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**DESK STUDY AND GROUND
INVESTIGATION REPORT**

**AT
SOUTH PARK MILLS
HARE LANE
PUDSEY**

**ON BEHALF OF
ACRIVARN LTD**





ARP GEOTECHNICAL LTD
CHARTERED CONSULTING ENGINEERS

DESK STUDY AND GROUND INVESTIGATION REPORT

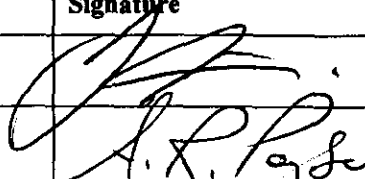
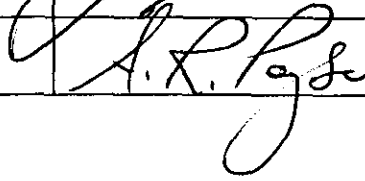
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AUGUST 2005

| Report No: ACR/01 | Name | Signature | Date |
|-------------------|-------------------------------|--|--------|
| Prepared By: | J D Quinn BSc FGS |  | 7/9/05 |
| Reviewed By: | A R Poyser BSc CEng MICE FIHT |  | 7/9/05 |

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1.0 EXECUTIVE SUMMARY

- 1.1 The geological map shows the site to be underlain by undifferentiated strata (a combination of sandstone, siltstone and mudstone) from the Lower Coal Measures of the Carboniferous Period. Alluvium is shown on the southern third of the site whereas no drift cover is shown on the remainder of the site. There are no faults within influencing distance of the site.
- 1.2 The site is not affected by coal mining.
- 1.3 The site has been occupied by various mills, associated structures and industrial buildings since the 1800s. There is the possibility of contamination arising from the previous industrial use. The buildings formerly and currently occupying the site will leave a legacy with the possibility of encountering buried foundations and structures, possibly including cellars, during redevelopment.
- 1.4 No radon protective measures are required for properties constructed on the site.
- 1.5 There are two closed landfills within a 500m radius of the site. Therefore, it is recommended that gas monitoring wells are installed as part of any future investigation to monitor any possible landfill gas migration to the site.
- 1.6 The southern portion of the site is within an area at risk of river flooding. A Flood Risk Assessment in accordance with PPS 15 'Planning and Flood Risk' may be required for the site.
- 1.7 The contamination testing revealed significant contamination in the made ground, topsoil and groundwater on the site, particularly with regard to hydrocarbons. A full contamination investigation and risk assessment is recommended in accordance with BS 10175 'Investigation of potentially contaminated sites', with additional sampling and

testing to assess the leachability of the soil contamination and extent of the severity of the *groundwater contamination*.

- 1.8 The natural subsoil and bedrock should be capable of supporting foundation loads from residential properties using traditional strip or trench filled foundations.
- 1.9 Excavations within the natural strata and made ground should generally be readily achieved using conventional hydraulic plant. The use of a hydraulic breaker may be required if any buried foundations or structures are encountered or for any penetration into intact rock.
- 1.10 Excavations should remain stable with minimum statutory support.
- 1.11 Groundwater may be encountered within excavations in the southern portion of the site, however, this should be controllable through intermittent pumping from an artificial sump.
- 1.12 Site classifications of DS-1, AC-1 and AC-1s apply to the site with regard to buried cementitious material.
- 1.13 The natural clay will provide a suitable subgrade for carriageway construction and should provide a design CBR value of 3%. In some areas, carriageway formation on natural ground will not be feasible. In these areas, it may be possible to remove a nominal thickness of made ground and to recompact the material to a controlled specification.

2.0 TERMS OF REFERENCE

- 2.1 Acrivarn Ltd are considering developing the site at South Park Mills, Hare Lane, Pudsey with residential properties. It was considered appropriate to implement a desk study and ground investigation to provide information to aid viability assessment and design of any subsequent development.
- 2.2 ARP Geotechnical Ltd were appointed by ID Planning, acting on behalf of Acrivarn Ltd to carry out the investigation, which involved a desk study assessment of the geological and coal mining aspects, Ordnance Survey archive plans search, environmental search, radon gas appraisal and indicative flood risk, together with an intrusive ground investigation by excavating trial holes on the site to assess the subsoil conditions.
- 2.3 The investigation was implemented generally in accordance with BS 5930 1999 'Code of Practice for Site Investigations' and NHBC Standard Chapter 4.1 'Land quality - managing ground conditions'. This report is limited to the data obtained. It should be noted that there is a possibility of variation in ground conditions between test locations and interpretation of strata is given for guidance only.
- 2.4 This report is intended to cover a wide scope of geotechnical issues and is not intended primarily to address contamination aspects, although this is briefly covered. A conceptual site model, appraisal of contaminant source - pathway - receptor linkages and a risk assessment do not, therefore, form part of this report. If deemed appropriate, this should be covered by any future investigation.
- 2.5 The general observation and assessment of the ground surface, and the identification/classification of vegetation is made in general terms only. It may be prudent for a specialist arboriculturist to undertake a more detailed survey.
- 2.6 The investigation was carried out in August 2005.

2.7 The report has been prepared for the sole use and reliance of the Appointee. The report shall not be relied upon or transferred to any other parties without the written agreement of ARP Geotechnical Ltd. No responsibility will be accepted where this report is used, either in its entirety or in part, by any other party.

3.0 SITE DESCRIPTION

- 3.1 The site, which is centred on Ordnance Survey Grid Reference SE226 316, is located at the southern end of Hare Lane, Pudsey and is a roughly rectangular shaped piece of land extending to an area of approximately 1.5Ha
- 3.2 At the time of the investigation, the site was accessed in the north-eastern corner via Hare Lane, which continued across the northern portion of the site and along the western site boundary. The site was mainly occupied by large industrial buildings (formerly mill buildings) in the central and north-eastern areas, housing a bakery equipment manufacturing company and a vehicle electrician business. The southern portion of the site was occupied by the remains of demolished, presumed industrial, buildings, a gravel access road extending along the southern boundary, and an artificial soil embankment extending along the eastern boundary. A warehouse building was present in the northern portion of the site, immediately north of Hare Lane and level gravel parking areas were located in the north-western and north-eastern corners of the site.
- 3.3 The site slopes steeply from the northern section to the south, until approximately 50m within the southern site boundary where the site has been levelled, in the area formerly occupied by, and surrounding, the demolished buildings. Level areas have also been created in the northern portion of the site to facilitate parking and access to buildings. A large, steeply sloping, ramp has been created along the south-eastern site boundary providing an alternative route between the northern and southern portions, other than the road in the west of the site. The surrounding land slopes to the south.
- 3.4 The northern, eastern and western site boundaries are formed mainly by a combination of mature and semi mature trees and bushes with a gate and occasional sections of metal fencing in the north-eastern corner. A scattering of semi mature trees and overgrown bushes are also present within the southern site boundary, with the actual boundary formed by a wooden post and wire fence.

- 3.5 The land beyond the northern, eastern and western boundaries comprises open grassland. A footpath is present beyond the southern boundary, immediately beyond which is an eastwards flowing stream, located at a level approximately 1m below that of the site.
- 3.6 A site location plan is presented in Appendix A.

4.0 NATURAL ENVIRONMENT

General Geology

- 4.1 The site is located on the Geological Map of Great Britain 1:50,000 Series Sheet 77, Huddersfield. The Solid and Drift Edition shows the majority of the site to be underlain by Undifferentiated Strata (a combination of sandstone, siltstone and mudstone) of the Lower Coal Measures of the Carboniferous Period. However, a geological boundary with the Elland Flags (a sandstone) is indicated within the northern site boundary. The southern third of the site is indicated as having a superficial cover of alluvium over the solid strata, whereas no drift cover is shown on the remainder of the site.
- 4.2 A northeast to southwest trending fault, with a downthrow to the southeast, is indicated approximately 300m northwest of the site. This fault should not impact upon the site.
- 4.3 Coal seams are indicated in the vicinity of the site. Therefore, a Coal Mining Report was obtained from the Coal Authority, and this is discussed further in Section 6.0 of this report.

Hydrogeology

- 4.4 The 1:100,000 scale Environment Agency Groundwater Vulnerability Map, Sheet 11, South Pennines, shows the strata beneath the site are classed as a Minor Aquifer. Minor Aquifers seldom produce large quantities of water for abstraction, but are important both for local supplies and in supplying base flow to rivers.
- 4.5 The soils overlying the north of the site are classed as being of High Leaching Potential classification H3. Soils with a H3 classification are described as shallow soils which readily transmit non-adsorbed pollutants and can attenuate adsorbed pollutants.
- 4.6 The soils in the south of the site are classed as being of Low Leaching Potential due to the horizontal water flow in this area as a result of the adjacent Pudsey Beck.

4.7 Contaminating material or activities could potentially affect the underlying Minor Aquifer in the northern portion of the site. However, due to horizontal water flow, contamination in the southern portion of the site is unlikely to affect the underlying Minor Aquifer, but could have an impact elsewhere in the catchment.

5.0 ORDNANCE SURVEY ARCHIVE PLANS

5.1 A visit was made to the West Yorkshire Archive Service in Wakefield to inspect Ordnance Survey archive plans of the Pudsey area to review the history of the site, and establish any former land use which may have contaminated the site or would adversely affect the proposed development. A summary of the plans reviewed is given below and copies of the relevant portions are presented in Appendix B. *N.B. Due to copyright, the Archive Service will not provide copies of plans less than 50 years old*

| Description | Scale | Date |
|------------------------|-------------------------|---------------------------------|
| County Line Series | | |
| Yorkshire Sheet 217 | 6" to 1 mile (1:10,560) | 1st Edition circa 1854 |
| Yorkshire Sheet 217SE | 6" to 1 mile (1:10,560) | 1894, 1908, 1932, 1938, 1948 |
| Yorkshire Sheet 217/11 | 25" to 1 mile (1:2,534) | 1893, 1921, 1932, 1938 |
| National Grid Series | | |
| SE2231 | 1 : 2,500 | 1956 |
| SE23SW | 1 : 10,000 | 1985 |

5.2 The first available plan, the 1st Edition circa 1854, shows the site and surrounding land to the north, east and west to be unoccupied, presumed agricultural land. The Pudsey Beck is present to the south of the site, and an area of woodland annotated as North Wood is present beyond.

5.3 The plans of the late 1800s indicate the construction of Hare Lane to the north of the site, and which is shown to enter the site from the northeastern corner, extend across the northern portion, and continue south within the western site boundary. The central and southwestern portion of the site is now occupied by the South Park Mills (Worsted) building. Immediately south of the Mill, there is an additional roadway and four smaller buildings including a gasometer. A rectangular Mill Pond is indicated in the northwestern portion of the site, and a Well is present nearby. An embankment is indicated to have been constructed in the northeastern corner of the site, and this is likely to be a result of the development on the site. A small circular building is indicated on the

northeastern site boundary which is annotated on later plans as a chimney. Beyond the northeastern boundary of the site, South Park Terrace is indicated to have been constructed.

- 5.4 *The plan of 1908 shows no significant change to the site.*
- 5.5 *The 25" to 1 mile scale plan of 1921 shows the Mill building to have expanded in size and to be annotated as a "Silk Noil". An additional building has been constructed to the northeast of the mill building, and tanks are shown in the eastern and southwestern areas of the site. The buildings, including the gasometer, to the south of the mill building are no longer shown. An additional building is also indicated in the northern portion of the site adjacent to the Mill Pond. The Mill Pond is now annotated a reservoir.*
- 5.6 *The plans of 1932 indicate the removal of the southern portion of the mill building. A small building is indicated to have been constructed in the far northwest of the site and a weir is shown to have been constructed on the Pudsey Beck beyond the southern boundary.*
- 5.7 *The situation indicated on the plan of 1932 is reflected in the plans of 1938. However, various smaller buildings are shown to have been constructed immediately south of the remaining mill building. In addition, the building in the far northwest is no longer shown.*
- 5.8 *No significant change is indicated on the plan of 1948.*
- 5.9 *The plan of 1956 shows additional development to have occurred to the mill building which now appears to be connected to the building in the northeastern corner of the site. Additional buildings are indicated to have been constructed in the southeastern corner and western area of the site.*
- 5.10 *The plan of 1984 shows the building in the western area of the site (shown on the plan of 1956) to have been removed, and indicates the construction of a separate larger building*

covering the majority of the southwestern area of the site. The reservoir in the northwestern portion of the site is also no longer shown. Since 1984, all buildings in the south of the site have been demolished.

- 5.11 In summary at sometime between 1854 and 1893, the site was developed with a Worsted Mill, pond and roadway, together with an assortment of smaller buildings, including a gasometer and a Well. The site was redeveloped as a Silk Mill in the 1920s which included the construction of tanks and additional buildings. Since the 1920s, the site has continued to be redeveloped with buildings regularly being demolished and constructed. There is a possibility of contamination arising from the sites industrial usage, including the possibility of fuel leakage/spillage from the tanks. A legacy will remain from the buildings formerly and currently occupying the site, with the possibility of encountering buried foundations and structures, possibly including cellars during redevelopment. There is no indication of town gas production on the site, and the gasometer was probably used for storage of gas for the mill.

6.0 COAL MINING

- 6.1 A coal mining report was obtained from The Coal Authority. A copy of the report is included in Appendix C and a summary is given below.
- 6.2 The site is unaffected by any past, present or future proposed underground mining. However, The Coal Authority refer to reserves of coal in the locality which could be worked at some time in the future, subject to feasibility, licenses and planning consents. Given the effective abandonment of the West Yorkshire Coalfield, any future workings are considered highly unlikely.
- 6.3 There are no known mine entries on or within 20m of the site.
- 6.4 The site is unaffected by any past, present or future opencast coal mining.
- 6.5 In the light of the above, the site is considered stable with regard to coal mining.

7.0 ENVIRONMENTAL SEARCHES

Radon Gas Appraisal

- 7.1 Building Research Establishment Report BR211 (1999) "Radon : guidance on protective measures for new dwellings" indicates that the site is outside any area of radon emission.
- 7.2 NRPB Document NRPB-W26, 2002, "Radon Atlas of England and Wales" indicates the site is not within a Radon Affected Area. Radon Affected Areas are defined as parts of the country with a 1% probability or more of present or future homes being above the Action Level of 200 Bq m⁻³.
- 7.3 In the light of the above, no radon protective measures are required for properties constructed on the site.

Environment Agency

- 7.4 The Data Maps on the Environment Agency website were assessed with regard to several environmental issues. The findings are given below.
- i) There are no IPC Authorisations within 500m of the site.
 - ii) There are no currently licensed landfills within 250m of the site.
 - iii) The far south of the site is in an area at risk of river flooding. A Flood Risk Assessment in accordance with PPS15 may be required for the site.
 - iv) The site is not within a Groundwater Source Protection Zone.
- 7.5 The web site does not include information on closed landfills. For this information, the Environment Agency were contacted direct. The Environment Agency refer to two closed landfill sites, referenced 4700/0348 and 4700/0520, located approximately 100m and 300m east of the site respectively. No further details were provided. There is a possibility of landfill gas migration to the site from the nearby closed landfill sites and, therefore, installation of gas monitoring wells should be installed as part of any future investigation to further assess this issue.

7.6 The Agency also stated that there are no licensed groundwater abstractions within a 1km radius of the site.

8.0 GROUND INVESTIGATION

Trial Holes

- 8.1 A trial hole investigation was carried out on 8th August 2005, using a JCB 3CX excavator, fitted with a backactor. 11No. holes were excavated to depths of between 1.0m and 3.4m below existing ground level, at the positions annotated TH1 to TH11 on the location plan presented in Appendix D.
- 8.2 The trial holes were organised and supervised by a member of ARP Geotechnical Ltd, who recorded the general succession of strata with depth, noted any groundwater regime and took disturbed samples for subsequent examination, and laboratory test as appropriate. The trial hole logs are presented in Appendix D.
- 8.3 The majority of trial holes in the northern and northwestern portions of the site revealed a layer of reworked natural clay with occasional gravel and fragments of concrete and brick, to a depth of between 0.5m and 1.0m, locally overlain by a thin cover of gravel or topsoil. TH1 and TH3 showed this to be underlain by firm to stiff, sandy, slightly gravelly clay to a depth of between 2.0m and 2.1m, which was then underlain by weak to moderately strong, thinly laminated mudstone bedrock. In the area of the former reservoir (TH2), the reworked clay was underlain by soft reworked alluvium to 2.8m depth, which was underlain by 0.3m of firm clay, overlying mudstone bedrock.
- 8.4 In the southern portion of the site, the majority of trial holes revealed a layer of made ground, generally consisting of a mixture of gravel, brick, concrete, metal, plastic and occasional bituminous material in a sandy clay matrix, to between 0.5m and 1.25m, locally overlain by a thin cover of either gravel or bituminous hardstanding. In TH7 and TH8, the made ground was underlain by reworked natural strata to a depth of between 0.95m and 1.15m. Underlying the made ground or reworked natural strata was soft alluvium to between 1.3m and 1.4m depth, followed by firm to stiff, locally soft, sandy, slightly gravelly clay to between 2.5m and 2.8m. The clay was underlain by moderately strong sandstone bedrock.

- 8.5 Trial hole TH9, located in the south eastern corner of the site, revealed made ground to a depth of 1.25m, overlying reworked alluvium to 3.3m depth, with sandstone bedrock beneath. This trial hole is thought to coincide with the area of a former building.
- 8.6 TH10, which was excavated through the embankment extending within the eastern site boundary, revealed reworked natural strata to 1.2m depth underlain by made ground, similar to that present in the southern portion of the site, to 3.2m
- 8.7 In the north eastern corner (TH11), made ground was present to 0.25m depth overlying 1.65m of firm clay and then sandstone bedrock.
- 8.8 A groundwater strike, with oil visible on its surface, was encountered at 2.4m depth in TH9.
- 8.9 *The trial hole sides remained stable for the period of excavation.*
- 8.10 In summary, the northern portion of the site is generally underlain by a layer of reworked natural strata or made ground to a depth of between 0.25m and 1.0m, which is underlain by firm to stiff clay, overlying either mudstone or sandstone bedrock. The southern portion of the site is generally underlain by made ground, locally with a layer of reworked natural strata, overlying soft alluvium to between 1.3m and 1.4m depth, followed by firm to stiff, locally soft, clay overlying sandstone bedrock. Deeper sequences of made ground were encountered in a soil embankment within the eastern site boundary, in the area of a former reservoir and in the area of a former building.

9.0 LABORATORY TESTING

9.1 2 No. samples of the natural strata were issued to the UKAS accredited UK Analytical Laboratory in Leeds for testing with regard to pH, plasticity index and water soluble sulphate content. In addition, a sample of the reworked natural strata and a sample of the made ground were issued to the ECoS Environmental Laboratory in Bradford for testing with regard to pH and water soluble sulphate content. The laboratory test certificates are presented in Appendix E, and a summary with some additional information is presented below.

| Trial Hole | Depth (m) | Stratum | MC | LL | PL | PI | <425µm | I'p | SO ₄ | pH |
|------------|-----------|------------------|------|----|----|----|--------|-----|-----------------|-----|
| TH 5 | 1.5 - 1.8 | Natural clay | 27.5 | 46 | 23 | 23 | 92.7 | 21 | 0.09 | 6.9 |
| TH 7 | 0.0 - 0.3 | Made ground | - | - | - | - | - | - | 0.101 | 7.9 |
| TH 7 | 1.0 - 1.3 | Alluvium | 40.1 | 60 | 31 | 29 | 96.1 | 27 | 0.14 | 6.3 |
| TH 10 | 0.2 - 0.4 | Reworked natural | - | - | - | - | - | - | 0.095 | 7.2 |

MC = Moisture Content % LL = Liquid Limit % PL = Plastic Limit %
 PI = Plasticity Index I'p = Modified Plasticity Index (PI x % < 425µm sieve/100)
 SO₄ = Sulphate content in g/l on a 2:1 water : soil extract pH = Acidity

9.2 The chemical analyses show the natural strata to have low sulphate content and slightly acidic pH. In accordance with the BRE Special Digest 1 'Concrete in aggressive ground', the Design Sulphate Class for the natural subsoils is DS-1. The Aggressive Chemical Environment for Concrete (ACEC) classes for the natural clay and alluvium are AC-1s and AC-1 respectively. Testing on the fill materials indicates classifications of DS-1 and AC-1 to be applicable.

9.3 The plasticity test data shows the natural clay and alluvium to be of intermediate and high plasticity respectively, in accordance with BS 5930 (1999) 'Code of Practice for Site Investigations'. When the percentage retained on the 425 micron BS sieve is considered, the Modified Plasticity Indices for the two materials, in accordance with NHBC Standard Chapter 4.2 "Building Near Trees" are 21 and 27. In accordance with the Standard, this equates to Medium Volume Change Potential.

- 9.4 The samples issued to the EC&S Environmental Laboratory, together with selected additional samples, were also tested for a suite of determinands for which Soil Guideline Values (SGVs) have been published by DEFRA. In order to give a wider spread of potential contaminants, the samples were also tested for further determinands listed on the results certificates. The results are presented in Appendix E and the findings are discussed below.
- 9.5 The strategy for the sampling implemented was to provide a general overview of any contamination within the various made ground, topsoil and groundwater on the site. The testing comprised:
- i) 1No. samples of topsoil
 - ii) 2No. samples of made ground
 - iii) 2No. samples of made ground comprising reworked natural material
 - iv) 1No. sample of groundwater
- 9.6 The results were compared with the Soil Guideline Values (SGVs) derived from the "CLEA" exposure model. Where no SGVs exist, the determinand was compared with other generally accepted generic thresholds for the respective determinand.
- 9.7 The results reveal the reworked natural strata from TH4 to contain elevated concentrations of total arsenic, copper, Total Petroleum Hydrocarbon (TPH) and Polyaromatic Hydrocarbon (PAH). The values registered were 43.1mg/kg, 218.4mg/kg, 1616mg/kg and 214.1mg/kg respectively. The total arsenic value exceeds the SGV of 20mg/kg, the copper and PAH values exceed the Dutch Intervention Values (DIVs) of 190mg/kg and 40mg/kg respectively, and the TPH value exceeds the generally accepted threshold value of 500mg/kg.
- 9.8 A slightly elevated concentration of PAH was also detected in the topsoil, with a value of 41mg/kg obtained.

- 9.9 The made ground contained significant contamination. A sample from TH7 contained elevated concentrations of lead, boron, copper, zinc and Total Petroleum Hydrocarbons, with values of 873.5mg/kg, 2.8mg/kg, 737.5mg/kg, 1391mg/kg and 31974mg/kg respectively. A sample of made ground from TH9 also contained elevated concentrations of copper and TPH, with values of 225.4mg/kg and 2131.5mg/kg. The SGV for lead is 450mg/kg, the DIV for zinc is 720mg/kg and the guideline value for boron is 3mg/kg.
- 9.10 The groundwater sample taken from TH9 contained an elevated concentration of TPH with a value of 3.69mg/l. This value exceeds the DIV for groundwater of 0.6mg/l.
- 9.11 With regard to the made ground and the reworked natural strata from TH4, the elevated concentrations of TPH and PAH in particular would be sufficient to render these materials unsuitable for reuse at or near the surface of a residential garden or soft landscaped area. *Leachability testing of these determinands would be required to determine whether they are likely to affect the adjacent watercourse or underlying Minor Aquifer.* If the determinands were proved to be non-leachable, then the material may be able to remain on site beneath, for example, a 0.75m cover blanket of inert material in soft landscaped areas, beneath areas of hardstanding or beneath building footprints, provided subfloor venting was provided. If the determinands are leachable then they would need to either be encased at shallow depth, within an impermeable barrier or removed from site. The above is subject to confirmation by the Local Regulatory Authorities.
- 9.12 It is likely that the contamination of the reworked natural strata is localised around TH4, however this could only be confirmed through further sampling and testing following demolition of the existing buildings.
- 9.13 The contamination of the groundwater, observed in the sample from TH9, has the potential to affect both the underlying Minor Aquifer and the adjacent watercourse. Therefore, further sampling, possibly by including the excavation of boreholes and installation of monitoring wells would be required to fully assess the extent of the groundwater contamination. The source of the contamination is likely to be the elevated

TPH levels in the made ground. However this should be confirmed through leachability testing and further sampling. Once the extent of the contamination is determined and the source identified, the source should be removed and, subject to the contamination extent, some remediation of groundwater may be necessary.

- 9.14 A full contamination investigation and Risk Assessment in accordance with BS 10175 'Investigation of potentially contaminated sites', with additional sampling and testing is advisable to address the above issues. This will allow a suitable remedial strategy to be designed and agreed with the Regulatory Authorities.

10.0 COMMENT AND CONCLUSION

General

- 10.1 The geological map shows the site to be underlain by undifferentiated strata (a combination of sandstone, siltstone and mudstone) of the Lower Coal Measures of the Carboniferous Period. The solid strata in the southern third of the site is indicated as having a cover of alluvium. However, there is no drift cover shown on the remainder of the site. There are no faults within influencing distance of the site.
- 10.2 The coal report indicates the site is stable with regard to coal mining.
- 10.3 The Ordnance Survey archive plans show that, at some time between 1854 and 1893, the site was developed with a Worsted Mill, pond and roadway, together with an assortment of smaller buildings, including a gasometer and a Well. The site was redeveloped as a Silk Mill in the 1920s and this included the construction of tanks and additional buildings. Since the 1920s, the site has continued to be redeveloped with buildings regularly demolished and reconstructed. A legacy will remain from the buildings formerly and currently occupying the site, with the possibility of encountering buried foundations and structures, possibly including cellars during development. The well is also likely to require filling and capping.
- 10.4 The ground investigation showed that the northern portion of the site is generally underlain by a layer of reworked natural strata or made ground to depths of between 0.25m and 1.0m, which is underlain by firm to stiff clay, overlying either mudstone or sandstone bedrock. The southern portion of the site is generally underlain by made ground, locally with a layer of reworked natural strata, overlying soft alluvium to between 1.3m and 1.4m depth, followed by firm to stiff, locally soft clay and then sandstone bedrock. Deeper sequences of made ground in the order of up to at least 3.2m, were encountered in a soil embankment within the eastern site boundary, in the area of a former reservoir and in the area of a former building.

Environmental Considerations

- 10.5 The radon assessment has indicated that no radon protection measures will be required for properties constructed on the site.
- 10.6 The landfill search indicated the presence of two closed landfills within a 500m radius of the site. Therefore, there is a possibility of landfill gas migration to the site and it is recommended that gas monitoring wells are installed on the site as part of any future investigation to further assess this issue.
- 10.7 The southern end of the site is within an area at risk from river flooding. A Flood Risk Assessment in accordance with PPS15 is probably required.
- 10.8 The contamination testing revealed elevated determinands to be present within the made ground, topsoil and groundwater across the site, particularly with regard to Total Petroleum Hydrocarbon (TPH). A full contamination investigation and risk assessment, in accordance with BS 10175 'Investigation of potentially contaminated sites', with additional sampling and testing is advisable to assess the leachability of the soil contamination and the extent and severity of the groundwater contamination. This will allow a suitable remedial strategy to be designed and agreed with the Regulatory Authorities.

Foundations

- 10.9 The natural clay and sandstone and mudstone bedrock encountered across the site should be suitable to accept foundation loads using traditional strip or trench fill foundations. The firm clay will provide an allowable bearing pressure of 125kN/m², whereas allowable bearing pressures of 200kN/m² and 300kN/m² are considered appropriate for the mudstone and sandstone bedrock respectively.
- 10.10 The clays were shown to be of medium volume change potential. Therefore, in accordance with NHBC Standard Chapter 4.2 "Building near trees", a minimum

foundation depth of 0.9m below adjacent finished ground level is applicable. However, in the presence of any proposed, existing or removed trees, the foundation may need to be deepened, depending on the type of tree and its distance from the face of the foundation.

- 10.11 The whole plan area of the foundation should be placed on similar material. If bedrock is encountered on part of a foundation, the rest of the plot should be deepened to ensure founding on similar material. The foundation should also be taken below the depth of any existing foundations, obstructions or made ground onto natural ground.

Excavations

- 10.12 Excavations within the made ground and natural strata should generally be readily achieved using conventional hydraulic plant. However, the use of a hydraulic breaker may be required if any buried foundations or structures are encountered, and for any penetration into intact rock.

- 10.13 Excavations should remain stable with minimum statutory support.

- 10.14 Groundwater may be encountered within excavations in the southern portion of the site, however, this should be controllable through intermittent pumping from an artificial sump. No groundwater suspected to contain contamination should be allowed to enter any drain or watercourse.

Chemical Precautions

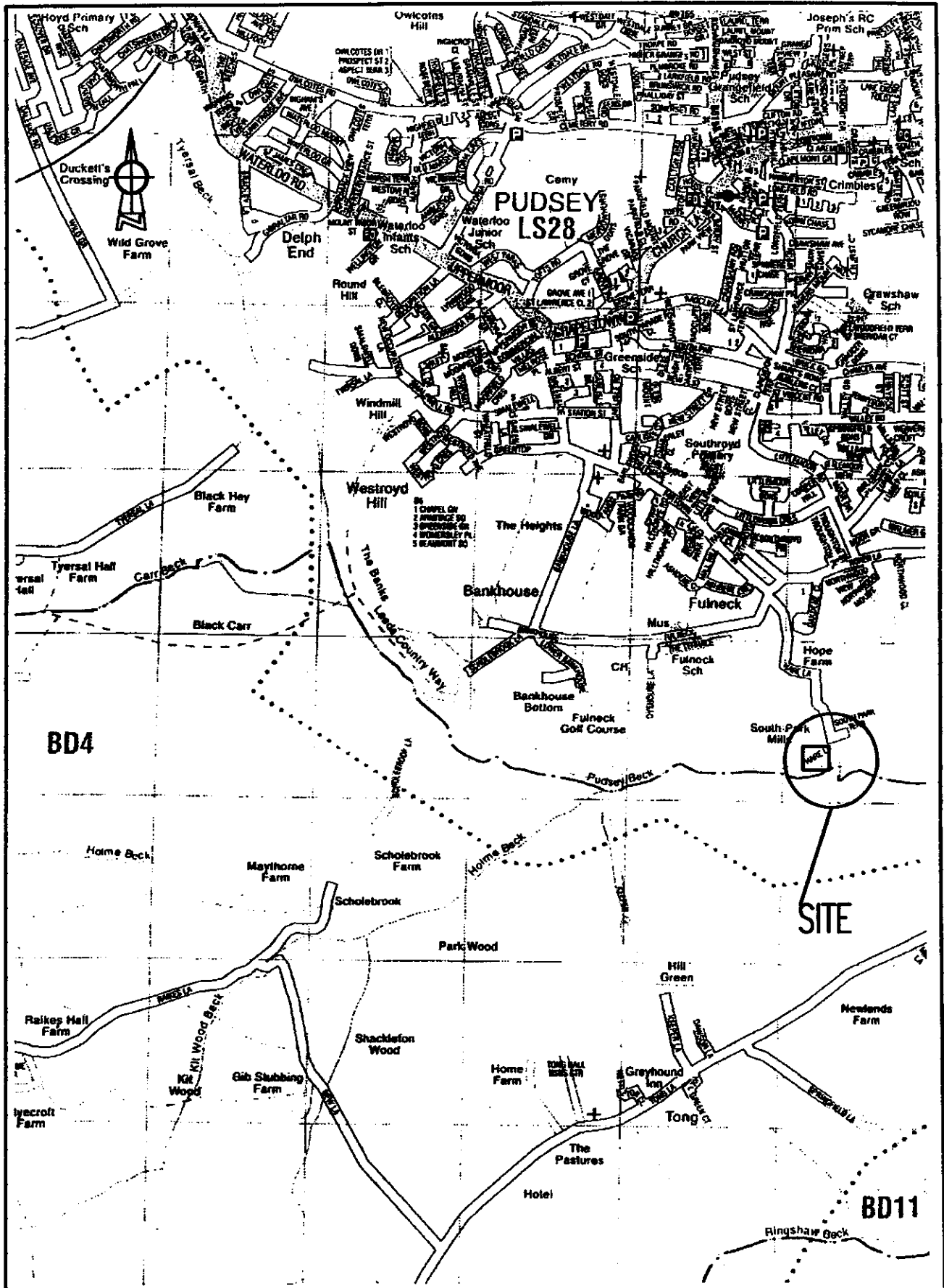
- 10.15 Classifications DS-1, AC-1 and AC-1s apply to the site with regard to foundation concrete and buried mortar. Therefore, good quality cementitious material with ordinary Portland cement should generally be adequate against chemical attack.


Carriageway Construction

- 10.16 For any areas of adoptable road pavement, the formation will be the natural clay. Below any obvious soft spots, and at equilibrium moisture content, a design CBR value of 3% is considered applicable. In some areas, carriageway formation on natural ground will not be feasible. In these areas, it may be possible to reach agreement with the Local Regulatory Authority to remove the upper 1.0m of made ground and to recompact the material to a controlled specification, or replace the material with a compacted granular sub-base.

APPENDIX A

SITE LOCATION PLAN



| | | | |
|--|--|---------------------------------|--------------------|
| Title SITE LOCATION PLAN |  ARP GEOTECHNICAL CHARTERED CONSULTING ENGINEERS Northwest House • 5/6 Northwest Business Park Savile Hill • Leeds LS6 2QH Telephone : 0113 245 0400 • Fax : 0113 244 3004 E-Mail : leeds@arpgeotechnical.co.uk | Scale NTS | Drawn LM |
| | | Date AUG 05 | Chk. |
| Project/ Client SOUTH PARK MILLS, PUDSEY ACRVARN LTD | | Drg. No. ACR/01/SI.01 | Rev. / |

APPENDIX B

ORDNANCE SURVEY ARCHIVE PLANS



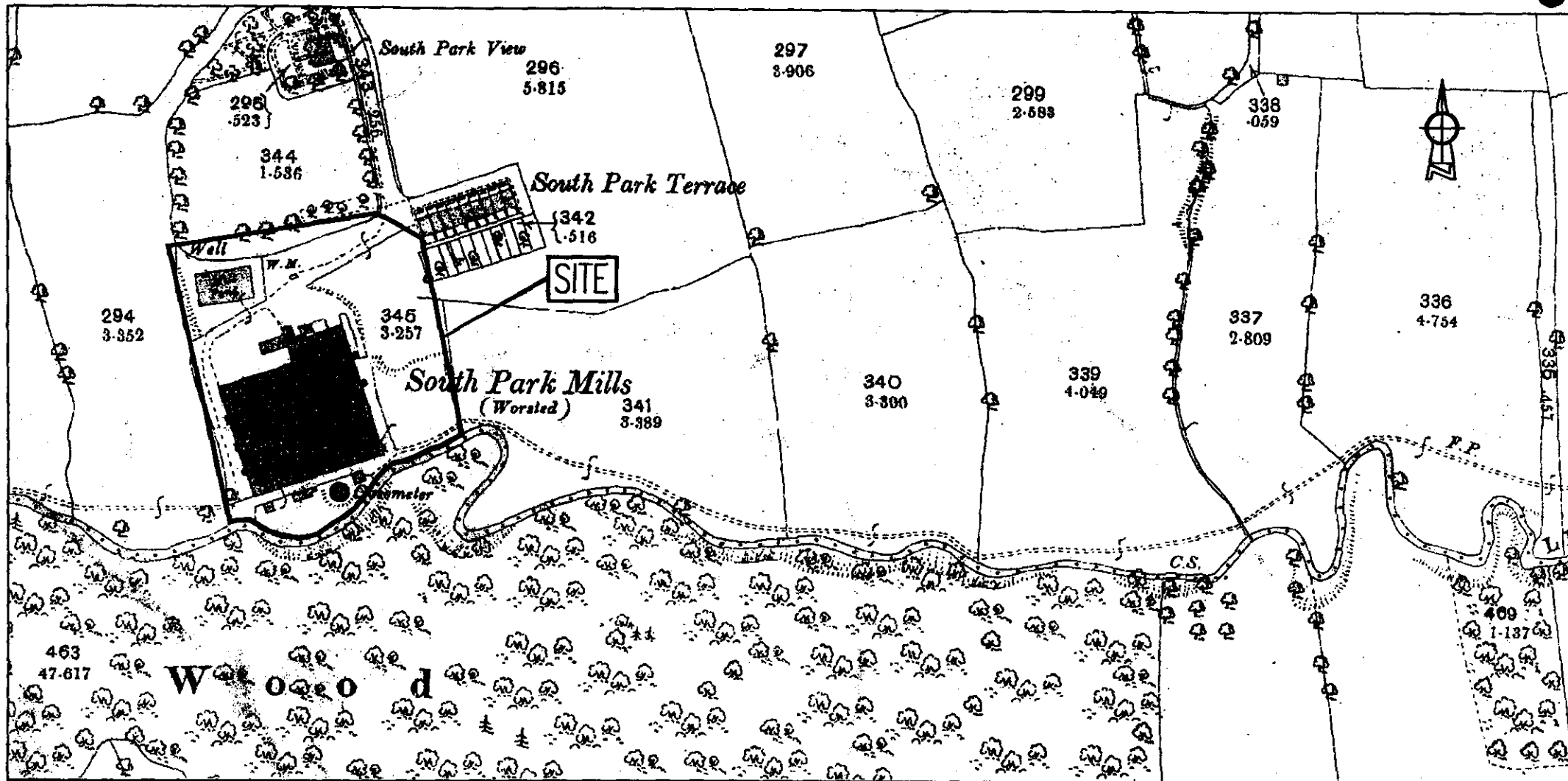
Title
YORKSHIRE SHEET 217
 6" to 1 mile (1st Edition)

Project/Client
SOUTH PARK MILL, HARE LANE, PUDSEY.
ACRVARN LTD.



ARP GEOTECHNICAL
 CHARTERED CONSULTING ENGINEERS
 Northwest House • 5/6 Northwest Business Park
 Servis Hill • Leeds LS8 2QH
 Telephone : 0113 245 8408 • Fax : 0113 244 3864
 E-Mail : leeds@arpgeotechnical.co.uk

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| Scale | N.T.S | Drawn | MW |
| Date | AUG 05 | Chk. | |
| Org. No. | ACR/01/A.01 | | Rev |



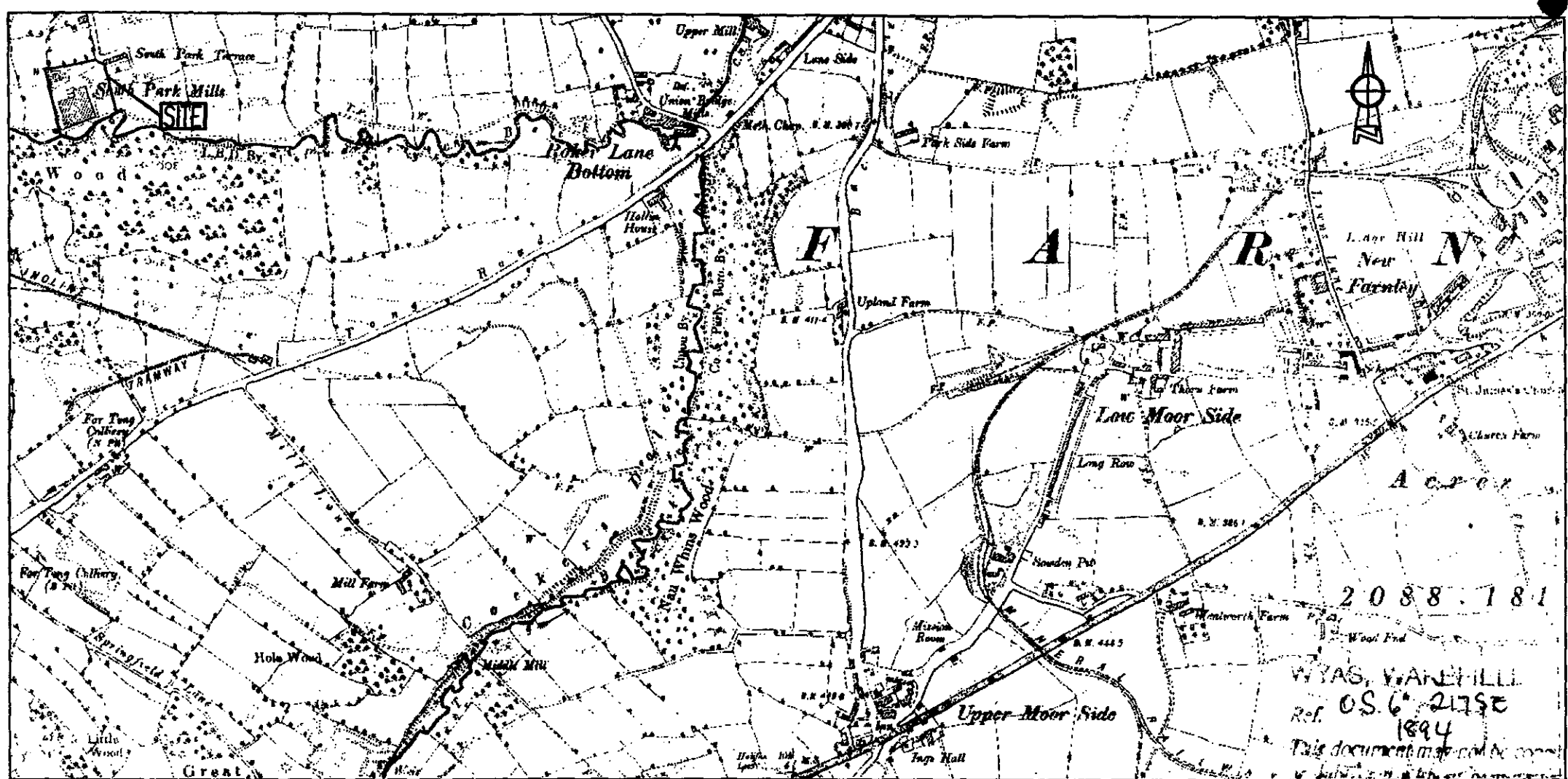
Title
YORKSHIRE SHEET 217/11
 25" to 1 mile (1893)

Project/Client
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ACRVARN LTD.



ARP GEOTECHNICAL
 CHARTERED CONSULTING ENGINEERS
 Northwest House • 5/6 Northwest Business Park
 Service Hill • Leeds LS8 2QH
 Telephone : 0113 245 8488 • Fax : 0113 244 3884
 E-Mail : leeds@arpgeotechnical.co.uk

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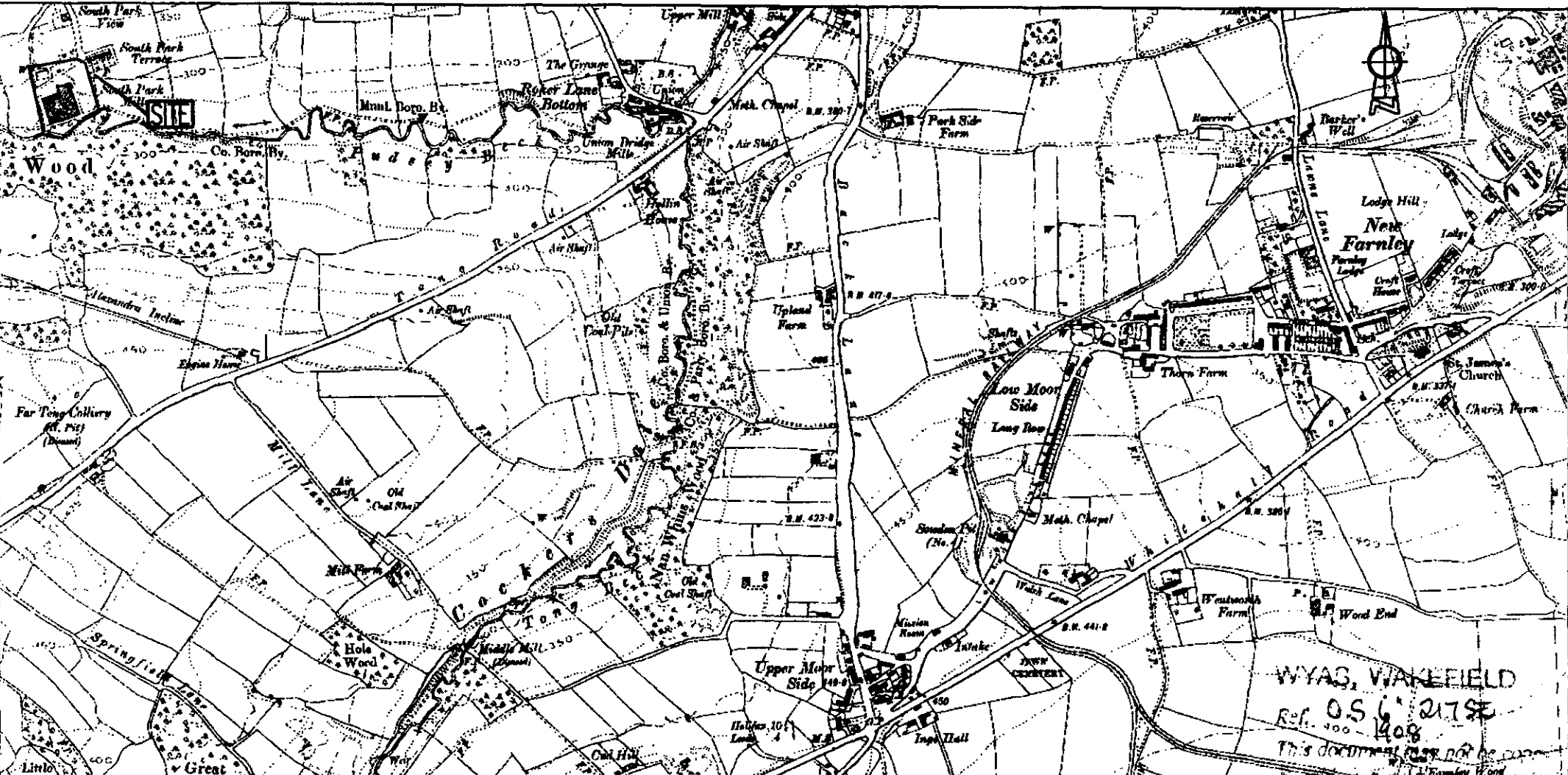
This YORKSHIRE SHEET 217/SE
 6" to 1 mile (1894)

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 ACRIVARN LTD.



ARP GEOTECHNICAL
 CHARTERED CONSULTING ENGINEERS
 Marlwood House - 5/8 Marlwood Business Park
 Service Hill - Leeds LS8 2QH
 Telephone : 0113 245 9400 - Fax : 0113 244 3084
 E-Mail : leeds@arpgeotechnical.co.uk


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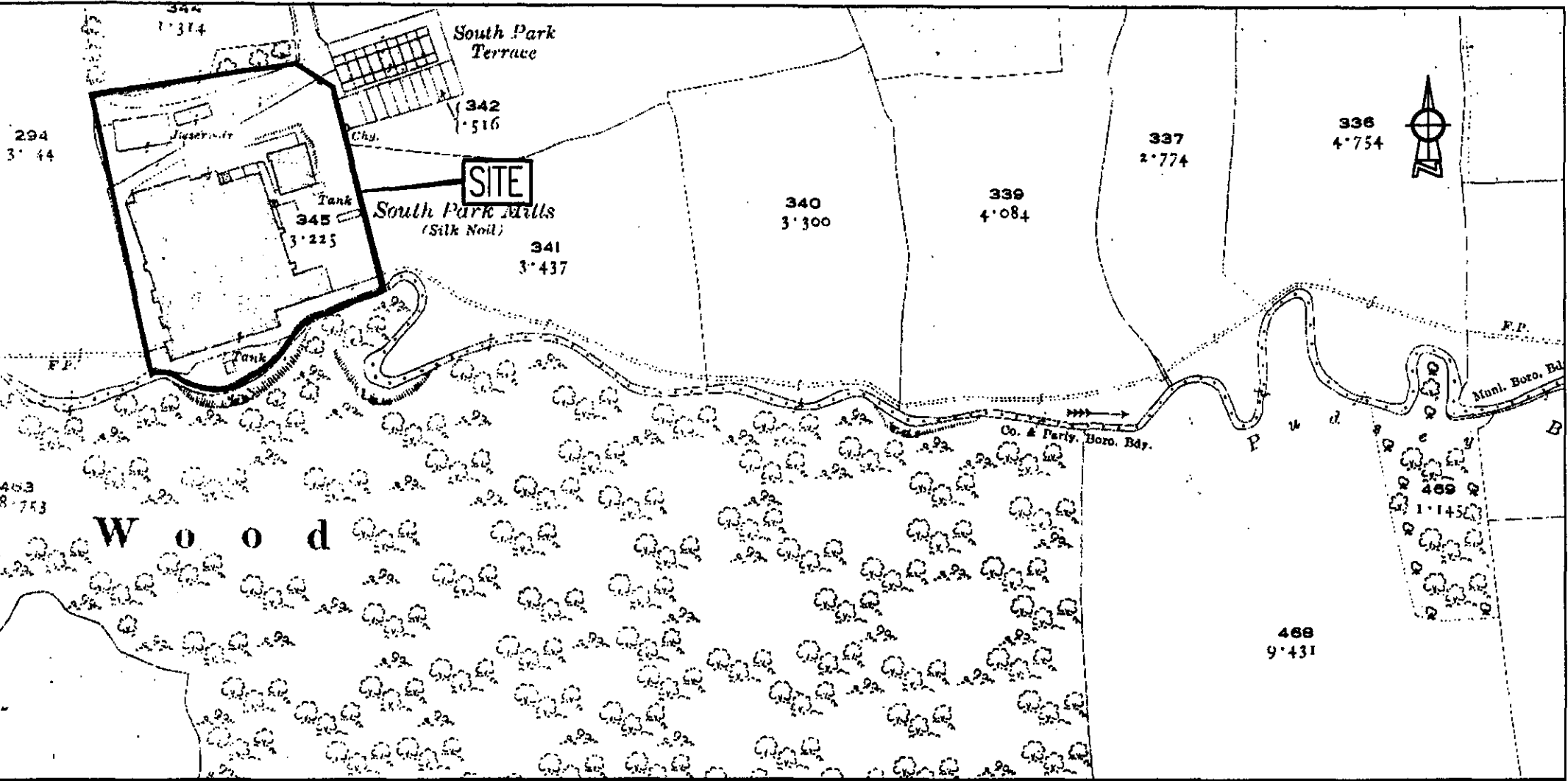
Title
YORKSHIRE SHEET 217/SE
 6" to 1 mile (1908)

Project/Client
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ACRIVARN LTD.



ARP GEOTECHNICAL
 CHARTERED CONSULTING ENGINEERS
 Northwest House • 5/6 Northwest Business Park
 Service Hill • Leeds LS6 2ZH
 Telephone : 0113 245 8488 • Fax : 0113 244 3884
 E-Mail : leeds@arpgeotechnical.co.uk

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| Date | AUG 05 | Chk. | |
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Title
YORKSHIRE SHEET 217/11
 25" to 1 mile (1921)

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ACRIVARN LTD.



ARP GEOTECHNICAL
 CHARTERED CONSULTING ENGINEERS
 Northwest House • 5/8 Northwest Business Park
 Service Hill • Leeds LS9 2QH
 Telephone : 0113 245 8400 • Fax : 0113 244 3084
 E-Mail : leads@arpgeotechnical.co.uk

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