

# St. Patrick's Hall, University of Reading

## Phase 2 Site Investigation

Curtins Ref: B041466.003/GB/8133

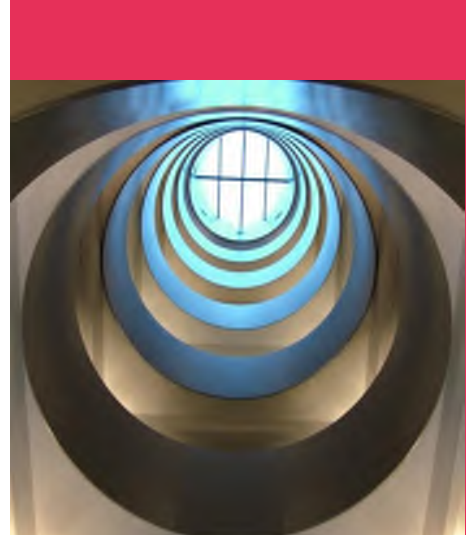
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Issue Date: 03 November 2017

Client Name: University Partnerships Programme

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Site Address: St Patricks Hall, Nourthcourt Avenue, Reading, RG2 7HB



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## **Revised Redevelopment of St Patrick's Hall Summary for Consultant Reports**

This Phase 2 Site Investigation Report (ref. B041466.003/GB/8133) has been prepared in relation to a revised application for the redevelopment of St Patrick's Hall to provide student accommodation and associated ancillary uses. A previous application (Council Planning Ref: 161182) for the redevelopment of the site was withdrawn following the local listing of Pearson's Court within the site. This revised application retains Pearson's Court and redevelops the remainder of the site.

The changes proposed as part of this revised scheme are summarised as follows:

- There is a net reduction in student bed numbers in comparison with the previous submission. The withdrawn application proposed 1024 new student bedspaces and 6 no. three bedroom flats for families, resulting in a net increase of 726 bedspaces. The revised application provides 884 new bedspaces and would retain 116 existing bedspaces within Pearson's Court. This results in a net increase of 702 bedspaces at the site.
- The demolition of the original Pearson's Court building no longer forms part of the plans for redevelopment.
- The Sets building to the south of the Pearson's courtyard will be removed and replaced with new, high-quality accommodation, this element of the scheme has been redesigned to complement the retained courtyard.
- The proposed new courtyard to the north of the site, has increased in massing to accommodate the need for student accommodation while retaining the locally listed Pearson's Court.
- The two low-rise buildings previously proposed in the southern part of the site have been removed in response to concerns raised regarding the proximity of the buildings to the nearby house.
- New low rise accommodation is proposed set further back from the southern boundary and deeper into the site to mitigate proximity to the neighbours.
- New accommodation is now proposed above the catering Hub building and to the centre of the site.
- The Social facilities including the bar, café and dining facilities will be located in the centre of the site away from the southern boundary.
- The Combined Heat and Power (CHP) energy centre has been relocated to the centre of the site away from the southern boundary.

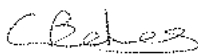
- Warden accommodation will be provided within the existing accommodation on the southern boundary and an updated Student Management Plan have been introduced as part of the revised application.

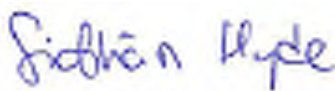
An executive summary detailing the main findings of the Phase 2 Report is presented below.

## Phase 2 Site Investigation

| Rev | Description                        | Issued by | Checked | Date             |
|-----|------------------------------------|-----------|---------|------------------|
| -   | Phase 2 Site Investigation         | GB        | SH      | 28 October 2016  |
| A   | Updated proposed development plans | DM        | GB      | 03 November 2017 |

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## Executive Summary

| Heading                                 | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|-----------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Site Details</b>                     | National Grid Reference 472690, 171750 with an area of 3.83ha.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Current Setting</b>                  | The site is currently an active part of the University of Reading, containing a mixture of student accommodation and educational buildings.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Development Proposals</b>            | It is understood that the development proposals comprise a new development consisting primarily of student accommodation buildings including a series of 4-6 storey blocks and 2.5-4 storey townhouses together with associated car parking and landscaping.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Site History</b>                     | The earliest available historical mapping shows the site as undeveloped, with residential dwelling occupying the northern area by 1912. Mapping dated 1932 shows residential area in the north and St Patricks Hall in the centre of the site. By the 1970s, a number of other University buildings also occupy the site with an electrical substation towards the northern part of the site. Further development occurs in the western part of the site in the 1990s, with the remainder of the site unchanged.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Fieldworks</b>                       | The intrusive investigation was undertaken in August 2016 and comprised 7 cable percussion boreholes (BH1-BH7), 10 window sample boreholes (WS1-WS10), 3 trial pits to undertake infiltration tests (TP1-TP3) and 9 in-situ plate load tests.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Ground Conditions</b>                | Made Ground/Possible Made Ground was encountered at all exploratory hole locations between 0.30m and 1.6m. Made Ground was underlain by the Boyn Hill Gravel Member to proven depths of between 3.20m and 5.50m; overlying the London Clay Formation to proven depths of between 14.90m and 19.60m bgl. This was further underlain by material interpreted as the Lambeth Group to the full depth of the investigation at 23.00m bgl.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Contamination</b>                    | With respect to the proposed end use of the site, ' <i>Residential without the Consumption of Produce</i> ' thresholds have been used as a conservative assessment.<br>One isolated exceedance of Arsenic was recorded in the Made Ground soils. However, the exceedance location and majority of the site will be occupied by buildings and hardstanding, therefore the risk to end users of the site posed by the shallow soils is currently considered <b>Low</b> and no specific remediation measures are recommended.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Controlled Waters</b>                | Five water samples were obtained from the boreholes with only two slightly elevated levels of Zinc recorded above EQS threshold levels. Considering the low level of contaminants detected, the risk to the underlying Secondary A aquifer and the nearest surface water feature is considered to be <b>Low</b> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Ground Gases</b>                     | Gas monitoring has been undertaken on two occasions to date and is on-going with a further four visits to be completed. The monitoring results recorded to date indicate CS1 gas regime requiring no gas protection measures. However final reporting of the monitoring visits will be undertaken when the monitoring regime is complete, with final risk assessments and recommendations made in the addendum report.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Preliminary Waste Classification</b> | The initial assessment revealed that of the twenty-nine soils tested, these soils have indicated to be non-hazardous waste for off-site disposal.<br>The Contractors should satisfy themselves regarding the classification of any waste arisings. Confirmation of acceptability should be sought from receiving landfill or treatment facility via the issue of laboratory chemical testing results.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Foundation Design</b>                | It is recommended that conventional shallow spread footings should be taken through any Made Ground and Possible Made Ground, and placed in the underlying natural strata (between 0.90m bgl and 1.60m bgl). Assuming a 0.60m wide strip foundation for the low rise and a 1m wide pad foundation for the multi-storey structures, shallow foundations placed in the clay deposits of the Boyn Hill Gravel Member may be designed to an allowable bearing pressure of 150kPa, which would provide an adequate factor of safety against shear failure.<br>Alternatively, where clay deposits of the Boyn Hill Gravel Member are absent and granular deposits of the Boyn Hill Gravel Member are proven at a shallow depth, foundations may be placed directly, or extended where practical, onto this material.<br>However, where clay deposits of the Boyn Hill Gravel Member are encountered within the same building footprint of any proposed structure, the more conservative allowable bearing pressure as indicated for the clay deposits should be adopted. |

| Heading                 | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|-------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Ground Floor Slabs      | <p>It is recommended that outside the zone of influence of trees, consideration is given to constructing the ground floor slab on formation prepared in the Made Ground. Any soft or deleterious material should be removed and replaced with properly compacted granular fill.</p> <p>However, due to the cohesive deposits of the Made Ground encountered in boreholes 4, 6 and trial pit TP3 and the variable clay deposits of the Boyn Hill Gravel Member across the site, when within the zone of influence of trees, consideration may wish to be given to suspending ground floor slabs over a void, in general accordance with NHBC guidelines.</p> |
| Excavations             | <p>Possible Made Ground and the granular beds of the Boyn Hill Gravel Member are unlikely to be stable in the short term.</p> <p>Groundwater, associated with the Boyn Hill Gravel Member, should be expected in shallow excavations for foundations or services, and seepages, associated with the claystone beds in the London Clay, should be anticipated</p>                                                                                                                                                                                                                                                                                            |
| Concrete Classification | <p>On the basis of the laboratory test results it is considered that a Design Sulphate Class for concrete located in the Made Ground/Possible Made Ground may be taken as DS-1. The site conditions would suggest that an ACEC class for the site of AC-1 would be appropriate.</p> <p>For concrete placed in the Boyn Hill Gravel Member a Design Sulphate Class of DS-1 may be taken, with an ACEC class of AC-2z.</p> <p>Should piles be adopted a Design Sulphate Class of DS-1 for the London Clay and DS-2 for the Lambeth Group, with an ACEC class of AC-1s would be appropriate.</p>                                                               |

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**Appendix A2 – Exploratory Borehole Logs, Trial Pits Logs and Photographs**

**Appendix A3 – Soakaway Results**

**Appendix A4 – Geotechnical Test Results**

**Appendix A5 – Chemical Laboratory Test Results**

**Appendix A6 – Gas Monitoring Results**

**Appendix A7 – Tier 1 Thresholds**

**Appendix A8 – Qualitative/Quantitative Risk Assessment Rationale**

## 1.0 Introduction

### 1.1 Project Background

In June 2016 Curtins were instructed by the University Partnership Programme (UPP) to undertake a Phase 2 Intrusive Geo-Environmental Investigation within the St Patricks Hall Campus at the University of Reading.

In November 2017 Curtins were instructed to amend this document in line with an alteration to the original proposals. These proposals involve the retention of Pearsons court which has recently been designated a locally listed building and reduction in the scale of development along the southern boundary in order to reduce the impact on nearby houses. There will be increased massing of development in other areas of the site to retain the number of student beds. These revised proposals are summarised on the insert at the beginning of this document.

The site is centred on national grid reference, 472690, 171750 with an area of 3.83ha. A location plan can be referred to in Appendix A1.

### 1.2 Development Proposals

The site is currently an active part of the University of Reading, containing a mixture of student accommodation and educational buildings.

It is understood that the development proposals comprise a new development consisting primarily of student accommodation buildings including a series of 4-6 storey blocks and 2.5-4 storey townhouses together with associated car parking and landscaping.

A proposed development plan is shown in Appendix A1.

### 1.3 Scope of Works

A Phase 1 Preliminary Site Assessment was undertaken principally to provide an overview of the geo-environmental setting of the site of interest with a brief assessment of any risks that could be presented to site users and the wider environment.

The Phase 2 Ground Investigation was undertaken in order to provide an assessment of the ground conditions on the subject site with respect to geotechnical properties and any potential contamination in the underlying soils and or groundwater and to confirm the geo-environmental conceptual model and associated risk determined in the Preliminary Site Assessment undertaken by Curtins in October 2015.

Specifically, the Phase 2 report is intended to determine,

- a) If there is a risk of the proposed end user being adversely impacted upon by potential contamination in shallow site soils that may be present on the site due to its known current, recent and historical use
- b) Undertake an initial assessment with respect to the significant risk of pollution to groundwater and or surface water from potential contamination that maybe present on the site due to its known historical use.
- c) If there is a risk to the end user from landfill type gases that could potentially accumulate under the proposed buildings.
- d) Recommendations for the design of foundations and building ground floor slabs.
- e) Recommendations for the specification of sub-structure concrete.

## 2.0 Summary of Phase 1 Desk Study

This section of the report presents a summary of Curtins Phase 1 Preliminary Site Assessment Curtins Ref: EB1834/GL/5073 Issue Date: 2 October 2015.

### 2.1 Site History

**Table 2.1** Previous Site Uses and Potential Sources of Contamination

| Date                         | Scale    | Description                                                                                                                                                                                                                                                                                                          |
|------------------------------|----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>1:10,560 and 1:10,000</b> |          |                                                                                                                                                                                                                                                                                                                      |
| 1883                         | 1:10,560 | The site is occupied by field and farmland only with sparse woodland to the northern corner.<br><br>The surrounding area is devolved to the north with residential and commercial dwellings located circa 200-100m from the site. Adjacent north west of the site is Whitley Park Farm.                              |
| 1900                         | 1:10,560 | The site remains the same as the previous historical map.<br><br>North east approximately 600m from the site illustrates heavy development of residential housing.                                                                                                                                                   |
| 1901                         | 1:10,560 | The site remains the same as the previous historical map.<br><br>The surrounding site remains the same as the previous historical map.                                                                                                                                                                               |
| 1913                         | 1:10,560 | The site is now occupied by a few small buildings to the north of the site.<br><br>The surrounding area continues to be developed in all northern areas from the sites boundary.                                                                                                                                     |
| 1933                         | 1:10,560 | The site is now occupied by St Patricks Hall which covers the majority of the site.<br><br>The surrounding areas in all compass directions illustrate continuous development. The most significant being adjacent east of the site and to the south where a number of residential buildings have now been developed. |
| 1938                         | 1:10,560 | The site remains the same as the previous historical map.<br><br>There are no significant changes illustrated apart from development in existing built up areas continues.                                                                                                                                           |
| 1948                         | 1:10,560 | The site and surrounding area remains predominantly the same as the previous historical map.                                                                                                                                                                                                                         |
| 1962                         | 1:10,000 | The site and surrounding area remains predominantly the same as the previous historical map.                                                                                                                                                                                                                         |
| 1973                         | 1:10,000 | The site now illustrates a new building located to the north of the site.<br><br>West of the site now illustrates more housing development.                                                                                                                                                                          |

|                                          |          |                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|------------------------------------------|----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1979                                     | 1:10,000 | The site and surrounding area remains predominantly the same as the previous historical map with only slight development to existing areas surrounding the site.                                                                                                                                                                                                                                                                                          |
| 1990                                     | 1:10,000 | The site remains the same as the previous historical map.<br>The surrounding site remains the same as the previous historical map.                                                                                                                                                                                                                                                                                                                        |
| 1995                                     | 1:10,000 | The site illustrates some development to the western part of the site and the surrounding area remains predominantly the same as the previous historical map.                                                                                                                                                                                                                                                                                             |
| 1999                                     | 1:10,000 | The site and surrounding area remains predominantly the same as the previous historical map.                                                                                                                                                                                                                                                                                                                                                              |
| 2006                                     | 1:10,000 | The site remains the same as the previous historical map.<br>West adjacent to the site boundary illustrates several new buildings possibly associated with the university buildings located on site.                                                                                                                                                                                                                                                      |
| 2015                                     | 1:10,000 | The site and surrounding area remains the same as the previous historical map.                                                                                                                                                                                                                                                                                                                                                                            |
| <b>1:1,250 and 1:2,500 Scale Mapping</b> |          |                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| 1877-1879                                | 1:2,500  | The site is open fields and farmland with some woodland to the northern corner on the sites boundary.<br>The surrounding area is predominantly open field and farmland with sparse woodland. Adjacent north west of the site boundary is Whitley Park Farm. Further north of the site boundary circa 100m is a slightly built up area of residential and commercial buildings. There is a small pond south west adjacent to the site surrounded by trees. |
| 1899                                     | 1:2,500  | The site remains the same as the previous historical map.<br>Allotment Gardens are recorded adjacent east of the site.                                                                                                                                                                                                                                                                                                                                    |
| 1912                                     | 1:2,500  | The site is now occupied by a few residential dwellings to the northern part of the site.<br>The surrounding area to the south east illustrates some development of residential dwellings and also to the north east circa 100m from the site boundary.                                                                                                                                                                                                   |
| 1932                                     | 1:2,500  | The site is now fully occupied with residential to the north and St Patricks Hall central of the site.<br>The surrounding area adjacent east shows significant development of residential dwellings up to 100m and also towards the south up to 150m.                                                                                                                                                                                                     |
| 1958-1959                                | 1:2,500  | The site remains the same as the previous historical map.<br>The surrounding area remains predominantly the same with development continuing to the south of the site.                                                                                                                                                                                                                                                                                    |
| 1958                                     | 1:1,250  | The site remains the same as the previous historical map.                                                                                                                                                                                                                                                                                                                                                                                                 |

|           |         |                                                                                                                                                                                                                                                                                                                                                                     |
|-----------|---------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1959      | 1:2,500 | No tiles are illustrated on the historical map.                                                                                                                                                                                                                                                                                                                     |
| 1969-1972 | 1:1,250 | The site is now completely occupied by St Patricks Hall and several additional University buildings across the site. There is an electrical Substation located towards the northern part of the site.<br>The surrounding area is now heavily developed and illustrates housing and commercial buildings in all surrounding areas from the site boundary up to 200m. |
| 1972-1993 | 1:1,250 | No tiles illustrated on map.                                                                                                                                                                                                                                                                                                                                        |
| 1990      | 1:1,250 | No tiles illustrated on map.                                                                                                                                                                                                                                                                                                                                        |
| 1993      | 1:1,250 | The site and surrounding area remains predominantly the same as the previous historical map.                                                                                                                                                                                                                                                                        |
| 1994-1995 | 1:1,250 | The site now illustrates additional building labelled Sherfield Hall (University Halls) to the western side of the boundary.                                                                                                                                                                                                                                        |
| 1993      | 1:1,250 | The site remains the same as the previous historical map.<br>The surrounding area remains the same as the previous historical map.                                                                                                                                                                                                                                  |

## 2.2 Geology

A study of the Envirocheck records and British Geological Survey (BGS) 1:50,000 mapping records (Bedrock and Superficial Editions) for Reading (Sheet 268) indicates the following geological succession underlying the site.

| Rock Name                                   | Rock Type           | Geological Age     |
|---------------------------------------------|---------------------|--------------------|
| North east corner – Boyn Hill Gravel Member | Sand and Gravel     | Wolstonian Hoxnian |
| London Clay Formation                       | Clay, Silt and Sand | Eocene – Eocene    |

There are no known BGS fault lines located within 1000m of the site boundary.

The Envirocheck Report confirms that there is a low risk to no hazard from the following ground stability hazards on and around the site; running sands, collapsible ground, compressible ground, landslide ground, shrinking or swelling clay and ground dissolution is recorded as a Low to 'no hazard' hazard potential. The Envirocheck Report confirms that the site falls within an intermediate probability radon area, as between 1 and 3% of homes are above the action level. No radon protective measures are necessary in the construction of new dwellings or extensions.

## **2.3 Hydrogeology and Hydrology**

The 1:100,000 Sheet 39 West London Groundwater Vulnerability Map indicates that the site, corresponding with the underlying solid geology, is underlain by Secondary A Aquifer in the superficial deposits in the north corner of the site and an Unproductive Strata in the bedrock aquifer designations.

Secondary Aquifer A are permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers.

Unproductive Strata are rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow.

The site is not situated within a Source Protection Zone (SPZ) or any sensitive land uses.

The nearest surface water feature is a drain or tertiary river, 15m south of the site.

There are no surface water abstractions within a 1000m of the site.

The nearest groundwater abstraction is located 189m east of the site and is located at Whiteknights Park, Reading.

Twelve Local Authority Pollution Prevention and Controls are recorded within a 1000m of the site boundary. The closest to the site is 149m north of the site, at 53 60 Christchurch Road, Reading, RG2 7AZ in November 2011.

Seven Pollution Incidents to Controlled Waters are recorded within a 1000m of the site boundary. The closest incident to the site boundary is 114m south-east of the site in June 1997. The pollutant was chemicals – Unknown and was Category 3 minor incident.

There is no risk from extreme flooding from rivers or sea without defences on the site.

## **2.4 Landfills**

There are no BGS Recorded Landfill Sites located within 1000m of the site.

There is one historical landfill site located 925 west and is located on Craddock Road. Specified waste included Inert and Industrial Waste.

## **2.5 Mining**

The Envirocheck report and Coal Authority Interactive Mapping confirms that the site is not within an area which may be affected by coal mining and as such a Coal Authority report has not been obtained

## **2.6 Unexploded Ordnance (UXO) Risk Assessment**

Risk mapping for UXOs has placed the site within a Moderate risk area.

Moderate-risk regions are those that show a bomb density of between 11 and 50 bombs per 1000 acres and that may contain potential WWII targets. Action to mitigate the risk is considered essential, albeit more likely that a reduced scope of work is required compared with that needed for high-risk regions.

The site has been largely developed since 1913 according to historical mapping.

Historical maps for the site and surrounding area show no evidence of bomb damage.

In light of these findings and in accordance with CIRIA's publication on managing UXO risks, it is recommended that no further action is warranted and a UXO risk assessment will not be required.

## **2.7 Other Significant Features Potentially Affecting Re-Development**

There are no special significant features that may potentially affect the development / re-development of the site.

## 3.0 Preliminary Conceptual Model

The following sub-sections present assessments of the potential sources, pathways and receptors that exist within the site conceptual model.

Potential source-pathway-receptor linkages that may arise are identified in the following section, the Qualitative Risk Assessment.

### 3.1 Potential Sources

- **Made-Ground Soils on site:** deemed likely; there is evidence of historical development and demolition on the site. It should be noted that poorly managed demolition can result in material such as asbestos or heating oil's being present in the sub-soils.

There may be fuel storage tanks or silos on the site associated with the farm buildings or asbestos used in the construction of the older buildings.

The nature and type of contamination may include, amongst others; ash and fill, hydrocarbons (e.g. fuel oils), heavy metals and asbestos.

- **Made-Ground soils off site:** deemed the result of soil exposure to patterns of development and demolition so there is potential for contamination to be present in Made Ground around the site.

Potential contaminants could arise due to geological origin, construction activities, atmospheric deposition and land management. The nature and type of general contamination may include, amongst others; ash and fill, hydrocarbons (e.g. fuel oils, heavy metals and asbestos)

- **Natural Soils both on and off site:** regionally elevated levels of metals may be present within the shallow soils, however the superficial and bedrock deposits beneath the site and within the immediate surrounding area are not considered to present significant sources of natural contamination.
- **Ground Gas Generation:** No operational or historic landfills are recorded within 1000m of the site. There are no records of organic rich drift deposits (e.g. peat) or coal measures.

### 3.2 Potential Pathways

- **Direct contact, ingestion and inhalation** (dust and vapours) may occur where the end user is exposed to; solid, dust or volatile components of Made Ground soils on site.
- **Vertical migration** may occur within the possible Made Ground deposits on site both upwards, due to processes including; capillary action, burrowing animals inducing soil mixing and

downwards into the natural deposits due to processes including; infiltration. Vertical migration of soil gases is identified as a specific pathway. Soil of high leaching potential are indicated as being present on the site, leaving potential for downward migration to controlled waters.

- **Lateral migration** may occur within the Made Ground or natural deposits due to processes including; the influence of perched or natural groundwater flow patterns and natural or man-made high permeability zones, e.g. sand lenses or drainage runs or pores/voids within natural and made-ground soils for soil and mine gases.

### 3.3 Potential Receptors

- **End users** including residents, visitors, maintenance staff and the general public.
- **Controlled waters (Groundwater).** The site is underlain by a Secondary Aquifer - A in the superficial deposits in the north east corner and a Unproductive Strata – in the bedrock aquifer designations

The site is not situated with a Source Protection Zone. The nearest groundwater abstraction is located 189m east of the site and is located at Whiteknights Park, Reading.

- **Controlled waters (Surface water).** The nearest surface water feature is a drain, 15m south of the site

There are no surface water abstractions within 1000m of the site.

- **Construction workers** during development of the site. Whilst unlikely, during the development of the site, construction workers may come into contact with any contamination that is on site. However, wearing the correct personal protective equipment (PPE) will reduce the risk.
- **Construction materials** buried concrete and water supply pipes may be compromised by the potential presence of aggressive ground conditions or contamination.
- **Local ecology** protected species on-site and within local habitats; e.g. woodland, hedgerow, grassland and water.

## 4.0 Phase 2 Investigation Proposal

### 4.1 General

The Phase 1 Preliminary Site Assessment Conceptual Site Model highlighted that there could be a generally **Moderate/Low** level of risk from potential contaminants.

It was recommended that an intrusive investigation is undertaken to confirm the findings of this desk study report.

The risk to the end user from ground gases was determined to be **Moderate/High** due to the severity of the consequence to human health effects from ground gases. Given the longstanding occupation of the site by 'recent' development with no known incidences it is assumed that buildings have working gas protection measures or indeed do not require them; in this case the risk would be reduced to Low. Gas monitoring and assessment were incorporated into any site investigation undertaken.

The risk to surface and groundwater has been assessed as **Low/Moderate** but assessment would likely only be required during future development. There is a risk albeit considered to be low that local remedial treatment could be required during future development.

It is understood that the development proposals comprise a new development consisting primarily of student accommodation buildings including a series of 4-5 storey blocks and 2 storey townhouses together with associated car parking and landscaping.

A strategy for the Phase 2 intrusive investigation was derived accordingly and also incorporated the contractor's requirements and comprised the following operations:

- Advancement, logging and sampling of representative soils in seven cable percussive boreholes to depths up to 25m
- Advancement, logging and sampling of representative soils in five window sample boreholes to depths up to 5m
- Insitu plate testing to advise hardstanding and pavement design.
- Environmental chemistry analysis for a suite of determinands reflecting the known use of the site on a number of samples representative of the made-ground and natural materials encountered.
- Geo-technical analysis of a number of samples to enable foundation assessment to be made.
- Soakaway testing to inform drainage design.
- Groundwater/gas monitoring / sampling of the installed boreholes.

## 5.0 Fieldwork

### 5.1 General

A geotechnical and geo-environmental site investigation was carried out between the 15<sup>th</sup> and 22<sup>nd</sup> August 2016.

The fieldworks were undertaken and supervised by Ian Farmer Associates Limited. The site work has been carried out on the basis of the practices set out in BS 5930:1999 and BS EN 1997-2:2007

Seven boreholes, designated BH1 to BH7, were sunk by light cable percussion method, ten boreholes, designated WS1 to WS10, were undertaken by percussive window sampler technique and three trial pits for the purpose of undertaking infiltration tests, designated TP1 to TP3, were dug by mechanical excavator at the positions shown on the exploratory hole location plan, Appendix A1.

The depths of boreholes and trial pits, descriptions of strata encountered and comments on groundwater conditions are given in the borehole and trial pit records, Appendix A2,

Representative disturbed and undisturbed samples were taken at the depths shown on the borehole and trial pit records and despatched to the laboratory. Standard (splitbarrel and cone) penetration tests were carried out in the boreholes in the various strata to assess the relative density or consistency. The values of penetration resistance are given in the borehole records.

Samples for environmental purposes were collected in amber glass jars and dispatched, under instruction from the client, to Scientific Analysis Laboratories for testing.

Infiltration tests were carried out in the trial pits, in line with guidelines given in BRE Digest 365. The results are included in Appendix A3.

In-situ plate bearing tests were undertaken at nine locations as indicated on the exploratory hole location plan and the results included in Appendix A4.

Gas and groundwater monitoring standpipes were installed in selected boreholes as detailed in the relevant borehole logs.

Initial groundwater and gas monitoring visits were made on the 25 August and 29 September 2016.

## 6.0 Laboratory Testing

### 6.1 Environmental Chemistry Testing

A programme of environmental chemistry testing was scheduled reflecting the findings of the desk study and on-site observations.

The sampling positions were targeted where required based on the Phase 1 Preliminary Site Assessment of the site accounting for the historical site use, proposed end use and the immediate environmental setting.

#### 6.1.1 Soil Analysis

The nature and type of soil contamination potentially present on the site was considered to include amongst others; organic matter, ash and fill, hydrocarbons (e.g. fuel oils), heavy metals and asbestos the extent of which is captured by the broad environmental testing suite listed in Table 6.1.1 below.

**Table 6.1.1** Environmental Chemistry Analysis Suite: Soils

| Suite Ref | Analysis                          | LOD                     | Suite Ref | Analysis                          | LOD                     |
|-----------|-----------------------------------|-------------------------|-----------|-----------------------------------|-------------------------|
| A         | Asbestos Screen                   |                         | B         | pH                                |                         |
|           | pH                                |                         |           | Soil Organic Matter               |                         |
|           | Soil Organic Matter               |                         |           | Arsenic                           | 5 mg/kg                 |
|           | Arsenic                           | 5 mg/kg                 |           | Boron (water soluble)             | 1 mg/kg                 |
|           | Boron (water soluble)             | 1 mg/kg                 |           | Cadmium                           | 0.5 mg/kg               |
|           | Cadmium                           | 0.5 mg/kg               |           | Chromium                          | 5 mg/kg                 |
|           | Chromium                          | 5 mg/kg                 |           | Chromium VI                       | 5 mg/kg                 |
|           | Chromium VI                       | 5 mg/kg                 |           | Copper                            | 5 mg/kg                 |
|           | Copper                            | 5 mg/kg                 |           | Lead                              | 5 mg/kg                 |
|           | Lead                              | 5 mg/kg                 |           | Mercury                           | 0.1 mg/kg               |
|           | Mercury                           | 0.1 mg/kg               |           | Nickel                            | 5 mg/kg                 |
|           | Nickel                            | 5 mg/kg                 |           | Selenium                          | 5 mg/kg                 |
|           | Selenium                          | 5 mg/kg                 |           | Zinc                              | 5 mg/kg                 |
|           | Zinc                              | 5 mg/kg                 |           | Cyanide (total)                   | 10 mg/kg                |
|           | Cyanide (total)                   | 10 mg/kg                |           | Sulphate (total)                  | 200 mg/kg               |
|           | Sulphate (total)                  | 200 mg/kg               |           | Sulphide                          | 2 mg/kg                 |
|           | Sulphide                          | 2 mg/kg                 |           | Sulphur (elemental)               | 20 mg/kg                |
|           | Sulphur (elemental)               | 20 mg/kg                |           | Phenols (screen)                  | 1 mg/kg                 |
|           | Phenols (screen)                  | 1 mg/kg                 |           | PAH's (USEPA16)                   | 0.1 mg/kg               |
|           | PAH's (USEPA16)                   | 0.1 mg/kg               |           | TPH (CWG Banding - Aro/Ali Split) | 0.01 mg/kg to 0.1 mg/kg |
|           | TPH (CWG Banding - Aro/Ali Split) | 0.01 mg/kg to 0.1 mg/kg |           |                                   |                         |

Nineteen soil samples taken from across the site were tested for Suite A (shallow samples) and ten samples were tested for Suite B (natural soils).

The laboratory test results of the environmental chemistry analyses can be referred to in Appendix A5 of this report.

### 6.1.2 Groundwater Analysis

Water samples were retrieved on a subsequent visit to the site from boreholes BH01, BH02, BH03, BH04 and BH07. The other boreholes did not produce enough water volume for a sample to be obtained.

All samples were tested for a range of contaminants as detailed in Table 6.1.2 below.

**Table 6.1.2:** Environmental Chemistry Analysis Suite: Water

| Suite Ref | Analysis                            | LOD      |
|-----------|-------------------------------------|----------|
| Water     | pH                                  |          |
|           | Total hardness (CaCO <sub>3</sub> ) | 1mg/l    |
|           | Arsenic                             | 1µg/l    |
|           | Boron (water soluble)               | 0.1mg/l  |
|           | Cadmium                             | 0.5µg/l  |
|           | Chromium                            | 0.1µg/l  |
|           | Copper                              | 0.1µg/l  |
|           | Lead                                | 1µg/l    |
|           | Mercury                             | 0.1µg/l  |
|           | Nickel                              | 1µg/l    |
|           | Selenium                            | 1µg/l    |
|           | Zinc                                | 1µg/l    |
|           | Cyanide (total)                     | 0.2mg/l  |
|           | Sulphate (total)                    | 10mg/l   |
|           | Sulphide                            | 0.2mg/l  |
|           | Phenols                             | 0.1mg/l  |
|           | PAH's (USEPA16)                     | 0.01µg/l |
|           | TPH (CWG Banding - Aro/Alk Split)   | 10µg/l   |

## 6.2 Geotechnical Testing

The suite of geotechnical analyses has been scheduled by Ian Farmers based upon the ground conditions encountered during site work and the proposed development end use.

All soil samples were prepared in accordance with BS1377: Part One: 1990 and representative sub-samples were taken for testing. The following tests were carried out:

- 10 No. Water Content Tests
- 13 No. Plasticity Index Tests
- 4 No. Particle Size Distributions (by Wet Sieving)
- 6 No. Particle Size Distributions (by Wet Sieving and Pipette Analysis)
- 34 No. Quick Undrained Single-stage Triaxial Tests
- 11 No. pH Values
- 11 No. Sulphate Contents (Water Soluble)
- 9 No. Special Digest 1 Test Suites

The laboratory test results of the geotechnical analyses can be referred to in Appendix A4 of this report.

## 7.0 Ground Conditions

The sequence of the strata encountered during the investigation generally confirms the anticipated geology as interpreted from the geological map, with superficial deposits of the Boyn Hill Gravel Member proven to underlie the entire site.

Interpolation of strata depths between locations should be undertaken with caution, particularly for depths of Made Ground where structures were still present at the time of the investigation.

The sequence and indicative thicknesses of strata are provided below:

**Table 7.0:** Strata Summary

| Strata Encountered                                  | Depth Encountered (m) |             | Strata Thickness (m) |
|-----------------------------------------------------|-----------------------|-------------|----------------------|
|                                                     | From                  | To          |                      |
| Made Ground/Possible Made Ground                    | 0.00                  | 0.30-1.60   | 0.30-1.60            |
| Boyn Hill Gravel Member                             | 0.30-1.60             | 3.20-5.50   | 2.06-4.85            |
| London Clay Formation                               | 3.20-5.50             | 14.90-19.60 | 10.65-14.50          |
| Lambeth Group (Woolwich Formation – Laminated Beds) | 14.90-19.60           | >23.00      | >5.10                |

### 7.1 Made Ground

Made Ground was encountered in all of the exploratory locations to proven depths of between 0.30m and 1.60m, and at an average of 0.66m below ground level (bgl).

This generally comprised in the majority of the locations of brown, orange brown gravelly silty slightly clayey to clayey fine and medium sand, and in boreholes 4 and 6, and trial pit 3 comprised firm friable dark brown, brown gravelly sandy to very sandy silty clay. In borehole WS8 this material was underlain by a fabric damp proof membrane.

Varying proportions of anthropogenic materials were encountered within this stratum including clinker, brick, concrete, wood, and glass fragments. Rare to occasional roots and rootlets were also observed within this stratum, and in borehole 3 pockets of firm friable dark brown and orange brown very gravelly very sandy clay were proven.

The Made Ground was overlain in boreholes 1, 2, 3, 5 and 7 by a 0.15m or 0.20m thick layer of topsoil, and in borehole WS8 overlain by a hardstanding of concrete cobbles, over a sub-base of light brown fine to coarse sand to 0.21m bgl.

Possible Made Ground was encountered beneath the Made Ground in borehole 6 to a proven depth at 1.60m bgl and comprised firm to stiff orange brown, dark brown and occasionally light grey slightly gravelly sandy clay.

## **7.2 Boyn Hill Gravel Member**

Material indicative of the Boyn Hill Gravel Member underlay the Possible Made Ground in borehole 6 and the Made Ground in the remaining exploratory locations to proven depths of between 3.20m and 5.50m bgl.

These deposits typically comprised medium dense to dense brown, orange brown very sandy silty slightly clayey to clayey medium and coarse angular to rounded gravel of flint, and medium dense to dense brown, orange brown gravelly slightly silty to silty slightly clayey to clayey fine to coarse sand with varying proportions of clay pockets.

In boreholes BH1, BH4, BH5, BH7, WS7 and WS9 this was overlain by a clay bed to proven depths of between 1.20m and 3.15m bgl, and was generally described as firm to stiff, becoming soft in borehole BH7, orange brown and light grey mottled, occasionally gravelly, sandy clay with occasional becoming rare roots and rootlets in BH7.

In boreholes WS4 and WS10 the gravel bed was absent, and as such, the clay bed extended from the base of the Made Ground to the full depth of the boreholes at 1.63m and 2.45m bgl respectively.

Further, window sampler boreholes WS1, WS2, WS3, WS5, WS6, WS9, and the trial pits were terminated in the Boyn Hill Gravel Member at depths of between 1.65m and 4.45m bgl.

## **7.3 London Clay Formation**

Deposits of the London Clay Formation were encountered below the Boyn Hill Gravel Member to proven depths in the cable percussion boreholes of between 14.90m and 19.60m bgl.

The stratum generally comprised unweathered stiff to very stiff, firm in boreholes WS7 and WS8, and extremely closely fissured and thinly laminated in the cable percussion boreholes, dark grey clay with rare to occasional pockets and lenses of light grey fine sand and shell fragments, and rare iron pyrite nodules.

Beds of claystone, 0.10m and 0.35m thick, were noted at depths of 7.10m in boreholes 3 and 6, 7.20m in borehole 4, and 17.55m in borehole 7.

The top 0.20m to 0.50m of the stratum was noted as being partially weathered, to depths of some 4.50m to 5.90m bgl, comprising firm to very stiff orange brown occasionally dark grey and light grey mottled clay with varying proportions of black kerogen staining.

In boreholes 6, WS7 and WS8 the partially weathered material appeared to be absent.

Window sampler boreholes WS7 and WS8 were terminated in the unweathered deposits at depths of 5.45m and 4.45m bgl respectively.

#### **7.4 Lambeth Group (Woolwich Formation – Laminated Beds)**

Material interpreted as the Laminated Beds of the Woolwich Formation underlay the London Clay Formation in the cable percussions boreholes to the full depth of the investigation at 23.00m bgl.

This unit generally consisted of stiff to very stiff, becoming firm to stiff friable, dark grey/dark green sandy silty clay with rare to occasional shell fragments, rare iron pyrite nodules in borehole 6 and rare lignite nodules in borehole 7.

Borehole 5 was terminated in a siltstone/claystone bed at a depth of 23.00m bgl.

#### **7.5 Groundwater**

Groundwater, associated with the Boyn Hill Gravel Member was encountered at depths of between 2.60m and 5.70m bgl in each of the cable percussion boreholes and in window sampler borehole WS8, rising to depths of between 2.55m and 5.55m in the cable percussion boreholes within a twenty-minute period.

## 8.0 Geochemical Ground and Groundwater Assessment

### 8.1 Overall Assessment

This section of the report includes the assessment of the potential contamination, solid, liquid and gas, identified on the subject site which may present a risk to the proposed end users, associated utilities and the wider environment.

In guidance published by the Environment Agency, the risk to human health or controlled waters is determined through an assessment of pollutant linkages between a source of contamination (within the ground or groundwater either on or off site) and a sensitive receptor such as end users of the site, building materials, edible plants grown in gardens or groundwater abstracted for drinking. This is termed a source-pathway-receptor relationship. The same model is applied to the assessment of risk arising from ground gases as detailed within BS8576:2013

These models have a common approach, which is one of a tiered assessment. At each stage of the assessment further detail can be applied to the conceptual site model to provide a detailed interpretation on a site by site basis. As part of the planning process this approach is adopted in order to establish either if the site is 'suitable for use' or whether additional work or else remedial work is required in order for the site to be deemed so.

The sub-sections hereafter therefore incorporate the first tier (Tier 1) of this approach otherwise referred to as the Generic Quantitative Risk Assessment (GQRA). The GQRA builds on the qualitative risk assessment presented in the Phase 1 Desk Study in conjunction with observations made during the ground investigation and is based solely on the results of the chemical and other testing data obtained as part of Curtins ground investigation. The GQRA is used to build/refine the Conceptual Site Model (CSM) for the site as detailed and presented in Section 8.0 of this report.

The following sections present more detail on the risk assessment methodology rationale for the main receptors.

#### Human Health Generic Quantitative Risk Assessment

Detailed guidance on human health risk assessment is available within a number of documents, published by both the Environment Agency and Defra. Guidance includes Contaminated Land Exposure Assessment (CLEA) v1.06 model (Science Report 2) and Science Report 3.

A generic quantitative risk assessment (GQRA) has been carried out for the Potential Contaminant Linkages (PCLs) investigated by screening of soil contamination data against relevant Generic Assessment Criteria (GAC) where available, including:

- i) **Soil Guideline Values (SGVs):** These have been published by the Environment Agency and are trigger values for screening out low risk areas of land contamination. SGV's give an indication of representative average concentrations of chemicals in soil, below which long-term health risks are likely to be minimal. SGVs have been published for a number of contaminants including arsenic, cadmium, mercury, nickel, selenium, BTEX, phenols and dioxins, furans and dioxin-like PCB substances for land uses including residential, allotments and commercial. The SGVs have been developed for a sandy loam soil with 6% soil organic matter (SOM) content;
- ii) **Supplementary Screening Values:** In addition to the SGVs developed by the EA other third party organisations have derived GACs for a wider range of contaminants and land uses using the CLEA Model. Curtins have adopted these numbers where applicable, including those developed by Atkins AtriskSoil™, the LQM/CIEH Suitable for Use Levels (S4UL) and EIC/AGS/CL:AIRE published thresholds.
- iii) **Category 4 Screening Levels (C4SLs):** In March 2014 Defra published C4SLs for arsenic, benzene, benzo(a)pyrene, cadmium, hexavalent chromium and lead. These values were derived to support the revised Part 2A Statutory Guidance issued in 2012 in which four categories of contaminated land are included, ranging from Category 1 (significant/high risk) to Category 4 (low risk). C4SLs are not representative of significant possibility of significant harm (SPoSH) and are low risk levels which, and therefore where the C4SLs are not exceeded, land can be demonstrated to be in Category 4 and cannot be determined as contaminated land.

The proposed use of the site, noted as educational with student accommodation; is considered to be most analogous with a Residential without the Consumption of Produce end-use scenario and so assessment has been undertaken against;

- *'Residential without the Consumption of Produce'* Tier 1 thresholds (SGVs & GACs) for contaminants of concern where Category 4 Screening Levels are not available.
- *'Residential without the Consumption of Produce'* Category 4 Screening Levels where available.

Details of the GAC's adopted for the GQRA are provided in Appendix A7.

## 8.2 Site Soils

As discussed previously, representative samples of the site soils were taken from the exploratory holes across the site.

The results of the environmental testing can be referred to in Appendix A5. Copies of the Tier 1 thresholds are contained within Appendix A7.

Soil organic matter (SOM) has a strong bearing on the availability of potential contaminants and therefore influences the Tier 1 thresholds. The average soil organic matter (SOM) values for the shallow site soils across the development site is less than 6% one of the broadly modelled SOM percentages, and therefore for comparison against Tier 1 thresholds a conservative SOM of 1.0% has been adopted.

With respect to the proposed end use of the site Tier 1 thresholds have been exceeded in the following locations on-site within the shallow site soils.

**Table 8.2** Location of exceeded Tier 1 Thresholds for 'Residential without consumption of produce' end use.

| Location | Depth (m) | Strata      | Contaminant | Conc'n (mg/kg) | 1% SOM Tier 1 (mg/kg) |
|----------|-----------|-------------|-------------|----------------|-----------------------|
| WS3      | 0.3       | Made Ground | Arsenic     | 52             | 35                    |

### 8.2.1 Inorganics

- Arsenic

A slightly elevated level of Arsenic was observed above Tier 1 thresholds at a concentration which could present a risk to the proposed end user by direct contact and ingestion in one location within the Made Ground at a depth of 0.3m bgl. Analysis of a deeper soil sample at 1.00m depth in the natural strata recorded a lower concentration of arsenic of 25mg/kg.

The location of the exceedance in WS3 will be beneath a building in the final development thereby breaking any pathway to end users of the site.

### 8.2.2 Waste Classification

An initial assessment for the waste classification of the shallow soils encountered on site has been carried out using the Waste Soils Characterisation Assessment Tool, Cat-WasteSoil, developed by McArdle and Atkins. This online tool gives a rapid assessment of contaminated soils and their classification as either hazardous or non-hazardous waste.

The twenty nine Made Ground and natural samples collected have been entered into the Cat-WasteSoil tool, resulting in an initial classification of the shallow soil samples as non-hazardous waste.

Preliminary waste classification is undertaken to offer indicative advice with respect to disposal requirements. Landfill operators are not obliged to accept waste and, if they were to do so, may have

specific requirements beyond those outlined above prior to acceptance such as Waste Acceptance Criteria (WAC) Testing. Landfill operators should be contacted to confirm the above classifications or otherwise

### 8.2.3 Water Supply Pipes

No elevated concentrations of contamination with respect to the protection of water supply pipes were determined within the Topsoil / Made Ground or natural strata. Therefore, it is recommended that appropriate materials for water supply pipes would comprise Poly Ethylene (PE) pipes. The exact requirements are to be confirmed with the relevant utility supplier.

## 8.3 Controlled Waters

On a subsequent visit to the site water samples were retrieved from boreholes BH01, 2, 3, 4, and 7 and tested for a range of contaminants.

The results of the water analysis have been compared against the relevant UK water quality criteria (Environmental Quality Standards, (EQS) or Drinking Water Standards, (DWS). When none are available the WHO thresholds have been used as an initial assessment tool.

With reference to the UK water quality criteria thresholds, initial assessment shows that Tier 1 thresholds have been exceeded in the groundwater samples as follows.

**Table 8.3:** Location of Tier 1 Exceedances in the groundwater samples

| Exploratory Hole | Determinant | Concentration | EQS (freshwater) Threshold | EU DWS Threshold | WHO Threshold |
|------------------|-------------|---------------|----------------------------|------------------|---------------|
| BH01             | Zinc        | 350ug/l       | 50ug/l                     | 5000ug/l         | 3000ug/l      |
| BH02             | Zinc        | 390ug/l       | 50ug/l                     | 5000ug/l         | 3000ug/l      |

There is an exceedance of Zinc within BH01 and BH02 when compared to the EQS freshwater standard but not when compared to the EU drinking water standard or WHO thresholds.

The site is underlain by a Secondary A Aquifer within the superficial deposits and an unproductive aquifer in the Clay bedrock deposits.

The site is not situated within a Source Protection Zone. There are no potable water abstractions within 1000m of the site.

It can therefore be considered that the risk to groundwater and surface water receptors from the proposed works is **Low** based on the following:

- The low chemical concentrations found in groundwater and site soils

- Absence of sensitive groundwater and surface water receptors
- In addition, it is considered that the development of the site will present opportunities for betterment with likely removal of some Made Ground and the reduction in infiltration through development.

The results of the environmental chemistry analyses can be referred to in Appendix A5 of this report.

## 8.4 Soil Gases

Standpipe installations were incorporated in fifteen boreholes across the site.

Gas monitoring has been undertaken across the site on two occasions to date and is ongoing with a further four visits to be completed. Barometric pressure has been recorded at 1005 and 1008mb during the visits.

Gas flow recorded within the boreholes varies from undetectable to 0.2l/hr.

- **Methane**

Methane concentrations were recorded ranging from undetectable to 0.1% $\text{v/v}$ .

Based on the maximum flow rate of 0.2l/hr and the highest recorded methane concentration of 0.2%, a gas screening value of 0.0002l/hr is calculated.

- **Carbon Dioxide**

Carbon dioxide concentrations recorded varied between being undetectable to 4.9%  $\text{v/v}$ .

Based on the maximum flow rate of 0.2l/hr and the highest recorded Carbon Dioxide concentration of 4.9%, a gas screening value of 0.0098l/hr is calculated.

- **Summary**

With reference to Situation A non-traditional construction as defined by the NHBC and the modified Wilson & Card classification as contained within CIRIA C665, the maximum carbon dioxide concentration and gas screening value indicate Characteristic Situation 1 (CS1) requiring no gas protection measures. It is recommended this is reviewed further on completion of gas monitoring.

As the maximum concentration of Carbon Dioxide recorded to date is close to the 5%  $\text{v/v}$  threshold for CS2 gas regime; and with four monitoring visits remaining, it is considered prudent that an allowance is made for gas protection measures in line with CS2 gas regime.

Until completion of gas monitoring, the risk posed by gases is assessed to be **Moderate**.

The results of the gas monitoring can be referred to in Appendix A6.

The final results and any recommendations regarding the ground gas risk assessment will be issued as an addendum to this report upon completion of the monitoring.

## 9.0 Revised Conceptual Model

The Preliminary Conceptual Site Model (PCSM) discussed in Section 3.0 of this report has been revised following the GQRA in Section 8.0 above. The Conceptual Site Model (CSM) is presented in the table on the following page.

The CSM details the source-pathway-receptor linkages or potential pollutant linkages (PPL) that have been identified for the site. The GQRA details the associated level of risk relating to these potential pollutant linkages.

The CSM concerns risk to human health and Water Environment with additional, more specific risk assessment protocols contained within the main body of this reporting, as detailed below.

The CSM follows the framework outlined within CIRIA C552 which is summarised within Appendix A8.

The 'risk rating' within the CSM refers to the risk that the source, pathway, receptor linkage or PPL is complete. Unless specifically stated it does not necessarily refer to an immediate risk and is intended to be used as a tool to assess the necessity for further assessment/investigation.

### 9.1 Additional Risk Assessments

The following risk assessments, listed below, are not included within the main CSM and GQRA but none-the-less can be of critical importance to the onward development of the site.

- The risk presented by Radon is discussed and assessed in Section 2.2
- The risk presented by Mining is discussed and assessed in Section 2.5
- The risk presented by Unexploded Ordnance (UXO) is discussed and assessed in Section 2.6

Under current health and safety legislation, employers are required to carry out their own appropriate risk assessments and mitigation to protect themselves and their employees, other human receptors and the environment from potential contamination. Such risks must be adequately mitigated by law, specifically the Construction Design Management (CDM) Regulations, 2015 which require that potential risks to human health and the environment from construction activities are appropriately identified and all necessary steps taken to eliminate / manage that risk. It has been assumed that any future construction works on site will be undertaken in compliance with these requirements and therefore construction workers involved in the building works at the site have been discounted as a human receptor in the conceptual site model. Reference should be given to the environmental testing results discussed within Section 8.0 and presented within Appendix A5.

Qualitative Risk  
Assessment

Generic  
Quantitative Risk  
Assessment

Detailed  
Quantitative Risk  
Assessment or;  
Remedial Action

- The table below represents the first stage in the land quality risk assessment process; the Qualitative Risk Assessment.
- In order for a development site to be deemed 'suitable for use' the level of risk needs to be brought down to acceptable levels, i.e. low to negligible risk. The purpose of each stage of risk assessment is ultimately to establish if there is a requirement for additional levels of assessment to be made in order to have sufficient confidence to support a risk characterisation or management decision, e.g. remedial action.
- In the absence of specific site data a Generic Quantitative Risk Assessment is invariably recommended.

| Conceptual Site Model                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                         |                                                                                                            | Qualitative Risk Assessment                                 |                                                                                                                                                                                                                                                     |                             | Action                                                       |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|--------------------------------------------------------------|
| Source                                                                                                                                                                                                                                                                                                                                                                                                                                           | Pathway(s)                                                                                                                                                                                                                                              | Receptor(s)                                                                                                | Consequence<br>(Potential Severity)                         | Likelihood of Occurrence                                                                                                                                                                                                                            | Risk Rating                 |                                                              |
| <b>On-Site Sources of Potential Contamination</b><br><br>Made Ground was encountered in all exploratory holes across the site beneath a surface covering of topsoil or concrete, with a maximum depth of 1.60m encountered.<br><br>An isolated occurrence of an elevated concentration of arsenic above the conservative 'Residential without the Consumption of Produce' thresholds was identified in the Made Ground sample from WS3 at 0.30m. | <b>Direct contact, ingestion, inhalation (dust and vapours)</b><br><br>Residents and general public                                                                                                                                                     | <b>End user of site</b><br><br>Residents and general public                                                | <b>Medium</b><br><br>Chronic health risk                    | <b>Unlikely</b><br><br>Limited contaminants above threshold values detected in shallow soils<br><br>The location of the exceedance in WS3 will be beneath a building in the final development thereby breaking any pathway to end users of the site | <b>Low</b>                  | <b>No Further Action Recommended</b>                         |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <b>Vertical migration through the superficial deposits (soils)</b><br><br>May occur due to processes including; capillary action, burrowing animals inducing soil mixing and downwards into the natural deposits through infiltration.                  | <b>Water Environment</b><br><br>Secondary A Aquifer<br><br>The site is not within a Source Protection Zone | <b>Medium</b><br><br>Pollution of sensitive water resources | <b>Unlikely</b><br><br>Limited contaminants above threshold values detected in groundwater                                                                                                                                                          | <b>Low</b>                  | <b>No Further Action Recommended</b>                         |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <b>Horizontal migration over and through the superficial deposits (soils)</b><br><br>May occur due to the influence of perched or natural groundwater flow patterns and natural or man-made high permeability zones, e.g. sand lenses or drainage runs. | <b>Water Environment</b><br><br>River                                                                      | <b>Medium</b><br><br>Pollution of sensitive water resources | <b>Unlikely</b><br><br>Limited contaminants above threshold values detected in shallow soils<br><br>Run off will be controlled by buildings and hardstanding                                                                                        | <b>Low</b>                  | <b>No Further Action Recommended</b>                         |
| <b>On and off-site soils with the potential to generate ground gases</b><br><br>Infilled land, Made Ground deposits and superficial soils                                                                                                                                                                                                                                                                                                        | <b>Vertical and horizontal migration through the superficial and bedrock deposits</b>                                                                                                                                                                   | <b>End user of site</b><br><br>Residents and general public                                                | <b>Medium</b>                                               | <b>Likely</b><br><br>Slightly elevated levels of Carbon Dioxide and methane recorded to date                                                                                                                                                        | <b>Moderate (currently)</b> | <b>Completion of current gas monitoring regime required.</b> |

## 10.0 Geotechnical Assessment

### 10.1 Structural Design

It is understood that the proposed development is to consist of a number of four storey and two five/six storey blocks of flats, and two storey town houses for student accommodation, together with a new low rise central hub building, road link and areas of hard and soft landscaping.

### 10.2 Assessment of Soil Conditions

The Boyn Hill Gravel Member encountered on the site was principally coarse grained, granular.

SPT 'N' values reported on the borehole logs are as measured and uncorrected.

Removing undisturbed samples of over-consolidated fissured clays from boreholes can result in disturbance of the material that is exacerbated during subsequent preparation for laboratory testing. This can result in misleadingly low shear strengths being obtained in the laboratory.

In some cases, in-situ testing is more advantageous when compared with taking undisturbed samples followed by laboratory tests.

Work undertaken by Stroud, determined a relationship between SPT 'N' values and the undrained shear strengths of many over-consolidated clays.

Further work by Stroud and Butler in which data was analysed from sites covering a wide range of glacial deposits, confirmed there to be a correlation between the 'N' value and undrained shear strength.

The relationship was of the form:

- $c_u = F1 \times N$
- $m_v = 1/F \times N$   
where
- $c_u$  = Undrained shear strength
- $m_v$  = Coefficient of compressibility
- $F1$  and  $F2$  = Factors

It was determined by Stroud that  $F1$  varied between 4kPa for material of high plasticity and 6kPa for material of low plasticity. Similarly,  $F2$  varied between

400kPa and 600kPa. Clayton (1995) further showed, using part of Stroud's data, that  $F1=11$  when fissuring is removed by remoulding, i.e. in unfissured soils.

It is considered that for the London Clay encountered on this site a value of  $F1 = 6.3\text{kPa}$  and  $F2 = 0.63\text{m}^2/\text{MN}$  would be appropriate, whilst for the Laminated Beds of the Woolwich Formation an  $F1$  value of  $4.3\text{kPa}$  and a  $F2$  value of  $0.43\text{m}^2/\text{MN}$  might be suitable.

A plot of strength with depth including values derived from this relationship is provided in Appendix A4,

### **10.3 Made Ground/Possible Made ground**

Laboratory testing undertaken within the cohesive Made Ground deposit in borehole 4 recorded a natural moisture content of 16% and a plasticity index of 25%, which when modified for gravel content recorded a modified plasticity index of 15%. These results indicate the cohesive Made Ground deposit at this location to be of intermediate plasticity and of low volume change potential as defined by the National House Building Council.

The plastic index test result is presented on the plasticity classification chart, Appendix A4

Laboratory testing undertaken within the granular Made Ground deposit in borehole WS10 recorded a natural moisture content of 8% and a plasticity index of 9%, indicating the deposit to be non-plastic. The plastic index test result is presented on the plasticity classification chart, Appendix A4.

A particle size distribution undertaken on a bulk sample from the granular Made Ground deposit in borehole 5 indicated a gravel content of 40%, sand content of 42%, silt content of 15% and clay content of 4%.

An SPT undertaken in the cohesive Possible Made Ground deposit in borehole 6 at 1.20m recorded an 'N' value of 16.

The results of chemical tests in these deposits indicate a sulphate concentration in the soil of between 11mg/l and 54mg/l as a 2:1 water/soil extract, with pH values in the range of 6.1 to 9.3.

### **10.4 Boyn Hill Gravel Member (Clay)**

Laboratory testing undertaken in these beds recorded natural moisture contents of between 19% and 32%, with an average of 25%, and plasticity indices of between 20% and 41%, with an average of 29%. The plastic index test results are presented on the plasticity classification chart, Appendix A4.

These results indicate clay beds of the Boyn Hill Gravel Member is of intermediate to high plasticity and of medium to high volume change potential as defined by the National House Building Council and other published data.

It is considered that a plasticity index value of 29% could be adopted for this stratum and that for design purposes, medium volume change potential should be adopted. Changes in moisture content will result in moderate changes in volume, seasonal changes being exacerbated by the presence of trees.

Consistency index determinations were between 0.65 and 1.06 suggesting the stratum to be variable ranging from firm to very stiff.

An unconsolidated un-drained triaxial compression test, undertaken on 'undisturbed' (Class B) sample suggests a  $c_u$  value of 151kPa.

SPTs were undertaken and where full penetration was achieved, recorded 'N' values of between 7 and 22, with an average of 15. However, it should be noted that three of the seven 'N' values used for this assessment were between the junction of the Made Ground and the clay beds of the Boyn Hill Gravel Member.

The results of chemical tests in the clay beds of the Boyn Hill Gravel Member indicate a sulphate concentration in the soil of 19mg/l as a 2:1 water/soil extract, with a pH values of 6.

#### 10.4.1 Suggested Soil Properties and Derived Values

Summary of the geotechnical parameters derived from the laboratory and insitu testing for the clay beds of the Boyn Hill Gravel Member is as follows:

**Table 9.4.1:** Geotechnical Parameters

|                          | Minimum | Maximum | Mean |
|--------------------------|---------|---------|------|
| Moisture Content (%)     | 19      | 32      | 25   |
| Plasticity Index (%)     | 20      | 41      | 29   |
| SPT 'N' Value            | 7       | 22      | 15   |
| Consistency Index Values | 0.65    | 1.06    | 0.86 |

#### 10.5 Boyn Hill Gravel Member (Granular)

Particle size distributions undertaken on bulk samples from the granular beds in the cable percussion boreholes indicated a gravel content of between 1% and 75%, sand content of between 22% and 81% and silt/clay content of between 3% and 20%.

SPT's were undertaken and where full penetration was achieved, recorded 'N' values of between 6 and 92, with an average of 35, indicating this deposit generally to be of dense compaction.

The results of chemical tests in the granular beds of the Boyn Hill Gravel Member indicate a sulphate concentration in the soil of between 18mg/l and 24mg/l as a 2:1 water/soil extract, with pH values in the range of 5.3 to 8.3.

## **10.6 London Clay**

Laboratory testing undertaken in the London Clay recorded natural moisture contents of between 26% and 34%, with an average of 29%, and plasticity indices of between 38% and 52%, with an average of 45%. The plastic index test results are presented on the plasticity classification chart, Appendix A4.

Based on these results it is considered that a mean plasticity index value of 45% could be adopted for this stratum and that for design purposes, high volume change potential should be adopted. Changes in moisture content will result in significant changes in volume, seasonal changes being exacerbated by the presence of trees.

Consistency index determinations were between 0.89 and 0.98 suggesting the stratum to be generally stiff.

Unconsolidated un-drained triaxial compression tests, undertaken on 'undisturbed' (Class B) samples suggest  $c_u$  values to be in the range of 76kPa and 313kPa, averaging 150kPa.

SPTs were undertaken and where full penetration was achieved, recorded 'N' values of between 10 and 33, with an average of 22, which when using the correlations and relationships indicated in paragraph 6.3 above suggests  $c_u$  values of between 63kPa and 208kPa, averaging 139kPa.

Further using the correlations and relationships indicated in paragraph 6.3 above suggests  $m_v$  values of between 0.05m<sup>2</sup>/MN and 0.16m<sup>2</sup>/MN, averaging 0.07m<sup>2</sup>/MN.

Assumed  $m_v$  values for this stratum range from 0.10m<sup>2</sup>/MN to 0.30m<sup>2</sup>/MN.

The results of chemical tests indicate a sulphate concentration in the London Clay of between 39mg/l and 620mg/l as a 2:1 water/soil extract, a total sulphate concentration of between 0.02% and 0.13% and total sulphur of between 0.41% and 1.10%, with pH values in the range of 6.6 to 8.5

### **10.6.1 Suggested Soil Properties and Derived Values**

Summary of the geotechnical parameters derived from the laboratory and insitu testing for the London Clay is as follows:

**Table 10.6.1:** Geotechnical Parameters

|                                                                                                      | Minimum | Maximum | Mean |
|------------------------------------------------------------------------------------------------------|---------|---------|------|
| Moisture Content (%)                                                                                 | 26      | 34      | 29   |
| Plasticity Index (%)                                                                                 | 38      | 52      | 45   |
| Consistency Index Values                                                                             | 0.89    | 0.98    | 0.94 |
| SPT 'N' Value                                                                                        | 10      | 33      | 22   |
| Consistency, $c_u$ (kPa)                                                                             | 76      | 313     | 150  |
| Derived Consistency, $c_u$ (kPa)<br>For $f_1=6.3\text{kPa}$                                          | 63      | 208     | 139  |
| Derived Compressibility, $m_v$<br>( $\text{m}^2/\text{MN}$ )<br>For $f_2 = 0.63\text{m}^2/\text{MN}$ | 0.05    | 0.16    | 0.07 |
| Assumed Compressibility<br>from Literature, $m_v$ ( $\text{m}^2/\text{MN}$ )                         | 0.10    | 0.30    | n/a  |

## 10.7 Lambeth Group (Woolwich Formation – Laminated Beds)

Unconsolidated un-drained triaxial compression tests, undertaken on 'undisturbed' (Class B) samples suggest  $c_u$  values to be in the range of 253kPa and 342kPa, averaging 297Pa.

SPTs were undertaken and where full penetration was achieved, recorded 'N' values of between 40 and 97, with an average of 62, which when using the correlations and relationships indicated in paragraph 6.3 above suggests  $c_u$  values of between 172kPa and 417Pa, averaging 266kPa

Further using the correlations and relationships indicated in paragraph 6.3 above suggests  $m_v$  values of between 0.02 $\text{m}^2/\text{MN}$  and 0.06 $\text{m}^2/\text{MN}$ , averaging 0.04 $\text{m}^2/\text{MN}$ .

The results of chemical tests indicate a sulphate concentration in the Lambeth Group of 1000mg/l and 1300mg/l as a 2:1 water/soil extract, a total sulphate concentration of 0.03% and 0.30% and total sulphur of 1.10%, with pH values of 8.2 and 8.3

### 10.7.1 Suggested Soil Properties and Derived Values

Summary of the geotechnical parameters derived from the laboratory and insitu testing for the Laminated Beds of the Woolwich Formation is as follows:

**Table 10.7.1:** Geotechnical Parameters

|                                                                                                   | Minimum | Maximum | Mean |
|---------------------------------------------------------------------------------------------------|---------|---------|------|
| SPT 'N' Value                                                                                     | 40      | 97      | 62   |
| Consistency, cu (kPa)                                                                             | 253     | 342     | 297  |
| Derived Consistency, cu (kPa)<br>For $f_1=4.3\text{kPa}$                                          | 172     | 417     | 266  |
| Derived Compressibility, mv<br>( $\text{m}^2/\text{MN}$ )<br>For $f_2 = 0.43\text{m}^2/\text{MN}$ | 0.02    | 0.06    | 0.04 |

## 10.8 Foundations Options

On the basis of observations made on site together with results of in-situ and laboratory tests, consideration could be given to the adoption of shallow spread foundations to support the proposed structures.

Outside the zone of influence of existing and proposed trees, it is recommended that conventional shallow spread footings should be taken through any Made Ground and Possible Made Ground, and placed in the underlying natural strata at a minimum depth of 0.90m bgl. Due to the depth of Made Ground/Possible Made Ground encountered in the boreholes, it is likely that foundations would have to be placed locally at depths up to 1.60m bgl.

Such foundations, assuming a 0.60m wide strip foundation for proposed low rise structures and a 1m wide pad foundation for proposed high rise structures, placed in the clay deposits of the Boyn Hill Gravel Member at the minimum depth of 0.90m bgl, with a characteristic cu value of 75kPa may be designed to an allowable bearing pressure of 150kPa, which would provide an adequate factor of safety against shear failure. Settlements are likely to be less than 20mm, however, these should be checked when the final structural loading is known.

Within the zone of influence of recently removed, existing or proposed trees, foundations should be taken through the Made Ground and Possible Made Ground and placed at depths recommended by the NHBC for soils of medium volume change potential, or to the top of the granular material, whichever is the shallowest. Compressible material should be placed on the inside faces of foundations as specified by the NHBC.

As an alternative, where clay deposits of the Boyn Hill Gravel Member are absent and granular deposits of the Boyn Hill Gravel Member are proven at a shallow depth, foundations may be placed directly or

extended where practical onto this granular deposit. Such foundations, may be designed to an allowable bearing pressure of 200kPa, which should be sufficiently conservative to prevent overstressing of the underlying London Clay.

However, where clay deposits of the Boyn Hill Gravel Member are encountered within the same building footprint of any proposed structure, the more conservative allowable bearing pressure as indicated for the clay deposits should be adopted.

It may be considered that for foundations over a certain depth and for proposed high rise structures it may be more practical and economical to adopt a piled foundation solution. Guidelines for the design of piles are given in Appendix A4, which may be used with the plot of 'N' value and shear strength with depth.

Within the zone of influence of trees the piles should be sleeved to depths equivalent to those specified by the NHBC for a foundation at the same location. Compressible material should be placed below and on the inside faces of pile caps and beams, as specified by the NHBC.

The carrying capacity of piles depends not only on their size and the ground conditions but also on their method of installation. Pile design and installation are continuously evolving processes and state-of-the-art techniques are often employed before they reach the public domain, perhaps several years down the line. Therefore, it is recommended that specialist Piling Contractors be contacted as to the suitability and carrying capacity of their piles in the ground conditions pertaining to the site.

It should be noted that groundwater was present and claystones were encountered, which could affect the installation of the piles.

## **10.9 Ground Floor Slabs**

On the basis of observations on site together with the results of laboratory tests, it is recommended that outside the zone of influence of trees, consideration is given to constructing the ground floor slab on formation prepared in the Made Ground. Any soft or deleterious material should be removed and replaced with properly compacted granular fill.

However, due to the cohesive deposits of the Made Ground encountered in boreholes 4, 6 and trial pit TP3 and the variable clay deposits of the Boyn Hill Gravel Member across the site, when within the zone of influence of trees, consideration may wish to be given to suspending ground floor slabs over a void, in general accordance with NHBC guidelines.

## **10.10 Excavations**

The safety of all excavations should be assessed and managed in accordance with Regulation 22 of CDM 2015 Managing Health and Safety in Construction.

However, on the basis of observations on site together with the results of insitu and laboratory tests, it is considered that shallow excavations for foundations and services encountering the Made Ground, Possible Made Ground and the granular beds of the Boyn Hill Gravel Member are unlikely to be stable in the short term.

The safety of excavations may be managed by measures such as trench support or reducing side angles to ensure that no excavation or part of an excavation collapses, no material adjacent to any excavation is dislodged or falls and no person is buried or trapped in an excavation by material which is dislodged or falls.

Groundwater, associated with the Boyn Hill Gravel Member, should be expected in shallow excavations for foundations or services, and seepages, associated with the claystone beds in the London Clay, should be anticipated. On a return monitoring visit to the site groundwater was recorded in the standpipes at levels of between 2.03m and 4.86m bgl.

Perched groundwater is unlikely to be present in the Made Ground and Possible Made Ground overlying the Boyn Hill Gravel Member. However, if present it is considered that this could be dealt with by the use of a small pump.

## **10.11 Roads and Hardstanding Design**

The structural design of a road or hard standing is based on the strength of the subgrade, which is assessed on the California Bearing Ratio, CBR, scale from which the subgrade surface modulus can be estimated. Experience has indicated that the measurement of the in-situ CBR value tends to give unreliable results because of the influence of the moisture content of the materials. In practice, the correlation given by the Highways Agency is usually more appropriate than direct determination of the CBR.

The process of design given in the guidance notes requires an estimate of CBR and subgrade stiffness modulus to be made at the design stage and in-situ measurement prior to construction.

An assessment of CBR values derived from laboratory descriptions, limited laboratory testing and classification tests of the strata is as follows:

**Table 10.11.1: CBR Values**

| Strata                                           | CBR Value (%) |
|--------------------------------------------------|---------------|
| Cohesive Made Ground Deposits                    | 5             |
| Granular Made Ground Deposits                    | 20            |
| Clay Deposits of the Boyn Hill Gravel Member     | 4             |
| Granular Deposits of the Boyn Hill Gravel Member | 20            |

The assessment assumes there to be a low water table, average construction conditions and a thin pavement construction.

Any areas of soft or deleterious material in the Made Ground or Boyn Hill Gravel Member should be excavated and replaced with a properly compacted granular fill.

In-situ plate bearing tests were undertaken at nine locations across the site in order to assess the California Bearing Ratio, CBR. The results of which are included in Appendix A4, with a summary provided in the table below:

**Table 10.11.2: Plate Bearing Summary**

| Plate Location | Depth (m) | Soil Description                                                 | In Situ Moisture Content (%) | Derived CBR Value (%) |
|----------------|-----------|------------------------------------------------------------------|------------------------------|-----------------------|
| Plate 1        | 0.20      | Brown gravelly sandy CLAY with frequent rootlets                 | 5.4                          | 4.5                   |
| Plate 2        | 0.20      | Brown gravelly sandy CLAY with frequent rootlets                 | 6.5                          | 8.8                   |
| Plate 3        | 0.20      | Brown gravelly sandy CLAY with frequent rootlets                 | 9.8                          | 4.5                   |
| Plate 4        | 0.20      | Light brown slightly gravelly clayey SAND with frequent rootlets | 4.8                          | 3.1                   |
| Plate 5        | 0.20      | Brown gravelly sandy CLAY with frequent rootlets                 | 5.1                          | 3.5                   |
| Plate 6        | 0.20      | Light brown slightly gravelly clayey SAND with frequent rootlets | 6.1                          | 6.2                   |

| Plate Location | Depth (m) | Soil Description                                                 | In Situ Moisture Content (%) | Derived CBR Value (%) |
|----------------|-----------|------------------------------------------------------------------|------------------------------|-----------------------|
| Plate 7        | 0.20      | Light brown slightly gravelly clayey SAND with frequent rootlets | 7.5                          | 6.2                   |
| Plate 8        | 0.20      | Brown gravelly sandy CLAY with frequent rootlets                 | 11                           | 3.5                   |
| Plate 9        | 0.20      | Light brown slightly gravelly clayey SAND with frequent rootlets | 6.0                          | 4.0                   |

For routine cases, all material within 450mm of the road surface should be non frost-susceptible.

## 10.12 Chemical Attack on Buried Concrete

The site has been classified in accordance with BRE Special Digest 1, and laboratory testing undertaken accordingly. It is recommended that the guidelines given in BRE Special Digest 1 be adopted.

Characteristic values for each stratum have been derived from laboratory results for pH, 2:1 water/soil extract (WS), total (acid) soluble sulphate (AS), equivalent Total Potential Sulphate (TPS) and Oxidisable Sulphate (OS), and are presented in the table below, together with Design Sulphate Class and the ACEC Class:

**Table 10.12:** Soil Sulphate Content:

| Stratum                          | pH  | WS (mg/l) | AS (%) | TPS (%) | OS (%) | Groundwater Condition | DS  | AC    |
|----------------------------------|-----|-----------|--------|---------|--------|-----------------------|-----|-------|
| Made Ground/Possible Made Ground | 6.1 | 54        | n/a    | n/a     | n/a    | Mobile                | 1   | 1     |
| Boyn Hill Gravel Member          | 5.4 | 23        | n/a    | n/a     | n/a    | Mobile                | 1   | 2z    |
| London Clay                      | 6.6 | 440       | 0.10   | 3.11    | 3.00   | Static                | 4/1 | 3s/1s |
| Lambeth Group                    | 8.2 | 1300      | 0.30   | 3.30    | 3.00   | Static                | 4/2 | 3s/1s |

Values for OS greater than 0.30% indicate that pyrite is present and may be oxidised to sulphate where the ground is disturbed.

On the basis of the laboratory test results it is considered that a Design Sulphate Class for concrete located in the Made Ground/Possible Made Ground may be taken as DS-1. The site conditions would suggest that an ACEC class for the site of AC-1 would be appropriate.

For concrete placed in the Boyn Hill Gravel Member a Design Sulphate Class of DS-1 may be taken, with an ACEC class of AC-2z. Concrete placed in ACEC Classes that include the suffix 'z' primarily have to resist acid conditions, however, it should be noted that three of the five samples tested within this stratum recorded pH values of greater than 7 (boreholes 1, 2 and 6), and as such, further laboratory testing result in re-classification to AC-1.

Where concrete is to be exposed to disturbed ground in which pyrite is available to be oxidised to sulphate, in this instance the London Clay below a depth of about 3.20m bgl, consideration should be given to a Design Sulphate Class of DS-4 with an ACEC class of AC-3s. However, it is considered that oxidation is unlikely to occur below this depth following the installation of piles. Therefore, it is recommended that should piles be adopted a Design Sulphate Class of DS-1 for the London Clay and DS-2 for the Lambeth Group, with an ACEC class of AC-1s would be appropriate.

### **10.13 Surface Water Soakaways**

Infiltration tests were undertaken in trial pits TP1, TP2 and TP3 at depths of between 2.19m and 2.41m bgl within the granular deposits of the Boyn Hill Gravel Member. The tests were carried out in general accordance with BRE 365.

The results of the tests gave infiltration rates in the granular deposits of the Boyn Hill Gravel Member of between  $3.61 \times 10^{-6}$ m/s and  $6.73 \times 10^{-6}$ m/s which suggests the stratum to be of poor drainage characteristics.

The drainage designer is to consider these as a preliminary indication of soil percolation properties but is also to take appropriate account of the description of the site soils in the exploratory hole logs along with proposed changes in site levels. A fully designed soakaway should be constructed to test capacity in appropriate locations relevant to the discharge points, all to the specification of the drainage designer, before the drainage designer confirms the drainage strategy for the site.

## 11.0 Conclusions & Recommendations

### 11.1 Conclusions

A revised tabulated revised Conceptual Site Model has been derived following the findings on the Generic Quantitative Risk Assessment risk assessment and is presented in Section 9.0.

#### 11.1.1 Ground Model

Made Ground was encountered at all exploratory hole locations between 0.30m and 1.60m beneath surface coverings of topsoil or concrete (WS8). Made Ground generally comprised brown, orange brown gravelly silty slightly clayey to clayey fine and medium sand, and in boreholes 4 and 6, and trial pit 3 comprised firm friable dark brown, brown gravelly sandy to very sandy silty clay. Varying proportions of anthropogenic materials were encountered within this stratum including clinker, brick, concrete, wood, and glass fragments.

Material indicative of the Boyn Hill Gravel Member underlay the Possible Made Ground in borehole 6 and the Made Ground in the remaining exploratory locations to proven depths of between 3.20m and 5.50m bgl. These deposits typically comprised medium dense to dense brown, medium and coarse gravel of flint, and medium dense to dense brown fine to coarse sand with varying proportions of clay pockets.

Deposits of the London Clay Formation were encountered below the Boyn Hill Gravel Member to proven depths in the cable percussion boreholes of between 14.90m and 19.60m bgl. The stratum generally comprised unweathered stiff to very stiff, firm in boreholes WS7 and WS8, and extremely closely fissured and thinly laminated dark grey clay with rare to occasional pockets and lenses of light grey fine sand and shell fragments, and rare iron pyrite nodules.

Material interpreted as the Laminated Beds of the Woolwich Formation underlay the London Clay Formation in the cable percussions boreholes to the full depth of the investigation at 23.00m bgl. This unit generally consisted of stiff to very stiff, becoming firm to stiff friable, dark grey/dark green sandy silty clay with rare to occasional shell fragments.

#### 11.1.2 Risk Assessments

The environmental chemistry soil results from twenty nine samples have been compared with the Tier 1 criteria for soils with respect to human health against the conservative '*Residential without the Consumption of Produce*' thresholds using SGV, GAC and where available S4UL thresholds.

With respect to the proposed end use of the site, an isolated contaminant exceedance has been recorded on site with respect to Arsenic in a Made Ground sample from WS3. Analysis of a deeper soil sample at 1.00m depth in the natural strata recorded a lower concentration of arsenic of 25mg/kg.

The location of the exceedance in WS3 will be beneath a building in the final development thereby breaking any pathway to end users of the site. Therefore, any potential exposure to contamination will be mitigated and associated risks considered as **Low**.

Groundwater analysis on five samples collected from the borehole have recorded an exceedance of Zinc above EQS freshwater threshold levels in the samples from BH01 and BH02. No DWS or WHO thresholds have been exceeded.

The site is underlain by a Secondary A Aquifer within the superficial deposits and an unproductive aquifer in the clay bedrock deposits. The site is not located within a SPZ.

It can therefore be considered that the risk to groundwater and surface water receptors from the proposed works is **Low** due to the limited contaminated recorded, absence of sensitive controlled water receptors and the likely removal of some Made Ground and the reduction in infiltration across the site as a part of the development.

Ground gas monitoring has been undertaken on two occasions to date with four monitoring visits remaining. To date, maximum Carbon Dioxide and Methane concentrations of 4.9% v/v and 0.1% v/v have been recorded respectively; with a maximum flow of 0.2 l/hr recorded.

Until completion of gas monitoring, the risk posed by gases is assessed to be **Moderate**.

The final results and any recommendations regarding the ground gas risk assessment will be issued as an addendum to this report upon completion of the monitoring.

## 11.2 Recommendations

Based on the findings of the ground investigation, the following recommendations are made:

- 1) In general, it is recommended that construction workers are provided with appropriate PPE and sanitary facilities with reference to the environmental testing results presented herein and within Appendix A5.
- 2) As the maximum concentration of Carbon Dioxide recorded to date is close to the 5% v/v threshold for CS<sub>2</sub> gas regime; and with four monitoring visits remaining, it is considered prudent that an allowance is made for gas protection measures in line with CS<sub>2</sub> gas regime at this stage. This will be reviewed further on completion of gas monitoring.

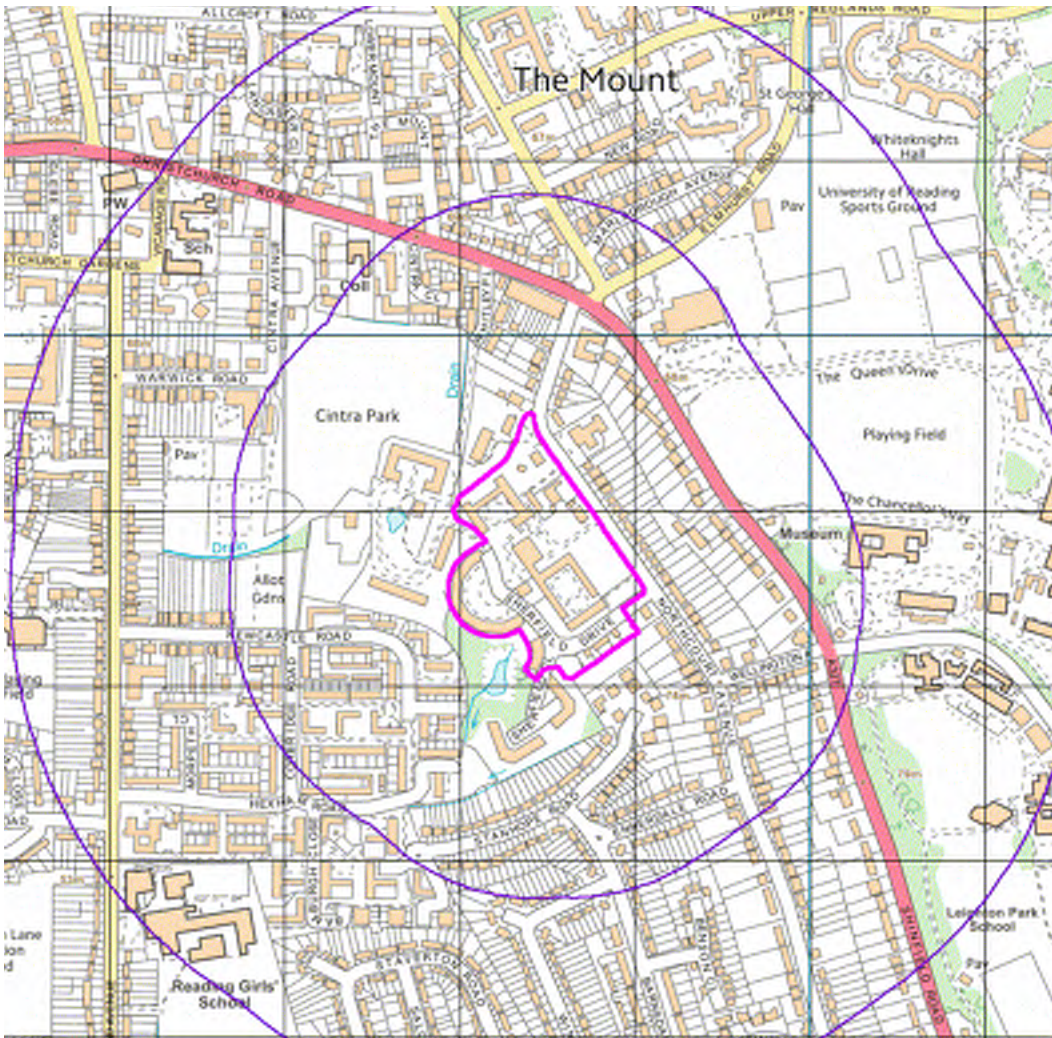
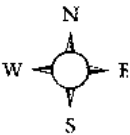
## 12.0 References

1. Curtins Phase 1 Preliminary Site Assessment Curtins Ref EB1834/GL/5073 dated 2 October 2015.
2. *Environment Agency 2004 Procedures for the management of land Contamination Contaminated Land Report 11 (CLR11).*
3. British Standards Institution (2011) *Investigation of Potentially Contaminated Sites* (report no. BS10175).
4. British Standards Institution BSI (2010) *Code of Practice for Site Investigations* (report no. BS5930).
5. British Standards Institution (2006) *Eurocode 7: Geotechnical Design* (report no. BS EN 1997).
6. British Standards Institution (2013) *Guidance on Investigations for Ground Gas, Permanent Gas and Volatile Organic Compounds (VOCs)* (report no. BS8576:2013).
7. Environment Agency (2014) *Contaminated Land Exposure (CLEA) Tool* (version 1.06).
8. Environment Agency (2009) *Human Health Toxicological Assessment of Contaminants in Soil* (report no. SC050021/SR2)
9. Environment Agency (2009) *Updated Technical Background to the CLEA Model* (report no. SC050021/SR3).
10. Department of Environment Food and Rural Affairs (DEFRA) (2012) *Environmental Protection Act 1990: Part 2A Contaminated Land Statutory Guidance* (report no. PB13735).
11. CIRIA (2007) *Assessing Risks Posed by Hazardous Ground Gases to Buildings* (report no. C665)
12. British Standards Institution (2015) *Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings* (report no. BS8485).
13. Environment Agency (2006) *Remedial Targets Methodology - Hydrogeological Risk Assessment for Land Contamination*
14. Water, England and Wales (2000) *The Water Supply (Water Quality) Regulations 2000* (report no. 3184)
15. Environment Agency (2011) *H1 Annex J Groundwater* (report no. V2.1)
16. Environment Agency (2015) *Guidance on the Classification and Assessment of Waste Technical Guidance WM3* (1<sup>st</sup> Edition 2015)
17. The Coal Authority interactive map viewer

## Appendix A1 – Drawings

- Site Location Plan
- Proposed Development Plan
- Borehole Location Plan
- Conceptual Site Model

# Site Location Plan



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## Key

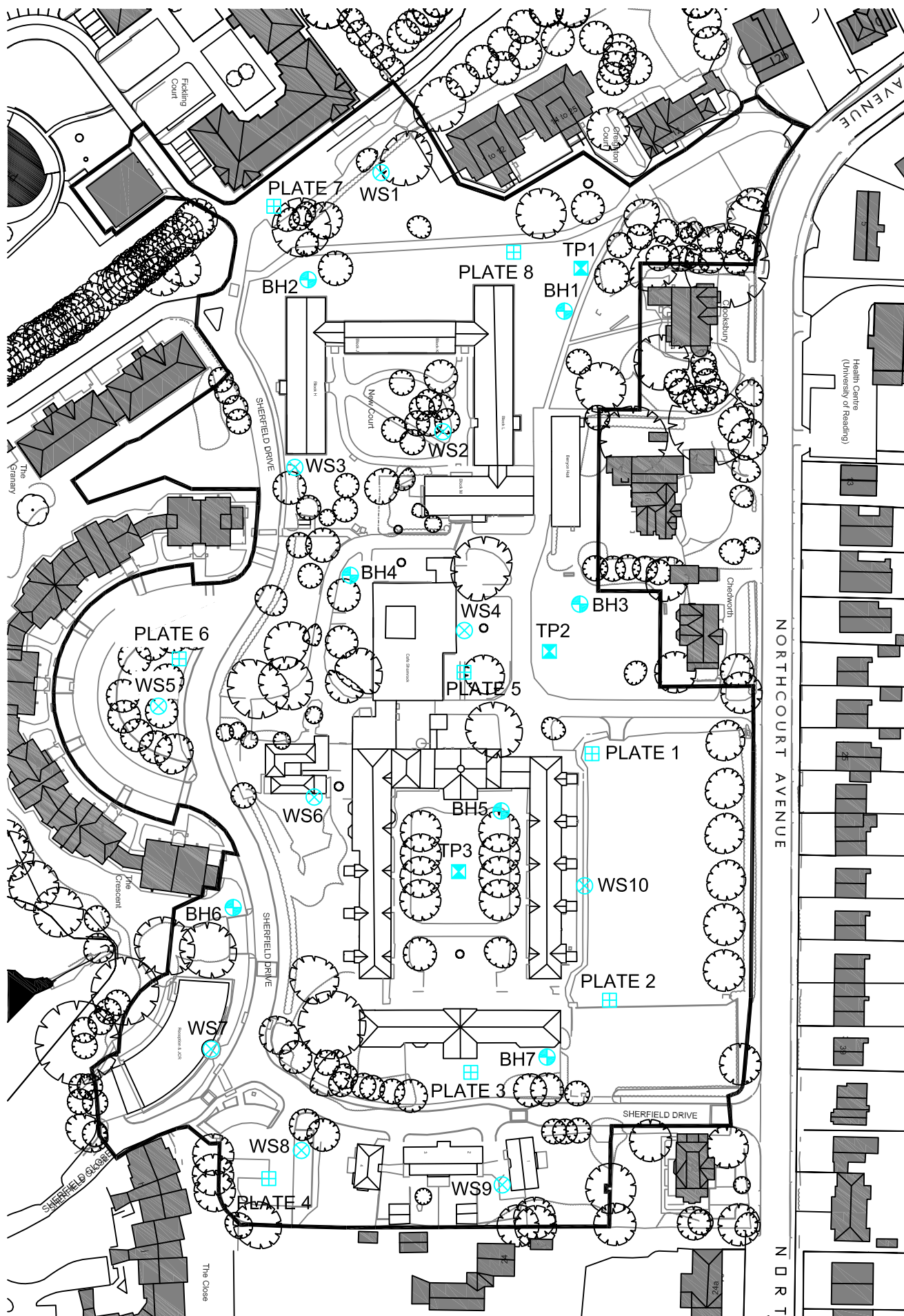
 Approximate site boundary

| Project                   |
|---------------------------|
| St Patricks Hall, Reading |
| Drawing Title             |
| Site Location Plan        |

| Job Reference |
|---------------|
| B041466.003   |
| Date          |
| 01.10.2015    |

| Author  |
|---------|
| GL      |
| Checked |
| DM      |

  
Bristol  
Quayside  
40-58 Hotwell Road  
Bristol  
BS8 4UQ  
T. 0117 302 7560

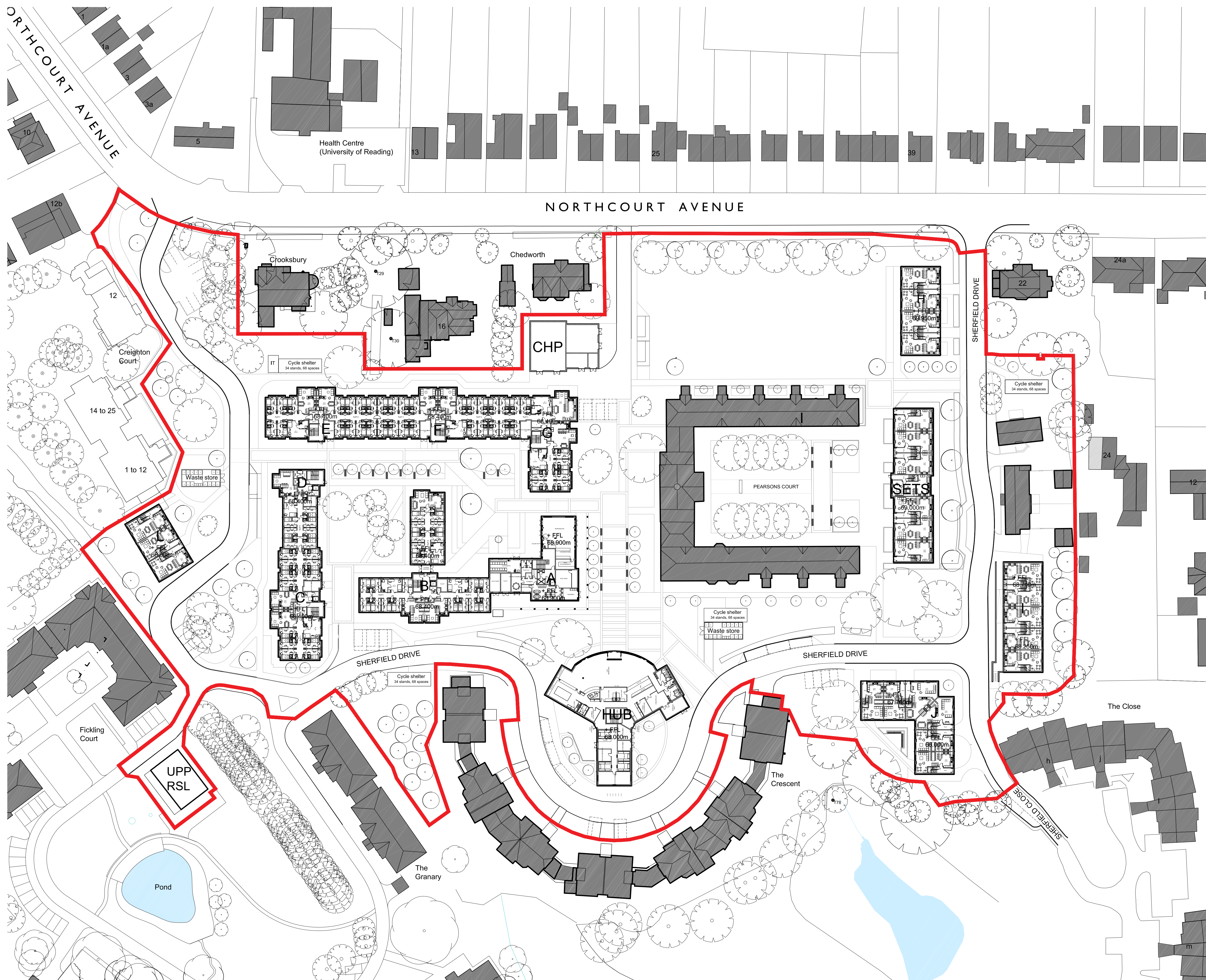
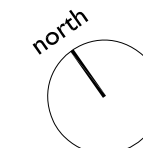


Scale : N.T.S.

Drawn By : P.L.E.

Job No: 52527

Fig: A1.2



|           |      |      |      |     |
|-----------|------|------|------|-----|
| Amendment | Drwn | Chkd | Date | Rev |
|-----------|------|------|------|-----|



w|a willmore ile architects

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[enquiries@hoganiles.com](mailto:enquiries@hoganiles.com)

Drawing Status **PLANNING**

Client

UNIVERSITY PARTNERSHIPS PROGRAMME

Job Title

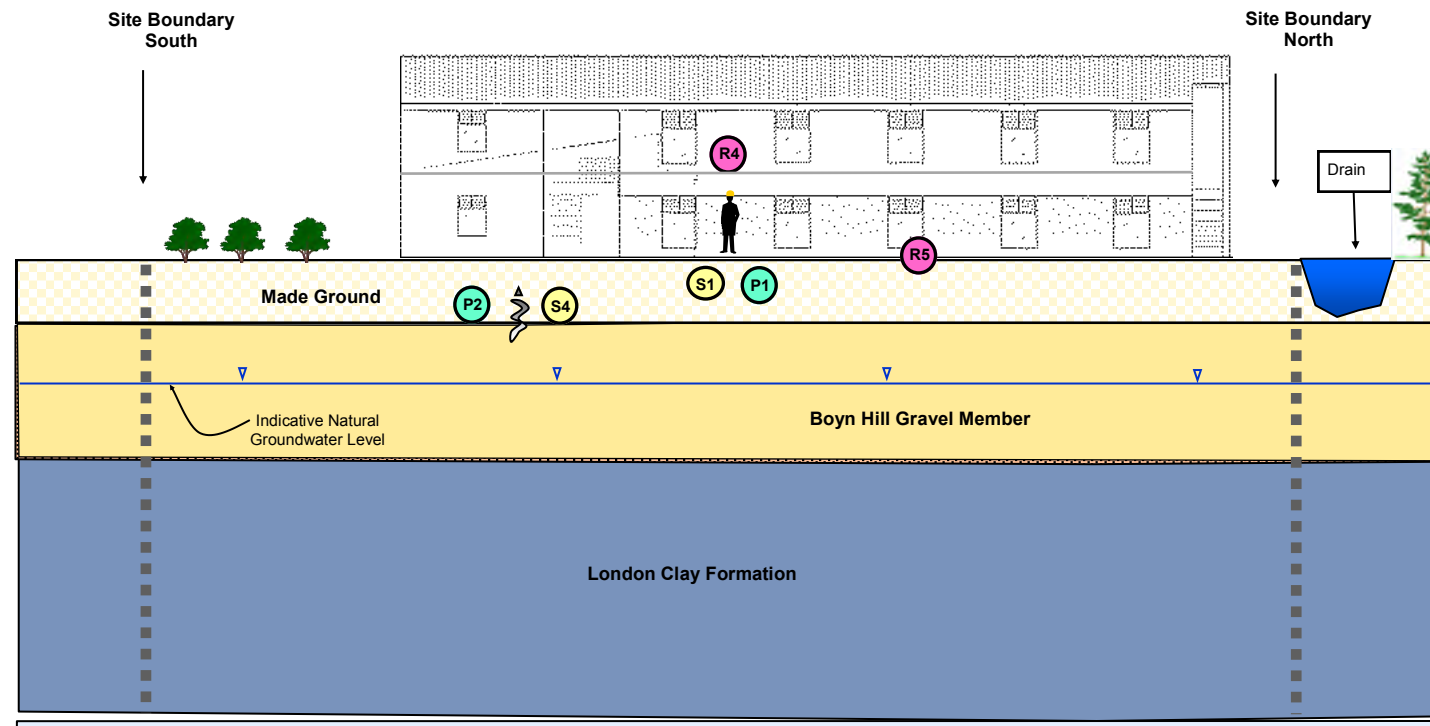
Job Title ST PATRICKS HALL  
UNIVERSITY OF READING

Drawing Title

## PROPOSED SITE PLAN

|                                     |            |             |               |                  |
|-------------------------------------|------------|-------------|---------------|------------------|
| Scale<br>1:500                      | Size<br>A1 | Drawn<br>RT | Checked<br>AI | Date<br>NOV 2017 |
| Dwg No<br>StP-WIA-00-GF-DR-A-000003 |            |             |               | Rev              |

# St Patricks Hall, Reading



## Sources

- S1** Made-ground (On site)
- S2** Made-ground (Off site)
- S3** Natural soils (On & off site)
- S4** Ground gas sources
- S5** Radon geology
- S6** Unexploded ordnance

## Pathways

- P1** Direct contact, ingestion and or inhalation
- P2** Vertical migration
- P3** Horizontal migration
- P4** Collapse

## Receptors

- R1** End users
- R2** Groundwater
- R3** Surface water
- R4** Construction workers
- R5** Construction materials
- R6** Local ecology



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## Project

St Patricks Hall, Reading

## Drawing Title

Diagrammatic Conceptual Model

## Job Reference

B041466.003

## Date

02.10.2015

## Author

GL

## Checked

DM

## Client

University Partnerships Programme

## Scale

Not to scale

## Appendix A2 – Exploratory Borehole Logs, Trial Pits and Photographs

|                                                                                                                                                                                                                                                                                                                                                                                         |                   |                                         |                 |                                                                                 |             |                                                                                                      |                                                                                                                                                                                                                                                                                                                        |                        |                 |       |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|-----------------------------------------|-----------------|---------------------------------------------------------------------------------|-------------|------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|-----------------|-------|
| IAN FARMER ASSOCIATES                                                                                                                                                                                                                                                                                                                                                                   |                   |                                         |                 |                                                                                 |             | Site<br>University of Reading, St Patricks Hall Redevelopment, 20 Northcourt Avenue, Reading RG2 7HB |                                                                                                                                                                                                                                                                                                                        | Borehole Number<br>BH1 |                 |       |
| Boring Method<br>Cable Percussion                                                                                                                                                                                                                                                                                                                                                       |                   | Casing Diameter<br>150mm cased to 4.60m |                 | Ground Level (mOD)<br>68.20                                                     |             | Client<br>Curtins                                                                                    |                                                                                                                                                                                                                                                                                                                        | Job Number<br>52527    |                 |       |
|                                                                                                                                                                                                                                                                                                                                                                                         |                   | Location<br>472825.3 E 171903.1 N       |                 | Dates<br>16/08/2016                                                             |             | Engineer                                                                                             |                                                                                                                                                                                                                                                                                                                        | Sheet<br>1/2           |                 |       |
| Depth (m)                                                                                                                                                                                                                                                                                                                                                                               | Sample / Tests    | Casing Depth (m)                        | Water Depth (m) | Field Records                                                                   | Level (mOD) | Depth (m) (Thickness)                                                                                | Description                                                                                                                                                                                                                                                                                                            | Legend                 | Water           | Instr |
| 0.20<br>0.30                                                                                                                                                                                                                                                                                                                                                                            | ES1<br>D1         |                                         |                 |                                                                                 | 68.05       | (0.15)<br>0.15                                                                                       | *TOPSOIL.                                                                                                                                                                                                                                                                                                              |                        |                 |       |
| 0.60-1.10<br>0.70                                                                                                                                                                                                                                                                                                                                                                       | B1<br>ES2         |                                         |                 |                                                                                 | 67.65       | (0.40)<br>0.55                                                                                       | MADE GROUND comprising topsoil composed of dry orange brown gravelly silty slightly clayey fine and medium SAND with occasional rootlets and rare medium gravel size brick fragments. Gravel is subangular to rounded fine to coarse of flint.                                                                         |                        |                 |       |
| 1.20-1.65<br>1.20-1.70                                                                                                                                                                                                                                                                                                                                                                  | SPT(C) N=19<br>B2 |                                         | DRY             | 4,4/4,6,5,4                                                                     | 67.00       | (0.65)<br>1.20                                                                                       | Firm to stiff orange brown, light grey and occasionally red mottled very gravelly sandy to very sandy CLAY with occasional black kerogen staining. Gravel is angular to rounded fine to coarse of flint. Sand is predominantly medium and coarse. (BOYN HILL GRAVEL MEMBER)                                            |                        |                 |       |
| 2.20-2.60                                                                                                                                                                                                                                                                                                                                                                               | SPT(C) 50/250     |                                         | DRY             | 7,7/12,15,15,8                                                                  |             |                                                                                                      | Medium dense orange brown very sandy silty clayey angular to rounded predominantly fine and medium GRAVEL of flint with occasional to frequent pockets of firm orange brown, light grey and occasionally red mottled very gravelly very sandy clay. Sand is predominantly medium and coarse. (BOYN HILL GRAVEL MEMBER) |                        |                 |       |
| 2.70-3.20                                                                                                                                                                                                                                                                                                                                                                               | B3                |                                         |                 |                                                                                 |             | (3.10)                                                                                               | From 2.70m; Damp with occasional pockets of clay.                                                                                                                                                                                                                                                                      |                        |                 |       |
| 3.20-3.65                                                                                                                                                                                                                                                                                                                                                                               | SPT(C) N=45       | 3.20                                    | DRY             | Slow(1) at 3.10m, rose to 2.85m in 20 mins, sealed at 4.50m.<br>7,8/10,10,12,13 |             |                                                                                                      | From 3.20m; Dense.                                                                                                                                                                                                                                                                                                     |                        |                 |       |
| 4.20-4.65<br>4.30-4.70                                                                                                                                                                                                                                                                                                                                                                  | SPT(C) N=16<br>B4 | 4.20                                    | DRY             | 7,7/6,4,3,3                                                                     | 63.90       | 4.30                                                                                                 | Very stiff orange brown, dark and light grey mottled CLAY with frequent black kerogen staining. (LONDON CLAY FORMATION)                                                                                                                                                                                                |                        |                 |       |
| 4.90<br>5.00-5.45                                                                                                                                                                                                                                                                                                                                                                       | D2<br>U1          | 4.60                                    | DRY             | 45 blows                                                                        | 63.40       | (0.50)<br>4.80                                                                                       | Very stiff extremely closely fissured, becoming thinly laminated dark grey CLAY. (LONDON CLAY FORMATION)                                                                                                                                                                                                               |                        |                 |       |
| 5.50                                                                                                                                                                                                                                                                                                                                                                                    | D3                |                                         |                 |                                                                                 |             |                                                                                                      |                                                                                                                                                                                                                                                                                                                        |                        |                 |       |
| 6.00-6.50                                                                                                                                                                                                                                                                                                                                                                               | B5                |                                         |                 |                                                                                 |             |                                                                                                      |                                                                                                                                                                                                                                                                                                                        |                        |                 |       |
| 6.50-6.95<br>6.50-6.95                                                                                                                                                                                                                                                                                                                                                                  | SPT N=17<br>D4    | 4.60                                    | DRY             | 2,3/4,4,5,4                                                                     |             |                                                                                                      | From 6.50m to 6.95m; Stiff to very stiff with rare medium gravel size iron pyrite nodules.                                                                                                                                                                                                                             |                        |                 |       |
| 7.50                                                                                                                                                                                                                                                                                                                                                                                    | D5                |                                         |                 |                                                                                 |             |                                                                                                      | From 7.50m; With rare fine shell fragments.                                                                                                                                                                                                                                                                            |                        |                 |       |
| 8.00-8.45                                                                                                                                                                                                                                                                                                                                                                               | U2                | 4.60                                    | DRY             | 65 blows                                                                        |             |                                                                                                      |                                                                                                                                                                                                                                                                                                                        |                        |                 |       |
| 8.50                                                                                                                                                                                                                                                                                                                                                                                    | D6                |                                         |                 |                                                                                 |             |                                                                                                      | From 8.50m; Slightly fissured and slightly laminated with rare to occasional pockets and lenses of grey fine sand.                                                                                                                                                                                                     |                        |                 |       |
| 9.00                                                                                                                                                                                                                                                                                                                                                                                    | D7                |                                         |                 |                                                                                 |             |                                                                                                      |                                                                                                                                                                                                                                                                                                                        |                        |                 |       |
| 9.50-9.95<br>9.50-9.95                                                                                                                                                                                                                                                                                                                                                                  | SPT N=24<br>D8    | 4.60                                    | DRY             | 3,4/5,6,6,7                                                                     |             |                                                                                                      |                                                                                                                                                                                                                                                                                                                        |                        |                 |       |
| Remarks<br>Standpipe installation - plain standpipe installed to 1.00m surrounded with bentonite, slotted standpipe installed to 10.00m and sealed with bentonite to 11.00m. Fitted with a gas tap and a stop cock cover.<br>1 hour moving excess borehole arisings to skip and 0.50 hour moving Heras fencing.<br>*Drillers description.<br>Excavating from 0.00m to 1.20m for 1 hour. |                   |                                         |                 |                                                                                 |             |                                                                                                      |                                                                                                                                                                                                                                                                                                                        | Scale (approx)<br>1:50 | Logged By<br>EM |       |
|                                                                                                                                                                                                                                                                                                                                                                                         |                   |                                         |                 |                                                                                 |             |                                                                                                      |                                                                                                                                                                                                                                                                                                                        | Figure No.<br>A2.1     |                 |       |

|                                                                                                                  |                        |                                                |                        |                      |                                    |                              |                                                                                                                                                                                                    |                                                                                       |                               |              |
|------------------------------------------------------------------------------------------------------------------|------------------------|------------------------------------------------|------------------------|----------------------|------------------------------------|------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|-------------------------------|--------------|
| <div> IAN FARMER ASSOCIATES</div> |                        |                                                |                        |                      |                                    |                              | <b>Site</b><br>University of Reading, St Patricks Hall Redevelopment, 20 Northcourt Avenue, Reading RG2 7HB                                                                                        |                                                                                       | <b>Borehole Number</b><br>BH1 |              |
| <b>Boring Method</b><br>Cable Percussion                                                                         |                        | <b>Casing Diameter</b><br>150mm cased to 4.60m |                        |                      | <b>Ground Level (mOD)</b><br>68.20 |                              | <b>Client</b><br>Curtins                                                                                                                                                                           |                                                                                       | <b>Job Number</b><br>52527    |              |
|                                                                                                                  |                        | <b>Location</b><br>472825.3 E 171903.1 N       |                        |                      | <b>Dates</b><br>16/08/2016         |                              | <b>Engineer</b>                                                                                                                                                                                    |                                                                                       | <b>Sheet</b><br>2/2           |              |
| <b>Depth (m)</b>                                                                                                 | <b>Sample / Tests</b>  | <b>Casing Depth (m)</b>                        | <b>Water Depth (m)</b> | <b>Field Records</b> | <b>Level (mOD)</b>                 | <b>Depth (m) (Thickness)</b> | <b>Description</b>                                                                                                                                                                                 | <b>Legend</b>                                                                         | <b>Water</b>                  | <b>Instr</b> |
| 10.50                                                                                                            | D9                     |                                                |                        |                      |                                    | (11.50)                      | From 10.50m; With rare to occasional fine and medium shell fragments.                                                                                                                              |    |                               |              |
| 11.00-11.45                                                                                                      | U3                     | 4.60                                           | DRY                    | 70 blows             |                                    |                              |                                                                                                                                                                                                    |    |                               |              |
| 11.50                                                                                                            | D10                    |                                                |                        |                      |                                    |                              |                                                                                                                                                                                                    |    |                               |              |
| 12.00                                                                                                            | D11                    |                                                |                        |                      |                                    |                              |                                                                                                                                                                                                    |    |                               |              |
| 12.50-12.95<br>12.50-12.95                                                                                       | SPT N=28<br>D12        | 4.60                                           | DRY                    | 4,4/6,7,7,8          |                                    |                              |                                                                                                                                                                                                    |    |                               |              |
| 13.50                                                                                                            | D13                    |                                                |                        |                      |                                    |                              |                                                                                                                                                                                                    |    |                               |              |
| 14.00-14.45                                                                                                      | U4                     | 4.60                                           | DRY                    | 85 blows             |                                    |                              |                                                                                                                                                                                                    |    |                               |              |
| 14.50                                                                                                            | D14                    |                                                |                        |                      |                                    |                              |                                                                                                                                                                                                    |    |                               |              |
| 15.00                                                                                                            | D15                    |                                                |                        |                      |                                    |                              |                                                                                                                                                                                                    |   |                               |              |
| 15.50-15.95<br>15.50-15.95                                                                                       | SPT N=32<br>D16        | 4.60                                           | DRY                    | 4,5/7,8,8,9          |                                    |                              |                                                                                                                                                                                                    |  |                               |              |
| 16.50-16.95<br>16.50<br>16.50-16.95                                                                              | SPT N=46<br>D17<br>D18 | 4.60                                           | DRY                    | 5,6/9,11,14,12       | 51.90                              | 16.30                        | Firm occasionally friable dark grey sandy silty CLAY with rare becoming occasional fine and medium shell fragments. Sand is fine and medium. (LAMBETH GROUP - WOOLWICH FORMATION 'LAMINATED BEDS') |  |                               |              |
| 17.00-17.50                                                                                                      | B6                     |                                                |                        |                      |                                    |                              |                                                                                                                                                                                                    |  |                               |              |
| 18.00-18.40<br>18.00-18.45                                                                                       | SPT 50/250<br>D19      | 4.60                                           | DRY                    | 8,9/10,13,16,11      |                                    | (3.70)                       | From 18.00m; Firm to stiff occasionally friable.                                                                                                                                                   |  |                               |              |
| 19.00                                                                                                            | D20                    |                                                |                        |                      |                                    |                              | From 19.00m; Soft to firm friable, becoming firm to stiff friable.                                                                                                                                 |  |                               |              |
| 19.55-19.95<br>19.55-19.95                                                                                       | SPT 50/250<br>D21      | 4.60                                           | DRY                    | 11,12/14,14,13,9     | 48.20                              | 20.00                        |                                                                                                                                                                                                    |  |                               |              |
| <b>Remarks</b>                                                                                                   |                        |                                                |                        |                      |                                    |                              |                                                                                                                                                                                                    | <b>Scale (approx)</b><br>1:50                                                         | <b>Logged By</b><br>EM        |              |
|                                                                                                                  |                        |                                                |                        |                      |                                    |                              |                                                                                                                                                                                                    | <b>Figure No.</b><br>A2.1                                                             |                               |              |
|                                                                                                                  |                        |                                                |                        |                      |                                    |                              |                                                                                                                                                                                                    |                                                                                       |                               |              |



|                                                                                                             |                                                |                                      |
|-------------------------------------------------------------------------------------------------------------|------------------------------------------------|--------------------------------------|
| <b>Site</b><br>University of Reading, St Patricks Hall Redevelopment, 20 Northcourt Avenue, Reading RG2 7HB |                                                | <b>Borehole Number</b><br><b>BH2</b> |
| <b>Boring Method</b><br>Cable Percussion                                                                    | <b>Casing Diameter</b><br>150mm cased to 4.60m | <b>Ground Level (mOD)</b><br>67.78   |
| <b>Client</b><br>Curtins                                                                                    |                                                | <b>Job Number</b><br>52527           |
| <b>Location</b><br>472771.2 E 171872.9 N                                                                    |                                                | <b>Engineer</b>                      |
| <b>Dates</b><br>15/08/2016                                                                                  |                                                | <b>Sheet</b><br>1/2                  |

| Depth (m) | Sample / Tests | Casing Depth (m) | Water Depth (m) | Field Records                                                   | Level (mOD) | Depth (m) (Thickness)  | Description                                                                                                                                                                                                                    | Legend | Water | Instr |
|-----------|----------------|------------------|-----------------|-----------------------------------------------------------------|-------------|------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|-------|-------|
| 0.30      | ES1            |                  |                 |                                                                 | 67.58       | (0.20)                 | *TOPSOIL.                                                                                                                                                                                                                      |        |       |       |
| 0.50-1.00 | B1             |                  |                 |                                                                 | 67.28       | 0.20<br>(0.30)<br>0.50 | *MADE GROUND comprising topsoil composed of dry friable brown gravelly clay fill.                                                                                                                                              |        |       |       |
| 1.20-1.56 | SPT(C) 50/210  |                  |                 |                                                                 |             | (0.60)                 | MADE GROUND comprising topsoil composed of orange brown gravelly silty slightly clayey fine and medium SAND with occasional rootlets and rare roots. Gravel is predominantly subangular to rounded medium and coarse of flint. |        |       |       |
| 1.20      | ES2            |                  | DRY             | 4,5/11,18,21                                                    | 66.68       | 1.10                   | Very dense orange brown very sandy clayey angular to rounded predominantly fine and medium GRAVEL of flint with rare pockets of clay and rootlets. Sand is predominantly medium and coarse. (BOYN HILL GRAVEL MEMBER)          |        |       |       |
| 1.20-1.70 | B2             |                  |                 |                                                                 |             |                        |                                                                                                                                                                                                                                |        |       |       |
| 2.20-2.60 | SPT(C) 50/245  | 1.60             | DRY             | 8,8/12,14,18,6                                                  |             |                        |                                                                                                                                                                                                                                |        |       |       |
| 2.70-3.20 | B3             |                  |                 | Seepage(1) at 2.60m, rose to 2.55m in 20 mins, sealed at 4.30m. |             | (3.15)                 | From 2.70m; Damp slightly clayey. No pockets of clay or rootlets.                                                                                                                                                              |        |       |       |
| 3.20-3.65 | SPT(C) N=30    | 3.20             | DRY             | 7,8/7,8,7,8                                                     |             |                        | From 3.20m; Dense.                                                                                                                                                                                                             |        |       |       |
| 4.20-4.65 | SPT(C) N=14    | 4.20             | DRY             | 4,5/3,3,4,4                                                     | 63.53       | 4.25                   | Stiff to very stiff orange brown occasionally dark and light grey mottled CLAY with frequent black kerogen staining. (LONDON CLAY FORMATION)                                                                                   |        |       |       |
| 4.40      | D1             |                  |                 |                                                                 | 63.18       | (0.35)<br>4.60         | Stiff to very stiff dark grey CLAY. (LONDON CLAY FORMATION)                                                                                                                                                                    |        |       |       |
| 4.70      | D2             |                  |                 |                                                                 |             |                        |                                                                                                                                                                                                                                |        |       |       |
| 5.00-5.45 | U1             | 4.60             | DRY             | 50 blows                                                        |             |                        |                                                                                                                                                                                                                                |        |       |       |
| 5.50      | D3             |                  |                 |                                                                 |             |                        |                                                                                                                                                                                                                                |        |       |       |
| 5.75-6.25 | B4             |                  |                 |                                                                 |             |                        | From 5.50m; Extremely closely fissured and thinly laminated.                                                                                                                                                                   |        |       |       |
| 6.50-6.95 | SPT N=16       | 4.60             | DRY             | 3,3/3,4,4,5                                                     |             |                        |                                                                                                                                                                                                                                |        |       |       |
| 6.50-6.95 | D4             |                  |                 |                                                                 |             |                        | From 6.50m; Very stiff.                                                                                                                                                                                                        |        |       |       |
| 7.50      | D5             |                  |                 |                                                                 |             |                        |                                                                                                                                                                                                                                |        |       |       |
| 8.00-8.45 | U2             | 4.60             | DRY             | 70 blows                                                        |             |                        |                                                                                                                                                                                                                                |        |       |       |
| 8.50      | D6             |                  |                 |                                                                 |             |                        |                                                                                                                                                                                                                                |        |       |       |
| 9.00      | D7             |                  |                 |                                                                 |             |                        |                                                                                                                                                                                                                                |        |       |       |
| 9.50-9.95 | SPT N=23       | 4.60             | DRY             | 4,4/5,5,6,7                                                     |             |                        |                                                                                                                                                                                                                                |        |       |       |
| 9.50-9.95 | D8             |                  |                 |                                                                 |             | (10.30)                | From 9.00m; Slightly fissured and slightly laminated with rare to occasional pockets and lenses of light grey fine sand.                                                                                                       |        |       |       |

**Remarks**

Standpipe installation - plain standpipe installed to 1.00m surrounded with bentonite, slotted standpipe installed to 10.00m and sealed with bentonite to 11.00m. Fitted with a gas tap and a stop cock cover.

1 hour moving excess borehole arisings to skip and reinstating borehole, and 1 hour moving Heras fencing.

\*Drillers description.

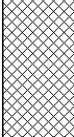
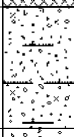
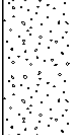
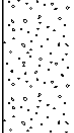
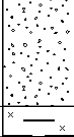
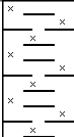
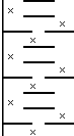
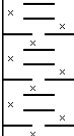
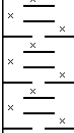
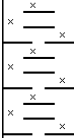
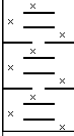
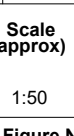
Excavating from 0.00m to 1.20m for 1 hour.

**Scale (approx)**  
1:50

**Logged By**  
EM

**Figure No.**  
A2.2

|                                                                                                       |                |                                         |                 |                             |             |                                                                                                      |             |                        |       |       |
|-------------------------------------------------------------------------------------------------------|----------------|-----------------------------------------|-----------------|-----------------------------|-------------|------------------------------------------------------------------------------------------------------|-------------|------------------------|-------|-------|
|  IAN FARMER ASSOCIATES |                |                                         |                 |                             |             | Site<br>University of Reading, St Patricks Hall Redevelopment, 20 Northcourt Avenue, Reading RG2 7HB |             | Borehole Number<br>BH2 |       |       |
| Boring Method<br>Cable Percussion                                                                     |                | Casing Diameter<br>150mm cased to 4.60m |                 | Ground Level (mOD)<br>67.78 |             | Client<br>Curtins                                                                                    |             | Job Number<br>52527    |       |       |
|                                                                                                       |                | Location<br>472771.2 E 171872.9 N       |                 | Dates<br>15/08/2016         |             | Engineer                                                                                             |             | Sheet<br>2/2           |       |       |
| Depth (m)                                                                                             | Sample / Tests | Casing Depth (m)                        | Water Depth (m) | Field Records               | Level (mOD) | Depth (m) (Thickness)                                                                                | Description | Legend                 | Water | Instr |
| 10.50                                                                                                 | D9             |                                         |                 |                             |             |                                                                                                      |             |                        |       |       |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                          |                                         |                 |                                                                            |                |                                                                                                      |                                                                                                                                                                                                                                                                                                            |                                                                                       |                        |       |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|-----------------------------------------|-----------------|----------------------------------------------------------------------------|----------------|------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|------------------------|-------|
|  IAN FARMER ASSOCIATES                                                                                                                                                                                                                                                                                                                                                                                                               |                          |                                         |                 |                                                                            |                | Site<br>University of Reading, St Patricks Hall Redevelopment, 20 Northcourt Avenue, Reading RG2 7HB |                                                                                                                                                                                                                                                                                                            |                                                                                       | Borehole Number<br>BH3 |       |
| Boring Method<br>Cable Percussion                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                          | Casing Diameter<br>150mm cased to 5.50m |                 | Ground Level (mOD)<br>68.28                                                |                | Client<br>Curtins                                                                                    |                                                                                                                                                                                                                                                                                                            |                                                                                       | Job Number<br>52527    |       |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                          | Location<br>472868.4 E 171843.1 N       |                 | Dates<br>16/08/2016                                                        |                | Engineer                                                                                             |                                                                                                                                                                                                                                                                                                            |                                                                                       | Sheet<br>1/2           |       |
| Depth (m)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Sample / Tests           | Casing Depth (m)                        | Water Depth (m) | Field Records                                                              | Level (mOD)    | Depth (m) (Thickness)                                                                                | Description                                                                                                                                                                                                                                                                                                | Legend                                                                                | Water                  | Instr |
| 0.40<br>0.40-0.80                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | ES1<br>B1                |                                         |                 |                                                                            | 68.08          | (0.20)<br>0.20                                                                                       | *Brown gravelly TOPSOIL.                                                                                                                                                                                                                                                                                   |    |                        |       |
| 1.00<br>1.20-1.65<br>1.20-1.60                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | ES2<br>SPT(C) N=24<br>B2 |                                         | DRY             | 5,5/6,6,5,7                                                                | 67.08          | (1.00)<br>1.20                                                                                       | MADE GROUND comprising topsoil composed of dark brown and orange brown silty very clayey fine and medium SAND and angular to rounded fine to coarse GRAVEL of flint with firm friable orange brown very gravelly sandy clay and firm friable dark brown very sandy gravelly clay, and occasional rootlets. |    |                        |       |
| 2.00-2.45<br>2.00-2.40                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | SPT(C) N=38<br>B3        | 2.00                                    | DRY             | 7,7/8,9,9,12                                                               | 66.28          | (0.80)<br>2.00                                                                                       | Medium dense orange brown slightly silty very clayey predominantly medium to coarse SAND and angular to rounded fine to coarse GRAVEL of flint with frequent pockets of firm orange brown, light grey and occasionally red mottled very gravelly very sandy clay. (BOYN HILL GRAVEL MEMBER)                |    |                        |       |
| 3.00-3.45<br>3.00-3.40                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | SPT(C) N=40<br>B4        | 3.00                                    | DRY             | 8,8/10,10,9,11                                                             |                | (2.50)                                                                                               | Wet, becoming damp dense orange brown very sandy slightly clayey angular to rounded predominantly medium and coarse GRAVEL of flint with rare pockets of soft grey sandy clay. Sand is predominantly medium and coarse. (BOYN HILL GRAVEL MEMBER)                                                          |    |                        |       |
| 4.00-4.40<br>4.00-4.45                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | B5<br>SPT(C) N=18        | 4.00                                    | 3.80            | Medium(1) at 3.80m, rose to 3.70m in 20 mins, sealed at 4.50m. 4,4/6,4,4,4 |                |                                                                                                      | From 3.00m; Brown/orange brown and sandy. Not clayey and no pockets of clay.                                                                                                                                                                                                                               |   |                        |       |
| 4.50<br>4.70                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | D1<br>D2                 |                                         |                 |                                                                            | 63.78<br>63.58 | 4.50<br>(0.20)<br>4.70                                                                               | From 4.00m; Orange brown and slightly sandy.                                                                                                                                                                                                                                                               |  |                        |       |
| 5.00-5.45<br>5.00-5.45                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | SPT N=12<br>D3           | 5.00                                    | DRY             | 1,2/3,3,3,3                                                                |                |                                                                                                      | Firm to stiff orange brown CLAY with frequent pockets and lenses of orange brown silt. (LONDON CLAY FORMATION)                                                                                                                                                                                             |  |                        |       |
| 6.00                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | D4                       |                                         |                 |                                                                            |                |                                                                                                      | Very stiff, becoming extremely closely fissured and thinly laminated dark grey CLAY with rare fine shell fragments. (LONDON CLAY FORMATION)                                                                                                                                                                |  |                        |       |
| 6.50-6.95                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | U1                       | 5.50                                    | DRY             | 42 blows                                                                   |                |                                                                                                      | From 6.00m; Stiff to very stiff.                                                                                                                                                                                                                                                                           |  |                        |       |
| 6.95<br>7.10-7.20                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | D5<br>B6                 |                                         |                 |                                                                            |                |                                                                                                      | From 6.95m; With rare to occasional pockets and lenses of light grey fine sand.                                                                                                                                                                                                                            |  |                        |       |
| 7.50                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | D6                       |                                         |                 |                                                                            |                |                                                                                                      | *From 7.10m to 7.20m; CLAYSTONE recovered as stiff dark grey CLAY with occasional medium gravel to cobble size fragments of claystone, and occasional pockets and lenses of light grey silt.                                                                                                               |  |                        |       |
| 8.00-8.45<br>8.00-8.45                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | SPT N=14<br>D7           | 5.50                                    | DRY             | 2,2/2,4,4,4                                                                |                |                                                                                                      | From 7.50m; Very stiff.                                                                                                                                                                                                                                                                                    |  |                        |       |
| 9.00                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | D8                       |                                         |                 |                                                                            |                |                                                                                                      | At 9.00m; Stiff to very stiff.                                                                                                                                                                                                                                                                             |  |                        |       |
| 9.50-9.95                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | U2                       | 5.50                                    | DRY             | 48 blows                                                                   |                |                                                                                                      |                                                                                                                                                                                                                                                                                                            |  |                        |       |
| <b>Remarks</b><br>Standpipe installation - plain standpipe installed to 1.00m surrounded with bentonite, slotted standpipe installed to 10.00m and sealed with bentonite to 11.00m. Fitted with a gas tap and a stop cock cover.<br>1 hour clearing borehole area and moving excess borehole arisings to skip.<br>1 hour moving and erecting Heras fencing.<br>*Drillers description.<br>Chiselling from 7.10m to 7.20m for 0.50 hours. Water added from 1.20m to 4.00m. Excavating from 0.00m to 1.20m for 1 hour. |                          |                                         |                 |                                                                            |                |                                                                                                      |                                                                                                                                                                                                                                                                                                            | Scale (approx)<br>1:50                                                                | Logged By<br>EM        |       |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                          |                                         |                 |                                                                            |                |                                                                                                      |                                                                                                                                                                                                                                                                                                            | Figure No.<br>A2.3                                                                    |                        |       |

|                                     |                          |                                         |                 |               |                             |                       |                                                                                                                                                                               |                    |                        |       |
|-------------------------------------|--------------------------|-----------------------------------------|-----------------|---------------|-----------------------------|-----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|------------------------|-------|
| IAN FARMER ASSOCIATES               |                          |                                         |                 |               |                             |                       | Site<br>University of Reading, St Patricks Hall Redevelopment, 20 Northcourt Avenue, Reading RG2 7HB                                                                          |                    | Borehole Number<br>BH3 |       |
| Boring Method<br>Cable Percussion   |                          | Casing Diameter<br>150mm cased to 5.50m |                 |               | Ground Level (mOD)<br>68.28 |                       | Client<br>Curtins                                                                                                                                                             |                    | Job Number<br>52527    |       |
|                                     |                          | Location<br>472868.4 E 171843.1 N       |                 |               | Dates<br>16/08/2016         |                       | Engineer                                                                                                                                                                      |                    | Sheet<br>2/2           |       |
| Depth (m)                           | Sample / Tests           | Casing Depth (m)                        | Water Depth (m) | Field Records | Level (mOD)                 | Depth (m) (Thickness) | Description                                                                                                                                                                   | Legend             | Water                  | Instr |
| 9.95                                | D9                       |                                         |                 |               |                             |                       |                                                                                                                                                                               |                    |                        |       |
| 10.50                               | D10                      |                                         |                 |               |                             | (11.55)               |                                                                                                                                                                               |                    |                        |       |
| 11.00-11.45<br>11.00-11.45          | SPT N=24<br>D11          | 5.50                                    | DRY             | 3,4/5,6,6,7   |                             |                       | From 11.00m; Slightly fissured and slightly laminated.                                                                                                                        |                    |                        |       |
| 12.00                               | D12                      |                                         |                 |               |                             |                       |                                                                                                                                                                               |                    |                        |       |
| 12.50-12.95                         | U3                       | 5.50                                    | DRY             | 60 blows      |                             |                       |                                                                                                                                                                               |                    |                        |       |
| 12.95                               | D13                      |                                         |                 |               |                             |                       |                                                                                                                                                                               |                    |                        |       |
| 13.50                               | D14                      |                                         |                 |               |                             |                       |                                                                                                                                                                               |                    |                        |       |
| 14.00-14.45<br>14.00-14.45          | SPT N=32<br>D15          | 5.50                                    | DRY             | 4,4/6,8,8,10  |                             |                       |                                                                                                                                                                               |                    |                        |       |
| 15.00                               | D16                      |                                         |                 |               |                             |                       | At 15.00m; Slightly sandy.                                                                                                                                                    |                    |                        |       |
| 15.50-15.95                         | U4                       | 5.50                                    | DRY             | 72 blows      |                             |                       |                                                                                                                                                                               |                    |                        |       |
| 15.95                               | D17                      |                                         |                 |               | 52.03                       | 16.25                 | Very stiff dark grey sandy CLAY with occasional becoming rare fine and medium shell fragments. Sand is fine and medium. (LAMBETH GROUP - WOOLWICH FORMATION 'LAMINATED BEDS') |                    |                        |       |
| 16.80<br>17.00-17.38<br>17.00-17.45 | D18<br>SPT 52/225<br>D19 | 5.50                                    | DRY             | 7,8/12,17,23  |                             |                       | From 17.00m; Firm to stiff friable.                                                                                                                                           |                    |                        |       |
| 18.00                               | D20                      |                                         |                 |               |                             | (3.75)                |                                                                                                                                                                               |                    |                        |       |
| 18.50-18.95                         | U5                       | 5.50                                    | DRY             | 96 blows      |                             |                       |                                                                                                                                                                               |                    |                        |       |
| 18.95                               | D21                      |                                         |                 |               |                             |                       | At 18.95m; Stiff to very stiff thinly laminated and slightly sandy.                                                                                                           |                    |                        |       |
| 19.50-19.88<br>19.50-19.95          | SPT 57/225<br>D22        | 5.50                                    | DRY             | 8,9/14,17,26  | 48.28                       | 20.00                 |                                                                                                                                                                               |                    |                        |       |
| Remarks                             |                          |                                         |                 |               |                             |                       |                                                                                                                                                                               | Scale (approx)     | Logged By              |       |
|                                     |                          |                                         |                 |               |                             |                       |                                                                                                                                                                               | 1:50               | EM                     |       |
|                                     |                          |                                         |                 |               |                             |                       |                                                                                                                                                                               | Figure No.<br>A2.3 |                        |       |



|                                                                                                             |                                                |                                      |
|-------------------------------------------------------------------------------------------------------------|------------------------------------------------|--------------------------------------|
| <b>Site</b><br>University of Reading, St Patricks Hall Redevelopment, 20 Northcourt Avenue, Reading RG2 7HB |                                                | <b>Borehole Number</b><br><b>BH4</b> |
| <b>Boring Method</b><br>Cable Percussion                                                                    | <b>Casing Diameter</b><br>150mm cased to 4.50m | <b>Ground Level (mOD)</b><br>68.27   |
|                                                                                                             | <b>Location</b><br>472822.5 E 171818.5 N       | <b>Dates</b><br>17/08/2016           |
|                                                                                                             |                                                | <b>Client</b><br>Curtins             |
|                                                                                                             |                                                | <b>Engineer</b>                      |
|                                                                                                             |                                                | <b>Job Number</b><br>52527           |
|                                                                                                             |                                                | <b>Sheet</b><br>1/2                  |

| Depth (m)                      | Sample / Tests           | Casing Depth (m) | Water Depth (m) | Field Records                                                              | Level (mOD)             | Depth (m) (Thickness)            | Description                                                                                                                                                                                                                                                                                                               | Legend | Water | Instr |
|--------------------------------|--------------------------|------------------|-----------------|----------------------------------------------------------------------------|-------------------------|----------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|-------|-------|
| 0.40<br>0.40-0.80              | ES1<br>B1                |                  |                 |                                                                            |                         | (1.40)                           | MADE GROUND comprising topsoil composed of firm friable dark brown occasionally orange brown gravelly very sandy very silty CLAY with occasional rootlets, rare medium gravel size clinker fragments and fine gravel size brick fragments. Gravel is angular to rounded fine to coarse of flint. Sand is fine and medium. |        |       |       |
| 1.00<br>1.20-1.65<br>1.20-1.60 | ES2<br>SPT(C) N=22<br>B2 |                  | DRY             | 5,5/6,6,4,6                                                                | 66.87                   | 1.40<br>(0.60)                   | From 1.20m; Very gravelly sandy silty. Gravel is predominantly angular and subangular.<br><br>Very stiff orange brown, light grey and red mottled very gravelly very sandy CLAY. Gravel is angular to subrounded fine to coarse of flint. Sand is predominantly medium and coarse. (BOYN HILL GRAVEL MEMBER)              |        |       |       |
| 2.00-2.45<br>2.00-2.40         | SPT(C) N=51<br>B3        | 2.00             | DRY             | 6,7/9,12,14,16                                                             | 66.27                   | 2.00                             | Very dense orange brown gravelly silty clayey predominantly medium and coarse SAND. Gravel is predominantly angular and subangular, becoming angular to subrounded fine and medium of flint. (BOYN HILL GRAVEL MEMBER)                                                                                                    |        |       |       |
| 3.00-3.45<br>3.00-3.40         | SPT(C) N=41<br>B4        | 3.00             | DRY             | 7,7/9,10,10,12                                                             |                         | (2.00)                           | From 3.00m; Dense with occasional pockets of firm friable orange brown and light grey mottled very gravelly very sandy clay.                                                                                                                                                                                              |        |       |       |
| 4.00-4.40<br>4.00-4.45<br>4.40 | B5<br>SPT(C) N=17<br>D1  | 4.00             | 3.90            | Medium(1) at 3.80m, rose to 3.70m in 20 mins, sealed at 4.30m. 4,5/5,5,4,3 | 64.27<br>63.97<br>63.77 | 4.00<br>(0.30)<br>(0.20)<br>4.50 | Wet medium dense orange brown very sandy slightly clayey angular to rounded predominantly fine and medium GRAVEL of flint. Sand is predominantly medium and coarse. (BOYN HILL GRAVEL MEMBER)                                                                                                                             |        |       |       |
| 4.70<br>5.00-5.45<br>5.00-5.45 | D2<br>SPT N=14<br>D3     | 4.50             | DRY             | 2,2/3,3,4,4                                                                |                         |                                  | Stiff orange brown CLAY with frequent black kerogen staining. (LONDON CLAY FORMATION)<br><br>Stiff to very stiff extremely closely fissured dark grey CLAY. (LONDON CLAY FORMATION)                                                                                                                                       |        |       |       |
| 6.00<br>6.50-6.95              | D4<br>U1                 | 4.50             | DRY             | 44 blows                                                                   |                         |                                  |                                                                                                                                                                                                                                                                                                                           |        |       |       |
| 6.95<br>7.20-7.30<br>7.50      | D5<br>B6<br>D6           |                  |                 |                                                                            |                         |                                  | From 6.95m; Very stiff thinly laminated.<br><br>*From 7.20m to 7.30m; CLAYSTONE recovered as stiff dark grey CLAY with frequent fine to coarse gravel size fragments of claystone and rare fine and medium shell fragments.                                                                                               |        |       |       |
| 8.00-8.45<br>8.00-8.45         | SPT N=19<br>D7           | 4.50             | DRY             | 3,3/4,5,5,5                                                                |                         |                                  | From 7.50m; With rare to occasional fine and medium shell fragments, and pockets and lenses of light grey fine sand.                                                                                                                                                                                                      |        |       |       |
| 9.00<br>9.50-9.95              | D8<br>U2                 | 4.50             | DRY             | 52 blows                                                                   |                         |                                  |                                                                                                                                                                                                                                                                                                                           |        |       |       |

#### Remarks

Standpipe installation - plain standpipe installed to 1.00m surrounded with bentonite, slotted standpipe installed to 10.00m and sealed with bentonite to 11.00m. Fitted with a gas tap and a stop cock cover.  
1 hour clearing borehole area and moving excess borehole arisings to skip.  
1 hour erecting Heras fencing.  
\*Drillers description.  
Chiselling from 7.20m to 7.30m for 0.50 hours. Water added from 3.00m to 4.50m. Excavating from 0.00m to 1.20m for 1 hour.

Scale (approx)

1:50

Logged By

EM

Figure No.

A2.4

|                                                                                                                  |                       |                                                |                        |                      |                                    |                                                                                     |                                                                                                                                                                                                                                                     |                                                                                       |                                      |              |
|------------------------------------------------------------------------------------------------------------------|-----------------------|------------------------------------------------|------------------------|----------------------|------------------------------------|-------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|--------------------------------------|--------------|
| <div> IAN FARMER ASSOCIATES</div> |                       |                                                |                        |                      |                                    |                                                                                     | <b>Site</b><br>University of Reading, St Patricks Hall Redevelopment, 20 Northcourt Avenue, Reading RG2 7HB                                                                                                                                         |                                                                                       | <b>Borehole Number</b><br><b>BH4</b> |              |
| <b>Boring Method</b><br>Cable Percussion                                                                         |                       | <b>Casing Diameter</b><br>150mm cased to 4.50m |                        |                      | <b>Ground Level (mOD)</b><br>68.27 |                                                                                     | <b>Client</b><br>Curtins                                                                                                                                                                                                                            |                                                                                       | <b>Job Number</b><br>52527           |              |
|                                                                                                                  |                       | <b>Location</b><br>472822.5 E 171818.5 N       |                        |                      | <b>Dates</b><br>17/08/2016         |                                                                                     | <b>Engineer</b>                                                                                                                                                                                                                                     |                                                                                       | <b>Sheet</b><br>2/2                  |              |
| <b>Depth (m)</b>                                                                                                 | <b>Sample / Tests</b> | <b>Casing Depth (m)</b>                        | <b>Water Depth (m)</b> | <b>Field Records</b> | <b>Level (mOD)</b>                 | <b>Depth (m) (Thickness)</b>                                                        | <b>Description</b>                                                                                                                                                                                                                                  | <b>Legend</b>                                                                         | <b>Water</b>                         | <b>Instr</b> |
| 9.95                                                                                                             | D9                    | 4.50                                           | DRY                    | 4,4/6,6,6,8          |                                    | (11.80)                                                                             |                                                                                                                                                                                                                                                     |    |                                      |              |
| 10.50                                                                                                            | D10                   |                                                |                        |                      |                                    |                                                                                     |                                                                                                                                                                                                                                                     |    |                                      |              |
| 11.00-11.45<br>11.00-11.45                                                                                       | SPT N=26<br>D11       |                                                |                        |                      |                                    |                                                                                     |                                                                                                                                                                                                                                                     |    |                                      |              |
| 12.00                                                                                                            | D12                   |                                                |                        |                      |                                    |                                                                                     |                                                                                                                                                                                                                                                     |    |                                      |              |
| 12.50-12.95                                                                                                      | U3                    | 4.50                                           | DRY                    | 64 blows             |                                    |                                                                                     | At 12.95m; With rare coarse gravel size iron pyrite nodules.                                                                                                                                                                                        |    |                                      |              |
| 12.95                                                                                                            | D13                   |                                                |                        |                      |                                    |  |                                                                                                                                                                                                                                                     |                                                                                       |                                      |              |
| 13.50                                                                                                            | D14                   |                                                |                        |                      |                                    |  |                                                                                                                                                                                                                                                     |                                                                                       |                                      |              |
| 14.00-14.45<br>14.00-14.45                                                                                       | SPT N=29<br>D15       | 4.50                                           | DRY                    | 4,5/6,7,7,9          |                                    |  |                                                                                                                                                                                                                                                     |                                                                                       |                                      |              |
| 15.00                                                                                                            | D16                   | 4.50                                           | DRY                    | 74 blows             |                                    |                                                                                     | From 13.50m; Slightly fissured and slightly laminated.                                                                                                                                                                                              |    |                                      |              |
| 15.50-15.95                                                                                                      | U4                    |                                                |                        |                      |                                    |                                                                                     |                                                                                                                                                                                                                                                     |    |                                      |              |
| 15.95                                                                                                            | D17                   |                                                |                        |                      |                                    |                                                                                     |                                                                                                                                                                                                                                                     |  |                                      |              |
| 16.30                                                                                                            | D18                   |                                                |                        |                      |                                    |                                                                                     |                                                                                                                                                                                                                                                     |  |                                      |              |
| 17.00-17.45<br>17.00-17.45                                                                                       | SPT N=57<br>D19       | 4.50                                           | DRY                    | 7,7/11,13,13,20      | 51.97                              | 16.30                                                                               | Very stiff dark green/dark grey, becoming stiff to very stiff slightly laminated dark grey sandy silty CLAY with rare to occasional fine and medium shell fragments. Sand is fine and medium. (LAMBETH GROUP - WOOLWICH FORMATION 'LAMINATED BEDS') |  |                                      |              |
| 18.00                                                                                                            | D20                   | 4.50                                           | DRY                    | 92 blows             |                                    | (3.70)                                                                              | From 18.00m; Firm to stiff friable.                                                                                                                                                                                                                 |  |                                      |              |
| 18.50-18.95                                                                                                      | U5                    |                                                |                        |                      |                                    |                                                                                     |                                                                                                                                                                                                                                                     |  |                                      |              |
| 18.95                                                                                                            | D21                   |                                                |                        |                      |                                    |                                                                                     |                                                                                                                                                                                                                                                     |  |                                      |              |
| 19.50-19.88<br>19.50-19.95                                                                                       | SPT 60/225<br>D22     | 4.50                                           | DRY                    | 9,9/16,18,26         |                                    |                                                                                     | From 19.50m; Firm to very stiff friable.                                                                                                                                                                                                            |  |                                      |              |
|                                                                                                                  |                       |                                                |                        |                      | 48.27                              | 20.00                                                                               |                                                                                                                                                                                                                                                     |  |                                      |              |
| <b>Remarks</b>                                                                                                   |                       |                                                |                        |                      |                                    |                                                                                     |                                                                                                                                                                                                                                                     | <b>Scale (approx)</b>                                                                 | <b>Logged By</b>                     |              |
|                                                                                                                  |                       |                                                |                        |                      |                                    |                                                                                     |                                                                                                                                                                                                                                                     | 1:50                                                                                  | EM                                   |              |
|                                                                                                                  |                       |                                                |                        |                      |                                    |                                                                                     |                                                                                                                                                                                                                                                     | <b>Figure No.</b><br>A2.4                                                             |                                      |              |

|                                                                                                                                                                    |                            |                                                |                        |                                                              |                    |                                                                                                             |                                                                                                                                                                                                                                                            |                                                                                       |                        |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|------------------------------------------------|------------------------|--------------------------------------------------------------|--------------------|-------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|------------------------|
|                                                                                     |                            |                                                |                        |                                                              |                    | <b>Site</b><br>University of Reading, St Patricks Hall Redevelopment, 20 Northcourt Avenue, Reading RG2 7HB |                                                                                                                                                                                                                                                            | <b>Borehole Number</b><br><b>BH5</b>                                                  |                        |
| <b>Boring Method</b><br>Cable Percussion                                                                                                                           |                            | <b>Casing Diameter</b><br>150mm cased to 5.50m |                        | <b>Ground Level (mOD)</b><br>68.99                           |                    | <b>Client</b><br>Curtins                                                                                    |                                                                                                                                                                                                                                                            | <b>Job Number</b><br>52527                                                            |                        |
|                                                                                                                                                                    |                            | <b>Location</b><br>472890.9 E 171769.5 N       |                        | <b>Dates</b><br>17/08/2016                                   |                    | <b>Engineer</b>                                                                                             |                                                                                                                                                                                                                                                            | <b>Sheet</b><br>1/3                                                                   |                        |
| <b>Depth (m)</b>                                                                                                                                                   | <b>Sample / Tests</b>      | <b>Casing Depth (m)</b>                        | <b>Water Depth (m)</b> | <b>Field Records</b>                                         | <b>Level (mOD)</b> | <b>Depth (m) (Thickness)</b>                                                                                | <b>Description</b>                                                                                                                                                                                                                                         | <b>Legend</b>                                                                         | <b>Water</b>           |
| 0.15-0.45<br>0.20                                                                                                                                                  | B1<br>ES1                  |                                                |                        |                                                              | 68.84              | (0.15)<br>0.15                                                                                              | *TOPSOIL.                                                                                                                                                                                                                                                  |    |                        |
| 0.50-1.00<br>0.60                                                                                                                                                  | B2<br>ES2                  |                                                |                        |                                                              | 68.49              | (0.35)<br>0.50                                                                                              | MADE GROUND comprising topsoil composed of dry brown very gravelly silty slightly clayey fine to coarse SAND with occasional rootlets. Gravel is angular to rounded predominantly fine and medium of flint.                                                |    |                        |
| 1.20-1.65<br>1.20<br>1.20-1.65<br>1.50-2.00                                                                                                                        | SPT N=22<br>D1<br>D2<br>B3 |                                                | DRY                    | 3,4/6,5,6,5                                                  | 67.54              | (0.95)<br>1.45                                                                                              | Stiff to very stiff, becoming very stiff orange brown and light grey mottled sandy, becoming sandy to very sandy CLAY. Sand is fine and medium. (BOYN HILL GRAVEL MEMBER)                                                                                  |    |                        |
| 2.20-2.65                                                                                                                                                          | SPT(C) N=23                | 2.20                                           | DRY                    | 5,5/5,7,6,5                                                  |                    | (2.65)                                                                                                      | Medium dense orange brown slightly silty slightly clayey fine to coarse SAND with occasional to frequent pockets of soft to firm orange brown and light grey mottled sandy, becoming slightly gravelly sandy to very sandy clay. (BOYN HILL GRAVEL MEMBER) |    |                        |
| 3.00-3.50<br>3.20-3.65                                                                                                                                             | B4<br>SPT(C) N=26          | 3.20                                           | DRY                    | 4,4/6,7,7,6                                                  |                    |                                                                                                             | From 1.50m; Gravelly, silty and clayey.                                                                                                                                                                                                                    |    |                        |
| 4.20-4.65<br>4.20-4.70                                                                                                                                             | SPT(C) N=38<br>B5          | 4.20                                           | DRY                    | 5,6/8,9,10,11                                                | 64.89              | 4.10                                                                                                        | From 3.00m; Slightly gravelly.                                                                                                                                                                                                                             |    |                        |
| 5.20                                                                                                                                                               | D3                         |                                                |                        | Slow(1) at 4.75m, rose to 4.50m in 20 mins, sealed at 5.20m. | 63.89              | (1.00)<br>5.10                                                                                              | Damp dense brown/orange brown predominantly medium and coarse SAND and angular to rounded fine to coarse GRAVEL of flint. (BOYN HILL GRAVEL MEMBER)                                                                                                        |    | ▼1<br>▽1               |
| 5.50-5.95<br>5.50<br>5.50-5.95                                                                                                                                     | SPT N=14<br>D4<br>D5       | 5.50                                           | DRY                    | 2,3/3,3,4,4                                                  | 63.59              | (0.30)<br>5.40                                                                                              | Firm to stiff orange brown occasionally light grey mottled CLAY with rare black kerogen staining. (LONDON CLAY FORMATION)                                                                                                                                  |    |                        |
| 6.00-6.50                                                                                                                                                          | B6                         |                                                |                        |                                                              |                    |                                                                                                             | Stiff to very stiff extremely closely fissured dark grey CLAY. (LONDON CLAY FORMATION)                                                                                                                                                                     |    |                        |
| 7.00-7.45                                                                                                                                                          | U1                         | 5.50                                           | DRY                    | 50 blows                                                     |                    |                                                                                                             |                                                                                                                                                                                                                                                            |    |                        |
| 7.50                                                                                                                                                               | D6                         |                                                |                        |                                                              |                    |                                                                                                             |                                                                                                                                                                                                                                                            |    |                        |
| 8.00                                                                                                                                                               | D7                         |                                                |                        |                                                              |                    |                                                                                                             | From 8.00m; With rare pockets and lenses of light grey silt.                                                                                                                                                                                               |    |                        |
| 8.50-8.95<br>8.50-8.95                                                                                                                                             | SPT N=20<br>D8             | 5.50                                           | DRY                    | 3,3/4,5,5,6                                                  |                    |                                                                                                             | From 8.60m; Thinly laminated.                                                                                                                                                                                                                              |   |                        |
| 9.50                                                                                                                                                               | D9                         |                                                |                        |                                                              |                    |                                                                                                             | From 9.50m; With rare fine and medium shell fragments.                                                                                                                                                                                                     |  |                        |
| <b>Remarks</b><br>1 hour reinstating borehole and moving excess borehole arisings to skip.<br>*Drillers description.<br>Excavating from 0.00m to 1.20m for 1 hour. |                            |                                                |                        |                                                              |                    |                                                                                                             | <b>Scale (approx)</b><br>1:50                                                                                                                                                                                                                              |                                                                                       | <b>Logged By</b><br>EM |
|                                                                                                                                                                    |                            |                                                |                        |                                                              |                    |                                                                                                             | <b>Figure No.</b><br>A2.5                                                                                                                                                                                                                                  |                                                                                       |                        |
|                                                                                                                                                                    |                            |                                                |                        |                                                              |                    |                                                                                                             |                                                                                                                                                                                                                                                            |                                                                                       |                        |

|  IAN FARMER ASSOCIATES |                 |                                         |                 |                 |                             |                       | Site<br>University of Reading, St Patricks Hall Redevelopment, 20 Northcourt Avenue, Reading RG2 7HB        |                                                                                       | Borehole Number<br>BH5                                                                |  |
|-------------------------------------------------------------------------------------------------------|-----------------|-----------------------------------------|-----------------|-----------------|-----------------------------|-----------------------|-------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|--|
| Boring Method<br>Cable Percussion                                                                     |                 | Casing Diameter<br>150mm cased to 5.50m |                 |                 | Ground Level (mOD)<br>68.99 |                       | Client<br>Curtins                                                                                           |                                                                                       | Job Number<br>52527                                                                   |  |
|                                                                                                       |                 | Location<br>472890.9 E 171769.5 N       |                 |                 | Dates<br>17/08/2016         |                       | Engineer                                                                                                    |                                                                                       | Sheet<br>2/3                                                                          |  |
| Depth (m)                                                                                             | Sample / Tests  | Casing Depth (m)                        | Water Depth (m) | Field Records   | Level (mOD)                 | Depth (m) (Thickness) | Description                                                                                                 | Legend                                                                                | Water                                                                                 |  |
| 10.00-10.45                                                                                           | U2              | 5.50                                    | DRY             | 70 blows        |                             | (14.20)               | From 11.00m; Very stiff                                                                                     |    |                                                                                       |  |
| 10.50                                                                                                 | D10             |                                         |                 |                 |                             |                       |                                                                                                             |    |                                                                                       |  |
| 11.00                                                                                                 | D11             |                                         |                 |                 |                             |                       |                                                                                                             |    |                                                                                       |  |
| 11.50-11.95                                                                                           | SPT N=25<br>D12 | 5.50                                    | DRY             | 4,4/5,7,6,7     |                             |                       |                                                                                                             |    |                                                                                       |  |
| 12.50                                                                                                 | D13             |                                         |                 |                 |                             |                       |                                                                                                             |    |                                                                                       |  |
| 13.00-13.45                                                                                           | U3              | 5.50                                    | DRY             | 80 blows        |                             |                       |                                                                                                             |    |                                                                                       |  |
| 13.50                                                                                                 | D14             |                                         |                 |                 |                             |                       |                                                                                                             |    |                                                                                       |  |
| 14.00                                                                                                 | D15             |                                         |                 |                 |                             |                       |                                                                                                             |    |                                                                                       |  |
| 14.50-14.95                                                                                           | SPT N=29<br>D16 | 5.50                                    | DRY             | 3,4/6,7,8,8     |                             |                       |                                                                                                             |    |                                                                                       |  |
| 15.50                                                                                                 | D17             |                                         |                 |                 |                             |                       |                                                                                                             |    |                                                                                       |  |
| 16.00-16.45                                                                                           | U4              | 5.50                                    | DRY             | 85 blows        |                             |                       | From 17.50m; With rare pockets and lenses of light grey fine sand. No pockets or lenses of light grey silt. |    |                                                                                       |  |
| 16.50                                                                                                 | D18             |                                         |                 |                 |                             |                       |                                                                                                             |    |                                                                                       |  |
| 17.00                                                                                                 | D19             |                                         |                 |                 |                             |                       |                                                                                                             |   |                                                                                       |  |
| 17.50-17.95                                                                                           | SPT N=32<br>D20 | 5.50                                    | DRY             | 4,5/7,8,8,9     |                             |                       |                                                                                                             |  |                                                                                       |  |
| 18.50                                                                                                 | D21             |                                         |                 |                 |                             |                       |                                                                                                             |  |                                                                                       |  |
| 19.00-19.45                                                                                           | U5              | 5.50                                    | DRY             | 90 blows        |                             |                       |                                                                                                             |  |                                                                                       |  |
| 19.50                                                                                                 | D22             |                                         |                 |                 | 49.39                       |                       |                                                                                                             | 19.60                                                                                 |  |  |
| 19.70                                                                                                 | D23             |                                         |                 |                 |                             |                       |                                                                                                             |                                                                                       |  |  |
| 19.75-20.20                                                                                           | SPT N=47        | 5.50                                    | DRY             | 8,9/10,11,12,14 |                             |                       |                                                                                                             |                                                                                       |  |  |
| Remarks                                                                                               |                 |                                         |                 |                 |                             |                       |                                                                                                             | Scale (approx)<br>1:50                                                                | Logged By<br>EM                                                                       |  |
|                                                                                                       |                 |                                         |                 |                 |                             |                       |                                                                                                             | Figure No.<br>A2.5                                                                    |                                                                                       |  |



**IAN FARMER  
ASSOCIATES**

**Site**

University of Reading, St Patricks Hall Redevelopment, 20  
Northcourt Avenue, Reading RG2 7HB

**Borehole  
Number**

**BH5**

**Boring Method**

Cable Percussion

**Casing Diameter**

150mm cased to 5.50m

**Ground Level (mOD)**

68.99

**Client**

Curtins

**Job  
Number**

52527

**Location**

472890.9 E 171769.5 N

**Dates**

17/08/2016

**Engineer**

**Sheet**

3/3

| Depth<br>(m)                              | Sample / Tests                     | Casing<br>Depth<br>(m) | Water<br>Depth<br>(m) | Field Records | Level<br>(mOD) | Depth<br>(m)<br>(Thickness) | Description                                                                                                                                                                                          | Legend | Water |
|-------------------------------------------|------------------------------------|------------------------|-----------------------|---------------|----------------|-----------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|-------|
| 19.75-20.20                               | D24                                |                        |                       |               |                |                             | (LAMBETH GROUP - WOOLWICH FORMATION<br>'LAMINATED BEDS')                                                                                                                                             |        |       |
| 20.50-21.00                               | B7                                 |                        |                       |               |                |                             | From 20.50m to 21.00m; Firm to very stiff friable.                                                                                                                                                   |        |       |
| 21.25-21.56<br>21.25-21.56                | SPT 50/155<br>D25                  | 5.50                   | DRY                   | 10,10/21,26,3 |                | (3.35)                      | From 21.25m; Very sandy.                                                                                                                                                                             |        |       |
| 22.25                                     | D26                                |                        |                       |               |                |                             | From 22.25m; Firm.                                                                                                                                                                                   |        |       |
| 22.75-22.96<br>22.75-22.95<br>22.95-23.00 | SPT 25*/125<br>50/80<br>D27<br>D28 | 5.50                   | DRY                   | 12,13/45,5    | 46.04<br>45.99 | 22.95<br>23.00              | From 22.75m; With frequent shell fragments.<br><br>*SILTSTONE recovered predominantly as angular and<br>subangular medium and coarse gravel size claystone<br>fragments.<br><br>Terminated at 23.00m |        |       |

**Remarks**

Chiselling from 22.95m to 23.00m for 0.50 hours.

**Scale  
(approx)**

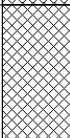
1:50

**Logged  
By**

EM

**Figure No.**

A2.5

|                                                                                                                                                                                                                                                                                                       |                   |                                         |                 |                                                                |                             |                       |                                                                                                                                                                                                                                                                                                       |                                                                                       |                        |  |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|-----------------------------------------|-----------------|----------------------------------------------------------------|-----------------------------|-----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|------------------------|--|
|  IAN FARMER ASSOCIATES                                                                                                                                                                                                 |                   |                                         |                 |                                                                |                             |                       | Site<br>University of Reading, St Patricks Hall Redevelopment, 20 Northcourt Avenue, Reading RG2 7HB                                                                                                                                                                                                  |                                                                                       | Borehole Number<br>BH6 |  |
| Boring Method<br>Cable Percussion                                                                                                                                                                                                                                                                     |                   | Casing Diameter<br>150mm cased to 4.50m |                 |                                                                | Ground Level (mOD)<br>68.10 |                       | Client<br>Curtins                                                                                                                                                                                                                                                                                     |                                                                                       | Job Number<br>52527    |  |
|                                                                                                                                                                                                                                                                                                       |                   | Location<br>472847 E 171733.4 N         |                 |                                                                | Dates<br>18/08/2016         |                       | Engineer                                                                                                                                                                                                                                                                                              |                                                                                       | Sheet<br>1/2           |  |
| Depth (m)                                                                                                                                                                                                                                                                                             | Sample / Tests    | Casing Depth (m)                        | Water Depth (m) | Field Records                                                  | Level (mOD)                 | Depth (m) (Thickness) | Description                                                                                                                                                                                                                                                                                           | Legend                                                                                | Water                  |  |
| 0.30-0.70<br>0.40                                                                                                                                                                                                                                                                                     | B1<br>ES1         |                                         |                 |                                                                |                             | (0.70)                | MADE GROUND comprising topsoil composed of a firm friable and friable dark brown slightly gravelly very sandy silty CLAY with rare medium gravel size glass fragments and fine and medium gravel size brick fragments. Gravel is angular to rounded fine to coarse of flint. Sand is fine and medium. |    |                        |  |
| 1.00                                                                                                                                                                                                                                                                                                  | ES2               |                                         |                 |                                                                | 67.40                       | 0.70                  |                                                                                                                                                                                                                                                                                                       |                                                                                       |                        |  |
| 1.20-1.65<br>1.20-1.60                                                                                                                                                                                                                                                                                | SPT(C) N=16<br>B2 |                                         | DRY             | 2,2/3,3,4,6                                                    |                             | (0.90)                | POSSIBLE MADE GROUND comprising firm to stiff orange brown, dark brown and occasionally light grey slightly gravelly sandy CLAY. Gravel is predominantly angular and subangular fine and medium of flint. Sand is predominantly medium and coarse.                                                    |    |                        |  |
| 2.00-2.45<br>2.00-2.40                                                                                                                                                                                                                                                                                | SPT(C) N=17<br>B3 | 2.00                                    | DRY             | 2,3/4,4,3,6                                                    | 66.50                       | 1.60                  | Medium dense gravelly silty clayey fine to coarse SAND with occasional pockets of clay. Gravel is subangular and subrounded predominantly fine and medium of flint. (BOYN HILL GRAVEL MEMBER)                                                                                                         |    |                        |  |
| 3.00-3.45<br>3.00-3.40                                                                                                                                                                                                                                                                                | SPT(C) N=21<br>B4 | 3.00                                    | DRY             | 3,3/4,5,5,7                                                    | 65.20                       | 2.90                  | Medium dense brown, orange brown very slightly clayey predominantly medium and coarse SAND and angular to rounded fine to coarse GRAVEL of flint with rare pockets of clay. (BOYN HILL GRAVEL MEMBER)                                                                                                 |   |                        |  |
| 4.00-4.40                                                                                                                                                                                                                                                                                             | B5                |                                         |                 | Medium(1) at 3.90m, rose to 3.80m in 20 mins, sealed at 4.40m. |                             | (1.50)                |                                                                                                                                                                                                                                                                                                       |                                                                                       |                        |  |
| 4.00-4.45<br>4.50                                                                                                                                                                                                                                                                                     | SPT(C) N=27<br>D1 | 4.00                                    | 3.90            | 6,6/7,8,7,5                                                    | 63.70                       | 4.40                  | From 4.00m; Orange brown sandy GRAVEL. No pockets of clay.                                                                                                                                                                                                                                            |  |                        |  |
| 5.00-5.45<br>5.00-5.45                                                                                                                                                                                                                                                                                | SPT N=13<br>D2    | 4.50                                    | DRY             | 1,2/3,3,3,4                                                    |                             |                       | Firm to stiff dark grey CLAY. (LONDON CLAY FORMATION)                                                                                                                                                                                                                                                 |  |                        |  |
|                                                                                                                                                                                                                                                                                                       |                   |                                         |                 |                                                                |                             |                       |                                                                                                                                                                                                                                                                                                       |  |                        |  |
|                                                                                                                                                                                                                                                                                                       |                   |                                         |                 |                                                                |                             |                       |                                                                                                                                                                                                                                                                                                       |  |                        |  |
|                                                                                                                                                                                                                                                                                                       |                   |                                         |                 |                                                                |                             |                       |                                                                                                                                                                                                                                                                                                       |  |                        |  |
|                                                                                                                                                                                                                                                                                                       |                   |                                         |                 |                                                                |                             |                       |                                                                                                                                                                                                                                                                                                       |  |                        |  |
|                                                                                                                                                                                                                                                                                                       |                   |                                         |                 |                                                                |                             |                       |                                                                                                                                                                                                                                                                                                       |  |                        |  |
|                                                                                                                                                                                                                                                                                                       |                   |                                         |                 |                                                                |                             |                       |                                                                                                                                                                                                                                                                                                       |  |                        |  |
|                                                                                                                                                                                                                                                                                                       |                   |                                         |                 |                                                                |                             |                       |                                                                                                                                                                                                                                                                                                       |  |                        |  |
| 6.00                                                                                                                                                                                                                                                                                                  | D3                |                                         |                 |                                                                |                             |                       | From 6.00m; Very stiff extremely closely fissured.                                                                                                                                                                                                                                                    |  |                        |  |
| 6.50-6.95                                                                                                                                                                                                                                                                                             | U1                | 4.50                                    | DRY             | 40 blows                                                       |                             |                       |                                                                                                                                                                                                                                                                                                       |  |                        |  |
| 7.00<br>7.10-7.20                                                                                                                                                                                                                                                                                     | D4<br>B6          |                                         |                 |                                                                |                             |                       | *From 7.10m to 7.20m; CLAYSTONE recovered as very stiff thinly laminated dark grey CLAY with frequent fine to coarse gravel and cobble size fragments of claystone and rare fine and medium shell fragments.                                                                                          |  |                        |  |
| 7.50                                                                                                                                                                                                                                                                                                  | D5                |                                         |                 |                                                                |                             |                       |                                                                                                                                                                                                                                                                                                       |  |                        |  |
| 8.00-8.45<br>8.00-8.45                                                                                                                                                                                                                                                                                | SPT N=19<br>D6    | 4.50                                    | DRY             | 2,3/4,4,5,6                                                    |                             |                       | From 8.00m; Thinly laminated with rare to occasional pockets and lenses of light grey silt and fine sand.                                                                                                                                                                                             |  |                        |  |
|                                                                                                                                                                                                                                                                                                       |                   |                                         |                 |                                                                |                             |                       |                                                                                                                                                                                                                                                                                                       |  |                        |  |
|                                                                                                                                                                                                                                                                                                       |                   |                                         |                 |                                                                |                             |                       |                                                                                                                                                                                                                                                                                                       |  |                        |  |
|                                                                                                                                                                                                                                                                                                       |                   |                                         |                 |                                                                |                             |                       |                                                                                                                                                                                                                                                                                                       |  |                        |  |
| 9.00                                                                                                                                                                                                                                                                                                  | D7                |                                         |                 |                                                                |                             |                       | From 9.00m; With rare fine and medium shell fragments.                                                                                                                                                                                                                                                |  |                        |  |
| 9.50-9.95                                                                                                                                                                                                                                                                                             | U2                | 4.50                                    | DRY             | 54 blows                                                       |                             |                       |                                                                                                                                                                                                                                                                                                       |  |                        |  |
|                                                                                                                                                                                                                                                                                                       |                   |                                         |                 |                                                                |                             |                       |                                                                                                                                                                                                                                                                                                       |  |                        |  |
|                                                                                                                                                                                                                                                                                                       |                   |                                         |                 |                                                                |                             |                       |                                                                                                                                                                                                                                                                                                       |  |                        |  |
|                                                                                                                                                                                                                                                                                                       |                   |                                         |                 |                                                                |                             |                       |                                                                                                                                                                                                                                                                                                       |  |                        |  |
|                                                                                                                                                                                                                                                                                                       |                   |                                         |                 |                                                                |                             |                       |                                                                                                                                                                                                                                                                                                       |  |                        |  |
|                                                                                                                                                                                                                                                                                                       |                   |                                         |                 |                                                                |                             |                       |                                                                                                                                                                                                                                                                                                       |  |                        |  |
|                                                                                                                                                                                                                                                                                                       |                   |                                         |                 |                                                                |                             |                       |                                                                                                                                                                                                                                                                                                       |  |                        |  |
|                                                                                                                                                                                                                                                                                                       |                   |                                         |                 |                                                                |                             |                       |                                                                                                                                                                                                                                                                                                       |  |                        |  |
| <b>Remarks</b><br>1 hour clearing borehole area and moving excess borehole arisings to skip.<br>1 hour dismantling and erecting Heras fencing.<br>*Drillers description.<br>Chiselling from 7.10m to 7.20m for 0.5 hours. Water added from 3.60m to 4.40m. Excavating from 0.00m to 1.20m for 1 hour. |                   |                                         |                 |                                                                |                             |                       |                                                                                                                                                                                                                                                                                                       | Scale (approx)                                                                        | Logged By              |  |
|                                                                                                                                                                                                                                                                                                       |                   |                                         |                 |                                                                |                             |                       |                                                                                                                                                                                                                                                                                                       | 1:50                                                                                  | EM                     |  |
|                                                                                                                                                                                                                                                                                                       |                   |                                         |                 |                                                                |                             |                       |                                                                                                                                                                                                                                                                                                       | Figure No.<br>A2.6                                                                    |                        |  |

|                                                                                                                  |                 |                                         |                 |                 |                             |                       |                                                                                                                                                                                     |                                                                                       |                        |  |
|------------------------------------------------------------------------------------------------------------------|-----------------|-----------------------------------------|-----------------|-----------------|-----------------------------|-----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|------------------------|--|
| <div> IAN FARMER ASSOCIATES</div> |                 |                                         |                 |                 |                             |                       | Site<br>University of Reading, St Patricks Hall Redevelopment, 20 Northcourt Avenue, Reading RG2 7HB                                                                                |                                                                                       | Borehole Number<br>BH6 |  |
| Boring Method<br>Cable Percussion                                                                                |                 | Casing Diameter<br>150mm cased to 4.50m |                 |                 | Ground Level (mOD)<br>68.10 |                       | Client<br>Curtins                                                                                                                                                                   |                                                                                       | Job Number<br>52527    |  |
|                                                                                                                  |                 | Location<br>472847 E 171733.4 N         |                 |                 | Dates<br>18/08/2016         |                       | Engineer                                                                                                                                                                            |                                                                                       | Sheet<br>2/2           |  |
| Depth (m)                                                                                                        | Sample / Tests  | Casing Depth (m)                        | Water Depth (m) | Field Records   | Level (mOD)                 | Depth (m) (Thickness) | Description                                                                                                                                                                         | Legend                                                                                | Water                  |  |
| 9.95                                                                                                             | D8              | 4.50                                    | DRY             | 4,4/5,6,6,7     |                             | (13.00)               |                                                                                                                                                                                     |    |                        |  |
| 10.50                                                                                                            | D9              |                                         |                 |                 |                             |                       |                                                                                                                                                                                     |    |                        |  |
| 11.00-11.45<br>11.00-11.45                                                                                       | SPT N=24<br>D10 |                                         |                 |                 |                             |                       |                                                                                                                                                                                     |    |                        |  |
|                                                                                                                  |                 |                                         |                 |                 |                             |                       |                                                                                                                                                                                     |    |                        |  |
|                                                                                                                  |                 |                                         |                 |                 |                             |                       |                                                                                                                                                                                     |    |                        |  |
| 12.00                                                                                                            | D11             | 4.50                                    | DRY             | 62 blows        |                             |                       |                                                                                                                                                                                     |    |                        |  |
| 12.50-12.95                                                                                                      | U3              |                                         |                 |                 |                             |                       |                                                                                                                                                                                     |    |                        |  |
| 12.95                                                                                                            | D12             |                                         |                 |                 |                             |                       |                                                                                                                                                                                     |    |                        |  |
| 13.50                                                                                                            | D13             |                                         |                 |                 |                             |                       |                                                                                                                                                                                     |    |                        |  |
|                                                                                                                  |                 |                                         |                 |                 |                             |                       |                                                                                                                                                                                     |    |                        |  |
| 14.00-14.45<br>14.00-14.45                                                                                       | SPT N=31<br>D14 | 4.50                                    | DRY             | 5,5/6,8,8,9     |                             |                       |                                                                                                                                                                                     |  |                        |  |
|                                                                                                                  |                 |                                         |                 |                 |                             |                       |                                                                                                                                                                                     |  |                        |  |
|                                                                                                                  |                 |                                         |                 |                 |                             |                       |                                                                                                                                                                                     |  |                        |  |
|                                                                                                                  |                 |                                         |                 |                 |                             |                       |                                                                                                                                                                                     |  |                        |  |
|                                                                                                                  |                 |                                         |                 |                 |                             |                       |                                                                                                                                                                                     |  |                        |  |
| 15.00                                                                                                            | D15             | 4.50                                    | DRY             | 70 blows        |                             |                       |                                                                                                                                                                                     |  |                        |  |
| 15.50-15.95                                                                                                      | U4              |                                         |                 |                 |                             |                       |                                                                                                                                                                                     |  |                        |  |
| 15.95                                                                                                            | D16             |                                         |                 |                 |                             |                       |                                                                                                                                                                                     |  |                        |  |
| 16.50                                                                                                            | D17             |                                         |                 |                 |                             |                       |                                                                                                                                                                                     |  |                        |  |
|                                                                                                                  |                 |                                         |                 |                 |                             |                       |                                                                                                                                                                                     |  |                        |  |
| 17.00-17.45<br>17.00-17.45                                                                                       | SPT N=33<br>D18 | 4.50                                    | DRY             | 5,5/7,8,9,9     | 50.70                       | 17.40                 | Very stiff dark grey sandy silty CLAY with rare becoming occasional fine and medium shell fragments. Sand is fine and medium. (LAMBETH GROUP - WOOLWICH FORMATION 'LAMINATED BEDS') |  |                        |  |
|                                                                                                                  |                 |                                         |                 |                 |                             |                       |                                                                                                                                                                                     |  |                        |  |
|                                                                                                                  |                 |                                         |                 |                 |                             |                       |                                                                                                                                                                                     |  |                        |  |
|                                                                                                                  |                 |                                         |                 |                 |                             |                       |                                                                                                                                                                                     |  |                        |  |
|                                                                                                                  |                 |                                         |                 |                 |                             |                       |                                                                                                                                                                                     |  |                        |  |
| 18.00                                                                                                            | D19             | 4.50                                    | DRY             | 90 blows        |                             | (2.60)                |                                                                                                                                                                                     |  |                        |  |
| 18.50-18.95                                                                                                      | U5              |                                         |                 |                 |                             |                       |                                                                                                                                                                                     |  |                        |  |
| 18.95                                                                                                            | D20             |                                         |                 |                 |                             |                       |                                                                                                                                                                                     |  |                        |  |
|                                                                                                                  |                 |                                         |                 |                 |                             |                       |                                                                                                                                                                                     |  |                        |  |
|                                                                                                                  |                 |                                         |                 |                 |                             |                       |                                                                                                                                                                                     |  |                        |  |
| 19.50-19.95<br>19.50-19.95                                                                                       | SPT N=60<br>D21 | 4.50                                    | DRY             | 9,9/12,14,16,18 | 48.10                       | 20.00                 | From 18.95m; Stiff to very stiff occasionally friable with rare medium and coarse gravel size iron pyrite nodules.<br><br>From 19.50m; Firm friable. No iron pyrite nodules.        |  |                        |  |
|                                                                                                                  |                 |                                         |                 |                 |                             |                       |                                                                                                                                                                                     |  |                        |  |
|                                                                                                                  |                 |                                         |                 |                 |                             |                       |                                                                                                                                                                                     |  |                        |  |
|                                                                                                                  |                 |                                         |                 |                 |                             |                       |                                                                                                                                                                                     |  |                        |  |
|                                                                                                                  |                 |                                         |                 |                 |                             |                       |                                                                                                                                                                                     |  |                        |  |
| Remarks                                                                                                          |                 |                                         |                 |                 |                             |                       |                                                                                                                                                                                     | Scale (approx)                                                                        | Logged By              |  |
|                                                                                                                  |                 |                                         |                 |                 |                             |                       |                                                                                                                                                                                     | 1:50                                                                                  | EM                     |  |
|                                                                                                                  |                 |                                         |                 |                 |                             |                       |                                                                                                                                                                                     | Figure No.<br>A2.6                                                                    |                        |  |



**Site**

University of Reading, St Patricks Hall Redevelopment, 20 Northcourt Avenue, Reading RG2 7HB

**Borehole  
Number  
BH7**

**Boring Method**

Cable Percussion

**Casing Diameter**

150mm cased to 6.00m

**Ground Level (mOD)**

69.69

**Client**

Curtins

**Job  
Number  
52527**

**Location**

472929.2 E 171739.9 N

**Dates**

18/08/2016

**Engineer**

**Sheet  
1/3**

| Depth (m)                           | Sample / Tests      | Casing Depth (m) | Water Depth (m) | Field Records                                                         | Level (mOD) | Depth (m) (Thickness) | Description                                                                                                                                                                                                                                                                     | Legend | Water | Instr |
|-------------------------------------|---------------------|------------------|-----------------|-----------------------------------------------------------------------|-------------|-----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|-------|-------|
| 0.20-0.60<br>0.30                   | B1<br>ES1           |                  |                 |                                                                       | 69.49       | (0.20)<br>0.20        | *TOPSOIL.                                                                                                                                                                                                                                                                       |        |       |       |
| 0.70-1.20<br>0.80                   | B2<br>ES2           |                  |                 |                                                                       | 69.04       | (0.45)<br>0.65        | MADE GROUND comprising topsoil composed of a dry orange brown slightly gravelly to gravelly silty very clayey fine and medium SAND with frequent rootlets and occasional roots. Gravel is subangular to rounded fine to coarse of flint.                                        |        |       |       |
| 1.20<br>1.20-1.65                   | D1<br>U1            |                  | DRY             | 75 blows                                                              |             | (1.50)                | Very stiff orange brown and light grey mottled sandy CLAY with occasional becoming rare rootlets and rare roots. Sand is fine and medium. (BOYN HILL GRAVEL MEMBER)                                                                                                             |        |       |       |
| 1.70                                | D2                  |                  |                 |                                                                       |             |                       | From 1.70m; No roots or rootlets.                                                                                                                                                                                                                                               |        |       |       |
| 2.20-2.65<br>2.25-2.65<br>2.25-2.75 | SPT N=8<br>D3<br>B3 | 2.20             | DRY             | 3,3/1,2,2,3                                                           | 67.54       | 2.15<br>(1.00)        | Soft to firm, becoming soft orange brown occasionally light grey mottled sandy CLAY. Sand is fine and medium. (BOYN HILL GRAVEL MEMBER)                                                                                                                                         |        |       |       |
| 3.20-3.65<br>3.25-3.75              | SPT N=22<br>B4      | 3.20             | DRY             | 4,4/4,5,6,7                                                           | 66.54       | 3.15<br>(1.25)        | Medium dense orange brown slightly gravelly silty clayey predominantly fine and medium SAND with frequent pockets of soft orange brown sandy clay and occasional black kerogen staining. Gravel is subangular and subrounded fine to coarse of flint. (BOYN HILL GRAVEL MEMBER) |        |       |       |
| 4.20-4.65<br>4.50-5.00              | SPT(C) N=28<br>B5   | 4.20             | DRY             | 4,4/7,6,8,7                                                           | 65.29       | 4.40<br>(1.10)        | Wet medium dense orange brown occasionally brown clayey predominantly medium and coarse SAND and subangular to rounded fine to coarse GRAVEL of flint. (BOYN HILL GRAVEL MEMBER)                                                                                                |        |       |       |
| 5.20-5.65<br>5.50-5.90              | SPT(C) N=17<br>B6   | 5.20             | DRY             | 3,3/6,6,3,2                                                           | 64.19       | 5.50<br>(0.40)        | Very stiff orange brown, dark grey and occasionally light grey mottled CLAY with frequent pockets and lenses of orange brown/red brown silt. (LONDON CLAY FORMATION)                                                                                                            |        |       |       |
| 6.00<br>6.00-6.45<br>6.50           | D4<br>U2<br>D5      | 6.00             | DRY             | Slow(1) at 5.70m, rose to 5.55m in 20 mins, sealed at 6.00m. 60 blows | 63.79       | 5.90                  | Very stiff extremely closely fissured dark grey CLAY with rare fine becoming fine and medium shell fragments. (LONDON CLAY FORMATION)                                                                                                                                           |        |       |       |
| 7.00-7.50                           | B7                  |                  |                 |                                                                       |             |                       |                                                                                                                                                                                                                                                                                 |        |       |       |
| 7.50-7.95<br>7.50-7.95              | SPT N=24<br>D6      | 6.00             | DRY             | 3,3/5,6,6,7                                                           |             |                       | From 7.50m; Thinly laminated.                                                                                                                                                                                                                                                   |        |       |       |
| 8.50                                | D7                  |                  |                 |                                                                       |             |                       | From 8.50m; With rare pockets and lenses of light grey fine sand.                                                                                                                                                                                                               |        |       |       |
| 9.00-9.45                           | U3                  | 6.00             | DRY             | 65 blows                                                              |             |                       |                                                                                                                                                                                                                                                                                 |        |       |       |
| 9.50                                | D8                  |                  |                 |                                                                       |             |                       | From 9.50m; Slightly fissured and slightly laminated.                                                                                                                                                                                                                           |        |       |       |

**Remarks**

Standpipe installation - plain standpipe installed to 1.00m surrounded with bentonite, slotted standpipe installed to 10.00m and sealed with bentonite to 11.00m. Fitted with a gas tap and a stop cock cover.  
1 hour clearing borehole area and moving excess borehole arisings to skip.  
1 hour dismantling and moving Heras fencing.  
\*Drillers description.  
Excavating from 0.00m to 1.20m for 1.25 hours.

**Scale (approx)**

1:50

**Logged By**

EM

**Figure No.  
A2.7**

|                          |                            |
|--------------------------|----------------------------|
| <b>Client</b><br>Curtins | <b>Job Number</b><br>52527 |
| <b>Engineer</b>          | <b>Sheet</b><br>2/3        |

| Description                                                                                                                                                                                                                                                                                                                      | Legend | Water | Instr |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|-------|-------|
| <p>At 11.50m; With rare fine and medium gravel size fragments of claystone.</p> <p>From 12.50m; Stiff to very stiff.</p> <p>From 14.50m; Very stiff.</p> <p>*From 17.55m to 17.90m; CLAYSTONE recovered as coarse gravel size and cobble size fragments of claystone.</p>                                                        |        |       |       |
| <p>Stiff to very stiff occasionally friable dark grey occasionally dark green sandy silty CLAY with rare to occasional fine and shell fragments. Sand is fine and medium. (LAMBETH GROUP - WOOLWICH FORMATION 'LAMINATED BEDS')</p> <p>From 19.20m to 19.65m; With rare fine and medium gravel size black lignite fragments.</p> |        |       |       |

|                           |                      |
|---------------------------|----------------------|
| <b>Scale<br/>(approx)</b> | <b>Logged<br/>By</b> |
| 1:50                      | EM                   |

**Figure No.**  
A2.7



University of Reading, St Patricks Hall Redevelopment, 20  
Northcourt Avenue, Reading RG2 7HB

**Borehole  
Number**  
**BH7**

|                      |
|----------------------|
| <b>Boring Method</b> |
| Cable Percussion     |

**Casing Diameter**  
150mm cased to 6.00m

|                    |       |
|--------------------|-------|
| Ground Level (mOD) | 69.69 |
|--------------------|-------|

|               |         |
|---------------|---------|
| <b>Client</b> | Curtins |
|---------------|---------|

Job  
Number  
52527

|                 |                       |
|-----------------|-----------------------|
| <b>Location</b> | 472929.2 E 171739.9 N |
|-----------------|-----------------------|

|              |            |
|--------------|------------|
| <b>Dates</b> | 18/08/2016 |
|--------------|------------|

**Engineer**

Sheet  
3/3

| Depth<br>(m) | Sample / Tests | Casing<br>Depth<br>(m) | Water<br>Depth<br>(m) | Field Records | Level<br>(mOD) | Depth<br>(m)<br>(Thickness) | Description                 | Legend | Water | Instr |
|--------------|----------------|------------------------|-----------------------|---------------|----------------|-----------------------------|-----------------------------|--------|-------|-------|
|              |                |                        |                       |               | 49.69          | 20.00                       | grey.<br>Complete at 20.00m |        |       |       |

Remarks

**Scale (approx)**

1:50

Logged  
By  
  
EM

Figure No.  
A2.7

|                                                |                                   |                             |                   |                     |
|------------------------------------------------|-----------------------------------|-----------------------------|-------------------|---------------------|
| Excavation Method<br>Percussive Window Sampler | Dimensions                        | Ground Level (mOD)<br>68.03 | Client<br>Curtins | Job Number<br>52527 |
|                                                | Location<br>472781.6 E 171902.8 N | Dates<br>19/08/2016         | Engineer          | Sheet<br>1/1        |

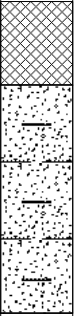
[illegible]

## Remarks

Groundwater not observed.  
Standpipe installation - plain standpipe installed to 0.40m surrounded with bentonite, slotted standpipe installed to 1.40m. Fitted with a gas tap and a stop cock cover.  
Window sampling apparatus terminated at 1.40m.

| Scale (approx) | Logged By |
|----------------|-----------|
| 1:50           | FA        |

Figure No. A2.8

|  <b>IAN FARMER ASSOCIATES</b>                                                                                                                                                              |                |                                          |                   |                                    |                       | <b>Site</b><br>University of Reading, St Patricks Hall Redevelopment, 20 Northcourt Avenue, Reading RG2 7HB                                                                                                                                                                                                                                                                                                                                                                         |                                                                                     | <b>Number</b><br><b>WS2</b> |                           |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|------------------------------------------|-------------------|------------------------------------|-----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-----------------------------|---------------------------|
| <b>Excavation Method</b><br>Percussive Window Sampler                                                                                                                                                                                                                     |                | <b>Dimensions</b>                        |                   | <b>Ground Level (mOD)</b><br>68.08 |                       | <b>Client</b><br>Curtins                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                     | <b>Job Number</b><br>52527  |                           |
|                                                                                                                                                                                                                                                                           |                | <b>Location</b><br>472805.3 E 171847.3 N |                   | <b>Dates</b><br>19/08/2016         |                       | <b>Engineer</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                     | <b>Sheet</b><br>1/1         |                           |
| Depth (m)                                                                                                                                                                                                                                                                 | Sample / Tests | Water Depth (m)                          | Field Records     | Level (mOD)                        | Depth (m) (Thickness) | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Legend                                                                              | Water                       | Instr                     |
| 0.10                                                                                                                                                                                                                                                                      | ES1            |                                          |                   |                                    | (0.55)                | MADE GROUND comprising grass over brown gravelly slightly clayey fine to coarse SAND with occasional brick, concrete and wood fragments. Gravel is angular to subrounded fine to coarse of flint.<br>From 0.36m; Brown with frequent brick fragments.<br><br>Dense brown slightly gravelly clayey fine to coarse SAND. Gravel is angular to subrounded fine to coarse of flint. (BOYN HILL GRAVEL MEMBER)<br><br>From 1.20m; Orange brown and very clayey.<br>From 1.60m; Gravelly. |  |                             |                           |
| 0.50                                                                                                                                                                                                                                                                      | D1             |                                          |                   | 67.53                              | 0.55                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                     |                             |                           |
| 0.60                                                                                                                                                                                                                                                                      | ES2            |                                          |                   |                                    |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                     |                             |                           |
| 1.00                                                                                                                                                                                                                                                                      | D2             |                                          | 1,1/1,1,2,2       |                                    | (1.50)                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                     |                             |                           |
| 1.20-1.65                                                                                                                                                                                                                                                                 | SPT N=6        |                                          |                   |                                    |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                     |                             |                           |
| 1.20                                                                                                                                                                                                                                                                      | D3             |                                          |                   |                                    |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                     |                             |                           |
| 1.60-2.05                                                                                                                                                                                                                                                                 | SPT N=90       |                                          | 10,13/17,17,28,28 |                                    |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                     |                             |                           |
| 1.60                                                                                                                                                                                                                                                                      | D4             |                                          |                   | 66.03                              | 2.05                  | Terminated at 2.05m                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                     |                             |                           |
| <b>Remarks</b><br>Groundwater not observed.<br>Standpipe installation - plain standpipe installed to 0.70m surrounded with bentonite, slotted standpipe installed to 1.70m. Fitted with a gas tap and a stop cock cover.<br>Window sampler apparatus terminated at 1.60m. |                |                                          |                   |                                    |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | <b>Scale (approx)</b><br><br>1:50                                                   | <b>Logged By</b><br><br>FA  | <b>Figure No.</b><br>A2.9 |



**Site**

University of Reading, St Patricks Hall Redevelopment, 20  
Northcourt Avenue, Reading RG2 7HB

**Number  
WS3**

**Excavation Method**

Percussive Window Sampler

**Dimensions**

**Ground Level (mOD)**

67.96

**Client**

Curtins

**Job  
Number  
52527**

**Location**

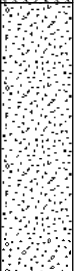
472799.3 E 171833.9 N

**Dates**

19/08/2016

**Engineer**

**Sheet  
1/1**

| Depth<br>(m) | Sample / Tests | Water<br>Depth<br>(m) | Field Records   | Level<br>(mOD) | Depth<br>(m)<br>(Thickness) | Description                                                                                                                                                                          | Legend                                                                              | Water | Instr |
|--------------|----------------|-----------------------|-----------------|----------------|-----------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------|-------|
| 0.30         | ES1            |                       |                 |                | (0.60)                      | MADE GROUND comprising grass over brown<br>gravelly fine to coarse SAND with occasional brick<br>and concrete fragments. Gravel is angular to<br>subrounded fine to coarse of flint. |  |       |       |
| 0.50         | D1             |                       |                 | 67.36          | 0.60                        | Dense brown gravelly fine to coarse SAND. Gravel<br>is angular to rounded fine to coarse of flint. (BOYN<br>HILL GRAVEL MEMBER)<br>From 1.00m; Orange brown and clayey.              |  |       |       |
| 1.00         | D2             |                       | 6,12/12,12,10,6 |                | (1.78)                      |                                                                                                                                                                                      |                                                                                     |       |       |
| 1.00         | ES2            |                       |                 |                |                             |                                                                                                                                                                                      |                                                                                     |       |       |
| 1.20-1.65    | SPT N=40       |                       |                 |                |                             |                                                                                                                                                                                      |                                                                                     |       |       |
| 1.20         | D3             |                       |                 |                |                             |                                                                                                                                                                                      |                                                                                     |       |       |
| 1.60         | D4             |                       |                 |                |                             |                                                                                                                                                                                      |                                                                                     |       |       |
| 2.00-2.38    | SPT 69/225     |                       | 12,14/18,24,27  | 65.58          | 2.38                        | Terminated at 2.38m                                                                                                                                                                  |                                                                                     |       |       |

**Remarks**

Groundwater not observed.  
Standpipe installation - plain standpipe installed to 1.00m surrounded with bentonite, slotted standpipe installed to 2.00m. Fitted with a gas tap and  
a stop cock cover.  
Borehole terminated at 2.375m.

**Scale  
(approx)**

1:50

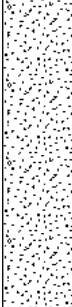
**Logged  
By**

FA

**Figure No.**

A2.10

|                                                                                                                                                                                                                                                     |                |                                   |               |                             |                                                                                                      |                                                                                                                                                                                                                     |                                                                                                                 |                     |                     |                                                                                     |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|-----------------------------------|---------------|-----------------------------|------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------|---------------------|---------------------|-------------------------------------------------------------------------------------|
| if IAN FARMER ASSOCIATES                                                                                                                                                                                                                            |                |                                   |               |                             | Site<br>University of Reading, St Patricks Hall Redevelopment, 20 Northcourt Avenue, Reading RG2 7HB |                                                                                                                                                                                                                     |                                                                                                                 | Number<br>WS4       |                     |                                                                                     |
| Excavation Method<br>Percussive Window Sampler                                                                                                                                                                                                      |                | Dimensions                        |               | Ground Level (mOD)<br>68.50 |                                                                                                      | Client<br>Curtins                                                                                                                                                                                                   |                                                                                                                 | Job Number<br>52527 |                     |                                                                                     |
|                                                                                                                                                                                                                                                     |                | Location<br>472859.3 E 171829.4 N |               | Dates<br>19/08/2016         |                                                                                                      | Engineer                                                                                                                                                                                                            |                                                                                                                 | Sheet<br>1/1        |                     |                                                                                     |
| Depth (m)                                                                                                                                                                                                                                           | Sample / Tests | Water Depth (m)                   | Field Records | Level (mOD)                 | Depth (m) (Thickness)                                                                                | Description                                                                                                                                                                                                         | Legend                                                                                                          | Water               | Instr               |                                                                                     |
| 0.20                                                                                                                                                                                                                                                | ES1            |                                   | 2,2/2,3,4,7   | 68.20                       | (0.30)<br>0.30                                                                                       | MADE GROUND comprising grass over brown gravelly clayey fine to coarse SAND with occasional brick fragments, roots and rootlets, and rare concrete fragments. Gravel is angular to rounded fine to coarse of flint. |                              |                     |                     |                                                                                     |
| 0.50                                                                                                                                                                                                                                                | D1             |                                   |               |                             | (1.33)                                                                                               |                                                                                                                                                                                                                     | Firm brown gravelly sandy CLAY. Gravel is angular to rounded fine to coarse of flint. (BOYN HILL GRAVEL MEMBER) |                     |                     |  |
| 0.60                                                                                                                                                                                                                                                | ES2            |                                   |               |                             |                                                                                                      |                                                                                                                                                                                                                     |                                                                                                                 |                     |                     |                                                                                     |
| 1.00                                                                                                                                                                                                                                                | D2             |                                   |               |                             |                                                                                                      |                                                                                                                                                                                                                     |                                                                                                                 |                     |                     |                                                                                     |
| 1.20-1.65                                                                                                                                                                                                                                           | SPT N=16       |                                   |               | 66.87                       | 1.63                                                                                                 | Terminated at 1.63m                                                                                                                                                                                                 |                                                                                                                 |                     |                     |                                                                                     |
| 1.20                                                                                                                                                                                                                                                | D3             |                                   |               |                             |                                                                                                      |                                                                                                                                                                                                                     |                                                                                                                 |                     |                     |                                                                                     |
| Remarks<br>Groundwater not observed.<br>Standpipe installation - plain standpipe installed to 0.60m surrounded with bentonite, slotted standpipe installed to 1.60m. Fitted with a gas tap and a stop cock cover.<br>Borehole terminated at 1.625m. |                |                                   |               |                             |                                                                                                      |                                                                                                                                                                                                                     | Scale (approx)<br>1:50                                                                                          | Logged By<br>FA     | Figure No.<br>A2.11 |                                                                                     |

|                                                                                                                                                                                                                                                           |                |                                 |                   |                             |                                                                                                      |                                                                                                                                                                                                   |                                                                                     |                     |       |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|---------------------------------|-------------------|-----------------------------|------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|---------------------|-------|
| if IAN FARMER ASSOCIATES                                                                                                                                                                                                                                  |                |                                 |                   |                             | Site<br>University of Reading, St Patricks Hall Redevelopment, 20 Northcourt Avenue, Reading RG2 7HB |                                                                                                                                                                                                   |                                                                                     | Number<br>WS5       |       |
| Excavation Method<br>Percussive Window Sampler                                                                                                                                                                                                            |                | Dimensions                      |                   | Ground Level (mOD)<br>67.91 |                                                                                                      | Client<br>Curtins                                                                                                                                                                                 |                                                                                     | Job Number<br>52527 |       |
|                                                                                                                                                                                                                                                           |                | Location<br>472806.4 E 171759 N |                   | Dates<br>18/08/2016         |                                                                                                      | Engineer                                                                                                                                                                                          |                                                                                     | Sheet<br>1/1        |       |
| Depth (m)                                                                                                                                                                                                                                                 | Sample / Tests | Water Depth (m)                 | Field Records     | Level (mOD)                 | Depth (m) (Thickness)                                                                                | Description                                                                                                                                                                                       | Legend                                                                              | Water               | Instr |
| 0.20                                                                                                                                                                                                                                                      | ES1            |                                 |                   | 67.51                       | (0.40)<br>0.40                                                                                       | MADE GROUND comprising grass over brown gravelly fine to coarse SAND with occasional brick fragments, rare roots and rootlets. Gravel is angular to rounded fine to coarse of flint.              |  |                     |       |
| 0.50                                                                                                                                                                                                                                                      | D1             |                                 |                   |                             |                                                                                                      |                                                                                                                                                                                                   |                                                                                     |                     |       |
| 0.50                                                                                                                                                                                                                                                      | ES2            |                                 |                   |                             |                                                                                                      |                                                                                                                                                                                                   |                                                                                     |                     |       |
| 1.00                                                                                                                                                                                                                                                      | D2             |                                 |                   |                             |                                                                                                      |                                                                                                                                                                                                   |                                                                                     |                     |       |
| 1.20-1.65                                                                                                                                                                                                                                                 | SPT(C) N=17    |                                 | 3,3/4,4,4,5       |                             | (2.05)                                                                                               | Dense brown gravelly to very gravelly fine to coarse SAND. Gravel is angular and subangular fine to coarse of flint. (BOYN HILL GRAVEL MEMBER)<br>From 1.10m; Orange brown and slightly gravelly. |  |                     |       |
| 1.20                                                                                                                                                                                                                                                      | D3             |                                 |                   |                             |                                                                                                      |                                                                                                                                                                                                   |                                                                                     |                     |       |
| 1.60                                                                                                                                                                                                                                                      | D4             |                                 |                   |                             |                                                                                                      |                                                                                                                                                                                                   |                                                                                     |                     |       |
| 2.00-2.45                                                                                                                                                                                                                                                 | SPT(C) N=81    |                                 | 15,24/27,16,17,21 |                             |                                                                                                      | From 1.85m; Very gravelly, poor sample recovery.                                                                                                                                                  |                                                                                     |                     |       |
| 2.00                                                                                                                                                                                                                                                      | D5             |                                 |                   | 65.46                       | 2.45                                                                                                 |                                                                                                                                                                                                   |                                                                                     |                     |       |
|                                                                                                                                                                                                                                                           |                |                                 |                   |                             |                                                                                                      | Terminated at 2.45m                                                                                                                                                                               |                                                                                     |                     |       |
| <b>Remarks</b><br>Groundwater not observed.<br>Standpipe installation - plain standpipe installed to 1.00m surrounded with bentonite, slotted standpipe installed to 2.00m. Fitted with a gas tap and a stop cock cover.<br>Borehole terminated at 2.45m. |                |                                 |                   |                             |                                                                                                      |                                                                                                                                                                                                   | Scale (approx)                                                                      | Logged By           |       |
|                                                                                                                                                                                                                                                           |                |                                 |                   |                             |                                                                                                      |                                                                                                                                                                                                   | 1:50                                                                                | FA                  |       |
|                                                                                                                                                                                                                                                           |                |                                 |                   |                             |                                                                                                      |                                                                                                                                                                                                   | Figure No.<br>A2.12                                                                 |                     |       |

|                                                                                                                                                                                                                                                                            |                       |                                        |                      |                                    |                                                                                                             |                                                                                                                                                                                                                    |                                                                                     |                            |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|----------------------------------------|----------------------|------------------------------------|-------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|----------------------------|
|  <b>IAN FARMER ASSOCIATES</b>                                                                                                                                                               |                       |                                        |                      |                                    | <b>Site</b><br>University of Reading, St Patricks Hall Redevelopment, 20 Northcourt Avenue, Reading RG2 7HB |                                                                                                                                                                                                                    | <b>Number</b><br><b>WS6</b>                                                         |                            |
| <b>Excavation Method</b><br>Percussive Window Sampler                                                                                                                                                                                                                      |                       | <b>Dimensions</b>                      |                      | <b>Ground Level (mOD)</b><br>68.58 |                                                                                                             | <b>Client</b><br>Curtins                                                                                                                                                                                           |                                                                                     | <b>Job Number</b><br>52527 |
|                                                                                                                                                                                                                                                                            |                       | <b>Location</b><br>472846 E 171761.7 N |                      | <b>Dates</b><br>19/08/2016         |                                                                                                             | <b>Engineer</b>                                                                                                                                                                                                    |                                                                                     | <b>Sheet</b><br>1/1        |
| <b>Depth (m)</b>                                                                                                                                                                                                                                                           | <b>Sample / Tests</b> | <b>Water Depth (m)</b>                 | <b>Field Records</b> | <b>Level (mOD)</b>                 | <b>Depth (m) (Thickness)</b>                                                                                | <b>Description</b>                                                                                                                                                                                                 | <b>Legend</b>                                                                       | <b>Water</b>               |
| 0.20                                                                                                                                                                                                                                                                       | ES1                   |                                        |                      | 68.18                              | (0.40)                                                                                                      | MADE GROUND comprising grass over brown gravelly clayey fine to coarse SAND with occasional brick fragments, roots and rootlets, and rare clinker fragments. Gravel is angular to rounded fine to coarse of flint. |  |                            |
| 0.50                                                                                                                                                                                                                                                                       | D1                    |                                        |                      |                                    | 0.40                                                                                                        |                                                                                                                                                                                                                    |                                                                                     |                            |
| 0.50                                                                                                                                                                                                                                                                       | ES2                   |                                        |                      |                                    |                                                                                                             | Dense brown and orange brown gravelly clayey fine to coarse SAND. Gravel is angular to rounded fine to coarse of flint. (BOYN HILL GRAVEL MEMBER)                                                                  |  |                            |
| 1.00                                                                                                                                                                                                                                                                       | D2                    |                                        |                      |                                    |                                                                                                             |                                                                                                                                                                                                                    |                                                                                     |                            |
| 1.20-1.65                                                                                                                                                                                                                                                                  | SPT(C) N=18           |                                        | 2,3/4,4,5,5          |                                    | (1.95)                                                                                                      |                                                                                                                                                                                                                    |                                                                                     |                            |
| 1.20                                                                                                                                                                                                                                                                       | D3                    |                                        |                      |                                    |                                                                                                             |                                                                                                                                                                                                                    |                                                                                     |                            |
| 1.60                                                                                                                                                                                                                                                                       | D4                    |                                        |                      |                                    |                                                                                                             | Terminated at 2.35m                                                                                                                                                                                                |                                                                                     |                            |
| 1.90-2.35                                                                                                                                                                                                                                                                  | SPT(C) N=79           |                                        | 7,10/15,15,22,27     | 66.23                              | 2.35                                                                                                        |                                                                                                                                                                                                                    |                                                                                     |                            |
| <b>Remarks</b><br>Groundwater not observed.<br>Standpipe installation - plain standpipe installed to 0.90m surrounded with bentonite, slotted standpipe installed to 1.90m. Fitted with a gas tap and a stop cock cover.<br>Window sampling apparatus terminated at 1.90m. |                       |                                        |                      |                                    |                                                                                                             |                                                                                                                                                                                                                    | <b>Scale (approx)</b><br>1:50                                                       | <b>Logged By</b><br>FA     |
|                                                                                                                                                                                                                                                                            |                       |                                        |                      |                                    |                                                                                                             |                                                                                                                                                                                                                    | <b>Figure No.</b><br>A2.13                                                          |                            |



**Site**

University of Reading, St Patricks Hall Redevelopment, 20 Northcourt Avenue, Reading RG2 7HB

**Number  
WS7**

**Excavation Method**

Percussive Window Sampler

**Dimensions**

**Location**

472864.8 E 171708.9 N

**Ground Level (mOD)**

67.71

**Client**

Curtins

**Job  
Number  
52527**

**Engineer**

**Sheet  
1/1**

| Depth (m) | Sample / Tests | Water Depth (m) | Field Records | Level (mOD) | Depth (m) (Thickness) | Description                                                                                                                                                                                                                                            | Legend | Water | Instr |
|-----------|----------------|-----------------|---------------|-------------|-----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|-------|-------|
| 0.10      | ES1            |                 |               |             | (0.45)                | MADE GROUND comprising topsoil composed of dark brown slightly gravelly slightly clayey fine to coarse SAND with occasional brick fragments, roots and rootlets, and rare concrete fragments. Gravel is angular to subrounded fine to coarse of flint. |        |       |       |
| 0.50      | D1             |                 |               | 67.26       | 0.45                  |                                                                                                                                                                                                                                                        |        |       |       |
| 0.80      | ES2            |                 |               |             | (0.95)                | Firm orange brown sandy CLAY with occasional light grey mottling. Sand is fine and medium. (BOYN HILL GRAVEL MEMBER)                                                                                                                                   |        |       |       |
| 1.00      | D2             |                 |               |             |                       |                                                                                                                                                                                                                                                        |        |       |       |
| 1.20-1.65 | SPT(C) N=11    |                 | 2,2/2,3,3,3   |             |                       | Dense orange brown slightly gravelly slightly clayey fine to coarse SAND. Gravel is angular to rounded fine to coarse of flint. (BOYN HILL GRAVEL MEMBER)<br>From 1.90m to 2.30m; Not gravelly.                                                        |        |       |       |
| 1.20      | D3             |                 |               | 66.31       | 1.40                  |                                                                                                                                                                                                                                                        |        |       |       |
| 1.60      | D4             |                 |               |             |                       |                                                                                                                                                                                                                                                        |        |       |       |
| 2.00-2.45 | SPT(C) N=13    |                 | 4,4/3,3,3,4   |             | (1.80)                |                                                                                                                                                                                                                                                        |        |       |       |
| 2.00      | D5             |                 |               |             |                       | Firm dark grey CLAY. (LONDON CLAY FORMATION)                                                                                                                                                                                                           |        |       |       |
| 2.50      | D6             |                 |               |             |                       |                                                                                                                                                                                                                                                        |        |       |       |
| 3.00-3.45 | SPT(C) N=10    |                 | 2,2/2,2,3,3   |             |                       |                                                                                                                                                                                                                                                        |        |       |       |
| 3.00      | D7             |                 |               | 64.51       | 3.20                  |                                                                                                                                                                                                                                                        |        |       |       |
| 3.50      | D8             |                 |               |             |                       |                                                                                                                                                                                                                                                        |        |       |       |
| 4.00-4.45 | SPT(C) N=12    |                 | 2,2/3,3,3,3   |             | (2.25)                |                                                                                                                                                                                                                                                        |        |       |       |
| 4.00      | D9             |                 |               |             |                       |                                                                                                                                                                                                                                                        |        |       |       |
| 4.50      | D10            |                 |               |             |                       |                                                                                                                                                                                                                                                        |        |       |       |
| 5.00-5.45 | SPT N=14       |                 | 2,2/3,3,4,4   |             |                       | Complete at 5.45m                                                                                                                                                                                                                                      |        |       |       |
| 5.00      | D11            |                 |               | 62.26       | 5.45                  |                                                                                                                                                                                                                                                        |        |       |       |

**Remarks**

Groundwater not observed.  
Standpipe installation - plain standpipe installed to 1.00m surrounded with bentonite, slotted standpipe installed to 5.00m. Fitted with a gas tap and a stop cock cover.

**Scale (approx)**

1:50

**Logged By**

FA

**Figure No.**

A2.14

|  <b>IAN FARMER ASSOCIATES</b>                                                                                |                               |                                          |                                          |                                    |                       | <b>Site</b><br>University of Reading, St Patricks Hall Redevelopment, 20 Northcourt Avenue, Reading RG2 7HB                                                                                                        |                               | <b>Number</b><br><b>WS8</b> |                            |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------|------------------------------------------|------------------------------------------|------------------------------------|-----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------|-----------------------------|----------------------------|
| <b>Excavation Method</b><br>Percussive Window Sampler                                                                                                                                       |                               | <b>Dimensions</b>                        |                                          | <b>Ground Level (mOD)</b><br>68.02 |                       | <b>Client</b><br>Curtins                                                                                                                                                                                           |                               | <b>Job Number</b><br>52527  |                            |
|                                                                                                                                                                                             |                               | <b>Location</b><br>472899.4 E 171690.8 N |                                          | <b>Dates</b><br>18/08/2016         |                       | <b>Engineer</b>                                                                                                                                                                                                    |                               | <b>Sheet</b><br>1/1         |                            |
| Depth (m)                                                                                                                                                                                   | Sample / Tests                | Water Depth (m)                          | Field Records                            | Level (mOD)                        | Depth (m) (Thickness) | Description                                                                                                                                                                                                        | Legend                        | Water                       | Instr                      |
| 0.30                                                                                                                                                                                        | ES1                           |                                          |                                          | 67.81                              | (0.21)<br>0.21        | MADE GROUND comprising CONCRETE cobbles to 0.055m over sub-base composed of light brown fine to coarse SAND.                                                                                                       |                               |                             |                            |
| 0.50                                                                                                                                                                                        | D1                            |                                          |                                          |                                    | (0.79)                | MADE GROUND comprising brown gravelly slightly clayey fine to coarse SAND with occasional brick and concrete fragments over a fabric damp proof membrane. Gravel is angular to subrounded fine to coarse of flint. |                               |                             |                            |
| 1.00<br>1.00<br>1.20-1.65<br>1.20                                                                                                                                                           | D2<br>ES2<br>SPT(C) N=7<br>D3 |                                          | 1,2/1,2,2,2                              | 67.02                              | 1.00                  | Dense orange brown slightly clayey fine to coarse SAND. (BOYN HILL GRAVEL MEMBER)                                                                                                                                  |                               |                             |                            |
| 1.60                                                                                                                                                                                        | D4                            |                                          |                                          |                                    |                       |                                                                                                                                                                                                                    |                               |                             |                            |
| 2.00-2.45<br>2.00                                                                                                                                                                           | SPT(C) N=16<br>D5             |                                          | 3,4/4,4,4,4                              |                                    | (2.60)                |                                                                                                                                                                                                                    |                               |                             |                            |
| 2.50                                                                                                                                                                                        | D6                            |                                          |                                          |                                    |                       |                                                                                                                                                                                                                    |                               |                             |                            |
| 3.00-3.45<br>3.00                                                                                                                                                                           | SPT(C) N=13<br>D7             |                                          | 2,1/1,3,4,5<br>Water strike(1) at 3.10m. |                                    |                       | From 3.10m; Gravelly. Gravel is angular to rounded fine to coarse of flint.                                                                                                                                        |                               |                             |                            |
| 3.50                                                                                                                                                                                        | D8                            |                                          |                                          | 64.42                              | 3.60                  | Firm grey CLAY. (LONDON CLAY FORMATION)                                                                                                                                                                            |                               |                             |                            |
| 4.00-4.45<br>4.00                                                                                                                                                                           | SPT N=11<br>D9                |                                          | 3,3/2,3,3,3                              |                                    | (0.85)                |                                                                                                                                                                                                                    |                               |                             |                            |
|                                                                                                                                                                                             |                               |                                          |                                          | 63.57                              | 4.45                  | Complete at 4.45m                                                                                                                                                                                                  |                               |                             |                            |
| <b>Remarks</b><br>Standpipe installation - plain standpipe installed to 1.00m surrounded with bentonite, slotted standpipe installed to 4.00m. Fitted with a gas tap and a stop cock cover. |                               |                                          |                                          |                                    |                       |                                                                                                                                                                                                                    | <b>Scale (approx)</b><br>1:50 | <b>Logged By</b><br>FA      | <b>Figure No.</b><br>A2.15 |



**Site**

University of Reading, St Patricks Hall Redevelopment, 20  
Northcourt Avenue, Reading RG2 7HB

**Number  
WS9**

**Excavation Method**

Percussive Window Sampler

**Dimensions**

**Ground Level (mOD)**

69.39

**Client**

Curtins

**Job  
Number  
52527**

**Location**

472944.7 E 171712 N

**Dates**

18/08/2016

**Engineer**

**Sheet  
1/1**

| Depth<br>(m) | Sample / Tests    | Water<br>Depth<br>(m) | Field Records | Level<br>(mOD) | Depth<br>(m)<br>(Thickness) | Description                                                                                                                                                                                                           | Legend | Water | Instr |
|--------------|-------------------|-----------------------|---------------|----------------|-----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|-------|-------|
| 0.15         | ES1               |                       |               |                | (0.60)                      | MADE GROUND comprising grass over brown<br>gravelly fine to coarse SAND with occasional brick,<br>roots and rootlets, and rare concrete fragments.<br>Gravel is angular to rounded fine to coarse of flint.           |        |       |       |
| 0.50         | D1                |                       |               | 68.79          | 0.60                        |                                                                                                                                                                                                                       |        |       |       |
| 0.60         | ES2               |                       |               |                |                             | Firm friable orange brown slightly gravelly sandy<br>CLAY with light grey mottling. Gravel is angular to<br>rounded fine to coarse of flint. (BOYN HILL<br>GRAVEL MEMBER)<br>From 1.00m; Stiff and slightly gravelly. |        |       |       |
| 1.00         | D2                |                       | 2,2/2,3,4,4   |                | (1.50)                      |                                                                                                                                                                                                                       |        |       |       |
| 1.20-1.65    | SPT(C) N=13<br>D3 |                       |               |                |                             |                                                                                                                                                                                                                       |        |       |       |
| 1.20         |                   |                       |               |                |                             |                                                                                                                                                                                                                       |        |       |       |
| 1.60         | D4                |                       |               |                |                             |                                                                                                                                                                                                                       |        |       |       |
| 2.00-2.45    | SPT(C) N=15<br>D5 |                       | 2,4/4,4,3,4   | 67.29          | 2.10                        | Dense light brown slightly gravelly slightly clayey<br>fine to coarse SAND. Gravel is angular and<br>rounded fine to coarse of flint. (BOYN HILL<br>GRAVEL MEMBER)                                                    |        |       |       |
| 2.00         |                   |                       |               |                |                             |                                                                                                                                                                                                                       |        |       |       |
| 2.50         | D6                |                       |               |                |                             |                                                                                                                                                                                                                       |        |       |       |
| 3.00-3.45    | SPT(C) N=24<br>D7 |                       | 4,5/6,6,6,6   |                | (2.35)                      |                                                                                                                                                                                                                       |        |       |       |
| 3.00         |                   |                       |               |                |                             | From 3.30m; Orange brown. Not clayey.                                                                                                                                                                                 |        |       |       |
| 3.50         | D8                |                       |               |                |                             |                                                                                                                                                                                                                       |        |       |       |
| 4.00-4.45    | SPT(C) N=15<br>D9 |                       | 2,2/2,2,5,6   | 64.94          | 4.45                        | Complete at 4.45m                                                                                                                                                                                                     |        |       |       |
| 4.00         |                   |                       |               |                |                             |                                                                                                                                                                                                                       |        |       |       |

**Remarks**

Groundwater not observed.  
Standpipe installation - plain standpipe installed to 1.00m surrounded with bentonite, slotted standpipe installed to 4.00m. Fitted with a gas tap and  
a stop cock cover.

**Scale  
(approx)**

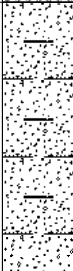
1:50

**Logged  
By**

FA

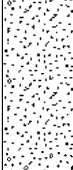
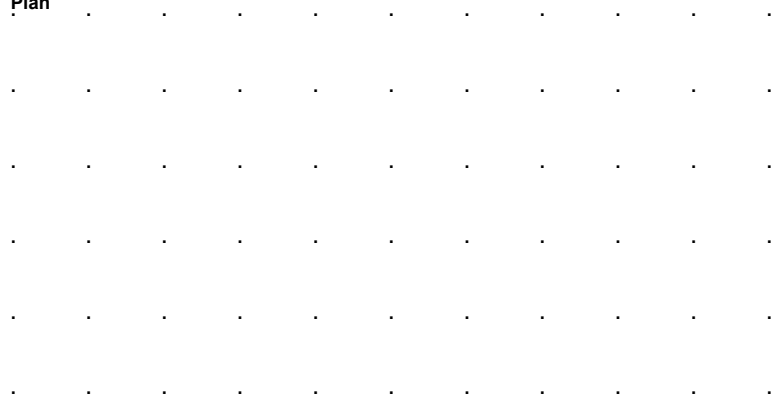
**Figure No.**  
A2.16

|  <b>IAN FARMER ASSOCIATES</b>                                                                                                                                              |                |                                          |               |                                    | <b>Site</b><br>University of Reading, St Patricks Hall Redevelopment, 20 Northcourt Avenue, Reading RG2 7HB |                                                                                                                                                                                                                | <b>Number</b><br><b>WS10</b>                                                        |                            |       |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|------------------------------------------|---------------|------------------------------------|-------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|----------------------------|-------|
| <b>Excavation Method</b><br>Percussive Window Sampler                                                                                                                                                                                                     |                | <b>Dimensions</b>                        |               | <b>Ground Level (mOD)</b><br>69.36 |                                                                                                             | <b>Client</b><br>Curtins                                                                                                                                                                                       |                                                                                     | <b>Job Number</b><br>52527 |       |
|                                                                                                                                                                                                                                                           |                | <b>Location</b><br>472920.2 E 171791.5 N |               | <b>Dates</b><br>18/08/2016         |                                                                                                             | <b>Engineer</b>                                                                                                                                                                                                |                                                                                     | <b>Sheet</b><br>1/1        |       |
| Depth (m)                                                                                                                                                                                                                                                 | Sample / Tests | Water Depth (m)                          | Field Records | Level (mOD)                        | Depth (m) (Thickness)                                                                                       | Description                                                                                                                                                                                                    | Legend                                                                              | Water                      | Instr |
| 0.10                                                                                                                                                                                                                                                      | ES1            |                                          |               |                                    | (0.50)                                                                                                      | MADE GROUND comprising grass over brown gravelly fine to coarse SAND with occasional brick fragments, roots and rootlets, and rare clinker fragments. Gravel is angular to subrounded fine to coarse of flint. |  |                            |       |
| 0.50                                                                                                                                                                                                                                                      | D1             |                                          |               | 68.86                              | 0.50                                                                                                        |                                                                                                                                                                                                                |                                                                                     |                            |       |
| 0.70                                                                                                                                                                                                                                                      | ES2            |                                          |               |                                    |                                                                                                             | Firm brown and orange brown gravelly sandy CLAY. Gravel is angular to subrounded fine to coarse of flint. (BOYN HILL GRAVEL MEMBER)                                                                            |  |                            |       |
| 1.00                                                                                                                                                                                                                                                      | D2             |                                          |               |                                    |                                                                                                             |                                                                                                                                                                                                                |                                                                                     |                            |       |
| 1.20-1.65                                                                                                                                                                                                                                                 | SPT(C) N=7     |                                          | 1,1/2,2,1,2   |                                    | (1.95)                                                                                                      |                                                                                                                                                                                                                |                                                                                     |                            |       |
| 1.20                                                                                                                                                                                                                                                      | D3             |                                          |               |                                    |                                                                                                             |                                                                                                                                                                                                                |                                                                                     |                            |       |
| 1.60                                                                                                                                                                                                                                                      | D4             |                                          |               |                                    |                                                                                                             |                                                                                                                                                                                                                |                                                                                     |                            |       |
| 2.00-2.45                                                                                                                                                                                                                                                 | SPT(C) N=18    |                                          | 2,3/4,4,5,5   |                                    |                                                                                                             |                                                                                                                                                                                                                |                                                                                     |                            |       |
| 2.00                                                                                                                                                                                                                                                      | D5             |                                          |               | 66.91                              | 2.45                                                                                                        | Terminated at 2.45m                                                                                                                                                                                            |                                                                                     |                            |       |
| <b>Remarks</b><br>Groundwater not observed.<br>Standpipe installation - plain standpipe installed to 1.00m surrounded with bentonite, slotted standpipe installed to 2.00m. Fitted with a gas tap and a stop cock cover.<br>Borehole terminated at 2.45m. |                |                                          |               |                                    |                                                                                                             |                                                                                                                                                                                                                | <b>Scale (approx)</b><br>1:50                                                       | <b>Logged By</b><br>FA     |       |
|                                                                                                                                                                                                                                                           |                |                                          |               |                                    |                                                                                                             |                                                                                                                                                                                                                | <b>Figure No.</b><br>A2.17                                                          |                            |       |

|                                                                                                              |                       |                                          |                      |                                    |                              |                                                                                                                                                                     |  |                                                                                     |              |
|--------------------------------------------------------------------------------------------------------------|-----------------------|------------------------------------------|----------------------|------------------------------------|------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|-------------------------------------------------------------------------------------|--------------|
|  <b>IAN FARMER ASSOCIATES</b> |                       |                                          |                      |                                    |                              | <b>Site</b><br>University of Reading, St Patricks Hall Redevelopment, 20 Northcourt Avenue, Reading RG2 7HB                                                         |  | <b>Trial Pit Number</b><br><b>TP1</b>                                               |              |
| <b>Excavation Method</b><br>Mechanical Excavator                                                             |                       | <b>Dimensions</b>                        |                      | <b>Ground Level (mOD)</b><br>68.17 |                              | <b>Client</b><br>Curtins                                                                                                                                            |  | <b>Job Number</b><br>52527                                                          |              |
|                                                                                                              |                       | <b>Location</b><br>472825.5 E 171925.8 N |                      | <b>Dates</b><br>16/08/2016         |                              | <b>Engineer</b>                                                                                                                                                     |  | <b>Sheet</b><br>1/1                                                                 |              |
| <b>Depth (m)</b>                                                                                             | <b>Sample / Tests</b> | <b>Water Depth (m)</b>                   | <b>Field Records</b> | <b>Level (mOD)</b>                 | <b>Depth (m) (Thickness)</b> | <b>Description</b>                                                                                                                                                  |  | <b>Legend</b>                                                                       | <b>Water</b> |
| 0.40                                                                                                         | ES1                   |                                          |                      | 67.57                              | 0.60                         | MADE GROUND comprising grass over brown gravelly slightly clayey fine to coarse SAND with roots and rootlets. Gravel is angular to rounded fine to coarse of flint. |  |  |              |
| 0.90<br>1.00                                                                                                 | ES2<br>B1             |                                          |                      |                                    | (1.81)                       | Orange brown gravelly clayey fine to coarse SAND with occasional pockets of clay. Gravel is angular to rounded fine to coarse of flint. (BOYN HILL GRAVEL MEMBER)   |  |  |              |
| 2.00                                                                                                         | B3                    |                                          |                      | 65.76                              | 2.41                         | Complete at 2.41m                                                                                                                                                   |  |                                                                                     |              |
| <b>Plan</b>                                                                                                  |                       |                                          |                      |                                    |                              | <b>Remarks</b><br>Groundwater not observed.                                                                                                                         |  |                                                                                     |              |
| . . . . .<br>. . . . .<br>. . . . .<br>. . . . .<br>. . . . .<br>. . . . .                                   |                       |                                          |                      |                                    |                              | <b>Scale (approx)</b><br>1:50                                                                                                                                       |  |                                                                                     |              |
|                                                                                                              |                       |                                          |                      |                                    |                              | <b>Logged By</b><br>FA                                                                                                                                              |  | <b>Figure No.</b><br>A2.18                                                          |              |

| Depth<br>(m) | Sample / Tests | Water<br>Depth<br>(m) | Field Records | Level<br>(mOD) | Depth<br>(m)<br>(Thickness) | Description                                                                                                                                                                              | Legend                                                                              |
|--------------|----------------|-----------------------|---------------|----------------|-----------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| 0.20<br>0.20 | B1<br>ES1      |                       |               | 67.98          | (0.45)<br>0.45              | MADE GROUND comprising grass over brown slightly gravelly fine to coarse SAND with occasional brick fragments, roots and rootlets. Gravel is angular to rounded fine to coarse of flint. |  |
| 0.70<br>1.00 | ES2<br>B2      |                       |               | 67.03          | (0.95)<br>1.40              | Orange brown clayey fine to coarse SAND and angular to rounded fine to coarse GRAVEL of flint. (BOYN HILL GRAVEL MEMBER)                                                                 |  |
| 2.00         | B3             |                       |               | 66.06          | (0.97)<br>2.37              | Orange brown gravelly fine to coarse SAND with occasional pockets of firm grey clay. Gravel is angular to rounded fine to coarse of flint. (BOYN HILL GRAVEL MEMBER)                     |  |
|              |                |                       |               |                |                             | Complete at 2.37m                                                                                                                                                                        |                                                                                     |

|                                                                                                                                                                                                                                                                                                                                                                                                                   |                           |            |  |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------|------------|--|
| <div>Plan</div> <div><div><div><div><div></div></div></div><div><div><div></div></div></div><div><div><div></div></div></div><div><div><div></div></div></div><div><div><div></div></div></div><div><div><div></div></div></div><div><div><div></div></div></div><div><div><div></div></div></div><div><div><div></div></div></div><div><div><div></div></div></div><div><div><div></div></div></div></div></div> | Remarks                   |            |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                   | Groundwater not observed. |            |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                   |                           |            |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                   |                           |            |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                   |                           |            |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                   |                           |            |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                   |                           |            |  |
| Scale (approx)                                                                                                                                                                                                                                                                                                                                                                                                    | Logged By                 | Figure No. |  |
| 1:50                                                                                                                                                                                                                                                                                                                                                                                                              | FA                        | A2.19      |  |

|                                                                                                              |                       |                                            |                      |                                    |                              |                                                                                                                                                                                                         |  |                                                                                     |              |
|--------------------------------------------------------------------------------------------------------------|-----------------------|--------------------------------------------|----------------------|------------------------------------|------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|-------------------------------------------------------------------------------------|--------------|
|  <b>IAN FARMER ASSOCIATES</b> |                       |                                            |                      |                                    |                              | <b>Site</b><br>University of Reading, St Patricks Hall Redevelopment, 20 Northcourt Avenue, Reading RG2 7HB                                                                                             |  | <b>Trial Pit Number</b><br><b>TP3</b>                                               |              |
| <b>Excavation Method</b><br>Mechanical Excavator                                                             |                       | <b>Dimensions</b><br>0.50m x 1.93m x 2.19m |                      | <b>Ground Level (mOD)</b><br>68.98 |                              | <b>Client</b><br>Curtins                                                                                                                                                                                |  | <b>Job Number</b><br>52527                                                          |              |
|                                                                                                              |                       | <b>Location</b><br>472886 E 171784.1 N     |                      | <b>Dates</b><br>16/08/2016         |                              | <b>Engineer</b>                                                                                                                                                                                         |  | <b>Sheet</b><br>1/1                                                                 |              |
| <b>Depth (m)</b>                                                                                             | <b>Sample / Tests</b> | <b>Water Depth (m)</b>                     | <b>Field Records</b> | <b>Level (mOD)</b>                 | <b>Depth (m) (Thickness)</b> | <b>Description</b>                                                                                                                                                                                      |  | <b>Legend</b>                                                                       | <b>Water</b> |
| 0.50                                                                                                         | B1                    |                                            |                      | 68.38                              | (0.60)                       | MADE GROUND comprising grass over topsoil composed of firm friable brown gravelly sandy CLAY with occasional brick fragments, roots and rootlets. Gravel is angular to rounded fine to coarse of flint. |  |  |              |
| 1.00                                                                                                         | B2                    |                                            |                      | 67.98                              | (0.40)                       | Orange brown gravelly clayey fine to coarse SAND. Gravel is angular to rounded fine to coarse of flint. (BOYN HILL GRAVEL MEMBER)                                                                       |  |  |              |
|                                                                                                              |                       |                                            |                      |                                    | (1.19)                       | Orange brown slightly gravelly fine to coarse SAND. Gravel is angular to rounded fine to coarse of flint. (BOYN HILL GRAVEL MEMBER)                                                                     |  |  |              |
| 2.00                                                                                                         | B3                    |                                            |                      | 66.79                              | 2.19                         | Complete at 2.19m                                                                                                                                                                                       |  |                                                                                     |              |
| <b>Plan</b><br>            |                       |                                            |                      |                                    |                              | <b>Remarks</b><br>Groundwater not observed.                                                                                                                                                             |  |                                                                                     |              |
|                                                                                                              |                       |                                            |                      |                                    |                              |                                                                                                                                                                                                         |  |                                                                                     |              |
|                                                                                                              |                       |                                            |                      |                                    |                              |                                                                                                                                                                                                         |  |                                                                                     |              |
|                                                                                                              |                       |                                            |                      |                                    |                              |                                                                                                                                                                                                         |  |                                                                                     |              |
|                                                                                                              |                       |                                            |                      |                                    |                              |                                                                                                                                                                                                         |  |                                                                                     |              |
|                                                                                                              |                       |                                            |                      |                                    |                              | <b>Scale (approx)</b><br>1:50                                                                                                                                                                           |  | <b>Logged By</b><br>FA                                                              |              |



Trial Pit 1



Trial Pit 1



Trial Pit 2



Trial Pit 2



Trial Pit 3



Trial Pit 3