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12 November 2004

DESK STUDY REPORT
FOR
CLARK WEIGHTMAN
On a site at
Former Barton Gas Works
Off Dam Road, Barton Upon Humber
Lincolnshire

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DRAWINGS 12040483/001 Site Location Plan

APPENDIX A Landmark Environmental Report with Historical Plans

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A FACTUAL INFORMATION

1.0 INTRODUCTION

1.1 This report describes a desk study investigation carried out for Clark Weightman on the former Barton gas works, off Dam Road, Barton Upon Humber, Lincolnshire.

1.2 It is understood that the site is to be redeveloped with a number of residential properties with private gardens.

1.3 The objectives of this desk study were to obtain information relating to the likely ground conditions in order to make a preliminary assessment of suitable methods of design and construction for foundations and roads etc. for the proposed development. In addition an initial desk based assessment for potential contamination and ground gas has been carried out to determine the need for possible remediation requirements. A preliminary environmental assessment including the creation of a preliminary conceptual site model has been carried out to determine factors potentially affecting the site development.

1.4 This report has been produced on behalf of the Client, Clark Weightman, and no responsibility is accepted to any Third Party for all or any part. This report should not be relied upon or transferred to any other parties without the express written authorisation of Joynes Pike & Associates Limited. If any unauthorised Third Party comes into possession of this report, they rely on it at their own risk and the authors owe them no duty of care or skill.

1.5 Findings and opinions conveyed via the desk study within this report are based on information obtained from a variety of sources as detailed within this report, which Joynes Pike & Associates Limited believes are reliable. Nevertheless, Joynes Pike & Associates Limited cannot and does not guarantee the authenticity or reliability of the information it has relied upon.

1.6 A site walkover survey has not been carried out as part of this assessment.

1.7 The site plans enclosed in this report should not be scaled off.

2.0 THE SITE

2.1 Location and Access

2.1.1 The site is roughly rectangular in shape, covering an approximate area of 0.7 acres 0.3ha in area and is situated adjacent to the north of Dam Road, Barton upon Humber, Lincolnshire.

The site is centred on National Grid Reference TA 0276 2259 as shown on the Site Location Plan, Drawing No. 12040483/01.

The Site is located approximately 850m South of the River Humber.

2.1.2 Access to the site is gained via Dam road.

2.2 Site Description

The current state of the site is unknown at this stage as no walk over was requested.

3.0 DESK STUDY

3.1 Sources of Information

3.1.1 An Envirocheck Report provided by Landmark Information Group Services for the site has been commissioned. Appended to this report in Appendix A are Historical Ordnance Survey maps, which have been inspected to determine previous land uses, potentially contaminative uses and any changes in land use of the site.

3.1.2 The editions reviewed are listed below;

Series	MAP SHEET	SCALE	YEAR OF PUBLICATION
Yorkshire	239-00 254a-00	1:10560	1855
Lincolnshire	007-05	1:2,500	1882
Lincolnshire	007-NW/SW	1:10,560	1890
Yorkshire	239- SE	1:10,560	1892
Lincolnshire	007-05	1:2,500	1908
Lincolnshire	007-NW/SW	1:10,560	1908-1911
Yorkshire	239- SE	1:10,560	1911
Lincolnshire	007-NW/SW	1:10,560	1930-1933
Lincolnshire	007-05	1:2,500	1932
Yorkshire	239- SE	1:10,560	1938
Lincolnshire	007-NW/SW	1:10,560	1948-1951
National Grid	TA02SW	1:2560	1956
National Grid	TA0222/322	1:2500	1968
National Grid	TA02SW	1:10,000	1971
National Grid	TA0222/322	1:2,500	1976
National Grid	TA02SW	1:10,000	1982
National Grid	TA0222/322	1:2,500	1983
National Grid	TA02SW	1:10,000	1994
National Grid	TA02SW	1:10,000	2000

3.1.3 Reference has also been made to the following sources:

- BRE211 “Radon: Guidance on protective measures for new dwellings”.
- Law Society Guidance notes and Directory for coal mining searches, 1998 Edition.
- DoE industry Profile gas works, coke works and other coal carbonizations plants (extract in APPENDIX B).

3.2 Historical Search

Upon review of the historical maps (enclosed with the Landmark Envirocheck Report as Appendix A) the following observations were made.

1888 – 1890 editions

The site is shown to be occupied by a Gas Works. A number of buildings and a circular feature, possibly a gasometer are shown on the site.

The surrounding area is occupied by farmland with a windmill shown to the north and a Brick Yard and Station to the east. A rope works is shown to the north of the site. A Chemical Works is marked north of the site fronting the River Humber and Barton Haven.

1908 edition

The site and surrounding area are shown as the previous editions however an additional circular feature is now shown on site. Numerous brick works to the north fronting the River Humber.

1911 edition

The site is as previous editions however a whiting works is shown beyond the northern site boundary. The circular gasholders are not shown and the site is no longer marked as a Gas Works.

1930's editions

The gasholders and buildings shown are as on 1908 edition, although site not marked as a Gas Works. A Gasometer is shown, but the previously shown building is not. The brick works to the north renamed tile works. There are many brick pits shown to the north and north east of the site associated with the brick works.

1956 edition

The site is as previous editions however the whiting works has gone. The chemical works to the north is shown to have expanded.

1968 editions

No appreciable changes on site. Housing development has increased to the south of the site.

1976 edition

The former gasholders are shown as tanks. Surrounding features are the same as previous editions. Some of the flooded former clay pits to the north are shown as infilled.

1982 edition

The tanks are no longer shown on this edition and the site is no longer labelled. Two buildings are shown on site to the north west and south west. The surrounding area to the Humber Bridge which is now shown, on the 1982 edition, shows works, warehouses, hopers and conveyors to the east of the site.

1984 edition

The site and immediate surrounding area are unchanged. The chemical works to the north is no longer indicated.

2000 edition

Little change of significance to the site and surrounding area. Parts of former clay pits appear further infilled.

3.3 Geology

3.3.1 The British Geological Survey sheet 80, Kingston Upon Hull indicates the site to be underlain by the Ferriby Chalk with reddened basal beds of the Upper Cretaceous Chalk.

3.3.2 Drift deposits are shown to include marine Estuarine Alluvium, glacial head, brick earth, peat, river terrace deposits.

3.3.3 It should be noted that the BGS have records of a number of boreholes on the site and in the area and it may be worth obtaining this data if possible, as it may yield useful data.

3.4 Mining

3.4.1 The site is not located in an area affected by coal mining.

3.5 Environmental Considerations

3.5.1 An Envirocheck report has been commissioned as part of this assessment a copy of which is enclosed as Appendix A. The pertinent features of the report are presented below.

3.5.2 There are no known landfills within 500 meters of the site boundary.

3.5.3 There has been one recorded pollution incident to controlled waters within 250m of the site boundary, an oil spill to Furlings Drain in 1994, however this is unlikely to affect the redevelopment of the site. The incident was recorded as significant.

3.5.4 There are no water abstractions within 500m of the site, the nearest is 745m to the west but was revoked. The nearest public supply borehole is 1.8 km to the south east at Barton Pumping Station.

3.5.5 There are three discharge consents within 250m of the site none of which are likely to affect the redevelopment of the site.

3.5.6 The site is shown to be on a tidal indicative flood plane and as such a flood risk assessment may be required.

3.5.7 The Groundwater vulnerability map attached to the landmark Envirocheck Report shows the site to lie on a major aquifer with soils of high leaching potential.

3.5.8 This means that the soils have little or no ability to attenuate / diffuse source pollutants, which can as a result move readily to the underlying groundwater.

3.5.9 The nearest site of special scientific interest (SSSI) is the Humber Estuary to the north and north east.

B ASSESSMENT / RECOMMENDATIONS

4.0 PRELIMINARY GEOTECHNICAL ASSESSMENT

4.1 General

4.1.1 The assessment and recommendations below are based on the desk study information available only and will require refining based on the results of a full geo-environmental site investigation.

4.1.2 It has been assumed for the purposes of this assessment that the proposed development levels will be similar to existing. Should development levels vary significantly from existing it may be necessary to revise recommendations made below.

4.1.3 It is considered that there will be localised significant thicknesses of made ground associated with former site features for example gas holders, former buildings.

4.1.4 The natural soils underlying the site are assumed to be drift deposits of Marine and Estuarine Alluvium Glacial Head and possibly Peat overlying Upper Cretaceous Chalk. The Estuarine Alluvium may contain layers of peat and soft clay material and as such may have a low bearing capacity and/or may be compressible.

4.1.5 Natural ground is expected to be encountered at relatively shallow depths on the site away from current or former on-site structures.

4.2 Foundations/Floor Slab Design

4.2.1 Based on the information available at present it is not possible to speculate on possible foundation designs until intrusive ground investigation works have been undertaken.

4.2.2 No Radon protection measures are required for this site, however gas monitoring should be undertaken on site due to the previous use of the site as a gas works. On completion of a gas monitoring programme gas protection recommendations will then be made.

4.3 Construction

4.3.1 In accordance with guidelines contained in Part 1 of BRE Special Digest 1: Concrete in aggressive ground (2001), from consideration of the sites geology and ground conditions, the site has been categorised as a Brownfield site. The natural ground on the site has been assigned an ACEC (Aggressive Chemical Environmental for Concrete) Class AC – 2.

4.3.2 In areas of fill containing unnatural material which are to remain in contact with buried concrete and concrete products then it would be prudent to adopt Sulphate resistance precaution.

4.3.3 In addition, given the nature of the potential contaminants resulting from the sites previous use it is recommended that an allowance is made for protecting water services on site, particularly water supply pipes, which could be penetrated by certain organic contaminants suspected to be present.

4.3.4 If significant contamination is encountered during site investigation works, a more robust concrete mix may be required.

4.4 Road / Pavement Design

4.4.1 It is anticipated that road formation will be within Made Ground materials. This material will require removing, sorting and replacing in compacted to layers to achieve a CBR value of 2%.

4.4.2 Specialist geotextile details may be required where areas of estate road cross over from areas where the depth of the made ground varies rapidly or the sub strata are proved to be highly compressible.

4.5 Soakaways

4.5.1 Based on the information available to date, it is considered that the site is unlikely to be suitable for adopting soakaways to dispose of surface water due to the past site use and anticipated cohesive natural strata anticipated beneath the site.

4.5.2 Surface water from both highway and domestic drainage should therefore be designed and taken of site.

5.0 PRELIMINARY ENVIRONMENTAL ASSESSMENT

5.1 Contamination

5.1.1 Soil

Based on the available information relating to known historical uses of the site, it is considered extremely likely that the site will be affected by moderate to significant ground contamination.

Given due consideration to the historical use of the site, reference has been made to the Department of the Environment Industry Profiles as outlined in Section 3.1 of this report and it is considered likely that the soils at the site will be affected by the following potential Principal Contaminants of Concern (PCOC's). Much depends upon the age of gas production on the site and the size of the operation. Contaminants may include.

ORGANIC

Constituents of coal tar	aromatic hydrocarbons e.g. benzene toluene, and xylenes polycyclic aromatic hydrocarbons (PAH's) e.g. naphthalene and anthracene hydroxyl substituted phenyls e.g. phenols, cresol, xylenols and related compounds, sodium phenoxide, heterocyclic nitrogen compounds e.g. pyridine organo-sulphur compounds e.g. thiophane nitrogen compounds e.g. hydrazine (boiler maintenance), triethanolamine 2-mercaptobenzothiazole
Fuels	petroleum naphtha (low boiling point fractions of petroleum)

INORGANIC

Acids	Sulphuric Hydrochloric Acid Tar (low pH PPH's)
Alkalis	Sodium hydroxide Sodium carbonate

Other inorganic compounds	sulphates sulphides carbonates phosphates cyanides-mostly complex cyanides such as ferrycyanides and ferrocyanides ammonium sulphate and ammonium cyanide (from ammoniacal liquor) thiocyanates oxides elemental sulphur arsenatic salts calcium hydrosulphate and calcium thiocarbonate (foul lime)
Metals and metal compounds	cadmium chromium* cobalt* copper iron* lead nickel* manganese magnesium mercury molybdenum*

Asbestos

*oxides of cobalt, chromium, iron, molybdenum, nickel and zinc used as catalysts in the coal carbonization process.

Extracts of the examined DOE profiles are presented as Appendix B

Many of the identified PCOC's are highly toxic to human health and some are carcinogenic. All may affect aquatic species and groundwater quality.

In view of the above, it is considered that the site potentially contains numerous sources of contamination resulting from both historical uses.

5.1.2 Leachate

It is impossible to predict the potential mobility of contaminants without undertaking laboratory testing of samples collected from a suitably designed site investigation. However given the potential for significant liquid

contaminants being present (i.e. PAH's, creosols, phenols, BTEX), it is considered likely that the mobility of the soil contamination will be significant.

5.1.3 Groundwater

It is considered likely at this stage that groundwater contamination may have occurred beneath the site due to spillages from the surface and possible ruptured tanks and pipelines.

It should be noted, however, that it would be prudent to allow for a detailed investigation of the groundwater beneath the site to assess the impact of the anticipated existing contaminated soils.

5.2 Ground Gases

5.2.1 No Radon Protective Measures are required for the site. However a ground gas monitoring investigation will be required for the site to determine if the on site made ground is gassing.

5.3 Other Considerations

5.3.1 The existing buildings on site are Likely to be of a wide range of ages and they will contain building materials which may contain asbestos. It is therefore recommended that a Type 3 Asbestos Survey is carried out prior to any demolition of existing structures.

6.0 PRELIMINARY CONCEPTUAL SITE MODEL

6.1 Potential Sources

6.1.1 Based on the current knowledge of the site and its historical uses, it is considered that there are numerous potential sources of significant contamination on the site associated with both historical and current site uses. The principal sources of contamination are likely to be tar pits, gasholders, coal carbonization process (retorts) and the refining purifying process.

6.2 Potential Receptors

6.2.1 Following redevelopment of the site, it is considered that the potential receptors at risk from potential contamination are future occupants, particularly those in the traditional residential dwellings with associated private gardens, the groundwater beneath the site of the nearby tidal drain to the River Humber.

6.3 Potential Exposure Pathways

6.3.1 The identified receptors at the site may be exposed to potential contaminants by a number of plausible pathways.

6.3.2 Future occupants may be exposed to potential contaminants through the following pathways:

Traditional house occupants

- Direct ingestion of contaminated soils/ground water/liquids/sludge)
- Ingestion of vegetables grown in contaminated soils
- Ingestion of contaminated soils attached to vegetables grown in contaminated soils
- Ingestion of dust derived from contaminated soils
- Absorbent contaminants through dermal contact
- Inhalation of dust derived from contaminated soils
- Inhalation of vapours derived from contaminated
- Permeation of water pipes by organic contaminants

6.3.3 Potential contamination present on the site, which are potentially mobile present a potential risk to groundwater by leaching or direct movement through the permeable soils to affect groundwater and any nearby watercourses.

6.4 Potential Pollutant Leakages

SOURCE	PATHWAY	RECEPTORS
Contamination Soil	Ingestion Dermal Contact Inhalation	Future Residents
Contamination Soil	Inhalation of Vapours	Future Residents & Existing Neighbouring Residents
Contamination Soil	Root Uptake	Future Residents
Contamination Soil	Leaching/direct movement	Groundwater & Watercourses
Contamination Soil	Aggressive Attack	Building Materials
Contaminated Groundwater/Leachate	Ingestion/dermal Contact	Future Residents & Neighbouring Residents
Contaminated Groundwater/Leachate	Inhalation of Vapours	Building Materials
Contaminated Groundwater/Leachate	Direct Contact	Building Products/ Concrete/Plastics
Contaminated Groundwater/Leachate	Direct Lateral Migration	Watercourses
Ground Gases	Lateral/Vertical Migration	Future Residents & Existing Neighbouring Residents
Contamination Soil/ Groundwater	Permeation of Service Pipes	Future Residents Water Quality

7.0 CONCLUSION AND RECOMMENDED FURTHER WORKS

7.1 It is recommended that the following investigation works are carried out to characterize the site in more details.

- Intrusive investigation on targeted and non-targeted basis to assess all identified potential issues and to characterize as far as reasonable the site and its environmental setting including the following targets:
    - Location and form of backfilling of former underground features.
- Appropriate site investigation, in situ testing and laboratory to confirm geotechnical and geochemical conditions.
- Gas and groundwater monitoring.
- Detailing quantitative site specific risk assessment where hazards are identified.

7.2 The result of the investigation and analysis should be assessed in accordance with current UK guidance and in particular the provision of the CLR reports and associated CLEA model. This may require detailed site specific risk assessment if significant concentrations of potentially hazardous substances are encountered.

7.3 It is recommended that the relevant regulatory bodies Environment Agency and Local Authorities ENV Health are consulted prior to investigation works commencing to ensure that their concerns are addressed satisfactorily. At this stage, it is considered highly likely works will be necessary. The anticipated remediation requirements are presented in Section 8 below.

7.3.1 In addition, we would recommended that a Type 3 Asbestos Survey is carried out prior to any demolition and site clearance works.

8.0 ANTICIPATED REMEDIATION REQUIREMENTS

8.1 An assessment of available information has been made of the potential contaminants, pathways and receptors. It is considered likely remedial requirements will be required in order to render the site suitable for re-use as residential properties and to reduce the potential risks to environmental receptors to within acceptable levels.

8.2 It should be noted that the assessment presented is based on the desk study information, our experience similar sites and recent experience of regulatory requirements.

8.3 In addition, no preliminary discussions have been made with either the Local Authority or the Environment Agency. It is recommended that should the site be progressed any proposed investigations are submitted to them for comment in order to address their specific concerns/requirements. In addition, we would recommend that site specific detailed information is requested from them prior to undertaking a detailed investigation.

8.4 In general, the remediation philosophy to be adopted is to break the identification pollution linkages i.e. by removing one of the key parameters, the source, the pathway or the receptor. As removed of any of the identified receptors is unlikely it will be necessary to mitigate the risks by remove/reduce the source, or remove the pathway or both.

8.5 It is anticipated that, at this stage it will be necessary to excavate and remove grossly contaminated soils to a suitability licensed off site disposal facility “Grossly Contamination” being defined by detailed site specific quantitative risk assessment for both human health and groundwater.

8.6 In addition to the identified potential area of gross contamination it is considered likely that shallow made ground materials across the site will contain slight to moderate levels of contamination, which may also require some form of remediation.

8.7 At this stage it is recommended that an allowance is made for providing a minimum of 1000mm of clean cover in garden areas which, due to the lack of suitable materials on site, will require importing from an approved source.

8.8 Given the types of contamination anticipated it is recommended that an allowance is made to provide suitably protected underground pipe work for water supply and disposal etc. It may be necessary to adopt ductaline or ductile iron pipes for water supply purposes and hydrocarbon resistance rubber seals for drainage pipes and/or provide clean granular pipe surround.

8.9 The level of investigation and risk assessment require to design a suitable remediation strategy is likely to be high in order to address all potential historical sources of contamination and to ensure uncertainty is minimized.

We trust the above provides you with all you require at this stage, although should you have any queries please do not hesitate to contact us.

For and Behalf of Joynes Pike & Associates Limited

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DRAWINGS

APPENDIX A

Landmark Envirocheck Report with Historical Plans

APPENDIX B
DOE Industry Profile Extract