



PROPOSED SPECIALIST CARE UNIT, BROAD GREEN ROAD, LIVERPOOL

SEDDON CONSTRUCTION LTD

GRS0112-1458

05/03/2012



GEO TECHNICAL AND GEOENVIRONMENTAL
DESK STUDY REPORT

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EXECUTIVE SUMMARY

Seddon Construction Ltd proposes to develop a site at the former Gardeners Arms Pub, Broad Green Road, Liverpool, L13 5SF.

The development is likely to involve the construction of a specialist care unit with associated access roads, car parking and landscaped areas.

The site has changed very little since the earliest record in 1851 with Oak Vale Cottage in same place as pub. This pub is then marked from 1894 and is likely to have undergone modernisation over time. It is not known when the current car park was developed.

The published geology shows the site to be directly underlain by bedrock (pebbly Sandstone). However the presence of made ground and thin drift deposits cannot be entirely ruled out.

The site is in an area not considered to be affected by past, present or future coal mining activities.

Based on the historical and current uses of the site and surrounding area, a preliminary qualitative risk assessment has been carried out. This assessment concludes that the risk to the proposed development in terms of contaminated land and ground gas is low.

In order to provide a cost effective and targeted approach, an intrusive investigation is recommended which should comprise of shallow mini-percussive boreholes. Gas and groundwater standpipes should be installed to establish ground gas and groundwater levels and monitored over an appropriate timeframe. Geotechnical and chemical testing on selected soil and water samples should be carried out.

1 INTRODUCTION

1.1 GENERAL

Seddon Construction Ltd (Seddon) proposes to develop a site at the former Gardeners Arms Pub, Broad Green Road, Liverpool, L13 5SF.

The development is likely to involve the construction of a specialist care unit with associated access roads, car parking and landscaped areas.

Geoenvironmental Risk Solutions Ltd (GRS) has been appointed as geotechnical and geoenvironmental consultants for the project by Booth King Partnership (BKP) on behalf of the client.

This report forms the Phase 1 Desk Study and comprises a review of available historical, geological, geoenvironmental and geotechnical data together with information gained from a walkover survey of the site.

This report has been carried out with reference to and in line with British Standard BS 10175:2011 Investigation of Potentially Contaminated Sites – Code of Practice.

Although every effort has been made to provide a comprehensive review of the site, GRS cannot accept responsibility for any omissions or errors in data obtained from third parties.

1.2 DATA SOURCES

This desk study report has been prepared using both site specific and generic data sources all of which are listed below combined with previous experience of projects in the area.

Landmark SiteCheck Review 13/01/12

Landmark Geological Datasheets 27/02/12

Site Walkover, GRS 21/02/12.

Environment Agency Online Flood Map

2 THE SITE

2.1 SITE LOCATION AND DESCRIPTION

The site is located at the former Gardeners Arms Pub, Broad Green Road, Liverpool, L13 5SF at approximate national grid reference NGR: 340010, 390590. A site location plan is presented as Figure 1 in Appendix A.

The site is an irregularly shaped parcel of land measuring approximately 0.4 Hectares in area. It is split topographically with the now disused pub located on the lower plateau to the south and west of the site with a car park servicing both the pub and a bowling club on the upper plateau to the north and east of the site. The difference in height between the two plateaus is approximately 2.5m. The lower plateau currently contains the former Gardeners Arms pub which at the time of writing of this report was disused and boarded up. To the south and east of the pub are areas of hardstanding including a ramped access road to the upper plateau. To the immediate rear of the pub are retaining structures between the upper and lower plateaus. The car park on the upper plateau is of tarmac formation surrounded by grass and vegetation including several mature trees. It was noted that some minor fly tipping and rubbish was present in vegetated areas.

Immediately surrounding the site is a bowling green and club to the northwest which is accessed through the site, residential houses to the northeast, a road named The Green followed by residential housing to the southeast, Broad Green Road to the south and to the west are further residential houses. To the east, the site is approximately 2.0m above The Green.

The main access to the site is via Broad Green Road. Access to the upper plateau car park is prevented by a locked bollard. There is also limited access to the areas to the rear of the existing pub.

Photographs of the site taken during the walkover survey are presented in Appendix E.

2.2 SITE HISTORY

2.2.1 GENERAL

The site history is based on the available historical plans contained within the SiteCheck Review supplied by the Landmark Information Group Ltd (LIG) which are listed below. The historical plans are presented in Appendix B.

Date	Complete/ Incomplete (C/I)
1851	C
1881	I
1894	C
1909	C
1928	C
1956-1957	C
1965-1968	C
1974-1978	C
1982-1990	C
1983-1987	I

2.2.2 PREVIOUS LAND USE

1851

The northeast of the site is shown to be open fields. The south of the site is shown to contain Oak Vale Cottage bound by Perlicon Road. The Liverpool to Manchester Railway Line is marked approximately 260m to the south. A small pond is marked approximately 50m to the north of the site followed by Highfield House 100m away. The surrounding area comprises predominantly open fields and farmhouses.

1894

Oak Vale Cottage is now marked as the Gardeners Arms Public House. The surrounding area remains predominantly open fields however there has been a small increase in residential dwellings.

1909

There has been no change on site. Perlicon Road to the south of the site is now named Broad Green Road. Highfield Infirmary is marked approximately 250m to the northeast.

1928

There has been no change on site. Edge Lane Drive is now marked adjacent to the southeast boundary of the site. The pond and Highfield House to the north are no longer marked. Highfield Infirmary is now marked as Highfield Sanatorium. There has been further residential development in the surrounding area.

1956-1957

The site remains unchanged. The area to the northwest of the site which is presently a bowling green is shown as open land. Schools are marked approximately 100m to the north. Highfield Sanatorium is now marked as Broad Green Hospital. The surrounding area is now dense residential land use.

1982-1990

A drain is marked to the northeast of the site.

2.2.3 RECENT SITE HISTORY

Edge Lane Drive no longer exists and a small access road is in its place named The Green. The open land to the northwest of the site is a bowling green.

2.3 PROPOSED DEVELOPMENT

It is proposed to build a specialist care unit with associated access roads and car parking. A preliminary architects drawing provided by BKP show that the building will be predominantly situated to the north (upper plateau) of the site comprising one storey. The very southern part of the building will comprise two storeys as it will bridge across the lower plateau. The proposed car park will be located at the south of the site where the existing pub stands. A private secure garden will be located to the northeast of the site with small areas of landscaping throughout. The preliminary drawing is presented as Figures 2 in Appendix A.

3 ENVIRONMENTAL SETTING

3.1 GENERAL

The site is located in a generally residential setting with very little commercial/industrial land use in the surrounding area. The following statutory information is presented in detail in Appendix B.

The 250m radius search is considered as the most pertinent to the proposed development.

3.2 CONTEMPORARY TRADE DIRECTORY ENTRIES

A search encompassing a 250m radius around the site boundary revealed a limited amount of trade entries which could cause a contaminative constraint to the development of the site.

The registered contemporary trade entries are listed in the table below with a brief description of the processes or activity.

Table 3.2 - Contemporary Trade Entries within 250m of the Development

Business Name	Distance from Site (m)	Direction	Status	Activity
Appliance Repairs	192	S	Active	Domestic Appliances – Servicing, Repairs and Parts

The above listed trade entry is not considered to pose a risk to the site.

Numerous trade entries exist outside the 250m radius but are unlikely to pose a constraint to the proposed site developments.

3.3 DISCHARGE CONSENTS

No discharge consents are listed within a 500m radius of the site.

3.4 POLLUTION INCIDENTS TO CONTROLLED WATERS

No pollution incidents to controlled waters exist within the 500m radius around the site.

3.5 WASTE

No records of historical landfill sites, waste transfer, management, treatment or disposal sites are located within 250m of the proposed site.

3.6 SENSITIVE LAND USES

The site is located in a nitrate vulnerable zone. No other sensitive land uses are located within a 250m radius of the site.

3.7 HYDROGEOLOGY

3.7.1 GEOLOGICAL CLASSIFICATION

The site lies above a principal aquifer as defined by the Environment Agency (EA). The EA define a principal aquifer as layers of rock or drift deposits that have high intergranular and/or fracture permeability - meaning they usually provide a high level of water storage. They may support water supply and/or river base flow on a strategic scale. In most cases, principal aquifers are aquifers previously designated as major aquifer.

Likely risks to protected waters are presented in Table 9.2 in Section 9 of this report.

3.7.2 SOIL CLASSIFICATION

Further to the above definition the soils beneath the site have been defined as having a high leaching potential, that is they are considered to have a high potential for contaminants to be leached from them by the presence of a percolating liquid i.e. water.

This worst case vulnerability classification (H) is reserved for restored mineral workings and urban areas until proved otherwise by site investigation and subsequent laboratory testing.

3.8 HYDROLOGY

The closest body of water lies at the northeast boundary of the site and comprises a drain feature.

3.9 FLOODING

Flooding has become a major issue during the past few years, with a number of large flood events impacting many towns and villages. The EA is the main source of consultation regarding the impact that flooding would have to the development, whether issuing standing advice for proposed developments or by direct and ongoing consultation throughout the planning process. The EA produces flood maps for the whole country by looking at historical and possible sources and paths of fluvial and marine causes of flooding. These maps however, do not cover the potential of flooding to occur by any other sources e.g. groundwater, surface runoff, snowmelt, service failure.

A preliminary assessment of the fluvial and tidal risk of flooding on site indicates that the site (based on EA Flood Maps and Envirocheck Data) is in an area of Low likelihood of being affected by a flood event. That is to say that there is less than 0.1% (1 in 1000) chance of flooding from rivers or seas in any single year.

3.10 RADON

Based on the available information the site lies within an area where less than 1% of homes are above the action level. This could be easily confirmed by testing of existing structures in the vicinity.

3.11 INVASIVE SPECIES

No obvious evidence of invasive species was noted at the time of the site walkover survey. If invasive species are encountered during the intrusive investigation or development phase, advice should be sought.

3.12 UNEXPLODED ORDNANCE

Historical evidence indicates that Liverpool was a target for bombing during periods of World War II. An initial search for the potential risk of unexploded ordnance in the area of the site has been carried out through the Zetica website. This preliminary search indicates the site to be in an area at high risk of unexploded ordnance. A drawing showing the risk level is presented as Figure 3 in Appendix A. Due to the risk level GRS was instructed by the client to commission a preliminary UXO risk assessment report. This was obtained from Landmark and was carried out by Alpha6 on behalf of Landmark. The preliminary risk assessment studies detail military and bombing records in the area and assign a risk level based on this information. This site has been characterised as 'UXO Probability Assessment = 3 Rating, indicating a low possibility of UXO encounter'. The report concludes that in light of the findings and in accordance with CIRIA's publication on managing UXO risks, it is recommended that no further action is warranted to address the level of UXO risk at this site. A copy of this report is presented as Appendix D of this report.

3.13 ASBESTOS

Given the age of the current building on site (Gardeners Arms pub) there is the potential for asbestos to be present within the fabric of the building. It is therefore recommended that a Type 3 Asbestos Survey is carried out prior to any demolition works.

4 GEOLOGY

The geology underlying the site has been obtained from the Landmark Geology Datasheet (presented in Appendix C) which utilises the BGS 1:50000 Runcorn Sheet 87 and is summarised below.

4.1 PUBLISHED DATA

4.1.1 SUPERFICIAL DEPOSITS

The site is shown by the geology datasheet to be directly underlain by bedrock. However the data may not include made ground deposits which may be present directly below the surface. The nearest drift deposits are shown adjacent to the northwestern boundary of the site and are described as Devensian Till which comprises Diamicton and sandy gravelly cobbly clay. Given the scale of mapping of the published data it is possible that thin deposits of this drift material may be present underlying the site.

4.1.2 BEDROCK

The bedrock is shown to comprise the Chester Pebble Beds Formation described as pebbly (gravelly) sandstone.

5 COAL MINING

The Landmark Sitecheck indicates that this site is not in an area likely to be affected by past, present or future coal mining activities.

6 PREVIOUS GROUND INVESTIGATIONS

No details of any previous investigations were available to GRS at the time of writing this report.

7 REVIEW OF POTENTIAL SOURCES OF CONTAMINATION

As part of the risk assessment process it is necessary to identify potential sources of contamination and chemicals of concern based on the historical uses of the site.

As well as potential contamination from past and present uses, there is the risk of ground gas generation from both natural and anthropogenic sources.

The potential sources are reviewed in the tables below, which have been compiled with reference to the Environment Agencies Industry Profiles where available. The contaminating agents and their toxicological effects to humans are discussed in section 8 of this report.

Table 7.1 - Review of Potentially Contaminative Land Uses on and immediately surrounding the site

Industry/ Process	On/Off Site Past/Present	Distance From Site (m)	Contaminating Agents	Causes
Made ground	On site	0	Various	Presence of made ground is likely and could potentially comprise various contaminants
Infilled ground	On site	0	Various	Unknown backfill
Pollution incident	Off site	25m	Household waste	Category 2 Significant Incident. Further details are not known.
Infilled Pond	Off Site	50m	Ground Gas.	Unknown backfill

Without site specific information it is impossible to determine to any degree of accuracy the risk to the site from ground gas. However a tentative assessment would place the site at low risk given the fact that infilled ground and ponds exist on the site and in the surrounding area.

8 SUMMARY OF POTENTIAL CONTAMINANTS AND THEIR CHARACTERISTICS

The various contaminants and their potential effects are summarised in the table below.

Table 8 - Summary of Contaminants and their Typical Characteristics.

Contaminants	Typical Effects	Mobility
Metals: i.e. Arsenic, Lead, Zinc, Copper, Nickel, and Boron.	Most are known to be toxic to humans in sufficient quantities. Exposure through ingestion or dermal contact can result in a variety of effects such as kidney, liver, lung and brain damage. Some are carcinogenic. Others are toxic to plants and can inhibit their growth.	Generally poor mobility, however this can vary due to soil pH. They may be present as additives within more mobile phases such as liquids.
Inorganic Compounds: Acids, Alkalis, Cyanides, Sulphate compounds.	Causes skin irritation. Sulphate and chloride compounds can cause the deterioration of concrete.	Variable, largely dependent upon solubility.
Organic Compounds: Polyaromatic Hydrocarbons (PAH), Fuels, Oils, Solvents, and Phenols.	A wide range of human health effects including brain damage and cancer. Damage to concrete and underground services. Flammability and or explosion risk.	The lighter compounds are typically highly mobile in both liquid and vapour form. Heavier compounds such as tars are less mobile. Chlorinated solvents are generally heavier than water and can migrate downwards through aquifers.
Ground gases (Natural and Anthropogenic): Methane, Carbon Dioxide, Oxygen depletion and Hydrogen Sulphide.	Explosion, asphyxiation and toxicity.	Highly mobile in solution or in gaseous phase.
Asbestos	Exposure through inhalation can result in cancer of the lung, mesothelioma and asbestosis.	Asbestos is not soluble or biodegradable. Chrysotile (white asbestos) is the only form that can be attacked by acid.

9 CONCEPTUAL GROUND MODEL AND PRELIMINARY RISK ASSESSMENT

This is a preliminary qualitative assessment and should be augmented by sampling and testing to confirm the assumptions below and should be amended/developed to take into account any significant changes caused by the proposed end use e.g. landscaping etc, and any further information as it becomes available.

9.1 CURRENT LEGISLATION

The current UK framework (Contaminated Land Exposure Assessment (CLEA)) for the assessment of potentially contaminated land as set out by the Department of the Environment, Farming and Rural Affairs (DEFRA) is based on the pollutant linkage or Source-Pathways-Receptor scenario.

In order for land to be legally classified as contaminated under Part IIa of the Environmental Protection Act (EPA) 1990 all three of the elements pollutant linkage must be present.

Generic land uses have been published under the CLEA guidance and are divided into the following categories.

Residential

Allotments

Commercial / Industrial

Each of these generic land uses has a prescribed set of pathways and assumptions associated with them which effectively characterise the land in terms of the way it is used. Further to this a set of Soil Guideline Values (SGV's) for a limited number of contaminants have been developed and published by DEFRA. It should be noted that CLEA is concerned with *human health only*. Where the proposed land use does not fall into any of the above categories, further land use scenarios are available to use for example Atkins AtRisk SSVs which are derived in house by Atkins using the CLEA framework.

9.2 PRELIMINARY QUALITATIVE RISK ASSESSMENT

For the purposes of this qualitative assessment, the land use of **Residential without Plant Uptake** best fits the proposed development and as such will be used for the assessment of any potential risks to human health. However it should be noted that although this is considered to be the closest land use to the proposed development, residential without plant uptake is conservative.

In order to assess a potential site it is a requirement of the CLEA model that a preliminary conceptual model of the site is prepared which clearly identifies the likely sources, pathways and receptor elements.

The preliminary conceptual model in terms of pollutant linkages is presented in Table 9.2 below.

The overall assessment of the potential materials present on site indicates that there is an overall **Low** risk.

Based on the assumptions within Table 9.2, materials on or below the site should be assessed in terms of concentrations of potential contaminants of concern considered in Table 7. Any site investigation performed should be adequately designed to address these issues.

Table 9.2 - Pollutant Linkages within the Preliminary Conceptual Model

Source	Pathway	Receptor	Likelihood of risk
Soil	Dermal Contact with outdoor soil	End Users/Builders/Contractors	Low
Soil	Dermal Contact with indoor dust	End Users	Low
Soil	Outdoor inhalation of fugitive dust	End Users/Builders/Contractors	Low
Soil	Indoor inhalation of dust	End Users	Low
Soil	Outdoor ingestion of soil	End Users	Low
Soil	Indoor Ingestion of soil	End Users/Builders/Contractors	Low
Soil	Outdoor inhalation of soil vapours	End Users/Builders/Contractors	Low
Soil	Indoor inhalation of soil vapours	End Users	Low
Soil	Leaching	Groundwater	Low
Soil	Soil Pore Migration	Buildings/Sub Surface Structures	Low
Groundwater	Contact	Construction and Maintenance Workers	Low
Groundwater	Migration	Protected Waters	Low
Groundwater	Migration	Buildings/Sub Surface Structures	Low
Ground Gas	Migration through ground	End Users/Builders/Contractors	Low

10 SUMMARY OF AVAILABLE INFORMATION

Item No.	Item Title	Item Description	Comments
1	The Site	The site is presently a disused pub and car park. The car park is still in active use by a Bowling Club adjacent to the northwest of the site. The site is split over two levels, the upper plateau containing the car park and the lower plateau containing the pub.	Information based on site visit and available maps.
2	History	The site has changed very little since the earliest record in 1851 with Oak Vale Cottage in same place as the present pub. This pub is then marked from 1894 and is likely to have undergone modernisation over time. It is not known when the current car park was developed.	Taken from historical ordnance survey plans and a site visit.
3	Geology	The published geology shows the site to be directly underlain by bedrock (pebbly Sandstone). However, presence of made ground and thin drift deposits cannot be entirely ruled out.	Information from British Geological Survey (BGS).
4	Mining	The site is not affected by coal mining.	Information from Landmark SiteCheck Review (13/01/12)
5	Ground Conditions	Thin made ground deposits over bedrock are expected to underlie the site.	Further ground investigation is required to establish site specific ground conditions.
6	Groundwater	Groundwater may be encountered at relatively shallow depths given the aquifer designations below the site.	Ground Investigation necessary to establish groundwater regimes.
7	Landfill	No records of landfill are found within proximity of the site. However records indicate that infilled ground are located on and around the site. Details of backfill are not known.	Contamination and Ground Gas may have migrated onto site.
8	Contamination	There are minimal potential sources of contamination.	Chemical testing on soil is recommended.
9	Geotechnical Constraints	There is the potential for made ground to be present directly underlying the surface.	Further investigation required.
10	Geoenvironmental Constraints	The site has been given an overall low risk in terms of contamination and ground gas.	Chemical testing on soil and ground gas monitoring is recommended to confirm the risk level.
11	Proposed Foundations	It is likely that the proposed building can be supported over traditional shallow foundations.	Ground Investigation is required to determine site specific parameters.
12	Proposed Ground Investigation	It is recommended that a targeted site investigation is carried out to identify potential ground related risks. Once identified, these risks can be addressed at the design stage or controlled during construction.	The SI is likely to comprise of mini-percussive boreholes. Gas and Groundwater standpipes should be installed to establish ground gas and groundwater levels. Geotechnical and chemical testing on selected soil and water samples should be carried out.

11 DEVELOPMENT CONSIDERATIONS

11.1 GEOTECHNICAL CONSTRAINTS

11.1.1 SUBSURFACE CONCRETE

There is the potential that soil or groundwater contamination on site could damage subsurface concrete. Suitable testing should be undertaken to allow the adequate design of any subsurface concrete.

11.1.2 FOUNDATIONS

It is likely that traditional pad and strip footings will be sufficient for the proposed development of the specialist care unit. However, foundations for any new structures on site will require site specific parameters and a site investigation should be carried out to obtain the relevant data.

11.1.3 SERVICES

Services are likely to exist on site which may or may not be live. A suitably qualified utility tracing contractor should be employed to further delineate the location of the services, which may require protection or diversion to accommodate the new development.

11.2 GEOENVIRONMENTAL CONSTRAINTS

11.2.1 CONTAMINATED SOILS

There is the potential albeit small for contaminated material to be present on site. The overall risk of this potential contamination is considered to be low. It is therefore recommended that a suitably designed site investigation should be carried out in order to assess the quality of the soils and therefore the potential risks to the development.

11.2.2 ASBESTOS

As discussed in section 3.13 it is recommended that a Type 3 Asbestos Survey is carried out prior to demolition of the disused pub.

11.2.3 WASTE DISPOSAL

Should it be necessary to remove any material from the site Waste Acceptance Criteria (WAC) testing should be carried out prior to removal in order to classify the materials for disposal at a suitably licenced landfill.

It should be noted that WAC testing can take up to 10 days to perform and sufficient time should be allowed in order to prevent delays to the construction program.

12 DESIGN ASSUMPTIONS - RISK MATRIX

Item Description	Comments	Risk	Recommendations
Foundations	Ground conditions are expected to comprise made ground over bedrock.	4	An investigation specific to the development is required.
Ground Slab Build Up	Ground bearing slabs may be feasible on this site.	4	Investigation to assess near surface soil properties is required.
Mining	The site is not within an area affected by coal mining.	1	None.
Contamination	There is the potential albeit low that contamination from historical uses is present on site.	3	Further investigation required.
Ground Gas	Ground gas risk is considered to be low given infilled ground on and surrounding the site.	3	Further investigation/monitoring required.
Pavement Build Up	Paved areas will be required for access routes and car parking.	3	Investigation required to determine pavement design parameters.
Slopes	There is potential for slopes to be present on site. However exact details are not known.	2	Further advice should be sought if slopes are to feature in the development.
Cut and Fill	There are no details of any cut and fill requirements at this stage. However initial architect's drawings show the proposed building over a split level.	2	If cut and fill is required then further advice should be sought.
Retaining Walls	Retaining structures already exist on site between the upper and lower plateaus. The fate of these is at present unknown. Details of any retaining walls required to accommodate the proposed development are currently unavailable.	2	Further advice should be sought if retaining walls are required as part of this development.
Flooding	There is less than 0.1% chance of flooding from rivers or seas.	1	None.
Drainage	Provision of SUDS may be feasible	3	Further investigation of feasibility required.
Radon	Less than 1 % of homes are below the action level.	1	None.

1. The recommendations are based on available information on 05/03/12.
2. A full site investigation has to be carried out before design scheme.
3. The risks are on a scale of 1 to 5.
4. Risks rated 1 & 2 no action. Risks rated 3 & 4 can be downgraded with further information which is due to become available. Those rated 5 need costs allocating.

13 SITE INVESTIGATION RECOMMENDATIONS

13.1 GENERAL

The proposed development will see a marked change to the site with the replacement of the pub with a car park and the existing car park replaced by the proposed care unit. It is likely that the local authority will require site specific ground information in order to facilitate any planning applications. Further to this an assessment of the ground conditions will be required to assess foundation requirements for any new structures, risks from ground gas and potential contamination.

13.2 PROPOSED INVESTIGATION

The details of the intrusive site investigation should be decided and agreed with client once the proposed site layout has been finalised. However, the following information is considered to be a guide to the likely methods and quantities of the required investigation.

13.2.1 MINI-PERCUSSIVE BOREHOLES

Mini Percussive boreholes are a relatively quick and economic method of investigating shallow ground conditions. The mini-percussive boreholes can be used to establish geotechnical and geoenvironmental soil parameters as well as the installation of groundwater/ground gas monitoring wells. Standard Penetration Tests (SPT's) can be obtained from mini-percussive boreholes which give an indication of relative density in granular soil and indicative strength/cohesion of cohesive soils. Mini-percussive holes can also be continued by Dynamic Probe which gives a continuous indication of relative strength/density.

It is recommended that 2 days of mini-percussive investigations should be carried out at this site. On average up to five mini-percussive holes can be completed within a day.

13.2.2 GROUND GAS/ GROUNDWATER INSTALLATIONS

Standpipe installations will allow the monitoring of any ground gas present and of any ground water regime beneath the site. Ground Gas has been highlighted as a low risk to the site from potential migration from two infilled ponds on site and a nearby historic reservoir but the nature of the backfill is unknown. In order to assess the risk from Ground Gas and to assess the groundwater regime beneath the site, it is recommended that three installations are formed on the site. The installations should then be monitored six times over an appropriate timescale using a GA2000 or similar landfill gas analyser.

13.2.3 LABORATORY TESTING

Based on the preliminary risk assessment detailed in the review of potential sources of contaminants in section 7 of this report, geoenvironmental testing should as a minimum comprise of a generic suite of analysis (As,Cd,Cr,Cu,Hg,Ni,Pb,Se,Zn, hot water soluble boron, water soluble sulphate, free Sulphur, pH, Total and Free Cyanide, Thiocyanate, Sulphide, Phenol-monohydric, TPH and total PAH) on a sufficient number of samples. If olfactory or visual evidence of hydrocarbons is encountered during the intrusive investigation, consideration should be given to more detailed hydrocarbon screening as appropriate. The published geology suggests the site to be directly underlain by bedrock. However some made ground and drift deposits may be present. If granular strata are encountered, geotechnical testing should comprise of particle size distribution (PSD) tests as a minimum and if necessary compaction related testing. If any cohesive strata are encountered then sufficient testing should be performed on disturbed or undisturbed specimens for moisture content, Atterberg limit, determination of CBR and undrained unconsolidated shear strength as a minimum and consolidation analysis if required.

