# MWDA: Gillmoss Materials Recovery Facility

**Geology, Soils and Contamination Report**

10 December 2008

*Prepared for*
Merseyside Waste Disposal Authority

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# Abbreviations

| | |
|---|---|
| ACEC | Aggressive Chemical Environment for Concrete classification |
| ATEX | The framework for controlling explosive atmospheres and the standards of equipment and protective systems used in them. Based on the requirements of two European Directives. |
| CBR | Californian Bearing Ratio |
| CIRIA | The Construction Industry Research and Information Association |
| CLEA | Contaminated Land Exposure Assessment |
| CLR | Contaminated Land Research |
| CoC | Contaminant of Concern |
| CPT | Cone Penetration Test |
| DDT | Dichlorodiphenyltrichloroethane |
| DOE | Department of the Environment |
| DS | Design Class |
| DWS | Drinking Water Standard |
| EA | Environment Agency |
| EQS | Environmental Quality Standard |
| GQA | General Quality Assessment |
| GSV | Gas Screening Value |
| HSE | Health and Safety Executive |
| IFA | Ian Farmer Associates Ltd |
| IPPC | Integrated Pollution Prevention Control |
| LAAPC | Local Authority Air Pollution Control |
| m aOD | Metres above Ordnance Datum |
| m bgl | Metres below ground level |
| MCERTS | The Environment Agency's Monitoring Certification Scheme |
| MRF | Materials Recovery Facility |
| MWDA | Merseyside Waste Disposal Authority |
| NRPB | National Radon Protection Board |
| PAH | Polyaromatic Hydrocarbon |
| PCB | Polychlorinated Biphenyl |
| SGV | Soil Guideline Value |
| SPT | Standard Penetration Test |
| SPZ | Source Protection Zone |
| TPHCWG | Total Petroleum Hydrocarbons Criteria Working Group |
| UKAS | United Kingdom Accreditation Service |

# 1 Introduction

## 1.1 Introduction to Report

This assessment has been produced to support the planning application for a Materials Recovery Facility (MRF) commissioned by Merseyside Waste Disposal Authority (MWDA).

The objective is to assess the geology, soils, contamination and related environmental liabilities and constraints associated with the development of a MRF on the south west corner of the larger Gillmoss site. Figure 1 presents a site location plan, Figure 2 presents the boundary of the study area and Figure 3 presents a proposed site layout.

This report draws together the findings of a previous Mouchel ground investigation (undertaken in January 2007) and the findings of two intrusive investigations undertaken during December 2005 and also in September 2007, both independent of any input from Mouchel.

This assessment provides the following elements:

- A review of environmental data including a description of the site, site history, geology, hydrogeology and hydrology;
- A summary of the ground conditions encountered including a preliminary foundation design;
- An assessment of the risks to human health and controlled waters, together with a conceptual ground model;
- Mitigation measures (if required); and
- Conclusions and recommendations.

## 1.2 Disclaimer

The site reviewed in this report is based on the boundaries as defined by MWDA at the time of appointment. Mouchel prepared this report based on the available information received during the study period. Although every reasonable effort has been made to obtain all of the relevant information available, all potential constraints and liabilities with the site may not necessarily have been revealed.

Mouchel has also used reasonable skill, care and diligence in the design of the investigation of the site. The inherent infinite variation of ground condition allows only definition of the actual conditions at the location and depths of exploratory holes, while at intermediate locations conditions can only be inferred.

The report has been prepared and written for the exclusive benefit of MWDA for the purpose of providing geo-environmental information to support a planning application

for the development of a materials recovery facility. The report contents should not be used out of that context. Furthermore, new information, changed practices or new legislation may necessitate revised interpretation of the report after the date of its submission.

# 2 Policy and Legislation

The Conceptual Site Model has been designed and assessed in accordance with current legislation and the associated guidelines (including Model Procedures for the management of Contaminated Land CLR11), given the proposed development of the site as a MRF.

For this site any contamination issues will be addressed through the planning process in accordance with Planning Policy Statement 23 Annex 2, rather than Part 2A of the Environmental Protection Act. This legislative regime is founded on the "suitable for use" approach, which solely assesses the risk to the users of the site, posed by contamination, by using the source-pathway-receptor model in relation to the site users. It should be borne in mind that if the site is solely assessed on a suitable for use basis, other contaminated land liabilities may remain under the Part 2A regime, and therefore remediation may be required in addition at a later date under the Part 2A regime.

However, the determination of appropriate mitigation identified as part of the planning process is based on a similar assessment to that undertaken under Part 2A as described below.

It should be noted that any redevelopment of the site could actually create new pathways that could increase the liabilities associated with the site.

Section 57 of the Environment Act 1995 adds Part 2A (ss.78A-18YC) to the Environmental Protection Act 1990 and contains the legislative framework for identifying and dealing with contaminated land. The regulations cover the following:

- Land to be designated as special sites;
- Pollution of controlled waters;
- Content of remedial notices, and persons to whom they should be copied;
- Compensation for rights of entry, etc.; and
- Grounds of appeal against a remediation notice.

Local authorities (district councils and unitary authorities) are the enforcing authority for contaminated land and the Environment Agency is the enforcing agency for any land designated as a special site due to the nature of its contamination.

In identifying contaminated land, local authorities will be required to act in accordance with guidance from the Secretary of State. Section 78A(2) defines contaminated land as:

"land which appears …to be in such a condition, by reason of substances in, on or under the land that -

a) significant harm is being caused or there is a significant possibility of such harm being caused; or

b) pollution of controlled waters is being, or is likely to be caused"

This will be amended by the Water Act 2003 to:

"significant pollution of controlled waters is being caused or there is a significant possibility of such pollution being caused;"

The Statutory Guidance defines what "harm" is to be regarded as "significant" to:

- Human beings: death, disease, serious injury, genetic mutation, birth defects, or the impairment of reproductive functions. Disease is to be taken to mean an unhealthy condition of the body or some part thereof;
- Living organisms or ecological systems: an irreversible or other substantial adverse change in the functioning of the habitat or site; and
- Property (buildings): structural failure or substantial damage making them unfit for their intended purpose.

Other forms of 'property' considered under Part 2A include crops (including timber), domestically grown produce, livestock or other owned or domesticated animals and wild animals subject to shooting or fishing rights.

For there to be an environmental liability associated with the site there must be a source of risk, a receptor and a pathway between them i.e. a pollutant linkage. On each individual site, there may be more than one pollutant linkage and each of these requires individual assessment. Should a pollutant linkage be determined then remedial action would be required.

*Table 2-1. Summary of Pollutant Linkage Components.*

| | |
|---|---|
| Source | The hazardous substance / agent |
| Pathway | The entity that is vulnerable to the adverse effects of the hazardous substance or agent |
| Receptor | The means by which the hazardous substance / agent comes into contact with, or otherwise affects the target |

# 3 Methodology

## 3.1 Desk Based Assessment

The desk based assessment, undertaken in accordance with industry best practice and applicable sections of BS5930:1999, provides the following elements:

- A review of Ordnance Survey historic maps detailing the development history of the site and the immediate and wider surrounds to assess the potential for soil, groundwater or surface water contamination;
- A review of a site centred Landmark Envirocheck® report, detailing pollution incidents, discharge constraints, water abstractions and landfill sites, associated within the site and within a 500 m radius of the site; and
- A review of the geological, hydrogeological and hydrological data associated with the site, culminating in an assessment of the potential for contaminant migration and the sensitivity of the local water resources.

## 3.2 Intrusive Ground Investigations

Three phases of intrusive ground investigations have been carried out since 2005.

- December 2005, undertaken by Ian Farmer Associates (IFA) for North Midland Construction Plc (Mouchel had no input to this phase of work);
- January 2007, undertaken by IFA for MWDA and designed and monitored by Mouchel; and
- September 2007, undertaken by IFA for MWDA (Mouchel had no input to this phase of work).

Appendix A presents the IFA factual reports for each investigation. Figure 4 presents the exploratory hole locations for each investigation. The scope and methodologies for these investigations are discussed below.

### *3.2.1 Ground Investigation – December 2005*

The IFA Report W05/4810 dated March 2006 and prepared for North Midland Construction Plc reports the findings of a ground investigation carried out between 13th and 15th December 2005. The report states that '*the locations of exploratory holes have been planned, where possible, in general accordance with CLR 4, ref 5.2 and the site works carried out on the basis of the practices set out in BS 10175:2001, ref 5.3 and BS5930:1999 ref 5.4*'.

This investigation comprised four cable percussion boreholes drilled to between 9.0 m and 10.0 m below ground level (bgl) and five machine excavated trial pits to between 1.2 m and 4.0 m bgl.

Disturbed and undisturbed soil samples were taken and standard (split-barrel and cone) penetration tests were carried out in the boreholes. In-situ testing comprised four Californian Bearing Ration tests and four density determinations by core cutter method.

No monitoring wells were installed during the investigation and no chemical testing of samples was undertaken.

Selected soil samples were tested in accordance with BS1377 for the following geotechnical tests:

- Moisture content;
- Liquid and plastic limits;
- Particle size distribution;
- Sedimentation;
- Bulk density and hand vane;
- Particle density;
- Acid soluble and water soluble sulphate;
- pH; and
- Undrained shear strength.

The geotechnical test results are presented as an Appendix to the factual report.

*3.2.2 Ground Investigation – January 2007*

The IFA Report W07/40028 dated March 2007 and prepared for Mouchel Parkman (now Mouchel) reports the findings of a ground investigation carried out between 9th and 22nd January 2007. This investigation was designed (and monitored full time) by Mouchel in accordance with BS10175:2001 and BS5930:1999.

The investigation targeted the whole waste facility site, but only one borehole, BH1 and two trial pits, TP3 and TP5 are relevant to this Assessment.

Disturbed and undisturbed soil samples were taken for geotechnical testing and environmental samples were taken in amber jars and stored in a cool box prior to dispatch to the testing laboratory.

Standard (split-barrel and cone) penetration tests were carried out in the borehole and a monitoring well was installed (on the instruction of the Mouchel Engineer).

Soil samples were prepared in accordance with BS1377:1990 part 1 and representative sub-samples were taken for the following suite of geotechnical testing:

- Moisture content;
- Plasticity indices;
- Particle size distribution;
- Undrained triaxial compression without pore water pressure;
- One-dimensional consolidation test; and
- British Research Establishment Special Digest 1 (BRE SD1) suite.

The geotechnical test results are presented as an Appendix to the factual report.

Prior to commencement of the investigation, anecdotal information from MWDA indicated that the site may have previously been used for the manufacture of munitions or related activities. Therefore the programme of works was amended slightly to allow the trial pitting to proceed to gain soil samples which were tested for the following list of determinants by BAE systems at Chorley, prior to the cable percussion drilling being allowed to start (subject to the tests being negative).

- Nitrocellulose (NC);
- Pentaerythritol tetranitrate (PETN);
- Cyclotetramethylene tetranitramine (HMX);
- Hexanitrostilbene (NHS);
- Cyclotrimethylenetrinitramine (RDX);
- Picrite;
- Nitroglycol (EGDN);
- Picric Acid;
- Tetryl;
- 2,6 Dinitrotoluene (2,6 DNT);
- Nitroglycerine (NG);
- 2,4 Dinitrotoluene (2,4 DNT);

- 2,4,6 Trinitrotoluene (TNT); and
- Thiocyanate, magnesium, organic content, strontium, antimony, bismuth, phosphorus and moisture content.

The locations of exploratory holes were limited by underground services and access restrictions.

On completion of the investigation, gas and ground water monitoring was undertaken on three occasions. The installations were monitored for the presence of ground gases using a fully calibrated GA2000 Gas Analyser. The analyser is designed to record concentrations of methane ($CH_4$), carbon dioxide ($CO_2$), oxygen ($O_2$), carbon monoxide (CO), hydrogen sulphide ($H_2S$) as well as barometric pressure (mB) and, with the flow pod attachment, flow rate (litre/hour). Ground water levels (metres below ground level - m bgl) were measured using a standard ATEX dipmeter.

A groundwater sample was recovered on one occasion upon completion of the site works. Industry best practice[i] was followed with the well purged of three volumes prior to the sample being taken.

The soil and water samples were scheduled by Mouchel and sent to Chemtest Ltd of Newmarket for MCERTS/UKAS accredited testing (where applicable).

The soils were tested for the following suites:

- General suite – arsenic, cadmium, chromium, hexavalent chromium, lead, mercury, selenium, copper, nickel, zinc, boron, total cyanide, thiocyanate, sulphide, elemental sulphur, water soluble sulphate, total phenols and pH;
- Loss on ignition and total organic carbon;
- Asbestos;
- Speciated 16 polyaromatic hydrocarbons (PAH's);
- Total petroleum hydrocarbons Criteria Working Group (TPHCWG);
- Volatile and semi-volatile organic compounds; and
- Pesticides and herbicides.

Soil leachability testing for a similar suite was undertaken on a limited number of samples. The water sample was also tested for a similar suite of determinants.

[i] BS10175: 2001 - Investigation of potentially contaminated sites. Code of practice

Complete chemical test results are presented in Appendix B of this Assessment report.

*3.2.3 Ground Investigation – September 2007*

The IFA Report W05/402206 dated January 2008 and prepared for Mersey Waste Holdings Ltd reports the findings of a ground investigation carried out on 25th September 2007. The report states that '*the locations of exploratory holes were indicated by the Engineer and the site works carried out on the basis of the practices set out in BS 10175:2001, ref 5.3 and BS5930:1999 ref 5.4*'.

This investigation comprised six machine excavated trial pits to between 1.4 m and 2.6 m bgl.

Environmental samples were taken in amber jars and stored in a cool box.

No geotechnical testing was undertaken and IFA state that the suite of chemical analysis was based on comments made by Liverpool City Council. Chemical analysis for asbestos and polychlorinated biphenyls was carried out on eight soil samples by Derwentside Environmental Testing Services Ltd. Tests were MCERTS/UKAS accredited where applicable.

## 3.3 Risk Assessment Methodology

*3.3.1 Human Health Risk Assessment*

Three soil samples taken during the January 2007 investigation were scheduled for chemical analysis.

The proposed development is for a materials recovery facility and therefore the soil results have been compared with commercial / industrial screening values to assess risks posed to human health by site based contaminants. As final site levels have not been determined, all results have been included in the assessment, regardless of their depth.

The number of samples within the data set is small (four or less) therefore the mean and maximum value tests as outlined under Contaminated Land Research (CLR) guidance, in particular the CLR7 report should be treated with caution. As an additional screen, the results have been compared directly with the screening values. The methodology used to derive screening values and complete the assessment is presented in detail in Appendix D.

*3.3.2 Phytotoxic Risk Assessment*

Soil results for boron, copper, zinc and nickel have been used to assess risks to plants. In the absence of any other suitable guidance results have been compared against ICRCL Table 3, Group B values.

*3.3.3 Groundwater Risk Assessment*

Risks posed to controlled waters by site-based contaminants within and derived from the made ground have been assessed in accordance with the Environment Agency

guidance – 'Remedial Target Methodology – Hydrogeological Risk Assessment for Land Contamination' published 2006.

Groundwater results have been used to assess risks to both the underlying major aquifer and the River Alt (given the close proximity of the river to the site). Results have been compared against UK Drinking Water Standards (DWS) and Environmental Quality Standards (EQS).

*3.3.4 Ground Gas Risk Assessment*

The ground gas results have been assessed in accordance with BS8485:2007 and the CIRIA document C665 - Assessing Risks Posed by Hazardous Ground Gases to Buildings.

The CIRIA guidance differentiates between low rise housing developments (Situation B) and all other development types (Situation A). The proposed industrial end use would be classified as Development Situation A.

# 4 Baseline Conditions

## 4.1 Site Location and Description

The site is located at National Grid Reference NGR SJ 396 964 (339661; 396499) as indicated on Figure 1.

A general site walkover was undertaken on 3rd September 2006. The proposed site layout is shown on Figure 3.

*Table 4-1. Summary of the Site Features and its Surroundings.*

| | |
|---|---|
| Size (ha) | 1.6. Square shaped parcel of land. |
| Boundaries | Northwest: Fence. |
| | Northeast: Soil bund. |
| | Southeast: Fence. |
| | Southwest: Fence. |
| Current site use | Vacant land. |
| Access | This portion of land is accessed from the main site access road. |
| Ground surface and vegetation | 100% soft standing comprising grass and a few small shrubs and trees. |
| Topography | Flat. |
| Surface water features | No surface water features. The surface can become waterlogged during periods of heavy rain. |
| Building condition | No buildings present. |
| Fly-tipping / visual contamination | No evidence of fly-tipping or visual contamination observed. |
| Health and safety issues | None noted. |
| Adjacent land use description | North west: Waste facility access road with vacant land beyond up to a residential housing development. |
| | North east: Gillmoss waste facility to the north and vacant land beyond the bund to the north east. |
| | South east: Vacant site, awaiting development. |
| | South west: Beyond the highway, an area of shrubs with effluent treatment works beyond. |

## 4.2 Site History

### *4.2.1 On Site*

According to the first historical maps available for review dated 1850, at this time the site was under agricultural usage. A road is present along the western boundary. Lowndes Lane is marked east west across the centre of the site. An unnamed road runs south across the site from Lowndes Lane.

No significant changes are recorded until 1955 when the site was developed as part of a larger Electrical and Mechanical Engineering Works that occupied the land to the north, south and east of the site. A travelling crane and 4 tanks are recorded as part of this development close to the northern boundary. The 1974 map indicates two tanks close to the western boundary. No significant changes are recorded until 1989 when the works have been demolished and the site now appears to be vacant land. No further changes are apparent up to the present day.

### *4.2.2 Surrounding Area*

The first historical map available for review, dated 1850, indicates the immediate and wider surrounds primarily comprised open land (probably agricultural). Lownde's Farm is located 240 m east. The River Alt is recorded approximately 40 m west and 240 m northeast. A well is recorded on the west boundary.

By 1893, an aqueduct is located 10 m west, leading to a pumping station approximately 150 m west. The River Alt to the west has been straightened and is now 100 m from the boundary at is closest point. A crane and tank are also associated with the pumping station. The aqueduct is no longer marked on the 1908 map. This site, later annotated as West Derby Sewage Farm was subject to numerous phases of expansion until the present day, including the addition of a large storage tank, filter/settling beds and changes in the configuration and size of structures on site.

By 1955 the site and adjacent northern, eastern and southern sites have been developed as an Electrical and Mechanical Engineering Works. The River Alt to the north and northwest appears to have been straightened. The land 100 m to the north appears to have been raised and is now marked as a sports ground. 240 m to the south the A580 dual carriageway is marked.

The 1967 map indicates that a building and probable car parking has been constructed at the sports ground.

The 1977 map indicates Gillmoss Industrial Estate has been developed approximately 200 m east.

The 1989 map indicates that the works had been demolished and a waste disposal works is marked adjacent to the northeast corner of the site. The land adjacent to the north and east boundaries appears vacant. A works is marked to the south. The sports ground is no longer marked on the 1989 map and by 1995, residential development had commenced.

## 4.3 Environmental Data

A summary of pertinent information provided by the Envirocheck® report and not included elsewhere within this assessment is presented below. A copy of the Envirocheck report dated 18th September 2006 is presented in Appendix C.

*Table 4-2. Summary of the Environmental Database Report.*

| | 0-250 m | 250-500 m | Details |
|---|---|---|---|
| Current registered landfill or other waste disposal sites. | 2 | 1 | The two records within 250 m have both been revoked. The single record 250 m-500 m from the site, reference 1413 is for BP Oil UK Ltd for a petrol filling station. The record indicates that the authorisation has varied. |
| Former landfills or other waste disposal sites | 0 | 0 | No former landfill sites identified within a 500 m radius. |
| Waste Treatment sites | 0 | 1 | There is currently one operational waste management site within a 500 m radius.<br>• Located approximately 400 m west at Fazakerley waste water treatment works. The licence number is 30469 (469/02) and the site is categorised as a biological treatment site. The licence was issued by the Environment Agency May 1995. |
| Operational Waste Management Sites | 0 | 3 | Only 2 operational licenses are identified. A third, issued to Shell Direct Fuels (license number 54259) has been surrendered.<br>• Located at the adjacent waste transfer station (the record is probably incorrectly located in the Landmark report). The licence number is 54263 (469/02) and the site is categorised as a household, commercial and industrial transfer station. The licence was issued by the Environment Agency August 1995.<br>• Located approximated 230 m west at Fazakerley waste water treatment works. The license number is 54269 and the site is categorised as a biological treatment site. The license was issued May 1995 and modified January 2006. |
| Operational Waste Transfer Sites | 3 | 0 | There are currently three operational waste transfer site within a 500 m radius.<br>• Two records refer to the adjacent Gillmoss waste transfer station. The first is dated January 1998, held by MWDA and is superceeded by the second. The second, licence number is 30408 (408/02), held by Mersey Waste Holdings Ltd is categorised as a transfer station for household, commercial and industrial waste. The licence was issued by the Environment Agency August 1995.<br>• License number 30388 (388/02) held by PDC Fuels Ltd and located in Gillmoss Industrial Estate (approximately 160m east) is categorised as a transfer station for drums/barrels contaminated with oils, petroleum based fuels, scrap oil tanks and waste oils. The Environment Agency issued the license in July 1992. The record shows the licence has a completion certificate. |

| | 0-250 m | 250-500 m | Details |
|---|---|---|---|
| Substantial Pollution Incident Register | 0 | 0 | No pollution events were identified within a 500 m radius of the subject site within the last 5 years that have been noted on the Substantiated Pollution Incident Register. |
| Local Authority Air Pollution Controls (LAAPC) | 0 | 0 | No registered LAAPCs identified within a 500 m radius. |
| IPPC Part A Authorisations | 0 | 0 | There are no registered IPPC Part A authorisations within a 500 m radius. |
| LAPPC permits | 2 | 1 | Both the authorisations within 250 m have been revoked.<br>• Permit reference 1413 held by BP Oil UK Ltd located on East Lancashire Road, approximately 450 m south west is for a petrol filling station. The permit is dated September 1998. The record shows the authorisation has varied. |
| IPPC Registered Waste Sites | 0 | 0 | There are no registered IPPC waste sites within a 500 m radius. |
| Radioactive Substance Consents | 0 | 0 | No radioactive substances consents have been attributed to the subject site and none have been identified within a 500 m radius. |
| NIHHS | 0 | 0 | There are no Notifications of Installations Handling Hazardous Substances within a 500 m radius. |
| Planning Hazardous Substances Consents | 0 | 0 | There are no Planning Hazardous Substance Consents within a 500 m radius. |
| Control of Major Accident Hazard (COMAH) sites | 0 | 1 | Shell Direct (UK) Ltd have an active COMAH site approximately 310 m to the east. |
| Sensitive Land Uses | 1 | 0 | A nitrate vulnerable zone is located approximately 100 m north east. |
| Fuel Sites | 0 | 0 | No current fuel station entries are recorded within 500 m. |

## 4.4 Geology, Hydrogeology and Hydrology

Desk based research of the local geology, hydrogeology and hydrology was carried out in order to establish the potential for migration of contamination, if present, onto or away from the site, and to assess the surface water and groundwater sensitivity of the site area.

### *4.4.1 Geology*

The Geological Survey of Great Britain solid and drift geological map of Wigan (Sheet 84) indicates that that the site is directly underlain by recent drift deposits comprising the Shirdley Hill Sands, further underlain by Glacial Till deposits. The thickness of these deposits could not be ascertained through a review of the referenced geological maps. The drift deposits overly Sherwood Sandstone bedrock.

### *4.4.2 Soils*

The Soil Survey of England and Wales map 'Soils of Midland and Western England' indicates that the soils of the site are unclassified, due to being in an urban setting.

The Environment Agency's Policy and Practice for the Protection of Groundwater indicates the site to contain soils where the leaching potential is unknown, due to being an urban area. A worse case vulnerability is therefore assumed: high leaching potential. These are soils which readily transmit liquid discharges because they are either shallow, or susceptible to rapid by-pass flow directly to rock, gravel or groundwater.

*4.4.3 Coal Mining*

The Coal Authority has no record of the area of the site being subject to any known working of coal by either underground or opencast methods. As such a Coal Mining Report was not considered necessary.

*4.4.4 Radon*

NRPB-R290 Radon: Guidance on Protective Measures for New Dwellings (1999) indicates that the site lies within an area where less than 1% of homes are above the Radon Action Level, and as such indicates that no radon protection measures within buildings are required.

## 4.5 Hydrogeology

The site is directly underlain by the Shirdley Hill Sands (Minor Aquifer), further underlain at depth by Sherwood Sandstone (Major Aquifer).

## 4.6 Hydrology

The closest surface water feature is the River Alt approximately 100 m west.

## 4.7 Groundwater Abstractions

The Envirocheck report records there are no licensed water abstractions attributed to the site or within 500 m. However, there may be the possibility of private abstractions located close to the site that have not been recorded by Landmark.

## 4.8 Source Protection Zones

The Environment Agency website (http://www.environment-agency.gov.uk) shows that the site does not lie within a source protection zone (SPZ) however a total catchment SPZ (zone II) is located approximately 100 m to the south of the site.

## 4.9 River Quality

The Envirocheck Report indicates that the river chemistry quality of the River Alt is classified under the Environment Agency's (EA) General Quality Assessment (GQA) Scheme. Data from the Envirocheck report and the Environment Agency website indicate that the objective of a fair (D) classification has been met between 2006 and 2001. During 2000 and 1999, the classification was poor (E).

## 4.10 Discharge Consents

The Envirocheck report records there are 36 discharge consents within a 250 m radius of the site. Also recorded was one Water Industry Act referral within 250 m of the site. Two of these refer to Merseyside Waste Disposal Authority and the remainder refer to United Utilities. The two MWDA records are both revoked. Of

the United Utilities records, four are currently under appeal and the remainder are beyond their revocation date.

## 4.11 Pollution Incidents

The Envirocheck report records 13 pollution incidents to controlled waters within 250 m of the site. Two relate to the adjacent waste transfer station site and are category 3 – minor incidents. The remainder are either category 3 – minor incidents or category 2 – significant incidents.

## 4.12 Flooding

The Environment Agency website (http://www.environment-agency.gov.uk) shows that the site is not within an area that is at risk of flooding.

## 4.13 Conceptual Ground Model

### *4.13.1 Potential Contamination Issues*

The site has been previously developed as an electrical and mechanical engineering works. According to the Department of the Environment (DOE) industry profile for engineering works (aircraft manufacturing works, electrical and electronic equipment manufacturing works, mechanical engineering and ordnance works) possible contaminants are likely to include: metals and metalloids, inorganic compounds, acids, alkalis, asbestos, polychlorinated biphenyls, organic solvents, halogenated compounds, solvents, oils and lubricants, mineral oils and effluent treatment chemicals/sludges. All these contaminants have potential to pose a risk to human health and controlled waters.

### *4.13.2 Potential Geotechnical Issues*

The former site usage as an electrical and mechanical engineering works indicates that made ground is likely to be present including buried structures such as foundations, basements, floor slabs, voids and former services. The presence of these could affect development works and should be considered when planning the works.

## 4.14 Ground Conditions

### *4.14.1 Made Ground*

Made ground was encountered in each exploratory hole at depths between 0.3 m and at least 2.6 m bgl. The base was not proven in TP05 at 1.7 m (January 2007 investigation) or in TP06 at 2.6 m (September 2007 investigation). The made ground generally comprised brown, slightly clayey gravelly SAND or sandy GRAVEL. The gravel component generally comprised brick, concrete, sandstone, metal, plastic, wood, ceramic, clinker, mudstone, burnt shale, glass, slate and ash. Occasional boulders and cobbles of brick and concrete were also encountered. CLAY made ground was encountered at one location – BH1 (January 2007 investigation).

### *4.14.2 Superficial Deposits*

Superficial deposits, where encountered generally comprised firm (occasionally soft) becoming stiff with depth (sandy / gravelly) CLAY or SAND. Occasional cobbles of sandstone were recorded.

### 4.14.3 *Bedrock*

Bedrock was encountered in a number of locations. Table 4-3 summarises where bedrock was encountered.

*Table 4-3. Summary of Bedrock*

| Investigation | Location | Depth (m bgl) | Level (m aOD) | Engineers Description |
|---|---|---|---|---|
| January 2007 | BH1 | 7.00 | 10.13 | Possible weathered sandstone (recovered as sand) |
| | | 7.10 | 10.03 | Red brown sandstone |
| December 2005 | BH1 | 6.30 | - | Very weak red brown and yellow sandstone (recovered as sand) |
| | | 8.60 | - | Red brown sandstone |
| | BH2 | 6.30 | - | Very weak red brown sandstone (recovered as sand) |
| | | 9.30 | - | Weak red brown and yellow sandstone |
| | BH3 | 6.90 | - | Very weak red brown sandstone (recovered as sand) |
| | | 9.70 | - | Weak red brown and yellow sandstone (recovered as gravel) |
| | BH4 | 6.80 | - | Very weak red brown and yellow sandstone (recovered as sand) |
| | | 9.20 | - | Weak, yellow brown and red sandstone (recovered as gravel) |

### 4.14.4 *Obstructions*

Various obstructions were encountered during the three phases of intrusive investigations and these are summarised in Table 4-4.

*Table 4-4. Summary of Encountered Obstructions.*

| Investigation | Location | Depth (m bgl) | Level (m aOD) | Engineers Description |
|---|---|---|---|---|
| January 2007 | TP03 | 0.8 | 16.62 | Small land drain encountered (trending north-south) slight inflow of water. |
| | TP05 | 1.7 | 15.23 | Trial pit terminated at 1.7 m bgl due to obstruction (probable concrete) |
| December 2005 | TP5 | 0.5 | | Concrete piling cap encountered at 0.5 m bgl (1.6 m x 1.7 m). |

### 4.14.5 *In-situ Geotechnical Testing*

Standard penetration tests (SPT's) or cone penetration test (CPT's) in boreholes and hand shear vane and Californian bearing ratio (CBR) tests were undertaken in-situ

during the investigation and the results are summarised in Table 4-5. The data are also presented in the relevant factual reports presented as Appendix A.

*Table 4-5. Summary of In-situ Geotechnical Testing.*

| Investigation | Location | Depth (m bgl) | Strata Type | SPT N-value | Hand Shear Vane (kPa) | CBR |
|---|---|---|---|---|---|---|
| January 2007 | BH01 | 2.0-2.45 | Clay | 11 | - | - |
| | | 4.0-4.45 | Clay | 16 | - | - |
| | | 6.0-6.45 | Clay | 18 | - | - |
| | | 7.0-7.26 | Weathered sandstone | 25/140, 50/115 | - | - |
| | | 8.0-8.07 | Sandstone | 25/35, 50/115 | - | - |
| | TP03 | 1.0 | Clay | - | 35 | - |
| | | 2.0 | Clay | - | 58 | - |
| | | 4.0 | Clay | - | 86 | - |
| December 2005 | BH1 | 1.2-1.65 | Made ground | 16 (CPT) | - | - |
| | | 2.0-2.45 | Made ground | 11 (CPT) | - | - |
| | | 3.0-3.45 | Clay | 11 | - | - |
| | | 5.0-5.45 | Clay | 15 | - | - |
| | | 7.5-7.79 | Weathered sandstone | 50/135 | - | - |
| | | 8.9-8.95 | Sandstone | 25/30, 50/20 (CPT) | - | - |
| | BH2 | 1.2-1.65 | Made ground | 22 (CPT) | - | - |
| | | 2.0-2.45 | Made ground / Clay | 13 (CPT) | - | - |
| | | 4.0-4.45 | Clay | 16 | - | - |
| | | 6.0-6.45 | Clay / Sand | 22 | - | - |
| | | 7.5-7.77 | Weathered sandstone | 50/120 | - | - |
| | | 8.5-8.68 | Weathered sandstone | 25/95, 50/80 (CPT) | - | - |
| | | 9.5-9.54 | Weathered sandstone | 25/10, 50/25 (CPT) | - | - |
| | BH3 | 1.2-1.65 | Made ground | 7 (CPT) | - | - |
| | | 2.0-2.45 | Made ground / Clay | 8 | - | - |
| | | 4.0-4.45 | Clay | 15 | - | - |
| | | 6.5-6.95 | Clay | 25 | - | - |

| Investigation | Location | Depth (m bgl) | Strata Type | SPT N-value | Hand Shear Vane (kPa) | CBR |
|---|---|---|---|---|---|---|
| | | 8.0-8.14 | Weathered sandstone | 25/75 | - | - |
| | | 9.5-9.72 | Weathered sandstone | 50/70, 50/20 (CPT) | - | - |
| | | 10-10.03 | Weathered sandstone | 25/5 | - | - |
| | BH4 | 1.2-1.65 | Made ground | 6 | - | - |
| | | 3.0-3.45 | Clay | 13 | - | - |
| | | 5.0-5.45 | Clay | 16 | - | - |
| | | 7.5-7.95 | Weathered sandstone | 54 | - | - |
| | | 9.0-9.24 | Weathered sandstone | 50/85 | - | - |
| | | 9.5-9.56 | Weathered sandstone | 25/30 | - | - |
| | TP1A | 0.5 | Clay | - | - | 1.4 |
| | TP02 | 0.6 | Clay | - | - | 2.8 |
| | TP03 | 1.1 | Clay | - | - | 2.6 |
| | TP04 | 1.0 | Clay | - | - | 2.2 |

### *4.14.6 Groundwater*

Groundwater was encountered at a number of locations during the intrusive investigations and the strikes are summarised in Table 4-6.

*Table 4-6. Summary of Water Strikes During the Investigation Phases.*

| Investigation | Location | Depth (m bgl) | Level (m aOD) | Strata | Engineers Description |
|---|---|---|---|---|---|
| September 2007 | TP06 | 0.5 | - | Made ground | Groundwater located at 0.5 m |
| | TP08 | 0.0 | - | Made ground | Groundwater located at 0.0 m |
| | TP09 | 0.3 | - | Made ground | Groundwater located at 0.3 m |
| | TP10 | 0.2 | - | Made ground | Groundwater located at 0.2 m |
| | TP11 | 0.0 | - | Made ground | Groundwater located at 0.0 m |
| January 2007 | BH1 | 5.9 | 11.23 | Clay | Rose to 4.8 m (12.33 m aOD) after 20 minutes. |
| | TP05 | 1.5 | 15.43 | Made ground | Moderate inflow of water |
| December 2005 | BH1 | 2.0 | - | Made ground | Rose to 1.5 m after 20 minutes. |
| | | 6.5 | - | Weak Sandstone | Rose to 6.0 m after 20 minutes |
| | BH2 | 1.0 | - | Made ground | Rose to 0.9 m in 20 minutes |

| Investigation | Location | Depth (m bgl) | Level (m aOD) | Strata | Engineers Description |
|---|---|---|---|---|---|
| | | 6.4 | - | Sandstone | Rose to 4.5 m in 20 minutes |
| | BH3 | 1.5 | - | Made ground | Rose to 1.0 m in 20 minutes |
| | | 7.0 | - | Sandstone | Rose to 5.0 m in 20 minutes |
| | BH4 | 7.0 | - | Sandstone | Rose to 5.0 m in 20 minutes |
| | TP2 | 0.4 | - | Made ground | Groundwater located at 0.4 m |

Groundwater monitoring (undertaken by Mouchel) of borehole BH1, drilled during the January 2007 investigation was undertaken on three occasions. The monitoring well response zone was installed within the natural clay. The results are summarised in Table 4-7.

*Table 4-7. Summary of Groundwater Monitoring.*

| Date | Depth (m bgl) | Level (m aOD) |
|---|---|---|
| 24th January 2007 | 2.66 | 14.47 |
| 1st February 2007 | 2.66 | 14.47 |
| 13th February 2007 | 2.50 | 14.36 |

### *4.14.7 Ground Gas*

Gas monitoring undertaken by Mouchel of borehole BH1 (from the January 2007 investigation) was carried out on three occasions. The results are summarised in Table 4-8.

*Table 4-8. Summary of Gas Monitoring*

| Date | Barometric trend | Air pressure (mBar) | Flow (l/hr) | $CH_4$ (%) | $CO_2$ (%) | $O_2$ (%) | $H_2S$ (ppm) | CO (ppm) |
|---|---|---|---|---|---|---|---|---|
| 24th January 2007 | Steady | 1026 | -0.4 | 0.0 | 0.1 | 13.5 | 0.0 | 0.0 |
| 1st February 2007 | Rising | 1027 | -3.9 | 0.0 | 0.0 | 14.3 | 0.0 | 0.0 |
| 13th February 2007 | Rising | 1002 | 0.0 | 0.0 | 0.3 | 13.8 | 0.0 | 0.0 |

### *4.14.8 Visual and Olfactory Contamination*

The only visual or olfactory evidence of contamination was observed during the December 2005 investigation. Organic material with a slight organic odour was noted in the shallowest made ground strata in BH1, BH2, BH3, BH4, TP1A, TP2, TP3 and TP4. Moderate organic odour was also observed in TP4 between 0.5 m and 0.8 m bgl.

*4.14.9 Chemical Testing*

Sections 3.2.2 and 3.2.3 include details of the chemical testing carried out during the January 2007 and September 2007 investigations.

*4.14.10 Asbestos*

No asbestos was identified in samples from either TP3 or TP5 during the January 2007 investigation. Eight samples (from six locations) were tested from the September 2007 investigation and asbestos was identified at two locations – TP07 at 0.4 m bgl (amosite and chrysotile) and TP11 at 1.5 m bgl (chrysotile).

*4.14.11 Polychlorinated Biphenyls (PCB's)*

PCB's were tested for during the September 2007 investigation and detected above the limit of detection in TP10 at 0.4 m, TP10 at 1.2 m and TP11 at 1.5 m bgl.

*4.14.12 Volatile and Semi Volatile Organic Compounds and Pesticides/Herbicides*

Trichloroethene was identified in TP5 at 0.0-1.7 m (January 2007 investigation) at a concentration of 9.3 µg/kg.

Pesticides and herbicides were not detected in the sample for which they were tested.

*4.14.13 Explosive Chemicals Screening*

Two samples recovered from the trial pits were submitted for a comprehensive suite of explosive chemicals, as detailed in Appendix B. None of the referenced chemicals were detected.

# 5 Potential Effects without Mitigation

## 5.1 Geotechnical Issues

### *5.1.1 Foundation Design*

It should be noted that at the time of writing no detailed design parameters such as loads and settlement tolerances for the proposed structure were available. Consequently, the following comments and recommendations are given in general terms only and therefore, the advice of specialist contractors should be sought to formulate the most economic and satisfactory piling scheme and on the feasibility of applying treatment and what bearing capacity and tolerances on total and differential settlement could be achieved.

Factual reports detailing the geotechnical in situ and laboratory results are presented as Appendix A. Summary tables are presented in Section 4.

It is understood that the proposed development of a MRF would comprise a building likely to be of portal frame construction with associated service roads and parking. This Section will require further review with respect to potential foundation options once the detailed design of the building is finalised.

The made ground is not considered to represent a suitable bearing stratum due to its variable and potentially compressible nature and deleterious matter.

Lightly loaded structures that are not unduly sensitive to settlement may be suitable for the adoption of spread foundations placed within the drift deposits (clay/sand) beneath any made ground. The thickness and nature of the made ground in TP05 (January 2007 investigation) is likely to preclude the use of spread foundations.

For significantly loaded areas or structures sensitive to settlement, consideration could be given to utilising deep foundations such as piled foundations to transfer the structural load down to more competent strata.

Consideration could be given to the use of suitably reinforced spread foundations with prior ground improvement.

Conventional ground bearing floor slabs would likely experience potentially significant total and differential settlements as a result of the variability in the near surface ground conditions (made ground).

Consideration would need to be given to the extent to which maintenance of a very uniform, level floor surface is required, in conjunction with the imposed floor loading to be catered for.

If high floor slab loading needs to be catered for and/or if a very uniform level surface is essential then the following options are available for consideration:

- Suspend slabs with piles and ground beams designed on the same basis as the main foundations.

- Ground improvement using a grid of vibro stone columns prior to the use of suitably reinforced ground bearing slabs.

Advice from a specialist ground treatment contractor should be sought.

Consideration needs to be given to the advice given earlier in this report when selecting the type of floor slab for use and the required gas protection measures.

Groundwater may be present within the excavation depth range for buried structures. Should groundwater levels be within the excavation depth then dewatering or water exclusion measures would be required.

Obstructions have been encountered during the intrusive investigations that may require removal during redevelopment.

It is recommended that in-situ CBR / plate bearing tests are undertaken to assess the strength of the near surface materials to enable pavement foundation design to be undertaken.

#### *5.1.2 BRE SD1 Assessment*

Adopting conditions of a brownfield site with mobile groundwater a Design Sulphate Class of DS-1 and an ACEC Class of AC-1 should be used in accordance with BRE Special Digest 1, Concrete in Aggressive Ground, 2005

### 5.2 Gas Risk Assessment

No methane, hydrogen sulphide or carbon monoxide was recorded. Minimal carbon dioxide was recorded up to 0.3 %. Oxygen was depleted on each occasion and was recorded between 13.5 % and 14.3 %. Flow rates varied from -3.9 to 0.0 litres per hour.

In accordance with the new CIRIA document C665, Assessing Risks Posed by Hazardous Ground Gases to Buildings, the highest Gas Screening Value (GSV) is used to assess the required gas protection measures.

The CIRIA guidance differentiates between low rise housing developments (Situation B) and all other development types (Situation A). The proposed end use as a materials recovery facility would be classified as Development Situation A.

Given the negative flow rates and very low carbon dioxide concentration, a GSV cannot be calculated, but ‘characteristic situation 1’ is considered appropriate. In accordance with Table 8.6 of CIRIA C665, no special precautions are considered necessary. It should be noted that the gas assessment has been undertaken on the results of three monitoring visits of one monitoring well located within natural clay.

## 5.3 Human Health Risk Assessment

Four soil samples from the January 2007 investigation scheduled for chemical analysis have been used to assess the risks to human health. Additional PCB and asbestos testing undertaken as part of the September 2007 investigation were also assessed. Appendix E presents the screening tables.

The screening (statistical and direct comparison) did not identify any potential outliers and no results exceeded the screening values.

Asbestos, PCB's and trichloroethene were identified and are discussed below.

### 5.3.1 *Asbestos*

Asbestos was not identified in the samples from the January 2007 investigation for which it was tested. However, the September 2007 investigation identified amosite in TP07 at 0.4 m bgl and chrysotile in TP07 at 0.4 m bgl and TP11 at 1.5 m bgl.

### 5.3.2 *Volatile and Semi-Volatile Organic Compounds*

Trichloroethene was identified in TP5 at 0.0-1.7 m (January 2007 investigation) at a concentration of 9.3 µg/kg.

### 5.3.3 *Pesticides and Herbicides*

Pesticides and herbicides were not detected in the sample for which they were tested.

### 5.3.4 *Polychlorinated Biphenyls*

No screening value exists for PCB's, therefore a value of limit of detection, in this case 0.01 mg/kg has been used.

Three samples from the September 2007 investigation identified PCB's above the limit of detection - TP10 at 0.4 m (17 mg/kg), TP10 at 1.2 m (0.56 mg/kg) and TP11 at 1.5 m bgl (1.3 mg/kg).

PCBs have been demonstrated to cause a variety of adverse health effects and have been shown to cause cancer in animals as well as a number of serious non-cancer health effects in animals, including effects on the immune system, reproductive system, nervous system and endocrine system. They can be easily ingested through consumption of contaminated food or soil or absorbed through dermal contact with contaminated liquids or soils.

### 5.3.5 *Explosive Chemicals*

None of the explosive chemical tested for were identified.

## 5.4 Risk to Construction Workers

A human health short-term exposure assessment has been undertaken to identify potential risks to site workers and longer term maintenance workers due to ground contamination. This assessment does not include human health risks due to any other materials or activities undertaken during the proposed works, but does relate to

the short term human health risk posed to ground workers from chemical species identified during the site investigations. This assessment is for short term (acute) exposure only and is therefore not assessed under the current contaminated land regime which covers chronic – long term exposure.

The assessment was carried out in general accordance with the Health and Safety Executive (HSE) document 'Protection of Workers and the General Public during the Development of Contaminated Land' (1991) 'Guidelines for the Safe Investigation by Drilling of Landfills and Contaminated Land' Thomas Telford (1993) and with reference to 'A Guide to Safe Working on contaminated sites' CIRIA Report 132 (1996). The assessment has been undertaken with the following methodology:

- Selection of contaminants of concern (CoCs) and initial screening exercise;
- Selection of screening values for human health hazard assessment; and
- Determination of protective measures and/or further consideration required.

This assessment deals solely with short term exposure based on an eight hour working day due to the nature of activities that would be undertaken within and around the site. However, this assessment will also apply to any maintenance workers on the site during the operational period who could be likely to come into contact with / be exposed to soil. These risks can be mitigated by the methods discussed in Section 6.

*5.4.1 Identification of Potential Contaminants*

The contaminants found to be present at low concentrations i.e. below the level of laboratory detection were screened out.

Reference has also been made to Appendix 2 of the above mentioned HSE document (2007). This lists a variety of determinants, although not an exhaustive list and suggests ranges of results for the classification of contaminated soils.

Those parameters with maximum concentrations within the range typical for uncontaminated and only slightly contaminated soils have also been screened out, as the results suggest background levels. Finally, in the absence of any other applicable screening values, concentrations have been compared against the CLEA commercial land-use soil guideline values SGVs. Those concentrations below the SGVs have been screened out.

Those parameters screened out in this initial exercise are deemed to present a low or insignificant risk to ground workers and therefore they are not considered further in this assessment.

To highlight the toxicity or carcinogenicity of each contaminant, the international risk phrases are included where applicable.

Appendix E presents the screening Table.

*5.4.2 Assessment of Contaminants of Concern*

Following the initial screening of laboratory results for soils, no species were highlighted in the initial screening Table.

However, asbestos, PCB's and trichloroethene have been identified at the site and are carried forward for assessment.

*5.4.3 Summary of Risks to Construction/Maintenance Workers*

The identified concentration of trichloroethene – 9.3 µg/kg is not considered to be significant. Therefore the only contaminants considered to present a risk to construction workers and site maintenance workers are PCB's and asbestos.

## 5.5 Phytotoxicity Risk Assessment

Appendix E presents the screening Tables for the phytotoxicity risk assessment.

Screening of four samples from the January 2007 investigation did not highlight any exceedences of the screening values. No risk to plants is therefore considered to exist and no further action is considered necessary.

## 5.6 Controlled Waters Risk Assessment

Appendix F presents the screening Tables for the controlled waters risk assessment.

*5.6.1 Risks to the Underlying Aquifer*

Chemical test results from BH1 (January 2007 investigation) indicate exceedences of the DWS screening values for arsenic, cis-1-2-dichloroethene and trichloroethene. Trichloroethene was also identified in the made ground TP05. The monitoring well response zone is within the natural clay which is noted to contain sand bands and it can be concluded that this water is in hydraulic continuity with the underlying aquifer.

It is therefore considered that the made ground is having a slight impact on the underlying aquifer.

*5.6.2 Risks to Surface Waters*

Chemical test results from BH1 (January 2007 investigation) indicate that the limits of detection for phenols, anthracene, benzo(a)anthracene, benzo(a)pyrene, fluoranthene, pyrene, hexachlorobutdiene, total DDT and aldrin/dieldrin all exceed the EQS screening values. However, the results for these determinants are all below the limit of detection. No other determinants exceed the screening values, therefore no significant risk to surface waters is considered to exist.

## 5.7 Revised Conceptual Ground Model

### *5.7.1 Considerations*

The only contaminants identified that may pose a risk to human health (both construction/maintenance workers and future site users) are asbestos and polychlorinated biphenyls. Trichloroethene was also identified at low concentrations at one location. However, these risks can be mitigated by the methods discussed in Section 6.

Arsenic, cis-1-2-dichloroethene and trichloroethene exceeded the DWS screening values and are considered to be impacting slightly on the underlying aquifer.

Identified receptors are future site users, construction/maintenance workers and controlled aquifer waters. Whilst the River Alt is a potential receptor, the EQS assessment did not identify any potential risk to this controlled water.

Pathways through which contaminated made ground could impact the identified receptors are:-

- Future site users, construction/maintenance workers – direct contact, ingestion and inhalation.
- Controlled aquifer waters – leaching and vertical/lateral migration of contaminants through permeable sand bands within the underlying clays could allow contaminants to impact controlled aquifer waters.

The made ground is not considered suitable as a bearing stratum and therefore any foundations will likely require founding on the underlying clay or bedrock.

Groundwater was encountered at shallow depth and may be present within the excavation depth for buried structures.

Obstructions were encountered during the investigation that may impact any excavations or earthworks during construction. A land drain, probable concrete obstruction and a concrete piling cap were encountered at shallow depth.

Figure 5A presents a visual representation of the conceptual site model and Figure 5B presents the conceptual site model flow chart.

### 5.7.2 *Summary of Environmental Liabilities and Pollutant Linkages*

Table 5-1 summarises the environmental liabilities and pollutant linkages associated with the site. Appendix G presents the risk classification matrix.

*Table 5-1. Summary of Environmental Liabilities and Pollutant Linkages*

| Source | Pathway | Receptor | Risk | Rationale |
|---|---|---|---|---|
| Contaminated Made Ground | Direct Contact | Site users, construction/ maintenance workers | High risk | The presence of asbestos and PCB's pose a significant risk to both construction/maintenance workers and future site users. |
| | Ingestion | | | |
| | Inhalation | | | |
| | Leaching / vertical and lateral migration | Controlled waters – major aquifer | Moderate / Low risk | The presence of sand bands within the underlying clay indicates potential pathways for migration of contaminants. A large proportion of the site will be hard standing and a formal drainage system will help to minimise rainwater infiltration and in turn minimise contaminant migration. The site is not located within a Source Protection Zone. |

### 5.7.3 *Summary of Potential Development Constraints*

Table 5-2 summarises the geotechnical liabilities and development constraints associated with the site.

*Table 5-2. Summary of Geotechnical Liabilities and Development Constraints*

| Issue | Risk category of abnormal costs | Rationale |
|---|---|---|
| Buried former foundations or structures | Low / Medium | The site has previously been occupied by part of a large electrical and mechanical engineering works. Buried structures were encountered during the investigation that may require removal. |
| Shallow ground water | Low / Medium | Shallow ground water may be encountered in excavations and could require pumping and disposal. |
| Foundation design | Low / Medium | Given the variable nature of the made ground and depending upon the final building design, there may be a need for piled foundations and/or ground improvement. |

# 6 Mitigation Measures

## 6.1 Human Health

An assessment of the contaminants identified at the site identified PCB's and asbestos as posing a potentially unacceptable risk to site users (including future maintenance workers) following redevelopment and to construction workers during redevelopment. Mitigation measures are discussed below.

### *6.1.1 Polychlorinated Biphenyls and Asbestos Contamination*

For the proposed industrial end use of the site, PCB's and asbestos are considered to be the only contaminants identified that pose a risk to the health of future site users, construction workers and future maintenance workers.

Discussion with regulatory authorities would be prudent to ascertain the most pragmatic and cost effective route to dealing with the PCB / asbestos contamination. Options for consideration could include:

- Capping with inert soil to prevent direct contact, ingestion or inhalation should the locations be outside the footprint of the building.
- If the building is to be sited on the locations where PCB's have been identified, excavated material should be disposed of off-site to a suitably licensed facility. Depending upon any development proposals, contaminated material not requiring excavation could be built on or capped with hard standing to remove the pathway.
- Inert trench fill should be considered for service runs to protect future maintenance workers. This is considered best practice on construction sites. The service providers should be contacted to confirm appropriate pipe material.

The developer / ground engineering contractor should assess the risks posed by these contaminants to their staff prior to commencement on site. As a minimum, it is recommended that a full Health and Safety plan should be produced prior to work commencing, that good site practice of gloves and coveralls are maintained to prevent skin adsorption and incidental ingestion, and that dust is kept to a minimum by damping down to prevent incidental inhalation. Other good site hygiene practices such as washing hands before eating should be strictly followed.

## 6.2 Controlled Waters

Chemical test results from BH1 (January 2007 investigation) indicate that the made ground is impacting slightly on the underlying aquifer. It is therefore recommended that discussions are undertaken with the Environment Agency at the earliest opportunity to determine a suitable course of action (if any is required). Redevelopment of the site predominantly with hard standing may reduce the

infiltration of rainwater and in turn may minimise leaching of contaminants into the groundwater.

## 6.3 Geotechnical Issues

Consideration should be given to the possibility that buried former structures may require excavation during the redevelopment works.

There is a possibility that ground water may be encountered during excavation that requires pumping to keep the excavation dry. If this is required, it is likely that a discharge consent from United Utilities prior to disposal to foul sewer will be required.

Depending upon the final building design and loading requirements, advice from specialist piling / ground improvement may need to be sought to provide the most appropriate / cost effective design.

# 7 Conclusions and Recommendations

## 7.1 Conclusions

Only one phase of development has occurred at the site with an electrical and mechanical engineering works present between circa 1955-1988. It is believed that the works were developed earlier than 1955, but no maps were available between 1928 and 1955 to confirm this.

Made ground was encountered to between 0.3 m bgl and at least 2.6 m bgl. Superficial clay deposits were encountered underlying the made ground and overlying sandstone bedrock encountered at between 6.3 m bgl and 9.7 m bgl. The made ground is not considered a suitable founding stratum. Depending upon the final building design and loading requirements, spread foundations within the clay or piled foundations within the bedrock are considered likely to be suitable. Ground improvement may be necessary depending upon the need to minimise differential settlement of the floor slabs. Advice from specialists regarding piling and ground improvement may need to be sought to provide the most appropriate and cost effective foundation design depending upon final design and loadings.

Asbestos and polychlorinated biphenyls (and one low concentration of trichloroethene) have been identified that could pose a potential risk to future site users and construction/maintenance workers in the absence of appropriate mitigation.

Arsenic, cis-1-2-dichloroethene and trichloroethene are considered to be slightly impacting the underlying aquifer. However, redevelopment of the site, predominantly with hard standing may help to minimise rainwater infiltration which in turn may help to reduce the impact on the aquifer. It is recommended that discussions are undertaken with the Environment Agency at the earliest opportunity to determine a suitable course of action (if any is required) with regard to the groundwater.

An assessment of the risk to buried concrete in accordance with the BRE SD1 indicates that the Design Sulphate class is DS-1 and the ACEC class is AC-1 (assuming mobile groundwater).

Gas monitoring indicates that characteristic situation 1 is applicable given the low concentrations of carbon dioxide recorded and the absence of methane.

## 7.2 Recommendations

Mitigation measures for the asbestos and PCB contamination could include capping with inert soil or excavation and offsite disposal, depending upon the location of the building and hard standing. Inert trench fill should be considered for service runs to protect maintenance workers. Discussion with regulatory authorities would be prudent to ascertain the most pragmatic and cost effective route to dealing with the asbestos and PCB contamination.

The developer / ground engineering contractor should assess the risks posed by these contaminants to their staff prior to commencement on site. As a minimum, it is recommended that a full Health and Safety plan should be produced, that good site practice of using gloves and coveralls are maintained and that dust is kept to a minimum. Other good site hygiene practices such as washing hands before eating should be strictly followed.

Buried former structures may require excavation and/or removal during the redevelopment works.

A discharge consent from United Utilities may be required to dispose of water pumped from any excavations.

# 8 References

The Environment Agency (2002) Model Procedures for the management of Contaminated Land CLR11

ODPM (2004) Planning Policy Statement 23 – Planning and Pollution Control

BSi (2001) BS10175:2001 Investigation of Potentially Contaminated Sites.

BSi (1999) BS5930:1999. Code of Practice for Site Investigation

BSi (1990) BS1377: 1990. Methods of tests for soils and civil engineering purposes

Building Research Establishment BRE (2005) Special Digest 1: Concrete in Aggressive Ground

The Environment Agency (2002) Contaminated Land Regime CLR 7 and CLR 8.

The Environment Agency (2008) Contaminated Land Regime CLR9 and CLR 10.

CIRIA (2007) C665, Assessing risks posed by hazardous ground gases to buildings

NRPB (1999) R290 Radon: Guidance on Protective Measures for New Dwellings

British Standards (2007) BS 8485:2007 Code of practice for the characterisation and remediation from ground gas in affected developments.

Health and Safety Executive (HSE) (1991) - Protection of Workers and the General Public during the Development of Contaminated Land.

Thomas Telford (1993) - Guidelines for the Safe Investigation by Drilling of Landfills and Contaminated Land.

CIRIA (1996) – Report 132 A Guide to Safe Working on contaminated sites.