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# SITE INVESTIGATION REPORT

## LAND OFF WARDENTREE LANE
## SPALDING
## LINCOLNSHIRE

**Report Reference C14985**

**On behalf of:-**

**Claire Tidswell & Mark Preston**
**29 Suttons Lane**
**Deeping Gate**
**Peterborough**
**PE6 9AA**

**April 2020**

**CLAIRE TIDSWELL & MARK PRESTON**

**BARKER STOREY MATTHEWS**

# SITE INVESTIGATION REPORT

# FOR

# PROPOSED RESIDENTIAL DEVELOPMENT

# AT

# LAND OFF WARDENTREE LANE

# SPALDING

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## INTRODUCTION

The clients, Claire Tidswell and Mark Preston, propose to build a new residential development on a former nursery site north of Wardentree Lane, Spalding in Lincolnshire.

Ground Engineering Limited was commissioned by the client, under the direction of property agents Barker Storey Matthews, to carry out a site investigation to determine the nature and geotechnical properties of the underlying soils, and provide information for the design and construction of the foundations. A desk study checking past uses and a contamination assessment were also included within the scope of this report.

## LOCATION, TOPOGRAPHY AND GEOLOGY OF THE SITE

The site of the proposed development is located at a former nursery to the north of Wardentree Lane (B1180), approximately 100m east of its junction with Spalding Road (B1356), on the northern side of Spalding in Lincolnshire. The National Grid Reference for the centre of the site is TF 2466 2508 and its location is shown on plans following this report text.

The approximately 4 hectare, rectangular shaped site is approximately 340m long fronting Wardentree Lane and extends 120m north. The western part of the site was formerly occupied by Redmile Nurseries, and the eastern part an undeveloped arable field at the time of this investigation. The site contained some greenhouses, which were in use by a tenant. An above ground heating oil tank was present adjacent a greenhouse in the western part of the site. Two brick buildings close to the western boundary of the site were also being let out for storage. The site is bounded by Wardentree Lane to the south; by a pumping station and dwellings fronting Wardentree Lane to the west; by Blue Gowt Drain to the north; and by Pennygate Drain to the east. Trees were present along the southern and eastern boundaries of the site.

A high pressure gas main aligned north-south crosses the eastern field part of the site, its route marked by posts on the northern and southern boundaries, the gas main then turns west along the southern boundary of the site. A foul rising main is also present beneath the northern part of the site, from the pumping station to the west and following the southern bank of Blue Gowt Drain along the northern edge of the site.

The level site stands at an elevation of about 3mOD in an area of low-lying Fenland. Approximately 1.1km to the south-east of the site is a former 'Roman Bank' which marked the limit of land reclamation by 1300AD.

The geological map for the area, sheet 144 at 1:50,000 scale, shows the site to be underlain by a thick succession of Terrington Beds, more recently identified as Tidal Flat Deposits. These silt and fine sand soils are indicated to rest on the solid geology of the Oxford Clay Formation at depth. Previous work in the vicinity has found a glacial Boulder Clay or 'Till' beneath the surface layer of Tidal Flat Deposits.

## HISTORY OF THE SITE

Research into the site history involved reference to historical Ordnance Survey (OS) maps, photographs and information obtained from the internet. The map extracts and photographs studied are presented in the desk study map section, Appendix 1, and are described below. Distances are approximate.

| *OS Map Extract* | *Description* |
|---|---|
| **1886**<br>Lincolnshire<br>Sheet 134.10<br>Scale 1:2500<br>**Figure A** | The site is undeveloped and comprised a large field. A footpath is shown aligned north-west to south-east across the site. Drains are shown around the boundaries of the field. An east-west aligned road is shown to the south of the site. A house is shown to the south-east of the site beyond the boundary drain. A pond is shown 15m west of the site. |
| **1887**<br>Lincolnshire<br>Sheet 134SW<br>Scale 1:10,560<br>**Figure B** | The site area appears unchanged. The site is in a rural area on the northern side of Wardentree Lane. A railway line is shown 350m east of the site. |
| **1904**<br>Lincolnshire<br>Sheet 134.10<br>Scale 1:2500<br>**Figure C** | The site and immediate surrounding area appear generally unchanged. An outbuilding is shown adjacent the house to the south-east of the site. |
| **1932**<br>Lincolnshire<br>Sheet 134.10<br>Scale 1:2500<br>**Figure D** | The site area appears unchanged. The house to the south-east of the site is no longer shown. |
| **1938**<br>Lincolnshire<br>Sheet 134SW<br>Scale 1:10,560<br>**Figure E** | Buildings are shown in the western part of the site which is denoted as a Nursery. A new road and houses are shown to the south-west of the site on the southern side of Wardentree Lane. |
| **1950**<br>Lincolnshire<br>Sheet 134SW<br>Scale 1:10,560<br>**Figure F** | An additional small building is shown in the western part of the site. New houses have also been built on the southern side of Wardentree Lane. Blue Gowt Drain is denoted bordering the northern boundary of the site. |

| *OS Map Extract* | *Description* |
|---|---|
| **1967**<br>Sheets TF2424 & TF2425<br>Scale 1:2500<br>**Figure G** | The site is named Redmile Nurseries. Glasshouses denoted on the site have been extended and a new glasshouse added. Two smaller rectangular buildings are present in the western most part of the site. The footpath no longer crosses the site. Pennygate Drain is denoted bounding the site to the east. A sewage pumping station is shown to the west of the site, beyond the boundary drain. The pond to west of the site has been infilled. Additional houses have been built on the southern side of Wardentree Lane, and poultry houses are denoted to the rear of one of them. |
| **1986**<br>Sheets TF2424 & TF2425<br>Scale 1:2500<br>**Figure H** | A new glasshouse is shown in the central northern part of the site. |
| **1992**<br>Sheets TF22NW, NE, SW & SE<br>Scale 1:10,000<br>**Figure I** | The site and immediate surrounding area appear generally unchanged. A new house is shown approximately 20m to the east of the site. |
| **1992**<br>Sheets TF2424 & TF2425<br>Scale 1:2500<br>**Figure J** | The site and immediate surrounding area appear unchanged. |
| **1995**<br>Sheets TF2424 & TF2425<br>Scale 1:2500<br>**Figure K** | A new rectangular glasshouse is shown on the site. |
| **2001**<br>Sheets TF22NW, NE, SW & SE<br>Scale 1:10,000<br>**Figure L** | The site and immediate surrounding area appear unchanged. |
| **2003**<br>Sheets TF2424NW & NE, TF2425SW & SE<br>Scale 1:1250<br>**Figure M** | The western part of the site remained developed with glasshouses, and the eastern part of the site has remained undeveloped. |
| **2018**<br>GroundSure Aerial Photograph of Site (Appendix 2) | The glasshouses are evident in the western part of the site, however some have been dismantled. A new feature (tank) is evident adjacent the north-western corner of the glasshouse in the south-western part of the site. The eastern part of the site is an arable field. Mature trees are evident along the southern and eastern boundaries of the site. A large new housing development is under construction to the south of the site. |
| **2019**<br>Sheets TF2424 & TF2425 (BT)<br>Not to Scale<br>**Figure N** | The site and immediate surrounding area appear unchanged. A circular tank is shown adjacent the glasshouse in the south-west of the site. New BT connections are denoted to the north-west of the site, indicating a proposed development. |

| *OS Map Extract* | *Description* |
|---|---|
| **2020**<br>Sheets TF22NW, NE, SW & SE<br>Scale 1:10,000<br>**Figure O** | The site and immediate surrounding area appear unchanged. |

**Summary of Historical Information**

The Ordnance Survey map of 1886 showed that the site was undeveloped within a rural area and crossed by a footpath. Glasshouses had been built on the western part of the site between 1932 and 1938, and the site was denoted as a nursery. Additional glasshouses were constructed, and others demolished, and the site has remained in this configuration to the present day.

The area around the site was initially fields between Pinchbeck and Spalding. New housing had been built to the south-west of the site by 1938, and further housing to the south in the 1960s.

## SUMMARY OF ENVIRONMENTAL DATA

Appendix 2 contains information derived from Environmental Databases for a radius of up to 2,000m from the site. The information covers datasets held by Groundsure with contributors including the local authority, the Environment Agency (EA), British Geological Survey, Ordnance Survey and the Coal Authority and the results, within a radius of 250m, are summarised below:

| **1. Historical Industrial Sites** | **On-Site** | **0 - 250m** |
|---|---|---|
| Potentially Contaminative Uses (1:10,000 mapping) | 5 | 1 |
| Historical Tank Database | 0 | 0 |
| Historical Energy Features Database | 0 | 5 |
| Historical Petrol & Fuel Site Database | 0 | 0 |
| Historical Garage & Motor Vehicle Repair Database | 0 | 0 |
| Potentially Infilled Land | 0 | 2 |
| **2. Environmental Permits, Incidents and Registers** | **On-Site** | **0 - 250m** |
| Sites Holding Environmental Permits/Authorisations | 1 | 3 |
| Records of COMAH and NIHHS Sites | 0 | 0 |
| Environment Agency Recorded Pollution Incidents | 0 | 4 |
| Sites Determined as Contaminated Land under Part IIA EPA 1990 | 0 | 0 |
| **3. Landfill and Other Waste Sites** | **On-Site** | **0 - 250m** |
| Landfill Sites | 0 | 0 |
| Landfill and Other Waste Sites | 0 | 0 |
| **4. Current Land Use** | **On-Site** | **0 - 250m** |
| Current Industrial Sites Data | 0 | 10 |
| Records of Petrol and Fuel Sites | 0 | 0 |
| Underground High Pressure Oil and Gas Pipelines | 0 | 0 |
| **5. Geology** | | |
| Artificial Ground or Made Ground records | No | |
| Superficial Ground and Drift Geology records | Yes | |
| **6. Hydrogeology and Hydrology** | **On-Site** | **0 - 250m** |
| Productive strata within superficial geology | No | |
| Productive strata within solid geology | No | |
| Groundwater Abstraction Licences | 0 | 0 |
| Surface Water Abstraction Licences | 0 | 0 |
| Potable Water Abstraction Licences | 0 | 0 |
| Source Protection Zones | 0 | 0 |
| River Quality Data | No | No |
| Detailed River Network Entries | 0 | 54 |
| Surface Water Features | Yes | Yes |

| 7. Flooding | | | | | |
|---|---|---|---|---|---|
| Environment Agency indicative Zone 2 floodplains within 250m of site | | | | Yes | |
| Environment Agency indicative Zone 3 floodplains within 250m of site | | | | Yes | |
| Risk of flooding from rivers & the sea (RoFRaS) rating | | | | Medium | |
| Flood defences within 250m of site | | | | No | |
| Any areas benefitting from flood defences within 250m of site | | | | No | |
| Flood storage areas within 250m of site | | | | No | |
| Maximum BGS groundwater flooding susceptibility within 50m of site | | | | Not Prone | |
| BGS confidence rating for groundwater susceptibility areas | | | | Not Applicable | |
| **8. Designated Environmentally Sensitive Sites** | | | | **On Site** | **0 - 250m** |
| Environmentally sensitive sites | | | | 0 | 0 |
| **9. Natural Hazards (on site)** | | | | | |
| **Hazard** | **Negligible** | **Very Low** | **Low** | **Moderate** | **High** |
| Shrinking or Swelling Clay | - | - | On-site | - | - |
| Landslides | - | On-site | - | - | - |
| Soluble rocks | On-site | - | - | - | - |
| Compressible Ground | - | - | - | On-site | - |
| Collapsible Rocks | On-site | - | - | - | - |
| Running Sand | - | - | - | On-site | - |
| **9.2. Radon** | | | | | |
| The property is not in a Radon Affected Area, as less than 1% of properties are above the action level.<br>No Radon Protective Measures are required for new properties or extensions. | | | | | |
| **10. Mining** | | | | | |
| Coal mining areas within 75m of site | | | | No | |
| Non coal-mining areas within 50m of site | | | | No | |
| Brine affected areas within 75m of study site | | | | No | |

## Database Summary

Historically, nurseries are identified on the site; with an electricity sub-station 116m to the south-west of the site. No petrol, fuel or garages are recorded within 250m of the site.

The former pond 15m west on the site is an area of potentially infilled land. The sewage pumping station immediately west of the site has a discharge consent for storm sewage overflow into the Blue Gowt Drain. Three dangerous substance inventory sites, for authorised use of pH, are recorded 44m to 236m to the east of the site, all of which are not active. Four pollution incidents are recorded between 62m and 220m of the site, for events which occurred between 2002 and 2009, for various waste materials, which had minor to significant impact on water. No historic landfills are recorded on, or within 250m of the site.

Current land uses around the site include the electricity sub-station 116m south-west; vehicle hire; parts and repair businesses 166m south-east; and a tank 198m south-east.

Superficial Tidal Flat Deposits are shown beneath the site, which are classified by the EA as an 'Unproductive' stratum. The solid geology Oxford Clay Formation underlying the site is also classified by the EA as an 'Unproductive' stratum. There are no groundwater abstractions within 250m of the site. The site is not within a source protection zone.

The nearest surface water feature is the Blue Gowt Drain along the northern boundary of the site. The site is within a Zone 2 and Zone 3 floodplain, and has a medium risk of flooding. The site is not within an environmentally sensitive area.

There is a moderate hazard from compressible ground and running sand; a low hazard from shrinking and swelling clay; a very low hazard from landslides; and a negligible hazard from soluble rocks and collapsible rocks. The site is not in an area affected by mining.

The site is not in a radon affected area, and no radon protection measures are required for new properties on the site.

## PRELIMINARY RISK ASSESSMENT

Potential sources of contamination present on or beneath the site would relate primarily to; the historical use of the site; the presence of contaminated soil; and the potential presence of hazardous or ground gas beneath the site.

In order to assess the risks associated with the presence of ground contamination the linkages between the sources and potential receptors to contamination need to be established and evaluated. This is in accordance with the Environmental Protection Act 1990, which provides a statutory definition of Contaminated Land. To fall within this definition it is necessary that, as a result of the condition of the land, substances may be present on or under the land such that;

- *Significant harm is being caused or there is a significant possibility of such harm being caused; or*
- *Pollution of controlled waters is being, or is likely to be, caused.*

There are three principal factors that are assessed whilst undertaking a qualitative risk assessment for any site. These are the presence of a contamination source, the existence of migration pathways and the presence of a sensitive target(s). It should be noted that it is necessary for each element of source, pathway and target to be present in order for exposure of a human or environmental receptor to occur.

UK Government guidance on the assessment of contaminated land, requires risk to human health and the environment to be reviewed using source – pathway – target relationships. If each of these elements is present, the linkage provides a potential risk to the identified targets.

***Contaminants*** or ***potential pollutants*** identified as ***sources*** in relation to the identified previous uses are listed overleaf in Table 1.

**Table 1: Identified Potential Contaminant Sources**

| *Contaminant Source* | *Comments* |
|---|---|
| Drainage/ Buildings/ Above Ground Tank | Effluent from existing field drains could provide a contaminant source. The buildings and glasshouses may include asbestos containing materials (ACM). The above ground fuel tank is also a potential source of contamination. |
| Soil Beneath Site | Contamination may be present within any made ground on the site. |
| Soil Gas | Potential soil gas generated from made ground or naturally deposited organic soils. |
| Ground Contamination Outside Site Boundary | Ground contamination migrating from adjoining sites. |

A ***Pathway*** is defined as one or more routes through which a receptor is being, or could be, exposed to, or affected by, a given contaminant.

Potential ***Targets or Receptors*** fall within the categories of Human Health, Water Environment, Flora and Fauna, and Building Materials.

There are a number of possible pathways for the contaminants identified on the site to impact human and/or environmental receptors and these are summarised in Tables 2 and 3.

**Table 2: Human Receptors and Pathways**

| *Human Receptor-Mechanism* | *Typical Exposure Pathway* |
|---|---|
| Human Inhalation | Breathing Dust and Fumes<br>Breathing Gas emissions |
| Human Ingestion | Eating<br>-contaminated soil, for example by small children<br>-produce grown on contaminated soil<br>Ingesting dust or soil on vegetables<br>Drinking contaminated water |
| Human Contact | Direct skin contact with contamination<br>Direct skin contact with contaminated liquids |

**Table 3: Water Receptors and Pathways**

| *Receptor-Water Environment* | *Typical Exposure Pathway* |
|---|---|
| **Groundwater**<br>The superficial Tidal Flat Deposits and solid geology Oxford Clay are indicated to be 'Unproductive' strata.<br>The site is not within a Source Protection Zone. | Surface infiltration of atmospheric waters into the soils beneath the site could wash or dissolve potential contaminants and migrate to underlying groundwater.<br><br>Contamination leads to restriction/prevention of use as a resource, for example, drinking water, and can have secondary impacts on other resources, which depend on it. |
| **Surface Water/Watercourses**<br>The nearest surface water feature is Blue Gowt Drain immediately north of the site. | Surface infiltration of atmospheric waters into the soils beneath the site could wash or dissolve potential contaminants and laterally migrate.<br>Contamination leads to a restriction/prevention of use:<br>-as drinking water resource<br>-for amenity use<br>Effects on aquatic life. |

## Preliminary Conceptual Model

Assessment of the potential linkage between ground contamination sources, human and environmental receptors have been assessed based on the desk study research documented in the preceding sections of this report.

A generalised preliminary conceptual model is presented below in Table 4.

**Table 4: Preliminary Conceptual Model Relative to Residential Development**

| Receptors | Pathway | Estimated Potential for Linkage with Contaminant Sources | | | |
|---|---|---|---|---|---|
| | | **Drainage/ Buildings/Above Ground Tank** | **Soil Beneath Site** | **Soil Gas** | **Ground Contamination Outside Site Boundary** |
| Human Health – ground or construction workers | Ingestion and Inhalation of contaminated Soil, Dust and Vapour | Low likelihood/ Likely/Likely | Low likelihood | Low likelihood | Low likelihood |
| Human Health – end users | Ingestion and Inhalation of contaminated Soil, Dust and Vapour | Unlikely | Low likelihood | Low likelihood | Low likelihood |
| Water Environment | Migration through ground into surface water or surrounding groundwater | Low likelihood | Low likelihood | Unlikely | Low likelihood |
| Flora | Vegetation on site growing on contaminated soil | Low likelihood | Low likelihood | Low likelihood | Unlikely |
| Building Materials | Contact with contaminated soil | Low likelihood | Low likelihood | Low likelihood | Low likelihood |

| **Key to Table 4**<br>**Estimated Potential for Linkage with Contaminant Source** | **Definition** |
|---|---|
| **High likelihood** | 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. |
| **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.<br>Circumstances are such that an event is not inevitable, but possible in the short term and likely over the long term. |
| **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 an 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. |
| **N/A** | Not Applicable. |

## SITE WORK

The site work conducted between 25th February and 6th March 2020 comprised six cable percussion boreholes (BH1 to BH6) and ten machine excavated trial pits (TP1 to TP10). The positions are shown on the exploratory hole location plan following this report text.

Public utility service drawings were sourced and consulted prior to determining the exploratory hole positions. Prior to excavation, a service scan was made at each position using a CAT (Cable Avoidance Tool) to check for the absence of detectable buried services that may otherwise have been damaged by the investigation. Exploratory hole positions were agreed with Cadent Gas at a site meeting prior to the start of the investigation.

The exploratory hole records, presented following the plans, give the descriptions and depths of the various strata encountered, details of all samples taken, in-situ tests and the groundwater conditions observed during and on completion of excavation and boring.

### Cable Percussion Boreholes

The boreholes BH1 to BH6 were undertaken by a standard cable percussive boring rig, using claycutter and shell boring tools within 150mm diameter casing installed to a maximum 11.80m depth. The boreholes were sunk to depths of 15.00m below ground level.

Representative small disturbed and bulk samples of soil were taken from the boring tools at regular intervals throughout the depth of the boreholes. A water sample was also taken from BH6 once sufficient water had entered the borehole.

Undisturbed samples 100mm in diameter were taken within clay soils, the ends of the samples were capped to maintain them in as representative condition as possible during transit to the laboratory.

Standard penetration tests (SPT) were undertaken in order to give an indication of the in-situ density of the soils. The tests were made by driving a solid cone (C) or split spoon (S) attachment into the soil at the base of the borehole by means of an automatic trip hammer weighing 63.50kg falling freely through 760mm. The penetration resistance was determined as the number of blows 'N' required to drive the tool the final 300mm of a total penetration of

450mm into the soil ahead of the borehole. The SPT test is fully described in BS EN22476:3:2005, the results of these tests are presented on the borehole records and have been plotted against depth in Figure 1 and the soil profile Figure 3.

On completion the boreholes were backfilled with arisings and the surfaces reinstated.

**Machine Excavated Trial Pits**

Trial pits TP1 to TP10 were excavated using a JCB 3CX to depths of between 3.00m and 3.40m. The exposed strata were sampled and recorded by a Geoenvironmental Engineer. Representative small, bulk and environmental jar samples of soil were taken at regular intervals throughout the depth of each trial pit.

An immediate assessment of the apparent shear strength of clay was made within the trial pits using a hand shear vane. The apparent cohesion results have been plotted against depth in Figure 2 with the triaxial test results from the boreholes.

A Mackintosh Probe (MP) was used to provide an indication of the density of the soils at regular depth intervals within selected trial pits. The 25mm diameter solid cone point of the probe was screwed onto the rods and driven into the ground by repeated blows of a 4.5kg slide hammer with a fall of 0.30m. The depth penetrated for 100 blows was recorded and is presented on the trial pit records.

The trial pits were backfilled with compacted arisings upon completion.

## LABORATORY WORK

The samples were inspected in the laboratory and assessments of the soil characteristics have been taken into account during preparation of the borehole and trial pit records. The soil descriptions have been made in accordance with BS5930:2015. The geotechnical test results, undertaken in accordance with BS1377:1990 & 2016, are presented following the exploratory hole records. The chemical test results follow the geotechnical test results.

The moisture content and index properties of selected soil samples were determined as a guide to soil classification and behaviour. The liquid limit was determined by a cone penetrometer.

The particle size distribution of selected samples of silt and sand were determined by sieve analysis. The particle size distribution passing the 63μm sieve was obtained by pipette sedimentation on selected samples. Results of these tests have been combined and are presented as particle size distribution curves at the end of this report.

Test specimens were prepared at full diameter from selected undisturbed samples. Immediate undrained triaxial compression tests were performed under single-stage confining cell pressures. The moisture content and bulk density of each specimen were also determined. When the undisturbed samples were unsuitable for triaxial testing, hand shear vane tests were undertaken instead. Both triaxial and hand vane results are plotted against depth in Figure 2.

An indication of the settlement characteristics of a selected sample was obtained from a test in the consolidation apparatus or oedometer. The test was performed on a 50mm or 75mm diameter sample, about 19mm thick, contained in a steel ring. The sample was saturated and the swelling pressure balanced prior to applying a constant load with drainage at both ends. When primary compression was complete, the load was increased and this repeated for three increments of load. The sample was then unloaded in a single stage. The rate and total amount of consolidation were continually monitored using a computer controlled E.L.E. Datasystem 7 Unit. The results were plotted and analysed by the computer for each increment of load to obtain

the coefficients of compressibility (mv), and of consolidation (cv), which govern the amount and rate of settlement, respectively.

California Bearing Ratio (CBR) tests were performed on selected recompacted near surface samples in accordance with Lincolnshire County Council's specification. The samples were recompacted using a 2.5kg rammer (BS light) or vibrating hammer, and the test consisted of jacking into the soil a cylindrical plunger with a cross sectional area of 1935mm$^2$. A force of 50N was applied initially to seat the plunger on the soil surface and then the plunger was made to penetrate the soil at a uniform rate of 1mm/min. Readings of force were taken at intervals of penetration of 0.25mm to a penetration not exceeding 7.50mm. The CBR value is the ratio of the force required to achieve 2.5mm or 5.0mm penetration to standard forces expressed as a percentage.

Selected samples of soil and groundwater were analysed to determine the concentration of soluble sulphates. The pH values were also determined.

Chemical analysis of six soil samples recovered from the exploratory holes was undertaken, by an independent laboratory, primarily for characterisation purposes. The samples were tested for a suite encompassing a wide range of potential contaminants outlined by the Environment Agency (EA) and National House Building Council (NHBC) document R&D 66; 2008 'Guidance for the Safe Development of Housing on Land Affected by Contamination'. Two of the samples were also tested for speciated total petroleum hydrocarbons (TPH), BTEX and MTBE.

## GROUND CONDITIONS

The ground conditions have been plotted as a soil profile in Figure 3. The ground conditions comprised a surface layer of made ground or topsoil to between 0.20m and 1.50m depth, underlain by superficial Tidal Flat Deposits comprising clay, silt and sand, which generally became very soft and organic with depth. The anticipated Till (Boulder Clay) was encountered in the boreholes below between 9.60m and 11.60m depth. Groundwater was recorded between 1.00m and 3.20m depth during the investigation.

### Made Ground/Topsoil

Made ground and topsoil was generally encountered to between 0.20m and 0.50m depth, and locally to 1.00m and 1.50m depth in BH3 and BH1 respectively in the area of the greenhouses. In the western nursery part of the site, a 0.20m to 0.30m thick compacted surface layer of grey and brown, silty sand and gravel fill was present. The made ground/topsoil generally comprised soft, brown and dark brown, slightly sandy, slightly gravelly, silty clay. The gravel fraction comprised angular to rounded flint, quartzite, igneous rock, oolitic limestone, and locally with occasional ash, coal, clinker, asphalt, glass, concrete, brick, plastic and metal fragments.

### Tidal Flat Deposits

Beneath the surface made ground and topsoil at between 0.20m and 1.50m depth, soft or firm, locally stiff (TP7), orange brown, light brown and light grey, initially slightly sandy and gravelly (BH1, BH2, BH3 and TP1), silty clay was encountered, locally varying to sandy, clayey silt and silty fine sand. The gravel fraction where present comprised angular to rounded flint, quartzite and limestone. Across the site, below between 1.70m and 2.80m depth, the clay became very soft and organic. These soils were considered to represent the anticipated superficial Tidal Flat Deposits, and were encountered to depths of between 9.60m (BH1) and 11.60m (BH6). The trial pits were completed within the Tidal Flat Deposit soils.

**Till (Boulder Clay)**

At depths of between 9.60m and 11.60m, grey and brown, slightly sandy, slightly gravelly, silty clay was encountered to at least the base of the boreholes at a depth of 15.00m, a thickness of between at least 3.40m and 5.40m. These clay soils were initially firm becoming stiff, and locally very stiff below 10.00m to 13.00m depth, which were considered to represent superficial glacial Till.

**Groundwater**

Groundwater seepages were recorded during excavation of the trial pits at between 1.00m (TP6 & TP10) and 3.00m (TP1 & TP5) depth. Groundwater was recorded at between 2.20m and 3.30m depth on completion of the trial pits. Groundwater was also recorded at 1.70m depth in BH6, rising to 1.00m depth, and was recorded at 4.60m below ground level on completion of the borehole and removal of the casing, however this level may have still been rising. The other boreholes were dry during boring, and on completion, however the casing may have sealed off groundwater seepages.

**Observations**

Live roots were observed to a maximum depth of 1.70m in BH2.

**Excavation Stability**

The trial pit sides were generally unstable and collapsed below 0.20m to 2.30m depth.

**Evidence of Contamination**

The made ground encountered during this investigation was not noted to have olfactory or visual evidence of fuel contamination. The made ground contained occasional fragments of ash, coal, clinker, asphalt, glass, concrete, brick, plastic and metal. No asbestos containing materials were noted in the soils during this investigation, or during testing.

## COMMENTS ON THE GROUND CONDITIONS IN RELATION TO FOUNDATION DESIGN AND CONSTRUCTION

This investigation found made ground or topsoil to depths of between 0.20m and 1.50m, covering superficial soft or firm, becoming very soft and organic clay Tidal Flat Deposits, varying to loose becoming very loose silty sand Tidal Flat Deposits; and firm to very stiff glacial Till below 9.60m to 11.60m depth. Groundwater was met as shallow as 1.00m depth during the investigation. The superficial deposits (clay, silt and sand) could offer support for lightly to modest loaded traditional foundations for the proposed housing development, however large irregular shaped buildings and heavy loads are likely to require piled foundations.

Prior to any site works, including demolition and site clearance, Cadent Gas Limited should be consulted about operating procedures in excavating near or indeed even crossing the high pressure gas main which crosses the site. The location of the foul rising main along the northern edge of the site should also be established.

The clays of the Tidal Flat Deposit only locally had a thin firm 'crust' which may be capable of supporting lightly loaded structures, but these soils rapidly became very soft with increasing depth. The proposed houses should not be supported on traditional foundations cast within the shallow soils, unless the structures are lightly loaded and could tolerate significant total and differential consolidation movements. Deepened foundations will be locally required on this site, due to the proximity of hedgerows and trees around the site boundaries, in order to penetrate the zones of root influence within the low volume change potential clays.

Foundations should extend through any stiff, desiccated, root affected clays, but in so doing would approach the underlying very soft, organic clay, which offers very limited support for deepened traditional foundations. Ground improvement techniques would not be suitable for these very soft and organic soils. The limited bearing pressures and potentially high compressibility of the shallow soils and shallow groundwater table, together with some effects of desiccation within the near-surface clays and potential differential settlements, means that a piled

foundation scheme would be the most appropriate foundation solution to support the proposed buildings across most of this site.

Floor slabs could be ground bearing in areas where they are well away from the influence of trees, although differential movements are likely to occur.

**Traditional Shallow Foundations**

Large scale processes of natural sedimentation allow a certain degree of confidence to be placed in the absence of important variation of the engineering properties of natural soils across sites. The made ground had variable bearing properties and was found to a maximum depth of 1.50m, and soft or very soft organic Tidal Flat Deposits were encountered below 1.70m to 2.80m depth. The made ground and organic soils should be avoided as bearing strata.

Samples of the near surface clay had modified plasticity indices of between 14% and 31%, and the silty clay is rated as having a low to medium volume change potential based on NHBC Standards Chapter 4.2 'Building near trees' (2020). A minimum foundation depth of 0.90m in the naturally deposited clay soils beneath this site, where remote from trees, would be considered appropriate in order to penetrate the zone affected by seasonal moisture content and volume change. The 'firm crust' of the near surface clays could be used for shallow foundations, however the variable strength and compressibility of the clay soils is likely to lead to unacceptably high total and differential settlements, and it is recommended that foundations are extended into the underlying non-shrinkable silty sand soils where present.

In summary, foundations for the new dwellings will need to be a minimum of 0.90m deep, and preferably extended into non-shrinkable silty sand soils where present. Deepened foundations will encounter the organic clay and are likely to be below the groundwater table, in which case piled foundations would be recommended. Piled foundations may provide an economic alternative to support the proposed dwellings, particularly as deepened foundations are likely to have unacceptably high total and differential settlements.

It is important therefore that foundations are extended below the proposed minimum 0.90m depth where roots from trees are present, both in areas where the trees remain and have been removed, in order to penetrate the zones of potential shrinkage or heave movements. In areas within the zones of root influence, raft foundations could provide an economic foundation alternative. This will require any underlying root affected clay soils to be removed and replaced with non-shrinkable compacted stone to a maximum of 1.25m below ground level. This solution would also avoid requirement for anti-heave precautions, such as void forming or compressible materials, which should be incorporated alongside strip foundations within root affected clay soils.

Foundations should extend through any topsoil, made ground or stiff, root affected clays. The firm and locally soft clay/silt soils found at the minimum foundation depth of 0.90m offer a maximum safe bearing capacity of 40kN/$m^2$ with a factor of 3.0 incorporated, for a 0.60m wide strip foundation, which is limited by the strength of the underlying soft clays. Deeper foundations would have a lower maximum safe bearing capacity. Similarly, the Tidal Flat Deposits beneath a nominal 12m by 8m raft foundation would have a maximum safe bearing capacity of 15kN/$m^2$ with the same factor of safety of 3.0 incorporated. Estimated consolidation settlement beneath such a raft is likely to be in excess of 50mm.

The non-shrinkable, orange brown and brown, silty fine sand found at the south-eastern end of the site (BH5, TP8, TP9 & TP10) offers a maximum safe bearing pressure of 100kN/$m^2$ for foundations up to 1.20m width, where present above the groundwater table. The above bearing pressure should ensure that settlement beneath such foundations would be within 25mm. Settlement within the underlying sand should occur as the loads are applied.

Structures founded within the Tidal Flat Deposits would have to tolerate potentially large total and differential settlements, which may be exaggerated where the foundations cross any natural variation different soil types. Differential settlements are likely to occur across individual building plots, due to variation in thickness and compressibility of the underlying soils. Further differential movements will occur if and where foundation pressures locally increase along foundation runs. Movements could be further exacerbated by effects of

desiccation, which could also locally generate upward heave movements. New foundations should incorporate reinforcement in order to minimise differential movements along or between them.

**Excavations**

Cadent Gas Limited should be consulted before any equipment is brought onto the site for site clearance or excavations. The made ground together with the underlying soils should be easily removed within excavations for the proposed buildings. The sides of excavations within any made ground and Tidal Flat Deposits, are likely to be unstable and should not be relied upon to stand unsupported.

Excavations could be expected to encounter groundwater at depths between 1.00m and 3.00m, which is likely to reflect the water level in nearby drains. The groundwater levels may fluctuate seasonally and such inflows would locally be accompanied by 'running sand' conditions and resulting instability. Care should be taken not to excavate below the water table in the absence of suitable groundwater control and side support, such as dewatering via screened sumps or well points and interlocking sheeting. The clays, and silty sands are prone to softening, deterioration and loosening in the presence of water, with loss of their modest bearing properties. Care should be taken to keep the excavations dry.

Attention should be given where personnel are to enter deep excavations, when sides should either be safely battered back, or close side support provided, in order to comply with statutory safety requirements and prevent sidewall collapse.

**Piled Foundations**

Piled foundations may be used to support the proposed dwellings, particularly as foundations greater than 2.50m deep and extending below the groundwater table are required. The underlying glacial Till would provide a suitable pile bearing stratum. The advice of a specialist piling contractor should be sought with regard to suitable methods of pile installation. The very soft, organic clay and silty sand of the Tidal Flat Deposits will require use of casing for

bored piles and attention should be made to the possibility of 'necking' of concrete within such soils. Driven, bored or Continuous Flight Augered (CFA) piles could be used, however vibrations from driven piles could be transmitted through organic soils and affect the Cadent gas main.

Preliminary working loads for a single bored pile may be estimated for preliminary cost and design purposes using the pile bearing coefficients given over page, which are based on the following assumptions;

1. The ultimate load on a pile would be the sum of the adhesion in clay, and friction in sand, acting on the shaft of the pile together with the end bearing load.
2. The adhesion acting on the shaft of a pile is a function of the values of apparent cohesion within the clay, presented on the laboratory test results and plotted against depth in Figure 2. The adhesion assumes that the very soft organic clay soil would not be surcharged by surface or floor loadings. If these soils are surcharged then negative shaft adhesion would need to be considered.
3. The friction acting on the shaft of a pile is a function of the density of sand, taken from the SPT 'N' values presented on the borehole records, plotted against depth in Figure 1, on the soil profile Figure 3, and the effective overburden pressure.
4. The end bearing load would be a function (9.0) of the average cohesion of the clay at the level of the pile base.
5. A factor of safety of at least 2.0 would be used to assess the working load and if test loading of selected piles were not practical, the factor of safety (F) would be increased to at least 2.5.
6. Where piles are installed in groups it will be necessary to position them at least 3.0 diameters apart, centre-to-centre, otherwise a reduction in individual working load will need to be taken into account.

| Item | Ultimate Pile Bearing Value (kN/m$^2$) |
|---|---|
| Adhesion in made ground or root affected clay | Ignored |
| Adhesion/friction in very soft & organic clay to 10.00m | 5 |
| Adhesion in firm/stiff Till, 10.00m to 12.00m depth | 35 |
| Adhesion in stiff/very stiff Till 12.00m to 15.00m | 75 |
| End bearing in stiff/very stiff Till, below 12.00m depth | 1350 |

Based on these coefficients at the centrally located BH3, it is estimated that a single 450mm diameter bored pile installed to 12m depth within the stiff Till, would have a working load of 150kN (F=2.5). A single 450mm diameter pile extended to 14m depth within the stiff Till, would have a working load of 235kN (F=2.5).

Larger diameter piles would have increased working loads. For example, the same 12m and 14m length piles at 600mm diameter would have a working load of 240kN (F=2.5) and 350kN (F=2.5) respectively.

These values assume that negative skin friction resulting from surcharging of the compressible and organic Tidal Flat Deposits is not generated. If surcharge loads are to be applied to the ground around the piles, for example by ground bearing floor slabs, it would be necessary to reduce the estimated working loads of the piles by the drag down force within the made ground and very soft organic clays settling around the pile shaft.

The advice of a specialist piling contractor should be sought prior to design.

**Floor Slabs**

Ground bearing floor slabs could be adopted for the new properties where they are beyond the zones of influence from trees, and the naturally deposited clay/silt and non-shrinkable silty sand soils are present at shallow depth.

Ground bearing floor slabs should not be adopted for proposed buildings within influencing distance of neighbouring trees, particularly where buildings are proposed close to the site margins. Damaging differential heave movements could occur across such slabs, particularly

where they cover any clay affected by recently severed tree roots. Suspended floor slabs will be required to avoid the anticipated large total and differential consolidation settlements, any negative skin friction, together with any volume change movements within root affected clays, providing that the sub-floor gaps recommended in Table 7 of the NHBC Standards Chapter 4.2 (2020), are adopted.

Raft foundations should avoid problems associated with shallow root affected clays, since they will require a minimum depth of 0.75m and in areas close to trees they will need to be placed on a compacted stone blanket extending up to 1.25m below ground level.

**Hardstanding**

Naturally deposited, generally soft, silty clays or loose, clayey or silty fine sand was encountered at sub-grade level across this site.

Based on IAN 73/06, Table 5.1 recommends a design CBR value of 1% for silt, and 3% for sandy clay with a plasticity index of 10%.

Laboratory CBR tests yielded CBR values ranging between 0.3% and 2.3%. A design CBR value of 1.0% for the naturally deposited sandy, silty clay should be adopted for hardstanding design on this site, although the pavement construction will need to be at least 450mm thick since the silty soils are considered to be potentially frost susceptible in accordance with Road Note 29, Appendix 1.

The sub-grade should be suitably compacted and inspected, with any topsoil, very soft, organic or desiccated clays, being removed and replaced with suitable well-graded coarse-grained fill. Care should be taken not to allow exposed silt/clay soils at sub-grade level to become exposed to inclement weather conditions, since they are prone to rapid softening and deterioration. A permeable geotextile should be incorporated in order to prevent both loss of any sub-base material into the sub-grade and migration of sub-grade soils into the overlying sub-base.

**Sulphate Conditions**

Sulphate analysis of selected samples of soil and groundwater yielded soluble sulphate concentrations within Design Sulphate Classes DS-1 for the soil, and DS-2 for the groundwater, of the BRE Special Digest 1, Table C1 (2001), presented in Appendix 3. The pH results of the samples ranged between 7.4 and 8.3 indicating alkaline conditions.

These results indicate an Aggressive Chemical Environment for Concrete (ACEC) Class of AC-2 for buried concrete. This ACEC Class should be considered when specifying a Design Chemical Class (DC Class) for buried concrete on this site, as detailed in the above cited BRE document.

## COMMENTS ON THE SOIL CHEMICAL TEST RESULTS

The results of the laboratory chemical testing on near surface soil samples have primarily been compared to soil screening values (SSVs) produced by Land Quality Management Limited (LQM) and the Chartered Institute for Environmental Health (CIEH) presented in their document 'The LQM/CIEH S4ULs for Human Health Risk Assessment: 2015 (Publication Number S4UL3608)'. The LQM/CIEH S4ULs are intended for use in assessing the potential risks posed to human health by contaminants in soil and are transparently-derived and cautious 'trigger values' above which further assessment of the risks or remedial action may be needed. The S4ULs (Suitable for Use Levels) have been derived, in accordance with UK legislation and Environment Agency policy, using a modified version of the Environment Agency CLEA 1.06 software.

Reference has also been given to ATRISKsoil soil screening values produced by Atkins Limited and provided under licence to Ground Engineering Limited. Atkins SSVs have been derived in line with the Environment Agency 2009 guidance using the CLEA 1.071 software. With the absence of a S4UL for cyanide the ATRISKsoil SSV has been used as the soil screening criteria within this report.

In 2014 the Department for Environment Food and Rural Affairs (DEFRA) published, in their document SP1010, Category 4 Screening Levels (C4SL) for several contaminants including lead. The C4SL represent screening levels below which the land could be considered suitable for a specified use and definitely not contaminated land in respect of those determinands. With the absence of S4UL for lead the C4SL has been used as the soil screening criteria within this report.

For each contaminant the adopted soil screening criteria have been calculated for the following land uses:

- Residential use with home grown produce
- Residential use without home grown produce
- Commercial and industrial usage

The intended purpose of the SSVs are as “intervention values” in the regulatory framework for assessment of human health risks in relation to land use. These values are not binding standards, but are intended to inform judgements about the need for action to ensure that a new use of land does not pose any unacceptable risks to the health of the intended users.

Table 5 compares the test results for the made ground with the SSVs in relation to the specified uses. The number of test results, which exceed these values, are also provided. Statistical analysis would not be meaningful for the small dataset and has not been undertaken.

## Table 5: Comparison of Chemical Test Results with SSVs for Near Surface Soils

| Determinand | Number of Samples | Min Value mg/kg | Max Value mg/kg | Number of Samples Exceeding SSV for | | | Assessment Method | Soil Screening Criteria 2.5% SOM | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Residential with home grown produce | Residential without home grown produce | Commercial/ Industrial | | Residential with home grown produce mg/kg | Residential without home grown produce mg/kg | Commercial/ Industrial mg/kg |
| **Organic Matter** | 6 | 2.3% | 3.7% | - | - | - | - | - | - | - |
| **Arsenic** | 6 | 11 | 16 | 0 | 0 | 0 | S4UL | 37 | 40 | 640 |
| **Cadmium** | 6 | <0.2 | <0.2 | 0 | 0 | 0 | S4UL | 11 | 85 | 190 |
| **Chromium (III)** | 6 | 16 | 25 | 0 | 0 | 0 | S4UL | 910 | 910 | 8600 |
| **Chromium (VI)** | 6 | <4.0 | <4.0 | 0 | 0 | 0 | S4UL | 6 | 6 | 33 |
| **Lead** | 6 | 17 | 370 | 1 | 1 | 0 | C4SL | 200 | 310 | 2330 |
| **Mercury** | 6 | <0.3 | <0.3 | 0 | 0 | 0 | S4UL | 11 | 15 | 320 |
| **Selenium** | 6 | <1.0 | <1.0 | 0 | 0 | 0 | S4UL | 250 | 430 | 12,000 |
| **Nickel** | 6 | 11 | 22 | 0 | 0 | 0 | S4UL | 130 | 180 | 980 |
| **Phenols** | 6 | <1.0 | <1.0 | 0 | 0 | 0 | S4UL | 200 | 690 | 690 |
| **Benzo[a]pyrene** | 6 | <0.05 | 24 | 1 | 1 | 1 | S4UL | 0.98 | 1.2 | 15 |
| **Copper** | 6 | 13 | 29 | 0 | 0 | 0 | S4UL | 2400 | 7100 | 68,000 |
| **Zinc** | 6 | 58 | 140 | 0 | 0 | 0 | S4UL | 3700 | 40,000 | 730,000 |
| **Free Cyanide** | 6 | <1 | <1 | 0 | 0 | 0 | ATRISK | 34 | 34 | 34 |

Notes
S4UL and C4SL for metals were derived using 6% SOM. These values are not sensitive to SOM and would also be applicable for 1% SOM and 2.5% SOM.
LQM/CIEH S4ULs 'Copyright Land Quality Management Limited reproduced with permission; Publication Number S4UL3608. All rights reserved'.
ATRISKsoil SSVs produced by Atkins Limited and provided under licence to Ground Engineering Limited.

**Discussion of Soil Results**

The results of the laboratory analysis indicate that the near surface soil contains an elevated concentration of lead and an elevated concentration of benzo[a]pyrene (both from TP2 at 0.20m depth), which exceeded the soil screening criteria for residential with home grown produce end use; and for residential without home grown produce end use. The lead concentration did not exceed the associated soil screening criteria for a commercial/industrial end use, however the benzo[a]pyrene concentration did exceed this criteria.

Levels of all remaining elements and compounds in the samples tested were within the associated soil screening values for both residential end uses and for commercial/industrial end use.

Due to the limited number of samples tested, statistical analysis is not considered to be meaningful.

The made ground encountered during this investigation was not noted to have olfactory or visual evidence of fuel contamination. Total petroleum hydrocarbon (TPH) concentrations of 170mg/kg (TP1) and 1120mg/kg (TP2) were recorded in the samples tested, the latter result is considered to be due to ash and asphalt within the sample, and these concentrations are not considered significant.

No asbestos containing materials (ACM) were observed within the made ground soils during site work or testing in the laboratory.

In conclusion, some of the near surface soils would be suitable in the proposed gardens and landscaped areas of the residential development, whilst granular sub-base soils containing lead (TP2) would only be suitable beneath buildings and areas of permanent hardstanding.

## UPDATED CONCEPTUAL MODEL

Assessment of the potential linkage between ground contamination sources, human and environmental receptors have been assessed based on the desk study research and the intrusive ground investigation documented in the preceding sections of this report.

A generalised conceptual model relative to the existing site and proposed residential use of the site is presented in Table 6 below.

**Table 6: General Conceptual Model Relative to Future Residential Development**

| Receptors | Pathway | Estimated Potential for Linkage with Contaminant Sources | | | |
|---|---|---|---|---|---|
| | | Drainage/ Buildings/ Tank | Soil | Soil Gas | Off-Site Sources |
| Human Health – ground workers | Ingestion and Inhalation of contaminated Soil, Dust and Vapour | Low/ Moderate/ Moderate | Low | Low | Very Low |
| Human Health – users of completed development | Ingestion and Inhalation of contaminated Soil, Dust and Vapour | N/A | Low | Low | Very Low |
| Water Environment | Migration through ground into surface water or groundwater | Low | Very Low | Very Low | Low |
| Flora | Vegetation on site growing on contaminated soil | Very Low | Very Low | Very Low | Very Low |
| Building Materials | Contact with contaminated soil | Very Low | Very Low | Very Low | Very Low |

| Key to Table 6 Risk | Definition |
|---|---|
| **Very High** | 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>The risk, if realised, is likely to result in a substantial liability.<br>Urgent investigation (if not undertaken already) and remediation are likely to be required. |
| **High** | 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.<br>Urgent investigation (if not undertaken already) and remedial works may be necessary in the short term and likely over the long term. |
| **Moderate** | It is possible that harm could arise to a designated receptor from an identified hazard. However, it 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. |
| **Low** | 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. |
| **Very Low** | 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. |
| **N/A** | Not Applicable because the proposed development will remove the source. |

## COMMENTS ON GROUND CONTAMINATION IN RELATION TO PROPOSED DEVELOPMENT

Anticipated exposure scenarios relating to the existing site, the site history and proposed residential end use of the site, in the context of the conceptual model, are discussed as follows.

This investigation may not have revealed the full extent of contamination on the site and appropriate professional advice should be sought if subsequent site work reveals materials that may appear to be contaminated.

### Contaminated Soil

On the basis of the ground investigation, the site is underlain by between 0.20m and 1.50m of made ground and topsoil. The made ground was generally in the western nursery part of the site, and the topsoil in the eastern field area. The chemical testing has identified an elevated concentration of lead and benzo[a]pyrene in the sub-base fill (TP2), this granular fill soil would not be suitable in respect to the proposed gardens or soft landscaping in the residential development, but would be suitable beneath buildings or areas of permanent hardstanding. The presence of contaminants (lead and benzo[a]pyrene) in the made ground indicates that there is a low risk of contaminants affecting groundworkers during any construction works, and there will be a very low risk of affecting future end users of the site.

The underlying naturally deposited soils encountered beneath the site would generally be considered suitable for retention and re-use within the development if required. The near surface granular sub-base soils would be considered unsuitable for retention or re-use within gardens or landscaped areas, and where present in such areas should be removed and replaced with suitable clean topsoil.

**Existing Drainage**

Redundant drain runs, where encountered, should be removed from beneath the site and precautions should ensure that any remaining effluent is directly disposed off-site. The integrity of existing drainage should be checked, and if they are to be retained any damaged sections should be replaced prior to development. The latter measures should minimise any future risk to human health and the water environment.

**Buildings**

The existing buildings and greenhouses within the site may have asbestos containing materials within them and an asbestos survey should be undertaken prior to demolition for the proposed redevelopment. Suitable precautions, in line with current best practice, should be put in place to protect workers from the effects of asbestos material, during the site clearance and redevelopment phases.

There is a very low risk of contamination affecting the existing and proposed structures, and their foundations.

**Above Ground Tank**

The above ground fuel tank adjacent the greenhouse in the westernmost part of the site is believed to contain kerosene. Suitable precautions, in line with current best practice, should be put in place to protect workers during the removal of the tank and associated pipework. Any contaminated soil beneath and around the tank should also be suitably disposed of.

**Soil Gas**

According to the environmental database there are no landfills recorded within 250m of the site. The site is generally underlain by a thin layer of made ground and topsoil, covering variable Tidal Flat Deposits which become organic, and glacial Till at depth.

There is a low risk that hazardous gases would affect groundworkers during the construction phase and a low risk of hazardous gases affecting future users of the site.

Consideration should be given to gas monitoring within deep or confined spaces, particularly where thick made ground and organic soils are present, to ensure safety of personnel entering them, since carbon dioxide could accumulate within any excavations, service chambers or sub-structures.

The site is not in a radon affected area, and no radon protection measures are required for new properties on the site.

**Human Health - Construction Workers**

Based on the chemical test results, no special precautions would be required during the development of the site by workers who may come into contact with the soil during groundworks, providing standard precautions are adopted which should generally include the procedures given by the Health and Safety Executive (The Blue Book) HS(G)66.

For the protection of workers during groundworks the following is recommended:

a) Limit repeated or prolonged skin contact with soils by wearing gloves with sleeves rolled down.

b) Washing facilities should be made available to groundworkers, so as to minimise the potential for inadvertent ingestion of soil.

c) If any soils are revealed which are different to those encountered by this ground investigation, the advice of a specialist should be sought in view of classifying the material and ascertaining its risk to groundworkers.

d) Suitable precautions, in line with current best practice, should be put in place to protect workers from the effects of asbestos containing material, during the site clearance phase.

**Human Health - Users of Completed Development**

The results of the chemical analysis undertaken would indicate that the made ground (excluding the sub-base fill) and near surface soils should be considered suitable for re-use at the surface in any new garden, landscaped or planted areas. Where sub-base fill is present

in private residential garden areas, it is recommended that the made ground should either be completely removed, or removed and replaced with up to 1.00m of clean inert topsoil or clean granular fill. In landscaped and patio areas the sub-base fill should be removed and replaced with up to 0.60m of clean inert topsoil or clean granular fill.

The made ground could be considered for re-use beneath proposed buildings and permanent hardstanding, if suitable for engineering purposes, where it is unlikely to affect future users of the site, however these soils could affect buried services.

Any soil imported to site must be certified as "suitable for use".

**Water Environment**

The site is underlain by superficial Tidal Flat Deposits, Till and solid geology Oxford Clay, which are indicated by the EA to be 'Unproductive' strata. The nearest surface water feature is Blue Gowt Drain along the northern boundary of the site. The site does not lie within a source protection zone.

Groundwater was recorded as shallow as 1.00m below ground level during the investigation.

The risk to the water environment from soil contaminants is considered very low as it is unlikely that the proposed development and contaminants within the made ground soils would impact the quality of the water environment.

**Effects on Building Materials and Buried Services**

The sulphate requirements for buried concrete have been discussed in the previous section of this report.

The local water supply company should be consulted if new buried plastic water pipes are to be installed within the made ground soils on this site.

**Off-Site Disposal of Soil Arisings**

The results of chemical analysis are provided following the exploratory hole records and can be used within the information necessary for basic characterisation of the soil destined for landfill. The Environment Agency publication Hazardous Waste, Technical Guidance WM3 outlines the methodology for classifying wastes and should be referenced for guidance. The test results (total metals, hydrocarbons and cyanide) should be compared to the relevant thresholds to determine whether they fall into the primary categories of non-hazardous or hazardous waste and will help indicate the likely European Waste Catalogue (EWC) code which is determined by the waste type. Asbestos containing materials would be considered hazardous and should be appropriately disposed of.

Excavated material and excess spoil should always be classified prior to removal from site as required by 'Duty of Care' (Environmental Protection Act, 1990) legislation. This means that material has to be given a proper description and waste classification prior to removal. Basic characterisation is the responsibility of the waste producer, whilst compliance checking and on-site verification are generally the responsibility of the landfill operator. The landfill operator will need to liaise with the waste producer, as the approach relies on the information from basic characterisation.

It is expected that arisings of natural soils from the excavations across this site would fall into the inert category under the European Waste Catalogue description 'Soil and Stones', EWC code 17 05 04 with restrictions excluding topsoil and peat.

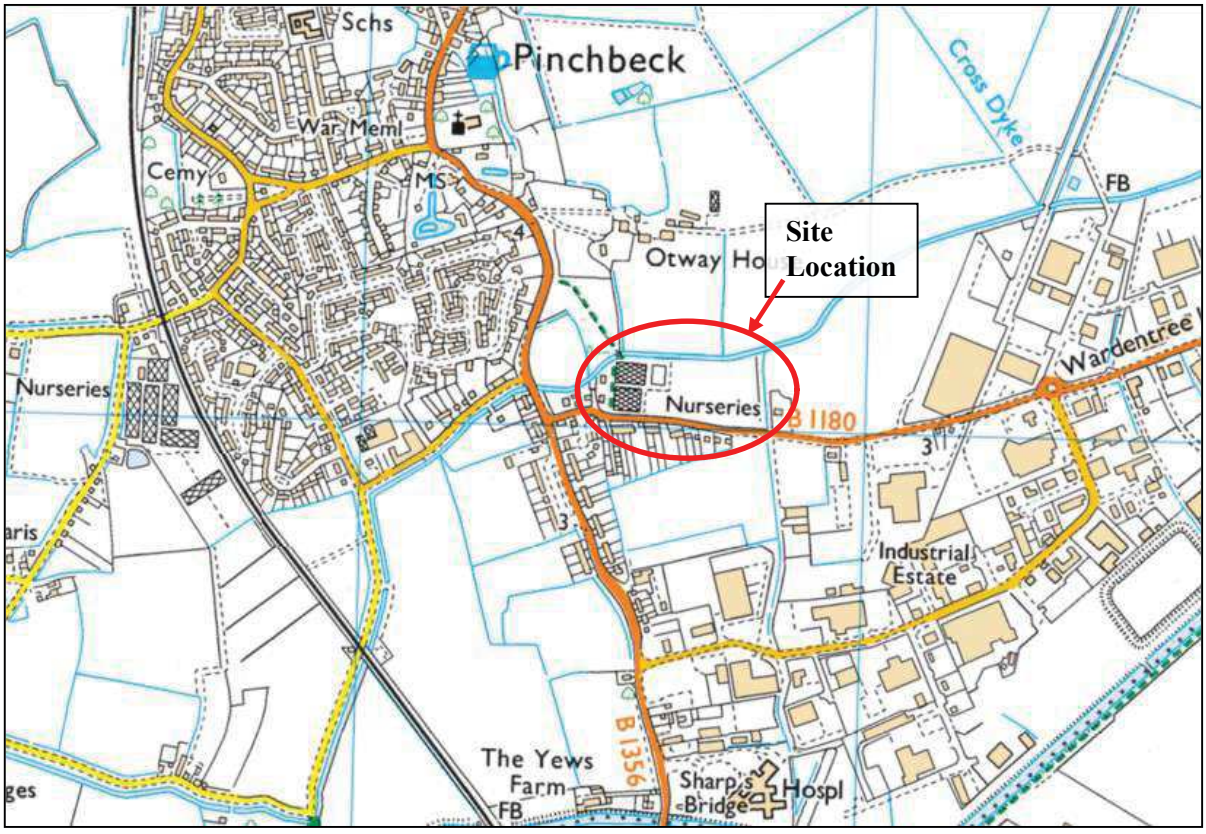
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# Site Location Plan

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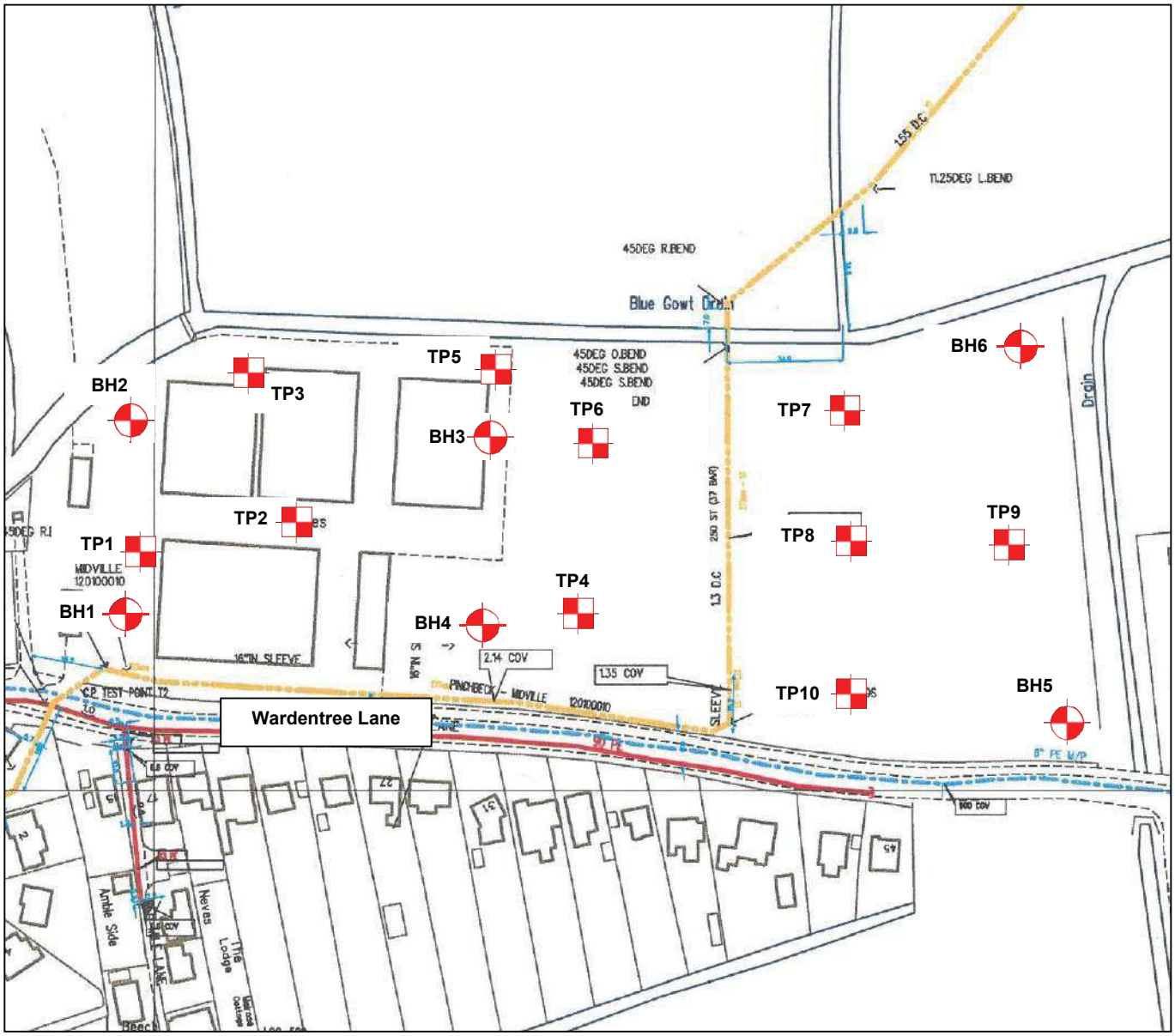



**Not To Scale**

| | | |
|---|---|---|
| **Project : Land off Wardentree Lane, Spalding, Lincolnshire**<br><br>**Client : Claire Tidswell and Mark Preston** | **GROUND ENGINEERING LIMITED**<br>Peterborough Tel : 01733 566566 | **Project No.**<br>**C14985** |

# Exploratory Hole Location Plan

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**Not To Scale**

| | | |
|---|---|---|
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**GROUND ENGINEERING LIMITED**

Tel: 01733-566566
www.groundengineering.co.uk

Site: LAND OFF WARDENTREE LANE, SPALDING

BOREHOLE BH1

Date: 02/03/20

Hole Size: 150mm dia to 15.00m

Ground Level:

| Samples and in-situ Tests | | | (Date) Casing | Description of Strata | Legend | Depth m | O.D. Level m |
|---|---|---|---|---|---|---|---|
| Depth m | Type | Blows | | | | | |
| 0.10 | D1 | | | MADE GROUND - Grey and brown, clayey SAND AND GRAVEL. Gravel is angular to rounded flint, igneous rock and brick fragments. | | 0.20 | |
| 0.20 | D2 | | | | | | |
| 0.30-0.80 | B1 | | | MADE GROUND - Brown and grey, gravelly, sandy SILT with pockets of soft, silty clay. Gravel is angular to rounded flint, coal and igneous rock. | | | |
| 1.00 | D3 | | | | | 1.00 | |
| 1.20-1.40 | B2 | | | Soft, grey, brown and orange brown, slightly sandy, silty CLAY with rare, fine to medium flint gravel. | | | |
| 1.35-1.65 | C | N6 | 1.20 | | | | |
| 1.40-1.70 | B3 | | | (TIDAL FLAT DEPOSIT) | | | |
| 1.70-2.20 | B4 | | | | | 1.70 | |
| 1.85-2.15 | S | N4 | 1.60 | Loose, grey, brown and orange brown, sandy SILT. (TIDAL FLAT DEPOSIT) | | | |
| 2.15 | D4 | | | | | 2.20 | |
| 2.20 | D5 | | | Soft, brown, orange brown and dark grey, slightly sandy, silty, slightly organic CLAY. | | | |
| 2.30-2.80 | B5 | | 2.30 | | | | |
| 2.45-2.75 | S | N4 | | | | | |
| 2.75 | D6 | | | ...Becoming very soft below 2.90m depth with silt/sand partings. | | | |
| 2.90 | D7 | | | | | | |
| 3.00-3.50 | B6 | | | | | | |
| 3.15-3.45 | S | N2 | 3.00 | | | | |
| 3.45 | D8 | | | | | | |
| 4.00-4.50 | B7 | | | | | | |
| 4.15-4.45 | S | N2 | 4.00 | | | | |
| 4.45 | D9 | | | | | | |
| 5.00-5.50 | B8 | | | | | | |
| 5.15-5.45 | S | N2 | 5.00 | | | | |
| 5.45 | D10 | | | | | | |
| 6.00 | D11 | | | | | | |
| 6.50-7.00 | B9 | | | | | | |
| 6.65-6.95 | S | N2 | 6.50 | | | | |
| 6.95 | D12 | | | (TIDAL FLAT DEPOSIT) | | | |
| 7.50 | D13 | | | | | | |
| 8.00-8.50 | B10 | | | | | | |
| 8.15-8.45 | S | N2 | 8.00 | | | | |
| 8.45 | D14 | | | | | | |
| 9.00 | D15 | | | | | | |
| 9.60-10.00 | B11 | | | | | 9.60 | |
| 9.65-9.95 | S | N22 | 9.50 | Stiff, brown and grey, slightly gravelly, silty CLAY with occasional partings of sand. Gravel is angular to rounded flint and chalk. (TILL) | | | |
| 9.95 | D16 | | | | | 10.00 | |

REMARKS
1. Excavating a pit from 0.00m to 1.20m for 1 hour
2. Live roots observed to 0.20m depth
3. Borehole cased to 10.00m depth

Project No 14985

Scale 1:50

Page 1/2

KEY
D - Disturbed Sample
B - Bulk Sample
U - Undisturbed Sample
W - Water Sample
S/C - SPT Spoon/Cone
▽ Water Strike
▼ Water Rise
N/* - SPT Blows for 0.3m or given penetration
ES - Environmental Sample
V - Vane Shear Test Cohesion ( ) kPa
▼c Level on completion
c▼w Level casing withdrawn
▼s Standpipe Level

| Groundwater Strikes | | | | | | Groundwater Observations | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Depth m | | | | | Depth m | | |
| No | Struck | Rose to | Rate | Cased | Sealed | Date | Hole | Casing | Water |
| | | | | | | 02/03/20 | 15.00 | 10.00 | dry |
| | | | | | | 02/03/20 | 15.00 | 0.00 | dry |

**GROUND ENGINEERING LIMITED**

Tel: 01733-566566
www.groundengineering.co.uk

Site: LAND OFF WARDENTREE LANE, SPALDING

BOREHOLE
BH1

Date: 02/03/20

Hole Size: 150mm dia to 15.00m

Ground Level:

| Samples and in-situ Tests | | | (Date) Casing | Description of Strata | Legend | Depth m | O.D. Level m |
|---|---|---|---|---|---|---|---|
| Depth m | Type | Blows | | | | | |
| | | | | Very stiff, dark brown, light grey and orange brown mottled, slightly sandy, slightly gravelly, silty CLAY with occasional partings of sand. Gravel is sub-angular to rounded chalk and flint. | | 10.00 | |
| 10.50 | D17 | | | | | | |
| 11.00-11.40 | U1 | 65 | 10.00 | | | | |
| 11.50 | D18 | | | | | | |
| 12.00 | D19 | | | | | | |
| 12.50-12.90 | U2 | 75 | 10.00 | | | | |
| 13.00 | D20 | | | (TILL) | | | |
| 13.50-13.90 | U3 | 80 | 10.00 | | | | |
| 14.00 | D21 | | | | | | |
| 14.50-14.90 | U4 | 90 | 10.00 | | | | |
| 15.00 | D22 | | | | | 15.00 | |
| | | | | Borehole completed at 15.00m depth | | | |

REMARKS

Project No
14985

Scale
1:50

Page
2/2

KEY

D - Disturbed Sample
B - Bulk Sample
U - Undisturbed Sample
W - Water Sample
S/C - SPT Spoon/Cone
▽ Water Strike
▼ Water Rise
N/* - SPT Blows for 0.3m or given penetration
ES - Environmental Sample
V - Vane Shear Test Cohesion ( ) kPa
▼c Level on completion
c▼w Level casing withdrawn
▼s Standpipe Level

| Groundwater Strikes | | | | | | Groundwater Observations | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Depth m | | | | | | Depth m | | |
| No | Struck | Rose to | Rate | Cased | Sealed | Date | Hole | Casing | Water |
| | | | | | | | | | |

**GROUND ENGINEERING LIMITED**

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Site: LAND OFF WARDENTREE LANE, SPALDING

BOREHOLE BH2

Date: 27/02/20 to 28/02/20

Hole Size: 150mm dia to 15.00m

Ground Level:

| Samples and in-situ Tests | | | (Date) Casing | Description of Strata | Legend | Depth m | O.D. Level m |
|---|---|---|---|---|---|---|---|
| Depth m | Type | Blows | | | | | |
| 0.10 | D1 | | | MADE GROUND – Brown, gravelly, silty SAND with pockets of soft clay. Gravel is angular to rounded oolitic limestone and coal. | | 0.20 | |
| 0.20 | D2 | | | | | | |
| 0.30–0.80 | B1 | | | Soft, brown and grey, slightly gravelly, sandy, silty CLAY with occasional partings of sand. Gravel is angular to rounded flint and limestone. | | | |
| 1.00 | D3 | | | | | | |
| 1.20–1.70 | B2 | | | | | | |
| 1.35–1.65 | S | N4 | 1.20 | (TIDAL FLAT DEPOSIT) | | | |
| 1.65 | D4 | | | | | 1.70 | |
| | | | | Very soft, brown and grey, sandy, silty, organic CLAY with occasional partings of sand and black carbonaceous specks. | | | |
| 2.20–2.70 | B3 | | | | | | |
| 2.35–2.65 | S | N2 | 1.60 | | | | |
| 2.65 | D5 | | | | | | |
| 2.70 | D6 | | 2.80 | | | | |
| 2.80–3.20 | U1 | 8 | | | | | |
| 3.30 | D7 | | | | | | |
| 3.80–4.40 | U2 | 8 | 3.10 | | | | |
| 4.30 | D8 | | | | | | |
| 4.80–5.20 | U3 | 8 | 4.50 | (TIDAL FLAT DEPOSIT) | | | |
| 5.30 | D9 | | | | | | |
| 5.80 | D10 | | | | | | |
| 6.30–6.70 | U4 | 8 | 6.10 | | | | |
| 6.80 | D11 | | | | | | |
| 7.30 | D12 | | | | | | |
| | | | | ...Becoming firm below 7.80m depth. | | | |
| 7.80–8.10 | U5 | 8 | 7.50 | | | | |
| 8.20 | D13 | | | | | | |
| 8.80 | D14 | | | | | | |
| 9.30–9.70 | U6 | 10 | 9.10 | | | | |
| 9.80 | D15 | | | | | | |
| 10.00 | D16 | | | | | 10.00 | |

REMARKS
1. Excavating a pit from 0.00m to 1.20m for 1 hour
2. Live roots observed to 1.70m depth
3. Borehole cased to 10.20m depth

Project No 14985

Scale 1:50

Page 1/2

KEY
D - Disturbed Sample
B - Bulk Sample
U - Undisturbed Sample
W - Water Sample
S/C - SPT Spoon/Cone
▽ Water Strike
▼ Water Rise
N/* - SPT Blows for 0.3m or given penetration
ES - Environmental Sample
V - Vane Shear Test Cohesion ( ) kPa
▼c Level on completion
c▼w Level casing withdrawn
▼s Standpipe Level

Groundwater Strikes

| No | Struck Depth m | Rose to Depth m | Rate | Cased | Sealed |
|---|---|---|---|---|---|
| | | | | | |

Groundwater Observations

| Date | Hole Depth m | Casing Depth m | Water |
|---|---|---|---|
| 27/02/20 | 10.70 | 10.20 | dry |
| 28/02/20 | 10.70 | 10.20 | dry |
| 28/02/20 | 15.00 | 10.20 | dry |

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Site: LAND OFF WARDENTREE LANE, SPALDING

BOREHOLE
BH2

Date: 27/02/20 to 28/02/20

Hole Size: 150mm dia to 15.00m

Ground Level:

| Samples and in-situ Tests | | | (Date) Casing | Description of Strata | Legend | Depth m | O.D. Level m |
|---|---|---|---|---|---|---|---|
| Depth m | Type | Blows | | | | | |
| 10.20-10.60 | U7 | 60 | 10.20 | Stiff, brown and grey, slightly sandy, slightly gravelly, silty CLAY. Gravel is angular to rounded chalk and flint. | | 10.00 | |
| 10.70 | D17 | | | | | | |
| 11.20 | D18 | | | | | | |
| 11.70-12.10 | U8 | 70 | 10.20 | | | | |
| 12.20 | D19 | | | | | | |
| 12.70 | D20 | | | | | | |
| | | | | ...Becoming very stiff below 13.00m depth. | | | |
| 13.20-13.60 | U9 | 80 | 10.20 | | | | |
| 13.70 | D21 | | | | | | |
| | | | | (TILL) | | | |
| 14.20 | D22 | | | | | | |
| 14.50-4.90 | U10 | 90 | 10.20 | | | | |
| 15.00 | D23 | | | | | 15.00 | |
| | | | | Borehole completed at 15.00m depth | | | |

REMARKS

Project No 14985

Scale 1:50

Page 2/2

KEY
D - Disturbed Sample
B - Bulk Sample
U - Undisturbed Sample
W - Water Sample
S/C - SPT Spoon/Cone
▽ Water Strike
▼ Water Rise
N/* - SPT Blows for 0.3m or given penetration
ES - Environmental Sample
V - Vane Shear Test Cohesion ( ) kPa
▼c Level on completion
c▼w Level casing withdrawn
▼s Standpipe Level

| Groundwater Strikes | | | | | | Groundwater Observations | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Depth m | | | | | | Depth m | | |
| No | Struck | Rose to | Rate | Cased | Sealed | Date | Hole | Casing | Water |
| | | | | | | | | | |

**GROUND ENGINEERING LIMITED**

Tel: 01733-566566
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Site: LAND OFF WARDENTREE LANE, SPALDING

BOREHOLE BH3

Date: 03/03/20

Hole Size: 150mm dia to 15.00m

Ground Level:

| Samples and in-situ Tests | | | (Date) Casing | Description of Strata | Legend | Depth m | O.D. Level m |
|---|---|---|---|---|---|---|---|
| Depth m | Type | Blows | | | | | |
| 0.10 | D1 | | | MADE GROUND - Soft, brown, slightly sandy, slightly gravelly, silty CLAY. Gravel is angular to rounded oolitic limestone, flint, brick, glass and concrete. | | | |
| 0.20-0.70 | B1 | | | | | | |
| 1.00 | D2 | | | | | | |
| 1.20-1.50 | B2 | | | | | | |
| 1.35-1.65 | C | N5 | 1.20 | | | | |
| 1.50-1.70 | B3 | | | | | 1.50 | |
| 1.70-2.20 | B4 | | | Soft, brown, grey and orange brown, slightly sandy, slightly gravelly, silty CLAY with occasional pockets of sand. Gravel is angular to rounded limestone and flint. | | | |
| 1.85-2.15 | S | N3 | 1.70 | | | | |
| 2.15 | D3 | | | (TIDAL FLAT DEPOSIT) | | | |
| 2.50 | D4 | | | | | 2.50 | |
| 2.60-3.10 | B5 | | | Soft, becoming very soft, brown and grey, silty CLAY. | | | |
| 2.75-3.05 | S | N3 | 2.60 | | | | |
| 3.05 | D5 | | | | | | |
| 3.60-4.10 | B6 | | | | | | |
| 3.75-4.05 | S | N2 | 3.60 | | | | |
| 4.05 | D6 | | | (TIDAL FLAT DEPOSIT) | | | |
| 4.60-5.10 | B7 | | | | | | |
| 4.75-5.05 | S | N2 | 4.60 | | | | |
| 5.05 | D7 | | | | | | |
| 5.60 | D8 | | | | | 5.60 | |
| 6.10-6.60 | B8 | | | Very soft, grey and black, silty, organic CLAY. | | | |
| 6.25-6.55 | S | N2 | 6.10 | | | | |
| 6.55 | D9 | | | | | | |
| 7.10 | D10 | | | | | | |
| 7.60-8.10 | B9 | | | | | | |
| 7.75-8.05 | S | N2 | 7.60 | | | | |
| 8.05 | D11 | | | (TIDAL FLAT DEPOSIT) | | | |
| 8.60 | D12 | | | | | | |
| 9.10-9.60 | B10 | | | | | | |
| 9.25-9.55 | S | N2 | 9.10 | | | | |
| 9.55 | D13 | | | | | | |
| | | | | | | 10.00 | |

REMARKS
1. Excavating a pit from 0.00m to 1.20m for 1 hour
2. Live roots observed to 1.00m depth
3. Borehole cased to 10.20m depth

Project No 14985

Scale 1:50

Page 1/2

KEY
D - Disturbed Sample
B - Bulk Sample
U - Undisturbed Sample
W - Water Sample
S/C - SPT Spoon/Cone
▽ Water Strike
▼ Water Rise
N/* - SPT Blows for 0.3m or given penetration
ES - Environmental Sample
V - Vane Shear Test Cohesion ( ) kPa
▼c Level on completion
c▼w Level casing withdrawn
▼s Standpipe Level

| Groundwater Strikes | | | | | | Groundwater Observations | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Depth m | | | | | Depth m | | |
| No | Struck | Rose to | Rate | Cased | Sealed | Date | Hole | Casing | Water |
| | | | | | | 03/03/20 | 15.00 | 10.20 | dry |
| | | | | | | 03/03/20 | 15.00 | 0.00 | dry |

| GROUND ENGINEERING LIMITED<br>Tel: 01733-566566<br>www.groundengineering.co.uk | Site: LAND OFF WARDENTREE LANE, SPALDING | BOREHOLE BH3 |
|---|---|---|
| | Date: 03/03/20 — Hole Size: 150mm dia to 15.00m | Ground Level: |

| Samples and in-situ Tests | | | (Date) Casing | Description of Strata | Legend | Depth m | O.D. Level m |
|---|---|---|---|---|---|---|---|
| Depth m | Type | Blows | | | | | |
| 10.10 | D14 | | | | | | |
| 10.20-10.50 | U1 | 70 | 10.20 | Firm, grey and brown, slightly gravelly, silty CLAY. Gravel is sub-rounded chalk and flint. | | 10.00 | |
| 10.60 | D15 | | | | | | |
| 11.20 | D16 | | | (TILL) | | | |
| 11.70-12.10 | U2 | 80 | 10.20 | | | | |
| 12.20 | D17 | | | | | | |
| 12.70 | D18 | | | | | 12.70 | |
| | | | | Very stiff, fissured to stiff, dark brown, grey and orange brown, slightly gravelly, silty CLAY. Gravel is angular to rounded flint and chalk. | | | |
| 13.20-13.50 | U3 | 85 | 10.20 | | | | |
| 13.60 | D19 | | | (TILL) | | | |
| 14.20 | D20 | | | | | | |
| 14.50-14.90 | U4 | 90 | 10.20 | | | | |
| 15.00 | D21 | | | | | 15.00 | |
| | | | | Borehole completed at 15.00m depth | | | |

REMARKS

Project No 14985

Scale 1:50 | Page 2/2

KEY
D - Disturbed Sample
B - Bulk Sample
U - Undisturbed Sample
W - Water Sample
S/C - SPT Spoon/Cone
▽ Water Strike
▼ Water Rise
N/* - SPT Blows for 0.3m or given penetration
ES - Environmental Sample
V - Vane Shear Test Cohesion ( ) kPa
▼c Level on completion
c▼w Level casing withdrawn
▼s Standpipe Level

| Groundwater Strikes | | | | | | Groundwater Observations | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Depth m | | | | | | Depth m | | |
| No | Struck | Rose to | Rate | Cased | Sealed | Date | Hole | Casing | Water |
| | | | | | | | | | |

**GROUND ENGINEERING LIMITED**

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Site: LAND OFF WARDENTREE LANE, SPALDING

BOREHOLE BH4

Date: 04/03/20

Hole Size: 150mm dia to 15.00m

Ground Level:

| Samples and in-situ Tests | | | (Date) Casing | Description of Strata | Legend | Depth m | O.D. Level m |
|---|---|---|---|---|---|---|---|
| Depth m | Type | Blows | | | | | |
| 0.10 | D1 | | | Soft, brown and orange brown, sandy, silty CLAY. Sand is fine grained. | | | |
| 0.20-0.70 | B1 | | | | | | |
| 1.00 | D2 | | | ...Becoming very soft below 1.00m depth. | | | |
| 1.20-1.70 | B2 | | | | | | |
| 1.35-1.65 | S | N3 | 1.20 | (TIDAL FLAT DEPOSIT) | | | |
| 1.65 | D3 | | | | | | |
| 2.10 | D4 | | | | | 2.10 | |
| 2.20-2.70 | B3 | | | Very soft, brown and grey, silty, slightly organic CLAY with dark grey staining and slightly organic odour. | | | |
| 2.35-2.65 | S | N3 | 1.60 | | | | |
| 2.65 | D5 | | | | | | |
| 3.20-3.70 | B4 | | | | | | |
| 3.35-3.65 | S | N2 | 3.10 | | | | |
| 3.65 | D6 | | | | | | |
| 4.20-4.70 | B5 | | | | | | |
| 4.35-4.65 | S | N2 | 4.20 | | | | |
| 4.65 | D7 | | | | | | |
| 5.20-5.70 | B6 | | | | | | |
| 5.35-5.65 | S | N2 | 5.20 | | | | |
| 5.65 | D8 | | | | | | |
| 6.20 | D9 | | | | | | |
| 6.70-7.20 | B7 | | | | | | |
| 6.85-7.15 | S | N2 | 6.70 | (TIDAL FLAT DEPOSIT) | | | |
| 7.15 | D10 | | | | | | |
| 7.70 | D11 | | | | | | |
| 8.20-8.70 | B8 | | | | | | |
| 8.35-8.65 | S | N3 | 8.20 | | | | |
| 8.65 | D12 | | | | | | |
| 9.20 | D13 | | | | | | |
| 9.70-10.20 | B9 | | | | | 10.00 | |

REMARKS
1. Excavating a pit from 0.00m to 1.20m for 1 hour
2. Live roots observed to 0.10m depth
3. Borehole cased to 10.50m depth

Project No 14985

Scale 1:50

Page 1/2

KEY
D - Disturbed Sample
B - Bulk Sample
U - Undisturbed Sample
W - Water Sample
S/C - SPT Spoon/Cone
▽ Water Strike
▼ Water Rise
N/* - SPT Blows for 0.3m or given penetration
ES - Environmental Sample
V - Vane Shear Test Cohesion ( ) kPa
▼c Level on completion
c▼w Level casing withdrawn
▼s Standpipe Level

| Groundwater Strikes | | | | | | Groundwater Observations | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Depth m | | | | | | Depth m | | |
| No | Struck | Rose to | Rate | Cased | Sealed | Date | Hole | Casing | Water |
| | | | | | | 04/03/20 | 15.00 | 10.50 | dry |
| | | | | | | 04/03/20 | 15.00 | 0.00 | dry |

**GROUND ENGINEERING LIMITED**

Tel: 01733-566566
www.groundengineering.co.uk

Site: LAND OFF WARDENTREE LANE, SPALDING

BOREHOLE BH4

Date: 04/03/20

Hole Size: 150mm dia to 15.00m

Ground Level:

| Samples and in-situ Tests | | | (Date) Casing | Description of Strata | Legend | Depth m | O.D. Level m |
|---|---|---|---|---|---|---|---|
| Depth m | Type | Blows | | | | | |
| 10.15 | D14 | | | Very soft, brown and grey, silty CLAY with dark grey staining and slightly organic odour. (TIDAL FLAT DEPOSIT) | | 10.00 | |
| 10.40 | D15 | | 10.50 | | | 10.40 | |
| 10.50-10.90 | U1 | 70 | | Firm, dark brown and light grey, slightly sandy, slightly gravelly, silty CLAY. Gravel is sub-angular to rounded quartz, quartzite, flint, chalk and occasional shell fragments. | | | |
| 11.00 | D16 | | | | | | |
| 11.50 | D17 | | | | | | |
| 12.00-12.40 | U2 | 80 | 10.50 | ...Becoming stiff below 11.00m depth and very stiff below 12.00m depth. | | | |
| 12.50 | D18 | | | | | | |
| 13.00 | D19 | | | | | | |
| 13.50-13.90 | U3 | 85 | 10.50 | | | | |
| 14.00 | D20 | | | (TILL) | | | |
| 14.50-14.90 | U4 | 90 | 10.50 | | | | |
| 15.00 | D21 | | | | | 15.00 | |
| | | | | Borehole completed at 15.00m depth | | | |

REMARKS

Project No 14985

Scale 1:50

Page 2/2

KEY

D - Disturbed Sample
B - Bulk Sample
U - Undisturbed Sample
W - Water Sample
S/C - SPT Spoon/Cone
▽ Water Strike
▼ Water Rise

N/* - SPT Blows for 0.3m or given penetration
ES - Environmental Sample
V - Vane Shear Test Cohesion ( ) kPa
▼c Level on completion
c▼w Level casing withdrawn
▼s Standpipe Level

| Groundwater Strikes | | | | | | Groundwater Observations | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Depth m | | | | | | Depth m | | |
| No | Struck | Rose to | Rate | Cased | Sealed | Date | Hole | Casing | Water |
| | | | | | | | | | |

**GROUND ENGINEERING LIMITED**

Tel: 01733-566566
www.groundengineering.co.uk

Site: LAND OFF WARDENTREE LANE, SPALDING

BOREHOLE BH5

Date: 06/03/20

Hole Size: 150mm dia to 15.00m

Ground Level:

| Samples and in-situ Tests | | | (Date) Casing | Description of Strata | Legend | Depth m | O.D. Level m |
|---|---|---|---|---|---|---|---|
| Depth m | Type | Blows | | | | | |
| 0.10 | D1 | | | TOPSOIL - Soft, dark brown and brown, sandy, silty CLAY. | | 0.30 | |
| 0.30 | D2 | | | | | | |
| 0.40-0.90 | B1 | | | Loose, light brown and orange brown, clayey, very silty SAND. | | | |
| 1.10 | D3 | | | | | | |
| 1.20-1.70 | B2 | | | | | | |
| 1.35-1.65 | S | N4 | 1.20 | | | | |
| 1.65 | D4 | | | | | | |
| | | | | ...Becoming very loose below 2.20m depth. | | | |
| 2.20-2.70 | B3 | | | | | | |
| 2.35-2.65 | S | N3 | 1.60 | (TIDAL FLAT DEPOSIT) | | | |
| 2.65 | D5 | | | | | 2.80 | |
| 2.80 | D6 | | | | | | |
| 3.00-3.50 | B4 | | | Very soft, dark grey, very silty CLAY. | | | |
| 3.15-3.45 | S | N3 | 3.00 | | | | |
| 3.45 | D7 | | | | | | |
| 4.00-4.50 | B5 | | | | | | |
| 4.15-4.45 | S | N3 | 4.00 | | | | |
| 4.45 | D8 | | | | | | |
| 5.00-5.50 | B6 | | | | | | |
| 5.15-5.45 | S | N2 | 5.00 | | | | |
| 5.45 | D9 | | | | | | |
| 6.00 | D10 | | | | | | |
| 6.50-7.00 | B7 | | | ...With peaty organic matter and rare shell fragments below 6.50m depth. | | | |
| 6.65-6.95 | S | N2 | 6.50 | | | | |
| 6.95 | D11 | | | | | | |
| 7.50 | D12 | | | | | | |
| 8.00-8.50 | B8 | | | (TIDAL FLAT DEPOSIT) | | | |
| 8.15-8.45 | S | N2 | 8.00 | | | | |
| 8.45 | D13 | | | | | | |
| 9.00 | D14 | | | | | | |
| 9.50-10.00 | B9 | | | | | | |
| 9.65-9.95 | S | N3 | 9.50 | | | | |
| 9.95 | D15 | | | | | 10.00 | |

REMARKS
1. Excavating a pit from 0.00m to 1.20m for 1 hour
2. Live roots observed to 0.30m depth
3. Borehole cased to 11.80m depth

Project No 14985

Scale 1:50

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KEY
D - Disturbed Sample
B - Bulk Sample
U - Undisturbed Sample
W - Water Sample
S/C - SPT Spoon/Cone
▽ Water Strike
▼ Water Rise
N/* - SPT Blows for 0.3m or given penetration
ES - Environmental Sample
V - Vane Shear Test Cohesion ( ) kPa
▽c Level on completion
c▽w Level casing withdrawn
▼s Standpipe Level

| Groundwater Strikes | | | | | | Groundwater Observations | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Depth m | | | | | | Depth m | | |
| No | Struck | Rose to | Rate | Cased | Sealed | Date | Hole | Casing | Water |
| | | | | | | 06/03/20 | 15.00 | 11.80 | dry |
| | | | | | | 06/03/20 | 15.00 | 0.00 | dry |

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Site: LAND OFF WARDENTREE LANE, SPALDING

BOREHOLE
BH5

Date: 06/03/20

Hole Size: 150mm dia to 15.00m

Ground Level:

| Samples and in-situ Tests | | | (Date) Casing | Description of Strata | Legend | Depth m | O.D. Level m |
|---|---|---|---|---|---|---|---|
| Depth m | Type | Blows | | | | | |
| | | | | Very soft, dark grey, clayey SILT with occasional peaty organic matter and rare shell fragments. | | 10.00 | |
| 10.50 | D16 | | | | | | |
| | | | | (TIDAL FLAT DEPOSIT) | | | |
| 11.00-11.50 | B10 | | | | | | |
| 11.15-11.45 | S | N3 | 11.00 | | | 11.40 | |
| 11.45 | D17 | | | | | | |
| 11.60 | D18 | | | Stiff, becoming very stiff, dark brown, grey and orange brown, slightly sandy, slightly gravelly, silty CLAY. Gravel is sub-angular to rounded chalk and flint. | | | |
| 11.80-12.20 | U1 | 75 | 11.80 | | | | |
| 12.30 | D19 | | | | | | |
| 12.80 | D20 | | | | | | |
| | | | | (TILL) | | | |
| 13.30-13.70 | U2 | 85 | 11.80 | | | | |
| 13.80 | D21 | | | | | | |
| 14.30 | D22 | | | | | | |
| 14.50-14.90 | U3 | 90 | 11.80 | | | | |
| 15.00 | D23 | | | | | 15.00 | |
| | | | | Borehole completed at 15.00m depth | | | |

REMARKS

Project No 14985

Scale 1:50

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KEY

D - Disturbed Sample
B - Bulk Sample
U - Undisturbed Sample
W - Water Sample
S/C - SPT Spoon/Cone
▽ Water Strike
▼ Water Rise

N/* - SPT Blows for 0.3m or given penetration
ES - Environmental Sample
V - Vane Shear Test Cohesion ( ) kPa
▽c Level on completion
c▽w Level casing withdrawn
▼s Standpipe Level

| Groundwater Strikes | | | | | | Groundwater Observations | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Depth m | | | | | | Depth m | | |
| No | Struck | Rose to | Rate | Cased | Sealed | Date | Hole | Casing | Water |
| | | | | | | | | | |

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Site: LAND OFF WARDENTREE LANE, SPALDING

BOREHOLE
BH6

Date: 06/03/20

Hole Size: 150mm dia to 15.00m

Ground Level:

| Samples and in-situ Tests | | | (Date) Casing | Description of Strata | Legend | Depth m | O.D. Level m |
|---|---|---|---|---|---|---|---|
| Depth m | Type | Blows | | | | | |
| 0.10 | D1 | | | Firm, dark brown, sandy, silty CLAY. | | | |
| 0.20-0.70 | B1 | | | (TIDAL FLAT DEPOSIT) | | 0.70 | |
| 1.00 | D2 | | 1 ▼ | Soft, light brown and grey, sandy, silty CLAY with pockets of orange brown sand. | | | |
| 1.20-1.60 | U1 | 30 | 1.20 | (TIDAL FLAT DEPOSIT) | | | |
| 1.70 | D3 | | 1 ▽ | | | | |
| 1.70 | W1 | | | | | | |
| 2.00 | D4 | | | | | 2.00 | |
| 2.10-2.60 | B2 | | | Very soft, grey, very silty CLAY with peaty organic matter. | | | |
| 2.25-2.55 | S | N2 | 2.10 | | | | |
| 2.55 | D5 | | | | | | |
| 3.10-3.60 | B3 | | | | | | |
| 3.25-3.55 | S | N3 | 3.10 | | | | |
| 3.55 | D6 | | | | | | |
| 4.10-4.60 | B4 | | | | | | |
| 4.25-4.55 | S | N2 | 4.10 | | | | |
| 4.55 | D7 | | c▼w | | | | |
| 5.10-5.60 | B5 | | | | | | |
| 5.25-5.55 | S | N1 | 5.10 | | | | |
| 5.55 | D8 | | | | | | |
| 6.10 | D9 | | | | | | |
| 6.60-7.10 | B6 | | | ...With rare shell fragments below 6.60m depth. | | | |
| 6.75-7.05 | S | N2 | 6.60 | | | | |
| 7.05 | D10 | | | | | | |
| 7.60 | D11 | | | | | | |
| 8.10-8.60 | B7 | | | | | | |
| 8.25-8.55 | S | N3 | 8.10 | | | | |
| 8.55 | D12 | | | | | | |
| 9.10 | D13 | | | (TIDAL FLAT DEPOSIT) | | | |
| 9.60-10.10 | B8 | | | | | | |
| 9.75-10.05 | S | N2 | 9.60 | | | 10.00 | |

REMARKS
1. Excavating a pit from 0.00m to 1.00m for 1 hour
2. Live roots observed to 1.20m depth
3. Borehole cased to 11.80m depth

Project No 14985

Scale 1:50

Page 1/2

KEY
D - Disturbed Sample
B - Bulk Sample
U - Undisturbed Sample
W - Water Sample
S/C - SPT Spoon/Cone
▽ Water Strike
▼ Water Rise
N/* - SPT Blows for 0.3m or given penetration
ES - Environmental Sample
V - Vane Shear Test Cohesion ( ) kPa
▼c Level on completion
c▼w Level casing withdrawn
▼s Standpipe Level

Groundwater Strikes

| No | Depth m Struck | Rose to | Rate | Cased | Sealed |
|---|---|---|---|---|---|
| 1 | 1.70 | 1.00 | medium | 1.20 | 1.90 |

Groundwater Observations

| Date | Depth m Hole | Casing | Water |
|---|---|---|---|
| 05/03/20 | 15.00 | 11.80 | dry |
| 05/03/20 | 15.00 | 0.00 | 4.60 |

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Site: LAND OFF WARDENTREE LANE, SPALDING

BOREHOLE BH6

Date: 06/03/20

Hole Size: 150mm dia to 15.00m

Ground Level:

| Samples and in-situ Tests | | | (Date) Casing | Description of Strata | Legend | Depth m | O.D. Level m |
|---|---|---|---|---|---|---|---|
| Depth m | Type | Blows | | | | | |
| 10.05 | D14 | | | Very loose, dark grey, clayey SILT with peaty organic matter and occasional bivalve shells. | | 10.00 | |
| | | | | (TIDAL FLAT DEPOSIT) | | | |
| 11.60 | D15 | | | | | 11.60 | |
| 11.80-12.25 | U2 | 65 | 11.80 | Intially firm, becoming very stiff below 11.80m, brown and grey, slightly sandy, slightly gravelly, silty CLAY. Gravel is sub-angular to rounded chalk, flint, quartzite, calcareous sandstone and limestone. | | | |
| 12.30 | D16 | | | | | | |
| 12.80 | D17 | | | (TILL) | | | |
| 13.30-13.70 | U3 | 80 | 11.80 | | | | |
| 13.80 | D18 | | | | | | |
| 14.30 | D19 | | | | | | |
| 14.50-14.90 | U4 | 90 | 11.80 | | | | |
| 15.00 | D20 | | | | | 15.00 | |
| | | | | Borehole completed at 15.00m depth | | | |

REMARKS

Project No 14985

Scale 1:50

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KEY

D - Disturbed Sample
B - Bulk Sample
U - Undisturbed Sample
W - Water Sample
S/C - SPT Spoon/Cone
▽ Water Strike
▼ Water Rise

N/*- SPT Blows for 0.3m or given penetration
ES - Environmental Sample
V - Vane Shear Test Cohesion ( ) kPa
▼c Level on completion
c▼w Level casing withdrawn
▼s Standpipe Level

| Groundwater Strikes | | | | | | Groundwater Observations | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Depth m | | | | | | Depth m | | |
| No | Struck | Rose to | Rate | Cased | Sealed | Date | Hole | Casing | Water |
| | | | | | | | | | |

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Site: LAND OFF WARDENTREE LANE, SPALDING

TRIAL PIT
TP1

Date: 25/02/20

Pit Size: 2.00m L x 0.70m W x 3.00m D.

Ground Level:

| Samples and in-situ Tests | | | (Date) Water | Description of Strata | Legend | Depth m | O.D. Level m |
|---|---|---|---|---|---|---|---|
| Depth m | Type | Result | | | | | |
| 0.20 | D1 | | | MADE GROUND - Firm, dark brown, gravelly, silty CLAY. Gravel is angular to rounded quartzite, ash and brick fragments. | | | |
| 0.20 | ES1 | | | | | | |
| 0.20 | V1 | (54) | | | | | |
| 0.50-0.70 | B1 | | | | | 0.50 | |
| 0.60 | D2 | | | Firm, friable, dark grey, slightly gravelly, silty CLAY. Gravel is fine and medium, angular to sub-rounded flint and quartzite. (TIDAL FLAT DEPOSIT) | | | |
| 0.60 | ES2 | | | | | 0.70 | |
| 0.60 | V2 | (70) | | | | | |
| 0.80-1.20 | B2 | | | Brown and grey, slightly clayey, very silty SAND. Sand is fine grained. | | | |
| 0.80 | D3 | | | | | | |
| 1.50 | D4 | | | (TIDAL FLAT DEPOSIT) | | | |
| 2.00 | D5 | | | | | | |
| 2.30-3.00 | B3 | | | | | | |
| 2.50 | D6 | | | | | 2.60 | |
| | | | | Soft, grey and brown CLAY. | | | |
| | | | | (TIDAL FLAT DEPOSIT) | | | |
| 3.00 | D7 | | ▽ 1 | | | 3.00 | |
| | | | | Pit completed at 3.00m depth | | | |

KEY
- D - Disturbed Sample
- B - Bulk Sample
- U - Undisturbed Sample
- R - Root Sample
- W - Water Sample
- ES - Environmental Sample
- ▽ Water Strike
- ▼ Water Rise
- ▼c Level on completion
- MP - Mackintosh Probe
- P( ) - Hand Penetrometer Cohesion ( ) kPa
- V - Vane Shear Test Cohesion ( ) kPa

REMARKS
1. No live roots observed
2. Pit sides unstable below 0.90m depth
3. Groundwater met at 3.00m depth on completion

Project No 14985

Scale 1:25

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**GROUND ENGINEERING LIMITED**

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Site: LAND OFF WARDENTREE LANE, SPALDING

TRIAL PIT
TP2

Date: 25/02/20

Pit Size: 2.00m L x 0.70m W x 3.20m D.

Ground Level:

| Samples and in-situ Tests | | | (Date) Water | Description of Strata | Legend | Depth m | O.D. Level m |
|---|---|---|---|---|---|---|---|
| Depth m | Type | Result | | | | | |
| | | | | MADE GROUND - Light brown, silty SAND AND GRAVEL. Gravel is angular to rounded limestone, quartzite and brick fragments. | | 0.10 | |
| 0.20 | D1 | | | MADE GROUND - Dense, dark grey and black, silty SAND AND GRAVEL. Gravel is angular to rounded quartzite, ash, asphalt and clinker. | | 0.30 | |
| 0.20 | ES1 | | | | | | |
| 0.50-0.80 | B1 | | | Brown, grey and orange brown mottled, silty SAND. Sand is fine grained. | | | |
| 0.50 | D2 | | | | | | |
| 1.00 | D3 | | | | | | |
| 1.50 | D4 | | | (TIDAL FLAT DEPOSIT) | | | |
| 2.00 | D5 | | | | | 2.20 | |
| 2.30-3.00 | B2 | | 1 ▽ | Soft to very soft, grey and brown, slightly organic CLAY. | | | |
| 2.30 | D6 | | | | | | |
| | | | | (TIDAL FLAT DEPOSIT) | | | |
| 2.90 | D7 | | | | | | |
| 3.20 | D8 | | ▼c | | | 3.20 | |
| | | | | Pit completed at 3.20m depth | | | |

KEY

- D - Disturbed Sample
- B - Bulk Sample
- U - Undisturbed Sample
- R - Root Sample
- W - Water Sample
- ES - Environmental Sample
- ▽ Water Strike
- ▼ Water Rise
- ▼c Level on completion
- MP - Mackintosh Probe
- P( ) - Hand Penetrometer Cohesion ( ) kPa
- V - Vane Shear Test Cohesion ( ) kPa

REMARKS

1. No live roots observed
2. Seepage at 2.30m depth
3. Pit sides collapsed below 0.70m depth
4. Groundwater stood at 3.20m depth on completion

| Project No | |
|---|---|
| 14985 | |
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Site: LAND OFF WARDENTREE LANE, SPALDING

TRIAL PIT
TP3

Date: 25/02/20

Pit Size: 2.30m L x 0.70m W x 3.20m D.

Ground Level:

| Samples and in-situ Tests | | | (Date) Water | Description of Strata | Legend | Depth m | O.D. Level m |
|---|---|---|---|---|---|---|---|
| Depth m | Type | Result | | | | | |
| | | | | MADE GROUND - Light brown, silty SAND AND GRAVEL. Gravel is angular to sub-rounded limestone, ash and brick fragments. | | 0.15 | |
| 0.20 | D1 | | | MADE GROUND - Light brown and grey, silty SAND AND GRAVEL with occasional cobbles of brick. Gravel is angular to rounded flint, quartzite, ash and brick fragments. | | 0.30 | |
| 0.20 | ES1 | | | Firm, dark grey and brown, silty CLAY. | | | |
| 0.40 | D2 | | | | | | |
| 0.40 | ES2 | | | | | | |
| 0.40 | V1 | (72) | | | | | |
| 0.50-0.70 | B1 | | | (TIDAL FLAT DEPOSIT) | | | |
| 0.54-0.79 | MP1 | 100 | | | | | |
| 0.70-1.00 | B2 | | | | | | |
| 0.79-1.09 | MP2 | 100 | | | | 0.80 | |
| 0.80 | D3 | | | Medium dense, brown and grey, slightly gravelly, very silty SAND. Gravel is fine sub-angular flint. | | | |
| | | | | (TIDAL FLAT DEPOSIT) | | | |
| 1.50 | D4 | | | | | 1.50 | |
| | | | | Soft, grey, brown and orange brown, slightly sandy to sandy, silty CLAY. | | | |
| 2.00 | D5 | | | (TIDAL FLAT DEPOSIT) | | | |
| | | | | | | 2.30 | |
| | | | ▽ | Very soft, grey and brown, silty, slightly organic CLAY. | | | |
| 2.50 | D6 | | | | | | |
| | | | | (TIDAL FLAT DEPOSIT) | | | |
| | | | ▼c | | | | |
| | | | | | | 3.20 | |
| 3.20 | D7 | | | Pit completed at 3.20m depth | | | |

KEY

- D - Disturbed Sample
- B - Bulk Sample
- U - Undisturbed Sample
- R - Root Sample
- W - Water Sample
- ES - Environmental Sample
- ▽ Water Strike
- ▼ Water Rise
- ▼c Level on completion
- MP - Mackintosh Probe
- P( ) - Hand Penetrometer Cohesion ( ) kPa
- V - Vane Shear Test Cohesion ( ) kPa

REMARKS

1. Live roots observed to 0.20m depth
2. Seepage at 2.40m depth
3. Pit sides unstable below 2.30m depth
4. Groundwater stood at 3.00m depth on completion

| Project No | |
|---|---|
| 14985 | |
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Site: LAND OFF WARDENTREE LANE, SPALDING

TRIAL PIT
TP4

Date: 25/02/20

Pit Size: 2.30m L x 0.70m W x 3.40m D.

Ground Level:

| Samples and in-situ Tests | | | (Date) Water | Description of Strata | Legend | Depth m | O.D. Level m |
|---|---|---|---|---|---|---|---|
| Depth m | Type | Result | | | | | |
| 0.10 | V1 | (60) | | MADE GROUND - Firm, dark brown, slightly gravelly, sandy, silty CLAY. Gravel is angular to rounded flint, ash and brick fragments. | | | |
| 0.15-0.32 | MP1 | 100 | | | | | |
| 0.20 | D1 | | | | | | |
| 0.20 | ES1 | | | | | | |
| 0.32-0.51 | MP2 | 100 | | | | | |
| 0.50-0.80 | B1 | | | | | 0.50 | |
| | | | | Firm, grey and brown, slightly sandy, silty CLAY. | | | |
| 0.70 | D2 | | | | | | |
| 1.00 | D3 | | | (TIDAL FLAT DEPOSIT) | | | |
| 1.00 | V2 | (58) | | | | | |
| 1.00-1.40 | MP3 | 100 | | | | 1.20 | |
| | | | | Very soft, brown, orange brown and grey, very sandy, silty CLAY. Sand is fine and medium grained. | | | |
| 1.50-2.00 | B2 | | | | | | |
| 1.50 | D4 | | | | | | |
| | | | | (TIDAL FLAT DEPOSIT) | | | |
| 2.20 | D5 | | ▽ 1 | | | 2.30 | |
| | | | | Very soft, grey and brown, silty CLAY. | | | |
| 2.50-3.40 | B3 | | | | | | |
| 3.00 | D6 | | | (TIDAL FLAT DEPOSIT) | | | |
| | | | ▼c | | | 3.40 | |
| 3.40 | D7 | | | Pit completed at 3.40m depth | | | |

KEY
- D - Disturbed Sample
- B - Bulk Sample
- U - Undisturbed Sample
- R - Root Sample
- W - Water Sample
- ES - Environmental Sample
- ▽ Water Strike
- ▼ Water Rise
- ▼c Level on completion
- MP - Mackintosh Probe
- P( ) - Hand Penetrometer Cohesion ( ) kPa
- V - Vane Shear Test Cohesion ( ) kPa

REMARKS
1. Live roots observed to 0.20m depth
2. Seepage at 2.30m depth
3. Pit sides unstable below 1.20m depth
4. Groundwater stood at 3.30m depth on completion

Project No 14985

Scale 1:25

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Site: LAND OFF WARDENTREE LANE, SPALDING

TRIAL PIT
TP5

Date: 25/02/20

Pit Size: 2.30m L x 0.70m W x 3.30m D.

Ground Level:

| Samples and in-situ Tests | | | (Date) Water | Description of Strata | Legend | Depth m | O.D. Level m |
|---|---|---|---|---|---|---|---|
| Depth m | Type | Result | | | | | |
| 0.10 | D1 | | | MADE GROUND - Light brown, silty SAND AND GRAVEL. Gravel is angular to rounded limestone, quartzite and brick fragments. | | 0.30 | |
| 0.10 | ES1 | | | | | | |
| 0.35 | D2 | | | MADE GROUND - Firm, dark brown, slightly gravelly, sandy, silty CLAY with occasional cobbles of brick. Gravel is angular to sub-rounded ash, brick fragments, slate and limestone. | | 0.40 | |
| 0.35 | ES2 | | | | | | |
| 0.35 | V1 | (61) | | | | | |
| 0.50-0.80 | B1 | | | | | 0.60 | |
| 0.50 | V2 | (45) | | Firm, brown, orange brown and grey, slightly sandy, silty CLAY. (TIDAL FLAT DEPOSIT) | | | |
| 0.60 | D3 | | | | | | |
| | | | | Light brown and orange brown, clayey, very silty SAND. | | | |
| 1.20 | D4 | | | (TIDAL FLAT DEPOSIT) | | | |
| 1.80 | D5 | | | | | 1.90 | |
| 2.00-2.50 | B2 | | | Firm, brown and orange brown, very sandy, silty CLAY. Sand is fine grained. | | | |
| 2.30 | D6 | | | (TIDAL FLAT DEPOSIT) | | | |
| 2.70 | D7 | | | | | 2.80 | |
| 3.00 | D8 | | ▽1 | Very soft, grey and brown, slightly sandy, silty, slightly organic CLAY. | | | |
| | | | ▼c | (TIDAL FLAT DEPOSIT) | | | |
| 3.30 | D9 | | | | | 3.30 | |
| | | | | Pit completed at 3.30m depth | | | |

KEY

- D - Disturbed Sample
- B - Bulk Sample
- U - Undisturbed Sample
- R - Root Sample
- W - Water Sample
- ES - Environmental Sample
- ▽ Water Strike
- ▼ Water Rise
- ▼c Level on completion
- MP - Mackintosh Probe
- P( ) - Hand Penetrometer Cohesion ( ) kPa
- V - Vane Shear Test Cohesion ( ) kPa

REMARKS

1. No live roots observed
2. Groundwater met at 3.00m depth
3. Pit sides unstable below 2.00m depth
4. Groundwater stood at 3.20m depth on completion

| Project No | |
|---|---|
| 14985 | |
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Site: LAND OFF WARDENTREE LANE, SPALDING

TRIAL PIT
TP6

Date: 25/02/20

Pit Size: 2.40m L x 0.80m W x 3.00m D.

Ground Level:

| Samples and in-situ Tests | | | (Date) Water | Description of Strata | Legend | Depth m | O.D. Level m |
|---|---|---|---|---|---|---|---|
| Depth m | Type | Result | | | | | |
| 0.20 | D1 | | | MADE GROUND - Firm, brown and dark brown, slightly gravelly, silty CLAY. Gravel is fine and medium, angular flint, ash and rare metal fragments. | | | |
| 0.20 | ES1 | | | | | | |
| 0.20 | V1 | (58) | | | | 0.40 | |
| 0.50-0.80 | B1 | | | Firm, brown and orange brown, slightly sandy, silty CLAY. | | | |
| 0.50 | D2 | | | | | | |
| 0.50 | V2 | (70) | | | | | |
| 0.80 | D3 | | | | | | |
| | | | ▽1 | | | | |
| | | | | (TIDAL FLAT DEPOSIT) | | | |
| 1.50 | D4 | | | | | 1.70 | |
| | | | | Grey and brown, silty fine SAND. | | | |
| 2.10 | D5 | | | | | | |
| 2.50-2.80 | B2 | | | (TIDAL FLAT DEPOSIT) | | | |
| 2.70 | D6 | | | | | 2.80 | |
| | | | ▼c | Grey and dark grey, silty, organic SAND. Sand is fine grained. | | | |
| 3.00 | D7 | | | (TIDAL FLAT DEPOSIT) | | 3.00 | |
| | | | | Pit completed at 3.00m depth | | | |

KEY
- D - Disturbed Sample
- B - Bulk Sample
- U - Undisturbed Sample
- R - Root Sample
- W - Water Sample
- ES - Environmental Sample
- ▽ Water Strike
- ▼ Water Rise
- ▼c Level on completion
- MP - Mackintosh Probe
- P( ) - Hand Penetrometer Cohesion ( ) kPa
- V - Vane Shear Test Cohesion ( ) kPa

REMARKS
1. Live roots observed to 0.40m depth
2. Seepage at 1.00m depth
3. Pit sides unstable below 0.20m depth
4. Groundwater stood at 2.90m depth on completion

| Project No | |
|---|---|
| 14985 | |
| Scale | Page |
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Site: LAND OFF WARDENTREE LANE, SPALDING

TRIAL PIT
TP7

Date: 25/02/20

Pit Size: 2.40m L x 0.70m W x 3.00m D.

Ground Level:

| Samples and in-situ Tests | | | (Date) Water | Description of Strata | Legend | Depth m | O.D. Level m |
|---|---|---|---|---|---|---|---|
| Depth m | Type | Result | | | | | |
| 0.10 | D1 | | | MADE GROUND – Firm, brown and dark brown, slightly gravelly, silty CLAY. Gravel is angular brick fragments and ash. | | | |
| 0.10 | ES1 | | | | | | |
| 0.30 | V1 | (60) | | | | 0.40 | |
| 0.50-0.80 | B1 | | | Stiff, orange brown, brown and grey, slightly sandy, silty, slightly organic CLAY. | | | |
| 0.50 | D2 | | | | | | |
| 0.60 | V2 | (98) | | | | | |
| 1.00 | D3 | | | ...Becoming firm below 1.00m depth. | | | |
| 1.50 | D4 | | | | | | |
| 2.00 | D5 | | | (TIDAL FLAT DEPOSIT) | | | |
| | | | 1 ▽ | | | 2.60 | |
| 2.70-3.00 | B2 | | | Very soft, brown, silty CLAY. | | | |
| | | | ▼c | (TIDAL FLAT DEPOSIT) | | | |
| 3.00 | D6 | | | | | 3.00 | |
| | | | | Pit completed at 3.00m depth | | | |

KEY

- D - Disturbed Sample
- B - Bulk Sample
- U - Undisturbed Sample
- R - Root Sample
- W - Water Sample
- ES - Environmental Sample
- ▽ Water Strike
- ▼ Water Rise
- ▼c Level on completion
- MP - Mackintosh Probe
- P( ) - Hand Penetrometer Cohesion ( ) kPa
- V - Vane Shear Test Cohesion ( ) kPa

REMARKS

1. Live roots observed to 0.50m depth
2. Groundwater met at 2.60m depth
3. Pit sides unstable below 1.00m depth
4. Groundwater stood at 2.80m depth on completion

| Project No | |
|---|---|
| 14985 | |
| Scale | Page |
| 1:25 | 1/1 |

**GROUND ENGINEERING LIMITED**

Tel: 01733-566566
www.groundengineering.co.uk

Site: LAND OFF WARDENTREE LANE, SPALDING

TRIAL PIT
TP8

Date: 25/02/20

Pit Size: 2.30m L x 0.80m W x 3.00m D.

Ground Level:

| Samples and in-situ Tests | | | (Date) Water | Description of Strata | Legend | Depth m | O.D. Level m |
|---|---|---|---|---|---|---|---|
| Depth m | Type | Result | | | | | |
| | | | | MADE GROUND - Firm, locally soft, brown and dark brown, silty CLAY. | | | |
| 0.20 | D1 | | | | | | |
| 0.20 | ES1 | | | | | | |
| 0.15-0.35 | MP1 | 100 | | | | | |
| 0.20 | V1 | (34) | | | | 0.40 | |
| 0.35-0.59 | MP2 | 100 | | Medium dense, orange brown and brown, silty SAND, Sand is fine grained. | | | |
| 0.50-0.80 | B1 | | | | | | |
| 0.50 | D2 | | | | | | |
| 0.59-0.82 | MP3 | 100 | | | | | |
| 0.90 | D3 | | | | | | |
| 1.00-1.65 | MP4 | 100 | | | | | |
| 1.50 | D4 | | | ...Becoming clayey below 1.50m depth. | | | |
| | | | | (TIDAL FLAT DEPOSIT) | | 2.00 | |
| | | | | Grey, dark grey and brown, silty SAND. Sand is fine grained. | | | |
| 2.20 | D5 | | | | | | |
| 2.50-3.00 | B2 | | | (TIDAL FLAT DEPOSIT) | | | |
| 3.00 | D6 | | ▽ 1 | | | 3.00 | |
| | | | | Pit completed at 3.00m depth | | | |

KEY
- D - Disturbed Sample
- B - Bulk Sample
- U - Undisturbed Sample
- R - Root Sample
- W - Water Sample
- ES - Environmental Sample
- ▽ Water Strike
- ▼ Water Rise
- ▼c Level on completion
- MP - Mackintosh Probe
- P( ) - Hand Penetrometer Cohesion ( ) kPa
- V - Vane Shear Test Cohesion ( ) kPa

REMARKS
1. No live roots observed
2. Pit sides unstable at 0.50m depth
3. Pit sides collapsed below 0.80m depth
4. Groundwater met at 3.00m depth on completion

Project No 14985

Scale 1:25

Page 1/1

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Site: LAND OFF WARDENTREE LANE, SPALDING

TRIAL PIT
TP9

Date: 25/02/20

Pit Size: 2.40m L x 0.80m W x 3.00m D.

Ground Level:

| Samples and in-situ Tests | | | (Date) Water | Description of Strata | Legend | Depth m | O.D. Level m |
|---|---|---|---|---|---|---|---|
| Depth m | Type | Result | | | | | |
| 0.10 | D1 | | | MADE GROUND - Firm, brown and dark brown, slightly sandy, silty CLAY with rare fragments of plastic. | | | |
| 0.10 | ES1 | | | | | | |
| 0.40 | D2 | | | | | | |
| 0.40 | ES2 | | | | | 0.50 | |
| 0.40 | V1 | (70) | | Firm, friable, brown, orange brown and dark brown, slightly sandy, silty CLAY. (TIDAL FLAT DEPOSIT) | | | |
| 0.50-0.80 | B1 | | | | | | |
| 0.60 | D3 | | | | | 0.80 | |
| 0.60 | V2 | (52) | | Brown and orange brown, silty SAND. Sand is fine grained. | | | |
| | | | | ...Becoming sandy, clayey SILT below 1.20m depth. | | | |
| 1.20 | D4 | | | | | | |
| | | | | (TIDAL FLAT DEPOSIT) | | | |
| 1.80 | D5 | | | | | 2.00 | |
| | | | | Soft, brown and grey, slightly sandy, silty CLAY with rare fossil teeth. | | | |
| 2.20 | D6 | | | (TIDAL FLAT DEPOSIT) | | 2.30 | |
| 2.40 | D7 | | | Dark grey, silty, organic SAND. | | | |
| 2.50-3.00 | B2 | | ▽1 | | | | |
| | | | | (TIDAL FLAT DEPOSIT) | | | |
| 3.00 | D8 | | ▼c | | | 3.00 | |
| | | | | Pit completed at 3.00m depth | | | |

KEY

- D - Disturbed Sample
- B - Bulk Sample
- U - Undisturbed Sample
- R - Root Sample
- W - Water Sample
- ES - Environmental Sample
- ▽ Water Strike
- ▼ Water Rise
- ▼c Level on completion
- MP - Mackintosh Probe
- P( ) - Hand Penetrometer Cohesion ( ) kPa
- V - Vane Shear Test Cohesion ( ) kPa

REMARKS

1. Live roots observed to 0.60m depth
2. Groundwater met at 2.60m depth
3. Pit sides stable
4. Groundwater stood at 2.95m depth on completion

| Project No | |
|---|---|
| 14985 | |
| Scale | Page |
| 1:25 | 1/1 |

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Site: LAND OFF WARDENTREE LANE, SPALDING

TRIAL PIT
TP10

Date: 25/02/20

Pit Size: 2.40m L x 0.80m W x 3.40m D.

Ground Level:

| Samples and in-situ Tests | | | (Date) Water | Description of Strata | Legend | Depth m | O.D. Level m |
|---|---|---|---|---|---|---|---|
| Depth m | Type | Result | | | | | |
| 0.10 | D1 | | | MADE GROUND – Firm, dark brown, slightly gravelly, sandy, silty CLAY. Gravel is fine and medium, sub-angular flint and ash. | | | |
| 0.10 | ES1 | | | | | 0.40 | |
| 0.50–0.80 | B1 | | | Orange brown and brown, sandy, clayey SILT. | | | |
| 0.50 | D2 | | | | | | |
| 1.00 | D3 | | ▽ 1 | | | | |
| 1.40 | D4 | | | (TIDAL FLAT DEPOSIT) | | | |
| 1.80 | D5 | | | | | 2.00 | |
| | | | | Dark grey, silty fine SAND with layers of soft, organic clay and rare shell fragments. | | | |
| 2.20 | D6 | | | | | | |
| 2.50–3.40 | B2 | | | | | | |
| | | | ▼c | (TIDAL FLAT DEPOSIT) | | | |
| 3.40 | D7 | | | | | 3.40 | |
| | | | | Pit completed at 3.40m depth | | | |

KEY

- D - Disturbed Sample
- B - Bulk Sample
- U - Undisturbed Sample
- R - Root Sample
- W - Water Sample
- ES - Environmental Sample
- ▽ Water Strike
- ▼ Water Rise
- ▼c Level on completion
- MP - Mackintosh Probe
- P( ) - Hand Penetrometer Cohesion ( ) kPa
- V - Vane Shear Test Cohesion ( ) kPa

REMARKS

1. Live roots observed to 0.50m depth
2. Pit sides unstable at 0.30m depth
3. Seepage at 1.00m depth
4. Groundwater stood at 2.70m depth on completion

| Project No | |
|---|---|
| 14985 | |
| Scale | Page |
| 1:25 | 1/1 |

# LABORATORY TEST RESULTS

CONTRACT LAND OFF WARDENTREE LANE, SPALDING

| Bore-hole | Sample | Depth m | Classification | | | | Density | | Triaxial Compression | | | | | Sulphates ($SO_4$) | | | | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Liquid Limit % | Plastic Limit % | Plasticity Index % | Moisture Content % | Bulk $Mg/m^3$ | Dry $Mg/m^3$ | Type | Principal Stress Difference kPa | Cell Pressure kPa | Shear Strength kPa | Angle of Shear Resistance degrees | Soil: Total % Dry Wt. | Soil: Aqueous Extract mg/l | Water mg/l | pH | |
| BH1 | U1 | 11.00 - 11.40 | | | | 21 | 2.16 | 1.79 | Q | 421 | 200 | 210 | 0 | | | | | |
| | U2 | 12.50 - 12.90 | | | | 21 | 2.14 | 1.78 | Q | 382 | 220 | 191 | 0 | | | | | |
| | U3 | 13.50 - 13.90 | | | | 22 | 2.14 | 1.76 | Q | 386 | 240 | 193 | 0 | | | | | |
| | U4 | 14.50 - 14.90 | | | | 23 | 2.15 | 1.75 | Q | 320 | 260 | 160 | 0 | | | | | |
| BH2 | U1 | 2.80 - 3.20 | | | | 87 | 1.52 | 0.81 | Q | 18 | 50 | 9 | 0 | | | | | |
| | U2 | 3.80 - 4.40 | | | | 84 | 1.56 | 0.85 | Q | 33 | 60 | 16 | 0 | | | | | |
| | U3 | 4.80 - 5.20 | | | | 96 | 1.44 | 0.73 | Q | 30 | 80 | 15 | 0 | | | | | |
| | U4 | 6.30 - 6.70 | | | | 100 | 1.48 | 0.74 | Q | 30 | 115 | 15 | 0 | | | | | |
| | U5 | 7.80 - 8.10 | | | | | | | | | | | | | | | | Vane test = 42kPa |
| | U6 | 9.30 - 9.70 | | | | | | | | | | | | | | | | Vane test = 48kPa |

U - UNDISTURBED SAMPLE
D - DISTURBED SAMPLE
B - BULK SAMPLE
W - WATER SAMPLE

C.U. - CONSOLIDATED UNDRAINED
C.D. - CONSOLIDATED DRAINED
Q. - IMMEDIATE UNDRAINED
Q.M. - IMMEDIATE UNDRAINED MULTISTAGE

Aqueous Extract 2:1 Water:Soil

14985

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# LABORATORY TEST RESULTS

CONTRACT LAND OFF WARDENTREE LANE, SPALDING

| Bore-hole | Sample | Depth m | Classification | | | | Density | | Triaxial Compression | | | | | Sulphates ($SO_4$) | | | | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Liquid Limit % | Plastic Limit % | Plasticity Index % | Moisture Content % | Bulk $Mg/m^3$ | Dry $Mg/m^3$ | Type | Principal Stress Difference kPa | Cell Pressure kPa | Shear Strength kPa | Angle of Shear Resistance degrees | Soil: Total % Dry Wt. | Soil: Aqueous Extract mg/l | Water mg/l | pH | |
| BH2 | U7 | 10.20 - 10.60 | | | | 22 | 2.11 | 1.72 | Q | 251 | 185 | 125 | 0 | | | | | |
| | U8 | 11.70 - 12.10 | | | | 22 | 2.09 | 1.72 | Q | 230 | 210 | 115 | 0 | | | | | |
| | U9 | 13.20 - 13.60 | | | | 22 | 2.11 | 1.74 | Q | 401 | 240 | 200 | 0 | | | | | |
| | U10 | 14.50 - 14.90 | | | | 17 | 2.17 | 1.85 | Q | 567 | 265 | 283 | 0 | | | | | |
| BH3 | U1 | 10.20 - 10.50 | | | | 33 | 1.92 | 1.44 | Q | 92 | 185 | 46 | 0 | | | | | |
| | U2 | 11.70 - 12.10 | | | | 22 | 2.24 | 1.84 | Q | 126 | 210 | 63 | 0 | | | | | |
| | U3 | 13.20 - 13.50 | | | | 21 | 2.15 | 1.77 | Q | 384 | 240 | 192 | 0 | | | | | |
| | U4 | 14.50 - 14.90 | | | | 22 | 2.13 | 1.75 | Q | 275 | 265 | 138 | 0 | | | | | |
| BH4 | U1 | 10.50 - 10.90 | | | | 20 | 2.17 | 1.82 | Q | 120 | 190 | 60 | 0 | | | | | |
| | U2 | 12.00 - 12.40 | | | | 22 | 2.15 | 1.77 | Q | 381 | 210 | 191 | 0 | | | | | |

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Q. - IMMEDIATE UNDRAINED
Q.M. - IMMEDIATE UNDRAINED MULTISTAGE

Aqueous Extract 2:1 Water:Soil

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# LABORATORY TEST RESULTS

CONTRACT LAND OFF WARDENTREE LANE, SPALDING

| Bore-hole | Sample | Depth m | Classification | | | | Density | | Triaxial Compression | | | | | Sulphates ($SO_4$) | | | | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Liquid Limit % | Plastic Limit % | Plasticity Index % | Moisture Content % | Bulk $Mg/m^3$ | Dry $Mg/m^3$ | Type | Principal Stress Difference kPa | Cell Pressure kPa | Shear Strength kPa | Angle of Shear Resistance degrees | Soil: Total % Dry Wt. | Soil: Aqueous Extract mg/l | Water mg/l | pH | |
| BH4 | U3 | 13.50 - 13.90 | | | | 21 | 2.14 | 1.76 | Q | 405 | 240 | 203 | 0 | | | | | |
| | U4 | 14.50 - 14.90 | | | | 22 | 2.10 | 1.72 | Q | 323 | 260 | 162 | 0 | | | | | |
| BH5 | U1 | 11.80 - 12.20 | | | | 19 | 2.18 | 1.82 | Q | 390 | 210 | 195 | 0 | | | | | |
| | U2 | 13.30 - 13.70 | | | | 22 | 2.10 | 1.73 | Q | 393 | 240 | 197 | 0 | | | | | |
| | U3 | 14.50 - 14.90 | | | | 22 | 2.12 | 1.75 | Q | 431 | 260 | 215 | 0 | | | | | |
| BH6 | U1 | 1.20 - 1.60 | | | | 26 | 2.01 | 1.59 | Q | 74 | 50 | 37 | 0 | | | | | |
| | W1 | 1.70 | | | | | | | | | | | | | | 502 | 7.4 | |
| | U2 | 11.80 - 12.25 | | | | 22 | 2.08 | 1.71 | Q | 397 | 210 | 198 | 0 | | | | | |
| | U3 | 13.30 - 13.70 | | | | 20 | 2.13 | 1.77 | Q | 277 | 240 | 139 | 0 | | | | | |
| | U4 | 14.50 - 14.90 | | | | 17 | 2.16 | 1.85 | Q | 554 | 260 | 277 | 0 | | | | | |

U - UNDISTURBED SAMPLE
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B - BULK SAMPLE
W - WATER SAMPLE

C.U. - CONSOLIDATED UNDRAINED
C.D. - CONSOLIDATED DRAINED
Q. - IMMEDIATE UNDRAINED
Q.M. - IMMEDIATE UNDRAINED MULTISTAGE

Aqueous Extract 2:1 Water:Soil

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# LABORATORY TEST RESULTS

CONTRACT LAND OFF WARDENTREE LANE, SPALDING

| Trial-pit | Sample | Depth m | Classification | | | | Density | | Triaxial Compression | | | | | Sulphates ($SO_4$) | | | C.B.R. | | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Liquid Limit % | Plastic Limit % | Plasticity Index % | Moisture Content % | Bulk $Mg/m^3$ | Dry $Mg/m^3$ | Type | Principal Stress Difference kPa | Cell Pressure kPa | Shear Strength kPa | Angle of Shear Resistance degrees | Soil: Total % Dry Wt. | Soil: Aqueous Extract mg/l | Water mg/l | pH | Top % | Base % | |
| TP1 | D3 | 0.80 | | | | | | | | | | | | | 214 | | 7.8 | | | |
| TP2 | B1 | 0.50 - 0.80 | | | | 28 | 1.88 | 1.49 | | | | | | | | | | 0.4 | 0.4 | 0% retained on 20mm sieve |
| TP3 | D3 | 0.80 | 39 | 20 | 19 | 30 | | | | | | | | | | | | | | SOIL CLASSIFICATION = CI<br>2% retained on 425µm sieve |
| TP4 | B1 | 0.50 - 0.80 | 54 | 23 | 31 | 32 | 1.90 | 1.45 | | | | | | | | | | 1.6 | 1.3 | SOIL CLASSIFICATION = CH<br>1% retained on 425µm sieve<br>0% retained on 20mm sieve |
| | D3 | 1.00 | | | | | | | | | | | | | 82 | | 8.0 | | | |
| TP5 | D3 | 0.60 | 42 | 19 | 23 | 26 | | | | | | | | | | | | | | SOIL CLASSIFICATION = CI<br>0% retained on 425µm sieve |
| TP6 | D3 | 0.80 | 37 | 20 | 17 | 25 | | | | | | | | | | | | | | SOIL CLASSIFICATION = CI<br>1% retained on 425µm sieve |
| TP7 | B1 | 0.50 - 0.80 | 52 | 22 | 30 | 31 | 1.89 | 1.44 | | | | | | | | | | 1.8 | 1.9 | SOIL CLASSIFICATION = CH<br>0% retained on 425µm sieve<br>0% retained on 20mm sieve |
| | D3 | 1.00 | | | | | | | | | | | | | 200 | | 7.9 | | | |
| TP8 | B1 | 0.50 - 0.80 | | | | 26 | 1.91 | 1.52 | | | | | | | | | | 0.3 | 0.3 | 0% retained on 20mm sieve |

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C.D. – CONSOLIDATED DRAINED
Q. – IMMEDIATE UNDRAINED
Q.M. – IMMEDIATE UNDRAINED MULTISTAGE

Aqueous Extract 2:1 Water:Soil

C.B.R. – CALIFORNIA BEARING RATIO

14985

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# LABORATORY TEST RESULTS

CONTRACT LAND OFF WARDENTREE LANE, SPALDING

| Trial-pit | Sample | Depth m | Classification | | | | Density | | Triaxial Compression | | | | | Sulphates ($SO_4$) | | | | C.B.R. | | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Liquid Limit % | Plastic Limit % | Plasticity Index % | Moisture Content % | Bulk $Mg/m^3$ | Dry $Mg/m^3$ | Type | Principal Stress Difference kPa | Cell Pressure kPa | Shear Strength kPa | Angle of Shear Resistance degrees | Soil: Total % Dry Wt. | Soil: Aqueous Extract mg/l | Water mg/l | pH | Top % | Base % | |
| TP9 | B1 | 0.50 - 0.80 | 36 | 22 | 14 | 20 | 2.03 | 1.69 | | | | | | | | | | 2.3 | 3.3 | SOIL CLASSIFICATION = CI<br>0% retained on 425µm sieve<br>0% retained on 20mm sieve |
| TP10 | D3 | 1.00 | | | | | | | | | | | | | 66 | | 8.1 | | | |

U - UNDISTURBED SAMPLE
D - DISTURBED SAMPLE
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W - WATER SAMPLE

C.U. - CONSOLIDATED UNDRAINED
C.D. - CONSOLIDATED DRAINED
Q. - IMMEDIATE UNDRAINED
Q.M. - IMMEDIATE UNDRAINED MULTISTAGE

Aqueous Extract 2:1 Water:Soil

C.B.R. - CALIFORNIA BEARING RATIO

14985

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GROUND ENGINEERING LIMITED

Newark Road Peterborough
t: 01733 566566
e: admin@groundengineering.co.uk

UKAS TESTING
8180

# TEST CERTIFICATE

## Determination of Particle Size Distribution

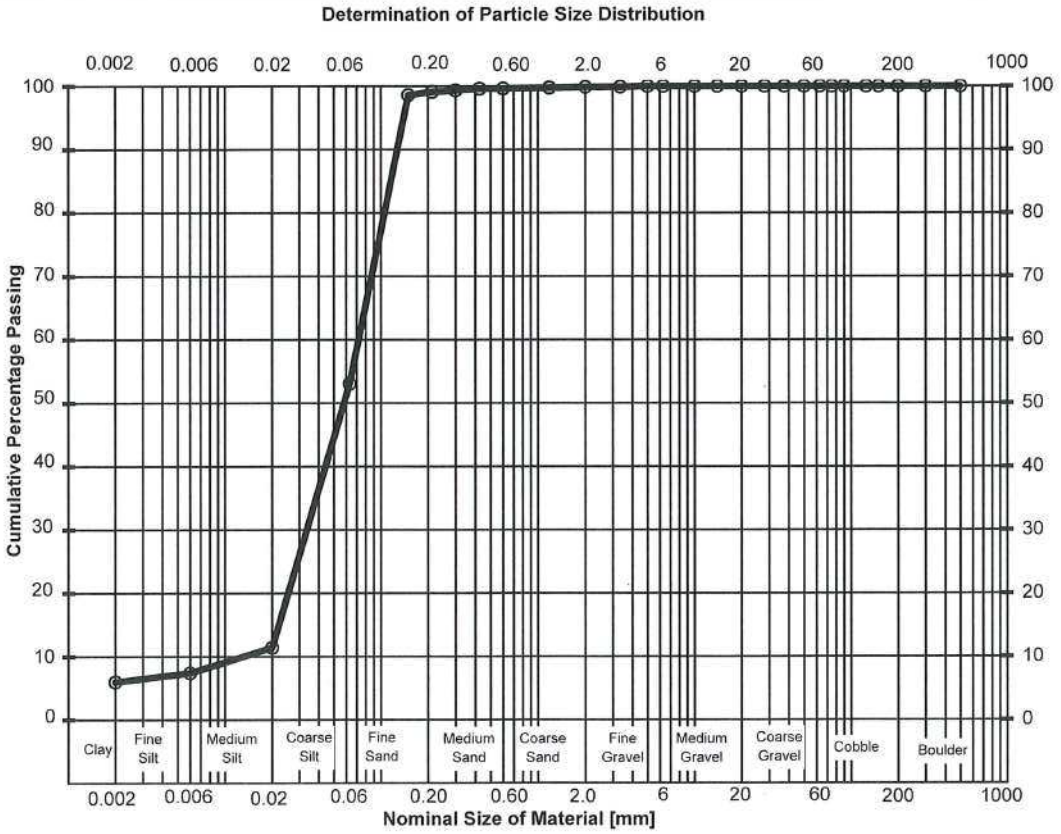
Tested in Accordance with BS 1377-2: 1990: Clause 9.2 & 9.4
Sieved Grading and Sedimentation by Pipette

| | | | |
|---|---|---|---|
| Client: | Ground Engineering Ltd | Certificate Number: | PL6999-1/1/710-2 |
| Client Address: | Newark Road | Client Reference: | C14985 |
| | Peterborough | Lab Job Number: | PL6999-1 |
| | PE1 5UA | Date Sampled: | Unknown |
| | | Date Received: | 28.02.2020 |
| Contact: | Simon Weatherley | Date Tested: | 04.03.2020 |
| | | Certificate of Sampling: | N/A |
| Site Name: | Land off Wardentree Lane | Sampling Certificate No.: | N/A |
| Site Address: | Spalding | Sampled By: | Client |

**TEST RESULTS** **Laboratory Reference:** PL6999-1/1 **Pre-treatment for organic material:** No
**Client Reference:** B2

**Sample Description:** Brown dark brown black slightly clayey SILT/SAND. *petro-chemical odour.

**Material Specification:** Not Required **Depth Top:** 0.80m
**Location:** TP1 **Depth Base:** 1.20m
**Source:** **Supplier:**




**Sieve Analysis**

| Sieve mm | %Passing |
|---|---|
| 125 | 100 |
| 90 | 100 |
| 75 | 100 |
| 63 | 100 |
| 50 | 100 |
| 37.5 | 100 |
| 28 | 100 |
| 20 | 100 |
| 14 | 100 |
| 10 | 100 |
| 6.3 | 100 |
| 5.0 | 100 |
| 3.35 | 100 |
| 2.00 | 100 |
| 1.18 | 100 |
| 0.600 | 100 |
| 0.425 | 100 |
| 0.300 | 99 |
| 0.212 | 99 |
| 0.150 | 99 |
| 0.063 | 53 |
| **0.020** | **11** |
| **0.006** | **7** |
| **0.002** | **6** |

Comments: Data relevant to material below 63 microns is outside the current scope of UKAS accreditation

Approved Signatory: M. Hartnup - Laboratory Manager Signed:

**for and on behalf of Ground Engineering Ltd**

Date Reported: 23.03.2020 Page 1 of 1
Form Number: GELab/C/709-2 Version 52

Opinions and interpretations expressed herein are outside of the scope of the UKAS Accreditation
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Registration Number: 6929574
Reg Office: Ground Engineering Ltd
Newark Rd, Peterborough PE1 5UA

GROUND ENGINEERING

Newark Road Peterborough
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e: admin@groundengineering.co.uk

UKAS TESTING
8180

# TEST CERTIFICATE

## Determination of Particle Size Distribution

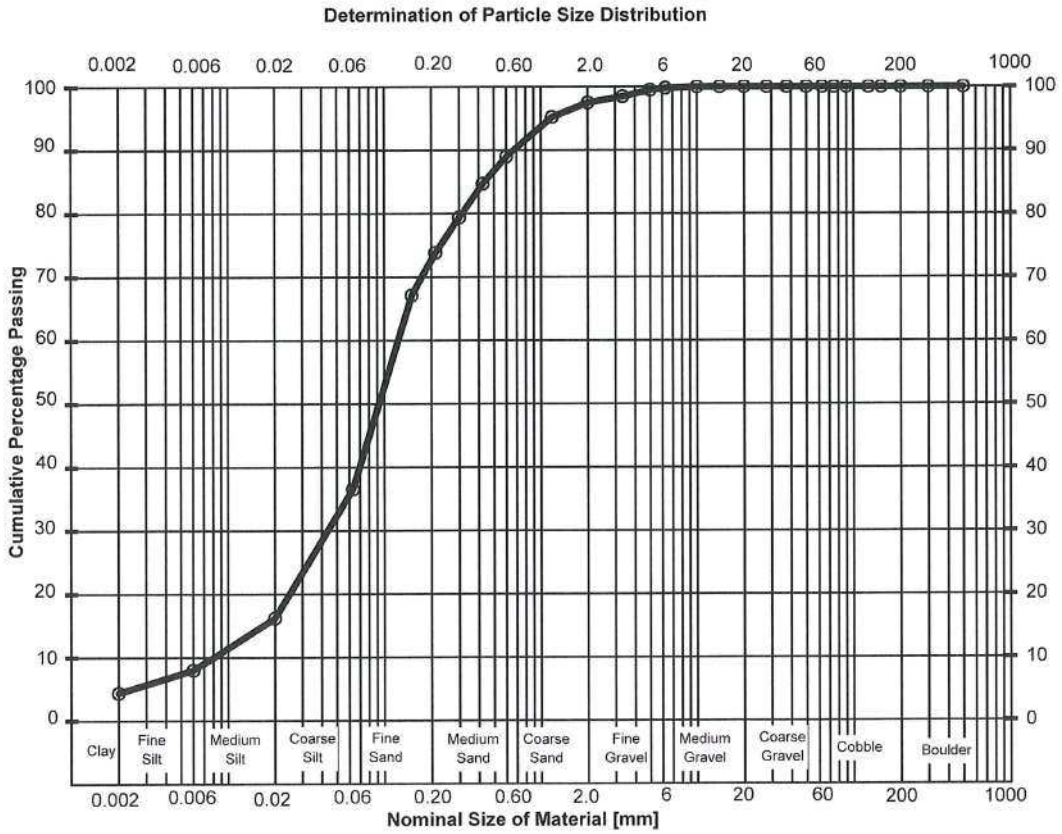
Tested in Accordance with BS 1377-2: 1990: Clause 9.2 & 9.4
Sieved Grading and Sedimentation by Pipette

| | | | |
|---|---|---|---|
| Client: | Ground Engineering Ltd | Certificate Number: | PL6999-1/4/710-2 |
| Client Address: | Newark Road | Client Reference: | C14985 |
| | Peterborough | Lab Job Number: | PL6999-1 |
| | PE1 5UA | Date Sampled: | Unknown |
| | | Date Received: | 28.02.2020 |
| Contact: | Simon Weatherley | Date Tested: | 04.03.2020 |
| | | Certificate of Sampling: | N/A |
| Site Name: | Land off Wardentree Lane | Sampling Certificate No.: | N/A |
| Site Address: | Spalding | Sampled By: | Client |

**TEST RESULTS** **Laboratory Reference:** PL6999-1/4 **Pre-treatment for organic material:** No
**Client Reference:** B1

**Sample Description:** Firm and Stiff friable brown orange-brown grey-brown black slightly sandy SILT/CLAY. *Slight petro-chemical odour.

**Material Specification:** Not Required **Depth Top:** 0.70m
**Location:** TP3 **Depth Base:** 1.00m
**Source:** **Supplier:**




**Sieve Analysis**

| Sieve mm | %Passing |
|---|---|
| 125 | 100 |
| 90 | 100 |
| 75 | 100 |
| 63 | 100 |
| 50 | 100 |
| 37.5 | 100 |
| 28 | 100 |
| 20 | 100 |
| 14 | 100 |
| 10 | 100 |
| 6.3 | 100 |
| 5.0 | 99 |
| 3.35 | 98 |
| 2.00 | 97 |
| 1.18 | 95 |
| 0.600 | 89 |
| 0.425 | 85 |
| 0.300 | 79 |
| 0.212 | 74 |
| 0.150 | 67 |
| 0.063 | 37 |
| **0.020** | **16** |
| **0.006** | **8** |
| **0.002** | **4** |

Comments: Data relevant to material below 63 microns is outside the current scope of UKAS accreditation

Approved Signatory: M. Hartnup - Laboratory Manager Signed:

**for and on behalf of Ground Engineering Ltd**

Date Reported: 23.03.2020 Page 1 of 1
Form Number: GELab/C/709-2 Version 52

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GROUND ENGINEERING LIMITED

Newark Road Peterborough
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UKAS TESTING
8180

# TEST CERTIFICATE

## Determination of Particle Size Distribution

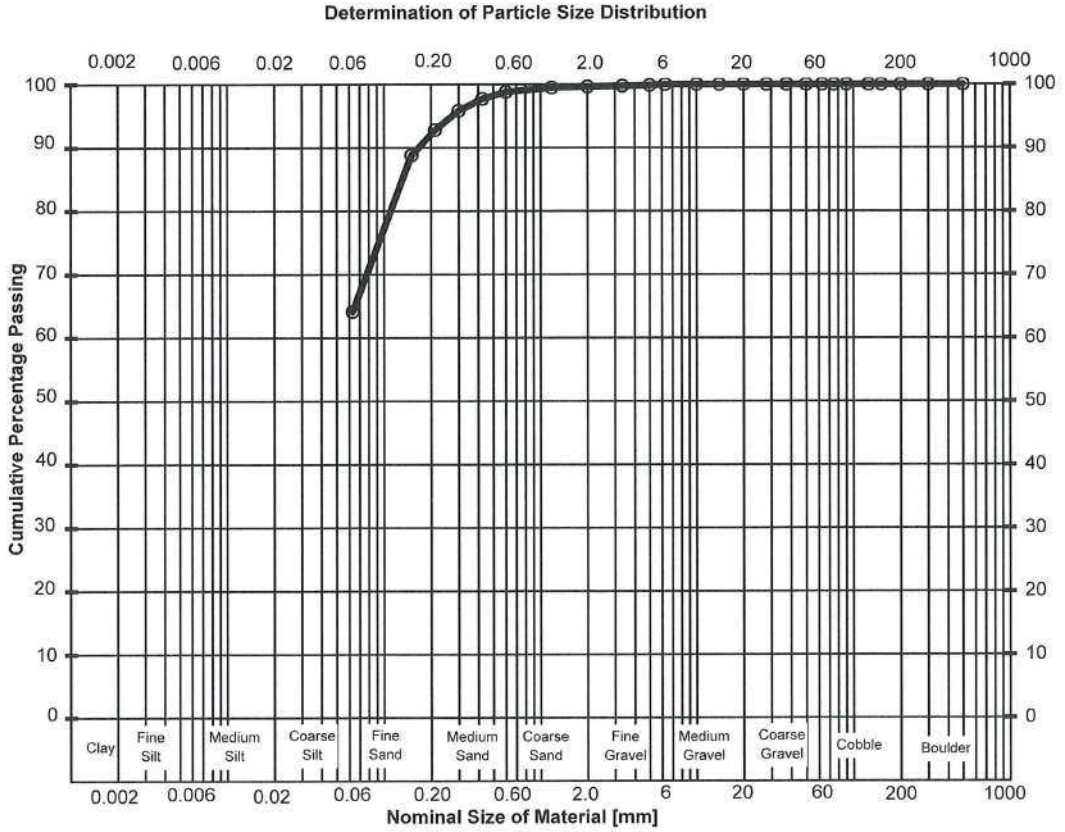
Tested in Accordance with BS 1377-2: 1990: Clause 9.2
Sieved Grading

| | | | |
|---|---|---|---|
| Client: | Ground Engineering Ltd | Certificate Number: | PL6999-1/8/710-2 |
| Client Address: | Newark Road | Client Reference: | C14985 |
| | Peterborough | Lab Job Number: | PL6999-1 |
| | PE1 5UA | Date Sampled: | Unknown |
| | | Date Received: | 28.02.2020 |
| Contact: | Simon Weatherley | Date Tested: | 04.03.2020 |
| | | Certificate of Sampling: | N/A |
| Site Name: | Land off Wardentree Lane | Sampling Certificate No.: | N/A |
| Site Address: | Spalding | Sampled By: | Client |

**TEST RESULTS** **Laboratory Reference:** PL6999-1/8 **Pre-treatment for organic material:** N/A
**Client Reference:** B2

**Sample Description:** Very Soft brown orange-brown grey-brown sandy SILT/CLAY.

**Material Specification:** Not Required **Depth Top:** 1.50m
**Location:** TP4 **Depth Base:** 2.00m
**Source:** **Supplier:**




**Sieve Analysis**

| Sieve mm | %Passing |
|---|---|
| 125 | 100 |
| 90 | 100 |
| 75 | 100 |
| 63 | 100 |
| 50 | 100 |
| 37.5 | 100 |
| 28 | 100 |
| 20 | 100 |
| 14 | 100 |
| 10 | 100 |
| 6.3 | 100 |
| 5.0 | 100 |
| 3.35 | 100 |
| 2.00 | 100 |
| 1.18 | 99 |
| 0.600 | 99 |
| 0.425 | 98 |
| 0.300 | 96 |
| 0.212 | 93 |
| 0.150 | 89 |
| 0.063 | 64 |
| **0.020** | |
| **0.006** | |
| **0.002** | |

Comments:

Approved Signatory: M. Hartnup - Laboratory Manager Signed:

**for and on behalf of Ground Engineering Ltd**

Date Reported: 23.03.2020 Page 1 of 1
Form Number: GELab/C/709-2 Version 52

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# TEST CERTIFICATE

## Determination of Particle Size Distribution

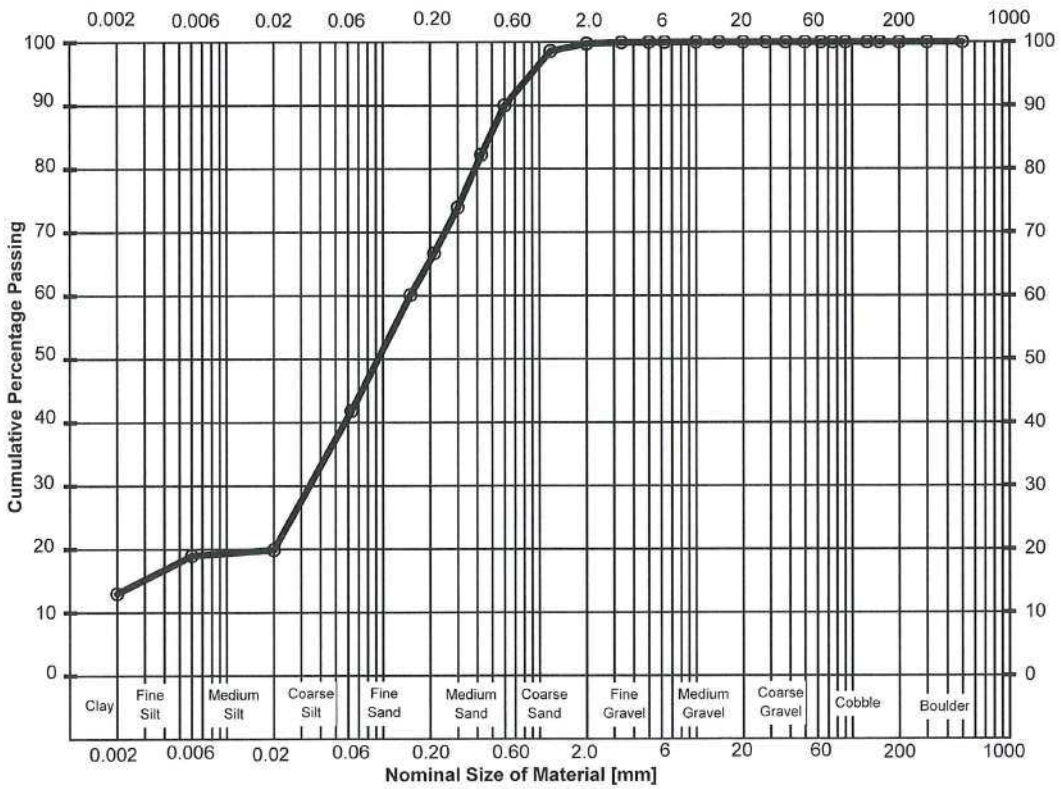
Tested in Accordance with BS 1377-2: 1990: Clause 9.2 & 9.4
Sieved Grading and Sedimentation by Pipette

| | | | |
|---|---|---|---|
| Client: | Ground Engineering Ltd | Certificate Number: | PL6999-1/9/710-2 |
| Client Address: | Newark Road | Client Reference: | C14985 |
| | Peterborough | Lab Job Number: | PL6999-1 |
| | PE1 5UA | Date Sampled: | Unknown |
| | | Date Received: | 28.02.2020 |
| Contact: | Simon Weatherley | Date Tested: | 04.03.2020 |
| | | Certificate of Sampling: | N/A |
| Site Name: | Land off Wardentree Lane | Sampling Certificate No.: | N/A |
| Site Address: | Spalding | Sampled By: | Client |

**TEST RESULTS** **Laboratory Reference:** PL6999-1/9 **Pre-treatment for organic material:** No
**Client Reference:** B1

**Sample Description:** Firm brown orange-brown clayey silty SAND.

**Material Specification:** Not Required **Depth Top:** 0.50m
**Location:** TP5 **Depth Base:** 0.80m
**Source:** **Supplier:**




**Sieve Analysis**

| Sieve mm | %Passing |
|---|---|
| 125 | 100 |
| 90 | 100 |
| 75 | 100 |
| 63 | 100 |
| 50 | 100 |
| 37.5 | 100 |
| 28 | 100 |
| 20 | 100 |
| 14 | 100 |
| 10 | 100 |
| 6.3 | 100 |
| 5.0 | 100 |
| 3.35 | 100 |
| 2.00 | 100 |
| 1.18 | 99 |
| 0.600 | 90 |
| 0.425 | 82 |
| 0.300 | 74 |
| 0.212 | 67 |
| 0.150 | 60 |
| 0.063 | 42 |
| **0.020** | **20** |
| **0.006** | **19** |
| **0.002** | **13** |

Comments: Data relevant to material below 63 microns is outside the current scope of UKAS accreditation

Approved Signatory: M. Hartnup - Laboratory Manager Signed:

**for and on behalf of Ground Engineering Ltd**

Date Reported: 23.03.2020 Page 1 of 1
Form Number: GELab/C/709-2 Version 52

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# TEST CERTIFICATE

## Determination of Particle Size Distribution

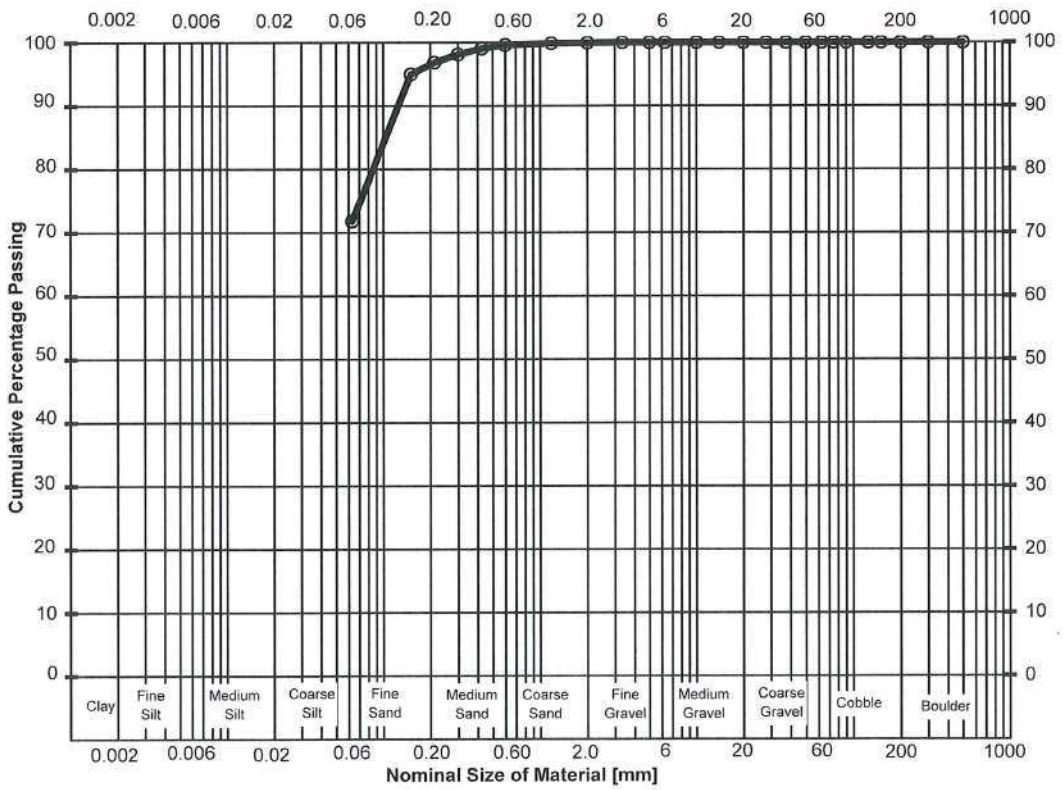
Tested in Accordance with BS 1377-2: 1990: Clause 9.2
Sieved Grading

| | | | |
|---|---|---|---|
| Client: | Ground Engineering Ltd | Certificate Number: | PL6999-1/11/710-2 |
| Client Address: | Newark Road<br>Peterborough<br>PE1 5UA | Client Reference: | C14985 |
| | | Lab Job Number: | PL6999-1 |
| | | Date Sampled: | Unknown |
| | | Date Received: | 28.02.2020 |
| Contact: | Simon Weatherley | Date Tested: | 04.03.2020 |
| | | Certificate of Sampling: | N/A |
| Site Name: | Land off Wardentree Lane | Sampling Certificate No.: | N/A |
| Site Address: | Spalding | Sampled By: | Client |

**TEST RESULTS** **Laboratory Reference:** PL6999-1/11 **Pre-treatment for organic material:** N/A
**Client Reference:** B2

**Sample Description:** Firm brown orange-brown clayey silty SAND.

**Material Specification:** Not Required **Depth Top:** 2.00m
**Location:** TP5 **Depth Base:** 2.50m
**Source:** **Supplier:**




**Sieve Analysis**

| Sieve mm | %Passing |
|---|---|
| 125 | 100 |
| 90 | 100 |
| 75 | 100 |
| 63 | 100 |
| 50 | 100 |
| 37.5 | 100 |
| 28 | 100 |
| 20 | 100 |
| 14 | 100 |
| 10 | 100 |
| 6.3 | 100 |
| 5.0 | 100 |
| 3.35 | 100 |
| 2.00 | 100 |
| 1.18 | 100 |
| 0.600 | 100 |
| 0.425 | 99 |
| 0.300 | 98 |
| 0.212 | 97 |
| 0.150 | 95 |
| 0.063 | 72 |
| **0.020** | |
| **0.006** | |
| **0.002** | |

Comments:

Approved Signatory: M. Hartnup - Laboratory Manager Signed:

**for and on behalf of Ground Engineering Ltd**

Date Reported: 23.03.2020 Page 1 of 1
Form Number: GELab/C/709-2 Version 52

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# TEST CERTIFICATE

## Determination of Particle Size Distribution

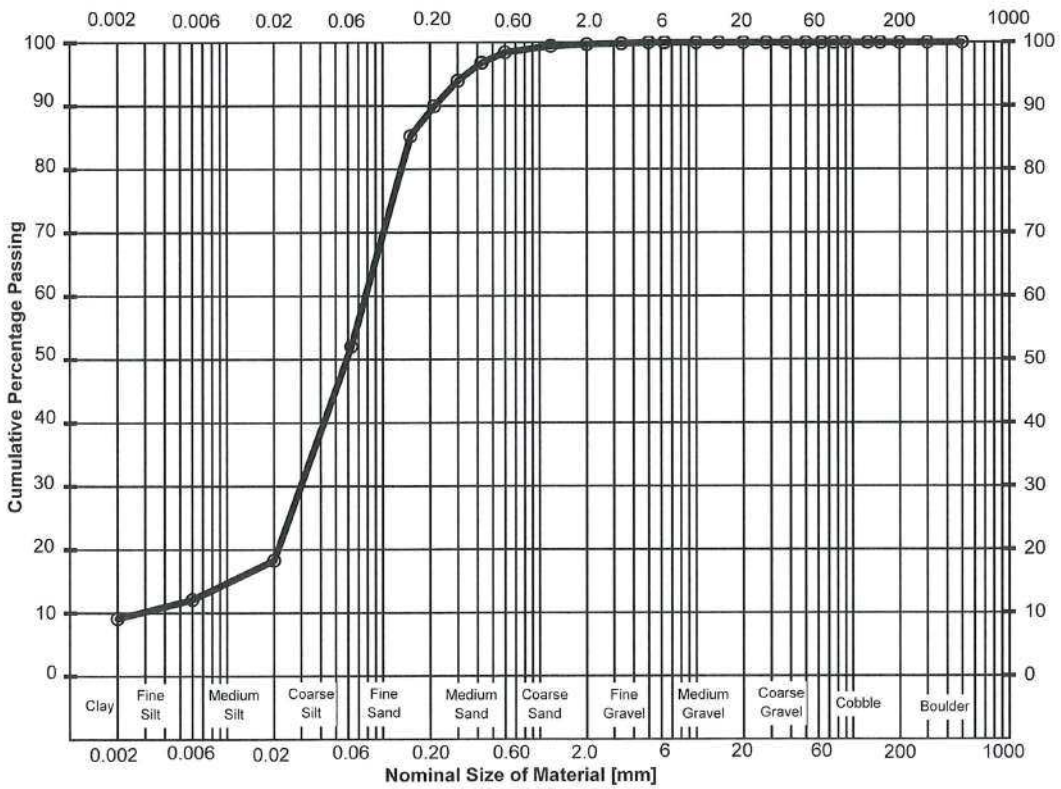
Tested in Accordance with BS 1377-2: 1990: Clause 9.2 & 9.4
Sieved Grading and Sedimentation by Pipette

| | | | |
|---|---|---|---|
| Client: | Ground Engineering Ltd | Certificate Number: | PL6999-1/17/710-2 |
| Client Address: | Newark Road | Client Reference: | C14985 |
| | Peterborough | Lab Job Number: | PL6999-1 |
| | PE1 5UA | Date Sampled: | Unknown |
| | | Date Received: | 28.02.2020 |
| Contact: | Simon Weatherley | Date Tested: | 04.03.2020 |
| | | Certificate of Sampling: | N/A |
| Site Name: | Land off Wardentree Lane | Sampling Certificate No.: | N/A |
| Site Address: | Spalding | Sampled By: | Client |

**TEST RESULTS** **Laboratory Reference:** PL6999-1/17 **Pre-treatment for organic material:** No
**Client Reference:** B1

**Sample Description:** Brown orange-brown clayey SILT/SAND.

**Material Specification:** Not Required **Depth Top:** 0.50m
**Location:** TP10 **Depth Base:** 0.80m
**Source:** **Supplier:**




**Sieve Analysis**

| Sieve mm | %Passing |
|---|---|
| 125 | 100 |
| 90 | 100 |
| 75 | 100 |
| 63 | 100 |
| 50 | 100 |
| 37.5 | 100 |
| 28 | 100 |
| 20 | 100 |
| 14 | 100 |
| 10 | 100 |
| 6.3 | 100 |
| 5.0 | 100 |
| 3.35 | 100 |
| 2.00 | 100 |
| 1.18 | 99 |
| 0.600 | 98 |
| 0.425 | 97 |
| 0.300 | 94 |
| 0.212 | 90 |
| 0.150 | 85 |
| 0.063 | 52 |
| **0.020** | **18** |
| **0.006** | **12** |
| **0.002** | **9** |

Comments: Data relevant to material below 63 microns is outside the current scope of UKAS accreditation

Approved Signatory: M. Hartnup - Laboratory Manager Signed:

**for and on behalf of Ground Engineering Ltd**

Date Reported: 23.03.2020 Page 1 of 1
Form Number: GELab/C/709-2 Version 52

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# TEST CERTIFICATE

## One-Dimensional Consolidation Properties

(Tested in accordance with BS1377 : Part 5 1990)

| | | | |
|---|---|---|---|
| Client: | Ground Engineering | Certificate Number: | PL7006-1-5/731 |
| Client Address: | Newark Road | Client Reference Number: | C14985 |
| | Peterborough | Date Sampled: | Unknown |
| | Cambridgeshire | Date Received: | 13.03.2020 |
| Postcode: | PE1 5UA | Date Tested: | 24.03.2020 |
| Contact: | Simon Weatherley | Sampling Certificate No: | N/A |
| Site Name: | Land off Wardentree Lane | Certificate of Sampling: | N/A |
| Site Address: | Spalding | Sampled By: | Client |

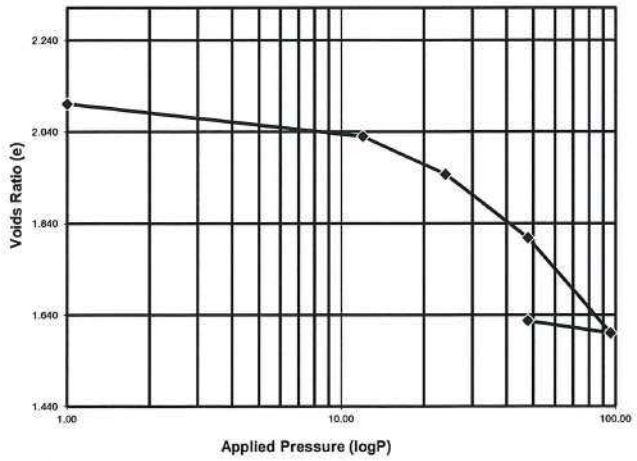
### Test Details

| | | |
|---|---|---|
| Location: | BH2 | |
| Sample Ref: | U1 | |
| Sample Description: | Very soft brown gray black slightly organic CLAY with peaty pockets. | |
| Particle Density ( $Mg/m^3$ ): | 2.5 | Assumed |
| Mean Lab Temp. ( $^oC$ ): | 22 | |
| Variations from Standard: | None | |
| Lab Reference: | PL7006-1-5 | |
| Depth: | 3.10 m | |

### Specimen Details

| | INITIAL | FINAL |
|---|---|---|
| Height ( mm ): | 18.67 | 15.82 |
| Bulk Density ( $Mg/m^3$ ): | 1.47 | 1.57 |
| Moisture Content ( % ): | 83 | 65 |
| Dry Density ( $Mg/m^3$ ): | 0.81 | 0.95 |
| Voids Ratio: | 2.101 | 1.627 |
| Degree of Saturation ( % ): | 98.5 | 100.0 |
| Diameter ( mm ): | 74.98 | N/A |
| Swelling Pressure ( kPa ): | 1 | N/A |
| Method of time fitting used: | Log Time | N/A |

**Voids Ratio against logarithm of Applied Pressure**




| Applied Pressure (kPa) | Coefficient of Compressibility $m_v$ ($m^2$/MN) | Coefficient of Consolidation $c_v$ ($m^2$/year) |
|---|---|---|
| 1 | | |
| 12 | 2.10 | 0.78 |
| 24 | 2.28 | 0.56 |
| 48 | 1.96 | 0.38 |
| 96 | 1.55 | 0.30 |
| 48 | 0.22 | --- |
| | | |
| | | |
| | | |

Comments:

Approved Signatory: [x] M.Hartnup - Laboratory Manager
[ ] L.Petch - Team Leader

Signed:

**for and on behalf of Ground Engineering Ltd**

Date Reported: 03/04/2020

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**Simon Weatherley**
Ground Engineering Limited
Newark Road
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**t:** 01923 225404
**f:** 01923 237404
**e:** reception@i2analytical.com

# Analytical Report Number : 20-89513

| | | | |
|---|---|---|---|
| **Project / Site name:** | Nursery, Wardentree Lane, Pinchleek | **Samples received on:** | 28/02/2020 |
| **Your job number:** | SW1C14985 | **Samples instructed on:** | 28/02/2020 |
| **Your order number:** | | **Analysis completed by:** | 05/03/2020 |
| **Report Issue Number:** | 1 | **Report issued on:** | 05/03/2020 |
| **Samples Analysed:** | 6 soil samples | | |

**Signed:**

Zina Abdul Razzak
Senior Quality Specialist

**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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Any assessments of compliance with specifications are based on actual analytical results with no contribution from uncertainty of measurement. Application of uncertainty of measurement would provide a range within which the true result lies. An estimate of measurement uncertainty can be provided on request.


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

**Analytical Report Number: 20-89513**

**Project / Site name: Nursery, Wardentree Lane, Pinchleek**

| Lab Sample Number | | | | 1455981 | 1455982 | 1455983 | 1455984 | 1455985 |
|---|---|---|---|---|---|---|---|---|
| Sample Reference | | | | TP1 | TP2 | TP3 | TP4 | TP6 |
| Sample Number | | | | D2 | D1 | D1 | D1 | D1 |
| Depth (m) | | | | 0.60 | 0.20 | 0.20 | 0.20 | 0.20 |
| Date Sampled | | | | 25/02/2020 | 25/02/2020 | 25/02/2020 | 25/02/2020 | 25/02/2020 |
| 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 | 20 | 7.7 | 11 | 16 | 16 |
| Total mass of sample received | kg | 0.001 | NONE | 0.52 | 0.49 | 0.55 | 0.52 | 0.54 |
| **General Inorganics** | | | | | | | | |
| pH - Automated | pH Units | N/A | MCERTS | 8.0 | 8.3 | 8.2 | 8.2 | 7.4 |
| Total 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 | 85 | 55 | 75 | 30 | 41 |
| Water Soluble SO4 16hr extraction (2:1 Leachate Equivalent) | g/l | 0.00125 | MCERTS | 0.043 | 0.027 | 0.038 | 0.015 | 0.020 |
| Water Soluble SO4 16hr extraction (2:1 Leachate Equivalent) | mg/l | 1.25 | MCERTS | 42.5 | 27.4 | 37.5 | 15.1 | 20.3 |
| Organic Matter | % | 0.1 | MCERTS | 3.0 | 3.7 | 2.3 | 3.4 | 2.6 |
| **Total Phenols** | | | | | | | | |
| Total Phenols (monohydric) | mg/kg | 1 | MCERTS | < 1.0 | < 1.0 | < 1.0 | < 1.0 | < 1.0 |
| **Speciated PAHs** | | | | | | | | |
| Naphthalene | mg/kg | 0.05 | MCERTS | < 0.05 | 0.31 | < 0.05 | < 0.05 | < 0.05 |
| Acenaphthylene | mg/kg | 0.05 | MCERTS | < 0.05 | 0.94 | < 0.05 | < 0.05 | < 0.05 |
| Acenaphthene | mg/kg | 0.05 | MCERTS | < 0.05 | 0.76 | < 0.05 | < 0.05 | < 0.05 |
| Fluorene | mg/kg | 0.05 | MCERTS | < 0.05 | 0.95 | < 0.05 | < 0.05 | < 0.05 |
| Phenanthrene | mg/kg | 0.05 | MCERTS | < 0.05 | 13 | < 0.05 | 0.41 | < 0.05 |
| Anthracene | mg/kg | 0.05 | MCERTS | < 0.05 | 4.1 | < 0.05 | < 0.05 | < 0.05 |
| Fluoranthene | mg/kg | 0.05 | MCERTS | 0.76 | 35 | 0.42 | 0.77 | < 0.05 |
| Pyrene | mg/kg | 0.05 | MCERTS | 0.70 | 33 | 0.37 | 0.72 | < 0.05 |
| Benzo(a)anthracene | mg/kg | 0.05 | MCERTS | 0.48 | 24 | 0.28 | 0.39 | < 0.05 |
| Chrysene | mg/kg | 0.05 | MCERTS | 0.45 | 16 | 0.22 | 0.36 | < 0.05 |
| Benzo(b)fluoranthene | mg/kg | 0.05 | MCERTS | 0.57 | 26 | 0.37 | 0.45 | < 0.05 |
| Benzo(k)fluoranthene | mg/kg | 0.05 | MCERTS | 0.19 | 14 | 0.15 | 0.17 | < 0.05 |
| Benzo(a)pyrene | mg/kg | 0.05 | MCERTS | 0.29 | 24 | 0.27 | 0.31 | < 0.05 |
| Indeno(1,2,3-cd)pyrene | mg/kg | 0.05 | MCERTS | < 0.05 | 11 | < 0.05 | < 0.05 | < 0.05 |
| Dibenz(a,h)anthracene | mg/kg | 0.05 | MCERTS | < 0.05 | 3.3 | < 0.05 | < 0.05 | < 0.05 |
| Benzo(ghi)perylene | mg/kg | 0.05 | MCERTS | < 0.05 | 13 | < 0.05 | < 0.05 | < 0.05 |
| **Total PAH** | | | | | | | | |
| Speciated Total EPA-16 PAHs | mg/kg | 0.8 | MCERTS | 3.44 | 218 | 2.08 | 3.58 | < 0.80 |



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

**Analytical Report Number: 20-89513**

**Project / Site name: Nursery, Wardentree Lane, Pinchleek**

| Lab Sample Number | | | | 1455981 | 1455982 | 1455983 | 1455984 | 1455985 |
|---|---|---|---|---|---|---|---|---|
| Sample Reference | | | | TP1 | TP2 | TP3 | TP4 | TP6 |
| Sample Number | | | | D2 | D1 | D1 | D1 | D1 |
| Depth (m) | | | | 0.60 | 0.20 | 0.20 | 0.20 | 0.20 |
| Date Sampled | | | | 25/02/2020 | 25/02/2020 | 25/02/2020 | 25/02/2020 | 25/02/2020 |
| 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 | 11 | 15 | 11 | 14 | 12 |
| Boron (water soluble) | mg/kg | 0.2 | MCERTS | 3.2 | 1.9 | 1.9 | 3.2 | 1.9 |
| Cadmium (aqua regia extractable) | mg/kg | 0.2 | MCERTS | < 0.2 | < 0.2 | < 0.2 | < 0.2 | < 0.2 |
| Chromium (hexavalent) | mg/kg | 4 | MCERTS | < 4.0 | < 4.0 | < 4.0 | < 4.0 | < 4.0 |
| Chromium (III) | mg/kg | 1 | NONE | 18 | 22 | 16 | 23 | 24 |
| Chromium (aqua regia extractable) | mg/kg | 1 | MCERTS | 20 | 23 | 16 | 25 | 25 |
| Copper (aqua regia extractable) | mg/kg | 1 | MCERTS | 22 | 29 | 13 | 19 | 13 |
| Lead (aqua regia extractable) | mg/kg | 1 | MCERTS | 50 | 370 | 17 | 36 | 29 |
| Mercury (aqua regia extractable) | mg/kg | 0.3 | MCERTS | < 0.3 | < 0.3 | < 0.3 | < 0.3 | < 0.3 |
| Nickel (aqua regia extractable) | mg/kg | 1 | MCERTS | 16 | 22 | 11 | 19 | 18 |
| Selenium (aqua regia extractable) | mg/kg | 1 | MCERTS | < 1.0 | < 1.0 | < 1.0 | < 1.0 | < 1.0 |
| Zinc (aqua regia extractable) | mg/kg | 1 | MCERTS | 67 | 140 | 58 | 65 | 61 |
| **Monoaromatics & Oxygenates** | | | | | | | | |
| Benzene | µg/kg | 1 | MCERTS | < 1.0 | < 1.0 | - | - | - |
| Toluene | µg/kg | 1 | MCERTS | < 1.0 | < 1.0 | - | - | - |
| Ethylbenzene | µg/kg | 1 | MCERTS | < 1.0 | < 1.0 | - | - | - |
| p & m-xylene | µg/kg | 1 | MCERTS | < 1.0 | < 1.0 | - | - | - |
| o-xylene | µg/kg | 1 | MCERTS | < 1.0 | < 1.0 | - | - | - |
| MTBE (Methyl Tertiary Butyl Ether) | µg/kg | 1 | MCERTS | < 1.0 | < 1.0 | - | - | - |
| **Petroleum Hydrocarbons** | | | | | | | | |
| TPH-CWG - Aliphatic >EC5 - EC6 | mg/kg | 0.001 | MCERTS | < 0.001 | < 0.001 | - | - | - |
| TPH-CWG - Aliphatic >EC6 - EC8 | mg/kg | 0.001 | MCERTS | < 0.001 | < 0.001 | - | - | - |
| TPH-CWG - Aliphatic >EC8 - EC10 | mg/kg | 0.001 | MCERTS | < 0.001 | < 0.001 | - | - | - |
| TPH-CWG - Aliphatic >EC10 - EC12 | mg/kg | 1 | MCERTS | 9.9 | < 1.0 | - | - | - |
| TPH-CWG - Aliphatic >EC12 - EC16 | mg/kg | 2 | MCERTS | 21 | 9.3 | - | - | - |
| TPH-CWG - Aliphatic >EC16 - EC21 | mg/kg | 8 | MCERTS | 36 | 31 | - | - | - |
| TPH-CWG - Aliphatic >EC21 - EC35 | mg/kg | 8 | MCERTS | 110 | 92 | - | - | - |
| **TPH-CWG - Aliphatic (EC5 - EC35)** | mg/kg | 10 | MCERTS | 170 | 130 | - | - | - |
| TPH-CWG - Aromatic >EC5 - EC7 | mg/kg | 0.001 | MCERTS | < 0.001 | < 0.001 | - | - | - |
| TPH-CWG - Aromatic >EC7 - EC8 | mg/kg | 0.001 | MCERTS | < 0.001 | < 0.001 | - | - | - |
| TPH-CWG - Aromatic >EC8 - EC10 | mg/kg | 0.001 | MCERTS | < 0.001 | < 0.001 | - | - | - |
| TPH-CWG - Aromatic >EC10 - EC12 | mg/kg | 1 | MCERTS | < 1.0 | 1.6 | - | - | - |
| TPH-CWG - Aromatic >EC12 - EC16 | mg/kg | 2 | MCERTS | < 2.0 | 39 | - | - | - |
| TPH-CWG - Aromatic >EC16 - EC21 | mg/kg | 10 | MCERTS | < 10 | 290 | - | - | - |
| TPH-CWG - Aromatic >EC21 - EC35 | mg/kg | 10 | MCERTS | < 10 | 660 | - | - | - |
| **TPH-CWG - Aromatic (EC5 - EC35)** | mg/kg | 10 | MCERTS | < 10 | 990 | - | - | - |



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**Analytical Report Number: 20-89513**

**Project / Site name: Nursery, Wardentree Lane, Pinchleek**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Lab Sample Number** | | | | 1455986 | | | | |
| **Sample Reference** | | | | TP8 | | | | |
| **Sample Number** | | | | D1 | | | | |
| **Depth (m)** | | | | 0.20 | | | | |
| **Date Sampled** | | | | 25/02/2020 | | | | |
| **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 | 18 | | | | |
| Total mass of sample received | kg | 0.001 | NONE | 0.47 | | | | |
| **General Inorganics** | | | | | | | | |
| pH - Automated | pH Units | N/A | MCERTS | 7.9 | | | | |
| Total Cyanide | mg/kg | 1 | MCERTS | < 1 | | | | |
| Water Soluble Sulphate as $SO_4$ 16hr extraction (2:1) | mg/kg | 2.5 | MCERTS | 89 | | | | |
| Water Soluble SO4 16hr extraction (2:1 Leachate Equivalent) | g/l | 0.00125 | MCERTS | 0.045 | | | | |
| Water Soluble SO4 16hr extraction (2:1 Leachate Equivalent) | mg/l | 1.25 | MCERTS | 44.5 | | | | |
| Organic Matter | % | 0.1 | MCERTS | 2.9 | | | | |
| **Total Phenols** | | | | | | | | |
| Total Phenols (monohydric) | mg/kg | 1 | MCERTS | < 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 | < 0.05 | | | | |
| Pyrene | mg/kg | 0.05 | MCERTS | < 0.05 | | | | |
| Benzo(a)anthracene | mg/kg | 0.05 | MCERTS | < 0.05 | | | | |
| Chrysene | mg/kg | 0.05 | MCERTS | < 0.05 | | | | |
| Benzo(b)fluoranthene | mg/kg | 0.05 | MCERTS | < 0.05 | | | | |
| Benzo(k)fluoranthene | mg/kg | 0.05 | MCERTS | < 0.05 | | | | |
| Benzo(a)pyrene | mg/kg | 0.05 | MCERTS | < 0.05 | | | | |
| 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 | < 0.80 | | | | |



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**Project / Site name: Nursery, Wardentree Lane, Pinchleek**

| Lab Sample Number | | | | 1455986 | | | | |
|---|---|---|---|---|---|---|---|---|
| Sample Reference | | | | TP8 | | | | |
| Sample Number | | | | D1 | | | | |
| Depth (m) | | | | 0.20 | | | | |
| Date Sampled | | | | 25/02/2020 | | | | |
| 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 | | | | |
| Boron (water soluble) | mg/kg | 0.2 | MCERTS | 2.4 | | | | |
| Cadmium (aqua regia extractable) | mg/kg | 0.2 | MCERTS | < 0.2 | | | | |
| Chromium (hexavalent) | mg/kg | 4 | MCERTS | < 4.0 | | | | |
| Chromium (III) | mg/kg | 1 | NONE | 25 | | | | |
| Chromium (aqua regia extractable) | mg/kg | 1 | MCERTS | 26 | | | | |
| Copper (aqua regia extractable) | mg/kg | 1 | MCERTS | 17 | | | | |
| Lead (aqua regia extractable) | mg/kg | 1 | MCERTS | 120 | | | | |
| Mercury (aqua regia extractable) | mg/kg | 0.3 | MCERTS | < 0.3 | | | | |
| Nickel (aqua regia extractable) | mg/kg | 1 | MCERTS | 19 | | | | |
| Selenium (aqua regia extractable) | mg/kg | 1 | MCERTS | < 1.0 | | | | |
| Zinc (aqua regia extractable) | mg/kg | 1 | MCERTS | 69 | | | | |
| **Monoaromatics & Oxygenates** | | | | | | | | |
| Benzene | µg/kg | 1 | MCERTS | - | | | | |
| Toluene | µg/kg | 1 | MCERTS | - | | | | |
| Ethylbenzene | µg/kg | 1 | MCERTS | - | | | | |
| p & m-xylene | µg/kg | 1 | MCERTS | - | | | | |
| o-xylene | µg/kg | 1 | MCERTS | - | | | | |
| MTBE (Methyl Tertiary Butyl Ether) | µg/kg | 1 | MCERTS | - | | | | |
| **Petroleum Hydrocarbons** | | | | | | | | |
| TPH-CWG - Aliphatic >EC5 - EC6 | mg/kg | 0.001 | MCERTS | - | | | | |
| TPH-CWG - Aliphatic >EC6 - EC8 | mg/kg | 0.001 | MCERTS | - | | | | |
| TPH-CWG - Aliphatic >EC8 - EC10 | mg/kg | 0.001 | MCERTS | - | | | | |
| TPH-CWG - Aliphatic >EC10 - EC12 | mg/kg | 1 | MCERTS | - | | | | |
| TPH-CWG - Aliphatic >EC12 - EC16 | mg/kg | 2 | MCERTS | - | | | | |
| TPH-CWG - Aliphatic >EC16 - EC21 | mg/kg | 8 | MCERTS | - | | | | |
| TPH-CWG - Aliphatic >EC21 - EC35 | mg/kg | 8 | MCERTS | - | | | | |
| **TPH-CWG - Aliphatic (EC5 - EC35)** | mg/kg | 10 | MCERTS | - | | | | |
| TPH-CWG - Aromatic >EC5 - EC7 | mg/kg | 0.001 | MCERTS | - | | | | |
| TPH-CWG - Aromatic >EC7 - EC8 | mg/kg | 0.001 | MCERTS | - | | | | |
| TPH-CWG - Aromatic >EC8 - EC10 | mg/kg | 0.001 | MCERTS | - | | | | |
| TPH-CWG - Aromatic >EC10 - EC12 | mg/kg | 1 | MCERTS | - | | | | |
| TPH-CWG - Aromatic >EC12 - EC16 | mg/kg | 2 | MCERTS | - | | | | |
| TPH-CWG - Aromatic >EC16 - EC21 | mg/kg | 10 | MCERTS | - | | | | |
| TPH-CWG - Aromatic >EC21 - EC35 | mg/kg | 10 | MCERTS | - | | | | |
| **TPH-CWG - Aromatic (EC5 - EC35)** | mg/kg | 10 | MCERTS | - | | | | |



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* 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 * |
|---|---|---|---|---|
| 1455981 | TP1 | D2 | 0.60 | Brown loam and clay with gravel. |
| 1455982 | TP2 | D1 | 0.20 | Brown loam and clay with gravel and vegetation. |
| 1455983 | TP3 | D1 | 0.20 | Brown loam and clay with gravel and vegetation. |
| 1455984 | TP4 | D1 | 0.20 | Brown clay and loam with vegetation. |
| 1455985 | TP6 | D1 | 0.20 | Brown clay and loam. |
| 1455986 | TP8 | D1 | 0.20 | Brown clay and loam. |


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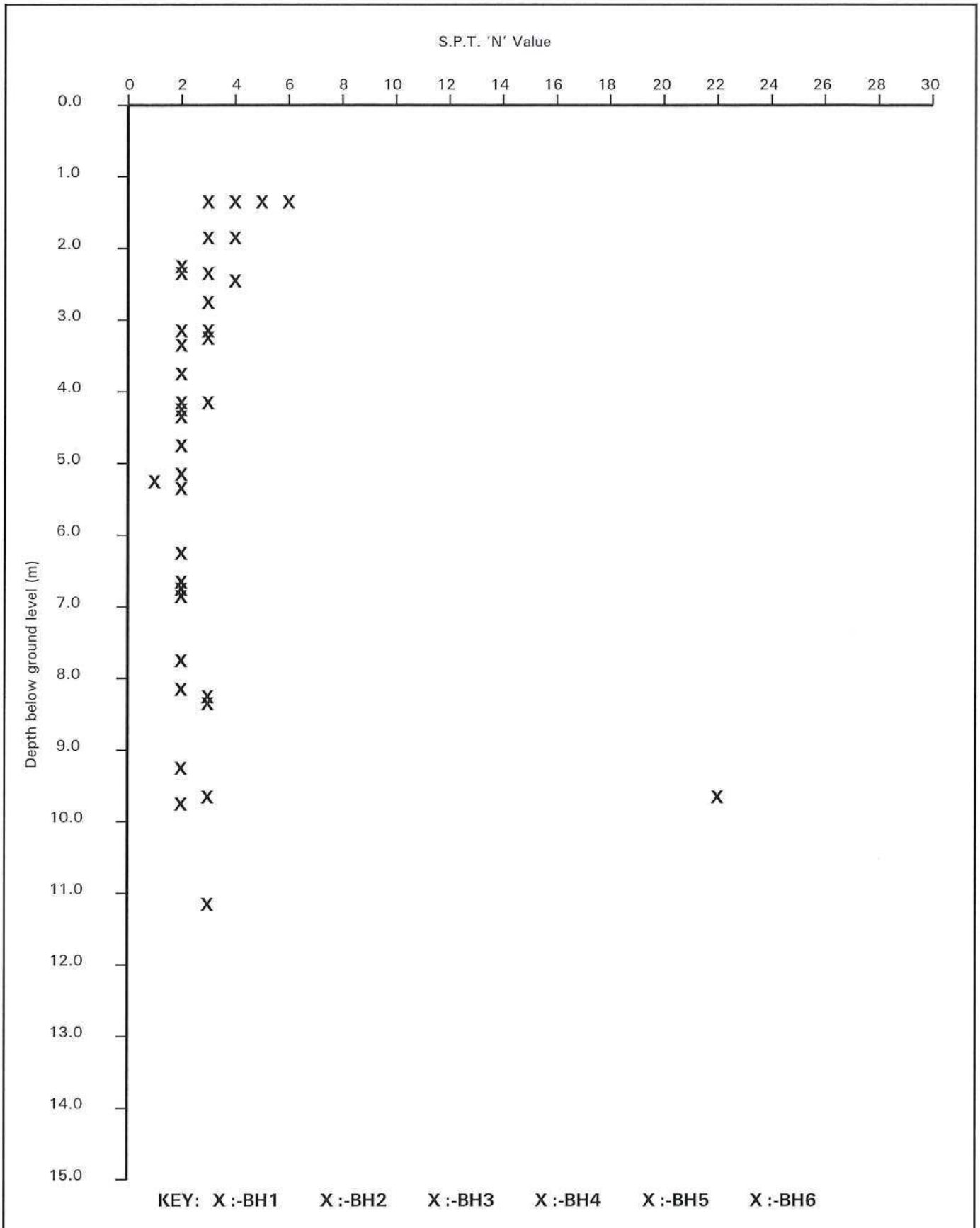
**Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Water (PrW)**

| Analytical Test Name | Analytical Method Description | Analytical Method Reference | Method number | Wet / Dry Analysis | Accreditation Status |
|---|---|---|---|---|---|
| Boron, water soluble, in soil | Determination of water soluble boron in soil by hot water extract followed by ICP-OES. | In-house method based on Second Site Properties version 3 | L038-PL | D | MCERTS |
| BTEX and MTBE in soil (Monoaromatics) | Determination of BTEX in soil by headspace GC-MS. | In-house method based on USEPA8260 | L073B-PL | W | MCERTS |
| Cr (III) in soil | In-house method by calculation from total Cr and Cr VI. | In-house method by calculation | L080-PL | W | NONE |
| Hexavalent chromium in soil | 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. (30 oC) | In house method. | L019-UK/PL | W | NONE |
| Monohydric phenols in soil | Determination of phenols in soil by extraction with sodium hydroxide followed 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 |
| Organic matter (Automated) in soil | Determination of organic matter in soil by oxidising with potassium dichromate followed by titration with iron (II) sulphate. | In house method. | L009-PL | D | MCERTS |
| pH in soil (automated) | Determination of pH in soil by addition of water followed by automated electrometric measurement. | In house method. | L099-PL | D | MCERTS |
| 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. | 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 |
| TPHCWG (Soil) | Determination of hexane extractable hydrocarbons in soil by GC-MS/GC-FID. | In-house method with silica gel split/clean up. | L088/76-PL | W | MCERTS |

**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.**

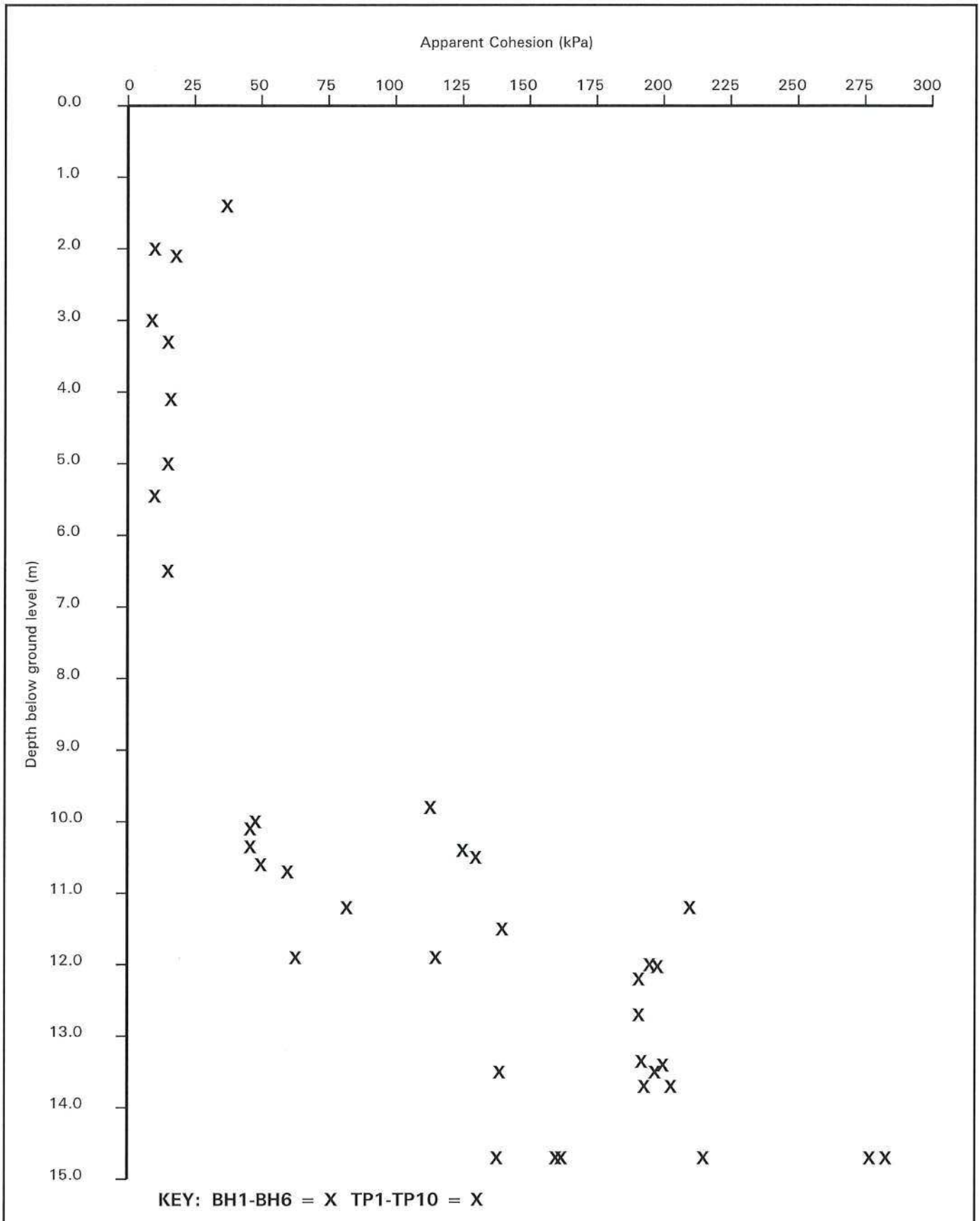


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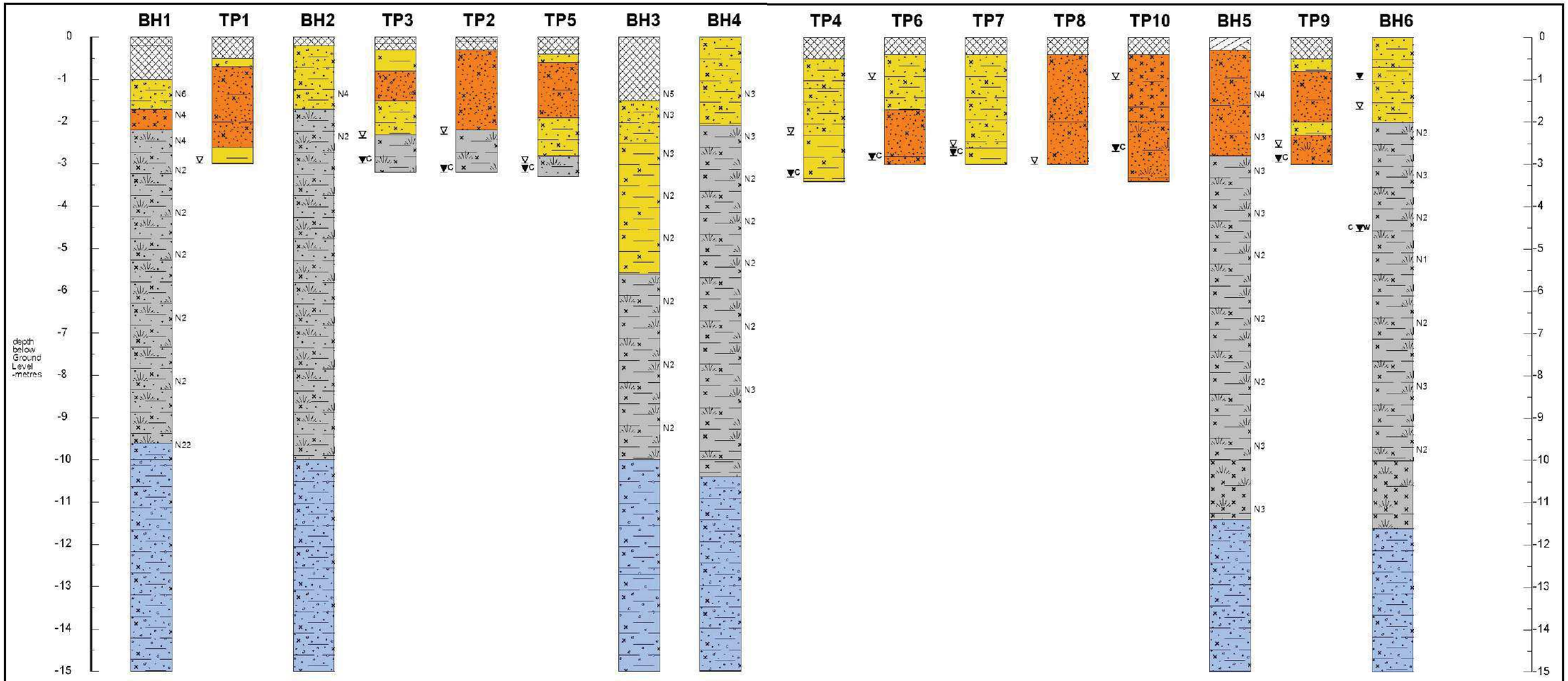

S.P.T. 'N' Value vs Depth below ground level (m).

| | | |
|---|---|---|
| SITE | LAND OFF WARDENTREE LANE, SPALDING | |
| CLIENT | CLAIRE TIDSWELL & MARK PRESTON | Contract Number 14985 |
| GROUND ENGINEERING LIMITED Tel: 01733-566566 www.groundengineering.co.uk | Date 20/04/20 | Figure 1 |




Apparent Cohesion (kPa) vs Depth below ground level (m).

| | | |
|---|---|---|
| SITE | LAND OFF WARDENTREE LANE, SPALDING | |
| CLIENT | CLAIRE TIDSWELL & MARK PRESTON | Contract Number 14985 |
| GROUND ENGINEERING LIMITED Tel: 01733-566566 www.groundengineering.co.uk | Date 20/04/20 | Figure 2 |




## KEY TO LEGENDS

- MADE GROUND
- TOPSOIL
- TIDAL FLAT DEPOSIT - Silty CLAY
- TIDAL FLAT DEPOSIT - Sandy SILT
- TIDAL FLAT DEPOSIT - Silty SAND
- TIDAL FLAT DEPOSIT - Slightly organic CLAY
- TILL
- ▽ Groundwater Encountered
- ▼ Groundwater Rise
- ▼c Level on Completion
- c▼w Level Casing Withdrawn

| | | | |
|---|---|---|---|
| SITE | LAND OFF WARDENTREE LANE, SPALDING | | Contract No. 14985 |
| CLIENT | CLAIRE TIDSWELL & MARK PRESTON | Soil Profile | Vertical Scale 1:100 |
| ©GROUND ENGINEERING, NEWARK ROAD, PETERBOROUGH. Tel (01733) 566566 | | Date 20/04/20 | Fig. No 3 |