PHASE 1 GEO-ENVIRONMENTAL GROUND INVESTIGATION
AT
SALEM MILL, OFF HYDE BANK ROAD, NEW MILLS, HIGH PEAK, DERBYSHIRE, SK22 4BN
FOR
AIM ENGINEERING LIMITED

Integra Consulting Engineers
Fountain House
Fountain Street
Manchester
M2 2EE

Tel 0161-237-3400
Fax 0161-237-3635

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By: SS

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1.0 EXECUTIVE SUMMARY

1.1 Integra Consulting Engineers Ltd has been instructed by AIM Engineering Limited to undertake a Phase 1 geo-environmental ground investigation at Salem Mill, New Mills in Derbyshire. The Ordnance Survey national grid reference for the centre of the site is Easting: 400230 and Northing: 385900.

1.2 The objectives of the report were to assess the probable geological and contaminated land conditions on and beneath the surface and to identify potential contaminants present at the site. A preliminary conceptual model was then to be developed to define the scope and extent of any further investigations deemed necessary.

1.3 The site comprises an irregular shaped plot of land of approximately 0.2 hectares in area and the elevation across the site is generally level at approximately 147m above Ordnance Datum (AOD). The site is currently occupied by an 18th century four storey gritstone mill (Salem Mill) and a number of relatively recently built masonry clad garages adjoined to the east of the original mill building. The external area to the front of the buildings is covered in concrete hardstanding and a thin strip of soft landscaping is present around the southern and eastern site boundaries.

1.4 The western section of the site is underlain by drift deposits of Pleistocene alluvium which in turn is underlain by Carboniferous Lower Coal Measures. The eastern section of the site is underlain by drift deposits of Quaternary boulder clay which in turn is underlain by Lower Coal Measures sandstone. The area of the site is classed as a minor aquifer by the Environment Agency and due to the potential permeability of the overlying drift deposits it is possible that any on site contamination may permeate into the underlying aquifer. The site does not lie within a Source Protection Zone but has been affected by extreme flooding in the recent past.

1.5 The site was occupied by an 18th century traditional textile mill originally used for cotton weaving. During the late 19th century, the mill was utilised as a chemical works until the 1930's. The site was occupied by a sheet metal fabrication company from 1965 until circa 2006 and additional garage buildings were constructed during the 1970's.

1.6 A number of potential contamination sources were located on site and these include the historic chemical works and the more recent sheet metal fabrication works which occupied the mill building. In summary, a wide range of contaminants could be present on site originating from a variety of current and historical sources. In addition, made ground could be present beneath the site and hence pose a risk to human health from ground gases and It is therefore recommended that a gas monitoring programme is undertaken.

1.7 The River Sett is situated adjacent to the northern site boundary and therefore there is a potential pathway for contaminants via lateral migration through soils / groundwater and overland flow into this potential receptor. The site lies within a Flood Zone and will therefore require a Flood Risk Assessment (FRA). It is also in an area where basic radon protective measures are required although it is not situated in an area affected by coal mining or brine extraction.

1.8 In summary, the site is expected to be affected by contamination due to its past and present uses and as the proposed development is a residential housing estate with gardens the risk to human health from any on-site contamination sources and ground gases will be a necessary consideration. There may also be a risk to groundwater contained in the underlying minor aquifer and the nearby River Sett may also be at risk from on-site contamination sources. It is therefore recommended that a Phase 2 intrusive geo-environmental investigation is undertaken. The scope of the proposed investigation is shown on the site plan contained in Appendix 9.

2.0 INTRODUCTION

This Phase 1 geo-environmental ground investigation and report has been prepared at the request of Mr Jim Carter of Shaw Cavanagh Limited acting on behalf of AIM Engineering Limited.

Instructions to proceed were received in July 2009. Desk study work was undertaken between 12th and 19th August 2009. The walk over survey was carried out on 13th August 2009.

The Phase 1 report is to be used for submission to the Local Authority as part of the forthcoming planning application for the re-development of the site into a residential housing estate. The proposed development is to include the renovation of the existing mill building into one and two bed apartments and the construction of 7 No. three bed and 4 No. two bed, two storey residential dwellings with gardens and parking facilities at the front of the properties. The proposed development plan is contained in Appendix 10.

3.0 BRIEF

The brief was to carry out a Phase 1 geo-environmental ground investigation at Salem Mill, off Hyde Bank Road, New Mills, High Peak in Derbyshire. The extent of the site is shown on the aerial photograph and site plans contained in Appendix 1. The investigation was to include for the following studies:

a) A desk study involving examination of available geological maps, historical Ordnance Survey maps, environmental maps and available Coal Authority plans to assess the probable geological and contaminated land conditions on and below the site.

b) A walk over study of the site to ascertain any evidence of previous and current site uses that may have caused contamination of the ground and surface waters at the site. During the walk over survey, the topography of the site was to be noted along with any land features that could give an indication of probable sub-surface features and formations.

c) Identify probable contaminants that may be present at the site using current contaminated land guidance and identify potential receptors which could be at risk from potential contaminants.

d) Develop a conceptual model for the site to assess the potential risks of contamination.

e) Determine whether further investigation and assessment is required.

f) Define the scope and extent of further investigations.

A detailed report was to be provided to summarise findings and recommendations.

4.0 LIMITATIONS OF INVESTIGATION WORK AND REPORT

Desk Study References

The desk study has been produced using historical Ordnance Survey maps and environmental maps available at the time the report has been produced. The environmental information used was the current information available at the time of writing but there is no absolute guarantee of accuracy.

Boreholes / Trial Pits

Where the spacing of trial pits or boreholes for future intrusive investigation work has been presented as part of this report, the spacing has been determined to provide a reasonable indication of the general ground conditions and extent of land / groundwater contamination on the site but the number has ultimately been limited by commercial constraints. The ground conditions at the proposed borehole / trial pit locations are no absolute guarantee of the ground conditions between such locations. Due allowance should be made for the possibility of variation in conditions between borehole / trial pit locations when preparing any assessments of the final foundation and land / groundwater remediation proposals.

Extent of Contamination Studies

This report is strictly limited to the nature of contamination contained within the ground and groundwater at the site. The report does not cover environmental aspects such as air or noise pollution and ground vibrations and the like. In addition, ecological matters relating to wildlife, flora and fauna have not been investigated as part of this report. In particular, the site has not been inspected for the presence or otherwise of Japanese Knotweed. It is recommended that the Client appoints a specialist in this subject to carry out a detailed inspection of the site if its presence is suspected.

Flooding

Flooding in this report is defined as flooding caused by the sea, ditches, rivers, streams, ponds, lakes, reservoirs and the like. It does not extend to flooding caused by surcharged piped drainage systems and investigations into flooding of this nature are excluded from this report.

5.0 THIRD PARTIES

This report has been prepared for the sole use of AIM Engineering Limited. It must not be copied or passed onto any third party or used for any purpose other than which it was prepared without the permission of the author. This report is copyright.

6.0 SCOPE OF INVESTIGATION WORK

6.1 Walk Over Survey

The site was visited during dry and bright weather conditions and visually examined for evidence of the following:

a) Features that could indicate the probable presence of contamination on site from present or past site uses.

b) Physical features that could indicate the nature of the sub-surface ground conditions or features.

Photographs were taken of the site during the walkover survey and these photographs are contained in Appendix 2.

6.2 Desk Study Documentation

The following documents were obtained and examined during the desk study:

a) An aerial photograph of the site dated circa 2000. The photograph is contained in Appendix 1.

b) Historical Ordnance Survey maps as follows:

- 1:2500 dated 1880 – 1890
- 1:10,560 dated 1881
- 1:10560 dated 1882
- 1:2500 dated 1888
- 1:2500 dated 1892
- 1:2500 dated 1898
- 1:2500 dated 1898 – 1899
- 1:10,560 dated 1899
- 1:10,560 dated 1899
- 1:2500 dated 1909
- 1:10,560 dated 1912

- 1:2500 dated 1921 – 1922
- 1:10,560 dated 1923 – 1924
- 1:2500 dated 1938
- 1:10,560 dated 1938
- 1:10560 dated 1938
- 1:10560 dated 1938 – 1948
- 1:2500 dated 1946 – 1978
- 1:10,560 dated 1948
- 1:10,000 dated 1954 – 1955
- 1:2500 dated 1968 – 1972
- 1:10,000 dated 1970 – 1977
- 1:2500 dated 1975
- 1:2500 dated 1979 – 1987
- 1:10000 dated 1980
- 1:2500 dated 1983
- 1:2500 dated 1987 – 1991
- 1:10,000 dated 1991 – 1995
- 1:2500 dated 1991
- 1:2500 dated 1992 – 1993
- 1:2500 dated 1993 – 1995
- 1:2500 dated 1996
- 1:10000 dated 1999 – 2000
- 1:10000 dated 2006
- 1:10,000 dated 2009

These maps are contained in Appendix 3.

c) Environmental maps obtained through Envirocheck as follows:

- Environment Agency and hydrological map dated 1999 to 2009.
- Groundwater vulnerability map dated 1999.
- Sensitive land uses map dated 1997 to 2009.
- Summary maps showing locations of recorded waste sites, industrial land use sites and hazardous substances sites in adjacent areas.

These maps are contained in Appendix 4.

d) An environmental report obtained from Landmark, the environmental database company, which provides a list of recorded past and present activities at or adjacent to the site which could have an impact on the levels of contamination in the soils and groundwater at the site.

This report is contained in Appendix 5.

e) The British Geological Survey 1:10,560 solid and drift geological maps, reference numbers: SK 08 NW and SJ 98 NE. A part extract of the maps covering the area under consideration are contained in Appendix 6. The extracts have been copied under licence from the British Geological Survey.

f) Coal Authority search report reference: 00035926-09. The report is contained in Appendix 6.

g) The Indicative Atlas of Radon in England and Wales published by the British Geological Society and the Health Protection Agency was examined to assess the probable presence or otherwise of radon gas in the ground. An extract of the relevant map is contained in Appendix 7. The BR211 Radon Report was obtained from the British Geological Survey and is also contained in Appendix 7.

h) A visit was made to the Coal Authority record office in Mansfield to investigate coal mining activities in the vicinity of the site.

i) A visit was made to New Mills Library to supplement the research.

7.0 FINDINGS

7.1 Description of the Site

The site is located in the mature residential / commercial town centre of New Mills which is situated in the north western corner of the Peak District National Park in Derbyshire. The national Ordnance Survey grid reference for the centre of the site is Easting: 400230 and Northing: 385900, the site is located at postcode SW22 4BN and the location is shown on the site plans in Appendix 1.

The site is bounded by the River Sett to the north, traditional gritstone cottages and a garage (Woodside) are located to the west of the site, an historic burial ground is present to the south of the site and open vegetated land is situated to the east of the site. An aerial photograph of the site prior to works commencing is also contained in Appendix 1.

The site consists of an irregular shaped plot of land approximately 0.2 hectares in area at a generally level elevation of approximately 147m AOD and is accessed via Hyde Bank Road.

The site is currently occupied by an 18th century 4 storey gritstone mill building (Salem Mill) and a number of relatively recently built masonry clad garages joined to the east of the original mill structure. The external area to the front of the buildings is covered in concrete hardstanding with a thin strip of soft landscaping present along the southern and eastern site boundaries.

7.2 Walk Over Survey

During the walk over survey, the following features were noted relating to geology and contaminated land matters:

Geology

During the site reconnaissance, it was noted that the site had a generally level elevation with no evidence of ground movement or instability based on an examination of the external areas of the site and the fabrics of the existing buildings. In addition, there was no evidence of geological faulting, mining activities or rock exposures recorded on the site.

The land to the south of the site was noted as being elevated approximately 2.5m above the existing site level and the land situated to the east of the site was elevated approximately 1.5m above the existing site level. The site is elevated approximately 2.0m above the River Sett which is situated adjacent to the north of the site.

The ground underfoot was noted as being relatively dry due the impermeability of the concrete hardstanding which covers the majority of the external surfaces of the site. There are no apparent watercourses located on the site although the River Sett runs parallel to the northern site boundary.

Contaminated Land

Between 1965 and circa 2006, the site was utilised by a sheet metal fabrication company and the presence of heavy machinery was observed within the site buildings during the site reconnaissance. It was apparent during the site walkover that potentially harmful chemicals have been stored / used on the site due to the presence of an emergency eye wash and empty storage drums displaying irritant warning labels. There was no olfactory evidence of contamination observed during the site walkover.

Photographs taken during the walkover survey are contained in Appendix 2.

7.3 Geology

The 1:10,560 geological map of the area (ref: SK 08 NW) indicates that the western section of the site is underlain by drift deposits of Pleistocene alluvium which in turn is underlain by Carboniferous Lower Coal Measure. The eastern section of the site is underlain by drift deposits of Pleistocene boulder clay which in turn is underlain by sandstone from the Carboniferous Lower Coal Measures.

A rock exposure located approximately 200m south of the site comprises 2m of flaggy sandstone with interbedded silty mudstone layers which is underlain by 4.5m of massive sandstone. A dip of 3˚ to the south east was recorded in these beds.

The site is located in the core of an anticlinal fold structure with the Red Ash coal seam outcropping approximately 200m north of the site and 300m to the east of the site. A fault is located 150m north of the site and is downthrown to the north.

7.4 Site History

The site development history has been researched by reference to historical maps and street plans. These are included in Appendix 3 to this report and the principal observations are summarised below.

1:2500 dated 1880 – 1890

The site is situated in the centre of the small manufacturing settlement of New Mills, Derbyshire. This map indicates that the north west corner of the site is occupied by the eastern part of Salem Mill which is a large L-shaped building. The southern section of the site is occupied by open land with a few small buildings situated close to the western site boundary. The River Sett is located adjacent to the northern site boundary with a sluice and weir indicated on this part of the river. There is a Methodist Chapel and burial ground located approximately 50m south of the site and a chemical works 100m south of the site. Railway lines are located 100m east of the site and the Global Iron Works 190m south of the site. The land to the west of the site has a relatively high density of residential terraced properties with the land to the east comprising railway land and fields.

1:10560 dated 1881

This map is incomplete and does not cover the entire area of the site.

1:10560 dated 1882

There are no discernable changes on site between this map and the 1881 map. A colliery is located 500m west of the site and a mill pond is located 250m south east of the site.

1:2500 dated 1888

This map is incomplete and does not cover the entire area of the site.

1:2500 dated 1892

This map is incomplete and does not cover the entire area of the site.

1:2500 dated 1898

This map is incomplete and does not cover the entire area of the site.

1:2500 dated 1898 – 1899

Salem Mill is classified as producing chemicals and an embankment is indicated crossing the centre of the site. There is a higher density of residential properties in the surrounding area. The chemical works located 100m south of the site is now noted as being disused.

1:10560 dated 1899

There are no discernable changes on site between this map and the 1898 – 1899 map. A shaft is located approximately 350m west of the site.

1:2500 dated 1909

This map is incomplete and does not cover the entire area of the site.

1:10560 dated 1912

There are no discernable changes on site between this map and the 1899 map. The River Sett is noted as flowing north to south.

1:2500 dated 1921 – 1922

There are no discernable changes on site between this map and the 1912 map.

1:10560 dated 1923 – 1924

There are no discernable changes on site between this map and the 1921 – 1924 map. An old coal pit is located 500m south west of the site.

1:2500 dated 1938

Salem Mill is noted as being disused and sloping masonry is indicated adjacent to the east of the mill building.

1:10560 dated 1938

There are no discernable changes on site between this map and the 1938 map. There is a higher density of buildings to the west and south of the site.

1:10560 dated 1938 – 1948

There are no discernable changes on site between this map and the 1938 map.

1:2500 dated 1946 – 1978

An additional rectangular building has been constructed adjacent to the east of Salem Mill and is labelled as 'Works'.

1:10560 dated 1948

There are no discernable changes on site between this map and the 1946 – 1978 map.

1:10000 dated 1954 – 1955

There are no discernable changes on site between this map and the 1948 map.

1:2500 dated 1968 – 1972

There is additional residential housing to the west of the site.

1:10000 dated 1970 – 1977

There are no discernable changes on site between this map and the 1968 – 1972 map. There is a higher density of buildings in the surrounding area.

1:2500 dated 1975

This map is incomplete and does not cover the entire area of the site.

1:2500 dated 1979 – 1987

There are no discernable changes on site between this map and the 1970 – 1977 map.

1:10560 dated 1980

There are no discernable changes on site between this map and the 1979 – 1987 map.

1:2500 dated 1983

This map is incomplete and does not cover the entire area of the site.

1:2500 dated 1987 – 1991

There are no discernable changes between this map and the 1980 map.

1:10000 dated 1991 – 1995

This map is incomplete and does not cover the entire area of the site.

1:2500 dated 1991

There are no discernable changes between this map and the 1987 – 1991 map.

1:2500 dated 1992 – 1993

There are no discernable changes between this map and the 1991 map.

1:2500 dated 1993 – 1995

There are no discernable changes between this map and the 1992 – 1993 map.

1:2500 dated 1996

There are no discernable changes between this map and the 1993 – 1995 map.

1:10000 dated 1999 – 2000

There are no discernable changes on site between this map and the 1996 map.

1:10000 dated 2006

There are no discernable changes between this map and the 1999 – 2000 map.

1:10000 dated 2009

There are no discernable changes between this map and the 2006 map.

7.5 Waters and Flooding

Environmental data relevant to the site and its immediately surrounding area has been obtained from sources available in the public domain. In addition, an environmental report was obtained from Landmark, the commercial suppliers of environmental data. The Landmark report and associated maps that have been reviewed are presented in Appendices 4 and 5 and the principal observations in relation to waters and flooding can be summarised as follows:

- The site is located in an area prone to extreme flooding from rivers or seas without defences and will require a Flood Risk Assessment (FRA) to comply with Planning Policy Statement 25 (PPS25) Development and Flood Risk.
- The River Sett is located parallel to the northern site boundary and a river quality sampling point located 16m south east of the site obtained a GQA River Quality Grade C dated 2000.
- The site is not located on or near a groundwater Source Protection Zone.
- There are two water abstraction points within 1 km of the site;
    - A surface water abstraction point permit dated from 2007 / 2008 until 2017 and located 642m south of the site is sourced from the River Goyt for production of energy (hydroelectric) and aquaculture uses.
    - A groundwater abstraction point located 650m east of the site is sourced from the pumphouse at Hayfield Road for manufacturing purposes.
- The area of the site is classed as a minor aquifer by the Environment Agency with soils of a low leaching potential in which pollutants are unlikely to penetrate the soil layer because water movement is horizontal or they have the ability to attenuate diffuse pollutants.

- There were 4 pollution incidents to controlled waters within 250m of the site:
    - A minor pollution incident to controlled waters approximately 15m west of the site occurred in January 1995 and involved the release of crude sewage into the River Sett.
    - A minor pollution incident to controlled waters approximately 122m south west of the site occurred in February 1995 and involved the release of detergents / surfactants into a tributary of the River Sett.
    - A significant pollution incident to controlled waters approximately 166m south of the site occurred in September 1992 and involved the release of detergents / surfactants into the River Sett / River Goyt.
    - A minor pollution incident to controlled waters approximately 195m south west of the site occurred in June 1997 and involved the release of detergents / surfactants into a freshwater stream.
- The site is within a nitrate vulnerable zone with regard to surface waters.

7.6 Hazardous Installations, Landfill and Waste

The following information relating to hazardous installations, landfill and waste obtained from the Landmark report, published information and the walkover survey can be summarised as follows:

- A permitted Local Authority Pollution Prevention and Controls is located approximately 170m south of the site which relates to waste oil burners.
- A registered waste treatment or disposal site dated March 1993 is located approximately 166m south of the site and authorised wastes include bonded asbestos integral with scrap and metal scrap.
- Sett Sheet Metal Co Ltd, a sheet metal works, was located in the north of the site and is currently inactive.
- Woodside Garage is located adjacent to the western site boundary and is currently active.
- There are no registered / historical landfills within 400m of the site.
- Industrial land uses within 100m of the site include engineering services and road haulage services.

7.7 Mining

7.7.1 Coal Mining

The Coal Authority report (ref: 00035926-09) was obtained on the basis that the development site is located within a recognised coal production area. The report confirms that the site is not within the zone of likely physical influence on the surface from past underground workings. This information is consistent with the findings of the geological map desk study. No other issues were raised relating to present or future workings (other than the usual reserved rights for extraction of remaining coal) or undocumented historical shallow mine workings.

A visit made to the Coal Authority record office in Mansfield indicated that the Coal Authority did not hold any records / evidence that mine workings were situated beneath the site from the mid 19th Century to present.

7.7.2 Brine Extraction

The site is not subject to past or future ground subsidence from salt or brine extraction.

7.8 Radon

The Indicative Atlas of Radon in England and Wales produced by the Health Protection Agency and British Geological Survey indicates that the site lies in an area unaffected by radon with between 3% to 5% of homes at or above the Action Level. On this basis, the BR211 Radon Report was acquired from the British Geological Survey and this report confirms that the site requires basic radon protective measures in accordance with BRE Report BR211: Radon: Protective measures for new buildings.

Map 13 of the Indicative Atlas of Radon in England and Wales contains information on the region in which the site is located and is presented in Appendix 7 along with the BR211 Radon Report.

8.0 CONCLUSIONS

8.1 General

The site walkover indicated that the site is presently occupied by a number of buildings including a large rendered gritstone mill structure and a number of masonry clad buildings joined to the east of the mill building. The mill was originally utilised for cotton weaving but has since had a variety of industrial uses including chemical manufacturing from the late 19th century until the 1920's and more recently, the site has been utilised by a sheet metal fabrication company. During the site walkover it was noted that heavy machinery associated with this metal fabrication works is still present at the site. The exact nature of the previous site manufacturing processes is not clear from the historical records studied, although visual evidence suggests that the potential for contaminative activities to have previously taken place on the site exists.

8.2 Geology

The desk study carried out indicated that the upper drift alluvial deposits underlie the western section of the site with the eastern section of the site underlain by glacial boulder clay. The underlying solid geology is Carboniferous Lower Coal Measures. Despite the presence of coal deposits and coal mining in the vicinity of New Mills, there was no evidence of mining activities on or in close proximity to the site. These findings are consistent with the Coal Authority Report (ref: 00035926-09) which confirms that the site is not located within the zone of likely physical influence on the surface from underground mine workings and in addition no records relating to the site were available at the Coal Authority records office in Mansfield.

In order to determine the ground conditions with more certainty, it is recommended that boreholes and trial pit excavations are undertaken on site together with associated laboratory geotechnical tests. On the basis of the results of this intrusive investigation (refer to section 8.10 for details), final proposals for structures, roads and sewers can be prepared.

8.3 Contaminated Land Legislative Framework

The assessment of contaminated soils is carried out within the current legal framework, which is based upon the Environmental Protection Act Part 2A and current national planning guidelines. Under this framework, the potential contamination of a proposed development site is a material planning consideration. In addition, land that is deemed harmful to human health or has the potential to pollute waters can be designated as contaminated land and appropriate remediation can be enforced by the Local Authority.

Following the "Way Forward" report undertaken by Department for Environment, Food and Rural Affairs (DEFRA), a new approach to land contamination was issued by DEFRA and the Environment Agency (EA). Two documents have been produced which supersede the previous Contaminated Land Reports (CLR) 7 – 10. The two reports are 'Human health toxicological assessment of contaminants in soil' (formerly CLR 9) and 'Updated technical background to the CLEA model' (formerly CLR 10) and other supporting documentation including revised toxicological reports.

Broadly, the approach consists of preparation of conceptual models to illustrate how potential contamination (source) can reach (through a pathway) humans or receptors (targets).

As a result of these conceptual models, each of which are site specific, a risk analysis can be carried out to determine the frequency of testing to establish levels of source contamination, possible mobility of those contaminants and the potential hazards those mobilised contaminants could cause to human receptors.

In addition to direct human receptors, water courses, aquifers and agricultural resources must be considered as these are potential indirect pathways to humans.

The government is part way through the publication of a number of updated toxicological reports and associated updated Soil Guideline Values which give guidance on acceptable soil contamination for a limited number of contaminants and further authoritative guidance on the toxicity of other contaminants for risk assessment purposes.

As of March 2009, updated toxicological reports and revised Soil Guideline Values have been published for the following determinands:

- Arsenic
- Nickel
- Selenium
- Benzene
- Toluene
- Ethylbenzene
- Mercury (elemental, methyl and inorganic)
- Xylene (O, M and P)

Where no updated toxicological reports or Soil Guideline Values are available, the existing toxicological reports and associated Soil Guideline Values will naturally be used to classify the risk and toxicity posed by the selected determinands.

In addition, where updated Soil Guideline Values and/or toxicological reports are not available, guidance is available from the Environment Agency on acceptable methods of assessing human health risks utilising recognised methodology developed in the UK and abroad. The means available to assess human health risks and to be utilised on this site are as follows:

Assessment	**Means**
Production of conceptual models	Human health toxicological assessment of contaminants in soil and Contaminated Land Report 11
Scope of contamination testing	Human health toxicological assessment of contaminants in soil (2009) and DEFRA Industry Profiles
Contamination sampling rates	Contaminated Land Report 4
Laboratory testing	MCERTS Accreditation
Acceptable contamination levels for Arsenic, Nickel, Mercury, Selenium, Ethylbenzene, Toluene, Benzene and Xylenes	Updated Published Soil Guideline Value Reports (March 2009 onwards)
Acceptable contamination levels for Cadmium, Chromium, Lead and Phenol	Current Published Soil Guideline Value Reports (2002 – 2004)
Acceptable levels for other contaminants except cyanide and except where the conceptual model includes dermal absorption	SNIFFER Worksheets
Acceptable contamination levels for cyanide and where the conceptual model includes dermal absorption	RISC v 4.02 and updated technical background to the CLEA model
Assessment of Total Petroleum Hydrocarbons within the above framework as adopted by the Environment Agency	Total Petroleum Hydrocarbon Criteria Working Group and updated technical background to the CLEA model

8.4 Sources of Contamination and Probable Contaminants

The historical Ordnance Survey maps, the Envirocheck report and other environmental information reveal that the site has historically been occupied by a chemical works and since 1965, a sheet metal fabrication company. Both of these past land uses are considered to be potential sources of contamination. In addition, embankments previously located on the site could be indicative of imported made ground deposits of an unknown origin.

In consideration of the above, the guidance contained in Contaminated Land Report 8 and the appropriate DEFRA industry profile, it is therefore proposed to test for the following contaminants on the site both within the soils and any groundwater encountered during the intrusive investigation works:

Metals and metalloids

Arsenic, barium, beryllium, boron, cadmium, chromium, copper, lead, mercury, nickel, selenium, vanadium, zinc

Non metals and inorganics

Asbestos, cyanide, sulphate, sulphur, pH

Organic contaminants

Phenol, benzene, toluene, ethylbenzene, xylenes, Total Petroleum Hydrocarbon (TPH) screen followed by Speciated Aliphatic and Aromatic Total Petroleum Hydrocarbon Fractions (TPHCWG) where appropriate, Speciated Polyaromatic Hydrocarbons (PAH), semi-volatile organic compounds and volatile organic compounds.

Due to the potential presence of made ground deposits, it is proposed to test for the following ground gases over a minimum three month monitoring period:

Methane, carbon dioxide and hydrogen sulphide

8.5 Pathways for Contamination

Waters

The area of the site is classed as a minor aquifer with soils of a low leaching potential, however the drift deposits overlying the western section of the site consist of alluvium which may allow the leaching of any on site contaminants into the underlying aquifer. It can therefore be concluded that if leachable contamination exists at the site, there is a potential pathway to the underlying groundwater. The River Sett is located parallel to the northern site boundary and therefore, if there was leachable contamination present on the site, there may be a pathway via migration through perched water and overland flow into the adjacent River Sett.

Site Occupants

The pathways along which contamination could potentially reach the targets on site after completion of development works are detailed in Contaminated Land Report 10 but can be summarised as follows:

a) Ingestion of soil and / or dust
b) Ingestion of home grown vegetables
c) Ingestion of soil on home grown vegetables
d) Inhalation of soil and / or dust
e) Dermal contact with soil and / or dust
f) Inhalation of soil vapours

8.6 Targets of Contamination

Targets for these pathways include the following:

a) Homeowners
b) Construction workers
c) The general public
d) Groundwater contained within minor aquifer.
e) Surface water features e.g. River Sett.

8.7 Conceptual Model for Human Health Risk Assessment

Site conceptual models in the form of linkage tables for the purposes of a preliminary risk assessment regarding human health of site occupants has been produced as a result of the probable contaminants, pathways and receptors identified in sections 8.4, 8.5 and 8.6 above:

CONTAMINANT	PATHWAY	RECEPTOR
Arsenic Barium Chromium Vanadium	Ingestion of contaminated soil and/or dust	Human occupant & construction worker
	Dermal contact with contaminated soil and /or dust	Human occupant & construction worker
	Inhalation of contaminated dust	Human occupant & construction worker
Beryllium Cadmium Copper Lead Nickel Zinc Boron Selenium Inorganic mercury compounds Methylmercury Cyanide Sulphur	Ingestion of contaminated soil and/or dust	Human occupant & construction worker
	Dermal contact with contaminated soil and/or dust	Human occupant & construction worker
	Inhalation of contaminated dust	Human occupant & construction worker
	Plant uptake	Human occupants consuming home-grown vegetables.
Sulphur Sulphate Complex Cyanide	Direct contact with building fabric	Fabric of buildings on and off site
	Plant uptake	Human occupants consuming home-grown vegetables.
pH	Direct contact with building fabric	Fabric of buildings on and off site

CONTAMINANT	PATHWAY	RECEPTOR
Total Petroleum Hydrocarbons Volatile Organic Compounds Semi-Volatile Organic Compounds Polycyclic Aromatic Hydrocarbons Semi-volatile organic compounds Volatile organic compounds Phenols Benzene Toluene Ethylbenzene Xylenes Elemental Mercury	Ingestion of contaminated soil and/or dust	Human occupants & construction workers
	Inhalation of contaminated dust	Human occupants & construction workers
	Dermal contact with contaminated soil and/or dust	Human occupants & construction workers
	Inhalation of soil vapours indoors and outdoors	Human occupants & construction workers
	Plant uptake	Human occupants consuming home-grown vegetables.
Asbestos	Inhalation of contaminated dust	Human occupants & construction workers
Carbon dioxide	Inhalation of accumulated CO_2 gas	Human occupant
Methane	Accumulation in buildings	Human occupant & building
Hydrogen Sulphide	Inhalation of accumulated HS_2 gas	Human occupant

8.8 Conceptual Model For Waters Risk Assessment

The site conceptual model produced as a result of the probable contaminants, pathways and targets can be summarised diagrammatically and a sketch is contained in Appendix 8.

Broadly, there is a potential risk to the groundwater contained in the underlying aquifer due to the possible permeability of the overlying geological alluvium deposits. There is a potential risk to the River Sett from lateral migration of any on-site contaminants through near surface soils and shallow groundwater and via overland flow.

Three surface / groundwater water abstraction points located within 1km of the site are considered to be of a low sensitivity due to their distance from the site and the influences of dispersion and dilution. It is therefore considered that any site contamination would have a negligible effect on water resources close to the development site.

In addition, a site conceptual model in the form of a linkage table for the purposes of a preliminary risk assessment for pollution of controlled waters has been produced as a result of the probable contaminants, pathways and receptors identified in sections 8.4, 8.5 and 8.6 above as follows:

CONTAMINANT	PATHWAY	RECEPTOR
Arsenic Barium Chromium Vanadium Beryllium Cadmium Copper Lead Mercury Nickel Zinc Boron Selenium Cyanide Total Petroleum Hydrocarbons Volatile Organic Compounds Semi-Volatile Organic Compounds Polycyclic Aromatic Hydrocarbons Phenols Benzene Toluene Ethylbenzene Xylenes	Migration through ground vertically into groundwater	Groundwater within aquifer Discharges from groundwater, e.g. springs and rivers Wetlands and groundwater-dependant ecosystems Aquatic organisms
	Overland flow	Surface water courses e.g. River Sett Aquatic organisms
	Migration through ground laterally into Shallow water	Surface water courses e.g. River Sett Aquatic organisms
Sulphur Sulphate pH	Migration through ground vertically into groundwater	Groundwater within aquifer Discharges from groundwater, e.g. springs and rivers

8.9 Preliminary Risk Assessment Summary

Human Health

There may be a risk to human health due to the past and present uses of the site and it is therefore recommended that a Phase 2 investigation to include soil and groundwater is undertaken in order to determine if any contamination is present on the site. There may be a risk to human health from exposure to ground gases and accordingly, a subterranean gas monitoring programme is recommended prior to the commencement of the site development.

Waters / Groundwater

There is a potential risk of contamination to groundwater within the underlying aquifer below the site due to the nature of the geological drift cover. There may be a potential risk to the River Sett as a result of overland flow and lateral migration through soil / groundwater. A waters conceptual model and diagram is included in Appendix 8 and chemical testing of the groundwater is recommended.

As a result of the risks identified, a Phase 2 intrusive environmental ground investigation including contamination testing of soils and groundwater should be undertaken on the basis of this Phase 1 report. Depending on the levels of contaminants encountered on site, a Phase 3 numerical risk assessment may be required to determine the acceptable levels of contamination.

8.10 Scope of Phase 2 Intrusive Geo-Environmental Ground Investigation

As a result of the preliminary risk assessment undertaken, a Phase 2 intrusive environmental ground investigation should be carried out to determine the concentrations of probable contaminants in the ground. This investigation should include the installation of boreholes and excavation of trial pits across the site. Samples of soil and groundwater should be collected and an MCERTS accredited laboratory should undertake chemical composition tests to determine chemical contamination levels.

The frequency of sampling of soils on the site should be carried out to provide a 95 percent certainty that representative levels of contamination are detected. It is therefore important to assess the areas under scrutiny and the associated depths of potentially contaminated soils to be able to determine the spacing of sampling points and the number of samples for each point.

On the basis of the above, it is therefore proposed that a Phase 2 intrusive investigation should be carried out on site to include the following elements:

- 3 No. 150mm diameter shell and auger boreholes to a depth of 6m below ground level.
- 1 No. 150mm diameter shell and auger borehole to a depth of 12m below ground level.
- Gas testing wells to be installed in the above boreholes.
- 8 No. mechanically excavated trial pits to a depth of 2m below ground level.
- CBR testing.
- Standard penetration tests.
- Undisturbed sampling for triaxial testing.
- Plasticity Index tests.
- Moisture content testing of clays in the vicinity of trees.
- Chemical tests for contaminants scheduled in 8.4.

The scope of the proposed Phase 2 investigation works are shown on the site plan in Appendix 9.

9.0 RECOMMENDATIONS

9.1 As a result of the risks identified, a Phase 2 intrusive environmental ground investigation including contamination testing of soils, groundwater and ground gases should be undertaken on the basis of this Phase 1 report. In addition, these works should include sufficient boreholes, trial pits and associated laboratory tests to establish the actual ground conditions at the site so that designs for foundations, roads and drainage works can be completed.

9.2 The following works comprise the recommended scope of the Phase 2 intrusive investigation:

- 3 No. 150mm diameter shell and auger boreholes to a depth of 6m below ground level.
- 1 No. 150mm diameter shell and auger boreholes to a depth of 12m below ground level.
- Gas testing wells to be installed in the above boreholes.
- 8 No. mechanically excavated trial pits to a depth of 2m below ground level.
- CBR testing.
- Standard penetration tests.
- Undisturbed sampling for triaxial testing.
- Plasticity Index tests.
- Moisture content testing of clays around trees.
- Chemical tests for contaminants as scheduled in section 8.4.

The scope of the proposed Phase 2 investigation works are also shown on the site plan in Appendix 8.

9.3 From the results of the Phase 2 work, a Phase 3 numerical risk assessment may be required and the conceptual models refined accordingly.

9.4 From the results of the Phase 2 intrusive works, the type of foundation construction and associated bearing capacities should be calculated.

9.5 In addition, from the results of the Phase 2 intrusive works, the type of buried services, highway and drainage constructions should be established.

9.6 A site specific Flood Risk Assessment to comply with PPS25 will be required by the Environment Agency and should be prepared as part of a separate report.

APPENDIX 1

SITE LOCATION PLANS AND AERIAL PHOTOGRAPH

APPENDIX 2

WALK OVER SURVEY PHOTOGRAPHS

APPENDIX 3

HISTORICAL ORDNANCE SURVEY MAPS

APPENDIX 4

ENVIRONMENTAL MAPS

APPENDIX 5

LANDMARK ENVIRONMENTAL REPORT

APPENDIX 6

EXTRACTS OF 1:10,000 BGS GEOLOGICAL MAP AND COAL AUTHORITY MINING REPORT

APPENDIX 7

EXTRACTS OF RADON ATLAS FOR ENGLAND AND WALES AND BR211 RADON REPORT

APPENDIX 8

CONCEPTUAL MODEL FOR CONTAMINATION OF WATERS

APPENDIX 9

SITE PLAN SHOWING SCOPE OF THE PHASE 2 INVESTIGATION

APPENDIX 10

PROPOSED DEVELOPMENT PLAN