

National Consultancy, Locally Delivered

GEO-ENVIRONMENTAL SITE ASSESSMENT MOUNT ROAD, LEEK

REC REFERENCE: 100693p1r2

REPORT PREPARED FOR: GREEN GATE HOMES (NW) LTD

AUGUST 2016





QUALITY ASSURANCE

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| Date | April 2016 | August 2016 | August 2016 |
| Prepared by | Graham Walker | Calum Dowd | Colin Wardle |
| Qualifications | BSc (Hons) FGS | - | Technical Manager |
| Signature | Gutable | aboud | 1.1.1. |
| Checked by | M Hamill | Owen Stevens | V Timson |
| Qualifications | BSc (Hons), PGDip, MIEnvSc | MSc, BSc (Hons), CEng, CGeol, Eur Geol, CPhys, CSci, CEnv, FGS, MInstP, MRICS | Principal Consultant |
| Signature | Hal | Mun | Mr. |
| Authorised by | Owen Stevens | Owen Stevens | L Stock |
| Qualifications | MSc, BSc (Hons), CEng, CGeol, Eur Geol, CPhys, CSci, CEnv, FGS, MInstP, MRICS | MSc, BSc (Hons), CEng, CGeol, Eur Geol, CPhys, CSci, CEnv, FGS, MInstP, MRICS | Principal Consultant |
| Signature | Attun | Mun | Brock |
| Project number | 100693 | | |





| Site Address | Mount Road, Leek, Staffs, ST13 5BU | |
|----------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| Grid Reference | E: 399503 N: 355901 | |
| Site Area | 0.41 ha | |
| Current Site Use | Two enclosed fields, separated by a low wire fence. Livestock are housed within them along with temporary pens. The site slopes downwards towards the southwest. | |
| Historical Site Use | The site has never undergone any significant development. | |
| Adjacent Site Uses | Leek Moorlands Hospital is situated approximately 300 metres north of the site and a petrol filling station is also situated 100 metres north of the site. Open fields are situated to the south of the site and residential areas exist to the north west, west and east. | |
| Consitivity Cotting | Hydrogeology: The site is underlain by a Secondary A aquifer, with a thin layer (approx. 2m) of clay offering limited protection. There are no potable groundwater abstractions within 1km of the site. | |
| Sensitivity Setting | Hydrology: The nearest surface watercourse is approximately 250m from the site.Sensitive Land Uses - Residential properties are in close proximity to the site. | |
| Landfill Sites & Ground Gases | Several historic clay pits and a brick works are shown on the historical maps to the east of the site, up until 1951, which may act as a potential source of ground gas however; these have not been recorded as landfill sites. | |
| Radon | No radon protection measures are required. | |
| Coal Mining / Land Stability | The site is not within an areas affected by coal mining. | |
| Intrusive Ground Inv | restigation | |
| | No Made Ground deposits were encountered on site. Drift Glacial Till (clay) underlies the topsoil and extends to rockhead at a depth of | |
| | between 2.00m and 3.00m. The clay is typically firm, becoming stiff with depth. | |
| | Solid Interbedded sandstone and mudstone was encountered from depths of 2.00m bgl. | |
| | Groundwater Groundwater was encountered in two of the five window sample holes (WS103 at 2.30m & WS105 at 1.70m). Shallow water ingress was also seen, from perched water overlying the clay deposits. | |



| Tier II Contaminated Land Risk Assessment | | |
|-------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| Human Health | No pollutant linkage identified. | |
| Controlled Waters | No pollutant linkage identified. | |
| Ground Gas | No pollutant linkage identified. | |
| Potable Water Infrastructure | Standard PE pipe should be adequate for the site. | |
| Conceptual Site Model (CSM) | No on-site sources of contaminants were identified which could be considered to pose a risk to human health or controlled water receptors and the identified potential off-site sources are not considered to have viable pollutant linkages. | |
| Geotechnical Assess | ment | |
| Underground Obstructions | None anticipated based on the lack of previous development on the site. | |
| | It is considered that the target stratum of stiff high strength clay is suitable for shallow strip footings, anticipated at a depth of around 1.50m bgl. | |
| Foundation Options | Further considerations should be given to plots in the vicinity of existing and proposed trees in accordance with NHBC guidance to determine any requirement for the deepening of foundations for a medium volume change potential clay. | |
| Soak-away Drainage | The site is not considered suitable for a sustainable soakaway drainage solution and allowances should be provided to mitigate against the likelihood of water ingress into site excavations. | |
| Sulphate Assessment | No precautions required. Class ACEC AC-1s. | |
| CBR Design % | A preliminary assessment suggests a CBR value of 3% is likely to be achievable for the road infrastructure. | |
| Recommendations | | |

Geotechnical

A tree constraints / influence assessment should be carried out to determine any requirement for the deepening of foundations for plots in the vicinity of existing or proposed trees.

Environmental

The site is considered suitable for development without the requirement for any enabling or post construction remedial action.



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1.0 INTRODUCTION

1.1 Background

Resource and Environmental Consultants (REC) Ltd have been commissioned to undertake a Phase I and II Site Investigation at the site off Mount Road, Leek.

1.2 Proposed Development

REC Ltd understands that Green Gate Homes (NW) Ltd are considering the redevelopment of the site for residential properties comprising houses and bungalows with associated car parking, landscaping and infrastructure.

1.3 Objectives

The objectives of the geo-environmental investigation are to:

- Review historical plans, geology, hydrogeology, site sensitivity, flood-plain issues, mining records and any local authority information available in order to complete a Desk Study in line with Environment Agency (EA) document Model Procedures for the Management of Contaminated Land (Contaminated Land Report 11 (CLR11));
- Undertake a preliminary stage of sampling and analysis to provide an overview of environmental issues identified;
- Assess the implications of any potential environmental risks, liabilities and development constraints associated with the site in relation to the future use of the site and in relation to off-site receptors;
- Assess the geotechnical information and provide preliminary recommendations in relation to foundations, pavement construction and floor slabs;
- Provide an assessment of the soakage of the underlying soils to assist in the design of infiltration based SuDS; and,
- Provide recommendations regarding future works required.

1.4 Sources of Information

Background information was sought from the following sources:

- Groundsure Database Search;
- Historical mapping dated 1878 to 2014;
- A site walkover;
- On-line planning records held by Staffordshire County Council;
- Environment Agency GIS Databases (www.environment-agency.gov.uk/wiyby);
- Radon: Guidance on protective measures for new buildings (BRE Document BR 211, 2015);
- *i* British Geological Survey Mapping.

1.5 Risk Classification



REC Ltd has utilised the available data to classify the site on the basis of its likely contaminated land liability and potential for geotechnical constraints in relation to the property development. The risk classification definitions are summarised below:

| Risk | Definition |
|-------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Low | There are unlikely to be significant contaminated land liabilities/geotechnical constraints associated with the property. |
| Low-Moderate | There are unlikely to be significant contaminated land liabilities/geotechnical constraints associated with the property with regard to the proposed use. However, minor issues may require further consideration in the event of a future redevelopment of the site etc. |
| Moderate | Some potential contaminated land liabilities/geotechnical constraints are likely to affect the property as a result of historical and/or current activities. The risks identified are unlikely to pose an immediate significant issue but the purchaser/developer may wish to make further enquiries of the vendor or undertake further environmental improvements. Redevelopment of the site will likely require further site investigation. |
| Moderate- High | Some potentially significant contaminated land liabilities/geotechnical constraints have been identified at the property that requires further assessment including intrusive ground investigations. |
| High | Significant potential contaminated land liabilities/geotechnical constraints have been identified at the property. Further assessment including intrusive ground investigation will be required to determine to level of risk and associated liability. |

Table 1.1: Risk Classification Summary

1.6 Limitations & Definitions

The limitations of this report are presented in Appendix I.

All acronyms used within this report are summarised within Appendix II.



2.0 SITE SETTING

2.1 Site Details

Table 2.1: Site Location Summary

| Site Address | Mount Road, Leek, Staffs, ST13 5BU |
|-------------------------|------------------------------------|
| National Grid Reference | E: 399503 N: 355901 |
| Site Area | 0.41 ha |

A site location map, Drawing No. 100693-001, is presented in Appendix III.

2.2 Current Site Use

Site Walkover Brief

A site walkover was completed on 25th February 2016 and the following site description comprises the site's current layout / features based on the REC Engineer's observations at the time of the site walkover. The walkover is primarily used to identify potential sources of soil and water contamination present at the site. The walkover is not a professional assessment of any potential future remedial, demolition or decommissioning works required and advice on such matters should be sought by the appropriate specialist contractors.

Site Description

The subject site is a roughly rectangular shaped parcel of land located just off Ashbourne Road, which converges with Mount Road at the sites eastern boundary. It sits south of Poplar Service Station and south east of Fair View Road, a residential area.

The site is currently two enclosed fields, separated with a wire fence, with several established trees at its borders. The site slopes down towards the west and there are a few temporary wooden, metal structures within the north of the site which are used to house livestock (pigs and goats) and a greenhouse is also present.

The site is considered to represent a very low environmental risk in its current state.

A petrol filling station is situated approximately 50m north of the site and several historical clay pits are located directly adjacent to the sites eastern boundary, which are now ponds.

Hazardous Materials Storage

No above ground storage tanks (AST) or Underground Storage Tanks (USTs) were observed at the site.

Polychlorinated Biphenyls (PCBs)

No equipment that may potentially contain PCBs was observed at the site.

Asbestos Containing Materials (ACMs)

No potential ACMs were observed at the site.



Waste Storage

No potentially hazardous waste streams are currently generated at the site. Additionally, there was no evidence of any 'fly-tipped' waste.

2.3 Surrounding Area

The surrounding land uses are summarised below:

| Direction | Land Use |
|-----------|---------------------------------------------------------------------------------------|
| North | Petrol filling station, residential areas and a small local hospital (Leek Moorlands) |
| East | A small number residential dwellings and farmland beyond these. |
| South | Farmland |
| West | A small residential estate and farmland beyond this. |

Table 2.2: Surrounding Land Use Summary



3.0 SITE HISTORY

3.1 On-Site Historical Development

From the earliest mapping record available (1879) the site is shown to be undeveloped and with the site boundaries present as to the current day.

Historical mapping indicates that the site remains undeveloped up to the current day. It is unclear as to what land use the site has been utilised for; however for the purposes of this report it can be postulated that the site has been used as agricultural land and as an area of public open space.

3.2 Off-Site Historical Development

Few potentially significant off-site sources have been identified within the historical mapping; however, two features have been identified, which are as follows:

Table 3.2 Summary of Potentially Contaminative Off-Site Historical Land Uses

| Surrounding Feature | Dates | Distance | Direction |
|--------------------------------------------------|--------------|----------|-------------|
| Brick Works and associated clay pits; | Pre 1879 | | |
| - Ceased operations and partly developed | Pre 1925 | | |
| into residential housing | | 25m | North east. |
| Further housing development; | Circa. 1960s | | |
| Further housing development. | Circa. 2010s | | |
| Carago (lator a potrol filling station) | Pre 1964 to | 60m | North |
| Garage (luter a petrol jilling station) | Present | oum | north. |

3.3 Planning History

REC has undertaken a review of on-line planning records held by Staffordshire County Council and no planning applications for the subject site are recorded.



4.0 GEO-ENVIRONMENTAL SETTING

4.1 Geology & Hydrogeology

The British Geological Survey (BGS) map for the site, (Sheet 111, 1:50,000, Buxton, Solid & Drift edition) indicates that the site is underlain by the following geological sequence:

| Geological Unit | Classification | Description | Aquifer Classification | Sensitivity |
|--------------------|-----------------------|--------------------------------------|------------------------|-------------|
| Drift | None Recorded | N/A | N/A | N/A |
| Solid | Morridge Formation | Mudstone, Siltstone and Sandstone | Secondary (A) | Moderate |

Table 4.1:Geological Summary

The Groundsure report indicates there are no potable or surface water abstractions within 2km from the site and the site does not lie within a Source Protection Zone.

Based on the local topography and location of surface watercourses it is considered likely that shallow groundwater, if present, will flow in a westerly direction.

4.2 Natural Geological Hazards

GIS modelling data held by the BGS has determined the following risks at the site from natural geological hazards:

| Table 4.2: | Natural Geological Hazards |
|------------|----------------------------|
|------------|----------------------------|

| Hazard | Hazard Risk Rating |
|----------------------|--------------------|
| Shrink-Swell Clay | Very Low |
| Landslides | Low |
| Ground Dissolution | Null - Negligible |
| Compressible Ground | Null - Negligible |
| Collapsible Deposits | Very Low |
| Running Sand | Null – Negligible |

Given the above and on an assessment of the geological mapping and local topography, there is considered to be no significant constraints posed to the site from geological hazards and no precautions or further investigations are required.

4.3 Coal Mining

The site is in an area which is not affected by coal mining and therefore no Coal Authority Coal Mining Report was obtained for the purposes of this report and there is considered to be no significant risk of ground instability associated with coal mining beneath the site.

4.4 Hydrology

The nearest surface water course is an unnamed Tertiary River located 250m south of the site, flowing in a westerly direction.



4.5 Radon Risk Potential

In accordance with BR 211, Radon Guidance on Protective Measures for New Buildings (2015), the site does not require radon protective measures (Map 17).

4.6 Industrial Land Uses

The site has no previous industrial land uses and lies within a predominantly rural and residential setting. A petrol station is present adjacent to the north of the site.

4.7 Sensitive Land Uses

The following sensitive land uses have been identified within close proximity to the site;

- Residential properties are located to the northeast, north and northwest;
- Leek Moorlands hospital is located ~300m north of the site; and,
- Agricultural areas to the southern regions of the site.

4.8 Site Sensitivity Assessment

The site is considered to be located within a **high** sensitivity setting in regard of human health on the basis that there are residential dwellings in close proximity to the site and the proposed development is for housing.

The site is considered to be located within a **low to moderate** sensitivity setting in regard of controlled waters on the basis that:

- The underlying bedrock is classed as a Secondary A Aquifer and is offered little protection from leaching / migration as drift deposits are recorded as absent;
- ✓ There are no potable abstractions within 1km of the site.

4.9 Geotechnical Assessment

The following potential geotechnical constraints have been identified:

- The potential for shallow bedrock may prove to be a constraint for undertaking shallow excavation works; and,
- The influence of established trees along the borders of the site should be considered if clays are encountered.



5.0 **REGULATORY INFORMATION**

5.1 Landfill Sites and Waste Treatment Sites

Two historic landfills are recorded within a 1km radius of the site:

- **V** Knivedon Farm, Mount Road. 500m NE. License: Surrendered. Waste Type: Unknown.
- ✓ Weston Street. 938m N. License: Surrendered. Waste type: Unknown.

These are not considered to be within influencing distance of the site; however some unrecorded landfilling may have occurred within the former clay pits.

5.2 Pollution Incidents

No pollution incidents are recorded within 250m of the site.

5.3 Regulatory Database

The following information has been obtained from a commercially available environmental database. The summary table 5.1 only includes records not otherwise detailed in the report.

| Activity | 0- 249m | 250- 500m | Details |
|--------------------------------------------------------------------------|------------|--------------|-----------------------------------------------------------------------------------------------------|
| Contaminated Land Register Entries and Notices | 0 | 0 | Not Applicable (N/A). |
| Authorised industrial processes (IPC/IPPC/LAPPC). | 0 | 0 | N/A. |
| Fuel Stations Entries | 1 | 0 | On-site – N/A Off-site – Poplar Service Station. 78m north, status: open. Fuel company: Esso. |
| Licensed radioactive substances | 0 | 0 | N/A. |
| Enforcements, prohibitions or prosecutions | 1 | 0 | Poplar Service Station – No enforcements notified. |
| Discharge Consents | 0 | 0 | N/A |
| Pollution Incidents | 0 | 0 | N/A |
| Consents issued under the Planning (Hazardous Substances) Act 1990 | 0 | 0 | N/A |
| Control of Major Accident Hazard (COMAH) sites | 0 | 0 | N/A. |
| Contaminated Land Register Entries and Notices | 0 | 0 | Not Applicable (N/A). |

Table 5.1 Summary of Regulatory Activities



6.0 INITIAL CONCEPTUAL SITE MODEL (CSM)

6.1 Initial CSM

In accordance with Environment Agency, CLR 11 (2004) and BSI 10175 (Code of Practice for Investigation of Potentially Contaminated Land), REC Ltd have developed an initial CSM to identify potential contamination sources, migration pathways and receptors within the study area.

6.2 Contaminant Sources

On-site Potential Sources

The available historical OS maps indicate that the site has remained undeveloped since before 1879 and therefore no significant contamination sources have been identified. The site is currently pasture land and represents a low environmental risk.

Off-site Potential Sources

The petrol station located to the north of the site may be a potential source of hydrocarbons, with possible leakages and spills migrating within the shallow groundwater southward. This could pose a risk to groundwaters and as a vapour risk to future residents.

The former clay pits on the opposing side of Mount Road, which have now been developed into residential housing, may have been subject to unrecorded waste disposal / infilling and therefore represents a potential gas risk.

6.3 Potential Pathways

Receptors may be potentially at risk from the identified potential sources of contamination via the following pathways:

- ✓ Migration of permanent gases, via permeable strata, from the former clay pits;
- Migration of hydrocarbons within shallow groundwaters, from the adjacent petrol station; and,
- ✓ Migration of vapours from hydrocarbon contamination beneath the site.

6.4 **Potential Receptors**

The following potential receptors have been identified:

Human Health

- Site investigation and construction workers during the redevelopment of the site from hazardous short term exposure;
- Future users of the site and buildings;

Controlled Waters



6.5 Preliminary Risk Assessment

Human Health

<u>On-site</u>

The potential for on-site contamination is considered to be **very low** based on the site remaining undeveloped since before 1879 and no significant on-site sources of contamination have been identified.

<u>Off-site</u>

Two possible pollutant pathways from off-site sources of contaminants have been identified.

The risk of permanent gases migrating from unrecorded waste disposal activities from the former clay pits is considered to be **very low**, as any waste disposal would have occurred approximately 50 years ago and any waste present would be past its peak generation potential. In addition the former clay pit site has undergone several phases of residential development.

The risk posed by Poplar Service Station to the north is considered **moderate**. This is an active Service Station and as such, provides fuel for vehicles which is stored in underground tanks which are within close proximity to the subject site. Furthermore, the condition of these tanks is unknown. The risk posed by hydrocarbons migrating southwards from the adjacent petrol station is considered moderate, due to its proximity and the possibility of a chronic leak causing a plume to spread beneath the site, representing a risk due to vapours and permeation into potable infrastructure.

Controlled Waters

No significant on-site sources of contamination have been identified which may pose a risk to controlled surface or groundwaters. However the groundwaters beneath the site may be impacted with hydrocarbons from the adjacent petrol station. Overall the risk to controlled waters is considered **low**.

Ecological Sites / Ecosystems

A number of sensitive ecological receptors have been identified on the site as follows:

- Established trees on-site; and,
- Livestock contained on site;

It is anticipated that the risk to ecological receptors on-site and off-site is **low** based on the overall low potential for contamination to be present.

Buildings, Foundations and Services

Future redevelopment of the site will include the construction of new foundations. Elevated sulphate concentrations could affect the integrity of buried concrete structures. Services may be affected by the presence of aggressive contaminants which may corrode or penetrate services. Water supply pipes can be susceptible to penetration by hydrocarbons which may then affect the quality of the water supply. The risk to potable infrastructure is considered **moderate** due to the potential risk from the adjacent petrol station.



Overall Environmental Risk Assessment

The preliminary risk to the site is considered **low – moderate.** There are limited on and off-site sources which could be represent a probable pollutant pathway; however the risk posed to the site from the adjacent petrol station needs further consideration and investigation.



7.0 SITE INVESTIGATION

7.1 General

A ground investigation was designed based on the findings of the desk study with exploratory holes advanced to target possible migration pathways form the petrol station and former clay pits. In addition, exploratory holes have also been advanced to provide information on baseline conditions across the site and to collect geotechnical information to assist in the design and construction of the proposed development.

Exploratory fieldwork was completed on 25th February 2016. The works are summarised in Table 7.1, below and an Exploratory Hole Location Plan is presented as Drawing No. 100693-002 contained in Appendix III.

| Location Hole | Potential Source/Rationale | Туре | Maximum Depth (m bgl) | Monitoring Wells Response Zone |
|---------------|--------------------------------------|----------------|-----------------------------|-----------------------------------|
| WS101 | Petrol Station and former clay pits. | Window Sample | 5.35m | 0.50m – 2.50m |
| WS102 | Petrol Station | Window Sample | 3.42m | 0.50m – 2.00m |
| WS103 | Petrol Station | Window Sample | 5.35m | 1.00m – 3.00m |
| WS104 | Baseline conditions | Window Sample | 2.43m | N/A |
| WS105 | Petrol Station and former clay pits. | Window Sample | 4.43m | 0.50m – 2.50m |
| IP101 | Baseline conditions. | Inspection Pit | 1.00m | N/A |
| IP102 | Baseline conditions. | Inspection Pit | 1.00m | N/A |

Table 7.1:Summary of Fieldwork

The exploratory holes were designed to provide geotechnical information, and to retrieve environmental samples for chemical testing in order to confirm the findings of the Initial Conceptual Site Model (ICSM).

7.2 In-Situ Testing

7.2.1 Standard Penetration Tests

In-situ geotechnical testing was conducted using the Standard Penetration Test at 1m intervals within the windowless sample probeholes. The results are shown on the exploratory hole logs contained in Appendix VII, presented in Table 8.2 and discussed in Sections 8 and 10.



7.3 Laboratory Analysis

7.3.1 Chemical Analysis

Selected soil samples were submitted for a range of chemical analysis, including the following:

- Made Ground
 - None Made Ground absent
- Topsoil
 - 4 No. Heavy metal suites, with cyanide and phenol;
 - 4 No. Speciated USEPA16 PAHs;
 - 4 No. Banded Hydrocarbons (TPH);
 - 4 No. Asbestos ID; and,
 - 2 No. TOC and SOM.

Clay

- 2 No. Heavy metal suites, with pH, sulphate, cyanide and phenol;
- 2 No. Speciated USEPA16 PAHs;
- 4 No. Banded Hydrocarbons (TPH);
- 2 No. Asbestos ID; and,
- 2 No. TOC and SOM.

Groundwater

• 3 No. Banded Hydrocarbons (TPH).

Scientific Analysis Laboratories (SAL) Ltd of Manchester undertook the analytical work, the results of which are included in Appendix VII and discussed in Section 9.

7.3.2 Geotechnical Laboratory Analysis

Selected soil samples were submitted to Professional Soil Laboratories (PSL) Ltd of Doncaster, where the following geotechnical tests were undertaken:

7 No. Atterberg Limits Determinations; and,

In addition to the above tests, SAL Ltd undertook carried out the following:

10 No. pH and 2:1 sulphate (SO₄)

The results of the geotechnical analysis are presented in Appendix X, with the exception of the pH and sulphate analysis which is reported with the chemical results in Appendix VII.

7.4 Gas and Groundwater Monitoring

Following the intrusive phase of site works, gas and groundwater monitoring was undertaken from the 2nd March 2016 to the 24th March, a total of three visits were completed.

Gas flow was measured, followed by the sampling of gas for determining the concentrations of methane (CH_4), carbon dioxide (CO_2) and Oxygen (O_2) using an ATEX and MCERTS accredited and calibrated hand-held gas analyser (GFM 436). Groundwater monitoring was undertaken using an electronic dip meter.

Ground gas results are discussed in Section 9 and the recorded groundwater levels are summarised in Section 8.2 and discussed within Section 10.



8.0 GROUND AND GROUNDWATER CONDITIONS

8.1 Ground Conditions

8.1.1 Summary of Ground Conditions

Whilst recorded geology showed drift deposits to be absent from the site, the intrusive works showed clay to be overlying the bedrock, with a maximum depth of superficials recorded as 3.00m. the ground conditions are summarised below:

| Table 8.1 | Summary of Strata |
|-----------|-------------------|
| | |

| Strata | Typical Description | Min Depth to Top of Strata (m) | Max Depth to Top of Strata (m) | Max Thickness (m) |
|--------------|-----------------------------------------------------------------------------------------|--------------------------------------|--------------------------------------|----------------------|
| TOPSOIL | Dark brown clayey fine to medium sand with occasional roots and rootlets. | 0.00 | 0.00 | 0.50 |
| GLACIAL TILL | Firm light brown to grey in places sandy slightly gravelly CLAY. | 0.30 | 0.50 | 2.60 |
| MUDSTONE | Weak dark grey weathered MUDSTONE | 2.00 | 3.00 | BASAL UNIT |
| SANDSTONE | Weak light brown to grey in places, weathered SADNSTONE with interbedded mudstone | 2.50 | 2.50 | BASAL UNIT |

8.1.2 Made Ground

Made Ground deposits were not present in any of the exploratory hole locations.

8.1.3 Drift Deposits

Superficial glacial till deposits were encountered in all exploratory holes and were observed to be of variable strength, generally soft to firm within the upper metre from ground level and becoming stiff with depth.

8.1.4 Solid Geology

Bedrock was encountered at depths between 2.00m and 3.00m bgl in all window sample probe holes. Weak weathered mudstone was present in WS101, WS102, WS103 & WS104 and weak fine grained sandstone with interbedded mudstone was encountered in WS105.

8.1.5 Soil Consistency

Standard Penetration Test results shown in Table 8.2, overleaf indicates that the drift deposits are generally low strength and firm, becoming medium strength and stiff with depth.



| Table 8.2 | Standard Penetration Test Results | | | | | | | | | |
|-----------|-----------------------------------|-----------------------|-------------------------|---------------------------|--------------------------------------|--------------------------------------------------------------------|--|--|--|--|
| Boreholes | Start Depth (m bgl) | Geological Unit | CPT/SPT "N" Value | Eurocode Soil strength | Consistency / Density (BS5930) | Approximate Undrained Shear Strength (kN/m ²) | | | | |
| | 0.90 | | 8 | Medium Strength | Stiff | 41 | | | | |
| | 2.00 | | 15 | Medium Strength | Stiff | 69 | | | | |
| WS101 | 3.00 | | 29 | Very High | Stiff To Very Stiff | - | | | | |
| | 4.00 | MORRIDGE FORMATION | 40 | Extremely High | Very Stiff / Hard | - | | | | |
| | 5.00 | | >50 | Extremely High | Very Stiff / Hard | - | | | | |
| WS102 | 1.00 | | 10 | Medium Strength | Stiff | 50 | | | | |
| | 2.00 | GLACIAL TILL | 14 | Medium Strength | Stiff | 64 | | | | |
| | 3.00 | MORRIDGE FORMATION | >50 | Extremely High | Very Stiff / Hard | - | | | | |
| | 1.00 | | 5 | Low Strength | Firm | 25 | | | | |
| W(\$102 | 2.00 | GLACIAL TILL | 13 | Medium Strength | Stiff | 59 | | | | |
| W3103 | 3.00 | MORRIDGE | 28 | Very High | Stiff To Very Stiff | - | | | | |
| | 4.00 | FORMATION | >50 | Extremely High | Very Stiff / Hard | - | | | | |
| WS104 | 1.00 | GLACIAL TILL | 5 | Low Strength | Firm | 25 | | | | |
| W3104 | 2.00 | MORRIDGE FORMATION | >50 | Extremely High | Very Stiff / Hard | - | | | | |
| | 1.00 | | 7 | Low Strength | Firm | 35 | | | | |
| | 2.00 | | 11 | Medium Strength | Stiff | 50 | | | | |
| 002102 | 3.00 | MORRIDGE | 43 | Extremely High | Dense | - | | | | |
| | 4.00 | FORMATION | >50 | Extremely High | Very Dense | - | | | | |



8.1.6 Soil Plasticity

The Atterberg Limits determinations, summarised in Table 8.3 below, show the clay to be typically of high plasticity with a medium volume change potential.

| Location | Depth (m bgl) | Natural MC (%) | Plastic Limit (%) | Liquid Limit (%) | Plasticity Index (%) | Plasticity | Modified Plasticity Index (%) | Volume Change Potential |
|----------|------------------|----------------------|-------------------------|------------------------|----------------------------|--------------|-------------------------------------|-------------------------------|
| WS101 | 0.80 | 28 | 24 | 58 | 34 | | 33 | |
| WS101 | 1.60 | 28 | 26 | 62 | 36 | High | 36 | |
| WS101 | 2.40 | 23 | 25 | 61 | 36 | підн | 36 | Madium |
| WS103 | 1.00 | 22 | 24 | 59 | 35 | | 33 | Medium |
| WS103 | 2.60 | 21 | 21 | 44 | 23 | Intermediate | 23 | |
| WS103 | 1.60 | 28 | 22 | 44 | 22 | mermediate | 22 | |
| WS105 | 1.00 | 47 | 32 | 76 | 44 | Very High | 44 | High |

 Table 8.3
 Summary of Plasticity Index Test Results

8.1.7 pH and Sulphate

Chemical analyses for pH and soluble sulphate content contained in Appendix VII, shows that the soils at the site meet Class DS-1, Aggressive Chemical Environment for Concrete Classification (ACEC) AC-1s in accordance with BRE Special Digest 1 (2005).

Soil Concrete Design Parameters

| = | 10 |
|---|----------------------|
| = | 0.15m → 2.90m |
| = | 5.1 → 6.7 |
| = | ≤ 100 mg/l |
| = | Static |
| | = = = = |

8.2 Groundwater Conditions

Groundwater strikes were encountered within two window samples at depths of 2.30m and 1.70m bgl. Several locations also had seepages from shallow depths (<0.50m) due to perched water overlying the clay, indicating that the site is poorly drained, this is further supported by the 'boggy' conditions seen underfoot, as shown in the site photographs in Appendix IV.

8.3 Ground Gas & Groundwater Monitoring

The results of the gas and groundwater monitoring rounds are presented in Table 8.4, overleaf.



Table 8.4Summary of ground gas and groundwater monitoring results

| Well | Date | CH₄ Initial (%v/v) | CH₄ Steady (%v/v) | CH₄ GSV (I/hr) | CO ₂ Initial (%v/v) | CO ₂ Steady (%v/v) | CO₂ GSV (%v/v) | O ₂ (%v/v) | Atmos. (mb) | Atmos. Dynamic | Flow (l/hr) | Response Zone (m bgl) | Depth to Base (m bgl) | Depth to Water (m bgl) |
|-------|------------|--------------------------|-------------------------|----------------------|--------------------------------------|-------------------------------------|----------------------|--------------------------|----------------|-------------------|----------------|-----------------------------|-----------------------------|------------------------------|
| | 02/03/2016 | 0.1 | 0.1 | 0.0001 | 1.1 | 1.1 | 0.0011 | 19.8 | 995 | Falling | 0.1 | 1.00 - 2.00 | 2.03 | 2.01 |
| WS101 | 11/03/2016 | 0.1 | 0.1 | 0.0001 | 1.4 | 1.4 | 0.0014 | 18.3 | 1024 | Steady | 0.1 | 1.00 - 2.00 | 2.04 | 2.03 |
| | 24/03/2016 | 0.1 | 0.1 | 0.0001 | 1.2 | 1.2 | 0.0012 | 18.8 | 1011 | Falling | 0.1 | 1.00 - 2.00 | 2.03 | 2.01 |
| | 02/03/2016 | 0.1 | 0.1 | 0.0001 | 0.3 | 0.3 | 0.0003 | 20.1 | 995 | Falling | 0.1 | 0.50 – 2.00 | 2.53 | 0.30 |
| WS102 | 11/03/2016 | 0.1 | 0.1 | 0.0001 | 0.1 | 0.1 | 0.0001 | 20.3 | 1024 | Steady | 0.1 | 0.50 – 2.00 | 2.55 | 0.31 |
| | 24/03/2016 | 0.1 | 0.1 | 0.0001 | 0.6 | 0.6 | 0.0006 | 19.2 | 1011 | Falling | 0.1 | 0.50 – 2.00 | 2.54 | 0.24 |
| | 02/03/2016 | 0.1 | 0.1 | 0.0001 | 0.1 | 0.1 | 0.0001 | 20 | 995 | Falling | 0.1 | 1.00 - 3.00 | 2.69 | 0.43 |
| WS104 | 11/03/2016 | 0.1 | 0.1 | 0.0001 | 0.1 | 0.1 | 0.0001 | 19.7 | 1024 | Steady | 0.1 | 1.00 - 3.00 | 2.69 | 0.46 |
| | 24/03/2016 | 0.1 | 0.1 | 0.0001 | 0.1 | 0.3 | 0.0001 | 20.3 | 1011 | Falling | 0.1 | 1.00 - 3.00 | 2.70 | 0.35 |
| | 02/03/2016 | 0.1 | 0.1 | 0.0001 | 0.1 | 0.1 | 0.0001 | 20.2 | 995 | Falling | 0.1 | 0.50 – 2.50 | 2.42 | 0.21 |
| WS105 | 11/03/2016 | 0.1 | 0.1 | 0.0001 | 0.1 | 0.1 | 0.0001 | 20.4 | 1024 | Steady | 0.1 | 0.50 – 2.50 | 2.41 | 0.36 |
| | 24/03/2016 | 0.1 | 0.1 | 0.0001 | 0.1 | 0.1 | 0.0001 | 20.5 | 1011 | Falling | 0.1 | 0.50 – 2.50 | 2.43 | 0.23 |



9.0 TIER II QUALITATIVE CONTAMINATED LAND RISK ASSESSMENT

REC has undertaken a Tier II qualitative risk assessment to determine if any potential contaminants within the underlying soils and groundwater pose an unacceptable level of risk to the identified receptors.

9.1 Human Health Risk Assessment

At a Tier II stage, the long term (chronic) toxicity risk to human health is assessed by utilising appropriate and conservative generic assessment criteria (GAC) to determine whether there are actual or potential unacceptable risks at the site and if any viable pollutant linkages are present.

To undertake the Tier II assessment within the context of the development proposal, REC has determined that the most appropriate GAC values available will be those based upon a residential land use with the cultivation and ingestion of home-grown produce taken into account.

The following assessment, summarised below and overleaf in Table 9.1, has primarily adopted the S4UL (Suitable for Use Levels reference values published by LQM/CIEH in 2015, the S4ULs). Currently, no published GAC value is available for cyanide and therefore REC has utilised the Environmental Agency Contaminated Land Exposure Assessment Tool (CLEA v1.06) to derive the relevant GAC for this proposed land use. Due to the absence of a published lead GAC for direct use within the planning regime, the 2014 Defra C4SL (Category 4 Screening Level) has been used as this value is considered to incorporate the latest toxicological, bioaccessibility and exposure modelling research to date.

| Determinand | Units | GAC | GAC Source | n | [mc] | Location / Strata | Primary Pathways | Assessment |
|------------------------|-------|-------|---------------|---|------|----------------------|---------------------|-------------------|
| Inorganics | | | | | | | | |
| Arsenic | mg/kg | 37 | (i) | 9 | 32 | | 1 | No Further |
| Cadmium | mg/kg | 11 | (i) | 9 | <1 | N/A | 1, 2 | Action |
| Chromium (VI) | mg/kg | 6 | (i) | 9 | <1 | | 1, 2, 3 | Action |
| Lead | mg/kg | 200 | (iv) | 9 | 210 | WS103 0.20m | 1, 2 | See Discussion |
| Mercury [Inorganic] | mg/kg | 40 | (i) | 9 | <1 | | 1, 2 | |
| Nickel | mg/kg | 130 | (i) | 9 | 19 | | 1 | |
| Selenium | mg/kg | 250 | (i) | 9 | <3 | | 1, 2 | No Further |
| Copper | mg/kg | 2,400 | (i) | 9 | 110 | N/A | 1, 2 | |
| Zinc | mg/kg | 3,700 | (i) | 9 | 230 | | 1, 2 | ACTION |
| Cyanide [Total] | mg/kg | 791 | (v) | 9 | <1 | | 1 | |
| Asbestos | - | D. | - | 9 | N.D. | | 3 | |
| Organics | - | - | - | - | - | | | |
| Phenols | mg/kg | 280 | (ii) | 9 | <1 | | 2 | |
| Naphthalene | mg/kg | 2.3 | (ii) | 9 | <0.1 | | 4 | |
| Acenaphthylene | mg/kg | 170 | (ii) | 9 | <0.1 | | 2 | |
| Acenaphthene | mg/kg | 210 | (ii) | 9 | <0.1 | | 2 | |
| Fluorene | mg/kg | 170 | (ii) | 9 | <0.1 | | 2 | No Further |
| Phenanthrene | mg/kg | 95 | (ii) | 9 | 2.1 | N/A | 2 | Action |
| Anthracene | mg/kg | 2,400 | (ii) | 9 | 0.5 | | 2 | Action |
| Fluoranthene | mg/kg | 280 | (ii) | 9 | 4.9 | | 1, 2 | |
| Pyrene | mg/kg | 620 | (ii) | 9 | 3.9 | | 1, 2 | |
| Benzo(a) Anthracene | mg/kg | 7.2 | (ii) | 9 | 2.5 | | 1 | |

Table 5.1: Summary of Human Health Toxicity Assessment for a Residential End Use



| Determinand | Units | GAC | GAC Source | n | [mc] | Location / Strata | Primary Pathways | Assessment | | |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|------|---------------|---|-------|----------------------|---------------------|----------------------|--|--|
| Chrysene | mg/kg | 15 | (ii) | 9 | 2.3 | | 1 | | | |
| Benzo(b) Fluoranthene | mg/kg | 2.6 | (ii) | 9 | 2.9 | WS105 0.15m | 1 | See Discussion | | |
| Benzo(k) Fluoranthene | mg/kg | 77 | (ii) | 9 | 1.4 | N/A | 1 | No Further Action | | |
| Benzo(a)Pyrene | mg/kg | 2.2 | (ii) | 9 | 2.4 | WS105 0.15m | 1 | See Discussion | | |
| Indeno (123-cd)Pyrene | mg/kg | 27 | (ii) | 9 | 0.7 | N/A | 1 | No Further Action | | |
| Dibenzo(a,h) Anthracene | mg/kg | 0.24 | (ii) | 9 | 0.4 | WS105 0.15m | 1 | See Discussion | | |
| Benzo(ghi) Perylene | mg/kg | 320 | (ii) | 9 | 1.5 | N/A | 1 | No Further Action | | |
| Organics – TPHs | 1 | r | r | r | r | | r | | | |
| TPH C₅-C ₆ | mg/kg | 42 | (iii) | 9 | <0.10 | | 4 | | | |
| TPH C ₆ -C ₈ | mg/kg | 100 | (iii) | 9 | <0.10 | | 4 | | | |
| TPH C ₈ -C ₁₀ | mg/kg | 27 | (iii) | 9 | <0.10 | | 4 | No Further | | |
| TPH C ₁₀ -C ₁₂ | mg/kg | 74 | (iii) | 9 | <1 | N/A | 4 | Action | | |
| TPH C ₁₂ -C ₁₆ | mg/kg | 140 | (111) | 9 | <1 | | 1, 4 | - | | |
| TPH C_{16} - C_{21} | mg/kg | 260 | (111) | 9 | 12 | | 1 | | | |
| Key [mc] Maximum Concentration Recorded D. Detected N.D. None Detected (Limit of Detection = <0.0001%) | | | | | | | | | | |
| Generic Assessment Criteria (GAC) Source(i)LQM/CIEH Suitable For Use Level (S4UL) (2015);(ii)S4UL – Conservative Assessment Approach of 1% SOM;(iii)S4UL –1% SOM and assumed worst case aliphatic / aromatic compound;(iv)Defra Category 4 Screening Level (2014);(v)CLEA 1.06 Derived Value. | | | | | | | | | | |

It should be noted that no visual or olfactory evidence of contamination was observed during the works on site or in any of the exploratory hole locations.

The exceedances within Table 9.1 were all encountered within the topsoil at the site, with the PAH exceedances being encountered in WS105. To allow for a more accurate assessment using generic criteria, the initial exceedances have been summarised in the table overleaf with the GAC values being amended to those for a 6% SOM soil; which is considered to be more representative of a topsoil strata, as indicated in the 13% reading in WS105.



| Contaminant | GAC (6% SOM) | Max. Result | Strata | Avg. Strata Concentration | Comment | | | | | | |
|------------------------|-----------------|-------------|---------|------------------------------|-----------|--|--|--|--|--|--|
| Lead | 200 mg/kg | 210 mg/kg | TOPSOIL | 170 mg/kg | See below | | | | | | |
| Benzo(b)Fluoranthene | 3.7 mg/kg | 2.9 mg/kg | TOPSOIL | 1.5 mg/kg | No action | | | | | | |
| Benzo(a)Pyrene | 3.0 mg/kg | 2.4 mg/kg | TOPSOIL | 1.3 mg/kg | No action | | | | | | |
| Dibenzo(a,h)Anthracene | 0.3 mg/kg | 0.4 mg/kg | TOPSOIL | 0.2 mg/kg | See below | | | | | | |

Table 9.2:Exceedance Summary Table

<u>Lead</u>

A single sample of lead marginally exceeded the GAC criteria, with a maximum concentration of 210mg/kg being recorded within the topsoil. The sample is considered to be representative of the variation shown within the topsoil, with the average concentration being 170mg/kg.

As the elevation is not considered to be a hotspot / outlier and the exceedance is minor, there is not considered to be any unacceptable level of risk posed by lead to human health receptors.

<u>PAHs</u>

Taking into account the GACs applicable for the higher SOM content within the soil, benzo(b)Fluoranthene and benzo(a)pyrene are no longer seen to show any exceedances and are therefore not considered to pose a risk to human health at the development.

An exceedance is still shown for dibenzo(a,h)anthracene; however, as the exceedance is considered minor and all other representative topsoil samples fall below the GAC value, including the average result, there is considered to be no overall unacceptable risk and no requirement for remedial action.

9.2 Controlled Waters – Tier 1 Assessment

The site is underlain by relatively thin, low permeability Glacial Till deposits over a Secondary A Aquifer within the Morridge Formation. The nearest surface watercourse is present approximately 250m away from the site and is considered unlikely to be within influencing distance.

Overall the site is considered to represent a low to moderate sensitivity for controlled waters due to the relatively thin nature of the clay deposits and limited protection this would offer to the underlying aquifer. However, no sources of soluble or leachable contaminants at the site were identified within the desk based study or during the intrusive works.

The petrol station to the north of the site represents a potential source of hydrocarbons; however, no olfactory or visual evidence of hydrocarbons were observed within the soils and groundwater. In addition, laboratory analysis of shallow groundwaters are considered to be very low and show no indication of being impacted with hydrocarbons.

With the lack of identified on-site contaminant sources and no evidence of contaminants being present migrating from off-site sources, there is considered to be no viable pollutant linkage and therefore no unacceptable risk posed to controlled water receptors.



9.3 Ground Gas

In accordance with BR 211, Radon Guidance on Protective Measures for New Buildings (2015), the site does not require radon protective measures (Map 17).

No Made Ground or other sources considered to have the potential to generate ground gases were identified in the Tier 1 assessment or observed at the site and there is considered to be no viable on-site gas risk.

Off-site, two potential sources have been identified, as follows:

- Leakages from underground fuel storage tanks located to the north of the site; and,
- Potential infilling of the historic brick / clay pits, located approximately 80m north east.

The three rounds of gas monitoring showed no elevated levels of carbon dioxide or methane in any of the monitoring installations across the site and groundwater analysis showed no evidence of being impacted with hydrocarbons / fuel. In addition, the underling clay deposits are likely to prove an effective barrier against the migration of contaminants and gases.

In accordance with guidance presented within CIRIA C665, there is not considered to be any viable gas generation sources and no requirement for installing gas protection measures is considered necessary. CIRIA CS-1 conditions apply.

9.4 Revised Conceptual Site Model

The initial conceptual site model has been revised in light of the ground investigation and the chemical analysis results presented the previous sections. The revised conceptual site model has been developed for the proposed future land use based upon the understanding of surface and subsurface features, the potential contaminant sources, transport pathways and receptors, as detailed below and summarised in Table 9.3.

| Source | Pathway | Receptor | Potential Risk | Remediation / Mitigation |
|---------------------------------------------------------------|----------------------------|-------------------------------------|----------------|-------------------------------------------------------------|
| No significant on site sources identified | No pollutant linkage | Human Health | | |
| | | Controlled Water | Very Low | No remedial works required. |
| | | Built Environment | | |
| Petrol Station / | Inhalation and ingestion | Human Health | Very Low | No remedial works required. |
| Off-site migration | Migration | Controlled Waters | Very Low | No remedial works required. |
| of hydrocarbons | Permeation | Potable Infrastructure | Very Low | Standard PE Pipe considered suitable. |
| Aggressive Chemical Environment | Direct Contact | Built Infrastructure | Very Low | ACEC AC-1s concrete design. |
| Radon | Inhalation | Human Health | Very Low | No radon protection measures required |
| Ground gases from Infilled Ground (former clay pits) | Migration and accumulation | Human Health / Built Environment | Very Low | CIRIA CS-1 conditions. No gas protection measures required. |

 Table 9.3
 Revised Conceptual Site Model



10.0 GEOTECHNICAL ASSESSMENT

10.1 Proposed Development

REC Ltd understands that Green Gate Homes (NW) Ltd are considering the redevelopment of the site for residential properties comprising houses and bungalows with associated car parking, landscaping and infrastructure. Details of the proposed loadings are not known at this stage and therefore the following assessment is for preliminary purposes only and a presumed line loading of 75kN/m² has been used.

10.2 Summary of Ground Conditions

Ground conditions identified at the site are summarised in Section 8 and essentially comprise topsoil over natural deposits of Glacial Till (clay). Bedrock was encountered at shallow depths of between 2.0m bgl and 3.0m bgl and consisted of interbedded sandstone and mudstone.

No Made Ground was encountered.

During the Ground Investigation, groundwater strikes were encountered at depths of between 1.70m and 2.30m bgl and shallow water ingress was observed from perched water overlying the clay deposits at depth of less than half a metre.

10.3 Site Preparation

The site should be cleared and any vegetation below areas of proposed development stripped in accordance with Series 200 of the Specification for Highway Works. This should include:

- Roots present below the footprint of proposed structures and infrastructure should be grubbed out and the resulting void infilled with suitable compacted engineered fill; and,
- Site re-grading may be required to obtain the optimum development platform for the proposed end use.

10.4 Foundation Conditions and Bearing Capacity

General

An assessment of the Allowable Bearing Capacity (ABC) for cohesive strata at the site has been undertaken using data obtained from in-situ SPT tests. The results of the tests have been plotted as Allowable Bearing Capacity (ABC) for a strip foundation against depth and are shown on Graph 10.1 overleaf.

As can be observed from the Graph, the ABC's generally increase with depth across the site, with an average bearing capacity of 72kN/m² anticipated at a depth of between 1.00m and 1.45m bgl.

The ground conditions are considered to be relatively consistent across site, with little consideration needed to account for differential settlements due to varying strata types. However, the clay is of a high plasticity and at the top end of a moderate volume change potential clay, therefore a minimum foundation depth of 1.25m should be maintained throughout the development in accordance with NHBC guidance.



Further consideration will also need to be given to the influence of existing and proposed trees and any requirement for the deepening of foundations when within influencing distance.





Standard strip foundations are considered suitable for the development (when using an assumed line loading of 75 kN/m²); however deep trench fill foundations, or other alternative foundation solutions, may be required for plots within the influencing distance of existing and proposed trees, an assessment of tree influence should be made in accordance with NHBC standards..

When taking into account both the anticipated bearing capacity and volume change potential, a preliminary assessment would indicate that a minimum foundation depth of 1.50m bgl should apply, with the foundations deepened to key into the target stratum of stiff, high strength clay.

10.5 Ground Floor Slabs

Due to the high plasticity of the clay, it is recommended that suspended floor slabs are utilised, in order to account for the shrink-swell potential. Where suspended floor slabs are employed ventilation of the under floor void will be required to address condensation issues.

10.6 Road and Pavement Construction

An assessment of the clay deposits and plasticity values recorded against reference material within the Highways Design Manual (Part 2 HD 25/94, Volume 7, Table 2.1) indicated that CBR Values of 3% may be achievable on site; however, it is recommended that this is re-assessed using on site plate



tests of the formation level. Following excavation the sub formation should be proof rolled and any soft material inspected and removed.

10.7 Drainage

Due to the typically low permeability of the clay strata across the site and the shallow perched water encountered, the site is not considered suitable for a sustainable soakaway drainage solution.

It is recommended that an adequate drainage system for surface water be installed by a competent contractor in order to prevent surface water ponding or collecting during and post construction, which may in turn lead to deterioration of the founding stratum.

10.8 Concrete Durability

Chemical analyses for pH and soluble sulphate content contained in Appendix VII, shows that the soils at the site meet Class DS-1, Aggressive Chemical Environment for Concrete Classification (ACEC) AC-1s in accordance with BRE Special Digest 1 (2005).

10.9 Excavations

Site observations indicated that excavations should be feasible in the near surface with normal plant.

Groundwater ingress was encountered at shallow depths due to perched water overlying the low permeability clay. A surface water drainage strategy should be put in place for the construction phase, to allow for the removal of water from foundation, drainage or service excavations.



11.0 CONCLUSIONS & RECOMMENDATIONS

Geotechnical Assessment

Foundations

It is considered that the target stratum of stiff high strength clay is suitable for shallow strip footings. Further considerations should be given to plots in the vicinity of existing and proposed trees in accordance with NHBC guidance to determine any requirement for the deepening of foundations for a medium volume change potential clay.

A suspended floor slab will be required to account for the high clay plasticity.

Pavement Design

A preliminary assessment suggests a CBR value of 3% is likely to be achievable for the road infrastructure.

Drainage Design

The site is not considered suitable for a sustainable soakaway drainage solution and allowances should be provided to mitigate against the likelihood of water ingress into site excavations.

Concrete Design Class

Concrete design sulphate class DS-1 and ACEC AC-1s classifications apply.

Potable Infrastructure

Standard PE pipes should be suitable for potable water infrastructure.

Revised Conceptual Site Model

No on-site sources of contaminants were identified which could be considered to pose a risk to human health or controlled water receptors and the identified potential off-site sources are not considered to have viable pollutant linkages.

Recommendations

Geotechnical

A tree constraints / influence assessment should be carried out to determine any requirement for the deepening of foundations for plots in the vicinity of existing or proposed trees.

Environmental

The site is considered suitable for development without the requirement for any enabling or post construction remedial action.

END OF REPORT

APPENDIX I

LIMITATIONS



- 1. This report and its findings should be considered in relation to the terms of reference and objectives agreed between REC Ltd and the Client as indicated in Section 1.2.
- 2. For the work, reliance has been placed on publicly available data obtained from the sources identified. The information is not necessarily exhaustive and further information relevant to the site may be available from other sources. When using the information it has been assumed it is correct. No attempt has been made to verify the information.
- 3. This report has been produced in accordance with current UK policy and legislative requirements for land and groundwater contamination which are enforced by the local authority and the Environment Agency. Liabilities associated with land contamination are complex and requires advice from legal professionals.
- 4. During the site walkover reasonable effort has been made to obtain an overview of the site conditions. However, during the site walkover no attempt has been made to enter areas of the site that are unsafe or present a risk to health and safety, are locked, barricaded, overgrown, or the location of the area has not be made known or accessible.
- 5. Access considerations, the presence of services and the activities being carried out on the site limited the locations where sampling locations could be installed and the techniques that could be used.
- 6. In addition to the above REC Ltd note that when investigating, or developing, potentially contaminated land it is important to recognise that sub-surface conditions may vary spatially and also with time. The absence of certain ground, ground gas, and contamination or groundwater conditions at the positions tested is not a guarantee that such conditions do not exist anywhere across the site. Due to the presence of existing buildings and structures access could not be obtained to all areas. Additional contamination may be identified following the removal of the buildings or hard standing.
- 7. Site sensitivity assessments have been made based on available information at the time of writing and are ultimately for the decision of the regulatory authorities.
- 8. Where mention has been made to the identification of Japanese Knotweed and other invasive plant species and asbestos or asbestos-containing materials this is for indicative purposes only and do not constitute or replace full and proper surveys.
- 9. The executive summary, conclusions and recommendations sections of the report provide an overview and guidance only and should not be specifically relied upon without considering the context of the report in full.
- 10. This report presents an interpretation of the geotechnical information established by excavation, observation and testing. Whilst every effort is made in interpretative reporting to assess the soil conditions over the Site it should be noted that natural strata vary from point to point and that man made deposits are subject to an even greater diversity. Groundwater conditions are dependent on seasonal and other factors. Consequently there may be conditions present not revealed by this investigation.
- 11. REC can not be held responsible for any use of the report or its contents for any purpose other than that for which it was prepared. The copyright in this report and other plans and documents prepared by REC is owned by them and no such plans or documents may be reproduced, published or adapted without written consent. Complete copies of this may, however, be made and distributed by the client as is expected in dealing with matters related to its commission. Should the client pass copies of the report to other parties for information, the whole report should be copied, but no professional liability or warranties shall be extended to other parties by REC in this connection without their explicit written agreement there to by REC.
- 12. Rather, this investigation has been undertaken to provide a preliminary characterisation of the existing sub-surface geotechnical characteristics and make up and the findings of this study are our best interpretation of the data collected, within the scope of work and agreed budget. New information, revised practices or changes in legislation may necessitate the re-interpretation of the report, in whole or in part.
- 13. This investigation has been undertaken to reasonably characterise existing sub-surface conditions and the findings of this study are our best interpretation of the data collected, within the scope of work and agreed budget. New information, revised practices or changes in legislation may necessitate the re-interpretation of the report, in whole or in part.

APPENDIX II

GLOSSARY



TERMS

| AST | Above Ground Storage Tank | |
|--------------|------------------------------------------------------------|--|
| BGS | British Geological Survey | |
| BSI | British Standards Institute | |
| BTEX | Benzene, Toluene, Ethylbenzene, Xylenes | |
| CIEH | Chartered Institute of Environmental Health | |
| CIRIA | Construction Industry Research Association | |
| CLEA | Contaminated Land Exposure Assessment | |
| CSM | Conceptual Site Model | |
| DNAPL | Dense Non-Aqueous Phase Liquid (chlorinated solvents, PCB) | |
| DWS | Drinking Water Standard | |
| EA | Environment Agency | |
| EQS | Environmental Quality Standard | |
| GAC | General Assessment Criteria | |
| GL | Ground Level | |
| GSV | Gas Screening Value | |
| HCV | Health Criteria Value | |
| ICSM | Initial Conceptual Site Model | |
| LNAPL | Light Non-Aqueous Phase Liquid (petrol, diesel, kerosene) | |
| ND | Not Detected | |
| LMRL | Lower Method Reporting Limit | |
| NR | Not Recorded | |
| РАН | Poly Aromatic Hydrocarbon | |
| PCB | Poly-Chlorinated Biphenyl | |
| PID | Photo Ionisation Detector | |
| QA | Quality Assurance | |
| SGV | Soil Guideline Value | |
| SPH | Separate Phase Hydrocarbon | |
| Sp.TPH (CWG) | Total Petroleum Hydrocarbon (Criteria Working Group) | |
| SPT | Standard Penetration Test | |
| SVOC | Semi Volatile Organic Compound | |
| UST | Underground Storage Tank | |
| VCCs | Vibro Concrete Columns | |
| VOC | Volatile Organic Compound | |
| WTE | Water Table Elevation | |