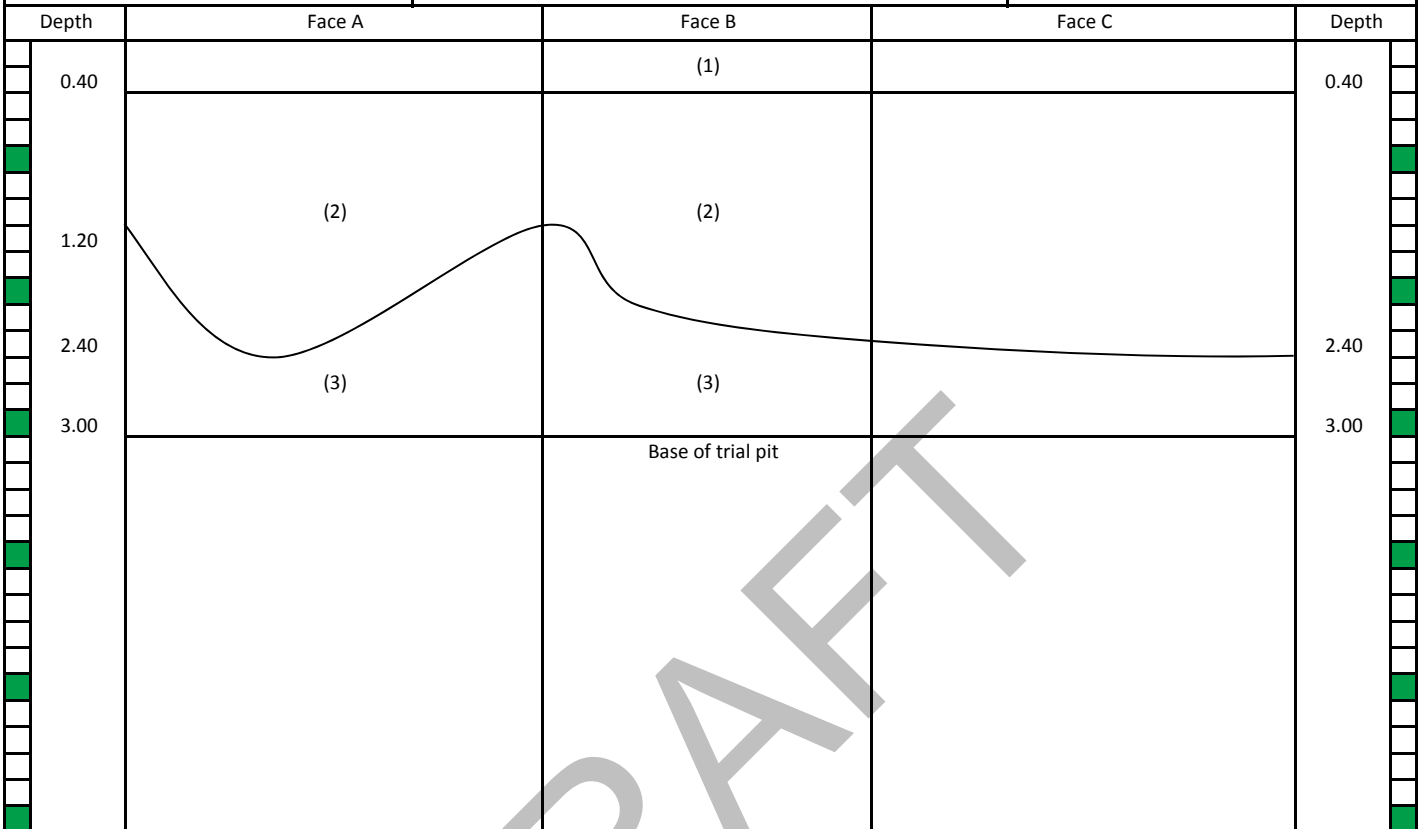
Groundwater not encountered.

Logged by

SR

Logged on site during excavation

Checked by



Sampling			Strata		
Sample/Test Depth	Type	Strength (kN/m ²)	Ref. No.	Strata Depth	Description
			1	0.00 - 0.40	Grass over firm consistency brown slightly gravelly sandy clay with rootlets. Gravel is fine to coarse angular to subangular with flint and occasional brick fragments (MADE GROUND)
			2	0.40 - 1.20/2.40	Stiff consistency orangish brown mottled grey gravelly silty CLAY. Gravel is fine to coarse angular to subangular of flint (CLAY-WITH-FLINTS) ...becoming very stiff consistency and friable below 1.5 m
			3	1.20/2.40 - 3.00	Structureless CHALK composed of white silty fine to coarse subangular GRAVEL with occasional flint. Clasts are extremely weak to weak low density (UPPER CHALK: GRADE Dc) ...chalk clasts becoming weak below 2.5 m

Remarks	Notes 1. All logging and sampling in accordance with BS 5930:2015 2. Symbols and abbreviations are explained on the accompanying key 3. All linear dimensions are in metres unless otherwise stated
----------------	---



Saskia Richards
Crossfield Consulting Ltd
The Granary
White Hall Farm
Leamington Road
Long Itchington
Warwickshire
CV47 9PU

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


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

e: mail@crossfield-consulting.co.uk

Analytical Report Number : 17-62717

Project / Site name: Maylands Gateway, Hemel Hempstead **Samples received on:** 04/10/2017
Your job number: CCL02935 **Samples instructed on:** 04/10/2017
Your order number: PO10311 **Analysis completed by:** 16/10/2017
Report Issue Number: 1 **Report issued on:** 16/10/2017
Samples Analysed: 7 soil samples

Signed: _____


Vineetha Meethale Vettil
Senior Account Manager
For & on behalf of i2 Analytical Ltd.

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

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

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

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

Excel copies of reports are only valid when accompanied by this PDF certificate.

Analytical Report Number: 17-62717

Project / Site name: Maylands Gateway, Hemel Hempstead

Your Order No: PO10311

Lab Sample Number				830010	830011	830012	830013	830014
Sample Reference				TPCCL112	TPCCL113	TPCCL113	TPCCL114	TPCCL115
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				1.80-2.00	1.40-1.50	2.30-2.50	0.80-1.00	0.00-0.20
Date Sampled				03/10/2017	03/10/2017	03/10/2017	03/10/2017	03/10/2017
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status					
Stone Content	%	0.1	NONE	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Moisture Content	%	N/A	NONE	27	12	19	18	11
Total mass of sample received	kg	0.001	NONE	2.0	1.7	1.8	1.6	1.6

Asbestos in Soil Screen / Identification Name	Type	N/A	ISO 17025	Amosite	-	-	-	-
Asbestos in Soil	Type	N/A	ISO 17025	Detected	Not-detected	Not-detected	Not-detected	Not-detected
Asbestos Quantification (Stage 2)	%	0.001	ISO 17025	< 0.001	-	-	-	-
Asbestos Quantification Total	%	0.001	ISO 17025	< 0.001	-	-	-	-

General Inorganics

pH - Manual	pH Units	N/A	MCERTS	-	7.5**	-	-	-
pH - Automated	pH Units	N/A	MCERTS	7.1	-	7.9	8.3	8.0
Total Cyanide	mg/kg	1	MCERTS	< 1	250	2	< 1	1
Total Sulphate as SO ₄	mg/kg	50	MCERTS	2300	960	480	550	870
Water Soluble SO ₄ 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	0.84	0.020	0.031	0.027	0.019
Sulphide	mg/kg	1	MCERTS	110	180	6.1	1.1	5.4
Total Sulphur	mg/kg	50	MCERTS	3100	1400	320	240	1000
Total Organic Carbon (TOC)	%	0.1	MCERTS	2.7	9.8	1.7	0.5	4.1

Total Phenols

Total Phenols (monohydric)	mg/kg	1	MCERTS	< 1.0	15	< 1.0	< 1.0	< 1.0
----------------------------	-------	---	--------	-------	----	-------	-------	-------

Speciated PAHs

Naphthalene	mg/kg	0.05	MCERTS	< 0.05	8.4	< 0.05	< 0.05	< 0.05
Acenaphthylene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Acenaphthene	mg/kg	0.05	MCERTS	< 0.05	2.8	< 0.05	< 0.05	< 0.05
Fluorene	mg/kg	0.05	MCERTS	< 0.05	4.0	< 0.05	< 0.05	< 0.05
Phenanthrene	mg/kg	0.05	MCERTS	< 0.05	14	< 0.05	< 0.05	< 0.05
Anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Fluoranthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Pyrene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Benzo(a)anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Chrysene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Benzo(a)pyrene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05

Total PAH

Speciated Total EPA-16 PAHs	mg/kg	0.8	MCERTS	< 0.80	28.8	< 0.80	< 0.80	< 0.80
-----------------------------	-------	-----	--------	--------	------	--------	--------	--------

Heavy Metals / Metalloids

Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	13	78	10	16	18
Boron (water soluble)	mg/kg	0.2	MCERTS	2.2	6.6	2.0	0.5	1.3
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	0.4	< 0.2	< 0.2	< 0.2	< 0.2
Chromium (hexavalent)	mg/kg	4	MCERTS	< 4.0	< 4.0	< 4.0	< 4.0	< 4.0
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	26	330	24	50	21
Copper (aqua regia extractable)	mg/kg	1	MCERTS	42	1100	19	20	11
Lead (aqua regia extractable)	mg/kg	1	MCERTS	59	71	39	49	16
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	24	610	16	13	15
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	510	270	58	120	57

Analytical Report Number: 17-62717

Project / Site name: Maylands Gateway, Hemel Hempstead

Your Order No: PO10311

Lab Sample Number	830010			830011			830012			830013			830014		
Sample Reference	TPCCL112			TPCCL113			TPCCL113			TPCCL114			TPCCL115		
Sample Number	None Supplied			None Supplied			None Supplied			None Supplied			None Supplied		
Depth (m)	1.80-2.00			1.40-1.50			2.30-2.50			0.80-1.00			0.00-0.20		
Date Sampled	03/10/2017			03/10/2017			03/10/2017			03/10/2017			03/10/2017		
Time Taken	None Supplied			None Supplied			None Supplied			None Supplied			None Supplied		
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status												

Monoaromatics

Compound	Units	Limit of detection	Accreditation Status	830010	830011	830012	830013	830014
Benzene	µg/kg	1	MCERTS	< 1.0	6.5	< 1.0	< 1.0	< 1.0
Toluene	µg/kg	1	MCERTS	< 1.0	18	< 1.0	< 1.0	< 1.0
Ethylbenzene	µg/kg	1	MCERTS	< 1.0	170	< 1.0	< 1.0	< 1.0
p & m-xylene	µg/kg	1	MCERTS	< 1.0	680	< 1.0	< 1.0	< 1.0
o-xylene	µg/kg	1	MCERTS	< 1.0	630	< 1.0	< 1.0	< 1.0
MTBE (Methyl Tertiary Butyl Ether)	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0

Petroleum Hydrocarbons

Parameter	Units	Limit of detection	Accreditation Status	830010	830011	830012	830013	830014
TPH-CWG - Aliphatic >EC5 - EC6	mg/kg	0.001	MCERTS	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
TPH-CWG - Aliphatic >EC6 - EC8	mg/kg	0.001	MCERTS	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
TPH-CWG - Aliphatic >EC8 - EC10	mg/kg	0.001	MCERTS	< 0.001	23	< 0.001	< 0.001	< 0.001
TPH-CWG - Aliphatic >EC10 - EC12	mg/kg	1	MCERTS	< 1.0	1500	< 1.0	< 1.0	< 1.0
TPH-CWG - Aliphatic >EC12 - EC16	mg/kg	2	MCERTS	< 2.0	4000	< 2.0	< 2.0	< 2.0
TPH-CWG - Aliphatic >EC16 - EC21	mg/kg	8	MCERTS	< 8.0	16000	< 8.0	< 8.0	< 8.0
TPH-CWG - Aliphatic >EC21 - EC35	mg/kg	8	MCERTS	9.4	38000	< 8.0	14	< 8.0
TPH-CWG - Aliphatic (EC5 - EC35)	mg/kg	10	MCERTS	11	60000	< 10	15	< 10
TPH-CWG - Aromatic >EC5 - EC7	mg/kg	0.001	MCERTS	< 0.001	0.006	< 0.001	< 0.001	< 0.001
TPH-CWG - Aromatic >EC7 - EC8	mg/kg	0.001	MCERTS	< 0.001	0.018	< 0.001	< 0.001	< 0.001
TPH-CWG - Aromatic >EC8 - EC10	mg/kg	0.001	MCERTS	< 0.001	4.5	< 0.001	< 0.001	< 0.001
TPH-CWG - Aromatic >EC10 - EC12	mg/kg	1	MCERTS	< 1.0	620	< 1.0	1.6	< 1.0
TPH-CWG - Aromatic >EC12 - EC16	mg/kg	2	MCERTS	< 2.0	1700	< 2.0	2.8	< 2.0
TPH-CWG - Aromatic >EC16 - EC21	mg/kg	10	MCERTS	< 10	12000	< 10	< 10	< 10
TPH-CWG - Aromatic >EC21 - EC35	mg/kg	10	MCERTS	< 10	37000	26	99	< 10
TPH-CWG - Aromatic (EC5 - EC35)	mg/kg	10	MCERTS	12	51000	36	110	< 10

** pH analysis carried out manually due to high water absorption by the samples.

Analytical Report Number: 17-62717

Project / Site name: Maylands Gateway, Hemel Hempstead

Your Order No: PO10311

Lab Sample Number				830015	830016		
Sample Reference				TPCCL115	TPCCL116		
Sample Number				None Supplied	None Supplied		
Depth (m)				1.50-1.80	0.30-0.60		
Date Sampled				03/10/2017	03/10/2017		
Time Taken				None Supplied	None Supplied		
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status				
Stone Content	%	0.1	NONE	< 0.1	< 0.1		
Moisture Content	%	N/A	NONE	16	18		
Total mass of sample received	kg	0.001	NONE	1.7	1.7		

Asbestos in Soil Screen / Identification Name	Type	N/A	ISO 17025	-	-		
Asbestos in Soil	Type	N/A	ISO 17025	Not-detected	Not-detected		
Asbestos Quantification (Stage 2)	%	0.001	ISO 17025	-	-		
Asbestos Quantification Total	%	0.001	ISO 17025	-	-		

General Inorganics

pH - Manual	pH Units	N/A	MCERTS	-	-		
pH - Automated	pH Units	N/A	MCERTS	7.4	8.0		
Total Cyanide	mg/kg	1	MCERTS	< 1	11		
Total Sulphate as SO ₄	mg/kg	50	MCERTS	390	600		
Water Soluble SO ₄ 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	0.11	0.15		
Sulphide	mg/kg	1	MCERTS	6.6	28		
Total Sulphur	mg/kg	50	MCERTS	320	920		
Total Organic Carbon (TOC)	%	0.1	MCERTS	0.9	1.1		

Total Phenols

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

Speciated PAHs

Naphthalene	mg/kg	0.05	MCERTS	< 0.05	< 0.05		
Acenaphthylene	mg/kg	0.05	MCERTS	< 0.05	< 0.05		
Acenaphthene	mg/kg	0.05	MCERTS	< 0.05	0.32		
Fluorene	mg/kg	0.05	MCERTS	< 0.05	0.15		
Phenanthrene	mg/kg	0.05	MCERTS	< 0.05	0.23		
Anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05		
Fluoranthene	mg/kg	0.05	MCERTS	< 0.05	0.34		
Pyrene	mg/kg	0.05	MCERTS	< 0.05	0.34		
Benzo(a)anthracene	mg/kg	0.05	MCERTS	< 0.05	0.25		
Chrysene	mg/kg	0.05	MCERTS	< 0.05	0.27		
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05		
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05		
Benzo(a)pyrene	mg/kg	0.05	MCERTS	< 0.05	< 0.05		
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	< 0.05	< 0.05		
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05		
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	< 0.05	< 0.05		

Total PAH

Speciated Total EPA-16 PAHs	mg/kg	0.8	MCERTS	< 0.80	1.90		
-----------------------------	-------	-----	--------	--------	------	--	--

Heavy Metals / Metalloids

Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	9.4	17		
Boron (water soluble)	mg/kg	0.2	MCERTS	0.3	2.0		
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	0.4	0.8		
Chromium (hexavalent)	mg/kg	4	MCERTS	< 4.0	< 4.0		
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	23	39		
Copper (aqua regia extractable)	mg/kg	1	MCERTS	18	35		
Lead (aqua regia extractable)	mg/kg	1	MCERTS	35	49		
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3	< 0.3		
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	21	26		
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0	< 1.0		
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	59	76		

Analytical Report Number: 17-62717

Project / Site name: Maylands Gateway, Hemel Hempstead

Your Order No: PO10311

Lab Sample Number	830015			830016				
Sample Reference	TPCCL115			TPCCL116				
Sample Number	None Supplied			None Supplied				
Depth (m)	1.50-1.80			0.30-0.60				
Date Sampled	03/10/2017			03/10/2017				
Time Taken	None Supplied			None Supplied				
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status					

Monoaromatics

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

Petroleum Hydrocarbons

TPH-CWG - Aliphatic >EC5 - EC6	mg/kg	0.001	MCERTS	< 0.001	< 0.001		
TPH-CWG - Aliphatic >EC6 - EC8	mg/kg	0.001	MCERTS	< 0.001	< 0.001		
TPH-CWG - Aliphatic >EC8 - EC10	mg/kg	0.001	MCERTS	< 0.001	< 0.001		
TPH-CWG - Aliphatic >EC10 - EC12	mg/kg	1	MCERTS	< 1.0	< 1.0		
TPH-CWG - Aliphatic >EC12 - EC16	mg/kg	2	MCERTS	< 2.0	11		
TPH-CWG - Aliphatic >EC16 - EC21	mg/kg	8	MCERTS	< 8.0	110		
TPH-CWG - Aliphatic >EC21 - EC35	mg/kg	8	MCERTS	< 8.0	380		
TPH-CWG - Aliphatic (EC5 - EC35)	mg/kg	10	MCERTS	< 10	490		

TPH-CWG - Aromatic >EC5 - EC7	mg/kg	0.001	MCERTS	< 0.001	< 0.001		
TPH-CWG - Aromatic >EC7 - EC8	mg/kg	0.001	MCERTS	< 0.001	< 0.001		
TPH-CWG - Aromatic >EC8 - EC10	mg/kg	0.001	MCERTS	< 0.001	< 0.001		
TPH-CWG - Aromatic >EC10 - EC12	mg/kg	1	MCERTS	< 1.0	< 1.0		
TPH-CWG - Aromatic >EC12 - EC16	mg/kg	2	MCERTS	< 2.0	6.9		
TPH-CWG - Aromatic >EC16 - EC21	mg/kg	10	MCERTS	< 10	74		
TPH-CWG - Aromatic >EC21 - EC35	mg/kg	10	MCERTS	27	300		
TPH-CWG - Aromatic (EC5 - EC35)	mg/kg	10	MCERTS	33	380		

** pH analysis carried out manually due to high water absorption by the samples.



Analytical Report Number: 17-62717
Project / Site name: Maylands Gateway, Hemel Hempstead
Your Order No: PO10311

Certificate of Analysis - Asbestos Quantification

Methods:

Qualitative Analysis

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

Quantitative Analysis

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

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

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

Both Qualitative and Quantitative Analyses are UKAS accredited.

Sample Number	Sample ID	Sample Depth (m)	Sample Weight (g)	Asbestos Containing Material Types Detected (ACM)	PLM Results	Asbestos by hand picking/weighing (%)	Total % Asbestos in Sample
830010	TPCCL112	1.80-2.00	106	Loose Fibres	Amosite	< 0.001	< 0.001

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

Analytical Report Number : 17-62717

Project / Site name: Maylands Gateway, Hemel Hempstead

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

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

Lab Sample Number	Sample Reference	Sample Number	Depth (m)	Sample Description *
830010	TPCCL112	None Supplied	1.80-2.00	Brown clay and sand with vegetation.
830011	TPCCL113	None Supplied	1.40-1.50	Brown clay and sand with gravel and tar.
830012	TPCCL113	None Supplied	2.30-2.50	Brown clay with vegetation.
830013	TPCCL114	None Supplied	0.80-1.00	Light brown clay.
830014	TPCCL115	None Supplied	0.00-0.20	Brown sandy loam with gravel and vegetation.
830015	TPCCL115	None Supplied	1.50-1.80	Brown clay and sand with gravel and vegetation.
830016	TPCCL116	None Supplied	0.30-0.60	Brown clay and sand with gravel.

DRAFT

Analytical Report Number : 17-62717

Project / Site name: Maylands Gateway, Hemel Hempstead

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

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Asbestos identification in soil	Asbestos Identification with the use of polarised light microscopy in conjunction with disperion staining techniques.	In house method based on HSG 248	A001-PL	D	ISO 17025
Asbestos Quantification - Gravimetric	Asbestos quantification by gravimetric method - in ouse method based on references.	HSE Report No: 83/1996, HSG 248, HSG 264 & SCA Blue Book (draft).	A006-PL	D	ISO 17025
Boron, water soluble, in soil	Determination of water soluble boron in soil by hot water extract followed by ICP-OES.	In-house method based on Second Site Properties version 3	L038-PL	D	MCERTS
BTEX and MTBE in soil (Monoaromatics)	Determination of BTEX in soil by headspace GC-MS.	In-house method based on USEPA8260	L073B-PL	W	MCERTS
D.O. for Gravimetric Quant if Screen/ID positive	Dependent option for Gravimetric Quant if Screen/ID positive scheduled.	In house asbestos methods A001 & A006.	A006-PL	D	NONE
Hexavalent chromium in soil	Determination of hexavalent chromium in soil by extraction in water then by acidification, addition of 1,5 diphenylcarbazine followed by colorimetry.	In-house method	L080-PL	W	MCERTS
Metals in soil by ICP-OES	Determination of metals in soil by aqua-regia digestion followed by ICP-OES.	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil.	L038-PL	D	MCERTS
Moisture Content	Moisture content, determined gravimetrically.	In-house method based on BS1377 Part 2, 1990, Chemical and Electrochemical Tests	L019-UK/PL	W	NONE
Monohydric phenols in soil	Determination of phenols in soil by extraction with sodium hydroxide followed by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (skalar)	L080-PL	W	MCERTS
pH in soil	Determination of pH in soil by addition of water followed by electrometric measurement.	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests	L005-PL	W	MCERTS
pH in soil (automated)	Determination of pH in soil by addition of water followed by automated electrometric measurement.	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests	L099-PL	D	MCERTS
Speciated EPA-16 PAHs in soil	Determination of PAH compounds in soil by extraction in dichloromethane and hexane followed by GC-MS with the use of surrogate and internal standards.	In-house method based on USEPA 8270	L064-PL	D	MCERTS
Stones content of soil	Standard preparation for all samples unless otherwise detailed. Gravimetric determination of stone > 10 mm as % dry weight.	In-house method based on British Standard Methods and MCERTS requirements.	L019-UK/PL	D	NONE
Sulphate, water soluble, in soil (16hr extraction)	Determination of water soluble sulphate by ICP-OES. Results reported directly (leachate equivalent) and corrected for extraction ratio (soil equivalent).	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests, 2:1 water:soil extraction, analysis by ICP-OES.	L038-PL	D	MCERTS
Sulphide in soil	Determination of sulphide in soil by acidification and heating to liberate hydrogen sulphide, trapped in an alkaline solution then assayed by ion selective electrode.	In-house method	L010-PL	D	MCERTS
Total cyanide in soil	Determination of total cyanide by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (Skalar)	L080-PL	W	MCERTS
Total organic carbon (Automated) in soil	Determination of organic matter in soil by oxidising with potassium dichromate followed by titration with iron (II) sulphate.	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests	L009-PL	D	MCERTS

Iss No 17-62717-1 Maylands Gateway, Hemel Hempstead CCL02935

This certificate should not be reproduced, except in full, without the express permission of the laboratory.

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

Page 8 of 9



Analytical Report Number : 17-62717

Project / Site name: Maylands Gateway, Hemel Hempstead

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

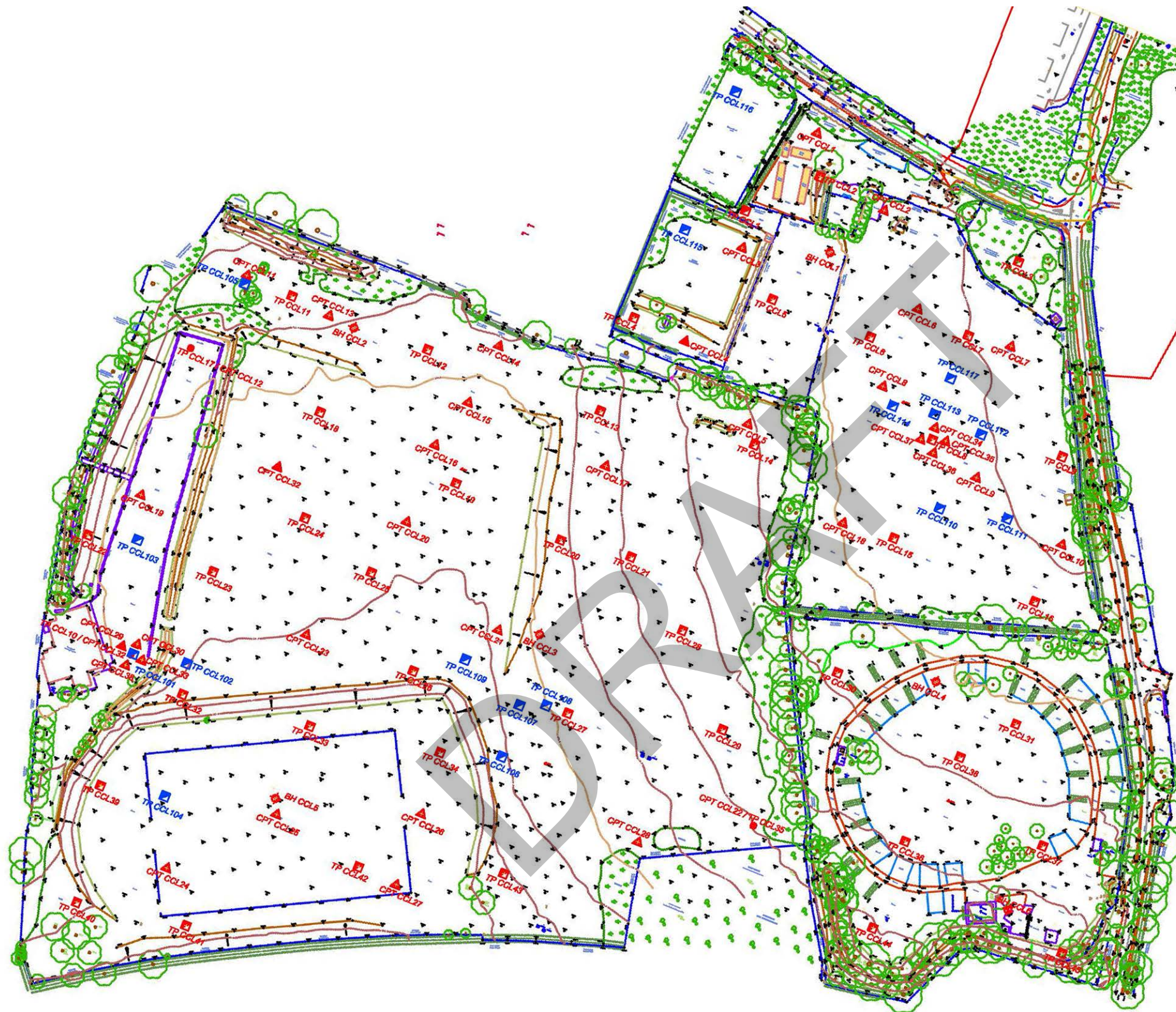
Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Total sulphate (as SO4 in soil)	Determination of total sulphate in soil by extraction with 10% HCl followed by ICP-OES.	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests	L038-PL	D	MCERTS
Total Sulphur in soil	Determination of total sulphur in soil by extraction with aqua-regia, potassium bromide/bromate followed by ICP-OES.	In-house method based on BS1377 Part 3, 1990, and MEWAM 2006 Methods for the Determination of Metals in Soil	L038-PL	D	MCERTS
TPHCWG (Soil)	Determination of hexane extractable hydrocarbons in soil by GC-MS/GC-FID.	In-house method	L088/76-PL	W	MCERTS

For method numbers ending in 'UK' analysis have been carried out in our laboratory in the United Kingdom.

For method numbers ending in 'PL' analysis have been carried out in our laboratory in Poland.

Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC.

DRAFT



KEY:

- ▣ Location of Trial Pits – Crossfield Consulting Limited (March 2017)*
- ⊕ Location of LCP Boreholes – Crossfield Consulting Limited (March 2017)*
- ▲ Location of CPT Boreholes – Crossfield Consulting Limited (March 2017)*
- ▣ Location of Trial Pits – Crossfield Consulting Limited (October 2017)

*Refer to the Supplementary Ground Investigation Report (CCL02935.CD47) for factual records from exploratory holes undertaken in March 2017.

EXPLORATORY HOLE LOCATION PLAN
Scale 1:2000

Plan based on the Topographical Survey drawing by Greenhatch Group, dated January 2016. Drawing No. 22846_T_ Rev. 1

DRAFT

APPENDIX II

APPENDIX II – BASIS OF GEOTECHNICAL ASSESSMENT FOR FOUNDATIONS

Geotechnical Design Category of Structure: 2

Design Working Life: Standard building structure (50 years)

Design Approach: 1

1. Geotechnical Model

Following the earthworks recommended in Section 9 of the Report, the following parameters are considered appropriate for foundation design purposes:

General Description of Strata (and classification)	Parameter	Characteristic Value & Units	Remarks
High strength clay (Engineered Fill)	γ	20 kN/m ³	Based on laboratory test results
	c_u	75 kN/m ²	Minimum required strength
	ϕ_u	0°	
High strength, gravelly silty clay (Clay-with-Flints formation)	γ	20 kN/m ³	Based on site data
	c_u	75 kN/m ²	Based on site data
	ϕ_u	0°	
	Modified PI	40%	High volume-change potential NHBC (2017)
Structureless chalk composed of white silty gravel. Clasts are low density (Upper Chalk: Grade Dc)	N	15	Based on site data
	γ	17 kN/m ³	Based on site description

Characteristic Depth to Groundwater (or groundwater level): >15 m

Reference should be made to Sections 8 of the report for an assessment of overall ground stability, seismic risk, combined failure of the structure/ground, excessive settlements and potential soil-volume changes (including heave).

2. Imposed Actions from Proposed Structure

The following are generic values, based on the development proposed, as described in the report. In compliance with BS EN 1997-1:2004, final designs should include consideration of the calculated imposed loads.

Imposed Load on Foundations: Column loads up to 1350 kN

Imposed Load from Floor Slab: up to 50 kN/m² (time averaged load of 35 kN/m² used for settlement assessments)

Serviceability Limit Values (Columns)

Maximum Total Settlement: 25 mm

Maximum Differential Settlement: 15 mm

Serviceability Limit Values (Floor Slab)

Angular Distortion: 1/500

If loads are significantly different to these stated above, additional assessment will be required.

3. Geometry of Proposed Foundation

Footing Width (assumed for assessment): Up to 3.0 m wide pads

Footing Depth (assumed for assessment): Minimum 1.0 m

4. Shallow Foundations

In assessing the allowable bearing pressures below structural foundations, a number of methods are used, as outlined below.

4.1. Fine Grained Soils

Where the foundations are to be placed on these soils, the ultimate bearing capacity has been estimated using the method proposed by Terzaghi (1943) using total stress parameters. Partial factors have been considered in this assessment, in accordance with BS EN 1997-1:2004 and the relevant National Annex.

The recommended Net Allowable Bearing Pressure is based on a value less than 0.3 times the ultimate bearing capacity and, therefore, the serviceability limit state will be satisfied where imposed serviceability loading is not greater than this value.

4.2. Coarse Grained Soils

Where foundations are to be placed on these soils, the allowable bearing pressure is estimated using the method of Terzaghi and Peck, as modified by Meyerhof (1965). Using this method, total settlements are assumed to be not greater than 25 mm (and a detailed serviceability limit calculation is not necessary).