

**PHASE 1 AND 2 GEOTECHNICAL AND
GEO-ENVIRONMENTAL SITE INVESTIGATION**

**SHORTWOOD BUSINESS PARK,
HOYLAND, BARNESLEY**

FOR

E. V. WADDINGTON LIMITED



34072-02

30 March 2012

**PHASE 1 AND 2 GEOTECHNICAL AND
GEO-ENVIRONMENTAL SITE INVESTIGATION**

**SHORTWOOD BUSINESS PARK,
HOYLAND, BARNSELEY**

FOR

E. V. WADDINGTON LIMITED

Job No. : 34072
Report Status : Final
Document Date : 30 March 2012

Approved :



G M Seaman

Also at: Pearson Court, 3 Kings Road, Fleet, GU51 3DL Tel: 01252 360 580 Fax: 01252 360581

Directors: G M Seaman BSc, CEng, FICE, FStructE S D Preston BEng, CEng, FICE, FStructE N J Baines BSc, CEng, MICE, MCIWEM
P Richardson BSc, CEng, MICE, MStructE J M Wood BSc, CEng, MICE, FStructE M J Yates BSc(Eng), ACGI, CEng, MICE, FStructE
K R Pursall BEng, CEng, MStructE S R Ellis BEng, CEng, MStructE, AMICE
Senior Associates: K Newsome BSc, CEng, MICE, MStructE S J Mitchell BSc, MSc, CEng, MEI, MCIBSE, MASHRAE
Associates: A Jones BEng, CEng, MICE, MStructE M Young MA, CEng, MICE, MStructE C A Wood BSc, CEng, MStructE, AMICE
A Allison BEng C A Topliss BSc, CEnv, CSci, SiLC, CGeol, AMICE, FGS S J English BEng, CEng, MStructE A R Priest BEng

CONTENTS

1.0	EXECUTIVE SUMMARY	6
2.0	INTRODUCTION.....	8
2.1	Terms of Reference	8
2.2	Context	8
2.3	Aims and Objectives	8
2.4	Scope of Investigation	9
2.5	Limitations of Investigation	9
3.0	THE SITE	11
3.1	Description.....	11
4.0	REVIEW OF RSK REPORT	12
4.1	Site History	12
4.2	Geology and Groundwater Vulnerability	12
4.2.1	Geology	12
4.2.2	Groundwater Vulnerability	13
4.2.3	Hydrology	13
4.3	Mining	13
4.3.1	Opencast	13
4.3.2	Highwalls	14
4.3.3	Underground Mining	14
4.4	Flooding	14
4.5	Intrusive Site Investigation by RSK.....	15
4.5.1	Ground Conditions	15
4.5.2	Settlement of Opencast Backfill	15
4.5.3	Ground Gases	16
4.5.4	Gas Monitoring	16
4.5.5	Contamination Appraisal	16
5.0	OUTLINE CONCEPTUAL MODEL	17

6.0	GROUND INVESTIGATION	18
6.1	Site Works	18
7.0	GROUND CONDITIONS.....	19
7.1	Made Ground – Opencast Backfill	19
7.2	Natural Ground	20
7.3	Highwalls	20
7.4	Obstructions	20
7.5	Groundwater	21
7.6	Evidence of Contamination.....	21
8.0	GEOTECHNICAL APPRAISAL.....	22
8.1	General	22
8.2	Foundations	22
8.3	Ground Floors.....	23
8.4	Superstructure Precautions	23
8.5	Excavation Problems	23
8.6	Obstructions	23
8.7	Surface Water Drainage	23
8.8	Concrete	23
9.0	REFINEMENT OF OUTLINE CONCEPTUAL MODEL	24
9.1	Source Characterisation	24
9.2	Ground Conditions.....	24
9.3	Gas Precautions	24
9.4	Unexpected Contamination	24
10.0	RISK ASSESSMENT	25
10.1	Human Health – Future Site Users, Staff and Visitors.....	25
10.2	Human Health – Construction Workers and Maintenance Staff	25
10.3	Plants.....	25
10.4	Controlled Waters	26
10.5	Construction Materials.....	26
10.6	Unexpected Contamination Encountered During Groundworks	26
11.0	CONTAMINATION - RECOMMENDATIONS AND APPROVALS.....	27

APPENDICES

Appendix 1 'Exploratory Hole Location Plan', drawing reference 34072/006 Revision A

'Overall Exploratory Hole Location Plan' drawing reference 34072//007 Revision A

Appendix 2 RSK Report

Appendix 3 Trial Pit Logs

1.0 EXECUTIVE SUMMARY

1. Eastwood & Partners were instructed by E V Waddington Ltd to carry out an intrusive investigation of approximately 2 hectares of land located around Ordnance Survey national grid reference 435866 401454. The site is an empty plot within the Shortwood Business Park off the Dearne Valley Parkway to the south of Barnsley.
2. Historically, the site has undergone two phases of opencast workings in the 1960s and the 1990s. The workings were backfilled on completion of each phase of coal extraction.
3. Older deep coal mining has also been undertaken below the site. All ground movements associated with the deep mining should have ceased by now, and no precautions against mining subsidence are considered necessary.
4. The ground conditions on the site comprise well consolidated backfill of reworked clay, sand and mudstone and sandstone gravel to depths of up to approximately 6 m below current ground level. Below the fill, stiff clay or mudstone or sandstone bedrock is present.
5. Opencast high walls are present close to the northern and eastern boundaries of the site. These are generally of low height and do not extend into the site to any great distance. These high walls should not influence the proposed development. A high wall is also recorded across the centre of the site. Investigations indicate this not to be the case, with a gradual change in the depth of fill taking place rather than any steep change in depth of fill.
6. Reinforced concrete ground beams founded on the fill are considered appropriate for the lightweight structures proposed. In areas of shallow fill pad foundations founded on the natural ground may be appropriate. Ground bearing floor slabs may be used.
7. A design sulphate class of DS-2 AC-2 should be adopted for all sub-surface concrete on site.
8. No radon or ground gas precautions are required.
9. No elevated concentrations of any common contaminant have been recorded. No significant risk to human health, plants or controlled waters are anticipated. No remedial works are required. A nominal 150 mm layer of topsoil may be required in any landscaping strips as a growing medium for plants.
10. There is unlikely to be a significant risk to construction workers from contamination on the site but normal good hygiene precautions such as washing hands before eating should be implemented.

11. The conclusions made in this report in relation to contamination are subject to agreement by the approving bodies such as the Local Authority.

2.0 INTRODUCTION

2.1 Terms of Reference

This report presents the findings of a geotechnical and geo-environmental site investigation carried out by Eastwood and Partners (Consulting Engineers) Ltd for, and on the behalf of, E. V. Waddington Limited. Any other parties using the information in this report do so at their own risk and any duty of care is excluded.

2.2 Previous Investigations

A site investigation has previously been undertaken on this site by RSK Geoconsult Limited on behalf of others. The works comprised a desktop review of the previous uses of the site, as well as the excavation of trial pits and the drilling of boreholes. Groundwater and gas monitoring, and settlement monitoring was also undertaken. Eastwood & Partners have received a copy of this report.

RSK's report also makes reference to several previous investigations carried out in this area by themselves and by Mott MacDonald, although we do not have any further details regarding these previous investigations.

2.3 Aims and Objectives

The aims and objectives of this investigation were as follows.

- Review the previous report and reassess the findings relative to the current proposals;
- Assimilate Phase 1 data to derive an outline conceptual model identifying potential contaminants, pathways and receptors, as well as possible linkages between these;
- Obtain additional information and incorporate with previous data enabling refinement and subsequent further testing of the conceptual model;
- Confirm the findings of the previous report and detail the ground conditions and their geotechnical properties relative to the proposed development of commercial units, thus enabling outline foundation proposals to be made;
- Carry out tiered risk assessment to establish the likely risks to future receptors, involving the use of generic assessment criteria and where unacceptable risks are identified, site specific assessment criteria within a detailed quantitative risk assessment;
- Identify feasible remediation options if unacceptable risks are highlighted and develop an appropriate remediation strategy where remediation is required.

2.4 Scope of Investigation

This document is split into two sections. These constitute the findings of the Phase 1 and Phase 2 investigations, consecutively.

2.4.1 Phase 1

The Phase 1 investigation involved a review of RSK's findings, which was based on information extracted from published documentation as well as that obtained from a site reconnaissance. Information regarding the current and former land uses both on and surrounding the site, as well as the environmental sensitivity of the site location as determined by factors including geology, hydrogeology and hydrology were examined. Eastwood & Partners have reviewed this information against up-to-date records, including the following:

- Historical maps as shown on the website www.old-maps.co.uk.
- Geological Maps and associated Geological Memoirs
- Site walkover survey

2.4.2 Phase 2

This part of the investigation comprised intrusive works and laboratory analysis. The findings were used to test the conceptual model and produce a final risk assessment.

The intrusive works comprised trial pits which were excavated to enable:

- Examination of the upper few metres of ground;
- In situ description of soils, enabling any localised lateral and vertical changes in soil conditions to be logged;
- Assessment of any contamination identified using visual and olfactory methods;

In addition, the findings of RSK's report were used to confirm contamination levels within the soils. Gas monitoring and ground settlement monitoring were also carried out. These results have also been incorporated into this report.

2.5 Limitations of Investigation

This report is based on the assumption that the site will be developed with commercial units of conventional construction and that existing ground levels will not alter significantly. If this is not the case, further advice may be needed.

Where assessments of site areas affected in particular ways are given, these are approximate. All information, comments and opinions given in this report are based on the ground conditions encountered during the site work, on the results of laboratory testing carried out as part of the investigation and information gained from a geological and historical desk study. However, there may be conditions at the site that have not been taken into account, such as unpredictable soil strata and water conditions between or below investigation points.

This report considers the ground and groundwater and does not cover any buildings or their fabric. Generally, testing has only been carried out for contaminants identified as potentially present with no assessment made of biological contamination. Risks to ecological receptors, such as bats, have not been considered.

3.0 THE SITE

3.1 Description

The site is located to the north east of Shortwood Roundabout, on the A6195 Dearne Valley Parkway. The site is currently an empty plot within the Shortwood Business Park, which has been prepared for commercial development. The site has an area of approximately 2 hectares and is located around Ordnance Survey national grid reference 435866 401454 off the A6195 Dearne Valley Parkway to the south of Barnsley.

The plot is currently undeveloped, and is surfaced by scrub grass. The site level rises by about 3.5 m from north to south, with the southern boundary comprising an embankment rising around 4.5 m to the Dearne Valley Parkway.

Trees are present around the north eastern and northern boundaries, including hawthorn hedges, hazel, sycamore and willows. A ditch also crosses the northern part of the site. This does not appear to connect to any other water course or drain, and therefore it is assumed that this is a temporary feature to control surface water runoff from the undeveloped site.

Manholes are present in the west of the site. These are new connections for the proposed development.

The site is bounded by the access road into the business estate (Shortwood Way) to the west, by Stockwith Lane to the north and by Upper Hoyland Road to the east.

4.0 REVIEW OF RSK REPORT

4.1 Site History

Historical Ordnance Survey maps, obtained as part of RSK's previous report, have been reviewed to assess the previous use of the site and surrounding area. We do not have copies of the historical maps which they used to compile their Phase 1 information. However we have checked their findings with maps available on the website www.old-maps.co.uk.

The Shortwood Business Park is situated in an area formerly occupied by part of the High Royd Colliery within the Rockingham opencast site. The site was also occupied by the Hepworth Brickworks, probably supplied by clay pits immediately north west of the site. The opencast workings were undertaken in two phases, during the 1960s and the 1990s. Prior to the opencasting, the site appears to have been undeveloped.

After the second phase of opencast coal extraction, the site levels were restored to approximately the original levels using the natural overburden, under supervision. The fill was placed partly onto older backfill from the earlier phase of mining in the north of the site, and partly onto rockhead in the southern half. As the opencast mining took place in several phases, high walls are expected within both the natural bedrock and within the older backfill.

The surrounding area is predominantly agricultural or undeveloped land. Other pits and clay pits were formerly located around the site. The land to the north west was recently developed with commercial offices.

4.2 Geology and Groundwater Vulnerability

4.2.1 Geology

The geological map SE 30 SE (1:10,560) shows the site to overlie strata of the Middle Coal Measure. Sandstone, the Kent's Rock is conjectured to be present in the southern half of the site, with mudstones and shales in the northern half. The horizon of the Kent's Thin Coal separates the two strata types. However, due to the opencast workings, the southern half of the site is shown to contain colliery spoil. The Kent's Thick coal is also shown to outcrop in the north west of the site, with colliery backfill indicated. The strata dip towards the south east, meaning that the deepest opencast workings in the Kent's Thin coal will be in the south east of the site.

No faults or drift deposits are expected on site.

4.2.2 Groundwater Vulnerability

The 1:100,000 map of Groundwater Vulnerability shows the geology beneath the site contains a Secondary A aquifer, comprising permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers.

The overlying soils are recorded as being of high leaching potential. This is due to the site's location within an 'urbanised' area where fewer observations are available and therefore a worst case scenario is assumed. The surrounding land is generally classified as being of low leaching potential, and therefore this is more likely to be the actual classification of the soils.

The site is not located within a Groundwater Source Protection Zone, as identified by the Environment Agency.

4.2.3 Hydrology

The nearest major surface water feature is the Shortwood Dyke located around 500 m north west of the site. There is also a pond located approximately 100 m west of the site which appears to be the nearest surface water feature to the site.

4.3 Mining

4.3.1 Opencast

The shallowest seam of coal beneath the site is the Kent's Thin coal. This outcrops across the centre of the site, with an approximately east to west trend, dips towards the south. However, the seam has been extracted via opencast mining and is now absent from much of the site. The opencast workings were found to increase in depth from the north west towards the south east across the southern half of the site. The depth of fill encountered in RSK's investigation was around 1.0 to 2.5 m in the east, deepening to up to 6.5 m in the south western corner. Records of the former opencast, obtained by RSK but not seen by Eastwood & Partners, record a high wall around the eastern boundary of the site.

The Kent's Thick Coal is also expected to be present at shallow depth beneath the site. The geological map indicates the seam to outcrop in the north west of the site, although it is not clear if this is a surface outcrop or whether the seam was found in the base of the former clay pits to the north west of the site. RSK reviewed pit records from earlier phase of workings, and found no mention of the Kents Thick coal being worked on the site. Opencast workings were undertaken to the north and north west of the site during the 1990s, and a haul road into these pits was cut across the north western corner of the site. No workings for the Kent's Thick coal were recorded on the site. During RSK's investigation, an area of deeper made ground was encountered in the north

west of the site, in approximately the area in which the Kent's Thick coal is indicated to outcrop, where the boreholes recorded up to around 11 m of fill. RSK state in their report that this depth may be an over-exaggeration due to the method of drilling employed, and that the opencast record drawings indicate excavations only to around 6 m in this area. RSK considered it likely that weathered bedrock had been mistaken for fill within the boreholes in this area.

4.3.2 High Walls

Several high walls are inferred to be present around the site by the former opencast plans. These are predominantly around the site's boundary and are relatively small, according to the findings of RSK's they will range between approximately 1 m and 6 m around the south eastern boundary, and between 0.6 m and 5.0 m around the northern boundary.

A third highwall is inferred crossing the centre of the site from east to west, marking the boundary between the first and second phase of opencasting. RSK's investigations indicate that this is only around 2 m in height across the central area of the site, deepening to up to 11 m (more likely to be 6 m – see sections 3.6.2 above) in the west.

A highwall is also possibly present in the north western corner where the former haul road was cut into the ground. The anticipated locations of the highwalls are indicated on the exploratory hole location plan, Drawing Number 34072/006, in Appendix 1.

4.3.3 Underground Mining

RSK contacted the South Yorkshire Mining Advisory Service during one of their earlier investigations on the Shortwood site. A brief synopsis of this consultation is that several seams of coal have been worked at depth beneath the site. Records indicate that the worked seams are between 65 m and 420 m below ground level, and that any ground movement associated with these workings should have ceased by now.

4.4 Flooding

According to the Environment Agency website, the site does not lie within an area at risk from flooding by rivers.

4.5 Intrusive Site Investigation by RSK

Sixteen trial pits were excavated across the site in November 2006. In addition, six rotary boreholes were undertaken across the site. A further sixteen trial pits excavated in February 2008. The positions of all of the exploratory holes excavated on the site in relation to the current proposed development have been plotted on Eastwood & Partner's Drawing Number 34072/007 revision A, which is included in Appendix 1.

4.5.1 Ground Conditions

4.5.1.1 Opencast Backfill

Opencast backfill materials were encountered in the majority of the exploratory holes. RSK report that two types of backfill were present, which concurs with the information that there were two phases of opencast workings undertaken on the site.

The backfill was found to comprise loose to moderately compact/firm to stiff gravel and cobbles of mudstone in a clay matrix, which represents reworked natural overburden. Occasional boulders were also included within the backfill. Occasional pockets of material containing clinker, brick and ash were also encountered.

The backfill was found to depths of between 0.05 m and 6.4 m bgl in the south of the site with a trend of getting deeper towards to the south east. In the northern half of the site, between 0.6 m and up to 11.3 m of backfill were found, although the maximum depth recorded is possibly erroneous due to the drilling method used. A maximum depth of around 6 m is more likely.

No information regarding any compaction regime which may have been employed during either phase of backfilling was found.

4.5.1.2 Natural Ground

Within RSK's exploratory holes, the natural ground was found to comprise firm to stiff clay overlying mudstone and sandstone bedrock. Occasional thin bands of coaly shale were noted in some of the trial pits.

4.5.2 Settlement of Opencast Backfill

During another investigation in 1997, RSK monitored the relative levels of permanent ground markers installed on the site by others on four occasions. No surface settlement (due to self weight) was noted during this period.

In addition, six new permanent ground markers were installed as part of the RSK's investigation which were monitored every three months on four occasions between November 2006 and April

2007. The results of the monitoring show that self weight settlements of between 0 mm and 4 mm occurred over this period.

4.5.3 Ground Gases

Information supplied by the BRE states that the site lies within an area where no radon precautions are required.

There is one recorded landfill site within 250 m of the site. This is located 100 m north of the site and was active between 1962 and 1990, accepting inert and industrial wastes. In addition, much of the land to the north of the site has been worked as opencast coal mines or clay pits over the past 100 years. The site also contains backfilled opencast workings generally up to around 6 m bgl.

4.5.4 Gas Monitoring

RSK installed gas monitoring wells across the site during their investigations, and monitored these on six occasions between November 2006 and January 2007. No significant concentrations of methane were recorded in any of the wells. Carbon dioxide concentrations of up to 6.4% were recorded. However, no significant gas flow out of any of the wells were recorded. The results were compared with CIRIA document C659. Based on the worst case recorded during the monitoring (6.4% CO₂ flowing at 1.0 l/h), the site falls within the classification CS1. For this classification, no control measures are required to protect buildings against the ingress of ground gases.

4.5.5 Contamination Appraisal

During the previous investigation, six soil samples were selected and tested for a range of common contaminants including metals (arsenic, cadmium, chromium (total and hexavalent), copper, mercury, nickel, lead, selenium, and zinc) and sulphates. A further six samples were tested for total petroleum hydrocarbons (TPH). The results were compared with generic assessment values relating to an industrial/commercial end use.

The full results of the testing were not included within the version of the report made available to Eastwood & Partners. However, the text of the report states that none of the concentrations of metals recorded exceeded the relative assessment values, and that no concentration of TPH above the laboratory detection limit were recorded. RSK's conclusion was that no significant risk to human health, plants or controlled waters is presented by the soils on the site.

The results of the sulphate testing indicated that DS-2 AC-2 sulphate precautions are recommended for sub-surface concrete structures.

5.0 OUTLINE CONCEPTUAL MODEL

The current development proposals for the site include the construction of industrial units with limited landscaping. This is not therefore a particularly sensitive end use with respect to human health.

The results of RSK's previous investigation indicate that made ground is present across the site to depths in the region of 6 m, although up to 11 m of fill could be present in the north west of the site. The made ground comprises predominantly reworked natural overburden, placed on completion of opencast coal and clay pit workings. Prior to the opencast operations, the land was predominantly agricultural.

The testing carried out by RSK indicated there to be no elevated concentrations of any common contaminants in the materials which they encountered in their trial pits. No significant risk to human health, plants or controlled waters were therefore identified. The results of gas monitoring also indicated no elevated concentrations and subsequently, no risk to the proposed development.

The only potential risk to the proposed development will therefore be if materials differing to those described in the previous report are encountered.

6.0 GROUND INVESTIGATION

6.1 Site Works

A ground investigation was required to confirm the findings of the previous report with respect to the ground conditions in various areas of the site to suite the new development proposal.

We visited site on 2 November 2011 and excavated four trial pits, TP201-TP204, and four trenches, TT1 to TT4, to search for the high walls referred to by RSK and to validate the findings of their investigations.

The trial pits were excavated using a wheeled 360° excavator and reached depths of between 1.1 m and 3.6 m below ground level (bgl).

The trenches were up to 4.5 m in depth and 25 m in length. A log of the strata was taken every five metres along each trench.

Logs of the trenches and trial pits are presented in Appendix 3, and their locations are plotted on the '*Exploratory Hole Location Plan*', Drawing number 34072/006 revision A in Appendix 1.

7.0 GROUND CONDITIONS

7.1 Made Ground – Opencast Backfill

Opencast backfill materials were encountered from surface in all of the trial pits and trenches excavated by Eastwood & Partners.

Three main types of made ground were encountered which concurs with the RSK findings relating to the site having been backfilled in phases. The types of ground were as follows;

1. Sandy very gravelly brown clay was encountered in the south eastern corner of the site from ground level to approximately 1.4m depth. The depth decreased towards the centre of the site. The gravel within this materials comprised angular sandstone and mudstone fragments.
2. Dark grey to black gravelly cobbly clay was encountered in the southern section of the site up to a depth of 3.6m. The gravel and cobbles were predominantly of mudstone with rare brick fragments.
3. Grey brown sandy clay was encountered in the north and centre of the site from 0.8m bgl to depths greater than 4.5 m bgl. Within this material, the gravel was mainly of sandstone and mudstone with rare fragments or brick and coal.

The base of the made ground was encountered at depths of between 0.9 m to in excess of 4.5 m bgl within the trial pits and trenches.

TP202 and TP204 were positioned to the north and south of RSK's BH 205, where 6 m of backfill was recorded. Our trial pits found only 1.2 m to 2.3 m of backfill with stiff clay below. Similarly, Trench TT1 was excavated in the area adjacent to RSK's BH201 in the south eastern corner of the site. Here, 3.0 to 3.8 m of backfill was found in our trial pits, compared with the 6.4 m found in RSK's borehole. The trend of deepening made ground towards the south east, indicated by RSK's trial pits agrees with the depth of fill observed in the trench.

Trench TT2 was excavated in the west of the site up to the position of RSK borehole BH204, where over 11m of fill was recorded. The findings of our investigation found only 3.2 m of backfill over very stiff clay adjacent to BH205, although the fill deepened to over 4.5 m towards the west.

The above information concurs with RSK's statement that the depth of backfill was over estimated due to the method of drilling employed. Therefore the depth of backfill within the boreholes should not be relied upon. The depth of fill recorded within the trial pits excavated by RSK and Eastwood & Partners are broadly in agreement.

7.2 Natural Ground

The natural ground was found to comprise clay over sandstone or mudstone bedrock.

The clay represents a weathered portion of the bedrock, and where present was described as being stiff or very stiff. The clay was described as being sandy in TP201 and TP203, and contained sandstone and mudstone gravel in a number of locations.

Sandstone bedrock was encountered in TP203 in the north eastern corner of the site at approximately 1 m bgl. Sandstone was also encountered in Trench TT1 at depths of around 3.6 m to 4.2 m bgl, below a thin band of clay and very weak mudstone.

7.3 High Walls

Trench TT1 was excavated in the south east of the site to indicate whether the highwall identified by RSK extends into the area where it is intended to construct the proposed units. Within the trench, the base of the opencast backfill was found to rise gradually from the south towards the centre of the site, concurring with RSK's findings. No steep change in the level of the base of backfill was encountered in the trench, which was approximately 25 m in length. It appears therefore that the high wall close to the boundary does not extend laterally into the site by any great distance. This high wall is expected to be around 6 m high at its highest point in the south eastern corner.

Similarly, across the centre of the site, no evidence of a significant change in the depth of fill has been identified. RSK's trial pits indicate a change in the base of the fill of between 1.2 m in the east of the site, to between 2.8 m and 3.5 m in the centre. In the west of the site, the fill deepens to at least 4.5 m to 5.0 m, and is possibly even up to 6 m deep. However, trenches TT2 and TT3 indicate a gradual change in the depth, rather than a steeply sloping face.

In the north of the site, the depth of backfill is generally between 2.0 m and 3.0 m. In our trial pit TP204, the depth of fill was found to be 2.3 m, which compares with RSK's TP2 which is adjacent. However, a localised deepening of the fill to in excess of 4.9 m was found in RSK pit TP114 to the north west. There is likely to be a high wall running along the northern site boundary with High Royd Lane. However, it appears that this wall is of low height, with the exception of a localised deepening of the fill around the area of TP114. Due to its limited height, the high wall is not expected to extend onto the site by more than around 3 m laterally and should not therefore significantly affect the proposed development.

7.4 Obstructions

In trench TT3, a sandstone boulder was encountered at 1.5 m to 1.8 m bgl in the western end of the trench. This boulder could not be excavated through.

The general backfill materials were found to contain numerous cobbles of mudstone and sandstone, although these did not cause any significant issues when excavating the trial pits.

7.5 Groundwater

Groundwater was generally encountered in the base of our trial pits at the interface of the backfill materials and the natural, impermeable natural clay, mudstone and sandstone. We consider that this is perched water, trapped within the fill materials, rather than representing the natural groundwater level.

7.6 Evidence of Contamination

Visual or olfactory evidence of possible significant contamination was not identified in any of the exploratory holes. The materials encountered in our exploratory holes were generally as those described in RSK's trial pits.

8.0 GEOTECHNICAL APPRAISAL

8.1 General

The intrusive investigations indicate that opencast backfill materials are present all across the site. The depth of fill is generally less than 3 m, increasing in the south east and the western areas of the site.

High walls are located near the perimeter of the site, although these seem to be of relatively low height and lateral extent. Information given to RSK indicates that a high wall is present across the centre of the site. Based on the findings of RSK's trial pits, supplemented by the pits excavated by Eastwood & Partners, this does not appear to be the case. Although there is a deepening of the backfill from the centre of the site towards the north, the change is gradual and is only around 2 m in depth.

Several of the boreholes drilled by RSK indicate significant changes in the depth of fill, particularly in the west (11 m of fill recorded) and in the south east (where 6 m of fill was recorded). The trial pit information indicates these findings to be erroneous, probably due to the driller not recognising the change between backfill and natural weathered rock or clay due to the method of drilling employed. We believe that the borehole information cannot therefore be relied upon.

Monitoring of the self weight settlement of the fill by RSK did not indicate any significant change in ground level. A significant amount of self weight settlement is not expected due to the limited depth of fill. The materials have been in place for around 20 years, and the majority of initial settlement is expected to have already occurred. The proposed units will be a lightweight construction, and the amount of settlement due to loading is expected to be low. Inundation settlement is unlikely to be a significant issue as the natural water table is not expected to rise into the backfill and will remain in the underlying bedrock.

The natural clay is described as stiff or very stiff, and therefore a safe bearing capacity of at least 150 kN/m² can be assumed on this material, increasing significantly in the mudstone or sandstone bedrock.

8.2 Foundations

For the proposed development, which comprises a number of lightweight commercial/industrial steel framed units, the most appropriate foundation solution will be to use reinforced concrete ground beams. The buildings are generally situated away from the areas of deepest fill, although the proposed layout has still to be finalised. The depth of fill beneath the proposed buildings is expected to be relatively modest. Pads should therefore be taken through to the base of the fill and constructed on the stiff natural clay or weathered bedrock where this is practical. Alternatively

reinforced concrete ground beam foundations may be possible founded on the fill. Where possible, the pads for each building should be constructed on the same material (i.e. all on clay or all on bedrock for each building) to limit the potential for any differential settlement.

8.3 Ground Floors

Ground bearing concrete floors may be used within the proposed development. The opencast backfill should be proof rolled prior to casting the slab, and any soft spots removed and backfilled with suitable granular material.

8.4 Superstructure Precautions

No additional superstructure precautions will be required due to the ground conditions encountered.

8.5 Excavation Problems

We do not anticipate any problems excavating trenches within natural ground on site, although the made ground is expected to be unstable in excavations left open for any period of time.

Support will be required in accordance with current Health & Safety Regulations wherever access is required to trenches deeper than 1.2 m or less where there is risk of collapse.

8.6 Obstructions

Significant obstruction are not expected to be encountered on site. Localised boulders may be contained within the backfill, which will need to be removed.

8.7 Surface Water Drainage

The backfill material is expected to be relatively permeable and soakaways may therefore work. However, it is not recommended that soakaways are used on this site. The concentration of water flows into filled ground in the vicinity of buildings can lead to localised inundation of the fill and in turn can lead to excessive localised settlement. This should be avoided.

Surface water from the proposed development should therefore be directed into a piped drainage system. It appears that provision has been made in the overall business park development for a connection from the currently proposed site, with manholes located in the west of the site.

8.8 Concrete

The results of RSK's chemical testing indicated that a sulphate resistance class of DS-2 AC-2 is required on this site.

9.0 REFINEMENT OF OUTLINE CONCEPTUAL MODEL

9.1 Source Characterisation

RSK's report indicated that the site was predominantly undeveloped prior to two phases of opencast coal workings. The only potential sources of contamination identified were therefore the inclusion of manmade materials within the backfill. Chemical testing undertaken by RSK did not reveal any elevated concentrations of any common contaminant, and therefore no significant risk to human health, plants or controlled waters were identified.

9.2 Ground Conditions

The soils encountered within the trial pits excavated by Eastwood & Partners are comparable in description to those described by RSK in their investigation. Generally, the backfill materials comprise reworked natural overburden of sand, clay and mudstone or sandstone gravel. Very limited amounts of ash, clinker or brick were encountered. General contamination levels are not expected to be high within the predominantly naturally derived materials.

9.3 Gas Precautions

No radon precautions are required.

Past monitoring of ground gases produced within the backfill underlying the site did not reveal any significant concentration or flow of any gas. Ground gas precautions are not considered to be necessary based on the results of this testing. The material is not expected to be gassing significantly after 20 years and the proposed development in any case comprises well ventilated units.

9.4 Unexpected Contamination

No visual or olfactory observations of unexpected contamination were noted. There is no reason to suspect that the materials encountered within the trial pits excavated by Eastwood & Partners will contain any higher concentrations of any contaminant than those recorded during the previous testing and therefore the level of risk presented by these materials should not change. For this reason, no additional testing has been carried out.

10.0 RISK ASSESSMENT

10.1 Human Health – Future Site Users, Staff and Visitors

The site is to have a commercial/industrial end use, and will be predominantly hard covered. There will be little opportunity for general site users to have any contact with the soils which underlie the site. Limited areas of soft landscaping are proposed, although these will generally consist of landscaping borders around the perimeter of the site of slopes created around the buildings during the earth works phase of the development. These areas will be tended by maintenance groundworkers and staff or visitors should not have any significant contact with the soil.

No remedial works are considered necessary at this stage, and no significant risk to human health is anticipated to be presented by the soils which are present.

10.2 Human Health – Construction Workers and Maintenance Staff

Ground workers employed during the construction phase of the development and maintenance staff employed post construction are most at risk of harm due to them having direct contact with the soils. However, the contact is generally of short duration, and all competent ground workers will be aware of the potential risks associated with soils of this nature. Therefore the overall risk to the health of construction workers and grounds staff is considered to be low.

Normal site procedures such as the wearing of gloves when handling soils, and the washing of hands prior to eating should still be implemented despite no significant concentrations of contaminants being encountered.

Any unusual, brightly coloured, ashy or odorous material encountered during construction should be brought to the attention of the site staff and investigated.

10.3 Plants

No significant risk to plants has been identified.

The site is currently covered by scrub grass and therefore the soils appear capable of supporting plant growth. However, if more sensitive species of grass or plants are to be grown in the landscaping areas, a nominal 150 mm layer of topsoil may need to be provided as a growing medium.

10.4 Controlled Waters

No significant risk to controlled waters have been identified. Once developed, the site will be predominantly hard covered and positive drainage will be provided, meaning that the potential for surface water to permeate through the soils will be greatly reduced from present, thus reducing the potential risk even further.

10.5 Construction Materials

The results of the sulphate testing carried out by RSK indicated that DS-2 AC-2 sulphate precautions are required for sub-surface concrete structures.

10.6 Unexpected Contamination Encountered During Groundworks

It is considered unlikely that further significant contamination will be encountered during the construction works on the site.

Should any unusual, brightly coloured, ashy or odorous material be encountered during construction this should be brought to the attention of the site staff and investigated. Where necessary, Eastwood & Partners should be consulted and additional works may be specified depending on the level and nature of the suspected contamination. These works may include site visits, additional testing or removal of the material from site.

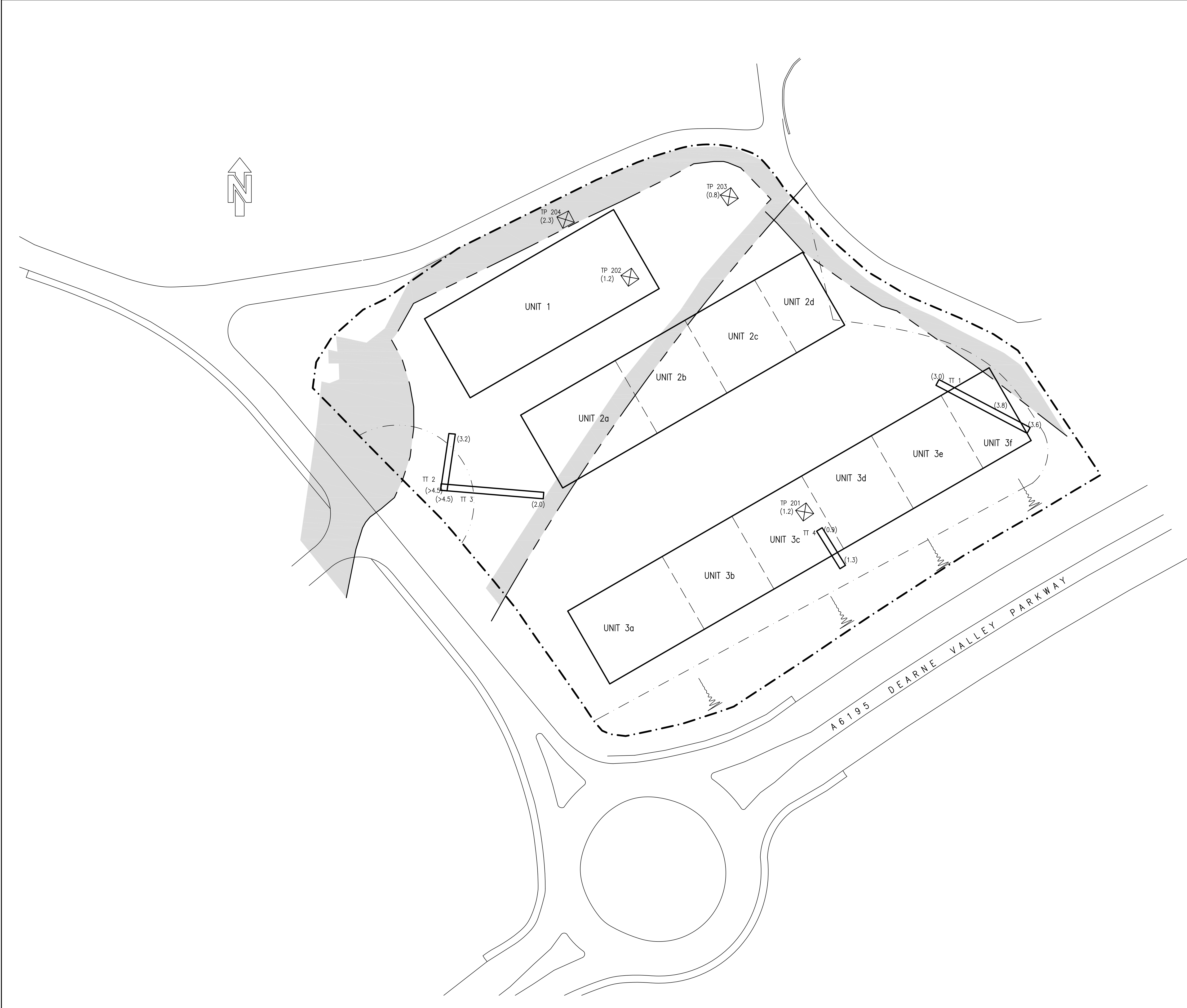
11.0 CONTAMINATION - RECOMMENDATIONS AND APPROVALS

1. No elevated concentrations of any common contaminant were recorded in the soils on the site in relation to the proposed development of commercial/industrial units. Therefore no significant risk to human health, plants or controlled waters are anticipated and no remedial works should be required.
2. A nominal 150 mm covering of topsoil may be required as a growing medium in landscaping areas, depending on the nature of the proposed planting in these areas.
3. DS-2 AC-2 sulphate precautions are required for buried concrete structures.
4. No radon or ground gas precautions are required at the site.
5. There should be no significant contamination risks to construction workers from the ground on the site but normal good hygiene precautions such as washing hands before eating should be implemented.
6. The conclusions made in this report in relation to contamination are subject to agreement by the approving bodies such as the Local Authority.

Appendix 1

'Exploratory Hole Location Plan', drawing reference 34072/006 Revision A

'Overall Exploratory Hole Location Plan' drawing reference/007 Revision A



Information within this drawing is not necessarily produced to scale.
Always use figured dimensions and co-ordinates – if in doubt, ask.

LEGEND

E+P Trial pits excavated November 2011

E+P Trial Trench excavated November 2011

Depth of fill indicated in metres.

Site boundary

Assumed location of Kents Thin coal seam outcrop

Assumed location of Kents Thick coal seam outcrop

Highwall position indicate by RSK drawing 10911-3(00)0002B.

A	First Issue.			
REV	DESCRIPTION	SIG	CHK	DATE

E.V. WADDINGTON LTD

SHORTWOOD BUSINESS PARK,
HOYLAND

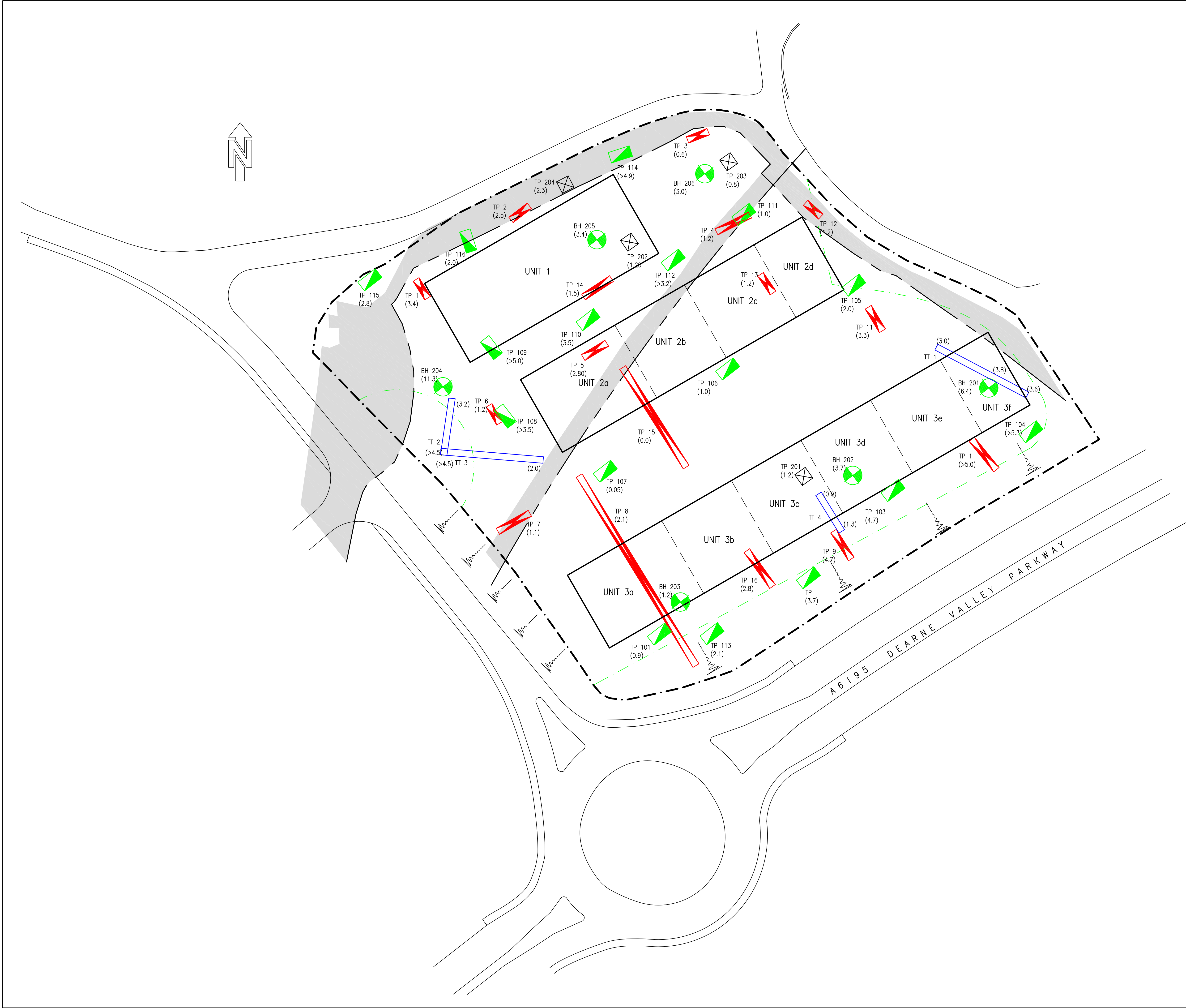
EASTWOOD & PARTNERS
EXPLORATORY HOLE LOCATION
PLAN

Eastwood & Partners
CONSULTING ENGINEERS

St. Andrew's House
23 Kingfield Road
Sheffield
S11 9AS
Tel 0114 255 4554
Fax 0114 255 4330

mail@eastwoodandpartners.com
www.eastwoodandpartners.com

SCALE WHEN PLOTTED AT A1 1:500		DRAWING STATUS INFORMATION	
DRAWN RH	CHECKED AK	DATE 14-10-11	DRAWING NUMBER 34072/006
			REV A



Information within this drawing is not necessarily produced to scale.
Always use figured dimensions and co-ordinates – if in doubt, ask.

- NOTES
- LEGEND
- RSK Trial pits excavated 2006
 - RSK Boreholes drilled 2007
 - RSK Trial pit locations excavated 2008
 - E+P Trial pits excavated November 2011
 - E+P Trial Trench excavated November 2011
 - (2.0) Depth of fill indicated in metres.
 - Site boundary
 - Assumed location of Kents Thin coal seam outcrop
 - Assumed location of Kents Thick coal seam outcrop
 - Highwall position indicate by RSK drawing 10911-3(00)0002B.

A	First Issue.			
REV	DESCRIPTION	SIG	CHK	DATE
E.V. WADDINGTON LTD				
SHORTWOOD BUSINESS PARK, HOYLAND				
OVERALL EXPLORATORY HOLE LOCATION PLAN				
Eastwood & Partners CONSULTING ENGINEERS St. Andrew's House 23 Kingfield Road Sheffield S11 9AS Tel 0114 255 4554 Fax 0114 255 4330 mail@eastwoodandpartners.com www.eastwoodandpartners.com EOP				
SCALE WHEN PLOTTED AT A1 1:500		DRAWING STATUS INFORMATION		
DRAWN RH/CB	CHECKED AK	DATE 02-03-12	DRAWING NUMBER 34072/007	REV A

Appendix 2

RSK Report

**ADDITIONAL SITE INVESTIGATION
PHASE 3, SHORTWOOD BUSINESS PARK
HOYLAND, BARNSELEY**

PRIORITY SITES LIMITED

15 APRIL 2008

CONFIDENTIAL

**ADDITIONAL SITE INVESTIGATION
PHASE 3, SHORTWOOD BUSINESS PARK
HOYLAND, BARNSELEY**

REPORT NO : 10911-R2

**Client : Priority Sites Limited
Thunderhead Ridge
Glasshoughton
WF10 4U**

DOCUMENT ISSUE STATUS

Report Issue	FINAL		
Reference Number	10911-R2 (02)		
<i>Title</i>	<i>Name</i>	<i>Signature</i>	<i>Date</i>
Author	Jon Clayton		15 April 2008
Project Manager	Gary McGuicken		15 April 2008
Technical Reviewer	Gary McGuicken		15 April 2008

This report is not to be used for contractual or engineering purposes unless the above is signed where indicated by both the project manager and the technical reviewer of the report and the report is designated "FINAL".

TABLE OF CONTENTS

1.	INTRODUCTION	1
1.1	OBJECTIVE	1
1.2	SCOPE OF WORKS	1
1.3	LIMITATIONS	2
2.	BACKGROUND TO CONTAMINATION RISK ASSESSMENT	2
2.1	GENERAL	2
2.2	SOIL SCREENING	3
2.3	GROUNDWATER ASSESSMENT	5
2.4	BACKGROUND TO GROUND GAS ASSESSMENT	6
3.	SITE INFORMATION	6
3.1	LOCATION AND DESCRIPTION OF SITE	6
3.2	HISTORY OF SITE	7
3.3	GEOLOGY, HYDROLOGY AND HYDROGEOLOGY OF SITE	7
3.4	MINING HISTORY	8
4.	PREVIOUS INVESTIGATIONS	9
5.	CONSULTATION WITH BRE	9
6.	INITIAL SITE CONCEPTUAL MODEL	10
6.1	POTENTIAL SOURCES OF CONTAMINATION	10
6.2	SENSITIVE RECEPTORS	10
6.3	MIGRATION ROUTES	11
7.	SITE WORK	11
7.1	TRIAL PITS	12
7.2	BOREHOLES	12

7.3	INSTALLATION OF MONITORING WELLS	13
8.	MONITORING	13
8.1	GAS MONITORING	13
8.2	GROUNDWATER MONITORING	13
8.3	SETTLEMENT MONITORING	14
9.	LABORATORY TESTING	14
9.1	CONTAMINATION ANALYSES	14
9.2	GEOTECHNICAL TESTING	14
10.	FINDINGS OF THE INVESTIGATION	15
10.1	GROUND CONDITIONS	15
10.2	SELF-WEIGHT SURFACE SETTLEMENT MONITORING	18
10.3	GROUND GAS	18
10.4	GROUNDWATER LEVELS	19
11.	GENERIC QUANTITATIVE RISK ASSESSMENT	19
11.1	HAZARD ASSESSMENT OF SOILS	19
11.2	HAZARD ASSESSMENT OF GROUNDWATER	20
11.3	HAZARD ASSESSMENT OF GROUND GAS	21
11.4	REVISED CONCEPTUAL SITE MODEL	21
12.	GEOTECHNICAL ASSESSMENT	22
12.1	GROUND CONDITIONS BENEATH UNIT AREAS	22
12.2	REQUIRED ACTION AND GROUND TREATMENT	24
12.3	INFRASTRUCTURE	25
12.4	CHEMICAL ATTACK ON BURIED CONCRETE	26
13.	WASTE CLASSIFICATION	26

14. REFERENCES

28

LIST OF TABLES

Table 1	Results of Gas Monitoring on Phase 3 – (29 November 2006)
Table 2	Results of Gas Monitoring on Phase 3 – (05 December 2006)
Table 3	Results of Gas Monitoring on Phase 3 – (21 December 2006)
Table 4	Results of Gas Monitoring on Phase 3 – (09 January 2007)
Table 5	Results of Gas Monitoring on Phase 3 – (16 January 2007)
Table 6	Results of Gas Monitoring on Phase 3 – (22 January 2007)
Table 7	Contamination Analysis on Soil Samples
Table 8	TPH Analysis on Soil Samples
Table 9	Dissolved Sulphate Analysis on Groundwater Sample

LIST OF FIGURES

Figure 1	Site Location Map
Figure 2	Phase 3 Site Plan

LIST OF APPENDICES

Appendix A	Service Constraints
Appendix B	RSK Derivation of Soil Screening Values
Appendix C	Phase 3 Trial Pit Records
Appendix D	Phase 3 Borehole Records
Appendix E	Phase 3 Groundwater Elevations
Appendix F	Phase 3 Self-Weight Surface Settlement Monitoring Results
Appendix G	Phase 3 Natural Strata Elevations

1. INTRODUCTION

RSK Geoconsult Limited (RSK) was commissioned by William Saunders Partnership (WmSP) acting on behalf of Priority Sites Limited (Priority Sites) to carry out a site investigation and self-weight settlement monitoring works over the Phase 3 area of Shortwood Business Park, Hoyland, Barnsley. This was carried out to provide information on ground conditions and to investigate the potential for contamination, so that requirements for ground treatment, foundation design and remediation of contaminated areas could be assessed. This work was carried out between November 2006 and February 2008 and is in accordance with RSK proposals reference T6280-01 (01) issued on 25 October 2006 and 10911L09 issued on 16 January 2008.

The Shortwood Business Park site is part of a reinstated opencast coal mine. Two phases of backfilling have occurred at the site; the first following coal extraction in the 1960s; and the second during site reinstatement in 1996. The Phase 3 area comprises areas of newer fill over older fill materials and areas where new fill was placed directly on to bedrock.

Prior to this investigation, RSK have performed some surface settlement monitoring over the Phase 3 area but no intrusive site works.

The latest phase of intrusive investigation carried out by RSK in February 2008 comprised the excavation of 16 trial pits. This phase of investigation was specifically designed to assess geotechnical constraints relating to the proposed building layout provided on W^M Saunders Partnership LLP drawing no. E9247(SK)19, dated January 2008. RSK have labelled the units 1 to 6 for ease of description (see Figure 2).

1.1 OBJECTIVE

The two main objectives of the investigation were to provide:

1. Information on the site setting and contamination present. This is required for assessing relevant pollutant linkages, undertaking risk assessment and, where necessary, determining remedial options. These works were carried out in accordance with the risk assessment sections of the Model Procedures for the Management of Land Contamination (CLR 11) ⁽¹⁾; and
2. Information to assist with recommending appropriate ground treatment, foundation design and remedial measures for the Phase 3 area to allow the development to proceed.

1.2 SCOPE OF WORKS

The scope of work performed on the Phase 3 area comprised the following:

- Consultation with the BRE regarding scope of additional site investigation works;
- Monitoring over a 6-month period of six existing surface settlement markers;
- Excavation of trial pits and drilling of rotary boreholes with coring to determine accurately the depth of fill material / depth to rock head;
- Soil sampling and laboratory testing for a variety of determinands;
- Installation of monitoring wells in the boreholes;
- Groundwater gauging and ground gas monitoring;
- Data appraisal and discussion on foundation design with BRE; and
- Preparation of this report containing ground treatment, foundation design and remediation recommendations.

1.3 LIMITATIONS

The comments given in this report and the opinions expressed are based on information held by RSK, information within previous RSK reports, the ground conditions encountered during the recent site work and results of field monitoring. However, there may be conditions pertaining at the site that have not been disclosed by the investigation and which 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 may differ from that found in the investigation. Also groundwater levels vary due to seasonal or other effects and, at times may differ significantly from those reported.

This report is subject to the RSK Geoconsult Limited Service Constraints, given in Appendix A.

2. BACKGROUND TO CONTAMINATION RISK ASSESSMENT

When assessing the contaminants that are likely to be present at a site or, through intrusive investigation, are actually encountered within soils or groundwater beneath a site, a contamination risk assessment is carried out to determine if the contaminants pose a risk to humans or the environment. The following sections describe the methodology used to assess the contamination risks.

2.1 GENERAL

The process of contamination risk assessment comprises four stages:

1. Hazard identification: establishes what contaminant sources are present at a site.
2. Hazard assessment: analyses the potential for unacceptable risks associated with the contaminant sources (identifies potential pathways and receptors, potential resultant pollutant linkages and potential effects).

3. Risk estimation: predicts the magnitude and probability of the possible consequence (the degree of harm or pollution that may result and which receptors may be affected and the likelihood) that may arise as a result of a hazard.
4. Risk evaluation: decides whether a risk is unacceptable.

To undertake this assessment, it is necessary to define a conceptual model for the site to identify the hazards, the receptors potentially affected and the potential linkages that can connect them. An initial conceptual model for this site, which was derived from the review of available information and historical data, is described in Section 6. The conceptual model was used to define the scope of intrusive investigation required to complete stages 1 and 2 (above) and provide input for stages 3 and 4. These stages are described in Section 11.

2.2 SOIL SCREENING

When assessing the risks posed by contaminants in soils it is useful to be able to compare the concentrations encountered with screening values. Such screening values (soil guideline values – SGVs) have been published by DEFRA ^(2,3,4) for a number of inorganic compounds, however there are many contaminants for which screening values have not yet been published in the UK.

The SGVs derived from the CLEA model and published by DEFRA provide initial assessment criteria to establish whether sources of contamination are significant. These can then be compared with the site-specific analytical data to establish whether the hazards have the potential to cause unacceptable generic health risks.

In March 2004, the Environment Agency released a policy statement ⁽⁵⁾ concerning the assessment of chronic risk to human health from contaminated soils. This states the application of non-UK derived screening values, such as Dutch, American or Canadian, is not appropriate since they do not ensure compliance with UK policy (for example health criteria, exposure scenario and receptor characteristics). Consequently, they state that in the absence of appropriate UK-derived SGVs a Tier 3 Detailed Quantitative Risk Assessment (DQRA) should be carried out.

RSK has followed this approach to derive soil screening values for relevant contaminants for which SGVs are as yet not published. Details of these derivations are given in Appendix B and the resulting list of generic assessment criteria (GAC) or Soil Screening Values (SSV) is given in the table below:

Generic Health Risk Assessment Criteria

Soil Contaminant	Commercial Soil Screening Values (mg/kg)	Residential with plant Uptake Soil Screening Values (mg/kg)
Inorganic Compounds		
Selenium (Se)	8000 ^(a)	35 ^(a)
Arsenic (As)	500 ^(a)	20 ^(a)
Cadmium (Cd)	1400 ^(a)	1,2,8 ^{(a)(e)}
Chromium (hexavalent) (Cr)	5000 ^(a)	130 ^(a)
Lead (Pb)	750 ^(a)	450 ^(a)
Mercury (Hg)	480 ^(a)	8 ^(a)
Copper (Cu)	250 ^(c) phytotoxic 420 ^(g) ingestion	250 ^(c) phytotoxic 420 ^(g) ingestion
Nickel (Ni)	5000 ^(a)	50 ^(a)
Zinc (Zn)	1000 ^(c) phytotoxic 880 ingestion ^(g)	1000 ^(c) phytotoxic 880 ingestion ^(g)
Water Soluble Boron (B)	0.5 ^(d)	0.5 ^(d)
pH Value	5.5	<6 and >8
Total Cyanide	8700 ^(b)	360 ^(b)
Organic Compounds / Hydrocarbons		
Aliphatics** C ₅ to C ₆	-	280000 ^(b)
Aliphatics** C ₆ to C ₈	-	280000 ^(b)
Aliphatics** C ₈ to C ₁₀	-	14 ^(b)
Aliphatics** C ₁₀ to C ₁₂	90000 ^(b)	5500 ^(b)
Aliphatics** C ₁₂ to C ₁₆	90000 ^(b, k)	5500 ^(b, k)
Aliphatics** C ₁₆ to C ₂₁	-	110000 ^(b, k)
Aliphatics** C ₂₁ to C ₃₅	-	110000 ^(b, k)
Aromatics** C ₅ to C ₇	6.8 ^(b)	0.085 ^(b)
Aromatics** C ₇ to C ₈	460 ^(b)	5.7 ^(b)
Aromatics** C ₈ to C ₁₀	230 ^(b)	2.9 ^(b)
Aromatics** C ₁₀ to C ₁₂	36000 ^(b)	2.9 ^(b)
Aromatics** C ₁₂ to C ₁₆	36000 ^(b, k)	13 ^(b, k)
Aromatics** C ₁₆ to C ₂₁	27000 ^(b, k)	1700 ^(b, k)
Aromatics** C ₂₁ to C ₃₅	27000 ^(b, k)	1700 ^(b, k)
Benzene (1%, 2.5%, 5% SOM) ⁽⁶⁾	1.66, 3.80, 7.32 ^(h, i)	0.024, 0.056, 0.109 ^(h, i)
Toluene (1%, 2.5%, 5% SOM) ⁽⁶⁾	150, 350, 680 ^(a, h)	3, 7, 14 ^(a, h)
Ethyl Benzene (1%, 2.5%, 5% SOM) ⁽⁶⁾	48000 ^(a, h)	9, 21, 41 ^(a, h)
Xylene (1%, 2.5%, 5% SOM) ⁽⁶⁾	(130 ^{b, m}) 340, 825, 1650 ^(h, i)	6, 15, 30 ^(h, i)
PAH* Threshold (fluoranthene)	240 ^(b)	8.8 ^(b)

Soil Contaminant	Commercial Soil Screening Values (mg/kg)	Residential with plant Uptake Soil Screening Values (mg/kg)
Non-Threshold (benzo-a-pyrene)	7.6 (construction)	1.1 ^(j, k)
Phenol (1%, 2.5%, 5% SOM) ⁽⁶⁾	21900, 43000, 78000 ^(a)	78, 150, 280 ^(a)
Naphthalene	7.16 ^(b, h)	0.315 ^(b, h)

- a. CLEA Value.
- b. RSK Derived Soil Screening Values (SSV).
- c. ICRCL 70/90 – Notes on restoration and aftercare of metalliferous mining sites.
- d. In absence of UK-specific value, the US ASTDR ecological value has been used (SGV value not planned to be produced by DEFRA/Environment Agency).
- e. pH dependent (pH 6, 7, 8) respectively.
- f. $TOC = SOM \times 0.58$ (TOC – total organic carbon, SOM – soil organic matter)
- g. The SSVs for copper and zinc were derived using CLR10 exposure averages for soil and vegetable consumption in BP-RISC. 100% bioavailability is assumed.
- h. This value is based on vapour inhalation only.
- i. Proposed SGV (DEFRA).
- j. This value is based on soil ingestion, not plant uptake.
- k. Aromatic C₅ to C₇ only. All others do not represent a risk.

*The values presented are the lowest calculated SSVs for individual compounds and do not represent a total hydrocarbon value.

** Assuming SOM of 2.5%

The SSVs listed in the table above for Commercial end use have been used in the generic quantitative risk assessment to evaluate the contamination hazards identified on the site in Section 11.

2.3 GROUNDWATER ASSESSMENT

As an initial screen to assess the risks posed by contaminated groundwater at a site, the groundwater analysis data may be compared directly to the most relevant groundwater screening values for the site, either published EU Drinking Water Standards (DWS)⁽⁶⁾ when the site is in the vicinity of a potentially vulnerable drinking water supply or the Environment Quality Standards (EQSs) published by the Environment Agency⁽⁷⁾, where contaminated water could potentially impact aquatic ecosystems.

If the initial screen identifies potential risks associated with impacted groundwater on the site, it is necessary to more accurately assess the risks to the wider groundwater and surface water environment by determining the concentration of pollutant likely to be

encountered at the relevant points of exposure (POEs), which could be a nearby river, an underlying aquifer etc. This is carried out using computer modelling using site data and the appropriate methods of modelling are described in R&D 20 ⁽⁸⁾. Modelled concentrations at the relevant POE are then compared to relevant groundwater screening values and risks are assessed.

2.4 BACKGROUND TO GROUND GAS ASSESSMENT

Filled ground/made ground has the potential to generate and emit ground gases such as carbon dioxide and methane, which may be hazardous in certain concentrations in certain situations.

The approach to dealing with elevated concentrations of ground gases has changed recently. The current approach requires a risk-based assessment in interpreting the findings of a gas monitoring survey and has been developed to prevent over-engineering of buildings where there is very low risk.

For commercial developments, guidance on the requirement for gas measures is provided in CIRIA Report C659 ⁽⁹⁾, which has been used to assess the requirement for ground gas ingress prevention measures at the site.

3. SITE INFORMATION

The information contained in this section has been compiled from recent RSK site visits and a review of the previous reports described in Section 4.

3.1 LOCATION AND DESCRIPTION OF SITE

The Phase 3 area ('the site') lies in an area of predominantly open grassed land and may be located by National Grid reference 435760 401470. A site location map is presented as Figure 1. The site and the position of the proposed units are shown in Figure 2.

The site forms the southeastern portion of the Shortwood Business Park. The Phase 3 area is bounded to the north by Upper Hoyland Road, with an area of land proposed for a hospital redevelopment beyond (N.B. this is not yet developed). It is bounded to the east by Upper Hoyland Road with High Royd Farm beyond and to the south by the Dearne Valley Parkway with open land on the other side. To the west of the site is the access road into the business park, with Phase 1 of the business park (recently developed with three commercial units) beyond.

The ground level rises gently from the northern end of the site to the centre of the site, then rises more steeply from the centre of the site to the main road along the southern boundary.

3.2 HISTORY OF SITE

The Shortwood Business Park site comprises an area formerly occupied by part of the High Royd Colliery, part of the Rockingham opencast site and the Hepworth brickworks. The site has been used previously for clay removal for brick manufacture, two phases (in the 1960s and 1990s) of open cast coal extraction and older deep coal mining.

Some infilling of excavations occurred following the earlier phase of mining activity and more recently when the site was restored to approximately original levels with overburden material between 1994 and 1996 by Mott MacDonald. This more recent infilling took place on a compaction base of either rockhead or old fill materials. The areas of the two types of compaction base are shown on drawings provided at the time of reinstatement: Hepworths Base Levels plan IV, 1996 and Hepworths Base Areas plan III, 1996.

The approximate areas of the two types of compaction base (taken from the two Hepworths drawings) are shown on Figure 2. Generally, over the northern half of the site, new fill was placed directly onto older fill materials and over the southern half of the site new fill was placed directly onto rockhead.

The type of compaction that the old and new fill was subject to over the Phase 3 area is unknown. High walls (steep sides of excavations) from previous coal mining activity exist beneath the Phase 3 area, within both rock and old fill materials.

Further details of the history of the Shortwood Business Park site may be found in RSK previous report reference 10568R4(00), dated July 2004.

3.3 GEOLOGY, HYDROLOGY AND HYDROGEOLOGY OF SITE

Geology

Available geological records for the area ⁽¹⁰⁾ indicate the site to be underlain by Shales, Sandstones and Mudstones of the Middle Coal Measures of Upper Carboniferous age at the approximate lithological horizon of the Kents Thin and Kents Thick Coal Seams. Both the Kents Thick and Kents Thin seams have been worked in the area by open cast methods. In Phase 3 only the Kents Thin seam has been worked in this manner.

Hydrology

The site lies at an elevation of approximately 128m AOD. Ground levels rise by approximately 8m from the northern boundary to southern boundary.

An old balancing pond is located approximately 100m to the west of the Phase 3 area and the new one is located approximately 20m to the north of that. The new balancing pond receives surface runoff and shallow perched water from the surrounding soils. The water levels in the old and new ponds were approximately 5m and 3m below the surrounding ground level respectively at the time of the site works.

Shortwood Dyke lies approximately 500m northwest of the site and appears to drain in a northeasterly direction, but (with the exception of the balancing ponds) there are no other significant water features within 500m of the site.

Hydrogeology

The Groundwater Vulnerability Map⁽¹¹⁾ shows the site as 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. Therefore the vulnerability of the groundwater to possible contamination at the site is considered to be relatively low.

3.4 MINING HISTORY

With reference to the South Yorkshire Mining Advisory Service Mineral Report provided to ENSR International (former name of RSK) dated 09/07/1996 during previous involvement at the site, the following comments are made regarding previous coal extraction at the site:

In the Phase 3 area the Kents Thin Seam was subject to open cast extraction between 1961 and 1962. This report does not refer to any extraction of the Kents Thick seam from the Phase 3 area.

According to the Mineral Report, the land 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 resulting at the surface in association with this mining activity would have been complete over 20 years ago (from 1996).

A second phase of coal extraction occurred at the Shortwood business park site in the 1990s. From the records available it does not appear that coal was extracted from the Phase 3 area, however a haul road was excavated, which crossed the northwestern corner of the Phase 3 area.

4. PREVIOUS INVESTIGATIONS

RSK (formerly RSK ENSR and ENSR International) has been involved with the former brickworks site and the current Shortwood Business Park site since before the restoration works were carried out by Mott MacDonald to reinstate ground levels in 1997.

Information from the following previous reports was considered relevant when scoping this investigation and compiling this report.

ENSR International, Site Contamination Audit of the Former Upper Hoyland Brickworks for Hepworth Properties Limited – reference 60017, June 1997.

Desk study and site investigation carried out over the area of the former brickworks located to the northwest of the Phase 3 area.

Mott MacDonald report on behalf of RJB Mining (UK) Limited, Rockingham Open Cast Coal Site Compaction of Backfill on Hepworth Properties Land, July 1997.

A report on infilling and compaction works carried out on the site to reinstate ground levels between 1994 and 1996. It contains various 'Hepworth Plans', including the Hepworth Base Levels plan (16 October 1996) and Hepworth Base Areas plan (7 October 1996), which have been referred to in this report. Various high walls are indicated on the plans, and their approximate locations in the Phase 3 area have been incorporated into the Site Plan, Figure 2 for illustrative purposes only (these positions should not be relied upon).

RSK ENSR Limited, Site Investigation and Settlement Monitoring, Shortwood Business Park, Hoyland, reference 10568R4(00), dated 27 July 2005

Site investigation and surcharge pilot testing over the Phase 2 area.

RSK ENSR Limited, Phase One Units 1 to 3 Surcharge Works, Shortwood Business Park, Hoyland, reference 10684R1(02), dated 23 May 2005

Surcharge works carried out over the areas of Units 1 to 3 on the Phase 1 area.

5. CONSULTATION WITH BRE

Due to the complexity of the ground conditions at the Shortwood Business Park site, representatives of the Buildings Research Establishment (BRE) have been involved in foundation assessment work on the adjacent Phase 1 area (and proposed Phase 2 area). With respect to the Phase 3 area, BRE were consulted by RSK in November 2006 to discuss the proposed scope of site investigation works and in January 2007 to discuss the results of the site investigation works and the way forward for the development of the Phase 3 area.

6. INITIAL SITE CONCEPTUAL MODEL

In accordance with the Model Procedures for the Management of Land Contamination ⁽¹⁾, the information from the desk study and previous site visits was used to generate a preliminary risk assessment (PRA) to determine the likely contamination risks associated with the site. As part of the PRA, an initial conceptual site model (CSM) was produced to illustrate the potentially complete source-pathway-receptor linkages likely to be present at the site. The initial CSM was then used to design an intrusive investigation that would provide the required information about the presence or absence of the identified potential pollutant linkages so that a revised conceptual model could be produced, which would be based on actual site data.

The potential sources, pathways and receptors identified by the initial CSM are discussed in turn below. The site investigation that was carried out is described in Sections 7 to 9 and the revised CSM is discussed in Section 11.4.

6.1 POTENTIAL SOURCES OF CONTAMINATION

The site has been used previously for the extraction of clay and coal. After the coal mining activity ceased, ground levels were restored and the land does not appear to have had any specific use since this was carried out. In the light of the site history it is considered that the potential sources of contamination on the subject-site are likely to be associated with the fill materials.

Potential On-Site Sources

- Possible contaminated materials within fill materials; and
- Ground gas (carbon dioxide and methane) in filled areas.

Potential Off-Site Sources

- The land immediately surrounding the site has been used for coal mining but no other industrial activities. The ground has been reinstated with reworked colliery waste, which has the potential to generate carbon dioxide;
- There is an old tip located on the northern boundary of the northeastern quarter of the business park site, which has the potential to generate ground gases; and
- The area of the old brickworks (with two disused coal mining shafts) lies off the subject site 100m to the northwest.

6.2 SENSITIVE RECEPTORS

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

- Future users of the site;
- Construction workers at the site;

- Neighbouring residents;
- Groundwater in the minor aquifer beneath the site; and
- Water in the new balancing pond.

6.3 MIGRATION ROUTES

The routes by which the potential sources could come into contact with the potential receptors identified above are:

- Dermal contact with contaminated soils;
- Ingestion of contaminated soils;
- Leaching of contaminants from soils to water;
- Migration of impacted water to minor aquifer or pond water; and
- Migration of ground gas or vapours and inhalation by humans.

In order to confirm the presence or absence of the potential contamination sources identified in the initial conceptual model and to provide further information on migration pathways and receptors, a programme of intrusive site work, monitoring and laboratory testing was carried out. The site work carried out and the findings are discussed in detail in the following sections of this report.

7. SITE WORK

The site work was performed in order to provide accurate information about the ground conditions and depth of fill materials over the Phase 3 area. It was also performed to provide information on contaminants present at the site so that a revised conceptual site model could be produced.

The site work on Phase 3 was carried out by RSK between 13 November 2006 and 27 February 2008. The site work included the excavation of trial pits, drilling of rotary boreholes, ground gas monitoring, groundwater sampling and groundwater gauging. The site work carried out is summarised in the table below and the locations of the trial pits, boreholes and settlement monitoring pins are shown on Figure 2.

Date	Activities	Company
Site Investigation		
13/11/06	Excavation of sixteen trial pits TP101 to TP116	Supervised by RSK
20/11/06 to 27/11/06	Drilling of six rotary boreholes BH201 to BH206 and installation of monitoring wells in all boreholes except BH203.	Supervised by RSK
29/11/06	Gas monitoring and groundwater gauging	RSK
05/12/06	Gas monitoring and groundwater gauging	RSK
21/12/06	Gas monitoring and groundwater gauging	RSK

Date	Activities	Company
09/01/07	Gas monitoring and groundwater gauging	RSK
16/01/07	Gas monitoring and groundwater gauging	RSK
22/01/07	Gas monitoring and groundwater gauging	RSK
<i>Surveying and Levelling of Settlement Monitoring Pins</i>		
13/11/06	Location of 6 existing permanent ground markers (PGMs)	Cheshire Surveys for RSK
22/11/06	Survey of PGMs and trial pit locations	Cheshire Surveys for RSK
28/11/06	Finish surveying of PGMs and trial pits	Cheshire Surveys for RSK
15/01/07	Levelling of PGMs	Cheshire Surveys for RSK
02/03/07	Levelling of PGMs	Cheshire Surveys for RSK
05/04/07	Levelling of PGMs	Cheshire Surveys for RSK
26/02/08 to 27/02/08	Excavation of sixteen trial pits TP1 to TP16	Supervised by RSK

7.1 TRIAL PITS

Sixteen trial pits (TP101 to TP116) were excavated using a 22 tonne tracked excavator in November 2006. A further sixteen trial pits (TP1 to TP16) were excavated using a 16 tonne tracked excavator in February 2008. Selected soil samples were taken for laboratory analysis. Descriptions of the strata encountered together with comments on groundwater conditions and pit stability are given in the trial pit records presented in Appendix C.

The trial pits excavated in November 2006 were surveyed to confirm the lateral position and elevation. Prior to the excavation of trial pits in February 2008, the corners of the proposed buildings, as provided on Wm Saunders Partnership proposed development plan, dated January 2008, were marked out on site with pegs by a surveyor. The top of each peg was also provided with the elevation above Ordnance Datum. The trial pits were then located to specifically assess the ground conditions close to each proposed building.

7.2 BOREHOLES

Six boreholes (BH201 to BH206) were sunk using rotary methods. Open hole drilling was performed through the fill materials where possible (where the sides of the borehole remained stable), however, in some cases the holes required casing through the made ground to prevent collapse. When it was considered rock head had been reached, several metres of rock were cored (except in borehole BH201 due to collapse of fill materials) and examined to ensure that natural strata had been proven. Drilling was progressed until rock head was encountered.

The depths of the boreholes, descriptions of the strata encountered and comments on groundwater conditions are given in the borehole records presented in Appendix D.

7.3 INSTALLATION OF MONITORING WELLS

Perforated standpipes (53mm diameter) were installed in all boreholes except one (BH203) to enable future monitoring of ground gas concentrations and flow rates and groundwater levels.

The standpipes were surrounded by pea gravel and sealed at the surface with bentonite pellets. Gas valves were fixed to the top of the installations, which were left protruding from the ground a little to enable identification during monitoring visits.

Details of the installations are given on the respective records presented in Appendix D.

8. MONITORING

8.1 GAS MONITORING

Return visits were made to site on six occasions between 29 November 2006 and 22 January 2007 to monitor the installations for ground gases.

Concentrations of methane, carbon dioxide and oxygen were recorded using an infrared gas analyser. Both peak and steady concentrations were recorded along with atmospheric pressure and weather conditions.

Flow rates of gas from the installations were recorded using a mass flow balance transducer. The results of the gas monitoring are given in Tables 1 to 6.

8.2 GROUNDWATER MONITORING

Water levels in the standpipes were recorded using a dip meter during the gas monitoring visits. The results are given in Tables 1 to 6.

The distance from the top of well casing (TOC) to ground level was measured for each installation on one occasion and on subsequent visits groundwater levels were recorded relative to this level.

The groundwater elevations in the monitoring wells across Phase 3 have been calculated based on the ground levels shown on WmSP drawing SL7313(SY)01A Rev A (Aug 2001) and are presented in Appendix E.

One groundwater sample was placed into a one litre glass bottle using a disposable plastic bailer for laboratory analysis.

8.3 SETTLEMENT MONITORING

The surveyors used a total monitoring station to record the level of each of the six PGMs located on Phase 3 at monthly intervals, starting on 29 November 2006. The surveyors had originally monitored the PGMs in April 2004, when a number of them were installed. Recent monitoring has been carried out on the following four occasions:

- 29 November 2006
- 15 January 2007
- 2 March 2007
- 5 April 2007

The results of the PGM level monitoring to date are given in Appendix F.

9. LABORATORY TESTING

All testing has been carried out at UKAS-accredited laboratories following MCERTS procedures where appropriate.

9.1 CONTAMINATION ANALYSES

Chemical analyses were carried out on number of representative samples of the made ground and natural soils as follows:

- 6 soil samples from trial pits were analysed for a suite of contaminants including pH, total sulphate, water soluble sulphate and total metals (arsenic, cadmium, chromium (total and hexavalent), copper, mercury, nickel, lead, selenium and zinc). The results of these analyses are presented in Table 7.
- 6 soil samples from trial pits were analysed for total petroleum hydrocarbons (TPH). The results are included in Table 8.

9.2 GEOTECHNICAL TESTING

An assessment of the potential for chemical attack on buried concrete based on current BRE guidance ⁽¹²⁾ was carried out.

The following samples were tested for soluble sulphate (soil) and dissolved sulphate (water) concentrations using the BRE method.

- 6 soil samples from trial pits. The results are included in Table 7.
- 1 groundwater sample from monitoring well BH201. The results are included in Table 9.

10. FINDINGS OF THE INVESTIGATION

10.1 GROUND CONDITIONS

The ground conditions encountered in the investigation have been evaluated taking into account the Hepworth plans and records of the extraction and reinstatement works that have been carried out over the Phase 3 area. This indicates that the northern half of the site contains new fill materials (placed in the 1990s) on top of old fill (placed at an unknown time) and that the southern half of the site contains new fill on bedrock. The approximate locations of the high walls identified from the Hepworth plans are shown on the Site Plan, Figure 2 for illustrative purposes only.

All intrusive investigation locations are indicated on the Site Plan, Figure 2 along with the depths to natural strata / rockhead encountered in each location.

The depths to natural strata / rockhead have been converted to elevations in metres above Ordnance Datum (mAOD) using elevations provided in the WmSP topographic survey (drawing SL7313 (SY)01A Rev A Aug 2001), which has been incorporated into RSK Figure 2. The elevations of trial pit locations provided by Cheshire Surveys during their survey of 29 November 2006 are also provided. Additionally, the stratum depths provided in trial pits (TP1 to TP16) excavated in February 2008 have been converted to elevations from survey information provided on the pegged-out proposed building locations. The elevations at which natural strata was encountered at each intrusive location are presented in Figure 2 and the depths and elevations are given in Appendix G.

For the purposes of this discussion the Phase 3 area will be divided into northern and southern halves. The northern half contains proposed units 1 and 2 and the southern half contains proposed units 3, 4, 5 and 6 (see Figure 2). The implications for the proposed site layout are given in Section 12.

Southern Half of Phase 3

Made ground was encountered in all intrusive locations over the southern half of the site, with the exception of TP15. The depth of made ground typically increases from the north west to the south east. The shallowest made ground was encountered in trial pit TP107 (0.05m) and the deepest made ground was encountered in borehole BH201 (6.40m). However, the trend of made ground increasing to the south east was not supported in trial pits TP7 and TP8, which proved made ground to a depth of 1.1m and 2.1m, respectively.

The made ground comprises loose to moderately compact / firm to stiff gravel or gravel and cobbles in a clay matrix with occasional boulders in some locations (reworked

mudstone). This material is very similar to the fill materials encountered in Phases 1 and 2 of the development.

Rockhead was encountered beneath the made ground in all locations over the southern half of the site except TP10 and TP104. The encountered bedrock typically comprised very weak weathered to very weathered orange grey mudstone and sandstone.

The elevation of the rockhead typically decreases (i.e. rock gets deeper) from west to east over the southern half of the site. However, trial pit TP7 and the northern end of trial pit TP8 indicate the bedrock to become locally deeper in the north western corner of this part of the site. The elevation drops by approximately 1.30m between trial pit TP107 (western side) and trial pit TP105 (eastern side) and it drops by approximately 6.00m between trial pit TP101 (western side) and borehole BH201 (eastern side). There is also a drop of approximately 3.00m from south to north at the western side of the area and a locally deeper area in the north western corner indicated by a difference in elevation of 2.5m between trial pits TP107 and TP7.

Rockhead is at its lowest elevation at the southeastern corner of the southern half of the site, which is consistent with there being a high wall within the rock along the southeastern boundary of the site according to the Hepworth Base Levels plan (plan of October 1996). This high wall is indicated on the Site Plan, Figure 2.

Northern Half of Phase 3

Made ground was encountered at all intrusive locations to depths of between 0.60m and 11.30m below current ground levels. At the northwestern and eastern corners of the northern half of the site, made ground was encountered to relatively shallow depth (2.80m and 0.60m respectively). However, over the rest of the northern half of the site made ground was indicated at depths of between 3.00m (BH206) and 11.30m (BH204).

In several of the trial pits more than one distinct layer of made ground was encountered. The upper layer was generally described as gravel and cobbles in a clayey matrix, while the lower layer was a very similar material within a more sandy matrix (reworked mudstone in both cases). Occasional boulders were encountered in both materials. The distinct layers described above may correspond to the new and old fill materials placed over this part of the site. Both materials are similar to the fill encountered on the Phase 1 and 2 areas of the development.

In several locations the reworked mudstone contained variable amounts of other materials including concrete boulders (TP108, TP109 and possibly BH204), brick fragments (TP109), clinker fragments (TP1) and metal pieces (TP110). This material is probably old fill.

Natural rock was encountered in eight trial pits (TP1-TP4, TP6, TP14, TP115 and TP116) at depths ranging between 1.50m and 3.60m and in all boreholes at depths of between 1.20m (BH203) and 11.30m (BH204). This comprised very weak very weathered orange grey mudstone and sandstone.

Summary

In summary, new fill materials are present on top of bedrock over the southern half of the site and new fill materials are present over older fill materials in the northern half of the site. Fill materials are deepest in the southwestern corner of the northern half of the site. Over the southern part of the site, rockhead dips down from the western half of the site to the southeastern corner.

The new and old fill materials are not easily distinguishable and are similar to fill materials encountered across the Phase 1 and Phase 2 areas of the business park.

Several buried high walls cut into rock are understood to exist over the Phase 3 area. The intrusive investigation has partially confirmed the presence of the high walls. Only the depth to natural deposits/bedrock can be confirmed and whether the inferred high walls are likely to have a detrimental affect on the proposed development. The lateral position of high walls were indicated in the following places, with the depth to walls based on the investigation findings (see Figure 2: Site Plan):

- Along the eastern site boundary, dipping from road level to a maximum depth of approximately 6.5m below ground level at the southeastern corner of the site.
- Along the northern site boundary, dipping from road level to a maximum depth of more than 4.90m at the northeastern corner of the site.
- Through the centre of the site from west to east, dipping from approximately ground level to a maximum depth of more than 11.0m below ground level at the western end and 3.0m below ground level at the eastern end.

Another buried high wall is inferred to exist at the northwestern boundary of the site.

The ground conditions encountered during the intrusive investigation appear to be consistent with the ground conditions illustrated on the Hepworth drawings, with the exception of boreholes BH204 and BH205. Borehole BH204, in particular, indicates the depth of made ground to be about 5m greater than that shown on the Hepworth drawings and in borehole BH205 by possibly 2m to 3m. A possible reason for these anomalies is the method of drilling employed. The boreholes were advanced through the made ground by rotary open hole techniques using a rock roller bit to the point that the driller thought they had hit solid strata. At this stage core drilling was performed to confirm the presence of rock. The rock roller drilling is the only practical method of

penetrating the made ground but determination of the strata largely has to be based upon the drillers judgement. When the rock is relatively weak, it is quite possible he will not have picked up the base of the made ground and inadvertently extended the rock roller drilling too far.

10.2 SELF-WEIGHT SURFACE SETTLEMENT MONITORING

A number of permanent ground markers (PGMs) (referenced 50F, 51, 52, 53F, 67 and 68) have been installed on the Phase 3 area to monitor self-weight surface settlement: PGMs 50F and 53F are original markers that were installed by RJB Mining in 1997; PGMs 51 and 52 are new markers, installed by RSK in 2003 to replace two original RJB markers that had been lost (51F and 52F); and PGMs 67 and 68 are new markers installed by RSK in 2003.

The levels of PGMs 50F and 53F (and the old markers 51F and 52F) were monitored by RJB four times in 1997. Surface settlement was not observed over this period, and due to the use of an unknown benchmark, these results did not tie in with the subsequent monitoring of PGMs 50F and 53F by RSK.

All six of the PGMs were monitored by RSK between November 2003 and April 2004 and the results were reported in RSK report reference 10568-4 (00). Self-weight surface settlement monitoring was not observed on the Phase 3 area in 2004.

The monitoring results to date are presented in Appendix F.

Reference to the results indicates that from 14 April 2004 to 5 April 2007 one PGM has gone down by 4mm; one PGM has gone up by 4mm; one has shown no change; and the other three have gone down by 1mm or 2mm. This indicates that there has been effectively no settlement over this time period.

10.3 GROUND GAS

Negligible concentrations of methane were encountered on all occasions in all monitoring wells.

Steady carbon dioxide (CO₂) concentrations of more than 4.0% by volume were encountered in four of the five monitoring wells (not BH206) on one or more occasions. Concentrations of between 2%v/v and 5%v/v were encountered regularly and occasional negligible concentrations were recorded. The maximum recorded concentration was 6.4% in borehole BH201.

Depleted concentrations of oxygen were encountered where elevated carbon dioxide was recorded.

Gas flow rates were generally low or negligible.

An assessment of the risks associated with ground gas at the site is given in Section 11.3.

10.4 GROUNDWATER LEVELS

Measured groundwater levels and calculated elevations relative to Ordnance Datum are presented in Appendix E.

Groundwater depths did not vary significantly with time over the monitoring period.

Groundwater elevations decrease from the southeastern corner of the site towards the northwest. The groundwater elevations appear to indicate that either:

- The water beneath the site is present as isolated pockets of perched water within the made ground with elevations decreasing to the northwest; or
- The groundwater is present as a single connected body beneath the site with a gradient of approximately 0.1 from the southeastern corner (BH201) to the northwestern corner of the site (BH204) (this calculation is given in Appendix E). This situation is considered unlikely.

11. GENERIC QUANTITATIVE RISK ASSESSMENT

In order to determine if the concentrations of determinands encountered in the soils and groundwater represent a risk to human health or controlled water a Generic Quantitative Risk Assessment (GQRA) has been carried out.

The GQRA compares analysis results with generic screening values for each determinand. Where the concentration exceeds the screening value, an exceedance is noted and comments are made.

11.1 HAZARD ASSESSMENT OF SOILS

The results of the contamination analyses of soils from the trial pits have been compared with the soil generic assessment criteria (GAC) described in the table in Section 2 (for Commercial end use) to establish whether a hazard in the source/pathway/receptor linkage is likely to be present.

Metal Contaminants

The results of the metals analysis and the comparison to the soil generic assessment criteria are given in Table 7.

There were no exceedances of the GAC for any of the determinands tested based on Commercial end use GACs.

Organic Contaminants

The results of the total TPH analysis on soil samples and the comparison to the soil generic assessment criteria are given in Table 8.

All of the soil samples tested for total TPH returned concentrations below the detection limit and the screening value.

pH and Sulphates

The results of the pH, total sulphates and soluble sulphates analysis on soil samples are presented in Table 7.

The results show that the soil samples tested were generally slightly alkaline. One sample had a slightly acidic pH value.

Total sulphate concentrations were generally below 2000mg/kg.

It is well documented that colliery waste is sometimes acidic with elevated concentrations of sulphates, which are phytotoxic. The samples tested generally did not have acidic pH values or high sulphate concentrations, however, topsoil should be imported to site to provide a suitable growing medium for landscaped areas during redevelopment.

11.2 HAZARD ASSESSMENT OF GROUNDWATER

Since evidence of contamination within the made ground and natural soils was not encountered during the site investigation, groundwater samples were not removed for chemical analysis.

The chemical analysis of soil samples indicates that there is no significant contamination source present within the soils at the site. Based on the soil testing results and the site history, it is considered very unlikely that there is a contamination hazard associated with the groundwater at the site.

11.3 HAZARD ASSESSMENT OF GROUND GAS

Based on the gas monitoring results obtained (see Tables 1 to 6) the risk of explosion due to accumulation of methane within the proposed buildings is considered to be negligible. However, there may be a risk associated with accumulation of carbon dioxide in the proposed buildings. This is examined further according to current guidance below.

With reference to CIRIA C659 ⁽⁹⁾ Table 8.5 (the current guidance), using the highest carbon dioxide concentration and gas flow rate (6.4% and 1.0l/hr) (recorded on 29 November and 22 January 2007, respectively) this gives a Gas Screening Value of $0.064 \times 1.0 = 0.064 \text{ l/hr}$. This categorises the site as CS1 (very low risk). Based on Table 8.6 in the guidance, remedial measures to prevent the ground gas ingress are not required for CS1 sites. Therefore no special precautions are required for the Phase 3 area with regard to protection of buildings.

However, suitable precautions should be taken if construction workers are required to enter excavations to prevent inhalation of elevated carbon dioxide concentrations. These are described fully in Section 12.4.

11.4 REVISED CONCEPTUAL SITE MODEL

Following the site work and laboratory testing, the initial CSM outlined in Section 6 has been revised using actual data for the site. The sources, pathways and receptors considered to be present at the site are listed below.

Sources

The following sources have been identified at the site during the site investigation works:

- Elevated concentrations of carbon dioxide gas within soils associated with generally low flow rates and depleted concentrations of oxygen.

Receptors

The following potential receptors are identified for the site based on the sources above:

- Construction workers.

Pathways

The following potential pathways may be relevant at the site:

- Migration of ground gas through permeable soils into excavations followed by accumulation and inhalation of carbon dioxide by humans.

Assessment of Pollutant Linkages and Potential Risks

The results of the site investigation indicate that there may be a potential risk to future site workers due to entry and accumulation of carbon dioxide in excavations. The details of how to control this risk are given in Section 12.4.

There do not appear to be any other complete pollutant linkages or potential risks to any receptors.

12. GEOTECHNICAL ASSESSMENT

12.1 GROUND CONDITIONS BENEATH UNIT AREAS

Within this section ground conditions are considered for each block of proposed units (1, 2, 3, 4, 5 and 6) in turn. The locations of the units and selected information on encountered ground conditions are indicated on the Site Plan, Figure 2. It is understood that the layout shown is proposed to be the final layout but will only be subject to change, if necessary.

Unit 1

The depth of made ground beneath the proposed finished floor level (129.50m) of this unit varies between 2.00m at the eastern edge (TP14) to 12.10m beyond the western wall (BH204). However, trial pits TP1, TP2, TP5 and TP6, which are located close the footprint of the building indicate made ground to vary in thickness between 1.55m (TP6) and 4.70m (TP1). As discussed in Section 10.1 above, due to the method of drilling and similarity of made ground and natural strata it is possible that the recorded depth to bedrock was misinterpreted in borehole BH204. This is supported by the significant variance in depth to natural deposits recorded in BH204 and the trial pits listed above. It is therefore considered unlikely that bedrock is greater than 4.7m below the proposed finish floor level of this unit.

Unit 2

The depth of made ground beneath the finished floor level (128.75m) of this unit varies between approximately 1.25m at the south western corner (TP14) and 6.25m beneath the western end of the building (BH205). However, exploratory holes BH206 and TP3, located at the eastern end of the proposed building, indicate made ground thickness of 3.55m and 1.60m, respectively. Sandstone bedrock was encountered at a depth of 3.30m below the proposed finish floor level of the plot in trial pit TP3. As with the ground

conditions discussed for Unit 1, the depth to bedrock indicated in the borehole log for BH206 does not appear consistent with the trial pits located in the vicinity of Unit 2. It is considered unlikely that bedrock will be encountered at depth greater than 4.0m below the proposed finish floor level of Unit 2.

The proposed position of this unit's south eastern corner is close to the inferred location of a buried high wall within the rock. However, the ground conditions described in trial pit TP4, which is located approximately 5m to the south of this building corner, indicates made ground to be approximately 1.0m thickness and underlying bedrock 1.85m below the proposed finish floor level.

Unit 3

The depth of made ground beneath the proposed finished floor level (129.25m) of this unit ranges from 0.20m (TP13) along the western building edge to 1.20m (TP12) along the eastern building edge. Highly weathered mudstone and weathered sandstone bedrock was encountered approximately 0.90m (TP13) and 0.60m (TP12) below the base of the made ground materials.

Unit 4

The depth of made ground beneath the finished floor level (130.75m) of this unit ranges between 0.85m (TP9) in the south western corner and 2.70m (TP11) in the north eastern corner. However, the nearest exploratory hole that penetrated the made ground deposits to the south east of the proposed building was BH201. This exploratory hole indicates the depth to bedrock beneath the finished floor level to be 3.75m.

Unit 5

The depth of made ground beneath the finished floor level (131.50m) of this unit ranges between 1.70m (TP15) and 1.95m (TP106) at the northern end. At the southern end of the unit the depth of made ground ranges from approximately 0.0m (TP16) to 1.6m (TP9) from west to east, with bedrock directly underlying this stratum at both locations.

Unit 6

The depth of made ground beneath the finished floor level (131.50m) of this unit is indicated to range from approximately 2.20m (TP8) and 2.65m (TP7) close to the northern end. However, due to the rise of ground levels to the south the bedrock surface is indicated to be approximately 1.50m above the proposed finished floor level.

12.2 REQUIRED ACTION AND GROUND TREATMENT

Units 1, 2 and 4 are underlain by about 2m to 5m thickness of new and old made ground. The investigations confirmed these materials to be of a similar nature to those encountered on phases 1 and 2 of the development. As a consequence it can be expected that there will be significant and unpredictable settlement under loading. To minimise the risk of excessive differential settlement, ideally the made ground should be treated over the plan areas of the building using surcharging techniques similar to those employed on phases 1 and 2. However, it is understood that material is not available to provide the surcharge loading. As a consequence lesser treatment methods will have to be adopted.

Following surcharging, the treatment method that has been demonstrated to achieve the greatest depth of influence is dynamic compaction (DC). Full scale DC is unlikely to be a practical option at the site and hence dynamic tamping should be considered. This treatment should be carried out over the entire plan area of the buildings and extending 2m beyond the foundations. Evidence from field trials undertaken by BRE indicates that in ideal conditions this technique can improve soils down to about 4m to 5m. However, the heterogeneous and clayey nature of the opencast backfill at this site is not ideal and lesser depths of treatment can therefore be expected. As a consequence the potential for excessive settlement will be reduced but not necessarily entirely eliminated. It is therefore recommended that after treatment spread footings are used to support the portal structures. To limit potential differential movement, it would be prudent to design the footings as lightly reinforced strips extending around the entire perimeter of the buildings. Such footings may be placed at a minimum depth of 900mm below final ground level and designed to an allowable net bearing pressure of 150kN/m². Notwithstanding the allowable net bearing pressure, it would be prudent to adopt a minimum foundation width of 1.5m in case there remains any metastable risk following the ground treatment. The floor slabs will have to be ground bearing but again there is risk of settlement. In order to reduce the risk of damage the reinforced floor should be cast in bays with dowel connections to prevent stepping between them.

Units 3, 5 and 6

Rockhead will be present between formation level and a maximum depth of about 2.7m. In these conditions it is recommended that the ground is reduced to formation level in order to identify the area when rockhead is present. The remaining areas of the buildings should be treated using dynamic tamping as described for units 1, 2 and 4 above.

The portal structures may be supported on spread foundations. These may either be placed at a consistent depth of 900mm below final ground level or stepped down to ensure they all are placed on the natural rock. The latter solution will entirely eliminate the risk of differential settlement but will require excavations of up to 2.7m. If this

approach is adopted an allowable net bearing pressure of 200kN/m² may be safely adopted. However, if it is decided to keep the foundations at one level the bearing pressure should be limited to 100kN/m² when the footings are placed on the made ground.

The dynamic tamping should sufficiently improve the made ground to eliminate the risk of excessive settlement of ground bearing floor slabs. However, there is likely to be some differential movement resulting from the varying thickness of supporting fill. It would, therefore, again be prudent to cast the slabs in bays with interconnecting dowels.

12.3 INFRASTRUCTURE

Road Construction

The ground conditions were not suitable for the use of in situ California Bearing Ratio (CBR) tests using the Mexecon Penetrometer. However, based on visual examination of the ground conditions, it is recommended that road pavements should be designed on a CBR value of between 2 and 5 per cent. All surface and any underlying 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.

Buried Services

All trial pit excavations remained stable; it is therefore considered that there will not be problems with collapse of shallow excavations during the installation of buried services. However for deep services there may be some collapse and indeed excavation may prove difficult and some over-dig should be expected.

It is considered that in most excavations standing water will not be present however given the generally low permeability nature of the soils some allowance should be made for pumping water from sumps.

The gas monitoring exercise has revealed elevated carbon dioxide concentrations within the monitoring standpipes in the Phase 3 area. If man-entry into any excavations greater than 1.2m in depth is required, then advanced and ongoing monitoring of oxygen concentrations and hazardous ground gases should be carried out and breathing apparatus should be available, to protect workers from inhalation of elevated concentrations of carbon dioxide.

It is recommended that, where possible, service entries and connections are designed to include flexible joints (to accommodate any small scale future settlements).

General Comments

It is considered unlikely, but if any intact coal seams are exposed during redevelopment works it is recommended that the coal is blinded off using a weak mix concrete or other suitable inert material to prevent future combustion.

Landscaped areas will require a cover of suitable imported topsoil to promote vegetation growth.

12.4 CHEMICAL ATTACK ON BURIED CONCRETE

This assessment of the potential for chemical attack on buried concrete is based on current BRE guidance ⁽¹²⁾ and the ground conditions currently present on site.

For the purposes of this assessment of the aggressive chemical environment, the site should be considered as a Brownfield development. A suite of chemical analyses appropriate to this site classification was carried out on soil and groundwater samples. The results of these analyses are included in Tables 7 and 9.

The maximum water-soluble sulphate content in soil of 0.150g/l has been taken as the characteristic value. As this value is below the limiting value of 3.0g/l consideration of magnesium is not required. Based on Table C2 in the guidance, result one for Design Sulphate Class for the site is DS-1.

The water-soluble sulphate content in groundwater of 0.674g/l has been taken as the characteristic value. As this value is below the limiting value of 3.0g/l consideration of magnesium is not required. Based on Table C2 in the guidance, result two for Design Sulphate Class for the site is DS-2.

From consideration of results one and two a Design Sulphate Class of DS-2 may be adopted for the site.

For the purposes of this assessment, the site has been classified as Brownfield. It has been assumed that groundwater conditions are mobile.

From consideration of the characteristic pH value, an Aggressive Chemical Environment for Concrete Classification of AC-2 may be assumed for design purposes.

13. WASTE CLASSIFICATION

Any material proposed for off-site disposal during development works should be given a proper description and waste classification as required by the Environmental Protection (Duty of Care Regulations) (1991).

To determine the likely waste classification of the soils beneath the site, the chemical analysis results for samples of the waste materials should be assessed using the criteria set out in Environment Agency Technical Guidance WM2 ⁽¹³⁾. According to this evaluation, the soils encountered during the site investigation would likely be classified as either Inert or Non-Hazardous for waste purposes.

If, during redevelopment, contaminated wastes are encountered that are classed as Hazardous according to the above guidance, these materials will require disposal and the receiving landfill site may require appropriate Waste Acceptance Criteria (WAC) testing results.

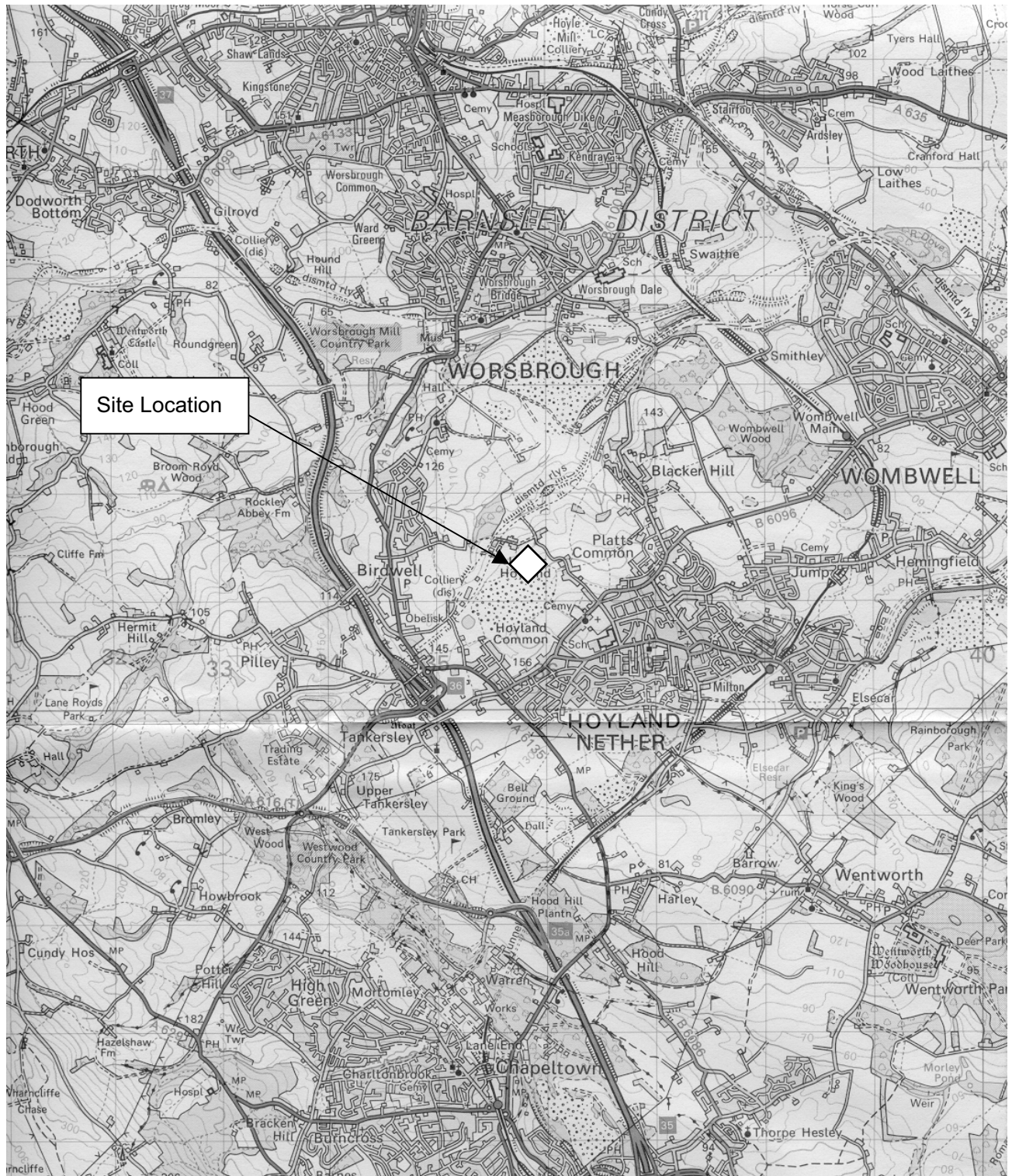
It should be noted that irrespective of the classification of the waste in accordance with document WM2, landfill-site specific conditions could restrict the types of wastes that sites can accept.

14. REFERENCES

1. Model Procedures for the Management of Land Contamination. Contaminated Land Report 11 (CLR 11). Published by DEFRA and the Environment Agency, September 2004.
2. Department of the Environment CLR Report No. 10. The Contaminated Land Exposure Assessment Model (CLEA): Technical basis and algorithms, Contaminated Land Research Report No. 10, London; Department of the Environment, March 2002.
3. Contaminants in soils; Collation of toxicological data and intake values for humans, R&D Publication TOX 1-10,11,12,14,16,17,18,19,20,21,22,23,24 and 25, Environment Agency, Bristol, ISBN 1 857 05742 2, 2002 to 2005.
4. Soil Guideline Values for Arsenic contamination; Soil Guideline Values for Cadmium contamination; Soil Guideline Values for Chromium contamination; Soil Guideline Values for Inorganic Mercury contamination; Soil Guideline Values for Nickel contamination; Soil Guideline Values for Selenium contamination; Soil Guideline Values for Lead contamination; Soil Guideline Values for Toluene Contamination and Soil Guideline Values for Ethylbenzene Contamination; R&D Publication SGV 1-10, 15 and 16, Environment Agency, Bristol ISBN 1 857 05755, 2002 to 2005.
5. Environment Agency Policy. Part IIA – Detailed Quantitative Assessment of Chronic Risks to Human Health from Contaminated Soils. Policy Number 119_04, dated 9 March 2004. EU Drinking Water Standard – EC Council Directive 98/83. EC Quality of Water Intended for Human Consumption.
6. EU Drinking Water Standard – EC Council Directive 98/83. EC Quality of Water Intended for Human Consumption.
7. Environment Agency Guidance to Local Authorities on Pollution of Controlled Waters for Part IIA of the EPA 1990. Version 2, 19 June 2001.
8. Environment Agency R&D Publication 20, Methodology for the Derivation of Remedial Targets for Soil and Groundwater.
9. CIRIA Report C659 – Assessing risks posed by hazardous ground gases to buildings. Wilson, Oliver, Mallett, Hutchings, Card, 2006.
10. British Geological Survey, Sheet 87, Barnsley (Solid and Drift) Scale 1:50 000, 1976.
11. National Rivers Authority, “Policy and Practice for the Protection of Groundwater”, Groundwater Vulnerability Map Sheet 11, South Pennines, Scale 1:100,000.

12. BRE Special Digest 1, Concrete in Aggressive Ground, BRE, Third Edition 17 June 2005.
13. Hazardous Waste: Interpretation of the definition and classification of hazardous waste (Technical Guidance WM2), Environment Agency, 2005.

FIGURES



Reproduced from the 1988 Ordnance Survey 1:50,000 Scale Landranger Map 111, OSGR – SD 800 035
with the permission of the Controller of Her Majesty's Stationary Office, Crown Copyright. Licence No. AL 52022A
RSK ENSR Limited, 172 Chester Road, Helsby, Cheshire WA6 0AR.

SITE LOCATION MAP

APPENDIX A

Service Constraints

RSK GEOCONSULT 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 Priority Sites Limited (the "client") in accordance with the terms of a contract between RSK and the "client" dated 2/11/06. 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

Derivations of SSVs

APPENDIX B

TABLE A
SUPPORTING DATA FOR GENERATION OF RSK SCREENING VALUES FOR SOILS AS PRESENTED IN TABLE 1 OF MAIN REPORT TEXT

Input	Comment
Toxicological Values	Where available CLR Tox reports have been used for all oral and inhalation Index Doses and TDSI's. The following additional data was used where Tox reports were not available. The Dioxin-like PCBs report was used for PCBs The TPHCWG data has been used to support speciated TPH modelling The USEPA IRIS database has been used for select threshold PAHs including the toxicological equivalency factors (TEF) for benzo-a-pyrene. ICRCL 70/90 – covers mining waste based on phytotoxicity – SSVs for human ingestion are higher for copper (420mg/kg) and slightly lower for zinc (880mg/kg). US ASTDR ecologically based SSV for water-soluble boron ⁽¹⁾ .
Risk Assessment Models	The Risk Based Corrective Action (RBCA) model produced by GSI Corp was used to generate soil ingestion and inhalation SSVs for residents, commercial workers and construction workers.
General Exposure Data	The exposure parameters contained within CLR10, along with CLR briefing notes, 1, 2 and 3 were consulted to provide the human, building and environmental parameters required within the risk assessment models.
Outline Human Parameters	Female Child – body weight 14.5kg, height 0.93m, active inhalation rate 0.609m ³ /hr, passive 0.223m ³ /hr, 706cm ² outdoor skin exposure area; Female Adult Resident – 68.5kg, 1.623m, 1.234m ³ , 0.411m ³ /hr, 1664cm ² ; Female Commercial Worker – 68.5kg, 1.623m, 1.234m ³ , 0.411m ³ /hr, 410cm ² (hands and face only) Construction Worker – 70kg, 1.693m, 1.456m ³ /hr (active only), 448cm ² .
Vegetable Consumption –zinc and copper only	The exposure data is taken from CLR-10; specifically tables 6.3 and 6.4. Conservative assumptions regarding bioavailability were made. SSVs for human ingestion of copper and zinc including vegetable-uptake developed using BP-RISC – body weight 15.8kg (5.5yrs exposure), 334 days/yr soil ingestion (average from Table 4.8), 100% bioavailability, consumption rate 1-4 year old (table 6.3)
Soil ingestion	100mg/day for children and construction workers, 40mg/day for adult residents and 30mg/day for commercial workers.
Building Parameters	A slab floor construction was assumed with no convective component. The building dimensions for business and residential were taken from CLR10. The air-exchange rates used are conservative and taken from CLEA Briefing Note 3. A bungalow construction has been used. Pressure differential has not been used for the initial review.
Vapour Exposure Modelling	The Johnson and Ettinger model is part of both risk assessment models and was used to determine exposure values for both indoor and outdoor air.
Environmental Assumptions	The length of the outdoor air wind box is 50m whilst depth of impact is from 0 – 2m below ground level in an average soil type with all contaminant concentrations set at 100mg/kg. The USEPA default was used for density which provides a more conservative estimate of impact mass. FOC is set at 0.005 (1% SOM). Impact to human health from contaminated groundwater has not been assessed here.
PAH SSV Derivation*	The SSV for the non-carcinogenic PAHs, with the exception of naphthalene (acenaphthylene, acenaphthene, fluorene, phenanthrene, anthracene, fluoranthene, pyrene, and benzo-ghi-pyrene) is based on the SSV for Fluoranthene (8.8mg/kg) which is based on soil ingestion. Naphthalene's SSV is calculated using RBCA based on the UK Tox report

Input	Comment
	The SSV for the carcinogenic PAHs is based on Benzo-a-Pyrene (1.1mg/kg). A toxic equivalency factor (TEF) based on Benzo-a-Pyrene would then be applied to the other 6 carcinogens.
PCBs SSV Derivation**	The SSV for the Dutch 6 PCBs (excludes Congener 118) is based on the USEPA IRIS average. The SSV for the WHO 10 PCBs is based on Congener 118 for which Tox data is included in Tox 12 ". Dioxin-like PCBs". The tox-data for the individual congeners 126 and 169 are also taken directly from Tox 12.
Speciated TPH SSV Derivation***	The TPH Criteria Working Group carbon fractions and toxicological values within the RBCA and BP-RISC data bases (and adopted by the USEPA) was used to develop SSVs for individual carbon fractions within the aliphatic and aromatic ranges. The petrol and diesel SSVs in Table 1 come from the summed SSVs for carbon ranges aromatic C ₆ to C ₁₀ and C ₁₀ to C ₁₆ respectively. Only the limited C ₁₀ to C ₁₆ for diesel was summed due to the elevated SSVs for higher carbon fractions which are based on ingestion, not inhalation.
1 - Water Soluble Boron	An extensive search was undertaken to find a scientifically based, relevant and authoritative soil screening value. There are no UK specific phytotoxic or human health values available to date, and a SGV value is not planned by to be developed by Defra / Environment Agency. No UK phytotoxic screening values could be found. An extensive search of the literature revealed that the US ASTDR have an ecologically based screening value, which is a scientifically based and authoritative value. The value can be found at http://www.srs.gov/general/enviro/erd/ffa/rdh/p71.PDF

* Individual PAH SSVs are presented in Table B.

** Individual PCBs SSVs are presented in Table C.

*** Individual TPH SSVs are presented in Table D.

Table B - Individual PAH SSVs and Benzo-a-Pyrene Toxic Equivalency factors (TEFs)

Compound	SSV (mg/kg)	Non-carcinogenic	Carcinogenic	TEF for BaP
Naphthalene	3.15-01	√		RBCA-Indoor air
Acenaphthylene	7.7E+1	√		RISC Soil ingestion
Acenaphthene	1.3E+3	√		"
Fluorene	1.1E+3	√		"
Phenanthrene	9.9E+2	√		"
Anthracene	1.4E+4	√		"
Fluoranthene	8.8E+0	√		"
Pyrene	2.4E+3	√		"
Benzo(a)Anthracene	1.3E+1		√	TEF for BaP - 0.1
Chrysene	1.3E+1		√	0.1
Benzo(b)Fluoranthene	1.6E+1		√	0.1
Benzo(k)Fluoranthene	1.6E+2		√	0.01
benzo-a-pyrene	1.1E+0		√	RBCA –soil ingestion
Indeno(1,2,3,c,d)Pyrene	1.7E+1		√	0.1
Dibenzo(a,h)Anthracene	1.8E+0		√	1.0
Benzo(g,h,i)Perylene-	2.8E+3	√		RISC – soil ingestion

The individual carcinogenic PAH SSVs were generated using relative values based on a toxic equivalency to Benzo-a-Pyrene (BaP) with the SSV for BaP calculated on soil ingestion only using the UK Tox report data.

Table C - PCB SSVs

Suite	SSV (mg/kg)	Congeners
PCBs-Dutch 6 (IRIS)	7	28, 52, 101, 118, 138, 153, 180
PCBs WHO-10 (118)	4.0E-1	77, 81, 105, 114, 118, 123, 156, 157, 167, 180
PCBs WHO-126*	4.0E-4	-
PCBs WHO-169*	4.0E-3	-

*Individual Congeners within the WHO suite of 12.

The SSVs for the Dutch 6 is based on the USEPA IRIS database average. This suite includes Congener 118 and include some of the more common PCBs, percentage wise. The PCBs in the WHO suite are less common but typically more harmful to human health. The SSVs for the WHO suite are based on TEF's for the individual Congener applied to each group, relative to Congener-126, which in turn has been toxicologically evaluated relative to dioxins. The WHO-suite of PCBs consists of 12 congeners but 126 and 169 are listed separately due to their greater toxicity.

Table D – Speciated TPH SSVs

Compound	SSV (mg/kg)	Exposure Pathway (model used)
Aliphatic 5-6	275000	Soil ingestion (RISC)
Aliphatic 6-8	275000	Soil Ingestion (RISC)
Aliphatic 8-10	14.3	Child indoor air (RBCA)
Aliphatic 10-12	5500	Soil Ingestion (RBCA)
Aliphatic 12-16	3000	Soil Ingestion (RISC)
Aliphatic 16-35	110000	Soil ingestion (RBCA)
Aromatic 5-7	0.0853	Child indoor air (RBCA)
Aromatic 7-8	5.73	"
Aromatic 8-10	2.87	"
Aromatic 10-12	2.87	"
Aromatic 12-16	13	"
Aromatic 16-21	1650	Soil ingestion (RBCA)
Aromatic 21-35	1650	"
SSVs for cumulative TPH for petrol and diesel		
PETROL RANGE	8.7	Aromatic C ₅₋₁₀
DIESEL RANGE	16	Aromatic C ₁₀₋₁₆

SSVs for soil consumption generated using RBCA do not include vegetable consumption but represent lower SSVs than previously calculated using RISC, which included vegetable consumption. Additional supporting data for the generation of the RBCA SSVs is available upon request.

APPENDIX C

Trial Pit Records

Trial Pit Record: TP1

Site: Hoyland	Start Date: 26/02/2008	Ground Level: 128.198
Client: William Saunders Partnership	End Date: 26/02/2008	Easting: -
Project No: 10911	Logged By: KF	Northing: -
Site National Grid Reference:	Excavation Method: Tracked excavator	
Site Level (mOD): 0.000	Plant:	
	Shoring/Support:	
	Trial Pit Length: 6.00	Trial Pit Width: 1.90

Samples & Tests			Strata Details			
Depth	Type	Result	Thk	Legend	Depth	Description
1.00	J		0.60		0.60	MADE GROUND (grey slightly sandy slightly gravelly clay, gravel is angular fine to coarse mudstone with occasional boulders)
			0.40		1.00	MADE GROUND (reddish brown slightly clayey sandy angular fine to coarse gravel of brick, mudstone and sandstone)
2.00	B		2.20			MADE GROUND (orange brown sandy slightly gravelly clay, sandstone, with many cobbles and some boulders. Gravel is angular fine to coarse)
3.30	J		0.20		3.20	MADE GROUND (black sandy, clayey angular fine to coarse gravel of brick, sandstone, mudstone and clinker)
3.50	B		0.20		3.40	
					3.60	Grey thickly laminated, occasionally tabular SANDSTONE, highly weathered
						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:

Slight seepage at 3.20m.

Stability:

Stable.

General Remarks:

Excavation moderately easy, became difficult at 3.60m.
Slight seepage at 3.20m.
Trial pit remained stable.

Trial Pit Record: TP2

Site: Hoyland	Start Date: 26/02/2008	Ground Level: 128.051
Client: William Saunders Partnership	End Date: 26/02/2008	Easting: -
Project No: 10911	Logged By: KF	Northing: -
Site National Grid Reference:	Excavation Method: Tracked Excavator	
Site Level (mOD): 0.000	Plant:	
	Shoring/Support:	
	Trial Pit Length: 6.30	Trial Pit Width: 1.90

Samples & Tests			Strata Details			
Depth	Type	Result	Thk	Legend	Depth	Description
			0.60		0.60	MADE GROUND (brown sandy gravelly friable clay, gravel is angular to subangular fine to coarse sandstone, mudstone and brick with some rootlets)
1.20	B		0.90		1.50	MADE GROUND (orange/brown slightly sandy gravelly clay, gravel is angular to subangular fine to coarse sandstone with many cobbles and some boulders)
1.80	J		0.60		2.10	MADE GROUND (black slightly sandy slightly gravelly clay, gravel is angular fine to coarse mudstone and sandstone)
			0.40		2.50	MADE GROUND (orange/brown slightly sandy slightly gravelly clay, gravel is angular to subangular fine to coarse sandstone)
2.70	J		0.50		3.00	Stiff orange/brown and grey mottled slightly sandy CLAY
			0.10		3.10	Firm orange/brown slightly sandy CLAY
			0.50		3.60	Stiff orange/brown and grey mottled slightly sandy CLAY
			0.20		3.80	Grey and brown thickly laminated SANDSTONE, highly weathered
						End of Trial Pit at 3.80 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:
Dry.

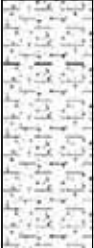
Stability:
Stable.

General Remarks:

Excavation easy to 3.60m.
Groundwater not encountered.
Trial pit remained stable.

Trial Pit Record: TP3

Site: Hoyland	Start Date: 26/02/2008	Ground Level: 127.737
Client: William Saunders Partnership	End Date: 26/02/2008	Easting: -
Project No: 10911	Logged By: KF	Northing: -
Site National Grid Reference:	Excavation Method: Tracked Excavator	
Site Level (mOD): 0.000	Plant:	
	Shoring/Support:	
	Trial Pit Length: 6.30	Trial Pit Width: 1.90

Samples & Tests			Strata Details			
Depth	Type	Result	Thk	Legend	Depth	Description
0.80	B		0.60		0.60	MADE GROUND (grass over grey slightly sandy gravelly clay, gravel is angular fine to coarse mudstone)
			1.70			Orange/brown and grey mottled sandy gravelly CLAY, gravel is angular to subangular fine to coarse sandstone with some cobbles
2.40	B		0.20		2.30 2.50	Grey thickly laminated predominantly tabular SANDSTONE, highly weathered 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.

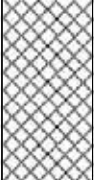
Groundwater Observations:
Dry.

Stability:
Stable.

General Remarks:
Excavation became difficult below 2.80m.
Groundwater not encountered.
Trial pit remained stable.

Trial Pit Record: TP4

Site: Hoyland	Start Date: 26/02/2008	Ground Level: 128.901
Client: William Saunders Partnership	End Date: 26/02/2008	Easting: -
Project No: 10911	Logged By: KF	Northing: -
Site National Grid Reference:	Excavation Method: Tracked Excavator	
Site Level (mOD): 0.000	Plant:	
	Shoring/Support:	
	Trial Pit Length: 6.50	Trial Pit Width: 1.90

Samples & Tests			Strata Details			
Depth	Type	Result	Thk	Legend	Depth	Description
0.50	J		1.20		1.20	MADE GROUND (grass over grey slightly sandy gravelly clay, gravel is angular fine to coarse mudstone)
			0.80		2.00	Orange/brown slightly sandy gravelly CLAY, gravel is angular to subangular fine to coarse sandstone with some cobbles
2.20	B		0.40		2.40	Grey thickly laminated, occasionally tabular SANDSTONE, highly weathered
						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:
Dry.

Stability:
Stable.

General Remarks:
Excavation difficult below 2.00m.
Groundwater not encountered.
Trial pit remained stable.

Trial Pit Record: TP5

Site: Hoyland	Start Date: 26/02/2008	Ground Level: 129.411
Client: William Saunders Partnership	End Date: 26/02/2008	Easting: -
Project No: 10911	Logged By: KF	Northing: -
Site National Grid Reference:	Excavation Method: Tracked Excavator	
Site Level (mOD): 0.000	Plant:	
	Shoring/Support:	
	Trial Pit Length: 7.50	Trial Pit Width: 1.90

Samples & Tests			Strata Details			
Depth	Type	Result	Thk	Legend	Depth	Description
0.80	B		1.20		1.20	MADE GROUND (grass over grey slightly sandy gravelly clay, gravel is fine to coarse mudstone, sandstone and brick)
			1.60			MADE GROUND (orange/brown and brown slightly sandy gravelly clay, predominantly sandstone, mudstone and brick with occasional pieces of wood and many cobbles and some boulders). Gravel is angular fine to coarse
3.50	B		1.30		2.80	Orange/brown slightly sandy clayey angular fine to coarse GRAVEL of sandstone with many cobbles and some boulders
					4.10	End of Trial Pit at 4.70 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:

Dry.

Stability:

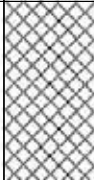
Stable.

General Remarks:

Excavation moderately easy, becoming difficult at 4.50m.
Groundwater not encountered.
Trial pit remained stable.

Trial Pit Record: TP6

Site: Hoyland	Start Date: 26/02/2008	Ground Level: 129.139
Client: William Saunders Partnership	End Date: 26/02/2008	Easting: -
Project No: 10911	Logged By: LA	Northing: -
Site National Grid Reference:	Excavation Method: Tracked Excavator	
Site Level (mOD): 0.000	Plant:	
	Shoring/Support:	
	Trial Pit Length: 3.20	Trial Pit Width: 1.90

Samples & Tests			Strata Details			
Depth	Type	Result	Thk	Legend	Depth	Description
0.40	J		1.20		1.20	MADE GROUND (grey slightly sandy gravelly clay, gravel is angular to subangular fine to coarse mudstone and sandstone)
2.80	B		2.60			Orange/brown and dark brown slightly sandy gravelly CLAY, gravel is angular to subangular fine to coarse with occasional boulders and bricks
3.60	J		0.20		3.80	Yellow brown thickly laminated occasional tabular SANDSTONE, highly weathered
					4.00	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:
Dry.

Stability:
Stable.

General Remarks:

Excavation was moderately easy, becoming difficult at 4.00m.
Groundwater not encountered.
Trial pit remained stable.

Trial Pit Record: TP7

Site: Hoyland	Start Date: 26/02/2009	Ground Level: 129.956
Client: William Saunders Partnership	End Date: 26/02/2009	Easting: -
Project No: 10911	Logged By: LA	Northing: -
Site National Grid Reference:	Excavation Method: Tracked Excavator	
Site Level (mOD): 0.000	Plant:	
	Shoring/Support:	
	Trial Pit Length: 10.00	Trial Pit Width: 2.00

Samples & Tests			Strata Details			
Depth	Type	Result	Thk	Legend	Depth	Description
2.00	B		1.10		1.10	MADE GROUND (firm grey slightly sandy gravelly clay, with frequent cobbles and boulders and occasional bricks). Gravel is angular to subangular fine to coarse
			2.80			Brown/grey slightly sandy gravelly friable CLAY, with many cobbles and occasional boulders. Gravel is angular to subangular fine to coarse sandstone
					3.90	End of Trial Pit at 3.90 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:
Groundwater encountered at 3.50m.

Stability:
Moderately unstable.

General Remarks:
Excavation moderately difficult (due to boulders).
Groundwater encountered at 3.50m.
Trial pit was moderately unstable.
Mudstone bedrock encountered at 2.3m on the southern face of pit.

Trial Pit Record: TP8

Site: Hoyland	Start Date: 26/02/2008	Ground Level: 134.112
Client: William Saunders Partnership	End Date: 26/02/2008	Easting: -
Project No: 10911	Logged By: LA	Northing: -
Site National Grid Reference:	Excavation Method: Tracked Excavator	
Site Level (mOD): 0.000	Plant:	
	Shoring/Support:	
	Trial Pit Length: 30.00	Trial Pit Width: 1.90

Samples & Tests			Strata Details			
Depth	Type	Result	Thk	Legend	Depth	Description
0.50 0.60	B J		2.10			MADE GROUND (grey/brown clayey gravel, gravel is fine to coarse angular)
			0.10		2.10 2.20	Mottled grey/orange highly laminated SANDSTONE, lightly weathered
						Rock encountered at 0.6m at northern end of pit
						Rock encountered at 1.1m in centre of pit
						Rock encountered at 2.1m at southern end of pit
						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:
Dry.

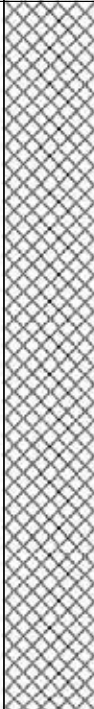
Stability:
Stable.

General Remarks:

Excavation moderately easy.
Groundwater not encountered.
Trial pit remained stable.

Trial Pit Record: TP9

Site: Hoyland	Start Date: 26/02/0008	Ground Level: 134.606
Client: William Saunders Partnership	End Date: 26/02/0008	Easting: -
Project No: 10911	Logged By: LA	Northing: -
Site National Grid Reference:	Excavation Method: Tracked Excavator	
Site Level (mOD): 0.000	Plant:	
	Shoring/Support:	
	Trial Pit Length: 9.00	Trial Pit Width: 1.90

Samples & Tests			Strata Details			
Depth	Type	Result	Thk	Legend	Depth	Description
2.00	B		4.70			MADE GROUND (grey slightly sandy gravelly clay with frequent sandstone and mudstone cobbles and occasional boulders. Gravel is subangular to angular fine to coarse sandstone and mudstone)
4.60	B		0.10		4.70 4.80	Mottled grey/orange thickly laminated SANDSTONE, highly weathered End of Trial Pit at 4.80 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:
Dry.

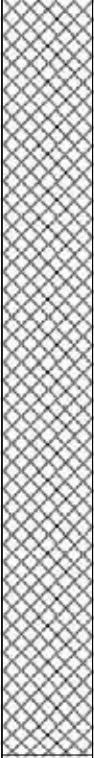
Stability:
Stable.

General Remarks:

Excavation was moderately easy, becoming difficult at 4.70m.
Groundwater not encountered.
Trial pit remained stable.

Trial Pit Record: TP10

Site: Hoyland	Start Date: 26/02/0008	Ground Level: 134.635
Client: William Saunders Partnership	End Date: 26/02/0008	Easting: -
Project No: 10911	Logged By: LA	Northing: -
Site National Grid Reference:	Excavation Method: Tracked Excavator	
Site Level (mOD): 0.000	Plant:	
	Shoring/Support:	
	Trial Pit Length: 10.70	Trial Pit Width: 1.90

Samples & Tests			Strata Details			
Depth	Type	Result	Thk	Legend	Depth	Description
1.00	J					MADE GROUND (grey slightly sandy gravelly clay, with some mudstone and sandstone cobbles. Gravel is subangular to angular fine to coarse sandstone and mudstone)
3.20	B		5.00			
					5.00	End of Trial Pit at 5.00 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:

Slight seepage at 5.00m.

Stability:

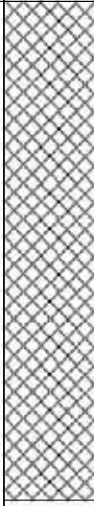
Stable.

General Remarks:

Excavation was moderately easy, difficult at 4.90m.
Slight seepage at 5.00m.
Trial pit remained stable.

Trial Pit Record: TP11

Site: Hoyland	Start Date: 26/02/0008	Ground Level: 131.379
Client: William Saunders Partnership	End Date: 26/02/0008	Easting: -
Project No: 10911	Logged By: LA	Northing: -
Site National Grid Reference:	Excavation Method: Tracked Excavator	
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	J		3.30			MADE GROUND (brown/grey slightly sandy gravelly clay with some cobbles. Gravel is subangular to angular fine to coarse mudstone and sandstone)
3.20	B		0.10		3.30 3.40	
						Orange/grey mottled thickly laminated SANDSTONE, highly weathered
						End of Trial Pit at 3.40 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:

Slight seepage at 3.30m.

Stability:

Stable.

General Remarks:

Excavation was moderately easy, becoming difficult at 3.30m.
Slight seepage at 3.30m.
Trial pit remained stable.

Trial Pit Record: TP12

Site: Hoyland	Start Date: 27/02/2008	Ground Level: 129.247
Client: William Saunders Partnership	End Date: 27/02/2008	Easting: -
Project No: 10911	Logged By: LA	Northing: -
Site National Grid Reference:	Excavation Method: Tracked Excavator	
Site Level (mOD): 0.000	Plant:	
	Shoring/Support:	
	Trial Pit Length: 5.60	Trial Pit Width: 1.90

Samples & Tests			Strata Details			
Depth	Type	Result	Thk	Legend	Depth	Description
			1.20			MADE GROUND (brown slightly sandy gravelly clay, gravel is fine to coarse subangular to angular mudstone and sandstone - coal band at 1.00m)
1.50	J		0.60		1.20	Mottled orange/brown friable MUDSTONE, highly-completely weathered
1.70	J		0.20		1.80	Orange/grey thickly laminated, occasionally tabular SANDSTONE, highly weathered
					2.00	End of Trial Pit at 2.00 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:

Dry.

Stability:

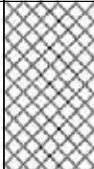
Stable.

General Remarks:

Excavation was moderately easy, becoming difficult at 2.00m.
Groundwater not encountered.
Trial pit remained stable.

Trial Pit Record: TP13

Site: Hoyland	Start Date: 27/02/2008	Ground Level: 130.244
Client: William Saunders Partnership	End Date: 27/02/2008	Easting: -
Project No: 10911	Logged By: LA	Northing: -
Site National Grid Reference:	Excavation Method: Tracked Excavator	
Site Level (mOD): 0.000	Plant:	
	Shoring/Support:	
	Trial Pit Length: 6.10	Trial Pit Width: 1.90

Samples & Tests			Strata Details			
Depth	Type	Result	Thk	Legend	Depth	Description
0.60	J		1.20			MADE GROUND (grey slightly sandy gravelly clay, gravel is fine to coarse subangular to angular mudstone and sandstone)
1.10	J				1.20	
			0.90			Firm to stiff mottled orange/grey friable CLAY
2.00	J		0.20		2.10	
					2.30	Orange/grey thickly laminated SANDSTONE, highly weathered
						End of Trial Pit at 2.30 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:

Dry.

Stability:

Stable.

General Remarks:

Excavation was moderately easy, becoming difficult at 2.10m.
Groundwater not encountered.
Trial pit remained stable.

Trial Pit Record: TP14

Site: Hoyland	Start Date: 27/02/2008	Ground Level: 128.977
Client: William Saunders Partnership	End Date: 27/02/2008	Easting: -
Project No: 10911	Logged By: LA	Northing: -
Site National Grid Reference:	Excavation Method: Tracked Excavator	
Site Level (mOD): 0.000	Plant:	
	Shoring/Support:	
	Trial Pit Length: 9.10	Trial Pit Width: 1.90

Samples & Tests			Strata Details			
Depth	Type	Result	Thk	Legend	Depth	Description
1.20 1.30	J B		1.10		1.10	MADE GROUND (grey slightly sandy gravelly clay, gravel is fine to coarse subangular to angular mudstone and sandstone)
			0.40		1.50	Firm orange/brown slightly sandy gravelly CLAY. Gravel is fine to coarse subangular to angular mudstone and sandstone - band/lens of coal at 1.40m
4.90	B		3.50		5.00	Grey/orange fissile, thickly laminated SANDSTONE, highly weathered
						End of Trial Pit at 5.00 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:
Dry.

Stability:
Stable.

General Remarks:

Excavation was moderately easy, becoming difficult at 5.00m.
Groundwater not encountered.
Trial pit remained stable.

Trial Pit Record: TP15

Site: Hoyland	Start Date: 27/02/2008	Ground Level: 130.514
Client: William Saunders Partnership	End Date: 27/02/2008	Easting: -
Project No: 10911	Logged By: LA	Northing: -
Site National Grid Reference:	Excavation Method: Tracked Excavator	
Site Level (mOD): 0.000	Plant:	
	Shoring/Support:	
	Trial Pit Length: 15.00	Trial Pit Width: 1.90

Samples & Tests			Strata Details			
Depth	Type	Result	Thk	Legend	Depth	Description
0.60	B		2.00		2.00	Orange/grey mottled gravelly CLAY. Gravel is fine to coarse subangular to angular mudstone and sandstone
1.00	J					
1.80	B					
						End of Trial Pit at 2.00 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:

Dry.

Stability:

Stable.

General Remarks:

Excavation was moderately easy, difficult at top 0.60m but able to break through. Groundwater not encountered. Trial pit remained stable.

Trial Pit Record: TP16

Site: Hoyland Client: William Saunders Partnership Project No: 10911			Start Date: 27/02/2008 End Date: 27/02/2008 Logged By: LA		Ground Level: 134.330 Easting: - Northing: -	
Site National Grid Reference: Site Level (mOD): 0.000			Excavation Method: Tracked Excavator Plant: Shoring/Support:			
			Trial Pit Length: 12.00		Trial Pit Width: 1.90	

Samples & Tests			Strata Details			
Depth	Type	Result	Thk	Legend	Depth	Description
1.40	J		2.80			MADE GROUND (grey gravelly clay, gravel is fine to coarse subangular to angular mudstone and sandstone)
1.80	B					
2.90	B		0.20		2.80 3.00	
						Orange/grey, thickly laminated SANDSTONE, highly weathered 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: Dry.	Stability: Stable.	General Remarks: Excavation was moderately easy, becoming difficult at 2.90m. Groundwater not encountered. Trial pit remained stable.
--	------------------------------	---

Trial Pit Record: TP101

Site: Hoyland	Start Date: 13/11/2006	Ground Level: -
Client: William Saunders Partnership	End Date: 13/11/2006	Easting: -
Project No: 10911	Logged By: PM	Northing: -
Site National Grid Reference:	Excavation Method: 22 tonne excavator	
Site Level (mOD): 0.000	Plant:	
	Shoring/Support: None	
	Trial Pit Length: 4.00	Trial Pit Width: 1.00

Samples & Tests			Strata Details			
Depth	Type	Result	Thk	Legend	Depth	Description
0.60	D		0.10		0.10	MADE GROUND (grass over pale brown gravelly clay - reworked mudstone)
			0.60			
			0.20		0.70	MADE GROUND (firm to stiff/loose to moderately compact grey reworked mudstone gravel in clayey matrix)
			0.40		0.90	MADE GROUND (loose to moderately compact pale brown reworked mudstone gravel in clayey matrix)
					1.30	Very weak, very weathered pale orange/grey MUDSTONE - sides smooth and solid End of Trial Pit at 1.30 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:

Groundwater was not encountered.

Stability:

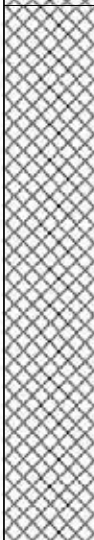
Sides remained stable.

General Remarks:

Evidence of contamination was not encountered.

Trial Pit Record: TP102

Site: Hoyland	Start Date: 13/11/2006	Ground Level: -
Client: William Saunders Partnership	End Date: 13/11/2006	Easting: -
Project No: 10911	Logged By: PM	Northing: -
Site National Grid Reference:	Excavation Method: 22 tonne excavator	
Site Level (mOD): 0.000	Plant:	
	Shoring/Support: None.	
	Trial Pit Length: 4.00	Trial Pit Width: 1.00

Samples & Tests			Strata Details			
Depth	Type	Result	Thk	Legend	Depth	Description
1.00	D		0.10		0.10	MADE GROUND (grass over pale brown gravelly clay - reworked mudstone)
			3.60			MADE GROUND (firm to stiff grey reworked mudstone gravel and cobbles in clay matrix, occasional boulders up to 0.5m cubed)
			0.30		3.70	Very weak, very weathered pale orange SANDSTONE
					4.00	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.

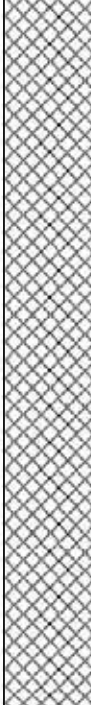
Groundwater Observations:
Slight groundwater entries at 3.90m.

Stability:
Sides remained stable.

General Remarks:
Evidence of contamination was not encountered.

Trial Pit Record: TP103

Site: Hoyland	Start Date: 13/11/2006	Ground Level: -
Client: William Saunders Partnership	End Date: 13/11/2006	Easting: -
Project No: 10911	Logged By:	Northing: -
Site National Grid Reference:	Excavation Method: 22 tonne excavator	
Site Level (mOD): 0.000	Plant:	
	Shoring/Support: None.	
	Trial Pit Length: 4.00	Trial Pit Width: 1.00

Samples & Tests			Strata Details			
Depth	Type	Result	Thk	Legend	Depth	Description
			4.70			MADE GROUND (firm to stiff grey reworked mudstone cobbles and gravel in clayey matrix - occasional (x5) square boulders)
			0.20		4.70 4.90	Very weak, very weathered orange/grey MUDSTONE - slight groundwater entries at base of trial pit End of Trial Pit at 4.90 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:

Slight groundwater entries at 4.80m.

Stability:

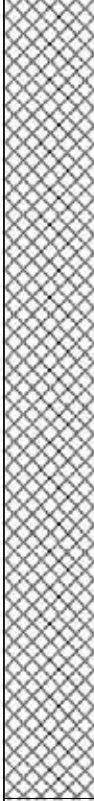
The sides of the trial pit remained stable throughout excavation.

General Remarks:

Evidence of contamination was not encountered.
No samples.

Trial Pit Record: TP104

Site: Hoyland	Start Date: 13/11/2006	Ground Level: -
Client: William Saunders Partnership	End Date: 13/11/2006	Easting: -
Project No: 10911	Logged By: PM	Northing: -
Site National Grid Reference:	Excavation Method: 22 tonne excavator	
Site Level (mOD): 0.000	Plant:	
	Shoring/Support: None.	
	Trial Pit Length: 4.00	Trial Pit Width: 1.00

Samples & Tests			Strata Details			
Depth	Type	Result	Thk	Legend	Depth	Description
2.00	D		5.30		5.30	MADE GROUND (loose to moderately compact/firm to stiff grey and pale orange cobbles and gravel of reworked mudstone in clayey matrix - occasional square boulders - not as compact as previous trial pits - pale orange from 1.00m - dark grey from 2.00m on one side of pit - groundwater entries at 5.00m End of Trial Pit at 5.30 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:

Groundwater entries at 5.00m, standing at 5.00m.

Stability:

The sides of the trial pit remained stable throughout excavation.

General Remarks:

Evidence of contamination was not encountered.

Trial Pit Record: TP105

Site: Hoyland	Start Date: 13/11/2006	Ground Level: -
Client: William Saunders Partnership	End Date: 13/11/2006	Easting: -
Project No: 10911	Logged By: PM	Northing: -
Site National Grid Reference:	Excavation Method: 22 tonne excavator	
Site Level (mOD): 0.000	Plant:	
	Shoring/Support: None.	
	Trial Pit Length: 4.00	Trial Pit Width: 1.00

Samples & Tests			Strata Details			
Depth	Type	Result	Thk	Legend	Depth	Description
1.00	D		2.00			MADE GROUND (grass over loose to moderately compact/firm to stiff dark grey and pale orange cobbles and gravel in clayey matrix - occasional boulders at surface)
2.10	D		0.20 0.10		2.00 2.20 2.30	Stiff grey and orange residual soil of MUDSTONE/laminated CLAY Very weak, very weathered orange and grey MUDSTONE End of Trial Pit at 2.30 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:

Groundwater was not encountered.

Stability:

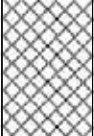
The sides of the trial pit remained stable throughout excavation.

General Remarks:

Evidence of contamination was not encountered.

Trial Pit Record: TP106

Site: Hoyland	Start Date: 13/11/2006	Ground Level: -
Client: William Saunders Partnership	End Date: 13/11/2006	Easting: -
Project No: 10911	Logged By: PM	Northing: -
Site National Grid Reference:	Excavation Method: 22 tonne excavator	
Site Level (mOD): 0.000	Plant:	
	Shoring/Support: None.	
	Trial Pit Length: 4.00	Trial Pit Width: 1.00

Samples & Tests			Strata Details			
Depth	Type	Result	Thk	Legend	Depth	Description
1.20	D		1.00		1.00	MADE GROUND (grass over loose to moderately compact/firm to stiff dark grey cobbles and gravel in clayey matrix)
			0.30		1.30	Very weak, very weathered orange and grey MUDSTONE
						End of Trial Pit at 1.30 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:

Groundwater was not encountered.

Stability:

The sides of the trial pit remained stable throughout excavation.

General Remarks:

Evidence of contamination was not encountered.

Trial Pit Record: TP107

Site: Hoyland	Start Date: 13/11/2006	Ground Level: -
Client: William Saunders Partnership	End Date: 13/11/2006	Easting: -
Project No: 10911	Logged By: PM	Northing: -
Site National Grid Reference:	Excavation Method: 22 tonne excavator	
Site Level (mOD): 0.000	Plant:	
	Shoring/Support: None.	
	Trial Pit Length: 4.00	Trial Pit Width: 1.00

Samples & Tests			Strata Details			
Depth	Type	Result	Thk	Legend	Depth	Description
1.00	D		0.05		0.05	MADE GROUND (grass over completely weathered mudstone)
			1.15		1.15	Very weak, extremely weathered pale orange and grey MUDSTONE - excavated as flat cobbles and gravel
					1.20	End of Trial Pit at 1.20 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:

Groundwater was not encountered.

Stability:

The sides of the trial pit remained stable throughout excavation.

General Remarks:

Evidence of contamination was not encountered.

Trial Pit Record: TP108

Site: Hoyland	Start Date: 13/11/2006	Ground Level: -
Client: William Saunders Partnership	End Date: 13/11/2006	Easting: -
Project No: 10911	Logged By: GH	Northing: -
Site National Grid Reference:	Excavation Method: 22 tonne excavator	
Site Level (mOD): 0.000	Plant:	
	Shoring/Support: None.	
	Trial Pit Length: 4.00	Trial Pit Width: 1.00

Samples & Tests			Strata Details			
Depth	Type	Result	Thk	Legend	Depth	Description
0.50	D		3.50		3.50	MADE GROUND (grass over loose to moderately compact/firm to stiff grey and pale orange layers of reworked mudstone cobbles and gravel in clay matrix - occasional boulders - 'old' concrete boulder/structure at 1.20m at northern end, moved towards south - mudstone boulder at 2.00m - concrete boulder at 2.50m to 3.00m - slight entries of groundwater at base of pit)
						End of Trial Pit at 3.50 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:

Slight groundwater entries at base of trial pit.

Stability:

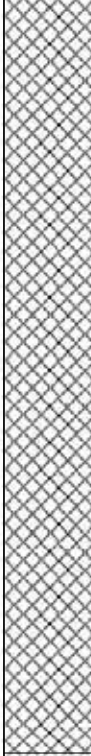
Sides of trial pit collapsed slightly.

General Remarks:

Trial pit abandoned. Evidence of contamination was not encountered. 'Old' indicates an old fashioned type of concrete.

Trial Pit Record: TP109

Site: Hoyland	Start Date: 13/11/2006	Ground Level: -
Client: William Saunders Partnership	End Date: 13/11/2006	Easting: -
Project No: 10911	Logged By: PM	Northing: -
Site National Grid Reference:	Excavation Method: 22 tonne excavator	
Site Level (mOD): 0.000	Plant:	
	Shoring/Support: None.	
	Trial Pit Length: 4.00	Trial Pit Width: 1.00

Samples & Tests			Strata Details			
Depth	Type	Result	Thk	Legend	Depth	Description
0.50	D		5.00		5.00	MADE GROUND (loose to moderately compact grey and pale orange and brown reworked mudstone cobbles and gravel in clay matrix, more cobbly below 4.50m - occasional boulders, 0.5m cubed - sides extremely stable below 1.00m (shiny walls) - occasional bricks at 4.50m (in wall) and arisings)
						End of Trial Pit at 5.00 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:

Groundwater was not encountered.

Stability:

The sides of the trial pit remained stable throughout excavation.

General Remarks:

Evidence of contamination was not encountered.

Trial Pit Record: TP110

Site: Hoyland	Start Date: 13/11/2006	Ground Level: -
Client: William Saunders Partnership	End Date: 13/11/2006	Easting: -
Project No: 10911	Logged By: PM	Northing: -
Site National Grid Reference:	Excavation Method: 22 tonne excavator	
Site Level (mOD): 0.000	Plant:	
	Shoring/Support: None.	
	Trial Pit Length: 4.00	Trial Pit Width: 1.00

Samples & Tests			Strata Details			
Depth	Type	Result	Thk	Legend	Depth	Description
2.00	D		1.30		1.30	MADE GROUND (grass over layers of reworked pale brown and dark grey mudstone cobbles and gravel in clay matrix)
			2.20		2.20	MADE GROUND (stiff grey mottled orange clay (reworked mudstone) - crushed metal debris at 2.50m at western end of pit)
			0.80		3.50	MADE GROUND (loose to moderately compact flat mudstone gravel in sandy matrix - possible top of natural material)
					4.30	End of Trial Pit at 4.30 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:

Groundwater was not encountered.

Stability:

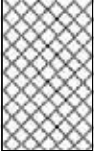
Sides stable.

General Remarks:

Evidence of contamination was not encountered.

Trial Pit Record: TP111

Site: Hoyland	Start Date: 13/11/2006	Ground Level: -
Client: William Saunders Partnership	End Date: 13/11/2006	Easting: -
Project No: 10911	Logged By: PM	Northing: -
Site National Grid Reference:	Excavation Method: 22 tonne excavator	
Site Level (mOD): 0.000	Plant:	
	Shoring/Support: None.	
	Trial Pit Length: 4.00	Trial Pit Width: 1.00

Samples & Tests			Strata Details			
Depth	Type	Result	Thk	Legend	Depth	Description
0.50	D		1.00		1.00	MADE GROUND (grass over pale grey fine to coarse gravel in clayey matrix - reworked mudstone)
			0.50		1.50	Very weak, completely weathered pale orange/grey MUDSTONE
			0.20		1.70	Very weak, very weathered pale orange/grey MUDSTONE
						End of Trial Pit at 1.70 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:

Groundwater was not encountered.

Stability:

The sides of the trial pit remained stable throughout excavation.

General Remarks:

Evidence of contamination was not encountered.

Trial Pit Record: TP112

Site: Hoyland	Start Date: 13/11/2006	Ground Level: -
Client: William Saunders Partnership	End Date: 13/11/2006	Easting: -
Project No: 10911	Logged By: PM	Northing: -
Site National Grid Reference:	Excavation Method: 22 tonne excavator	
Site Level (mOD): 0.000	Plant:	
	Shoring/Support: None.	
	Trial Pit Length: 4.00	Trial Pit Width: 1.00

Samples & Tests			Strata Details			
Depth	Type	Result	Thk	Legend	Depth	Description
			1.00		1.00	MADE GROUND (grass over grey/pale orange fine to coarse gravel and cobbles in clayey matrix)
			2.20			MADE GROUND (loose to moderately compact grey and pale orange flat fine to coarse gravel and cobbles in sandy matrix)
					3.20	End of Trial Pit at 3.20 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:

Groundwater was not encountered.

Stability:

The sides of the trial pit remained stable throughout excavation.

General Remarks:

Evidence of contamination was not encountered.

Trial Pit Record: TP113

Site: Hoyland	Start Date: 14/11/2006	Ground Level: -
Client: William Saunders Partnership	End Date: 14/11/2006	Easting: -
Project No: 10911	Logged By: PM	Northing: -
Site National Grid Reference:	Excavation Method: 22 tonne excavator	
Site Level (mOD): 0.000	Plant:	
	Shoring/Support: None.	
	Trial Pit Length: 4.00	Trial Pit Width: 1.00

Samples & Tests			Strata Details			
Depth	Type	Result	Thk	Legend	Depth	Description
			2.10			MADE GROUND (loose to moderately compact/firm to stiff pale brown over dark grey very clayey matrix with gravel and cobbles of mudstone - occasional small boulder)
			0.10		2.10 2.20	Very weak, very weathered pale orange and grey MUDSTONE
						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:

Groundwater was not encountered.

Stability:

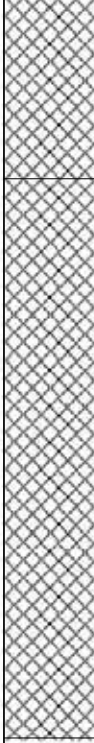
The sides of the trial pit remained stable throughout excavation.

General Remarks:

Evidence of contamination was not encountered. No samples.

Trial Pit Record: TP114

Site: Hoyland	Start Date: 14/11/2006	Ground Level: -
Client: William Saunders Partnership	End Date: 14/11/2006	Easting: -
Project No: 10911	Logged By: PM	Northing: -
Site National Grid Reference:	Excavation Method: 22 tonne excavator	
Site Level (mOD): 0.000	Plant:	
	Shoring/Support: None.	
	Trial Pit Length: 4.00	Trial Pit Width: 1.00

Samples & Tests			Strata Details			
Depth	Type	Result	Thk	Legend	Depth	Description
0.50	D		1.20		1.20	MADE GROUND (firm to stiff dark grey and orange gravelly clay - reworked mudstone - damp - slight water entries)
			3.70			MADE GROUND (loose to moderately compact pale grey and orange flat gravel and cobbles of mudstone in sandy matrix - becoming compact at 2.00m)
					4.90	End of Trial Pit at 4.90 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:

Slight groundwater entries within top 1.20m.

Stability:

Sides stable.

General Remarks:

Evidence of contamination was not encountered.

Trial Pit Record: TP115

Site: Hoyland	Start Date: 14/11/2006	Ground Level: -
Client: William Saunders Partnership	End Date: 14/11/2006	Easting: -
Project No: 10911	Logged By: PM	Northing: -
Site National Grid Reference:	Excavation Method: 22 tonne excavator	
Site Level (mOD): 0.000	Plant:	
	Shoring/Support: None.	
	Trial Pit Length: 4.00	Trial Pit Width: 1.00

Samples & Tests			Strata Details			
Depth	Type	Result	Thk	Legend	Depth	Description
			0.10		0.10	MADE GROUND (grass over dark brown clayey topsoil)
			0.50		0.60	MADE GROUND (firm dark bluey grey reworked mudstone - clay with gravel and cobbles)
			1.20			MADE GROUND (moderately compact pale cream fine to coarse gravel with a little cobbles in pale brown sandy matrix - fairly difficult digging)
			1.00		1.80	MADE GROUND (loose to moderately compact grey flat angular cobbles of mudstone in sandy matrix - difficult excavation below 2.10m - possible weathered rock)
			0.20		2.80	Compact pale brown and pale orange MUDSTONE
					3.00	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:

Groundwater was not encountered.

Stability:

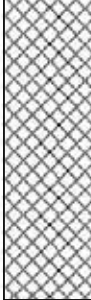
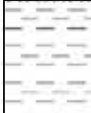
Sides stable.

General Remarks:

Evidence of contamination was not encountered. No samples.

Trial Pit Record: TP116

Site: Hoyland	Start Date: 14/11/2006	Ground Level: -
Client: William Saunders Partnership	End Date: 14/11/2006	Easting: -
Project No: 10911	Logged By: PM	Northing: -
Site National Grid Reference:	Excavation Method: 22 tonne excavator	
Site Level (mOD): 0.000	Plant:	
	Shoring/Support: None.	
	Trial Pit Length: 4.00	Trial Pit Width: 1.00

Samples & Tests			Strata Details			
Depth	Type	Result	Thk	Legend	Depth	Description
0.50	D		2.00			MADE GROUND (grass over brown gravelly, clayey matrix with occasional boulders and brick fragments - membrane material at 1.20m - grey 4 inch plastic land drain/buried pipe at 1.30m)
			0.80		2.00	Stiff pale grey, mottled orange CLAY with pockets of orange clayey gravel - weathered mudstone
			0.20		2.80 3.00	Very weak, very weathered grey and pale orange MUDSTONE 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:

Groundwater was not encountered.

Stability:

The sides of the trial pit remained stable throughout excavation.

General Remarks:

Evidence of contamination was not encountered. No samples.

Trial Pit Record: TP117

Site: Hoyland	Start Date: 14/11/2006	Ground Level: -
Client: William Saunders Partnership	End Date: 14/11/2006	Easting: -
Project No: 10911	Logged By: PM	Northing: -
Site National Grid Reference:	Excavation Method: 22 tonne excavator	
Site Level (mOD): 0.000	Plant:	
	Shoring/Support: None.	
	Trial Pit Length: 4.00	Trial Pit Width: 1.00

Samples & Tests			Strata Details			
Depth	Type	Result	Thk	Legend	Depth	Description
			4.10			MADE GROUND (reworked mudstone - excavated as gravel and cobbles in sandy matrix - metal tape at 3.50m)
			0.40		4.10	MADE GROUND (loose to moderately compact black fine to coarse gravel and cobbles of coal)
					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:

Groundwater was not encountered.

Stability:

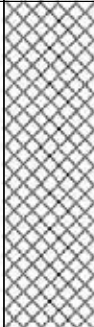
The sides of the trial pit remained stable throughout excavation.

General Remarks:

Evidence of contamination was not encountered. No samples. Ground level approximately 3.5m above old ground level.

Trial Pit Record: TP118

Site: Hoyland	Start Date: 14/11/2006	Ground Level: -
Client: William Saunders Partnership	End Date: 14/11/2006	Easting: -
Project No: 10911	Logged By: PM	Northing: -
Site National Grid Reference:	Excavation Method: 22 tonne excavator	
Site Level (mOD): 0.000	Plant:	
	Shoring/Support: None.	
	Trial Pit Length: 4.00	Trial Pit Width: 1.00

Samples & Tests			Strata Details			
Depth	Type	Result	Thk	Legend	Depth	Description
			2.20			MADE GROUND (reworked mudstone, occasional wood pieces)
			1.40		2.20	Stiff very dark grey slightly gravelly CLAY with some roots
			0.40		3.60	Loose to moderately compact flat gravel and cobbles of COAL
			0.20		4.00	Very weak, very weathered orange and grey MUDSTONE
					4.20	End of Trial Pit at 4.20 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:

Groundwater was not encountered.

Stability:

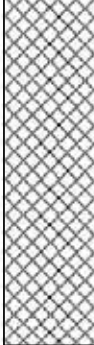
The sides of the trial pit remained stable throughout excavation.

General Remarks:

Evidence of contamination was not encountered. No samples.

Trial Pit Record: TP119

Site: Hoyland	Start Date: 14/11/2006	Ground Level: -
Client: William Saunders Partnership	End Date: 14/11/2006	Easting: -
Project No: 10911	Logged By: PM	Northing: -
Site National Grid Reference:	Excavation Method: 22 tonne excavator	
Site Level (mOD): 0.000	Plant:	
	Shoring/Support: None.	
	Trial Pit Length: 4.00	Trial Pit Width: 1.00

Samples & Tests			Strata Details			
Depth	Type	Result	Thk	Legend	Depth	Description
			2.30			MADE GROUND (replaced reworked mudstone with occasional bricks)
2.50	D		1.10		2.30	Stiff very dark grey fine to medium gravelly CLAY with occasional brick fragments - occasional coal fragments - rootlets - possible made ground
3.60	D		0.60		3.40	Loose to moderately compact gravel and cobbles of COAL/SHALE
			0.20		4.00	Very weak, very weathered pale orange and grey MUDSTONE
					4.20	End of Trial Pit at 4.20 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:

Groundwater was not encountered.

Stability:

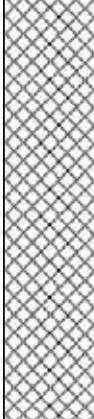
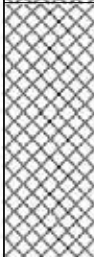
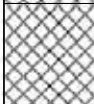
The sides of the trial pit remained stable throughout excavation.

General Remarks:

Evidence of contamination was not encountered. No samples.

Trial Pit Record: TP120

Site: Hoyland	Start Date: 14/11/2006	Ground Level: -
Client: William Saunders Partnership	End Date: 14/11/2006	Easting: -
Project No: 10911	Logged By: PM	Northing: -
Site National Grid Reference:	Excavation Method: 22 tonne excavator	
Site Level (mOD): 0.000	Plant:	
	Shoring/Support: None.	
	Trial Pit Length: 4.00	Trial Pit Width: 1.00

Samples & Tests			Strata Details			
Depth	Type	Result	Thk	Legend	Depth	Description
			2.80			MADE GROUND (replaced reworked mudstone - sides very stable due to being tracked over a lot during placement in this area)
			1.70		2.80	MADE GROUND (old grass over firm to stiff dark grey slightly gravelly, very silty clay with a little rootlets)
			0.70		4.50	MADE GROUND (mudstone boulders - 0.6x0.2x0.2 x 4 - 0.7x0.3x0.3 x 1 - 0.8x0.3x0.3 x 1)
			0.30		5.20	
					5.50	Loose to moderately compact black flat gravel and cobbles of COAL/SHALE End of Trial Pit at 5.50 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:

Groundwater was not encountered.

Stability:

Sides stable.

General Remarks:

Evidence of contamination was not encountered. No samples.

Trial Pit Record: TP121

Site: Hoyland	Start Date: 14/11/2006	Ground Level: -
Client: William Saunders Partnership	End Date: 14/11/2006	Easting: -
Project No: 10911	Logged By: PM	Northing: -
Site National Grid Reference:	Excavation Method: 22 tonne excavator	
Site Level (mOD): 0.000	Plant:	
	Shoring/Support: None.	
	Trial Pit Length: 4.00	Trial Pit Width: 1.00

Samples & Tests			Strata Details			
Depth	Type	Result	Thk	Legend	Depth	Description
			1.30			MADE GROUND (loose to moderately compact pale brown gravel and sand of mudstone)
			0.30		1.30	MADE GROUND (firm dark grey gravelly clay with some black shale)
			3.10		1.60	MADE GROUND (loose to moderately compact orange and grey fine to coarse gravel of mudstone/sandstone in sandy matrix with a little cobbles)
					4.70	End of Trial Pit at 4.70 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:

Groundwater was not encountered.

Stability:

The sides of the trial pit remained very stable throughout excavation.

General Remarks:

Evidence of contamination was not encountered. No samples.

Trial Pit Record: TP122

Site: Hoyland	Start Date: 14/11/2006	Ground Level: -
Client: William Saunders Partnership	End Date: 14/11/2006	Easting: -
Project No: 10911	Logged By: PM	Northing: -
Site National Grid Reference:	Excavation Method: 22 tonne excavator	
Site Level (mOD): 0.000	Plant:	
	Shoring/Support: None.	
	Trial Pit Length: 4.00	Trial Pit Width: 1.00

Samples & Tests			Strata Details			
Depth	Type	Result	Thk	Legend	Depth	Description
			0.30		0.30	MADE GROUND (loose to moderately compact firm brown gravelly clay with some cobbles - reworked mudstone)
						MADE GROUND (loose to moderately compact mid grey fine to coarse flat gravel and flat cobbles in fine sandy matrix with occasional boulders)
			4.40			
					4.70	End of Trial Pit at 4.70 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:

Groundwater was not encountered.

Stability:

The sides of the trial pit remained stable throughout excavation.

General Remarks:

Evidence of contamination was not encountered. No samples.

APPENDIX D

Borehole Records

Client: WILLIAM SAUNDERS PARTNERSHIP

Site: HOYLAND PHASE 2 AND 3 SI

Project No: 10911



Boring Method: Rotary duplex with air mist flush

Date: 17/01/2007-17/01/2007

Driller: Dan Bar Drilling

Logged By: PJM

Ground Level:

NOT DETERMINED

Top of Casing Elevation (m):

-

Record of : BH2

Sheet 1 of 3

Scale 1:50

Samples Depth	Tests (m) and Field Records	Level (m)	Depth / (Thk) (m)	Description	Legend	Well Diagram
		0.0		MADE GROUND (tarmac over road stone)		
		0.30		Pale brown CLAY		
		1.0				
		2.0				
		(4.20)				
		3.0				
		4.0				
		4.50		Grey/brown sandy CLAY		
		5.0				
		6.0				
		(3.50)				
		7.0				
		8.00	8.0	Brown gravelly SAND		
		(2.00)	9.0			
		10.0		Continued next sheet		

General Remarks:

Groundwater was struck at 8.00m and 20.00m.
Borehole backfilled with arisings.

Water Strikes

Chiselling

Borehole and Casing Details

Borehole

Casing

Strike
Σ
8.000

Level
▼
-

From:
(m)

To:
(m)

Time:
(hr's)

Depth
(m)

Diam.
(mm)

Depth
(m)

Diam.
(mm)

Client: WILLIAM SAUNDERS PARTNERSHIP

Site: HOYLAND PHASE 2 AND 3 SI

Project No: 10911



Boring Method: Rotary duplex with air mist flush

Date: 17/01/2007-17/01/2007

Driller: Dan Bar Drilling

Logged By: PJM

Ground Level:

NOT DETERMINED

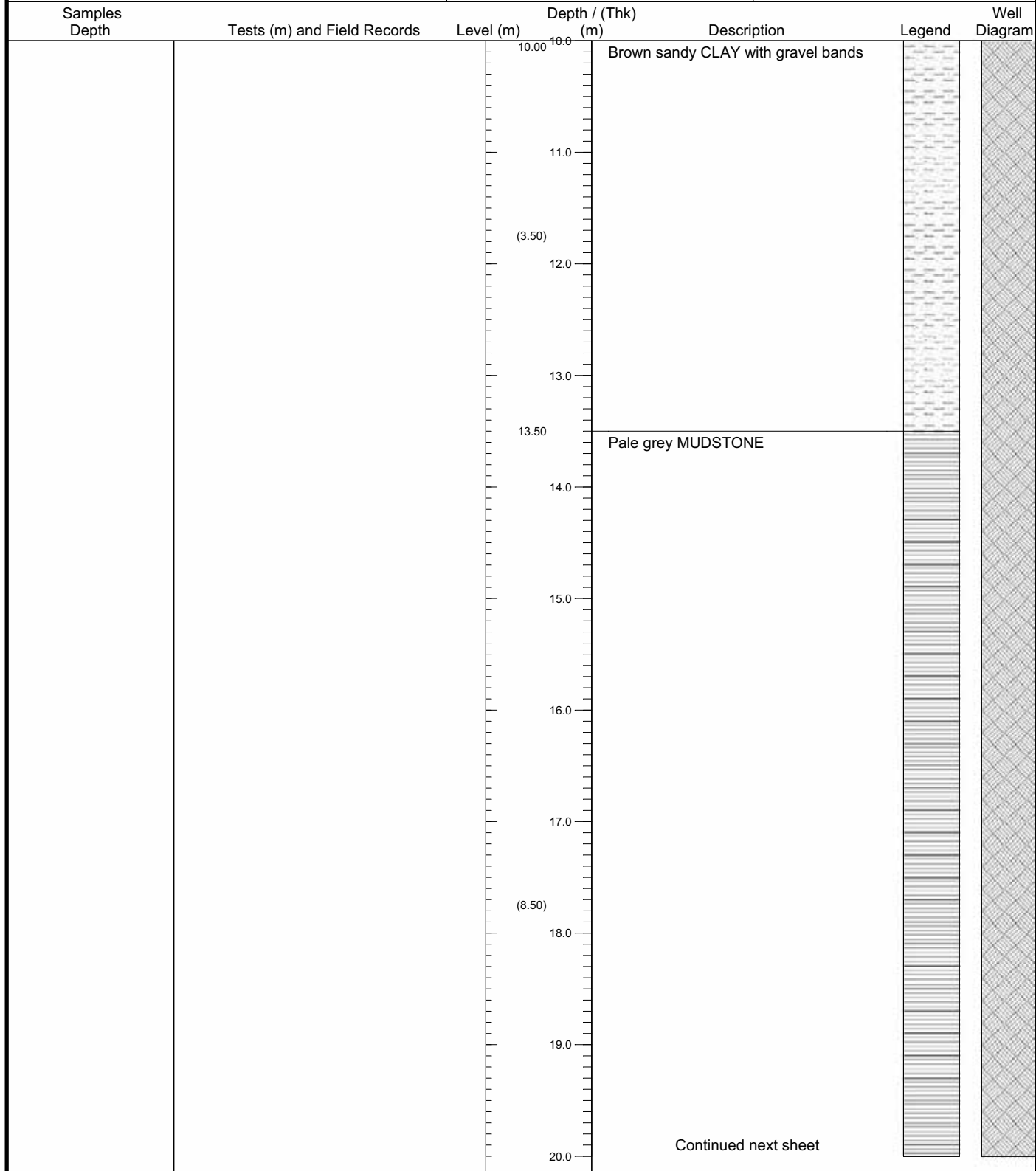
Top of Casing Elevation (m):

-

Record of : BH2

Sheet 2 of 3

Scale 1:50



General Remarks:

Groundwater was struck at 8.00m and 20.00m.
Borehole backfilled with arisings.

Water Strikes

Strike
Σ
20.000

Level
▼
-

Chiselling

From:
(m)
To:
(m)
Time:
(hr's)

Borehole and Casing Details

Borehole

Depth
(m)
Diam.
(mm)

Casing

Depth
(m)
Diam.
(mm)

Client: WILLIAM SAUNDERS PARTNERSHIP

Site: HOYLAND PHASE 2 AND 3 SI

Project No: 10911



Boring Method: Rotary duplex with air mist flush

Date: 17/01/2007-17/01/2007

Driller: Dan Bar Drilling

Logged By: PJM

Ground Level:

NOT DETERMINED

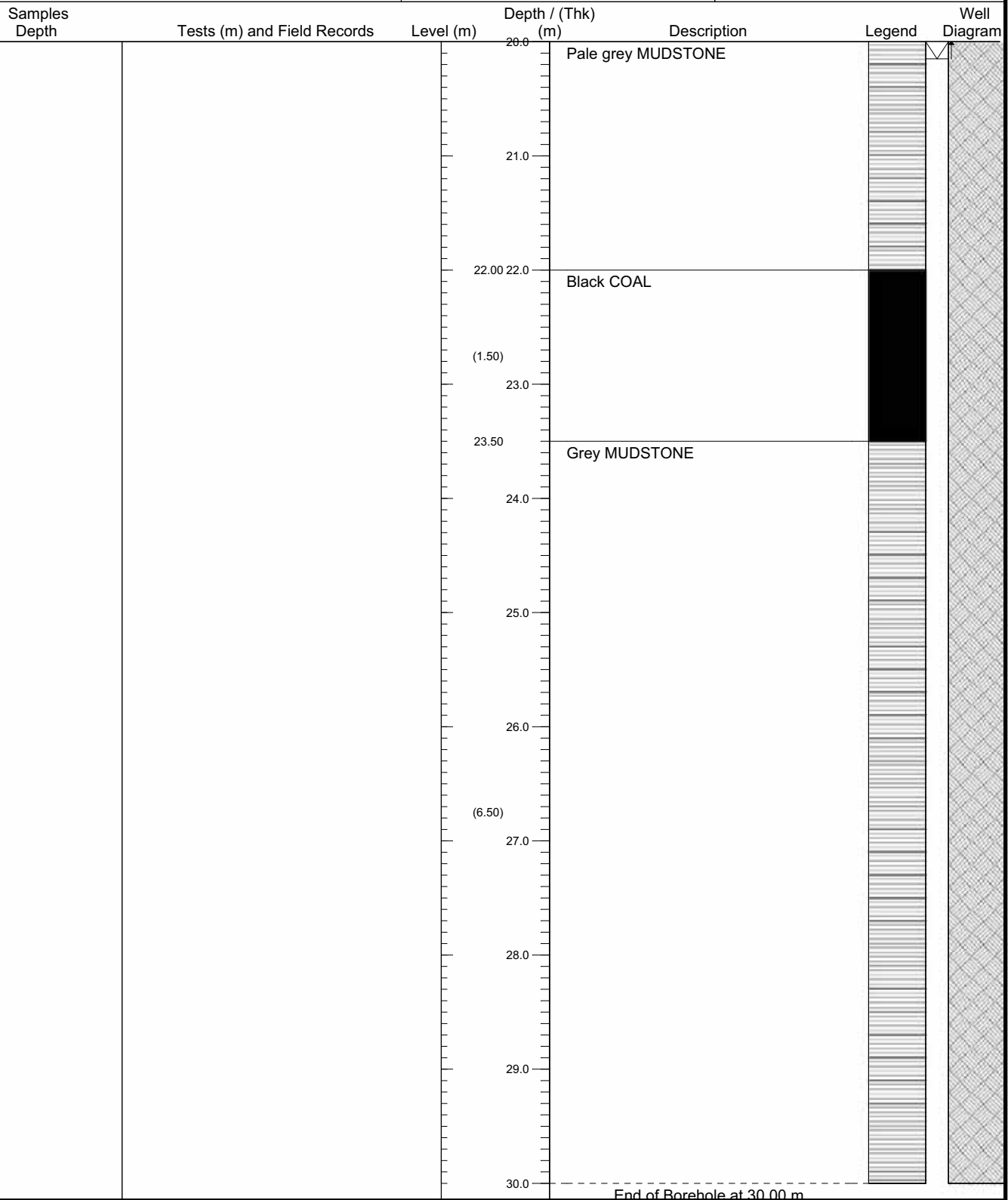
Top of Casing Elevation (m):

-

Record of : BH2

Sheet 3 of 3

Scale 1:50

**General Remarks:**

Groundwater was struck at 8.00m and 20.00m.
Borehole backfilled with arisings.

Water Strikes**Chiselling****Borehole and Casing Details****Borehole****Casing**

Strike
Σ
20.000

Level
▼
-

From:
(m)

To:
(m)

Time:
(hr's)

Depth
(m)

Diam.
(mm)

Depth
(m)

Diam.
(mm)

Client: WILLIAM SAUNDERS PARTNERSHIP

Site: HOYLAND PHASE 2 AND 3 SI

Project No: 10911



Boring Method: Rotary duplex with air mist flush

Date: 18/01/2007-18/01/2007

Driller: Dan Bar Drilling

Logged By: PJM

Ground Level:

NOT DETERMINED

Top of Casing Elevation (m):

-

Record of : BH3

Sheet 1 of 3

Scale 1:50

Samples Depth	Tests (m) and Field Records	Level (m)	Depth / (Thk) (m)	Description	Legend	Well Diagram
		0.0		Grass over brown CLAY		
		1.0				
		2.0				
		(4.50)				
		3.0				
		4.0				
		4.50		Grey brown sandy CLAY		
		5.0				
		6.0				
		(3.50)				
		7.0				
		8.00	8.0	Brown gravelly SAND		
		9.0				
		10.0		Continued next sheet		

General Remarks:

Groundwater was struck at 8.00m and 20.00m.
Borehole backfilled with arisings.

Water Strikes**Chiselling****Borehole and Casing Details****Borehole****Casing**

Strike
Σ
8.000

Level
▼
-

From:
(m)

To:
(m)

Time:
(hr's)

Depth
(m)

Diam.
(mm)

Depth
(m)

Diam.
(mm)

Client: WILLIAM SAUNDERS PARTNERSHIP

Site: HOYLAND PHASE 2 AND 3 SI

Project No: 10911



Boring Method: Rotary duplex with air mist flush

Date: 18/01/2007-18/01/2007

Driller: Dan Bar Drilling

Logged By: PJM

Ground Level:

NOT DETERMINED

Top of Casing Elevation (m):

-

Record of : BH3

Sheet 2 of 3

Scale 1:50

Samples Depth	Tests (m) and Field Records	Level (m)	Depth / (Thk) (m)	Description	Legend	Well Diagram
		10.0		Brown gravelly SAND		
		(5.50)				
		11.0				
		12.0				
		13.0				
		13.50		Grey MUDSTONE		
		14.0				
		15.0				
		16.0				
		17.0				
		18.0				
		19.0				
		(12.00)				
		20.0		Continued next sheet		

General Remarks:

Groundwater was struck at 8.00m and 20.00m.
Borehole backfilled with arisings.

Water Strikes**Chiselling****Borehole and Casing Details****Borehole****Casing**

Strike
Σ
20.000

Level
▼
-

From:
(m)

To:
(m)

Time:
(hr's)

Depth
(m)

Diam.
(mm)

Depth
(m)

Diam.
(mm)

Client: WILLIAM SAUNDERS PARTNERSHIP

Site: HOYLAND PHASE 2 AND 3 SI

Project No: 10911



Boring Method: Rotary duplex with air mist flush

Date: 18/01/2007-18/01/2007

Driller: Dan Bar Drilling

Logged By: PJM

Ground Level:

NOT DETERMINED

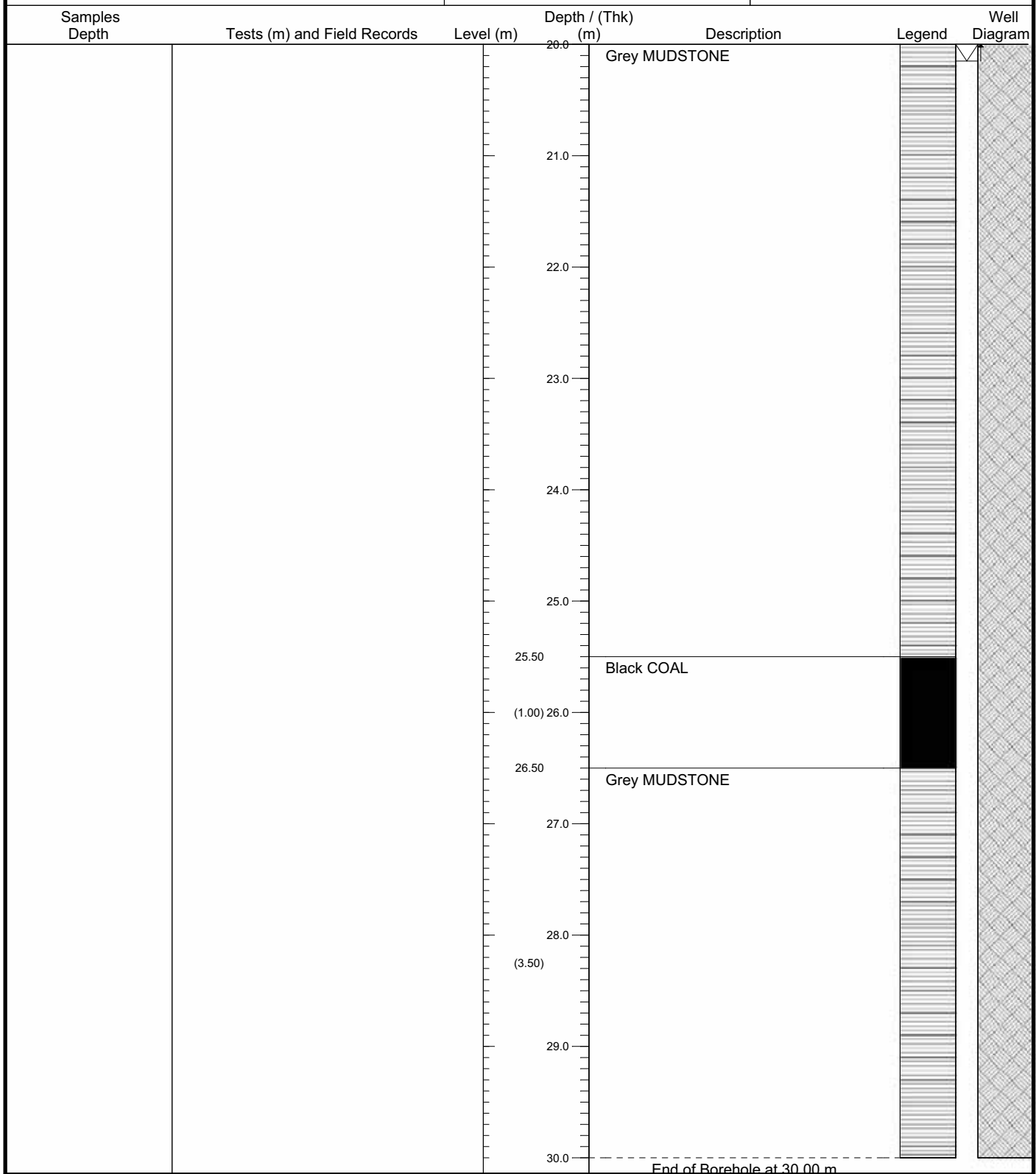
Top of Casing Elevation (m):

-

Record of : BH3

Sheet 3 of 3

Scale 1:50

**General Remarks:**

Groundwater was struck at 8.00m and 20.00m.
Borehole backfilled with arisings.

Water Strikes**Chiselling****Borehole and Casing Details****Borehole****Casing**

Strike
Σ
20.000

Level
▼
-

From:
(m)

To:
(m)

Time:
(hr's)

Depth
(m)

Diam.
(mm)

Depth
(m)

Diam.
(mm)

Client: WILLIAM SAUNDERS PARTNERSHIP

Site: HOYLAND PHASE 2 AND 3 SI

Project No: 10911



Boring Method: Rotary duplex with air mist flush

Date: 19/01/2007-19/01/2007

Driller: Dan Bar Drilling

Logged By: PJM

Ground Level:

NOT DETERMINED

Top of Casing Elevation (m):

-

Record of : BH4

Sheet 1 of 4

Scale 1:50

Samples Depth	Tests (m) and Field Records	Level (m)	Depth / (Thk) (m)	Description	Legend	Well Diagram
		0.0		Grass over brown CLAY - 1.00m inspection pit		
		1.0				
		(3.00)				
		2.0				
		3.00	3.0	Grey brown sandy CLAY		
		4.0				
		5.0				
		(5.00)				
		6.0				
		7.0				
		8.00	8.0	Brown gravelly SAND		
		9.0				
		10.0		Continued next sheet		

General Remarks:

Groundwater was struck at 8.00m and 20.00m.
Borehole backfilled with arisings.

Water Strikes

Chiselling

Borehole and Casing Details

Borehole

Casing

Strike
Σ
8.000

Level
▼
-

From:
(m)

To:
(m)

Time:
(hr's)

Depth
(m)

Diam.
(mm)

Depth
(m)

Diam.
(mm)

Client: WILLIAM SAUNDERS PARTNERSHIP

Site: HOYLAND PHASE 2 AND 3 SI

Project No: 10911



Boring Method: Rotary duplex with air mist flush

Date: 19/01/2007-19/01/2007

Driller: Dan Bar Drilling

Logged By: PJM

Ground Level:

NOT DETERMINED

Top of Casing Elevation (m):

-

Record of : BH4

Sheet 2 of 4

Scale 1:50

Samples Depth	Tests (m) and Field Records	Level (m)	Depth / (Thk) (m)	Description	Legend	Well Diagram
		10.0		Brown gravelly SAND		
		(5.50)				
		11.0				
		12.0				
		13.0				
		13.50		Grey MUDSTONE		
		14.0				
		15.0				
		16.0				
		17.0				
		18.0				
		19.0				
		20.0		Continued next sheet		

General Remarks:

Groundwater was struck at 8.00m and 20.00m.
Borehole backfilled with arisings.

Water Strikes**Chiselling****Borehole and Casing Details****Borehole****Casing**

Strike
Σ
20.000

Level
▼
-

From:
(m)

To:
(m)

Time:
(hr's)

Depth
(m)

Diam.
(mm)

Depth
(m)

Diam.
(mm)

Client: WILLIAM SAUNDERS PARTNERSHIP

Site: HOYLAND PHASE 2 AND 3 SI

Project No: 10911



Boring Method: Rotary duplex with air mist flush

Date: 19/01/2007-19/01/2007

Driller: Dan Bar Drilling

Logged By: PJM

Ground Level:

NOT DETERMINED

Top of Casing Elevation (m):

-

Record of : BH4

Sheet 3 of 4

Scale 1:50

Samples
Depth

Tests (m) and Field Records

Level (m)

Depth / (Thk)
(m)

Description

Legend

Well
Diagram

Grey MUDSTONE

(26.50)

Continued next sheet

General Remarks:Groundwater was struck at 8.00m and 20.00m.
Borehole backfilled with arisings.

Water Strikes

Chiselling

Borehole and Casing Details

Borehole

Casing

Strike
Σ
20.000Level
▼
-From:
(m)To:
(m)Time:
(hr's)Depth
(m)Diam.
(mm)Depth
(m)Diam.
(mm)

Client: WILLIAM SAUNDERS PARTNERSHIP

Site: HOYLAND PHASE 2 AND 3 SI

Project No: 10911



Boring Method: Rotary duplex with air mist flush

Date: 19/01/2007-19/01/2007

Driller: Dan Bar Drilling

Logged By: PJM

Ground Level:

NOT DETERMINED

Top of Casing Elevation (m):

-

Record of : BH4

Sheet 4 of 4

Scale 1:50

Samples Depth	Tests (m) and Field Records	Level (m)	Depth / (Thk) (m)	Description	Legend	Well Diagram
			30.0	Grey MUDSTONE		
			31.0			
			32.0			
			33.0			
			34.0			
			35.0			
			36.0			
			37.0			
			38.0			
			39.0			
			40.0	End of Borehole at 40.00 m		

General Remarks:

Groundwater was struck at 8.00m and 20.00m.
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: WILLIAM SAUNDERS PARTNERSHIP

Site: HOYLAND PHASE 2 AND 3 SI

Project No: 10911



Boring Method: Truck mounted rotary rig

Date: 20/11/2006-20/11/2006

Driller: Cape Site Services

Logged By: PJM

Ground Level:

NOT DETERMINED

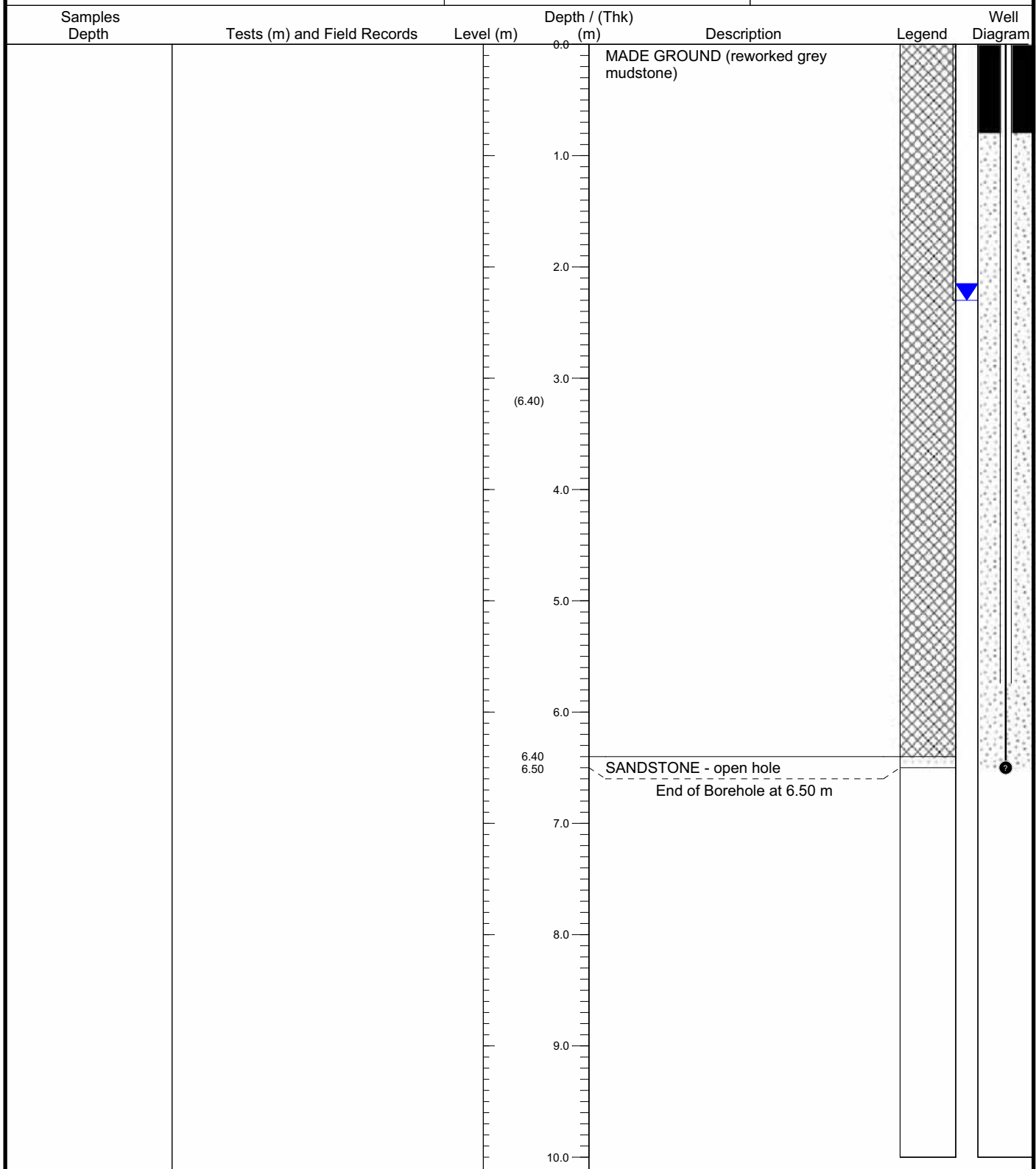
Top of Casing Elevation (m):

-

Record of : BH201

Sheet 1 of 1

Scale 1:50

**General Remarks:**

Core not taken.
 Installation: 2.00m plain 0.26m Agl to 1.74m bgl; 4.00m slotted 1.74m bgl to 5.74m bgl.
 Bentonite seal at surface.
 Pea gravel filter pack.
 Groundwater standing at 2.30m.

Water Strikes**Chiselling****Borehole and Casing Details****Borehole****Casing**

Strike

 0.000

Level

 2.300

From:
 (m)

To:
 (m)

Time:
 (hr's)

Depth
 (m)

Diam.
 (mm)

Depth
 (m)

Diam.
 (mm)

Client: WILLIAM SAUNDERS PARTNERSHIP

Site: HOYLAND PHASE 2 AND 3 SI

Project No: 10911



Boring Method: Truck mounted Rotary rig

Date: 20/11/2006-20/11/2006

Driller: Cape Site Services

Logged By: PJM

Ground Level:

NOT DETERMINED

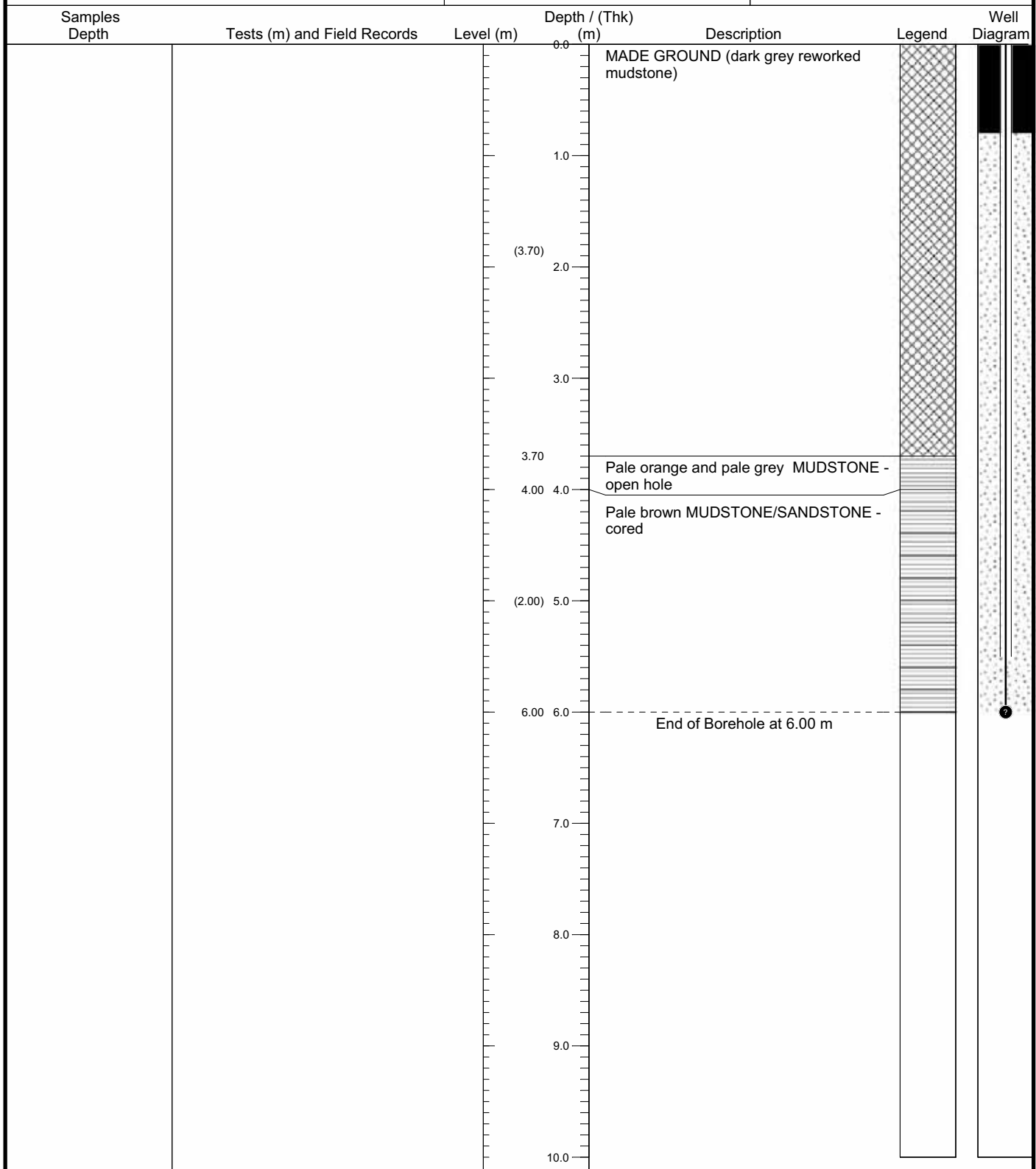
Top of Casing Elevation (m):

-

Record of : BH202

Sheet 1 of 1

Scale 1:50

**General Remarks:**

Core taken 4.00m - 6.00m.

Installation: 1.00m plain 0.50m Agl to 0.50m bgl; 5.00m slotted 0.50m bgl to 5.50m bgl.

Bentonite seal at surface.

Pea gravel filter pack.

Groundwater was not encountered.

Water StrikesStrike
ΣLevel
▼**Chiselling**From:
(m)To:
(m)Time:
(hr's)**Borehole and Casing Details****Borehole**Depth
(m)Diam.
(mm)**Casing**Depth
(m)Diam.
(mm)

Client: WILLIAM SAUNDERS PARTNERSHIP

Site: HOYLAND PHASE 2 AND 3 SI

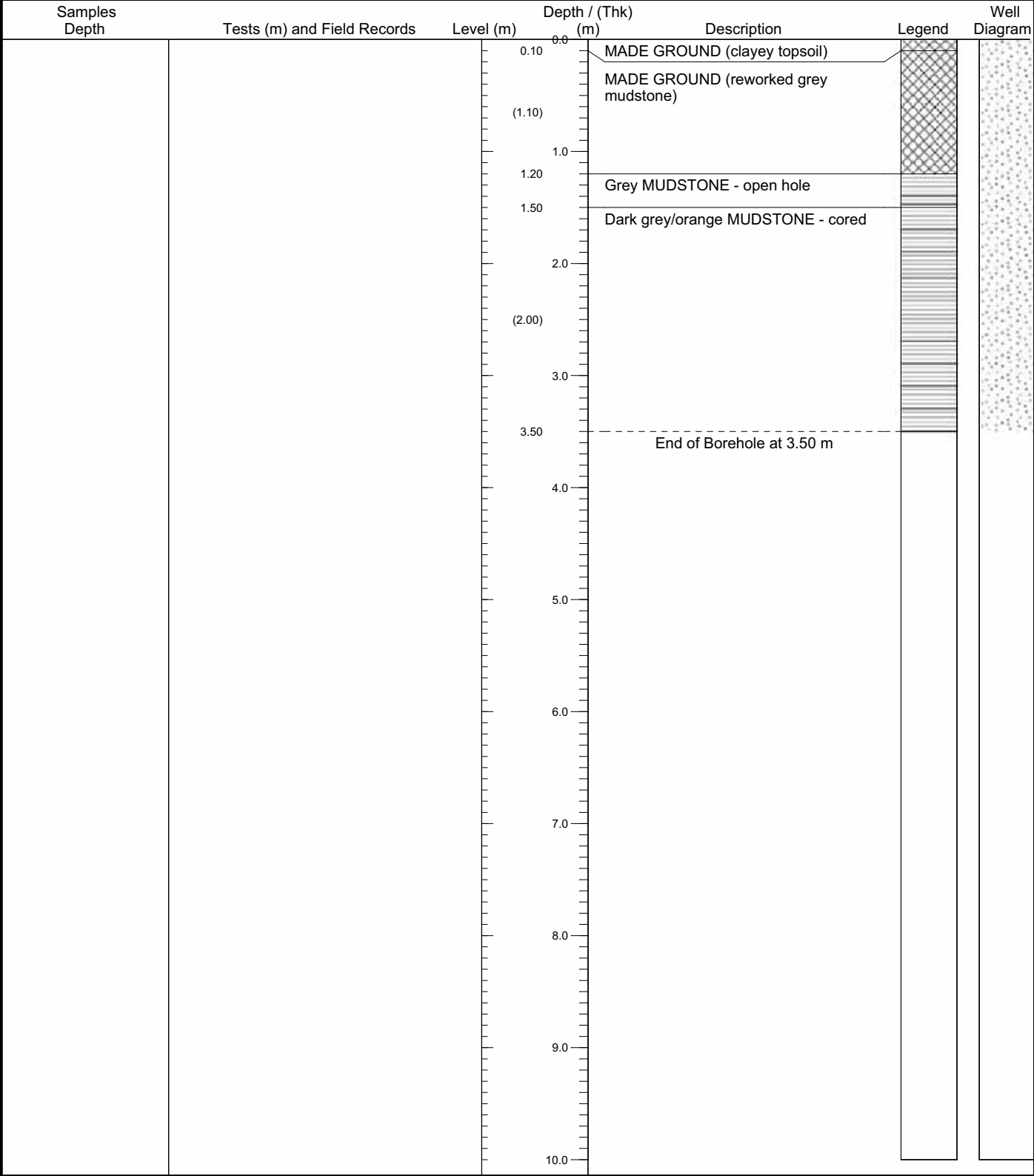
Project No: 10911



Boring Method: Truck mounted rotary rig
Date: 24/11/2006-24/11/2006
Driller: Piltec Drilling
Logged By: PJM

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

Record of : BH203
Sheet 1 of 1
Scale 1:50



General Remarks:

No installation.
Borehole backfilled with pea gravel.
No groundwater encountered.

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: WILLIAM SAUNDERS PARTNERSHIP

Site: HOYLAND PHASE 2 AND 3 SI

Project No: 10911



Boring Method: Truck mounted rotary rig

Date: 24/11/2006-24/11/2006

Driller: Piletec Drilling

Logged By: PJM

Ground Level:

NOT DETERMINED

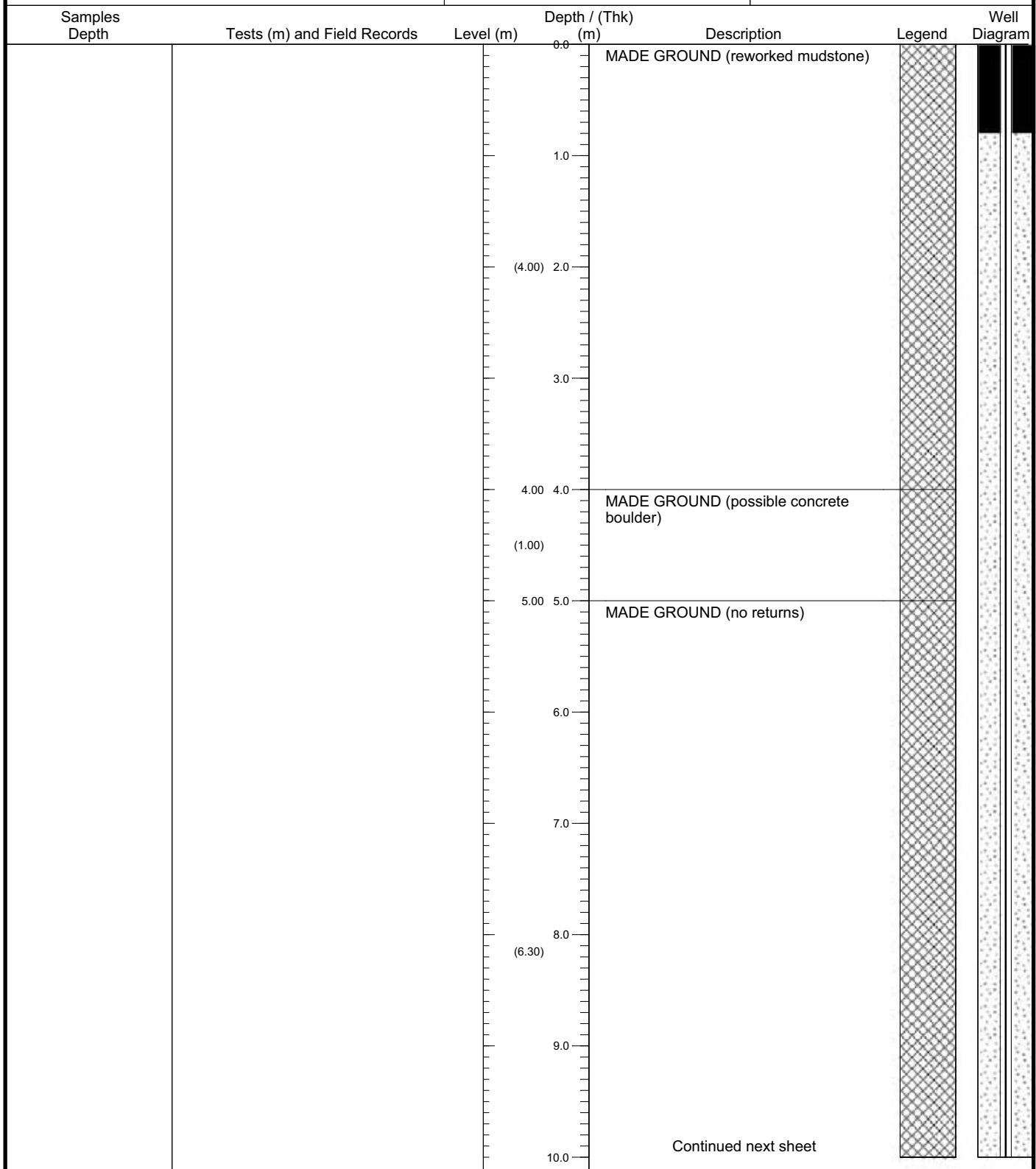
Top of Casing Elevation (m):

-

Record of : BH204

Sheet 1 of 2

Scale 1:50



General Remarks:

Installation: 1.25m plain 0.25m Agl to 1.00m bgl; 12.50m slotted 1.00m bgl to 13.50m bgl.

Bentonite seal at surface.

Pea gravel filter pack.

Groundwater was not encountered.

Water Strikes

Strike
∇

Level
▼

Chiselling

From:
(m)

To:
(m)

Time:
(hr's)

Borehole and Casing Details

Borehole

Depth
(m)

Diam.
(mm)

Casing

Depth
(m)

Diam.
(mm)

Client: WILLIAM SAUNDERS PARTNERSHIP

Site: HOYLAND PHASE 2 AND 3 SI

Project No: 10911



Boring Method: Truck mounted rotary rig

Date: 24/11/2006-24/11/2006

Driller: Piletec Drilling

Logged By: PJM

Ground Level:

NOT DETERMINED

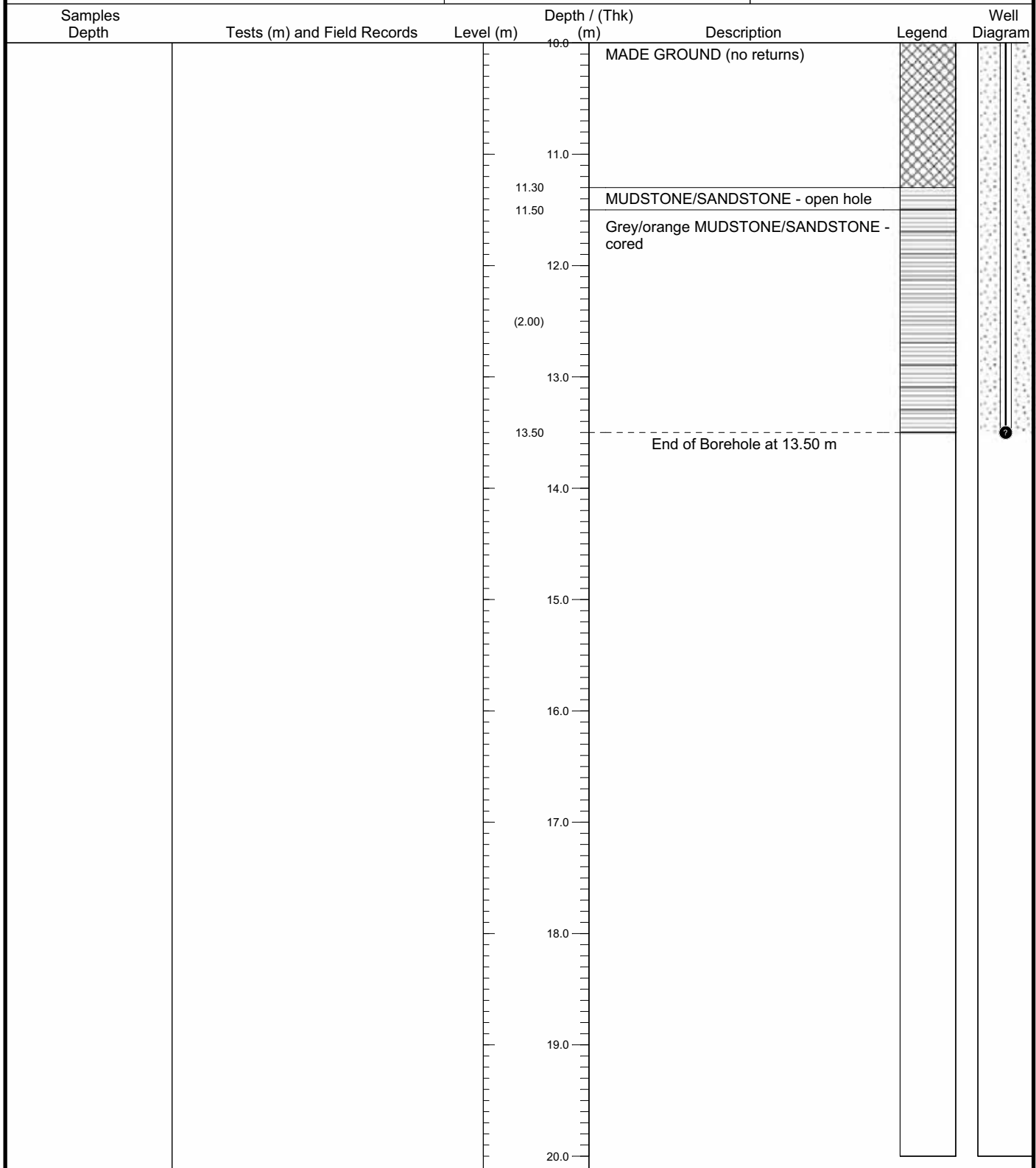
Top of Casing Elevation (m):

-

Record of : BH204

Sheet 2 of 2

Scale 1:50



General Remarks:

Installation: 1.25m plain 0.25m Agl to 1.00m bgl; 12.50m slotted 1.00m bgl to 13.50m bgl.
Bentonite seal at surface.
Pea gravel filter pack.
Groundwater was not encountered.

Water Strikes

Strike
Σ

Level
▼

Chiselling

From:
(m)

To:
(m)

Time:
(hr's)

Borehole and Casing Details

Borehole

Depth
(m)

Diam.
(mm)

Casing

Depth
(m)

Diam.
(mm)

Client: WILLIAM SAUNDERS PARTNERSHIP

Site: HOYLAND PHASE 2 AND 3 SI

Project No: 10911



Boring Method: Truck mounted rotary rig

Date: 24/11/2006-24/11/2006

Driller: Piltec Drilling

Logged By: PJM

Ground Level:

NOT DETERMINED

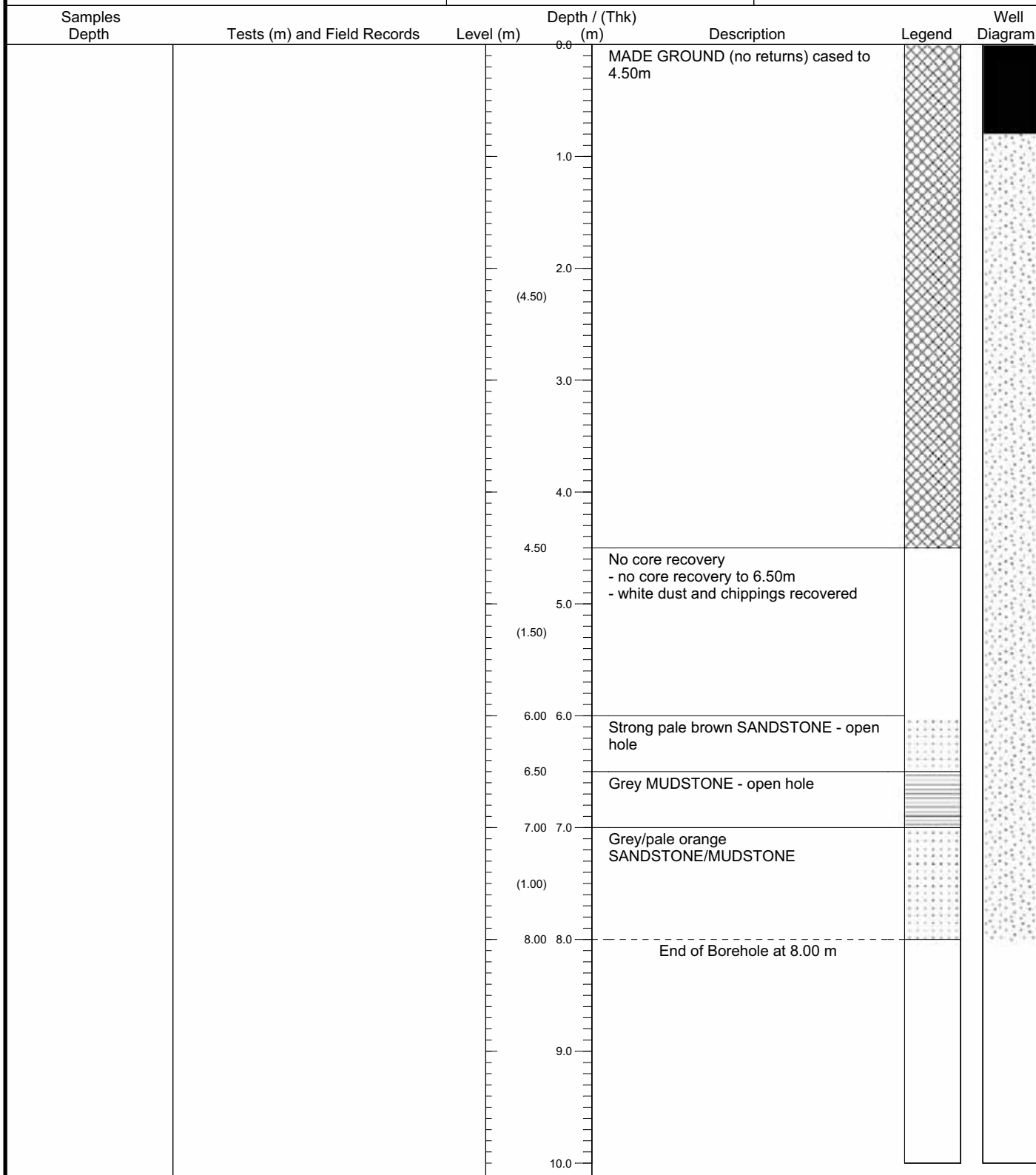
Top of Casing Elevation (m):

-

Record of : BH205

Sheet 1 of 1

Scale 1:50

**General Remarks:**

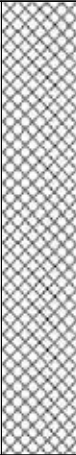
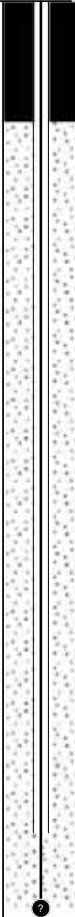
Installation: 2.00m plain 0.30m Agl to 1.70m bgl; 6.00m slotted 1.70m bgl to 7.70m bgl.

Bentonite seal at surface (0.80m - ground level).

Pea gravel filter pack.

Groundwater standing at 2.30m.

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

Client: WILLIAM SAUNDERS PARTNERSHIP									
Site: HOYLAND PHASE 2 AND 3 SI									
Project No: 10911									
Boring Method: Truck mounted rotary rig			Ground Level:			Record of : BH206			
Date: 27/11/2006-27/11/2006			NOT DETERMINED			Sheet 1 of 1			
Driller: Piltec Drilling			Top of Casing Elevation (m):			Scale 1:50			
Logged By: PJM			-						
Samples Depth	Tests (m) and Field Records	Level (m)	Depth / (Thk) (m)	Description	Legend	Well Diagram			
		0.0	0.0	MADE GROUND (reworked mudstone) - open hole					
		1.0							
		(3.00)							
		2.0							
		3.0	3.0	Pale grey and pale orange MUDSTONE - cored					
		4.0							
		(3.00)							
		5.0							
		6.0	6.0	End of Borehole at 6.00 m					
		7.0							
		8.0							
		9.0							
		10.0							
General Remarks: Installation: 1.00m plain 0.50m Agl to 0.50m bgl; 5.00m slotted 0.50m bgl to 5.50m bgl. Bentonite seal at surface. Pea gravel filter pack. Groundwater was not encountered.			Water Strikes		Chiselling			Borehole and Casing Details	
			Strike ⊷	Level ▼	From: (m)	To: (m)	Time: (hr's)	Depth (m)	Diam. (mm)

Client: WILLIAM SAUNDERS PARTNERSHIP

Site: HOYLAND PHASE 2 AND 3 SI

Project No: 10911



Boring Method: Truck mounted rotary rig

Date: 27/11/2006-27/11/2006

Driller: Piltec Drilling

Logged By: TR

Ground Level:

NOT DETERMINED

Top of Casing Elevation (m):

-

Record of : BH207

Sheet 1 of 1

Scale 1:50

Samples Depth	Tests (m) and Field Records	Level (m)	Depth / (Thk) (m)	Description	Legend	Well Diagram
		0.0		MADE GROUND (reworked mudstone)		
		(1.50)				
		1.0				
		1.50		SANDSTONE - open hole		
		2.0				
		(1.30)				
		2.80		Grey MUDSTONE - open hole		
		3.00 3.0		Strong orange/grey SANDSTONE - cored		
		4.0				
		(2.00)				
		5.00 5.0		End of Borehole at 5.30 m		
		6.0				
		7.0				
		8.0				
		9.0				
		10.0				

General Remarks:

Installation: 1.50m plain 0.20m Agl to 1.30m bgl; 4.00m slotted 1.30m bgl to 5.30m bgl.

Bentonite seal at surface.

Pea gravel filter pack.

Groundwater was not encountered.

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: WILLIAM SAUNDERS PARTNERSHIP

Site: HOYLAND PHASE 2 AND 3 SI

Project No: 10911



Boring Method: Truck mounted rotary rig

Date: 27/11/2006-28/11/2006

Driller: Piletec Drilling

Logged By: TR

Ground Level:

NOT DETERMINED

Top of Casing Elevation (m):

-

Record of : BH208

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 (reworked mudstone with sandstone boulder at 3.00m - 4.00m - open hole - cored 3.00m - 4.00m)		
			1.0			
			2.0			
			3.0			
			4.0			
			5.0			
			6.0			
			7.0			
		(14.50)	8.0			
			9.0			
			10.0			
				Continued next sheet		

General Remarks:

Installation: 1.10m plain 0.10m Agl to 1.00m bgl; 15.00m slotted 1.00m bgl to 16.00m bgl.

Bentonite seal at surface.

Pea gravel filter pack.

Groundwater was not encountered.

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: WILLIAM SAUNDERS PARTNERSHIP

Site: HOYLAND PHASE 2 AND 3 SI

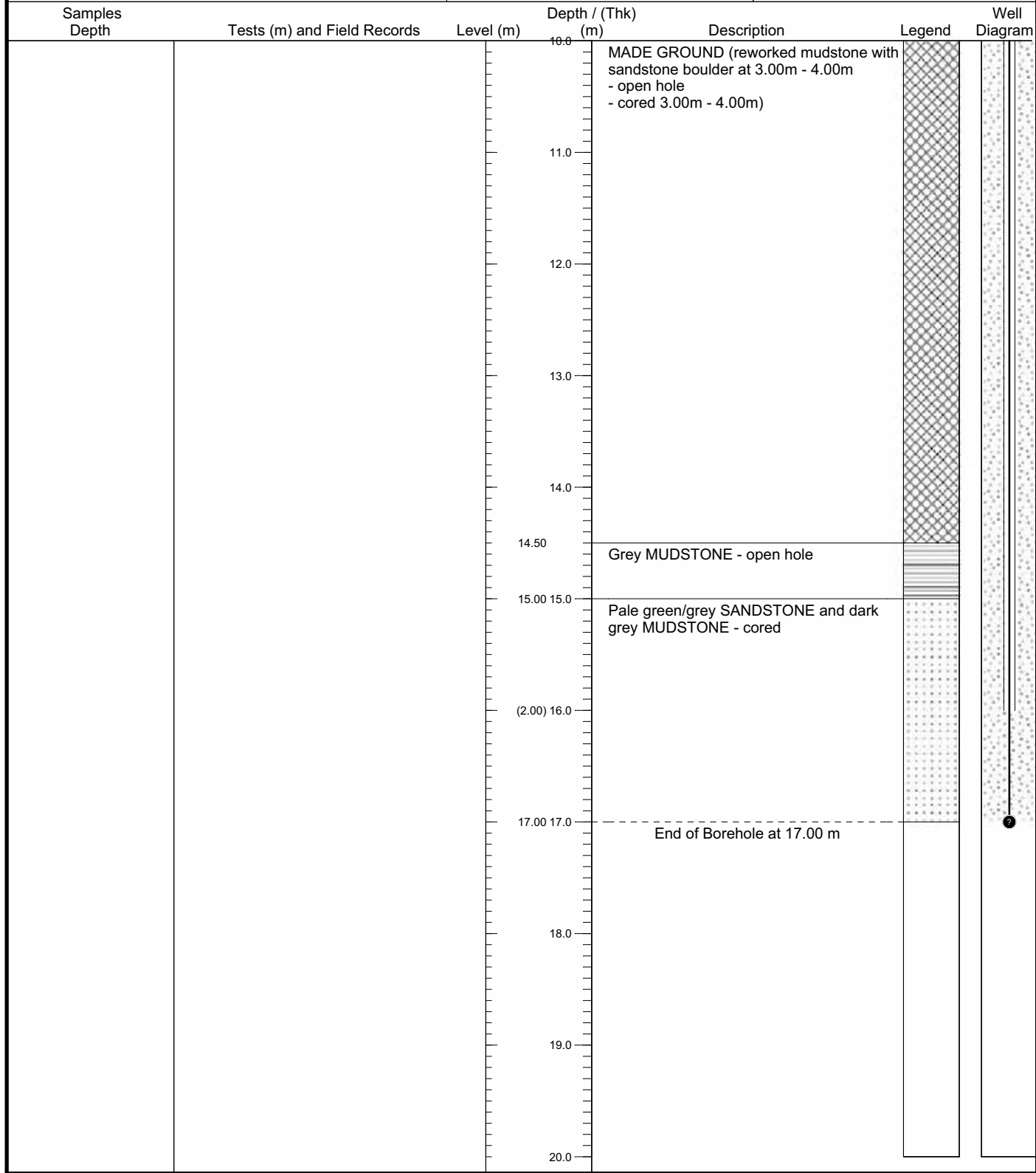
Project No: 10911



Boring Method: Truck mounted rotary rig
Date: 27/11/2006-28/11/2006
Driller: Piletec Drilling
Logged By: TR

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

Record of : BH208
Sheet 2 of 2
Scale 1:50



General Remarks:
Installation: 1.10m plain 0.10m Agl to 1.00m bgl; 15.00m slotted 1.00m bgl to 16.00m bgl.
Bentonite seal at surface.
Pea gravel filter pack.
Groundwater was not encountered.

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: WILLIAM SAUNDERS PARTNERSHIP

Site: HOYLAND PHASE 2 AND 3 SI

Project No: 10911



Boring Method: Truck mounted rotary rig

Date: 06/12/2006-06/12/2006

Driller: Piletec Drilling

Logged By: TR

Ground Level:

NOT DETERMINED

Top of Casing Elevation (m):

-

Record of : BH208A

Sheet 1 of 3

Scale 1:50

Samples Depth	Tests (m) and Field Records	Level (m)	Depth / (Thk) (m)	Description	Legend	Well Diagram
			0.0	MADE GROUND (reworked mudstone - open hole)		
			1.0			
			2.0			
			3.0			
			4.0			
			5.0			
			6.0			
			7.0			
			8.0			
			(17.00)			
			9.0			
			10.0	Continued next sheet		

General Remarks:

No installation.
Borehole backfilled with pea gravel.
Groundwater was not encountered.

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: WILLIAM SAUNDERS PARTNERSHIP

Site: HOYLAND PHASE 2 AND 3 SI

Project No: 10911



Boring Method: Truck mounted rotary rig
Date: 06/12/2006-06/12/2006
Driller: Piletec Drilling
Logged By: TR

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

Record of : BH208A
Sheet 2 of 3
Scale 1:50

Samples Depth	Tests (m) and Field Records	Level (m)	Depth / (Thk) (m)	Description	Legend	Well Diagram
			10.0	MADE GROUND (reworked mudstone - open hole)		
			11.0			
			12.0			
			13.0			
			14.0			
			15.0			
			16.0			
			17.00 17.0	Dark grey MUDSTONE and pale orange SANDSTONE - open hole to 17.50m - cored 17.50m - 20.50m		
			18.0			
			(3.50) 19.0			
			20.0	Continued next sheet		

General Remarks:

No installation.
Borehole backfilled with pea gravel.
Groundwater was not encountered.

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: WILLIAM SAUNDERS PARTNERSHIP

Site: HOYLAND PHASE 2 AND 3 SI

Project No: 10911



Boring Method: Truck mounted rotary rig

Date: 06/12/2006-06/12/2006

Driller: Piletec Drilling

Logged By: TR

Ground Level:

NOT DETERMINED

Top of Casing Elevation (m):

-

Record of : BH208A

Sheet 3 of 3

Scale 1:50

Samples Depth	Tests (m) and Field Records	Level (m)	Depth / (Thk) (m)	Description	Legend	Well Diagram
			20.0	Dark grey MUDSTONE and pale orange SANDSTONE		
			20.50	- open hole to 17.50m - cored 17.50m - 20.50m		
				End of Borehole at 20.50 m		
			21.0			
			22.0			
			23.0			
			24.0			
			25.0			
			26.0			
			27.0			
			28.0			
			29.0			
			30.0			

General Remarks:

No installation.
Borehole backfilled with pea gravel.
Groundwater was not encountered.

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)

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)
0.000	18.000							

Client: WILLIAM SAUNDERS PARTNERSHIP

Site: HOYLAND PHASE 2 AND 3 SI

Project No: 10911



Boring Method: Truck mounted rotary rig

Date: 28/11/2006-29/11/2006

Driller: Piletec Drilling

Logged By: TR

Ground Level:

NOT DETERMINED

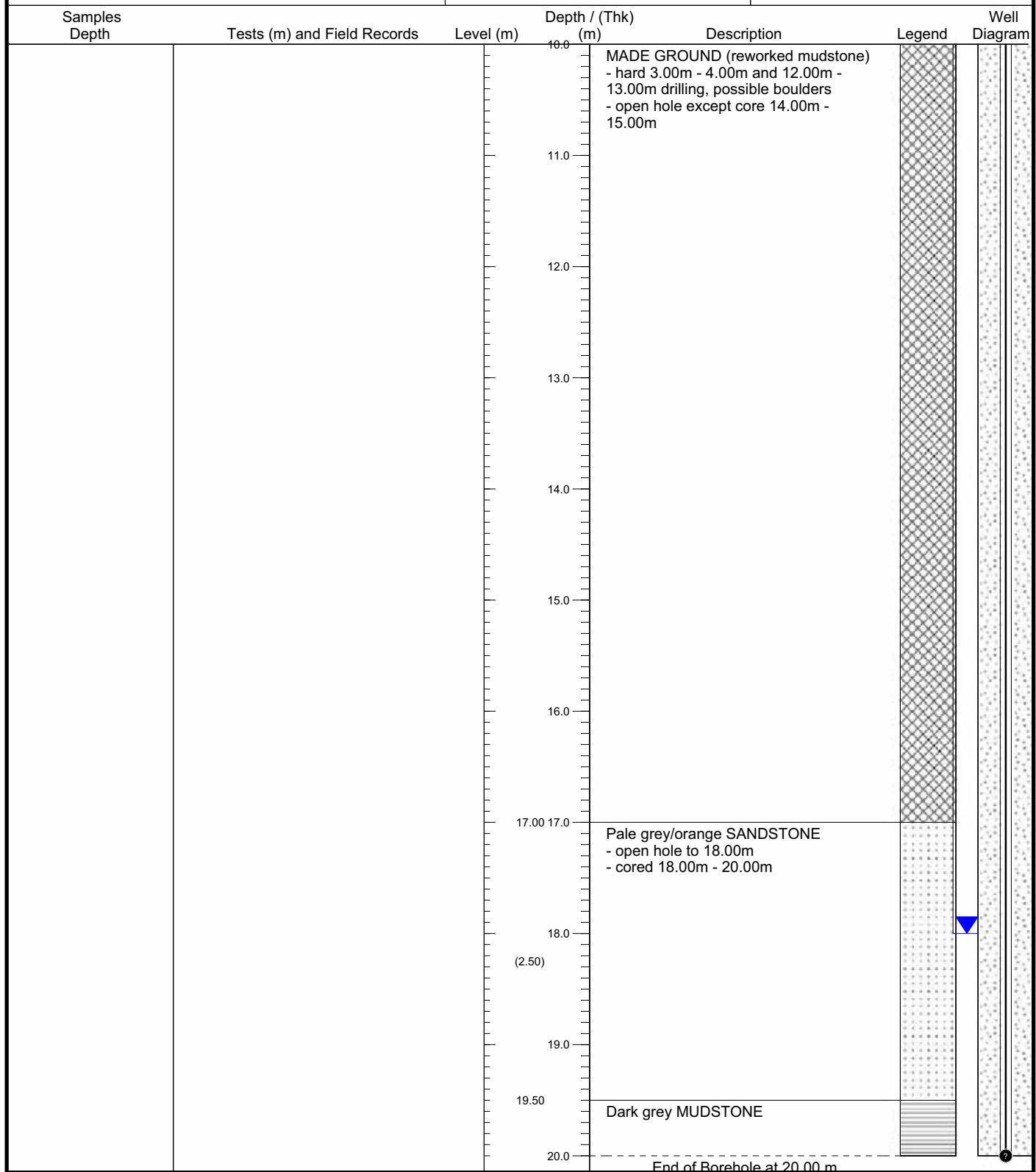
Top of Casing Elevation (m):

-

Record of : BH209

Sheet 2 of 2

Scale 1:50

**General Remarks:**

Installation: 1.20m plain 0.20m Agl to 1.00m bgl; 19.00m slotted 1.00m bgl to 20.00m bgl.

Bentonite seal at surface.

Pea gravel filter pack.

Groundwater standing at approximately 18.00m.

Groundwater standing at 2.30m.

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

Client: WILLIAM SAUNDERS PARTNERSHIP

Site: HOYLAND PHASE 2 AND 3 SI

Project No: 10911



Boring Method: Truck mounted rotary rig

Date: 29/11/2006-30/11/2006

Driller: Piletec Drilling

Logged By: TR

Ground Level:

NOT DETERMINED

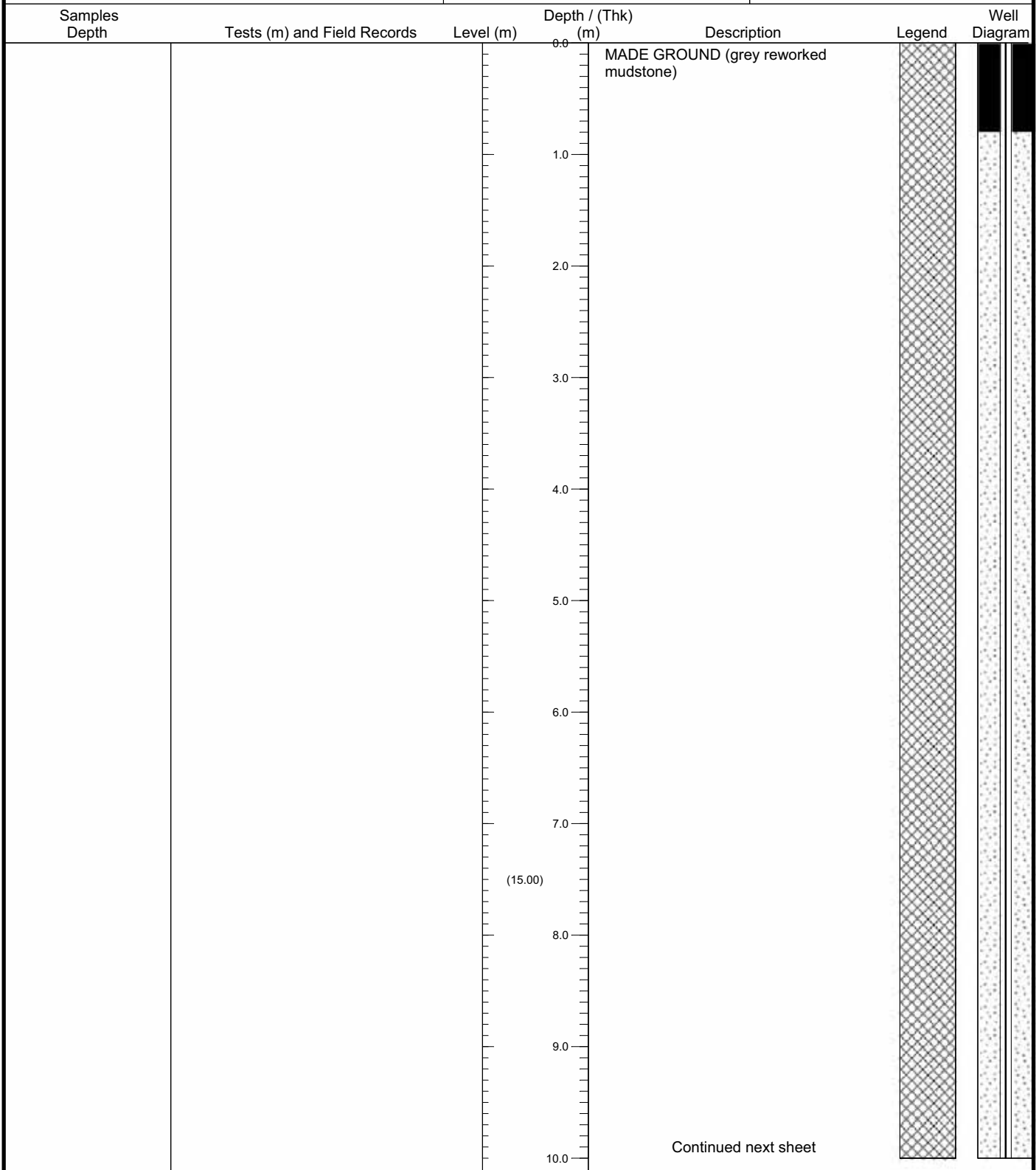
Top of Casing Elevation (m):

-

Record of : BH210

Sheet 1 of 3

Scale 1:50



General Remarks:

Installation: 1.00m plain 0.20m Agl to 0.80m bgl; 19.00m slotted 0.80m bgl to 19.80m bgl.
Bentonite seal at surface.
Pea gravel filter pack.
Slight groundwater entries at 14.00m - 15.00m.

Water Strikes

Strike
∇

Level
▼

Chiselling

From:
(m)

To:
(m)

Time:
(hr's)

Borehole and Casing Details

Borehole

Depth
(m)

Diam.
(mm)

Casing

Depth
(m)

Diam.
(mm)

Client: WILLIAM SAUNDERS PARTNERSHIP

Site: HOYLAND PHASE 2 AND 3 SI

Project No: 10911



Boring Method: Truck mounted rotary rig

Date: 29/11/2006-30/11/2006

Driller: Piletec Drilling

Logged By: TR

Ground Level:

NOT DETERMINED

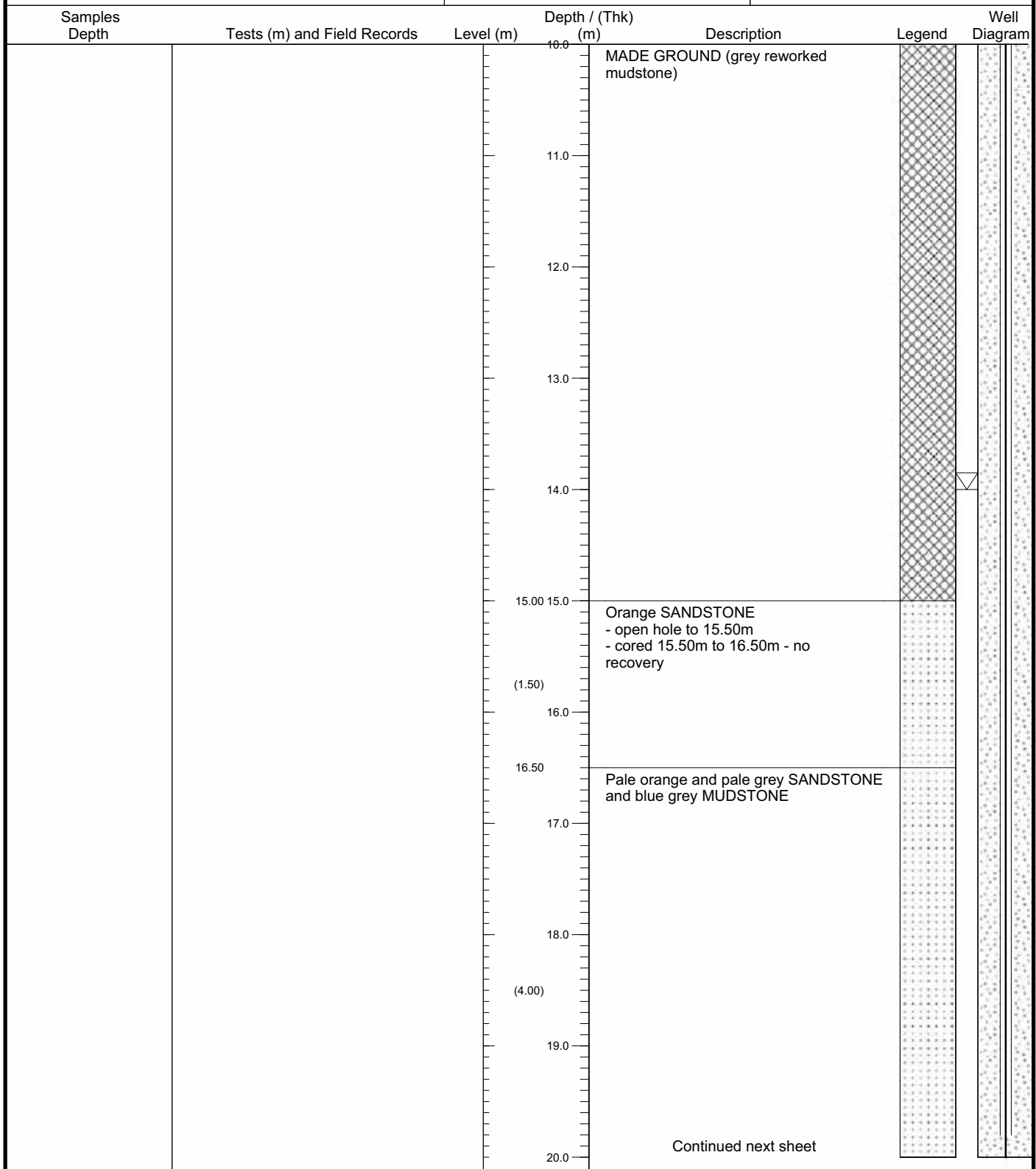
Top of Casing Elevation (m):

-

Record of : BH210

Sheet 2 of 3

Scale 1:50

**General Remarks:**

Installation: 1.00m plain 0.20m Agl to 0.80m bgl; 19.00m slotted 0.80m bgl to 19.80m bgl.

Bentonite seal at surface.

Pea gravel filter pack.

Slight groundwater entries at 14.00m - 15.00m.

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)
14.000	-							

Client: WILLIAM SAUNDERS PARTNERSHIP

Site: HOYLAND PHASE 2 AND 3 SI

Project No: 10911



Boring Method: Truck mounted rotary rig

Date: 29/11/2006-30/11/2006

Driller: Piletec Drilling

Logged By: TR

Ground Level:

NOT DETERMINED

Top of Casing Elevation (m):

-

Record of : BH210

Sheet 3 of 3

Scale 1:50

Samples Depth	Tests (m) and Field Records	Level (m)	Depth / (Thk) (m)	Description	Legend	Well Diagram
			20.0	Pale orange and pale grey SANDSTONE and blue grey MUDSTONE		
			20.50	End of Borehole at 20.50 m		
			21.0			
			22.0			
			23.0			
			24.0			
			25.0			
			26.0			
			27.0			
			28.0			
			29.0			
			30.0			

General Remarks:

Installation: 1.00m plain 0.20m Agl to 0.80m bgl; 19.00m slotted 0.80m bgl to 19.80m bgl.
Bentonite seal at surface.
Pea gravel filter pack.
Slight groundwater entries at 14.00m - 15.00m.

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: WILLIAM SAUNDERS PARTNERSHIP

Site: HOYLAND PHASE 2 AND 3 SI

Project No: 10911



Boring Method: Truck mounted rotary rig

Date: 30/11/2006-30/11/2006

Driller: Piletec Drilling

Logged By: TR

Ground Level:

NOT DETERMINED

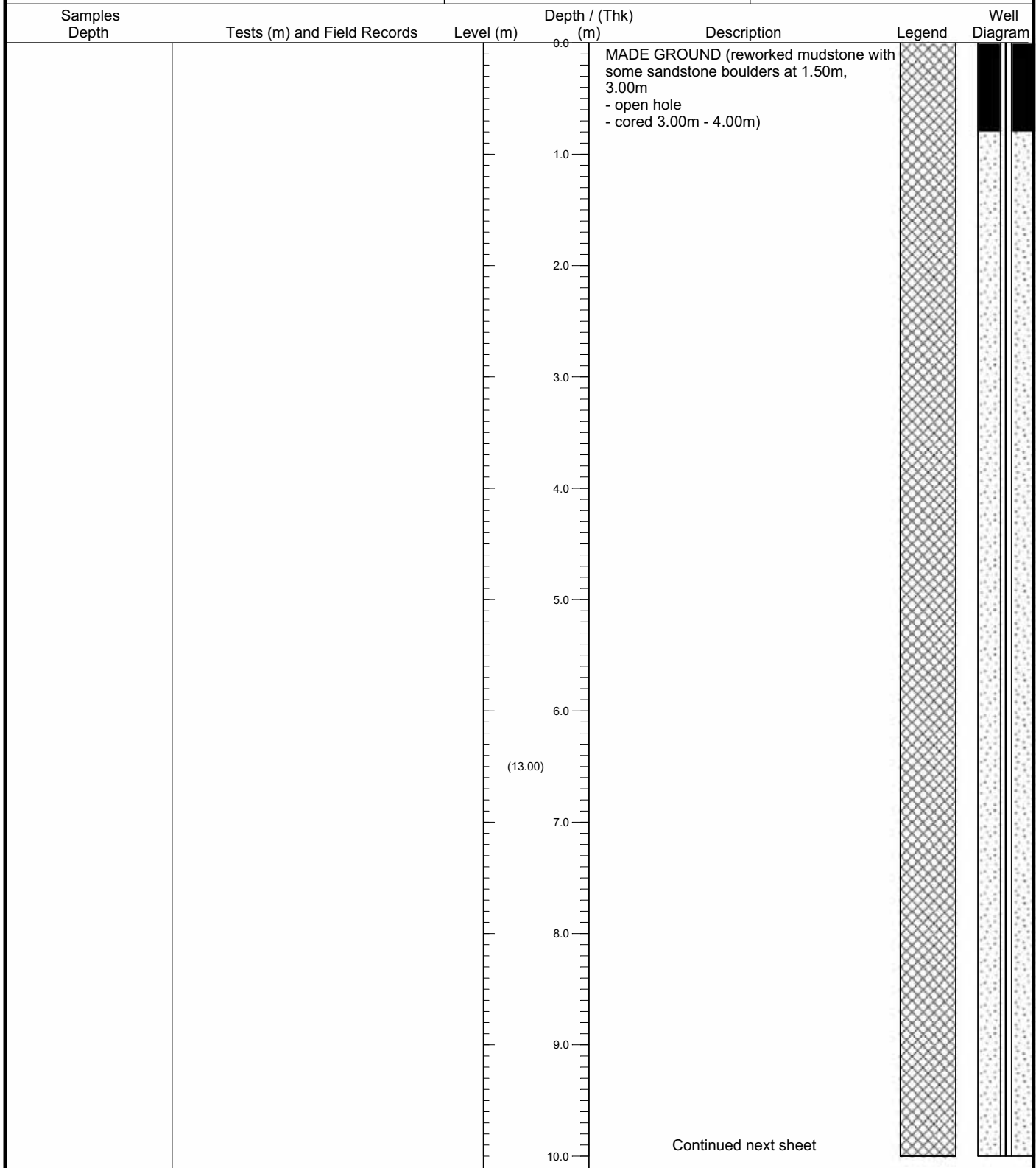
Top of Casing Elevation (m):

-

Record of : BH211

Sheet 1 of 2

Scale 1:50



General Remarks:

Installation: 1.20m plain 0.20m Agl to 1.20m bgl; 16.50m slotted 1.20m bgl to 17.70m bgl.
Bentonite seal at surface.
Pea gravel filter pack.
Groundwater was not encountered.
Groundwater standing at 2.30m.

Water Strikes

Strike
∇

Level
▼

Chiselling

From: (m)
To: (m)
Time: (hr's)

Borehole and Casing Details

Borehole

Depth (m)
Diam. (mm)

Casing

Depth (m)
Diam. (mm)

Client: WILLIAM SAUNDERS PARTNERSHIP

Site: HOYLAND PHASE 2 AND 3 SI

Project No: 10911



Boring Method: Truck mounted rotary rig

Date: 30/11/2006-30/11/2006

Driller: Piletec Drilling

Logged By: TR

Ground Level:

NOT DETERMINED

Top of Casing Elevation (m):

-

Record of : BH211

Sheet 2 of 2

Scale 1:50

Samples Depth	Tests (m) and Field Records	Level (m)	Depth / (Thk) (m)	Description	Legend	Well Diagram
			10.0	MADE GROUND (reworked mudstone with some sandstone boulders at 1.50m, 3.00m - open hole - cored 3.00m - 4.00m)		
			11.0			
			12.0			
			13.00	Pale orange SANDSTONE and blue/grey MUDSTONE - possible boulders to 15.50m - open hole to 13.50m - cored 13.50m - 15.50m - no recovery - cored 15.50m - 17.50m		
			14.0			
			15.0			
		(4.50)	16.0			
			17.0			
			17.50	End of Borehole at 17.50 m		
			18.0			
			19.0			
			20.0			

General Remarks:

Installation: 1.20m plain 0.20m Agl to 1.20m bgl; 16.50m slotted 1.20m bgl to 17.70m bgl.

Bentonite seal at surface.

Pea gravel filter pack.

Groundwater was not encountered.

Groundwater standing at 2.30m.

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

Client: WILLIAM SAUNDERS PARTNERSHIP

Site: HOYLAND PHASE 2 AND 3 SI

Project No: 10911



Boring Method: Truck mounted rotary rig

Date: 01/12/2006-01/12/2006

Driller: Piletec Drilling

Logged By: TR

Ground Level:

NOT DETERMINED

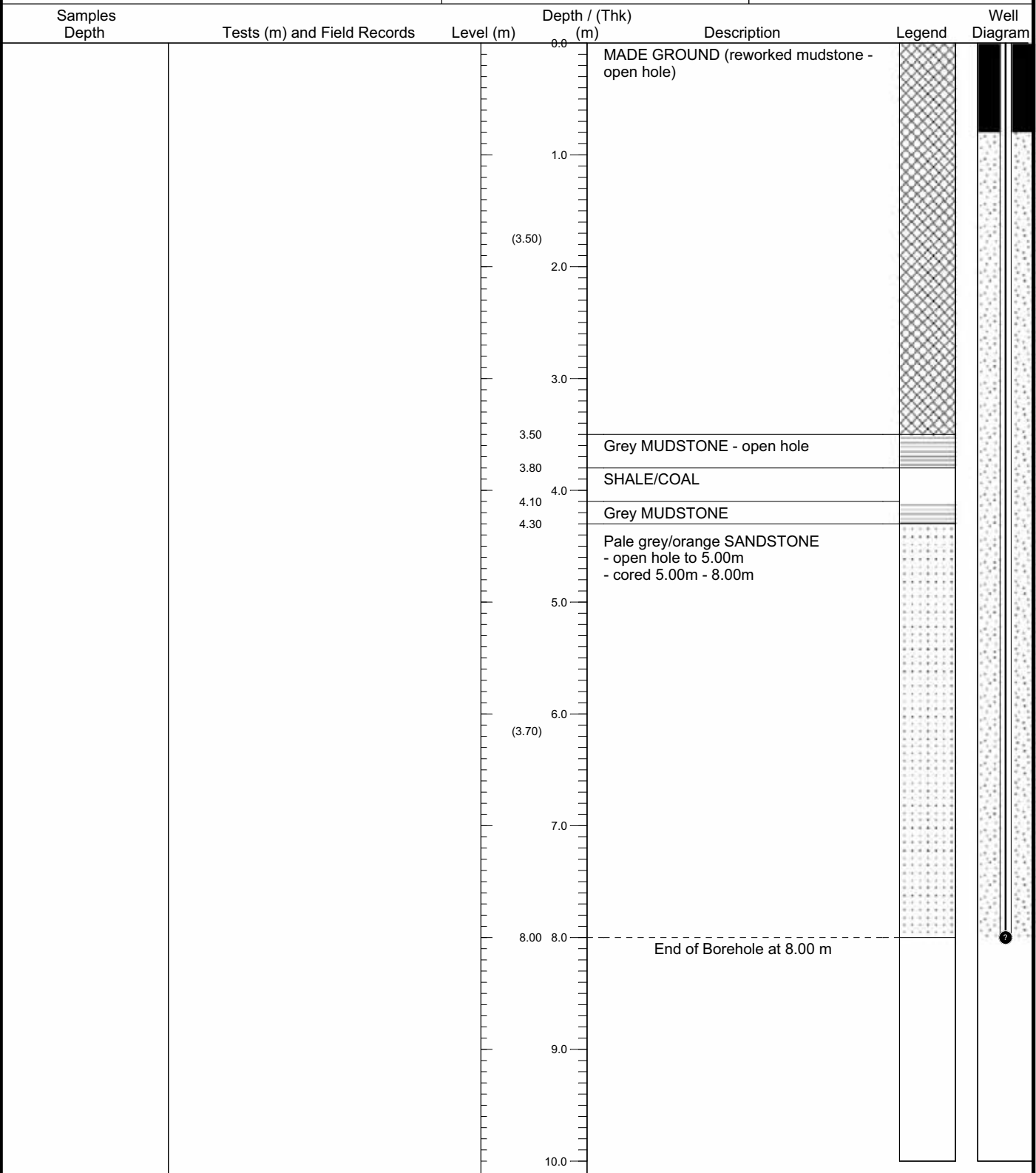
Top of Casing Elevation (m):

-

Record of : BH212

Sheet 1 of 1

Scale 1:50



General Remarks:

Installation: 1.20m plain 0.20m Agl to 1.00m bgl; 7.00m slotted 1.00m bgl to 8.00m bgl.
Bentonite seal at surface.
Pea gravel filter pack.
Groundwater was not encountered.

Water Strikes

Strike
∇

Level
▼

Chiselling

From:
(m)

To:
(m)

Time:
(hr's)

Borehole and Casing Details

Borehole

Depth
(m)

Diam.
(mm)

Casing

Depth
(m)

Diam.
(mm)

Client: WILLIAM SAUNDERS PARTNERSHIP

Site: HOYLAND PHASE 2 AND 3 SI

Project No: 10911



Boring Method: Truck mounted rotary rig

Date: 01/12/2006-01/12/2006

Driller: Piletec Drilling

Logged By: TR

Ground Level:

NOT DETERMINED

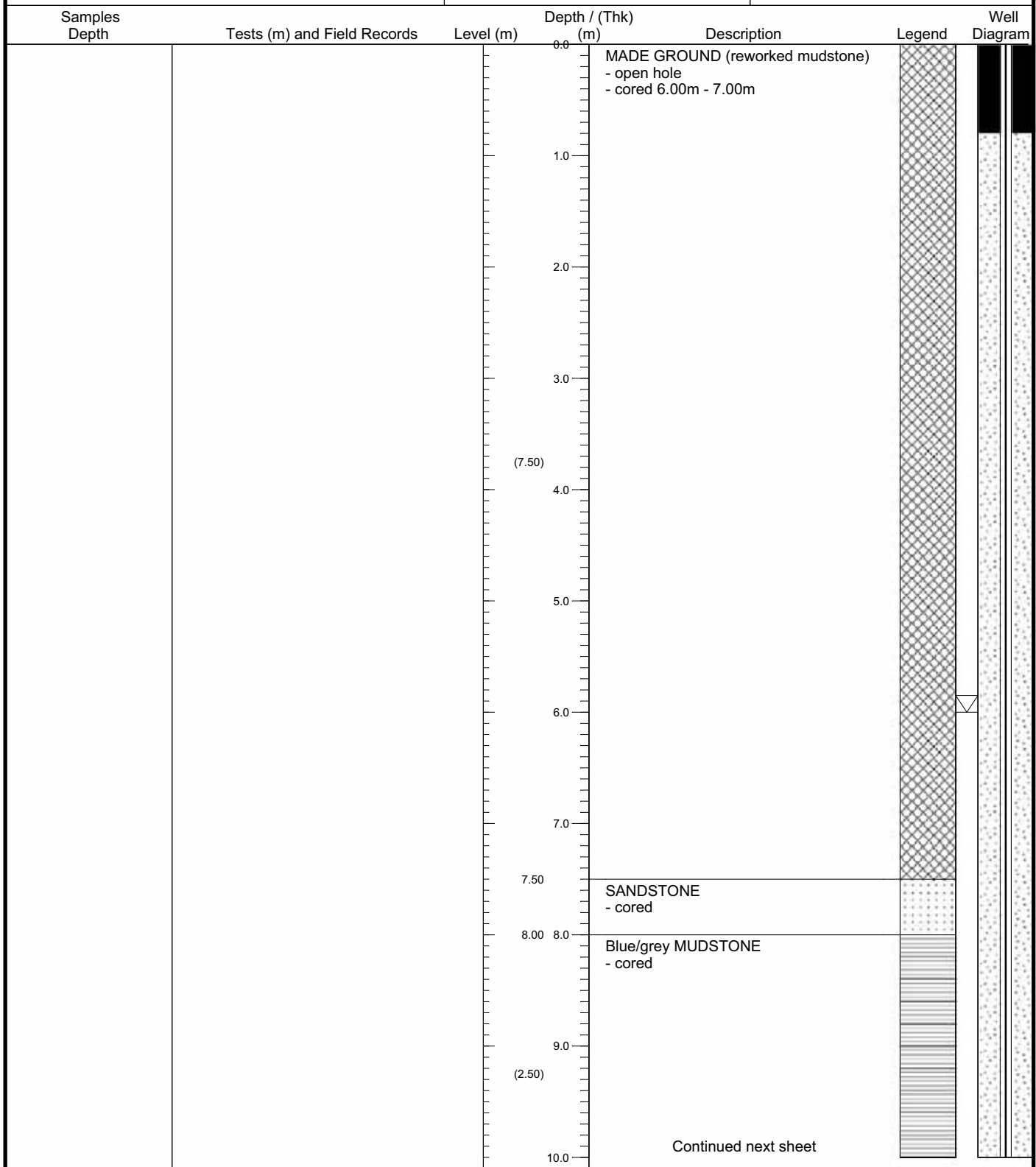
Top of Casing Elevation (m):

-

Record of : BH213

Sheet 1 of 2

Scale 1:50

**General Remarks:**

Installation: 1.20m plain 0.20m Agl to 1.00m bgl; 9.50m slotted 1.00m bgl to 10.50m bgl.

Bentonite seal at surface.

Pea gravel filter pack.

Groundwater standing at approximately 6.00m - 7.00m.

Water Strikes**Chiselling****Borehole and Casing Details****Borehole****Casing**Strike
Σ
6.000Level
▼
-From:
(m)To:
(m)Time:
(hr's)Depth
(m)Diam.
(mm)Depth
(m)Diam.
(mm)

Client: WILLIAM SAUNDERS PARTNERSHIP

Site: HOYLAND PHASE 2 AND 3 SI

Project No: 10911



Boring Method: Truck mounted rotary rig
Date: 01/12/2006-01/12/2006
Driller: Piletec Drilling
Logged By: TR

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

Record of : BH213
Sheet 2 of 2
Scale 1:50

Samples Depth	Tests (m) and Field Records	Level (m)	Depth / (Thk) (m)	Description	Legend	Well Diagram
		10.0	10.0	Blue/grey MUDSTONE - cored		
		10.50	10.50	End of Borehole at 10.50 m		
		11.0	11.0			
		12.0	12.0			
		13.0	13.0			
		14.0	14.0			
		15.0	15.0			
		16.0	16.0			
		17.0	17.0			
		18.0	18.0			
		19.0	19.0			
		20.0	20.0			

General Remarks:
Installation: 1.20m plain 0.20m Agl to 1.00m bgl; 9.50m slotted 1.00m bgl to 10.50m bgl.
Bentonite seal at surface.
Pea gravel filter pack.
Groundwater standing at approximately 6.00m - 7.00m.

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)

APPENDIX E

Groundwater Elevations

10911 R2 (00) Appendix E - Summary of Groundwater Depths and Elevations on Phase 3

Depth to Water relative to Top of Casing (TOC)

Borehole	DTW (mbTOC)						TOC to ground level (m)
Date	29-Nov-06	05-Dec-06	21-Dec-06	9-Jan-07	16-Jan-07	22-Jan-07	
Days after 27/11/06	2	8	24	43	50	56	
BH201	2.270	1.952	1.985	1.614	1.690	1.731	0.260
BH202	2.530	5.570	5.595	5.517	5.520	5.354	0.500
BH204	13.670	13.840	13.615	13.652	13.663	13.673	0.250
BH205	6.931	7.101	7.820	7.817	7.814	7.820	0.295
BH206	dry	5.087	5.540	4.793	5.009	5.139	0.470

Depth to Water relative to Ground Level

Borehole	DTW (mbGL)						Ground Elevation (mAOD)
Date	29-Nov-06	05-Dec-06	21-Dec-06	9-Jan-07	16-Jan-07	22-Jan-07	
Days after 27/11/06	2	8	24	43	50	56	
BH201	2.010	1.692	1.725	1.354	1.430	1.471	133.380
BH202	2.030	5.070	5.095	5.017	5.020	4.854	133.280
BH204	13.420	13.590	13.365	13.402	13.413	13.423	128.700
BH205	6.636	6.806	7.525	7.522	7.519	7.525	128.500
BH206	dry	4.617	5.070	4.323	4.539	4.669	128.200

Groundwater Elevation relative to Ordnance Datum (OD) and Elevation of Natural Strata

Borehole	Groundwater Elevation (mAOD)						Natural Material Elevation (mAOD)
Date	29-Nov-06	05-Dec-06	21-Dec-06	9-Jan-07	16-Jan-07	22-Jan-07	
Days after 27/11/06	2	8	24	43	50	56	
BH201	131.370	131.688	131.655	132.026	131.950	131.909	126.980
BH202	131.250	128.210	128.185	128.263	128.260	128.426	129.580
BH204	115.280	115.110	115.335	115.298	115.287	115.277	117.400
BH205	121.864	121.694	120.975	120.978	120.981	120.975	122.500
BH206	dry	123.583	123.130	123.877	123.661	123.531	125.200

DTW = Depth to water

mb = Metres below

TOC = Top of casing

GL = Ground level

AOD = Above Ordnance Datum

APPENDIX F

Self-Weight Surface Settlement Monitoring Results

10911 R2 (00) Appendix F - Summary of PGM Monitoring Results on Phase 3 to Date from 29/11/06

PGM Elevations (mAOD) on Dates Shown

PGM ID	14/04/2004	29/11/2006	15/01/2007	02/03/2007	05/04/2007
PEG50OLD	131.070	131.068	131.068	131.066	131.066
PEG51	131.263	131.262	131.262	131.260	131.261
PEG52	128.193	128.191	128.191	128.189	128.192
PEG53OLD	128.510	128.509	128.509	128.506	128.509
PEG67	128.909	128.911	128.913	128.910	128.913
PEG68	131.282	131.280	131.283	131.280	131.282

PGMs were installed in 2004 or if labelled 'old' were installed in 1997

Change in PGM Levels (m) from and to Dates Shown (- means level has gone up)

from	14/04/2004	29/11/2006	15/01/2007	02/03/2007	14/04/2004
to	29/11/2006	15/01/2007	02/03/2007	05/04/2007	05/04/2007
PEG50OLD	0.0022	0.0002	0.0021	-0.0006	0.004
PEG51	0.0013	-0.0002	0.0014	-0.0010	0.002
PEG52	0.0018	-0.0005	0.0022	-0.0024	0.001
PEG53OLD	0.0014	-0.0006	0.0037	-0.0036	0.001
PEG67	-0.0021	-0.0013	0.0029	-0.0030	-0.004
PEG68	0.0020	-0.0032	0.0027	-0.0017	0.000

APPENDIX G

Elevations of Natural Strata

10911 R2 (00) Appendix G - Depth to Rock and Elevation of Rock in all Locations on Phase 3

2006	Current Ground level (mAOD)		Depth to rock / natural (mbgl)	Natural Material Type		Approx Elevation of rock / natural (mAOD)
TP	*					
101	133.870		0.90	Mudstone		132.970
102	135.210		3.70	Sandstone		131.510
103	134.690		4.70	Mudstone		129.990
104	135.000	>	5.30	None	<	129.700
105	130.800		2.00	Mudstone		128.800
106	130.560		1.00	Mudstone		129.560
107	130.200		0.05	Mudstone		130.150
108	129.350	>	3.50	None	<	125.850
109	128.920	>	5.00	None	<	123.920
110	129.290	>	4.30	None	<	124.990
111	129.060		1.00	Mudstone		128.060
112	129.280	>	3.20	None	<	126.080
113	134.730		2.10	Mudstone		132.630
114	127.660	>	4.90	None	<	122.760
115	128.230		2.80	Mudstone		125.430
116	127.970		2.80	Clay over mudstone		125.170
BH	**					
201	133.380		6.40	Sandstone		126.980
202	133.280		3.70	Mudstone/sandstone		129.580
203	133.500		1.20	Mudstone		132.300
204	128.700		11.30	Mudstone/sandstone		117.400
205	128.500		6.00	Mudstone/sandstone		122.500
206	128.200		3.00	Mudstone		125.200

* taken from Cheshire Surveys' survey data 29/11/06

** taken from contours on WmSP topographical survey reproduced in Figure 2

< means less than

> means greater than

Appendix 3

Trial Pit Logs

Project Name
SHORTWOOD BUSINESS PARK

Project No.
34072

Co-ords: -
Level: -

Date
02/11/2011

Location: HOYLAND

Dimensions: -

Scale
1:25

Client: E V Waddington Limited

Depth
2.20m

Logged By
KLG

Samples & In Situ Testing

Depth (m)	Type	Results	Depth (m)	Level (m AOD)	Legend	Stratum Description	
			1.20			MADE GROUND: comprising gravelly cobbly clay. Gravel is sub angular mudstone and sandstone fragments.	1
			2.00			Stiff grey gravelly CLAY. Gravel is sub angular weak mudstone fragments.	
			2.20			Stiff orange laminated CLAY with rare ironstone nodules.	2
						Trialpit Complete at 2.20 m	
							3
							4

Remarks:

Groundwater: Groundwater encountered at base.



Project Name SHORTWOOD BUSINESS PARK	Project No. 34072	Co-ords: - Level: -	Date 02/11/2011
Location: HOYLAND		Dimensions: - Depth 3.60m	Scale 1:25
Client: E V Waddington Limited			Logged By KLG

Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description	
Depth (m)	Type	Results					
			0.70			MADE GROUND: comprising brown and grey sandy clay with rare boulders of sandstone.	
			1.20			MADE GROUND: comprising grey sandy clay.	1
			3.20			Stiff orange and grey mottled CLAY.	2
			3.60			Stiff dark grey very silty CLAY with rare fragments of coal.	3
						Trialpit Complete at 3.60 m	4

Remarks:

Groundwater: Groundwater encountered at base.

Project Name
SHORTWOOD BUSINESS PARK

Project No.
34072

Co-ords:	-
Level:	-

Date
02/11/2011

Location: HOYLAND

Dimensions:	-
-------------	---

Scale
1:25

Client: E V Waddington Limited

Depth
1.10m

Logged By
KLG

Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description	
Depth (m)	Type	Results					
			0.80 1.05 1.10			MADE GROUND: comprising grey slightly sandy gravelly clay. Gravel is of angular mudstone fragments.	
						Stiff dark orange, grey sandy gravelly CLAY. Gravel is angular sandstone.	1
						Refusal on solid SANDSTONE. ----- Trialpit Complete at 1.10 m	
							2
							3
							4

Remarks:

Groundwater: Groundwater encountered at base.



Project Name
SHORTWOOD BUSINESS PARK

Project No.
34072

Co-ords: -
Level: -

Date
02/11/2011

Location: HOYLAND

Dimensions: -

Depth
3.10m



Scale
1:25

Client: E V Waddington Limited

Logged By
KLG

Samples & In Situ Testing

Depth (m)	Type	Results	Depth (m)	Level (m AOD)	Legend	Stratum Description	
						MADE GROUND: comprising grey and brown slightly sandy gravelly clay. Gravel is of sandstone fragments.	1
			1.50			MADE GROUND: comprising stiff brown and orange clay.	
			1.90			MADE GROUND: comprising brown, black slightly gravelly clay. Gravel is rare brick fragments.	2
			2.30			Stiff orange and grey mottled CLAY.	
			3.10			Trialpit Complete at 3.10 m	3
							4

Remarks:

Groundwater: Groundwater encountered at base.



Project Name
SHORTWOOD BUSINESS PARK

Project No.
34072

Co-ords: -
Level: -

Date
02/11/2011

Location: HOYLAND

Dimensions: -

Depth
4.20m

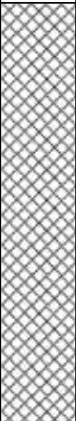


Scale
1:25

Client: E V Waddington Limited

Logged By
KLG

Samples & In Situ Testing

Depth (m)	Type	Results	Depth (m)	Level (m AOD)	Legend	Stratum Description	
			1.40			MADE GROUND: comprising sandy gravelly brown clay. Gravel is fine to coarse sub angular sandstone and mudstone fragments.	1
						MADE GROUND: dark grey to black gravelly cobbly clay. Gravel and cobbles are of sub-angular mudstone and rare brick fragments.	2
			3.60			Stiff mottled orange, grey and brown CLAY.	3
3.80	IPP	450	4.00			Weak grey clayey MUDSTONE, recovered as weak fine to coarse gravel to cobble sized fragments.	4
			4.20			Trialpit Complete at 4.20 m	

Remarks: Pit sides unstable

Groundwater: Groundwater encountered at base



Project Name
SHORTWOOD BUSINESS PARK

Project No.
34072

Co-ords: -
Level: -

Date
02/11/2011

Location: HOYLAND

Dimensions: -

Scale
1:25

Client: E V Waddington Limited

Depth
4.40m

Logged By
KLG

Samples & In Situ Testing

Depth (m)	Type	Results	Depth (m)	Level (m AOD)	Legend	Stratum Description	
			1.00			MADE GROUND: comprising brown sandy, gravelly clay. Gravel of sub angular sandstone and mudstone fragments.	1
						MADE GROUND: comprising dark grey to black gravelly cobbly Clay. Gravel and cobbles are of sub angular mudstone and rare brick fragments.	2
							3
			3.80			Very stiff mottled orange, brown and grey CLAY	4
			4.00			Weak grey clayey MUDSTONE. Recovered as fine to coarse gravel to cobble sized fragments.	
			4.20			Strong orange clayey SANDSTONE. Recovered as gravel to cobble sized fragments.	
			4.40			Trialpit Complete at 4.40 m	

Remarks:

Groundwater: Groundwater encountered at base



Project Name
SHORTWOOD BUSINESS PARK

Project No.
34072

Co-ords:	-
Level:	-

Date
02/11/2011

Location: HOYLAND

Dimensions: _____

Scale
1:25

Client: E V Waddington Limited

Depth
3.80m

Logged By
KLG

Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description	
Depth (m)	Type	Results					
						MADE GROUND: comprising dark grey to black gravelly cobbly Clay. Gravel and cobbles are of sub angular mudstone and rare brick fragments.	1
							2
							3
			3.50				
			3.70			Strong orange clayey SANDSTONE. Recovered as gravel to cobble sized fragments.	
			3.80			Trialpit Complete at 3.80 m	4

Remarks:	Pit sides unstable
----------	--------------------

Groundwater: Groundwater encountered at base



Project Name SHORTWOOD BUSINESS PARK	Project No. 34072	Co-ords: - Level: -	Date 02/11/2011
Location: HOYLAND		Dimensions: - Depth 3.80m	Scale 1:25
Client: E V Waddington Limited			Logged By KLG

Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description	
Depth (m)	Type	Results					
						MADE GROUND: comprising dark grey to black gravelly cobbly Clay. Gravel and cobbles are of sub angular mudstone and rare brick fragments.	1
							2
							3
			3.40			Weak grey clayey MUDSTONE. Recovered as fine to coarse gravel to cobble sized fragments.	
			3.60			Strong orange clayey SANDSTONE. Recovered as gravel to cobble sized fragments.	
			3.80			Trialpit Complete at 3.80 m	4

Remarks: Pit sides unstable
Groundwater: Groundwater encountered at base



Project Name
SHORTWOOD BUSINESS PARK

Project No.
34072

Co-ords: -
Level: -

Date
02/11/2011

Location: HOYLAND

Dimensions: -

Depth
3.50m



Scale
1:25

Client: E V Waddington Limited

Logged By
KLG

Samples & In Situ Testing

Depth (m)	Type	Results	Depth (m)	Level (m AOD)	Legend	Stratum Description	
			0.60			MADE GROUND: comprising grey brown sandy gravelly clay. Gravel of sandstone and mudstone fragments and rare brick.	
			1.80			MADE GROUND: comprising dark grey red brown, ashy sandy gravelly Clay. Gravel of mudstone fragments and rare coal fragments.	1
			3.20			MADE GROUND: comprising gravel slightly sandy gravelly clay. Gravel of sub angular sandstone and mudstone fragments and rare brick and concrete fragments.	2
3.30	IPP	425	3.50			Stiff mottled orange and grey CLAY.	3
						Trialpit Complete at 3.50 m	4

Remarks: Pit sides unstable

Groundwater: Groundwater encountered at base



Project Name
SHORTWOOD BUSINESS PARK

Project No.
34072

Co-ords: -
Level: -

Date
02/11/2011

Location: HOYLAND

Dimensions: -

Scale
1:25

Client: E V Waddington Limited

Depth
4.20m

Logged By
KLG

Samples & In Situ Testing

Depth (m)	Type	Results	Depth (m)	Level (m AOD)	Legend	Stratum Description	
			0.80			MADE GROUND: comprising grey brown sandy gravelly clay. Gravel of sandstone and mudstone fragments and rare brick.	
						MADE GROUND: comprising dark grey red brown, ashy sandy gravelly Clay. Gravel of mudstone fragments and rare coal fragments.	1
			2.80			MADE GROUND: comprising grey brown sandy gravelly clay. Gravel of sandstone and mudstone fragments and rare brick.	
			3.00			MADE GROUND: comprising stiff mottled orange and grey clay.	3
			3.20			MADE GROUND: comprising brown silty clay.	
			4.20			Trialpit Complete at 4.20 m	4

Remarks:

Groundwater: Groundwater encountered at base.



Project Name
SHORTWOOD BUSINESS PARK

Project No.
34072

Co-ords: -
Level: -

Date
02/11/2011

Location: HOYLAND

Dimensions: -

Scale
1:25

Client: E V Waddington Limited

Depth
4.50m

Logged By
KLG

Samples & In Situ Testing

Depth (m)	Type	Results	Depth (m)	Level (m AOD)	Legend	Stratum Description	
			1.20			MADE GROUND: comprising brown sandy gravelly clay. Gravel is angular brick and sandstone fragments.	1
						MADE GROUND: comprising silty clay with rare ash and brick fragments.	2
							3
							4
			4.50				
						Trialpit Complete at 4.50 m	

Remarks: Pit sides unstable

Groundwater: Groundwater encountered at base.



Project Name
SHORTWOOD BUSINESS PARK

Project No.
34072

Co-ords: -
Level: -

Date
02/11/2011

Location: HOYLAND

Dimensions: -

Depth
4.20m



Scale
1:25

Client: E V Waddington Limited

Logged By
KLG

Samples & In Situ Testing

Depth (m)	Type	Results	Depth (m)	Level (m AOD)	Legend
-----------	------	---------	-----------	---------------	--------

Stratum Description

MADE GROUND: comprising brown silty sandy slightly gravelly clay. Gravel is angular brick or concrete fragments or rare ash.

4.20

Trialpit Complete at 4.20 m

Remarks:

Groundwater: Groundwater encountered at base.



Project Name
SHORTWOOD BUSINESS PARK

Project No.
34072

Co-ords:	-
Level:	-

Date
02/11/2011

Location: HOYLAND

Dimensions:

Scale
1:25

Client: E V Waddington Limited

Depth
4.30m

Logged By
KLG

Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description	
Depth (m)	Type	Results					
			1.20			MADE GROUND: comprising brown silty sandy gravelly clay. Gravel of sandstone and rare brick fragments.	1
			1.80			MADE GROUND: comprising grey brown sandy gravelly clay. Gravel of sandstone and mudstone fragments and rare brick.	
			4.30			MADE GROUND: comprising gravel slightly sandy gravelly clay. Gravel of sub angular sandstone and mudstone fragments and rare brick and concrete fragments.	2
						Trialpit Complete at 4.30 m	3
							4

Remarks:	Pit sides unstable
----------	--------------------

Groundwater: Groundwater encountered at base.



Project Name
SHORTWOOD BUSINESS PARK

Project No.
34072

Co-ords: -
Level: -

Date
02/11/2011

Location: HOYLAND

Dimensions: -

Depth
1.80m



Scale
1:25

Client: E V Waddington Limited

Logged By
KLG

Samples & In Situ Testing

Depth (m)	Type	Results	Depth (m)	Level (m AOD)	Legend	Stratum Description	
			1.80			MADE GROUND: comprising brown slightly silty gravelly clay. Gravel is angular sandstone and rare brick fragments.	1
						Trialpit Complete at 1.80 m	2
							3
							4

Remarks:

Groundwater: Groundwater encountered at base.



Project Name
SHORTWOOD BUSINESS PARK

Project No.
34072

Co-ords: -
Level: -

Date
02/11/2011

Location: HOYLAND

Dimensions: -

Depth
1.50m



Scale
1:25

Client: E V Waddington Limited

Logged By
KLG

Samples & In Situ Testing

Depth (m)	Type	Results	Depth (m)	Level (m AOD)	Legend	Stratum Description	
			1.50			MADE GROUND: comprising brown slightly silty gravelly clay. Gravel is angular sandstone and rare brick fragments.	1
						Trialpit Complete at 1.50 m	2
							3
							4

Remarks:

Groundwater: Groundwater encountered at base.



Project Name SHORTWOOD BUSINESS PARK	Project No. 34072	Co-ords: - Level: -	Date 02/11/2011
---	----------------------	------------------------	--------------------

Location: HOYLAND	Dimensions: -	Scale 1:25
-------------------	---------------	---------------

Client: E V Waddington Limited	Depth 1.50m	Logged By KLG
--------------------------------	----------------	------------------

Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description	
Depth (m)	Type	Results					
						MADE GROUND: comprising grey brown slightly silty gravelly clay. Gravel is angular sandstone and rare brick fragments.	1
			1.30			Stiff brown CLAY.	
			1.50			Trialpit Complete at 1.50 m	2
							3
							4

Remarks:

Groundwater: Groundwater encountered at base.



Project Name
SHORTWOOD BUSINESS PARK

Project No.
34072

Co-ords: -
Level: -

Date
02/11/2011

Location: HOYLAND

Dimensions: -

Depth
4.00m

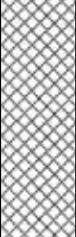


Scale
1:25

Client: E V Waddington Limited

Logged By
KLG

Samples & In Situ Testing

Depth (m)	Type	Results	Depth (m)	Level (m AOD)	Legend	Stratum Description	
			1.20			MADE GROUND: comprising grey brown sandy gravelly clay. Gravel is of sub angular mudstone and very rare brick fragments.	1
			2.00			MADE GROUND: comprising brown clay with lenses of dark grey gravelly clay. Gravel of sub angular brick fragments.	2
			4.00			Stiff brown CLAY.	3
						Trialpit Complete at 4.00 m	4

Remarks:

Groundwater: Groundwater encountered at base.



Project Name
SHORTWOOD BUSINESS PARK

Project No.
34072

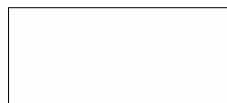
Co-ords: -
Level: -

Date
02/11/2011

Location: HOYLAND

Dimensions: -

Depth
3.50m



Scale
1:25

Client: E V Waddington Limited

Logged By
KLG

Samples & In Situ Testing

Depth (m)	Type	Results	Depth (m)	Level (m AOD)	Legend	Stratum Description	
			0.90			MADE GROUND: comprising light brown sandy gravelly clay.	
			2.00			MADE GROUND: comprising brown clay with lenses of grey gravelly clay Gravel of sub angular mudstone and rare concrete and brick fragments.	1
			3.50			Stiff brown CLAY.	2
						Trialpit Complete at 3.50 m	3
							4

Remarks:

Groundwater: Groundwater encountered at base.



Project Name
SHORTWOOD BUSINESS PARK

Project No.
34072

Co-ords: -
Level: -

Date
02/11/2011

Location: HOYLAND

Dimensions: -

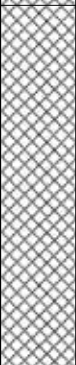
Scale
1:25

Client: E V Waddington Limited

Depth
4.00m

Logged By
KLG

Samples & In Situ Testing

Depth (m)	Type	Results	Depth (m)	Level (m AOD)	Legend	Stratum Description	
			0.60			MADE GROUND: comprising light brown sandy gravelly clay. Gravel is sub angular mudstone and rare brick fragments.	
			1.80			MADE GROUND: comprising brown clay with lenses of grey sandy gravelly clay. Gravel of mudstone fragments.	1
			4.00			Stiff brown CLAY.	2 3 4
Trialpit Complete at 4.00 m							

Remarks:

Groundwater: Groundwater encountered at base.



Project Name SHORTWOOD BUSINESS PARK	Project No. 34072	Co-ords: - Level: -	Date 02/11/2011
Location: HOYLAND		Dimensions: - Depth 1.60m	Scale 1:25
Client: E V Waddington Limited			Logged By KLG

Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description	
Depth (m)	Type	Results					
			1.30			MADE GROUND: comprising grey gravelly, cobbly clay. Gravel and cobbles are mudstone fragments.	1
			1.40			Stiff grey CLAY.	
			1.60			Stiff orange gravelly CLAY. Gravel is angular sandstone fragments.	
						----- Trialpit Complete at 1.60 m	2
							3
							4

Remarks:

Groundwater: Groundwater encountered at base.



Project Name SHORTWOOD BUSINESS PARK	Project No. 34072	Co-ords: - Level: -	Date 02/11/2011
---	----------------------	------------------------	--------------------

Location: HOYLAND	Dimensions: -	Scale 1:25
Client: E V Waddington Limited	Depth 1.30m	Logged By KLG

Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description	
Depth (m)	Type	Results					
						MADE GROUND: comprising grey gravelly cobbly clay. Gravel and cobbles are of mudstone fragments.	1
			1.20			Stiff orange gravelly CLAY. Gravel is angular sandstone fragments.	
			1.30			Trialpit Complete at 1.30 m	
							2
							3
							4

Remarks:

Groundwater: Groundwater encountered at base.



Project Name
SHORTWOOD BUSINESS PARK

Project No.
34072

Co-ords: -
Level: -

Date
02/11/2011

Location: HOYLAND

Dimensions: -

Depth
1.40m



Scale
1:25

Client: E V Waddington Limited

Logged By
KLG

Samples & In Situ Testing

Depth (m)	Type	Results	Depth (m)	Level (m AOD)	Legend	Stratum Description	
			0.90			MADE GROUND: comprising grey gravely cobbly clay. Gravel and cobbles are of angular mudstone fragments.	
						Stiff grey CLAY.	1
			1.20			Stiff orange gravely CLAY. Gravel is angular sandstone fragments.	
			1.40			----- Trialpit Complete at 1.40 m	
							2
							3
							4

Remarks:

Groundwater: Groundwater encountered at base.

