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Geo-environmental Ground Investigation Report

ON

PROPOSED RESIDENTIAL DEVELOPMENT

AT

CYPRESS HEIGHTS, MONK BRETTON

FOR

SAUL CONSTRUCTION LTD

AUGUST 2015

E15/6070/R001

Prepared by

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 Typical Site Conceptual Model

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0.0 EXECUTIVE SUMMARY

SITE	The site is irregularly shaped and located in the northern portion of a larger residential development. To the south are newly developed residential properties, to the east and north are residential properties, and to the west is an army reserve centre. At the time of the site investigation, the carriageway had been constructed leading onto the site surrounded by grass. The site falls from north to south and from west to east, with a steep banking down from the western boundary.
HISTORY	Historically, the western half of the site has been used for quarrying, and colliery workings have been undertaken within 50m north west of the site. Prior to the recent development of the site, the land was part of a builder's yard and depot.
GEOLOGY	The Phase 1 Desk Top Study notes that the site is located on Woolley Edge Rock (Sandstone) overlying Carboniferous Middle Coal Measures. A fault line is shown in the north east of the site running from north west to south east.
MINING/QUARRYING	The Coal Authority Report states that the property is within the likely zone of influence on the surface from workings in nine seams of coal at shallow to 380m depth, the last date of working being 1967. In addition to this, historical surface workings are recorded in the western portion of the site where the coal is shown to outcrop. The mine workings, including three mineshafts, have previously been treated. The treatment of the workings is detailed in Sirius Report SR1046/CS/4 "Completion Statement for the treatment of Shallow Mine Workings for land at Monk Bretton, Barnsley (Phase 2)" Dated August 2006.
HYDROLOGY	The nearest watercourse is the River Dearne located approximately 400m to the south-west The site lies outside of currently defined flood zones.
HYDROGEOLOGY	The underlying bedrock is classified as a minor aquifer, this is of high permeability. A small amount of perched groundwater was noted in TP04 in the north of the site at a depth of 0.8m below existing ground levels. No groundwater strikes were recorded within the rotary boreholes.

HAZARDOUS GAS

The property is in an area requiring radon protection measures. A maximum carbon dioxide concentration of 14.2% and methane concentration of 1.1% were recorded across the entire development. However, the 1.1% methane concentration was the initial reading on the visit and the concentration fell to less than 0.1% during the monitoring session. It is believed to be influenced by the concentrations of hydrocarbons within the soil in this location.

The gas monitoring installations in the immediate vicinity of this proposed stage of the development recorded maximum carbon dioxide concentrations of 5.2%, no methane and negligible flow rates.

Gas protection measures are required for the development.

CONTAMINATION

9.2.9 The made ground in TP03 proved an elevated level of Chromium of 430 mg/kg. Upon speciated analysis, this was proved to be entirely Chromium III and below the Chromium III tier 1 trigger level of 3000 mg/kg.

9.2.10 The made ground in TP03 also proved a marginally elevated level of Benzo(a)pyrene of 5.5 mg/kg. This was associated with an elevated total PAH level of 88 mg/kg.

REMEDIATION

Additional rotary boreholes in the south of the site proved solid ground. The previous investigation workings found no evidence of workings beneath the proposed properties in the north. No further ground stabilisation works are required.

A 750mm clean capping layer to garden areas consisting of 600mm sub-soils and 150mm topsoils has previously been agreed with Barnsley MBC and is stipulated in Sirius 'Method Statement for the Validation of Clean Capping Materials for land at Wakefield Road, Monk Bretton, Barnsley' ref: C1521/MS.

FOUNDATIONS

Foundations to Plots 1-4 and within the 20m influence zone of fault line recorded crossing the site to be 350mm thick RC35 concrete strip foundations with B785 mesh top and bottom.

Foundations to plots 5-20 overlying shallow depths of made ground and outside the influence of the fault line to be constructed with 200mm thick RC35 concrete with A252 mesh to the bottom face only. These will need to be deep strip/trench fill extending to the natural strata beneath the made ground.

Plots 21-28 are to be piled.

1.0 INTRODUCTION

- 1.1 As requested by Saul Construction, this practice carried out ground and contamination investigation works to the proposed development at Cypress Heights, Monk Bretton, Barnsley. The proposed investigation works were primarily focussed on shallow ground contamination and based on earlier investigation works undertaken by Sirius Geotechnical and Environmental Ltd.
- 1.2 The purpose of the report was to:-
 - 1.2.1 Identify the nature of the near surface strata, in order to enable recommendations to be made as to the most economic foundation solution for the proposed industrial development.
 - 1.2.2 Determine whether further ground stabilisation works would be required following the revision of the planning layout.
 - 1.2.3 Propose a suitable outline remediation strategy, which will enable the site to be developed safely, to the satisfaction of the overseeing regulators and in compliance with the current environmental standards.
- 1.3 Soil sampling was undertaken via trial pitting to determine the near surface strata. Distributed samples were taken for testing to ascertain the nature of the soils and fills present.
- 1.4 Borehole investigation works were undertaken where the revised planning layout differed significantly from the previous planning layout to determine the presence of shallow mine workings.
- 1.5 The conclusions and recommendations made in this report are limited to the findings of the Geotechnical Survey. The report is made on condition that Haigh Huddleston Associates will not in any circumstances be liable for loss, arising directly or indirectly from ground conditions encountered between trial pits or boreholes, which have not been revealed by the investigation.
- 1.6 Any opinion given on the possible configuration of strata between trial pit and borehole locations and below maximum depth of the investigation is for guidance only. Any remarks on groundwater conditions made are based solely on observations made at the time of investigation. Kindly note that levels may differ from those reported due to seasonal variations or other influences.

- 1.7 Furthermore, there is the possibility that any trial pits or boreholes undertaken as part of the investigatory works may be within the influence of existing foundations or excavations. Haigh Huddleston Associates cannot be held responsible for any failure of any excavations, foundations or structures within the influence of the trial pits or boreholes.

2.0 THE SITE

- 2.1 The site is part of a previously constructed larger development to the north of Carlton Road, Monk Bretton, Barnsley and is situated around National Grid reference SE 35095, 08487. A site location plan is shown on Figure 1 in Appendix A
- 2.2 The site is irregularly shaped and located in the northern portion of a larger residential development. To the south are newly developed residential properties, to the east and north are residential properties, and to the west is an army reserve centre. The site area is approximately 0.91ha.
- 2.3 At the time of the site investigation, the carriageway had been constructed leading onto the site surrounded by grass. There were two overgrown stockpiles located either side of the carriageway in the north of the site which were removed by the time of the second site visit.
- 2.4 The site falls from north to south and from west to east, with a steep banking down from the western boundary.
- 2.5 A revised planning layout has been proposed for the new scheme. This has resulted in the proposed plots and drives being indicated in slightly different locations when compared to the previous scheme.
- 2.6 Extensive remediation works had been undertaken on site based on the previous scheme, including the treatment of broken ground and three mine shafts in the vicinity of proposed plots 1-5.

3.0 SITE HISTORY

- 3.1 The initial Geo-Environmental Appraisal by Sirius Geotechnical and Environmental Ltd has been consulted and below is a brief description outlining the significant developments that may effect future construction on the site.
- 3.2 In 1850 the site is shown as part of Althersley Wood. There are fields to the boundaries of the woods.
- 3.3 By 1892 the western half of the site is shown as a quarry. Primrose Main Colliery is shown 200m to the west of the site.
- 3.4 By 1931 the wood is no longer shown. Colliery workings have extended to within 50m north west of the site. Further quarrying has been undertaken to the south of the development.
- 3.5 The colliery is no longer labelled in 1955 and a residential development is shown 50m north east of the site. This has extended to the eastern boundary of the site by 1962 and works are shown to the south of the site.
- 3.6 In 1970 there are depots shown to the north west and west of the site. A builder's yard is shown to the south west. There has been no change shown on site since 1931 until the current residential development.

4.0 SITE GEOLOGY & MINING

- 4.1 The Geoenvironmental Appraisal notes that the site is located on Woolley Edge Rock (Sandstone) overlying Carboniferous Middle Coal Measures.
- 4.2 A fault line is shown in the north east of the site running from north west to south east.
- 4.3 The Coal Authority Report states that the property is within the likely zone of influence on the surface from workings in nine seams of coal at shallow to 380m depth, the last date of working being 1957.
- 4.4 In addition to this, historical surface workings are recorded in the western portion of the site where the coal is shown to outcrop.
- 4.5 There are historical mineshafts and adits located immediately north west and south west of the site.
- 4.6 The mine workings, including three mineshafts, have previously been treated. The treatment of the workings is detailed in Sirius Report SR1046/CS/4 "Completion Statement for the treatment of Shallow Mine Workings for land at Monk Bretton, Barnsley (Phase 2)" Dated August 2006.

5.0 ENVIRONMENTAL CONSIDERATIONS

5.1 Radon

Basic Radon Protection measures are required for the site.

5.2 Landfill Sites

There are two local authority recorded landfill sites whose boundaries extend to within 100m of the western boundary of the site.

There is a further registered landfill site located 200m to the southwest that accepted construction and demolition waste and last licensed in 1981.

5.3 Flood Risk

The site lies outside of currently defined Environment Agency floodzones.

5.4 Groundwater

The underlying bedrock is classified as a minor aquifer, this is of high permeability.

There are no licensed discharge consents within 250m of the site.

There are no recorded pollution incidents to controlled waters within 250m of the site.

There are no recorded water abstractions within 250m of the site.

The site is not located in a source protection zone.

The nearest watercourse is the River Dearne located approximately 400m to the south-west.

6.0 PRELIMINARY CONCEPTUAL SITE MODEL

6.1 The initial stage in assessing the risks posed from contaminated land during the redevelopment of a site is to prepare a conceptual model. A generalised conceptual model can be developed highlighting the main pollutant linkages through a contaminant ► pathway ► receptor model for a residential development. In order to prepare the conceptual model for a particular site the following parameters need to be reviewed as discussed below.

6.2 Contamination of existing land can be caused by a number of factors, including:-

- i) Possible historical/current industrial activities.
- ii) Disposal of waste materials.
- iii) Storage of materials.
- iv) A number of natural processes can also lead to hazardous gases and elevated heavy metals.

6.3 Potential pathways can include ground and surface water, permeable strata, existing services providing a conduit and voided ground. Potential receptors can include human health, ecosystems, controlled waters and building structures. There are a number of ways that a receptor can be exposed to the contaminant these include, inhalation, direct contact, ingestion, dermal contact and uptake.

6.4 Sources of potential contamination, that could affect the proposed development, from either on or off site activities would include the following:-

- i) Ground gas migration from shallow mine workings within and adjacent the site boundary.
- ii) Former use of the site as a plant hire depot and builders yard.
- iii) Contaminants within infill material to former quarry located within site.

Based on the above activities the potential for some contamination to exist on site is considered to be moderate.

6.5 Considering the proposed residential end use, there will be two possible human receptor groups exposed to the existing onsite contamination:-

- a) Site operatives during development.
- b) End users, future site residents (the critical receptor is 0-6year-old child).

- 6.6 Human receptors may be exposed to site contamination by a number of possible pathways. These pathways are summarised in Table 1 below.

Table 1- Potential Human Exposure Pathways

<u>Human Exposure Pathway</u>	<u>Site Residents</u>	<u>Construction Workers</u>
Soil Ingestion	YES	YES
Consumption of Home Grown Vegetables	YES	NO
Dermal Contact	YES	YES
Dust Inhalation	YES	YES
Gases/Vapours	YES	NO

- 6.7 The construction workers will come into contact with any contaminated soil to a far greater extent than future residents. The exposure pathways are generally through dermal contact and indirect ingestion. However their exposure will be for a limited time and the provision and correct use of personnel protective equipment and adequate welfare facilities during construction should restrict their risks to acceptable levels
- 6.8 The risk of pollution to controlled waters by existing contamination is considered low. The site is underlain by strata that are classified as a minor aquifer. The nearest recorded watercourse is the River Dearne 400m south west of the site.
- 6.9 No specific areas of ecological importance have been identified in the initial desk top study. Therefore the site is considered to be in a low risk environmental setting. The potential for phototoxic materials to exist at shallow depth should be considered, these could pose a potential risk to new planting and soft landscaping areas within the proposed development.
- 6.10 The proposed planning drawings indicate residential properties to be constructed. The presence of elevated sulphates and hydrocarbons could affect the long term integrity of buried concrete structures, including foundations and drainage pipes. Plastic water supply pipes can also be damaged by the presence of hydrocarbon contamination.

7.0 FIELDWORK

- 7.1 Following the initial ground stabilisation works undertaken by Sirius and detailed in their report ref: SR1046/CS/4: Completion Statement for the Treatment of Shallow Mine Workings dated August 2006, further site investigation works have been undertaken on three separate occasions by Haigh Huddleston Associates.
- 7.2 A total of nine trial pits were undertaken on two occasions in April and July 2015. Additional borehole investigation works were undertaken on 4th – 5th June 2015 to confirm that the re-planned houses would not be affected as they lay outside the previously treated areas.
- 7.3 Materials encountered within the trial pits and boreholes were examined and categorised. The trial pit and borehole logs are contained within Appendix B at the rear of the report.
- 7.4 Soil samples were removed from the made and natural ground deposits within the trial pits. The samples were removed by operatives wearing gloves and placed into airtight clean plastic containers and glass bottles for transportation to the laboratory.
- 7.5 A total of six samples from the natural and made ground deposits were recovered from the trial holes for chemical analysis. The testing was carried out by a UKAS accredited laboratory to nationally or accredited in-house methods. The results of the contamination testing are contained within Appendix C of this report.
- 7.6 A full suite of determinants was analysed for, including a range of metals, metalloids, the EPA 16 PAHs and asbestos.
- 7.7 All samples were stored in airtight containers within cool boxes at approximately 4°C until delivery to the laboratory within 48 hours.

8.0 RESULTS OF THE INVESTIGATION

8.1 GEOTECHNICAL INVESTIGATION

- 8.1.1 A copy of the trial pit and borehole logs providing a complete record of strata encountered beneath the proposed development is presented in Appendix B.
- 8.1.2 The trial pits divided the site into two areas. In the south there was a shallow depth of made ground overlying weathered mudstone and in the north there was a greater depth of made ground overlying sandstone.
- 8.1.3 TP01 and TP02 in the south of the site proved 0.2-1.3m of made ground at the surface. The made ground consisted of crushed stone, gravel and the occasional crushed brick.
- 8.1.4 Beneath the made ground was a moderately weak brown mudstone excavated as gravels and cobbles. This was encountered at depths of 0.2m to 1.3m below existing ground levels. The trial pits were terminated in this strata.
- 8.1.5 In the north, the remaining trial pits proved 0.4m to over 2.9m of made ground at the surface. The made ground consisted of crush stone, gravels and the occasional crushed brick. The depth of made ground generally increased towards the west of the site. TP05, TP06 and TP07 terminated in the made ground strata. The made ground is typical of re-engineered material that had been consolidated to achieve a proposed capping level.
- 8.1.6 Underlying the made ground in TP03, TP04, TP08 and TP09 a moderately strong light brown/yellow sandstone was encountered. This was excavated as rounded gravels in a sandy matrix and rapidly became difficult to excavate. The sandstone was encountered at depths of 0.4m to 1.8m below existing ground levels.
- 8.1.7 Rotary borehole investigation works were only undertaken in the south of the site where the proposed plots 1-5 extended significantly beyond the previously drilled and grouted areas of site. This was also due to the previous investigation works proving broken ground and workings in the boreholes adjacent to the former shafts in the vicinity of plots 1-5.

8.1.8 Extensive borehole investigations had been undertaken in the north of the site previously and had encountered no evidence of workings. Additional borehole investigation works were therefore not considered necessary for the remainder of the site.

8.1.9 The boreholes proved up to 1.1m of clay overlying alternating bands of mudstone. An intact 0.8-1.3m thick coal seam was encountered at depths of 8.40m to 12.90m below existing ground levels.

8.1.9 The sides of the trial pit excavations were generally stable, with only minor instabilities noted within TP05 and TP06. It should be noted that the excavations only remained open for a short period of time prior to being backfilled.

8.2 GROUNDWATER

8.2.1 No groundwater was encountered in the trial pits in the south. A small amount of perched groundwater was noted in TP04 at a depth of 0.8m below existing ground levels.

8.2.2 No groundwater strikes were recorded within the rotary boreholes.

8.2.3 It should be recognised that ground water levels may vary throughout the year. During periods of heavy rainfall the groundwater levels may be substantially higher than the results revealed in this investigation.

8.3 GROUND GAS MONITORING

8.3.1 Gas monitoring was previously undertaken on site by Sirius Geotechnical and Environmental Ltd.

8.3.2 A maximum carbon dioxide concentration of 14.2% and methane concentration of 1.1% were recorded across the entire development. However, the 1.1% methane concentration was the initial reading on the visit and the concentration fell to less than 0.1% during the monitoring session. It is believed to be influenced by the concentrations of hydrocarbons within the soil in this location.

8.3.3 However, the gas monitoring installations in the immediate vicinity of this proposed stage of the development recorded maximum carbon dioxide concentrations of 5.2%, no methane and negligible flow rates.

9.0 CONTAMINATION

9.1 HUMAN HEALTH RISK ASSESSMENT

9.1.1 The appraisal of contaminated land within the UK is based on a risk assessment approach. The method involves the principle of defining a source ► pathway ► receptor, linkage to establish a human health risk. For any risk to exist to a potential receptor from an identified contaminant there must be an unbroken source ► pathway ► target relationship.

9.1.2 In the first instance site data for the contaminant levels are compared against guidance such as the CLEA values published by DEFRA. Should the site values exceed the guidance criteria, the contamination levels are recognised to have the potential to pose a risk to human health. Two scenarios are then available:-

- a) To break or remove one of the source ► pathway ► receptor linkages, by specifying an appropriate level of remedial work. Examples of remedial action may include the removal of the contaminated material or alternatively specifying a sufficient capping layer.
- b) The alternative approach is to provide a more detailed human health site specific risk assessment. This will involve examining factors such as soil properties, exposure assumptions, groundwater flows and contamination composition.

9.2 CONTAMINATION RESULTS

9.2.1 As stated above, in order to put the analytical results into context, the data has in the first instance been assessed in relation to several sets of guidelines: -

9.2.2 The analytical results have been assessed via an initial screening assessment with regard to the current Contaminated Land Exposure Assessment model (CLEA UK) for human health, which has been produced for the Environment Agency and the Department of Environment, Food and Rural Affairs (DEFRA). The CLEA model provides Soil Guideline Values (SGVs) for a limited range of contaminants only, and these are based on risk to human health. As such they do not take into account potential risks to other receptors eg groundwater and third party land.

- 9.2.3 It is proposed to redevelop the site for two storey residential properties with private garden areas. Soil results have therefore been assessed against the CLEA SGV's for residential use with plant uptake, as these are considered to be the most suitable guidelines to protect the most critical targets from contaminants via all possible exposure routes.
- 9.2.4 Where no CLEA SGV has been published, Generic Assessment Criteria (GAC) based on guidelines from the Chartered Institute of Environmental Health (CIEH) and Land Quality Management Ltd (LQM) for residential has been used. Where there is no GAC, guidance limits have been adopted from sources referenced in the table below.
- 9.2.5 A new approach is now being adopted for the calculation of SGV based on an acceptably low level of risk. These Category 4 Screening Levels (C4SL) have been calculated for six substances to date by modifying the toxilogical/exposure parameters within CLEA. C4SLs have been used as tier 1 trigger levels within this assessment, superseding the previous CIEH and LQM SGVs.
- 9.2.6 Assessment of risk is considered as a tiered approach. Assessment based on non intrusive means is considered Tier 1 assessment, comparison against SGVs and GACs is a Tier 2 assessment, and the generation of and comparison with Site Specific Assessment Criteria (SSAC) is a Tier 3 assessment and is conducted where deemed appropriate following the Tier 2 assessment.
- 9.2.7 The sulphate and acid concentrations have been compared against the BRE digest "Concrete in Aggressive Ground" parts 1-4. This will enable the concrete class to be specified in relation to possible contact with aggressive soils.
- 9.2.8 The results of the chemical analysis are presented on the laboratory analysis sheets with Appendix C. A summary of the significance of the results is presented in Table 2.

Table 3**Comparison of contaminant against accepted guidance values for Domestic Gardens**

<u>CONTAMINANT</u>	<u>DEFRA – SGV MG/KG</u>	<u>CONCENTRATION IN ALL SOILS. MG/KG</u>	<u>No. OF SAMPLES EXCEEDING GUIDANCE VALUES</u>	<u>PERCENTAGE OF SAMPLES EXCEEDING GUIDELINE VALUE</u>
Arsenic	37 (5)	3.4-26	0/6	
Cadmium	26 (5)	0.1-0.6	0/6	
Chromium	130 (2)	8.2-430	1/6	16.7%
Chromium III	3000	430	0/1	
Chromium VI	4.3	<1.0	0/1	
Lead	200 (5)	19-59	0/6	
Mercury (Total)	1 (1)	<0.05-0.11	0/6	
Selenium	350 (1)	<0.5-1.2	0/6	
Copper	130	9.6-46	0/6	
Nickel	130 (1)	5.4-110	0/6	
Zinc	200-300	38-110	0/6	
Sulphate	0.24 (3)	0.09-0.18	0/6	
Thiocyanate	50	<0.6-0.9	0/6	
Sulphide	250	<10-24	0/6	
Naphthalene	3.7 (4)	<0.1-0.4	0/6	
Benzo(a)pyrene	5 (5)	<0.1-5.5	1/6	16.7%
PAH (Total)	40	<1.6-9.6	1/6	16.7%
Phenols	210(4)	<0.3	0/6	
pH	6-8	7.8-11.0	5/6	83.3%

(1) DEFRA CLR Model residential with plant uptake published 2009.

(2) DEFRA CLR SGV's withdrawn used for initial comparison

(3) BS 8110 1985 Table 6.1

(4) CIEH – Land quality Management / Chartered Institute of Environmental Health Generic Assessment Criteria, 2009.

(5) Category 4 Screening Level

9.2.9 The made ground in TP03 proved an elevated level of Chromium of 430 mg/kg. Upon speciated analysis, this was proved to be entirely Chromium III and below the Chromium III tier 1 trigger level of 3000 mg/kg.

9.2.10 The made ground in TP03 also proved a marginally elevated level of Benzo(a)pyrene of 5.5 mg/kg. This was associated with an elevated total PAH level of 88 mg/kg.

9.2.11 No elevated sulphate levels were discovered in the samples taken from site.

Therefore a design sulphate class DS-1, ACEC class AC-2z, when compared against the BRE Special Digest 1 "Concrete in aggressive ground".

9.3 QUALITATIVE RISK ASSESSMENT

9.3.1 The Qualitative Risk Assessment is based upon the previously discussed source ► pathway ► receptor principle. In relation to the proposed site these may be described as follows:-

9.3.2 SOURCE

- i) Marginally elevated levels of Benzo(a)pyrene in the made ground.
- ii) Ground gas migration from shallow mine workings.

9.3.3 PATHWAYS

- i) Ingestion of contamination material.
- ii) Inhalation of contaminated particles.
- iii) Dermal contact with the known contamination.
- iv) Leaching to controlled waters.

9.3.4 RECEPTORS

- i) Residential end users.
- ii) Construction and maintenance workers.
- iii) Controlled waters.
- iv) The building structure.

9.3.5 Each of the receptors will now be appraised and attribute the likely risks involved.

i) **Residential end users.**

Based on the chemical results obtained it is considered that there is a **low** risk to end users from the contamination within the existing made ground and clays on site.

A marginally elevated level of benzo(a)pyrene of 5.5 mg/kg was present in the sample of made ground from TP03. The average concentration of benzo(a)pyrene for the samples of made ground was 1.7 mg/kg, which is a third of the tier 1 trigger level.

As there is no clean topsoil available on site, clean material will need to be imported to site to provide a growing medium. Due to the presence of made ground on site, it has previously been agreed with Barnsley MBC to have a minimum 750mm of clean capping material consisting of 600mm clean subsoils and 150mm clean topsoils. This is as stipulated in Sirius 'Method Statement for the Validation of Clean Capping Materials for land at Wakefield Road, Monk Bretton, Barnsley' ref: C1521/MS.

ii) Construction and Maintenance Workers.

It is considered that there is a **low** risk to construction and maintenance workers from the redevelopment of the site.

Construction workers should always wear PPE including overalls, boots and gloves when handling the contaminated materials onsite. In addition eating, drinking and smoking should be restricted to designated areas where the above hygiene facilities are available.

iii) Controlled Waters

The underlying bedrock is classified as a minor aquifer. There were only low levels of contaminants encountered within the made ground on site and the risk of existing contaminants leaching to controlled waters is considered **low**.

iv) Building Structures.

No elevated sulphate levels were discovered in the samples taken from site. Therefore a design sulphate class DS-1, ACEC class AC-2z, when compared against the BRE Special Digest 1 "Concrete in aggressive ground.

Service providers should be forwarded the final validated chemical levels in order for them to provide an accurate specification for the apparatus to be provided. New services should be surrounded and backfilled with clean material to afford some protection to the apparatus and allow any future maintenance work to be undertaken in clean material.

10.0 CONCLUSIONS AND RECOMMENDATIONS

10.1 GEOTECHNICAL ASSESSMENT

10.1.1 The fieldwork proved the site split into two separate areas with regards to foundation proposals. To the east of the proposed carriageway there was up to 1.5m of made ground overlying weathered mudstone or sandstone. To the west of the carriageway there was in excess of 2.9m of made ground recorded in some trial pits.

10.1.2 EAST OF THE CARRIAGEWAY (PLOTS 1-20)

10.1.2.1 For initial design purposes we would envisage a safe bearing capacity of 150kN/m² where foundations are deepened onto the weathered mudstone/sandstone beneath the fill material.

10.1.2.2 We would therefore suggest that the proposed two storey traditional house construction should be constructed on strip/trench fill footings founded entirely onto the weathered mudstone/sandstone strata. The entire footing should be deepened and constructed off similar rock strata to avoid potential differential settlement. The foundation widths will vary dependent upon the line loadings calculated.

10.1.2.3 Due to the previously treated workings beneath Plots 1-4, the foundations to these plots should be heavily reinforced and comprise of 350mm thk RC35 concrete with a single layer of B785 mesh to the top and bottom faces.

10.1.2.4 Plots 5-20 can be constructed off 200mm thick RC35 concrete with A252 mesh top the bottom face. However, due to the depth of made ground beneath plots 6-20 these will need to be deep strip/trench fill foundations extending to the natural strata beneath.

10.1.2.5 All foundations should be placed below a line of 45° drawn up from the base of any services or other structures. Foundations should be deepened where constructed adjacent to boundary retaining walls or existing buildings, to prevent any lateral forces being exerted on the retaining structure.

10.1.2.6 Particular care will also need to be exercised with any new landscape and planting proposals with their effects on the new foundations being considered prior to planting.

10.1.2.7 The geological maps for the site indicate that there a possible faultline crossing the site. We would recommend that the strip foundation design is strengthened in areas affected by the fault lines to accommodate any slight differential settlement. All foundation excavations should be inspected and where necessary strengthened. We would recommend the strip foundation is increased to 350mm thick with B785 mesh to top and bottom faces, the width of the strip would vary dependent upon the line loadings.

10.1.3 WEST OF THE CARRIAGEWAY (PLOTS 21-28)

10.1.3.1 The deeper made ground is not considered a suitable foundation material and therefore all loadings should be taken through these materials onto the underlying sandstone strata capable of providing adequate bearing.

10.1.3.2 We would therefore suggest that the proposed two storey traditional house construction should be constructed on piled foundations with a reinforced concrete suspended ground beam. The following general comments relating to piling are provided for guidance, and further advice should be sought from a specialist-piling contractor.

10.1.3.3 Piled foundations should extend and be socketed into the underlying bedrock. The deepest areas of made ground found within the boreholes was 3m, which is likely to increase toward the west. Therefore a preliminary estimate of 5-6m for the pile lengths should be allowed for.

10.1.3.4 It will be necessary to ensure that a minimum pile length of 3m is achieved for piles located in shallower sandstone deposits. Pile records should be checked to ensure that similar pile lengths are achieved throughout a plot and between adjacent structures.

10.1.3.5 The safe working load that may be supported on a pile is dependent on the pile diameter, its founding depth and the method of installation. As piles would be founded in bedrock, they will be essentially end bearing, although there may also be

some shaft adhesion within the infilled materials. It is essential that pile design allows for negative skin friction.

10.1.3.6 Driven piles may lessen the volume of potentially contaminated made ground requiring off-site disposal, compared with continuous flight auger piled foundations. However, driving can induce some ground vibration. Assessment of any vibration risk to adjacent structures and/or existing site features should be undertaken by pile designer.

10.1.3.7 On completion of the piling works, pile testing should be undertaken to confirm the adequacy and load carrying capacity of the installed piles.

10.1.3.8 Should any shallow obstructions occur, i.e. large boulders or existing foundations, they should either be grubbed-up, or alternatively replacement piles installed. The pile logs should be checked prior to the piling rig departing site, to ensure consistent pile lengths are installed throughout the site.

10.1.4 It is recommended however, that flexible service connections are used on this site, especially where they enter the buildings, in order to avoid any possible damage due to self-settlement of the weak strata once the site is developed.

10.1.5 At present it is not anticipated that excessive ground water control measures will be required. Please note that ground water flows can vary throughout the year and a further assessment should be undertaken if construction work is proposed following a prolonged rainfall event.

10.1.6 No elevated sulphate levels were discovered in the samples taken from site. Therefore a design sulphate class DS-1, ACEC class AC-2z, when compared against the BRE Special Digest 1 "Concrete in aggressive ground".

10.2 MINING

10.2.1 The treatment of historical mine workings beneath the site is detailed in Sirius Report SR1046/CS/4 "Completion Statement for the treatment of Shallow Mine Workings for land at Monk Bretton, Barnsley (Phase 2)" Dated August 2006.

10.2.2 The planning layout had been revised since the original mine treatment works, and additional rotary borehole investigation works were undertaken in the vicinity of Plots 1-5 and proved that no additional treatment works were required in this area.

10.2.3 Further changes in the planning layout were noted in the north of the site, however approximately 550 investigatory boreholes have been undertaken in this area of the site and have proven solid unworked coal.

10.2.4 We would therefor consider the proposed development is not at risk from historical shallow workings and that no further remediation/treatment is required to the workings.

10.3 GROUND FLOOR SLAB – GAS MEASURES

10.3.1 There are two landfill sites located within 100m of the western boundary of the site and shallow mine workings recorded within the site.

10.3.2 Gas monitoring undertaken previously in this phase of the development have recorded carbon dioxide concentrations up to 5.2%, no methane and a negligible flow rate.

10.3.2 Due to the depth of fill material on site, a suspended floor slab will be required for the proposed properties. Because of this, there is the potential for a build up of carbon dioxide and methane beneath the dwelling over an extended time period. We would therefore consider it prudent to adopt the following construction details:

- 2000g Visqueen Gas Barrier polyethylene DPM, with suspended precast concrete floor.
- Continuous membrane across the cavity/party walls.
- Cavity tray in the external walls.
- Fully sealed service entries and ducts to manufactures specification.
- Fully vented minimum 150mm deep void below suspended slab. To be increased to 250mm where the proximity of trees affect the foundation construction.

The passively ventilated sub-space void should be constructed with a cross ventilation (i.e. two opposite faces of the external walls to be vented), with ventilation set at a minimum of 2650mm²/m run of wall.

10.4 CONTAMINATION ASSESSMENT

10.4.1 The trial pit investigation proved the made ground across site varied from 0.2m in the south east to in excess of 2.9m in the north west.

10.4.2 A marginally elevated level of benzo(a)pyrene of 5.5 mg/kg was present in the sample of made ground from TP03. The average concentration of benzo(a)pyrene for the samples of made ground was 1.7 mg/kg, which is a third of the tier 1 trigger level.

10.4.3 As there is no clean topsoil available on site, clean material will need to be imported to site to provide a growing medium. Due to the presence of made ground on site, it has previously been agreed with Barnsley MBC to have a minimum 750mm of clean capping material to soft landscaped and garden areas consisting of 600mm clean subsoils and 150mm clean topsoils. This is as stipulated in Sirius 'Method Statement for the Validation of Clean Capping Materials for land at Wakefield Road, Monk Bretton, Barnsley' ref: C1521/MS.

10.4.4 All imported material to be used for the capping/topsoil layer should be uncontaminated and comply with the specification for Engineering Fill. All imported material should be tested for the range of contaminants listed previously in Table 2. Only material found to be below published trigger levels should be deemed uncontaminated and accepted for use on site.

10.4.5 If the imported material is from a Greenfield site, a minimum of 3 samples or 1 per 250m³ of imported material should be taken for testing, whichever is greater. If it is from a brownfield site, a minimum of 6 samples, or 1 per 100m³ of imported material should be taken for testing, whichever is greater. Material provided by a commercial supplier should be certified to the same level of testing, with the certificate less than two months old.

10.4.6 All imported certified material should be placed immediately. If this is not possible, or the material is not certified and sampling is to be carried out prior to being laid, it

should be securely stored on site prior to use to prevent possible contamination from any materials on site.

- 10.4.7 Any areas of made ground removed off site should be taken to a licensed waste site and full documentation should be obtained. Any material to be taken off-site should be suitably quarantined prior to removal to prevent cross contamination. Any relevant chemical test results should be given to the landfill operator, so that they can determine if this material is suitable to be disposed of in their licensed landfill.

11.0 SUGGESTED FURTHER WORK

- 11.1 Validation of the installation of the gas protection measures by an independent consultant.
- 11.2 Validation of the depth of clean capping material to the soft landscaped and garden areas.

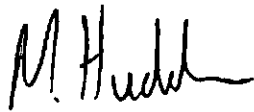
12.0 APPROVALS

12.1 Proposals for the remediation of contaminated land may require the approval of numerous bodies.

These include:

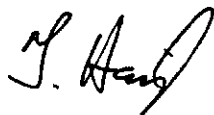
- a). Barnsley MBC Environmental Health Department as required by the building and planning regulations.
- b). The NHBC or similar as they will provide the insurance costs to cover the property.
- c). The Environment Agency if there are risks of contamination to ground or surface water systems. They will also require notification if material is removed from site and taken to an appropriate tip.
- d). Relevant highways and drainage authorities and other service companies may also wish to know about the level of contaminants.

Prepared by



M. Huddleston. MEng

Checked by



T. Haigh. BSc., C.Eng. M.I.C.E.

August 2015

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APPENDIX A

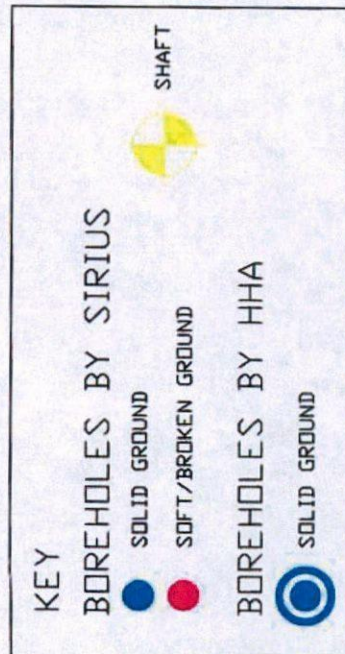
Site Location Plan

Dwg No. E15/6070/04A – Grouting Grid Layout to Plots 1-5

Dwg No. E15/6070/03A - Trial Pit Location Plan

Dwg No. E15/6070/08 - Typical Site Conceptual Model

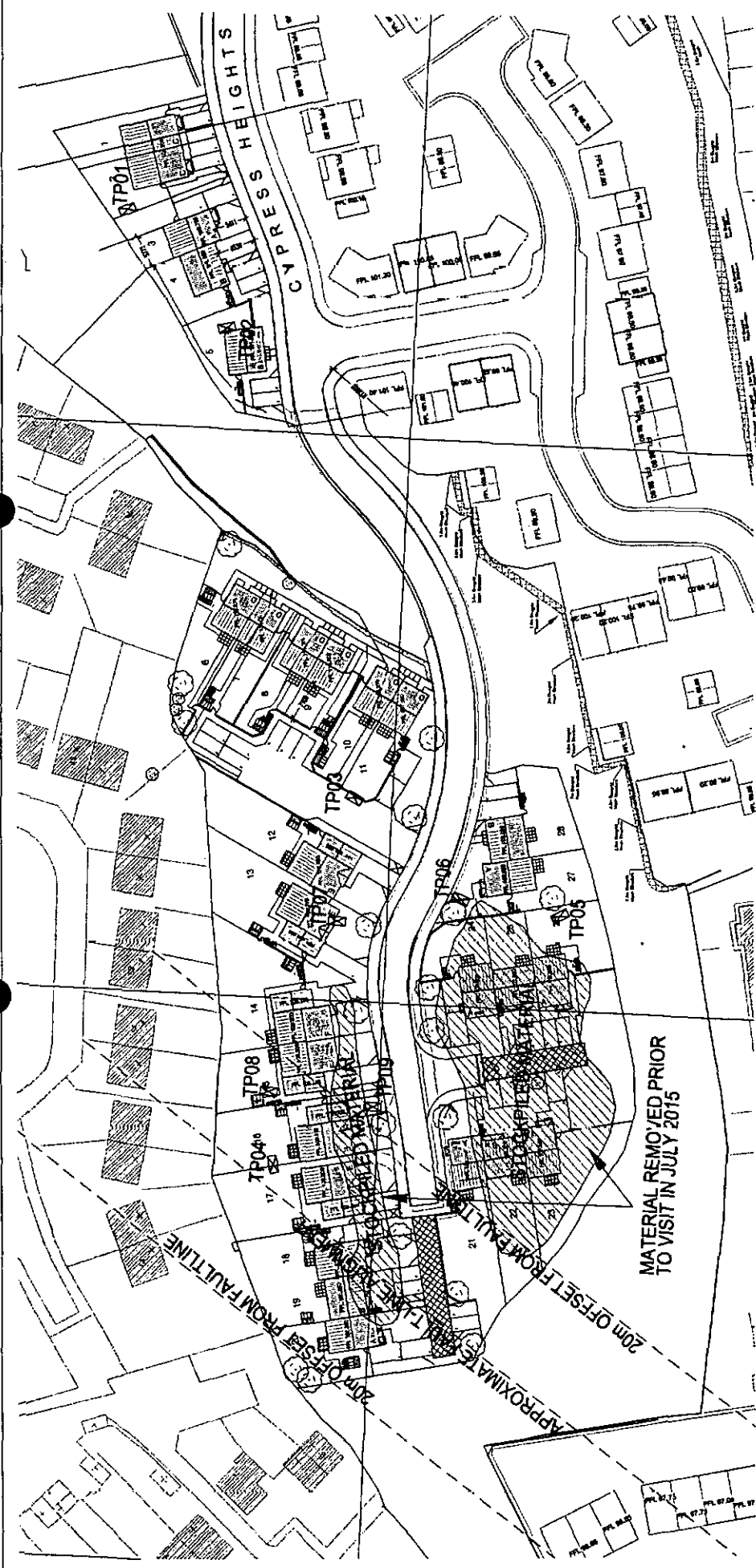




Civil Structural Engineering Consultants

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 Trevor.hughes@hughesdewsbury.co.uk

MD
Civil
SUAIL CONSTRUCTION
Project
CYPRESS HEIGHTS, BARNESLEY
Detailed
GROUTING GRID LAYOUT
Scale 1:200
Drawn LM
Checkd MH
Date Jun '15
Dwg No. E15/6079/D48



Rev A TP08 and TP09 added

21.07.15 MB



Haigh Huddleston & Associates

Civil Structural Engineering Consultants

Firm Buildings, 6th - 10th Leazes Rd, Newcastle, NE4 7BU
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 e info@haighhuddleston.co.uk

Client

Saul Construction

Project

Cypress Heights, Barnsley

Drawn

Trial P8 Location Plan

Date

May '15

Scale

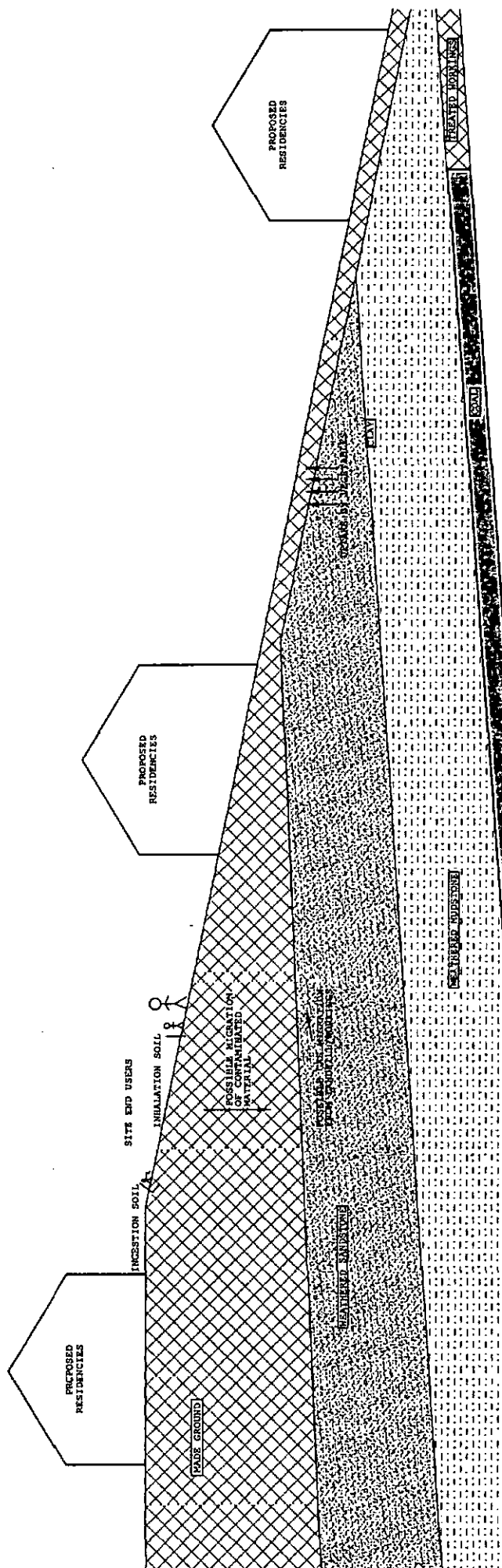
1:500

Drawn By

ET5/6070/USA

Sheet

012



 Haigh Huddleston & Associates Civil Structural Engineering Consultants Firth Buildings, 99 - 101 Leeds Rd, Dewsbury, WF12 7BU t 01924 464342 f 01924 450662 e trevor.haigh@haighhuddleston.co.uk	Client	Saul Construction Ltd			
	Project	Cypress Heights, Barnsley			
	Deddit	Typical Site Conceptual Model			
	Scale	Draw	Client	Date	Draw No.
	NTS	MD	Aug '15	E15/6070/08	

APPENDIX B

Trial Pit Logs

Borehole Logs



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FORM HHA 5

TRIAL HOLE NO. 1

Client : SAUL CONSTRUCTION

Job No : E15/6070

Site : CYPRESS HEIGHTS, BARNSELY

Date : APRIL 2015

0.0

0.2

Made ground.

0.5

Moderately weak brown slightly weathered mudstone excavated as angular gravels and cobbles.

1.0

1.3

End of trial pit.

1.5

2.0

2.5

3.0

3.5

4.0

REMARKS:

Ground water encountered during excavation

NO

Sample taken

NO

Sides of excavation remained stable

YES

Level

.....

NOTES:

.....
.....



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FORM HHA 5

TRIAL HOLE NO. 2

Client : SAUL CONSTRUCTION

Job No : E15/6070

Site : CYPRESS HEIGHTS, BARNSELY

Date : APRIL 2015

0.0

0.15

Rough grass over dark brown topsoil.

0.5

Made ground comprising of crushed stone, gravel, occasional crushed brick.

1.0

1.3

Moderately weak brown weathered mudstone excavated as shaley gravel.

1.5

1.5

2.0

2.5

3.0

3.5

4.0

REMARKS:

Ground water encountered during excavation

NO

Sample taken

NO

Sides of excavation remained stable

YES

Level

.....

NOTES:

.....
.....



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FORM HHA 5

TRIAL HOLE NO. 3

Client :	SAUL CONSTRUCTION	Job No :	E15/6070
Site :	CYPRESS HEIGHTS, BARNESLEY	Date :	APRIL 2015

0.0

		Rough grass over made ground. Sample at 0.2m.
	0.4	
0.5	0.5	Moderately strong yellowish brown sandstone. Unable to excavate further.
1.0		
1.5		
2.0		
2.5		
3.0		
3.5		
4.0		

REMARKS:

Ground water encountered during excavation

Sample taken

Sides of excavation remained stable

Level

NO

YES at 0.2m.

YES

.....

NOTES:

.....
.....



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FORM HHA 5

TRIAL HOLE NO. 4

Client : SAUL CONSTRUCTION

Job No : E15/6070

Site : CYPRESS HEIGHTS, BARNSELY

Date : APRIL 2015

0.0

0.5

1.0

1.5

1.8

2.0

2.0

2.5

3.0

3.5

4.0

Rough grass over made ground comprising of gravels and stone, occasional brick (loose fill).

Small amount of perched groundwater entering pit at 0.8m.

Moderately weak light brown sandstone excavated as rounded sandstone gravels in a sandy matrix.

REMARKS:

Ground water encountered during excavation

NO

Sample taken

NO

Sides of excavation remained stable

YES

Level

.....

NOTES:

.....
.....



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FORM HHA 5

TRIAL HOLE NO. 5

Client :	SAUL CONSTRUCTION	Job No :	E15/6070
Site :	CYPRESS HEIGHTS, BARNSELY	Date :	APRIL 2015

0.0

0.5

1.0

1.5

2.0

2.5

2.9

3.0

3.5

4.0

Rough grass over made ground comprising of gravels, occasional bricks.
Sample at 0.4m.

REMARKS:

Ground water encountered during excavation
Sample taken
Sides of excavation remained stable
Level

NO
YES at 0.4m.
sides generally stable – minor instability
.....

NOTES:

.....
.....



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FORM HHA 5

TRIAL HOLE NO. 6

Client :	SAUL CONSTRUCTION	Job No :	E15/6070
Site :	CYPRESS HEIGHTS, BARNSELY	Date :	APRIL 2015

0.0

Rough grass over made ground comprising of gravels, occasional bricks.

0.5

Sample at 0.7m.

1.0

1.5

2.0

2.0

2.5

3.0

3.5

4.0

REMARKS:

Ground water encountered during excavation

NO

Sample taken

YES at 0.7m

Sides of excavation remained stable

Sides generally stable – minor instability

Level

NOTES:

.....
.....



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FORM HHA 5

TRIAL HOLE NO. 7

Client :	SAUL CONSTRUCTION	Job No :	E15/6070
Site :	CYPRESS HEIGHTS, BARNSLEY	Date :	APRIL 2015
0.0			

		Rough grass over made ground.
0.5		
1.0		
	1.4	
1.5		
2.0		
2.5		
3.0		
3.5		
4.0		

REMARKS:

Ground water encountered during excavation NO
Sample taken NO
Sides of excavation remained stable YES
Level

NOTES:

.....
.....



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FORM HHA 5

TRIAL HOLE NO. 8

Client :	SAUL CONSTRUCTION	Job No :	E15/6070
Site :	CYPRESS HEIGHTS, BARNSELY	Date :	July 2015

0.0

0.5		
1.0		
1.3		
1.4		
1.5		
2.0		
2.5		
3.0		
3.5		
4.0		

Rough grass over made ground comprising of gravels and stone, occasional brick (loose fill).

Strong light brown sandstone difficult to excavate.

REMARKS:

Ground water encountered during excavation	NO
Sample taken	NO
Sides of excavation remained stable	YES
Level	

NOTES:

.....
.....



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FORM HHA 5

TRIAL HOLE NO. 9

Client :	SAUL CONSTRUCTION	Job No :	E15/6070
Site :	CYPRESS HEIGHTS, BARNSELY	Date :	July 2015

0.0

0.5

1.0

1.5

1.8

Rough grass over made ground comprising of gravels and stone, occasional brick (loose fill).

2.0

2.0

Moderately weak light brown sandstone excavated as rounded sandstone gravels in a sandy matrix.

2.5

3.0

3.5

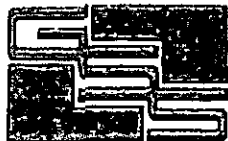
4.0

REMARKS:

Ground water encountered during excavation	NO
Sample taken	NO
Sides of excavation remained stable	YES
Level	

NOTES:

.....
.....



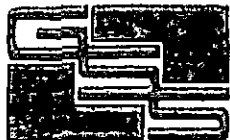
GROUND SUPPORT SERVICES (UK) LTD

GEOTECHNICAL AND GROUND SUPPORT FOUNDATION SPECIALISTS

Unit D2B Bryans Close, Harworth Industrial Estate, Harworth, South Yorkshire, DN11 8RY
Phone: 01302 744 322 Email: drillrig@hotmail.com Fax: 01909 540756

Site Investigation Drillers log			Site: <u>Cypress heights</u>			Sheet: <u>1 of 2</u>				
Rig: <u>Soilmec 400</u>			Crew: <u>G Pilkington M Maggard</u>			Date: <u>4.6.15</u>				
Hours on site:			Travelling Time:							
Equipment used:										
BH	Depth	Strata Description	BH	Depth	Strata Description					
		move rig to Cypress heights		9.50-15.00	mudstone grey					
LI179	0.00-1.10	Clay	JI175	0.00-0.10	Clay					
	1.10-3.60	mudstone brown		0.10-3.20	mudstone brown					
	3.60-5.40	mudstone grey		3.20-5.70	mudstone grey					
	5.40-8.40	mudstone black		5.70-9.40	mudstone black					
	8.40-9.20	Coal		9.40-10.20	Coal					
	9.20-15.00	mudstone grey		10.20-15.00	mudstone grey					
JI179	0.00-0.30	Clay	JI174	0.00-3.30	mudstone brown					
	0.30-3.20	mudstone brown		3.30-5.70	mudstone grey					
	3.20-5.20	mudstone grey		5.70-9.40	mudstone black					
	5.20-9.20	mudstone black		9.40-10.20	Coal					
	9.20-10.00	Coal		10.20-15.00	mudstone grey					
	10.00-16.30	mudstone grey								
	16.30-17.30	mudstone black	mm	LI172						
		with coal bands		0.00-3.60	mudstone brown					
	17.30-25.00	mudstone grey		3.60-6.40	mudstone grey					
				6.40-9.80	mudstone black					
JI177	0.00-0.10	Clay		9.80-10.60	Coal					
	0.10-3.30	mudstone brown		10.60-15.00	mudstone grey					
	3.30-5.20	mudstone grey								
	5.20-9.00	mudstone black								
	9.00-9.80	Coal								
Casing / Water level details										
BH	Casing Die	Casing Depth	Strike	Water Rise	Scaled	Totals	BH's	Drill	Case	Core
						Today				
						Previous				
						To date				

Signed: [Signature] Driller



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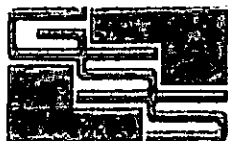
GEOTECHNICAL AND GROUND SUPPORT FOUNDATION SPECIALISTS

Unit D2B Bryans Close, Harworth Industrial Estate, Harworth, South Yorkshire, DN11 8RY

Phone: 01302 744 322 Email: drillrig@hotmail.com Fax: 01909 540756

Site Investigation Drillers log			Site: <u>Cypress heights</u>			Sheet: <u>2 of 2</u>				
Rig: <u>Soilmec 400</u>			Crew: <u>G Pilkington M Hoagard</u>			Date: <u>4-6-15</u>				
Hours on site:			Travelling Time:							
Equipment used:										
BH	Depth	Strata Description	BH	Depth	Strata Description	BH	Depth	Strata Description		
JS172	0.00-3.80	mudstone brown	KK169	0.00-4.00	mudstone brown					
	3.80-6.20	mudstone grey		4.00-7.10	mudstone grey					
	6.20-10.00	mudstone black		7.10-10.40	mudstone black					
	10.00-10.80	Coal		10.40-11.20	Coal					
	10.80-17.20	mudstone grey		11.20-15.00	mudstone grey					
	17.20-18.00	mudstone black								
		with coal bands	KK167	0.00-4.20	mudstone brown					
	18.00-25.00	mudstone grey		4.20-7.50	mudstone grey					
				7.50-10.70	mudstone black					
KK170	0.00-3.90	mudstone brown		10.70-11.50	Coal					
	3.90-6.80	mudstone grey		11.50-18.00	mudstone grey					
	6.80-10.00	mudstone black		18.00-18.80	mudstone black					
	10.00-10.80	Coal			with coal bands					
	10.80-15.00	mudstone grey		18.80-25.00	mudstone grey					
JS170	0.00-4.10	mudstone brown								
	4.10-6.90	mudstone grey								
	6.90-10.10	mudstone black								
	10.10-10.90	Coal								
	10.90-15.00	mudstone grey								
Casing / Water level details										
BH	Casing Die	Casing Depth	Strike	Water Rise	Scaled	Totals	BH's	Drill	Case	Core
						Today	11	185.00		
						Previous	—	—		
						To date	11	185.00		

Signed [Signature] Driller



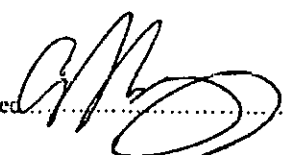
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Unit D2B Bryans Close, Harworth Industrial Estate, Harworth, South Yorkshire, DN11 8RY

Phone: 01302 744 322 Email: drillrig@hotmail.com Fax: 01909 540756

Site Investigation Drillers log			Site: Cypress heights			Sheet: 1 of 2				
Rig: Soilmecc 400			Crew: C. Pilkington M Meadows			Date: 5-6-15				
Hours on site:			Travelling Time:							
Equipment used:										
BH	Depth	Strata Description	BH	Depth	Strata Description					
NN165	0.00-5.40	mudstone brown		12.30-15.00	mudstone grey					
	5.40-8.60	mudstone grey								
	8.60-11.20	mudstone black	mm162	0.00-0.50	Clay					
	11.20-12.00	Coal		0.50-6.00	mudstone brown					
	12.00-15.00	mudstone grey		6.00-9.00	mudstone grey					
				9.00-11.80	mudstone black					
NN164	0.00-5.50	mudstone brown		11.80-12.60	Coal					
	5.50-8.80	mudstone grey		12.60-15.00	mudstone grey					
	8.80-11.30	mudstone black								
	11.30-12.10	Coal	mm163	0.00-0.30	Clay					
	12.10-15.00	mudstone grey		0.30-5.90	mudstone brown					
				5.90-9.00	mudstone grey					
NN163	0.00-0.60	Clay		9.00-11.50	mudstone black					
	0.60-5.80	mudstone brown		11.50-12.30	Coal					
	5.80-9.00	mudstone grey		12.30-18.70	mudstone grey					
	9.00-11.40	mudstone black		18.70-19.40	mudstone black					
	11.40-12.20	Coal			with coal bands					
	12.20-15.00	mudstone grey		19.40-25.00	mudstone grey					
NN162	0.00-0.40	Clay	LL163	0.00-5.90	mudstone brown					
	0.40-6.00	mudstone brown		5.90-8.90	mudstone grey					
	6.00-9.10	mudstone grey		8.90-11.80	mudstone black					
	9.10-11.50	mudstone black		11.80-12.60	Coal					
	11.50-12.30	Coal		12.60-15.00	mudstone grey					
Casing / Water level details										
BH	Casing Die	Depth	Strike	Water Rise	Sealed	Totals	BH's	Drill	Case	Core
						Today				
						Previous				
						To date				

Signed  Driller

APPENDIX C

Chemical Analysis of Samples

Summary of Chemical Analysis

Soil Samples

Our Ref 15-32005

Client Ref 6070

Contract Title CYPRESS HEIGHTS (SAUL)

Lab No	795536	795537	795538	795539	795540	795541
Sample ID	TP02	TP02	TP03	TP04	TP05	TP06
Depth	0.10	0.40	0.20	0.30	0.40	0.70
Other ID						
Sample Type	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
Sampling Date	08/04/15	08/04/15	08/04/15	08/04/15	08/04/15	08/04/15
Sampling Time	n/s	n/s	n/s	n/s	n/s	n/s

Test	Method	LOD	Units						
Metals									
Arsenic	DETSC 2301#	0.2	mg/kg	3.4	26	4.4	7.2	7.1	10
Cadmium	DETSC 2301#	0.1	mg/kg	0.1	0.6	0.4	0.4	0.4	0.4
Chromium	DETSC 2301#	0.15	mg/kg	8.2	48	430	87	34	41
Chromium III	DETSC 2301*	0.15	mg/kg			430			
Hexavalent Chromium	DETSC 2204*	1	mg/kg			< 1.0			
Copper	DETSC 2301#	0.2	mg/kg	9.6	46	16	19	16	26
Lead	DETSC 2301#	0.3	mg/kg	19	59	20	28	28	33
Mercury	DETSC 2325#	0.05	mg/kg	< 0.05	0.11	< 0.05	0.05	< 0.05	0.06
Nickel	DETSC 2301#	1	mg/kg	5.4	22	110	14	12	19
Selenium	DETSC 2301#	0.5	mg/kg	< 0.5	1.2	< 0.5	< 0.5	< 0.5	< 0.5
Zinc	DETSC 2301#	1	mg/kg	38	110	42	63	51	74
Inorganics									
pH	DETSC 2008#			9.4	7.8	11.0	9.6	9.2	9.0
Thiocyanate	DETSC 2130#	0.6	mg/kg	< 0.6	0.9	< 0.6	< 0.6	< 0.6	< 0.6
Sulphide	DETSC 2024#	10	mg/kg	12	24	< 10	16	< 10	< 10
Total Sulphate as SO4	DETSC 2321#	0.01	%	0.10	0.10	0.18	0.16	0.09	0.11
PAHs									
Naphthalene	DETSC 3301	0.1	mg/kg	< 0.1	0.4	< 0.1	< 0.1	< 0.1	< 0.1
Acenaphthylene	DETSC 3301	0.1	mg/kg	0.6	0.1	0.3	< 0.1	< 0.1	0.3
Acenaphthene	DETSC 3301	0.1	mg/kg	0.3	0.3	1.5	< 0.1	< 0.1	0.5
Fluorene	DETSC 3301	0.1	mg/kg	< 0.1	0.5	1.9	< 0.1	< 0.1	0.2
Phenanthrene	DETSC 3301	0.1	mg/kg	0.9	3.7	15	0.5	0.7	0.7
Anthracene	DETSC 3301	0.1	mg/kg	0.3	1.2	4.8	0.1	0.2	0.2
Fluoranthene	DETSC 3301	0.1	mg/kg	2.2	8.3	19	1.0	0.8	1.1
Pyrene	DETSC 3301	0.1	mg/kg	1.8	7.5	15	0.8	0.6	0.9
Benzo(a)anthracene	DETSC 3301	0.1	mg/kg	1.3	3.0	5.8	0.5	< 0.1	0.4
Chrysene	DETSC 3301	0.1	mg/kg	1.0	3.0	6.3	0.4	< 0.1	0.4
Benzo(b)fluoranthene	DETSC 3301	0.1	mg/kg	0.8	2.1	3.9	< 0.1	< 0.1	< 0.1
Benzo(k)fluoranthene	DETSC 3301	0.1	mg/kg	0.5	2.1	3.0	< 0.1	< 0.1	< 0.1
Benzo(a)pyrene	DETSC 3301	0.1	mg/kg	1.1	3.3	5.5	< 0.1	< 0.1	< 0.1
Indeno(1,2,3-c,d)pyrene	DETSC 3301	0.1	mg/kg	< 0.1	1.6	3.0	< 0.1	< 0.1	< 0.1
Dibenzo(a,h)anthracene	DETSC 3301	0.1	mg/kg	< 0.1	0.5	0.9	< 0.1	< 0.1	< 0.1
Benzo(g,h,i)perylene	DETSC 3301	0.1	mg/kg	< 0.1	1.1	2.3	< 0.1	< 0.1	< 0.1
PAH	DETSC 3301	1.6	mg/kg	11	39	88	3.3	2.3	4.7
Phenols									
Phenol - Monohydric	DETSC 2130#	0.3	mg/kg	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3

APPENDIX D

Extracts from the Geoenvironmental Appraisal

- ▲ WS13 SIRIUS WINDOW SAMPLE HOLE
 - ROT13 SIRIUS ROTARY HOLE
 - M JOYCE MONITORING BORE-HOLE
 - ⊗ SP13 SIRIUS STOCKPILE SAMPLES
 - ⊕ TP13 SIRIUS TRAIL PIT
 - ⊕ WELL INSTALLATION
 - ▲ ABOVE GROUND FUEL STORAGE TANK
 - ▲ AST
- THIS SURVEY HAS BEEN CONDUCTED IN ACCORDANCE WITH THE REQUIREMENTS OF THE METRIC SYSTEM AND THE METRIC SYSTEM OF UNITS.
- ALL DISTANCES ARE IN METERS AND ALL ANGLES ARE IN DEGREES.
- DATE OF SURVEY: 1998

Met

Land and Building



KEY

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
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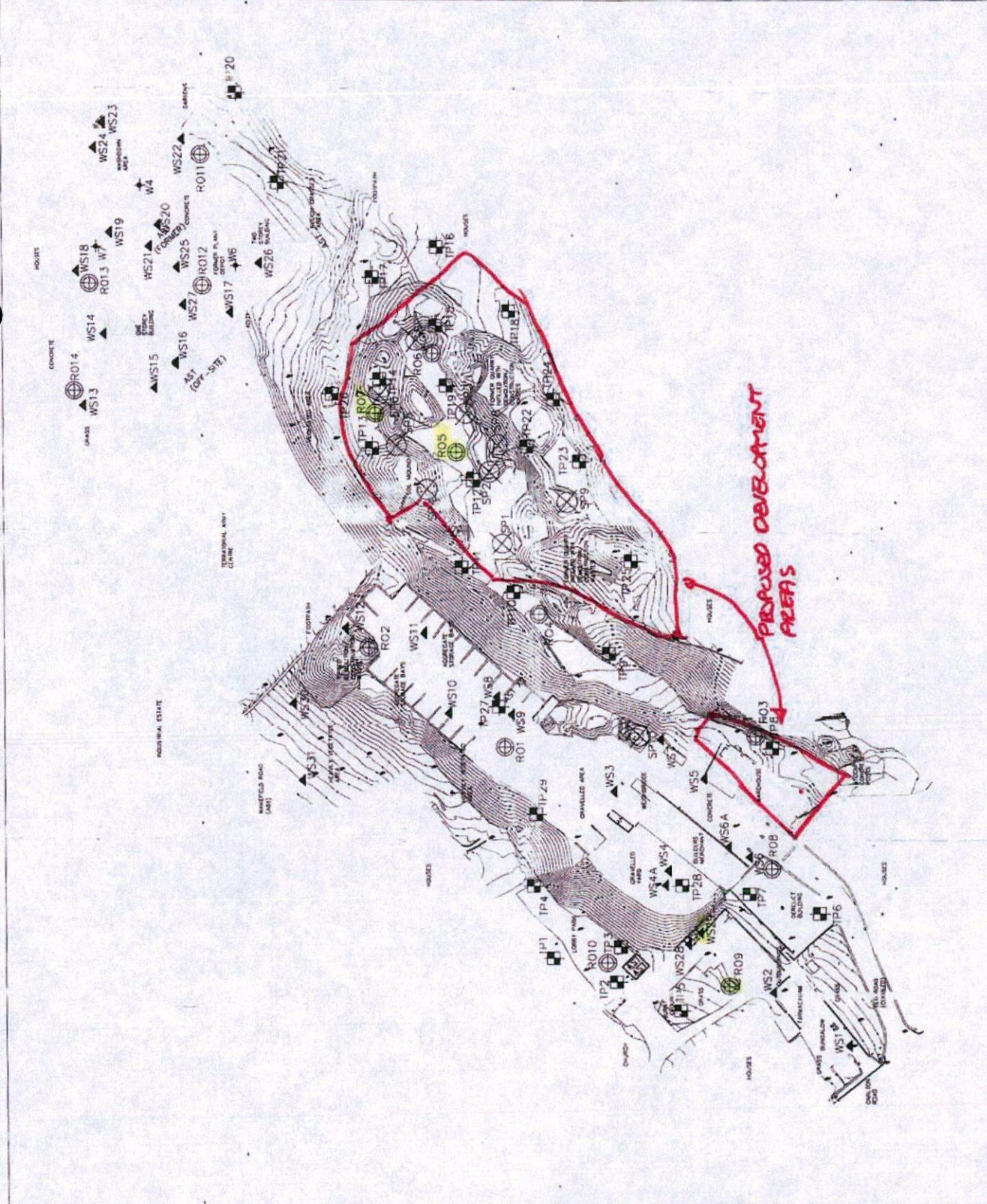


LANDLORDS AND JOINT VENTURES LTD.

WARRFIELD ROAD AND CARRINGTON ROAD, WARRINGTON.

EXPLANATORY NOTE LOCATION PLAN

Scale	1:500
Projection	OSGB36
Units	M
Angle	°



MONITORING RESULTS

Client: JS Bloor (Measham) Ltd and Larkland Ltd
Site: Wakefield Road, Carlton Road,
Barnsley
Date: 27/11/03

Job No: C0162

Sheet: 1 of 1

Ambient concentration (% Volume):				CH ₄		ND		CO ₂		ND	
				O ₂		21.0					
Monitoring Point		Gas Concentration							Gas Emission Rate	Remarks	
		Highest			Steady			(Lowest)			
Ref	GWL	CH ₄		CO ₂	CH ₄		CO ₂	O ₂	litre/hr		
	(m) bgl	% lcl	% v/v	(%)	% lcl	% v/v	(%)	(%)			
R01	Dry	ND	ND	12.1	ND	ND	12.0	3.0	ND		
R05	Dry	ND	ND	5.2	ND	ND	5.2	8.0	ND		
R07	10.40	ND	ND	2.8	ND	ND	2.8	11.0	ND		
R09	Dry	ND	ND	0.8	ND	ND	0.8	20.1	ND		
R010	9.12	ND	ND	ND	ND	ND	ND	20.9	ND		
R011	8.95	ND	ND	ND	ND	ND	ND	20.80	ND		
R014	Dry	ND	ND	12.1	ND	ND	10.9	8.2	ND		
WS21	Dry	ND	ND	4.5	ND	ND	4.5	9.0	ND		
WS29	Dry	ND	ND	1.5	ND	ND	1.5	18.7	ND		
WS30	Dry	ND	ND	ND	ND	ND	ND	20.7	ND		
W4	3.76	ND	ND	5.2	ND	ND	5.2	14.8	NR		
W6	Dry	ND	ND	1.6	ND	ND	1.6	18.5	ND		
W7	1.51	ND	ND	7.6	ND	ND	7.6	1.8	ND		
Barometric Pressure:		Start 0991 Finish 0991			Monitoring Equipment:			GA94			
Barometric Pressure Trend:		Stable			Date of Last Calibration:			20/11/03			
Weather:		Sunny			Operator			MW			
Ground:		Wet									
Key		Remarks									
ND - None Detected NR - Not Recorded POS - Positive Flow NEG - Negative Flow		1. Groundwater samples were taken from R010, R011 and BHA after purging 16 litres from R010 and 30 litres from R011. W4 was sampled without purging.									
		2. W6, W7 and W8 are 19mm piezometers from the MJA investigation (February 2003). Details unknown.									
		Checked:		RS		Approved:		F.S.			

SIRIUS

MONITORING RESULTS

Client: JS Bloor (Measham) Ltd and Larkland Ltd
Site: Wakefield Road, Carlton Road,
Barnsley
Date: 03/12/03

Job No: C0162

Sheet: 1 of 1

Ambient concentration (% Volume):	CH ₄	ND	CO ₂	ND
	O ₂	21.0		

[illegible]

Barometric Pressure:	Start 1017
	Finish 1017

Monitoring Equipment: GA94

Barometric Pressure Trend: Stable

Date of Last Calibration: 20/11/03

Weather: Overcast

Operator	MW
1	1
2	2
3	3
4	4
5	5
6	6
7	7
8	8
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10	10
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91	91
92	92
93	93
94	94
95	95
96	96
97	97
98	98
99	99
100	100

Ground: Wet

Key	Remarks
ND - None Detected NR - Not Recorded POS - Positive Flow NEG - Negative Flow	W4, W6 and W7 are 19mm piezometers from the MJA investigation (February 2003). Details unknown.

Checked:	RS	Approved:	
----------	----	-----------	---

SIRIUS

MONITORING RESULTS

Client: JS Bloor (Measham) Ltd and Larkland Ltd
Site: Wakefield Road, Carlton Road,
Barnsley
Date: 09/12/03

Job No: C0162

Sheet: 1 of 1

Ambient concentration (% Volume):	CH ₄	ND	CO ₂	ND
	O ₂	21.0		

[illegible]

Barometric Pressure:	Start 1013 Finish 1013
Barometric Pressure Trend:	Stable
Weather:	Overcast
Ground:	Wet

Monitoring Equipment:	GA94
Date of Last Calibration:	20/11/03
Operator	MW

Key	Remarks
ND - None Detected NR - Not Recorded POS - Positive Flow NEG - Negative Flow	W4, W6 and W7 are 19mm piezometers from the MJA investigation (February 2003). Details unknown. PID Readings: R01 0.2ppm, R05 0.1ppm, R07 ND, R09 0.1ppm, R010 0.7ppm, R011 0.3ppm, R014 0.6ppm, WS21 12.5ppm, WS29 1.3ppm, WS30 ND, BHA ND, BH1B ND, BHC 0.7ppm.

Checked:	RS	Approved:	
----------	----	-----------	---

SIRIUS

MONITORING RESULTS

Client: JS Bloor (Measham) Ltd and Larkland Ltd
Site: Wakefield Road, Carlton Road,
Barnsley
Date: 19/12/03

Job No: C0162

Sheet: 1 of 1

[illegible]

SIRIUS



At Sandman's, stocks

CLIENT DETAILS Envirocheck Order No. EC407296 1

Figure 1. A. (left) 4-oxo-4'-nitroacetophenone. B. (right) 4-oxo-4'-nitroacetophenone.

Customer Ref: MR ROB HOWE/C167

2145771194 33/11/15 MRS L JONES & SONS LTD
2145771194 33/11/15 MRS L JONES & SONS LTD

SECRET

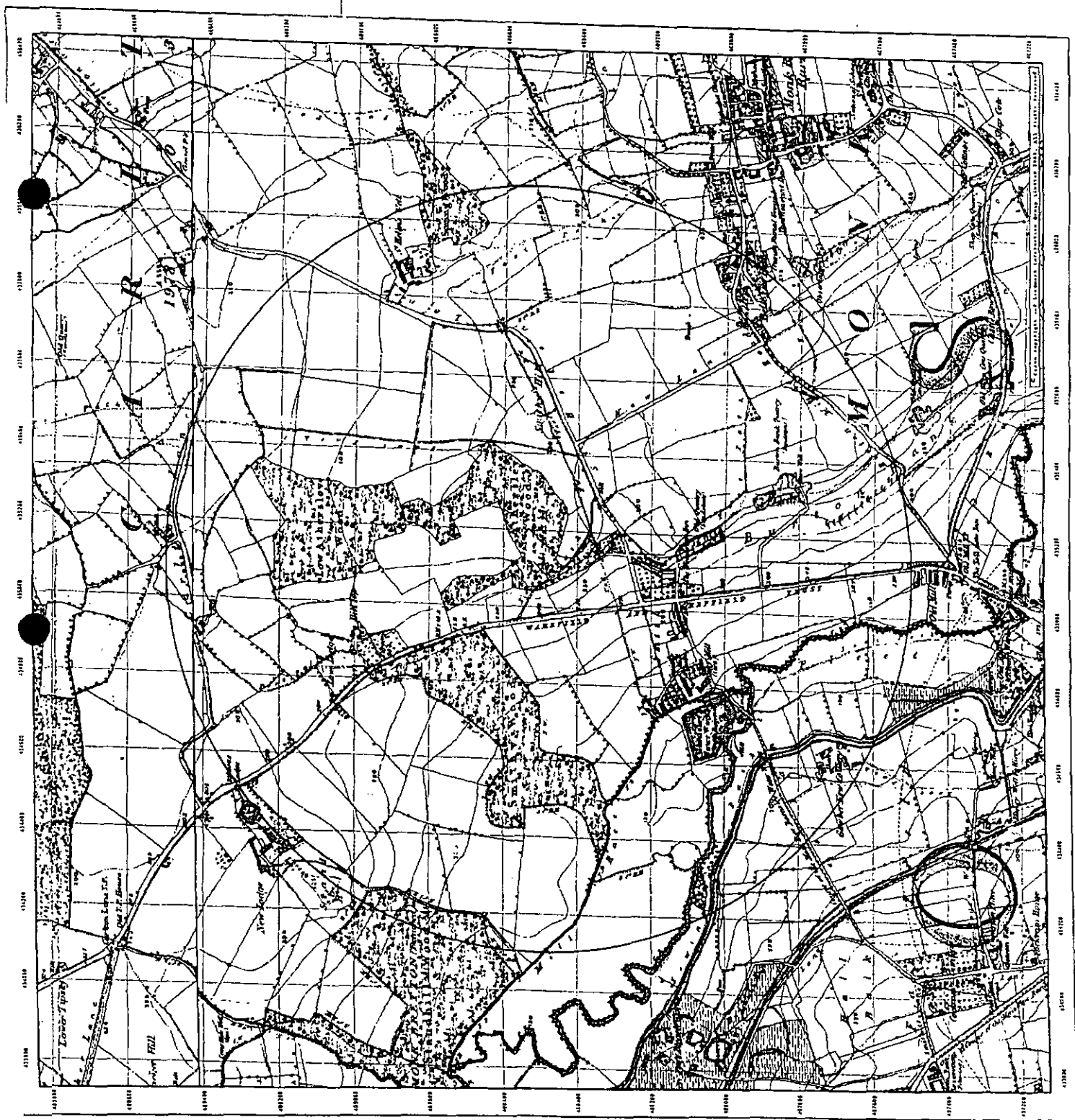
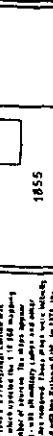
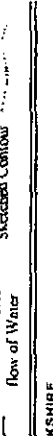
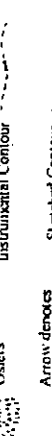
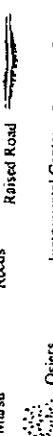
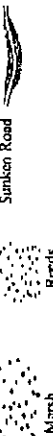
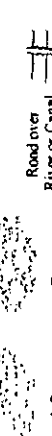
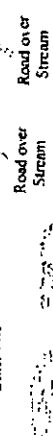
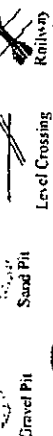
WHITE DETAILS **Grid Reference** **435100** **408500**

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MO put

AMSLBY

Historical Map Legend





Envirocheck

A Landmark Ltd

CLIENT DETAILS

Envirocheck Order No. EC402286

Customer Ref No. Rob Newell, C162

SUBSISTENCE & ENVIRONMENTAL

SITE 3 BOWCLIFFE ORANGE BOWCLIFFE HALL ESTATE

LEEDS

1323 6LP

SITE DETAILS

Grid Reference 435100 40851

Land On

Carlton Bowcliff Field Road

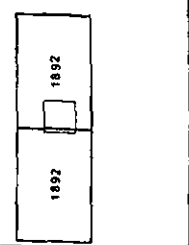
WARRICKLEY

Historical Map Legend

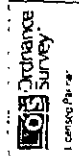
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	Gravel Pit		Clay Pit		Rough Pasture		Furze
	Refuse Heap		Shingle		Oscars		Ford
	Railway crossing		River or Canal		Level Crossing		Road crossing Railway
	Embankment		Cutting		Road over River or Canal		Arrow denotes flow of Water
	Road over single Stream						

YORKSHIRE

This historical map shows the area in the vicinity of the site, as it appeared in the year 1892. The map is a reproduction of the original map, which was published in 1892. The map is a reproduction of the original map, which was published in 1892. The map is a reproduction of the original map, which was published in 1892.

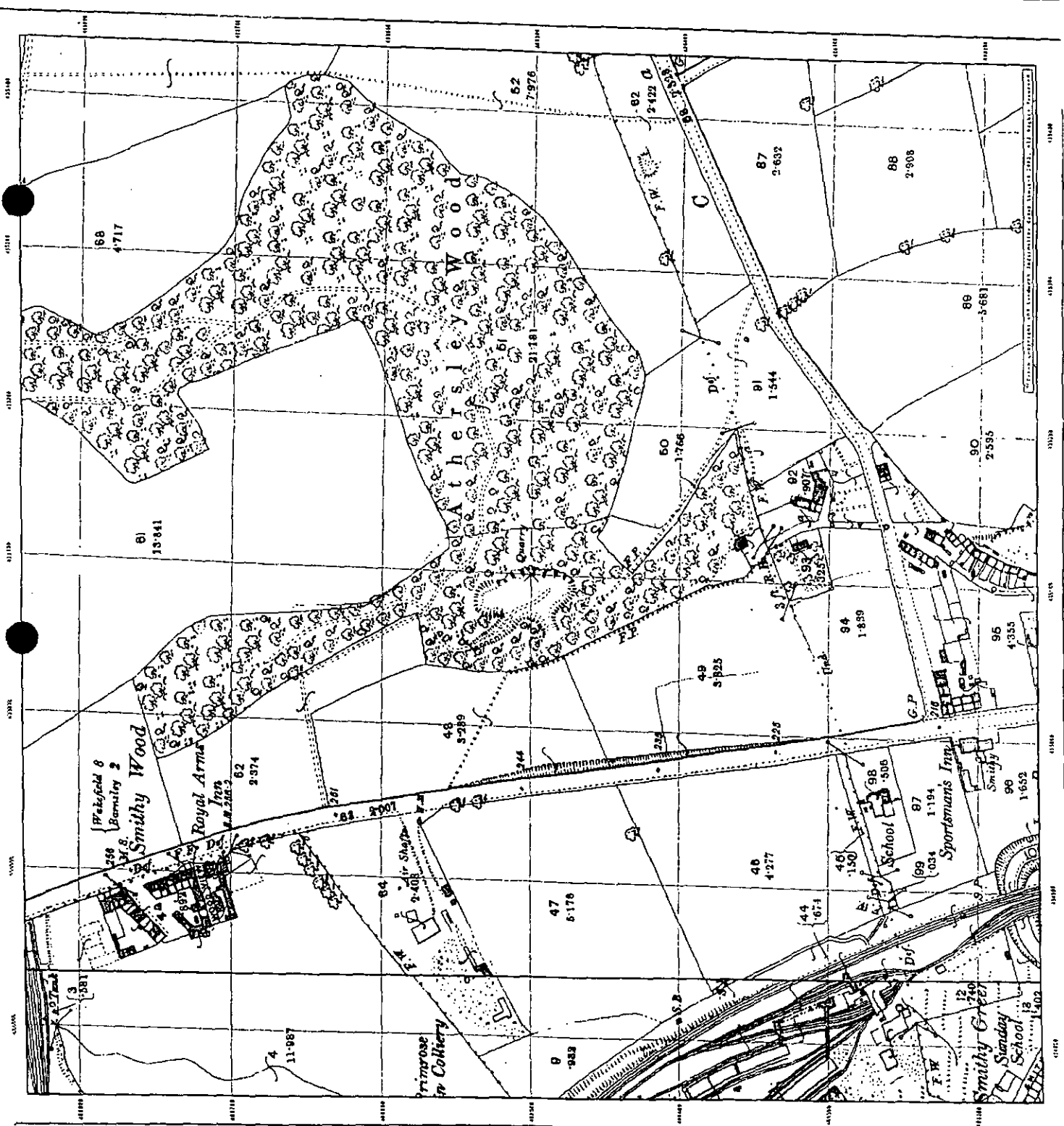


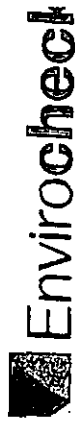
Date(s) of Publication



LANDMARK

Information Group





A Landmark Group

CLIENT DETAILS

Envirocheck Order No. EC407296

CUSTOMER Ref: Mr & Mrs Housley C112

SUBJECT: ENVIRONMENTAL & ENVIRONMENTAL

SITE: 3 BOWCLIFFE GRANGE BOWCLIFFE HALL ESTATE

LEDS

LEDS RLP

SITE DETAILS

Grid Reference 435100 40851

Level Off

Ceased Road/Wharfside Road

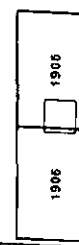
BARMLEY

Historical Map Legend	
	Quarry
	Sand Pit
	Clay Pit
	Refuse Heap
	Reeds
	Marsh
	Rough Pasture
	Oscars
	Shingle
	Railway crossing
	River or Canal
	Embankment
	Cutting
	Road over single stream
	Road over River or Canal
	Level Crossing
	Road Crossing Railway
	Arrow denoting flow of water

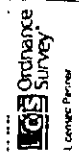
YORKSHIRE

This historical map has been reproduced from the original map held by the Yorkshire Archives and is published as a reproduction of the original map. The map is not a survey and is not intended to be used for any purpose other than as a guide to the location of the site. The map is not a survey and is not intended to be used for any purpose other than as a guide to the location of the site. The map is not a survey and is not intended to be used for any purpose other than as a guide to the location of the site.

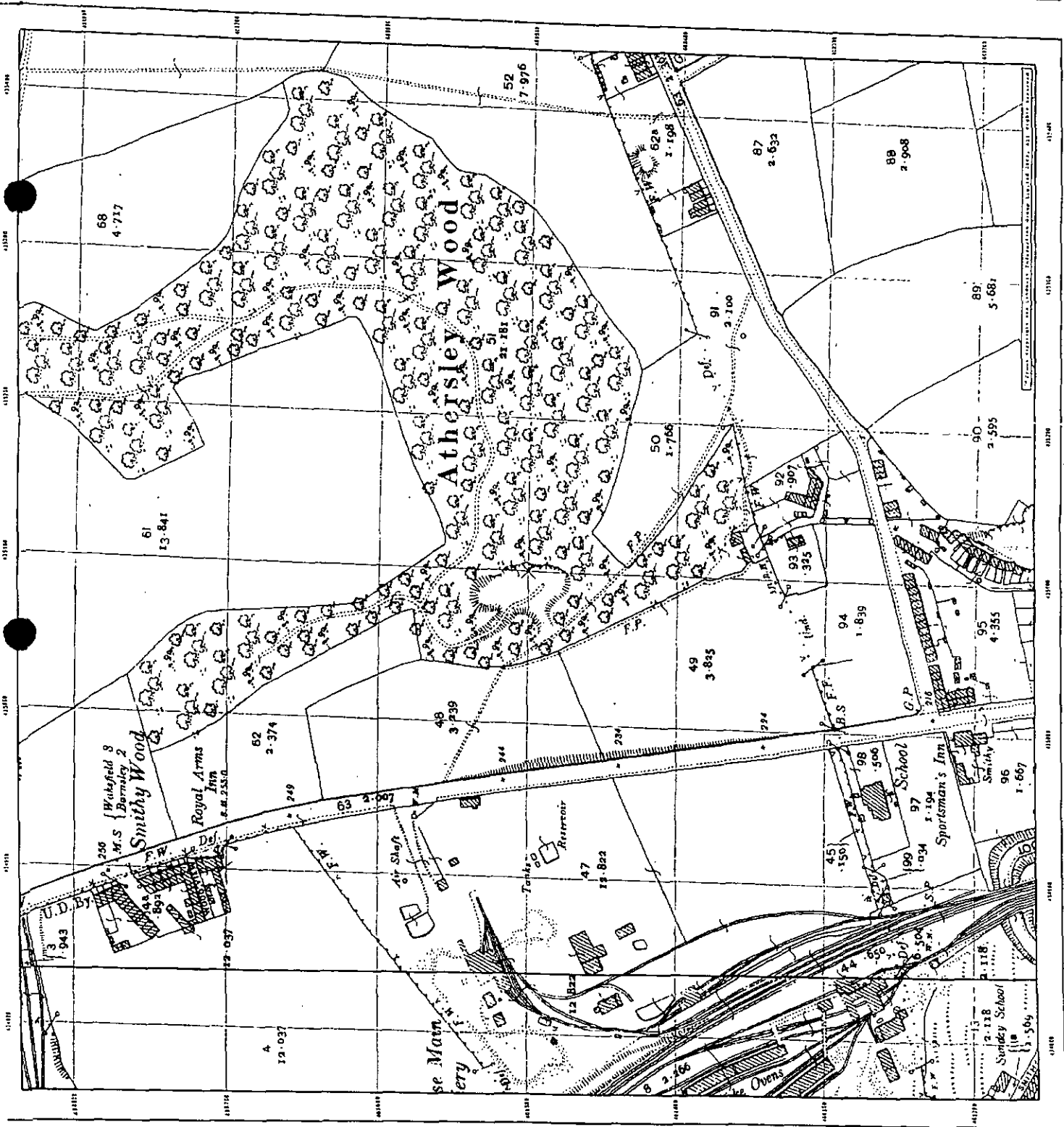
Scale 1:1000



Date(s) of Publication



LANDMARK
Information Group





A Larchmont Inc.

CLIENT DETAILS

Envirocheck Order No. EC407286

Customer Ref: Mr. Rob Hewitt C132

SINUS GEOTECHNICAL & ENVIRONMENTAL

SUITE 2 BOWCLIFFE ORANGE BOWCLIFFE HALL ESTATE

LEES

LEES SLIP

SITE DETAILS

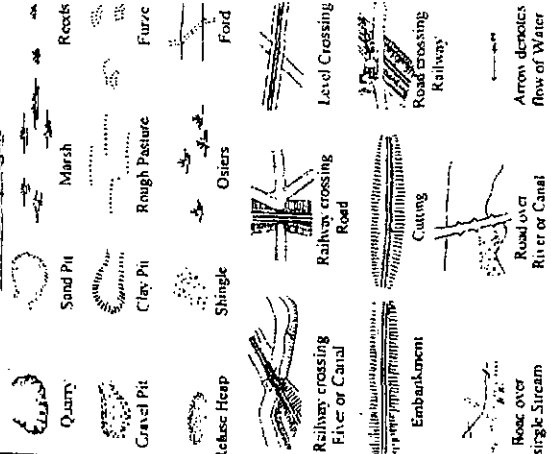
Grid Reference 435100 4085

Land ON

Cellar Road/Waterfield Road

BARNLEY

Historical Map Legend

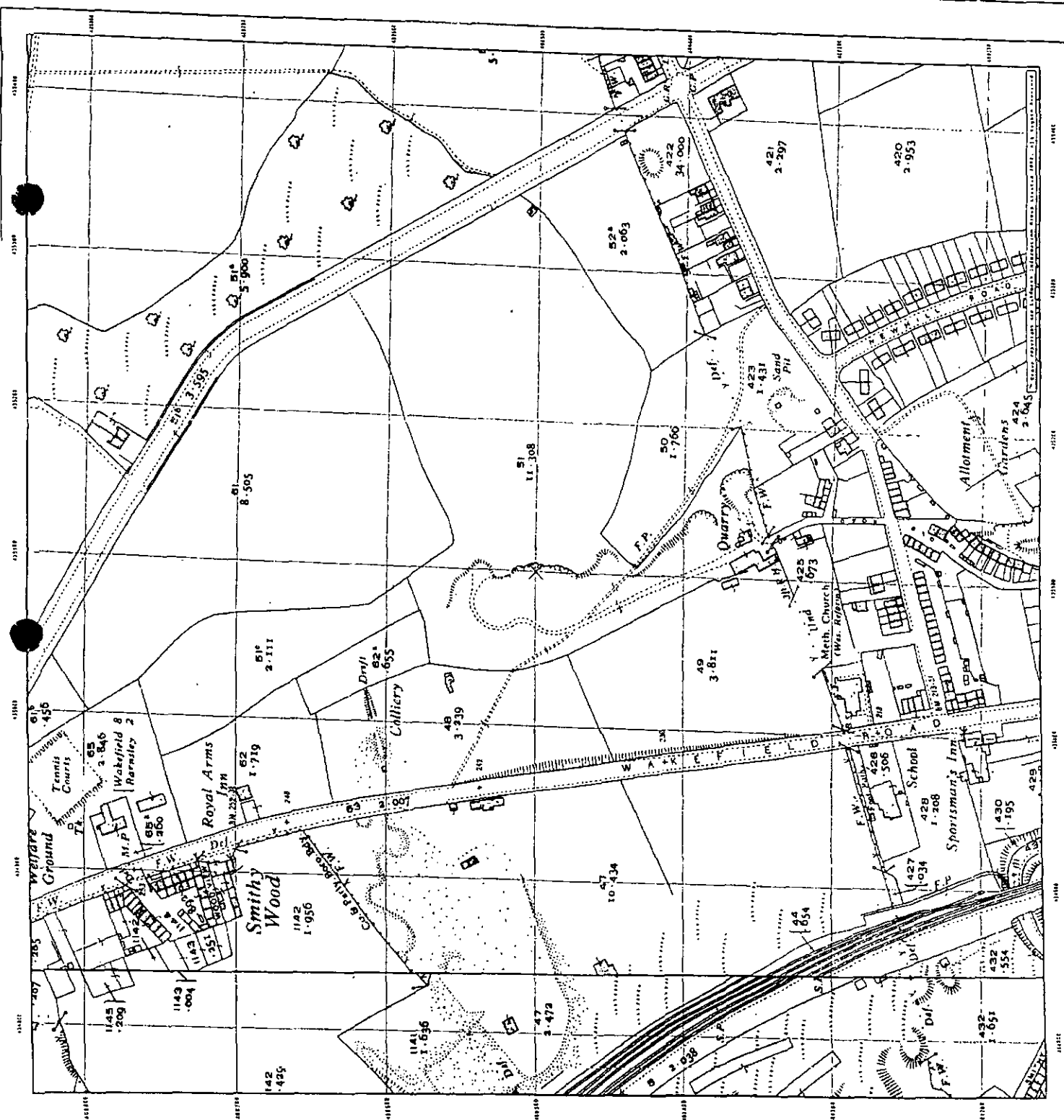
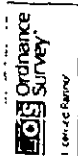


YORKSHIRE

This historical map shows the area as it appeared in the 19th century. It is based on the original map of the area, which was published in 1845. The map shows the area as it appeared in the 19th century, and it is based on the original map of the area, which was published in 1845. The map shows the area as it appeared in the 19th century, and it is based on the original map of the area, which was published in 1845.

1931

Date(s) of Publication





Envirocheck

A Landmark (print)

CLIENT DETAILS

Envirocheck Order No. EC407298

Customer Ref: Mr Rob Haywood C132

SUBS GEOTECHNICAL & ENVIRONMENTAL

SUITE 3 BOWCLIFFE GRANGE BOWCLIFFE HILL ESTATE

LEEDS

LS17 8LP

SITE DETAILS

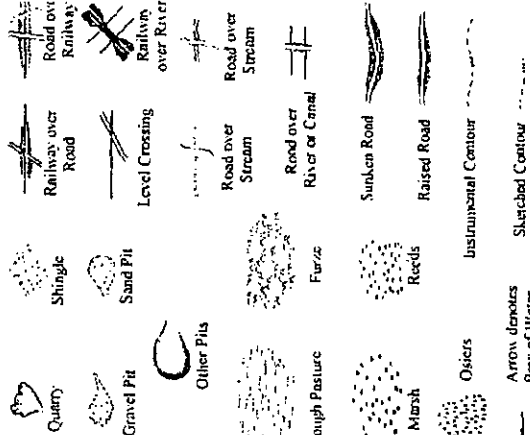
Grid Reference 435100 40865

Lead Off

Carbon Road/Wharfedale Road

BARNESLEY

Historical Map Legend



YORKSHIRE

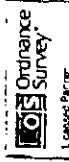
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with the aid of a 30mm wide lens. The maps were digitised for the purpose of the 1:125,000 scale map. The digitisation process was carried out by the Yorkshire Archives, Leeds and London in the 1980s. The digitisation process was carried out by the Yorkshire Archives, Leeds and London in the 1980s.

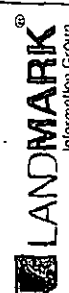
Printed on 100% recycled paper.

Printed on 100% recycled paper.

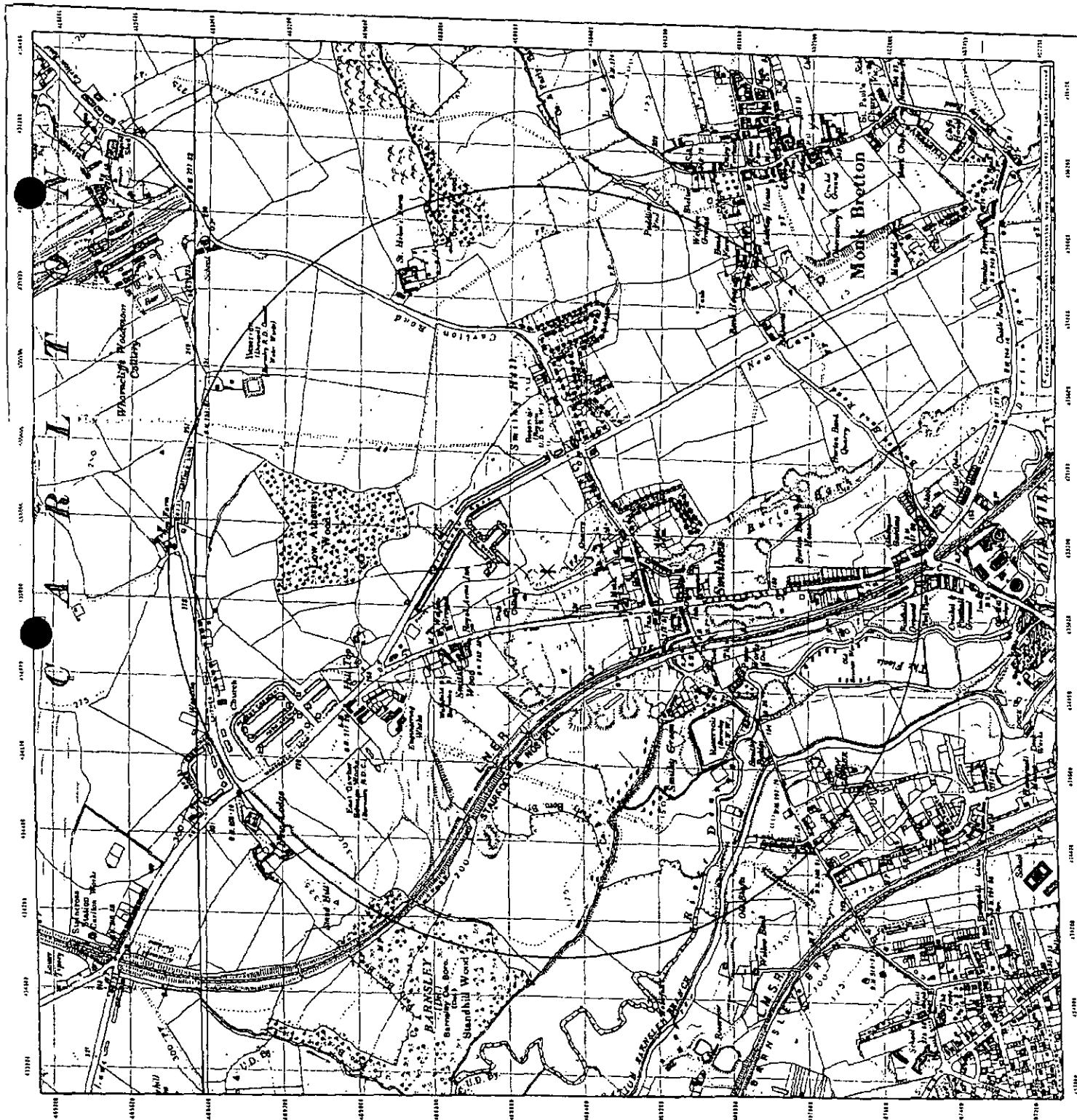
Date(s) of Publication



Ordnance Survey
Landmark Partner



LANDMARK
Information Group





CLIENT DETAILS
Envirocheck Order No. EC407296
(00-00) 1000 (1-00)

Customer Ref: Mr Rob Howells C102

SUITE 3 BOWCLIFFE GRANDE BOWCLIFFE HALL ESTATE

LEEDS

SITE DETAILS		Grid Reference	435100	40851
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AND ON

ADJUNCT

Historical Map Legend



Chalk Pit,
Clay Pit,
or Quarry.

 Gravel Pit Gravel Pit Gravel Pit

Sand pit

Sand pit

Sand pit

Disused Pit

Disused Pit

Disused Pit

Refuse or

Refuse or

Refuse or

Direction of Flow of V

Direction of Flow of V

Direction of Flow of V



Cutting

Cutting

Cutting

Road	Under	Over
...	...	...

Road	Under	Over
...	...	...

Road	Under	Over
1000	1000	1000
2000	2000	2000
3000	3000	3000
4000	4000	4000
5000	5000	5000
6000	6000	6000
7000	7000	7000
8000	8000	8000
9000	9000	9000
10000	10000	10000

ORDNANCE SURVEY PLAN

[illegible][illegible]

Date(s) of Publication

OS Ordnance Survey


LANDMARK[®]



CLIENT DETAILS
 Envirocheck Order No. EC407296.1
 CUSTOMER: Ref: Mr Rob Hewitt C168
 SUNDAY GEOTECHNICAL & ENVIRONMENTAL
 ROUTE 3 BOWCLIFFE GRANGE BOWCLIFFE HALL ESTATE
 LEEDS
 L22 5LP

SITE DETAILS
 Grid Reference 435100 40850
 LIND DIT
 Cullum Regis/Westfield Road
 BARNLEY

Historical Map Legend

Chalk Pit	Non-coniferous Trees	Brack
Clay Pit or Quarry	Gravel Pit	Coniferous Trees
Sand Pit	Scrub	Lake, Loch or Pond
Disused Pit or Quarry	Refuse or Sing Heap	Electricity Poles
Direction of Flow of Water	Shingle	Sand
Marsh	Standard Gauge	Multiple Gauge
Standard Gauge	Multiple Gauge	Single Track
Single Track	Siding, Tramway or Mineral Line	Narrow Gauge

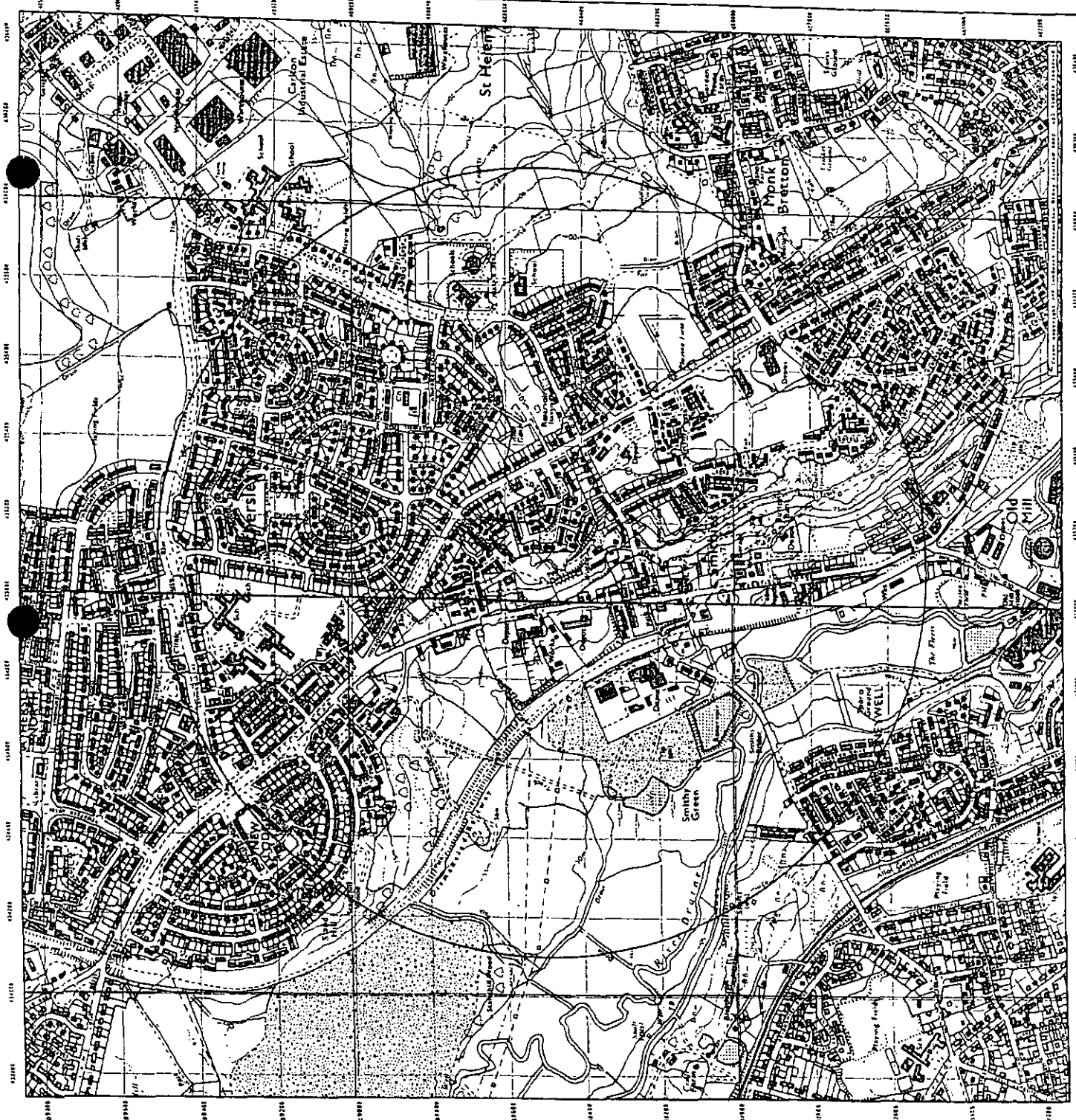
ORDNANCE SURVEY PLAN

This Ordnance Survey map is a reproduction of the original map, which was published in 1984. It is a 1:50,000 scale map, and is the latest edition of the map. The map is a reproduction of the original map, which was published in 1984. It is a 1:50,000 scale map, and is the latest edition of the map.

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Date(s) of Publication



CLIENT DETAILS Envirocheck Order No. EC407296.1
 Customer Ref: Mr Rob Howells, C192
 SINFUS GEOTECHNICAL & ENVIRONMENTAL
 SUITE 3 ROWCLIFFE GRANGE ROWCLIFFE HALL ESTATE
 LEEDS
 LS23 7LP

SITE DETAILS		Grid Reference	435100	40850
and Off				
Crimen Road/Highway 11111111 Road				
ARMLEY				

Historical Map Legend

	Chalk Pit.		Non-coniferous Trees		Black
	Clay Pit, or Quarry				Black

 Gravel Pit  Coniferous
Trees Heath.

 Sand Pit
  Scrub
  Rough Grass

Disused Pit
Pyon
or Pond
Reads

Refuse or Transmission	Pole	Electricity	Salinity
---	---	---	---

Direction of Flow of Water

	Multiple Track
	Standard Gauge

Order	Over	Crossing	Bridge	Siding, Trimming	or Material
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2					
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4					
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FINANCE SURVEY OF AN

THESE ARE THE NAMES OF THE MEN WHO WERE KILLED IN THE BOMBING OF THE LINCOLN CONTINENTAL HOTEL IN NEW YORK CITY ON APRIL 4, 1968.

Mass. has published data given on the number of offences since 1915. Even then the data before 1936, a HCS map was made by the State Protection, with independent

THE UNIVERSITY OF CHICAGO

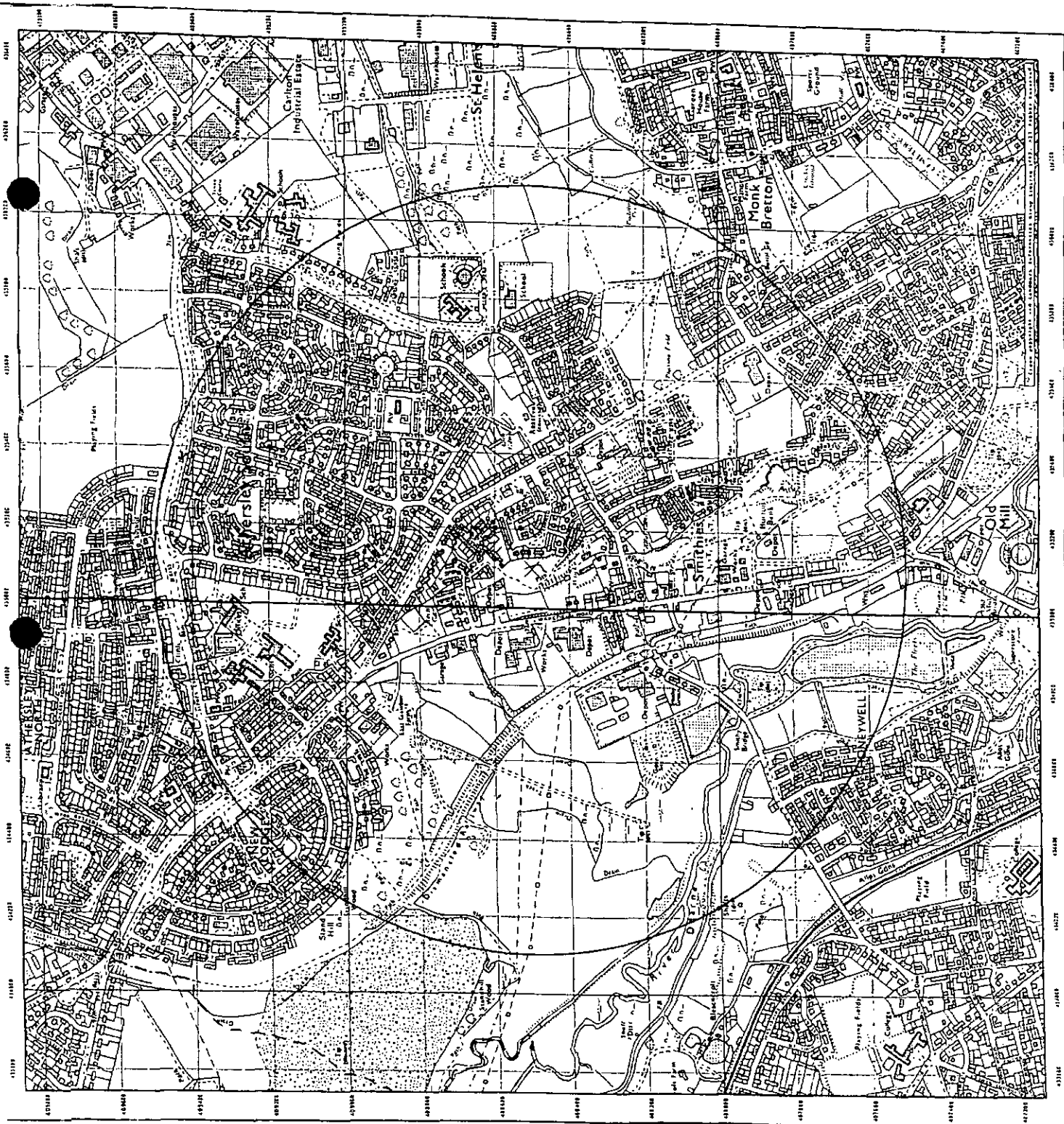
...with its military range and other
...has mounted. These drafts were made
...if with the approval of the 1572, the
...the maps as a project of the

[illegible]

Date(s) of Publication

16500

OS Ordnance Survey[®]
LANDMARK [®]

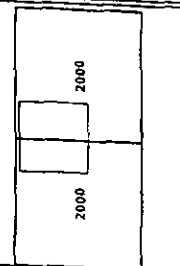
[illegible]

Historical Map Legend	
	Non-coniferous Trees
	Coniferous Trees
	Orchard
	Rough Grassland
	Heath
	Scrub
	Marsh, Salt Marsh or Reeds
	County Boundary (England only)
	Civil Parish or Community Boundary
	Constituency Boundary
	Pylon
	Telephone Lir (where shown)
	Electricity Transmission Line (with pole)
	Gravel Pit
	Shingle
	Refuse Tip or Slag Heap
	Sand
	Sand Pit
	Slopes
	District, Unitary, Metropolitan, London Borough Boundary

The statistical maps shown were produced from the Ordnance Survey 1:10 000 colour raster maps. These maps were derived from Landsat TM imagery using the mid 1980s map margins.

The film is highly detailed showing buildings, streets and many people. It was the all-Canada tour, 1963-64. Road shows are also included together with the musical and some bar and nightclub scenes. Good quality color film. Includes 16-story, multi-story apartment buildings.

1994-1995



Date(s) of Publication

...

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