# Phase II Environmental Assessment

## 4 Goxhill Avenue, Donington

Presented to **Mrs R Welsh**

Issued: April 2019

Delta-Simons Project No. 19-0346.01

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# Report Details

| | |
|---|---|
| **Client** | Mrs R Welsh |
| **Report Title** | Phase II Environmental Assessment |
| **Site Address** | 4 Goxhill Avenue, Donington, Spalding, PE11 4SZ |
| **Project No.** | 19-0346.01 |
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# Executive Summary

| | |
|---|---|
| **Brief** | Delta-Simons Environmental Consultants Limited ('Delta-Simons') was instructed by Mrs R Welsh (the "Client") to undertake a Phase II Environmental Assessment for land at 4 Goxhill Avenue, Donington, Spalding, PE11 4SZ (the "Site").<br><br>It is understood that the development proposals comprise the erection of a new detached bungalow and garage, with associated areas of soft landscaping. The purpose of this assessment is to identify the potential for land contamination issues to be present at the Site in the context of the proposed development. |
| **Site Setting** | The Site currently forms the southern part of the garden of an existing residential property known as 4 Goxhill Avenue. The majority of the Site is occupied by a lawn, with a number of small shrubs present along the boundaries. |
| **Ground Conditions** | The current ground investigation recorded a variable thickness of Made Ground, which is in turn underlain by Tidal Flat Deposits. Monitoring of the standpipe recorded the presence of shallow groundwater between 0.71 m and 0.97 m bgl. |
| **Land Contamination Assessment** | <u>Human Health</u><br><br>Although detectable concentrations of heavy metals and PAHs have been identified, none exceed their respective GAC. The risk to future residents is therefore considered to be low.<br><br>Although no elevated concentrations of contaminants have been identified, groundworkers and sub-surface maintenance workers should be made aware of the possibility of encountering contaminated soils through toolbox talks. Safe working procedures should be implemented, good standards of personal hygiene should be observed, and appropriate levels of PPE provided and utilised. This recommendation should be captured in Site health and safety documentation and in maintenance plans.<br><br><u>Controlled Waters</u><br><br>Elevated concentrations of contaminants have not been identified within the soils at the Site. Furthermore, given the presence of the underlying low permeability soils (Unproductive Strata), the risk of contaminants migrating into groundwater is considered to be low. No further action is required.<br><br><u>Built Environment</u><br><br>The requirement for barrier pipe materials should be confirmed by the local water company.<br><br>Buried concrete may be designed in accordance with DS-1 given the condition of the soils at the Site.<br><br><u>Ground Gas</u><br><br>Ground gas monitoring results indicate that the Site can be classified as Green / CS1 (Very Low Risk). No ground gas protection measures are necessary under this scenario. |

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| **Recommendations** | Based on the findings of this report, the following recommendations for supplementary works are made:<br>▲ Any topsoil imported onto the Site as part of the development works should be tested to confirm suitability, prior to, and once placed, in garden / landscaped areas;<br>▲ Unidentified localised areas of contamination may exist at the Site, and an appropriate 'hotspot' protocol should be in place for groundworkers to act upon should such contamination be identified during the construction process;<br>▲ As with all development sites, groundworkers who are required to perform sub-surface work at the Site should be made aware of the known contaminants in soil and groundwater and the possibility of encountering additional localised low levels of contamination. Therefore, good standards of personal hygiene should be observed, and appropriate levels of PPE utilised where necessary;<br>▲ Suitable dust suppression techniques will need to be implemented by the groundworkers during construction works;<br>▲ Waste classification has not been undertaken as part of the scope of works, should it be proposed to dispose of materials from the Site then specific additional investigations may be needed to classify the materials in accordance with current regulatory requirements; and<br>▲ Confirmation should be sought from the Local Water Authority as to whether they will require upgraded pipework to be installed for new service installations. |
| **This is intended as a summary only. Further detail and the limitations of the assessment are provided within the main body of the Report.** | |

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# 1.0 Introduction

## 1.1 Appointment

Delta-Simons Environmental Consultants Limited ("Delta-Simons") was instructed by Mrs R Welsh (the "Client") to prepare a Phase II Environmental Assessment for land at 4 Goxhill Avenue, Donington, Spalding, PE11 4SZ (the "Site"). A Site Location Map is presented as Figure 1.

## 1.2 Context & Purpose

The aim of the investigation is to complete a geo-environmental assessment of the proposed development area. The investigation will obtain information regarding ground conditions, from which risks to end-users, the environment and structures can be assessed, with mitigation measures outlined, if necessary.

The investigation will provide recommendations for further work based on the findings of the investigation, if required.

It is understood that the development proposals comprise the erection of a new detached bungalow and garage, with associated areas of soft landscaping. A Proposed Development Plan is presented as Figure 2.

## 1.3 Scope of Works

The scope of the investigation and layout of this report has been designed with consideration of *CLR11* (Environment Agency, 2004a) and *BS 10175:2011+A2:2017 Investigation of Potentially Contaminated Sites – Code of Practice (BSI, 2017)* and guidance on land contamination reports issued by the Environment Agency (EA) (2010a).

The project was carried out to an agreed brief as set out in Delta-Simons' proposal dated 13th February 2019. The scope of works is outlined in Section 3.2.1.

Specific sections of this report may generally follow guidance set out in Eurocode 7 for a Ground Investigation Report (GIR), as defined in BS EN 1997-1:2004 and BS EN 1997-2:2007. Eurocode 7 includes specific guidance on the number and spacing of investigation positions, methods of investigation and sample quality to be achieved which may not have been met by this investigation. The report also includes information which may support a Geotechnical Design Report (GDR) as defined in BS EN 1997-1:2004; however, unless otherwise explicitly stated, the investigation has not been undertaken in accordance with Eurocode 7 and the preliminary geotechnical interpretation, assessments, risk register and recommendations presented within this report may not meet the full requirements of a GDR. For the purposes of this report it is considered at this stage Geotechnical Category 2 is likely to be appropriate.

## 1.4 Existing Information

Delta-Simons has been provided with a previous Phase I Desk Study report for the Site prepared by Envirosolution Ltd. (Phase 1 Environmental Site Assessment Report, Land at Goxhill Avenue, Donington, Spalding, Lincolnshire PE11 4ZS, dated September 2018), which has been used to inform the proposed scope of works. This should be read in conjunction with this Report, although a summary of the information is provided.

## 1.5 Limitations

The assessment is limited to the issues agreed within the proposal for the works. Notes on limitations associated with this assessment are provided in Appendix A.

# 2.0 Site Details

## 2.1 Site Setting

A summary of the current Site status, environmental setting and key historical features is presented below. This has been summarised from the existing report listed in Section 1.4 which should be consulted for further detail.

| | | | |
|---|---|---|---|
| **Co-ordinates** | Centred approximately at National Grid Reference 520927, 335570. | Elevation | 5 m AOD |
| | | Area | 0.039 Ha |
| **Site Location** | The Site is located adjacent to the south of an existing residential property known as 4 Goxhill Avenue, in the village of Donington. The Site fronts onto Goxhill Avenue to the east and is bounded by wooden fences to the north, south, and west.<br>The immediate surrounding area is predominantly of residential use. | | |
| **Current Site Use** | The Site currently forms the southern part of the garden of an existing residential property known as 4 Goxhill Avenue. The majority of the Site is occupied by a lawn, with a number of small shrubs present along the boundaries. | | |
| **Proposed Development** | It is understood that the development proposals comprise the erection of a new detached bungalow and garage, with associated areas of soft landscaping. A Proposed Development Plan is presented as Figure 2. Identified human and built environment receptors (R) relevant to the proposed development comprise:<br>▲ Construction workers;<br>▲ Third parties during construction (adjacent Site users and adjacent residents);<br>▲ Future residents and maintenance workers; and<br>▲ The Built Environment (new buildings and infrastructure / utilities). | | |
| **Environmental Setting** | The Site is reported to be underlain by superficial Tidal Flat Deposits comprising of consolidated soft silty clay, with layers of sand, gravel, and peat.<br>The underlying bedrock is reported to comprise the Oxford Clay Formation comprising of mudstone.<br>The underlying superficial Tidal Flat Deposits and bedrock of Oxford Clay Formation are classified as Unproductive Strata.<br>The Site is not located within a groundwater source protection zone (SPZ).<br>The Site lies within a lower probability radon area where less than 1% of homes are estimated to be at or above the Action Level. No radon protection measures are necessary in the construction of new buildings at the Site.<br>The Site is in an area designated as 'Flood Risk 1' defined as land assessed as having less than 1 in 1000 annual probability of river or sea flooding.<br>No significant water course has been identified within 250 m of the Site. | | |
| **Key Historical Features** | According to the previous Phase I Desk Study, from the earliest reviewed map edition dated 1889, a gasworks with associated gas holder was present on-Site until 1973. Delta-Simons has reviewed the relevant historical maps and it appears that the gasworks was located beyond Goxhill Avenue to the west of the Site. The Site appears to have remained undeveloped historically, until 1988 when it was shown to comprise the garden of 4 Goxhill Avenue; remaining unchanged to present day.<br>Off-Site historical features were noted to comprise: | | |

| | |
|---|---|
| | ▲ 1889: Breweries located 62 m north, 138 m north-east, and 150 m west of the Site, which were redeveloped to comprise residential land use by 1905. A smithy, corn mill, and pond were also recorded from 1889 mapping 150 m north-east, 250 m south-east, and 233 m south-east of the Site, respectively. The corn mill was disused by 1905;<br>▲ 1973: Drains were shown 8 m and 45 m east, and 32 m, 62 m and 124 m to the west of the Site. An electrical substation was indicated 75 m north of the Site. A builder's yard 180 m north, engineering works 180 m east, and other unidentified works located between 150 m and 240 m from the Site. Tanks were shown 190 m east and 220 m south-east of the Site, and a timber yard 230 m north-east;<br>▲ 1988: A depot was indicated 54 m east of the Site, and the works mentioned above were still noted to be in use; and<br>▲ 2018: The surrounding area was shown to have been redeveloped, with restaurants and residential properties nearby. A timber yard was present within 250 m of the Site. |
| **Summary of Previous Report – Envirosolution Ltd, Phase I Environmental Site Assessment** | Pertinent information identified within the Phase 1 Environmental Site Assessment Report is detailed below.<br><u>Environmental Permits, Incidents and Registers</u><br>Three environmental permits were identified within 1 km of the Site as follows:<br>▲ G Barnsdale & Sons Ltd, concerning discharges to water and groundwater from a domestic property including a farmhouse, located 0.2 km north of the Site;<br>▲ Cowleys Endowed Schools Foundation, concerning discharges to water and groundwater regarding WwTW (not a water company), located 0.6 km south of the Site; and<br>▲ Mr Stephen Burden, concerning discharges to water and groundwater from real estate activities, located 0.9 km east of the Site.<br>There was a record of an incident of environmental pollution 738 m south-west of the Site which occurred in 2009, designated a Category 2 impact on water. Delta-Simons does not consider this to represent a potential source of contamination given its distance from the Site.<br><u>Conceptual Site Model</u><br>Potential on-Site sources of contamination were considered to comprise the gasworks, with potential contaminants including coal tar, cyanides, phenols, sulphur and asbestos. There was also considered to be a potential for hazardous ground gases to be present associated with potential Made Ground deposits beneath the Site. Delta-Simons consider the gas works to represent an off-Site source of contamination based upon the review of historical maps.<br>Potential off-Site sources of contamination included breweries, electrical substations, works, corn mill, smithy, engineering works, builders' yards and tanks. Potential contaminants of concern were considered to comprise heavy metals, hydrocarbons, polychlorinated biphenyls and asbestos.<br>Risk ratings were based on the likelihood and effect of the hazard taking place, and were indicated as the following:<br>▲ The risk of contaminated soils impacting future Site users, adjacent Site users, or construction workers via ingestions, inhalation, or dermal contact was considered to be high;<br>▲ The risk of contaminated soil or groundwater being in direct contact with buildings/ services was conserved to be moderate; |

| | |
|---|---|
| | ▲ The risk of contaminated groundwater migrating to controlled water receptors was considered to be low; and<br>▲ The risk of ground gas inhalation by future Site users, adjacent Site users, and construction workers, or ground gas ingress into buildings/services was considered to be high.<br><br><u>Conclusions and Recommendations</u><br><br>The conceptual site model indicated that the Site could be classified as moderate to high risk in terms of contamination, and the risks to the identified receptors following redevelopment was considered to be moderate to high.<br><br>It was recommended that prior to the Site redevelopment, a Phase 2 intrusive ground investigation should be undertaken to obtain additional information on the ground conditions and the contamination status of the Site. |

# 3.0 Site Investigation

## 3.1 Intrusive Investigation

Delta-Simons carried out intrusive investigation work on the 1st March 2019 to assess the potential linkages identified in the outline conceptual model (see 3rd Party Phase I Report).

### 3.1.1 Health & Safety Considerations

Each position was scanned with a CAT (cable avoidance tool) by the supervising engineer prior to excavation.

An initial assessment of the Site identified a Low risk in relation to Unexploded Ordnance (UXO) and so no specific precautionary measures were required for the works.

Future Contractors should undertake their own assessment of UXO risk in relation to their specific proposed scope of works.

## 3.2 Scope of Ground Investigation and Rationale

### 3.2.1 Scope

The ground investigation comprised the following items:

- Service avoidance exercise;
- Supervision of all works by a Delta-Simons Geo-Environmental engineer. All intrusive locations were logged to BS5930:2015 Code of Practice for Site Investigations;
- Excavation of four hand auger boreholes (HA101 to HA104) advanced to a maximum depth of 1.8 m bgl; and
- Installation of one ground gas monitoring well.

### 3.2.2 Rationale

| Location | Rationale | Key Contaminants of Concern |
|---|---|---|
| HA101, HA103, HA104 | To provide coverage of the proposed landscaped / garden area. | Asbestos, PAHs, heavy metals, petroleum hydrocarbons, total cyanide, total phenols, ammonia |
| HA102 | Positioned beneath the proposed building footprint for ground gas and groundwater level monitoring. | |

## 3.3 Ground Investigation Factual Data

An Exploratory Hole Location Plan is presented as Figure 3.

Delta-Simons engineer verified borehole logs are presented as Appendix C.

## 3.4 In-Situ Sampling

Sampling comprised disturbed tub and jar samples as detailed on the borehole logs.

## 3.5 Environmental Sampling, In-Situ Testing and Laboratory Analysis

Soils collected for laboratory analysis were placed in a variety of containers appropriate to the anticipated testing suite. Samples were stored in accordance with Delta-Simons' quality procedures to maintain sample integrity and preservation and to minimise the chance of cross contamination. Records of the samples taken as part of the Site investigation works, including their depths and location, are included within the exploratory hole records in Appendix C.

Samples analysed for environmental purposes were placed in chilled cool boxes on-Site and transported to the laboratory for analysis on completion of the Site investigation works.

The rationale for chemical analysis is presented in the table below and the results of the chemical laboratory testing are included in Appendix D.

| Analytes | No. of Samples Tested | Rationale |
|---|---|---|
| | Soil | |
| Asbestos | 6 | Common potential contaminant - Analysed in all samples of Made Ground. |
| As, Cd, Cu, Cr, Hg, Pb, Ni, Zn, speciated Polycyclic Aromatic Hydrocarbons (PAH), Total Petroleum Hydrocarbons. | 6 | Potential contaminants of concern, common to many sites. |
| Total Phenols, Ammonia, Total Cyanide. | 6 | Potential contaminants of concern, associated with historical off-Site gas works. |
| pH, water soluble sulphate | 6 | To assess potential for chemical attack on buried concrete. |

## 3.6 Monitoring Programme

Four rounds of groundwater level and ground gas monitoring were undertaken on the newly installed well (HA102) between 8th March 2019 and 1st April 2019. Measurements of the depth to groundwater within the monitoring wells were taken using an electronic dip meter. The groundwater level monitoring sheets are included as Appendix E.

To characterise the ground gas regime at the Site, an infrared gas meter was used to measure gas flow, concentrations of carbon dioxide (CO2), methane (CH4) and oxygen (O2) in percentage by volume. Initial and steady state concentrations were recorded. The atmospheric pressure before and during monitoring, together with the weather conditions, was recorded. All monitoring results obtained to date together with the temporal conditions are contained within Appendix E.

# 4.0 Ground Summary

## 4.1 Introduction

The sections below summarise the ground and groundwater conditions encountered during the Site investigation.

## 4.2 Ground Model

A summary of the observed ground conditions at the Site is provided below.

| Summary of Observed Ground Conditions | | | | |
|---|---|---|---|---|
| **Strata** | **Typical Strata Description** | **Depth Range of Strata Base (m)** | **Maximum Proven Thickness (m)** | **Comments** |
| Made Ground | Made Ground was overlain by grass, and generally comprised brown slightly silty clayey sand with rare gravel of sandstone, brick and flint.<br>Rare plastic, glass and ceramic fragments were also observed, as well as frequent fine rootlets. | *0.35 to 0.45* | *0.45* | *Rare coal fragments were observed in HA101.* |
| Tidal Flat Deposits | The Tidal Flat deposits initially comprised soft to firm brown orange mottled clay, followed by soft orangish brown slightly silty sandy clay.<br>Granular deposits comprising light brown slightly silty clayey sand were encountered beneath the clay in all locations. | *1.80* | - | *Rare carbonaceous deposits were observed in HA104.* |

## 4.3 Visual and Olfactory Evidence of Contamination - Soils

No olfactory evidence of potential gross contamination was observed within the soils during the investigation.

## 4.4 Groundwater

### 4.4.1 Strikes During Investigations

Groundwater was encountered within the Tidal Flat Deposits in all boreholes during excavation at depths of between 1.04 m bgl (HA103) to 1.30 m bgl (HA104).

### 4.4.2 Levels During Monitoring Programme

Groundwater levels were monitored on a total of four occasions between 8th March 2019 and 1st April 2019. Monitoring data is provided in Appendix E and summarised in the table below.

| Exploratory Hole | Response Zone | Water level during monitoring Max to Min Range | LNAPL Y/N | Stratum |
|---|---|---|---|---|
| | m bgl | m bgl | | |
| HA102 | 0.25 – 1.4 | 0.71 – 0.97 | N | Tidal Flat Deposits |

## 4.5 Visual and Olfactory Evidence of Contamination - Groundwater

No visual or olfactory evidence of potential gross contamination was observed within the groundwater during the investigation.

## 4.6 Geochemical Testing

Geochemical analysis was undertaken on samples of Made Ground and Tidal Flat Deposits, tested for selective contaminants (BRE Special Digest 1:2005 (3rd Edition), Concrete in Aggressive Ground, the results of which are summarised in the table below.

| Tests | No. of Tests | Minimum | Maximum |
|---|---|---|---|
| Soil - pH | 6 | 7.3 | 8.4 |
| Soil - Water Soluble Sulphate | 6 | 7.6 mg/L | 13.0 mg/L |

## 4.7 Chemical Attack on Buried Concrete

In accordance with the recommendations of BRE Special Digest 1, 'Concrete in Aggressive Ground' 2005, the conditions of the soils at the site would be classified as Design Sulphate Class DS-1 for soils, when considering the most appropriate type of concrete to be used at the site in order to resist chemical attack from elevated sulphate present in the soils (assuming non pyritic soils - no groundwater data available).

## 4.8 Ground Gas Data

Gas monitoring results are presented in Appendix E and are summarised in the table below, a total of four rounds of gas monitoring was undertaken over a period of four weeks.

Barometric pressures ranged from 1009 mB (visit 1) to 1032 mB (visit 3).

| Exploratory Hole | Steady Gas Concentration (%v/v) | | | | | | Steady Flow Rate (l/hr) | | Response Zone (m bgl) | | Stratum |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Methane | | Carbon Dioxide | | Oxygen | | | | | | |
| | Min | Max | Min | Max | Min | Max | Min | Max | From | To | |
| HA102 | <0.1 | <0.1 | 0.3 | 0.5 | 19.4 | 19.9 | <0.1 | 0.1 | 0.25 | 1.4 | Made Ground and Tidal Flat Deposits |

# 5.0 Generic Quantitative Risk Assessment

## 5.1 Introduction

The presence of hazardous substances in or on a site is generally only of concern if an actual or potential unacceptable risk exists. Legislation and guidance on the assessment of contaminated sites, consistent with UK best practice, acknowledges the need for a tiered risk-based approach. A Preliminary Risk Assessment is presented in Section 2.2. This section represents a Generic Quantitative Risk Assessment (GQRA) being a comparison of Site contaminant levels against Generic Assessment Criteria.

## 5.2 Human Health GQRA

The assessment of risks in relation to human health has been undertaken using Generic Assessment Criteria as detailed within the appropriate tables. Risks from soil, groundwater and Non-Aqueous Phase Liquids (NAPL) have been considered.

The end use scenario adopted for the assessment is a residential with consumption of home grown produce end use, considered appropriate based on the proposed development.

### 5.2.1 Risks from Soil Sources

Based on the proposed use of the Site for residential use, the soil and groundwater chemical data has been compared against a residential with consumption of home grown produce end use GAC for 1% soil organic matter (SOM) content.

The laboratory results for contaminants exceeding detection limit compared to their respective GAC are presented in the table below.

The primary exposure pathways considered in the risk assessment are as follows:

- Ingestion of soil and indoor dust and / or oral background exposure;
- Inhalation of dust (background and indoor);
- Direct dermal contact; and
- Inhalation of vapour (background and indoor).

| Contaminant | No. Samples | Max Conc. (mg/kg) | GAC (mg/kg) | GAC Source | No. Exceed GAC | Volatile | Location of Exceedances (depth) = Concentration (mg/kg) | Area of Site of Exceedance |
|---|---|---|---|---|---|---|---|---|
| Asbestos | 6 | N/A | Detected | DS | 0 | N | - | - |
| **Metals and metalloids (only those above detection)** | | | | | | | | |
| Arsenic | 6 | 16 | 37 | LQM | 0 | N | - | - |
| Chromium III | | 22 | 910 | LQM | | N | | |
| Copper | | 39 | 2400 | LQM | | N | | |
| Lead | | 120 | 200 | C4SL | | N | | |
| Mercury | | 0.8 | 40 | LQM | | N | | |
| Nickel | | 17 | 130 | LQM | | N | | |
| Zinc | | 130 | 3700 | LQM | | N | | |
| **Polyaromatic Hydrocarbons (only those above detection)** | | | | | | | | |
| Phenanthrene | 6 | 0.28 | 95 | LQM | 0 | N | - | - |
| Fluoranthene | | 0.50 | 280 | LQM | | N | | |
| Pyrene | | 0.45 | 620 | LQM | | N | | |
| Benzo(a)anthracene | | 0.50 | 7.2 | LQM | | N | | |
| Chrysene | | 0.47 | 15 | LQM | | N | | |
| Benzo(b)fluoranthene | | 0.48 | 2.6 | LQM | | N | | |
| Benzo(k)fluoranthene | | 0.20 | 77 | LQM | | N | | |
| Benzo(a)pyrene | | 0.41 | 2.2 | LQM | | N | | |

Notes: C4SL = Category 4 Screening Levels (C4SLs) published by DEFRA.
LQM = Land Quality Management/ CIEH S4Uls for Human Health Risk Assessment, 2014.

As shown in the table above, although detectable concentrations of heavy metals and PAHs have been identified, none of the concentrations exceed their respective GAC. Asbestos has not been identified in any of the samples analysed.

Given the proximity of the historical gas works, samples collected from the Site were also analysed for Total Petroleum Hydrocarbons (TPH), Ammonia, and Total Cyanide. All of the concentrations were below the limits of detection of the laboratory equipment.

The soil analysis results are considered further in the Conceptual Site Model (CSM) presented in Section 8.0 with regard to potential pollutant linkages.

### 5.2.2 Risks from Non-Aqueous Phase Liquids (NAPL)

Soil and groundwater exposure models used in generating Generic Assessment Criteria do not account for the potential for NAPL to represent a source of risk to human health, principally due to the production of vapours. Whilst it is possible to calculate theoretical soil saturation limits, in reality, due to co-solubility effects, these are not an appropriate indicator of the presence of NAPL. In order to assess the presence of NAPL, for petroleum hydrocarbons, an assessment criterion of 5,000 mg/kg has been applied based on professional experience.

The following has been identified in relation to NAPL at the Site:

- No observations of NAPL were made within the soils observed during drilling;
- No concentrations of Total Petroleum Hydrocarbons in excess of 5,000 mg/kg were recorded; and
- No NAPL was measured during groundwater monitoring works.

On this basis, there is no evidence of NAPL being present on the Site.

### 5.2.3 Potable Water Supply Pipes

The investigation requirements for the selection of potable water pipe material are set out in UKWIR Report 10/WM/03/21. Guidance for the Selection of Water Supply Pipes to be used in Brownfield Sites (UKWIR, 2010). This report has very specific and onerous investigation requirements and as such the detailed investigation of each utility route was not within the scope of this investigation.

It should be noted that at the time of this investigation the future routes of water supply pipes had not been established, hence the investigation and sampling strategy is not likely to be considered fully compliant with UKWIR recommendations. Consequently, a targeted investigation and specific sampling/analytical strategy may be required at a later date once the route(s) of the supply pipe(s) are known. In addition, it is recommended that the relevant water supply company be contacted at an early stage to confirm its requirements for assessment, which may not necessarily be the same as those recommended by UKWIR.

### 5.2.4 Building Materials

Risks to building materials associated with aggressive ground conditions is addressed in Section 4.7.

## 5.3 Waste Classification

This investigation was not undertaken to classify materials in terms of waste disposal. Where waste disposal is required, then a specific and detailed investigation in accordance with Environment Agency Guidance WM3 would typically be required.

Should soils be required to be disposed of from Site, the results of the chemical analysis should be forwarded to the proposed receiving facility who will determine what criteria they will accept the waste from Site as. Further investigation in addition to specific waste acceptance criteria (WAC) analysis may be required.

Considering the nature of the materials encountered, more cost efficient and sustainable methods of removing the material should be considered prior to disposal at landfill (e.g. registering with the CL:AIRE Register of Materials) in an attempt to find a site with a requirement for import of materials.

# 6.0 Bulk Ground Gas Risk Assessment

## 6.1 Ground Gas Conceptual Site Model

### 6.1.1 Sources

Historically the Site has remained undeveloped and has formed part of the garden of the adjacent residential property (4 Goxhill Avenue) since 1988. A gasworks was historically located in close proximity to the west of the Site until circa 1973. Shallow Made Ground has been encountered to a maximum depth of 0.45 m bgl.

The Made Ground generally comprises slightly silty clayey sand with rare gravel of sandstone, brick and flint. Rare fragments of plastic, glass and ceramic, as well as frequent fine rootlets were also observed. The Made Ground is therefore considered to represent a potential source of ground gas, although the volume of putrescible material appears to be low.

Surrounding historical land uses represent localised off-Site sources of ground gases.

According to the previous Phase I Report, no historical or current landfills have been identified within a 500 m radius of the Site.

### 6.1.2 Receptors

The principal receptors under consideration are future residents. Other receptors include adjacent site occupiers and future maintenance / construction workers.

### 6.1.3 Pathways

The underlying geology is likely to be of variable permeability with respect to ground gases. The Made Ground is granular and likely to allow preferential migration locally. The underlying Tidal Flat Deposits have predominantly been encountered as clayey sand / sandy clay and are therefore likely to limit vertical migration from below and also lateral migration.

Based on the above, migration of hazardous gases from off-Site sources is considered to be unlikely.

The most significant pathways with respect to future residents relate to the potential for gases to enter future dwellings. At present, no gas protections measures are assumed. Consequently, ingress into dwellings may be possible through voids in the floor including service entry points and cracks.

Future maintenance / construction workers may come into contact with hazardous ground gases via entry into below ground confined spaces such as excavations or service entries / inspection points.

## 6.2 Duration & Extent of Monitoring

Tables 5.5a and 5.5b within CIRIA C665 detail current recommended monitoring duration and frequency for sites in the UK. Based on the identification of potential sources in the preceding section, the gas generation potential is considered to be low, whilst the sensitivity of the proposed development is high.

Gas monitoring has been carried out upon the Site on four occasions following the intrusive investigation between 8th March 2019 and 1st April 2019. During the monitoring period, gas concentrations have been recorded in one monitoring position (HA102). The location of the monitoring well is highlighted on Figure 3 and has been positioned beneath the proposed building footprint.

Barometric pressures during the gas monitoring period ranged from 1009 mBar to 1032 mBar. Three of the four visits were completed during periods of falling pressure.

## 6.3 Ground Gas Risk Assessment

### 6.3.1 Background

Based on the proposed residential end use, the following documents have been consulted when assessing the gas regime at the Site:

- NHBC/RSK Group PLC (2007), Guidance on Evaluation of Development Proposals on Sites where Methane and Carbon Dioxide are Present, Report Edition No. 4; and
- British Standards Institute (BSI, 2015): Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings, BS:8485.

The presence of a source of hazardous gas within the ground does not necessarily indicate a risk will be present. Consideration of recorded gas flows together with source concentrations can allow an initial assessment to be made of the potential both for generation and subsequent migration of gas. A Characteristic Situation (CS) is derived from an assessment of the ground gas data and forms the basis of determining mitigation measures.

### 6.3.2 Gas Screening Value (GSV)

The Gas Screening Value (gas concentration as a fraction x maximum recorded flow) is used to provide an initial assessment of risks to future Site residents. The GSVs calculated for the monitoring well is presented in the following table.

| Location | Maximum Methane (%v/v) | Maximum Carbon Dioxide (%v/v) | Maximum Flow Rate (l/hr) | GSV / Characteristic Situation | | | | Flooded well (Frequency) |
|---|---|---|---|---|---|---|---|---|
| | | | | Methane | | Carbon Dioxide | | |
| | | | | GSV | CS | GSV | CS | |
| HA102 | <0.1 | 0.5 | 0.3 | 0.0003 | CS1 | 0.0015 | CS1 | N |

In accordance with NHBC and BSI guidance, and using maximum recorded parameters and the calculated GSVs, the proposed development has been classified as Green / CS1 (Very Low Risk). No ground gas protection measures are necessary under this scenario.

## 6.4 Radon

The Site is located in an area where radon protective measures are not required.

## 6.5 Organic Vapours

Sources of volatile vapours have not been identified at the Site.

# 7.0 Revised Conceptual Site Model

A revised CSM is presented in the table below and has been formulated taking into account all of the available data from the Delta-Simons intrusive investigation, suitable for a Site with a proposed residential end-use with consumption of home grown produce.

| Revised Conceptual Site Model | | | | |
|---|---|---|---|---|
| **Source** | **Pathways** | **Receptors** | **Confirmed Risk?** | **Mitigation** |
| Detectable concentrations of heavy metals and PAHs in shallow soils | Consumption of home grown produce and attached soil | Human health – future residents | No | Although detectable concentrations of heavy metals and PAHs have been identified, none exceed their respective GAC. The risk to future residents is therefore considered to be low. |
| | Ingestion and/or inhalation of soil/dust | Human health – construction workers | No | Although no elevated concentrations of contaminants have been identified, groundworkers and sub-surface maintenance workers should be made aware of the possibility of encountering contaminated soils through toolbox talks. Safe working procedures should be implemented, good standards of personal hygiene should be observed, and appropriate levels of PPE provided and utilised.<br>This recommendation should be captured in Site health and safety documentation and in maintenance plans. |
| | Migration of contaminants into groundwater | Unproductive Strata | No | Elevated concentrations of contaminants have not been identified within the soils at the Site. Furthermore, given the presence of the underlying low permeability soils (Unproductive Strata), the risk of contaminants migrating into groundwater is considered to be low. |
| | Direct contact between aggressive ground conditions and new infrastructure<br>Direct infiltration in potable water supply pipes | Built environment and service conduits | Possible | In accordance with the recommendations of BRE Special Digest 1, 'Concrete in Aggressive Ground' 2005, the conditions of the soils at the site would be classified as Design Sulphate Class DS-1 for soils, when considering the most appropriate type of concrete to be used at the site in order to resist chemical attack from elevated sulphate present in the soils (assuming non pyritic soils - no groundwater data available).<br>The local water provider should be consulted in order to confirm whether the use of barrier pipe materials for potable water supply pipes will be required. |

| | | | | |
|---|---|---|---|---|
| Hazardous ground gas | Indoor exposure / explosive hazard via enclosed space accumulation of ground gas | Future residents | No | Ground gas monitoring results indicate that the Site can be classified as Green / CS1 (Very Low Risk). No ground gas protection measures are necessary under this scenario. |
| Potentially unidentified 'hotspots' of contamination, which may be present in areas of the Site that have not been directly investigated | All pathways | All receptors | Unknown | As with all redevelopment works, a 'hotspot' protocol should be in place for groundworkers to act upon during any future redevelopment of the Site. |

# 8.0 Conclusions & Recommendations

## 8.1 Contamination Issues

The investigation has been carried out in order to provide information on the quality of the soil and groundwater beneath the Site in the context of land contamination and provide information on the ground gas regime beneath the Site for a residential end use. The assessment is being completed prior to the proposed redevelopment of the Site.

Buried concrete may be designed in accordance with DS-1 given the condition of the soils at the Site.

### 8.1.1 Human Health

Although detectable concentrations of heavy metals and PAHs have been identified, none exceed their respective GAC. The risk to future residents is therefore considered to be low.

Any topsoil imported onto the Site as part of the development works, or sourced from Site and re-used, should be tested to confirm suitability, prior to, and once placed, in garden / landscaped areas.

Although no elevated concentrations of contaminants have been identified, groundworkers and sub-surface maintenance workers should be made aware of the possibility of encountering contaminated soils through toolbox talks. Safe working procedures should be implemented, good standards of personal hygiene should be observed, and appropriate levels of PPE provided and utilised. This recommendation should be captured in Site health and safety documentation and in maintenance plans.

Ground gas monitoring results indicate that the Site can be classified as Green / CS1 (Very Low Risk). No ground gas protection measures are necessary under this scenario.

### 8.1.2 Controlled Waters

Elevated concentrations of contaminants have not been identified within the soils at the Site. Furthermore, given the presence of the underlying low permeability soils (Unproductive Strata), the risk of contaminants migrating into groundwater is considered to be low. No further action is required.

## 8.2 Recommendations for Supplementary Work

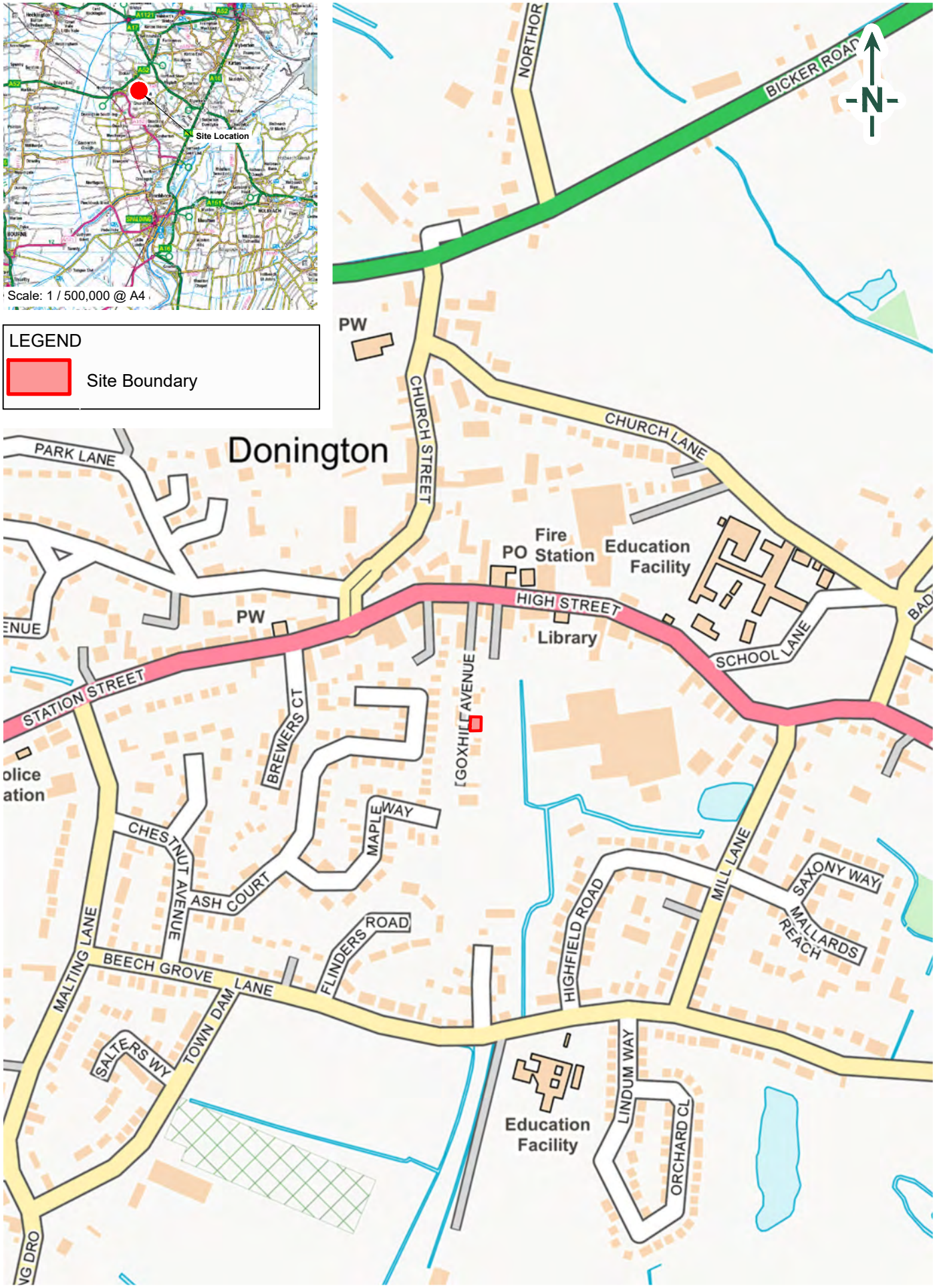
Based on the findings of this report, the following recommendations for supplementary works are made:

- Any topsoil imported onto the Site as part of the development works should be tested to confirm suitability, prior to, and once placed, in garden / landscaped areas;
- Unidentified localised areas of contamination may exist at the Site, and an appropriate ‘hotspot’ protocol should be in place for groundworkers to act upon should such contamination be identified during the construction process;
- As with all development sites, groundworkers who are required to perform sub-surface work at the Site should be made aware of the known contaminants in soil and groundwater and the possibility of encountering additional localised low levels of contamination. Therefore, good standards of personal hygiene should be observed, and appropriate levels of PPE utilised where necessary;
- Suitable dust suppression techniques will need to be implemented by the groundworkers during construction works;
- Waste classification has not been undertaken as part of the scope of works, should it be proposed to dispose of materials from the Site then specific additional investigations may be needed to classify the materials in accordance with current regulatory requirements; and
- Confirmation should be sought from the Local Water Authority as to whether they will require upgraded pipework to be installed for new service installations.

# Figure 1 – Site Location Map

LEGEND

Site Boundary




Scale: 1 / 5,000 @ A4

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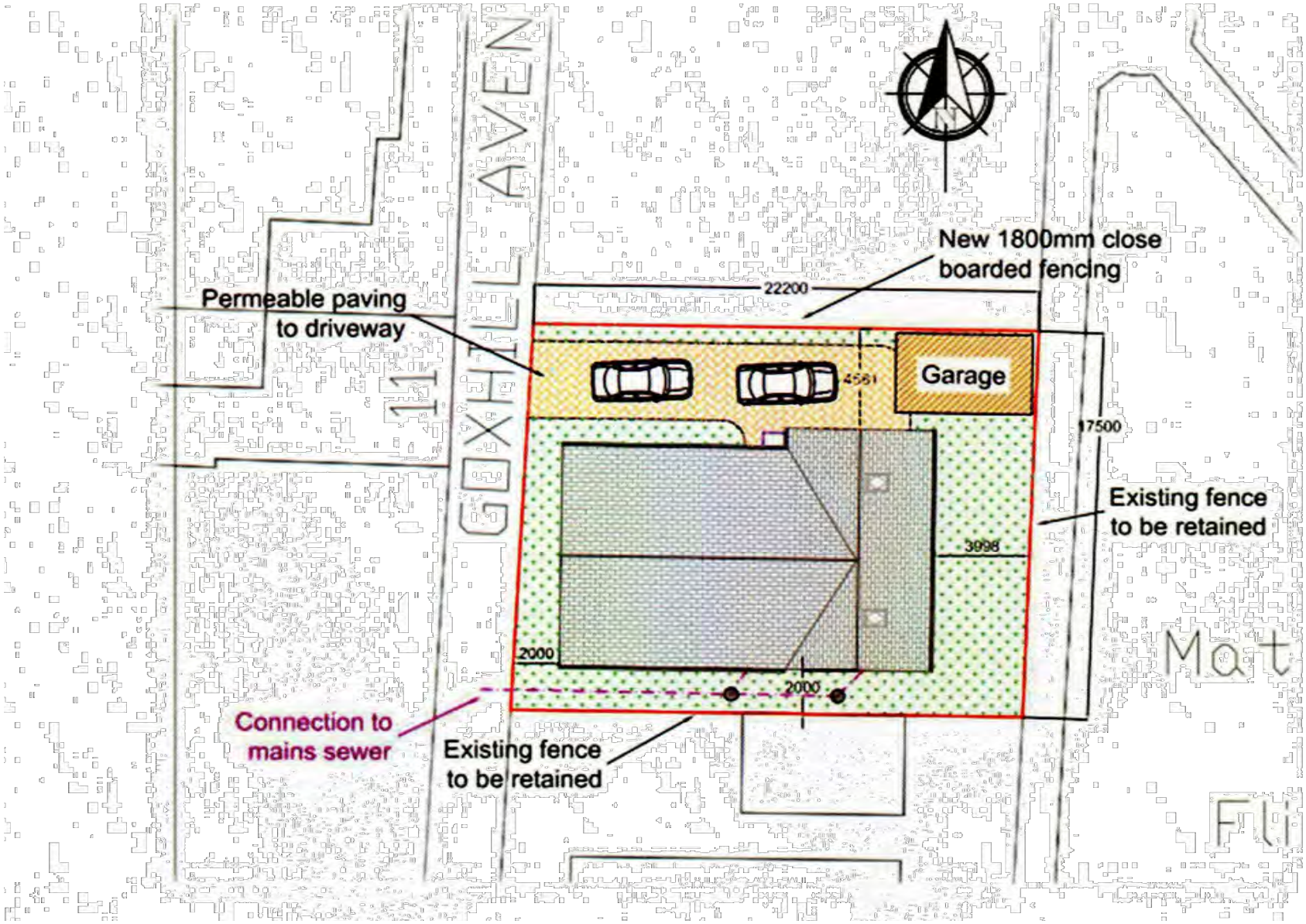
| TITLE: | DRAWN BY: KD | SCALE: To Scale@A4 | PROJECT NO: 19-0346.01 |
|---|---|---|---|
| Site Location Map<br>4 Goxhill Avenue<br>Donington, Spalding | CHECKED BY: DH | REVISION: 1 | FIGURE NO: 1 |
| | DATE: 4 April 2019 | | |

# Figure 2 – Proposed Development Plan




Site Plan Provided by Client

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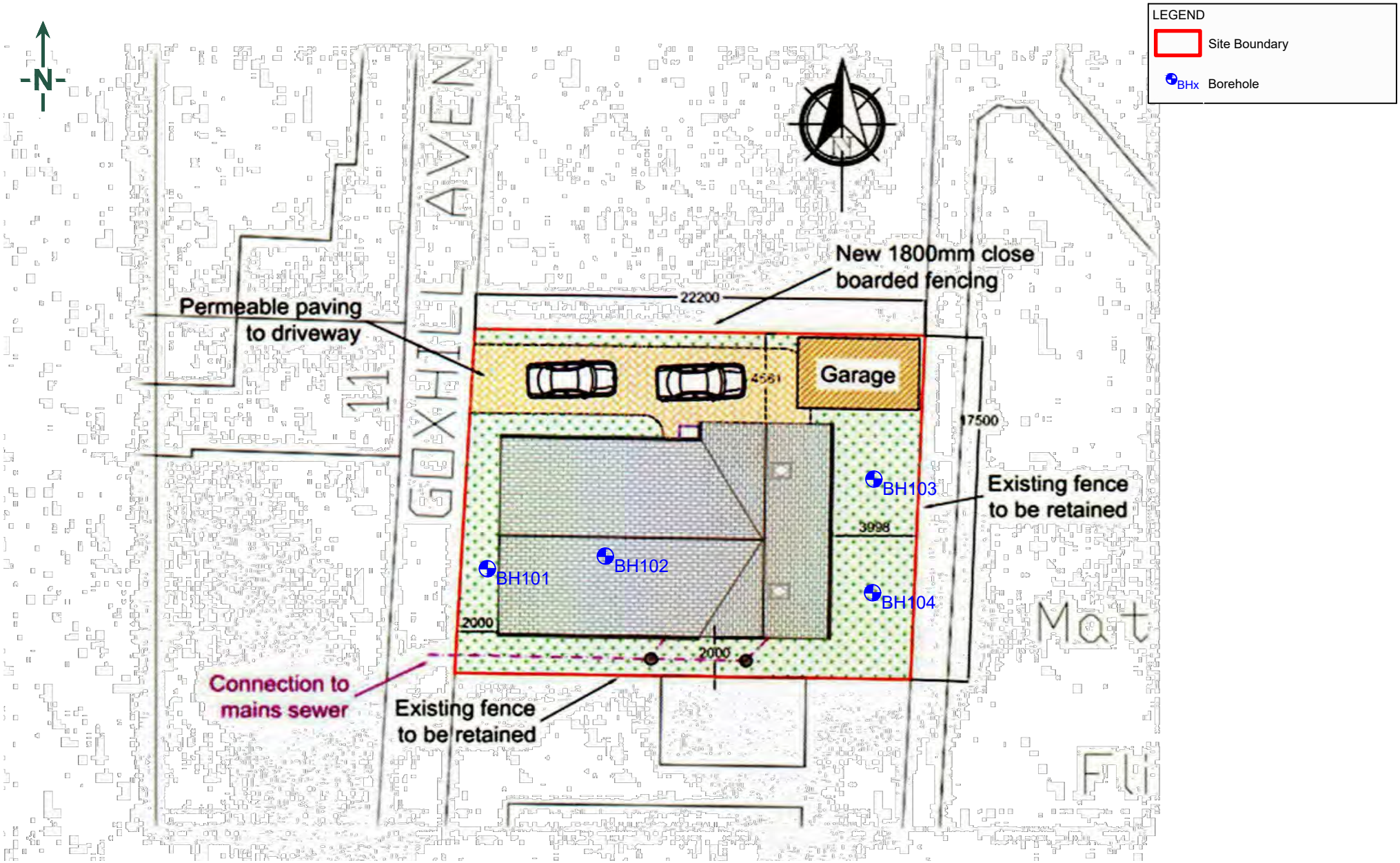
| TITLE: | DRAWN BY: | SCALE: | PROJECT NO: |
|---|---|---|---|
| Proposed Development Plan<br>4 Goxhill Avenue<br>Donington, Spalding | KD | Not to Scale | 19-0346.01 |
| | CHECKED BY: DH | REVISION: 1 | FIGURE NO: 2 |
| | DATE: 4 April 2019 | | |

# Figure 3 – Exploratory Hole Location Plan




Site Plan Provided by Client

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| TITLE: | DRAWN BY: | SCALE: | PROJECT NO: |
|---|---|---|---|
| Exploratory Hole Location Plan<br>4 Goxhill Avenue<br>Donington, Spalding | KD | Not to Scale | 19-0346.01 |
| | CHECKED BY: DH | REVISION: 1 | FIGURE NO: 3 |
| | DATE: 4 April 2019 | | |

# Appendix A – Limitations

# Limitations

The recommendations contained in this Report represent Delta-Simons professional opinions, based upon the information listed in the Report, exercising the duty of care required of an experienced Environmental Consultant. Delta-Simons does not warrant or guarantee that the Site is free of hazardous or potentially hazardous materials or conditions.

Delta-Simons obtained, reviewed and evaluated information in preparing this Report from the Client and others. Delta-Simons conclusions, opinions and recommendations has been determined using this information. Delta-Simons does not warrant the accuracy of the information provided to it and will not be responsible for any opinions which Delta-Simons has expressed, or conclusions which it has reached in reliance upon information which is subsequently proven to be inaccurate.

This Report was prepared by Delta-Simons for the sole and exclusive use of the Client and for the specific purpose for which Delta-Simons was instructed. Nothing contained in this Report shall be construed to give any rights or benefits to anyone other than the Client and Delta-Simons, and all duties and responsibilities undertaken are for the sole and exclusive benefit of the Client and not for the benefit of any other party. In particular, Delta-Simons does not intend, without its written consent, for this Report to be disseminated to anyone other than the Client or to be used or relied upon by anyone other than the Client. Use of the Report by any other person is unauthorised and such use is at the sole risk of the user. Anyone using or relying upon this Report, other than the Client, agrees by virtue of its use to indemnify and hold harmless Delta-Simons from and against all claims, losses and damages (of whatsoever nature and howsoever or whensoever arising), arising out of or resulting from the performance of the work by the Consultant.

# Appendix B – Risk Definitions

## Contaminated Land Risk Definitions

The following methodology is based on the methodology presented in CIRIA C552 Contaminated Land Risk Assessment: A Guide to Good Practice 2001. It requires the classification of the:

- Δ Magnitude of the potential consequence (severity) of the Risk occurring: and
- Δ Magnitude of the Probability (likelihood) of the Risk occurring.

The classifications are then compared to indicate the risk presented by each pollutant linkage.

**Consequence to Receptor Definition Matrix**

| | Human Health | Controlled Waters | Buildings/Services |
|---|---|---|---|
| **Severe Consequence** | Acute or chronic permanent impact on human health. | Sensitive controlled water pollution ongoing, or just about to occur. | Catastrophic collapse |
| **Medium Consequence** | Chronic permanent impact on human health | Gradual pollution of sensitive controlled water | Degradation of materials |
| **Mild Consequence** | Chronic temporary impact on human health | Gradual pollution of non-sensitive controlled water | Damage to building rendering it unsafe.to occupy (eg foundation damage resulting in instability). |
| **Minor Consequence** | Non-permanent health effects to human health (easily prevented by means such as personal protective clothing etc). | Slight discoloration of water | Easily repairable effects of damage to buildings, structures and services, i.e discoloration of concrete |

**Probability Definitions**

| Probability | Definition in Context |
|---|---|
| **Higher** | There is a pollution linkage and an event that either appears very likely in the short term and almost inevitable over the long term, or there is evidence at the receptor of harm or pollution.<br>Positive evidence of source, pathway and receptor. |
| **Likely** | There is a pollution linkage and all the elements are present and in the right place, which means that it is probable that an event will occur. Circumstances are such that an event is not inevitable, but possible in the short term and likely over the long term.<br>Suspect source, pathway, and receptor |
| **Low Likelihood** | There is a pollution linkage and circumstances are possible under which an event could occur.<br>However, it is by no means certain that even over a longer period such event would take place, and is less likely in the shorter term. |
| **Unlikely** | There is a pollution linkage but circumstances are such that it is improbable that an event would occur even in the very long term<br>No evidence of hazard, pathway, and receptor |

**Standard Risk Matrix**

| | | Consequence/ Magnitude of impact | | | |
|---|---|---|---|---|---|
| | | Severe | Medium | Mild | Minor |
| **Probability** | **High** | Very High | High | Moderate | Moderate/Low |
| | **Likely** | High | Moderate | Moderate/low | Low |
| | **Low Likelihood** | Moderate | Moderate/low | Low | Very Low |
| | **Unlikely** | Moderate/low | Low | Very Low | Very Low |

**Classified risks and likely action**

| **Significance Level** | **Definition/Comments** |
|---|---|
| Very High Risk | There is a high probability that severe harm could arise to a designated receptor from an identified hazard, OR, there is evidence that severe harm to a designated receptor is currently happening.<br>This risk, if realised, is likely to result in a substantial liability. Urgent investigation (if not undertaken already) and remediation are likely to be required.<br>Demonstrable contaminated land situation, highest threat & liability level, urgent action recommended. |
| High Risk | Harm is likely to arise to a designated receptor from an identified hazard.<br>Realisation of the risk is likely to present a substantial liability. Urgent investigation (if not undertaken already) is required and remedial works may be necessary in the short term and are likely over the longer term.<br>Likely contaminated land situation, risk assessment and action recommended. |
| Moderate | It is possible that harm could arise to a designated receptor from an identified hazard. However, if is either relatively unlikely that any such harm would be severe, or if any harm were to occur it is more likely that the harm would be relatively mild<br>Investigation (if not already undertaken) is normally required to clarify the risk and to determine the potential liability. Some remedial works may be required in the longer term.<br>Plausible contaminated land situation, risk assessment and possible action recommended. |
| Low Risk | It is possible that harm could arise to a designated receptor from an identified hazard, but it is likely that this harm, if realised, would at worst normally be mild.<br>Unlikely contaminated land situation, possible risk assessment and possible action. |
| Very Low Risk | There is a low possibility that harm could arise to a receptor. In the event of such harm being realised it is not likely to be severe.<br>Negligible risk, no action recommended except vigilance for changes in conditions. |

## Geotechnical Risk Classification

The geohazards listed in the report within Section 4 follow guidance presented in Clayton, C.R.I. (2001) *Managing Geotechnical Risk*, Thomas Telford and the Highways Agency document HD22/08 '*Managing Geotechnical Risk'* (2008) which aims to identify and manage the geotechnical risks associated with a scheme throughout its lifespan, from planning to construction to maintenance.

For each geohazard the probability of the hazard occurring (P) has been considered together with the impact it would have (I) if it were to happen to calculate the risk rating between 1 and 25.

Risks that fall within Moderate, Significant and Severe categories below are considered to be ***substantial*** and are therefore listed within the report.

| **Probability** | **(P)** |
|---|---|
| Very Likely (VLk) | 5 |
| Likely (Lk) | 4 |
| Plausible (P) | 3 |
| Unlikely (U) | 2 |
| Very Unlikely (VU) | 1 |

**X**

| **Impact** | **(I)** |
|---|---|
| Very High (VH) | 5 |
| High (H) | 4 |
| Medium (M) | 3 |
| Low (L) | 2 |
| Very Low (VL) | 1 |

**=**

| **(R)** | **Risk** |
|---|---|
| 20 – 25 | Severe |
| 15 – 19 | Substantial |
| 10 – 14 | Moderate |
| 5 – 9 | Minor |
| 1 – 4 | Negligible |

# Appendix C – Borehole Logs

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| Project No: | Hole ID: | Page: |
|---|---|---|
| 19-0346.01 | HA101 | 1 of 1 |

Project: **Goxhill Avenue, Donington**

# Hand Pit Log

Date: **01/03/2019**

Client: **Mrs R Welsh**

| Description of Strata | Legend | Strata Depth (m bgl) | Strata Thickness (m) | Reduced Level (mAOD) | Casing Diameter (mm) | Water | Sample Details: Depth (m) | Sample Details: Type | Sample Details: Ref | Test Details: Depth (m) | Test Details: Results | Backfill |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GRASS OVER: MADE GROUND: Brown slightly silty clayey fine to medium sand. Rare plastic, ceramic and coal fragments. Frequent fine rootlets. | | 0.42 | (0.42) | | | | 0.20 | ES | 1 | | | |
| Soft to firm brown orange mottled CLAY. (TIDAL FLAT DEPOSITS) | | 0.70 | (0.28) | | | | 0.70 | ES | 2 | | | |
| Soft light brown orange mottled slightly silty sandy CLAY. Sand is fine to medium. (TIDAL FLAT DEPOSITS) | | 1.00 | (0.30) | | | | | | | | | |
| Orangish brown slightly silty clayey fine to medium SAND. (TIDAL FLAT DEPOSITS) | | 1.60 | (0.60) | | | 1.21 ▼ | | | | | | |
| Hand pit complete at 1.60 m bgl. | | | | | | | | | | | | |

Remarks:
1. Logged in general accordance with BS 5930:2015.2. Area cleared for services prior to excavating.3. Groundwater was encountered at 1.21 m bgl.4. Borehole backfilled with arising.

| Water Level Observations | | | | | Pit Diameter | |
|---|---|---|---|---|---|---|
| Date | Time | Strike (m) | Duration | Standing | Depth (m) | Dia (mm) |
| | | 1.21 | | | | |

| Coordinates: | Elevation (mAOD): | Excavated By: | Plant Used: | Logged: | Checked: | Approved: | Scale: |
|---|---|---|---|---|---|---|---|
| | | Delta-Simons | Hand Tools | DH | AN | TH | 1:30 |

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| Project No: | Hole ID: | Page: |
|---|---|---|
| 19-0346.01 | HA102 | 1 of 1 |

Project: **Goxhill Avenue, Donington**

# Hand Pit Log

Date: **01/03/2019**

Client: **Mrs R Welsh**

| Description of Strata | Legend | Strata Depth (m bgl) | Strata Thickness (m) | Reduced Level (mAOD) | Casing Diameter (mm) | Water | Sample Details: Depth (m) | Sample Details: Type | Sample Details: Ref | Test Details: Depth (m) | Test Details: Results | Backfill |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GRASS OVER: MADE GROUND: Brown slightly silty clayey sand with rare gravel of subangular fine flint. Sand is fine to medium. Rare ceramic and brick fragments. Frequent fine rootlets. | | 0.41 | (0.41) | | | | 0.25 | ES | 1 | | | |
| Soft to firm brown orange mottled CLAY. (TIDAL FLAT DEPOSITS) | | 0.70 | (0.29) | | | | 0.60 | ES | 2 | | | |
| Soft light brown orange mottled slightly silty sandy CLAY. Sand is fine to medium. (TIDAL FLAT DEPOSITS) | | 0.80 | (0.10) | | | | | | | | | |
| Light orangish brown slightly silty clayey fine to medium SAND. (TIDAL FLAT DEPOSITS) | | 1.65 | (0.85) | | | 1.17 ▼ | | | | | | |
| Hand pit complete at 1.80 m bgl. | | | | | | | | | | | | |

Remarks:
1. Logged in general accordance with BS 5930:2015.2. Area cleared for services prior to excavating.3. Groundwater was encountered at 1.17 m bgl.4. Partial collapse at the base due to water ingress.5. Borehole installed with 19 mm diameter standpipe, gas bung and lockable traffic strength flush cover.

| Water Level Observations | | | | | Pit Diameter | |
|---|---|---|---|---|---|---|
| Date | Time | Strike (m) | Duration | Standing | Depth (m) | Dia (mm) |
| | | 1.17 | | | | |

| Coordinates: | Elevation (mAOD): | Excavated By: | Plant Used: | Logged: | Checked: | Approved: | Scale: |
|---|---|---|---|---|---|---|---|
| | | Delta-Simons | Hand Tools | DH | AN | TH | 1:30 |

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| Project No: 19-0346.01 | Hole ID: HA103 | Page: 1 of 1 |
|---|---|---|
| Project: Goxhill Avenue, Donington | | |
| Date: 01/03/2019 | Client: Mrs R Welsh | |

# Hand Pit Log

| Description of Strata | Legend | Strata Depth (m bgl) | Strata Thickness (m) | Reduced Level (mAOD) | Casing Diameter (mm) | Water | Sample Details: Depth (m) | Sample Details: Type | Sample Details: Ref | Test Details: Depth (m) | Test Details: Results | Backfill |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GRASS OVER: MADE GROUND: Brown slightly silty clayey fine to medium sand. Rare glass and brick fragments. Frequent fine rootlets. | | 0.35 | (0.35) | | | | 0.20 | ES | 1 | | | |
| Soft to firm light brown orange mottled CLAY. (TIDAL FLAT DEPOSITS) | | 0.70 | (0.35) | | | | 0.70 | ES | 2 | | | |
| Soft to firm orangish brown grey mottled slightly sandy CLAY. Sand is fine to medium. (TIDAL FLAT DEPOSITS) | | 1.00 | (0.30) | | | 1.04 ▼ | | | | | | |
| Soft orangish brown slightly sandy clay. Sand is fine to medium. (TIDAL FLAT DEPOSITS) | | 1.20 | (0.20) | | | | | | | | | |
| Orangish brown slightly silty clayey SAND. Sand is fine to medium. (TIDAL FLAT DEPOSITS) | | 1.60 | (0.40) | | | | | | | | | |
| Hand pit complete at 1.60 m bgl. | | | | | | | | | | | | |

Remarks:
1. Logged in general accordance with BS 5930:2015.2. Area cleared for services prior to excavating.3. Groundwater was encountered at 1.04 m bgl.4. Borehole backfilled with arising.

| Water Level Observations | | | | | Pit Diameter | |
|---|---|---|---|---|---|---|
| Date | Time | Strike (m) | Duration | Standing | Depth (m) | Dia (mm) |
| | | 1.04 | | | | |

| Coordinates: | Elevation (mAOD): | Excavated By: | Plant Used: | Logged: | Checked: | Approved: | Scale: |
|---|---|---|---|---|---|---|---|
| | | Delta-Simons | Hand Tools | DH | AN | TH | 1:30 |

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| Project No: 19-0346.01 | Hole ID: HA104 | Page: 1 of 1 |
|---|---|---|
| Project: Goxhill Avenue, Donington | | |
| Date: 01/03/2019 | Client: Mrs R Welsh | |

# Hand Pit Log

| Description of Strata | Legend | Strata Depth (m bgl) | Strata Thickness (m) | Reduced Level (mAOD) | Casing Diameter (mm) | Water | Sample Details: Depth (m) | Sample Details: Type | Sample Details: Ref | Test Details: Depth (m) | Test Details: Results | Backfill |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GRASS OVER: MADE GROUND: Brown slightly silty clayey fine to medium sand with rare gravel of sandstone, brick and flint. Frequent fine rootlets. | | 0.45 | (0.45) | | | | 0.25 | ES | 1 | | | |
| Soft brown sandy CLAY. Sand is fine to medium. Rare carbonaceous deposits. (TIDAL FLAT DEPOSITS) | | 1.00 | (0.55) | | | | 0.60 | ES | 2 | | | |
| Orangish brown slightly silty sandy CLAY. Sand is fine to medium. (TIDAL FLAT DEPOSITS) | | 1.20 | (0.20) | | | | | | | | | |
| Light brown slightly silty clayey fine to medium SAND. (TIDAL FLAT DEPOSITS) | | 1.40 | (0.20) | | | 1.30 ▼ | | | | | | |
| Light brown orange mottled slightly silty clayey fine to medium SAND. (TIDAL FLAT DEPOSITS) | | 1.80 | (0.40) | | | | | | | | | |
| Hand pit complete at 1.80 m bgl. | | | | | | | | | | | | |

Remarks:
1. Logged in general accordance with BS 5930:2015.2. Area cleared for services prior to excavating.3. Groundwater was encountered at 1.30 m bgl.4. Borehole backfilled with arising.

| Water Level Observations | | | | | Pit Diameter | |
|---|---|---|---|---|---|---|
| Date | Time | Strike (m) | Duration | Standing | Depth (m) | Dia (mm) |
| | | 1.30 | | | | |

| Coordinates: | Elevation (mAOD): | Excavated By: | Plant Used: | Logged: | Checked: | Approved: | Scale: |
|---|---|---|---|---|---|---|---|
| | | Delta-Simons | Hand Tools | DH | AN | TH | 1:30 |

# Appendix D – Soil Chemical Analysis Results

**Dina Haddad**
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# Analytical Report Number : 19-31383

| | | | |
|---|---|---|---|
| **Project / Site name:** | Goxhill Avenue, Donington | **Samples received on:** | 04/03/2019 |
| **Your job number:** | 19-0346.01 | **Samples instructed on:** | 04/03/2019 |
| **Your order number:** | DS44933 | **Analysis completed by:** | 11/03/2019 |
| **Report Issue Number:** | 1 | **Report issued on:** | 11/03/2019 |
| **Samples Analysed:** | 6 soil samples | | |

**Signed:** _____

Rexona Rahman
Head of Customer Services
**For & on behalf of i2 Analytical Ltd.**

Standard Geotechnical, Asbestos and Chemical Testing Laboratory located at: ul. Pionierów 39, 41 -711 Ruda Śląska, Poland.

Accredited tests are defined within the report, opinions and interpretations expressed herein are outside the scope of accreditation.

Standard sample disposal times, unless otherwise agreed with the laboratory, are :

| | |
|---|---|
| soils | - 4 weeks from reporting |
| leachates | - 2 weeks from reporting |
| waters | - 2 weeks from reporting |
| asbestos | - 6 months from reporting |

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The results included within the report are representative of the samples submitted for analysis.

**Analytical Report Number: 19-31383**

**Project / Site name: Goxhill Avenue, Donington**
**Your Order No: DS44933**

| **Lab Sample Number** | | | | 1168744 | 1168745 | 1168746 | 1168747 | 1168748 |
|---|---|---|---|---|---|---|---|---|
| **Sample Reference** | | | | HA101 | HA101 | HA102 | HA102 | HA103 |
| **Sample Number** | | | | ES1 | ES2 | ES1 | ES2 | ES1 |
| **Depth (m)** | | | | 0.20 | 0.70 | 0.25 | 0.60 | 0.20 |
| **Date Sampled** | | | | 01/03/2019 | 01/03/2019 | 01/03/2019 | 01/03/2019 | 01/03/2019 |
| **Time Taken** | | | | None Supplied | None Supplied | None Supplied | None Supplied | None Supplied |
| **Analytical Parameter (Soil Analysis)** | **Units** | **Limit of detection** | **Accreditation Status** | | | | | |
| Stone Content | % | 0.1 | NONE | < 0.1 | < 0.1 | < 0.1 | < 0.1 | < 0.1 |
| Moisture Content | % | N/A | NONE | 17 | 19 | 15 | 18 | 15 |
| Total mass of sample received | kg | 0.001 | NONE | 1.0 | 1.2 | 1.0 | 1.4 | 0.90 |
| Asbestos in Soil | Type | N/A | ISO 17025 | Not-detected | Not-detected | Not-detected | Not-detected | Not-detected |
| **General Inorganics** | | | | | | | | |
| pH - Automated | pH Units | N/A | MCERTS | 7.7 | 8.3 | 7.9 | 8.4 | 7.3 |
| Total Cyanide | mg/kg | 1 | MCERTS | < 1 | < 1 | < 1 | < 1 | < 1 |
| Complex Cyanide | mg/kg | 1 | MCERTS | < 1 | < 1 | < 1 | < 1 | < 1 |
| Free Cyanide | mg/kg | 1 | MCERTS | < 1 | < 1 | < 1 | < 1 | < 1 |
| Water Soluble Sulphate as $SO_4$ 16hr extraction (2:1) | mg/kg | 2.5 | MCERTS | 20 | 26 | 17 | 15 | 20 |
| Water Soluble SO4 16hr extraction (2:1 Leachate Equivalent) | g/l | 0.00125 | MCERTS | 0.010 | 0.013 | 0.0084 | 0.0076 | 0.0099 |
| Water Soluble SO4 16hr extraction (2:1 Leachate Equivalent) | mg/l | 1.25 | MCERTS | 10.2 | 13.0 | 8.4 | 7.6 | 9.9 |
| Ammonia as $NH_3$ | mg/kg | 0.5 | MCERTS | < 0.5 | < 0.5 | < 0.5 | < 0.5 | < 0.5 |
| **Phenols by GC-MS** | | | | | | | | |
| Phenol | mg/kg | 0.2 | NONE | < 0.2 | < 0.2 | < 0.2 | < 0.2 | < 0.2 |
| 2,4,5-Trichlorophenol | mg/kg | 0.2 | NONE | < 0.2 | < 0.2 | < 0.2 | < 0.2 | < 0.2 |
| 2,4,6-Trichlorophenol | mg/kg | 0.1 | NONE | < 0.1 | < 0.1 | < 0.1 | < 0.1 | < 0.1 |
| 2,4-Dichlorophenol | mg/kg | 0.3 | NONE | < 0.3 | < 0.3 | < 0.3 | < 0.3 | < 0.3 |
| 2,4-Dimethylphenol | mg/kg | 0.3 | NONE | < 0.3 | < 0.3 | < 0.3 | < 0.3 | < 0.3 |
| 2-Chlorophenol | mg/kg | 0.1 | NONE | < 0.1 | < 0.1 | < 0.1 | < 0.1 | < 0.1 |
| 2-Methylphenol | mg/kg | 0.3 | NONE | < 0.3 | < 0.3 | < 0.3 | < 0.3 | < 0.3 |
| 2-Nitrophenol | mg/kg | 0.3 | NONE | < 0.3 | < 0.3 | < 0.3 | < 0.3 | < 0.3 |
| 4-Chloro-3-methylphenol | mg/kg | 0.1 | ISO 17025 | < 0.1 | < 0.1 | < 0.1 | < 0.1 | < 0.1 |
| 4-Methylphenol | mg/kg | 0.2 | MCERTS | < 0.2 | < 0.2 | < 0.2 | < 0.2 | < 0.2 |
| **Total Phenols** | | | | | | | | |
| Total Phenols (GC-MS) | mg/kg | 1 | NONE | < 1.0 | < 1.0 | < 1.0 | < 1.0 | < 1.0 |
| **Speciated PAHs** | | | | | | | | |
| Naphthalene | mg/kg | 0.05 | MCERTS | < 0.05 | < 0.05 | < 0.05 | < 0.05 | < 0.05 |
| Acenaphthylene | mg/kg | 0.05 | MCERTS | < 0.05 | < 0.05 | < 0.05 | < 0.05 | < 0.05 |
| Acenaphthene | mg/kg | 0.05 | MCERTS | < 0.05 | < 0.05 | < 0.05 | < 0.05 | < 0.05 |
| Fluorene | mg/kg | 0.05 | MCERTS | < 0.05 | < 0.05 | < 0.05 | < 0.05 | < 0.05 |
| Phenanthrene | mg/kg | 0.05 | MCERTS | 0.23 | < 0.05 | 0.28 | < 0.05 | < 0.05 |
| Anthracene | mg/kg | 0.05 | MCERTS | < 0.05 | < 0.05 | < 0.05 | < 0.05 | < 0.05 |
| Fluoranthene | mg/kg | 0.05 | MCERTS | 0.50 | < 0.05 | 0.39 | < 0.05 | 0.29 |
| Pyrene | mg/kg | 0.05 | MCERTS | 0.45 | < 0.05 | 0.33 | < 0.05 | 0.28 |
| Benzo(a)anthracene | mg/kg | 0.05 | MCERTS | 0.48 | < 0.05 | 0.50 | < 0.05 | 0.27 |
| Chrysene | mg/kg | 0.05 | MCERTS | 0.47 | < 0.05 | 0.34 | < 0.05 | 0.21 |
| Benzo(b)fluoranthene | mg/kg | 0.05 | MCERTS | 0.48 | < 0.05 | 0.39 | < 0.05 | < 0.05 |
| Benzo(k)fluoranthene | mg/kg | 0.05 | MCERTS | 0.18 | < 0.05 | 0.20 | < 0.05 | < 0.05 |
| Benzo(a)pyrene | mg/kg | 0.05 | MCERTS | 0.41 | < 0.05 | 0.38 | < 0.05 | 0.22 |
| Indeno(1,2,3-cd)pyrene | mg/kg | 0.05 | MCERTS | < 0.05 | < 0.05 | < 0.05 | < 0.05 | < 0.05 |
| Dibenz(a,h)anthracene | mg/kg | 0.05 | MCERTS | < 0.05 | < 0.05 | < 0.05 | < 0.05 | < 0.05 |
| Benzo(ghi)perylene | mg/kg | 0.05 | MCERTS | < 0.05 | < 0.05 | < 0.05 | < 0.05 | < 0.05 |
| **Total PAH** | | | | | | | | |
| Speciated Total EPA-16 PAHs | mg/kg | 0.8 | MCERTS | 3.20 | < 0.80 | 2.81 | < 0.80 | 1.27 |


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The results included within the report are representative of the samples submitted for analysis.

**Analytical Report Number: 19-31383**

**Project / Site name: Goxhill Avenue, Donington**
**Your Order No: DS44933**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Lab Sample Number** | | | | 1168744 | 1168745 | 1168746 | 1168747 | 1168748 |
| **Sample Reference** | | | | HA101 | HA101 | HA102 | HA102 | HA103 |
| **Sample Number** | | | | ES1 | ES2 | ES1 | ES2 | ES1 |
| **Depth (m)** | | | | 0.20 | 0.70 | 0.25 | 0.60 | 0.20 |
| **Date Sampled** | | | | 01/03/2019 | 01/03/2019 | 01/03/2019 | 01/03/2019 | 01/03/2019 |
| **Time Taken** | | | | None Supplied | None Supplied | None Supplied | None Supplied | None Supplied |
| **Analytical Parameter (Soil Analysis)** | **Units** | **Limit of detection** | **Accreditation Status** | | | | | |
| **Heavy Metals / Metalloids** | | | | | | | | |
| Arsenic (aqua regia extractable) | mg/kg | 1 | MCERTS | 16 | 8.9 | 15 | 11 | 11 |
| Cadmium (aqua regia extractable) | mg/kg | 0.2 | MCERTS | < 0.2 | < 0.2 | < 0.2 | < 0.2 | < 0.2 |
| Chromium (hexavalent) | mg/kg | 1.2 | MCERTS | < 1.2 | < 1.2 | < 1.2 | < 1.2 | < 1.2 |
| Chromium (aqua regia extractable) | mg/kg | 1 | MCERTS | 22 | 18 | 20 | 19 | 20 |
| Copper (aqua regia extractable) | mg/kg | 1 | MCERTS | 39 | 11 | 34 | 9.6 | 32 |
| Lead (aqua regia extractable) | mg/kg | 1 | MCERTS | 120 | 13 | 84 | 12 | 79 |
| Mercury (aqua regia extractable) | mg/kg | 0.3 | MCERTS | 0.8 | < 0.3 | 0.5 | < 0.3 | < 0.3 |
| Nickel (aqua regia extractable) | mg/kg | 1 | MCERTS | 17 | 15 | 17 | 15 | 15 |
| Zinc (aqua regia extractable) | mg/kg | 1 | MCERTS | 130 | 41 | 110 | 40 | 110 |
| **Petroleum Hydrocarbons** | | | | | | | | |
| TPH C10 - C40 | mg/kg | 10 | MCERTS | < 10 | < 10 | < 10 | < 10 | < 10 |



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**Analytical Report Number: 19-31383**

**Project / Site name: Goxhill Avenue, Donington**
**Your Order No: DS44933**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Lab Sample Number** | | | | 1168749 | | | | |
| **Sample Reference** | | | | HA104 | | | | |
| **Sample Number** | | | | ES2 | | | | |
| **Depth (m)** | | | | 0.60 | | | | |
| **Date Sampled** | | | | 01/03/2019 | | | | |
| **Time Taken** | | | | None Supplied | | | | |
| **Analytical Parameter (Soil Analysis)** | **Units** | **Limit of detection** | **Accreditation Status** | | | | | |
| Stone Content | % | 0.1 | NONE | < 0.1 | | | | |
| Moisture Content | % | N/A | NONE | 15 | | | | |
| Total mass of sample received | kg | 0.001 | NONE | 1.3 | | | | |
| Asbestos in Soil | Type | N/A | ISO 17025 | Not-detected | | | | |
| **General Inorganics** | | | | | | | | |
| pH - Automated | pH Units | N/A | MCERTS | 8.1 | | | | |
| Total Cyanide | mg/kg | 1 | MCERTS | < 1 | | | | |
| Complex Cyanide | mg/kg | 1 | MCERTS | < 1 | | | | |
| Free Cyanide | mg/kg | 1 | MCERTS | < 1 | | | | |
| Water Soluble Sulphate as $SO_4$ 16hr extraction (2:1) | mg/kg | 2.5 | MCERTS | 16 | | | | |
| Water Soluble SO4 16hr extraction (2:1 Leachate Equivalent) | g/l | 0.00125 | MCERTS | 0.0078 | | | | |
| Water Soluble SO4 16hr extraction (2:1 Leachate Equivalent) | mg/l | 1.25 | MCERTS | 7.8 | | | | |
| Ammonia as $NH_3$ | mg/kg | 0.5 | MCERTS | < 0.5 | | | | |
| **Phenols by GC-MS** | | | | | | | | |
| Phenol | mg/kg | 0.2 | NONE | < 0.2 | | | | |
| 2,4,5-Trichlorophenol | mg/kg | 0.2 | NONE | < 0.2 | | | | |
| 2,4,6-Trichlorophenol | mg/kg | 0.1 | NONE | < 0.1 | | | | |
| 2,4-Dichlorophenol | mg/kg | 0.3 | NONE | < 0.3 | | | | |
| 2,4-Dimethylphenol | mg/kg | 0.3 | NONE | < 0.3 | | | | |
| 2-Chlorophenol | mg/kg | 0.1 | NONE | < 0.1 | | | | |
| 2-Methylphenol | mg/kg | 0.3 | NONE | < 0.3 | | | | |
| 2-Nitrophenol | mg/kg | 0.3 | NONE | < 0.3 | | | | |
| 4-Chloro-3-methylphenol | mg/kg | 0.1 | ISO 17025 | < 0.1 | | | | |
| 4-Methylphenol | mg/kg | 0.2 | MCERTS | < 0.2 | | | | |
| **Total Phenols** | | | | | | | | |
| Total Phenols (GC-MS) | mg/kg | 1 | NONE | < 1.0 | | | | |
| **Speciated PAHs** | | | | | | | | |
| Naphthalene | mg/kg | 0.05 | MCERTS | < 0.05 | | | | |
| Acenaphthylene | mg/kg | 0.05 | MCERTS | < 0.05 | | | | |
| Acenaphthene | mg/kg | 0.05 | MCERTS | < 0.05 | | | | |
| Fluorene | mg/kg | 0.05 | MCERTS | < 0.05 | | | | |
| Phenanthrene | mg/kg | 0.05 | MCERTS | < 0.05 | | | | |
| Anthracene | mg/kg | 0.05 | MCERTS | < 0.05 | | | | |
| Fluoranthene | mg/kg | 0.05 | MCERTS | 0.30 | | | | |
| Pyrene | mg/kg | 0.05 | MCERTS | 0.29 | | | | |
| Benzo(a)anthracene | mg/kg | 0.05 | MCERTS | 0.22 | | | | |
| Chrysene | mg/kg | 0.05 | MCERTS | 0.30 | | | | |
| Benzo(b)fluoranthene | mg/kg | 0.05 | MCERTS | 0.32 | | | | |
| Benzo(k)fluoranthene | mg/kg | 0.05 | MCERTS | 0.12 | | | | |
| Benzo(a)pyrene | mg/kg | 0.05 | MCERTS | 0.23 | | | | |
| Indeno(1,2,3-cd)pyrene | mg/kg | 0.05 | MCERTS | < 0.05 | | | | |
| Dibenz(a,h)anthracene | mg/kg | 0.05 | MCERTS | < 0.05 | | | | |
| Benzo(ghi)perylene | mg/kg | 0.05 | MCERTS | < 0.05 | | | | |
| **Total PAH** | | | | | | | | |
| Speciated Total EPA-16 PAHs | mg/kg | 0.8 | MCERTS | 1.78 | | | | |


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The results included within the report are representative of the samples submitted for analysis.

**Analytical Report Number: 19-31383**

**Project / Site name: Goxhill Avenue, Donington**
**Your Order No: DS44933**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Lab Sample Number** | | | | 1168749 | | | | |
| **Sample Reference** | | | | HA104 | | | | |
| **Sample Number** | | | | ES2 | | | | |
| **Depth (m)** | | | | 0.60 | | | | |
| **Date Sampled** | | | | 01/03/2019 | | | | |
| **Time Taken** | | | | None Supplied | | | | |
| **Analytical Parameter (Soil Analysis)** | **Units** | **Limit of detection** | **Accreditation Status** | | | | | |
| **Heavy Metals / Metalloids** | | | | | | | | |
| Arsenic (aqua regia extractable) | mg/kg | 1 | MCERTS | 16 | | | | |
| Cadmium (aqua regia extractable) | mg/kg | 0.2 | MCERTS | < 0.2 | | | | |
| Chromium (hexavalent) | mg/kg | 1.2 | MCERTS | < 1.2 | | | | |
| Chromium (aqua regia extractable) | mg/kg | 1 | MCERTS | 20 | | | | |
| Copper (aqua regia extractable) | mg/kg | 1 | MCERTS | 33 | | | | |
| Lead (aqua regia extractable) | mg/kg | 1 | MCERTS | 100 | | | | |
| Mercury (aqua regia extractable) | mg/kg | 0.3 | MCERTS | 0.8 | | | | |
| Nickel (aqua regia extractable) | mg/kg | 1 | MCERTS | 16 | | | | |
| Zinc (aqua regia extractable) | mg/kg | 1 | MCERTS | 99 | | | | |

**Petroleum Hydrocarbons**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| TPH C10 - C40 | mg/kg | 10 | MCERTS | < 10 | | | | |



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**Analytical Report Number : 19-31383**

**Project / Site name: Goxhill Avenue, Donington**

* These descriptions are only intended to act as a cross check if sample identities are questioned. The major constituent of the sample is intended to act with respect to MCERTS validation. The laboratory is accredited for sand, clay and loam (MCERTS) soil types. Data for unaccredited types of solid should be interpreted with care.

Stone content of a sample is calculated as the % weight of the stones not passing a 10 mm sieve. Results are not corrected for stone content.

| Lab Sample Number | Sample Reference | Sample Number | Depth (m) | Sample Description * |
|---|---|---|---|---|
| 1168744 | HA101 | ES1 | 0.20 | Brown loam and clay with gravel and vegetation. |
| 1168745 | HA101 | ES2 | 0.70 | Light brown sandy clay. |
| 1168746 | HA102 | ES1 | 0.25 | Brown loam and clay with vegetation and gravel |
| 1168747 | HA102 | ES2 | 0.60 | Light brown clay and sand with vegetation. |
| 1168748 | HA103 | ES1 | 0.20 | Brown loam and clay with vegetation and gravel |
| 1168749 | HA104 | ES2 | 0.60 | Brown clay and loam with gravel and vegetation. |



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**Analytical Report Number : 19-31383**

**Project / Site name: Goxhill Avenue, Donington**

**Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Water (PrW)**

| Analytical Test Name | Analytical Method Description | Analytical Method Reference | Method number | Wet / Dry Analysis | Accreditation Status |
|---|---|---|---|---|---|
| Ammonia as NH3 in soil | Determination of Ammonium/Ammonia/ Ammoniacal Nitrogen by the colorimetric salicylate/nitroprusside method, 10:1 water extraction. | In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton | L082-PL | W | MCERTS |
| Asbestos identification in soil | Asbestos Identification with the use of polarised light microscopy in conjunction with disperion staining techniques. | In house method based on HSG 248 | A001-PL | D | ISO 17025 |
| Complex Cyanide in soil | Determination of complex cyanide by calculation. | In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (Skalar) | L080-PL | W | MCERTS |
| Free cyanide in soil | Determination of free cyanide by distillation followed by colorimetry. | In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (Skalar) | L080-PL | W | MCERTS |
| Hexavalent chromium in soil (Lower Level) | Determination of hexavalent chromium in soil by extraction in water then by acidification, addition of 1,5 diphenylcarbazide followed by colorimetry. | In-house method | L080-PL | W | MCERTS |
| Metals in soil by ICP-OES | Determination of metals in soil by aqua-regia digestion followed by ICP-OES. | In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil. | L038-PL | D | MCERTS |
| Moisture Content | Moisture content, determined gravimetrically. | In-house method based on BS1377 Part 2, 1990, Chemical and Electrochemical Tests | L019-UK/PL | W | NONE |
| pH in soil (automated) | Determination of pH in soil by addition of water followed by automated electrometric measurement. | In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests | L099-PL | D | MCERTS |
| Phenols, speciated, in soil, by GCMS | Determination of speciated phenols in soil by extraction in dichloromethane and hexane followed by GC-MS. | In-house method based on USEPA 8270 | L064-PL | D | NONE |
| Speciated EPA-16 PAHs in soil | Determination of PAH compounds in soil by extraction in dichloromethane and hexane followed by GC-MS with the use of surrogate and internal standards. | In-house method based on USEPA 8270 | L064-PL | D | MCERTS |
| Stones content of soil | Standard preparation for all samples unless otherwise detailed. Gravimetric determination of stone > 10 mm as % dry weight. | In-house method based on British Standard Methods and MCERTS requirements. | L019-UK/PL | D | NONE |
| Sulphate, water soluble, in soil (16hr extraction) | Determination of water soluble sulphate by ICP-OES. Results reported directly (leachate equivalent) and corrected for extraction ratio (soil equivalent). | In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests, 2:1 water:soil extraction, analysis by ICP-OES. | L038-PL | D | MCERTS |
| Total cyanide in soil | Determination of total cyanide by distillation followed by colorimetry. | In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (Skalar) | L080-PL | W | MCERTS |
| TPH Banding in Soil by FID | Determination of hexane extractable hydrocarbons in soil by GC-FID. | In-house method, TPH with carbon banding and silica gel split/cleanup. | L076-PL | W | MCERTS |
| TPH Chromatogram in Soil | TPH Chromatogram in Soil. | In-house method | L064-PL | D | NONE |

**For method numbers ending in 'UK' analysis have been carried out in our laboratory in the United Kingdom.**
**For method numbers ending in 'PL' analysis have been carried out in our laboratory in Poland.**
**Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC.**



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The results included within the report are representative of the samples submitted for analysis.

# Appendix E – Field Monitoring Data/Gas Monitoring Data

| Site Name | Goxhill Avenue, Donington | Job number | 19-0346.01 | WEATHER | Start | End |
|---|---|---|---|---|---|---|
| | | | | Time | 12.35 | 12.50 |
| Client | Mrs R Welsh | Recorded by | AH | Pressure (mb) | 1010 | 1010 |
| | | | | Wind speed (m/s) | 16.00 | 16.00 |
| Date (DD/MM/YYYY) | 08/03/2019 | | | Wind Dir. (from) | South-west | South-west |
| Gas Analyser | GFM435 (Gas Kit 5) - 12233 | Visit Number | 1 | Temperature (°C) | 8.00 | 8.00 |
| Readings at start | $CH_4$ (% v/v) NR, $CO_2$ (% v/v) NR, $O_2$ (% v/v) NR, $H_2S$ (ppm) NR | | | Dry/Rain/Snow/Ice | Dry | Dry |
| General comments | | | | Rising/Falling Trend (for the three days before visit) | Falling and Rising | |

| Ref | GROUND GAS | | | | | | | | | | | | | GROUNDWATER | | | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Flow | | $CH_4$ | | $CO_2$ | | $O_2$ | | $H_2S$ | CO | VOC | Differential (Relative) Pressure | Atmos. Pressure | Depth to free product | Depth to water | Depth to base | (e.g. water colour, sheen, odour, damage to well or gas tap, flooded ground etc.) |
| | l/hr | | % v/v | | % v/v | | % v/v | | ppm | | | | | | | | |
| | Max | Steady | Max | Steady | Max | Steady | Min | Steady | Max | Max | Max | mb | mb | m | m | m | |
| | The formulae require that only numbers, "<0.1" for ground gas and flow or "DRY" for groundwater are entered in the sheet | | | | | | | | | | | | | | | | |
| HA102 | 0.1 | <0.1 | <0.1 | <0.1 | 0.3 | 0.3 | 19.4 | 19.7 | <0.1 | <0.1 | NR | 1.0 | 1009 | NR | 0.895 | 1.14 | |



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| Site Name | Goxhill Avenue, Donington | Job number | 19-0346.01 | WEATHER | Start | End |
|---|---|---|---|---|---|---|
| | | | | Time | 12.28 | 12.50 |
| Client | Mrs R Welsh | Recorded by | AH | Pressure (mb) | 1019 | 1019 |
| | | | | Wind speed (m/s) | 12.00 | 12.00 |
| Date (DD/MM/YYYY) | 18/03/2019 | | | Wind Dir. (from) | West | West |
| Gas Analyser | GFM435 (Gas Kit 5) - 12233 | Visit Number | 2 | Temperature (°C) | 10.00 | 10.00 |
| Readings at start | $CH_4$ (% v/v) NR; $CO_2$ (% v/v) NR; $O_2$ (% v/v) NR; $H_2S$ (ppm) NR | | | Dry/Rain/Snow/Ice | Dry | Dry |
| General comments | | | | Rising/Falling Trend (for the three days before visit) | Falling | |

| Ref | GROUND GAS | | | | | | | | | | | | | GROUNDWATER | | | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Flow | | $CH_4$ | | $CO_2$ | | $O_2$ | | $H_2S$ | CO | VOC | Differential (Relative) Pressure | Atmos. Pressure | Depth to free product | Depth to water | Depth to base | (e.g. water colour, sheen, odour, damage to well or gas tap, flooded ground etc.) |
| | l/hr | | % v/v | | % v/v | | % v/v | | ppm | | | | | | | | |
| | Max | Steady | Max | Steady | Max | Steady | Min | Steady | Max | Max | Max | mb | mb | m | m | m | |
| | The formulae require that only numbers, "<0.1" for ground gas and flow or "DRY" for groundwater are entered in the sheet | | | | | | | | | | | | | | | | |
| HA102 | 0.1 | <0.1 | <0.1 | <0.1 | 0.4 | 0.4 | 19.4 | 19.4 | <0.1 | <0.1 | NR | 0.0 | 1019 | NR | 0.71 | 1.06 | |



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| Site Name | Goxhill Avenue, Donington | Job number | 19-0346.01 | WEATHER | Start | End |
|---|---|---|---|---|---|---|
| | | | | Time | 12.21 | 12.30 |
| Client | Mrs R Welsh | Recorded by | AH | Pressure (mb) | 1032 | 1032 |
| | | | | Wind speed (m/s) | 16.00 | 16.00 |
| Date (DD/MM/YYYY) | 25/03/2019 | | | Wind Dir. (from) | North-west | North-west |
| Gas Analyser | GFM435 (Gas Kit 5) - 12233 | Visit Number | 3 | Temperature (°C) | 11.00 | 12.00 |
| Readings at start | $CH_4$ (% v/v) NR; $CO_2$ (% v/v) NR; $O_2$ (% v/v) NR; $H_2S$ (ppm) NR | | | Dry/Rain/Snow/Ice | Dry | Dry |
| General comments | | | | Rising/Falling Trend (for the three days before visit) | Rising | |

| Ref | GROUND GAS | | | | | | | | | | | | | GROUNDWATER | | | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Flow | | $CH_4$ | | $CO_2$ | | $O_2$ | | $H_2S$ | CO | VOC | Differential (Relative) Pressure | Atmos. Pressure | Depth to free product | Depth to water | Depth to base | (e.g. water colour, sheen, odour, damage to well or gas tap, flooded ground etc.) |
| | l/hr | | % v/v | | % v/v | | % v/v | | ppm | | | | | | | | |
| | Max | Steady | Max | Steady | Max | Steady | Min | Steady | Max | Max | Max | mb | mb | m | m | m | |
| | The formulae require that only numbers, "<0.1" for ground gas and flow or "DRY" for groundwater are entered in the sheet | | | | | | | | | | | | | | | | |
| HA102 | 0.3 | <0.1 | <0.1 | <0.1 | 0.5 | 0.5 | 19.6 | 19.7 | <0.1 | <0.1 | NR | 0.0 | 1032 | NR | 0.89 | 1.07 | |



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| Site Name | Goxhill Avenue, Donington | Job number | 19-0346.01 | WEATHER | Start | End |
|---|---|---|---|---|---|---|
| | | | | Time | 2:00 | 2:10 |
| Client | Mrs R Welsh | Recorded by | AH | Pressure (mb) | 1020 | 1020 |
| | | | | Wind speed (m/s) | 7.00 | 7.00 |
| Date (DD/MM/YYYY) | 01/04/2019 | | | Wind Dir. (from) | South-east | South-east |
| Gas Analyser | GFM436 (Gas Kit 4) - 11030 | Visit Number | 4 | Temperature (°C) | 10.00 | 12.00 |
| Readings at start | $CH_4$ (% v/v) NR; $CO_2$ (% v/v) NR; $O_2$ (% v/v) NR; $H_2S$ (ppm) NR | | | Dry/Rain/Snow/Ice | Dry | Dry |
| General comments | | | | Rising/Falling Trend (for the three days before visit) | Falling | |

| Ref | GROUND GAS | | | | | | | | | | | | | GROUNDWATER | | | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Flow | | $CH_4$ | | $CO_2$ | | $O_2$ | | $H_2S$ | CO | VOC | Differential (Relative) Pressure | Atmos. Pressure | Depth to free product | Depth to water | Depth to base | (e.g. water colour, sheen, odour, damage to well or gas tap, flooded ground etc.) |
| | l/hr | | % v/v | | % v/v | | % v/v | | ppm | | | | | | | | |
| | Max | Steady | Max | Steady | Max | Steady | Min | Steady | Max | Max | Max | mb | mb | m | m | m | |
| | The formulae require that only numbers, "<0.1" for ground gas and flow or "DRY" for groundwater are entered in the sheet | | | | | | | | | | | | | | | | |
| HA102 | 0.3 | 0.1 | <0.1 | <0.1 | 0.4 | 0.4 | 19.8 | 19.9 | <0.1 | <0.1 | NR | 1.0 | 1019 | NR | 0.97 | 1.07 | |

| Document No. C101 | Version: 1.1 | Issue Date: 11/07/17 | Author: J Rhoades / S Steele | Authorised By:K Hughes |
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