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SUPPLEMENTARY GEOENVIRONMENTAL REPORT
For land at
BANK END ROAD, WORSBROUGH BRIDGE, BARNSLEY.



Prepared for
Erris Homes Ltd

Prepared by

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1.0 INTRODUCTION.

1.1 Background.

On the further instructions of Erris Homes Ltd (Erris) G&M Consulting Ltd (G&M) has carried out a supplementary site investigation of land at Bank End Road, Worsbrough Bridge near Barnsley. It is proposed to develop the site for residential purposes, and this supplementary work was carried out primarily as a consequence of proposed changes to the development layout. Although further work was also recommended, in the previous G&M report, detailed in section 1.3 of this report, comprising the collation of geotechnical/geological information to assist with the design of the proposed retaining structures to the back of the site and to complete hazardous gas monitoring of wells installed during the previous fieldwork.

An indication of the proposed development is shown as a sketch drawing No C036/02/01, presented in Appendix A of this report. It is understood that at the time of writing of this report discussions are ongoing with the planning department of the local authority to agree the final layout. These discussions include agreement on the exact detail of the retaining structures required to the back of the site. Although only currently a sketch drawing it would appear as though consideration is being given to form a series of individual faces and intermediate benches in this particular part of the site. Currently no detailed development levels have been confirmed to G&M.

1.2 Project Brief.

The objectives of this supplementary investigation were as follows;

- To determine the geology and provide geotechnical information to assist with the design of the proposed retaining structures to the back of the site;
- To determine the nature and degree of near surface ground contamination at the back of the site; and,
- To complete the hazardous gas and groundwater monitoring.

The supplementary fieldwork was undertaken on the 23rd and 24th February 2010 and comprised the excavation of eleven trial pits.

Following completion of the supplementary fieldwork selected soil/rock samples were scheduled for a range of chemical and geotechnical laboratory tests. The gas and groundwater wells installed as part of the earlier investigation have continued to be monitored for hazardous gases on four further occasions from the visits made during the previous fieldwork.

1.3 Previous Reports.

Prior to the undertaking of this supplementary work, the site had been subject to previous recent investigation, summarised in the following G&M reports;

- 'Preliminary Investigation of land at Bank End Road, Worsbrough Bridge, Barnsley'. Report Ref C036/DS, dated May 2009.
- 'Geoenvironmental Report for land at Bank End Road, Worsbrough Bridge, Barnsley'. Report Ref C036/01, dated December 2009.

Prior to the above work the site has been subject to a previous site investigation carried out by Michael D Joyce Associates (MJA) in 1992. A copy of this report was made available to G&M, which was reviewed and summarised in the above referenced desk study.

This report on the supplementary work should be read in conjunction with the above referenced documents. The latter of which include issues relating to the investigation of potential shallow mine workings, and geoenvironmental aspects of the work including, assessment of hazardous gas and ground contamination conditions.

1.4 Limitations.

The comments and opinions presented in this report are based on the findings of a review of available information and ground conditions encountered during the intrusive investigation work. There may be other conditions prevailing on the site which have not been disclosed by this investigation and which have not been taken into account by this report. Responsibility cannot be accepted for conditions not revealed by the investigation. Any diagram or opinion of the possible configuration of ground conditions between exploratory holes is conjectural and given for guidance only and confirmation of intermediate ground conditions should be considered if deemed necessary.

The information contained within this report is limited to land within the site boundary, as indicated on Drawing No C036/02/02, presented in Appendix A of this report, and to areas accessible during the ground investigation. As a consequence of the steep nature of the site profile, access to some parts of the site was restricted.

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2.0 PROPOSED DEVELOPMENT.

Erris Homes Ltd is proposing to develop the site for residential purposes. The original development layout is shown on Drawing No C036/01/01, presented in G&M Report Ref C036/01 dated December 2009, referenced in Section 1.3 of this report. However following discussions with the local authority planning department changes to the layout are proposed with possible alternatives shown on the sketch drawing No C036/02/01, presented in Appendix A of this report.

Currently no detailed development layout and levels have been confirmed to G&M. However not withstanding this, it is apparent from the previous proposals and the sketch drawing referenced above, that in order to achieve probable development levels compared to current existing site levels a significant amount of cut earthworks is required, particularly in the northern and central parts of the site. Although

only currently a sketch drawing it would appear as though consideration is being given to form a series of individual faces and intermediate benches to retain ground at the back of the site.

3.0 GROUND INVESTIGATION.

3.1 Scope of Works.

The primary objective of this supplementary investigation was to investigate the underlying geology and provide geotechnical information particularly in the northern part of the site in the area of the proposed retaining structure(s). The information collated in this report should assist with the design of the proposed structures, which should be undertaken by a suitably qualified and experienced specialist contractor.

The supplementary fieldwork was undertaken on the 23rd and 24th February 2010, and comprised the excavation of eleven trial pits as detailed below;

Trial Pit No	Depth (m bgl)
TT101	3.9
TT102	3.8
TT102A	5.2
TT103	2.6
TP104	0.8
TP105	3.5
TP106	2.6
TP107	2.0
TP108	2.7
TP109	1.4
TP110	2.8

The trial pits were excavated using a 360° tracked excavator with a 0.8m wide bucket. On completion, the trial pits were backfilled with arisings in the approximate reverse order to which they were excavated.

The exploratory hole positions were set out and the fieldwork supervised by a G&M engineering geologist. The locations of the exploratory holes are shown on Drawing No C036/02/02, presented in Appendix A of this report.

A complete set of the exploratory hole records are presented in Appendix B of this report

3.2 Strata Description.

Depths and descriptions of strata encountered together with details of the samples recovered are presented on the exploratory hole record sheets presented in Appendix B of this report. A combination of procedures and principals contained in BS5930:(1999) and BS EN ISO 1997 (Eurocode 7) have been followed.

The depths of strata on the record sheets are recorded from current ground levels at each location, where excavations are made into sloping ground the depths are measured down the back face (high face) of the excavation.

3.3 Sampling and In-situ Testing

Samples were selected by a representative of G&M during the fieldworks. Disturbed samples of soil/rock for geotechnical and/or chemical analysis were placed in 1 litre plastic containers or large plastic bulk bags as appropriate.

Where cohesive soils were encountered, undrained shear strengths were assessed by means of hand shear vane testing in the sidewalls and base of the trial pits and on materials excavated to surface. The use of the shear vane was carried out in general accordance with BS1377:(1990).

3.4 Laboratory Testing

Chemical Testing

Selected soil samples were tested for a range of potential contaminants, under a sub-contract with Derwentside Environmental Testing Services Ltd (DETS), a UKAS/MCERTS accredited laboratory.

The analytes tested are listed in Section 5.1 of this report. The results, as received from the laboratory, are presented in Appendix C, and discussed in Section 5.2 of this report.

Geotechnical Testing

Selected soil samples were delivered to the laboratory of Professional Soils Laboratory (PSL), an external accredited geotechnical testing laboratory, for the following tests:

- Two particle size distribution (PSD) test by sieving.
- Three Atterberg Limits
- Two compaction (4.5kg rammer) tests

All testing was undertaken in accordance with BS1377:(1990) 'Methods of Test for Soils for Civil Engineering Purposes'.

Eighteen point load index tests were undertaken on samples recovered from the sandstone bedrock. The tests were carried out in accordance with the ISRM suggested methods. The tests were carried out on irregular samples.

The results of the testing as received from the laboratory are presented in Appendix D and discussed in Section 4.0 of this report.

4.0 GROUND CONDITIONS AND MATERIAL PROPERTIES

4.1 General Succession of Strata

A review of the geological maps of the area (BGS 1:50,000 Scale, Sheet 87 (Barnsley), BGS 1:10,000 Scale SE 30 SE) was undertaken as part of the preliminary investigation. These indicate that the site is underlain by strata of the Middle Coal Measures series. This is noted to comprise, siltstones, mudstones likely to be present in the southern part of the site and the Woolley Edge Sandstone likely to be present in the northern part of the site. The Meltonfield Coal seam (also referred to as the Woodmoor Coal) is conjectured to outcrop through the site. The strata are shown to dip 4 to 5° in a north easterly direction. The findings of the G&M investigations broadly concur with the published geology.

This supplementary intrusive investigation (as did the previous investigation) revealed the site to be underlain by made ground, particularly to the northern and western parts of the site, above Middle Coal Measures bedrock. Natural ground was not encountered in three of the trial pits which were respectively terminated at a depth of 3.8m (TT102), 3.5m (TP105) and 2.8m (TP110). Where encountered the Coal Measures strata were recorded in the trial pits as mudstones, sandstones and coal, proved to a maximum depth of 5.2m.

A complete record of all the strata encountered is provided in each individual exploratory hole log, presented in Appendix B of this report.

The locations of the trial pits excavated during the supplementary fieldwork are shown on Drawing No C036/02/02, presented in Appendix A of this report.

Made Ground

A variable thickness of made ground was encountered particularly in the northern and western parts of the site to depths of between 1.75m (TP106) to 4.4m (TT102A). The base of the made ground was not established in TP102, TP105 and TP110 due to ground instability preventing deeper excavation.

The made ground generally comprised gravels, cobbles and boulders of sandstone in a sandy gravelly matrix, and is considered to represent backfill/infill to the quarry which is likely to have encroached onto the western part of the site, identified in the desk study. The highwall of the quarry is thought to have been exposed in TT103.

It would appear from the excavation of trial pits TP105 and TP106 that the 'plateau' and existing steep slope is formed in part from tipped quarry waste.

Similar granular made ground was encountered in trial pit TP110 located in the south western part of the site. This was encountered to a depth in excess of 2.8m and is considered to comprise tipped quarry waste. Excavation below this depth proved difficult due to side wall instability. Stability of excavations in the made ground materials in general across the site was generally found to be very poor.

Middle Coal Measures

Trial pits TP108 and TP109 excavated in the southern part of the site encountered a gravel of sandstone with occasional cobbles and boulders between 1.5m (TP108) and 0.9m (TP109). It is possible that this material represents eroded materials washed from the upper parts of the slope. Underlying this material both trial pits encountered a weathered profile which typically comprised a very weak grey thickly laminated highly weathered silty mudstone, which was recovered from the trial pits as clay bound lithorelicts of mudstone. This strata was encountered at depths between 1.1m (TP109) and 2.1m (TP108). This mudstone was immediately overlain in both pits by a very weak completely weathered coal/carbonaceous mudstone, upto 0.6m thick (TP108). Based on the stratigraphic column it is likely that this represents the completely weathered Meltonfield Coal seam.

Where cohesive soils were encountered undrained shear strengths were measured by hand shear vanes, which recorded results of between 40kPa and >130kPa, indicating medium to very high strength soils.

Trial pits TT102 and TT102A were excavated towards what was considered to be the southern limit of the quarry shown on the historical maps as extending onto the north western part of the site. Trial pit TT102

was unable to penetrate the granular made ground and was terminated at 3.8m. However TT102A encountered a moderately weak very thinly bedded mudstone at 4.4m, which was overlain by granular made ground (quarry backfill).

Trial pits TT101, TT103, TP104, TP106 and TP107 excavated in the higher northern part of the site encountered the underlying sandstone bedrock, at depths of between 0.1m (TP104) and 2.6m (TP106).

In trial pit TT101 the weathered sandstone between 1.6m and 3.2m was recovered as gravel and cobble sized fragments.

Directly above the sandstone in trial pit TP106 a firm to stiff gravelly clay (lithorelicts of mudstone) was encountered between 1.75m and 2.6m (highly weathered mudstone). Sandstone was also seen at the northern end of this trial pit, overlying the mudstone.

From the examination of the exposure of sandstone in the sidewall of TT103 it is considered likely that this forms part of the highwall of the former quarry.

Summary details of the underlying bedrock are presented below;

Sandstone

Trial Pit No	Depth (m bgl)	Assessed Weathering Grade	Assessed Field Strength	Bedding	Assessed Jointing orientation/Spacing (mm)
TT101	1.6 to 3.2	Moderately	Very weak	Very thin dipping 15° to the south	Vertical/50 to 100
	3.2 to 3.85	Moderately to slightly	Moderately weak to moderately strong	Very thin to thin	-
	3.85 to 3.9	Slightly		Medium (plus), dipping 15° to the south	Vertical (open)/1400
TT103	0.3 to 2.6	Slightly	Moderately strong	Thick	Vertical (closed)/200mm
TP104	0.1 to 0.8	Slightly	Moderately strong	Thin to medium	2 sets vertical 90° to each other (closed)/150 to 300
TP106	2.6	-	Moderately strong	-	Vertical (open)/-
TP107	1.2 to 2.0	Moderately	Very weak	Very thin	Vertical/50 to 100

Note: '-' either assessment not possible or not noted in section

The bedding in the sandstone bedrock in TT101 was noted to dip 15° in a southerly direction. The published geological maps indicate that the underlying strata dip 4 to 5° in a north easterly direction. It is possible that this observation is a result of localised camber or creep.

Mudstone

Trial Pit No	Depth (m bgl)	Assessed Weathering Grade	Assessed Field Strength	Bedding	Assessed Jointing orientation/Spacing (mm)
TP102A	4.4 to 5.2	Moderately	Moderately weak	Very thin	-

Trial Pit No	Depth (m bgl)	Assessed Weathering Grade	Assessed Field Strength	Bedding	Assessed Jointing orientation/Spacing (mm)
TP106	1.75 to 2.6	Highly	Firm to stiff	Thickly laminated	-
TP108	2.1 to 2.7	Highly	Very weak (stiff)	Thickly laminated	-
TP109	1.1 to 1.4	Highly	Very weak (very stiff)	Thickly laminated	-

4.2 Groundwater.

No groundwater was encountered in the trial pits during this supplementary investigation.

However continued groundwater monitoring was undertaken in the wells installed as part of the previous works, refer to Section 1.3 of this report. Four further monitoring visits were undertaken and are detailed below;

Borehole No	Depth to base of monitoring pipe (m bgl)	Groundwater Level (m bgl) 17.01.10	Groundwater Level (m bgl) 06.02.10	Groundwater Level (m bgl) 20.02.10	Groundwater Level (m bgl) 13.03.10
R3	7.5	3.98	4.15	4.26	4.22
R4	12.0	Damp	Damp	Damp	Damp
R6	9.0	7.19	7.22	7.38	7.40

It should be borne in mind that water levels are likely to fluctuate with season/rainfall and may therefore be substantially higher at wetter times of year than those found during this investigation.

4.3 Geotechnical Properties.

The programme of geotechnical tests undertaken on selected samples is shown below;

Test Undertaken	Sample Reference	Strata	No of Tests
Particle Size Distribution	TP102 (1.5m) TP107 (1.0m)	Granular Made ground Natural granular	1 1
Atterberg Limits	TP106 (2.0m), TP108 (0.5m), TP109 (1.4m)	Natural cohesive	3
4.5k Compaction Test	TP102 (1.5m) TP107 (1.0m)	Granular Made ground Natural granular	1 1
Point Load Test	TT101 (3.9m), TT103 (0.5m), TT104 (0.5m)	Sandstone Bedrock	18

The Atterberg test results indicate the cohesive natural clays (weathered mudstone) to be of low to intermediate plasticity, with liquid limits ranging between 32% and 45%, and plasticity indices of between 14% and 21%, indicating a low to medium volume change potential. Natural moisture contents of the samples were found to vary between 15% and 20%.

Consistency indices of the clay soils indicate Ic values between 0.94 and 1.19 which indicates the clay soils to be typically of very stiff consistency which generally correlates with the field descriptions.

A PSD was undertaken on recovered samples from TP102 (1.5m), of the granular made ground (quarry backfill), and from TP107 (1.0m) of the weathered sandstone bedrock, and confirmed the visual field based classifications recorded on the logs. Excavation of these materials during any earthworks would indicate a coarse granular material and is likely to represent a Class 1 material in accordance with the Specification for Highway Works Series 600 - Earthworks.

Two 4.5kg rammer compaction tests were undertaken (TP107, 1.0m and TP102, 1.5m). The compaction tests were undertaken at a range of moisture contents to determine the optimum moisture content and dry density of the samples.

The optimum moisture content of both of the samples was found to be 10%, with a maximum dry density of 2.1mg/m^3 for both samples.

Significant thicknesses of granular made ground were found particularly in the north and western parts of the site, and was noted to contain a high proportion of cobbles and boulders. Provided this oversized material is either removed or further crushed, the granular made ground materials could be considered for recycling, in part to form a select granular engineering fill.

Point load testing was carried out on samples of sandstone bedrock recovered from selective trial pits. Results ranged between 0.21MPa (TT101) and 1.10MPa (TT101). Using a conversion factor of 20 for point load to UCS derived from Ciria document R181 – Piled foundations in weak rocks, the results indicate unconfined compressive strengths of between 4.2MPa and 22.0MPa which is 'weak' to 'moderately strong'. The field descriptions of the sandstone record the strength up to 'moderately strong'.

The majority of the silty mudstone encountered is described as stiff to very weak, with thickly laminated to very thin bedding and consequently were not suitable for point load testing.

The strengths given above, and used on the field logs are those defined in BS5930:(1999) before it was amended to comply with Eurocode 7. These have been used as they are currently more familiar to industry and relates directly to Figure 1 and Figure 2 presented in this report. Table 2 has been included to give a comparison of strength terms between the two standards.

5.0 GROUND CONTAMINATION CONDITIONS

5.1 General

Following on from the chemical contamination testing, preparation of a Conceptual Site Model, and semi quantitative risk assessment, presented in G&M Report C036/01 dated December 2009, three further samples were taken for analysis during the supplementary investigation works.

These further samples were taken from the northern part of the site, which it is understood is likely to be retained as an area of public open space and taken primarily to assess the suitability of retaining the soils currently present in this area as part of the development works.

Based on the above assessment, G&M submitted a test schedule, detailed below, to an accredited laboratory. This schedule also took into account visual evidence recorded during the previous and current site investigations.

Type of Sample	Sample Reference	Determinands
Made Ground (granular backfill)	TT102 (1.0m)	Arsenic, cadmium, chromium, copper, lead, nickel, selenium, zinc, total sulphate, water soluble sulphate, pH, phenol, speciated PAH Speciated TPH
Made Ground (Topsoil)	TP105 (0.8m) TP107 (0.2m)	

The results received from the laboratory are presented in Appendix C of this report.

The majority of initial screening levels used in the production of this assessment have been taken from the guidelines introduced by DEFRA, in the Contaminated Land Exposure Assessment (CLEA) Model, March 2002 and 2009 (where applicable), and by the Joint Land Quality Management Ltd (LQM) and Chartered Institute of Environmental Health (CIEH), Generic Assessment Criteria for Human Health Risk Assessment. 2nd Edition, 2009. Full details of the screening levels used are shown on Table 1 in this report.

The generic quantitative risk assessment carried out as part of this report assumes a **residential with plant uptake** end use.

5.2 Results

The 'as received' results of the soils analysis are presented in Appendix C, and are summarised in Table 1 of this report.

Elevated lead was encountered in sample TP105 (0.8m) at a concentration of 1400mg/kg compared to the Soil Guideline Value (SGV) of 450mg/kg. The same sample was also noted to exhibit elevated concentrations of Benzo(a)anthracene and Benzo(a)pyrene, recording values of 4.4mg/kg and 2.4mg/kg, against threshold values of 3.3mg/kg and 0.83mg/kg respectively.

It is apparent based on a review of the proposed development levels that a significant amount of soils will require removal from site to achieve these levels. Two of the samples tested TP105 (0.8m) and TP107 (0.2m) were taken to assess whether the topsoil materials currently present on site were suitable for use within the area of public open space in the northern part of the site.

Based on the chemical test results and a visual assessment of the textural quality of the topsoil it is considered unlikely that it would be suitable for reuse. It is recommended that the reworked topsoil materials currently present on site are disposed of to landfill as part of the general site strip and reprofiling works to achieve the proposed development levels. Although if considered appropriate further testing of this material can be undertaken to better assess the chemical characteristics. However field descriptions of the topsoil record significant amounts of coal, glass, bricks, plastic, timber and metal.

The concentrations of the analytes tested in sample TT102 (1.0m), which was taken from the granular made ground (quarry backfill) were all below the relevant screening levels and in accordance with the findings of the previous investigation work.

Chemical results indicate a design sulphate class of DS-1 and an ACEC class of AC-1s should be used, in accordance with BRE Special Digest 1 (2005) for the design of buried concrete, based on brownfield site designation and static groundwater conditions.

Chemical results should be forwarded to the appropriate utility companies in order to determine the necessity for service protection.

6.0 HAZARDOUS GAS MONITORING

6.1 General

The background and rationale to the gas monitoring undertaken on site is presented in G&M Report C036/01 dated December 2009, referenced in Section 1.3 of this report. The report also includes details and locations of the wells installed.

The above referenced report presented the results from three monitoring visits undertaken. A further four visits have been carried out and are discussed in the following sections. In total seven visits were made over a six month period.

6.2 Monitoring Procedure

The gas monitoring wells have been monitored for flow, methane, carbon dioxide and oxygen using a Gas Data GFM 430 gas analyser.

The gas monitoring was undertaken in accordance with the guidance given in CIRIA Report 151 'Interpreting Measurements of Gas in the Ground' (1995).

This report presents the results for four visits made to site to complete the recommended six month monitoring period. The installations have been monitored on 17th January 2010, 6th February 2010, 20th February 2010 and 13th March 2010.

The results of the gas monitoring are presented within Appendix E of this report.

6.3 Monitoring Results

Well	Range of Methane Concentrations (% v/v)	Range of Carbon Dioxide Concentrations (% v/v)	Range of Positive Flow Rates (litre/hour)
R3	Not Detected	0.1-0.9	Not Detected-0.2
R4	Not Detected	0.4-0.8	0.3-0.6
R6	Not Detected	Note Detected-0.4	0.3-0.7

Note: Atmospheric pressures varied between 984mb and 1020mb.

6.4 Discussion

In accordance with CIRIA Report C665 'Assessing Risks Posed by Hazardous Ground Gas to Buildings' the proposed end use dictates that the site be assessed under Situation B 'Low Rise Housing with a Ventilated Underfloor Void (min 150mm)'.

Since no methane has been detected, then based on a steady state concentration for carbon dioxide, the calculated Gas Screening Value (GSV) in accordance with CIRIA 665 is detailed below;

GSV (l/hr)	Gas Source Risk	Traffic Light System for 150mm void (Situation B)
0.0048	Carbon dioxide	Green

In accordance with CIRIA 665, with presently detected carbon dioxide concentrations coupled with low flow rates the site is classified as 'Green'. As such no special precautions are required. **These recommendations do not change from those presented in G&M Report No C036/01 dated December 2009.**

Radon protective measures are not currently required for the site.

7.0 CONCLUSIONS AND RECOMMENDATIONS.

7.1 General.

On the further instructions of Erris Homes Ltd (Erris) G&M Consulting Ltd (G&M) has carried out a supplementary site investigation of land at Bank End Road, Worsbrough Bridge near Barnsley. It is proposed to develop the site for residential purposes, and this supplementary work was carried out primarily as a consequence of proposed changes to the development layout. Although further work was also recommended in the previous G&M report, detailed in section 1.3 of this report, comprising the collation of geotechnical/geological information to assist with the design of the proposed retaining structures to the back of the site and to complete hazardous gas monitoring of wells installed during the previous fieldwork.

Currently no detailed development layout and levels have been confirmed to G&M. However not withstanding this it is apparent from the previous proposals and the sketch drawing C036/02/01, presented in Appendix A of this report, that in order to achieve probable development levels compared to current existing site levels a significant amount of cut earthworks is required, particularly in the northern and central parts of the site. Although only currently a sketch drawing it would appear as though consideration is being given to form a series of individual faces and intermediate benches to retain ground at the back of the site to achieve development levels at the front of the site.

As a consequence of ongoing discussions the retaining structures are preliminary, subject to design by specialist contractor and exact levels and layout. It is recommended that all design proposals should be submitted to regulatory bodies prior to commencement for their comment and approval.

This report should be read in conjunction with G&M Report No C036 and C036/01, detailed in Section 1.3. These reports provide details of historical development of the site, previous site investigation works,

foundation recommendations, hazardous gas monitoring, investigation of potential shallow mine workings and an assessment of chemical contamination.

7.2 Earthworks

It is apparent from the sketch drawing shown as Drawing No C036/02/01 presented in Appendix A of this report that proposed development levels across much of the site are significantly below existing levels, which will necessitate a significant amount of cut earthworks particularly to the northern and central parts of the site. Near vertical faces will be required particularly towards the northern boundaries of the site, to achieve proposed development levels.

Although at the time of writing of this report the exact location of the retaining structures and external development levels have not been made available to G&M, from the above referenced sketch drawing consideration is being given to form a series of individual faces and intermediate benches in this particular part of the site.

It is likely, given the current proposed alignment of the cut, as shown on Drawing No C036/02/01 presented in Appendix A of this report, that in the central and eastern areas of the site rock will be exposed at or close to the surface and may require little retention. The bedrock sequence is likely to comprise very weak to moderately strong sandstone of varying weathering grades which is underlain and possibly interbedded (trial pit TP106) with very weak to moderately weak silty mudstone. Retaining structures in these areas may therefore only be required to retain loose or weathered material and prevent degradation of the exposed cut face, particularly to the exposed mudstone. This however is subject to confirmation by the specialist contractor responsible for the design.

Excavation and forming suitable slope profiles within the bedrock for any proposed retaining structures to the back of the site will be influenced by a number of factors, including but not limited to the physical properties of the materials, jointing, dip of the strata, level of groundwater or perched water and the presence of old coal workings.

In the western area of the site, along the line of the proposed cut, the loose coarse granular material infilling the former quarry will be encountered, this was proven to a depth of approximately 7m at the rear of the site in the previous investigation and to 4.4m (TT102A) in the area of the proposed cut. Given the coarse nature of this material a natural angle of repose of the order of 40^{o} is anticipated; the natural steep angle of repose can be seen in the existing slope in the central area of the site which is formed in this material (TP105). Retaining structures likely to be suitable for this material would be gabions, reinforced earth or crib walling, or alternatively the material could be graded back at a shallower angle as the depth/width of the site increases in this area. The base of any retaining structure in this area should be founded on the underlying natural bedrock. This founding stratum should be inspected by a suitably experienced geologist. As a consequence of the likely thickness of backfill in the area of the former quarry suitable temporary works will need to be in place for the protection of workers during the construction works.

Care should be taken along the western edge of the site, where the quarry edge has not been located. Excavations may undermine the adjacent land/churchyard. Depending on the position of the cut line retaining walls may be required along the eastern and western boundary of the site south of the cut line.

The overall scheme of the retaining structures will be dependent on the level and position of the cut and the finished aesthetics required. The comments given in this report would need to be reassessed, once the

final alignment is known, with reference to the various ground investigations. The design of any agreed retaining structures should be carried out by a suitably qualified specialist contractor.

In trial pit TT101 the underlying sandstone bedrock was recorded as dipping approximately 15° south, i.e out of the existing slope. The published geological maps indicate local dip 4 to 5° towards the north, i.e into the existing slope. The reverse dip seen in TT101 may possibly be a result of localised camber or creep of the underlying bedrock close to the insitu vertical/steep slope.

Monitoring of the gas/water well installed in borehole R6 (drilled in the previous works), the location of which is shown on Drawing No C036/02/02 presented in Appendix A of this report, recorded a water level of between 7.19m and 7.40m below existing ground level, over the monitoring period. Unless further investigation of this is carried out to prove otherwise, it should be assumed that this is not a perched table, or an ingress of surface water runoff into the monitoring well from the materials above, and is indicative of the local groundwater regime. Therefore sufficient drainage provision should be prescribed to minimise the groundwater response and any associated issues of stability in the rock face at this point.

Exact identification of the weaker parts of the rock mass and seepage locations can only be undertaken once the rock face is exposed during excavation, where refinement of the preliminary design can be undertaken if necessary. It is recommended that excavation of the rock face is taken out in a number of sections, i.e. **not** excavated all at once. This will allow for further insitu measurement of joints and bedding, i.e. dip, strike and openness to determine if any adverse orientations exist which were not identified in the more restrictive excavations of the ground investigation.

All designs should be submitted to the various regulatory bodies for comment/approval **prior** to carrying out the works.

It is recommended that, as with any major excavation project, the slopes are inspected frequently by a competent Engineering Geologist or Geotechnical Engineer, during the course of the works, and that a validation report is prepared following completion to confirm the requirements of the designs were achieved.

Where areas of infilling are proposed to achieve development levels, any materials which are used for this purpose should be classified and placed in accordance with Series 600 (Earthworks) of the Department of Transport (DoT) 'Specification for Highway Works' 1998.

Excavations through any areas of made ground or quarry backfill should be assumed to be unstable and an allowance should be made for appropriate shoring or battering back to safe angles. No man entry into unsupported excavations should be allowed without an appropriate risk assessment. Reference to CIRIA 97 Trenching Practice should be made to establish suitable means of support or battering of excavation sides during construction.

Shallow excavations, less than 2m in depth, are generally expected to remain dry. Seepages or minor flows could occur locally. It should be possible to deal with these by pumping from sumps.

It is recommended that an adequate drainage system for surface water be installed by a competent contractor in order to prevent surface water ponding or collection during construction which may lead to deterioration of the founding stratum.

Where coal is exposed in excavations it should be blinded with lean mix concrete to avoid the possibility of spontaneous combustion.

The excavatability particularly of the sandstone bedrock will be dependent on the rock's mass strength, fracture spacing and size of excavation. As indicated on the excavatability chart, shown in Figure 1 and taken from Fookes (1994), for large excavations in sandstone, most of the bedrock falls within the category of easy to very hard rip. However if confined or difficult access excavations and trenches, are required then smaller less powerful equipment is likely to be used. As indicated in the Franklin (1971) excavatability chart shown in Figure 2, blasting to fracture/loosen may therefore be required for some excavation work. This, given the proximity of the existing houses is impracticable and therefore hydraulic or pneumatic breakers will be required to assist excavations where they extend into the underlying bedrock.

7.3 Contaminated Land

Results of the chemical testing carried out during the previous investigation works indicated that the granular quarry backfill materials were all below the relevant threshold values against which they were tested.

Further samples were tested during the supplementary works, one sample of the granular backfill conformed to the previous results. Two samples were taken of the reworked topsoil located to the back of the site. These were taken primarily to assess whether these materials could be retained in the areas of proposed public open space. One sample encountered elevated concentrations of lead, Benzo(a)anthracene and Benzo(a)pyrene.

It is recommended that the reworked topsoil materials currently present on site are disposed of to landfill as part of the general site strip and reprofiling works to achieve the proposed development levels.

If considered appropriate further testing of this material could be undertaken with the aim of undertaking a statistical approach to assessing the suitability of retaining the topsoil on site. Field descriptions of the topsoil did however record significant amounts of coal, glass, bricks, plastic, timber and metal, making the material texturally unsuitable.

If the removal of the topsoil materials is the preferred options then import of clean capping subsoils and topsoil will be required for areas of public open space and private gardens.

Chemical results should be forwarded to the appropriate utility companies in order to determine the necessity for service protection.

Localised areas of fly tipped household waste was noted particularly along the back slopes of the site adjacent to the back gardens of the residences along the northern site boundary which should be removed from site to a suitably licensed landfill facility during the development works.

Any materials removed from site should be removed in accordance with the Duty of care Regulations and the Landfill Directive.

It is possible that areas of more significant contamination may be encountered during the development works. If any areas of noxious, odorous, fibrous or liquid etc. contamination are encountered, then works should stop immediately and further advice sought from a suitably experienced and qualified consultant.

The proposed recommendations above should be agreed with the local authority environmental health department prior to carrying out the works.

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TABLES AND FIGURES

TABLE 1

Summary of Total Soil Concentrations and Generic Quantitative Risk Assessment

Parameter	Screening value (mg/kg, unless otherwise stated)	No. of samples above screening value	No. of samples tested	Maximum concentration above Screening Value (mg/kg, unless otherwise stated)
Metals/Metalloids				
Arsenic	32 [1]	0	3	
Cadmium	10[1]	0	3	
Chromium (Total)	130 [1]	0	3	
Lead	450 [1]	1	3	1400 – TP105 (0.8m)
Mercury	170 [1]	0	3	
Selenium	350 [1]	0	3	
Copper	111 [2]	0	3	
Nickel	130 [1]	0	3	
Zinc	330 [2]	0	3	
Inorganics				
pH	<5	0	3	
Water Soluble Sulphate	0.5 g/l [3]	0	3	
Organics				
PAHs				
Acenaphthene	195[2]	0	3	
Anthracene	2200[2]	0	3	
Acenaphthylene	162[2]	0	3	
Benzo(a)anthracene	3.3[2]	1	3	4.4 – TP105 (0.8m)
Benzo(b)fluoranthene	5.6[2]	0	3	
Benzo(k)fluoranthene	8.5[2]	0	3	
Benzo(g,h,i)perylene	44[2]	0	3	
Benzo(a)pyrene	0.83[2]	1	3	2.4 - TP105 (0.8m)
Chrysene	6.1[2]	0	3	
Dibenz(a,h)anthracene	0.77[2]	0	3	
Fluoranthene	260[2]	0	3	
Fluorene	160[2]	0	3	
Indeno(1,2,3-cd)pyrene	3.2[2]	0	3	
Naphthalene	0.68[2]	0	3	
Pyrene	564[2]	0	3	
Phenanthrene	92[2]	0	3	
TPH				
Aliphatic EC 5-6	17[2]	0	3	
Aliphatic EC >6-8	36[2]	0	3	
Aliphatic EC >8-10	8.8[2]	0	3	
Aliphatic EC >10-12	43[2]	0	3	
Aliphatic EC >12-16	350[2]	0	3	
Aliphatic EC >16-35	29,000[2]	0	3	
Aromatic EC 5-7	0.054[2]	0	3	
Aromatic EC >7-8	92[2]	0	3	
Aromatic EC >8-10	14[2]	0	3	
Aromatic EC >10-12	54[2]	0	3	
Aromatic EC >12-16	140[2]	0	3	
Aromatic EC >16-21	250[2]	0	3	
Aromatic EC >21-35	890[2]	0	3	
Organics				
Monohydric Phenol	180[1]	0	3	

[1] DEFRA (2002 and 2009), Soil Guideline Values – for residential with plant uptake
[2] LQM/CIEH (2009) Generic Assessment Criteria for Human Health Risk Assessment. 2nd Ed. (for a sandy soil with 1% SOM and pH 7.0)
[3] BRE (2005) Special Digest 1, 3rd Edition, Concrete in aggressive ground. Upper limits for DS-1 Design Sulphate Class concrete.

TABLE 2

Comparison of strength terms between BS5930:(1999) and Eurocode 7

BS5930 (1999)		Eurocode 7	
Description	**Strength (MPa)**	**Description**	**Strength (MPa)**
Very weak	<1.25	Extremely weak	<1.0
Weak	1.25-5.0	Very weak	1.0-5.0
Moderately weak	5.0-12.5	Weak	5.0-25.0
Moderately strong	12.5-50.0	Medium strong	25.0-50.0

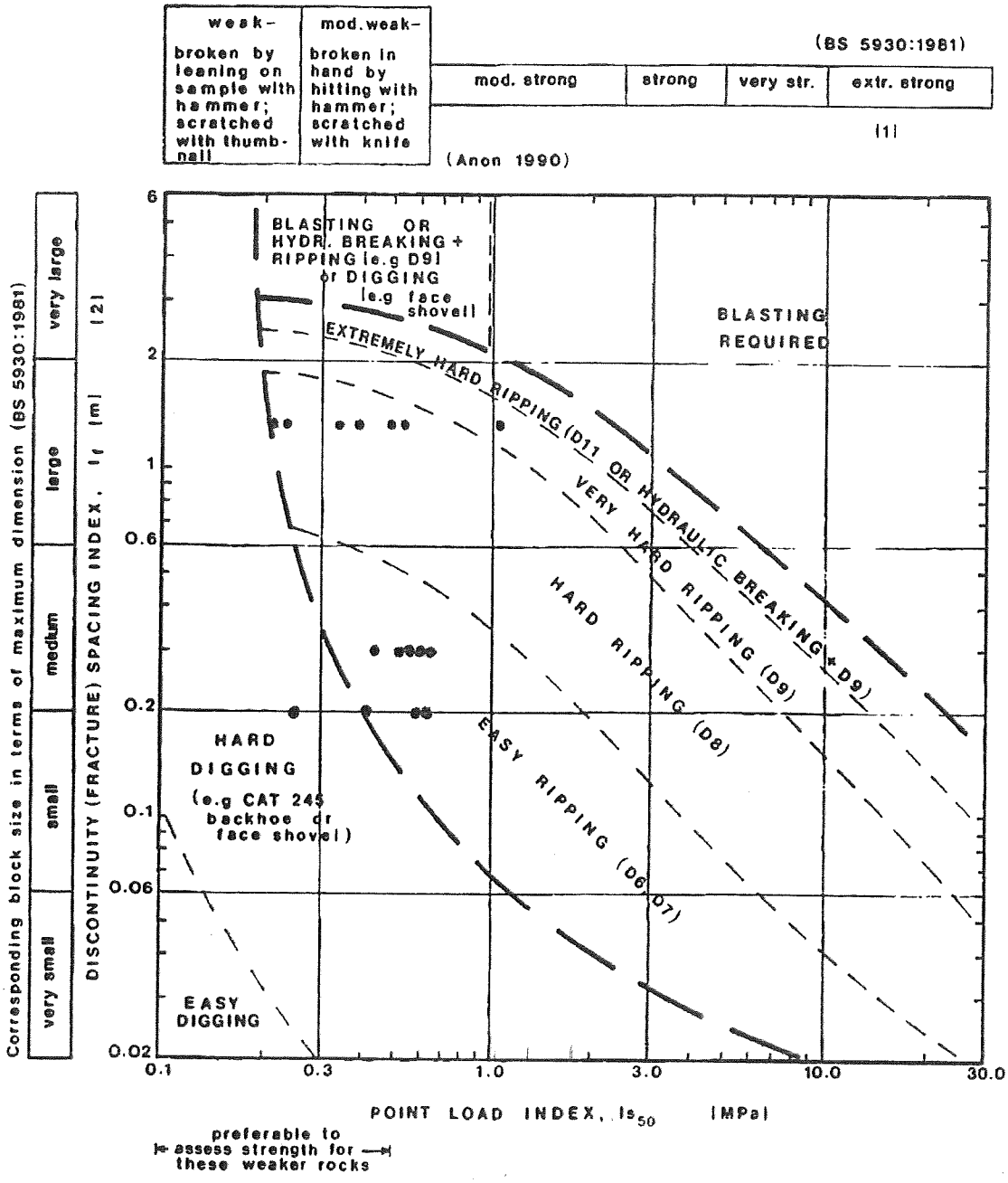


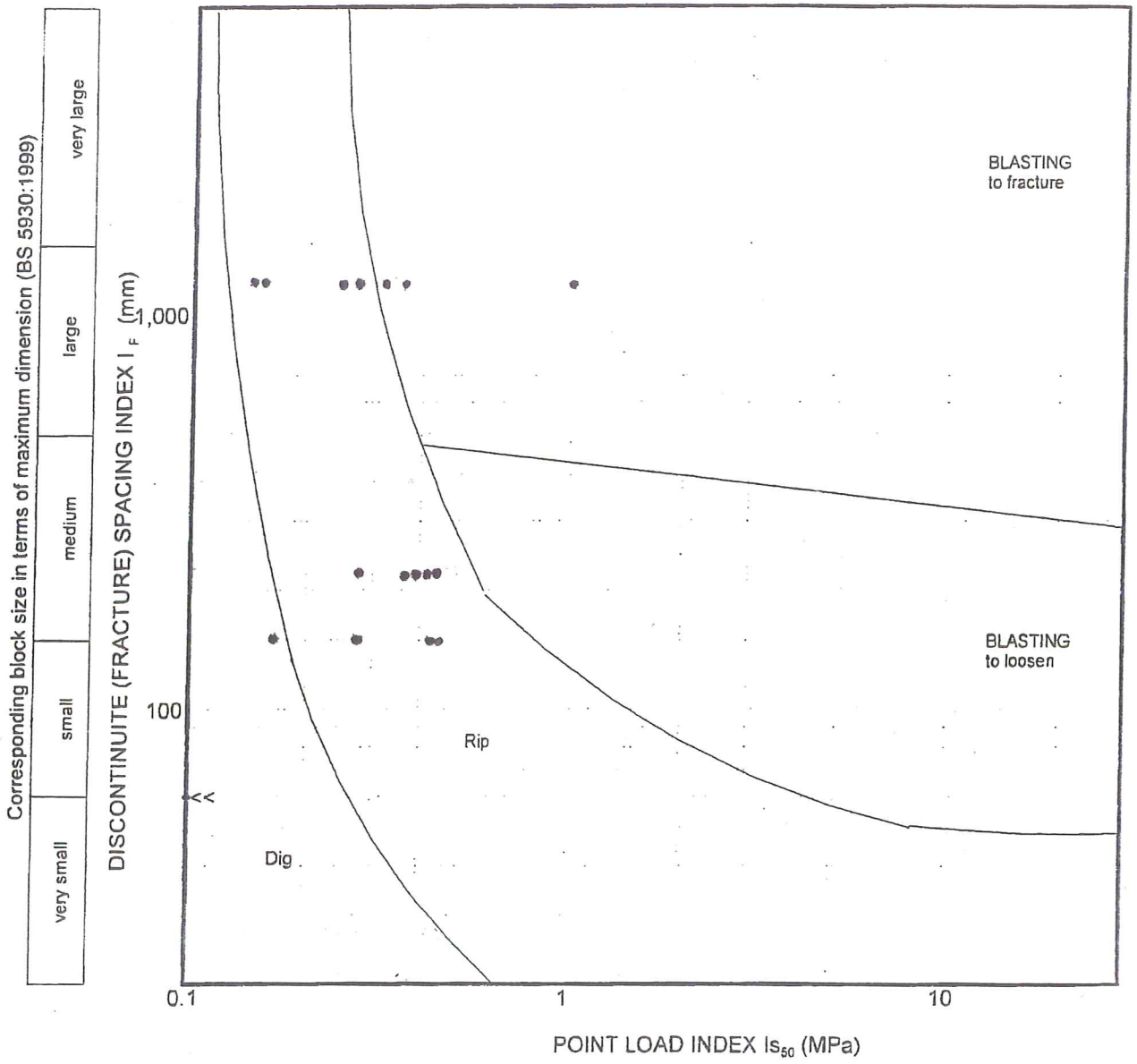
Figure 1 – Excavatability Graph

(After G.S Pettifer & P.G Fookes (1994))
Measurements should not be scaled from this figure

Client – Erris Homes Ltd

Site – Bank End Road, Worsbrough Bridge

Weak	Mod. Weak				
broken by leaning on sample with hammer	broken in hand by hitting with hammer	mod. strong	strong	very strong	extr. strong



Notes: [1] Approx. correlation with point load index (UCS = 20 Is50)

[2] Where the rock mass structure is unfavourable for ripping, If value should be increased.

Figure 2 – Trench Excavatability Graph

After Franklin Brock and Walton (1971)
Measurements should not be scaled from this figure

Client – Erris Homes Ltd

Site – Bank End Road, Worsbrough Bridge

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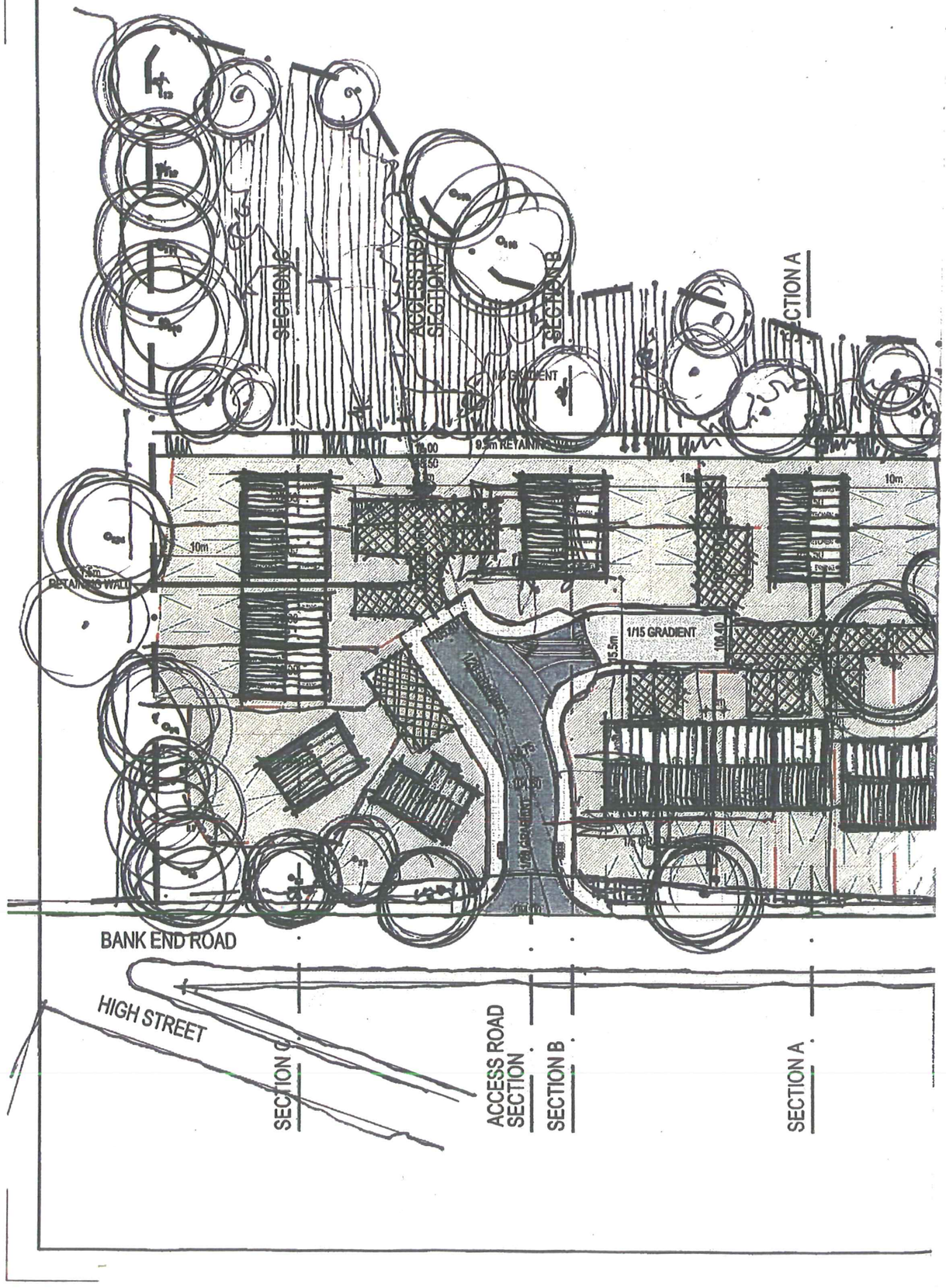
APPENDIX A

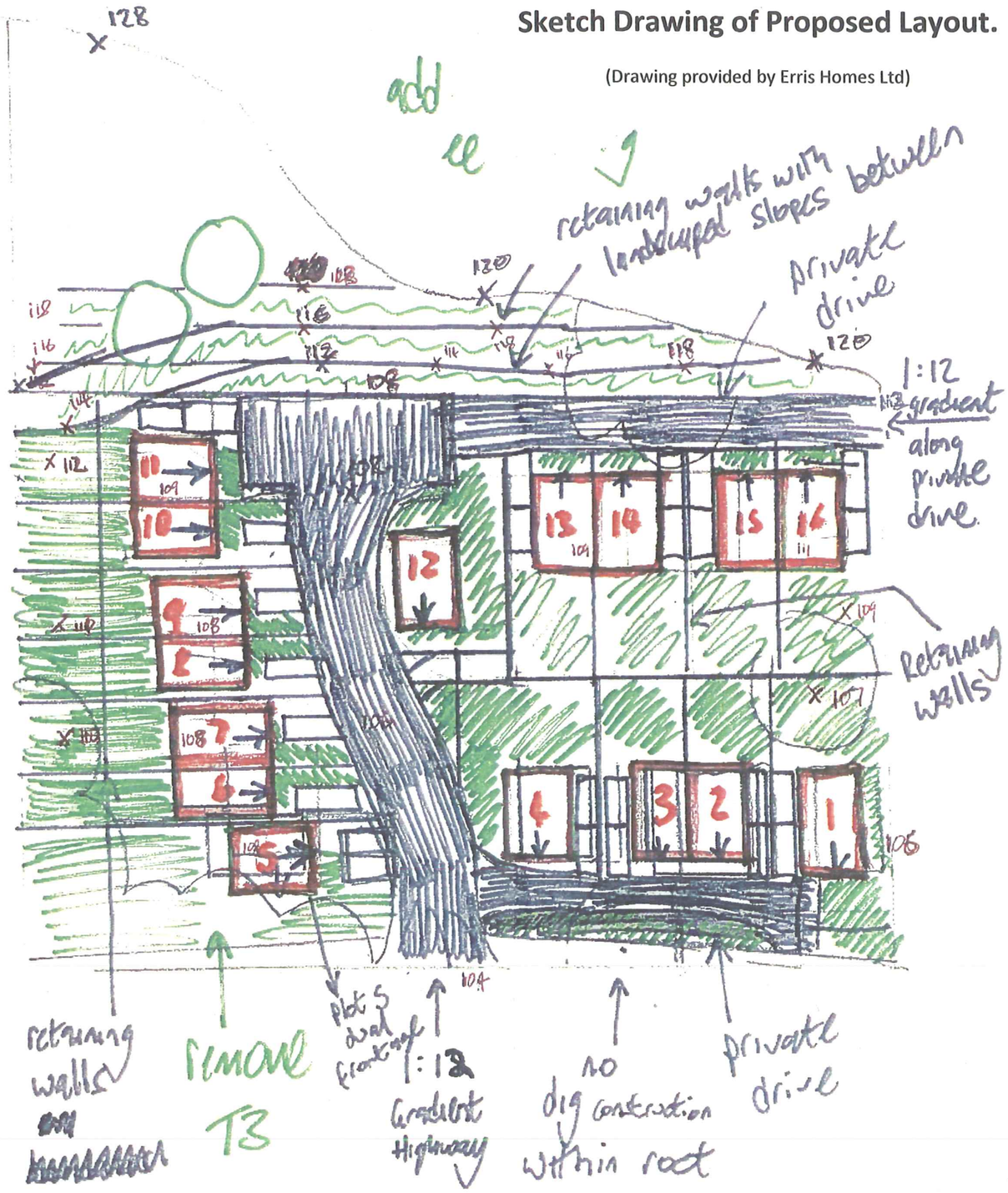
DRAWINGS

Drawing No C036/02/01

Sketch Drawing of Proposed Layout.

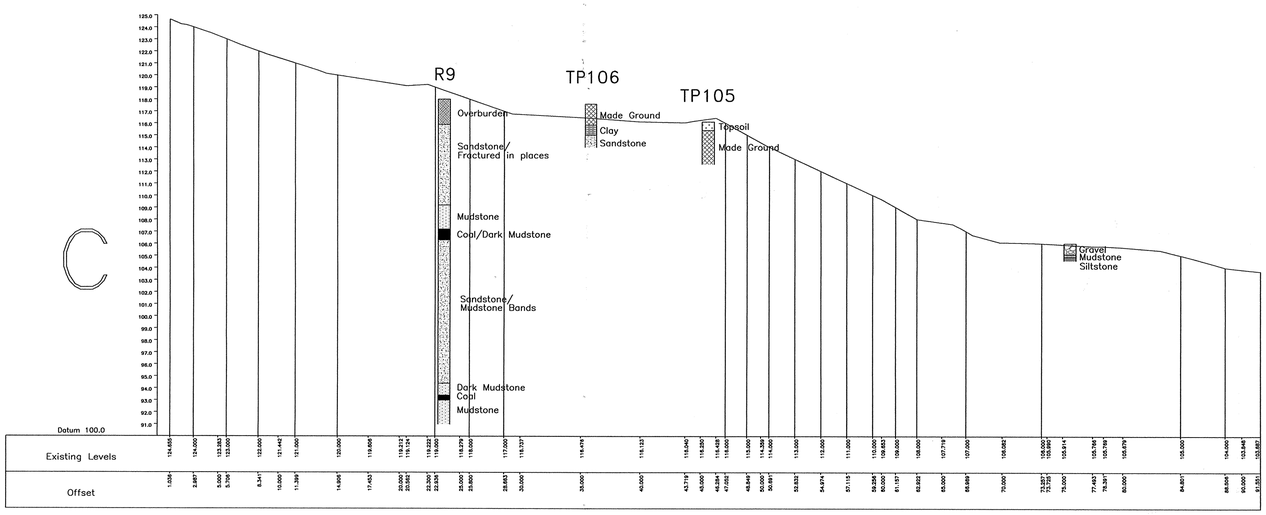
(Drawing provided by Erris Homes Ltd)

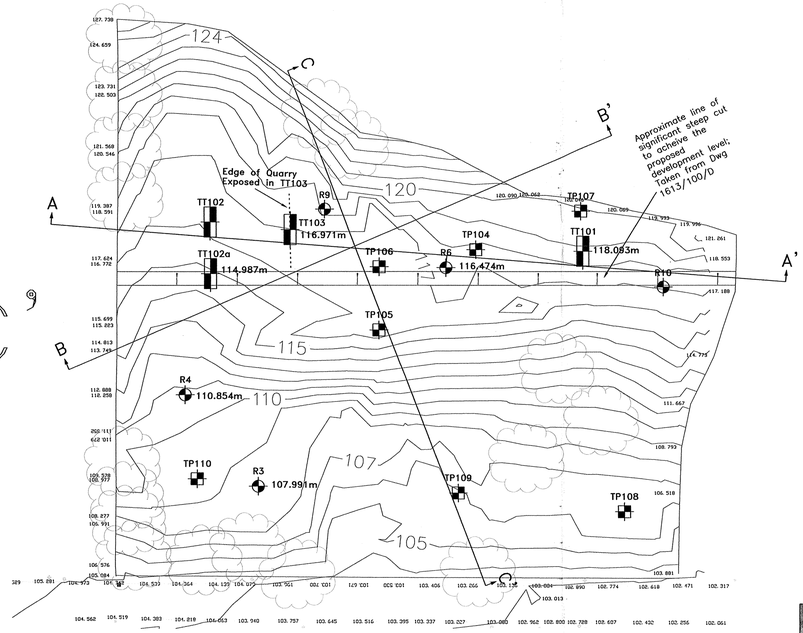




16 dwellings,
27 parking spaces
= approx 1.7 per dwelling.

G & M Consulting Ltd

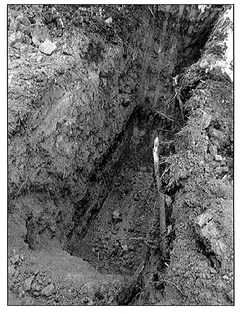




Exploratory Hole Locations (1:500).

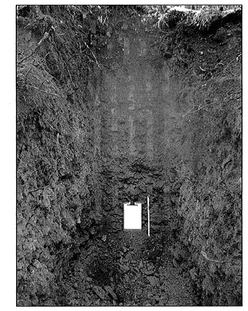

TT107


TT104


TT108

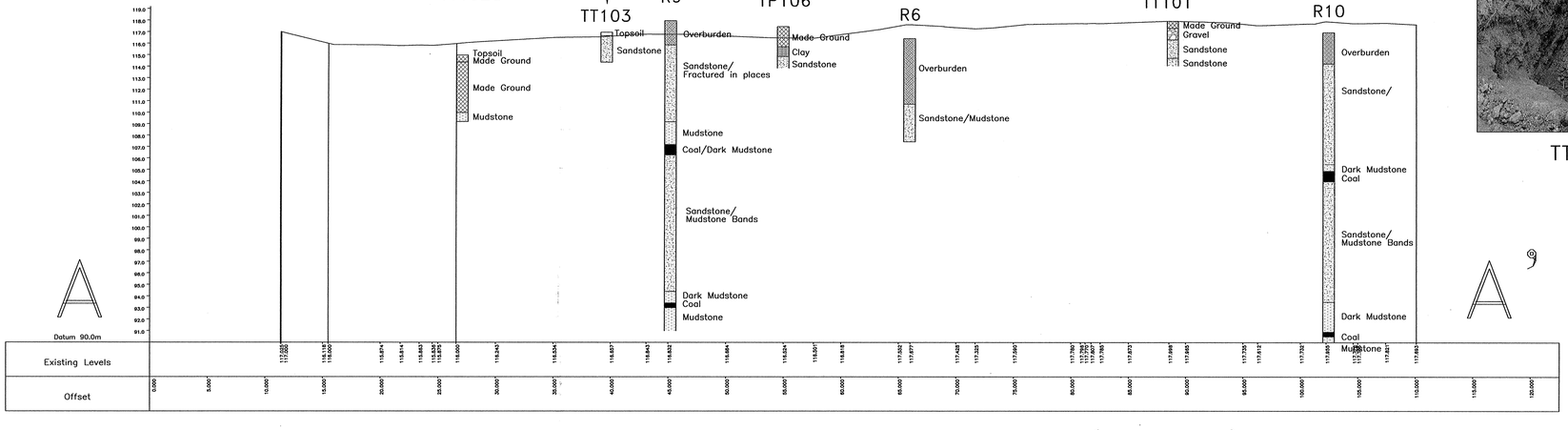

TT105


TT106


TT101


TT102a


TT103



Cross Sections (1:250)

Notes:

1. The accuracy and content of this drawing are dependent on the surveyed scale and survey specification, care should be taken when working with other plotted scales or from CAD.

2. Existing site survey details provided by Erris Homes.

3. Rotary open holes R3,R4,R6,R9 and R10 were drilled in the previous investigation works and are presented in G&M Report No C036/01 dated December 2009.

4. Currently exact details of location and levels for the retaining structures to the back of the site are not available.

5. It must be noted that the rotary hole techniques only recover small chip samples brought to the surface by flush returns. Consequently the strata descriptions and depth to strata boundaries should be only used as a guide to ground conditions.

Rev	Description of revision	Date

G & M Consulting Ltd

The Chestnuts,
Brackenhill Road,
East Lound,Haxey,
Doncaster,
DN9 2LR.

Site Name:
Erris Homes,
Bank End Road,
Worsbrough Bridge,
South Yorkshire.

Surveyed:	Drawn:	Checked:
-	CSm	GS

Title
Exploratory Holes and Cross Section.

Plotted Scale:	Date:	Sheet Size:
1:500	22 Dec 09	A1

Drawing No.	Revision
C036\02\02	-

G & M Consulting Ltd

APPENDIX B

EXPLORATORY HOLE RECORDS

G & M Consulting Ltd	TRIAL PIT RECORD		TP No	TT101
			Contract No	C036
Method 360° tracked excavator	Site	Bank End Road, Worsbrough Bridge	Date	23/02/10
			Scale	01:25
	Client	Erris Homes Ltd	Logged By	JM

Sample Details			Description	Depth (m)	Level (mAOD)	Legend
Type	Depth To-from (m)	Vane kN/m²				
			TOPSOIL : Dark brown to black very organic SILT with numerous roots up to 20mm diameter. Near surface, fragments of coal, glass, plastic bags, underlay and bricks.	0.60		
			Brown coarse angular GRAVEL and much cobbles of medium grained sandstone. Some clayey medium sand. No visible structure.	1.60		
			Very weak brown very thinly bedded medium grained SANDSTONE moderately weathered with vertical fractures 50 to 100mm spacing. Recovered as gravel and cobbles of sandstone. Bedding dips 15° to south i.e. Out of slope.	3.20		
			Moderately weak to moderately strong, grey discoloured brown on bedding, very thinly bedded to thinly bedded medium grained SANDSTONE moderately to slightly weathered			
Block	3.90		Moderately weak, medium bedded (plus), brown, medium grained SANDSTONE slightly weathered. Exposed at base of trial pit, unable to excavate. Vertical open (55mm) joints visible in base of trial pit at 1.4m spacings Trending parallel with the slope (East to West)	3.85		
			Trial pit ends at 3.9m Bedding noted as dipping 15° south, i.e out of the slope			

Remarks
No groundwater encountered
Faces unstable in made ground
Trial pit backfilled on completion of logging with excavated material.
Trial pit excavated into a slope, all depths measured down the upslope face.

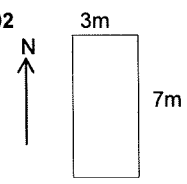
Sample Types
D - Disturbed
U - Undisturbed
W - Water

Fig No

G & M Consulting Ltd	TRIAL PIT RECORD		TP No	TT102
			Contract No	C036
Method 360° tracked excavator	Site	Bank End Road, Worsbrough Bridge	Date	23/02/10
			Scale	01:25
	Client	Erris Homes Ltd	Logged By	JM

Sample Details			Description	Depth (m)	Level (mAOD)	Legend
Type	Depth To-from (m)	Vane kN/m²				
D	1.00		MADE GROUND: Loose, coarse angular GRAVEL, COBBLES and BOULDERS of brown medium grained sandstone. Fines of sand and fine and medium angular gravel.			
Bulk	1.50					
			Trial pit ends at 3.8m			

Stetch Plan TT102



Remarks
No groundwater encountered
Faces unstable in made ground
Trial pit backfilled on completion of logging with excavated material.
Trial pit abandoned due to continual collapse.

Sample Types
D - Disturbed
U - Undisturbed
W - Water

Fig No

G & M Consulting Ltd	TRIAL PIT RECORD		TP No	TT102A
			Contract No	C036
Method 360° tracked excavator	Site	Bank End Road, Worsbrough Bridge	Date	23/02/10
			Scale	01:25
	Client	Erris Homes Ltd	Logged By	JM

Sample Details			Description	Depth (m)	Level (mAOD)	Legend
Type	Depth To-from (m)	Vane kN/m²				
			TOPSOIL: Dark brown to black very organic SILT.	0.10		
			MADE GROUND: Brown very clayey angular GRAVEL of sandstone.	0.60		
			MADE GROUND:Loose, coarse angular GRAVEL, COBBLES and BOULDERS of brown medium grained sandstone. Fines of sand and fine and medium angular gravel.	4.40		
			Moderately weak, grey discoloured brown, very thinly bedded silty MUDSTONE moderately weathered.			

Remarks
No groundwater encountered
Faces unstable in made ground
Trial pit backfilled on completion of logging with excavated material.
Trial pit excavated into a slope, all depths measured down the upslope face.

Sample Types
D - Disturbed
U - Undisturbed
W - Water

Fig No

G & M Consulting Ltd	TRIAL PIT RECORD		TP No	TT102A
			Contract No	C036
Method 360° tracked excavator	Site	Bank End Road, Worsbrough Bridge	Date	
			Scale	01:25
	Client	Erris Homes Ltd	Logged By	JM

Sample Details			Description	Depth (m)	Level (mAOD)	Legend
Type	Depth To-from (m)	Vane kN/m²				
			MUDSTONE (As Page 1)	5.20		
			Trial pit ends at 5.2m			

Remarks
No groundwater encountered
Faces unstable in made ground

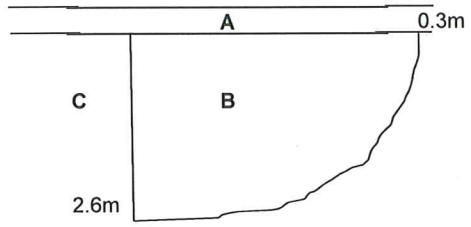
Sample Types
D - Disturbed
U - Undisturbed
W - Water

Fig No

G & M Consulting Ltd	TRIAL PIT RECORD	TP No	TT103
		Contract No	C036
Method: 360° tracked excavator	Site: Bank End Road, Worsbrough Bridge	Date	23/02/10
		Scale	01:25
	Client: Erris Homes Ltd	Logged By	JM

Sample Details: Type	Depth To-from (m)	Vane kN/m²	Description	Depth (m)	Level (mAOD)	Legend
Block	0.50					

TT103 Section

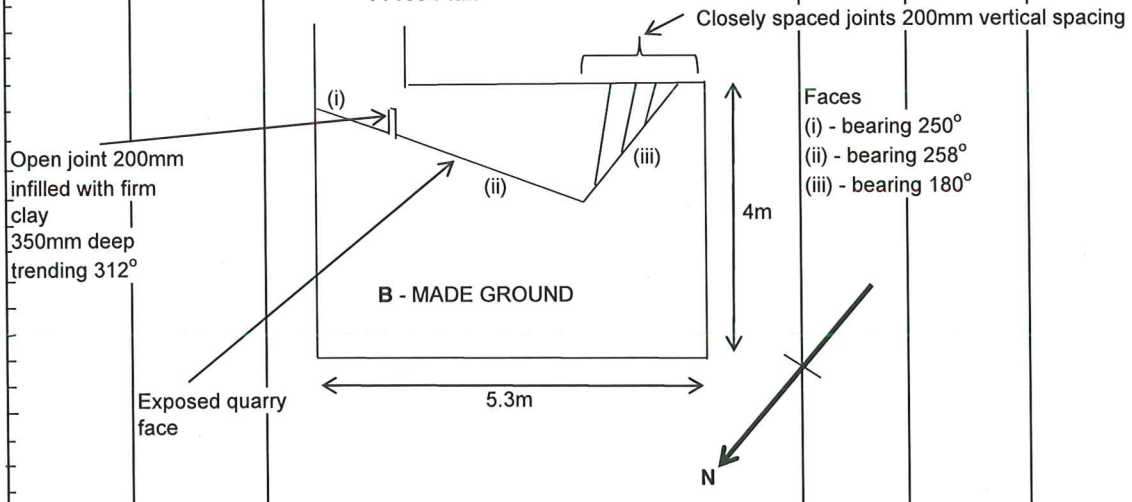


A - TOPSOIL: Dark brown to black organic SILT.

B - MADE GROUND: Loose, coarse angular GRAVEL, COBBLES and BOULDERS of brown medium grained sandstone. Fines of sand and fine and medium angular gravel.

C - Moderately strong, thickly bedded, medium grained SANDSTONE slightly weathered; 200mm spaced closed vertical joints in part of the exposed rock face.

TT103 Plan



Remarks
No groundwater encountered
Faces unstable in made ground

Sample Types
D - Disturbed
U - Undisturbed
W - Water

Fig No

G & M Consulting Ltd	TRIAL PIT RECORD		TP No		TP104
			Contract No		C036
Method 360° tracked excavator	Site	Bank End Road, Worsbrough Bridge	Date		23/02/10
			Scale		01:25
	Client	Erris Homes Ltd	Logged By		JM
Sample Details					
Type / Depth To-from (m) / Vane kN/m²	Description		Depth (m)	Level (mAOD)	Legend
Block 0.50	Brown angular GRAVEL of medium grained sandstone.		0.10		
	Moderately strong, thin to medium bedded, medium grained SANDSTONE slightly weathered. Set of closed vertical joints at 90° to each other 150 to 300mm spacing.		0.80		
	Trial pit ends at 0.8m				

Remarks
No groundwater encountered
Faces unstable in made ground
Trial pit backfilled on completion of logging with excavated material.

Sample Types
D - Disturbed
U - Undisturbed
W - Water

Fig No

G & M Consulting Ltd	TRIAL PIT RECORD		TP No	TP105
			Contract No	C036
Method 360° tracked excavator	Site	Bank End Road, Worsbrough Bridge	Date	24/02/10
			Scale	01:25
	Client	Erris Homes Ltd	Logged By	JM

Sample Details			Description	Depth (m)	Level (mAOD)	Legend
Type	Depth To-from (m)	Vane kN/m²				
D	0.80		TOPSOIL: Dark brown organic SILT with numerous roots up to 10mm diameter. Surface material of timber, timber, plastic and bricks	0.80		
			MADE GROUND: Brown angular COBBLES and BOULDERS of medium grained sandstone, occasional whole bricks. Some fines of sand and angular gravel.	3.50		
			Trial pit ends at 3.5m			

Remarks
No groundwater encountered
Faces unstable in made ground
Trial pit backfilled on completion of logging with excavated material.

Sample Types
D - Disturbed
U - Undisturbed
W - Water

Fig No

G & M Consulting Ltd	TRIAL PIT RECORD		TP No	TP106
			Contract No	C036
Method 360° tracked excavator	Site	Bank End Road, Worsbrough Bridge	Date	24/02/10
			Scale	01:25
	Client	Erris Homes Ltd	Logged By	JM

Sample Details			Description	Depth (m)	Level (mAOD)	Legend
Type	Depth To-from (m)	Vane kN/m²				
			A (noted in northern end to 1.45m) MADE GROUND: Loose, coarse angular GRAVEL, COBBLES and BOULDERS of brown medium grained sandstone. Fines of sand and fine to medium angular gravel. B (noted in southern end to 1.75m) MADE GROUND: Angular COBBLES comprising whole bricks with some sandstone blocks, masonry wall visible in central section of pit. Possible flagstone floor at base of made ground.			
Bulk	2.00		Firm to stiff friable gravelly CLAY. Gravel comprises fine to medium angular gravel size fragments of mudstone (lithorelicts). Bedding visible, thickly laminated. (Highly weathered mudstone.)	1.75		
			Trial pit terminated on moderately strong brown medium grained SANDSTONE. Unable to excavate. Open vertical joint visible in base of trial pit	2.6		
		Sandstone exposed in northern face	**Trial pit ends at 2.6m** **Sketch Section TP106** (Not to scale) Brick wall A B 1.45m 1.75m Clay Sandstone **Stetch Plan TP106** N 1.2m 4m			

Remarks
No groundwater encountered
Faces unstable in made ground

Sample Types
D - Disturbed
U - Undisturbed
W - Water

Fig No

G & M Consulting Ltd	TRIAL PIT RECORD		TP No	TP107
			Contract No	C036
Method 360° tracked excavator	Site	Bank End Road, Worsbrough Bridge	Date	24/02/10
			Scale	01:25
	Client	Erris Homes Ltd	Logged By	JM

Sample Details			Description	Depth (m)	Level (mAOD)	Legend
Type	Depth To-from (m)	Vane kN/m²				
D	0.20		TOPSOIL: Dark brown organic SILT with numerous roots up to 10mm diameter. Surface material of timber, plastic, metal, coal and bricks.	0.40		
Bulk	1.00		Brown medium to coarse angular GRAVEL much cobbles of medium grained sandstone. Some clayey medium sand. No visible structure.	1.20		
			Very weak brown very thinly bedded medium grained SANDSTONE moderately weathered with vertical fractures 50 to 100mm spacing. Recovered as gravel and cobbles of sandstone.			
			Trial pit ends at 2.0m			

Remarks
No groundwater encountered
Faces unstable in made ground
Trial pit backfilled on completion of logging with excavated material.

Sample Types
D - Disturbed
U - Undisturbed
W - Water

Fig No

G & M Consulting Ltd	TRIAL PIT RECORD		TP No	TP108
			Contract No	C036
Method 360° tracked excavator	Site	Bank End Road, Worsbrough Bridge	Date	
			Scale	01:25
	Client	Erris Homes Ltd	Logged By	JM

Sample Details			Description	Depth (m)	Level (mAOD)	Legend
Type	Depth To-from (m)	Vane kN/m²				
D	0.20		TOPSOIL: Dark brown organic SILT with numerous roots up to 10mm diameter.	0.40		
Bulk	0.50	54,42,40	Light brown medium to coarse angular GRAVEL of medium grained sandstone. Occasional cobbles and boulders up to 200x600x1000mm. Top 100mm of strata clay bound gravel	1.50		
			Very weak friable black COAL/carbonaceous MUDSTONE completely weathered.	2.10		
			Very weak (stiff) grey thickly laminated silty MUDSTONE highly weathered. Recovered as clay bound angular gravel (lithorelicts) of mudstone. Some brown iron staining on bedding planes. Becomes more sandy and less weathered at the base of	2.70		
			Trial pit ends at 2.7m			

Remarks
No groundwater encountered
Sidewalls stable during excavation
Trial pit backfilled on completion of logging with excavated material.

Sample Types
D - Disturbed
U - Undisturbed
W - Water

Fig No

G & M Consulting Ltd	TRIAL PIT RECORD		TP No	TP109
			Contract No	C036
Method 360° tracked excavator	Site	Bank End Road, Worsbrough Bridge	Date	24/02/10
			Scale	01:25
	Client	Erris Homes Ltd	Logged By	JM

Sample Details			Description	Depth (m)	Level (mAOD)	Legend
Type	Depth To-from (m)	Vane kN/m²				
D	0.50		Light brown coarse angular GRAVEL of medium grained sandstone. With much cobbles. Some sand and gravel.			
			Very weak friable black Coal/carbonaceous MUDSTONE, completely weathered. Seam thins out towards the centre of the trial pit, to the west	0.90 1.10		
Bulk	1.40	All attempts >130	Very weak (very stiff) grey thickly laminated silty MUDSTONE, highly weathered. Recovered as bound angular gravel (lithorelicts) of siltstone. Some brown iron staining on bedding planes.	1.40		
			Trial pit ends at 1.4m			

Remarks
No groundwater encountered
Faces unstable in made ground

Sample Types
D - Disturbed
U - Undisturbed
W - Water

Fig No

G & M Consulting Ltd	TRIAL PIT RECORD		TP No	TP110
			Contract No	C036
Method 360° tracked excavator	Site	Bank End Road, Worsbrough Bridge	Date	24/02/10
			Scale	01:25
	Client	Erris Homes Ltd	Logged By	JM

Sample Details			Description	Depth (m)	Level (mAOD)	Legend
Type	Depth To-from (m)	Vane kN/m²				
			TOPSOIL : Dark brown to black very organic SILT with angular gravel and cobbles of sandstone..	0.40		
D	0.50		MADE GROUND: Coarse angular COBBLES and BOULDERS of brown medium grained sandstone. Fines of sand and angular gravel.	2.80		
			Trial pit ends at 2.8m			

Remarks
No groundwater encountered
Faces unstable in made ground
Trial pit backfilled on completion of logging with excavated material.

Sample Types
D - Disturbed
U - Undisturbed
W - Water

Fig No

G & M Consulting Ltd

APPENDIX C

CHEMICAL LABORATORY RESULTS

dets
Derwentside Environmental Testing Services

UKAS TESTING
2139

Certificate of Analysis

Date: 12/03/2010

Certificate Number: 10-36016

Client:
G & M Consulting
The Chestnuts
Brackenhill Road
Doncaster
South Yorkshire
DN9 2LR

Our Reference:	10-36016
Client Reference:	C036
Contract Title:	Worsborough
Description:	3 soil samples
Date Received:	01/03/2010
Date Started:	02/03/2010
Date Completed:	12/03/2010
Test Procedures:	Identified by prefix DETSn, details available upon request.

Notes:
Observations and interpretations are outside the scope of UKAS accreditation
* denotes test not included in laboratory scope of accreditation
# denotes test that holds MCERT accreditation, however, MCERTS accreditation is only implied if the report carries the MCERTS logo
$ denotes tests completed by an approved subcontractor
I/S denotes insufficient sample to carry out test
U/S denotes that the sample is not suitable for testing
DETSM denotes tests carried out by DETS Midlands laboratory
Solid samples will be disposed 1 month and liquids 2 weeks after the date of issue of this test certificate
Asbestos subsamples will be kept for 6 months

Approved By:

Authorised Signatories: Rob Brown
Business Manager

This certificate is issued in accordance with dom Accreditation Service. The results reported herein relate only to the material supplied to the l l except in full, without the prior written approval of the laboratory.

Derwentside Environmental Testing Services Limited
Unit 2, Park Road Industrial Estate South, Consett, Co Durham, DH8 5PY
Tel: 01207 582333 • Fax 01207 582444 • email: info@dets.co.uk • www.dets.co.uk

Summary of Chemical Analysis
Soil Samples

Our Ref: 10-36016
Client Ref: C036
Contract Title: Worsborough

		Lab No.	245161	245162	245163
		Sample Ref	TT102	TP105	TP107
		Depth	1.00	0.80	0.20
		Other Ref			
		Sample Type			
Test	**Units**	**DETSxx**			
Arsenic	mg/kg	DETS 042#	5	7	16
Cadmium	mg/kg	DETS 042#	0.3	0.5	1.2
Chromium	mg/kg	DETS 042#	9	10	16
Copper	mg/kg	DETS 042#	8	16	37
Lead	mg/kg	DETS 042#	16	1400	180
Mercury	mg/kg	DETS 081#	0.20	3.0	0.39
Nickel	mg/kg	DETS 042#	15	12	17
Selenium	mg/kg	DETS 042#	< 0.5	< 0.5	< 0.5
Zinc	mg/kg	DETS 042#	32	290	160
Sulphate Aqueous Extract as SO4	mg/l	DETS 076#	23	18	67
pH		DETS 008#	7.9	8.4	7.8
Aliphatic C5-C6	mg/kg	DETS 072*	< 0.01	< 0.01	< 0.01
Aliphatic C6-C8	mg/kg	DETS 072*	< 0.01	< 0.01	< 0.01
Aliphatic C8-C10	mg/kg	DETS 072*	< 0.01	< 0.01	< 0.01
Aliphatic C10-C12	mg/kg	DETS 072#	< 1.5	< 1.5	< 1.5
Aliphatic C12-C16	mg/kg	DETS 072#	< 1.2	< 1.2	< 1.2
Aliphatic C16-C21	mg/kg	DETS 072#	< 1.5	< 1.5	< 1.5
Aliphatic C21-C35	mg/kg	DETS 072#	< 3.4	< 3.4	< 3.4
Aromatic C5-C7	mg/kg	DETS 072*	< 0.01	< 0.01	< 0.01
Aromatic C7-C8	mg/kg	DETS 072*	< 0.01	< 0.01	< 0.01
Aromatic C8-C10	mg/kg	DETS 072*	< 0.01	< 0.01	< 0.01
Aromatic C10-C12	mg/kg	DETS 072#	< 0.9	< 0.9	< 0.9
Aromatic C12-C16	mg/kg	DETS 072#	< 0.5	< 0.5	0.8
Aromatic C16-C21	mg/kg	DETS 072#	0.7	5.9	4.4
Aromatic C21-C35	mg/kg	DETS 072#	< 1.4	20	12
Aliphatic C5-C35	mg/kg	DETS 072*	< 10	< 10	< 10
Aromatic C5-C35	mg/kg	DETS 072*	< 10	26	17
TPH Ali/Aro	mg/kg	DETS 072*	< 10	27	18
Acenaphthene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1
Acenaphthylene	mg/kg	DETS 050	< 0.1	0.2	< 0.1
Anthracene	mg/kg	DETS 050	< 0.1	0.7	0.2
Benzo(a)anthracene	mg/kg	DETS 050	< 0.1	4.4	0.8
Benzo(a)pyrene	mg/kg	DETS 050	< 0.1	2.4	0.5
Benzo(b)fluoranthene	mg/kg	DETS 050	< 0.1	1.9	0.8
Benzo(k)fluoranthene	mg/kg	DETS 050	< 0.1	0.8	0.1
Benzo(g,h,i)perylene	mg/kg	DETS 050	< 0.1	1.1	0.4
Chrysene	mg/kg	DETS 050	< 0.1	5.0	0.8
Dibenzo(a,h)anthracene	mg/kg	DETS 050	< 0.1	0.4	0.1
Fluoranthene	mg/kg	DETS 050	< 0.1	2.8	1.3
Fluorene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1
Indeno(1,2,3-c,d)pyrene	mg/kg	DETS 050	< 0.1	0.9	0.5
Naphthalene	mg/kg	DETS 050	< 0.1	< 0.1	< 0.1
Phenanthrene	mg/kg	DETS 050	< 0.1	1.6	0.6
Pyrene	mg/kg	DETS 050	< 0.1	3.8	1.2
PAH	mg/kg	DETS 050	< 1.6	26	7.4

Summary of Chemical Analysis
Soil Samples

Our Ref: 10-36016
Client Ref: C036
Contract Title: Worsborough

		Lab No.	245161	245162	245163
		Sample Ref	TT102	TP105	TP107
		Depth	1.00	0.80	0.20
		Other Ref			
		Sample Type			
Test	**Units**	**DETSxx**			
Phenol - Monohydric	mg/kg	DETS 067#	< 0.3	0.5	< 0.3

G & M Consulting Ltd

APPENDIX D

GEOTECHNICAL LABORATORY RESULTS

PSL
Professional Soils Laboratory

LABORATORY REPORT

UKAS TESTING
4043

Contract Number: PSL10/0334

Client's Reference: Report Date: 09 March 2010

Client Name: G&M Consulting
The Chestnuts
Brackenhill Road
Haxey, Doncster
South Yorkshire
DN9 2LR

For the attention of: Graeme Swinbourne

Contract Title: Worsbrough Bridge.

Date Received: 26-Feb-10
Date Commenced: 26-Feb-10
Date Completed: 9-Mar-10

Notes: **Observations and Interpretations are outside the UKAS Accreditation**

A copy of the Laboratory Schedule of accredited tests as issued by UKAS is attached to this report. This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service. The results reported herein relate only to the material supplied to the laboratory. This certificate shall not be reproduced in full, without the prior written approval of the laboratory.

Checked and Approved Signatories:

R Gunson (Director)
A Watkins (Director)
D Lambe (Senior Technician)

5 – 7 Hexthorpe Road, Hexthorpe,
Doncaster DN4 0AR
tel: +44 (0)844 815 6641
fax: +44 (0)844 815 6642
e-mail: rgunson@prosoils.co.uk
awatkins@prosoils.co.uk

SUMMARY OF LABORATORY SOIL DESCRIPTIONS

Hole Number	Sample Number	Sample Type	Depth m	Description of Sample
TP102		B	1.50	Pale brown very sandy silty GRAVEL with many cobbles.
TP106		B	2.00	Grey sandy silty CLAY.
TP107		B	1.00	Pale brown very sandy silty GRAVEL with many cobbles.
TP108		B	0.50	Brown slightly gravelly sandy silty CLAY.
TP109		B	1.40	Grey sandy silty CLAY.

PSL
Professional Soils Laboratory

Compiled by	Date	Checked by	Date	Approved by	Date
	9/3/10		9/3/10		9/3/10

WORSBROUGH BRIDGE.

Contract No: PSL10/0334

Client Ref: C036

SUMMARY OF SOIL CLASSIFICATION TESTS

(B.S. 1377 : PART 2 : 1990)

Hole Number	Sample Number	Sample Type	Depth m	Moisture Content % Clause 3.2	Bulk Density Mg/m^3 Clause 7.2	Dry Density Mg/m^3 Clause 7.2	Particle Density Mg/m^3 Clause 8.	Liquid Limit % Clause 4.3/4.4	Plastic Limit % Clause 5.	Plasticity Index % Clause 6.	% Passing .425mm	Remarks
TP106		B	2.00	20				45	24	21	100	Intermediate plasticity CI.
TP108		B	0.50	15				32	18	14	94	Low plasticity CL.
TP109		B	1.40	15				38	21	17	100	Intermediate plasticity CI.

SYMBOLS : NP : Non Plastic

* : Liquid Limit and Plastic Limit Wet Sieved.

PSL
Professional Soils Laboratory

Compiled by	Date	Checked by	Date	Approved by	Date
	9/3/10		9/3/10		9/3/10

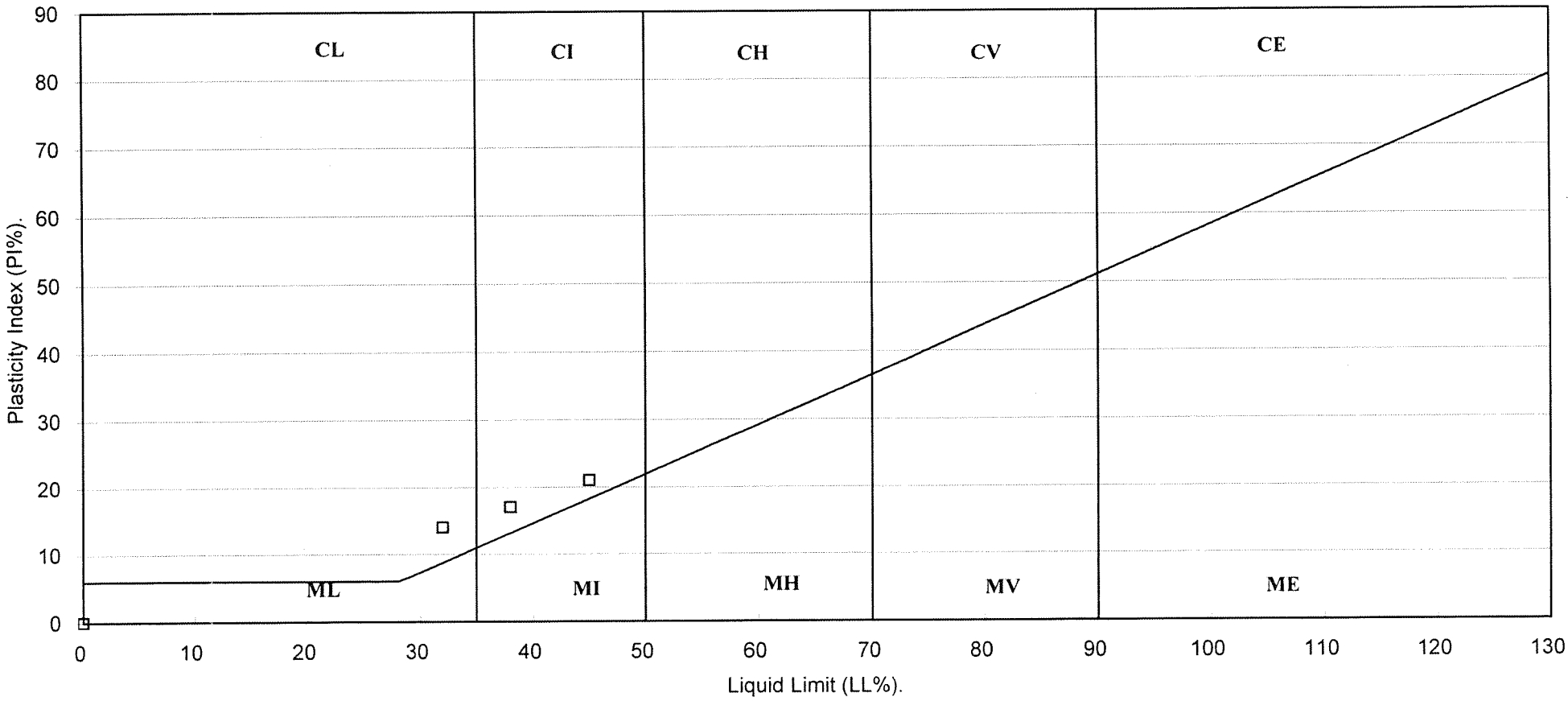
WORSBROUGH BRIDGE.

Contract No: PSL10/0334

Client Ref: C036

PLASTICITY CHART FOR CASAGRANDE CLASSIFICATION.

(B.S.5930 : 1999)



PSL Professional Soils Laboratory	Compiled by	Date	Checked by	Date	Approved by	Date
	Mar	9/3/10		9/3/10		9/3/10
	WORSBROUGH BRIDGE.				Contract No:	PSL10/0334
					Client Ref:	C036

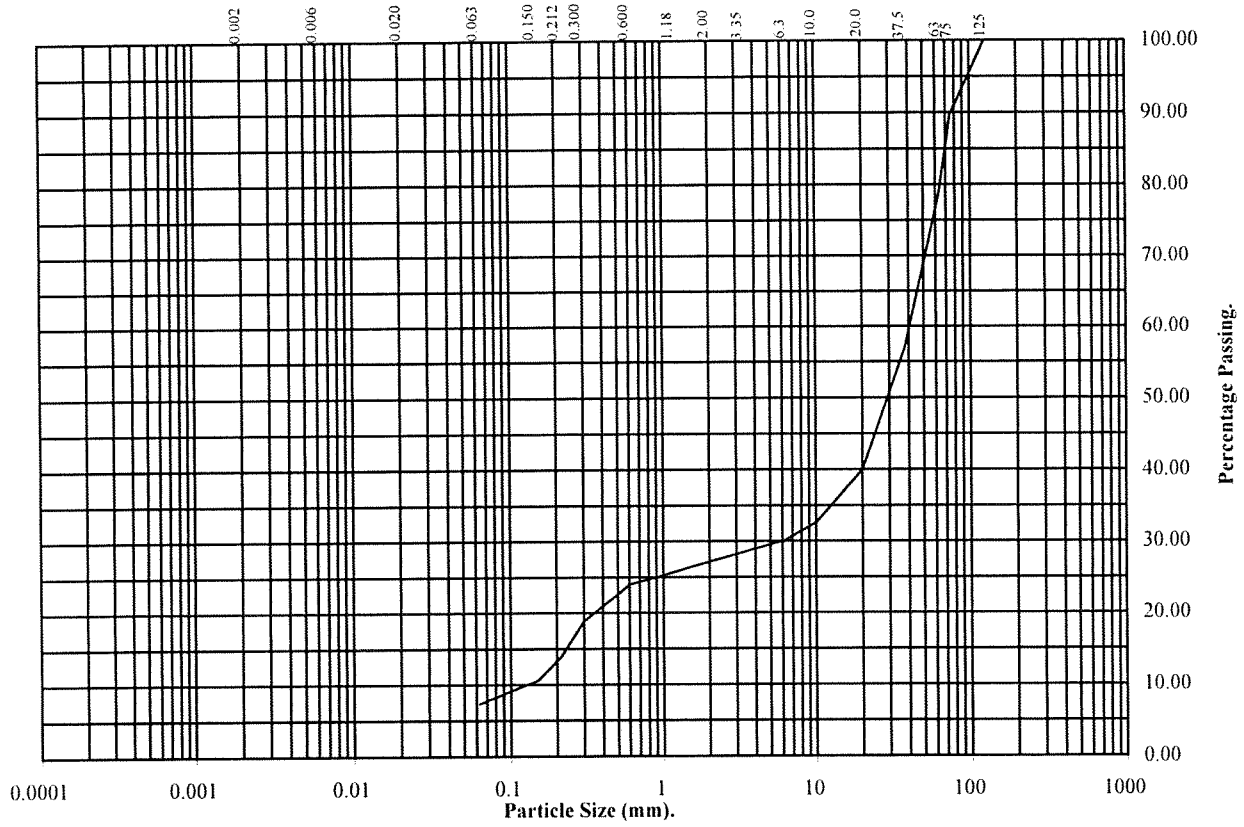
Particle Size Distribution Test

BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

Hole Number: TP102 **Depth (m):** 1.50

Sample Number: **Sample Type:** B



BS Test Sieve	Percentage Passing
125	100
75	90
63	79
37.5	57
20	40
10	33
6.3	30
3.35	28
2	27
1.18	26
0.6	24
0.3	19
0.212	14
0.15	11
0.063	7

Soil Fraction	Total Percentage
Cobbles	21
Gravel	52
Sand	20
Silt / Clay	7

Remarks:
See summary of soil descriptions.

Checked By	Date	Approved By	Date
[signature]	9/3/10	[signature]	9/3/10

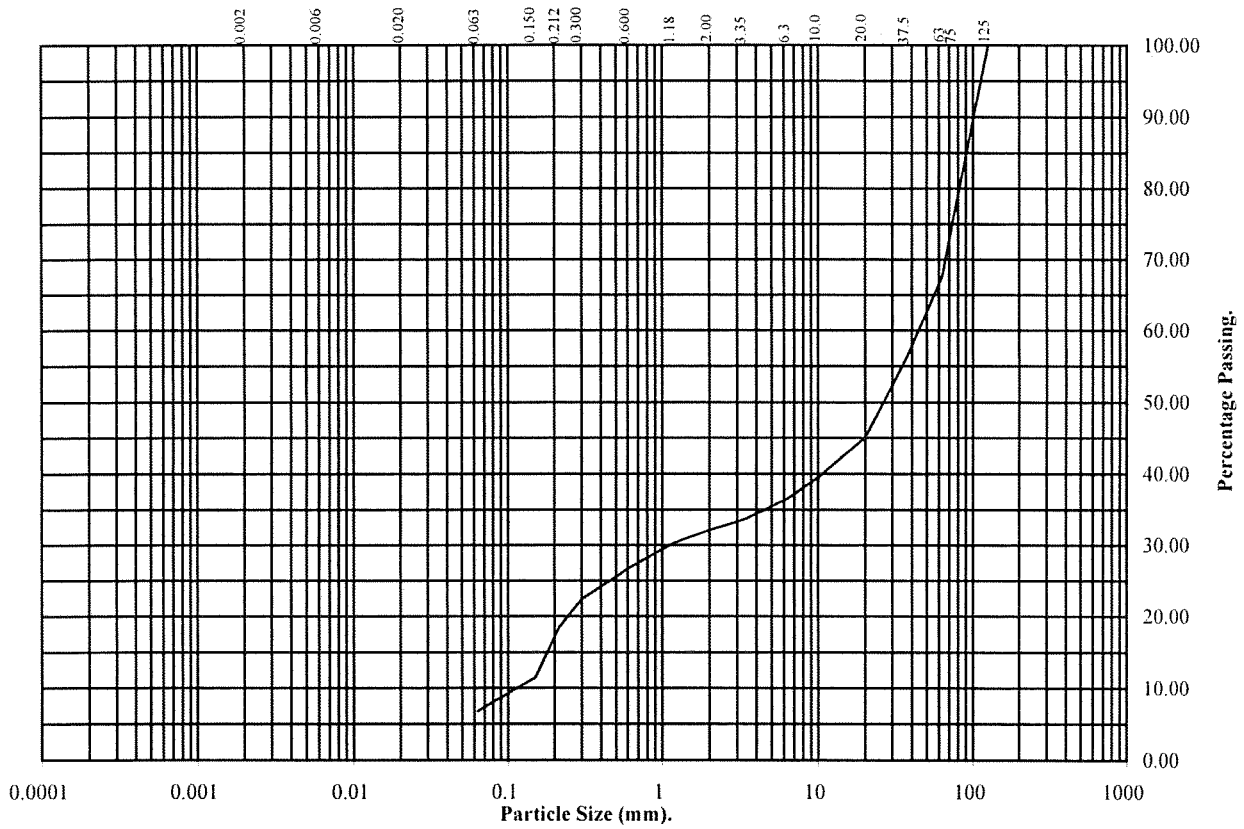
Particle Size Distribution Test

BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

Hole Number: TP107 **Depth (m):** 1.00

Sample Number: **Sample Type:** B



BS Test Sieve	Percentage Passing
125	100
75	76
63	68
37.5	57
20	45
10	40
6.3	37
3.35	34
2	32
1.18	30
0.6	27
0.3	22
0.212	18
0.15	12
0.063	7

Soil Fraction	Total Percentage
Cobbles	32
Gravel	36
Sand	25
Silt / Clay	7

Remarks:
See summary of soil descriptions.

Checked By	Date	Approved By	Date

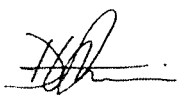
PSL Professional Soils Laboratory	**WORSBROUGH BRIDGE.**	**Contract No.: PSL10/0334**

SUMMARY OF POINT LOAD TESTS.

Int. J. Rock Mech. Sci. & Geomech. Abstr. Vol. 22, No. 2, pp. 51 - 60, 1985.

Borehole Number	Depth (m)	Type of Test d a b/t	Type of Test I //	Width (W) (mm)	Platen Separation (D) (mm)	Failure Load (P) (kN)	Equivalent Diameter (D_e) (mm)	Point Load (I_s) (MPa)	Size Factor (F)	Point Load Index ($I_{s(50)}$) (MPa)	Angle between plane of anisotropy & core axis	Type of anisotropy (Bedding or Cleavage)	Remarks.
TT101	3.90	i	I	105	32	4.17	65	0.97	1.13	1.10			
		i	I	70	44	1.93	63	0.49	1.11	0.55			
		i	I	105	50	2.11	82	0.32	1.25	0.39			
		i	I	105	80	3.82	103	0.36	1.39	0.49			
		i	//	49	43	0.64	52	0.24	1.02	0.24			
		i	//	49	38	0.49	49	0.21	0.99	0.21			
		i	//	65	40	1.34	58	0.40	1.07	0.43			
TT103	0.50	i	I	105	56	3.63	87	0.48	1.28	0.62			
		i	I	105	35	1.07	68	0.23	1.15	0.26			
		i	I	45	51	1.16	54	0.40	1.04	0.41			
		i	//	58	50	2.03	61	0.55	1.09	0.60			
		i	//	33	50	1.31	46	0.62	0.96	0.60			
TT104	0.50	i	I	110	40	2.64	75	0.47	1.20	0.57			
		i	I	110	52	2.49	85	0.34	1.27	0.43			
		i	I	110	44	3.03	79	0.49	1.23	0.60			
		i	//	37	68	1.96	57	0.61	1.06	0.65			
		i	//	50	40	1.34	50	0.53	1.00	0.53			
		i	//	60	53	1.62	64	0.40	1.11	0.44			

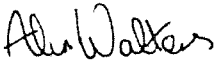
Key : d = diametral; a = axial; b = block; i = irregular lump test; I = perpendicular; // = parallel to planes of weakness.



Checked By

08/03/10

Date



Approved By

08/03/10

Date

Contract No.

9561-020310

Client Ref No.

PSL10/0334

page of

LABORATORY TESTING SERVICES LIMITED

Worsbrough Bridge

PSL
Professional Soils Laboratory

LABORATORY REPORT

UKAS TESTING
4043

Contract Number: PSL10/0455

Client's Reference: Report Date: 22 March 2010

Client Name: G&M Consulting
The Chestnuts
Brackenhill Road
Haxey, Doncster
South Yorkshire
DN9 2LR

For the attention of: Graeme Swinbourne

Contract Title: Worsbrough Bridge.

Date Received: 15-Mar-10
Date Commenced: 15-Mar-10
Date Completed:

Notes: **Observations and Interpretations are outside the UKAS Accreditation**

A copy of the Laboratory Schedule of accredited tests as issued by UKAS is attached to this report. This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service. The results reported herein relate only to the material supplied to the laboratory. This certificate shall not be reproduced in full, without the prior written approval of the laboratory.

Checked and Approved Signatories:

R Gunson
(Director)

A Watkins
(Director)

D Lambe
(Senior Technician)

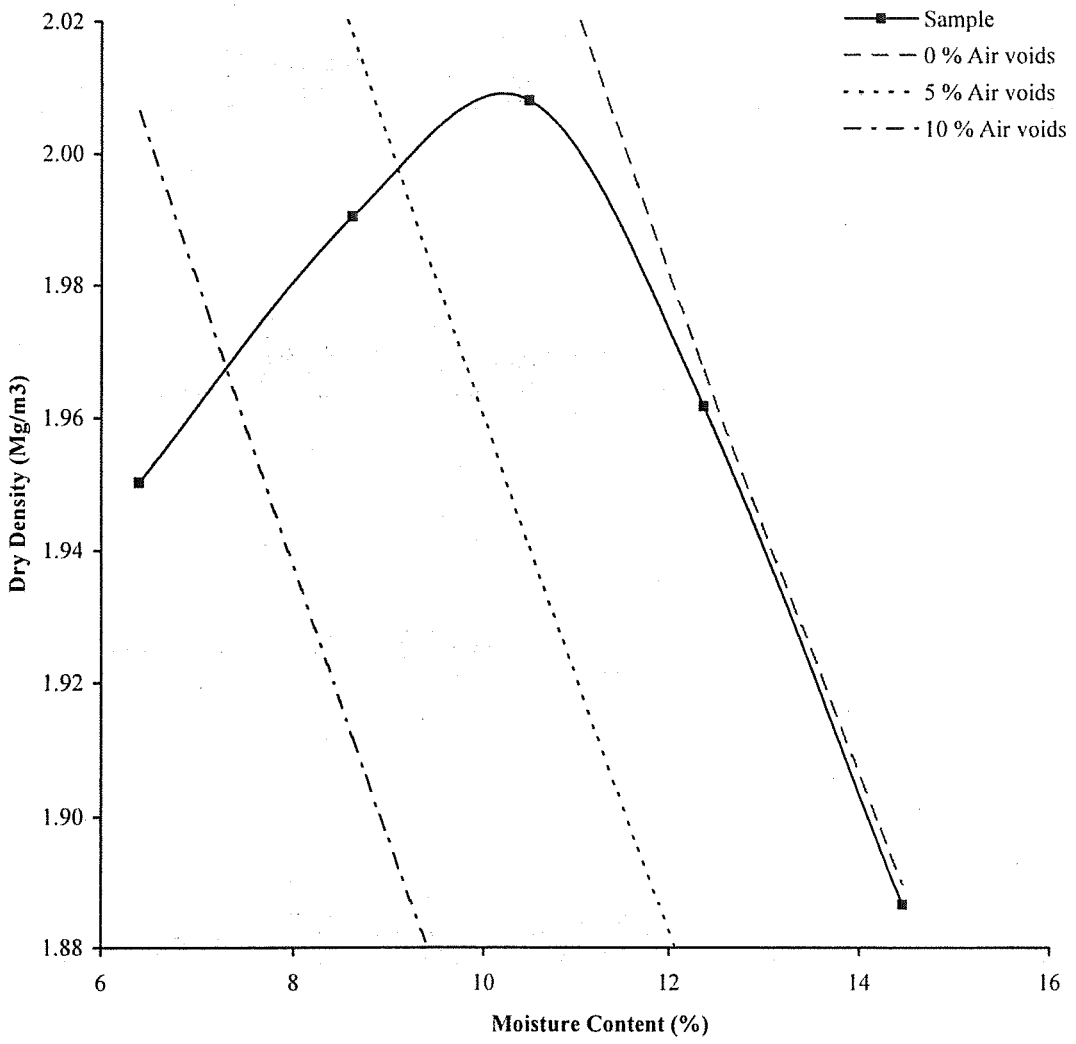
5 – 7 Hexthorpe Road, Hexthorpe,
Doncaster DN4 0AR
tel: +44 (0)844 815 6641
fax: +44 (0)844 815 6642
e-mail: rgunson@prosoils.co.uk
awatkins@prosoils.co.uk

Dry Density/Moisture Content Relationship Test

Non Compliance with BS 1377 : Part 4 : 1990

Hole Number: 102 **Depth (m) :** 1.50

Sample Number: **Sample Type:** B



Initial Moisture Content:	10	Method of Compaction	4.5kg / Separate Sample	
Particle Density (Mg/m3):	2.60	Assumed	Material Retained on 37.5 mm Test Sieve (%):	31
Maximum Dry Density (mg/m3):		2.01	Material Retained on 20.0 mm Test Sieve (%):	17
Optimum Moisture Content (%):		10		
Remarks	Brown very sandy clayey GRAVEL.			

Checked By	Date	Approved By	Date
RC	22/3/10	RC	22/3/10

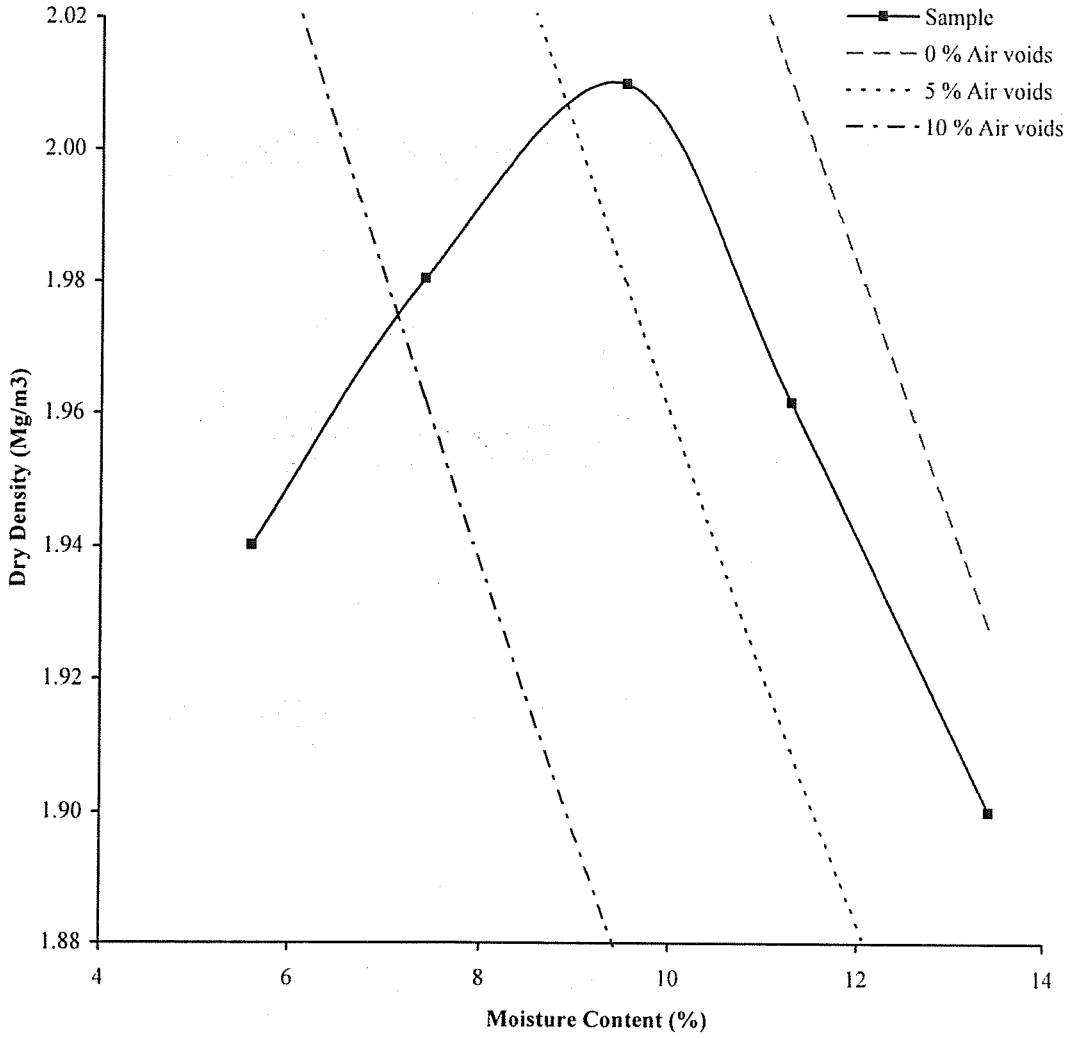
PSL Professional Soils Laboratory	WORSBOROUGH BRIDGE.	Contract No. PSL10/0455

Dry Density/Moisture Content Relationship Test

Non Compliance with BS 1377 : Part 4 : 1990

Hole Number: 107 **Depth (m) :** 1.00

Sample Number: **Sample Type:** B



Initial Moisture Content:	11	Method of Compaction	4.5kg / Separate Sample	
Particle Density (Mg/m3):	2.60	Assumed	Material Retained on 37.5 mm Test Sieve (%):	29
Maximum Dry Density (mg/m3):		2.01	Material Retained on 20.0 mm Test Sieve (%):	21
Optimum Moisture Content (%):		10		
Remarks	Brown very sandy clayey GRAVEL.			

Checked By	Date	Approved By	Date
RC	22/3/10	RC	22/3/10

PSL Professional Soils Laboratory	WORSBOROUGH BRIDGE.	Contract No. PSL10/0455

G & M Consulting Ltd

APPENDIX E

GAS MONITORING SHEETS

Ground Gas and Groundwater Monitoring Record Sheet

JOB DETAILS:

Client: Erris Homes Ltd **Job No:** C036
Site: Bank End Road, Worsbrough Bridge **Visit No:** 1 **of**
Date: 17/01/2010 **Operator:** GS **Project Manager:** GS

Monitoring Point	GAS CONCENTRATIONS												VOLATILES		FLOW DATA				WELL AND WATER DATA					Comments
	Methane (%v/v)		%LEL		Carbon dioxide (%v/v)		Carbon monoxide (ppmv)		Hydrogen sulphide (ppmv)		Oxygen (%v/v)		PID Peak (ppm)	Product thickness (mm)	Flow rate (l/hr)		Differential borehole Pressure (Pa)	Time for flow to equalise (secs)	Water level (mbgl)	Depth of well (m)	Reduced level (mAOD)	Water level (mAOD)	Response Zone	
	Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady			Peak	Steady								
R3	ND	ND	ND	ND	1.0	0.9					19.7	19.7	NR		ND	ND			3.98	7.5				
R4	ND	ND	ND	ND	0.8	0.8					19.1	19.1	NR		0.4	0.3			Damp	12.0				
R6	ND	ND	ND	ND	0.2	0.1					20.1	20.1	NR		0.3	0.3			7.19	9.0				
Max	0	0	0	0	1	0.9	0	0	0	0	20.1	20.1	0	0	0.4	0.3	0	0						
Min	0	0	0	0	0.2	0.1	0	0	0	0	19.1	19.1	0	0	0.3	0.3	0	0						
GSV (l/hr)	0				0.0027																			

METEOROLOGICAL AND SITE INFORMATION:

(Select correct box with X or enter data, as applicable)

State of ground:		Dry	X	Moist		Wet		Snow		Frozen
Wind:	X	Calm		Light		Moderate		Strong		
Cloud cover:	X	None		Slight		Cloudy		Overcast		
Preciptation:	X	None		Slight		Moderate		Heavy		
Barometric pressure (mbar):			1010	Before			1010	After		
Pressure trend:				Falling	X	Steady		Rising		
Air Temperature (Deg. C):				Before				After		

INSTRUMENTATION TECHNICAL SPECIFICATIONS:

Ground gas meter: GFM 430
Gas concentration: **CH_4** 0.2%@5%, 1.0@30%, 3.0@100% **CO_2** 0.1%@10%, 3.0%@30%,3.0%@100% **O_2**
Gas Range: **CH_4** 0 - 100% **CO_2** 0 - 100% **O_2** 0 - 25%
Gas Flow range: +100/-50 l/hour
Differential Pressure: (+/-) 1000 Pa
Date of last calibration: 12/12/2009
Date of next calibration: 13/12/2010

PID:
Calbrated range:
Calibration gas:
Response time:
Accuracy:
Date of last calibration:

Ground Gas and Groundwater Monitoring Record Sheet

JOB DETAILS:

Client: Erris Homes Ltd
Site: Bank End Road, Worsbrough Bridge
Date: 06/02/2010
Job No: C036
Visit No: 2 **of**
Operator: GS
Project Manager: GS

Monitoring Point	GAS CONCENTRATIONS												VOLATILES		FLOW DATA				WELL AND WATER DATA					Comments
	Methane (%v/v)		%LEL		Carbon dioxide (%v/v)		Carbon monoxide (ppmv)		Hydrogen sulphide (ppmv)		Oxygen (%v/v)		PID Peak (ppm)	Product thickness (mm)	Flow rate (l/hr)		Differential borehole Pressure (Pa)	Time for flow to equalise (secs)	Water level (mbgl)	Depth of well (m)	Reduced level (mAOD)	Water level (mAOD)	Response Zone	
	Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady			Peak	Steady								
R3	ND	ND	ND	ND	0.8	0.8					19.9	19.9	NR		ND	ND			4.15	7.5				
R4	ND	ND	ND	ND	0.4	0.4					20.2	20.2	NR		0.5	0.4			Damp	12.0				
R6	ND	ND	ND	ND	0.5	0.4					19.8	19.8	NR		0.6	0.6			7.22	9.0				
Max	0	0	0	0	0.8	0.8	0	0	0	0	20.2	20.2	0	0	0.6	0.6	0	0						
Min	0	0	0	0	0.4	0.4	0	0	0	0	19.8	19.8	0	0	0.5	0.4	0	0						
GSV (l/hr)	0				0.0048																			

METEOROLOGICAL AND SITE INFORMATION:

(Select correct box with X or enter data, as applicable)

State of ground:		Dry	X	Moist		Wet		Snow		Frozen
Wind:		Calm		Light	X	Moderate		Strong		
Cloud cover:		None		Slight	X	Cloudy		Overcast		
Preciptation:		None		Slight	X	Moderate		Heavy		
Barometric pressure (mbar):			998	Before			999	After		
Pressure trend:				Falling		Steady	X	Rising		
Air Temperature (Deg. C):				Before				After		

INSTRUMENTATION TECHNICAL SPECIFICATIONS:

Ground gas meter: GFM 430
Gas concentration: **CH_4** 0.2%@5%, 1.0@30%, 3.0@100% **CO_2** 0.1%@10%, 3.0%@30%,3.0%@100% **O_2**
Gas Range: **CH_4** 0 - 100% **CO_2** 0 - 100% **O_2** 0 - 25%
Gas Flow range: +100/-50 l/hour
Differential Pressure: (+/-) 1000 Pa
Date of last calibration: 12/12/2009
Date of next calibration: 13/12/2010

PID:
Calbrated range:
Calibration gas:
Response time:
Accuracy:
Date of last calibration:
Date of next calibration:

Ground Gas and Groundwater Monitoring Record Sheet

JOB DETAILS:

Client: Erris Homes Ltd **Job No:** C036
Site: Bank End Road, Worsbrough Bridge **Visit No:** 3 **of**
Date: 20/02/2010 **Operator:** ATS **Project Manager:** GS

Monitoring Point	GAS CONCENTRATIONS												VOLATILES		FLOW DATA				WELL AND WATER DATA					Comments
	Methane (%v/v)		%LEL		Carbon dioxide (%v/v)		Carbon monoxide (ppmv)		Hydrogen sulphide (ppmv)		Oxygen (%v/v)		PID Peak (ppm)	Product thickness (mm)	Flow rate (l/hr)		Differential borehole Pressure (Pa)	Time for flow to equalise (secs)	Water level (mbgl)	Depth of well (m)	Reduced level (mAOD)	Water level (mAOD)	Response Zone	
	Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady			Peak	Steady								
R3	ND	ND	ND	ND	0.1	0.1					20.3	20.3	NR		0.2	0.1			4.26	7.5				
R4	ND	ND	ND	ND	0.4	0.4					20.2	20.2	NR		0.8	0.6			Damp	12.0				
R6	ND	ND	ND	ND	0.3	0.3					20.5	20.5	NR		0.7	0.7			7.38	9.0				
Max	0	0	0	0	0.4	0.4	0	0	0	0	20.5	20.5	0	0	0.8	0.7	0	0						
Min	0	0	0	0	0.1	0.1	0	0	0	0	20.2	20.2	0	0	0.2	0.1	0	0						
GSV (l/hr)	0				0.0028																			

METEOROLOGICAL AND SITE INFORMATION:

(Select correct box with X or enter data, as applicable)

State of ground:		Dry	X	Moist		Wet		Snow		Frozen
Wind:		Calm	X	Light		Moderate		Strong		
Cloud cover:		None	X	Slight		Cloudy		Overcast		
Preciptation:	X	None		Slight		Moderate		Heavy		
Barometric pressure (mbar):			984	Before			984	After		
Pressure trend:				Falling		Steady	X	Rising		
Air Temperature (Deg. C):				Before				After		

INSTRUMENTATION TECHNICAL SPECIFICATIONS:

Ground gas meter: GFM 430
Gas concentration: **CH_4** 0.2%@5%, 1.0@30%, 3.0@100% **CO_2** 0.1%@10%, 3.0%@30%,3.0%@100% **O_2**
Gas Range: **CH_4** 0 - 100% **CO_2** 0 - 100% **O_2** 0 - 25%
Gas Flow range: +100/-50 l/hour
Differential Pressure: (+/-) 1000 Pa
Date of last calibration: 12/12/2009
Date of next calibration: 13/12/2010

PID:
Calbrated range:
Calibration gas:
Response time:
Accuracy:
Date of last calibration:
Date of next calibration:

Ground Gas and Groundwater Monitoring Record Sheet

JOB DETAILS:

Client: Erris Homes Ltd **Job No:** C036
Site: Bank End Road, Worsbrough Bridge **Visit No:** 4 **of**
Date: 13/03/2010 **Operator:** ATS **Project Manager:** GS

Monitoring Point	GAS CONCENTRATIONS												VOLATILES		FLOW DATA				WELL AND WATER DATA					Comments
	Methane (%v/v)		%LEL		Carbon dioxide (%v/v)		Carbon monoxide (ppmv)		Hydrogen sulphide (ppmv)		Oxygen (%v/v)		PID Peak (ppm)	Product thickness (mm)	Flow rate (l/hr)		Differential borehole Pressure (Pa)	Time for flow to equalise (secs)	Water level (mbgl)	Depth of well (m)	Reduced level (mAOD)	Water level (mAOD)	Response Zone	
	Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady			Peak	Steady								
R3	ND	ND	ND	ND	0.2	0.2					20.6	20.6	NR		0.2	0.2			4.22	7.5				
R4	ND	ND	ND	ND	0.5	0.5					20.6	20.6	NR		0.7	0.6			Damp	12.0				
R6	ND	ND	ND	ND	ND	ND					20.8	20.8	NR		0.6	0.6			7.40	9.0				
Max	0	0	0	0	0.5	0.5	0	0	0	0	20.8	20.8	0	0	0.7	0.6	0	0						
Min	0	0	0	0	0.2	0.2	0	0	0	0	20.6	20.6	0	0	0.2	0.2	0	0						
GSV (l/hr)	0				0.003																			

METEOROLOGICAL AND SITE INFORMATION:

(Select correct box with X or enter data, as applicable)

State of ground:	X	Dry		Moist		Wet		Snow		Frozen
Wind:	X	Calm		Light		Moderate		Strong		
Cloud cover:	X	None		Slight		Cloudy		Overcast		
Preciptation:	X	None		Slight		Moderate		Heavy		
Barometric pressure (mbar):			1020	Before			1020	After		
Pressure trend:				Falling	X	Steady		Rising		
Air Temperature (Deg. C):				Before				After		

INSTRUMENTATION TECHNICAL SPECIFICATIONS:

Ground gas meter: GFM 430
Gas concentration: CH_4 0.2%@5%, 1.0@30%, 3.0@100% CO_2 0.1%@10%, 3.0%@30%,3.0%@100% O_2
Gas Range: CH_4 0 - 100% CO_2 0 - 100% O_2 0 - 25%
Gas Flow range: +100/-50 l/hour
Differential Pressure: (+/-) 1000 Pa
Date of last calibration: 12/12/2009
Date of next calibration: 13/12/2010

PID: MiniRae 2000
Calbrated range: 0.1 - 10,000 ppm
Calibration gas: I - C_2H_8
Response time: <1 sec
Accuracy: (+/-) 5%
Date of last calibration: 20/11/2008
Date of next calibration: 20/11/2009