

**SITE ASSESSMENT
PROPOSED AUTISTIC HOSPITAL**

**SHORTWOOD BUSINESS PARK
HOYLAND
BARNSELEY**

REPORT NUMBER: 11061-R1 (01)

VELLA PARTNERSHIP

30 NOVEMBER 2007

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**Client : VELLA PARTNERSHIP
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EXECUTIVE SUMMARY

Vella Partnership (Vella) propose to redevelop the subject site with a hospital for the autistic. In August 2007, following completion of a Desk Study Report RSK was commissioned by Vella to carry out an intrusive investigation of the site. The aim of the investigation was to provide sufficient information regarding ground conditions to evaluate potential risks to end-users and the environment and, if necessary, generate outline remedial measures to facilitate the redevelopment to proceed safely. The investigation was also to provide outline foundation and infrastructure design recommendations.

The planned layout comprises an array of eight residential blocks surrounding a sports block, one hospital block located close to the southern boundary, and associated staff and visitor parking together with landscaping around the periphery of the site. The current site topography can be described as significantly variable although generally falling to the northeast. Proposals for the site include re-grading to provide a large level redevelopment platform for all the buildings. This will require cut of levels in the south, where a retaining wall is proposed, running parallel to the southern site boundary and infill over the northern eastern part of the site.

A Desk Study Report including a preliminary risk assessment (PRA) completed by RSK on behalf of Vella, identified a number of potential contamination sources, including a former refuse tip beneath part of the site which could generate soil, groundwater and gas contamination. There was also the potential for hazardous ground gases associated with former mining activities. Other potential development issues include the potential surface instability resulting from collapse of buried mineshafts.

Based on the PRA, RSK completed an intrusive investigation and subsequent laboratory analysis which have confirmed the site to generally have low levels of contamination. The presence of organic contamination was confirmed in the northern corner of the site, generally in the area of the former refuse tip. Although the generic quantitative risk assessment (GQRA) identified potential risks to sensitive receptors (future users of the site), the regrading required to create the development platform will address the potential contamination issues.

The investigation did not identify any methane and low concentrations of carbon dioxide that will require limited remedial measures.

Variable thicknesses of made ground associated with former opencast activities have resulted in a number of geotechnical constraints to development. Furthermore the stability issues associated with the buried mineshafts will have to be addressed.

Based on the findings of the RSK work, the following summarises the exceptional development costs items that will be required to overcome the environmental and geotechnical problems associated with the proposed scheme of site redevelopment:

- Provision of a clean cover system in areas of soft landscaping;

- Installation of gas resistant membranes ion the ground floors of all the buildings;
- Engineered regrading to create the level development platform;
- Piled foundations with suspended ground floors for all the buildings;
- Placement of an engineering grid over the area of the mineshafts prior to raising the ground level in this area.

It will be necessary to supervise and record the implementation of these remedial measures and ensure that all earthworks are properly controlled and recorded. Records from these works should be maintained and upon completion they should be presented in a Final Land Quality Statement for the development. This will be required in order to obtain regulatory approval and to satisfy requirements of funders for the project.

1. INTRODUCTION

RSK Geoconsult Limited (RSK) was commissioned by Vella Partnership in January 2007 to carry out a Preliminary Risk Assessment (PRA) for a parcel of land at Shortwood Business Park, Hoyland, Barnsley. The findings of the PRA were provided in RSK Preliminary Risk Assessment Report dated 30 January 2007 (Ref: 10950-R1 (00)).

In August 2007, RSK was commissioned by Vella Partnership to carry out an intrusive investigation of the site. Vella Partnership propose to redevelop the subject site with an autistic hospital. Information obtained during the PRA is included within this report.

The location of Shortwood Business Park is given in Figure 1⁽¹⁾. The parcel of land proposed for redevelopment by Vella Partnership forms the northeastern quarter of the Shortwood Business Park site. This parcel of land will be referred to in the this report as the 'subject site'.

1.1 Objectives

The objectives of this assessment are as follows:

- To enable sufficient information regarding ground conditions to be obtained from which risks to end-users and the environment can be assessed;
- To provide outline remedial measures, if deemed necessary, to allow the redevelopment of the site without posing risks to identified sensitive receptors (human and environmental); and
- To obtain sufficient information pertaining to ground conditions to assist in the design of foundations and infrastructure.

1.2 Scope

The scope of the investigation and layout of this report has been designed with UK guidance, CLR11⁽²⁾ and PPS23⁽³⁾ in mind together with guidance issued by the Environment Agency in July 2005 for land contamination reports. A summary of relevant legislation and government policies applicable to land development is included in Appendix B.

The risk management process comprises up to three stages of risk assessment: Preliminary, Generic Quantitative and Detailed Quantitative Risk Assessment (PRA, GQRA and DQRA). The basis for the risk assessment is a Conceptual Model that is produced as part of the Preliminary Risk Assessment and is updated throughout the risk management process.

The scope of works for the site assessment includes:

- A Preliminary Risk Assessment involving the review of existing reports, utility location information, geological, hydrogeological and hydrological information, a commercially available database, historical plans, correspondence with appropriate regulatory

authorities and site walkover. This information is used to construct an outline Conceptual Model and consider any possible pollutant linkages that may be present and design the intrusive investigation. This assessment was previously completed by RSK and the findings used in the current investigation of the site;

- Intrusive investigation and laboratory analysis to investigate possible pollutant linkages identified in the PRA and to enable the Conceptual Model to be refined;
- GQRA to assess possible pollutant linkages identified in the PRA and enable Outline Conceptual Model to be refined;
- Ground gas risk assessment for risks to construction workers and proposed end-users of the site; and
- A detailed quantitative risk assessment (DQRA) for human health and controlled waters and recommendations for ground treatment (if deemed applicable).

The results of the site investigation, *in-situ* tests and laboratory analysis pertinent to geotechnical issues, and the geotechnical conclusions and recommendations are given in Section 5.

1.3 Limitations

The comments given in this report and the opinions expressed are based on the ground conditions encountered during the site work and on the results of tests made in the field and in the laboratory. However, there may be conditions pertaining to the site that have not been disclosed by the investigation and therefore could not be taken into account. In particular, it should be noted that there may be areas of made ground not detected due to the limited nature of the investigation or the thickness and quality of made ground across the site may be variable. In addition, groundwater and ground gas levels may vary from those reported due to seasonal, or other, effects.

This report is subject to the RSK Geoconsult Limited service constraints given in Appendix A.

2. SITE DETAILS

This section has been completed using information from the previous RSK (and predecessor companies) reports for the site and surrounding area, a previously obtained Envirocheck ⁽⁴⁾ report for the site and a site walkover, carried out by RSK on 16 January 2007.

The two reports from RSK predecessor companies available for review are:

- Report 68105R1 Site Contamination Audit Former Upper Hoyland Brickworks, dated 6 June 1997.
- Report 10017R1 Land Quality Statement Land Around the Former Upper Hoyland Brickworks, dated 15 September 1997.

The first of these (68105R1) included a Desk Study Review and Intrusive Ground Investigation of part of the area of the subject site.

The second report (10017R1) covered a much larger area, then under the ownership of Hepworth Properties Limited. This report was more general in nature and discussed the restoration of the Former Coal Workings in the context of the areas surrounding the subject site.

Details in the following sections are taken largely from these previous reports.

2.1 Site Location

The site may be located by National Grid reference SE 358 018 ⁽¹⁾. A site location map is presented as Figure 1.

2.2 Site Description

The subject site (approximately 4 ha) forms the northeastern quarter of the Shortwood Business Park site, which is located in a mixed rural/residential/commercial area on the outskirts of Barnsley, just off the Dearne Valley Parkway. The site is currently open grassed land with some trees and shrubs.

The site is bounded to the northwest by a dismantled railway line, with open land beyond and to the northeast by High Royd Farm and residential properties with open land beyond. The southern boundary is formed by High Royd Lane, with Phase 3 of the Shortwood Business Park beyond (not yet developed) and the southwestern boundary is formed by a road, with the remaining areas of Shortwood Business Park beyond (currently partly redeveloped with commercial properties).

Ground levels vary considerably across the site, with levels falling from the southwest to the northeast from an elevation of approximately 128m above ordnance datum (AOD) at the southwestern corner to 105m AOD in the northeastern corner.

2.3 Future Development

The planned redevelopment layout of the site is shown on Figure 11 and indicates an array of eight residential blocks surrounding a sports block, one hospital block and associated staff and visitor parking and landscaping around the periphery of the site. RSK have been informed that future users (patients) will include teenage children who are likely to stay at the hospital over night. There are areas of soft landscaping although it is assumed that future users of the site will not occupy these areas for extended periods. On the information provided by the client, and assumptions made above, the proposed development has been assumed to be similar to that of a residential apartment development for the purpose of assessing potential risk to future users of the site.

2.4 Planning Permission

RSK are aware that 28 planning conditions currently relate to the proposed redevelopment of the site, provided by Barnsley Metropolitan Council Planning and Transportation Department. Planning Condition 16 covers the assessment of ground contamination and remediation matters, if required. This report is designed to specifically address Planning Condition 16.

3. PRELIMINARY RISK ASSESSMENT

The following sections describe the results of the review of available information for the site and the findings from the site inspection. The information together with that presented in Section 2 has then been used to identify potential contaminant sources and sensitive receptors, from which an outline Conceptual Model has been constructed.

3.1 Geology

Available geological records for the area ^(5,6) indicate the site to be underlain by Shales, Sandstones and Mudstones of the Middle Coal Measures of the Upper Carboniferous period at the horizon of the Kents Thin and Kents Thick Coal Seams.

Superficial soils are generally absent from the site area as these materials were removed as part of the open cast coal workings. The superficial soils in the area are predominantly boulder clay with glacial sand and gravel deposits. Much of the site is known to be underlain by made ground deposits which generally comprise re-worked and replaced overburden soils and rock arising from the open cast works.

3.2 Hydrogeology

The Groundwater Vulnerability Map ⁽⁷⁾ indicates the site to be underlain by a Minor Aquifer (Coal Measures) overlain by soils of High (a worst case scenario due to the availability of less data for urban areas) and Low leaching potential, in the southern and northern sections of the site, respectively. Therefore the vulnerability of the groundwater to possible contamination at the site is considered to be relatively low.

3.3 Hydrology and Flooding

The site lies at an elevation of between approximately 105m and 128m AOD with the ground level falling, steeply in places, to the northeast.

A new balancing pond is located just to the south west of the subject site, which receives surface run-off and shallow perched water from the surrounding soils. An old pond still remains (to the south of the former Brickworks, (see Figure 7)). However, it is understood that this no longer receives run-off water from the adjacent areas (as this is diverted into the new pond) and will be

infilled at some time in the near future. The water level in the new pond was approximately 4m below the surrounding ground level at the time of the site visit in January 2007.

A stream, Shortwood Dyke, lies approximately 250m to the north west of the subject site and appears to drain in a north easterly direction, but (with the exception of the balancing pond) there are no other significant water features within 500m of the site.

Surface infiltration of rainwater will be through areas of soft landscaping or via leaking drains, if present. Movement of shallow perched water in fill materials or near surface permeable soils is likely to be to the north east, following the local topography.

3.4 Site History Review

A review of the site history was carried out through the study of Ordnance Survey maps dating from the mid 1800s and information from the Regulatory Authorities and trade directories. The review is designed to identify potential historic sources of contamination that may have impacted soil or groundwater quality beneath the site and to identify any potentially contaminative land uses in the area that may have impacted the site.

3.4.1 Historic Maps

Historical Ordnance Survey maps for the whole of the area occupied by the Shortwood Business Park for between 1855 and 2000 have been reviewed. A selection of these maps are presented in Figures 2 to 7. These are not to scale; however, all the evaluations in this report have been made from the scaled plans.

The history of the subject site may be summarised as follows. The subject site was part of the High Royal Colliery and two coal mining shafts associated with this use are present within the north western part of the subject site. Subsequently the northwestern corner of the subject site was formerly occupied by part of Hoyland Brickworks, with an associated landfill area (annotated "refuse tip" on some plans) located approximately half way along the northern boundary of the site. It appears that the kilns were probably located on the north-western corner of the subject site. The eastern two-thirds of the site remained undeveloped. Open-cast coal mining occurred extensively to the south of the subject site in the 1960's and later to 1990's. Part of the open cast workings extended into the centre of the subject site from the south.

Further details of the history of the site are given below.

The 1855 map (Figure 2) indicates the site to be in a rural area, surrounded by fields and woods. A tannery is shown on the south western boundary of the subject site and High Royd Colliery is shown on-site close to the western boundary and a shaft (coal mining) is indicated. A railway line lies immediately to the north of the site. A road or track runs from High Royd Hill into the Colliery (a road exists in this position today).

By 1893 (Figure 3) the tannery is no longer shown and the Colliery has been replaced by Hoyland Brickworks, with associated kilns within the western section of the subject site. A clay pit is present immediately to the west of the subject site, within the wider confines of the Shortwood site.

By 1905 (Figure 4), the clay pit on the site has increased in size.

The map of 1962 (Figure 5) shows the clay pit excavations to have extended further, with a pond in the centre and labelled as a partly disused quarry. A number of new kilns and two chimneys are now present within the western section of the subject site.

By 1971 (Figure 6) it appears that some infilling of the clay pit and quarry over most of the area to the west of the subject site has occurred. Two ponds are shown to the south of the subject site. The walls of an inactive quarry are shown around the easternmost pond. A refuse tip and a warehouse are now indicated within the north western section of the subject site.

The map of 2000 (Figure 7) shows the site largely as it is today, after all of the excavations on the Shortwood site have been infilled (with the exception of the balancing pond, which remains in its current position on site). The warehouses, kilns and refuse tip are no longer indicated.

3.4.2 Mining History

Based on all available information the following comments are made regarding previous coal extraction at the site:

The Kents Thick Seam was subject to open cast extraction between 1962 and 1963, particularly in the southern section of the larger Shortwood site.

The area, including the subject site, has also been undermined in the past in several deep-worked coal seams, at depths of between 65m and 420m. However, it is stated that any mining subsidence at the surface in association with this mining activity should have ceased.

Two disused shafts, shown on the extract from the Geological Map⁽⁶⁾ presented in Figure 8, are present to the north west of the subject site. These shafts are thought to be sunk to a minimum depth of 65m to the Barnsley Seam, although the Coal Authority has no record of any treatment of these shafts. Anecdotal information indicates that during the clearance of the former brickworks buildings in 1997 that at least one of these shafts was encountered and comprised an approximately 5m diameter brick lined shaft which was not capped but backfilled with brick rubble.

More recent open cast works were carried out in the mid 1990s by RJB Mining. It is not clear how much of the subject area was included within these works, however, it is known that the main access road ran through the subject site and this was infilled (with several metres thickness of colliery spoil) on completion of the works around 1997.

3.4.3 Previous Environmental Assessment Information

Site Contamination Audit, June 1997

This investigation involved the excavation of trial pits and a gas spiking survey. It was carried out over the area of the former brickworks (part of which lies within the north western section of the subject site). The intrusive site works relating to the subject site comprised the excavation of seven trial pits, laboratory testing on six soil samples and a gas monitoring exercise.

The investigation did not identify any significant soil contamination, although a number of the heavy metals concentrations (arsenic, mercury, nickel and boron) marginally exceed the respective CLEA guidance values for residential gardens with plant uptake. Only the arsenic and water soluble boron concentrations exceed the CLEA values for residential gardens without plant uptake.

The results of the gas monitoring exercise (from gas spikes and standpipes installed in trial pits) indicate low or negligible concentrations of methane and low concentrations of carbon dioxide (up to a maximum of 5.7% by volume).

3.4.4 Additional Information

RSK were provided with a site plan produced by South Yorkshire Mining Advisory Service, dated 9 July 1996, which was hand annotated with a third mineshaft location. From a review of the data it is not possible to confirm whether the annotated mineshaft is a confirmed position of one of the two previously identified mineshafts, or indeed it is an additional mineshaft. Three historical mineshafts are therefore assumed to be present beneath the site. An extract of this plan is provided as Figure 9.

More recent investigations have been carried out on the adjacent sites in advance of development of the Shortwood Business Park. These investigations, which were carried out by RSK on behalf of Priority Sites (the developer of the Phase 1 Area of the Hoyland Business Park), included trial pit investigation over the subject site along the proposed route for services.

A number of the trial pits were excavated in the vicinity of the former refuse tip area and this was recorded in the trial pits as made ground consisting of bricks, metal wire, plastic pipe, plastic bags, textiles, wood and concrete. Four monitoring standpipes were installed within the refuse tip area. Slight hydrocarbon odours were noted within two of the trial pits within the refuse tip.

A number of soil samples were recovered from the trial pits on the subject site. The following laboratory analyses were carried out:

- Five samples for inorganic analyses;
- Three samples for polycyclic aromatic hydrocarbon (PAH) analysis (two of which were within the refuse tip); and
- Two samples for total petroleum hydrocarbon (TPH) analysis (both within the refuse tip).

The results indicated concentrations of inorganic determinants to be below the respective guidance values for residential gardens with plant uptake (the most stringent category) in all five samples tested.

The results of the PAH analysis indicate concentrations of individual PAH compounds to be significantly elevated (e.g. benzo-a-pyrene concentrations of up to 180mg/kg, compared with the RSK-derived screening values of 1.1mg/kg).

The results of the TPH analysis indicated elevated hydrocarbon concentrations.

The results of the gas monitoring indicated measurable concentrations of methane and carbon dioxide within all four of the installations located within the refuse tip (up to 4.9% methane and 7.3% carbon dioxide). These concentrations were associated with depleted oxygen concentrations (as low as 4.0%). The concentrations varied considerably in several of the installations from visit to visit.

3.4.5 Anecdotal Information

Information made available to RSK indicates that the buildings on the former brickworks were demolished and cleared by VHE Construction Plc during 1997. At a slightly later date the Dearne Towns Link Road was constructed to the south of the site and it is understood that arisings from this (some 30,000m³ of predominantly reworked mudstone) were placed over the former brickworks site to an average thickness of 1.5m.

3.4.6 Summary of Historic Potentially Contaminative Land Uses

A number of sources (and also potential sources) of contamination have been identified by the previous investigations, and a review of historical mapping. These include:

- Elevated heavy metals and sulphate concentrations in the made ground across the site;
- Elevated concentrations of organic compounds within the former refuse tip;
- Elevated ground gas concentrations within the former refuse tip; and
- Potential coal bed methane from the coal workings (including shafts) beneath the site.

3.4.7 Observations Relevant to Site Assessment

Both the 1997 and more recent investigations proved made ground, generally consisting of clayey sand with bricks and colliery waste, to depths of up to 5.50m. This was found to be underlain by firm natural clay.

The 1997 report gives details of the infilling and compaction works that were carried out on part of the subject site to reinstate ground levels between 1994 and 1996. These works were carried out by Mott MacDonald on behalf of RJB Mining (UK) Limited.

From all available information the following issues are identified on the subject site that may affect any future development:

- 3 No. Coal Mining Shafts. These will have to be located and treated before development can commence in their immediate vicinity. There may also have to be a building exclusion zone around the shafts.
- Refuse Tip Area. This has the potential for ground-gas generation and possible contamination and will have to be more fully assessed and characterised in order to determine appropriate foundations.
- Backfill Areas to Open Cast Coal Workings. Parts of the subject site overlie areas which have been backfilled from open cast works in the 1960s and those more recently worked by RJB in the 1990s. Over these areas it will be necessary to confirm ground conditions before determining foundation design for any new buildings.

3.5 Summary of Potential Contaminant Sources

Current sources of on-site contamination include:

- Elevated heavy metals and sulphate concentrations in the made ground across the site, including the former refuse tip;
- Elevated concentrations of organic compounds within the former refuse tip; and
- Elevated ground gas concentrations within the former refuse tip.

Historical sources of on-site contamination include:

- Contamination in the made ground across the site; and
- Potential coal bed methane from the coal workings (including shafts) beneath the site.

Current off-site sources of contamination include:

- Contamination in the made ground beyond the site boundary; and
- Ground gases within made ground beyond the site boundary.

Historical sources of off-site contamination include:

- Potential contamination associated with the former brick works, which is indicated to have extended beyond the current south western site boundary.

3.6 Sensitive Receptors

There are a number of sensitive receptors that may be affected by the potential, and identified contamination hazards identified above. These may include:

- Balancing pond to the south west;
- Shallow perched groundwater in the made ground;
- Plastic water supply pipes for proposed development;
- Proposed vegetation (plants and trees) in soft landscaped areas;
- Deeper groundwater in the minor aquifer (Carboniferous Coal Measures);

- Site operatives during redevelopment works;
- Site workers and end-users/occupants; and
- Neighbouring residents and surrounding areas.

3.7 Summary of Plausible Pathways

Plausible pathways by which potential contamination could come into contact with sensitive receptors include:

1. Direct contact with site personnel during excavation works;
2. Surface water run-off and/or infiltration to neighbouring residents and surrounding areas, and shallow and deep groundwater bodies;
3. Existing or proposed service runs to neighbouring residents and surrounding areas;
4. Direct contact with plastic water supply pipes;
5. Plant uptake;
6. Groundwater migration to shallow and deep groundwater bodies;
7. Ground gas migration to neighbouring residents and surrounding areas;
8. Organic vapour migration from volatile compounds to neighbouring residents and surrounding areas;
9. Ground gas migration to the proposed development;
10. Organic vapour migration to the proposed development;
11. Airborne dust during any development works or from areas of unsurfaced ground to site operatives during redevelopment, neighbouring residents and surrounding areas; and
12. Groundwater migration to balancing pond to the south west.

3.8 Data Gaps and Uncertainties

Data gaps identified for the subject site include the following:

- The full extent of the former refuse tip is not confirmed;
- The depth to natural stratum beneath the subject site has not been confirmed across the entire site. This information will be required for foundation design of the proposed development;
- An assessment of the current gas regime beneath the subject site has not been carried out, and as such, the associated potential risk is unconfirmed;
- The depth to groundwater beneath the site is not known, therefore the risk to off-site receptors cannot be confirmed; and
- The degree of soil and groundwater contamination present beneath the subject site, and the potential risks posed by this contamination, if present.

3.9 Outline Conceptual Model

The information presented in Sections 2.1, 2.2 and 3.1–3.7 has been used to compile an Outline Conceptual Model. The identified potential contaminants and receptors have been considered with any possible pathways that may link them.

The Outline Conceptual Model is shown schematically in cross-section as Figure 12 and summarised below.

Potential sources of contaminants, plausible pathways and sensitive receptors are provided in sections 3.5, 3.6 and 3.7.

The Conceptual Model identifies the following potential pollutant linkages:

1. Direct contact of contaminated soils and groundwater with site workers and end-users/occupants;
2. Transport of on-site soil and groundwater contamination by surface water run-off and/or infiltration to neighbouring residents and surrounding areas, and shallow and deep groundwater bodies;
3. Transport of on-site soil and groundwater contamination along existing or proposed service runs to neighbouring residents and surrounding areas;
4. On-site contaminated groundwater migration to shallow and deep groundwater bodies;
5. Lateral hazardous ground gas migration from historical mineshafts and underlying made ground soils through underlying soils to neighbouring residents and surrounding areas;
6. Lateral vapour migration from volatile compounds in underlying made ground soils to neighbouring residents and surrounding areas;
7. Hazardous ground gas migration from historical mineshafts and underlying made ground materials to proposed development;
8. On-site soil and groundwater contaminants permeating plastic water supply pipes for proposed development;
9. Phytotoxic effects on plants and vegetation of proposed development;
10. Vapour migration from volatile compounds in underlying made ground soils to proposed development; and
11. Groundwater migration to balancing pond to the south west;

3.10 Preliminary Risk Assessment Conclusions and Recommendations

The review of information and the construction of the Outline Conceptual Model highlights potential pollutant linkages. In order to investigate any unacceptable risk presented by these, an intrusive investigation was undertaken. An intrusive investigation provides further information on actual contaminants present and viable pathways to sensitive receptors.

4. ENVIRONMENTAL SITE INVESTIGATION

The intrusive site work was carried out during the period between 13 September and 4 October 2007 to further investigate the potential pollutant linkages identified in the Outline Conceptual Model. Photographs taken at the time of the investigation work are presented in Appendix D.

The works included the excavation of trial pits and the sinking of cable percussive boreholes and rotary boreholes, all of which were supervised by an engineer from RSK.

The locations of the trial pits, cable percussive boreholes and rotary boreholes are provided on Figure 10.

RSK carried out subsequent ground gas and groundwater monitoring between 3 October and 16 November 2007.

4.1 Sampling Strategy and Methodology

Exploratory holes were located across the site to recover representative soil samples of the made ground and underlying natural stratum. Gas and groundwater monitoring wells were installed in eleven of the fifteen boreholes drilled to allow the recovery of groundwater samples, to identify the level of groundwater and to assess the ground gas regime beneath the site.

Seven of the boreholes were sunk by rotary drilling techniques to establish the depth of the underlying Coal Measures bedrock. The rotary boreholes were located across the site to provide general coverage.

Eight boreholes were sunk by cable percussive techniques to provide general coverage across the site and to specifically assess the following:

- The extent of the historic refuse tip, believed to be located close to the north western boundary;
- The location of the former roadway for the open cast workings in the 1990's, extending from the southern tip of the site to the site centre;
- The three mineshafts indicated to be present on-site to the west; and
- The depth and composition of made ground beneath the footprints of the proposed buildings.

One of the boreholes (BH108) was left open on completion so that it could be drilled to greater depth by rotary techniques.

Twenty-four trial pits were excavated, either by a wheeled excavator with back-actor or by a 16 tonne tracked excavator. The trial pits provided further coverage across the site, specifically in areas inaccessible by drilling rigs and to assess the three historic mineshafts indicated to be present on-site to the west. Additionally, trial pits were excavated to assess the extent of the former refuse tip and to characterise the materials contained within.

4.1.1 Health and Safety Considerations

RSK were made aware of the existing sewers located beneath the site. RSK were informed that no other underground services are present. The supervising RSK engineer confirmed the location of all manhole covers and adjoining sewers before exploratory works were commenced.

A cable avoidance tool (CAT) was used to scan all exploratory hole positions prior to the commencement of the intrusive investigation.

4.1.2 Investigation Locations

The rationale for the location of the investigation locations is recorded in Table 2 and the locations are shown on Figure 10.

Table 2: Exploratory Hole Location Rationale

Exploratory Hole Number	Location and Rationale	Rationale for Installation
Trial pits TP101 – TP108	Located along the eastern boundary of the site to provide general coverage. Trial pits TP105-TP108 were located on areas of raised earth bunds to assess the composition of materials contained within.	No installations provided in trial pits
Trial pits TP109 and TP110	Located close to the south western boundary to provide general coverage and ground conditions close to the proposed retaining wall.	No installations provided in trial pits
Trial pits TP114, TP115, TP116 and TP117	Located in the northern corner of site to investigate extent of historical refuse tip and extent of hydrocarbon impacted soils identified in RBH104.	No installations provided in trial pits
Trial pits TPSO1, TPSO1A, TPSO2 and TPSO3	Located in the area of the site where three historical mineshafts are located. The aim of the excavation work was to identify the top of the mineshafts and/or confirm the depth to natural stratum in this area	No installations provided in trial pits
Boreholes BH101-BH108	Located across the site for general coverage to assess depth and nature of made ground and superficial deposits.	Gas and groundwater monitoring standpipes were installed in all boreholes to provide good coverage of the site to assess shallow groundwater flow direction, assess the shallow groundwater quality and to assess the ground gas regime beneath the site.
Boreholes RBH101-BH106	Located across the site to allow an assessment to be made of the depth to underlying bedrock and composition, and to provide additional coverage between boreholes BH101-BH108.	Gas and groundwater monitoring standpipes were installed in boreholes RBH103, RBH104 and RBH105 to provide additional gas monitoring positions. Borehole RBH104 was installed with a gas and groundwater monitoring well exclusively within the underlying bedrock to assess the quality of groundwater, and resting level.

The depths of the exploratory holes, descriptions of strata encountered, comments on groundwater conditions, samples obtained and installation details are included on the exploratory hole records in Appendix E.

4.1.3 Soil Sampling

Representative soil samples were taken from trial pits and cable percussive boreholes, throughout the full depth of excavation and drilling. Due to the method of drilling, undisturbed samples were not recovered within the boreholes drilled by rotary techniques. Where olfactory or visual evidence indicated potentially contaminated soils additional samples were taken of the particular material. Samples were collected and stored in accordance with the RSK quality procedures to maintain sample integrity and to minimise the chance of cross contamination. A total of 182 samples were taken which are recorded with the depths on the exploratory hole logs in Appendix E. The samples were transported to the laboratory in chilled cool boxes.

4.1.4 Groundwater Monitoring and Levelling

Depths to groundwater were recorded using an interface probe on 3 October 2007, which also allowed an assessment to be made on the presence of free phase hydrocarbons within all RSK boreholes. Six further groundwater monitoring visits were carried out between 10 October and 16 November 2007 using an electronic dip meter to measure groundwater levels. The monitoring results are given in Section 4.2.2.

The monitoring wells were surveyed relative to Ordnance Datum to enable groundwater flow direction and a hydraulic gradient to be inferred.

4.1.5 Groundwater Sampling

Groundwater sampling was undertaken using disposable bailers, placed in suitable containers and placed in chilled cool boxes.

Purging was undertaken comprising the removal of three well volumes. Sampling was then undertaken using a disposable bailer dedicated to each monitoring location to avoid the risk of cross contamination of samples.

The use of disposable bailers was the preferred option for sampling due to the depth to groundwater being typically greater than 5.0m. Equipment used to sample groundwater by means of the 'low-flow' methodology would not be able to raise groundwater from this depth, and would be likely to introduce air into the sample. Aeration of the groundwater sample would potentially affect the results of chemical testing.

The groundwater samples were collected in a variety of containers appropriate to the anticipated testing suite required. The containers were filled to capacity and placed in a cool box to minimise volatilisation. Samples were transported under Chain of Custody documentation to the testing laboratory by courier.

4.1.6 Ground Gas Monitoring

Ground gas monitoring was carried out over seven monitoring rounds.

An infrared gas meter was used to measure concentrations of carbon dioxide (CO₂), methane (CH₄) and oxygen (O₂) in percentage by volume. Initial and steady state concentrations were recorded. A separate flow meter was used to measure borehole gas flow rate in litres per hour (l/hr). In addition, during the monitoring round on 5 and 16 November 2007, all wells were screened with a Photo-Ionisation Detector to establish if there are any interferences from other hydrocarbons with the infrared gas meter.

All monitoring results are contained within Appendix F and discussed in Section 4.2.3.

4.2 Ground Conditions

The results of the onsite observations are detailed below.

4.2.1 Soil Stratigraphy

Across the site grass and rough vegetation is present at the surface. To the south west of the site centre, and to the east, are areas of thick vegetation including shrubs and immature trees. These areas could not generally be accessed for the site investigation works.

In the south east corner of the site are two raised earth mounds. The surface of the mounds are densely vegetated. These were investigated with two trial pits in each (TP105 to TP108) and were generally found to contain mostly reworked natural soils comprising gravelly silt and clay soils, with some concrete and broken brick and pipe remains. At the base of the trial pits in these earth mounds, associated with the adjacent ground level, apparent natural silt and clay soils were encountered.

In the southeastern portion of the subject site, on the most elevated part, trial pits (TP112 and TP113) generally revealed only a thin layer of made ground up to a maximum of 0.4m, overlying natural slightly sandy and slightly gravelly clay soils. The natural clays extended to depths of 1.5m (TP112) and 2.6m (TP112) bgl. The superficial deposits were underlain by sandstone bedrock, this being moderately to completely weathered at the encountered surface.

In the western area, boreholes BH101 to BH103 revealed made ground to depths of 5.9m (BH103) and 10.6m bgl (BH101). The made ground generally comprised reworked friable gravelly clay, and weathered mudstone and sandstone fragments. Occasional coaliferous fragments, brick and pipe remains were observed in this made ground material, as well as plastic, metal and glass in some places. Evidence of potentially contaminated soils consisted of the presence of ash in various horizons of made ground and pockets of black viscous liquid (possibly tar) and the hydrocarbon odour noted in BH101.

Further to the west of boreholes BH101 to BH103, the vertical extent of made ground was observed between 4.3m (TPS01A) and 5.3m bgl (TPS01). The full depth of made ground was not penetrated in trial pit TPS02, which was terminated at 3.6m. Close to the south eastern boundary the depth of made ground was recorded between 1.0m (TP111) and 3.1m (TP110). The full thickness of made ground was not recorded in TP109, which was terminated at 4.50m. The made ground generally comprised reworked clay and bedrock fragments with occasional bands of ash and brick.

In the northern corner of the site a horizon of made ground was encountered that was significantly different to that found across the remainder of the site. The material was typically black clay or sand of ash with metal, ceramic fragments, plastic, wood, and brick and concrete fragments with a hydrocarbon odour. This material was identified in trial pits TP114, TP115, TP117, TP118, TP119 and boreholes RBH104 and BH107. Trial pit TP115 was continued as a trench in a northerly direction as far as practicably possible, towards the site boundary (see Figure 10), and made ground with evidence of hydrocarbon contamination was present along its entire length. With the exception of trial pit TP119, where this made ground type was encountered at 0.2m below ground level, all other exploratory holes indicated a minimum cover of 0.9m above this layer. This material is considered likely to comprise materials associated with the former refuse tip in this area.

Underlying superficial deposits were encountered between thicknesses of 0.20m (TP112) and 5.3m (TPS01). The natural materials typically comprise gravelly clay. Other natural soils included horizons of silt and sand that are generally situated towards the south eastern boundary of the subject site. In the majority of boreholes the superficial materials were absent, with made ground directly overlying the Coal Measures bedrock.

Bedrock was encountered in all boreholes and four trial pits (TP102, TP110, TP112 and TP113) between depths of 0.1m (TP102) and 15.0m (RBH101 and BH108) bgl. The bedrock generally comprised interbedded horizons of sandstone and mudstone.

The investigation generally confirmed the geology indicated by geological maps for the area and the historical development of the site.

The trial pit and borehole records are presented in Appendix E and include the soil samples taken, visual or olfactory evidence of contamination and details of the installation of monitoring wells or reinstatement. Schematic cross-sections of the geology encountered are given in Figures 13 and 14.

4.2.2 Groundwater Regime

The results of the groundwater monitoring are provided in Appendix F. The data have been used to construct a piezometric surface, where possible, and this is presented on cross sections in Figures 13 and 14 and the Groundwater Contour Plot (Figure 15). The data indicate the shallow groundwater to be perched and not continuous beneath the site. There is no clear direction of

groundwater flow. Over the monitoring period groundwater levels in several boreholes reduced whilst in others it rose, providing further evidence of unconnected perched groundwater bodies beneath the site. Hydrocarbon odours were evident in groundwater sampled from borehole BH107.

4.2.3 Ground Gas Regime

During the monitoring period (see Appendix F), the highest recorded concentration of methane was 3.0% in borehole BH107. With the exception of boreholes BH101 (1.1%) and RBH105 (1.1%) on the 5 November 2007, and BH107 that generally indicated a concentration up to 3.0%, all reported methane concentrations were not above 0.5% and typically less than the gas monitor detection level of 0.1%.

The highest carbon dioxide concentration recorded over the monitoring period was 24.5% (steady concentration) in borehole RBH104. With the exception of RBH104, which also recorded the second highest concentration of 13.2% on 28 October 2007, all other reported carbon dioxide concentrations were below 8.3%. On at least one occasion six of the eleven monitoring wells reported a concentration of carbon dioxide greater than 5.0%, with a seventh recording a concentration of 4.8% on at least one occasion.

Steady state oxygen concentrations, below typical atmospheric conditions of approximately 20%, were recorded in all boreholes on at least one occasion. Of particular concern are the concentrations reported below 18.0% due to the abnormal affects on the human body when concentrations reach 17% or below. Concentrations of oxygen were reported significantly below 18.0% in all boreholes on at least one occasion, with the exception of borehole BH103 that recorded a minimum concentration of 19.4% during the monitoring period.

A Photo-Ionisation Detector was used during the monitoring visits to assess the potential concentrations of volatile compounds at each location. Over two consecutive monitoring rounds the highest concentration of volatile compounds was 0.8 parts per million (ppm) in borehole BH101. With the exception of borehole BH102 (0.3ppm), all reported concentrations of volatile compounds were below the level of instrument detection (0.1ppm).

The highest recorded flow rate during the monitoring period was 4.2 litres per hour (l/h) in borehole RBH104 on 3 October 2007. The second highest recorded flow rate of 2.5 l/h was also from RB104 on 15 October 2007. With the exception of borehole RBH104, flow rates were typically less than the level of instrument detection (0.1l/h). Only during the monitoring visit of 3 October 2007 were flow rates recorded greater than 0.1l/h (BH105: 0.4l/h and BH107: 0.6l/h), with the exception of borehole RBH104.

The ground gas results obtained from the site indicate an intermittent presence of slightly elevated carbon dioxide beneath the site. The vast majority of made ground materials encountered during the intrusive site investigation (predominantly reworked clay and bedrock

fragments) are unlikely to generate large quantities of ground gases, and this reflected in the flow rates obtained during the monitoring process.

Where visual and olfactory evidence of organic contamination has been identified, as in boreholes RBH104 and BH107 that have indicated hydrocarbon contamination, elevated concentrations of methane (BH107) and significantly elevated concentrations carbon dioxide (RBH104) have been recorded. The highest recorded flow rate of 4.2 l/h was also recorded at borehole RBH104.

In accordance with current guidance, provided in CIRIA Report 659 "Assessing Risk Posed By Hazardous Ground Gases To Buildings" (December 2006) ⁽⁸⁾, the results obtained from the gas monitoring are assessed by a system based on different scenarios. The scenarios relate to a range of characteristic situations (CS) comprising CS1, CS2, CS3, CS4, CS5 and CS6 and these are used to determine the level of risk presented by the presence of ground gases. Each CS category is defined by a Gas Screening Value (GSV), which is the multiple of the maximum gas concentration and flow rate measured in litres of gas per hour.

The highest theoretical methane flow per hour from the site is 0.126 litres per hour, based on the highest recorded flow rate of 4.2 litres/hour (RBH104) and highest concentration 3.0% (BH107) over the monitoring period. The site would therefore fall under characteristic situation CS2, which defines the risk classification as low.

The highest theoretical carbon dioxide flow per hour from the site is 1.029 litres per hour, based on the highest recorded flow rate of 4.2 litres/hour (RBH104) and highest concentration 24.5% (RBH104) over the monitoring period. The site would therefore fall under characteristic situation CS3, which defines the risk classification as moderate. As both the highest reported flow rate and carbon dioxide concentration are recorded at the same monitoring location, the classification would be considered acceptable.

Copies of the gas data records are included in Appendix F and results of the assessment of ground gas are provided in Section 4.8.5.

4.2.4 Observed Contamination

Olfactory evidence of hydrocarbon contamination was observed in a horizon of made ground in trial pits TP114, TP115 TP117-TP119 and boreholes RBH104 and BH107. The made ground materials where this contamination was observed comprise black clay or sand of ash with metal, ceramic fragments, plastic, wood, and brick and concrete fragments. The layer of hydrocarbon contaminated soils was encountered between 0.2m (TP119) and 4.2m (BH107) below ground level and ranged in thickness between 0.2m (1.4m-1.6m in TP117) and 2.8m (0.2m-3.0m in TP119). A hydrocarbon odour and visual evidence of a black viscous liquid was also observed in made ground from 3.6m to 5.6m in borehole BH101. The contamination observed in these materials is considered likely to be associated with the former refuse tip located in this area of the site.

Hydrocarbon odours were observed in boreholes RBH104 and BH107 during groundwater sampling.

4.3 Refined Conceptual Model

The findings of the intrusive investigation were used to assess the validity of the plausible pathways provided in the Outline Conceptual Model. The following pathways are discussed in turn and considered not be plausible based on the site investigation findings:

1. Direct contact with contaminated soils and groundwater by site personnel during excavation works is considered unlikely if appropriate personal protective equipment (PPE) is used. This PPE should include gloves, protective boots and overalls, as a minimum, and may also require protective glasses, face masks or respirators. Confirmation of the required PPE should be made following a site-specific risk assessment and method statement for the redevelopment construction work. However, a potential risk to the end-users of the site/occupants may still exist and therefore remains a plausible pathway to these receptors.

2. Following the development of the proposed buildings and associated areas of hardstanding, the vast majority of surface water run-off will be managed by site drainage. Infiltration will only be possible in areas of soft landscaping. Planted vegetation will reduce the volume of rainfall infiltrating through areas of landscaping to the underlying made ground materials.

3. The pathway along existing or proposed service runs is considered not plausible based on the route the service pipes would have to take to connect contaminated soils/ground gas from beneath the site to the potential receptor.

5. Based on the typically low flow rates of ground gases obtained during the gas monitoring period, and the vast majority of site soils encountered not considered as gas producing, the risk posed by ground gas migration to neighbouring residents and surrounding areas is low.

6. Very low concentrations of volatile compounds were reported during the gas monitoring period and the risk of vapour migration to the proposed development and neighbouring residents and surrounding areas is not considered plausible.

11. The outline conceptual model identified the balancing pond to the south west of the site as a receptor potentially at risk from on-site contamination. However, the intrusive site investigation has indicated shallow groundwater within the made ground to be perched and not continuous. The potential pathway to the balancing pond is therefore considered broken and the risk to this receptor is negligible.

The revised conceptual model identifies the following potential pollutant linkages:

1. Direct contact of contaminated soils and groundwater with end-users/occupants;
2. Phytotoxic effects on plants and vegetation of proposed development;

3. On-site soil and groundwater contaminants permeating plastic water supply pipes for proposed development;
4. On-site contaminated groundwater migration to shallow and deep groundwater bodies; and
5. Hazardous ground gas migration from historical mineshafts and underlying made ground materials to proposed development.

4.3.1 Uncertainty

The vast majority of made ground materials comprise reworked natural soils and for this reason there is some uncertainty relating to the interface between made ground and underlying natural superficial deposits.

Where visually observed hydrocarbon contaminated soils were identified in trial pit TP115, the dense vegetation and steep slope along the northern boundary prohibited investigation up to the site boundary. It is uncertain whether this contamination is contained within the site or extends beyond the northern site boundary.

Due to the rotary method of drilling at borehole RBH104, an undisturbed sample could not be taken over the depth interval where hydrocarbon odours were observed, hence preventing laboratory testing to characterise the contaminants present within the soil.

Groundwater levels recorded in RBH104 indicate the resting water level to be within the overlying made ground materials. However, the inferred depth of made ground at this location was based on a drillers description when rotary drilling. It is possible that the true depth to bedrock in RBH104 is 7.5m, and not 9.0m, as suggested by the borehole log provided. The revised depth to bedrock is considered more likely due to the monitoring well being installed between

4.4 Chemical Conditions of Soils

Soil and groundwater samples were submitted to Envirolab Limited for analysis as detailed on the Laboratory Chain of Custody forms. Full analytical certificates for soil and groundwater samples are provided in Appendices G and H, respectively and summary Tables of results in Appendix K. The results are discussed below.

4.4.1 Contamination Analyses

4.4.1.1 Soil

Thirteen soil samples were analysed for a broad range of inorganic contaminants including pH, arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium and zinc. The results of the analyses are presented in Table K1 of Appendix K.

Five soil samples were analysed for speciated hydrocarbons, including BTEX compounds (Benzene, Toluene, Ethyl Benzene and Xylene) and two tested for total hydrocarbons (TPH). The results of the analyses are presented in Tables K2 and K3, respectively (Appendix K).

Six soil samples were tested for speciated polycyclic aromatic hydrocarbons (PAHs). The results of the analyses are presented in Table K4 (Appendix K).

4.4.1.2 Water

Two groundwater samples obtained from boreholes RBH104 and BH107 were analysed for speciated hydrocarbons, including BTEX compounds, and speciated PAHs. The results of the analyses are presented in Tables K5 and K6 respectively (Appendix K).

In line with CLR11⁽²⁾ there are two stages of quantitative risk assessment, generic and detailed. The GQRA comprises the comparison of soil, groundwater and ground gas results with Generic Assessment Criteria (GAC) that are appropriate to the linkages being assessed. The GAC used in this assessment are included in Appendices I for human health (together with details of their derivation) and in Appendix J for the assessment of phytotoxic effects, risks to plastic utilities and to controlled waters.

4.5 Soils analyses

4.5.1 Inorganic Contaminants

Arsenic exceeded the GAC of 20mg/kg in one sample (63mg/kg) in trial pit TPS03 at 3.20m.

No other inorganic contaminants were identified at concentrations above the GAC for human health.

Slightly alkaline conditions were recorded in one sample (TP110; 1.2m) with a pH value of 9.08.

4.5.2 Organic Contaminants

GAC's were not exceeded for any BTEX compounds.

The speciated hydrocarbon results indicate concentrations ranging between 280.0mg/kg in borehole BH107 (4.60m) to 6112.5mg/kg in trial pit TP119 (2.0m). The individual carbon bands for each test result were compared to speciated GAC values and aromatic carbon bands C₁₀ – C₁₂ (57.8mg/kg), C₁₂ – C₁₆ (1310mg/kg) and C₁₆ – C₂₁ (1420mg/kg) were found to exceed the respective values.

Both of the samples tested for total hydrocarbons (TPH) recorded values which did not exceed the GAC value for human health.

The total concentrations of reported PAHs ranged between 1.39mg/kg (TP109 at 1.0m) to 598.11mg/kg (BH101 at 5.7m-6.9m). Exceedences of GAC values for individual PAH compounds were reported in four of the six samples tested. The benzo-a-pyrene (BAP) GAC of 1.1mg/kg was slightly exceeded in samples taken from TP108 (2.93mg/kg) and BH107 (2.86mg/kg) and Acenaphthene GAC of 9mg/kg in BH107 (10.60mg/kg). Samples taken from BH101 (5.7m-6.7m) and TP118 (1.60m) indicated significantly elevated concentrations of PAHs, with eight and four individual compounds exceeding GAC, respectively. Additionally, benzo-a-pyrene concentrations of up to 180mg/kg were reported in soil sampled from the area of the former refuse tip during a previous investigation.

4.6 Groundwater Analyses

The controlled waters GAC values were not exceeded for individual PAH compounds reported in groundwater taken from the underling bedrock formation. Six individual PAH compounds reported in the perched groundwater sample taken from BH107 exceed associated GAC values.

The total hydrocarbon concentrations for both groundwater samples taken (RBH104; 0.728mg/l and BH107; 1.322mg/l) exceed the controlled waters GAC of 0.1mg/l. Reported concentrations of BTEX compounds do not exceed controlled water GAC values.

The site investigation work, subsequent refinement of the Conceptual Model and GQRA work indicates that there are relevant pollutant linkages at the site, which require further consideration.

4.7 Relevant Linkages for Assessment

The linkages for assessment are presented in Table 3

Table 3: Linkages for Generic Quantitative Risk Assessment

Relevant Pollutant Linkage	GAC
Direct contact pathways to future users/site workers	Human health GAC for a residential apartment block end use without private gardens since proposed end use includes overnight stay by staff and patients.
Leaching and dissolved phase migration to minor aquifer	Those recorded in Table A3 of Appendix J for minor aquifers owing to linkages identified to the Middle Coal Measures bedrock.
Permeation of plastic water supply pipes	Those recorded in Table A2 of Appendix J for water supply pipes
Phytotoxic effects following uptake by plants	Those recorded in Table A1 of Appendix J for phytotoxic effects of contaminants
Concentrations of methane and carbon dioxide in ground gas entering and accumulating in: Depressions and excavations during any site works and development that could affect site workers; and	Gas Screening Values (GSV) have been calculated using maximum methane and carbon dioxide concentrations with maximum flow rates recorded at the site. The GSV have been compared to the Revised Wilson and Card Classification presented within CIRIA

Relevant Pollutant Linkage	GAC
Confined space in new buildings, which could affect future residents. In the case of methane, this could create a potentially explosive atmosphere, whilst death by asphyxiation could result from carbon dioxide.	Report⁽⁸⁾ owing to the development comprising residential blocks with the potential for ground bearing floor slabs.

4.8 Methodology and Results

The methodology and results of the generic quantitative risk assessment are presented for each relevant pollutant linkage in turn.

4.8.1 Direct Contact by Future Users/Site Workers

Although UK guidance^(CLR7 and 11) requires statistical analysis to be undertaken prior to comparison of the laboratory data with the GAC, samples were obtained on a targeted basis. Therefore, statistics are not appropriate and the laboratory analytical data has been compared directly to the GAC.

The elevated arsenic value of 63mg/kg was reported in a sample taken from trial pit TPS03 at 3.2m. If the soil containing this concentration was present at ground level it might create a slight risk to the end users. However this result was only identified in one sample at depth.

The results of the organic analyses of soil samples indicate a potential to risk to future users of the site from hydrocarbon contaminated soils in the vicinity of TP119. This trial pit is in the vicinity of the proposed residential block, situated furthest east. Results of PAH analysis of soil samples also indicate potential risk to human health in samples taken from TP118 (1.60m) and BH101 (5.7m-6.7m), which are in the vicinity of proposed residential blocks.

The slightly elevated concentration of BAP reported in TP108 (0.4m), will not remain a risk to human health of the future site users as long as the stockpile of soil it was sampled from is not placed directly beneath a proposed building. The exceedences of GAC values for Acenaphthene and BAP in BH107 will potentially pose a risk to the future users of the site.

4.8.2 Uptake of Contaminants by Vegetation Potentially Inhibiting Plant Growth

The results have been compared with the GAC presented in Appendix J for this linkage. The results indicate that a relevant pollutant linkage is unlikely to exist associated with phytotoxic effects.

4.8.3 Permeation of Plastic Utilities

The results have been compared to the GAC presented in Appendix J for this linkage. The results indicate that a relevant pollutant linkage may exist associated with the permeation of plastic utilities.

4.8.4 Leaching and Migration of Contaminants to Minor Aquifer

Groundwater was analysed for speciated PAHs and speciated hydrocarbons. These concentrations have been compared to the GAC for minor aquifers included in Appendix J and justified in Table A3. These were considered the most appropriate GAC owing to the site's location on a minor aquifer. The result of the analyses indicate a relevant pollutant linkage does exist although the impact on the groundwater within the minor aquifer is considered low. The controlled water GAC is based on the Environmental Quality Standard, which is used for the protection of aquatic life in surface waters. The PRA indicated that no surface water is potentially at risk from the site and therefore the reported concentration of hydrocarbon in RBH104 is considered to not pose a risk to any environmental receptors.

Soil samples were not analysed for leachable inorganic compounds due to the total concentrations indicating typically low values.

4.8.5 Ground Gas

In order to assess the significance of ground gases at the site, measured concentrations and flow rates have been used to generate Gas Screening Values (GSVs). These have then been compared to the Revised Wilson and Card Classification presented within CIRIA Report 659.

The site has been characterised as CS3 (see section 4.2 above).

4.9 Environmental Assessment Conclusions

The intrusive site investigation, and associated laboratory analyses, generally indicate low levels of inorganic contamination beneath the site but relatively high concentrations of PAH are associated with the fill within the former landfill in the northern corner of the site. A potential risk to future users of the site has been identified from this contamination. To reduce the risk from the inhalation pathway, it will be necessary to prevent ingress of any vapours into the buildings.

In the northern corner of the site surface levels are to be raised by 7m and 9m. The significant depth of engineered cover materials will eliminate risk to future users from direct contact or ingestion.

As stated above, with respect to the risk posed by ground gas, the site has been characterised as a CS3 site. On this basis, the following typical protective measures are recommended:

- a) Reinforced concrete cast in-situ floor slab (suspended, non-suspended or raft) and underfloor venting; or
- b) Beam and block or pre-cast concrete and under floor venting;
- c) All joints and penetrations are to be sealed;
- d) Proprietary gas resistant membrane; and
- e) Passively vented under floor void.

These provisions will eliminate the entry of hydrocarbon vapours thus eliminating that pathway.

5. GEOTECHNICAL SITE ASSESSMENT

As outlined in Section 1 it is proposed to construct a hospital for the autistic on the subject site. The aim of the geotechnical investigation is to ascertain ground conditions and provide sufficient data regarding the soil parameters to enable the design of foundations, floor slabs and infrastructure.

5.1 Methodology

As outlined in Section 4, eight boreholes were sunk by cable percussive techniques, seven boreholes were sunk by rotary drilling techniques and 24 trial pits were excavated for environmental purposes including ground gas monitoring. Information from these holes was also used for geotechnical purposes to characterise the ground conditions.

5.1.1 Intrusive Investigation Undertaken

5.1.1.1 Trial Pits

Twenty-four trial pits were excavated by mechanical means. Representative disturbed samples were taken and returned to the laboratory for analysis. The descriptions of the strata encountered together with comments on groundwater conditions and pit stability are given in the trial pit records presented in Appendix E. Four trial pits (TPS01, TPS01A, TPS02 and TPS03) were specifically excavated in the vicinity of the three historical mineshafts primarily to identify the location of the shafts, but to also confirm the depth to competent natural stratum.

5.1.1.2 Boreholes

Eight boreholes were sunk by light cable percussion techniques. The depths of the boreholes, descriptions of the strata encountered and comments on groundwater conditions are given in the borehole records presented in Appendix E.

Representative disturbed samples were taken throughout the full depth of boring. These were returned to the laboratory for examination and testing.

Standard penetration tests (SPTs) were carried out to assess the relative density, consistency or hardness of the strata. The values of penetration resistance (N values) are given in the borehole records.

Seven boreholes were sunk by rotary drilling techniques. The depths of the boreholes, descriptions of the strata encountered and comments on groundwater conditions are given in the borehole records presented in Appendix E.

Rotary 'open hole' drilling was performed through made ground deposits, with up to three metres of coring carried out through underlying natural strata to confirm the depth of bedrock. 100mm diameter undisturbed samples of the underlying bedrock were recovered, where possible, to confirm the depth and condition of the bedrock.

5.1.2 Exploratory Location Rationale

All boreholes were located across the site to provide general coverage of the underlying ground conditions. Cable percussive boreholes BH101, BH102 and BH103 were specifically located in the north western portion of the site to assist the assessment of competent natural stratum in this area. Boreholes RBH101, BH106, BH108 and RBH102 were located to also assess the depth to the former open cast access road that entered the site from the south. As described in Section 5.1.1.1 four trial pits (TPS01, TPS01A, TPS02 and TPS03) were specifically excavated in the vicinity of the three historical mineshafts primarily to identify the location of the shafts, but to also confirm the depth to competent natural stratum. Trial pits TP109, TP110 and TP111 were excavated in the close to the southern boundary in the vicinity of the proposed retaining wall. These exploratory holes were excavated to assess the ground conditions in this area.

5.1.3 In-situ Testing

In-situ standard penetration testing was generally carried out throughout the full depth of drilling in all cable percussive boreholes. The purpose of this testing was to allow an assessment to be made of the relative density of made ground materials, and competency of the underlying natural superficial deposits and Coal Measures bedrock.

5.1.4 Laboratory Analysis

The geotechnical testing completed has generally been carried out in accordance with the methods given in BS 1377.

The particle size distributions of three soil samples were determined by wet sieve/and sedimentation/analysis. The grading curves are presented in Appendix L.

Compaction testing was carried out on three soil samples.

The assessment of the potential for chemical attack on buried concrete based on current BRE guidance was carried out. The results of the analyses are given in Table K7 (Appendix K).

5.1.5 Groundwater Monitoring

As discussed in Section 4.2.2 of the report, groundwater monitoring was carried out over seven visits between 3 October and 16 November 2007. The results indicate the perched groundwater in made ground is not continuous.

5.2 Ground Conditions Encountered

A description of the ground conditions encountered across the site is given in section 4.2.1.

5.2.1 Assessment of Mining

The three historical mineshafts could not be located during the intrusive investigation. However, natural competent soils were indicated at a depth of approximately 5.3m below existing ground level in the area of the inferred mineshaft positions. This area is proposed to be raised by approximately 2.0m. The minimum 'no-build' radius from the inferred mineshaft locations would therefore be in the region of 7.0m. The proposed building locations are a minimum of 20m from the reported locations of the mineshafts. Consequently, the buildings should not be at risk should the mineshafts collapse. However there remains the potential for ground surface subsidence to occur in the vicinity of the shafts in areas proposed for landscaping. Since the shafts are now buried at a depth of about 5m it would require a major excavation to attempt to locate them. As an alternative, some protection could be offered by placement of a strong engineering geogrid over the current site surface. The geogrid would be placed over a radius of 15m from the recorded centre of the shafts before regrading takes place to raise the ground levels. This reinforcement would help span any collapse should it occur thus limiting any surface expression. Should settlement be observed at some stage in the future, the area could be fenced off then carefully excavated and the mineshaft, once identified, properly capped.

5.3 Chemical Attack on Buried Concrete

This assessment of the potential for chemical attack on buried concrete is based on current BRE guidance ⁽⁹⁾. The desk study and site walkover indicate that, for the purposes of this assessment of the aggressive chemical environment, the site should be considered as a brownfield development. The results of these analyses are given in Table K7 (Appendix K).

The RSK site investigation reported a maximum water-soluble sulphate content in groundwater of 0.2g/l. However, a review of the laboratory test results in the previous investigation (Site Contamination Audit, dated June 1997), indicates soluble sulphate concentrations from leachate testing to range between 0.497g/l and 1.530g/l. The characteristic value for the site is therefore considered to be 1.530g/l. As this value is below the limiting value of 3.0g/l consideration of magnesium is not required. On the basis of these results, and as a conservative approach to concrete design, the Design Sulphate Class would be DS-2 and the associated ACEC Class for location would be AC-2. Although for the purposes of this assessment the site has been classified as brownfield, the pH is nowhere less than the limiting value of 5.5. The third assessment of Design Sulphate Class specific to brownfield sites is therefore not required in this case.

5.4 Foundation Design

The proposed site development comprises significant re-grading of site materials to provide a large level platform. The proposed earthworks will result in all residential blocks, with the exception of the furthest south, being constructed on areas raised between 1.0m and 9.0m. Although the replaced materials should be properly engineered, the underlying made ground (of the underlying opencast backfill) remains considerably variable. Consequently, it is recommended that all the proposed buildings are provided with piled foundations and suspended ground floor slab. Piles should be designed to develop their carrying capacity by a combination of skin friction and end –bearing in the competent bedrock. Design should also allow for negative skin friction where the shafts are formed in made ground. To facilitate design, approximate depths to bedrock from the proposed development platform are plotted in Figure 17. It should be noted that pile installation will be difficult in these ground conditions and the precise method of construction will affect the carrying capacity. Consequently advice should be obtained from specialist contractors on the types of pile they would propose and the working loads they would expect to achieve.

5.5 Infrastructure

5.5.1 Road Construction

Following the proposed cut and fill earthworks operations, road pavement design should assume a California Bearing Ratio of between 2% and 5%. Any pockets of soft or loose material at formation level should be removed and replaced with well-compacted granular material. All formations should be compacted to make good any disturbance caused by excavation. It is recommended that the formation is not exposed for any period of time during inclement weather.

Provided the re-grading is carried out to a controlled specification, there should not be any need for special measures for service installation. However the 'reinforced area' around the mine shafts should be avoided.

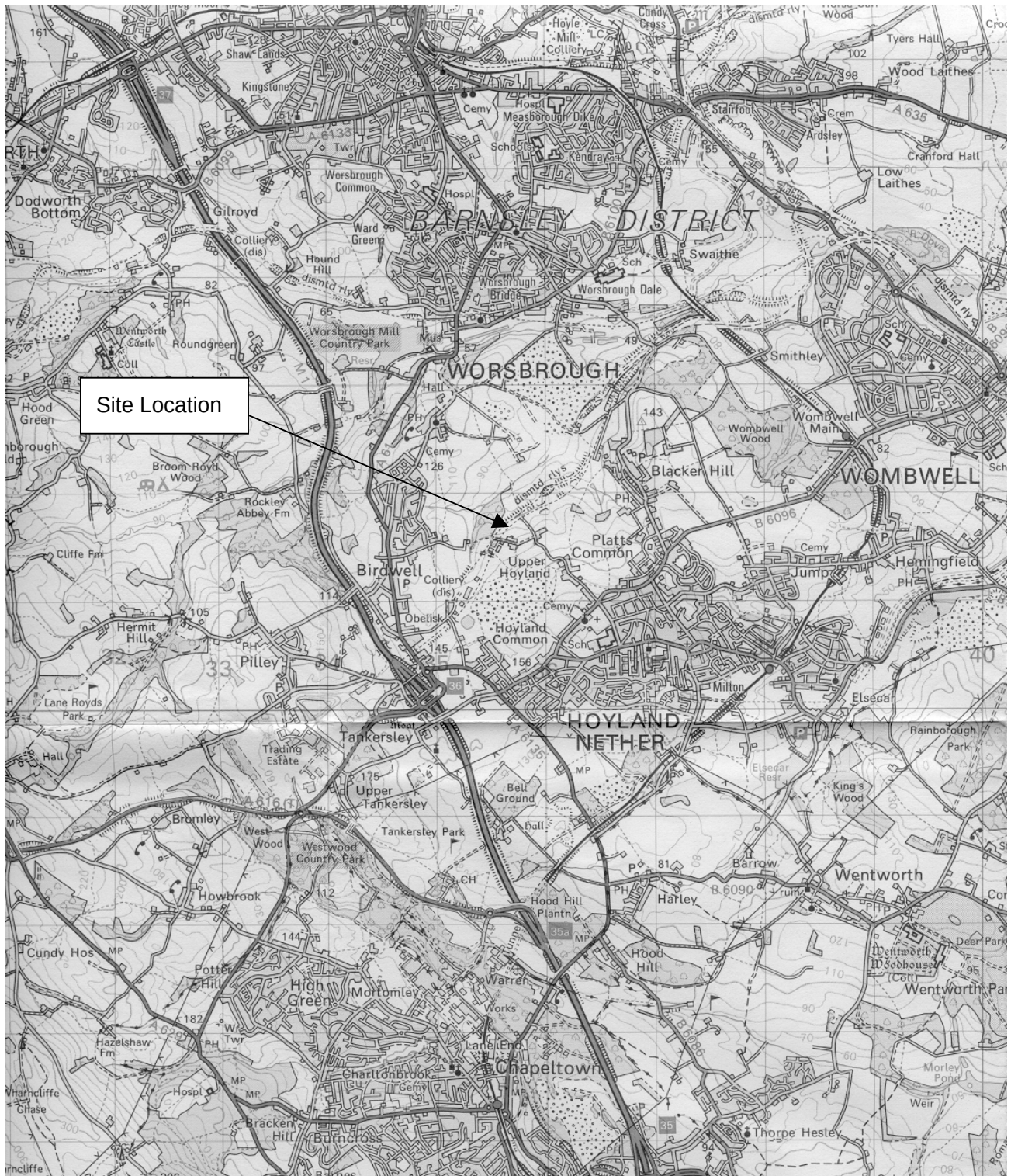
5.6 Utilities

Water supply pipes should be installed with 'protectaline', or similar, due to the potential for slightly elevated contaminants to exist in site soils, which would have a detrimental effect on plastic pipes.

6. REFERENCES

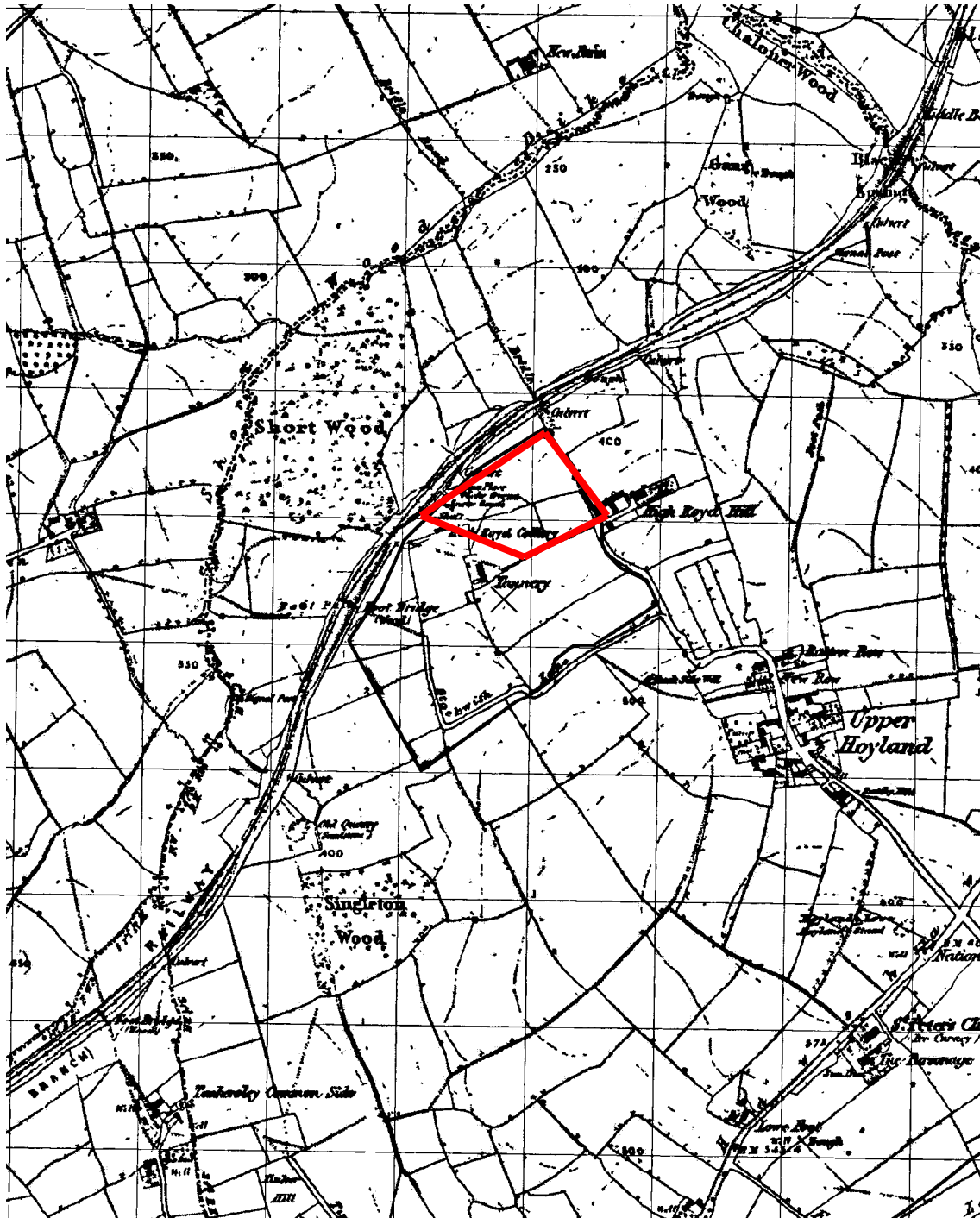
1. Ordnance Survey, Landranger Series Map Number 111 (Sheffield & Doncaster), 1:50,000, 2002
2. Model Procedures for the Management of Land Contamination. Contaminated Land Report 11 (CLR 11). Published by DEFRA and the Environment Agency, September 2004.
3. Office of the Deputy Prime Minister; Planning Policy Statement 23: Planning and Pollution Control, 2004.
4. Landmark Information Group, EnviroCheck Report Reference EC 702991-1-1, dated January 2007.
5. Geological Survey of Great Britain (England and Wales), Sheet 87 (Barnsley), Scale 1:50,000, Solid & Drift edition, 1976.
6. Geological Survey of England and Wales. Yorkshire Sheet 282 N.E. Edition of 1932. Scale Six Inches to One Statute Mile.
7. National Rivers Authority, "Policy and Practice for the Protection of Groundwater", 1:100,000 Scale Groundwater Vulnerability Map, Sheet 11 (South Pennines), 1997.
8. Wilson, S, et al. (2006) CIRIA Report 659 "Assessing Risk Posed By Hazardous Ground Gases To Buildings", Construction Industry Research and Information Association.
9. BRE Special Digest 1, Concrete in Aggressive Ground, BRE, Third Edition 17 June 2005.

FIGURES



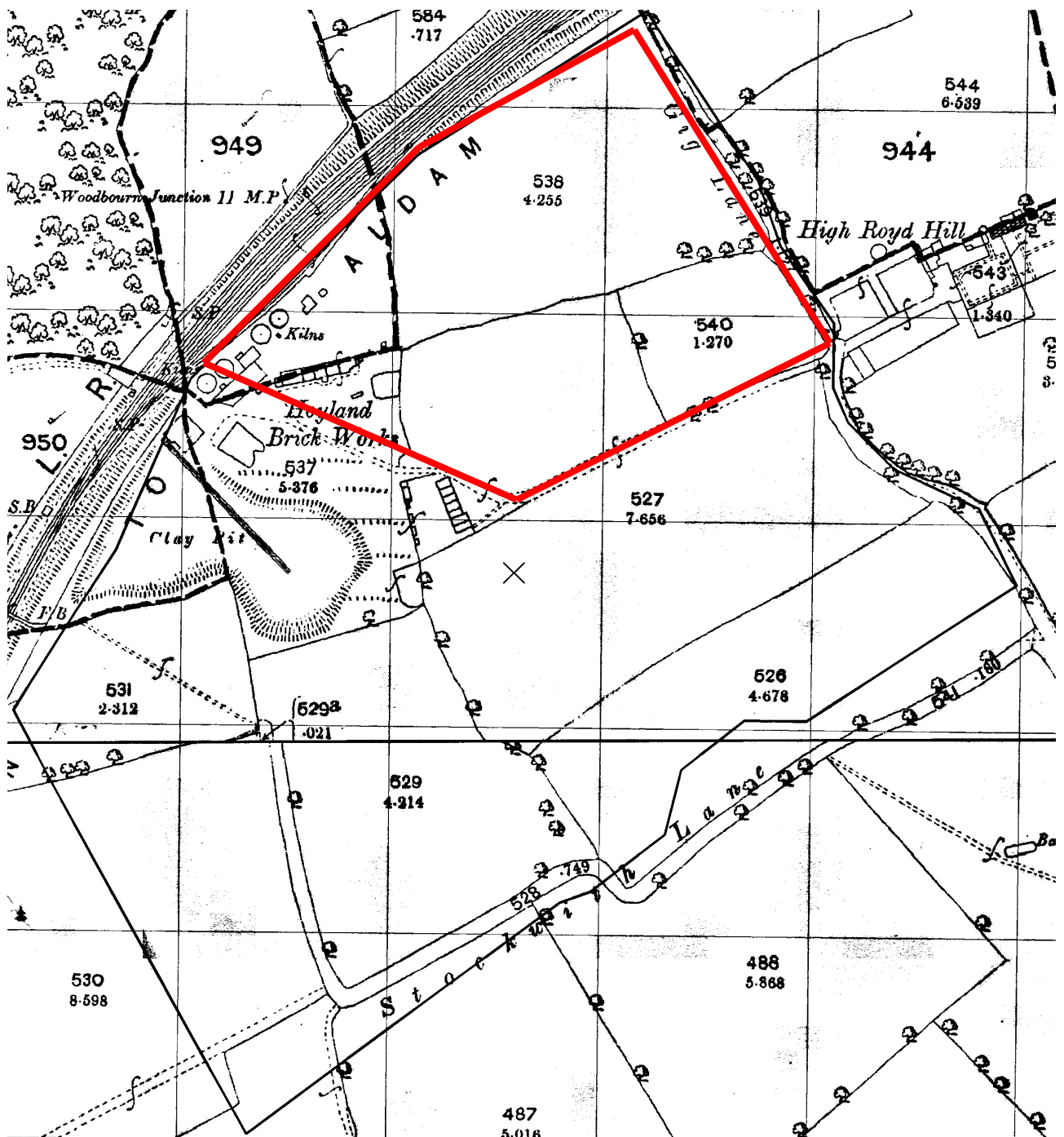
Reproduced from the 1988 Ordnance Survey 1:50,000 Scale Landranger Map 111, OSGR – SD 800 035
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SITE LOCATION MAP



EXTRACT FROM HISTORICAL MAP 1855

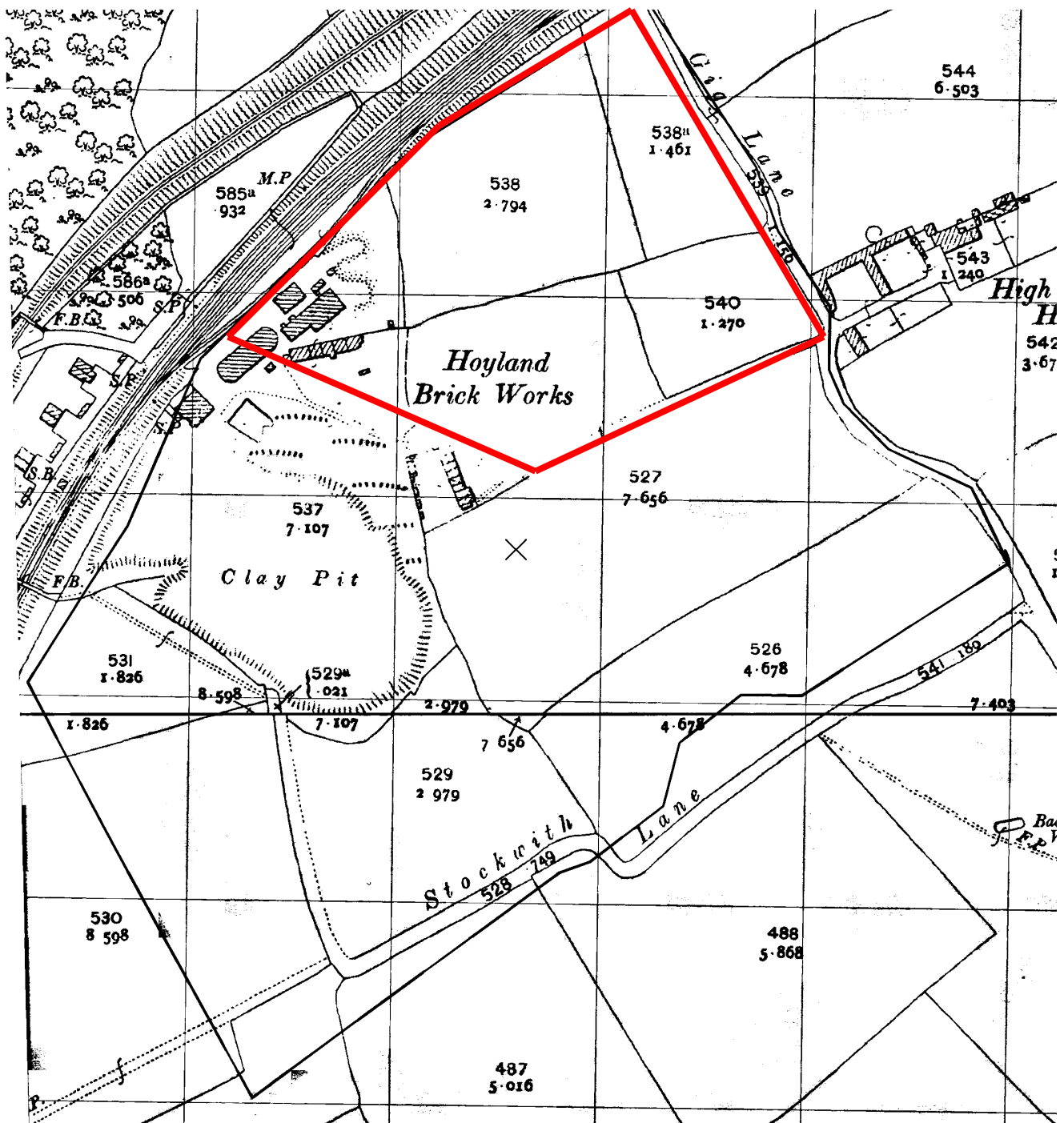
Approximate Boundary of Subject Site



EXTRACT FROM HISTORICAL MAP 1893

Approximate Boundary of Subject Site

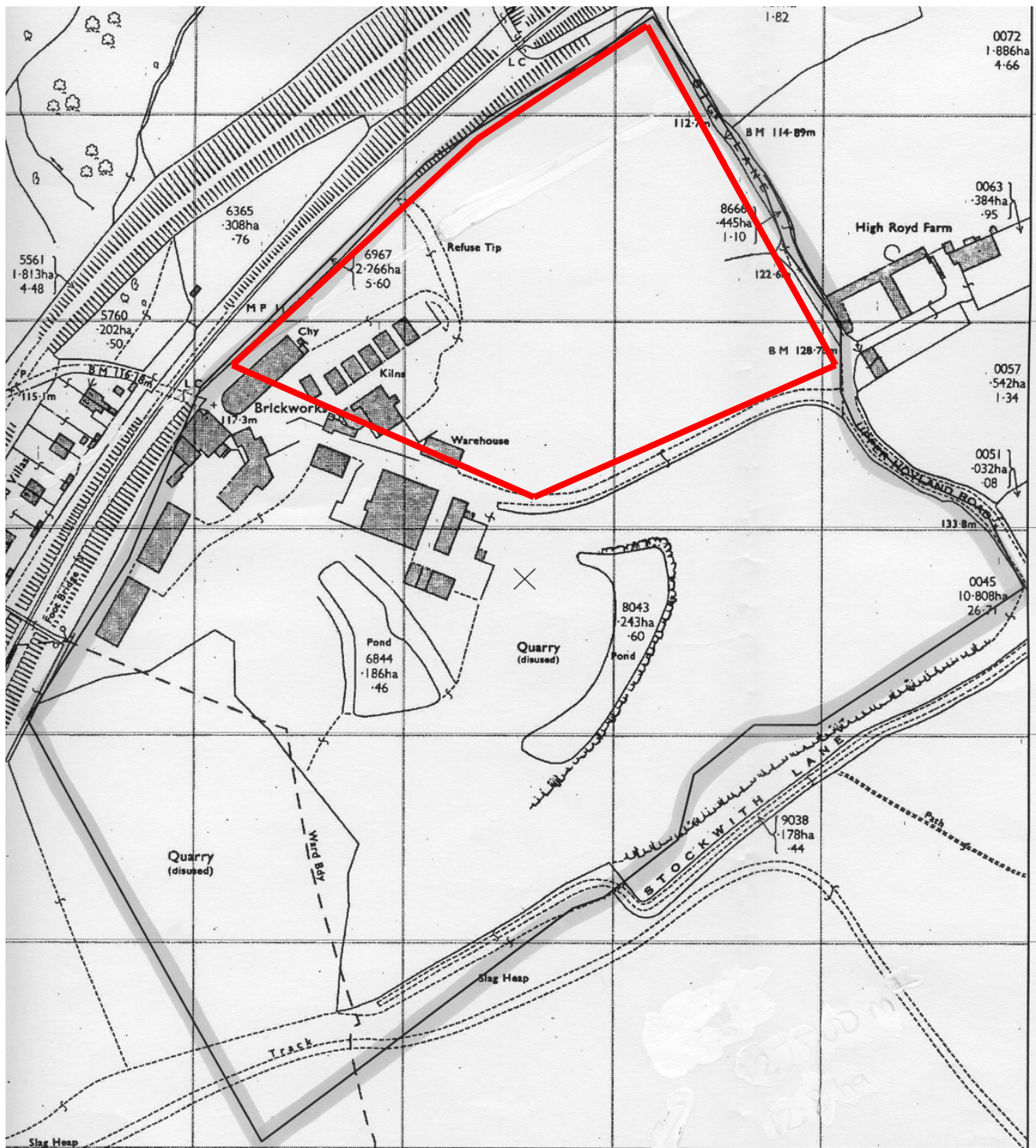




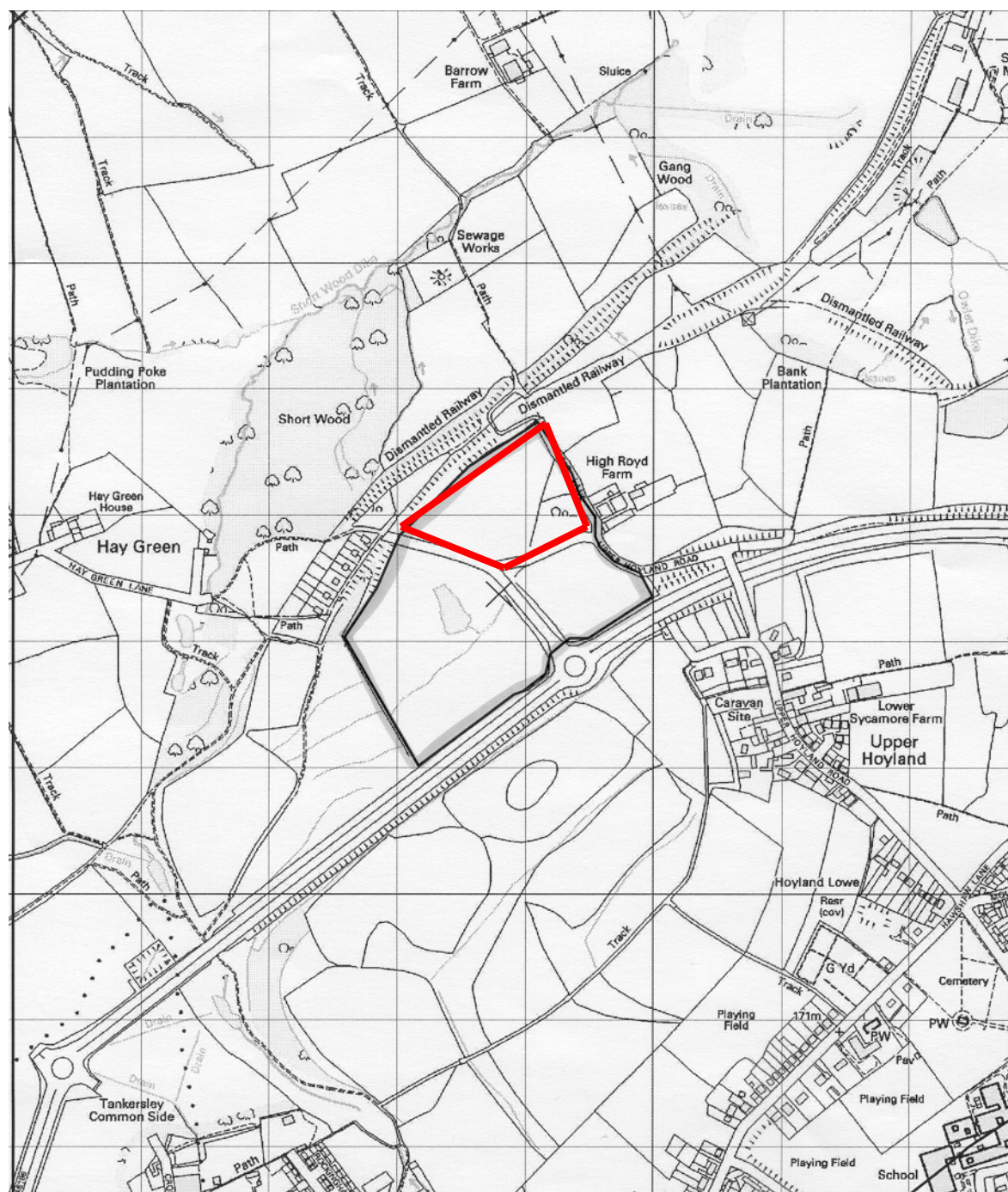
EXTRACT FROM HISTORICAL MAP 1905

Approximate Boundary of Subject Site



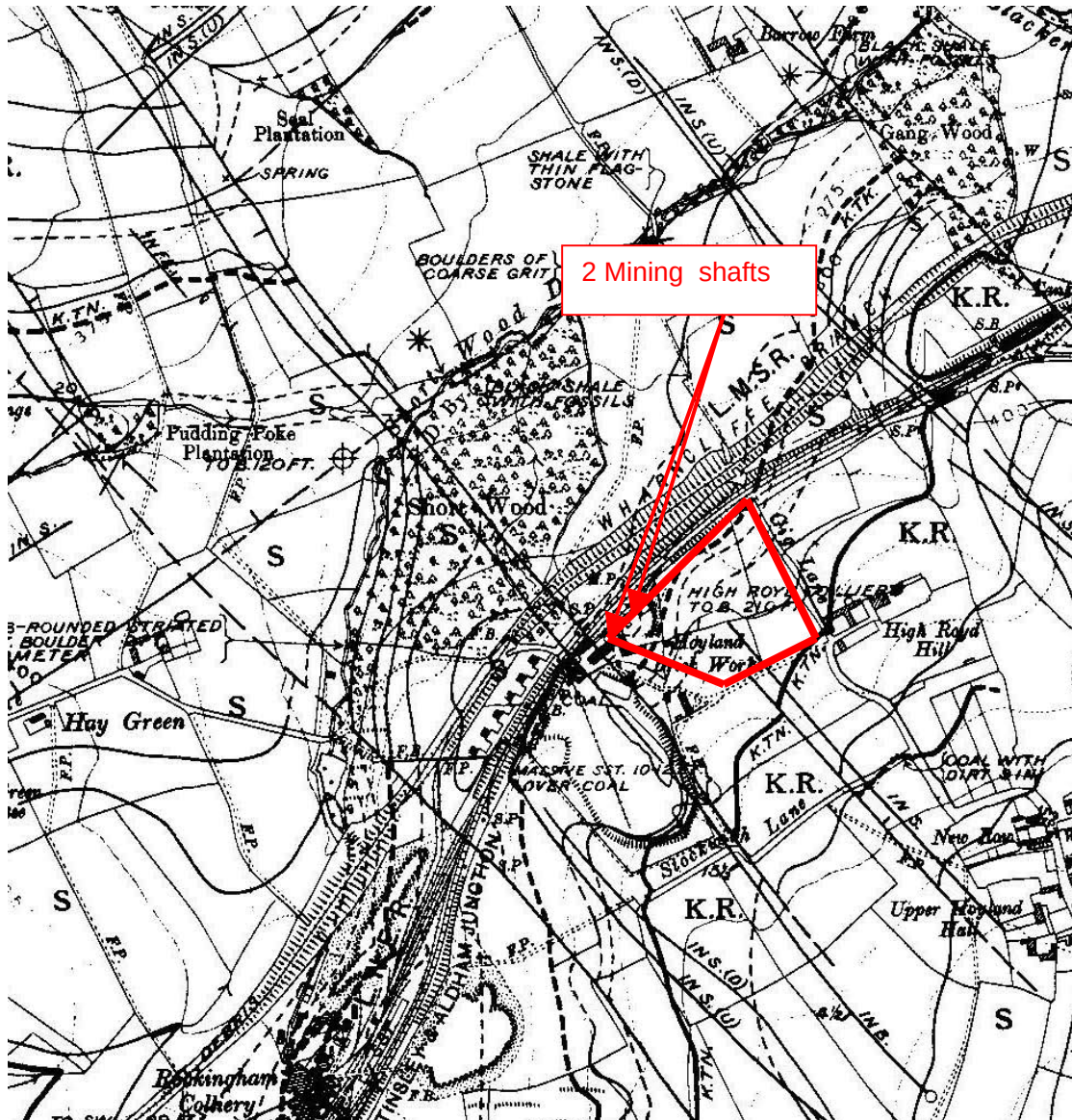


Approximate Boundary of Subject Site



EXTRACT FROM HISTORICAL MAP 2000

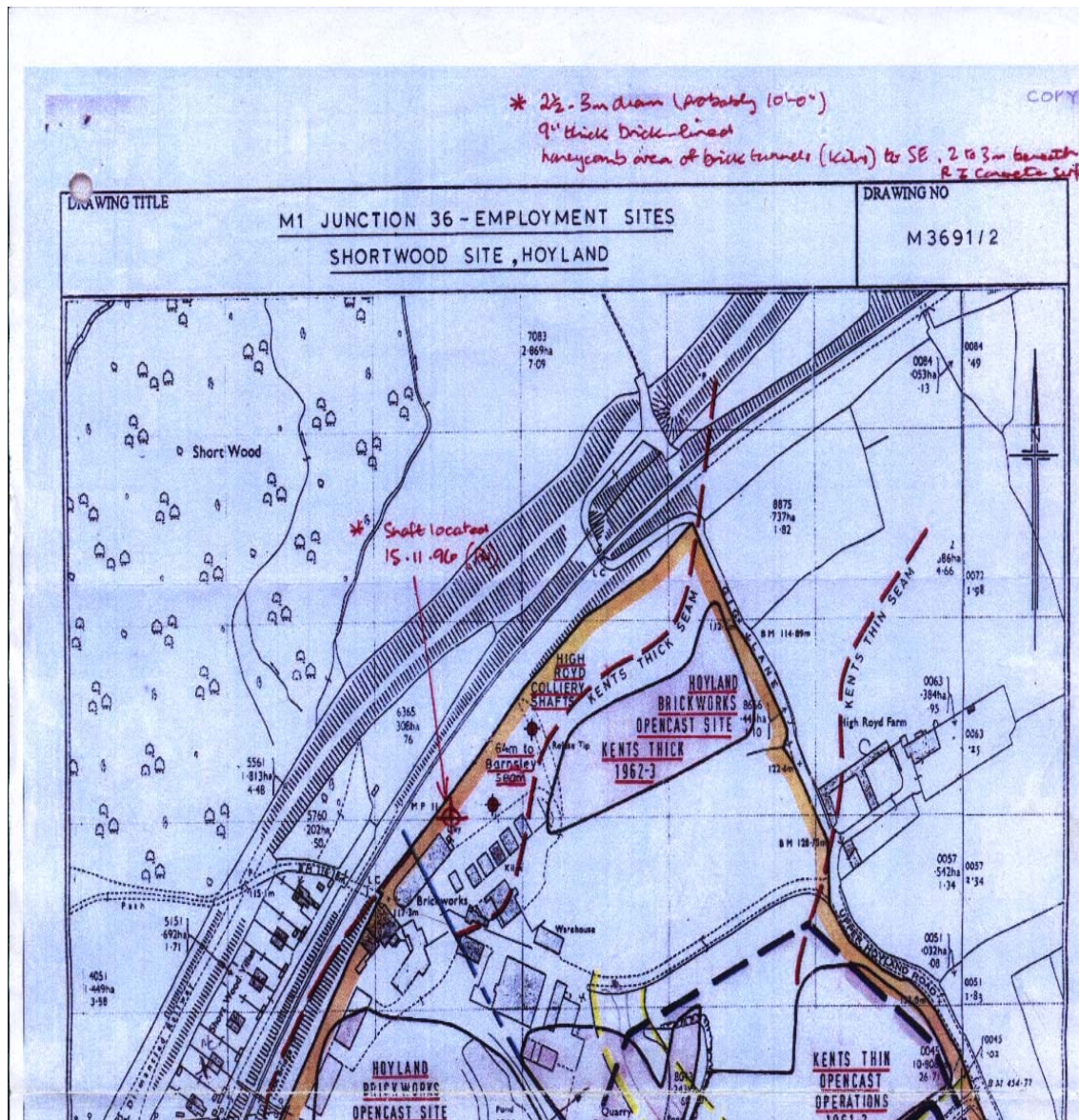
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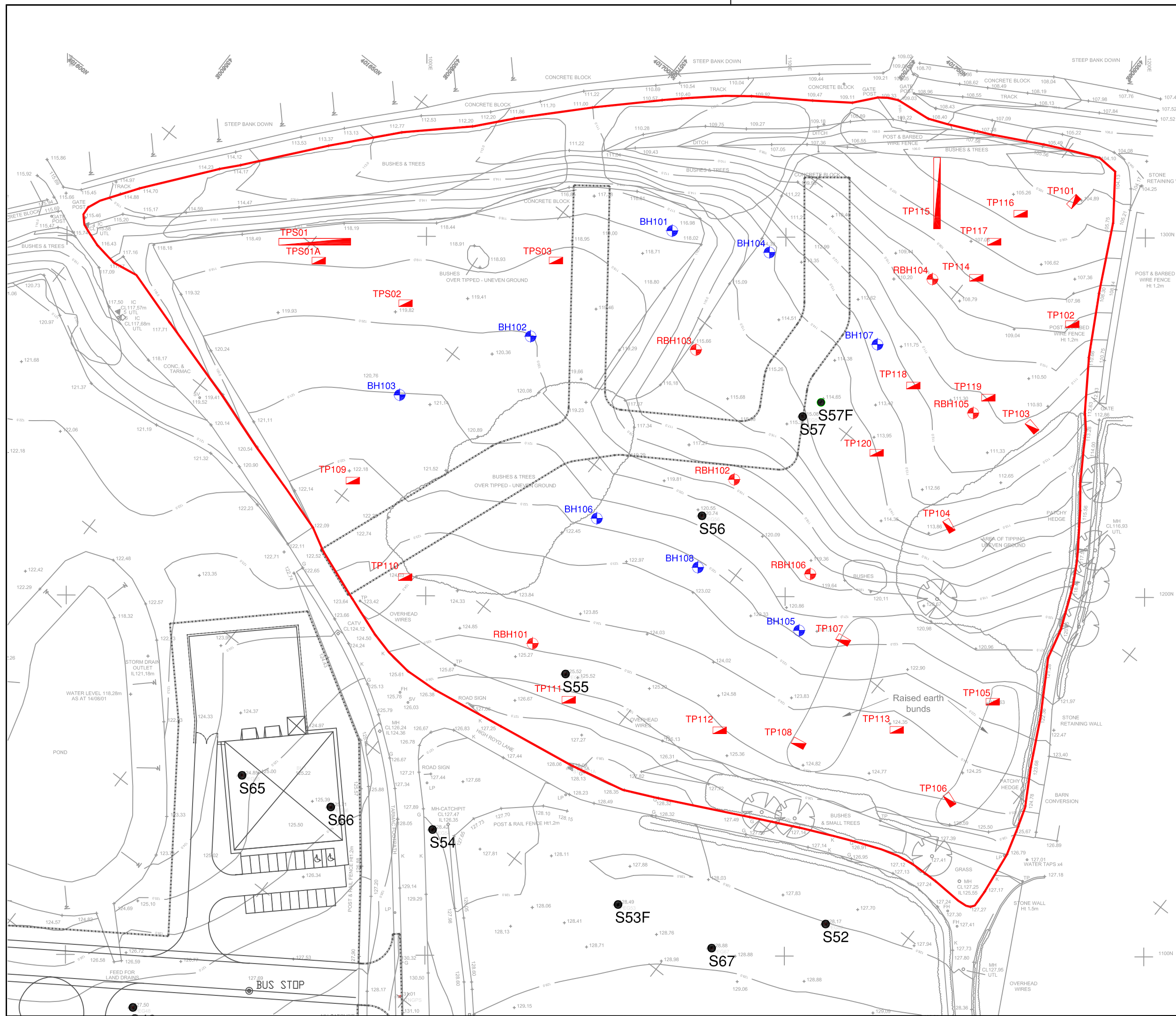
EXTRACT FROM GEOLOGICAL MAP - 1932
(Six Inches to One Statue Mile Scale Yorkshire 282NE)

Approximate Boundary of Subject Site





Extract from South Yorkshire Mining Advisory Service Plan (1996)



LEGEND

BH108 RSK Boreholes locations

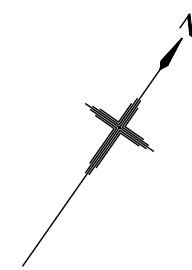
RBH106 RSK Rotary borehole locations

TP120/TPS03

 RSK Trial pit locations

— Site Boundary

S55 ● Ground Marker



A	21.09.07	FIRST ISSUE		HD	GMG
REV	DATE	DESCRIPTION		BY	CHD, APR.
Dimensions		Projection	Scale	Orig Size	
m			1:1000	A3	

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CLIENT

VELLA PARTNERSHIP

PROJECT

SHORTWOOD AUTISTIC HOSPITAL

TITLE	SITE PLAN
-------	-----------

JOB No.:			DRAWING FILE:	
11061			11061-1(01)D010A	
BY:	DATE:	CONTRACT NO.		REV:
HD	21.09.07		FIGURE 10	A





Red contours indicate preferred mounding to screen views from houses. 1 in 3 slope preferred on housing, western, side. 1 in 2.5 slope shown on eastern, development, side). Eastern side could be steepened or even terraced to provide interesting activity area.

LEGEND

A	21.09.07	FIRST ISSUE	HD	GMG	GMG
REV	DATE	DESCRIPTION	BY	CHD	APR.
Dimensions		Projection	Scale	Orig Size	
m			1:1000	A3	

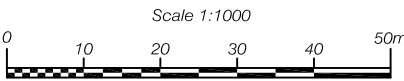


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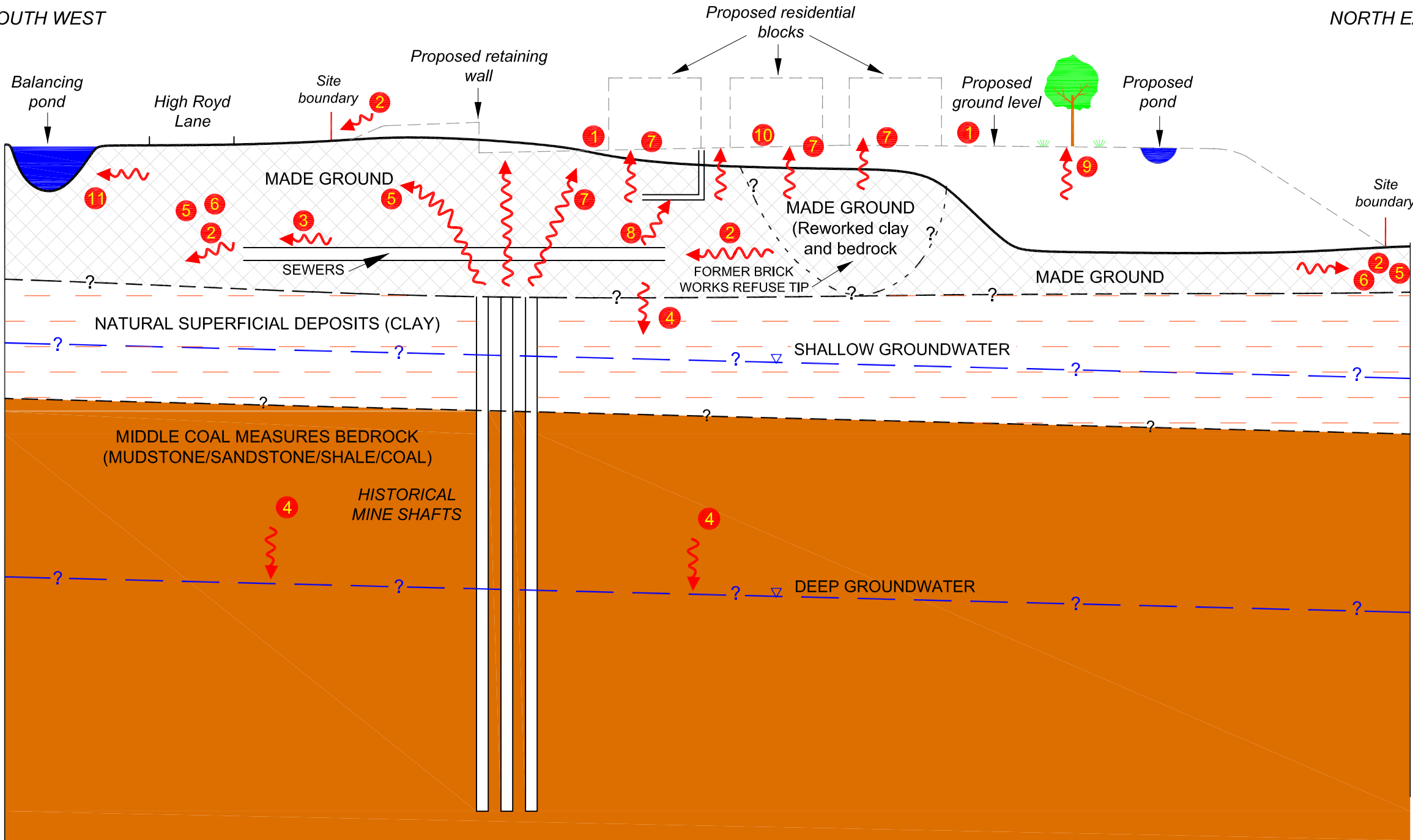
CLIENT	VELLA PARTNERSHIP
PROJECT	SHORTWOOD AUTISTIC HOSPITAL
TITLE	PROPOSED REDEVELOPMENT PLAN

JOB No.:	11061	DRAWING FILE:	11061-1(01)D011A
BY:	HD	DATE:	6.11.07
CONTRACT NO.:		REV:	A
FIGURE 11			



SOUTH WEST

NORTH EAST



RELEVANT POLLUTANT LINKAGES:

- 1 Direct contact of contaminated soils and groundwater with site workers and end users/occupants.

2 Surface water run-off and/or infiltration to neighbouring residents and surrounding areas, and shallow and deep groundwater bodies.

3 Existing or proposed service runs to neighbouring residents and surrounding areas.

4 Groundwater migration to shallow and deep groundwater bodies.

5 Ground gas migrating to neighbouring residents and surrounding areas.
- 6 Vapour migration from volatile compounds neighbouring residents and surrounding areas.

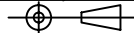
7 Ground gas migration to proposed development.

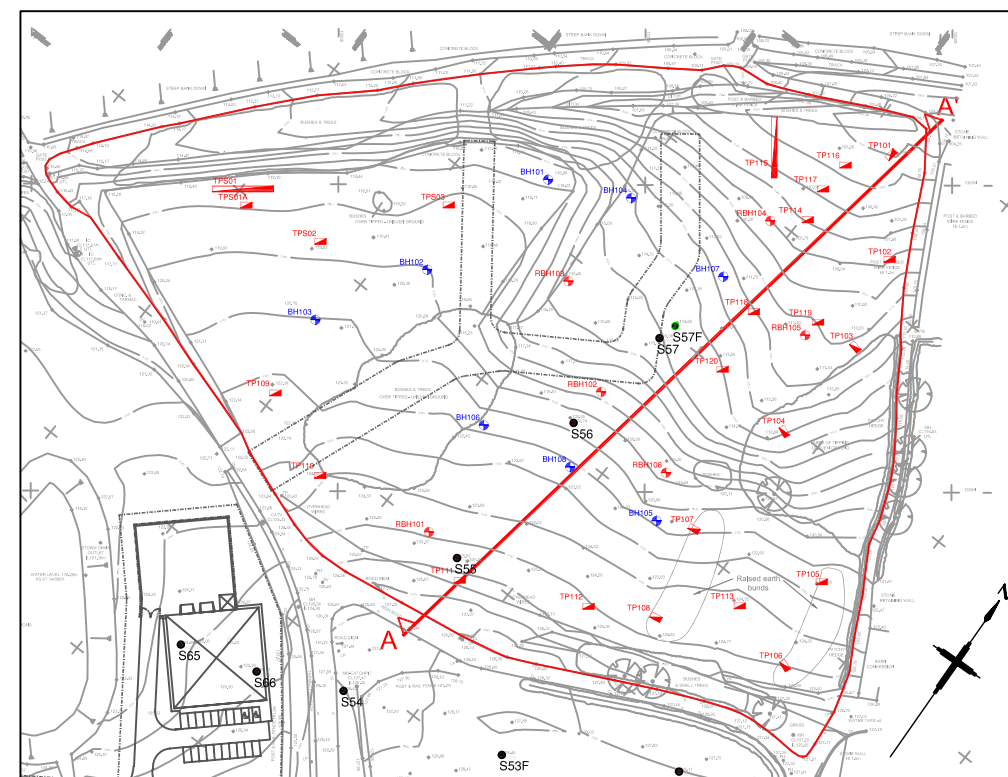
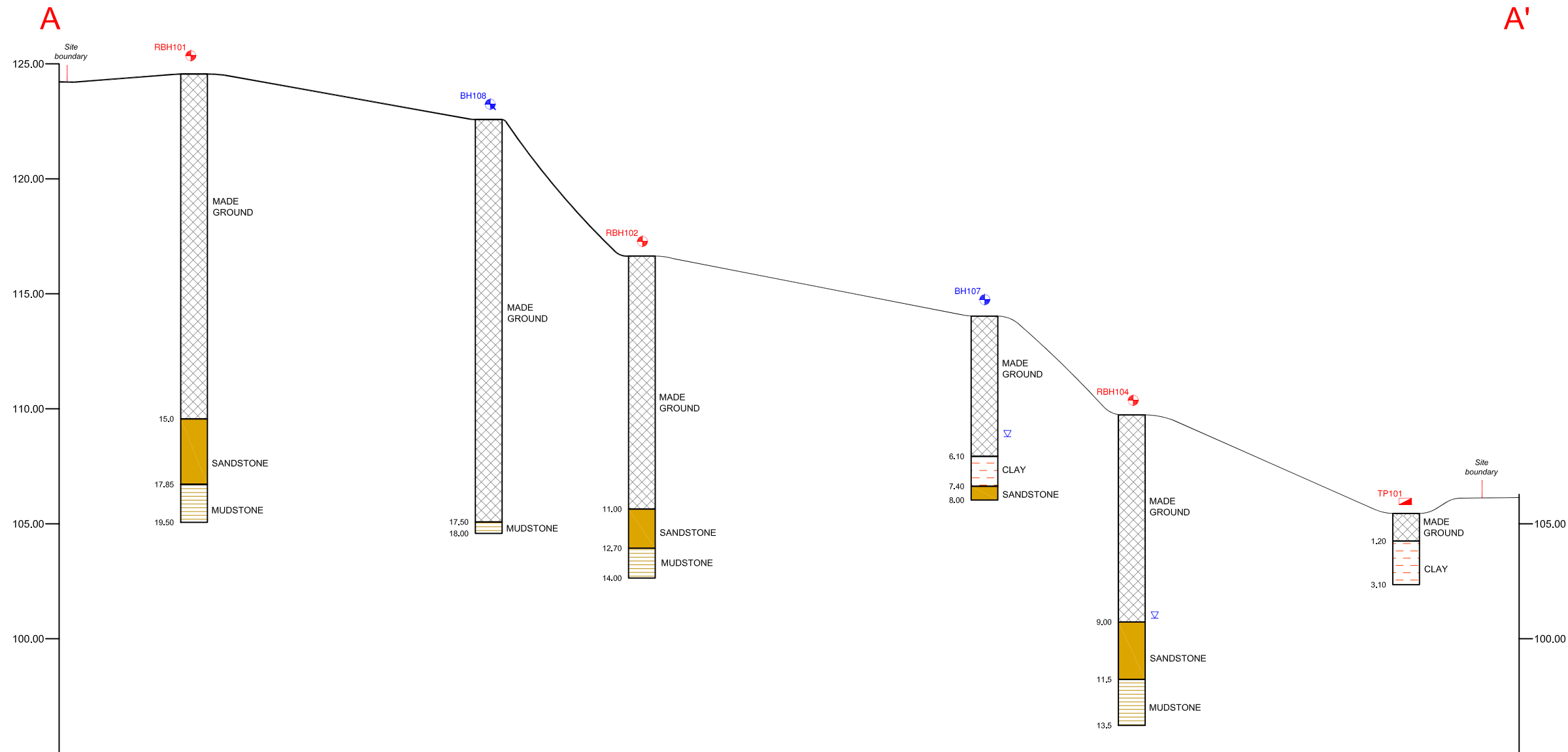
8 Permeation of plastic water pipes.

9 Phytotoxic effects on plants and vegetation.

10 Vapour migration to proposed development.

11 Groundwater migration to balancing pond to the south west.

A	26.11.07	FIRST ISSUE FOR REPORT		HD	JC JC
REV	DATE	DESCRIPTION		BY	CHD. APR.
Dimensions		Projection		Scale	Orig Size
m				NTS	A3
RSK GROUP PLC Spring Lodge 172 Chester Road Helsby Cheshire WA6 0AR Tel: +44 1928 726006 Fax: +44 1928 725633 Email: askensr@rskensr.com Web: www.rskensr.com					
CLIENT					
VELLA PARTNERSHIP					
PROJECT					
SHORTWOOD AUTISTIC HOSPITAL					
TITLE					
OUTLINE CONCEPTUAL MODEL					
JOB No.:			DRAWING FILE:		
11061			11061-1(01)D012A		
BY:	DATE:	CONTRACT NO.		REV:	
HD	26.11.07			FIGURE 12	A



LEGEND

- BH108 RSK Boreholes locations
- RBH106 RSK Rotary borehole locations
- TP120 RSK Trial pit locations
- Site Boundary
- S55 Ground Marker

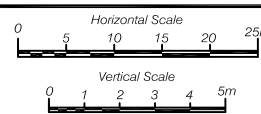
A	21.09.07	FIRST ISSUE	HD	GMG	GMG
REV	DATE	DESCRIPTION	BY	CHD	APR.
Dimensions		Projection	Scale	Orig Size	
m			AS SHOWN	A3	

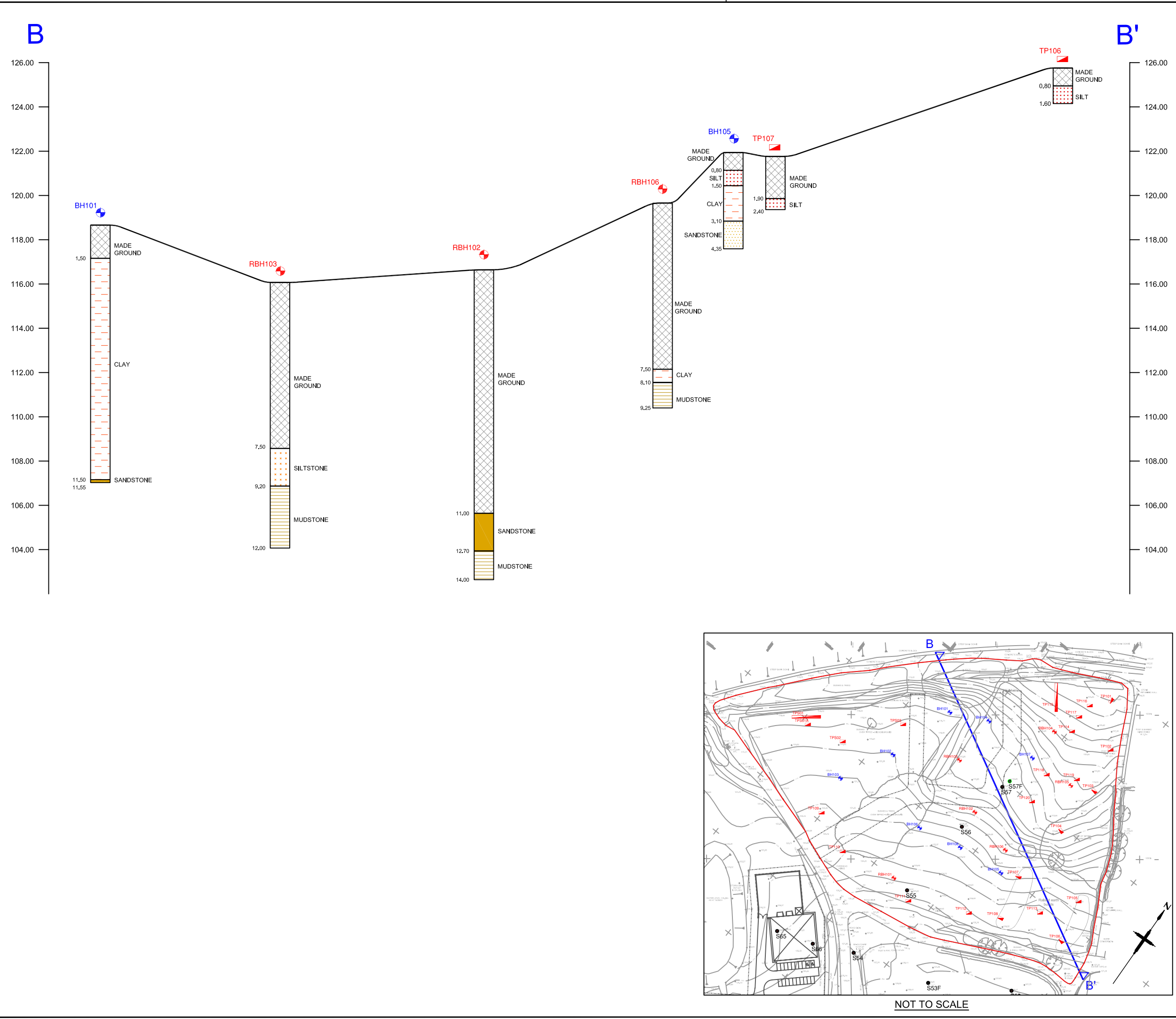


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PROJECT					
SHORTWOOD AUTISTIC HOSPITAL					
TITLE					
CROSS SECTION A-A'					
JOB No.:			DRAWING FILE:		
11061			11061-1(01)D013A		
BY:	DATE:	CONTRACT NO.	REV:		
HD	21.09.07		FIGURE 13		A





LEGEND

- BH108 RSK Boreholes locations
- RBH106 RSK Rotary borehole locations
- TP120 RSK Trial pit locations
- Site Boundary
- S55 Ground Marker

A	21.09.07	FIRST ISSUE	HD	GMG	GMG
REV	DATE	DESCRIPTION	BY	CHD	APR.
Dimensions		Projection	Scale	Orig Size	
m			AS SHOWN	A3	

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CLIENT

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PROJECT

SHORTWOOD AUTISTIC HOSPITAL

TITLE

CROSS SECTION B-B'

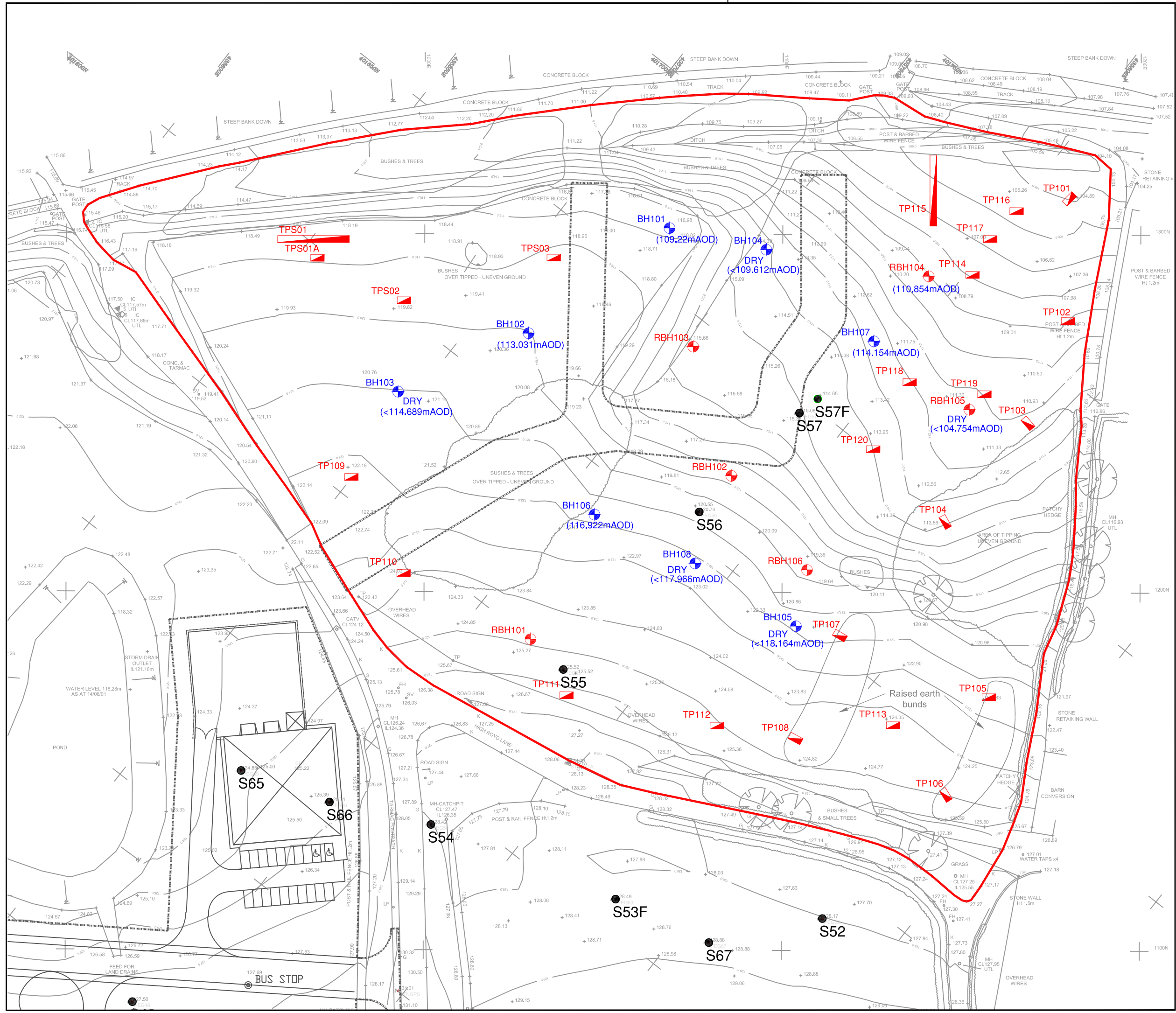
JOB No.:		DRAWING FILE:			
11061		11061-1(01)D014A			
BY:	DATE:	CONTRACT NO.			REV:
HD	21.09.07		FIGURE 14		A

Horizontal Scale

0 5 10 15 20 25m

Vertical Scale

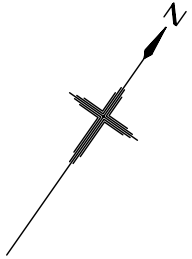
0 1 2 3 4 5m



LEGEND

- BH108**  RSK Boreholes locations
- RBH106**  RSK Rotary borehole locations
- TP120/TPS03**  RSK Trial pit locations
-  Site Boundary
- S55**  Ground Marker

(114.154mAOD) Groundwater level in meters above ordnance datum (mAOD)



A	29.11.07	FIRST ISSUE	HD	GMG	GMG
REV	DATE	DESCRIPTION	BY	CHD	APR.
Dimensions		Projection	Scale	Orig Size	
m			1:1000	A3	



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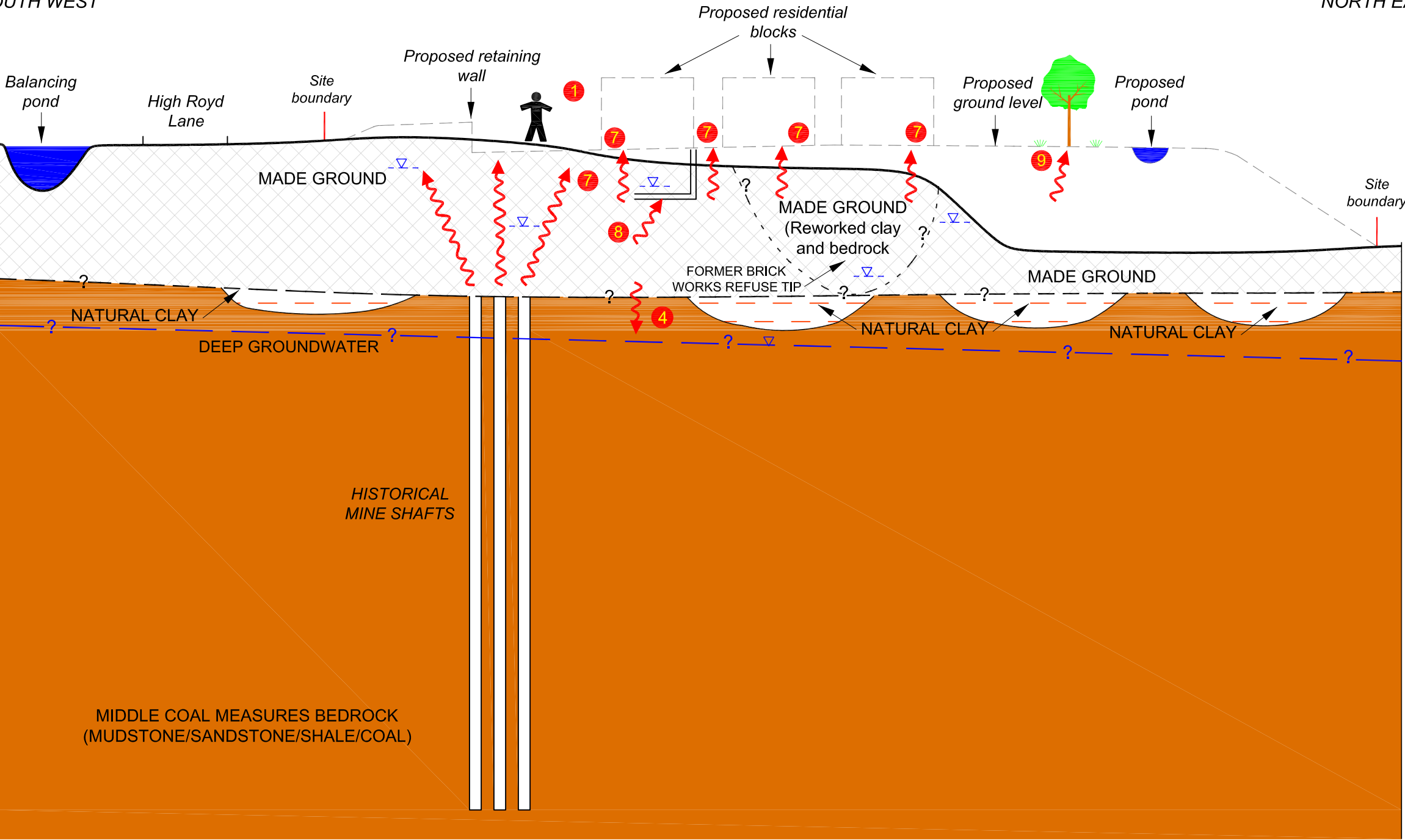
CLIENT	VELLA PARTNERSHIP
PROJECT	SHORTWOOD AUTISTIC HOSPITAL
TITLE	GROUNDWATER CONTOUR PLOT

JOB No.:	11061	DRAWING FILE:	11061-1(01)D015A
BY:	DATE:	CONTRACT NO.:	REV:
HD	29.11.07	FIGURE 15	A



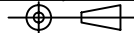
SOUTH WEST

NORTH EAST



RELEVANT POLLUTANT LINKAGES:

- ① Direct contact (dermal contact, ingestion, inhalation) of contaminated soils and groundwater with end-users/occupants.
- ④ On-site contaminated groundwater migration (vertical and horizontal) to shallow and deep groundwater bodies.
- ⑦ Hazardous ground gas migration from historical mineshafts and underlying made ground to proposed development.
- ⑧ On-site soil and groundwater contaminants permeating plastic water supply pipes for proposed development.
- ⑨ Phytotoxic effects on plants and vegetation of proposed development.

A	06.12.07	FIRST ISSUE FOR REPORT		HD	JC JC
REV	DATE	DESCRIPTION		BY	CHD. APR.
Dimensions		Projection	Scale	Orig Size	
m			NTS	A3	
RSK GROUP PLC Tel: +44 1928 726006 Fax: +44 1928 725633 Email: askensr@rskensr.com Web: www.rskensr.com Spring Lodge 172 Chester Road Helsby Cheshire WA6 0AR					
CLIENT					
VELLA PARTNERSHIP					
PROJECT					
SHORTWOOD AUTISTIC HOSPITAL					
TITLE					
REFINED CONCEPTUAL MODEL					
JOB No.:			DRAWING FILE:		
11061			11061-1(01)D016A		
BY:	DATE:	CONTRACT NO.		REV:	
HD	06.12.07			FIGURE 16	A

APPENDIX A: SERVICE CONSTRAINTS

**RSK LIMITED
SERVICE CONSTRAINTS**

1. This report and the site investigation carried out in connection with the report (together the "Services") were compiled and carried out by RSK Geoconsult Limited (RSK) for Vella Partnership (the "client") in accordance with the terms of a contract between RSK and the "client". The Services were performed by RSK with the skill and care ordinarily exercised by a reasonable environmental consultant at the time the Services were performed. Further, and in particular, the Services were performed by RSK taking into account the limits of the scope of works required by the client, the time scale involved and the resources, including financial and manpower resources, agreed between RSK and the client.
2. Other than that expressly contained in paragraph 1 above, RSK provides no other representation or warranty whether express or implied, in relation to the Services.
3. Unless otherwise agreed the Services were performed by RSK exclusively for the purposes of the client. RSK is not aware of any interest of or reliance by any party other than the client in or on the Services. Unless expressly provided in writing, RSK does not authorise, consent or condone any party other than the client relying upon the Services. Should this report or any part of this report, or otherwise details of the Services or any part of the Services be made known to any such party, and such party relies thereon that party does so wholly at its own and sole risk and RSK disclaims any liability to such parties. Any such party would be well advised to seek independent advice from a competent environmental consultant and/or lawyer.
4. It is RSK's understanding that this report is to be used for the purpose described in the introduction to the report. That purpose was a significant factor in determining the scope and level of the Services. Should the purpose for which the report is used, or the proposed use of the site change, this report may no longer be valid and any further use of or reliance upon the report in those circumstances by the client without RSK's review and advice shall be at the client's sole and own risk. Should RSK be requested to review the report after the date hereof, RSK shall be entitled to additional payment at the then existing rates or such other terms as agreed between RSK and the client.
5. The passage of time may result in changes in site conditions, regulatory or other legal provisions, technology or economic conditions which could render the report inaccurate or unreliable. The information and conclusions contained in this report should not be relied upon in the future without the written advice of RSK. In the absence of such written advice of RSK, reliance on the report in the future shall be at the client's own and sole risk. Should RSK be requested to review the report in the future, RSK shall be entitled to additional payment at the then existing rate or such other terms as may be agreed between RSK and the client.
6. The observations and conclusions described in this report are based solely upon the Services which were provided pursuant to the agreement between the client and RSK. RSK has not performed any observations, investigations, studies or testing not specifically set out or required by the contract between the client and RSK Limited. RSK is not liable for the existence of any condition, the discovery of which would require performance of services not otherwise contained in the Services. For the avoidance of doubt, unless otherwise expressly referred to in the introduction to this report, RSK did not seek to evaluate the presence on or off the site of asbestos, electromagnetic fields, lead paint, heavy metals, radon gas or other radioactive or hazardous materials.
7. The Services are based upon RSK's observations of existing physical conditions at the Site gained from a walkover survey of the site together with RSK's interpretation of information including documentation, obtained from third parties and from the client on the history and usage of the site. The Services are also based on information and/or analysis provided by independent testing and information services or laboratories upon which RSK was reasonably entitled to rely. The Services clearly are limited by the accuracy of the information, including documentation, reviewed by RSK and the observations possible at the time of the walkover survey. Further RSK was not authorised and did not attempt to independently verify the accuracy or completeness of information, documentation or materials received from the client or third parties, including laboratories and information services, during the performance of the Services. RSK is not liable for any inaccurate information or conclusions, the discovery of which inaccuracies required the doing of any act including the gathering of any information which was not reasonably available to RSK and including the doing of any independent investigation of the information provided to RSK save as otherwise provided in the terms of the contract between the client and RSK.
8. The phase II or intrusive environmental site investigation aspects of the Services is a limited sampling of the site at pre-determined borehole and soil vapour locations based on the operational configuration of the site. The conclusions given in this report are based on information gathered at the specific test locations and can only be extrapolated to an undefined limited area around those locations. The extent of the limited area depends on the soil and groundwater conditions, together with the position of any current structures and underground facilities and natural and other activities on site. In addition chemical analysis was carried out for a limited number of parameters [as stipulated in the contract between the client and RSK] [based on an understanding of the available operational and historical information,] and it should not be inferred that other chemical species are not present.
9. Any site drawing(s) provided in this report is (are) not meant to be an accurate base plan, but is (are) used to present the general relative locations of features on, and surrounding, the site.

**APPENDIX B: SUMMARY OF LEGISLATION AND POLICY RELATING TO
CONTAMINATED LAND**

Summary of Legislation and Policy Relating to Contaminated Land

Part IIA of the Environmental Protection Act (EPA) and its associated Contaminated Land Regulations 2000 (SI 2000/227) which came into force in England on 1 April 2000 are the basis for the current regulatory framework and form the statutory regime for the identification and remediation of contaminated land.

Part IIA of the EPA 1990 defines contaminated land as 'any land which appears to the Local Authority in whose area it is situated to be in such a condition by reason of substances in, on or under the land, that significant harm is being caused, or that there is significant possibility of significant harm being caused, or that pollution of controlled waters is being or is likely to be caused. Controlled waters, defined by the Water Resources Act, are considered to be all groundwater, inland waters and estuaries.

The intention of the EPA 1990 Part IIA is to deal with contaminated land issues that are considered to cause significant harm, on land that is not undergoing development, (see circular 2-2000 for definitions of what is significant harm, website link - <http://www.defra.gov.uk/environment/land/contaminated/circ2-2000/index.htm>).

The Water Framework Directive 2000/60/EC (WFD) legislation aims to deliver long-term protection of the water environment and to improve the quality of all waterbodies, including rivers, wetlands, coasts, estuaries, lakes, man made structures and groundwater.

The Water Resources Act 1991 introduces the term an offence to cause or knowingly permit pollution of controlled waters. The Act provides the Environment Agency with powers to implement remediation necessary to protect controlled waters and recover all reasonable costs of doing so. The Groundwater Regulations, 1998, aim to complement EPA1990. These Regulations give the Environment Agency the power to *prevent* the discharge of List I substances and *restrict* the discharge of List II substances to groundwater.

Contaminated land is often dealt with through Planning as a result of land redevelopment. This approach is documented in Planning Policy Statement: Planning and Pollution Control PPS23, which states that it remains the responsibility of the landowner and developer to identify land affected by contamination and carry out sufficient remediation to render the land suitable for use. The overall aim of the planning and pollution control policy is to promote the sustainable and beneficial use of land (and in particular encouraging reuse of previously developed land in preference to greenfield sites). Within this aim, polluting activities that are necessary for society and the economy should be so sited and planned, and subject to such planning conditions, that their adverse effects are minimised and contained to within acceptable limits.

APPENDIX C: RISK ASSESSMENT METHODOLOGY

Risk Assessment Methodology

CLR11 outlines the framework to be followed for risk assessment in the UK. The framework is designed to be consistent with UK legislation and policies including planning. Under CLR11, three stages of risk assessment exist: Preliminary, Generic Quantitative and Detailed Quantitative. An outline Conceptual Model should be formed at the preliminary risk assessment stage that collates all the existing information pertaining to a site in text, tabular or diagrammatic form. The outline conceptual model identifies potentially complete (termed possible) pollutant linkages (source–pathway–receptor) and is used as the basis for design of the site investigation. The outline Conceptual Model is updated as further information becomes available, for example as a result of the site investigation.

Production of a Conceptual Model requires an assessment of risk to be made. Risk is a combination of the likelihood of an event occurring and the magnitude of its consequences. Therefore, in order to assess risk both the likelihood and the consequences of an event must be taken into account. RSK has adopted guidance provided in CIRIA C552 for use in the production of Conceptual Models.

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

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

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

- Severe: Short term (acute) risk to human health likely to result in 'significant harm' as defined by the Environment Protection Act 1990, Part IIA. Short-term risk of pollution of sensitive water resources. Catastrophic damage to buildings or property. Short term risk to an ecosystem or organism forming part of that ecosystem (note definition of ecosystem in 'Draft Circular on Contaminated Land', DETR 2000);
- Medium: Chronic damage to human health ('significant harm' as defined in 'Draft Circular on Contaminated Land', DETR 2000), pollution of sensitive water resources, significant change in an ecosystem or organism forming part of that ecosystem (note definition of ecosystem in 'Draft Circular on Contaminated Land', DETR 2000);

- Mild: Pollution of non-sensitive water resources. Significant damage to crops, buildings, structures and services ('significant harm' as defined in 'Draft Circular on Contaminated Land', DETR 2000). Damage to sensitive buildings, structures or the environment; and
- Minor: Harm, not necessarily significant, but that could result in financial loss or expenditure to resolve. Non-permanent human health effects easily prevented by use of personal protective clothing. Easily repairable damage to buildings, structures and services.

Once the likelihood of an event occurring and its severity have been classified, a risk category can be assigned the table below.

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

Definitions of these risk categories are as follows together with an assessment of the further work that might be required:

- Very high: There is a high probability that severe harm could occur or there is evidence that severe harm is currently happening. This risk, if realised, could result in substantial liability and urgent investigation and remediation are likely to be required;
- High: Harm is likely to occur. Realisation of the risk is likely to present a substantial liability and urgent investigation is required and remedial works may be necessary in the short term and are likely over the long term;
- Moderate: It is possible that harm could arise, but it is unlikely that the harm would be severe and it is more likely that the harm would be relatively mild. Investigation is normally required to clarify the risk and determine the liability. Some remedial works may be required in the longer term;
- Low: It is possible that harm could occur, but it is likely that if realised this harm would at worst normally be mild; and
- Very Low: There is a low possibility that harm could occur and if realised the harm is unlikely to be severe.

APPENDIX D: SITE PHOTOGRAPHS



Photograph 1: Easterly View of Central Portion of Site and Mounded Soil in South Eastern corner of Site



Photograph 2: North Easterly View of Northern Corner of Site and Adjacent Land to the North

APPENDIX E: BOREHOLE/TRIAL PIT LOGS

Client: VELLA PARTNERSHIP
Site: SHORTWOOD AUTISTIC HOSPITAL
Project No: 11061



Boring Method: Air flush rotary with core recovery
Date: 18/09/2007-18/09/2007
Driller: Structural Soils
Logged By: RP

Ground Level:
124.560m
Top of Casing Elevation (m):
-

Record of : RBH101
Sheet 1 of 2
Scale 1:50

Samples Depth	Tests (m) and Field Records	Level (m)	Depth / (Thk) (m)	Description	Legend	Well Diagram
		0.0		MADE GROUND (Grey siltstone (driller's record))		
		1.0				
		2.0				
		(6.00) 3.0				
		4.0				
		5.0				
		118.56.00 6.0		MADE GROUND (Soft grey clay (driller's record))		
		(1.50) 7.0				
		117.06.50 8.0		MADE GROUND (Soft grey siltstone (driller's record))		
		(1.50) 9.0				
		115.56.00 9.0		MADE GROUND (Light brown sand/coal (driller's record)) Band of apparently intact coal from 10.2m - 10.5m		
		(1.50) 10.0		Continued next sheet		

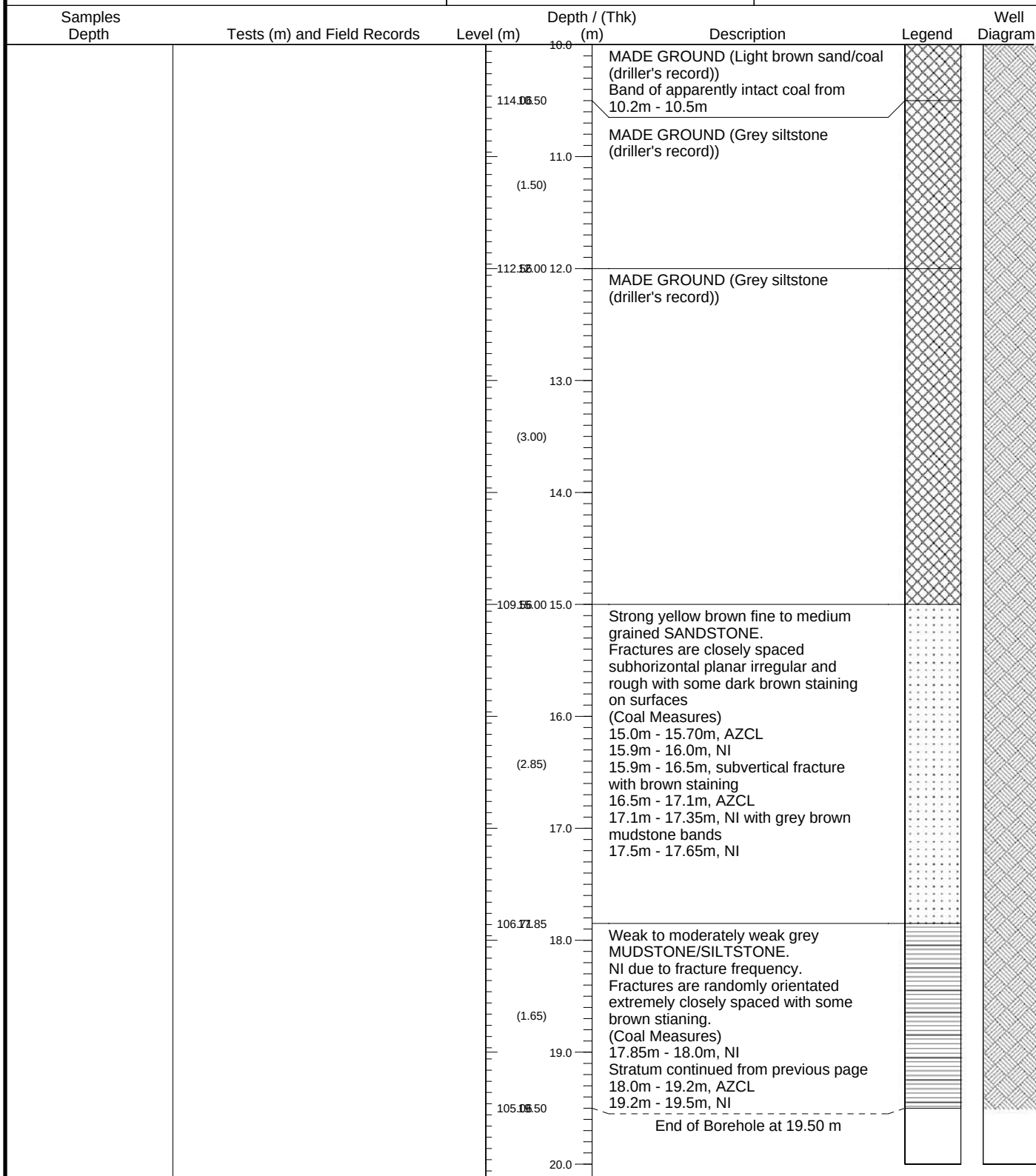
General Remarks:
Borehole backfilled with arisings.

Water Strikes		Chiselling			Borehole and Casing Details			
					Borehole		Casing	
Strike ↗	Level ▼	From: (m)	To: (m)	Time: (hr's)	Depth (m)	Diam. (mm)	Depth (m)	Diam. (mm)

Boring Method: Air flush rotary with core recovery
 Date: 18/09/2007-18/09/2007
 Driller: Structural Soils
 Logged By: RP

Ground Level:
 124.560m
 Top of Casing Elevation (m):
 -

Record of : RBH101
 Sheet 2 of 2
 Scale 1:50



General Remarks:
 Borehole backfilled with arisings.

Water Strikes		Chiselling			Borehole and Casing Details			
					Borehole		Casing	
Strike ↗	Level ▼	From: (m)	To: (m)	Time: (hr's)	Depth (m)	Diam. (mm)	Depth (m)	Diam. (mm)

Client: VELLA PARTNERSHIP
Site: SHORTWOOD AUTISTIC HOSPITAL
Project No: 11061



Boring Method: Air flush rotary with core recovery
Date: 19/09/2007-19/09/2007
Driller: Structural Soils
Logged By: RP

Ground Level:
116.640m
Top of Casing Elevation (m):
-

Record of : RBH102

Sheet 1 of 2

Scale 1:50

Samples Depth	Tests (m) and Field Records	Level (m)	Depth / (Thk) (m)	Description	Legend	Well Diagram
		0.0		MADE GROUND (Grey siltstone (driller's record))		
		(1.50)				
		1.0				
		115.11.50		MADE GROUND (Grey/yellow sandstone driller's record))		
		2.0				
		(3.00)				
		3.0				
		4.0				
		112.14.50		MADE GROUND (Yellow/grey sandstone (driller's record))		
		5.0				
		(1.50)				
		6.0		MADE GROUND (Grey/black siltstone (driller's record))		
		(1.50)				
		7.0				
		109.17.50		MADE GROUND (Grey/black siltstone (driller's record))		
		8.0				
		(3.00)				
		9.0				
		10.0		Continued next sheet		

General Remarks:
Borehole backfilled with arisings.

Water Strikes		Chiselling			Borehole and Casing Details			
					Borehole		Casing	
Strike ↗	Level ▼	From: (m)	To: (m)	Time: (hr's)	Depth (m)	Diam. (mm)	Depth (m)	Diam. (mm)

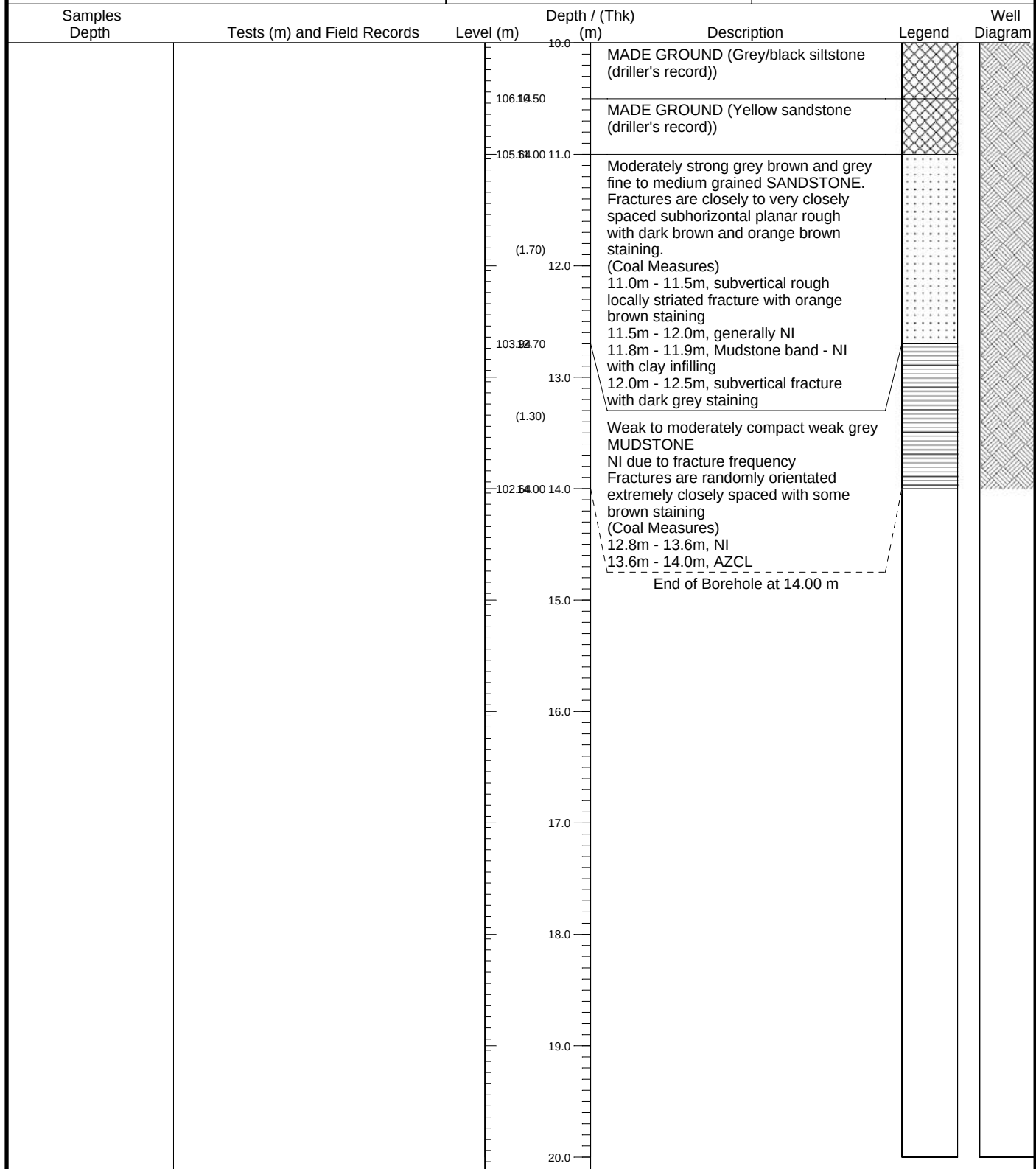
Client: VELLA PARTNERSHIP
Site: SHORTWOOD AUTISTIC HOSPITAL
Project No: 11061



Boring Method: Air flush rotary with core recovery
Date: 19/09/2007-19/09/2007
Driller: Structural Soils
Logged By: RP

Ground Level:
116.640m
Top of Casing Elevation (m):
-

Record of : RBH102
Sheet 2 of 2
Scale 1:50



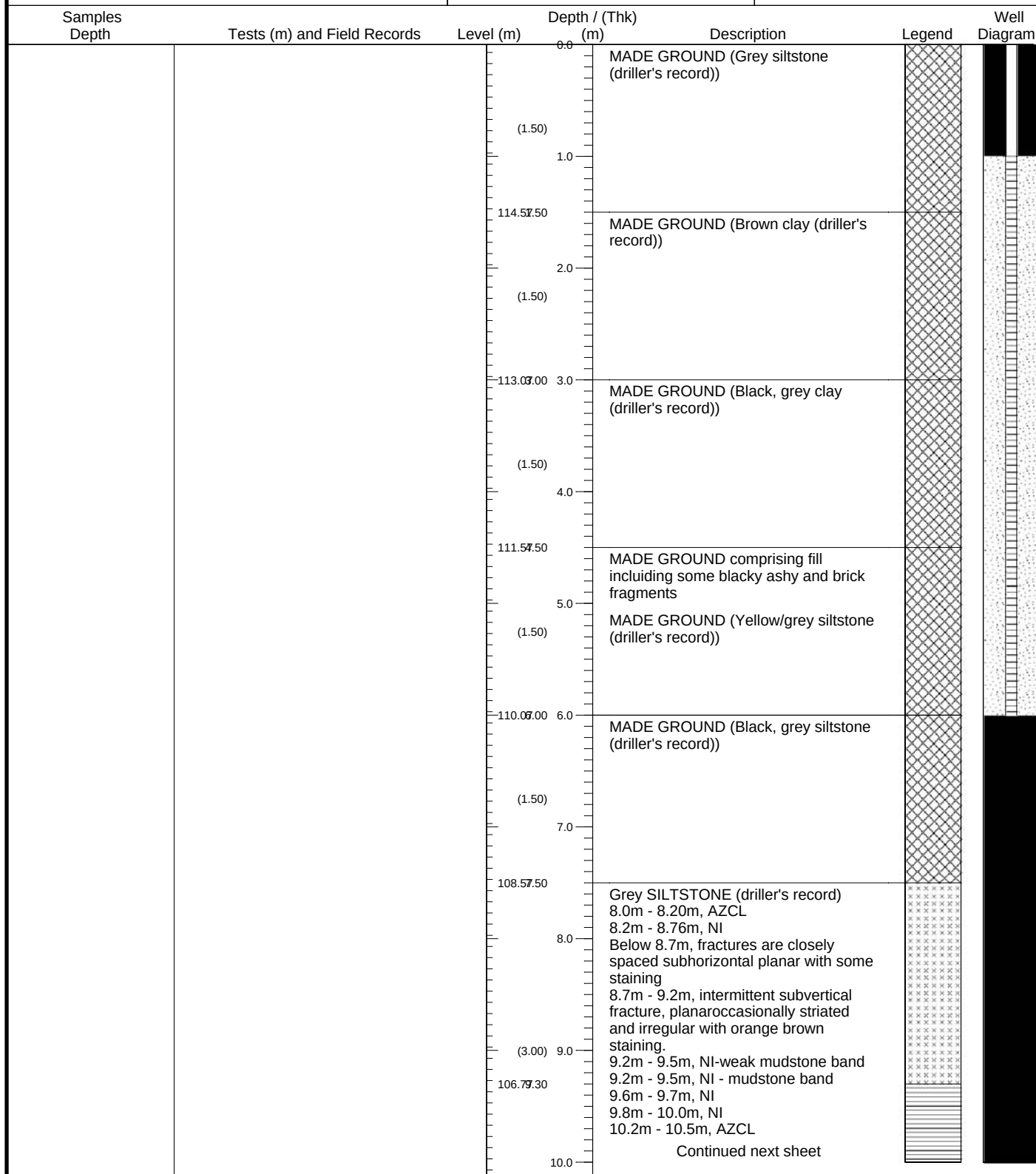
General Remarks:
Borehole backfilled with arisings.

Water Strikes		Chiselling			Borehole and Casing Details			
					Borehole		Casing	
Strike ↗	Level ▼	From: (m)	To: (m)	Time: (hr's)	Depth (m)	Diam. (mm)	Depth (m)	Diam. (mm)

Boring Method: Air flush rotary with core recovery
 Date: 19/09/2007-19/09/2007
 Driller: Structural Soils
 Logged By: RP

Ground Level:
 116.070m
 Top of Casing Elevation (m):
 -

Record of : RBH103
 Sheet 1 of 2
 Scale 1:50



General Remarks:
 Borehole backfilled to 6.5m bgl with bentonite and arisings and to 6.0m with filter sand.
 Standpipe installed to 6.0m bgl, ground level to 1.0m, plain pipe with bentonite annulus, 1.0m - 6.0m, slotted pipe with filter sand annulus.

Water Strikes		Chiselling			Borehole and Casing Details			
					Borehole		Casing	
Strike ↗	Level ▼	From: (m)	To: (m)	Time: (hr's)	Depth (m)	Diam. (mm)	Depth (m)	Diam. (mm)

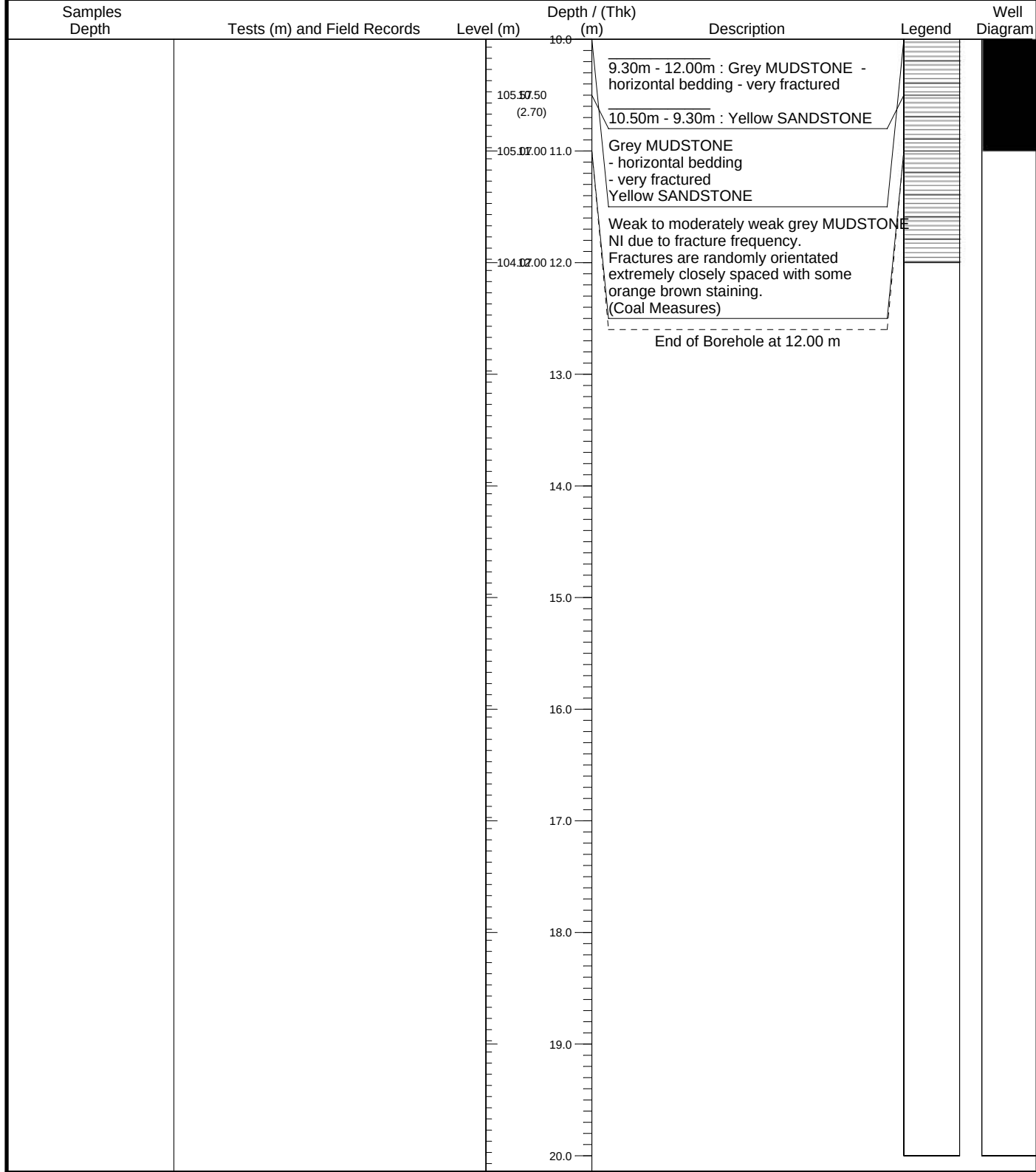
Client: VELLA PARTNERSHIP
Site: SHORTWOOD AUTISTIC HOSPITAL
Project No: 11061



Boring Method: Air flush rotary with core recovery
Date: 19/09/2007-19/09/2007
Driller: Structural Soils
Logged By: RP

Ground Level:
116.070m
Top of Casing Elevation (m):
-

Record of : RBH103
Sheet 2 of 2
Scale 1:50



General Remarks:
Borehole backfilled to 6.5m bgl with bentonite and arisings and to 6.0m with filter sand.
Standpipe installed to 6.0m bgl, ground level to 1.0m, plain pipe with bentonite annulus, 1.0m - 6.0m, slotted pipe with filter sand annulus.

Water Strikes		Chiselling			Borehole and Casing Details			
					Borehole		Casing	
Strike ↗	Level ▼	From: (m)	To: (m)	Time: (hr's)	Depth (m)	Diam. (mm)	Depth (m)	Diam. (mm)

Client: VELLA PARTNERSHIP
 Site: SHORTWOOD AUTISTIC HOSPITAL
 Project No: 11061



Boring Method: Air flush rotary with core recovery
 Date: 20/09/2007-20/09/2007
 Driller: Structural Soils
 Logged By: RP

Ground Level:
 109.730m
 Top of Casing Elevation (m):
 -

Record of : RBH104
 Sheet 1 of 2
 Scale 1:50

Samples Depth	Tests (m) and Field Records	Level (m)	Depth / (Thk) (m)	Description	Legend	Well Diagram
		0.0		MADE GROUND (Grey siltstone (driller's record))		
		(1.50)				
		1.0				
		108.2850		MADE GROUND (soft black silty slightly sandy clay - strong tar/hydrocarbon odour)		
		(1.50)				
		2.0				
		106.7300		MADE GROUND (Grey black clay (driller's record))		
		(1.50)				
		3.0				
		105.2850		MADE GROUND (Black brown clay (driller's record))		
		(1.50)				
		4.0				
		103.7300		MADE GROUND (Brown siltstone (driller's record))		
		(1.50)				
		5.0				
		102.2850		MADE GROUND (Yellow sandstone (driller's record))		
		(1.50)				
		6.0				
		100.7300		Strong yellow brown fine to medium grained SANDSTONE. Fractures are closely spaced subhorizontal planar with some dark brown staining on surfaces.		
		(1.50)				
		7.0				
		8.0				
		9.0				
		10.0		Continued next sheet		

General Remarks:

Standpipe installed to 13.5m bgl, ground level to 11.5m plain pipe with bentonite annulus, 11.5m - 11.35m, slotted pipe with filter sand annulus.

Water Strikes		Chiselling			Borehole and Casing Details			
					Borehole		Casing	
Strike ↗	Level ▼	From: (m)	To: (m)	Time: (hr's)	Depth (m)	Diam. (mm)	Depth (m)	Diam. (mm)

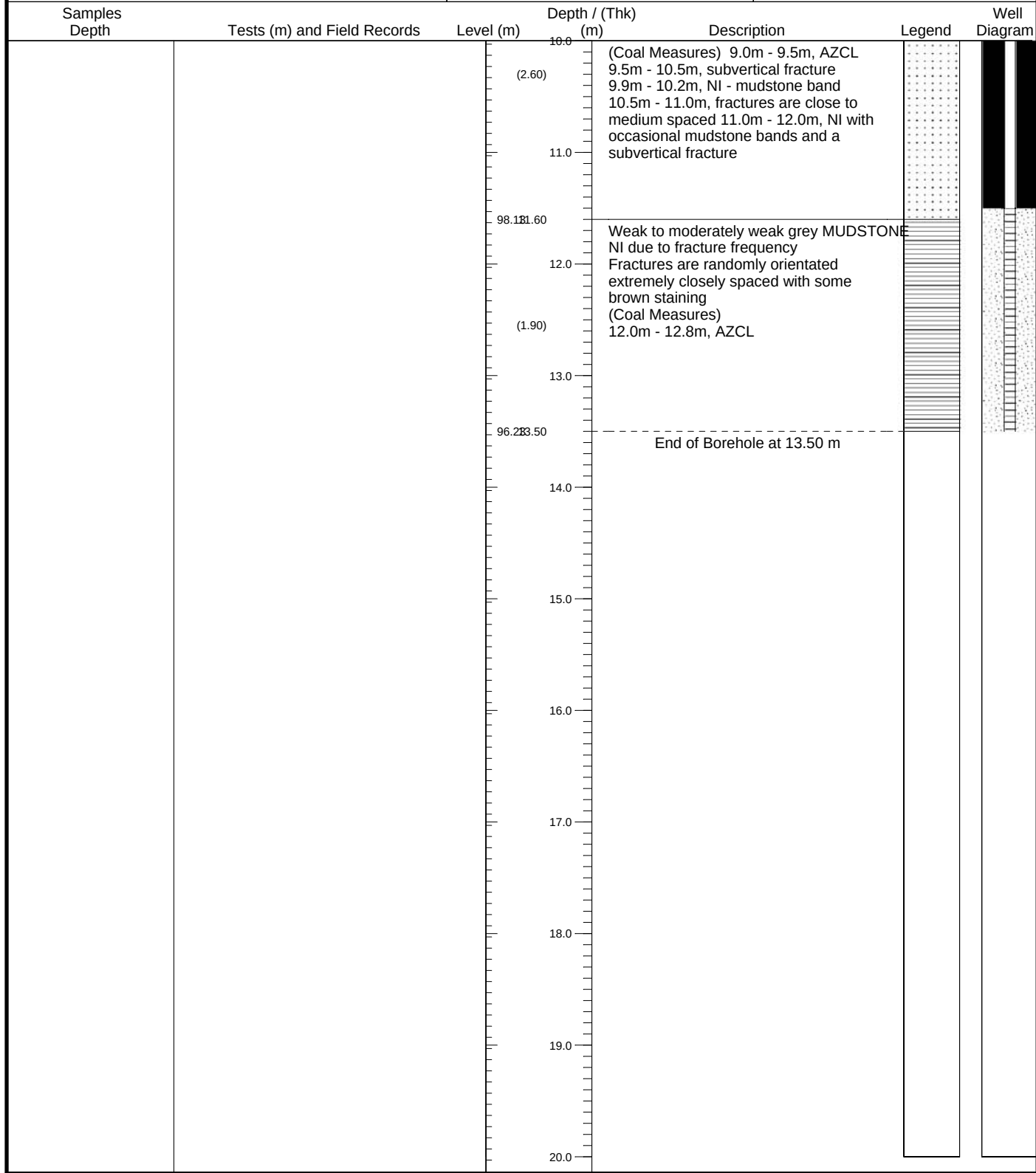
Client: VELLA PARTNERSHIP
Site: SHORTWOOD AUTISTIC HOSPITAL
Project No: 11061



Boring Method: Air flush rotary with core recovery
Date: 20/09/2007-20/09/2007
Driller: Structural Soils
Logged By: RP

Ground Level:
109.730m
Top of Casing Elevation (m):
-

Record of : RBH104
Sheet 2 of 2
Scale 1:50



General Remarks:
Standpipe installed to 13.5m bgl, ground level to 11.5m plain pipe with bentonite annulus, 11.5m - 11.35m, slotted pipe with filter sand annulus.

Water Strikes		Chiselling			Borehole and Casing Details			
					Borehole		Casing	
Strike ☰	Level ▼	From: (m)	To: (m)	Time: (hr's)	Depth (m)	Diam. (mm)	Depth (m)	Diam. (mm)

Client: VELLA PARTNERSHIP
Site: SHORTWOOD AUTISTIC HOSPITAL
Project No: 11061



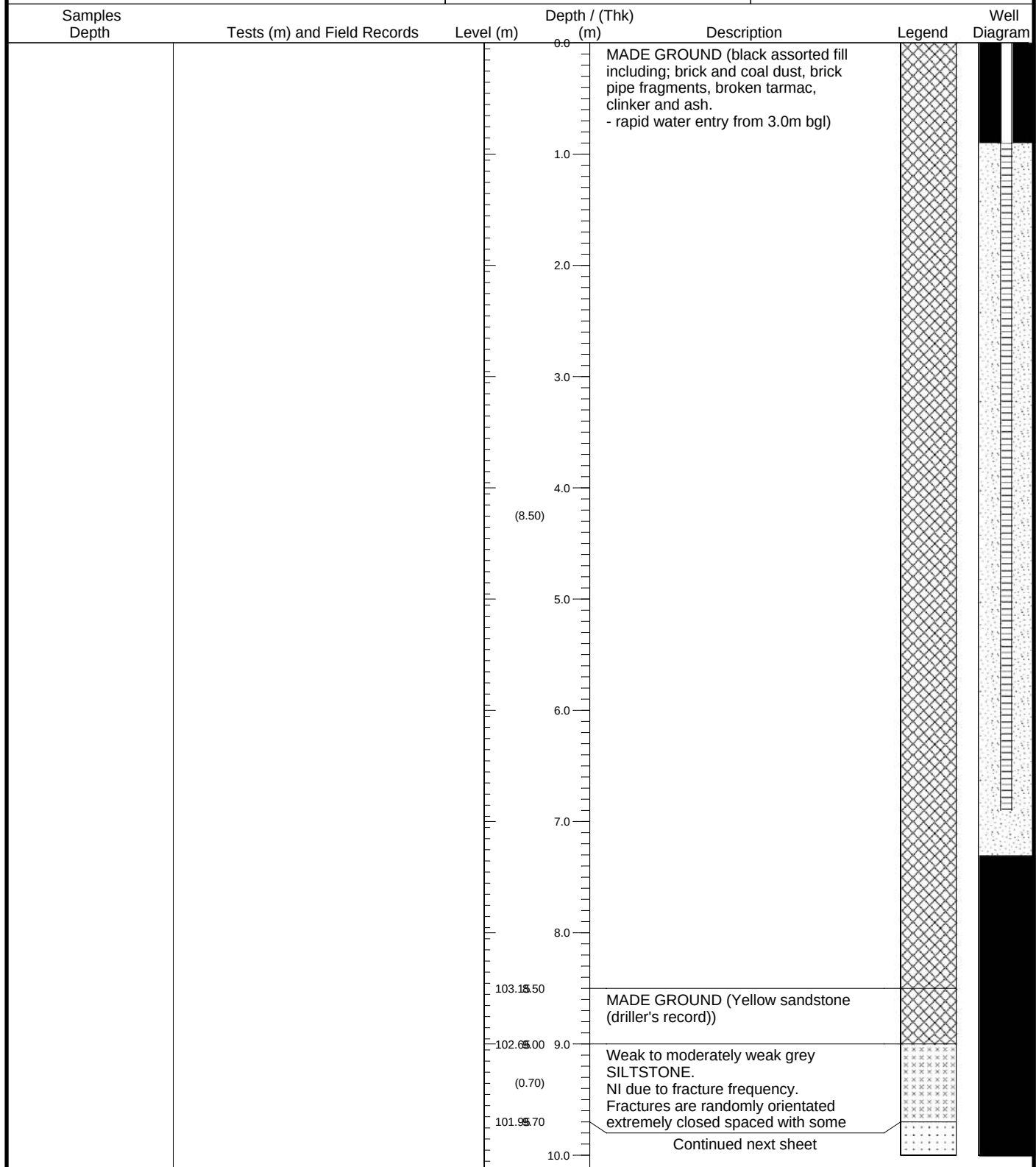
Boring Method: Air flush rotary with core recovery
Date: 20/09/2007-20/09/2007
Driller: Structural Soils
Logged By: KF

Ground Level:
111.654m
Top of Casing Elevation (m):
-

Record of : RBH105

Sheet 1 of 2

Scale 1:50



General Remarks:
Borehole backfilled with bentonite to 7.3m bgl, filter sand to 6.9m bgl.
Standpipe installed to 6.9m bgl, ground level to 0.9m, plain pipe with bentonite annulus, 0.9m to 6.9m, slotted pipe with filter sand annulus.

Water Strikes		Chiselling			Borehole and Casing Details			
					Borehole		Casing	
Strike ⊷	Level ▼	From: (m)	To: (m)	Time: (hr's)	Depth (m)	Diam. (mm)	Depth (m)	Diam. (mm)



Project No: 11061

Record of : RBH105

Sheet 2 of 2

Scale 1:50

-

Samples Depth	Tests (m) and Field Records	Level (m)	Depth / (Thk) (m)	Description	Legend	Well Diagram
		(1.30)	10.0	9.00m - 9.70m : brown staining and much clay infilling. (Coal Measures) Stratum continued from previous page.		
		100.65	11.0	9.70m - 11.00m : Moderately strong grey and yellow brown fine to medium grained SANDSTONE. fractures are closely spaced subhorizontal planar with some dark brown staining on surfaces. (Coal Measures)		
		100.15	11.50	10.5m - 10.9m, subvertical fracture with orange brown staining		
		99.65	12.0	Weak to moderately weak grey MUDSTONE. NI due to fracture frequency. Fractures are randomly orientated extremely closely spaced with some brown staining. (Coal Measures)		
			13.0	Strong yellow brown fine to medium grained SANDSTONE. Fractures are closely spaced subhorizontal planar with some dark brown staining on surfaces. (Coal Measures)		
			14.0	11.65m - 11.90m, NI - mudstone band and possible subvertical fracture		
				End of Borehole at 12.00 m		
			15.0			
			16.0			
			17.0			
			18.0			
			19.0			
			20.0			

General Remarks:
Borehole backfilled with bentonite to 7.3m bgl, filter sand to 6.9m bgl.
Standpipe installed to 6.9m bgl, ground level to 0.9m, plain pipe with bentonite annulus, 0.9m to 6.9m, slotted pipe with filter sand annulus.

[illegible]

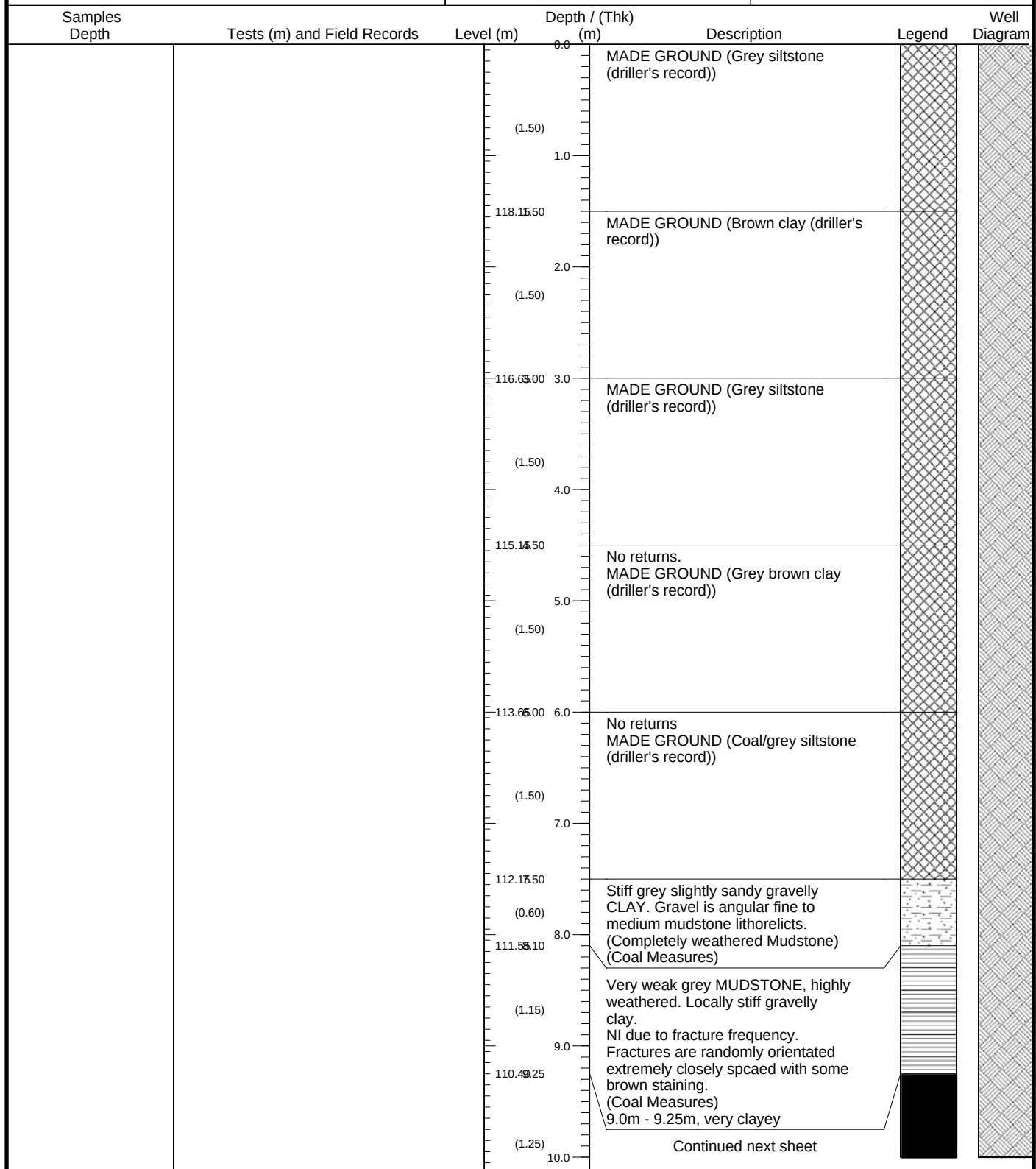
Client: VELLA PARTNERSHIP
 Site: SHORTWOOD AUTISTIC HOSPITAL
 Project No: 11061



Boring Method: Air flush rotary with core recovery
 Date: 21/09/2007-21/09/2007
 Driller: Structural Soils
 Logged By: RP

Ground Level:
 119.650m
 Top of Casing Elevation (m):
 -

Record of : RBH106
 Sheet 1 of 2
 Scale 1:50



General Remarks:
 Borehole backfilled with arisings.

Water Strikes		Chiselling			Borehole and Casing Details			
					Borehole		Casing	
Strike Σ	Level ▼	From: (m)	To: (m)	Time: (hr's)	Depth (m)	Diam. (mm)	Depth (m)	Diam. (mm)

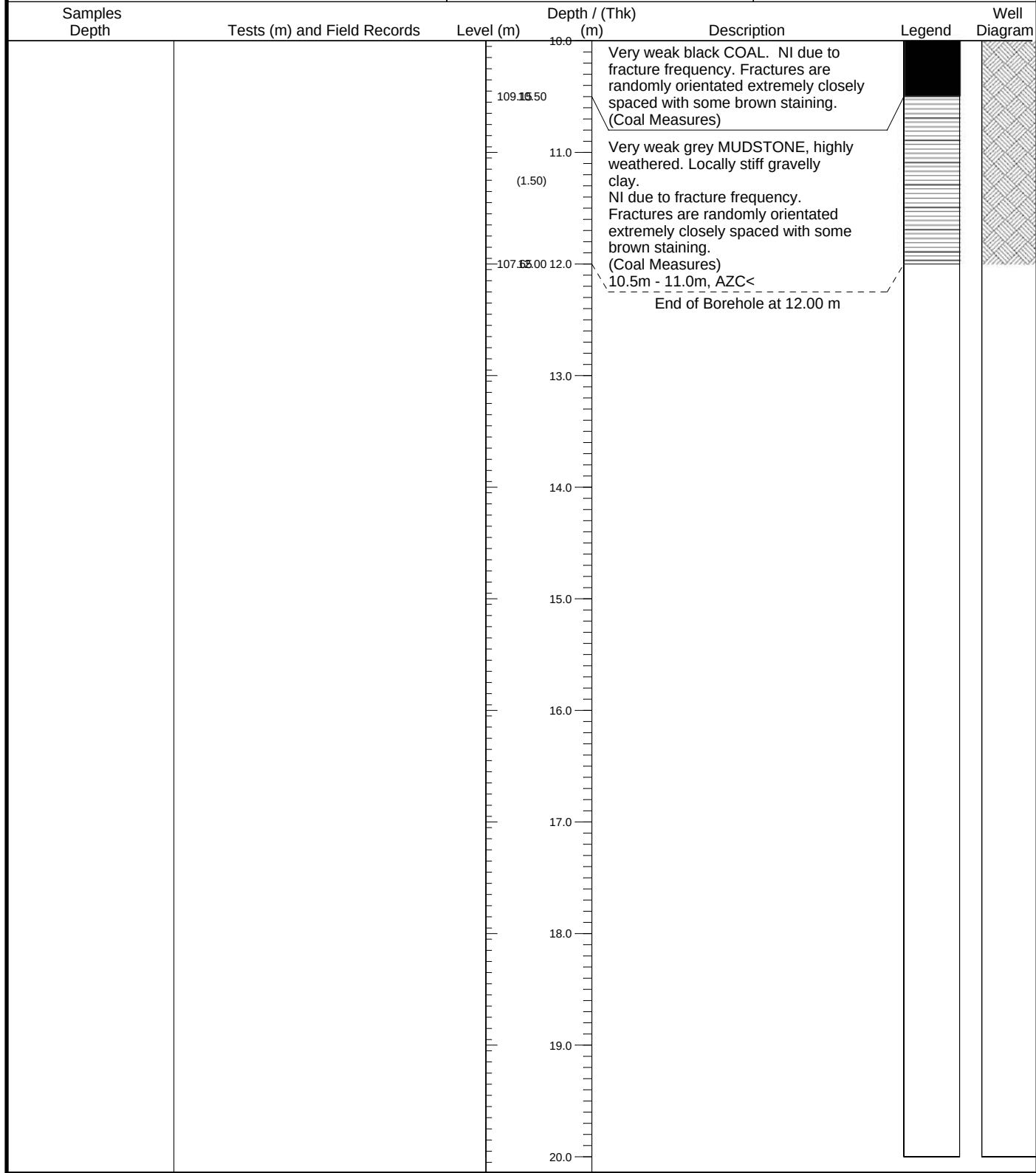
Client: VELLA PARTNERSHIP
Site: SHORTWOOD AUTISTIC HOSPITAL
Project No: 11061



Boring Method: Air flush rotary with core recovery
Date: 21/09/2007-21/09/2007
Driller: Structural Soils
Logged By: RP

Ground Level:
119.650m
Top of Casing Elevation (m):
-

Record of : RBH106
Sheet 2 of 2
Scale 1:50



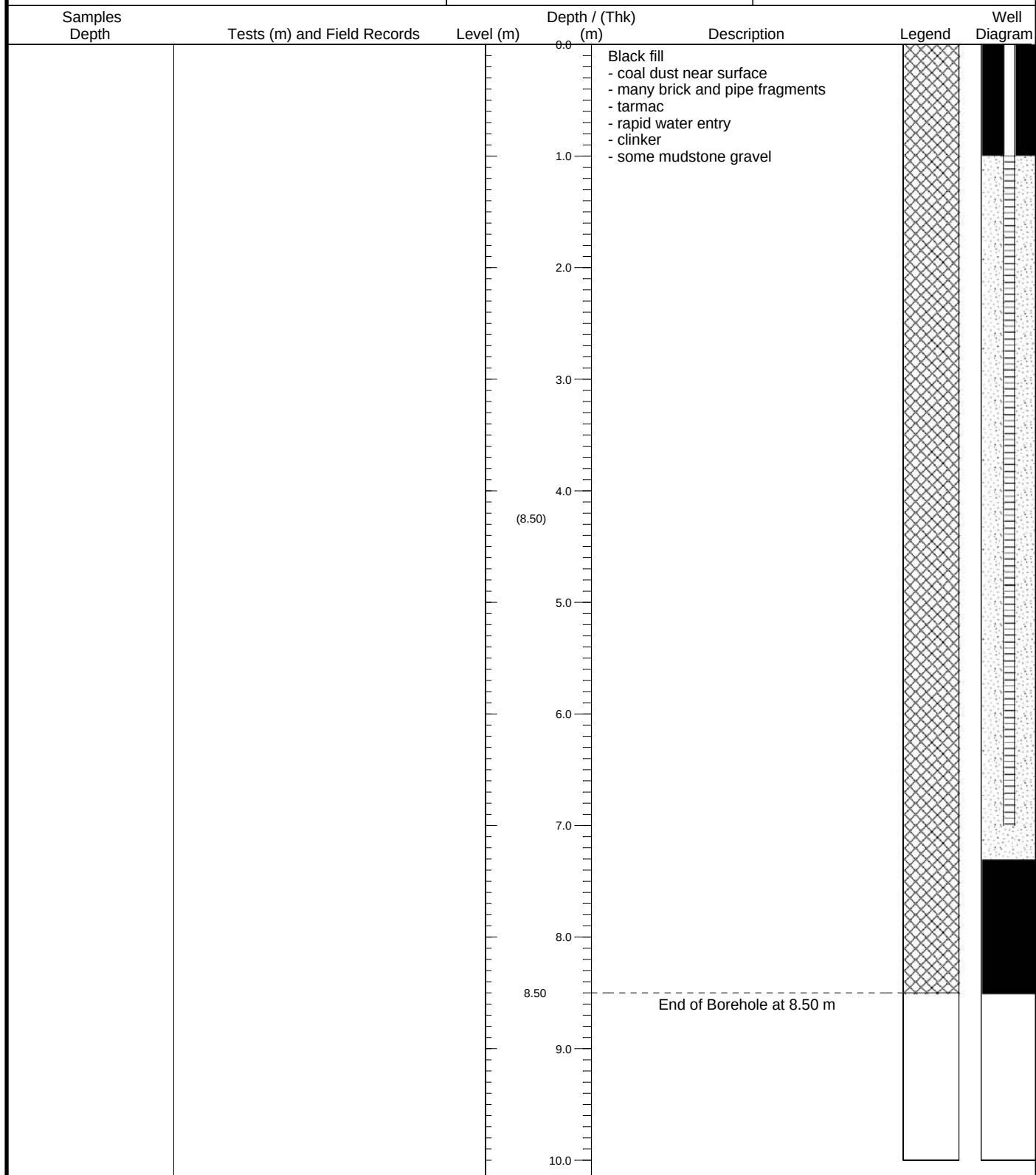
General Remarks:
Borehole backfilled with arisings.

Water Strikes		Chiselling			Borehole and Casing Details			
					Borehole		Casing	
Strike ☼	Level ▼	From: (m)	To: (m)	Time: (hr's)	Depth (m)	Diam. (mm)	Depth (m)	Diam. (mm)

Boring Method:
Date: -
Driller:
Logged By: RP

Ground Level:
NOT DETERMINED
Top of Casing Elevation (m):
-

Record of : RBH107
Sheet 1 of 1
Scale 1:50



General Remarks:
Standpipe installed to 7.0m, 1.0m plain, 6.0m slotted.
Backfilled with bentonite to 7.3m, sand to 1.0m, bentonite to ground level.

Water Strikes		Chiselling			Borehole and Casing Details			
					Borehole		Casing	
Strike ☰	Level ▼	From: (m)	To: (m)	Time: (hr's)	Depth (m)	Diam. (mm)	Depth (m)	Diam. (mm)

Client: VELLA PARTNERSHIP
 Site: SHORTWOOD AUTISTIC HOSPITAL
 Project No: 11061



Boring Method:
 Date: 13/09/2007-13/09/2007
 Driller:
 Logged By: RP

Ground Level:
 118.660m
 Top of Casing Elevation (m):
 -

Record of : BH101
 Sheet 1 of 2
 Scale 1:50

Samples Depth	Tests (m) and Field Records	Level (m)	Depth / (Thk) (m)	Description	Legend	Well Diagram
		0.0		MADE GROUND comprising grass over brown organic silt topsoil		
		(1.00)				
		117.6600	1.0	MADE GROUND comprising very friable grey clay with occasional brick pieces		
		117.1650				
			2.0	Soft black organic slightly gravelly CLAY - gravel is mostly angular sandstone and includes brick fragments and trace of glass and timber - occasional sandstone cobbles		
	2.45m, CPT N=7 (1,2,2,2,1,2)		(2.10)			
		3.0				
		115.0660				
4.00-5.00 B 001			4.0	Black ashy very sandy very gravelly silty CLAY - gravel mostly consists of red and yellow brick fragments - occasional pockets of soft grey clay - strong tar/creosote odour - occasional pockets of viscous tar		
	4.45m, CPT N=39 (14,10,12,13,8,6)		(2.10)			
5.00-6.00 B 002			5.0			
		112.9670				
5.70-6.90 D 003			6.0	Yellow, grey and black slightly ashy silty CLAY slightly gravelly - gravel mostly consists of yellow and red brick pieces		
6.00-7.00 B 004			(1.20)			
	6.45m, CPT N=6 (2,2,1,1,2,2)					
6.90-7.50 D 005			7.0	Firm, yellow, grey and dark brown slightly gravelly friable CLAY - closely spaced unevenly laminations - gravel is angular and includes black mudstone and coaliferous fragments - no laminations and more black colouration from 8.5m		
7.00-8.00 B 006		111.7690				
			8.0			
8.00-8.45 D 007						
8.00-9.00 B 008						
8.00-10.00 D 009						
	8.45m, SPT N=13 (2,2,3,3,3,4)		(3.70)			
			9.0			
9.00-10.00 B 010						
			10.0			
Continued next sheet						

General Remarks:

Groundwater was not encountered.
 Borehole backfilled with bentonite to 10.5m and filter sand to 10.0m.
 Standpipe installed to 10.0m bgl: ground level to 2.0m plain with bentonite annulus, 2.0m to 10.0m slotted with filter sand annulus.

Water Strikes		Chiselling			Borehole and Casing Details			
					Borehole		Casing	
Strike ↗	Level ▼	From: (m)	To: (m)	Time: (hr's)	Depth (m)	Diam. (mm)	Depth (m)	Diam. (mm)

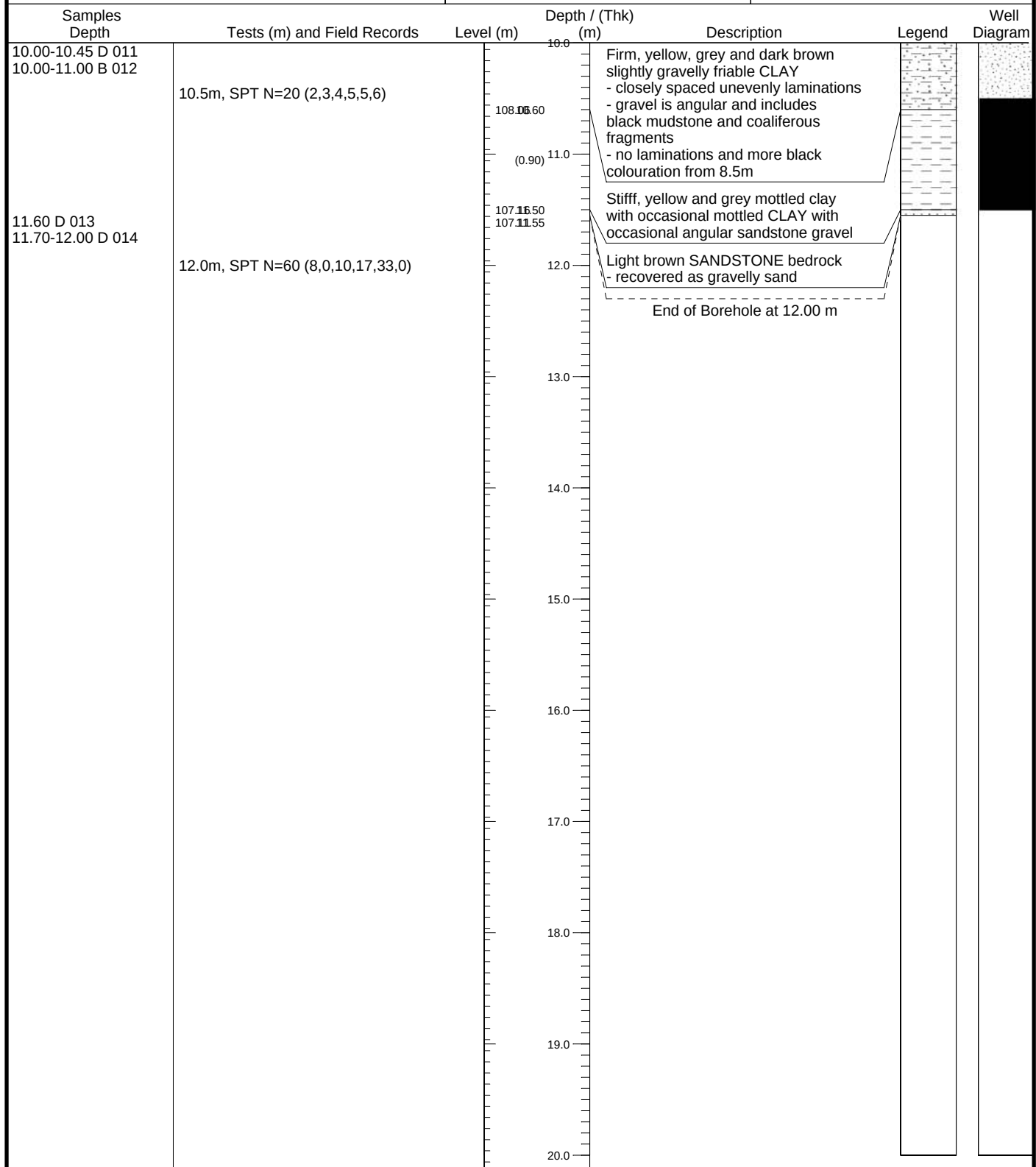
Client: VELLA PARTNERSHIP
 Site: SHORTWOOD AUTISTIC HOSPITAL
 Project No: 11061



Boring Method:
 Date: 13/09/2007-13/09/2007
 Driller:
 Logged By: RP

Ground Level:
 118.660m
 Top of Casing Elevation (m):
 -

Record of : BH101
 Sheet 2 of 2
 Scale 1:50



General Remarks:
 Groundwater was not encountered.
 Borehole backfilled with bentonite to 10.5m and filter sand to 10.0m.
 Standpipe installed to 10.0m bgl: ground level to 2.0m plain with bentonite anulus, 2.0m to 10.0m slotted with filter sand anulus.

Water Strikes		Chiselling			Borehole and Casing Details			
					Borehole		Casing	
Strike Σ	Level ▼	From: (m)	To: (m)	Time: (hr's)	Depth (m)	Diam. (mm)	Depth (m)	Diam. (mm)

Client: VELLA PARTNERSHIP
Site: SHORTWOOD AUTISTIC HOSPITAL
Project No: 11061



Boring Method:
Date: 14/09/2007-14/09/2007
Driller:
Logged By: RP

Ground Level:
119.751m
Top of Casing Elevation (m):
-

Record of : BH102
Sheet 1 of 1
Scale 1:50

Samples Depth	Tests (m) and Field Records	Level (m)	Depth / (Thk) (m)	Description	Legend	Well Diagram
0.00-1.00 B 001			0.0	MADE GROUND comprising grass over loose to moderately compact brown slightly gravelly slightly organic silt with occasional orange and grey firm clay pockets		
1.00-2.00 D 002 1.00-2.00 B 003		(2.30)	1.0			
2.00-3.00 B 004			2.0			
	2.45m, CPT N=3 (1,0,0,1,1,1)	117.45.30		MADE GROUND comprising firm grey slightly gravelly clay - very friable - gravel is mostly angular mudstone		
3.00-4.00 B 005		(1.20)	3.0			
		116.25.50		MADE GROUND comprising grey, yellow and black sandy gravelly slightly friable clay - sand is mostly brick fragments - gravel is mostly brick and sandstone		
4.00-5.00 D 006 4.00-5.00 B 007		(1.70)	4.0			
	4.45m, CPT N=15 (3,3,4,4,4,3)					
5.00-6.00 B 008 5.20-7.00 B 009		114.55.20	5.0	MADE GROUND comprising soft grey and yellow slightly gravelly silty clay - gravel is generally angular sandstone - much black coal dust from 7m to 8m		
6.50-7.00 B 010		(2.80)	6.0			
7.00-8.00 D 011 7.00-8.00 B 012			7.0			
	6.95m, CPT N=23 (4,6,7,8,5,3)					
8.00-8.45 D 013 8.00-9.00 B 014 8.10 D 015		111.75.00	8.0	Stiff to very stiff, yellow and grey mottled very friable CLAY - occasional angular sandstone and mudstone gravel - unevenly laminated - much coal dust 8.0m - 8.2m - possibly highly weathered mudstone and sandstone bedrock		
	8.45m, SPT N=22 (3,4,5,6,5,6)	(1.70)	9.0			
9.40 D 016 9.50-9.70 B 017 9.50-9.69 D 018		110.05.70		End of Borehole at 9.70 m		
	9.69m, SPT N=50 (16,9,0,33,17,0)		10.0			

General Remarks:
Groundwater was not encountered. Borehole backfilled to 8.5m with bentonite and to 7.8m with filter sand. Standpipe installed to 7.8m bgl: ground level to 1.8m plain with bentonite anulus, 1.8m to 7.8m slotted with filter sand anulus.

Water Strikes		Chiselling			Borehole and Casing Details			
					Borehole		Casing	
Strike ↗	Level ▼	From: (m)	To: (m)	Time: (hr's)	Depth (m)	Diam. (mm)	Depth (m)	Diam. (mm)

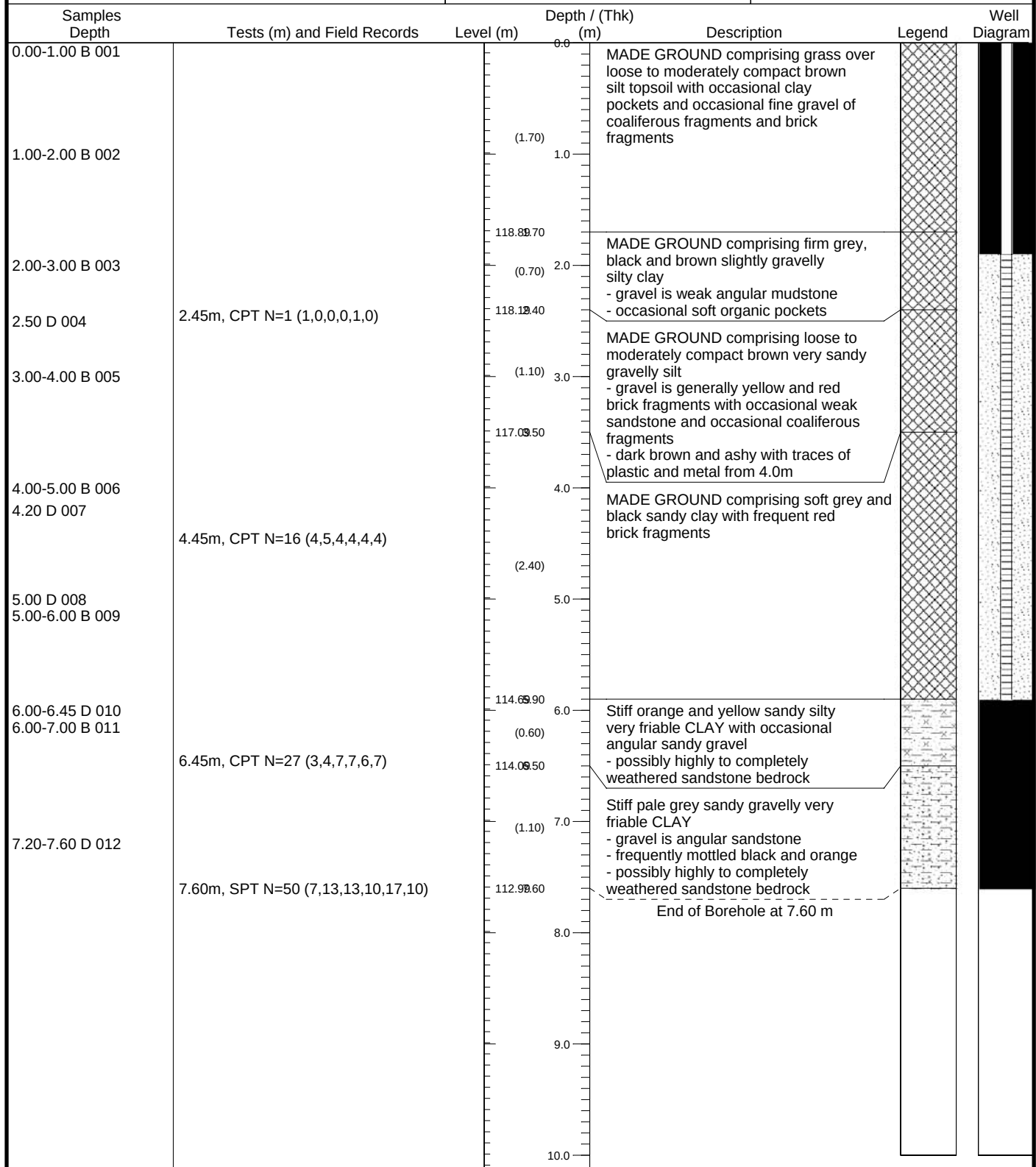
Client: VELLA PARTNERSHIP
Site: SHORTWOOD AUTISTIC HOSPITAL
Project No: 11061



Boring Method:
 Date: 17/09/2007-17/09/2007
 Driller:
 Logged By: RP

Ground Level:
 120.589m
 Top of Casing Elevation (m):
 -

Record of : BH103
 Sheet 1 of 1
 Scale 1:50



General Remarks:

Groundwater was not encountered. Borehole backfilled to 5.9m with bentonite and to 1.9m with filter sand. Standpipe installed to 5.9m bgl: ground level to 1.9m plain with bentonite anulus, 1.9m to 5.9m slotted with filter sand anulus.

Water Strikes		Chiselling			Borehole and Casing Details			
					Borehole		Casing	
Strike ↗	Level ▼	From: (m)	To: (m)	Time: (hr's)	Depth (m)	Diam. (mm)	Depth (m)	Diam. (mm)

Client: VELLA PARTNERSHIP
Site: SHORTWOOD AUTISTIC HOSPITAL
Project No: 11061



Boring Method:
 Date: 21/09/2007-21/09/2007
 Driller:
 Logged By: RP

Ground Level:
 114.512m
 Top of Casing Elevation (m):
 -

Record of : BH104
 Sheet 1 of 1
 Scale 1:50

Samples Depth	Tests (m) and Field Records	Level (m)	Depth / (Thk) (m)	Description	Legend	Well Diagram
0.00-1.00 B 001		0.00	0.00	MADE GROUND comprising grass over brown sandy slightly gravelly silt topsoil with occasional soft clay pockets		
1.00-2.00 B 002		113.80.70	1.00	MADE GROUND comprising loose to moderately compact black ashy sand - trace of gravel including pipe fragments		
1.50 D 003		(1.30)				
2.00-3.00 B 004		112.52.00	2.00	MADE GROUND comprising soft black ashy clayey silt		
2.50 D 005	2.45m, CPT N=2 (1,2,1,0,1,0)	(1.00)				
3.00-4.00 B 006 3.00-4.00 B 007		111.53.00	3.00	MADE GROUND comprising loose to moderately compact black and grey clayey gravelly sand - gravel is mostly fine and includes mudstone and pipe fragments - trace of timber		
4.00-5.00 B 008		110.54.00	4.00	Soft black and grey organic slightly sandy slightly gravelly CLAY - gravel is mostly brick and pipe fragments		
5.00-6.00 B 009		109.58.00	5.00	Firm grey slightly sandy CLAY - sand is coarse and mostly comprises coaliferous fragments		
5.50 B 010		108.98.60		Stiff grey brown gravelly CLAY - gravel is angular mudstone		
6.00-6.45 D 011 6.00-7.00 B 012		(0.90)	6.00			
	6.45m, CPT N=13 (1,2,3,3,4,3)	108.08.50		Brown and grey highly to completely weathered MUDSTONE bedrock - recovered as gravelly clay		
7.00-7.31 D 013		(0.80)	7.00			
	7.31m, SPT N=50 (8,11,14,27,9,0)	107.21.30		End of Borehole at 7.31 m		
			8.00			
			9.00			
			10.00			

General Remarks:

Groundwater was not encountered. Borehole backfilled to 4.9m with bentonite and to 4.9m with filter sand. Standpipe installed to 4.9m bgl: ground level to 0.9m plain with bentonite anulus, 0.9m to 4.9m slotted with filter sand anulus.

Water Strikes		Chiselling			Borehole and Casing Details			
					Borehole		Casing	
Strike ↗	Level ▼	From: (m)	To: (m)	Time: (hr's)	Depth (m)	Diam. (mm)	Depth (m)	Diam. (mm)

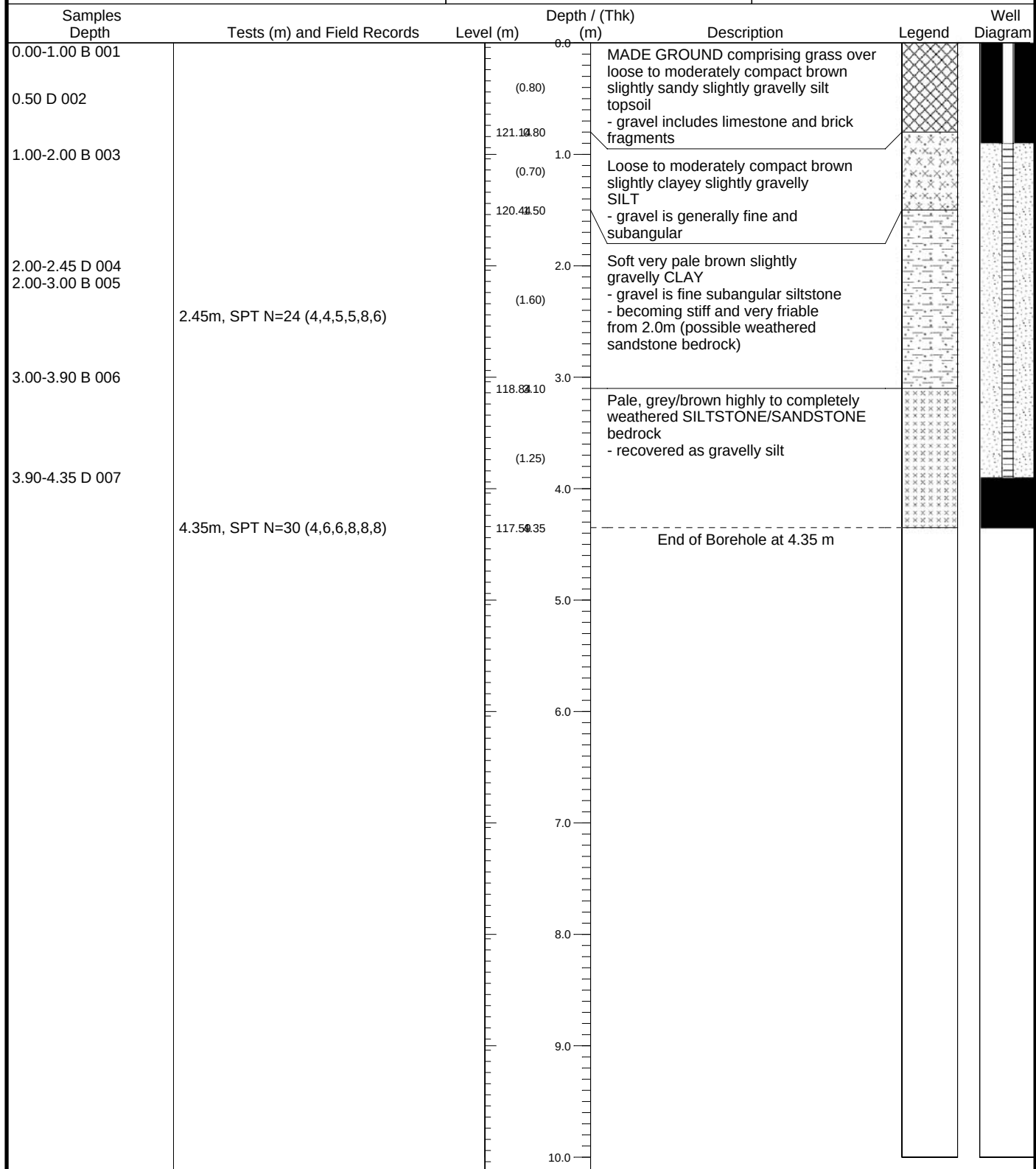
Client: VELLA PARTNERSHIP
 Site: SHORTWOOD AUTISTIC HOSPITAL
 Project No: 11061



Boring Method:
 Date: 21/09/2007-21/09/2007
 Driller:
 Logged By: RP

Ground Level:
 121.940m
 Top of Casing Elevation (m):
 -

Record of : BH105
 Sheet 1 of 1
 Scale 1:50



General Remarks:
 Groundwater was not encountered. Borehole backfilled to 3.9m with bentonite and to 0.9m with filter sand. Standpipe installed to 3.9m bgl: ground level to 0.9m plain with bentonite anulus, 0.9m to 3.0m slotted with filter sand anulus.

Water Strikes		Chiselling			Borehole and Casing Details			
					Borehole		Casing	
Strike ↗	Level ▼	From: (m)	To: (m)	Time: (hr's)	Depth (m)	Diam. (mm)	Depth (m)	Diam. (mm)

Client: VELLA PARTNERSHIP
Site: SHORTWOOD AUTISTIC HOSPITAL
Project No: 11061



Boring Method:
 Date: 18/09/2007-18/09/2007
 Driller:
 Logged By: RP

Ground Level:
 122.502m
 Top of Casing Elevation (m):
 -

Record of : BH106
 Sheet 1 of 1
 Scale 1:50

Samples Depth	Tests (m) and Field Records	Level (m)	Depth / (Thk) (m)	Description	Legend	Well Diagram
0.00-1.00 B 001			0.0			
0.50 D 002		(1.00)		MADE GROUND comprising grass over loose to moderately compact pale grey brown slightly gravelly sandy silt - gravel is mostly fine and includes limestone		
1.00-2.00 B 003		-121.50.00	1.0			
		(1.00)		MADE GROUND comprising soft to firm grey sandy slightly gravelly clay - gravel and sand comprise much limestone		
2.00-3.00 B 004		-120.50.00	2.0			
2.00-2.45 D 005	2.45m, SPT N=22 (4,5,6,7,5,4)			Pale brown and pale grey MUDSTONE bedrock - mudstone recoevered as grey gravelly sand from 5.2m - firm pale brown slightly gravelly very friable clay		
3.00-4.00 B 006			3.0	- gravel is angular mudstone - gravelly clay from 3.0m - orange colouration on surfaces - band of coal at 4.9m to 5.2m - grey gravelly sand from 5.2m - possibly highly weathered mudstone bedrock		
4.00-4.90 B 007			4.0			
4.00-4.45 D 008	4.45m, SPT N=42 (8,12,12,10,10,10)	(4.70)				
4.90 B 009			5.0			
4.90-5.35 D 010	5.35m, SPT N=50 (4,8,9,14,13,14)					
5.00-6.00 B 011			6.0			
6.50-6.66 S 012						
6.50-6.66 D 013		115.80.70	6.70	End of Borehole at 6.70 m		
			7.0			
			8.0			
			9.0			
			10.0			

General Remarks:

Groundwater was not encountered. Borehole backfilled to 5.8m with arisings and to 1.6m with filter sand. Standpipe installed to 5.8m bgl: ground level to 1.8m plain with bentonite anulus, 1.8m to 5.8m slotted with filter sand anulus.

Water Strikes		Chiselling			Borehole and Casing Details			
					Borehole		Casing	
Strike Σ	Level ▼	From: (m)	To: (m)	Time: (hr's)	Depth (m)	Diam. (mm)	Depth (m)	Diam. (mm)

Boring Method:
 Date: -
 Driller:
 Logged By: RP

Ground Level:
 114.030m
 Top of Casing Elevation (m):
 -

Record of : BH107
 Sheet 1 of 1
 Scale 1:50

Samples Depth	Tests (m) and Field Records	Level (m)	Depth / (Thk) (m)	Description	Legend	Well Diagram
0.00-1.00 B 001	2.15m, SPT N=0 (8,13,0,0,0,0)	113.33.70	0.0 (0.70)	MADE GROUND comprising grass over grey gravelly sandy soft topsoil - gravel includes angular limestone and mudstone		
1.00-2.00 B 002		111.92.10	1.0 (1.40)	MADE GROUND comprising very pale orange brown clayey gravelly sand - gravel is mostly subangular fine grained sandstone - possible highly weathered sandstone bedrock		
2.00-3.00 B 003		109.82.20	2.0 (2.10)	MADE GROUND comprising dark brown/black silty gravelly slightly organic sand - gravel is generally fine to coarse and includes brick fragments and sandstone - occasional pockets of firm grey gravelly clay - black and ashy 3.0m - 4.2m		
3.00-4.00 B 004		107.92.10	3.0 (1.30)	MADE GROUND comprising soft black sandy slightly gravelly clay with traces of plastic and timber - strong hydrocarbon/tar odour		
4.00 D 005 4.00-5.00 B 006		106.62.40	4.0 (0.60)	MADE GROUND comprising loose to moderately compact black gravelly sand of coaliferous fragments - slight sulphurous odour		
4.60 D 007		106.02.00	5.0 (1.20)	MADE GROUND comprising loose to moderately compact black gravelly sand of coaliferous fragments - slight sulphurous odour		
5.00-6.00 B 008			6.0	Dark and light grey sandy gravelly CLAY - gravel is weak angular mudstone - orange colouration on surfaces - possibly highly weathered mudstone bedrock		
5.50 D 009			7.0	Pale grey and orange highly weathered weak SANDSTONE and SILTSTONE bedrock - recovered as gravelly sand - occasional coal		
6.00-7.00 B 010			8.0	End of Borehole at 8.00 m		
7.00-8.00 B 011			9.0			
			10.0			

General Remarks:

Water Strikes		Chiselling			Borehole and Casing Details			
					Borehole		Casing	
Strike ↗	Level ▼	From: (m)	To: (m)	Time: (hr's)	Depth (m)	Diam. (mm)	Depth (m)	Diam. (mm)

Client: VELLA PARTNERSHIP
Site: SHORTWOOD AUTISTIC HOSPITAL
Project No: 11061



Boring Method: Air flush rotary with core recovery
 Date: 19/09/2007-19/09/2007
 Driller: Structural Soils
 Logged By: RP

Ground Level:
 122.580m
 Top of Casing Elevation (m):
 -

Record of : BH108
 Sheet 1 of 2
 Scale 1:50

Samples Depth	Tests (m) and Field Records	Level (m)	Depth / (Thk) (m)	Description	Legend	Well Diagram
0.00-1.00 B 001			0.0	MADE GROUND comprising grass over grey sandy gravelly silty very friable CLAY - gravel is mostly weak angular mudstone - occasional coaliferous fragments		
1.00-2.00 B 002			1.0	- occasional angular sandstone and limestone gravel - occasional timber pieces between 2.0m and 3.0m - pockets of soft silty slightly coarse sandy clay from 4.0m - possibly reworked weathered mudstone		
1.00-4.00 B 003						
2.00-3.00 B 004			2.0			
3.00-4.00 B 005		(6.00)	3.0			
4.00-5.00 B 006			4.0			
4.00-5.00 D 007						
5.00-6.00 B 008			5.0			
6.00-7.00 B 009		-116.58	6.0	MADE GROUND comprising grey clayey silty gravelly sand with occasional pockets of stiff sandy clay - gravel is mostly hard angular mudstone, siltstone and sandstone - occasional traces of brick fragments		
6.00-8.00 B 010						
7.00-8.00 B 011		(2.00)	7.0			
		-114.58	8.0	MADE GROUND (Grey siltstone (driller's record))		
		(1.00)				
		-113.58	9.0	MADE GROUND (Grey siltstone/coal (driller's record))		
		(1.50)				
			10.0	Continued next sheet		

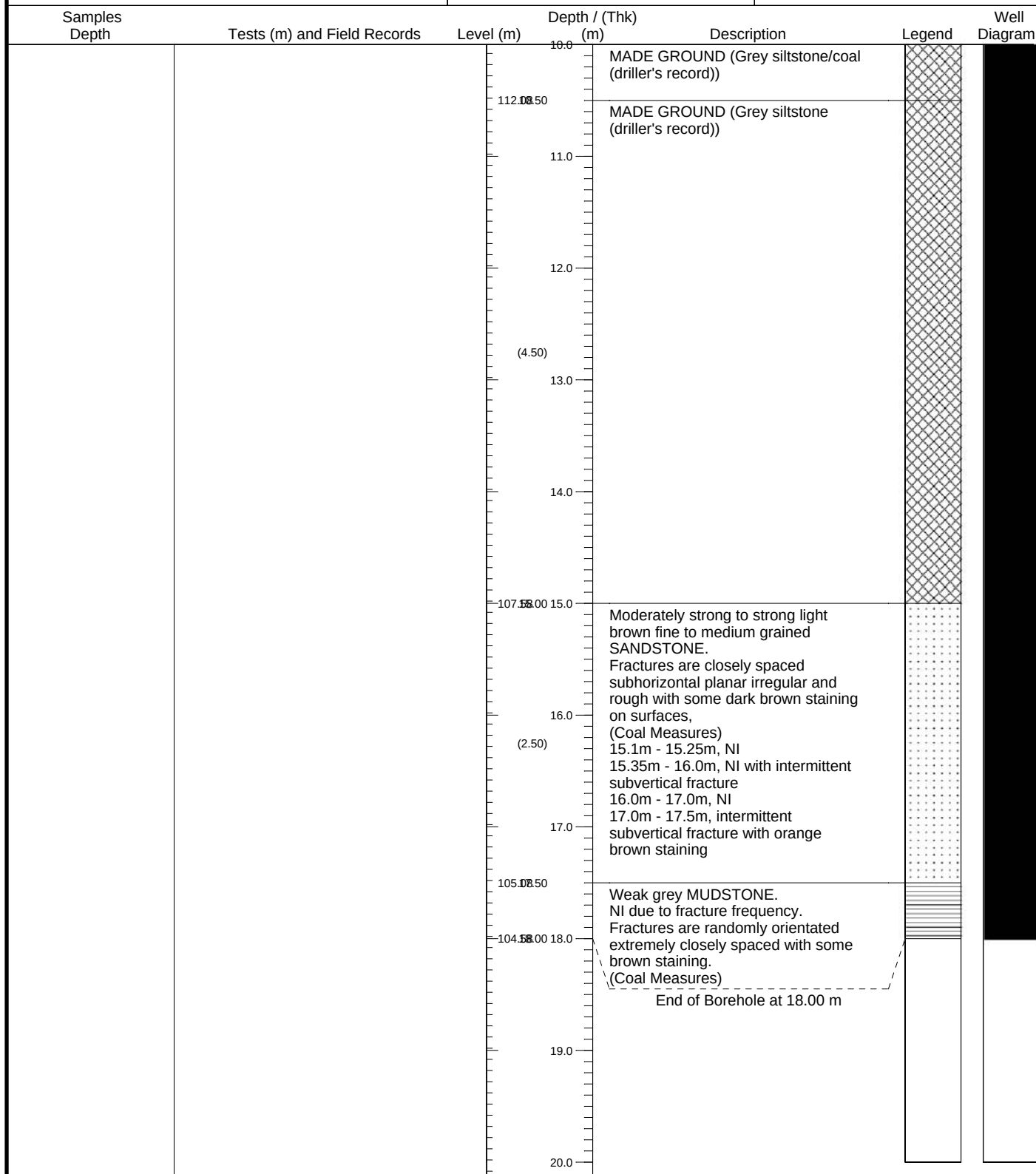
General Remarks:
 Borehole backfilled to 8.8m bgl with bentonite and arisings, to 8.7m with filter sand.
 Standpipe installed to 8.7m bgl; ground level to 1.7m, plain pipe with bentonite annulus, 1.7m to 8.7m, slotted pipe with filter sand annulus.

Water Strikes		Chiselling			Borehole and Casing Details			
					Borehole		Casing	
Strike ↗	Level ▼	From: (m)	To: (m)	Time: (hr's)	Depth (m)	Diam. (mm)	Depth (m)	Diam. (mm)

Boring Method: Air flush rotary with core recovery
 Date: 19/09/2007-19/09/2007
 Driller: Structural Soils
 Logged By: RP

Ground Level:
 122.580m
 Top of Casing Elevation (m):
 -

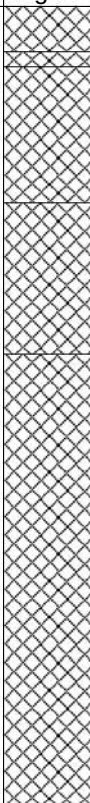
Record of : BH108
 Sheet 2 of 2
 Scale 1:50



General Remarks:
 Borehole backfilled to 8.8m bgl with bentonite and arisings, to 8.7m with filter sand.
 Standpipe installed to 8.7m bgl; ground level to 1.7m, plain pipe with bentonite annulus, 1.7m to 8.7m, slotted pipe with filter sand annulus.

Water Strikes		Chiselling			Borehole and Casing Details			
					Borehole		Casing	
Strike ↗	Level ▼	From: (m)	To: (m)	Time: (hr's)	Depth (m)	Diam. (mm)	Depth (m)	Diam. (mm)

Trial Pit Record: TPS01

Site: Shortwood Autistic Hospital				Start Date: 03/10/2007		Ground Level: -	
Client: Vella Partnership				End Date: 03/10/2007		Easting: -	
Project No: 11061				Logged By: KF		Northing: -	
Site National Grid Reference:				Excavation Method:			
Site Level (mOD): 0.000				Plant:			
				Shoring/Support:			
				Trial Pit Length: -		Trial Pit Width: -	
Samples & Tests			Strata Details				
Depth	Type	Result	Thk	Legend	Depth	Description	
0.35	D		0.30		0.30	MADE GROUND (grass over firm to stiff brown slightly sandy slightly gravelly clay (topsoil). Gravel is angular to subangular fine to medium sandstone and mudstone with many rootlets)	
			0.10		0.40		
1.00	D		0.90		1.30	MADE GROUND (firm dark grey slightly sandy gravelly clay. Gravel is a fine to coarse mudstone, occasionally tabular)	
1.80	D		1.00		2.30	MADE GROUND (firm to stiff pale orange brown slightly sandy gravelly clay. Gravel is angular to subangular fine to coarse sandstone and mudstone with some cobbles)	
						MADE GROUND (firm to stiff grey ad pale brown slightly sand gravelly clay. Gravel is angular to subangular fine to coarse sandstone and mudstone with some cobbles)	
			3.00			MADE GROUND (red brown slightly angular fine to coarse gravel of brick with many cobbles of brick. Locally very dark brown/black sand fill. Some bricks are in layered structure, possible former floor/walls)	
			0.30		5.30	Firm to stiff yellow grey brown gravelly CLAY. Gravel is a fine to coarse mudstone, occasionally tabular, with some brown veining	
					5.60		
						End of Trial Pit at 5.60 m	
General Notes:							
1. All linear dimensions are in metres unless otherwise stated							
2. All relative density/shear strength descriptions are based only on field observations and available in-situ test data.							
Groundwater Observations:			Stability:			General Remarks:	
						Face D - metal plate approximately 3.00m depth with brick arch below it. Trial pit was dry, similar, moderately easy excavation. Generally stable during excavation but pit side collapsed when pit was ~10m in length.	

Trial Pit Record: TPS01A

Site: Shortwood Autistic Hospital	Start Date: 03/10/2007	Ground Level: -
Client: Vella Partnership	End Date: 03/10/2007	Easting: -
Project No: 11061	Logged By: KF	Northing: -
Site National Grid Reference:	Excavation Method:	
Site Level (mOD): 0.000	Plant:	
	Shoring/Support:	
	Trial Pit Length: -	Trial Pit Width: -

Samples & Tests			Strata Details			
Depth	Type	Result	Thk	Legend	Depth	Description
			0.30		0.30	MADE GROUND (Grass over firm to stiff brown slightly sandy slightly gravelly clay (topsoil). Gravel is angular to subangular fine to medium sandstone and mudstone with many rootlets)
			0.10		0.40	
			0.90		1.30	MADE GROUND (firm dark grey slightly sandy slightly gravelly clay. Gravel is a fine to coarse mudstone, occasionally tabular)
						MADE GROUND (firm to stiff pale orange brown slightly sandy gravelly clay. Gravel is angular to subangular fine to coarse sandstone and mudstone with some cobbles)
			3.00			MADE GROUND (firm to stiff grey and pale brown slightly sandy gravelly clay. Gravel is angular to subangular fine to coarse sandstone and mudstone with some cobbles)
			0.20		4.30	MADE GROUND (locally pale yellow brown sandy angular fine to coarse sandstone with many cobbles)
					4.50	
						End of Trial Pit at 4.50 m

General Notes:

1. All linear dimensions are in metres unless otherwise stated
2. All relative density/shear strength descriptions are based only on field observations and available in-situ test data.

Groundwater Observations:

Stability:

General Remarks:

Face B - brick arch apparent in face.
Trial pits is dry, similar, stable
moderately easy excavation becoming
difficult below 4.30m.

Trial Pit Record: TPS02

Site: Shortwood Autistic Hospital	Start Date: 03/10/2007	Ground Level: -
Client: Vella Partnership	End Date: 03/10/2007	Easting: -
Project No: 11061	Logged By: KF	Northing: -
Site National Grid Reference:	Excavation Method:	
Site Level (mOD): 0.000	Plant:	
	Shoring/Support:	
	Trial Pit Length: -	Trial Pit Width: -

Samples & Tests			Strata Details			
Depth	Type	Result	Thk	Legend	Depth	Description
0.60	D		0.30		0.30	MADE GROUND (grass over firm brown slightly sandy slightly friable clay (topsoil) with many rootlets)
			0.30		0.60	MADE GROUND (firm grey and brown slightly sandy slightly gravelly clay. Gravel is angular to subangular fine to coarse mudstone and sandstone)
1.20	D		0.50		1.10	
1.40	D		0.30		1.40	MADE GROUND (red brown slightly sandy angular fine to coarse gravel of brick and mudstone)
1.70	J		0.05		1.45	
	J					MADE GROUND (firm to stiff orange brown slightly sandy gravelly clay. Gravel is angular to subangular fine to coarse mudstone and sandstone with some cobbles)
			1.75			MADE GROUND (black and dark grey slightly clayey slightly sandy angular fine to coarse gravel of mudstone)
					3.20	MADE GROUND (firm to stiff grey slightly sandy gravelly clay. Gravel is angular fine to coarse (often tabular) mudstone with many cobbles)
			0.40		3.60	MADE GROUND (dark brown/red/black slightly gravelly fine to coarse sand of ash. Gravel is angular fine to coarse brick and ash)
						End of Trial Pit at 3.60 m

General Notes:

- All linear dimensions are in metres unless otherwise stated
- All relative density/shear strength descriptions are based only on field observations and available in-situ test data.

Groundwater Observations:

Stability:

General Remarks:

Void encountered, broken through and tunnel encountered, 0.8x1.0m wide. Moderately easy excavation, similar except as described, stable, dry.

Trial Pit Record: TPS03

Site: Shortwood Autistic Hospital	Start Date: 03/10/2007	Ground Level: -
Client: Vella Partnership	End Date: 03/10/2007	Easting: -
Project No: 11061	Logged By: KF	Northing: -
Site National Grid Reference:	Excavation Method:	
Site Level (mOD): 0.000	Plant:	
	Shoring/Support:	
	Trial Pit Length: -	Trial Pit Width: -

Samples & Tests			Strata Details			
Depth	Type	Result	Thk	Legend	Depth	Description
1.50	D		0.40		0.40	MADE GROUND (grass over firm brown slightly sandy slightly gravelly slightly friable clay (topsoil). Gravel is angular to subangular fine to coarse mudstone and sandstone)
			0.50		0.90	MADE GROUND (firm orange brown slightly sandy slightly gravelly clay. Gravel is angular to subangular fine to coarse sandstone, mudstone and rare brick with occasional cobbles)
			1.90			MADE GROUND (firm to stiff grey gravelly clay. Gravel is angular to subangular fine to coarse mudstone, often tabular, with many cobbles and occasional boulders)
3.20	D				2.80	MADE GROUND (black/dark grey slightly clayey fine to coarse sand of ash and angular fine to coarse gravel of ash, brick, mudstone and sandstone with occasional pieces of wood (natural and made) and plastic, 4.00m no longer slightly clayey)
					2.40	
5.10	D				5.20	(Possible made ground) stiff pale yellow brown and grey slightly sandy slightly gravelly CLAY. Gravel is angular fine to coarse mudstone and sandstone with some cobbles
5.50	D		0.60		5.80	End of Trial Pit at 5.80 m

General Notes:

- All linear dimensions are in metres unless otherwise stated
- All relative density/shear strength descriptions are based only on field observations and available in-situ test data.

Groundwater Observations:

Stability:

General Remarks:

Dry, similar, stable, moderately ease excavation. Clay was encountered across all of base at pit, no markings/staining to suggest shaft.

Trial Pit Record: TP101

Site: Shortwood Autistic Hospital	Start Date: 13/09/2007	Ground Level: 105.450
Client: Vella Partnership	End Date: 13/09/2007	Easting: 381152.880
Project No: 11061	Logged By: RP	Northing: 373823.160
Site National Grid Reference:	Excavation Method:	
Site Level (mOD): 0.000	Plant: JCB 3CX	
	Shoring/Support:	
	Trial Pit Length: -	Trial Pit Width: -

Samples & Tests			Strata Details			
Depth	Type	Result	Thk	Legend	Depth	Description
0.10			0.10		0.10	Grass over very friable clayey silt TOPSOIL
0.50	D		1.10			MADE GROUND (stiff grey friable slightly gravelly silty clay with occasional subangular mudstone cobbles - gravel is angular to subangular mudstone - possibly natural soil)
0.60-0.70	D				1.20	Soft to firm grey/black organic CLAY with frequent vegetation remains - firm grey/blue with black friable clay with frequent rootlets from 1.6m
			1.40			Obstruction and pocket of brown medium and occasional coarse sand encountered at 2.0m in northern corner of pit.
					2.60	Obstruction possibly a metal pipe of approx 150mm diameter running parallel to north west boundary
3.00	D		0.50			Firm orange and grey mottled slightly friable slightly gravelly CLAY - occasional coaliferous fragments - occasional subangular cobbles of mudstone
					3.10	End of Trial Pit at 3.10 m

General Notes:

- All linear dimensions are in metres unless otherwise stated
- All relative density/shear strength descriptions are based only on field observations and available in-situ test data.

Groundwater Observations:

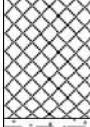
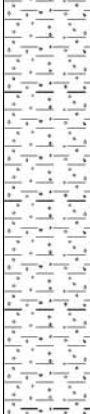
Stability:

General Remarks:

Sheet 1 of 1

Trial Pit Record: TP103

Site: Shortwood Autistic Hospital	Start Date: 13/09/2007	Ground Level: -
Client: Vella Partnership	End Date: 13/09/2007	Easting: -
Project No: 11061	Logged By: RP	Northing: -
Site National Grid Reference:	Excavation Method:	
Site Level (mOD): 0.000	Plant: JCB 3CX	
	Shoring/Support:	
	Trial Pit Length: -	Trial Pit Width: -

Samples & Tests			Strata Details			
Depth	Type	Result	Thk	Legend	Depth	Description
0.30	D		0.80		0.80	MADE GROUND (grass over loose to moderately compact black ashy sandy silt with occasional wastes including timber pieces, plastic, metal, glass, brick and pipe pieces)
0.70	D					
0.90	D					
1.50	B		2.80			Firm grey and brown mottled slightly gravelly CLAY - gravel is fine, angular, mudstone - becoming more orange with depth from 1.5m - frequent small coaliferous fragments from 1.5m - gravel becoming coarser with depth - with frequent black colouration with greater depth from 2.0m - clay is friable becoming silty gravelly CLAY from 3.0m (gravel is fine weak mudstone)
3.50	B				3.60	End of Trial Pit at 3.60 m

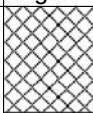
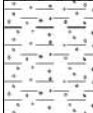
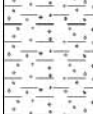
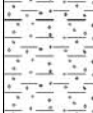
General Notes:

1. All linear dimensions are in metres unless otherwise stated
2. All relative density/shear strength descriptions are based only on field observations and available in-situ test data.

Groundwater Observations:	Stability:	General Remarks:

Trial Pit Record: TP104

Site: Shortwood Autistic Hospital	Start Date: 13/09/2007	Ground Level: -
Client: Vella Partnership	End Date: 13/09/2007	Easting: -
Project No: 11061	Logged By: RP	Northing: -
Site National Grid Reference:	Excavation Method:	
Site Level (mOD): 0.000	Plant: JCB 3CX	
	Shoring/Support:	
	Trial Pit Length: -	Trial Pit Width: -

Samples & Tests			Strata Details			
Depth	Type	Result	Thk	Legend	Depth	Description
0.40	D		0.70		0.70	MADE GROUND (comprising grass over black ashy fine sand of coal dust with occasional gravel and occasional wastes including timber and plastics - occasional brick and brick pieces)
0.90	D					
			2.30			
2.90	D				3.00	Firm, orange, grey and black friable gravelly CLAY - gravel is hard angular mudstone - becoming grey and silty from 2.3m
						End of Trial Pit at 3.00 m

General Notes:

1. All linear dimensions are in metres unless otherwise stated
2. All relative density/shear strength descriptions are based only on field observations and available in-situ test data.

Groundwater Observations:	Stability:	General Remarks:

Trial Pit Record: TP105

Site: Shortwood Autistic Hospital	Start Date: 13/09/2007	Ground Level: -
Client: Vella Partnership	End Date: 13/09/2007	Easting: -
Project No: 11061	Logged By: RP	Northing: -
Site National Grid Reference:	Excavation Method:	
Site Level (mOD): 0.000	Plant: JCB 3CX	
	Shoring/Support:	
	Trial Pit Length: -	Trial Pit Width: -

Samples & Tests			Strata Details			
Depth	Type	Result	Thk	Legend	Depth	Description
0.70	D		1.60			MADE GROUND (grass over dark brown sandy gravelly silt with occasional soft grey clay pockets - occasional broken brick and pipe and plastic)
			0.40		1.60	Firm black organic SILT with frequent vegetation remains
			0.80		2.00	Loose to moderately compact slightly cohesive brown SILT
			0.20		2.80	Firm, orange and brown mottled slightly gravelly CLAY
					3.00	- gravel is coarse angular consisting of mostly weak sandstone
						End of Trial Pit at 3.00 m

General Notes:

- All linear dimensions are in metres unless otherwise stated
- All relative density/shear strength descriptions are based only on field observations and available in-situ test data.

Groundwater Observations:

Stability:

General Remarks:

Sheet 1 of 1

Trial Pit Record: TP107

Site: Shortwood Autistic Hospital	Start Date: 13/09/2007	Ground Level: 121.760
Client: Vella Partnership	End Date: 13/09/2007	Easting: 316986.350
Project No: 11061	Logged By: RP	Northing: 251791.430
Site National Grid Reference:	Excavation Method:	
Site Level (mOD): 0.000	Plant: JCB 3CX	
	Shoring/Support:	
	Trial Pit Length: -	Trial Pit Width: -

Samples & Tests			Strata Details			
Depth	Type	Result	Thk	Legend	Depth	Description
0.40	D		0.50		0.50	MADE GROUND (grass over brown sandy gravelly silty topsoil with occasional broken brick fragments)
0.70	D					
0.80-1.30	B		1.40			MADE GROUND (firm grey and black clay with occasional vegetation remains and occasional organic pockets - very gravelly in places - occasional broken brick pieces - occasional cobbles, mostly consisting of strong blue mudstone - occasional boulder sized concrete pieces)
			0.30		1.90	Soft black organic SILT with frequent vegetation remains
			0.20		2.20	Loose to moderately compact slightly cohesive brown slightly gravelly SILT
					2.40	
						End of Trial Pit at 2.40 m

General Notes:

- All linear dimensions are in metres unless otherwise stated
- All relative density/shear strength descriptions are based only on field observations and available in-situ test data.

Groundwater Observations:	Stability:	General Remarks:

Trial Pit Record: TP108

Site: Shortwood Autistic Hospital	Start Date: 13/09/2007	Ground Level: -
Client: Vella Partnership	End Date: 13/09/2007	Easting: -
Project No: 11061	Logged By: RP	Northing: -
Site National Grid Reference:	Excavation Method:	
Site Level (mOD): 0.000	Plant: JCB 3CX	
	Shoring/Support:	
	Trial Pit Length: -	Trial Pit Width: -

Samples & Tests			Strata Details			
Depth	Type	Result	Thk	Legend	Depth	Description
			0.90		0.90	MADE GROUND (grass over loose to moderately compact sandy very gravelly silt with occasional brick fragments and broken glass)
			1.70			MADE GROUND (soft to firm black and grey organic gravelly clay with frequent vegetation remains - occasional cobbles of strong mudstone - occasional brick pieces - trace of coal fragments)
			0.30		2.60	Firm orange and grey mottled CLAY with occasional medium subangular orange and black mudstone gravel
					2.90	End of Trial Pit at 2.90 m

General Notes:

- All linear dimensions are in metres unless otherwise stated
- All relative density/shear strength descriptions are based only on field observations and available in-situ test data.

Groundwater Observations:

Stability:

General Remarks:

Trial Pit Record: TP109

Site: Shortwood Autistic Hospital	Start Date: 03/10/2007	Ground Level: -
Client: Vella Partnership	End Date: 03/10/2007	Easting: -
Project No: 11061	Logged By: KF	Northing: -
Site National Grid Reference:	Excavation Method:	
Site Level (mOD): 0.000	Plant:	
	Shoring/Support:	
	Trial Pit Length: -	Trial Pit Width: -

Samples & Tests			Strata Details			
Depth	Type	Result	Thk	Legend	Depth	Description
0.30	D		0.50		0.50	MADE GROUND (firm brown sandy slightly gravelly friable clay. Gravel is angular to subangular fine to coarse brick and sandstone with some cobbles of brick)
1.00	D		1.50			MADE GROUND (black/dark grey slightly clayey fine to coarse sand of ash and angular fine to coarse gravel of ash, brick, sandstone and mudstone)
1.90	D				2.00	MADE GROUND (stiff grey slightly sandy gravelly clay. Gravel is angular to subrounded fine to coarse mudstone with some cobble sof mudstone)
3.30	D		2.10			
4.30	D		0.40		4.10	MADE GROUND (dark brown and black slightly sandy gravelly clay. Gravel is angular fine to coarse brick, mudstone, ash and sandstone with some cobbles of brick)
					4.50	End of Trial Pit at 4.50 m

General Notes:

1. All linear dimensions are in metres unless otherwise stated
2. All relative density/shear strength descriptions are based only on field observations and available in-situ test data.

Groundwater Observations:

Stability:

General Remarks:

Dry, similar, stable, easy excavation to 4.10m, becoming difficult.

Trial Pit Record: TP110

Site: Shortwood Autistic Hospital	Start Date: 04/10/2007	Ground Level: -
Client: Vella Partnership	End Date: 04/10/2007	Easting: -
Project No: 11061	Logged By: KF	Northing: -
Site National Grid Reference:	Excavation Method:	
Site Level (mOD): 0.000	Plant:	
	Shoring/Support:	
	Trial Pit Length: -	Trial Pit Width: -

Samples & Tests			Strata Details			
Depth	Type	Result	Thk	Legend	Depth	Description
0.50	D		0.60		0.60	MADE GROUND (grass over firm brown sandy slightly gravelly friable clay (topsoil). Gravel is angular to subangular fine to coarse sandstone)
1.20	D	SV=60.0Kpa	1.20		1.80	MADE GROUND (dark brown/black clayey gravelly fine to coarse sand of ash. Gravel is angular to subangular fine to coarse brick, mudstone and sandstone with many pieces of plastic, material, ceramic, tiles, polystyrene, loose cables and pipes)
2.00	D					
2.40	B	SV=59.0Kpa	1.30			MADE GROUND (firm brown and orange brown locally grey slightly sandy slightly gravelly clay. Gravel is angular to subangular fine to coarse sandstone. Ceramic pipe encountered at 2.80m)
		SV=82.0Kpa				
3.20	D		0.20		3.10	Black COAL, recovered as slightly clayey angular tabular
3.40	D		0.30		3.30	fine to medium gravel of coal
3.60	B				3.60	Very weak grey MUDSTONE, highly to completely weathered, recovered as grey clayey vey weak angular tabular fine to medium gravel of mudstone
						End of Trial Pit at 3.60 m

General Notes:

1. All linear dimensions are in metres unless otherwise stated
2. All relative density/shear strength descriptions are based only on field observations and available in-situ test data.

Groundwater Observations:

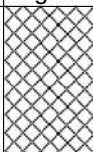
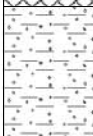
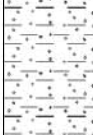
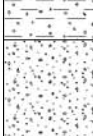
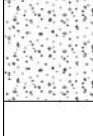
Stability:

General Remarks:

Dry, similar, stable, easy excavation.

Trial Pit Record: TP111

Site: Shortwood Autistic Hospital	Start Date: 04/10/2007	Ground Level: -
Client: Vella Partnership	End Date: 04/10/2007	Easting: -
Project No: 11061	Logged By: KF	Northing: -
Site National Grid Reference:	Excavation Method:	
Site Level (mOD): 0.000	Plant:	
	Shoring/Support:	
	Trial Pit Length: -	Trial Pit Width: -

Samples & Tests			Strata Details			
Depth	Type	Result	Thk	Legend	Depth	Description
0.50	D		1.00		1.00	MADE GROUND (sparse grass over firm pale grey very friable slightly sandy gravelly clay. Gravel is angular to subangular fine to coarse mudstone and siltstone and occasional sandstone, 1.00m piece of rope encountered)
1.40	D					(Possible made ground) firm grey slightly sandy gravelly CLAY. Gravel is angular to subangular fine to coarse mudstone, siltstone and occasional sandstone with many cobbles
2.00-2.20	B		2.00			- too gravelly for hand vane reading - 2.50m with occasional fragments of coal
2.80	D				3.00	
3.20	D					Orange brown gravelly slightly clayey fine to coarse SAND. Gravel is angular to subrounded fine to coarse siltstone and limestone with many cobbles and occasional boulders of limestone
4.00-4.20	B		1.30		4.30	
						End of Trial Pit at 4.30 m

General Notes:

- All linear dimensions are in metres unless otherwise stated
- All relative density/shear strength descriptions are based only on field observations and available in-situ test data.

Groundwater Observations:

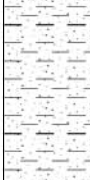
Stability:

General Remarks:

Dry, stable, similar, moderately easy excavation.

Trial Pit Record: TP112

Site: Shortwood Autistic Hospital	Start Date: 04/10/2007	Ground Level: -
Client: Vella Partnership	End Date: 04/10/2007	Easting: -
Project No: 11061	Logged By: KF	Northing: -
Site National Grid Reference:	Excavation Method:	
Site Level (mOD): 0.000	Plant:	
	Shoring/Support:	
	Trial Pit Length: -	Trial Pit Width: -

Samples & Tests			Strata Details			
Depth	Type	Result	Thk	Legend	Depth	Description
0.40	D	SV=120.0Kpa	0.20		0.20	MADE GROUND (grass over brown sandy slightly gravelly clay (topsoil). Gravel is a fine to coarse mudstone and sandstone with occasional pieces of glass)
0.80-1.00	B	SV=120.0Kpa	1.30			Very stiff pale yellow and mottled grey slightly sandy CLAY
1.80	D		0.60		1.50	Orange brown and grey slightly clayey angular fine to coarse GRAVEL of sandstone with many cobbles and boulders (completely to highly weathered sandstone)
2.00-2.10	B		0.10		2.10	Weak grey thickly laminated SANDSTONE, moderate to highly wethered. Recorded as slightly sandy slightly clayey angular fine to coarse tabular gravel and cobbles of grey sandstone
2.10-2.20	B				2.20	
						End of Trial Pit at 2.20 m

General Notes:

1. All linear dimensions are in metres unless otherwise stated
2. All relative density/shear strength descriptions are based only on field observations and available in-situ test data.

Groundwater Observations:

Stability:

General Remarks:

Dry, similar, stable, moderately easy excavation, became difficult below 1.80m.

Trial Pit Record: TP113

Site: Shortwood Autistic Hospital	Start Date: 04/10/2007	Ground Level: -
Client: Vella Partnership	End Date: 04/10/2007	Easting: -
Project No: 11061	Logged By: KF	Northing: -
Site National Grid Reference:	Excavation Method:	
Site Level (mOD): 0.000	Plant:	
	Shoring/Support:	
	Trial Pit Length: -	Trial Pit Width: -

Samples & Tests			Strata Details			
Depth	Type	Result	Thk	Legend	Depth	Description
0.20	D	SV=50.0Kpa	0.40		0.40	MADE GROUND (rough vegetation over brown sandy slightly friable clay (topsoil). Gravel is angular to subangular fine to coarse sandstone, mudstone and occasional brick with many rootlets)
0.60	D		0.70		1.10	Firm orange brown slightly sandy slightly gravelly CLAY. Gravel is angular to subangular fine to coarse sandstone
1.00	D					
1.20	D	SV=30.0Kpa				
1.60-1.80	B		0.80		1.90	Soft to firm orange brown mottled grey slightly sandy CLAY
2.00	D	SV=50.0Kpa				
		SV=110.0Kpa				
		SV=90.0Kpa	0.70			Stiff pale grey and dark orange brown slightly sandy CLAY with occasional angular fine to medium gravel of sandstone, with mudstone lithorelicts at 2.40m
2.40-2.60	B					
2.65	D		0.10		2.60	
2.70-2.80	B		0.10		2.70	Soft orange brown slightly sandy slightly gravelly CLAY. Gravel is angular to subangular fine to coarse sandstone (completely to highly weathered sandstone)
					2.80	Weak grey thickly laminated SANDSTONE, highly to moderately weathered. Recorded as slightly sandy slightly clayey grey angular fine to coarse tabular gravel and cobbles of sandstone
						End of Trial Pit at 2.80 m

General Notes:

- All linear dimensions are in metres unless otherwise stated
- All relative density/shear strength descriptions are based only on field observations and available in-situ test data.

Groundwater Observations:

Stability:

General Remarks:

Dry, stable, similar, easy excavation to 2.70m.

Trial Pit Record: TP114

Site: Shortwood Autistic Hospital	Start Date: 04/10/2007	Ground Level: -
Client: Vella Partnership	End Date: 04/10/2007	Easting: -
Project No: 11061	Logged By: KF	Northing: -
Site National Grid Reference:	Excavation Method:	
Site Level (mOD): 0.000	Plant:	
	Shoring/Support:	
	Trial Pit Length: -	Trial Pit Width: -

Samples & Tests			Strata Details			
Depth	Type	Result	Thk	Legend	Depth	Description
0.50	D	SV=98.0Kpa	1.60			MADE GROUND (firm to stiff pale brown slightly sandy gravelly clay. Gravel is angular subrounded fine to coarse sandstone and mudstone)
1.40	D				1.60	
1.80	D J		0.40		2.00	MADE GROUND (firm black sandy gravelly clay. Gravel is angular fine to coarse sandstone and mudstone with pieces of metal, caramics, plastic and material with strong odour of hydrocarbons)
2.30	D J		0.50		2.50	(Possible made ground) stiff brown slightly sandy slightly gravelly CLAY. Gravel is angular to subangular fine to coarse mudstone and sandstone with some cobbles and boulders
						End of Trial Pit at 2.50 m

General Notes:

1. All linear dimensions are in metres unless otherwise stated
2. All relative density/shear strength descriptions are based only on field observations and available in-situ test data.

Groundwater Observations:

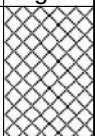
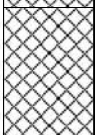
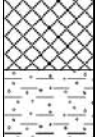
Stability:

General Remarks:

Dry, stable, similar, easy excavation.

Trial Pit Record: TP115

Site: Shortwood Autistic Hospital	Start Date: 04/10/2007	Ground Level: -
Client: Vella Partnership	End Date: 04/10/2007	Easting: -
Project No: 11061	Logged By: KF	Northing: -
Site National Grid Reference:	Excavation Method:	
Site Level (mOD): 0.000	Plant:	
	Shoring/Support:	
	Trial Pit Length: -	Trial Pit Width: -

Samples & Tests			Strata Details			
Depth	Type	Result	Thk	Legend	Depth	Description
0.30	D	SV=100.0Kpa	0.90		0.90	MADE GROUND (grass over firm brown slightly sandy slightly gravelly clay. Gravel is angular to subangular fine to coarse sandstone and mudstone with rare brick)
1.00	D J		1.30		2.20	MADE GROUND (black clayey gravelly fine to coarse sand of ash. Gravel is angular to subangular fine to coarse brick, sandstone, mudstone, ash and concrete with pieces of plastic, wood and metal with some cobbles of concrete and boulders with very strong odour of hydrocarbons)
2.00	D J		0.60		2.80	(Possible made ground) stiff grey brown slightly sandy gravelly CLAY. Gravel is angular to subangular fine to coarse mudstone, sandstone and rare limestone
2.60	D J					End of Trial Pit at 2.80 m

General Notes:

1. All linear dimensions are in metres unless otherwise stated
2. All relative density/shear strength descriptions are based only on field observations and available in-situ test data.

Groundwater Observations:

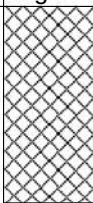
Stability:

General Remarks:

1.80m, becoming damp/wet, similar, stable, easy excavation.

Trial Pit Record: TP116

Site: Shortwood Autistic Hospital	Start Date: 04/10/2007	Ground Level: -
Client: Vella Partnership	End Date: 04/10/2007	Easting: -
Project No: 11061	Logged By: KF	Northing: -
Site National Grid Reference:	Excavation Method:	
Site Level (mOD): 0.000	Plant:	
	Shoring/Support:	
	Trial Pit Length: -	Trial Pit Width: -

Samples & Tests			Strata Details			
Depth	Type	Result	Thk	Legend	Depth	Description
0.60	D		1.30			MADE GROUND (grass over firm to stiff grey brown slightly sandy gravelly clay. Gravel is angular to subangular fine to coarse sandstone and mudstone)
1.60	D		0.40		1.30	MADE GROUND (black sandy slightly clayey angular fine to coarse gravel of ash and mudstone)
2.00	J		0.60		1.70	Firm black sandy slightly gravelly slightly peaty CLAY. Gravel is angular to subangular fine to coarse sandstone with strong organic odour
2.40	D		0.20		2.30	Stiff orange brown and grey slightly sandy slightly gravelly CLAY. Gravel is angular to subrounded fine to coarse sandstone
					2.50	End of Trial Pit at 2.50 m

General Notes:

1. All linear dimensions are in metres unless otherwise stated
2. All relative density/shear strength descriptions are based only on field observations and available in-situ test data.

Groundwater Observations:

Stability:

General Remarks:

Dry, stable, similar, easy excavation.

Trial Pit Record: TP117

Site: Shortwood Autistic Hospital	Start Date: 04/10/2007	Ground Level: -
Client: Vella Partnership	End Date: 04/10/2007	Easting: -
Project No: 11061	Logged By: KF	Northing: -
Site National Grid Reference:	Excavation Method:	
Site Level (mOD): 0.000	Plant:	
	Shoring/Support:	
	Trial Pit Length: -	Trial Pit Width: -

Samples & Tests			Strata Details			
Depth	Type	Result	Thk	Legend	Depth	Description
			1.40			MADE GROUND (firm pale brown slightly sandy slightly gravelly slightly friable clay. Gravel is angular to subrounded fine to coarse sandstone and mudstone)
			0.20		1.40	MADE GROUND (black sandy gravelly clay. Gravel is angular to subangular fine to coarse mudstone, brick and sandstone with odour of hydrocarbons) Firm to stiff orange brown and grey slightly sandy slightly gravelly CLAY. Gravel is angular to subangular fine to coarse sandstone Firm black sandy slightly gravelly CLAY. Gravel is angular to subangular fine to coarse sandstone with organic odour End of Trial Pit at 2.00 m
			0.20		1.60	
			0.20		1.80	
			0.20		2.00	

General Notes:

- All linear dimensions are in metres unless otherwise stated
- All relative density/shear strength descriptions are based only on field observations and available in-situ test data.

Groundwater Observations:

Stability:

General Remarks:

Dry, stable, similar, moderately easy excavation.

Trial Pit Record: TP118

Site: Shortwood Autistic Hospital	Start Date: 04/10/2007	Ground Level: -
Client: Vella Partnership	End Date: 04/10/2007	Easting: -
Project No: 11061	Logged By: KF	Northing: -
Site National Grid Reference:	Excavation Method:	
Site Level (mOD): 0.000	Plant:	
	Shoring/Support:	
	Trial Pit Length: -	Trial Pit Width: -

Samples & Tests			Strata Details			
Depth	Type	Result	Thk	Legend	Depth	Description
0.50	D		0.70		0.70	MADE GROUND (grass over firm pale grey brown slightly sandy slightly gravelly clay. Gravel is angular fine to coarse mudstone and sandstone)
1.00	D		0.70		1.40	MADE GROUND (stiff orange brown slightly sandy slightly gravelly clay. Gravel is angular to subangular fine to coarse sandstone with some cobbles)
1.60	D J		1.85			MADE GROUND (black slightly clayey gravelly fine to coarse sand of ash. Gravel is angular to subangular fine to coarse mudstone, brick and sandstone with pieces of plastic, glass and wood with strong odour of hydrocarbons)
2.60	D		0.05		3.25 3.30	Orange brown CLAY (no recovery but could be seen as bucket pulled water back) End of Trial Pit at 3.30 m

General Notes:

- All linear dimensions are in metres unless otherwise stated
- All relative density/shear strength descriptions are based only on field observations and available in-situ test data.

Groundwater Observations:

Stability:

General Remarks:

Similar, stable, easy excavation.

Trial Pit Record: TP119

Site: Shortwood Autistic Hospital	Start Date: 04/10/2007	Ground Level: -
Client: Vella Partnership	End Date: 04/10/2007	Easting: -
Project No: 11061	Logged By: KF	Northing: -
Site National Grid Reference:	Excavation Method:	
Site Level (mOD): 0.000	Plant:	
	Shoring/Support:	
	Trial Pit Length: -	Trial Pit Width: -

Samples & Tests			Strata Details			
Depth	Type	Result	Thk	Legend	Depth	Description
0.80	D		0.20		0.20	MADE GROUND (grass over firm black and orange brown slightly sandy slightly gravelly clay. Gravel is angular fine to coarse sandstone and mudstone)
2.00	D J		2.80			MADE GROUND (black slightly clayey gravelly fine to coarse sand of ash. Gravel is angular to subangular fine to coarse sandstone, brick, mudstone and concrete with many pieces of glass, plastic, polystyrene, wood and metal with strong odour of hydrocarbons)
3.10	D J		0.20		3.00 3.20	Firm orange brown mottled grey slightly sandy slightly gravelly CLAY. Gravel is angular fine to coarse sandstone End of Trial Pit at 3.20 m

General Notes:

- All linear dimensions are in metres unless otherwise stated
- All relative density/shear strength descriptions are based only on field observations and available in-situ test data.

Groundwater Observations:

Stability:

General Remarks:

Dry, similar, stable, moderately easy excavation.

Trial Pit Record: TP120

Site: Shortwood Autistic Hospital	Start Date: 04/10/2007	Ground Level: -
Client: Vella Partnership	End Date: 04/10/2007	Easting: -
Project No: 11061	Logged By: KF	Northing: -
Site National Grid Reference:	Excavation Method:	
Site Level (mOD): 0.000	Plant:	
	Shoring/Support:	
	Trial Pit Length: -	Trial Pit Width: -

Samples & Tests			Strata Details			
Depth	Type	Result	Thk	Legend	Depth	Description
0.60	D		1.20			MADE GROUND (grass over firm to stiff pale grey slightly sandy gravelly clay (slightly friable). Gravel is angular fine to coarse mudstone and sandstone with some cobbles)
1.30	D				1.20	
2.00-2.20	B		1.50			MADE GROUND (firm to stiff orange brown sandy gravelly friable clay. Gravel is angular fine to coarse sandstone with may cobbles and occasional boulders with rare pieces of plastic)
3.00	D		1.10		2.70	
3.90	D		0.20		3.80	MADE GROUND (black clayey gravelly fine to coarse sand of ash. Gravel is angular fine to coarse sandstone, mudstone, brick and concrete with pieces of wood, plastic and rope with odour of hydrocarbons)
					4.00	Stiff grey brown slightly sandy gravelly CLAY. Gravel is angular fine to coarse sandstone, mudstone and siltstone
						End of Trial Pit at 4.00 m

General Notes:

1. All linear dimensions are in metres unless otherwise stated
2. All relative density/shear strength descriptions are based only on field observations and available in-situ test data.

Groundwater Observations:

Stability:

General Remarks:

Dry, stable, similar, easy excavation.

APPENDIX F: GAS AND GROUNDWATER MONITORING RESULTS

Location	Methane (% v/v)		Carbon Dioxide (% v/v)		Oxygen (% v/v)		Peak Gas Flow (l/hr)	Depth to Water/Base BGL (m)
	Peak	Steady	Peak	Steady	Peak	Steady		
BH101	0.2	0.2	4.4	4.0	14.8	13.6	<0.1	9.575 / 10.0
BH102	<0.1	<0.1	2.4	2.4	17.5	17.5	0.1	6.895 / 7.80
BH103	<0.1	<0.1	0.5	0.5	20.2	19.9	-	Dry / 5.90
BH104	<0.1	<0.1	0.8	0.5	19.5	19.8	<0.1	Dry / 4.90
BH105	<0.1	<0.1	2.1	2.3	18.0	17.9	0.4	Dry / 3.90
BH106	<0.1	<0.1	3.7	4.3	12.8	10.7	<0.1	5.045 / 5.80
BH107	2.5	2.6	1.4	1.4	3.3	0.3	0.6	5.325 / 5.80
BH108	<0.1	<0.1	3.6	4.0	12.9	11.3	-0.4	Dry / 8.70
RBH103	<0.1	<0.1	1.9	1.8	17.5	17.7	<0.1	Dry / 6.00
RBH104	0.1	0.1	26.0	17.3	0.8	0.9	4.2	8.650 / 13.50

Results of Gas Monitoring – 3/10/07

Atmospheric Pressure: 1008mB
Equipment Used: Infra Red Gas Analyser (GFM400 series)
Photo Ionization Detector
Dip Meter
Weather: Dry
BGL Below Ground Level

Comments: None of the monitoring wells had gas taps on. Therefore only a few of the pipes were monitored until the gas taps were replaced.

Location	Methane (% v/v)		Carbon Dioxide (% v/v)		Oxygen (% v/v)		Peak Gas Flow (l/hr)	Depth to Water/Base BGL (m)
	Peak	Steady	Peak	Steady	Peak	Steady		
BH101	0.1	<0.1	<0.1	<0.1	20.8	20.7	<0.1	9.30 / 10.00
BH102	Not Monitored							
BH103	Not Monitored							
BH104	Not Monitored							
BH105	Not Monitored							
BH106	<0.1	<0.1	2.3	2.3	19.9	18.6	<0.1	5.00 / 5.80
BH107	2.4	2.4	1.8	1.8	4.5	0.8	<0.1	5.20 / 5.80
BH108	<0.1	<0.1	2.1	1.4	19.3	19.3	<0.1	8.60 / 8.70
RBH103	Not Monitored							
RBH104	Not Monitored							
RBH105	<0.1	<0.1	<0.1	<0.1	20.9	20.8	<0.1	6.24 / 6.90

Results of Gas Monitoring – 10/10/07

Atmospheric Pressure: 1008mB
Equipment Used: Infra Red Gas Analyser (GFM400 series)
Photo Ionization Detector
Dip Meter
Weather: Dry
BGL Below Ground Level

Comments: None of the monitoring wells had gas taps on. Therefore only a few of the pipes were monitored until the gas taps were replaced.

Location	Methane (% v/v)		Carbon Dioxide (% v/v)		Oxygen (% v/v)		Peak Gas Flow (l/hr)	Depth to Water/Base BGL (m)
	Peak	Steady	Peak	Steady	Peak	Steady		
BH101	0.4	0.4	2.9	2.9	18.9	11.6	<0.1	9.40 / 10.00
BH102	0.2	0.3	1.9	1.9	20.5	17.2	<0.1	6.64 / 7.80
BH103	0.2	0.2	<0.1	<0.1	20.7	20.6	<0.1	5.76 / 5.90
BH104	<0.1	<0.1	1.0	1.0	19.3	18.8	<0.1	4.66 / 4.90
BH105	<0.1	<0.1	4.8	4.8	19.0	17.4	<0.1	3.78 / 3.90
BH106	<0.1	<0.1	7.5	7.5	17.7	3.8	<0.1	5.02 / 5.80
BH107	<0.1	<0.1	1.8	1.8	4.0	<0.1	<0.1	5.25 / 5.80
BH108	<0.1	<0.1	1.1	1.1	19.2	19.1	<0.1	8.50 / 8.70
RBH103	<0.1	<0.1	0.6	0.6	20.3	19.7	<0.1	5.75 / 6.00
RBH104	<0.1	<0.1	25.2	24.5	2.9	1.5	2.5	8.63 / 13.50
RBH105	2.1	2.1	2.4	2.4	15.1	12.0	<0.1	6.47 / 6.90

Results of Gas Monitoring – 15/10/07

Atmospheric Pressure:

985-989mB

Equipment Used:

Infra Red Gas Analyser (GFM400 series)

Photo Ionization Detector

Dip Meter

Weather:

Dry and windy

BGL

Below Ground Level

Location	Methane (% v/v)		Carbon Dioxide (% v/v)		Oxygen (% v/v)		Peak Gas Flow (l/hr)	Depth to Water/Base BGL (m)
	Peak	Steady	Peak	Steady	Peak	Steady		
BH101	0.2	0.2	2.9	2.9	14.9	12.3	<0.1	9.43 / 10.00
BH102	<0.1	<0.1	0.8	0.8	19.6	19.1	<0.1	6.67 / 7.80
BH103	<0.1	<0.1	0.2	0.1	20.5	20.1	<0.1	5.85 / 5.90
BH104	<0.1	<0.1	1.9	1.9	18.2	17.5	<0.1	4.70 / 4.90
BH105	<0.1	<0.1	1.2	1.2	19.9	19.8	<0.1	3.77 / 3.90
BH106	<0.1	<0.1	2.2	2.2	16.6	15.0	<0.1	5.17 / 5.80
BH107	2.3	2.3	1.8	1.8	5.6	0.6	<0.1	5.34 / 5.80
BH108	<0.1	<0.1	1.7	1.7	17.2	16.4	<0.1	8.61 / 8.70
RBH103	<0.1	<0.1	2.3	2.3	15.0	15.0	<0.1	5.74 / 6.00
RBH104	<0.1	<0.1	0.5	0.4	20.1	20.0	<0.1	8.80 / 13.50
RBH105	<0.1	<0.1	0.1	0.1	20.2	20.1	<0.1	6.50 / 6.90

Results of Gas Monitoring – 22/10/07

Atmospheric Pressure:

989-993mB

Equipment Used:

Infra Red Gas Analyser (GFM400 series)

Photo Ionization Detector

Dip Meter

Weather:

Cold and dry

BGL

Below Ground Level

Location	Methane (% v/v)		Carbon Dioxide (% v/v)		Oxygen (% v/v)		Peak Gas Flow (l/hr)	Depth to Water/Base BGL (m)
	Peak	Steady	Peak	Steady	Peak	Steady		
BH101	<0.1	<0.1	7.3	7.3	8.2	<0.1	<0.1	9.39 / 10.00
BH102	<0.1	<0.1	0.6	0.6	20.1	19.8	<0.1	6.63 / 7.80
BH103	<0.1	<0.1	1.3	1.3	20.2	19.4	<0.1	Dry / 5.90
BH104	<0.1	<0.1	8.3	8.3	12.0	5.6	<0.1	Dry / 4.90
BH105	<0.1	<0.1	0.2	0.2	20.6	20.6	<0.1	3.73 / 3.90
BH106	<0.1	<0.1	5.8	5.8	14.1	8.4	<0.1	5.35 / 5.80
BH107	2.3	2.3	1.5	1.5	7.7	1.4	<0.1	5.25 / 5.80
BH108	<0.1	<0.1	1.9	1.9	17.4	15.3	<0.1	Dry / 8.70
RBH103	<0.1	<0.1	0.6	0.6	19.8	19.6	<0.1	Dry / 6.00
RBH104	<0.1	<0.1	13.2	13.2	10.2	9.0	1.1	8.84 / 13.50
RBH105	<0.1	<0.1	0.1	<0.1	20.6	20.6	<0.1	6.47 / 6.90

Results of Gas Monitoring – 28/10/07

Atmospheric Pressure:

986-990mB

Equipment Used:

Infra Red Gas Analyser (GFM400 series)

Photo Ionization Detector

Dip Meter

Weather:

Cold and dry

BGL

Below Ground Level

Location	Methane (% v/v)		Carbon Dioxide (% v/v)		Oxygen (% v/v)		VOC (ppm)		Peak Gas Flow (l/hr)	Depth to Water/ Base BGL (m)
	Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady		
BH101	1.1	1.1	7.1	7.1	6.0	1.8	0.8	0.7	<0.1	9.44 / 10.00
BH102	<0.1	<0.1	5.2	5.2	15.2	11.7	0.3	<0.1	<0.1	6.72 / 7.80
BH103	<0.1	<0.1	0.9	0.9	20.6	19.6	<0.1	<0.1	<0.1	Dry / 5.90
BH104	<0.1	<0.1	1.4	1.4	19.0	17.8	<0.1	<0.1	<0.1	Dry / 4.90
BH105	<0.1	<0.1	0.3	0.3	20.2	20.3	<0.1	<0.1	<0.1	Dry / 3.90
BH106	<0.1	<0.1	7.7	7.5	9.8	6.6	<0.1	<0.1	<0.1	5.58 / 5.80
BH107	2.6	2.6	1.5	1.5	9.2	1.9	<0.1	<0.1	<0.1	5.36 / 5.80
BH108	<0.1	<0.1	0.7	0.7	19.8	19.1	<0.1	<0.1	<0.1	Dry / 8.70
RBH103	<0.1	<0.1	1.4	1.4	18.7	18.0	<0.1	<0.1	<0.1	Dry / 6.00
RBH104	<0.1	<0.1	0.1	0.1	20.3	20.3	<0.1	<0.1	-1.5	8.96 / 13.50
RBH105	1.2	1.1	6.6	5.9	2.7	2.7	<0.1	<0.1	<0.1	Dry / 6.90

Results of Gas Monitoring – 5/11/07

Atmospheric Pressure:

995-997mB

Equipment Used:

Infra Red Gas Analyser (GFM400 series)

Photo Ionization Detector

Dip Meter

Weather:

Cold and dry

BGL

Below Ground Level

Location	Methane (% v/v)		Carbon Dioxide (% v/v)		Oxygen (% v/v)		VOC (ppm)		Peak Gas Flow (l/hr)	Depth to Water/ Base BGL (m)
	Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady		
BH101	0.7	0.7	7.6	7.5	15	<0.1	<0.1	<0.1	<0.1	9.46 / 10.00
BH102	<0.1	<0.1	1.6	1.6	20.4	18.7	<0.1	<0.1	<0.1	6.74 / 7.80
BH103	<0.1	<0.1	0.4	0.4	20.4	20.2	<0.1	<0.1	<0.1	Dry / 5.90
BH104	<0.1	<0.1	3.6	3.6	18.6	14.8	<0.1	<0.1	<0.1	Dry / 4.90
BH105	<0.1	<0.1	0.6	0.6	20.0	19.6	<0.1	<0.1	<0.1	Dry / 3.90
BH106	<0.1	<0.1	1.3	1.3	20.1	19.3	<0.1	<0.1	<0.1	5.59 / 5.80
BH107	3.0	3.0	1.6	1.6	7.7	0.1	<0.1	<0.1	<0.1	5.40 / 5.80
BH108	<0.1	<0.1	2.9	2.9	20.2	16.8	<0.1	<0.1	<0.1	Dry / 8.70
RBH103	<0.1	<0.1	2.7	2.7	20.1	13.7	<0.1	<0.1	<0.1	Dry / 6.00
RBH104	<0.1	<0.1	<0.1	<0.1	20.3	20.3	<0.1	<0.1	-1.5	9.19 / 13.50
RBH105	<0.1	<0.1	0.4	0.4	20.2	19.1	<0.1	<0.1	<0.1	Dry / 6.90

Results of Gas Monitoring – 16/11/07

Atmospheric Pressure:

995-997mB

Equipment Used:

Infra Red Gas Analyser (GFM400 series)

Photo Ionization Detector

Dip Meter

Weather:

Cold and dry

BGL

Below Ground Level

APPENDIX G: LABORATORY CERTIFICATES FOR SOIL ANALYSIS

Date: 23 October 2007
Your Ref: 11061
Our Ref: 11061-(3001)-021
Project Manager: Jon Clayton
Report to: Jon Clayton

Envirolab
Units 7 & 8
Sandpits Business Park
Mottram Road
Hyde
Cheshire
SK14 3AR

Final Test Report

Sample(s) of Soil and Water from Vella Partnership, Shortwood Autistic Hospital, Hoyland.
Received from RSK Group plc
Spring Lodge, 237 Chester Road, Helsby, Cheshire, WA6 0AR

Date of receipt 12 October 2007
Date of analysis 12 October 2007

Method Statement

Speciated TPH analysis is performed in accordance with procedures A-T-022 using GC-MS with Head Space & A-T-023 using GC-FID.

TPH analysis is performed in accordance with procedure A-T-007.

PAH analysis is performed in accordance with procedure A-T-019.

Loss on drying analysis is performed in accordance with procedure A-T-020.

Subcontract analysis was submitted to a laboratory on Envirolab's approved vendors list.

A copy of the report is attached, UKAS/MCERTS status is detailed on the report.

Prepared by:

Approved by:

Melanie Marshall
Lab Coordinator

Louise Adams
Associate Director - Operations



Opinions and interpretations expressed herein are outside the scope of UKAS accreditation.
Tests marked "*" in this report are not included in the UKAS Accreditation Schedule for Envirolab.
Analytical results reflect the quality of the sample at the time of analysis only.



Envirolab Ref.	PROCEDURE	ISO17025	MCERTS	70993	71010								
Location				TP115 D1	TP119 D2								
Depth (m)				2.0	2.0								
MTBE _R	A-T-022	Y	N	<0.01	<0.01								
Benzene _R	A-T-022	Y	N	<0.01	<0.01								
Toluene _R	A-T-022	Y	N	<0.01	<0.01								
Ethyl Benzene _R	A-T-022	Y	N	<0.01	<0.01								
m & p Xylene _R	A-T-022	Y	N	<0.01	<0.01								
o Xylene _R	A-T-022	Y	N	<0.01	<0.01								
Aliphatics C5-C6 _R	A-T-022	Y	N	<0.01	<0.01								
Aliphatics >C6-C8 _R	A-T-022	Y	N	<0.01	<0.01								
Aliphatics >C8-C10 _R	A-T-022	Y	N	<0.01	<0.01								
Aliphatics >C10-C12 _R	A-T-023	Y	N	<0.1	2.7								
Aliphatics >C12-C16 _R	A-T-023	Y	N	<0.1	297								
Aliphatics >C16-C21 _R	A-T-023	Y	N	<0.1	475								
Aliphatics >C21-C36 _R	A-T-023	Y	N	<0.1	1030								
Total Aliphatics		Y	N	<0.1	1804.70								
Aromatics >C5-C6 _R	A-T-022	Y	N	<0.01	<0.01								
Aromatics >C6-C8 _R	A-T-022	Y	N	<0.01	<0.01								
Aromatics >C8-C10 _R	A-T-022	Y	N	<0.01	<0.01								
Aromatics >C10-C12 _R	A-T-023	Y	N	10.3	57.8								
Aromatics >C12-C16 _R	A-T-023	Y	N	232	1310								
Aromatics >C16-C21 _R	A-T-023	Y	N	365	1420								
Aromatics >C21-C36 _R	A-T-023	Y	N	642	1520								
Total Aromatics		Y	N	1249.30	4307.80								
TPH (Aliphatics & Aromatics)		Y	N	1249.30	6112.50								

Table 1 - Soil Speciated TPH Results (mg/kg)

Envirolab Ref.	PROCEDURE	ISO17025	MCERTS	70994									
Location				TP115 D4									
Depth (m)				2.6									
TPH _R	A-T-007	Y	Y	<10									
H/C Range	A-T-007	N	N	-									
Comments	A-T-007	N	N	-									

Table 2 - Soil TPH Results (mg/kg, expressed on a dry weight basis)

Envirolab Ref.	PROCEDURE	ISO17025	MCERTS	70964	71006								
Location				TP109 D2	TP118 D3								
Depth (m)				1.0	1.6								
Naphthalene _R	A-T-019	Y	Y	0.45	2.02								
Acenaphthylene _R	A-T-019	Y	N	0.01	0.19								
Acenaphthene _R	A-T-019	Y	Y	0.03	7.26								
Fluorene _R	A-T-019	Y	Y	0.02	4.54								
Phenanthrene _R	A-T-019	Y	Y	0.52	27.5 ^								
Anthracene _R	A-T-019	Y	Y	<0.01	5.73								
Fluoranthene _R	A-T-019	Y	Y	0.07	47.1 ^								
Pyrene _R	A-T-019	Y	Y	0.08	42.3 ^								
Benz [a] anthracene _R	A-T-019	Y	Y	0.05	33.5 ^								
Chrysene _R	A-T-019	Y	Y	0.14	29.4 ^								
Benzo [b] fluoranthene _R Benzo [k] fluoranthene _R	A-T-019	Y	Y	<0.01	39.7 ^								
Benzo [a] pyrene _R	A-T-019	Y	Y	<0.01	22.6 ^								
Indeno [123-cd] pyrene _R	A-T-019	Y	Y	<0.01	7.62								
Dibenz [ah] anthracene _R	A-T-019	Y	Y	<0.01	1.62								
Benzo [ghi] perylene _R	A-T-019	Y	Y	0.02	9.30								
Total		Y	N	1.39	280.38								

Due to coelution Benzo [b] fluoranthene and Benzo [k] fluoranthene are reported as one value.

Table 3 - Soil PAH Results (mg/kg, expressed on a dry weight basis)

Soil Notes

1. For detailed matrix description please see attached sheet.
2. Analysis suffixed "d" were performed on the sample air dried at <30°C
3. Analysis suffixed "R" were performed on the sample as received. Where results are expressed on a dry weight basis, the samples were oven dried at 95°C.
4. Natural stones and debris are excluded from analyses.
5. Coarse granular material such as concrete, gravel & brick are not MCERTS accredited if they comprise the major part of the sample.

Envirolab Ref.	70964	70993	70994	71006	71010					
Location	TP109 D2	TP115 D1	TP115 D4	TP118 D3	TP119 D2					
Depth (m)	1.0	2.0	2.6	1.6	2.0					
Consistency	Firm	Firm	Firm	Firm	Firm					
Colour	Brown	Brown	Brown	Brown	Brown					
Soil Type	Sandy	Sandy	Sandy	Sandy	Sandy					
Comments	-	-	-	-	-					

Table 6 - Soil Matrix Table

ALcontrol Geochem Analytical Services

Sample Descriptions

Job Number: 07/18198/02/01

Client: Envirolab

Client Ref : 11061-3001

Grain sizes

<0.063mm Very Fine

0.1mm - 0.063mm Fine

0.1mm - 2mm Medium

2mm - 10mm Coarse

>10mm Very Coarse

[illegible]

* These descriptions are only intended to act as a cross check if sample identities are questioned, and to provide a log of sample matrices with respect to MCERTS validation. They are not intended as full geological descriptions.

We are accredited to MCERTS for sand, clay and loam/topsoil, or any of these materials-whether these are derived from naturally occurring soil profiles, or from fill/made ground, as long as these materials constitute the major part of the sample.

Other coarse granular materials such as concrete, gravel and brick are not accredited if they comprise the major part of the sample.

¹ Sample Description supplied by client

☒

1

» Shown on prev. report

Client Contact: Subcon

[illegible]

Date 22.10.2007

[†] ISO 9001:2000 accredited
[‡] MCHLTS accredited
* Subcontracted test
§ Shown on prev. report

Matrix: SOLID
Location: HOYLAND
Client Contact: Subcon

All results expressed on a dry weight basis.

Date 23.10.2007



ATTN: Envirolab Data

Date: 15 October, 2007
Our Reference: 07/17024/02/01
Your Reference: 11061-2851
Location: HOYLAND

A total of 15 samples was received for analysis between Thursday, 27 September 2007 and Monday, 01 October 2007 and completed on Monday, 08 October 2007. Accredited laboratory tests are defined in the log sheet, but opinions, interpretations and on-site data expressed herein are outside the scope of ISO 17025 accreditation. We are pleased to enclose our final report, it was a pleasure to be of service to you, and we look forward to our continuing association.

Should this report require incorporation into client reports, it must be used in its entirety and not simply with the data sections alone.

We are accredited to MCERTS for sand, clay and loam/topsoil, or any of these materials- whether these are derived from naturally occurring soil profiles, or from fill/made ground, as long as these materials constitute the major part of the sample. Other coarse granular materials such as concrete, gravel and brick are not accredited if they comprise the major part of the sample.

Signed

<u>Diane Whittlestone</u>	<u>Jane Seymour</u>	<u>David O'Hare</u>	<u>Caroline Suttie</u>
Customer Services	Customer Services	Customer Services	Customer Services

Valid if signed by any of the above signatories.

Compiled By


Sarah Broadbent



☒

- # ISO 17025 accredited
- M MCERTS accredited
- * Subcontracted test
- » Shown on prev. report

Matrix: SOLID
Location: HOYLAND
Client Contact: Envirolab Data

All results expressed on a dry weight basis.

Page 5 of 10

Envirolab Ref.	PROCEDURE	ISO17025	MCERTS	69616									
Location				BH101									
Depth (m)				6.9-7.5									
TPH _R	A-T-007	Y	Y	74									
H/C Range	A-T-007	N	N	C ₁₂ -C ₃₀									
Comments	A-T-007	N	N	Possibly PAH									

Table 2 - Soil TPH Results (mg/kg, expressed on a dry weight basis)

Envirolab Ref.	PROCEDURE	ISO17025	MCERTS	69607	69615	69618	69636						
Location				BH107	BH 101	BH102	TP108 D1						
Depth (m)				4.0	5.7-6.9	5.2-7.0	0.40						
Naphthalene _R	A-T-019	Y	Y	1.21	96.7 ^	0.49	0.09						
Acenaphthylene _R	A-T-019	Y	N	0.16	1.02	0.04	0.09						
Acenaphthene _R	A-T-019	Y	Y	10.60	108 ^	1.16	0.12						
Fluorene _R	A-T-019	Y	Y	4.25	64.7 ^	2.95	0.13						
Phenanthrene _R	A-T-019	Y	Y	7.04	69.3 ^	4.49	1.83						
Anthracene _R	A-T-019	Y	Y	1.40	18.4 ^	4.54	0.44						
Fluoranthene _R	A-T-019	Y	Y	6.19	50.0 ^	1.35	5.72						
Pyrene _R	A-T-019	Y	Y	5.26	42.5 ^	0.71	5.01						
Benz [a] anthracene _R	A-T-019	Y	Y	2.94	31.2 ^	0.39	3.41						
Chrysene _R	A-T-019	Y	Y	3.50	27.8 ^	0.55	3.92						
Benzo [b] fluoranthene _R Benzo [k] fluoranthene _R	A-T-019	Y	Y	3.65	28.8 ^	0.32	3.20						
Benzo [a] pyrene _R	A-T-019	Y	Y	2.86	24.1 ^	0.16	2.93						
Indeno [123-cd] pyrene _R	A-T-019	Y	Y	1.66	14.70	0.08	1.56						
Dibenz [ah] anthracene _R	A-T-019	Y	Y	0.19	1.99	0.03	0.26						
Benzo [ghi] perylene _R	A-T-019	Y	Y	2.08	18.9 ^	0.17	2.25						
Total		Y	N	52.99	598.11	17.43	30.96						

Due to coelution Benzo [b] fluoranthene and Benzo [k] fluoranthene are reported as one value.

Table 3 - Soil PAH Results (mg/kg, expressed on a dry weight basis)

^ Comments

Any individual PAH result >15mg/kg is not MCERTS accredited. Individual PAH <15mg/kg are MCERTS accredited except for Acenaphthylene.

Notes

1. For detailed matrix description please see attached sheet.
2. Analysis suffixed "d" were performed on the sample air dried at <30°C
3. Analysis suffixed "R" were performed on the sample as received. Where results are expressed on a dry weight basis, the samples were oven dried at 95°C.
4. Natural stones and debris are excluded from analyses.
5. Coarse granular material such as concrete, gravel & brick are not MCERTS accredited if they comprise the major part of the sample.
6. For MCERTS soil the validated range covers up to 15 mg/kg for PAH.

Envirolab Ref.	69606	69607	69612	69615	69616	69618	69636			
Location	BH107	BH107	BH104	BH 101	BH101	BH102	TP108 D1			
Depth (m)	4.6	4.00	1.5-3.0	5.7-6.9	6.9-7.5	5.2-7.0	0.4			
Consistency	Firm	Firm	Firm	Firm	Firm	Firm	Firm			
Colour	Black	Black	Black	Black	Brown	Brown	Brown			
Soil Type	Clay	Clay	Clay	Clay	Clay	Clay	Clay			
Comments	-	-	-	-	-	-	-			

Table 4 - Soil Matrix Table

ALcontrol Geochem Analytical Services Sample Descriptions

Job Number: 07/17024/02/01

Client: Envirolab

Client Ref : 11061-2851

Grain sizes

<0.063mm Very Fine

0.1mm - 0.063mm Fine

0.1mm - 2mm Medium

2mm - 10mm Coarse

>10mm Very Coarse

[illegible]

* These descriptions are only intended to act as a cross check if sample identities are questioned, and to provide a log of sample matrices with respect to MCERTS validation. They are not intended as full geological descriptions.

We are accredited to MCERTS for sand, clay and loam/topsoil, or any of these materials-whether these are derived from naturally occurring soil profiles, or from fill/made ground, as long as these materials constitute the major part of the sample.

Other coarse granular materials such as concrete, gravel and brick are not accredited if they comprise the major part of the sample.

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» Shown on prev. report

Client Contact: Envirolab Data

[illegible]

Date 16.10.2007

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- # ISO 17025 accredited
- M MCERTS accredited
- * Subcontracted test
- » Shown on prev. report

Matrix: SOLID

Location: HOYLAND

Client Contact: Envirolab Data

All results expressed on a dry weight basis.

Date 16.10.2007

**APPENDIX H: LABORATORY CERTIFICATES FOR
GROUNDWATER**

Envirolab Ref.	PROCEDURE	ISO17025	MCERTS	70944	70945								
Location				RBH 104	BH 107								
MTBE _R	A-T-022	Y	N	<1	<1								
Benzene _R	A-T-022	Y	N	<1	<1								
Toluene _R	A-T-022	Y	N	<1	<1								
Ethyl Benzene _R	A-T-022	Y	N	<1	3								
m & p Xylene _R	A-T-022	Y	N	2	3								
o Xylene _R	A-T-022	Y	N	<1	3								
Aliphatics C5-C6 _R	A-T-022	Y	N	<1	<1								
Aliphatics >C6-C8 _R	A-T-022	Y	N	<1	11								
Aliphatics >C8-C10 _R	A-T-022	Y	N	<1	<1								
Aliphatics >C10-C12 _R	A-T-023	Y	N	<5	<5								
Aliphatics >C12-C16 _R	A-T-023	Y	N	<5	<5								
Aliphatics >C16-C21 _R	A-T-023	Y	N	<5	142								
Aliphatics >C21-C36 _R	A-T-023	Y	N	<5	466								
Total Aliphatics		Y	N	<5	619								
Aromatics >C5-C6 _R	A-T-022	Y	N	<1	<1								
Aromatics >C6-C8 _R	A-T-022	Y	N	<1	<1								
Aromatics >C8-C10 _R	A-T-022	Y	N	1	5								
Aromatics >C10-C12 _R	A-T-023	Y	N	<5	41								
Aromatics >C12-C16 _R	A-T-023	Y	N	<5	273								
Aromatics >C16-C21 _R	A-T-023	Y	N	157	103								
Aromatics >C21-C36 _R	A-T-023	Y	N	570	281								
Total Aromatics		Y	N	728	703								
TPH (Aliphatics & Aromatics)		Y	N	728	1322								

Table 4 - Water Speciated TPH Results (µg/l)

Envirolab Ref.	PROCEDURE	ISO17025	MCERTS	70944	70945								
Location				RBH 104	BH 107								
Naphthalene _R	A-T-019	Y	N	0.38	53.9								
Acenaphthylene _R	A-T-019	Y	N	0.01	1.61								
Acenaphthene _R	A-T-019	Y	N	0.64	92.0								
Fluorene _R	A-T-019	Y	N	0.06	27.7								
Phenanthrene _R	A-T-019	Y	N	<0.01	2.59								
Anthracene _R	A-T-019	Y	N	<0.01	1.97								
Fluoranthene _R	A-T-019	Y	N	<0.01	1.44								
Pyrene _R	A-T-019	Y	N	<0.01	0.85								
Benz [a] anthracene _R	A-T-019	Y	N	<0.01	0.03								
Chrysene _R	A-T-019	Y	N	<0.01	0.02								
Benzo [b] fluoranthene _R Benzo [k] fluoranthene _R # _R	A-T-019	Y	N	<0.01	<0.01								
Benzo [a] pyrene _R	A-T-019	Y	N	<0.01	<0.01								
Indeno [123-cd] pyrene _R	A-T-019	Y	N	<0.01	0.02								
Dibenz [ah] anthracene _R	A-T-019	Y	N	<0.01	<0.01								
Benzo [ghi] perylene _R	A-T-019	Y	N	<0.01	<0.01								
Total		Y	N	1.09	182.13								

Due to coelution Benzo [b] fluoranthene and Benzo [k] fluoranthene are reported as one value.

Table 5 - Water PAH Results (µg/l)

Water Notes

- Analyses suffixed "R" were performed on the sample 'as received'.
- Analyses suffixed "F" were performed on the filtered sample.

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» Shown on prev. report

Client Contact: Subcon

Date 22.10.2007

APPENDIX I: HUMAN HEALTH GENERIC ASSESSMENT CRITERIA

Generic Assessment Criteria for Human Health
Residential Scenario - Flats

1. Model Selection

The Generic Assessment Criteria (GAC) were calculated using Risk-Based Corrective Action (RBCA) for two reasons. Firstly, it uses the Johnson and Ettinger (J&E) model, which has been incorporated into the current beta version of the UK Contaminated Land Exposure Assessment (CLEA) model and secondly, RBCA accounts for differential pressure in the indoor air inhalation pathway from both soil and groundwater. Another available model, the Risk-Integrated Software for Clean-ups (RISC), only accounts for differential pressure for indoor air inhalation from soil. One disadvantage is that the models only account for dissolved phase hydrocarbons.

2. Pathway Selection

Pathways considered in the residential end use include indoor air inhalation from soil and groundwater, ingestion of soil/indoor dust, and dermal contact with soil. CLEA residential end use also includes the outdoor air inhalation, vegetable ingestion and soil on vegetables pathways. Outdoor air inhalation was not modelled, as the indoor air pathway is typically more conservative. Pathways associated with home-grown vegetables were not modelled, as flats include soft landscaped rather than private gardens and thus this pathway is considered implausible. A conceptual model illustrating the linkages modelled is presented in Figure 1.

Within the model, the solubility limit of the determinant limits the extent of volatilisation, which in turn drives the indoor air inhalation pathway. In cases where the contaminant solubility is exceeded, a reliable method to derive GAC has not been determined, and the values calculated for the soil ingestion and dermal contact pathways are selected as the GAC.

3. Input Selection

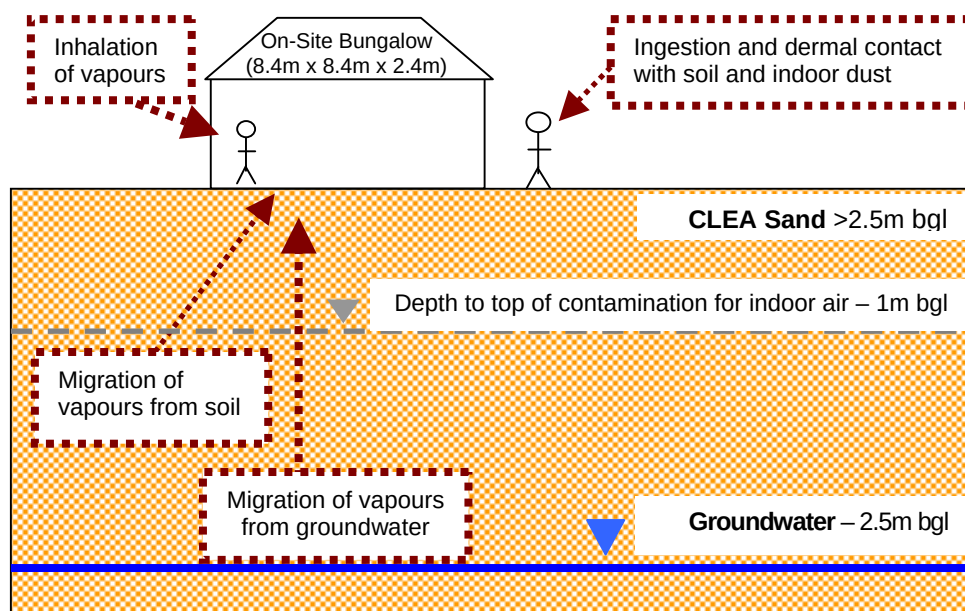
Where available, the published UK toxicity data has been used. For compounds where Tolerable Daily Soil Intakes (TDSI) for both a child and an adult are published, the value for the child was used in line with CLEA. For Total Petroleum Hydrocarbons (TPH), toxicity and chemical specific parameters from the TPH Criteria Working Group (TPHCWG) were used. Due to the lack of UK-specific data, default information in the RBCA model was used to evaluate MTBE. No published UK toxicity data was available for 1,2,4- and 1,3,5-trimethylbenzene. Data was collected from Syracuse Research Corporation database (<http://www.syrres.com/esc/physdemo.htm>) and the Risk Assessment Information System (<http://risk.lsd.ornl.gov/cgi-bin/tox/>). Toxicity reports have been generated by RSK in line with guidance in CLR9 for 14 of the 16 USEPA Polycyclic Aromatic Hydrocarbons (PAHs). The chemical and toxicity data used to generate the GAC was derived from these reports.

Building size, particularly height, is a sensitive parameter when considering the indoor air pathway. Building parameters for a CLEA bungalow (one floor) were used rather than the CLEA house (two floors) to reflect the height of a ground floor flat. A sand soil type was used in line with the published SGVs and a groundwater depth of 2.5m was used based on typical UK conditions. Groundwater depth is also a sensitive parameter for the indoor air pathway. If the groundwater is shallower than 2.0m bgl or deeper than 3.0m bgl, the GAC should be used with caution since they could be over or under conservative.

4. GAC

The GAC were produced using the input parameters in Tables 1 and 2 and the GAC are presented by pathway in Table 3. The final selected GAC are presented in Table 4.

Figure 1
Conceptual Model for Residential Scenario - Flats



Note: Exposure parameters shown on Table 1.

Table 1
Exposure Assessment Parameters for Residential Scenario - Flats – Inputs for RBCA Model

Parameter	Value	Justification
Averaging time	6 years	Equals exposure duration for residential use in line with Table 3.2, CLR10
Body weight	14.5kg	Average 0-6 year old female child in line with Table 5.6, CLR10 for residential use
Exposure frequency	365 days	In line with Tables 3.2, 4.3 and 4.4, CLR10 for a residential end use.
Exposure duration	6 years	
Ingestion rate for soil	100mg/day	Table 6.1, CLR10 value for a 0-6 year old ingesting soil and indoor dust
Total exposed skin surface area	1634cm ²	Equation: Total skin area (6167cm ²) x Fraction skin exposed outdoors (0.265) Mean of total skin area for 0-6 year old female, calculated from Appendix 1, BN 1 and mean of max fraction for outdoor exposure of a 0-6 year old female taken from Table 2, BN 1. Indoor exposure fraction is 0.33 but was not selected since a lower adherence factor is relevant for indoor exposure. This value is within the range of indoor and just above that for outdoor exposed skin in Appendix 1, BN1 and therefore is considered appropriate for use.
Soil/skin adherence factor	1mg/cm ²	In line with recommendations for a child resident for outdoor exposure. Table 3, BN1. Note indoor adherence factor is 0.06mg/cm ² , but 1mg/cm ² is considered more conservative.

Note: Briefing Notes (BN) are CLEA publications. BN1, Version 1.1, (March 2005). BN2, Version 1.1 (July 2004), BN3, Version 1.1 (July 2004).

Table 2
Additional Parameters for Residential Scenario - Flats - Inputs for RBCA Model

Parameter	Value	Justification
Depth to water bearing unit	2.5m	Assumed typical depth to groundwater based on RSK experience.
Depth to top of affected soil	1m	Default from BN 2 for the depth to impacted soil.
Depth to base of affected soil	2.5m	Taken equal to depth to water-bearing unit to reflect unsaturated zone thickness.
Affected soil area	70.56m ²	Taken equal to foundation area (8.4m x 8.4m) of CLEA bungalow, considered reasonable for a ground floor flat. BN 3.
Soil type – Sand in line with CLEA		
Total porosity	0.46 [-]	CLEA sand from Table 3, BN2 as this is the most permeable CLEA soil and was used to produce the published SGVs.
Volumetric water content	0.15 [-]	
Dry bulk density	1.6	
Vertical hydraulic conductivity	5.6m/d	
Vapour permeability	7.20E-12m ²	Calculated for a CLEA sand using equations in Appendix 2, BN2.
Capillary zone thickness	0.05m	Default value for sand from RBCA as RBCA sand is similar to CLEA sand and value is not included in BN 2.
Fraction of organic carbon	0.0058	Modelling used 1% SOM (0.58% TOC) in line with the published CLEA SGVs.
Soil/water pH	6.8	Taken as model default, which is considered reasonably conservative for UK.
Groundwater plume width at source	8.4m	Equal to width of CLEA bungalow (8.4m x 8.4m), Appendix 1, BN 3 considered reasonable for a ground floor flat.
Foundation area	70.56m ²	CLEA bungalow dimensions used (8.4m x 8.4m), Appendix 1, BN 3. Considered reasonable for a ground floor flat
Foundation perimeter	33.6m	
Building volume/area ratio	2.4m	Height of CLEA bungalow considered reasonable for a ground floor flat. Appendix 1, BN 3.
Building air exchange rate	12 No./day	CLEA BN 3 for a residential property.
Depth to slab base	0.15m	CLEA bungalow, Appendix 1, BN 3 for foundation or slab thickness which is considered reasonable for a ground floor flat.
Foundation crack fraction	0.00095	Calculated using building perimeter and foundation area in line with last paragraph of BN 3 (0.002m x perimeter/area).
Volumetric air content of cracks	0.31 [-]	Assumed equal to underlying soil type in assumption that cracks become filled with soil over time. Discussion for Equation 6 - Briefing Note 2. Underlying soil is assumed to be CLEA sand.
Volumetric water content of cracks	0.15 [-]	
Indoor/outdoor differential pressure	25g/cm/s ²	CLEA bungalow, Appendix 1, BN 3.

Note: Briefing Notes (BN) are CLEA publications. BN1, Version 1.1, (March 2005). BN2, Version 1.1 (July 2004), BN3, Version 1.1 (July 2004).

Table 3
Human Health Generic Assessment Criteria by Pathway for Residential Scenario - Flats

Compound	GAC for Inhalation of Indoor Air from Groundwater (a) (mg/l)	SSV Appropriate to Pathway		Selected GAC for Soil (a,b) (mg/kg)
		Soil/Dust Ingestion and Dermal Contact (mg/kg)	Inhalation of Indoor Air (mg/kg)	
Metals				
Arsenic	-	NC	NC	2.00E+01 (c)
Cadmium	-	NC	NC	3.00E+01 (c)
Chromium (total)	-	NC	NC	2.00E+02 (c)
Copper (j)	-	5.80E+03	-	5.80E+03
Lead	-	NC	NC	4.50E+02 (c)
Mercury	-	NC	NC	1.50E+01 (c)
Nickel	-	NC	NC	7.50E+01 (c)
Selenium	-	NC	NC	2.60E+02 (c)
Zinc (j)	-	4.40E+04	-	4.40E+04
Volatile Organic Compounds (e)				
Benzene	4.26E-02	1.60E+01	8.37E-02	8.37E-02
Toluene (1% SOM - see note d) (f)	2.96E+00	NC	NC	3.00E+00 (c)
Ethylbenzene (1% SOM - see note d) (f)	6.57E+00	NC	NC	1.60E+01 (c)
Xylene (f)	2.01E+00	9.80E+03	5.52E+00	5.52E+00
Methyl t-Butyl ether (g)	2.09E+02	4.77E+02	7.88E+01	7.88E+01
Trichloroethene	1.26E-01	2.86E+02	4.78E-01	4.78E-01
Tetrachloroethene	7.98E-01	7.71E+02	6.07E+00	6.07E+00
1,1,1-Trichloroethane	9.99E+00	9.49E+03	5.43E+01	5.43E+01
1,1,1,2 & 1,1,2,2-Tetrachloroethane	6.27E+00	9.17E+01	4.25E+00	4.25E+00
Carbon Tetrachloride	2.38E-02	2.21E+01	1.84E-01	1.84E-01
1,2-Dichloroethane	2.58E-02	1.90E+00	1.10E-02	1.10E-02
Vinyl Chloride	2.37E-03	2.21E-01	2.76E-02	2.76E-02
1,2,4-Trimethylbenzene (h)	4.52E-02	2.75E+03	1.56E-01	1.56E-01
1,3,5-Trimethylbenzene (h)	3.30E-02	2.75E+03	1.56E-01	1.56E-01
Semi-Volatile Organic Compounds (i)				
Acenaphthene	4.12E-01	9.28E+02	8.96E+00	8.96E+00
Acenaphthylene	5.85E-02	9.28E+01	7.43E-01	7.43E-01
Anthracene	ND	5.11E+04	ND	5.11E+04
Benzo(a)anthracene	ND	9.28E+00	ND	9.28E+00
Benzo(b)fluoranthene	ND	9.28E+00	ND	9.28E+00
Benzo(g,h,i)perylene	ND	1.39E+03	ND	1.39E+03
Benzo(k)fluoranthene	ND	9.28E+00	ND	9.28E+00
Chrysene	ND	9.28E+01	ND	9.28E+01
Dibenzo(a,h)anthracene	ND	9.28E-01	ND	9.28E-01
Fluoranthene	ND	9.28E+01	ND	9.28E+01
Fluorene	ND	6.45E+03	ND	6.45E+03
Indeno(1,2,3-cd)pyrene	ND	9.28E+00	ND	9.28E+00
Phenanthrene	ND	1.86E+03	ND	1.86E+03
Pyrene	ND	9.28E+02	ND	9.28E+02
Benzo(a)pyrene (e)	ND	1.10E+00	ND	1.10E+00
Naphthalene (e,f)	9.32E-01	1.10E+03	3.99E+00	3.99E+00
Phenol (c)	-	NC	NC	2.19E+04 (c)

Table 3
Human Health Generic Assessment Criteria by Pathway for Residential Scenario - Flats

Compound	GAC for Inhalation of Indoor Air from Groundwater (a) (mg/l)	SSV Appropriate to Pathway		Selected GAC for Soil (a,b) (mg/kg)
		Soil/Dust Ingestion and Dermal Contact (mg/kg)	Inhalation of Indoor Air (mg/kg)	
Table 3 Continued				
Total Petroleum Hydrocarbons (g)				
Aliphatic Hydrocarbons EC ₅ -EC ₆	8.12E-01	2.75E+05	ND	2.75E+05
Aliphatic Hydrocarbons >EC ₆ -EC ₈	5.48E-01	2.75E+05	ND	2.75E+05
Aliphatic Hydrocarbons >EC ₈ -EC ₁₀	1.82E-02	5.50E+03	2.63E+01	2.63E+01
Aliphatic Hydrocarbons >EC ₁₀ -EC ₁₂	1.17E-02	5.50E+03	2.63E+01	2.63E+01
Aliphatic Hydrocarbons >EC ₁₂ -EC ₁₆	ND	5.50E+03	ND	5.50E+03
Aliphatic Hydrocarbons >EC ₁₆ -EC ₂₁	-	1.10E+05	-	1.10E+05
Aliphatic Hydrocarbons >EC ₂₁ -EC ₃₅	-	1.10E+05	-	1.10E+05
Aromatic Hydrocarbons EC ₅ -EC ₇	3.67E-02	1.65E+02	1.56E-01	1.56E-01
Aromatic Hydrocarbons >EC ₇ -EC ₈	2.07E+00	1.10E+04	1.05E+01	1.05E+01
Aromatic Hydrocarbons >EC ₈ -EC ₁₀	5.97E-01	2.20E+03	5.26E+00	5.26E+00
Aromatic Hydrocarbons >EC ₁₀ -EC ₁₂	2.12E+00	2.20E+03	1.98E+01	1.98E+01
Aromatic Hydrocarbons >EC ₁₂ -EC ₁₆	5.60E+00	2.20E+03	1.04E+02	1.04E+02
Aromatic Hydrocarbons >EC ₁₆ -EC ₂₁	-	1.65E+03	-	1.65E+03
Aromatic Hydrocarbons >EC ₂₁ -EC ₃₅	-	1.65E+03	-	1.65E+03
Notes: "-" - GAC or SSV not calculated owing to low volatility of substance and therefore no pathway. EC - Equivalent Carbons. GAC - Generic Assessment Criteria. NC - Not calculated as published SGV exists. ND - Not determined. Calculated screening value exceeded the solubility limit used in RBCA. Theoretically, these compounds could not dissolve into a solution with high enough concentrations to pose a risk. The potential pathway is incomplete, as the solubility limit is exceeded and the RBCA model cannot consider free phase. RBCA - Risk-Based Corrective Action model, Version 1.3b (2000), (ASTM, 1998). SGV - Soil Guideline Values. SSV - Soil Screening Values. (a) Unless otherwise noted values were calculated by the RBCA model using default values shown in Table 1 and Table 2 of this Appendix. (b) Value selected is the lowest calculated from the direct contact pathways and indoor inhalation pathways. (c) GAC taken as published residential without plant uptake SGV. (d) The SGVs for toluene and ethylbenzene are dependent on Soil Organic Matter (SOM) (%) content. To obtain SOM from total organic carbon (TOC) (%) divide by 0.58%. 1% SOM is 0.58% TOC. DL Rowell Soil Science: Methods and Applications, Longmans, 1994. (e) Unless otherwise noted toxicity information and chemical parameters obtained from Environment Agency publications. (f) Child values for Total Daily Soil Intake were used for both the oral and inhalation pathways (oral values substituted for dermal pathway in absence of dermal values). (g) RBCA default values used for MTBE and hydrocarbon fractions. Hydrocarbons consistent with TPH Criteria Working Group (TPHCWG). (h) No UK data available, see Input Selection section for references. (i) Unless otherwise noted RSK toxicity values used. These were derived following the CLR9 hierarchy in absence of UK data. Toxicity reports available upon request. (j) Toxicity data taken from the RISC model.				

Table 4
Selected Human Health Generic Assessment Criteria for Residential Scenario - Flats

Compound	GAC for Groundwater (a) (mg/l)	GAC for Soil (a) (mg/kg)
Metals		
Arsenic	-	20
Cadmium	-	30
Chromium (total)	-	200
Copper	-	5,800
Lead	-	450
Mercury	-	15
Nickel	-	75
Selenium	-	260
Zinc	-	44,000
Volatile Organic Compounds		
Benzene	0.043	0.084
Toluene (SOM 1%, 2.5%, 5%)	3.0	3, 8, 15
Ethylbenzene (SOM 1%, 2.5%, 5%)	6.6	16, 41, 80
Xylene	2.0	5.5
Methyl t-Butyl ether	210	79
Trichloroethene	0.13	0.48
Tetrachloroethene	0.80	6.1
1,1,1-Trichloroethane	10	54
1,1,1,2 & 1,1,2,2-Tetrachloroethane	6.3	4.2
Carbon Tetrachloride	0.024	0.18
1,2-Dichloroethane	0.026	0.011
Vinyl Chloride	0.0024	0.028
1,2,4-Trimethylbenzene	0.045	0.16
1,3,5-Trimethylbenzene	0.033	0.16
Semi-Volatile Organic Compounds		
Acenaphthene	0.41	9.0
Acenaphthylene	0.059	0.74
Anthracene	ND	51,000
Benzo(a)anthracene	ND	9.3
Benzo(b)fluoranthene	ND	9.3
Benzo(g,h,i)perylene	ND	1,400
Benzo(k)fluoranthene	ND	9.3
Chrysene	ND	93
Dibenzo(a,h)anthracene	ND	0.93
Fluoranthene	ND	93
Fluorene	ND	6,500
Indeno(1,2,3-cd)pyrene	ND	9.3
Phenanthrene	ND	1,900
Pyrene	ND	930
Benzo(a)pyrene	ND	1.1
Naphthalene	0.93	4.0
Phenol	-	22,000
Total Petroleum Hydrocarbons		
Aliphatic Hydrocarbons EC ₅ -EC ₆	0.81	280,000
Aliphatic Hydrocarbons >EC ₆ -EC ₈	0.55	280,000
Aliphatic Hydrocarbons >EC ₈ -EC ₁₀	0.018	26
Aliphatic Hydrocarbons >EC ₁₀ -EC ₁₂	0.012	26
Aliphatic Hydrocarbons >EC ₁₂ -EC ₁₆	ND	5,500
Aliphatic Hydrocarbons >EC ₁₆ -EC ₂₁	-	110,000
Aliphatic Hydrocarbons >EC ₂₁ -EC ₃₅	-	110,000
Aromatic Hydrocarbons EC ₅ -EC ₇	0.037	0.16
Aromatic Hydrocarbons >EC ₇ -EC ₈	2.1	11
Aromatic Hydrocarbons >EC ₈ -EC ₁₀	0.60	5.3
Aromatic Hydrocarbons >EC ₁₀ -EC ₁₂	2.1	20
Aromatic Hydrocarbons >EC ₁₂ -EC ₁₆	5.6	100
Aromatic Hydrocarbons >EC ₁₆ -EC ₂₁	-	1,700
Aromatic Hydrocarbons >EC ₂₁ -EC ₃₅	-	1,700
Notes: "-" Value not applicable due to low volatility of substance. No value in table as groundwater ingestion not considered a plausible pathway. GAC - Generic Assessment Criteria. ND - Not determined. Value exceeded solubility limit used in RBCA. Theoretically these compounds could not dissolve into a solution with high enough concentrations to pose a risk, as solubility limit is exceeded the potential pathway is incomplete. RBCA - Risk-Based Corrective Action model, Version 1.3b (2000), (ASTM, 1998). (a) See Table 3 for calculation notes, values shown rounded to two significant figures.		

**APPENDIX J: GENERIC ASSESSMENT CRITERIA FOR PHYTOTOXIC EFFECTS,
PIPELINES AND CONTROLLED WATERS**

GENERIC ASSESSMENT CRITERIA FOR PHYTOTOXIC EFFECTS, PIPELINES AND CONTROLLED WATERS

This appendix presents the Generic Assessment Criteria (GAC) that RSK considers are suitable for assessing risks to:

- Vegetation via the uptake of phytotoxic determinants through plant roots;
- Water supply pipes constructed using conventional pipe materials, i.e. polyethylene; and
- Controlled waters.

The GAC for each of these receptors is discussed in turn.

PHYTOTOXIC DETERMINANTS TO FACILITATE HEALTHY PLANT GROWTH

Copper and zinc can inhibit plant growth but are not normally hazardous to human health. The GAC for this pollutant linkage have been taken from Department of the Environment Publication, Code of Practice for Agricultural Use of Sewage Sludge, 1996. The GAC for the phytotoxic determinants are presented in Table A1. The table also includes nickel since this is also phytotoxic determinant and the Soil Guideline Value (SGV which is protective of human health) for a commercial (5000mg/kg) or residential without plant uptake (75mg/kg) is greater than the GAC to protect plant growth in acidic soil. Therefore, the SGV may not be suitably protective of the phytotoxic effects pathway.

Table A1: Generic Assessment Criteria for Phytotoxic Determinants

Determinant	Generic Assessment Criteria (mg/kg)			
	pH 5.0 < 5.5	pH 5.5 < 6.0	pH 6.0 < 7.0	pH >7.0
Zinc	200	250	300	450
Copper	80	100	135	200
Nickel	50	60	75	110

WATER SUPPLY PIPES

Risks to water supply pipes have been assessed in accordance with the Water Regulations Advisory Scheme Information and Guidance Note 9-04-03, dated October 2002 and the flow chart included as Figure A1 in this appendix.

The regulations include a requirement to use only suitable materials when laying water pipes and laying water pipes without protection is not permitted at contaminated sites. The Water Supplier has a statutory duty to enforce the regulations. Therefore, this assessment is a guide, the results of which should be checked with the Water Supplier.

Since water supply pipes are typically laid at a minimum depth of 750mm below finished ground levels, sample results from depths between 0.5m and 1.5m below finished level are generally considered suitable for assessing risks to water supply. Samples outside these depths can be used providing the strata is the same as that in which water supply pipes are likely to be located.

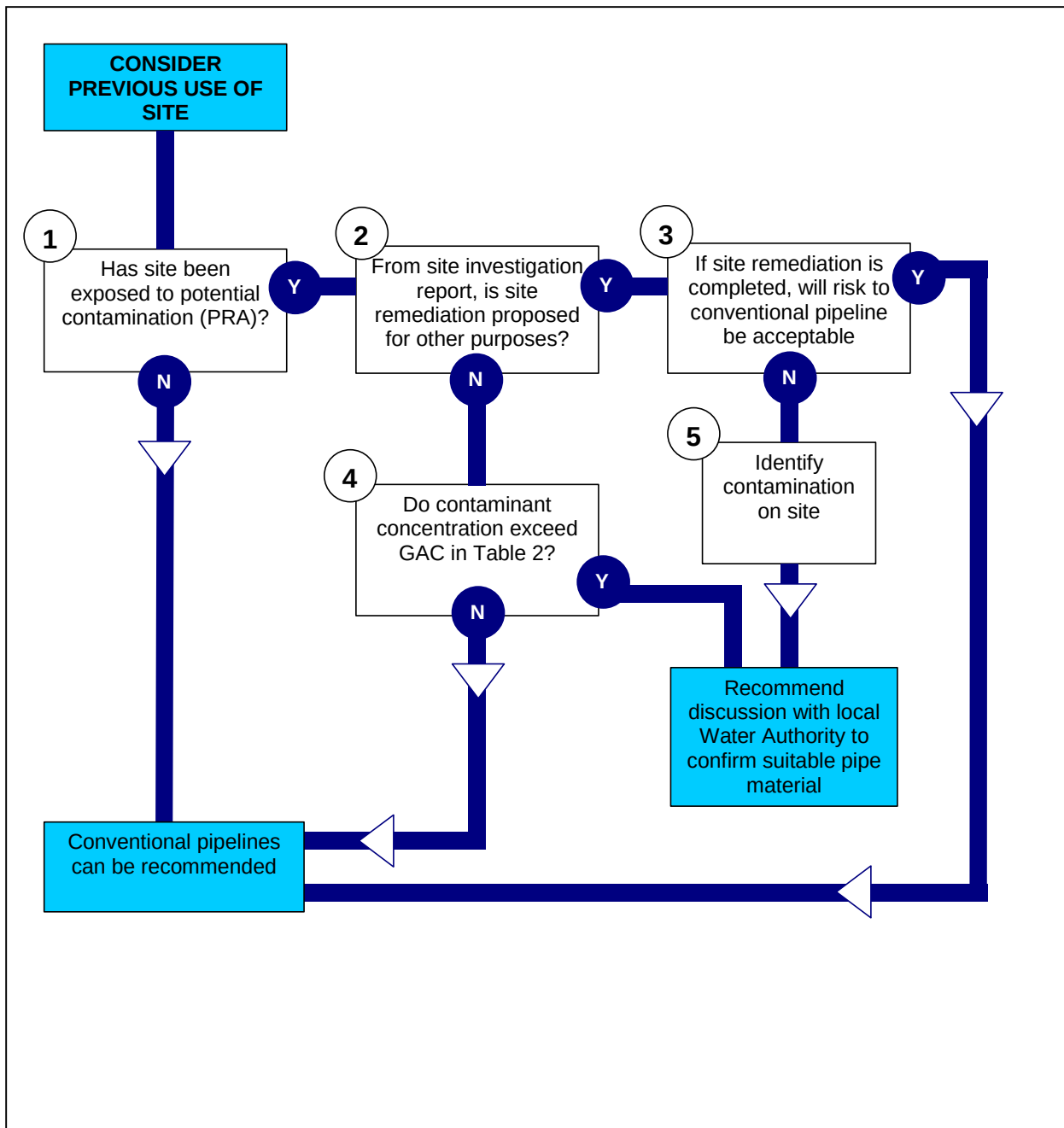
The GAC for this linkage are recorded in Table A2 and are based on recommendations of the 'Foundation for Water Research Guidance Note, FR0448: Laying Potable Water Pipelines in Contaminated Ground, 1994'. Owing to the number of caveats and lack of research into contaminants that could affect water supply, the Water Industry has undertaken research on a project entitled 'Pipe Materials Selection and Specification for use in Contaminated Land'. This document will be used to update the GAC for this pathway once available.

Table A2: Generic Assessment Criteria for Water Supply Pipes

CONTAMINANT	GAC (mg/kg dried soil)
Corrosion	
Sulphate (SO ₄)	2000
Sulphur (S)	5000
Sulphide	250
pH	Less than pH5 Greater than pH8
Toxic Substances	
Antimony (Sb)	10
Arsenic (As)	10*
Cadmium (Cd)	3
Chromium (hexavalent) (Cr)	25
Chromium (total) (Cr)	600
Cyanide (free) (CN)	25*
Cyanide (complexed) (CN)	250*
Lead (Pb)	500
Mercury (Hg)	1
Selenium (Se)	3
Thiocyanate (SCN)	50
Organic Contaminants	
Coal Tar	50
Cyclohexane extractable	50
Phenol	5
Polycyclic Aromatic Hydrocarbons	50
Toluene extractable	50
Petroleum Hydrocarbons	50
Notes: * denotes 'it is not recommended that water pipes should be laid in sites where these substances are identified or suspected'.	

FIGURE A1

FLOW CHART FOR WATER SUPPLY PIPELINE ASSESSMENT ADOPTED FROM
GUIDANCE NOTE 9-04-03



CONTROLLED WATERS

The GAC for controlled waters are presented in Table A3. In line with the Environment Agency's Remedial Targets Methodology dated December 2006, the GAC for controlled waters are termed 'target concentrations'.

The target concentration can be derived by several means with consideration to:

- Whether the substance is classified as List I or List II substance by the EU under the Groundwater Directive 80/68/EEC;
- Background concentrations in the aquifer; and
- Published guidance such as Environmental Quality Standards that are protective of ecology or The Water Supply (Water Quality) Regulations 2001 that are protective of drinking water.

A list of target concentrations considered suitable to assess risks to major aquifers and minor aquifers are presented in Table A3. Those for a major aquifer are taken from the UK Water Supply (Water Quality) Standards where possible owing to the possibility of a drinking water supply being within an influencing distance from the site or the possibility of one being installed. The target concentrations for a Minor Aquifer are generally taken as the freshwater Environmental Quality Standards where available owing to groundwater in Minor Aquifers commonly providing baseflow to surface watercourses.

Table A3: Target Concentrations for Controlled Waters

Determinant	Target Concentrations (mg/l)	
	Major Aquifer/Source Protection Zone	Minor Aquifer/Surface Watercourse
Metals		
Arsenic	0.01 ⁽¹⁾	0.05 ⁽⁷⁾
Cadmium	0.005 ⁽¹⁾	0.005 ⁽⁷⁾
Chromium (total)	0.05 ⁽¹⁾	0.005, 0.01, 0.02, 0.02, 0.05, 0.05 ⁽⁸⁾
Copper	2.0 ⁽¹⁾	0.001, 0.006, 0.01, 0.01, 0.01 0.028 ⁽⁸⁾
Lead	0.025 ⁽¹⁾	0.004, 0.01, 0.01, 0.02, 0.02, 0.02 ⁽⁸⁾
Mercury	0.001 ⁽¹⁾	0.001 ⁽⁷⁾
Selenium	0.01 ⁽¹⁾	0.01 ^(1,12)
Nickel	0.02 ⁽¹⁾	0.05, 0.1, 0.15, 0.15, 0.2, 0.2 ⁽⁸⁾
Zinc	5 ⁽²⁾	0.008, 0.05, 0.075, 0.075, 0.075, 0.125 ⁽⁸⁾

Chlorinated Solvents		
Trichloroethene	0.01 ⁽¹⁾	0.01 ⁽⁷⁾
Tetrachloroethene		0.01 ⁽⁷⁾
1,1,1-Trichloroethane	0.0001 ⁽³⁾	0.1 ⁽⁷⁾
1,1,2-Trichloroethane	0.0001 ⁽³⁾	0.4 ⁽⁷⁾
Carbon Tetrachloride	0.0001 ⁽³⁾	0.0001 ^(3,12)
1,2-Dichloroethane	0.003 ⁽¹⁾	0.01 ⁽⁷⁾
Vinyl Chloride	0.0005 ⁽¹⁾	0.0005 ^(1,12)
Tetrachloromethane	0.003 ⁽¹⁾	0.012 ⁽⁷⁾
Trihalomethanes	0.1 ⁽⁴⁾	0.1 ^(4,12)
Chloroform	-	0.012 ⁽⁷⁾
Polycyclic Aromatic Hydrocarbons		
Acenaphthene	0.0058 ^(9,13)	0.0058 ⁽⁹⁾
Acenaphthylene	0.0058 ^(9,13)	0.0058 ⁽⁹⁾
Anthracene	0.000012 ^(9,13)	0.000012 ⁽⁹⁾
Benzo(a)anthracene	0.000018 ^(9,13)	0.000018 ⁽⁹⁾
Benzo(b)fluoranthene	0.0001 ⁽¹⁾	0.000014 ⁽⁹⁾
Benzo(k)fluoranthene		0.000014 ⁽⁹⁾
Benzo(g,h,i)perylene		0.00002 ⁽⁹⁾
Indeno(1,2,3-cd)pyrene		No data ⁽⁹⁾
Chrysene	0.00001 ^(9,13)	0.00001 ⁽⁹⁾
Dibenzo(a,h)anthracene	0.00001 ^(9,13)	0.00001 ⁽⁹⁾
Fluoranthene	0.00001 ^(9,13)	0.00001 ⁽⁹⁾
Fluorene	0.0021 ^(9,13)	0.0021 ⁽⁹⁾
Phenanthrene	0.003 ^(9,13)	0.003 ⁽⁹⁾
Pyrene	0.00004 ^(9,13)	0.00004 ⁽⁹⁾
Benzo(a)pyrene	0.00001 ⁽¹⁾	0.000015 ⁽⁹⁾
Naphthalene	0.01 ^(9,13)	0.01 ⁽⁷⁾
Petroleum Hydrocarbons		
Total Petroleum Hydrocarbons	0.01 ⁽²⁾	0.01 ^(2,10)
Benzene	0.001 ⁽¹⁾	0.03 ⁽⁷⁾
Toluene	0.004 ⁽³⁾	0.05 ⁽⁷⁾
Ethylbenzene	0.02 ^(8,13)	0.02 ⁽⁸⁾
Xylene	0.003 ⁽³⁾	0.03 ⁽⁷⁾
Methyl t-Butyl ether	0.015 ⁽⁶⁾	0.015 ^(6,12)
Pesticides and Herbicides		
Aldrin	0.00003 ⁽¹⁾	0.00001 ⁽⁷⁾
Dieldrin	0.00003 ⁽¹⁾	0.00003 ^(1,12)
Heptachlor	0.00003 ⁽¹⁾	0.00003 ^(1,12)
Heptachlor epoxide	0.00003 ⁽¹⁾	0.00003 ^(1,12)

Other pesticides	0.0001 ⁽¹⁾	0.0001 ^(1,12)
Total pesticides	0.0005 ⁽¹⁾	0.0005 ^(1,12)
Endrin	0.000005 ^(7,13)	0.000005 ⁽⁷⁾
Total DDT	0.000025 ^(7,13)	0.000025 ⁽⁷⁾
Azinphos - methyl	0.00001 ^(7,13)	0.00001 ⁽⁷⁾
Cyfluthrin	0.000001 ^(7,13)	0.000001 ⁽⁷⁾
Demeton	0.0005 ^(7,13)	0.0005 ⁽⁷⁾
Dichlorvos	0.000001 ^(7,13)	0.000001 ⁽⁷⁾
Dimethoate	0.001 ^(7,13)	0.001 ⁽⁷⁾
Endosulphan	0.000003 ^(7,13)	0.000003 ⁽⁷⁾
Fenitrothion	0.000001 ^(7,13)	0.000001 ⁽⁷⁾
Flucifuron	0.001 ^(7,13)	0.001 ⁽⁷⁾
Malathion	0.00001 ^(7,13)	0.00001 ⁽⁷⁾
Mevinphos	0.00002 ^(7,13)	0.00002 ⁽⁷⁾
Omethoate	0.00001 ^(7,13)	0.00001 ⁽⁷⁾
PCSDs	0.00005 ^(7,13)	0.00005 ⁽⁷⁾
Permethrin	0.00001 ^(7,13)	0.00001 ⁽⁷⁾
Sulcofuron	0.025 ^(7,13)	0.025 ⁽⁷⁾
Triazaphos	0.000005 ^(7,13)	0.000005 ⁽⁷⁾
Atrazine & Simazine	0.002 ^(7,13)	0.002 ⁽⁷⁾
Bentazone	0.5 ^(7,13)	0.5 ⁽⁷⁾
Linuron	0.002 ^(7,13)	0.002 ⁽⁷⁾
Mecoprop	0.02 ^(7,13)	0.02 ⁽⁷⁾
Trifluralin	0.0001 ^(7,13)	0.0001 ⁽⁷⁾
Miscellaneous		
Cyanide	0.05 ⁽¹⁾	0.05 ^(1,12)
Phenol	0.0001 ⁽²⁾	0.03 ⁽⁷⁾
Sodium	200 ⁽¹⁾	170 ⁽⁷⁾
Chloride	250 ⁽¹⁾	250 ⁽⁷⁾
Ammonium (as NH ₄₊)	0.5 ⁽¹⁾	0.5 ^(1,12)
Ammonia (NH ₃ as N)	0.015 ^(7,13)	0.015 ⁽⁷⁾
Sulphate	250 ⁽¹⁾	400 ⁽⁷⁾
Iron	0.20 ⁽¹⁾	1 ⁽⁷⁾
Manganese	0.05 ⁽¹⁾	0.05 ^(1,12)
Aluminium	0.2 ⁽¹⁾	0.2 ^(1,12)
Nitrate (as NO ₃)	50 ⁽¹⁾	50 ^(1,12)
Nitrite (as NO ₂)	0.5 ⁽¹⁾	0.5 ^(1,12)

Notes

1. Statutory Instrument 2000 No 3184. The Water Supply (Water Quality) Regulations.
2. Statutory Instrument 1989 No 1147. The Water Supply (Water Quality) Regulations, 1989.
3. Environment Agency. Minimum Reporting Values listed in Appendix 7 of Hydrogeological Risk Assessments for Landfills and the Derivation of Groundwater Control and Trigger Levels. LFTGN01. Note target concentration for xylenes is 0.003mg/l each for o-xylene and m/p xylene.
4. Statutory Instrument 1989 No 3184. The Water Supply (Water Quality) Regulations, 2000 – sum of chloroform, bromoform, dibromochloromethane and bromodichloromethane.
5. Target concentration for Major Aquifer receptor taken as equal to target concentration for Minor Aquifer owing to absence of published guidance for PAH compounds other than those which are carcinogenic.
6. Environment Agency MTBE Guidance.
7. Freshwater Environmental Quality Standards.
8. Freshwater Environmental Quality Standards for all fish life (including game) and dependent upon hardness range. Hardness ranges are: 0-50mg/l CaCO₃, 50-100 mg/l CaCO₃, 100-150 mg/l CaCO₃, 150-200 mg/l CaCO₃, 200-250 mg/l CaCO₃ and >250 mg/l CaCO₃. The target concentrations included in Table 3 are listed in order of increasing calcium carbonate concentrations.
9. Polycyclic Aromatic Hydrocarbons (PAH): Priorities for Environmental Quality Standard Development, WRc Plc, R&D Technical Report P45. 2002. Where Predicted No-Effect Concentration is below the laboratory method detection limit (LMDL) for chrysene, dibenzo(ah)anthracene and fluoranthene, the target concentration has been set at the LMDL of 0.00001mg/l.
10. Owing to hydrocarbons being List I substances, 0.01mg/l (DWS) should be used in the first instance against the total of the hydrocarbon bands. However, if the hydrocarbon concentrations measured in groundwater exceed this value, an alternative value of 0.05mg/l could be used providing it is justified based on the type of aquifer and distance to secondary receptors such as a stream. The value is taken as the lowest concentration in Statutory Instrument 1996 No. 3001 titled The Surface Waters (Abstraction for Drinking Water) (Classification) Regulations, 1996.
11. Value for ethylbenzene taken from R&D Technical Report P2-115/TR4 – Proposed Environmental Quality Standards for Ethylbenzene in Water.
12. Where a published target concentration considered suitable for use with a Minor Aquifer could not be found for certain substances such as selenium, the target concentration used for the Major Aquifer has been adopted.
13. Where a published target concentration considered suitable for use with a major aquifer could not be found for certain substances such as ethylbenzene, the target concentration used for the minor aquifer has been adopted.

‘-’ A target concentration for chloroform for a major aquifer is absent since it is one of the trihalomethane compounds. See note 4 above.

APPENDIX K: SOIL AND GROUNDWATER ANALYSES SUMMARY TABLES

Location	BH101	BH102	BH103	BH104	Residential without Plant Uptake Screening Value (mg/kg)
Sample Depth (m)	5.7-6.9	1.0-2.0	2.5	1.5	
Sample Type					
Arsenic	13	14	18	9	20
Cadmium	2.3	<0.3	<0.3	<0.3	30
Chromium (total)	100	17	19	200	200
Copper	71	32	34	66	5,800
Lead	77	31	33	48	450
Mercury	<0.6	<0.6	<0.6	<0.6	15
Nickel	42	26	30	38	75
Selenium	<3	<3	<3	<3	260
Zinc	200	76	99	91	44,000
pH value	7.89	7.18	6.58	7.30	<6 and >8

Table K1: Results of RSK Contamination Suite Analyses on Soil Samples

Results are quoted as mg/kg unless stated otherwise

For origin of screening values given in the table see Appendix B

* Soil Guideline Value for cadmium based upon a pH of 6, 7 and 8, respectively

N Natural Soil

MG Made Ground

- No screening value established



Exceeds Screening Value for Residential Gardens without Plant Uptake

Location	BH104	BH105	BH107	BH107	Residential without Plant Uptake Screening Value (mg/kg)
Sample Depth (m)	5.5	0.3	4.0	5.5	
Sample Type					
Arsenic	11	5	8	-	20
Cadmium	<0.3	<0.3	<0.3	-	30
Chromium (total)	28	21	22	-	200
Copper	26	21	19	-	5,800
Lead	44	34	46	-	450
Mercury	<0.6	<0.6	<0.6	-	15
Nickel	22	24	29	-	75
Selenium	<3	<3	<3	-	260
Zinc	99	150	100	-	44,000
pH value	7.26	8.24	7.63	-	<6 and >8

Table K1 (continued): Results of RSK Contamination Suite Analyses on Soil Samples

Results are quoted as mg/kg unless stated otherwise

For origin of screening values given in the table see Appendix B

* Soil Guideline Value for cadmium based upon a pH of 6, 7 and 8, respectively

N Natural Soil

MG Made Ground

- No screening value established

 Exceeds Screening Value for Residential Gardens without Plant Uptake

Location	TP101	TP103	TP104	TP106	TP108	Residential without Plant Uptake Screening Value (mg/kg)
Sample Depth (m)	0.5	0.3	0.4	0.6	0.4	
Sample Type						
Arsenic	3	10	-	11	15	20
Cadmium	<0.3	0.7	-	1.4	0.4	30
Chromium (total)	23	100	-	84	64	200
Copper	27	74	-	73	62	5,800
Lead	16	50	-	65	170	450
Mercury	<0.6	9.9	-	<0.6	<0.6	15
Nickel	36	58	-	50	27	75
Selenium	<3	<3	-	<3	<3	260
Zinc	100	120	-	250	190	44,000
pH value	6.82	8.96		8.07	8.08	<6 and >8

Table K1 (continued): Results of RSK Contamination Suite Analyses on Soil Samples

Results are quoted as mg/kg unless stated otherwise

For origin of screening values given in the table see Appendix B

* Soil Guideline Value for cadmium based upon a pH of 6, 7 and 8, respectively

N Natural Soil

MG Made Ground

- No screening value established

 Exceeds Screening Value for Residential Gardens without Plant Uptake

Location	TP110	TP112	TP120	TP501	TP503	Residential without Plant Uptake Screening Value (mg/kg)
Sample Depth (m)	1.2	0.4	0.6	1.3	3.2	
Sample Type						
Arsenic	9	-	-	-	63	20
Cadmium	1.5	-	-	-	1.9	30
Chromium (total)	3.5	-	-	-	27	200
Copper	43	-	-	-	47	5,800
Lead	44	-	-	-	120	450
Mercury	1.5	-	-	-	1.5	15
Nickel	26	-	-	-	28	75
Selenium	<3	-	-	-	<3	260
Zinc	150	-	-	-	260	44,000
pH value	9.08	7.36	8.12	7.1	7.45	<6 and >8

Table K1 (continued): Results of RSK Contamination Suite Analyses on Soil Samples

Results are quoted as mg/kg unless stated otherwise

For origin of screening values given in the table see Appendix B

* Soil Guideline Value for cadmium based upon a pH of 6, 7 and 8, respectively

N Natural Soil

MG Made Ground

- No screening value established

 Exceeds Screening Value for Residential Gardens without Plant Uptake

Location	BH101	BH104	BH107	TP115	TP119	GAC value for flats (mg/kg)
Depth (m)	5.7-6.9	1.5-3.0	4.60	2.0	2.0	
Soil Type						
Methyl t-butyl ether	<0.05	<0.01	<0.05	<0.01	<0.01	79
Benzene	<0.05	<0.01	<0.05	<0.01	<0.01	0.084
Toluene	<0.05	<0.01	<0.05	<0.01	<0.01	3, 8, 15*
Ethylbenzene	<0.05	<0.01	<0.05	<0.01	<0.01	16, 41,
M & P Xylene	<0.05	<0.01	<0.05	<0.01	<0.01	5.5
O Xylene	<0.05	<0.01	<0.05	<0.01	<0.01	
Aliphatics						
>C ₅ -C ₆	0.05	<0.01	<0.05	<0.01	<0.01	280,000
>C ₆ -C ₈	0.05	<0.01	<0.05	<0.01	<0.01	280,000
>C ₈ -C ₁₀	<0.05	<0.01	<0.05	<0.01	<0.01	26
>C ₁₀ -C ₁₂	31.0	<0.1	10.5	<0.01	2.7	26
>C ₁₂ -C ₁₆	103	<0.1	40.3	<0.01	297	5,500
>C ₁₆ -C ₂₁	27.2	2.6	16.5	<0.01	475	110,000
>C ₂₁ -C ₃₆	56.7	349	2.4	<0.01	1030	110,000
Total Aliphatics	218.00	351.60	69.70	<0.01	1804.70	-
Aromatics						
>C ₅ -C ₆	<0.05	<0.01	<0.05	<0.01	<0.01	0.16
>C ₆ -C ₈	0.07	<0.01	<0.05	<0.01	<0.01	11
>C ₈ -C ₁₀	<0.05	<0.01	<0.05	<0.01	<0.01	5.3
>C ₁₀ -C ₁₂	20.8	0.9	14.5	10.3	57.8	20
>C ₁₂ -C ₁₆	114	4.7	99.9	232	1310	100
>C ₁₆ -C ₂₁	60.5	4.3	79.4	365	1420	1,700
>C ₂₁ -C ₃₆	72.9	72.8	16.5	642	1520	1,700
Total Aromatics	268.27	82.70	210.30	1249.30	4307.80	-
TPH	486.27	434.30	280.00	1249.30	6112.50	-

Table K2: Results of Speciated Hydrocarbon and BTEX Compounds Analyses on Soil Samples

Location	BH101	TP115	GAC value for flats (mg/kg)
Depth (m)	6.9-7.5	2.6	
Soil Type			
TPH	74	<10	8.7**/16***
H/C Range	C ₁₂ -C ₃₀	-	
Comments	Possibly PAH	-	

Table K3: Results of TPH Analyses on Soil Samples

Results are quoted as mg/kg unless stated otherwise

Location	BH101	BH102	BH107	TP108	TP109	TP118	GAC value for flats (mg/kg)
Depth (m)	5.7-6.9	5.2-7.0	4.0	0.40	1.0	1.6	
Soil Type							
Naphthalene	96.70	0.49	1.21	0.09	0.45	2.02	4
Acenaphthylene	1.02	0.04	0.16	0.09	0.01	0.19	0.74
Acenaphthene	108.00	1.16	10.60	0.12	0.03	7.26	9
Fluorene	64.70	2.95	4.25	0.13	0.02	4.54	6,500
Phenanthrene	69.30	4.49	7.04	1.83	0.52	27.5	1,900
Anthracene	18.40	4.54	1.40	0.44	<0.01	5.73	51,000
Fluoranthene	50.00	1.35	6.19	5.72	0.07	47.1	93
Pyrene	42.50	0.71	5.26	5.01	0.08	42.3	930
Benzo[a]anthracene	31.20	0.39	2.94	3.41	0.05	33.5	9.3
Chrysene	27.80	0.55	3.50	3.92	0.14	29.4	93
Benzo [b] fluoranthene	28.80	0.32	3.65	3.20	<0.01	39.7	9.3
Benzo [k] fluoranthene	28.80	0.32	3.65	3.20	<0.01	39.7	9.3
Benzo [a] pyrene	24.10	0.16	2.86	2.93	<0.01	22.6	1.1
Indeno (1,2,3 cd) pyrene	14.70	0.08	1.66	1.56	<0.01	7.62	9.3
Dibenzo [a,h] anthracene	1.99	0.03	0.19	0.26	<0.01	1.62	0.93
Benzo [g,h,i] perylene	18.90	0.17	2.08	2.25	0.02	9.30	1,400

Table K4: Results of Speciated PAH Analyses on Soil Samples

Results are quoted as mg/kg unless stated otherwise

MG Made Ground

N Natural

Exceeds GAC Value for Residential Gardens with Plant Uptake

Location	RBH104	RBH107
Depth (m)		
Soil Type		
Methyl t-butyl ether	<1	<1
Benzene	<1	<1
Toluene	<1	<1
Ethylbenzene	<1	3
M & P Xylene	2	3
O Xylene	<1	3
Aliphatics		
>C ₅ -C ₆	<1	<1
>C ₆ -C ₈	<1	11
>C ₈ -C ₁₀	<1	<1
>C ₁₀ -C ₁₂	<5	<5
>C ₁₂ -C ₁₆	<5	<5
>C ₁₆ -C ₂₁	<5	142
>C ₂₁ -C ₃₆	<5	466
Total Aliphatics	<5	619
Aromatics		
>C ₅ -C ₆	<1	<1
>C ₆ -C ₈	<1	<1
>C ₈ -C ₁₀	1	5
>C ₁₀ -C ₁₂	<5	41
>C ₁₂ -C ₁₆	<5	273
>C ₁₆ -C ₂₁	157	103
>C ₂₁ -C ₃₆	570	281
Total Aromatics	728	703
TPH	0.728	1.322

Table K5: Results of Speciated Hydrocarbon and BTEX Compounds on Water Samples

Results are quoted as µg/kg unless stated otherwise

Location	RBH104	RBH107
Depth (m)		
Soil Type		
Naphthalene	0.38	0.0539
Acenaphthylene	0.01	0.0016
Acenaphthene	0.64	0.092
Fluorene	0.06	0.0277
Phenanthrene	<0.01	0.00259
Anthracene	<0.01	0.00197
Fluoranthene	<0.01	0.00144
Pyrene	<0.01	0.00085
Benzo[a]anthracene	<0.01	0.00003
Chrysene	<0.01	0.00002
Benzo [b] fluoranthene	<0.01	-
Benzo [k] fluoranthene	<0.01	-
Benzo [a] pyrene	<0.01	0.0002
Indeno (1,2,3 cd) pyrene	<0.01	-
Dibenzo [a,h] anthracene	<0.01	-
Benzo [g,h,i] perylene	<0.01	-

Table K6: Results of Speciated PAH Analyses on Water Samples

Results are quoted as µg/kg unless stated otherwise

APPENDIX L: GEOTECHNICAL TESTING RESULTS CERTIFICATES



No 2652

ENVIROLAB LTD
Sandpits Business Park
Mottram Road
Hyde
Cheshire
SK14 3AR

11th October 2007

TESTING REPORT

ATTENTION: Iain Haslock

SITE: HOLYLAND

YOUR REF: 11061-2851-26120

CERTIFICATE NUMBER: 580107

DATE SAMPLES RECEIVED: 1st October 2007
DATE TESTING COMMENCED: 8th October 2007

SAMPLE DISPOSAL DATE: 11th November 2007

INSTRUCTIONS: Please carry out Particle Size Distribution and Compaction tests on samples provided.

Dear Mr Haslock,

I have pleasure in enclosing the test report for the above project that you submitted to us for testing.

Yours Sincerely

P Kent

P Kent
Laboratory Manager

Enc.



STRUCTURAL SOILS LTD

SITE INVESTIGATION

SOIL, ROCK &
MATERIAL TESTING

GEOTECHNICAL
CONSULTANCY

CONTAMINATED
LAND ASSESSMENT

18 FROGMORE ROAD
HEMEL HEMPSTEAD
HERTS
HP3 9RT
TEL: 01442 262 323
FAX: 01442 262 683
hemel@soils.co.uk
www.soils.co.uk

HEAD OFFICE:
Bristol

BRANCH OFFICE:
Castleford
West Yorkshire

Filename: 580107 / 01_SD.XLS

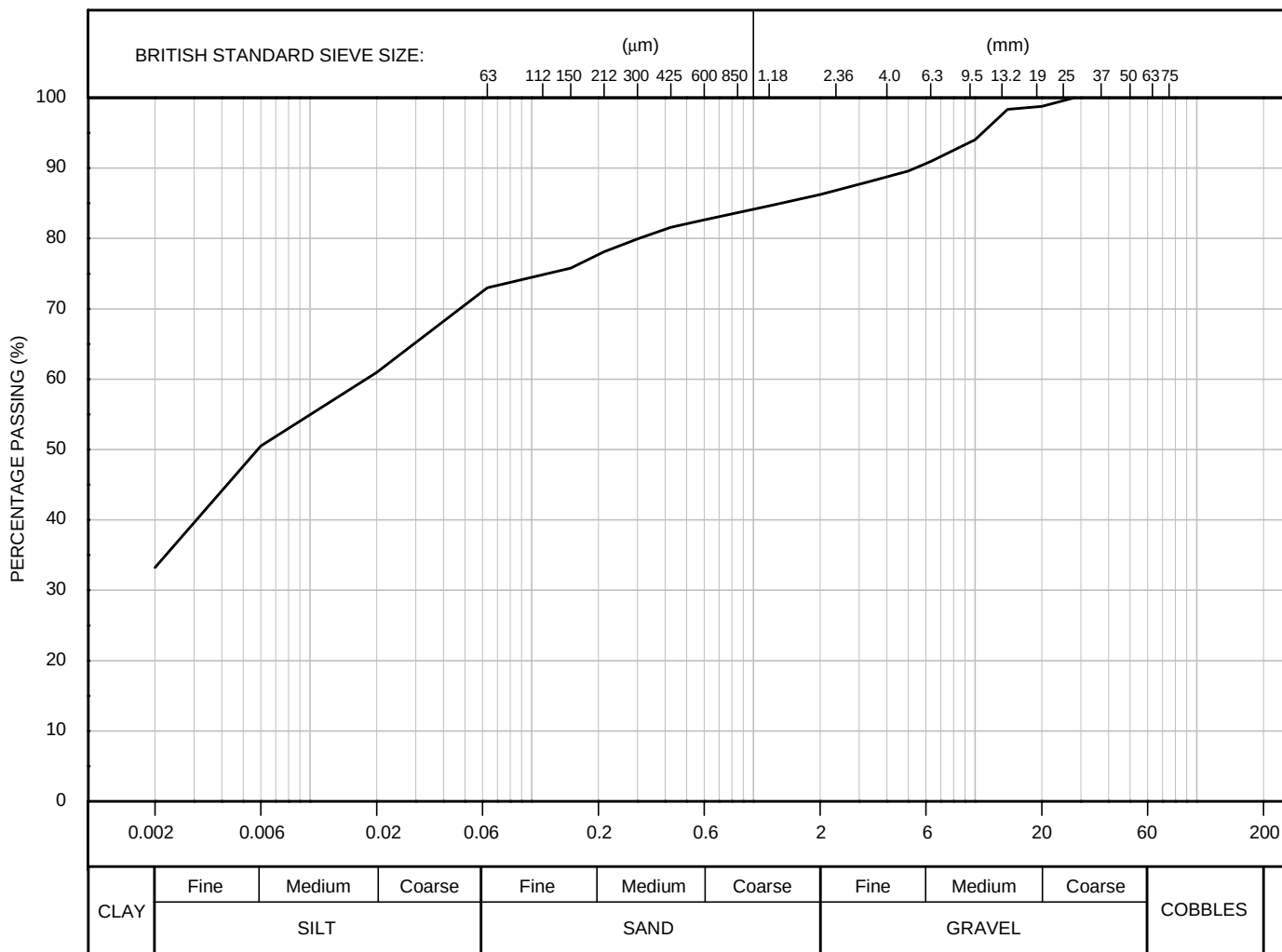
[illegible]

Key to Gravel Sizes:

fine	-	2 to 6mm
medium	-	6 to 20mm
coarse	-	20 to 60mm

Page 2 of 8

Date: 11/10/2007
Drawn by: SC



Curve	Borehole	Sample	Depth (m)	BS Test * Method	Pretreatment Method	Percentage soil types				
						Clay	Silt **	Sand	Gravel	Cobbles
1	BH101	69597	8.00	9.2/9.4	Sodium Hex.	33	39	14	14	-

Notes:

* Tested in accordance with the following clauses of BS 1377: Part 2: 1990

9.2 Wet sieve

9.4 Sedimentation by pipette

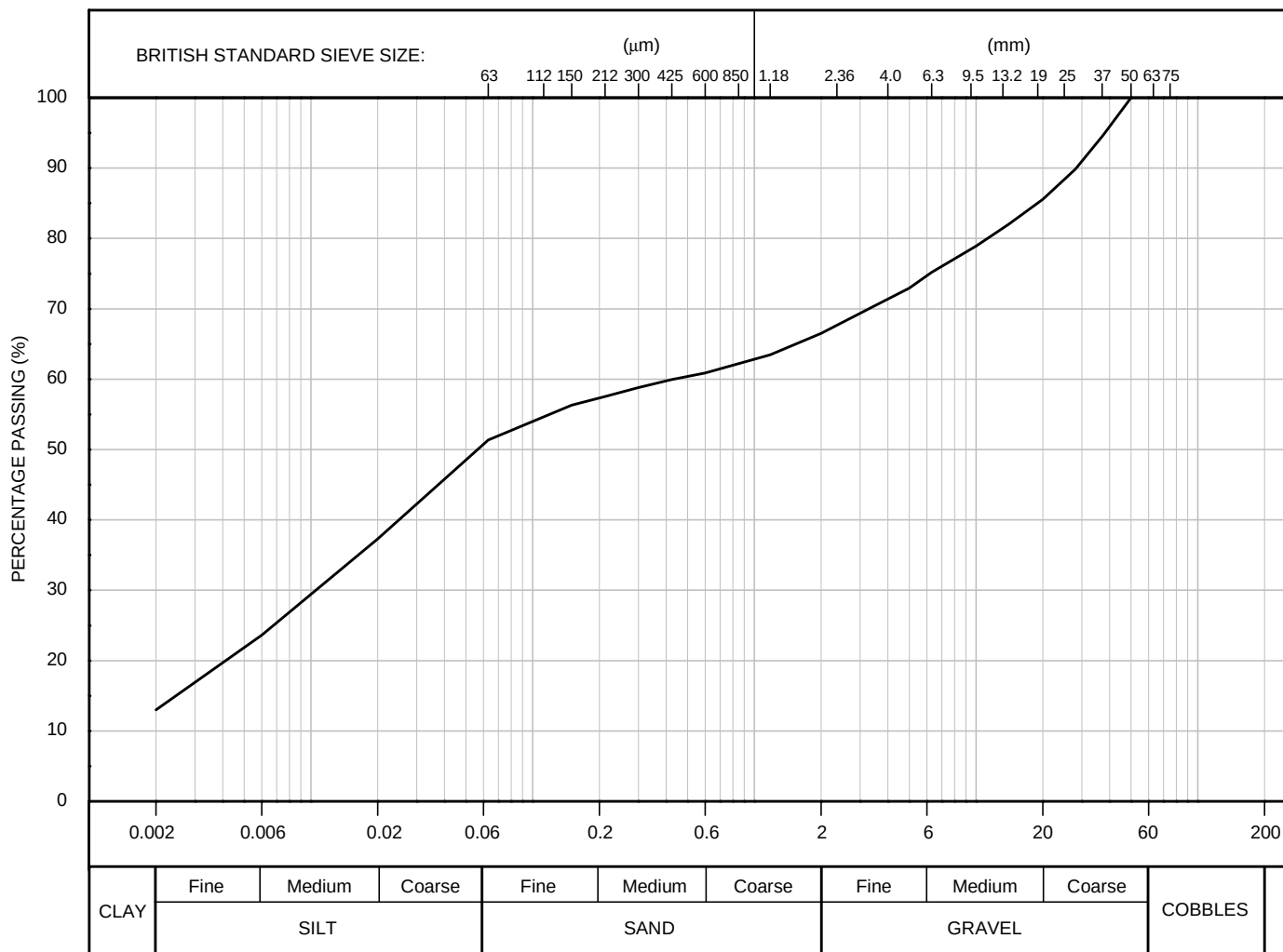
9.3 Dry sieve

9.5 Sedimentation by hydrometer

** Where a sedimentation test was not carried out, this figure represents total fines, i.e., particles of diameter less than 63 microns

PARTICLE SIZE DISTRIBUTION TEST RESULTS

Date: 11/10/2007
Drawn by: SC



Curve	Borehole	Sample	Depth (m)	BS Test * Method	Pretreatment Method	Percentage soil types				
						Clay	Silt **	Sand	Gravel	Cobbles
1	BH108	69609	1.00	9.2/9.4	Sodium Hex.	13	38	15	34	-

Notes:

* Tested in accordance with the following clauses of BS 1377: Part 2: 1990

9.2 Wet sieve

9.4 Sedimentation by pipette

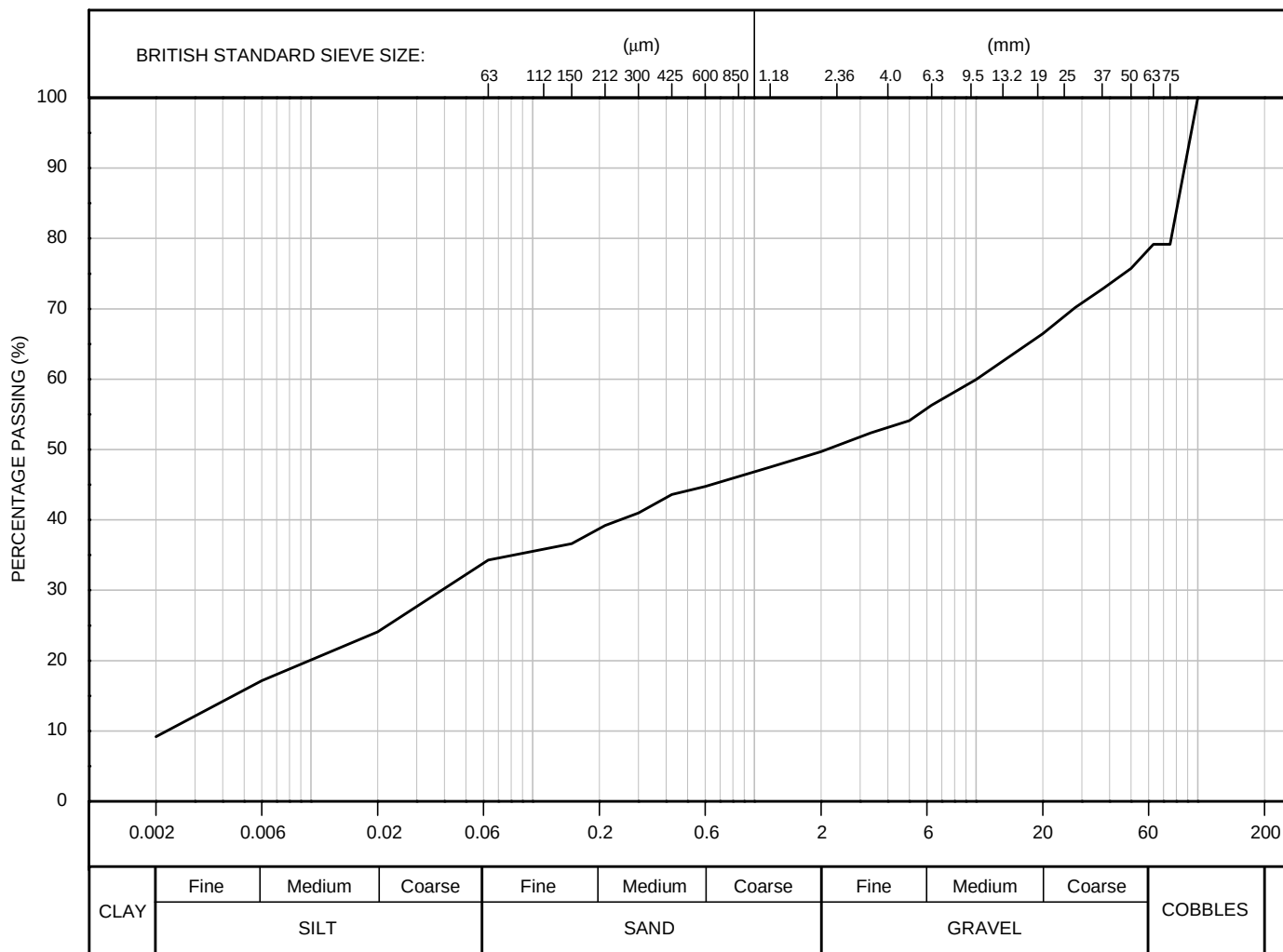
9.3 Dry sieve

9.5 Sedimentation by hydrometer

** Where a sedimentation test was not carried out, this figure represents total fines, i.e., particles of diameter less than 63 microns

PARTICLE SIZE DISTRIBUTION TEST RESULTS

Date: 11/10/2007
Drawn by: SC



Curve	Borehole	Sample	Depth (m)	BS Test * Method	Pretreatment Method	Percentage soil types				
						Clay	Silt **	Sand	Gravel	Cobbles
1	TP107	D3-69598	0.80	9.2/9.4	Sodium Hex.	9	25	16	28	22

Notes:

* Tested in accordance with the following clauses of BS 1377: Part 2: 1990

9.2 Wet sieve

9.4 Sedimentation by pipette

9.3 Dry sieve

9.5 Sedimentation by hydrometer

** Where a sedimentation test was not carried out, this figure represents total fines, i.e., particles of diameter less than 63 microns

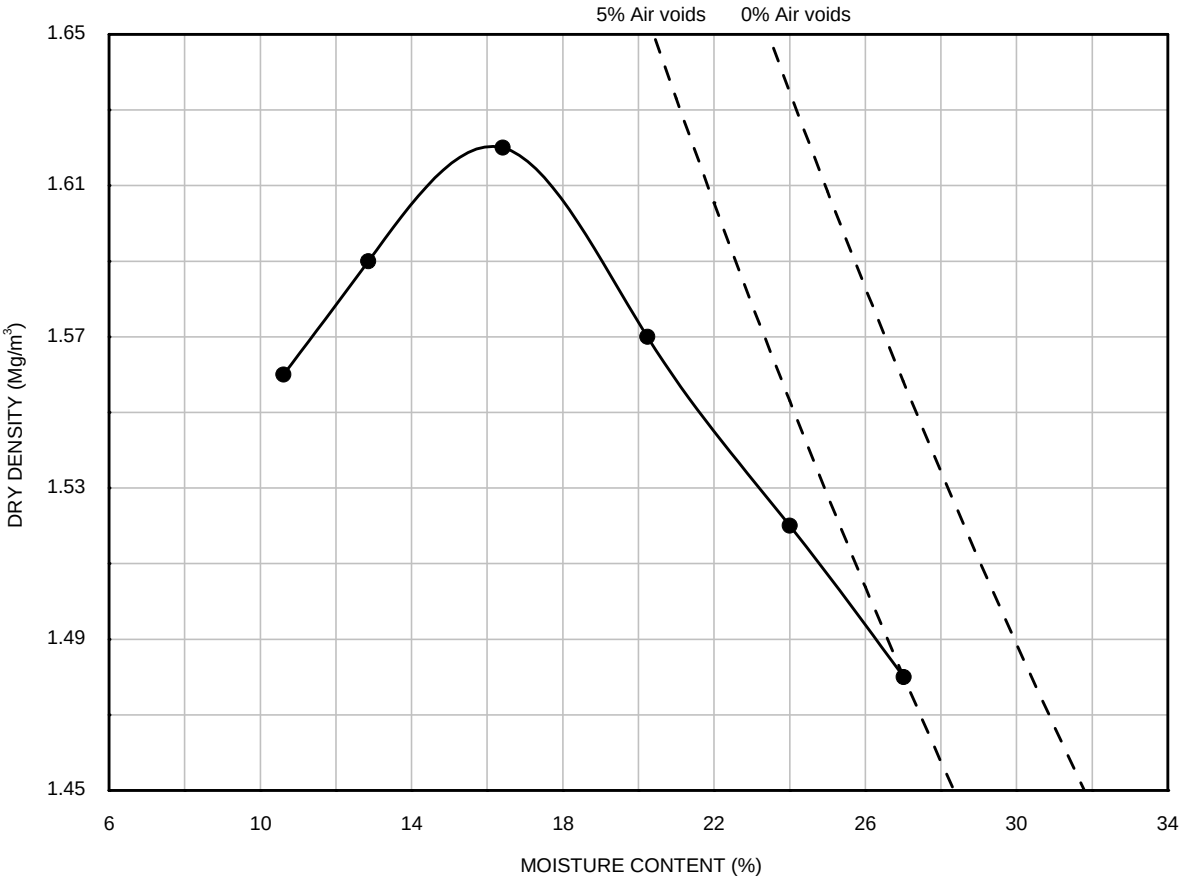
PARTICLE SIZE DISTRIBUTION TEST RESULTS

Date: 11/10/2007

Drawn by: SC

Template Issue: 2

Filename: 580107\ OTHER\ BH101_CO.OPJ



Tested in accordance with BS 1377: Part 4: 1990: (see table below for method used)

Clause 3.3: 2.5kg rammer 3 layers 27 blows/layer	Clause 3.4: 2.5kg rammer 3 layers 62 blows/layer	Clause 3.5: 4.5kg rammer 5 layers 27 blows/layer	Clause 3.6: 4.5kg rammer 5 layers 62 blows/layer	Clause 3.7: Vibrating hammer 3 layers 1 minute/layer
---	---	---	---	---

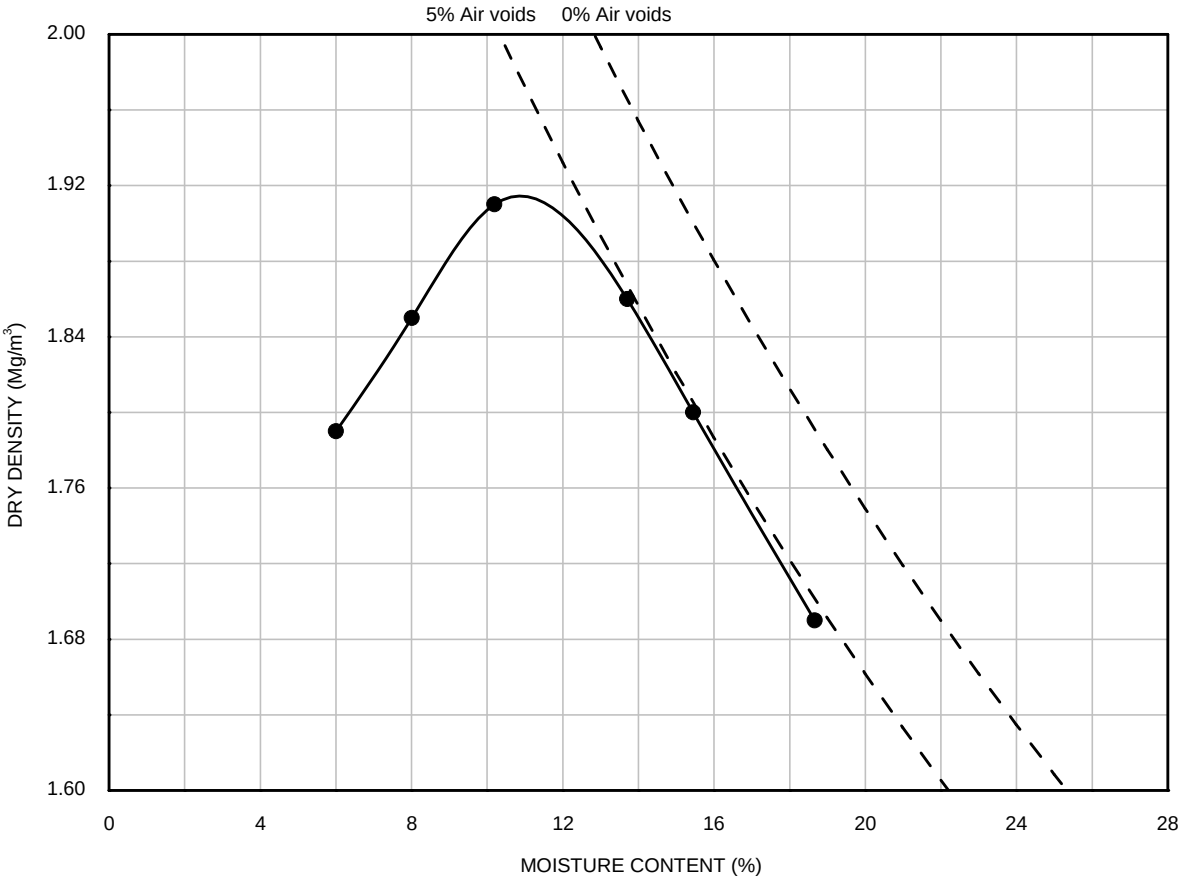
Optimum moisture content	: 16	%	Trial Pit	: BH101
Maximum dry density	: 1.62	Mg/m ³	Sample	: 69597
Test method (see above)	: 3.3		Depth (m)	: 8.00
Particle density	: 2.69	Mg/m ³ (Assumed)		
Proportion of sample > 20mm	: 2	%		

DETERMINATION OF DRY DENSITY/MOISTURE
CONTENT RELATIONSHIP BY COMPACTION

Date: 11/10/2007

Drawn by: SC

Template Issue: 2
Filename: 580107\ OTHER \ BH108_CO.OPJ



Tested in accordance with BS 1377: Part 4: 1990: (see table below for method used)				
Clause 3.3:	Clause 3.4:	Clause 3.5:	Clause 3.6:	Clause 3.7:
2.5kg rammer	2.5kg rammer	4.5kg rammer	4.5kg rammer	Vibrating hammer
3 layers	3 layers	5 layers	5 layers	3 layers
27 blows/layer	62 blows/layer	27 blows/layer	62 blows/layer	1 minute/layer

Optimum moisture content	: 11	%	Trial Pit	: BH108
Maximum dry density	: 1.91	Mg/m³	Sample	: 69609
Test method (see above)	: 3.3		Depth (m)	: 1.00
Particle density	: 2.69	Mg/m³ (Assumed)		
Proportion of sample > 20mm	: 7	%		

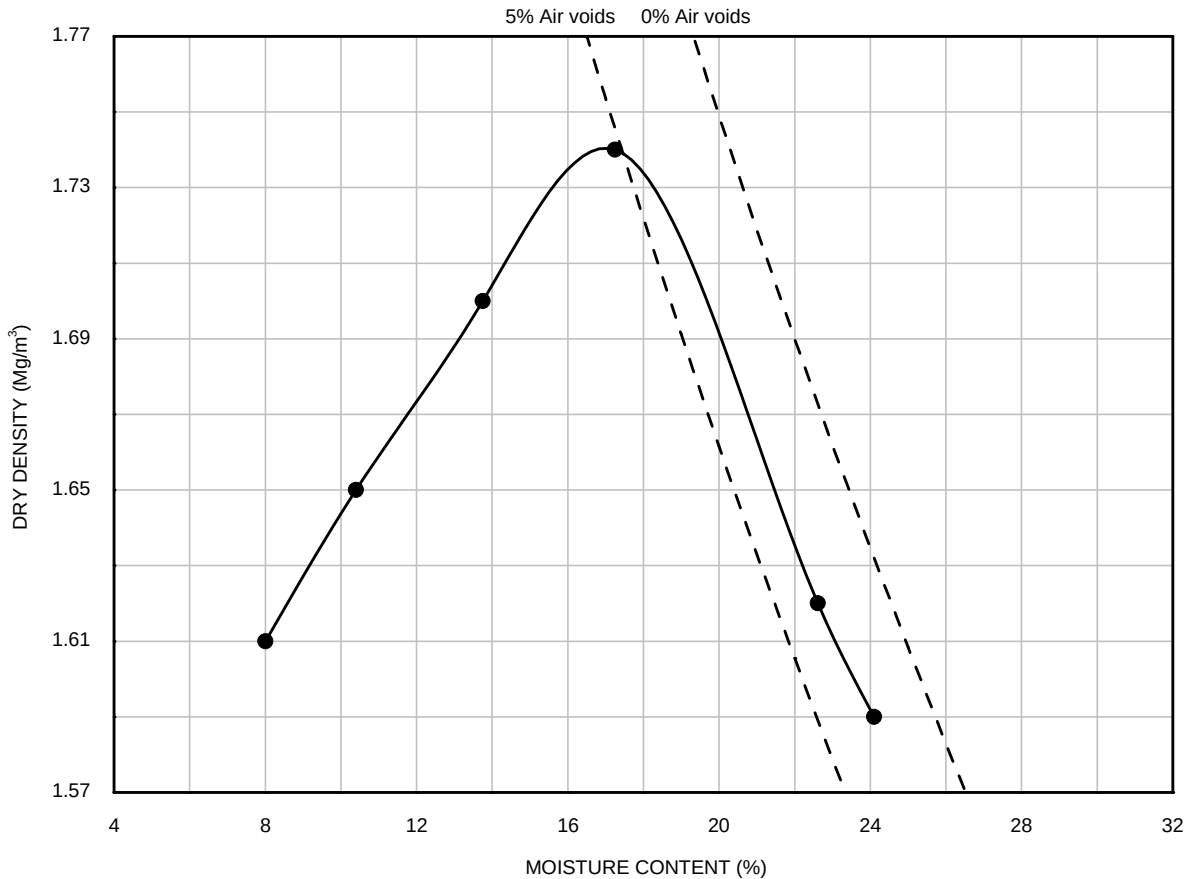
DETERMINATION OF DRY DENSITY/MOISTURE
CONTENT RELATIONSHIP BY COMPACTION

Date: 11/10/2007

Drawn by: SC

Template Issue: 2

Filename: 580107\ OTHER\ TP107_CO.OPJ



Tested in accordance with BS 1377: Part 4: 1990: (see table below for method used)

Clause 3.3:	Clause 3.4:	Clause 3.5:	Clause 3.6:	Clause 3.7:
2.5kg rammer	2.5kg rammer	4.5kg rammer	4.5kg rammer	Vibrating hammer
3 layers	3 layers	5 layers	5 layers	3 layers
27 blows/layer	62 blows/layer	27 blows/layer	62 blows/layer	1 minute/layer

Optimum moisture content	: 17	%
Maximum dry density	: 1.74	Mg/m ³
Test method (see above)	: 3.4	
Particle density	: 2.69	Mg/m ³ (Assumed)
Proportion of sample > 20mm	: 18	%

Trial Pit	: TP107
Sample	: D3-69598
Depth (m)	: 0.80

**DETERMINATION OF DRY DENSITY/MOISTURE
CONTENT RELATIONSHIP BY COMPACTION**