CJAssociates

# Ground Investigation No. 2071724
# Factual and Interpretative Report
# [DRAFT]
# Cowbridge Primary School
# Vale of Glamorgan

May 2021

**Geotechnical and environmental services you can rely on.**

**CJ Associates Geotechnical Limited**
Portview Road, Avonmouth, Bristol, BS11 9JE
Tel: 0117 982 1473

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# Factual and Interpretative Report
# [DRAFT]
# Cowbridge Primary School
# Vale of Glamorgan

## May 2021

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**Client:**
Morgan Sindall Construction & Infrastructure Ltd.

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# 1.INTRODUCTION

## 1.1 Instruction

C.J. Associates Geotechnical Limited (CJA) was instructed by Morgan Sindall Construction & Infrastructure Ltd (the Client) to carry out a ground investigation at Cowbridge Primary School in the Vale of Glamorgan, South Wales.

## 1.2 Proposed Development

According to information supplied by the Client, the proposed development will comprise a new 2-storey school building with associated areas of soft landscaping and hardstanding and a new MUGA pitch.

## 1.3 Brief and Report Scope

The general specification for the works was provided by [Client/Engineer] and incorporated the brief to undertake window sample boreholes and trial pits with associated sampling and in-situ testing, gas/groundwater monitoring, in situ CBR and soakaway testing, laboratory geotechnical and contamination testing and the provision of a Factual & Interpretative Report.

This report presents full factual records of the site work carried out, the ground conditions encountered in the exploratory holes, the in situ and laboratory test results and the results of any monitoring of ground installations. All information collected has been used to provide an interpretation of the ground conditions, with recommendations on geotechnical design and potential ground contamination risks for the proposed development.

## 1.4 Limitations

The recommendations and opinions expressed in this report are based on the strata observed in the exploratory holes, the results of the site and laboratory tests, and information obtained as part of the desk study or provided by others. CJA take no responsibility for conditions that have not been revealed by the exploratory holes, or which occur between them. Information provided from other sources is taken in good faith and CJA cannot guarantee its accuracy.

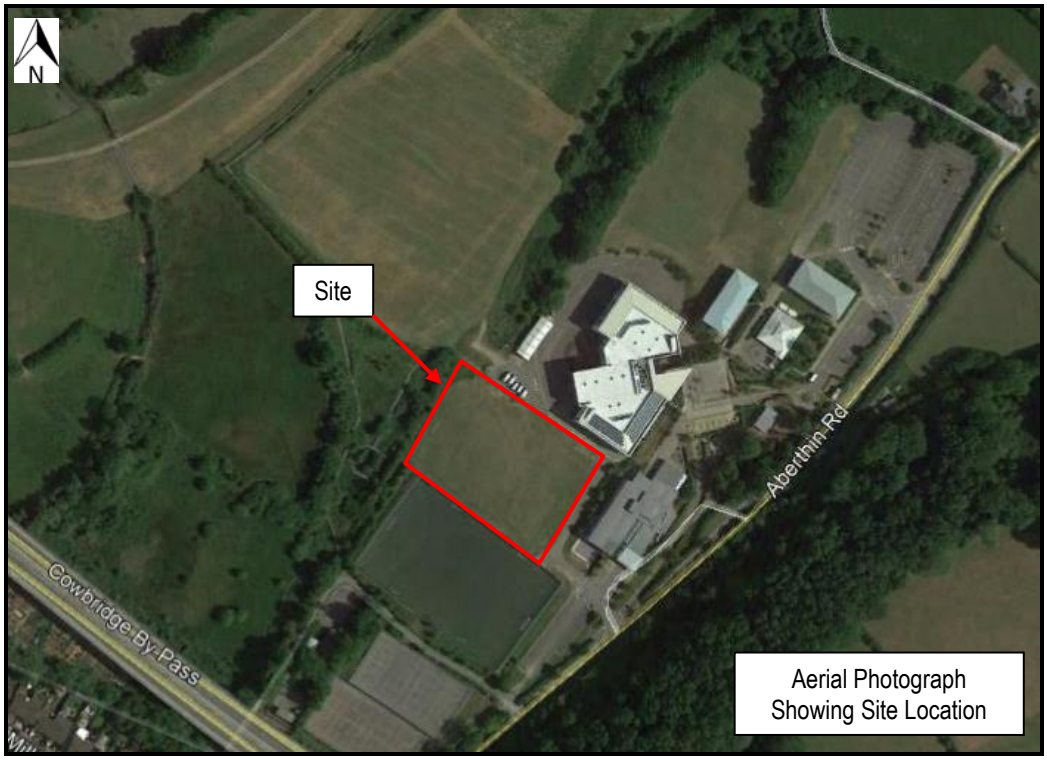
The report has been prepared exclusively for the Client, for the site area indicated, and for the purpose stated. CJA accepts no responsibility for any site, client or type of

development not indicated in this report. This report should be reviewed at all stages of construction by someone familiar with the terms and assumptions it contains. It is essential that a suitably qualified and experienced engineer be appointed for the design of the works, and supervise construction.

# 2.THE SITE

## 2.1 Site Location & Description

The site is an existing sports pitch located immediately southwest of the main buildings and associated infrastructure of Cowbridge Comprehensive School in the Vale of Glamorgan, South Wales at National Grid Reference ST 00232 74882, and is shown on the Site Location Plan, included in the Appendices to this report and in the aerial photograph below.




## 2.2 Published Geology

According to the British Geological Survey (BGS) the site is underlain by superficial Glaciofluvial Deposits overlying the Mercia Mudstone of Triassic Age.

The Glaciofluvial Deposits is described as comprising mostly coarse-grained sand and gravel with some layers of clay and silt. The underlying Mercia Mudstone is described as typically consisting of conglomerate and/or breccia with clasts derived locally from rocks lying immediately below the unconformable base of these deposits. The matrix generally consists of finer-grained rock fragments or, less commonly, siltstone, sandstone or micritic limestone.

# 3.FIELDWORK

## 3.1 General

The fieldwork, scheduled by the Client was carried out by CJA on 7th April 2021 and comprised window sampling, installation of standpipes, trial pitting and associated sampling and in situ testing.

The fieldwork was carried out generally in accordance with BS 5930:2015 *Code of Practice for Site Investigations*, *Eurocode 7*, and the Client's instructions, unless otherwise stated. The exploratory hole locations were determined by the Client and are shown approximately on the Exploratory Hole Location Plan, included in the Appendices. A summary of exploratory holes undertaken is presented in the following table.

***Summary of Exploratory Holes Undertaken***

| Hole | Type* | Depth (m) | Date Started | Date Finished | Backfill Details** |
|---|---|---|---|---|---|
| WS1 | WS | 5.00 | 07/04/21 | 07/04/21 | SP |
| WS2 | WS | 5.00 | 07/04/21 | 07/04/21 | A |
| WS3 | WS | 5.00 | 07/04/21 | 07/04/21 | A |
| WS4 | WS | 5.00 | 07/04/21 | 07/04/21 | SP |
| WS5 | WS | 5.00 | 07/04/21 | 07/04/21 | A |
| WS6 | WS | 5.00 | 07/04/21 | 07/04/21 | SP |
| TP1 | TP | 1.20 | 07/04/21 | 07/04/21 | A |
| TP2 | TP | 1.30 | 07/04/21 | 07/04/21 | A |
| TP3 | TP | 1.50 | 07/04/21 | 07/04/21 | A |
| TP4 | TP | 1.40 | 07/04/21 | 07/04/21 | A |
| TP5 | TP | 1.20 | 07/04/21 | 07/04/21 | A |
| TP6 | TP | 1.50 | 07/04/21 | 07/04/21 | A |
| DCP01 | TRL | 0.82 | 07/04/21 | 07/04/21 | - |
| DCP02 | TRL | 0.82 | 07/04/21 | 07/04/21 | - |
| DCP03 | TRL | 0.66 | 07/04/21 | 07/04/21 | - |
| DCP04 | TRL | 0.62 | 07/04/21 | 07/04/21 | - |
| DCP05 | TRL | 0.36 | 07/04/21 | 07/04/21 | - |
| DCP06 | TRL | 0.79 | 07/04/21 | 07/04/21 | - |

*WS = Window Sample, TP = Trial Pit, trl = In Situ CBR Test.
**A = Arisings, SP = standpipe

All exploratory hole locations were scanned for buried services using a Cable Avoidance Tool (CAT).

On completion all samples recovered from the site were taken to CJA's laboratory for further examination and testing. Details of the depths and types of samples recovered are indicated on the attached log sheets.

### 3.2 Window Sampler Boring

Six window sample boreholes (designated WS1 to WS6 inclusive) were each sunk to a depth of 5.00m below existing ground level.

Window sampler boring is carried out with a small, track-mounted rig, which uses a chain-driven trip hammer to drive sampling tubes or penetrometers into the ground. These tools are coupled to the anvil of the hammer by solid drill rods. Sampling tubes comprise “windowless samplers”, which are plain sampler tubes in which a continuous disturbed sample is recovered within a semi-rigid plastic liner. In order to reduce friction within the borehole, sampling tubes of progressively smaller diameter are used as the borehole depth increases. Sampler diameters generally range from between approximately 90mm to 50mm.

Standard penetration tests (SPT’s), as described below in the *In Situ Tests* section, were conducted in suitable materials.

Groundwater observations were noted where possible. These observations relate to the time of the investigation only, and do not necessarily reflect seasonal fluctuations.

In accordance with the Client’s instructions, a 50mm diameter standpipe was installed in WS1, WS4 and WS6, at depths of between 3.0m and 4.0m below ground level. Installation and backfill details are shown with the appropriate borehole logsheet.

### 3.3 Trial Pitting

To supplement the borehole investigation six trial pits (designated TP1 to TP6 inclusive) were excavated to depths of between 1.2m and 1.5m below existing ground level, using a wheeled excavator, under the direct and continuous supervision of CJA.

In situ Hand Shear Vane (HSV) tests were completed as appropriate, and representative disturbed samples were recovered from the excavated material as pitting proceeded. Details of groundwater conditions were noted.

The trial pits were backfilled immediately on completion of sampling and testing.

### 3.4 Groundwater / Gas Monitoring

CJA carried out groundwater/gas monitoring in standpipes after the fieldwork period, the results of which are presented in the Appendices to this report.

## 3.5 In Situ Tests

### 3.5.1 Standard Penetration Tests

Standard Penetration Tests (SPT's), were carried out in the window sample boreholes in accordance with BS EN ISO 22476-3. Standard Penetration Tests (SPT's) consist of the dynamic driving of a 450mm long, 50mm diameter "split-spoon" sampler, using a standard 63.5kg trip hammer, falling over a distance of 760mm. The hammer anvil is connected to the sampler by steel boring rods. A small disturbed sample is usually recovered from the sampling barrel during the test. In very coarse-grained materials, or weak rocks, the sampler (or sampler shoe) is generally replaced by a 60° solid steel cone (referred to as SPT (c) tests). No samples are recovered using a solid cone.

The number of hammer blows required to drive the sampler or cone each consecutive 75mm is recorded, and is shown on the attached borehole logs. The first 150mm is regarded as the seating penetration, and the last 300mm as the test drive. The result of the test, referred to as the "N-value", consists of the total number of blows relating to the test drive. Conventionally, the test drive is terminated after 50 blows if the full 300mm penetration has not been achieved. In this case the N-value is stated as N >

### 3.5.2 In situ CBR tests (TRL Dynamic Probe)

The California Bearing Ratio (CBR) of near surface materials was examined using hand held dynamic cone penetrometer. Each test was performed at existing ground surface. The test is performed by using an 8kg weight dropping a height of 575mm to drive a 20mm diameter 60 degree cone into the subsoil. The blow counts are recorded against penetration achieved and the results are plotted graphically. The CBR value of the various layers is then determined by reading from a graph showing the DCP-CBR relationship by Kleyn and Van Heerd(1983). Test Results are included in the Appendices to this report.

### 3.5.3 Soakaway Tests

Soakaway tests were carried out in all the trial pits generally in accordance with BRE Digest 365(2016), the results of which are included in the Appendices to this Report.

## 3.6 The Logging of Soils and Rocks

The logging of soils and rocks has been carried out in accordance with BS5930(2015) except where superseded by the soil and rock description methodology in BS EN14688-1(2002), BS EN 14688-2(2004) and BS EN 14689-1(2003).

# 4. LABORATORY WORK

## 4.1 Geotechnical Tests

A programme of laboratory testing was carried out on samples taken from the various strata to assist in classification and determine the engineering properties of the materials underlying the site. The testing was scheduled by CJA and carried out by CJA, Structural Soils and Envirolab. The test procedures used were generally in accordance with the methods described in BS1377:1990 and BS EN 17892-1:2014. Details of the specific tests used in each case are given below:

| TEST | STANDARD | No. |
|---|---|---|
| Water Content | BS EN 17892-1 : 2014 | 12 |
| Liquid Limit, Plastic Limit, Plasticity Index | BS1377:1990 Part 2, Clause 4/5 | 12 |
| Particle size distribution (wet) | BS1377:1990 Part 2, Clause 9.2 | 4 |
| Sedimentation by hydrometer | BS1377:1990 Part 2, Clause 9.5 | 1 |
| Sulphate content of 2:1 soil:water extract | BS1377:1990 Part 3, Clause 5 | 5 |
| pH value | BS1377:1990 Part 3, Clause 9 | 5 |

The results of the laboratory geotechnical tests are included in the Appendices to this Report.

## 4.2 Contamination Tests

The environmental chemistry of the ground was investigated by specialist chemical analysis of selected samples, scheduled by CJA and carried out by Envirolab.

Details of the specific tests used in each case are given below:

| TEST | No. |
|---|---|
| CJA General Contamination Suite:<br>*Arsenic, Beryllium, Boron, Cadmium, Chromium, Copper, Lead, Mercury, Nickel, Selenium, Vanadium, Zinc, Cyanide, Thiocyanate, Phenol, Sulphate ($SO_4$), Sulphide, pH, Sulphur, Soil Organic Matter and speciated Polyaromatic Hydrocarbons (PAH).* | 7 |
| Asbestos Screen | 7 |
| Speciated Total Petroleum Hydrocarbons (TPH) | 4 |
| Total TPH | 3 |

The results of the laboratory contamination tests are included in the Appendices to this Report.

The range of potentially hazardous contaminants present on the site can be wide and varied, and the suite has been chosen to reflect both commonly found contaminants and others indicated by research to have a significant risk of being present. It is, however, possible that others may exist for which analyses have not been carried out.

It is also possible that contaminants exist on the site but were not present at any of the exploratory hole locations.

# 5.GROUND CONDITIONS ENCOUNTERED

## 5.1 Soil Profile

The sequence of strata encountered beneath the site was:

- Topsoil/Made Ground
- Glaciofluvial deposits (orange/grey/brown sandy clay/silt)
- Weathered Mercia Mudstone (red brown clay/silt)

The depths of the various materials encountered in each of the exploratory holes are summarised in the following table. It is difficult, in places, to distinguish between Topsoil and Made Ground. For the purposes of this report surface layers are considered as Topsoil where there is no content (i.e. brick, concrete, clinker etc.) to suggest it is Made Ground. The Glaciofluvial Deposits and Weathered Mercia Mudstone are also similar and for the purposes of this report are referred to as 'Natural Clay'.

***Summary of Ground Conditions Encountered***

| Hole | Depth to Stratum (m) | | | | | | GROUNDWATER |
|---|---|---|---|---|---|---|---|
| | TOPSOIL | MADE GROUND | | | NATURAL CLAY | | |
| | Sandy/ gravelly CLAY with rootlets | Sandy/gravelly CLAY with brick, concrete, occ. plastic, clinker, slag | Clayey sandy GRAVEL with brick, clinker, concrete, slag | Asphalt | Orange brown sandy silty CLAY | Reddish brown CLAY/SILT | |
| WS1 | | GL-0.30 | 0.30-0.90 | | 0.90-4.50 | 4.50-5.00 | 1.10m |
| WS2 | GL-0.25 | | 0.25-1.00 | | | 1.00-5.00 | 1.30m |
| WS3 | | GL-1.30 | | | | 1.30-5.00 | 1.30m |
| WS4 | | GL-0.30 | | | 0.30-4.20 | 4.20-5.00 | 1.40m |
| WS5 | GL-0.15 | 0.15-0.90 | | | | 0.90-5.00 | 1.40m |
| WS6 | GL-0.20 | 0.20-0.65 | 0.65-0.85 | | 0.85-3.50 | 3.50-5.00 | 1.50m |
| TP1 | GL-0.20* | | | | 0.20-0.80 | 0.80-1.20 | Damp at 1.20m |
| TP2 | | GL-0.20 | | | 0.20-1.30 | | 1.30m |
| TP3 | | GL-0.90 | | | 0.90-1.50 | | Damp at 1.50m |
| TP4 | GL-0.20 | | 0.20-0.50* | 0.50-0.70 | 0.70-1.40 | | 1.40m |
| TP5 | | GL-0.90 | | | 0.90-1.20 | | 1.20m |
| TP6 | GL-0.15 | 0.15-0.80 | 0.80-0.95 | | 0.90-1.50 | | 1.50m |
| *geotextile at base | | | | | | | |

## 5.2 Obstructions

Underground man-made obstructions were not encountered in any of the exploratory holes.

## 5.3 Groundwater

Groundwater was encountered in all the exploratory holes except TP1 and TP3 at depths of between 1.10m and 1.50m below existing ground level.

Subsequent monitoring of groundwater in standpipes indicated groundwater levels at depths ranging between 1.18m$^{(WS4)}$ and 1.69m$^{(WS1)}$ below existing ground level.

## 5.4 Land Gas

Results obtained during the initial monitoring visit on 16th April 2021 indicated Methane ($CH_4$) levels = 0% by volume, Carbon Dioxide ($CO_2$) levels ranging from 0.1% to 1.2% by volume, and Oxygen ($O_2$) levels ranging from 18.7% to 19.9% by volume. Hydrogen Sulphide, Carbon Monoxide and hydrocarbon levels of 0ppm were recorded together with gas flow = 0l/hr and borehole pressure = 0Pa. Atmospheric pressure was recorded as 1033mb.

Results obtained during subsequent monitoring visits on 27th April 2021 and 11th May 2021 indicated Methane levels = 0% by volume, Carbon Dioxide levels ranging from 0.1% to 1.8% by volume, and Oxygen levels ranging from 18.9% to 20.0% by volume. Hydrogen Sulphide, Carbon Monoxide and hydrocarbon levels of 0ppm were recorded together with gas flow = 0l/hr and borehole pressure = 0Pa. Atmospheric pressure was recorded in the range 1005mb to 1009mb.

It should be noted that the concentrations and levels of mobile liquid and gaseous materials are likely to vary with time. The results obtained may therefore be representative of the conditions only at the time of sampling.

## 5.5 Visual / Olfactory Evidence of Contamination

No visual or olfactory evidence of contamination was observed on site or encountered in any of the exploratory holes during the investigation.

# 6. ENGINEERING PROPERTIES OF SOILS ENCOUNTERED

## 6.1 General

The following sections discuss the engineering and chemical properties of the strata encountered, based on results of in situ testing and laboratory testing obtained during this investigation.

***Summary of Laboratory Geotechnical Test Results***

| Location | Depth (mbgl) | Stratum* | CLASSIFICATION | | | | | | | | | CHEMICAL | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Water Content (%) | Liquid Limit (%) | Plastic Limit (%) | Plasticity Index (%) | PSD Cobbles (%) | PSD Gravel (%) | PSD Sand (%) | PSD Silt (%) | PSD Clay (%) | pH Value | Water Soluble Sulphate (mg/l) |
| WS1 | 0.30 | MGg | | | | | 26 | 38 | 21 | 15 | | | |
| WS1 | 1.00 | GFD | 19.7 | 47 | 17 | 30 | | | | | | 7.76 | 20 |
| WS1 | 2.00 | GFD | 23.5 | 35 | 16 | 19 | | | | | | | |
| WS2 | 0.25 | MGg | | | | | 0 | 61 | 31 | 8 | | | |
| WS2 | 1.00 | WMM | 23.0 | 36 | 16 | 20 | | | | | | 8.31 | <10 |
| WS2 | 3.00 | WMM | 22.2 | 31 | 16 | 15 | | | | | | | |
| WS3 | 1.30 | WMM | 21.5 | 42 | 16 | 26 | | | | | | 7.97 | <10 |
| WS3 | 3.00 | WMM | 24.2 | 31 | 16 | 15 | | | | | | | |
| WS4 | 1.00 | GFD | 24.2 | 47 | 17 | 30 | | | | | | | |
| WS5 | 0.90 | WMM | 19.2 | 26 | 14 | 12 | 0 | 3 | 27 | 51 | 19 | 7.94 | 20 |
| WS6 | 0.85 | GFD | 28.6 | 68 | 32 | 36 | | | | | | 6.65 | 20 |
| TP1 | 0.90 | WMM | 25.0 | 42 | 17 | 25 | | | | | | | |
| TP3 | 1.20 | GFD | 21.6 | 39 | 18 | 21 | | | | | | | |
| TP4 | 0.90 | GFD | 17.6 | 35 | 16 | 19 | | | | | | | |
| TP6 | 0.80 | MGg | | | | | 0 | 35 | 41 | 24 | | | |

*MGg = Made Ground (granular), GFD = Glaciofluvial Deposits, WMM = Weathered Mercia Mudstone

## 6.2 Made Ground

Laboratory **particle size distribution** (PSD) tests suggest the samples of Made Ground tested are predominantly sand or gravel with varying amounts of cobbles and silt/clay.

A single **SPT N value** of 7 has been obtained in the cohesive Made Ground at 1.0m depth in WS3. This result suggests the Made Ground here is soft.

In situ hand shear vane tests have given results of **shear strength** in the range 50kN/m$^2$ to 62kN/m$^2$, suggesting the cohesive Made Ground is firm.

## 6.3 Natural Clay

Atterberg Limit tests have given values of **liquid limit** in the range 26% to 68% and **plastic limit** values in the range 16% to 32%, resulting in values of **plasticity index** in the range 12% to 30%. These results suggest the samples tested are clay of intermediate to high plasticity as shown on the Plasticity Chart included in the Appendices. For design purposes, a value of plasticity index = 27% is recommended, based on the upper quartile value of the results.

In accordance with NHBC Chapter 4.2 Building Near Trees(2003) soils can be classified in terms of **volume change potential**, using the relationship:

$$I_p' = I_p \times \frac{\%\text{ less than } 425\mu m}{100\%}$$

….where $I_p'$ = modified plasticity index, $I_p$ = plasticity index.

Based on the laboratory test results, the above relationship and Table 1 of NHBC Chapter 4.2, the samples of Glaciofluvial Deposits are shown to have **low to medium volume change potential**.

**SPT N values** range from 2 to 14, as can be seen from SPT v Depth Plot included in the Appendices. These values suggest the clay is very soft to firm.

In situ hand shear vane tests have given results of **shear strength** in the range 30kN/m$^2$ to 80kN/m$^2$, suggesting the clay is soft to stiff.

Shear strength may also be estimated from a correlation by Stroud and Butler(1975): for a clay with a plasticity index of 27%, $c_u$ = 4.8 x SPT N value. A plot of strength v Depth is included in the Appendices, using both SPT correlated strengths and hand shear vane test results.

The following table summarises derived values of shear strength for preliminary design purposes, based on all the strength results.

***Summary of Recommended Design Shear Strength Values***

| Depth (m) | Range of Strength Values (kN/m²) | Design Strength Value* (kN/m²) |
|---|---|---|
| 1.00 | 14-60 | 19 |
| 2.00 | 10-38 | 12 |
| 3.00 | 14-34 | 16 |
| 4.00 | 14-62 | 14 |
| 5.00 | 14-67 | 48 |
| *based on lower quartile value of results | | |

**Effective stress strength parameters** may also be obtained from correlations with plasticity index. For a plasticity index of 27%:

- BS8002(1994), Table 2 gives $\phi'_{crit} \approx 26^o$;
- Gibson(1953), gives $\phi_d = 27.2^o$.

Based on all the above, design values of $\phi' = 26^o$ and $c' = 0kN/m^2$ are recommended for the clay.

The **coefficient of volume compressibility**, $m_v$ may also be estimated from a correlation by Stroud and Butler(1975): for a clay with a plasticity index of 27%, $m_v = 1 / (0.46 \times N \text{ value})$.

The following table summarises values of coefficient of volume compressibility, based on the above correlation.

***Recommended Design Coefficient of Volume Compressibility Values***

| Depth (m) | Range of N Values | Design N Value* | Coefficient of Volume Compressibility (m²/MN) | Comments |
|---|---|---|---|---|
| 1.00 | 3-8 | 4 | 0.54 | High Compressibility |
| 2.00 | 2-8 | 3 | 0.72 | High Compressibility |
| 3.00 | 2-7 | 3 | 0.72 | High Compressibility |
| 4.00 | 1-13 | 3 | 0.72 | High Compressibility |
| 5.00 | 3-14 | 10 | 0.22 | Medium Compressibility |
| *based on lower quartile value of results | | | | |

Laboratory test have given values of **water soluble sulphate** in the range <10mg/l to 20mg/l, together with **pH Values** in the range 6.65 to 8.31.

## 6.4 Results of In Situ Testing

The results of in situ CBR tests are summarised below.

***In Situ CBR Test Results***

| Location | Depth (mbgl) | CBR Value (%) |
|---|---|---|
| DCP01 | 0.137-0.414 | 14 |
| | 0.414-0.818 | 5.4 |
| DCP02 | 0.130-0.330 | 22 |
| | 0.330-0.824 | 8.6 |
| DCP03 | 0.127-0.659 | 20 |
| DCP04 | 0.052-0.430 | 22 |
| | 0.430-0.623 | 54 |
| DCP05 | 0.041-0.300 | 33 |
| | 0.300-0.360 | 66 |
| DCP06 | 0.122-0.422 | 10 |
| | 0.422-0.792 | 17 |

Results of soakaway testing are summarised in the following table.

***In Situ Soakaway Test Results***

| Location | Depth to base of pit (mbgl) | Soil Infiltration Rate* (m/s) |
|---|---|---|
| TP1 | 1.20 | $1.81 \times 10^{-6}$ |
| TP2 | 1.30 | $7.93 \times 10^{-7}$ |
| TP3 | 1.50 | $2.64 \times 10^{-6}$ |
| TP4 | 1.40 | $2.17 \times 10^{-6}$ |
| TP5 | 1.20 | $4.20 \times 10^{-6}$ |
| TP6 | 1.50 | $2.07 \times 10^{-6}$ |
| *Results extrapolated from data | | |

# 7.GEOTECHNICAL ASSESSMENT

## 7.1 Proposed Development

The proposed development will comprise a new 2-storey school building with associated areas of soft landscaping and hardstanding and a new MUGA pitch. At the time of writing this report, anticipated structural loadings were not known.

## 7.2 Ground Conditions Encountered

The exploratory holes have encountered topsoil and variable Made Ground (up to 1.3m thickness) overlying generally soft becoming firm clay, proven to a maximum depth of 5.0m below existing ground level. Groundwater was encountered in all the exploratory holes except TP1 and TP3 at depths of between 1.10m and 1.50m below existing ground level. Subsequent monitoring of groundwater in standpipes indicated groundwater levels at depths ranging between 1.18m$^{(WS4)}$ and 1.69m$^{(WS1)}$ below existing ground level. Significant levels of land gas have not been encountered.

## 7.3 Foundation Considerations

The main consideration on site is the significant thickness of poor quality (low strength/high compressibility clays) beneath the site, which will have an impact of foundation design.

The following sections discuss conventional shallow depth foundations and alternative foundation options, should allowable bearing pressures be too low and anticipated settlements too high.

### 7.3.1 Shallow Depth Spread Foundations

Based on the ground conditions encountered conventional shallow depth strip/pad foundations could be considered, taken down into the natural clay, subject to review of anticipated structural loadings and tolerance of the structure to settlement.

Foundations should be taken down a minimum 1m depth and placed in the natural clay. If any Made Ground or particularly soft or loose material is encountered at foundation level this should either be excavated and replaced with suitable granular fill, or the foundation extended to suitable stratum.

The following table summarises allowable bearing pressures for strip and pad foundations at depths of between 1.0m and 2.5m, placed in natural clay. The bearing pressures have been calculated based on Hansen's method(1978), and using a factor of safety of 3 against bearing capacity failure. Groundwater is assumed to be at foundation level.

***Summary of Allowable Bearing Pressures***

| Foundation Depth (mbgl) | Founding Stratum | Design Value (Section 6) | Foundation Type | Foundation Size | Allowable Bearing Pressure |
|---|---|---|---|---|---|
| 1.0 | Clay | $c_u$=19kN/m$^2$ | Strip | 0.4m | 50kN/m$^2$ |
| | | | | 0.9m | 45kN/m$^2$ |
| | | | Pad | 1m x 1m | 55kN/m$^2$ |
| | | | | 2m x 2m | 50kN/m$^2$ |
| 1.5 | Clay | $c_u$=19kN/m$^2$ | Strip | 0.4m | 55kN/m$^2$ |
| | | | | 0.9m | 50kN/m$^2$ |
| | | | Pad | 1m x 1m | 55kN/m$^2$ |
| | | | | 2m x 2m | 50kN/m$^2$ |
| 2.0 | Clay | $c_u$=12kN/m$^2$ | Strip | 0.4m | 35kN/m$^2$ |
| | | | | 0.9m | 35kN/m$^2$ |
| | | | Pad | 1m x 1m | 40kN/m$^2$ |
| | | | | 2m x 2m | 40kN/m$^2$ |
| 2.5 | Clay | $c_u$=12kN/m$^2$ | Strip | 0.4m | 40kN/m$^2$ |
| | | | | 0.9m | 40kN/m$^2$ |
| | | | Pad | 1m x 1m | 40kN/m$^2$ |
| | | | | 2m x 2m | 40kN/m$^2$ |

The following table summarises anticipated foundation settlements, based on strip/pad foundations being placed in the natural clay. For the purposes of the analyses, foundation loadings are taken as the allowable bearing pressure above, to give a worse-case scenario and the depth of influence of the foundation taken as 1.5 times the foundation width.

***Summary of Anticipated Settlements***

| Foundation Depth (mbgl) | Foundation Type | Foundation Size | Foundation Loading | Settlement (mm) | | |
|---|---|---|---|---|---|---|
| | | | | At Corner | At Centre | Average |
| 1.0 | Strip | 0.4m | 50kN/m² | - | - | 15-20 |
| | | 0.9m | 45kN/m² | - | - | 30-35 |
| | Pad | 1m x 1m | 55kN/m² | 40-45 | 10-15 | 30-35 |
| | | 2m x 2m | 50kN/m² | 65-70 | 15-20 | 50-55 |
| 1.5 | Strip | 0.4m | 55kN/m² | - | - | 20-25 |
| | | 0.9m | 50kN/m² | - | - | 30-35 |
| | Pad | 1m x 1m | 55kN/m² | 45-50 | 10-15 | 30-35 |
| | | 2m x 2m | 50kN/m² | 65-70 | 15-20 | 50-55 |
| 2.0 | Strip | 0.4m | 35kN/m² | - | - | 10-15 |
| | | 0.9m | 35kN/m² | - | - | 20-25 |
| | Pad | 1m x 1m | 40kN/m² | 30-35 | 5-10 | 25-30 |
| | | 2m x 2m | 40kN/m² | 50-55 | 10-15 | 35-40 |
| 2.5 | Strip | 0.4m | 40kN/m² | - | - | 15-20 |
| | | 0.9m | 40kN/m² | - | - | 20-25 |
| | Pad | 1m x 1m | 40kN/m² | 30-35 | 5-10 | 25-30 |
| | | 2m x 2m | 40kN/m² | 45-50 | 10-15 | 35-40 |

Settlements for other bearing pressures may be estimated on a pro-rata basis, but bearing pressures should not exceed the allowable net bearing pressure based on ultimate bearing capacity.

If trees are to be removed or planted as part of the redevelopment, in order to avoid possible excessive settlement due to water removal by trees during dry periods or ground heave due to tree removal, the recommendations of the National House Building Council Practice Standard “Building Near Trees”, although not strictly applicable, should be closely followed. In this context the clays beneath the site should be assumed as having a low volume change potential.

All foundation excavations will need careful inspection by a suitably qualified engineer or inspector to ensure the founding strata is suitable and uniform along the length of the foundation, and capable of taking the anticipated structural loadings.

Floor slabs should be designed as suspended where Made Ground is >600mm thickness or the slab is within the zone of influence of a tree. Floor slabs may be designed as ground bearing where Made Ground is excavated and replaced with a suitable granular fill and the slab is not located within the zone of influence of a tree.

From the above tables it can be seen the allowable bearing pressures are low and in some cases settlement high. Should these be unacceptable for the proposed building

alternative foundation options should be considered, and are discussed in the following sections.

### 7.3.2 Piles

Piled foundations could be considered, however additional boreholes will be required to investigate depth and nature of soils and bedrock at depth beneath the site.

The proposed development may be founded on a system of ground beams spanning onto piles taken down into suitable strata such as bedrock.

A variety of pile types may be used, including bored and continuous flight auger (CFA) piles. Driven piles may be suitable, subject to environmental and noise/vibration constraints.

Because of the various advantages and limitations of each pile type, and the cost implications, advice should be sought from specialist piling contractors to determine the most suitable and cost-effective type. They should also be able to give recommended pile diameters and depths and likely pile capacities, with guaranteed performance. It is recommended a pile test be carried out to confirm pile capacities. In assessing the pile capacities, contractors should make an allowance for the effects of negative skin friction, particularly in the made ground and soft clays.

There may be differential settlement between piled structures and the surrounding ground level. Provision should, therefore, be made to make up ground levels at threshold positions, loading bays, vehicle access doorways, etc. Alternatively, these materials should be removed and replaced in a controlled manner by suitable existing materials or imported engineered fill.

It is essential the advice of a specialist piling contractor is sought and that positive assurances are provided by the piling contractor that their proprietary system is capable of providing the required working loads in the ground conditions encountered.

Floor slabs should be designed as suspended if the piled solution is used.

### 7.3.3 Ground Improvement

Ground treatment (e.g. vibro displacement) may be an option, subject to environmental and noise/vibration constraints and ability of the near surface soils to provide sufficient lateral restraint.

For example, vibro stone columns are often used to solve a wide range of static, dynamic and seismic foundation problems by using powerful depth vibrators to densify soils of form stone columns that compact or reinforce soils in situ. Vibro systems can be used to treat granular deposits, fills, made ground and soft clays/silts.

Soils treated by vibro could offer an allowable bearing pressure in the range 100kN/$m^2$ to 200kN/$m^2$, depending on column spacings and ground encountered.

Once the treatment has been carried out, spread foundations may be adopted across the site, and designed to the loadings given above. Providing that any imported fill material between the tops of the columns and the underside of the floor slab is placed in a controlled manner, floor slabs may be ground bearing. Positive assurances should be sought from an experienced specialist contractor that the proprietary system proposed is capable of providing the required working loads in the ground conditions encountered, with a guarantee on maximum settlement for both footings and floor slabs.

### 7.3.4 Controlled Modulus Columns

Where traditional ground improvement techniques may not be suitable due to either poor soil strength, high loadings or tight settlement criteria, controlled modulus columns (CMCs) provide a fast and economical ground improvement alternative to piling.

The technique installs low strength concrete columns, 280mm to 500mm in diameter, up to 50m in depth using our displacement tools.

The benefits are:

- Ground bearing foundation solution utilising a distribution mattress.
- The rig working platform can be used as part of the distribution mattress.
- No breaking down of CMCs. Trimming is undertaken while the CMCs are still wet.
- The vibration free displacement process creates minimal spoil.

The technique can be used for a wide range of structures including heavily loaded commercial/industrial floor slabs, road and rail embankments, silos, tanks and wind turbines and residential buildings traditionally founded on driven piles.

Positive assurances should be sought from an experienced specialist contractor that the proprietary system proposed is capable of providing the required working loads in the ground conditions encountered, with a guarantee on maximum settlement for both footings and floor slabs. Foundations formed on CMCs should be suitably reinforced to mitigate minor movement between columns and the surrounding ground.

#### 7.3.5 Rafts

Alternatively thickened-edge raft foundations could be considered, placed at shallow depth in the clay and sufficiently reinforced to act as a rigid structure. For guidance a raft 10m x 5m placed at 0.6m depth in soft clay could be designed to an allowable bearing pressure of 25kN/m$^2$ . If rafts are to be considered additional in situ testing (plate bearing tests) should be carried out to confirm loadings at shallow depth and associated settlements.

### 7.4 Pavement Design

In situ CBR tests have given variable results of CBR in the rage 5% to 667%, within 0.8m of the existing site surface.

Based on the types of ground encountered, and the above results, it is recommended for preliminary design purposes a CBR value = 2% is adopted for all cohesive materials and CBR = 5% adopted for granular material.

Consideration should be given to the potential differing ground conditions near surface, which could cause pavements to be partly constructed on clay or variable made ground. In this context a flexible pavement design may be required.

Consideration should also be given to the use of geotextiles to allow reduction of capping thickness. For examples biaxial geogrids such as Tensar SSLA20 and SSLA30 are often used to reduce capping thickness. The advice of a suitable contractor should be sought as to the most appropriate type of geotextile to use in the ground conditions encountered at this site. For guidance, the following table gives a comparison of granular layer thickness with and without the use of a geotextile, in accordance with the requirement of HA25/94 Part 2.

| CBR | Unreinforced | | | Reinforced with Tensar Geogrid | | | | |
|---|---|---|---|---|---|---|---|---|
| | Sub-base | Capping | Total | Sub-base | Capping | No. of grids | Total | Thickness saving |
| 0.5% | Design not suitable | | | 200mm | 400mm | 2 | 600mm | - |
| 1.0% | 150mm | 600mm | 750mm | 400mm | 0 | 1 | 400mm | 350mm |
| 1.5% | 150mm | 600mm | 750mm | 310mm | 0 | 1 | 310mm | 440mm |
| 2.0% | 150mm | 600mm | 750mm | 260mm | 0 | 1 | 260mm | 490mm |
| 3.0% | 150mm | 350mm | 500mm | 210mm | 0 | 1 | 210mm | 290mm |
| 4.0% | 150mm | 300mm | 450mm | 175mm | 0 | 1 | 175mm | 275mm |
| 5.0% | 150mm | 250mm | 400mm | 160mm | 0 | 1 | 160mm | 240mm |
| These figures are suitable for light access roads and car parks, based on 1000 standard axles. For heavier loaded pavements the advice of specialist contractor should be sought. | | | | | | | | |

It should be noted the type of construction will depend on proposed finished pavement levels across the site and it is recommended the pavement design is reviewed once these levels are known. In this context, it is essential further in situ CBR testing is carried out once formation levels are known to confirm design CBR values.

All formation excavations should be examined by a suitably experienced engineer or inspector to check for soft or unsuitable material, which should be removed and replaced with compacted granular fill. Also, to ensure good compaction and remove unevenness, the formation should be compacted with equipment suitable for use in the ground conditions encountered. Careful inspection of this work will also help identify any soft spots at or just below formation level.

### 7.5 Chemical Attack on Buried Concrete

Chemical tests (see Appendices) show low levels of water soluble sulphates and near neutral to slightly alkaline conditions in the natural clays. Based on these conditions, it is recommended that for foundations in natural ground the Design Sulphate Class for the site, as defined in BRE Special Digest $1^{(2005)}$, be taken as DS-1, and the Aggressive Chemical Environment for Concrete (ACEC) site classification be taken as AC-1s.

For any ground-bearing floor slabs and shallow buried concrete within the made ground, the Design Sulphate Class may be taken as DS-2 and the ACEC site classification as AC-1s. The recommendations of BRE Special Digest 1 should be followed for concrete foundations and ground bearing floor slabs.

## 7.6 Suitability of Excavated Materials

Acceptability criteria and testing, and methods of compaction/placement will depend on the type of contract and specification used for the construction of the proposed development and it is recommended that earthworks specifications are reviewed by a suitably qualified engineer, once these have been prepared by the relevant parties.

For preliminary design purposes the classification testing carried out in this investigation may be used to generate acceptability limits for the fill material.

The suitability of excavated materials for re-use across the site is discussed in the following sections:

### 7.6.1 Granular Made Ground

Granular Made Ground could be suitable for re-use as structural fill, providing it is not contaminated and does not contain excessive amounts of clay and providing moisture contents are controlled during placement. The control of moisture contents will be important as the cohesive content of this stratum is likely to be sensitive to moisture content changes.

### 7.6.2 Cohesive Made Ground / Natural Clay

The cohesive Made Ground and soft near surface natural clay are unlikely to be suitable for re-use as fill, and should be used for landscaping purposes, providing they are not contaminated.

## 7.7 Temporary Works

Formations are likely to be susceptible to damage both by weather and trafficking, and should be protected immediately on exposure, particularly in areas where construction plant will access the site.

Excavations in Made Ground and soft near surface soils are likely to be unstable and should be battered back to an angle of 1 in 1, or a system of close sheeting and shoring adopted to ensure stability, and in particular where personnel are required to enter excavations.

All excavations should be adequately supported where personnel are required to enter.

Groundwater seepages could be encountered near surface within excavations, particularly during the wetter months of the year. If required intermittent pumping of excavations from a suitable located sump should be adequate at this site to keep excavations dry.

All materials on site should be capable of being excavated using conventional excavating machinery, with the exception of existing hardstanding, which will require the use of pneumatic breakers.

### 7.8 Drainage

Results of soakaway tests have given very low soil infiltration rates. Based on the ground conditions encountered and these results, soakaway drainage may be suitable on site, depending on inflow and outflow volumes of surface water drainage.

Careful consideration will also be required to the impact of shallow water table across the site which could restrict depth of soakaway construction.

# 8. ENVIRONMENTAL ASSESSMENT

## 8.1 Introduction

In accordance with current best practice, the assessment of potentially contaminated sites is normally carried out by means of a risk assessment, based on a conceptual model, which examines possible sources of contamination, potential receptors, and likely links between the two. For contamination to be a hazard, it must be demonstrated that there is an identifiable source of contamination (either inside or outside the site), potential receptors that may be at risk (occupiers of the site, for example, or the environment in general), and that there are also potential pathways through which the former may affect the latter.

Potential sources of contamination can be determined from the results of the laboratory tests that have been carried out on the soil samples. Other potential sources may be evident from the information on the history of the site and its environs. Contaminants are only a hazard if they are present in suitably high concentrations.

## 8.2 Conceptual Model

### 8.2.1 Contaminant Sources

Based on the current and historical uses of the site and its surroundings, and the findings of the investigation, it is concluded that the following contaminant sources should be considered:

***Historical/Current Site Sources***: The site has historically been undeveloped or used as a sports pitch associated with Cowbridge Comprehensive School, which is unlikely to be a potential source of contamination.

***Materials present on the site:*** No visual or olfactory evidence of contamination was observed on site or encountered in any of the exploratory holes during the investigation, however given presence of made ground encountered beneath parts of the site, this should be considered a potential source of contamination.

***Asbestos:*** Asbestos was not encountered on site during the fieldwork, or within any of the samples subsequently tested.

***Ground Water:*** Groundwater was encountered in all the exploratory holes except TP1 and TP3 at depths of between 1.10m and 1.50m below existing ground level. Subsequent monitoring of groundwater in standpipes indicated groundwater levels at depths ranging between 1.18m(WS4) and 1.69m(WS1) below existing ground level.

***Land Gas:*** Another potential source of contamination is land gas. Results obtained during monitoring visits indicated Methane levels = 0% by volume, Carbon Dioxide levels ranging from 0.1% to 1.8% by volume, and Oxygen levels ranging from 18.7% to 20.0% by volume. Hydrogen Sulphide, Carbon Monoxide and hydrocarbon levels of 0ppm were recorded together with gas flow = 0l/hr and borehole pressure = 0Pa. Atmospheric pressure was recorded in the range 1005mb to 1033mb.

***Contamination arising from external sources:*** Based on current site usage, it is unlikely that areas near to the site are considered likely to contain elevated concentrations of some contaminants, which might affect the site itself.

### 8.2.2 Contaminant Pathways:

Contaminants can reach potential receptors through various routes. The following are considered to be applicable to this site:

- **Ingestion:** Some contaminants can be harmful if ingested directly, either after handling contaminated soils, or due to eating plants grown in such soils that may not be thoroughly clean.
- **Absorption through Plants:** Other contaminants can be taken up by plants grown in contaminated soils, and ingested by anybody eating such plants.
- **Leachate:** Soluble fractions of some contaminants can leach into the ground, contaminating groundwater.
- **Services / Drains:** Contaminants in solution can be transported from one part of the site to another, or from outside the site to within the site, through old drains, or other service trenches which may be present.

### 8.2.3 Contaminant Receptors:

The following potential receptors are considered to be applicable to this site:

- **Future Site Occupants:** Future site occupants could be at risk from the effects of any contaminants in the soil and groundwater, and also from land gas.
- **Construction Workers:** The personnel involved in the construction of the proposed development are also at risk.
- **Construction Materials:** materials used in construction could be at risk from contamination.
- **Groundwater / River Water:** As well as being a potential source of contamination, the groundwater also needs to be considered as a potential receptor of further contamination.
- **Vegetation:** New planting on the site could be at risk from contamination.

## 8.3 Soil Risk Assessment

### 8.3.1 Risk of Soil Contamination - During Development

To assess the risk of soil contamination to construction and ground workers during development, guidelines from the HSE Document *'Protection of workers and the general public during development of contaminated land'*(1991) are used. The document assesses soil contamination test results and classifies the site as being uncontaminated or contaminated with varying degrees of contamination from 'slight' to 'unusually heavy'.

The guideline values and laboratory test results are summarised in the following table:

***Summary of guideline values for protection of workers and the general public during development of contaminated land***

| Contaminant | Typical Values* for: | | | | | Test Results | Class |
|---|---|---|---|---|---|---|---|
| | Uncontaminated Soils | Slight Contamination | Contaminated | Heavy Contamination | Unusually Heavy Contamination | | |
| | Class A | Class B | Class C | Class D | Class E | | |
| pH (acid) | 6-7 | 5-6 | 4-5 | 2-4 | <2 | | |
| pH (alkaline) | 7 - 8 | 8 - 9 | 9 - 10 | 10 - 12 | 12 | 7.14-9.02 | A-C |
| Arsenic | 0 - 30 | 30 - 50 | 50 - 100 | 100 - 500 | 500 | 2-5 | A |
| Cadmium | 0 - 1 | 1 - 3 | 3 - 10 | 10 - 50 | 50 | <0.5-0.9 | A |
| Chromium | 0 - 100 | 100 - 200 | 200 - 500 | 500 - 2500 | 2500 | 12-25 | A |
| Copper | 0 - 100 | 100 - 200 | 200 - 500 | 500 - 2500 | 2500 | 9-17 | A |
| Lead | 0 - 500 | 500 - 1000 | 1000 - 2000 | 2000 – 1% | 1.0% | 18-89 | A |
| Mercury | 0 - 1 | 1 - 3 | 3 - 10 | 10 - 50 | 50 | <0.17-0.37 | A |
| Nickel | 0 - 20 | 20 - 50 | 50 - 200 | 200 - 1000 | 1000 | 13-24 | A-B |
| Zinc | 0 - 250 | 250 - 500 | 500 - 1000 | 1000 - 5000 | 5000 | 38-100 | A |
| Boron | 0 - 2 | 2 - 5 | 5 - 50 | 50 - 250 | 250 | <1.0-1.1 | A |
| Selenium | 0 - 1 | 1 - 3 | 3 - 10 | 10 - 50 | 50 | <1 | A |
| Beryllium | 0 - 5 | 5 - 10 | 10 - 20 | 20 - 50 | 50 | <0.5-0.8 | A |
| Vanadium | 0 - 100 | 100 - 200 | 200 - 500 | 500 - 2500 | 2500 | 17-31 | A |
| Sulphate | 0 - 2000 | 2000 - 5000 | 5000 – 1% | 1% - 5% | 5.05% | <200-800 | A |
| Sulphur | 0 - 100 | 100 - 500 | 500 - 1000 | 1000 - 5000 | 5000 | <5 | A |
| Sulphide | 0 - 10 | 10 - 20 | 20 - 100 | 100 - 500 | 500 | <5-100 | A |
| Cyanide (free) | 0 - 1 | 1 - 5 | 5 - 50 | 50 - 100 | 100 | <1 | A |
| Thiocyanate | 0 - 10 | 10 - 50 | 50 - 100 | 100 - 500 | 2500 | <5-9 | A |
| Coal Tar | 0-500 | 500-1000 | 1000-2000 | 2000-1.0% | 1.0% | <10-125 | A |
| Phenol | 0 - 2 | 2 - 5 | 5 - 50 | 50 - 250 | 250 | <0.2 | A |

Based on the above results there is a generally low potential risk from soil contamination to construction workers, ground workers and members of the public, and appropriate measures, such as PPE, site health plans, appropriate disposal of material arisings will mitigate any risk.

### 8.3.2 Risk of Soil Contamination – After Development

As part of the contamination assessment, the chemical results obtained by CJA have been screened against accepted compliance criteria, namely:

- Defra C4SL Health Criteria Values (March 2014), where available; and
- CJA Tier 1 assessment values - based on LQM/CIEH Suitable 4 Use Levels(2015) (S4ULs).

The Land Quality Management (LQM)/Chartered Institute of Environmental Health (CIEH) 'Suitable 4 Use Levels' (S4ULs) have been derived for soil contaminants for which there are no C4SLs, and have been derived in accordance with UK legislation,

national and Environment Agency Policy and using the Environment Agency's tools and available guidance.

The S4ULs replace the previous LQM/CIEH Generic Assessment Criteria (GAC) published in 2009. The assessment criteria have been updated in line with developments in UK human health risk assessment, in particular the additional land uses and exposure assumptions presented in Defra's C4SL guidance. For each substance, S4ULs have been derived for six generic land uses (including the two Public Open Space land uses defined in C4SL guidance) and a range of Soil Organic Matter contents (organic contaminants only).

In March 2014 Defra published Category 4 Screening Levels (C4SLs) for assessment of land affected by contamination. C4SLs are intended for use in determining whether land is 'clearly not contaminated' as defined by the revised Part 2A Statutory Guidance, i.e. Category 4 is where there is no risk or the level of risk to human health is acceptably low. The framework developed presents a departure from the conventional approach of defining 'minimal risk' and the derivation of C4SLs has involved the development of a new toxicological criterion, the 'low level of toxicological concern' (LLTC), alongside modifications to the exposure modelling previously used to determine similar generic assessment criteria.

The S4ULs and C4SLs are intended to be used as generic assessment criteria and can be used in the preliminary evaluation of the risk to human health from long-term exposure to chemicals in soil. They represent values, which indicate to an assessor that soil concentrations above this level might present risk to the health of site-users and that further assessment, quantitative risk assessment, site investigation or remediation may be required.

The use of these reference values for initial screening purposes does not imply that they are categoric indicators of whether contamination conditions are significant, this being subject to a more detailed risk assessment.

In the case of possible receptors, one of the most significant factors is the proposed future use of the site (as some potential uses are much less sensitive to the presence of contamination than others).

At the time of writing this report the proposed development was a new education facility with associated buildings, sports pitches and areas of hardstanding and grassed playing fields.

Assessment criteria are based on factors such as site users and likely length of exposure to contamination. Commercial guideline criteria are derived using the age criteria of over 18 for 8.3 hours per day. Residential based criteria considers exposures to children (who are more sensitive to contamination) over more appropriate time periods (up to 23 hours per day for children under 4). Based on the type of proposed development it is likely there will be mixed users (adults and children) for varying amounts of time. Therefore, for the purposes of this report the following sections compare the results of contamination analyses to residential end use (without home grown produce) and public open spaces criteria (where available) as specified by Defra/LQM/CIEH.

The comparison of results is summarised in the following tables.

***Soil Results Comparison with Defra C4SL HCV/LLTC Values***

| Determinand | C4SL (mg/kg)* Residential without home grown produce | Min. (mg/kg) | Max. (mg/kg) | No. of Samples with Exceedences |
|---|---|---|---|---|
| **Arsenic** | 40 | 2 | 5 | 0 |
| **Benzene** | 3.3 | <0.01 | <0.01 | 0 |
| **Benzo(a)pyrene** | 5.3 | <0.04 | 0.18 | 0 |
| **Cadmium** | 149 | <0.5 | 0.9 | 0 |
| **Chromium VI** | 21 | <1 | <1 | 0 |
| **Lead** | 310 | 18 | 89 | 0 |
| *Minimal risk Health Criteria Values | | | | |

The samples have shown contaminants at levels below the recommended C4SL values.

The following contaminants were not assessed with respect to risks posed to Human Health as they are not generally considered to represent a significant risk to Human Health (CLR 8); sulphate and sulphide.

For contaminants not covered by the Defra C4SLs, reference is made to the Suitable for Use Levels (S4ULs) derived by The Land Quality Management Ltd & Chartered Institute of Environmental Health(2015), and summarised in the following table.

## *Soil Results Comparison with LQM/CIEH S4UL*

| Determinand | Suitable 4 Use Levels (mg/kg)* | | | No. of Samples | Min. (mg/kg) | Max. (mg/kg) | No of Exceedences |
|---|---|---|---|---|---|---|---|
| | **Residential** without homegrown produce (1) | **Public Open Space** Residential (2) | **Public Open Space** Parks (3) | | | | |
| ***Metals*** | | | | | | | |
| Beryllium | 1.7 | 2.2 | 63 | 7 | <0.5 | 0.8 | 0 |
| Boron | 11000 | 21000 | 46000 | 7 | <1.0 | 1.1 | 0 |
| Chromium | 910 | 1500 | 33000 | 7 | 12 | 25 | 0 |
| Copper | 7100 | 12000 | 44000 | 7 | 9 | 17 | 0 |
| Mercury | 1.2 | 16 | 30 | 7 | <0.17 | 0.37 | 0 |
| Nickel | 180 | 230 | 3400 | 7 | 13 | 24 | 0 |
| Selenium | 430 | 1100 | 1800 | 7 | <1 | <1 | 0 |
| Vanadium | 1200 | 2000 | 5000 | 7 | 17 | 31 | 0 |
| Zinc | 4000 | 81000 | 170000 | 7 | 38 | 100 | 0 |
| ***Petroleum Hydrocarbons*** | | | | | | | |
| Toluene | 880 | 56000 | 87000 | 7 | <0.01 | <0.01 | 0 |
| Ethylbenzene | 83 | 24000 | 17000 | 7 | <0.01 | <0.01 | 0 |
| o-xylenes | 88 | 41000 | 17000 | 7 | <0.01 | 0.01 | 0 |
| m-xylenes | 82 | 41000 | 17000 | 7 | <0.01 | 0.04 | 0 |
| p-xylenes | 79 | 41000 | 17000 | 7 | <0.01 | 0.04 | 0 |
| Aliphatic EC 5-6 | 42 | 570000 | 95000 | 7 | <0.01 | <0.01 | 0 |
| Aliphatic EC >6-8 | 100 | 600000 | 150000 | 7 | <0.01 | <0.01 | 0 |
| Aliphatic EC >8-10 | 27 | 13000 | 14000 | 7 | <1 | <1 | 0 |
| Aliphatic EC >10-12 | 130 | 13000 | 21000 | 7 | <1 | <1 | 0 |
| Aliphatic EC >12-16 | 1100 | 13000 | 25000 | 7 | 3 | 1 | 0 |
| Aliphatic EC >16-35 | 65000 | 250000 | 450000 | 7 | 2 | 75 | 0 |
| Aromatic EC 5-7 | 370 | 56000 | 76000 | 7 | <0.01 | <0.01 | 0 |
| Aromatic EC >7-8 | 860 | 56000 | 870000 | 7 | <0.01 | <0.01 | 0 |
| Aromatic EC >8-10 | 47 | 5000 | 7200 | 7 | <1 | 1 | 0 |
| Aromatic EC >10-12 | 250 | 5000 | 9200 | 7 | <1 | <1 | 0 |
| Aromatic EC>12-16 | 1800 | 5100 | 10000 | 7 | <1 | 3 | 0 |
| Aromatic EC>16-21 | 1900 | 3800 | 7600 | 7 | <1 | 8 | 0 |
| Aromatic EC>21-35 | 1900 | 3800 | 7800 | 7 | 3 | 42 | 0 |
| ***Polycyclic Aromatic Hydrocarbons*** | | | | | | | |
| Naphthalene | 2.3 | 4900 | 1200 | 7 | <0.03 | <0.03 | 0 |
| Acenaphthylene | 2900 | 15000 | 29000 | 7 | <0.01 | <0.01 | 0 |
| Acenaphthene | 3000 | 15000 | 29000 | 7 | <0.01 | 0.04 | 0 |
| Fluorene | 2800 | 9900 | 20000 | 7 | <0.01 | 0.04 | 0 |
| Phenanthrene | 1300 | 3100 | 6200 | 7 | <0.03 | 0.31 | 0 |
| Anthracene | 31000 | 74000 | 150000 | 7 | <0.02 | 0.08 | 0 |
| Fluoranthene | 1500 | 3100 | 6300 | 7 | <0.08 | 0.54 | 0 |
| Pyrene | 3700 | 7400 | 15000 | 7 | <0.07 | 0.38 | 0 |
| Benz(a)anthracene | 11 | 29 | 49 | 7 | <0.04 | 0.30 | 0 |
| Chrysene | 30 | 57 | 93 | 7 | <0.06 | 0.30 | 0 |
| Benzo(b)fluoranthene | 3.9 | 7.1 | 13 | 7 | <0.05 | 0.26 | 0 |
| Benzo(k)fluoranthene | 110 | 190 | 370 | 7 | <0.07 | 0.09 | 0 |
| Indeno(1,2,3-cd)pyrene | 45 | 82 | 150 | 7 | <0.03 | 0.10 | 0 |
| Dibenz(a,h)anthracene | 0.31 | 0.57 | 1.1 | 7 | <0.04 | <0.04 | 0 |
| Benzo(ghi)perylene | 360 | 640 | 1400 | 7 | <0.05 | 0.08 | 0 |
| ***Phenols*** | | | | | | | |
| Phenol | 750 | 760 | 760 | 7 | <0.2 | <0.2 | 0 |

The samples have shown most contaminants at levels below the recommended S4UL values.

## 8.4 Groundwater & Surface Water Risk Assessment

Based on the ground and groundwater conditions encountered and low levels of soil contamination encountered it is considered the risk to groundwater and surface water is low.

## 8.5 Land Gas Risk Assessment

The potential risk associated with gases being generated in the ground (whether from natural or man-made sources) depends on the concentrations of gas and its flow rate to the surface. These factors are assessed by monitoring of the gas installations in the boreholes. The variable nature of gas generation and the effect of barometric pressure on gas flow, means that the volume of gas potentially reaching the ground surface is normally inconsistent over time.

For the assessment of sites, in terms of the potential for ground gas to present a hazard, the risk based methodology detailed in CIRIA Report C665(2007) is used. This is a risk based approach that is designed to allow quick and easy design of gas protection for development by comparing the measured gas emission rates to Characteristic Situations, based on risk based Gas Screening Values (GSVs). The GSVs equate to the borehole gas volume flow rate as defined by Wilson and Card(1999) as the borehole flow rate multiplied by the concentration in the air stream of the particular gas being considered.

For the purposes of this evaluation the calculations will be carried out for both carbon dioxide and methane encountered in the boreholes on site, and a peak flow rate of 0.2l/hr assumed to give a worst case scenario adopted in order to establish the appropriate protection measures, as follows:

- Carbon dioxide: maximum flow rate = 0.2l/hr, max concentration = 1.8%
- Methane: maximum flow rate = 0.2l/hr, max concentration = 0.0%.

Based on the above figures, the GSV is calculated as:

- Carbon dioxide: GSV = 0.2 x 0.018 = 0.0036l/hr
- Methane: GSV = 0.2 x 0.03 = 0.0l/hr.

The results suggest the site can be given a Characteristic Situation of (1), i.e. 'very low risk', in accordance with the table below.

***Modified Wilson & Card Classification (CIRIA Report 659)***

| *Characteristic Situation (CIRIA Report 149)* | *Risk Classification* | *GSV ($CH_4$ or $CO_2$) (l/hr)* | *Additional Factors* | *Typical Source of Generation* |
|---|---|---|---|---|
| 1 | Very Low Risk | <0.07 | Typically methane ≤1%v/v and/or carbon dioxide ≤5% v/v. Otherwise consider increase to Situation 2. | Natural Soils with low organic content. "Typical" Made Ground. |
| 2 | Low Risk | <0.7 | Borehole flow rate not to exceed 70l/hr. Otherwise increase to Situation 3. | Natural soil, high peat/organic content. "Typical" Made Ground. |
| 3 | Moderate Risk | <3.5 | | Old landfill, inert waste, mineworking flooded. |
| 4 | Moderate to High Risk | <15 | Quantitative risk assessment required to evaluate scope of measures required. | Mineworking susceptible to flooding, completed landfill (WMP 26B criteria) |
| 5 | High Risk | <70 | | Mineworking unflooded inactive with shallow workings near surface. |
| 6 | Very High Risk | >70 | | Recent landfill site. |

According to Table 8.6 of CIRIA Report 665, no special precautions will be required for Characteristic Situation 1.

## 8.6 Risk from Asbestos

Asbestos has not been encountered in any of the exploratory holes or in any of the samples tested. It is therefore considered the risk from asbestos being present in the ground is low.

## 8.7 Risk to Buried Services

It is considered that, due to the low levels of contamination on the site, standard materials are likely to be appropriate for new water pipes. Further advice should be sought from the local water company.

Previous guidance on buried water pipes was contained in Water Regulations Advisory Scheme (WRAS) Guidance Note No. 9-04-03(2002), however this has been superseded by the UK Water Industry Research Report 'Guidance for the Selection of Water Supply Pipes to be used in Brownfield Sites' Ref 10/WM/03/21 (January 2011).

## 8.8 Risk to Vegetation/Planting

Elevated levels of boron, copper, nickel and zinc, which are phytotoxic and harmful to plants, have not been encountered. It is therefore considered the risk to new planting is low.

## 8.9 Site Risk Assessment

The following table presents an outline summary of the contamination assessment discussed above.

***Contamination Assessment Summary***

| Description of Receptor or Source | Risk rating |
|---|---|
| Health and safety of workers during development | Low |
| Current and future site users and third parties | Low |
| Risk to groundwater | Low |
| Risk to surface waters | Low |
| On site and off site migration of land gasses | Low |
| Presence of Asbestos in Made Ground | Low |
| Risk to Buried Services | Low |
| Risk to New Planting and Vegetation | Low |
| **OVERALL GROUND CONTAMINATION RISK RATING** | **Low** |

## 8.10 Discussion and Conclusions

The possible actions considered appropriate for the proposed development, together with other precautionary measures, are given below:

### 8.10.1 Contaminated Soils

Based on the laboratory test results there is a low potential risk from soil contamination to construction workers and groundworkers during ground works and appropriate measures such as PPE, site health plans and appropriate disposal of material arisings will mitigate any risk. The groundworks contractor will be required to provide a Soil Management Plan, including methods of dealing with any unanticipated contamination encountered during the ground works.

As discussed in the above sections, the contamination tests indicate generally low concentrations of the potential contaminants. It is therefore considered that, based on the information available, remedial action should not generally be required at this site.

Nevertheless, the presence of higher levels of contamination on areas of the site not covered by the exploratory holes should not be discounted and additional spot checks are recommended, particularly in areas of proposed soft landscaping.

Should any elevated levels of contamination be found in such areas, remedial measures, such as the replacement of the upper zone of contaminated soil with a suitable thickness of clean soil, may need to be undertaken.

### 8.10.2 Contaminated Groundwater

Due to the low levels of contamination found at the site, it is not considered likely that there would be a hazard to the groundwater beneath the site, and no remedial action should be necessary.

### 8.10.3 Land Gas

Based on the results of monitoring land gas protection measures will not be required for new buildings.

### 8.10.4 Waste Disposal

Soils excavated from the site should be disposed of at a suitable site registered to take the levels of contamination encountered, or may possibly be used as general fill at this or other sites. If reuse is considered, however, further testing may be required.

### 8.10.5 Site Personnel

As with all construction sites, personnel working on the site during the construction period should be encouraged to maintain a high standard of personal hygiene and on site washing facilities should be available.

### 8.10.6 Other Matters

Due diligence is required during the construction period, and should any further evidence of contamination be found, appropriate investigation and / or action should be taken. The significance of any contamination not discovered by this investigation is outside the scope of this report.

It is emphasised that only a small number of tests for contamination have been carried out, and that the possibility of further contamination existing elsewhere on the site cannot be ruled out. CJA does not accept any liability for contamination.

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CJAssociates

# APPENDICES

CJAssociates

# LOGSHEETS

CJAssociates

# KEY TO SYMBOLS

## CABLE PERCUSSIVE LOG SHEETS

| | |
|---|---|
| S | Standard penetration test (split spoon) |
| C | Standard penetration test (cone) |
| N | Penetration resistance: number of blows- (63.5kg hammer, 0.76m drop) for 300mm penetration |
| D | Disturbed sample |
| B | Bulk sample |
| W | Water sample |
| T | Small disturbed sample (plastic tub) |
| U | Undisturbed sample |
| b | No. of blows to drive U100 using 160kg hammer |
| X% | Percentage recovery in U100 or SPT |
| V | Vane test |
| P | Piston sample |
| J | Jar sample |

---

## ROTARY LOG SHEETS

| | |
|---|---|
| OH | Open hole drilling |
| RR | Rock roller drilling |
| DTH | "Down the hole" hammer drilling |
| C | Coring |
| W | Water sample |
| L | Windowless liner sample |
| D | Disturbed sample |
| S | Standard penetration test (split spoon) |
| C | Standard penetration test (cone) |

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## TRIAL PIT LOG SHEETS

| | |
|---|---|
| D | Disturbed sample |
| B | Bulk disturbed sample |
| U38 | Undisturbed 38mm dia. sample |
| U100 | Undisturbed 100mm dia. sample |
| BU | Block undisturbed sample |
| MP | Mackintosh probe test |
| HSV | Hand shear vane test |
| PBT | Plate bearing test |
| T | Small disturbed sample (plastic tub) |
| CBR(M) | California bearing ratio mould sample |
| CBR(P) | California bearing ratio penetrometer method |
| CBR(S) | California bearing ratio standard plunger method |
| W | Water sample |
| J | Jar sample |

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All rock and soil legends in accordance with B.S. 5930:1999 "Code of practice for site investigations".

# Window Sampler Borehole Log Sheet

WS No. **WS1**

CJAssociates
King Road Avenue
Bristol
BS11 9HF
Tel: 0117 982 1473

Site: **Cowbridge Primary School**
Job Number: **2071724**
Client: **Morgan Sindall**
Rig Type: **Competitor Dart**

Start Date: 07/04/2021
Finish Date: 07/04/2021
Sheet 1 of 1
Vertical Scale: 1:25

| Sample / Test Depth (m) | Sample Ref. | Windowless Sample (L) Blows / % rec. (sample dia.) | Standard Penetration Tests (SPTs) | | | | | | Depth (m) | Thickness (m) | Legend | Description of Strata | Reduced Level (m.O.D) | Installation |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Test Type | Seat. Blows | Test Drive Blows | Seat. Pen. | Test Pen. | N-Value | | | | | | |
| 0.00 - 0.30 | B1 | | | | | | | | | (0.30) | | MADE GROUND: Grass over soft to firm light brown slightly sandy slightly gravelly CLAY with many rootlets. Gravel is angular to sub-angular fine to coarse of sandstone and occasional brick and concrete. | | |
| 0.30 - 0.90 | B2 | | | | | | | | 0.30 | | | MADE GROUND: Greyish brown clayey sandy angular to sub-angular fine to coarse GRAVEL of sandstone, brick, concrete and clinker. | | |
| 0.50 | ES3 | | | | | | | | | (0.60) | | | | |
| 1.00 | | | S | 1,1 | 2,2,1,3 | 150 | 300 | N=8 | 0.90 | | | Soft orange brown slightly sandy silty CLAY. | | |
| 1.00 - 2.00 | B4 | | | | | | | | | | | *1.10m: Water inflow.* | | |
| 2.00 | | | S | 2,1 | 2,2,2,2 | 150 | 300 | N=8 | | | | | | |
| 2.00 - 3.00 | B5 | | | | | | | | | | | | | |
| | | | | | | | | | | (3.60) | | | | |
| 3.00 | | | S | 1,1 | 1,2,2,2 | 150 | 300 | N=7 | | | | | | |
| 3.00 - 4.50 | B6 | | | | | | | | | | | | | |
| 4.00 | | | S | 1,2 | 2,2,2,2 | 150 | 300 | N=8 | | | | | | |
| 4.50 - 5.00 | B7 | | | | | | | | 4.50 | | | Soft reddish brown clayey SILT. | | |
| | | | | | | | | | | (0.50) | | | | |
| 5.00 | | | S | 1,1 | 2,2,3,3 | 150 | 300 | N=10 | 5.00 | | | END OF BOREHOLE | | |

| | | | | | |
|---|---|---|---|---|---|
| General Remarks: | Windowless sample G.L. – 5.00m. Install 50mm monitoring pipe at 4.00m. | Water Remarks: | 1.10m: Water Inflow | Drilled By: | CF |
| | | Casing: | | Logged By: | AH |
| | | Coordinates: | | Checked By: | RA |

# Window Sampler
# Borehole Log Sheet

WS No. **WS2**

CJAssociates
King Road Avenue
Bristol
BS11 9HF
Tel: 0117 982 1473

Site: **Cowbridge Primary School**
Job Number: **2071724**
Client: **Morgan Sindall**
Rig Type: **Competitor Dart**

Start Date: 07/04/2021
Finish Date: 07/04/2021
Sheet 1 of 1
Vertical Scale: 1:25

| Sample / Test Depth (m) | Sample Ref. | Windowless Sample (L) Blows / % rec. (sample dia.) | Standard Penetration Tests (SPTs) | | | | | | Depth (m) | Thickness (m) | Legend | Description of Strata | Reduced Level (m.O.D) | Installation |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Test Type | Seat. Blows | Test Drive Blows | Seat. Pen. | Test Pen. | N-Value | | | | | | |
| 0.00 - 0.25 | B1 | | | | | | | | | (0.25) | | MADE GROUND: Grass over firm slightly sandy slightly gravelly CLAY with many rootlets. Gravel is angular to sub-angular fine to medium of sandstone. | | |
| 0.25 - 1.00 | B2 | | | | | | | | 0.25 | | | MADE GROUND: Dark grey to black locally brownish grey slightly silty sandy angular to sub-angular fine to coarse ashy GRAVEL of sandstone, mudstone, clinker and occasional slag. | | |
| 0.60 | ES3 | | | | | | | | | (0.75) | | | | |
| 1.00 | | | S | 0,- | 0,1,1,1 | 150 | 300 | N=3 | 1.00 | | | Very soft to soft locally firm reddish brown slightly sandy silty CLAY | | |
| 1.00 - 3.00 | B4 | | | | | | | | | | | *1.30m: Water inflow.* | | |
| 2.00 | | | S | 1,1 | 1,1,1,2 | 150 | 300 | N=5 | | | | | | |
| | | | | | | | | | | (3.30) | | | | |
| 3.00 | | | S | 0,- | 1,1,1,1 | 150 | 300 | N=4 | | | | | | |
| 3.00 - 4.30 | B5 | | | | | | | | | | | | | |
| 4.00 | | | S | 1,2 | 3,3,3,4 | 150 | 300 | N=13 | | | | | | |
| 4.30 - 5.00 | B6 | | | | | | | | 4.30 | | | Firm reddish brown slightly sandy clayey SILT. | | |
| | | | | | | | | | | (0.70) | | | | |
| 5.00 | | | S | 1,2 | 3,3,4,4 | 150 | 300 | N=14 | 5.00 | | | END OF BOREHOLE | | |

| | | | | | |
|---|---|---|---|---|---|
| General Remarks: | Windowless Sample G.L. – 5.00m. Backfill with bentonite. | Water Remarks: | 1.30m: Water Inflow | Drilled By: | CF |
| | | Casing: | | Logged By: | AH |
| | | Coordinates: | | Checked By: | RA |

# Window Sampler
# Borehole Log Sheet

WS No. **WS3**

CJAssociates
King Road Avenue
Bristol
BS11 9HF
Tel: 0117 982 1473

Site: **Cowbridge Primary School**
Job Number: **2071724**
Client: **Morgan Sindall**
Rig Type: **Competitor Dart**

Start Date: 07/04/2021
Finish Date: 07/04/2021
Sheet 1 of 1
Vertical Scale: 1:25

| Sample / Test Depth (m) | Sample Ref. | Windowless Sample (L) Blows / % rec. (sample dia.) | Standard Penetration Tests (SPTs) | | | | | | Depth (m) | Thickness (m) | Legend | Description of Strata | Reduced Level (m.O.D) | Installation |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Test Type | Seat. Blows | Test Drive Blows | Seat. Pen. | Test Pen. | N-Value | | | | | | |
| 0.00 - 0.20 | B1 | | | | | | | | | (0.20) | | MADE GROUND: Grass over firm slightly sandy slightly gravelly CLAY with many rootlets. Gravel is angular to sub-angular fine to medium of sandstone and occasional brick. | | |
| 0.20 - 1.30 | B2 | | | | | | | | 0.20 | | | MADE GROUND: Soft locally firm brown to reddish brown slightly sandy slightly gravelly to locally gravelly CLAY. Gravel is angular to sub-angular fine to coarse of sandstone, mudstone and occasional limestone, brick and clinker fragments. | | |
| 0.50 | ES3 | | | | | | | | | (1.10) | | | | |
| 1.00 | | | S | 2,1 | 2,1,2,2 | 150 | 300 | N=7 | | | | | | |
| 1.30 - 3.00 | B4 | | | | | | | | 1.30 | | | Very soft reddish brown slightly sandy CLAY. *1.30m: Water inflow* | | |
| 2.00 | | | S | 0,- | 0,-,1,1 | 150 | 300 | N=2 | | | | | | |
| 3.00 | | | S | 0,1 | 1,1,1,1 | 150 | 300 | N=4 | | (3.10) | | | | |
| 3.00 - 4.30 | B5 | | | | | | | | | | | | | |
| 4.00 | | | S | 0,- | 0,1,1,1 | 150 | 300 | N=3 | | | | | | |
| 4.30 - 5.00 | B6 | | | | | | | | 4.40 | | | Soft to firm reddish brown slightly sandy clayey SILT. | | |
| 5.00 | | | S | 1,2 | 2,2,3,3 | 150 | 300 | N=10 | 5.00 | (0.60) | | END OF BOREHOLE | | |

| | | | | | |
|---|---|---|---|---|---|
| General Remarks: | Windowless Sample G.L. – 5.00m. Backfill with bentonite. | Water Remarks: | 1.30m: Water Inflow | Drilled By: | CF |
| | | Casing: | | Logged By: | AH |
| | | Coordinates: | | Checked By: | RA |

# Window Sampler Borehole Log Sheet

WS No. **WS4**

Site: **Cowbridge Primary School**
Job Number: **2071724**
Client: **Morgan Sindall**
Rig Type: **Competitor Dart**

Start Date: 07/04/2021
Finish Date: 07/04/2021
Sheet 1 of 1
Vertical Scale: 1:25

CJAssociates
King Road Avenue
Bristol
BS11 9HF
Tel: 0117 982 1473

| Sample / Test Depth (m) | Sample Ref. | Windowless Sample (L) Blows / % rec. (sample dia.) | Standard Penetration Tests (SPTs) | | | | | | Depth (m) | Thickness (m) | Legend | Description of Strata | Reduced Level (m.O.D) | Installation |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Test Type | Seat. Blows | Test Drive Blows | Seat. Pen. | Test Pen. | N-Value | | | | | | |
| 0.00 - 0.30 | B1 | | | | | | | | | (0.30) | | MADE GROUND: Grass over firm slightly gravelly CLAY with many rootlets. Gravel is angular to sub-angular fine to medium of sandstone and occasional brick. | | |
| 0.20 | ES2 | | | | | | | | | | | | | |
| 0.30 - 1.00 | B3 | | | | | | | | 0.30 | | | Very soft to soft light brown to reddish brown locally slightly sandy silty CLAY. | | |
| 1.00 | | | S | 0,- | 1,1,1,1 | 150 | 300 | N=4 | | | | | | |
| 1.00 - 3.00 | B4 | | | | | | | | | | | *1.40m: Water inflow* | | |
| 2.00 | | | S | 0,- | 0,1,1,2 | 150 | 300 | N=4 | | | | | | |
| | | | | | | | | | | (3.90) | | | | |
| 3.00 | | | S | 0,- | 0,-,1,2 | 150 | 300 | N=3 | | | | | | |
| 4.00 | | | S | 0,- | 0,-,-,1 | 150 | 300 | N=1 | | | | | | |
| 4.20 - 5.00 | B5 | | | | | | | | 4.20 | | | Very soft reddish brown slightly sandy locally sandy clayey SILT. | | |
| | | | | | | | | | | (0.80) | | | | |
| 5.00 | | | S | 0,- | 0,1,1,1 | 150 | 300 | N=3 | 5.00 | | | END OF BOREHOLE | | |

| | | | | | |
|---|---|---|---|---|---|
| General Remarks: | Windowless sample G.L. – 5.00m. Install 50mm monitoring pipe at 3.00m. | Water Remarks: | 1.40m: Water Inflow | Drilled By: | CF |
| | | Casing: | | Logged By: | AH |
| | | Coordinates: | | Checked By: | RA |

# Window Sampler
# Borehole Log Sheet

WS No. **WS5**

CJAssociates
King Road Avenue
Bristol
BS11 9HF
Tel: 0117 982 1473

Site: **Cowbridge Primary School**
Job Number: **2071724**
Client: **Morgan Sindall**
Rig Type: **Competitor Dart**

Start Date: 07/04/2021
Finish Date: 07/04/2021
Sheet 1 of 1
Vertical Scale: 1:25

| Sample / Test Depth (m) | Sample Ref. | Windowless Sample (L) Blows / % rec. (sample dia.) | Standard Penetration Tests (SPTs) | | | | | | Depth (m) | Thickness (m) | Legend | Description of Strata | Reduced Level (m.O.D) | Installation |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Test Type | Seat. Blows | Test Drive Blows | Seat. Pen. | Test Pen. | N-Value | | | | | | |
| 0.00 - 0.15 | B1 | | | | | | | | | (0.15) | | MADE GROUND: Grass over firm slightly gravelly CLAY with many rootlets. Gravel is angular to sub-angular fine to medium of sandstone. | | |
| 0.15 - 0.90 | B2 | | | | | | | | 0.15 | | | MADE GROUND: Soft reddish brown locally greyish brown slightly sandy slightly gravelly locally gravelly CLAY. Gravel is angular to sub-angular fine to coarse of sandstone and occasional concrete and limestone. | | |
| 0.60 | ES3 | | | | | | | | | (0.75) | | | | |
| 0.90 - 3.00 | B4 | | | | | | | | 0.90 | | | Soft locally very soft reddish brown slightly sandy silty CLAY. | | |
| 1.00 | | | S | 3,2 | 2,2,1,3 | 150 | 300 | N=8 | | | | | | |
| | | | | | | | | | | | | *1.40m: Water inflow* | | |
| 2.00 | | | S | 1,1 | 2,2,2,2 | 150 | 300 | N=8 | | | | | | |
| | | | | | | | | | | (3.10) | | | | |
| 3.00 | | | S | 0,- | 0,-,1,1 | 150 | 300 | N=2 | | | | | | |
| 3.00 - 4.00 | B5 | | | | | | | | | | | | | |
| 4.00 | | | S | , | 1,1,2,3 | 150 | 300 | N=7 | 4.00 | | | | | |
| 4.00 - 5.00 | B6 | | | | | | | | | | | Soft to firm reddish brown locally slightly sandy clayey SILT. | | |
| | | | | | | | | | | (1.00) | | | | |
| 5.00 | | | S | 2,2 | 3,3,4,4 | 150 | 300 | N=14 | 5.00 | | | END OF BOREHOLE | | |

| | | | | | |
|---|---|---|---|---|---|
| General Remarks: | Windowless Sample G.L. – 5.00m. Backfill with bentonite. | Water Remarks: | 1.40m: Water Inflow | Drilled By: | CF |
| | | Casing: | | Logged By: | AH |
| | | Coordinates: | | Checked By: | RA |

# Window Sampler Borehole Log Sheet

WS No. **WS6**

CJAssociates
King Road Avenue
Bristol
BS11 9HF
Tel: 0117 982 1473

Site: **Cowbridge Primary School**
Job Number: **2071724**
Client: **Morgan Sindall**
Rig Type: **Competitor Dart**

Start Date: 07/04/2021
Finish Date: 07/04/2021
Sheet 1 of 1
Vertical Scale: 1:25

| Sample / Test Depth (m) | Sample Ref. | Windowless Sample (L) Blows / % rec. (sample dia.) | Standard Penetration Tests (SPTs) | | | | | | Depth (m) | Thickness (m) | Legend | Description of Strata | Reduced Level (m.O.D) | Installation |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Test Type | Seat. Blows | Test Drive Blows | Seat. Pen. | Test Pen. | N-Value | | | | | | |
| 0.00 - 0.20 | B1 | | | | | | | | | (0.20) | | MADE GROUND: Grass over firm slightly gravelly CLAY with many rootlets. Gravel is angular to sub-angular fine to medium of sandstone. | | |
| 0.20 - 0.65 | B2 | | | | | | | | 0.20 | | | | | |
| 0.40 | ES3 | | | | | | | | | (0.45) | | MADE GROUND: Soft to firm reddish brown slightly sandy slightly gravelly CLAY. Gravel is angular to sub-angular fine to coarse of sandstone and occasional limestone and clinker. | | |
| | | | | | | | | | 0.65 | | | | | |
| 0.85 - 2.00 | B4 | | | | | | | | 0.85 | (0.20) | | MADE GROUND: Dark brown to dark grey slightly clayey sandy angular to sub-angular fine to coarse ashy GRAVEL of sandstone, mudstone and clinker. | | |
| 1.00 | | | S | 2,1 | 2,2,1,1 | 150 | 300 | N=6 | | | | Very soft to soft reddish brown to brown slightly sandy silty CLAY. | | |
| | | | | | | | | | | (1.15) | | | | |
| | | | | | | | | | | | | *1.50m: Water inflow* | | |
| 2.00 | | | S | 0,- | 0,-,1,1 | 150 | 300 | N=2 | 2.00 | | | | | |
| 2.00 - 3.50 | B5 | | | | | | | | | | | Very soft to soft greyish brown sandy CLAY. | | |
| | | | | | | | | | | (1.50) | | | | |
| 3.00 | | | S | 1,1 | 1,1,1,2 | 150 | 300 | N=5 | | | | | | |
| 3.50 - 5.00 | B6 | | | | | | | | 3.50 | | | Very soft to soft becoming firm reddish brown silty CLAY. | | |
| 4.00 | | | S | 0,- | 1,1,-,1 | 150 | 300 | N=3 | | | | | | |
| | | | | | | | | | | (1.50) | | | | |
| 5.00 | | | S | 2,3 | 3,3,4,4 | 150 | 300 | N=14 | 5.00 | | | END OF BOREHOLE | | |

| | | | | | |
|---|---|---|---|---|---|
| General Remarks: | Windowless sample G.L. – 5.00m. Install 50mm monitoring pipe at 3.70m. | Water Remarks: | 1.50m: Water Inflow | Drilled By: | CF |
| | | Casing: | | Logged By: | AH |
| | | Coordinates: | | Checked By: | RA |

# Trial Pit Log Sheet

**TP No:** TP1

**Site:** Cowbridge Primary School

**Job Number:** 2071724

**Sheet 1 of 1**

**Client:** Morgan Sindall

**Date:** 07/04/2021

**Machine Type:** JCB 3cx

**Vertical Scale:** 1:10

CJAssociates
King Road Avenue
Avonmouth
Bristol
BS11 9HF

| Depth (m) | Samp Ref | Test / Sample Depth (m) | Test Results | Depth (m) | Thickness (m) | Legend | Description of Strata | Reduced Level (m.O.D) |
|---|---|---|---|---|---|---|---|---|
| | D | 0.10 | | | (0.20) | | MADE GROUND: Grass over firm slightly sandy slightly gravelly clayey SILT with many rootlets. Gravel is angular to sub-rounded fine to medium of sandstone and mudstone. | |
| | | | | 0.20 | | | Firm to stiff orange brown sandy clayey SILT.<br>0.20m: Geotextile | |
| | B | 0.40 - 0.60 | | | | | | |
| 0.50 | ES | 0.50 | | | (0.60) | | | |
| | | | | 0.80 | | | Soft to firm low strength reddish brown locally dark brown slightly sandy locally sandy CLAY. | |
| | B | 0.90 - 1.10 | | | | | | |
| 1.00 | ES | 1.00 | | | (0.40) | | 1.00m: HSV 30/6, 32/10, 40/16 kPa | |
| | | | | 1.20 | | | 1.20m: Damp.<br>END OF TRIAL PIT | |
| 1.50 | | | | | | | | |

Sample Types: D = Small disturbed sample; B = Bulk disturbed sample; J = Small disturbed sample (glass jar); T = Small disturbed sample (plastic tub); W = Water sample.

| | | | | | |
|---|---|---|---|---|---|
| Co-ordinates: | | Elevation (m) | | Trial Pit Width (m) 0.65 | Trial Pit Length (m) 1.80 |
| Trial Pit Side Stability: | Stable | | | Logged By: AH | Checked By: RA |
| Groundwater Observations: | 1.20m: Damp | | | Direction of Face A (degrees from N): 30 | Excavator D A C B |
| General Remarks: | Machine excavated pit G.L. – 1.20m. Carry out soakaway test. Backfill with arisings on completion. | | | | |

# Trial Pit Log Sheet

**TP No:** TP2

**Site:** Cowbridge Primary School

**Job Number:** 2071724

**Sheet 1 of 1**

**Client:** Morgan Sindall

**Date:** 07/04/2021

**Machine Type:** JCB 3cx

**Vertical Scale:** 1:10

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Bristol
BS11 9HF

| Depth (m) | Samp Ref | Test / Sample Depth (m) | Test Results | Depth (m) | Thickness (m) | Legend | Description of Strata | Reduced Level (m.O.D) |
|---|---|---|---|---|---|---|---|---|
| | D | 0.10 | | | (0.20) | | MADE GROUND: Grass over brown sandy slightly gravelly clayey SILT with many rootlets. Gravel is angular to sub-rounded fine to coarse of sandstone, mudstone and occasional brick. | |
| | | | | 0.20 | | | Firm orange brown sandy clayey SILT. | |
| | B | 0.40 - 0.60 | | | | | | |
| 0.50 | | | | | (0.70) | | | |
| | ES | 0.60 | | | | | | |
| | B<br>ES | 0.90<br>0.90 - 1.10 | | 0.90 | | | Soft to firm low strength reddish brown locally dark brown slightly sandy to locally sandy silty CLAY. | |
| 1.00 | | | | | (0.40) | | 1.10m: HSV 38/16, 32/12, 28/4 kPa | |
| | | | | 1.30 | | | 1.30m: Seepage<br>END OF TRIAL PIT | |
| 1.50 | | | | | | | | |

Sample Types: D = Small disturbed sample; B = Bulk disturbed sample; J = Small disturbed sample (glass jar); T = Small disturbed sample (plastic tub); W = Water sample.

| | | | | | |
|---|---|---|---|---|---|
| Co-ordinates: | | Elevation (m) | | Trial Pit Width (m) 0.70 | Trial Pit Length (m) 1.60 |
| Trial Pit Side Stability: | Stable | | | Logged By: AH | Checked By: RA |
| Groundwater Observations: | 1.30m: Seepage | | | Direction of Face A (degrees from N): 22 | Excavator D A C B |
| General Remarks: | Machine excavated pit G.L. – 1.30m. Carry out soakaway test. Backfill with arisings on completion. | | | | |

# Trial Pit Log Sheet

**TP No:** TP3

**Site:** Cowbridge Primary School

**Job Number:** 2071724

**Sheet 1 of 1**

**Client:** Morgan Sindall

**Date:** 07/04/2021

**Machine Type:** JCB 3cx

**Vertical Scale:** 1:25

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Bristol
BS11 9HF

| Depth (m) | Samp Ref | Test / Sample Depth (m) | Test Results | Depth (m) | Thickness (m) | Legend | Description of Strata | Reduced Level (m.O.D) |
|---|---|---|---|---|---|---|---|---|
| | D | 0.10 | | 0.20 | (0.20) | | Grass over brown sandy slightly gravelly clayey SILT with many rootlets. Gravel is angular to sub-rounded fine to coarse of sandstone, mudstone and occasional brick and plastic fragments. | |
| | B | 0.40 - 0.60 | | | | | Stiff medium strength orange brown and dark brown slightly sandy gravelly CLAY. Gravel is angular to sub-rounded fine to coarse of sandstone and occasional clinker and slag. | |
| 0.50 | ES | 0.50 | | | (0.70) | | 0.50m: HSV 40/12, 44/18, 50/16 kPa | |
| | | | | 0.90 | | | Firm dark greyish brown slightly sandy slightly gravelly clayey SILT. Gravel is angular to sub-angular fine to medium of sandstone and mudstone. | |
| 1.00 | B | 1.20 - 1.40 | | | (0.60) | | | |
| | ES | 1.30 | | | | | | |
| 1.50 | | | | 1.50 | | | 1.50m: Damp | |
| | | | | | | | END OF TRIAL PIT | |
| 2.00 | | | | | | | | |
| 2.50 | | | | | | | | |
| 3.00 | | | | | | | | |
| 3.50 | | | | | | | | |
| 4.00 | | | | | | | | |
| 4.50 | | | | | | | | |

Sample Types: D = Small disturbed sample; B = Bulk disturbed sample; J = Small disturbed sample (glass jar); T = Small disturbed sample (plastic tub); W = Water sample.

| | | | | | |
|---|---|---|---|---|---|
| Co-ordinates: | | Elevation (m) | | Trial Pit Width (m) 0.70 | Trial Pit Length (m) 1.70 |
| Trial Pit Side Stability: | Stable | | | Logged By: AH | Checked By: RA |
| Groundwater Observations: | 1.50 | | | Direction of Face A (degrees from N): 38 | Excavator D A B C |
| General Remarks: | Machine excavated pit G.L. – 1.50m. Carry out soakaway test. Backfill with arisings on completion. | | | | |

# Trial Pit Log Sheet

**TP No:** TP4

**Site:** Cowbridge Primary School

**Job Number:** 2071724

**Sheet 1 of 1**

**Client:** Morgan Sindall

**Date:** 07/04/2021

**Machine Type:** JCB 3cx

**Vertical Scale:** 1:10

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Bristol
BS11 9HF

| Depth (m) | Samp Ref | Test / Sample Depth (m) | Test Results | Depth (m) | Thickness (m) | Legend | Description of Strata | Reduced Level (m.O.D) |
|---|---|---|---|---|---|---|---|---|
| | | | | | (0.20) | | MADE GROUND: Grass over brown sandy slightly gravelly clayey SILT with many rootlets. Gravel is angular to sub-rounded fine to coarse of sandstone. | |
| | B | 0.20 - 0.40 | | 0.20 | | | | |
| | ES | 0.30 | | | (0.30) | | MADE GROUND: Greyish brown silty sandy angular to sub-angular fine to coarse GRAVEL of sandstone and occasional brick, concrete and clinker with low cobble content. Cobbles are angular of sandstone and brick. | |
| 0.50 | | | | 0.50 | | | MADE GROUND: Asphalt. | |
| | B | 0.60 | | | (0.20) | | 0.50m: Geotextile | |
| | | | | 0.70 | | | Firm to stiff medium strength light brown to orange brown slightly sandy to sandy silty CLAY. | |
| | B | 0.90 - 1.10 | | | | | | |
| 1.00 | ES | 1.00 | | | (0.70) | | 1.00m: HSV 50/20, 56/22, 60/20 kPa | |
| | | | | 1.40 | | | 1.40m: Seepage | |
| | | | | | | | END OF TRIAL PIT | |
| 1.50 | | | | | | | | |

Sample Types: D = Small disturbed sample; B = Bulk disturbed sample; J = Small disturbed sample (glass jar); T = Small disturbed sample (plastic tub); W = Water sample.

| | | | | | |
|---|---|---|---|---|---|
| Co-ordinates: | | Elevation (m) | | Trial Pit Width (m) 0.70 | Trial Pit Length (m) 1.80 |
| Trial Pit Side Stability: | Stable | | | Logged By: AH | Checked By: RA |
| Groundwater Observations: | 1.40m: Seepage | | | Direction of Face A (degrees from N): 230 | Excavator D A B C |
| General Remarks: | Machine excavated pit G.L. – 1.40m. Carry out soakaway test. Backfill with arisings on completion. | | | | |

# Trial Pit Log Sheet

**TP No:** TP5

**Site:** Cowbridge Primary School

**Job Number:** 2071724

**Sheet 1 of 1**

**Client:** Morgan Sindall

**Date:** 07/04/2021

**Machine Type:** JCB 3cx

**Vertical Scale:** 1:25

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Bristol
BS11 9HF

| Depth (m) | Samp Ref | Test / Sample Depth (m) | Test Results | Depth (m) | Thickness (m) | Legend | Description of Strata | Reduced Level (m.O.D) |
|---|---|---|---|---|---|---|---|---|
| | | | | 0.15 | (0.15) | | Grass over brown sandy slightly gravelly clayey SILT with many rootlets. Gravel is angular to sub-rounded fine to coarse of sandstone, mudstone and occasional brick. | |
| 0.50 | B<br>ES | 0.50<br>0.50 - 0.70 | | 0.90 | (0.75) | | Stiff light brown to orange brown slightly sandy gravelly CLAY with low cobble content. Gravel is angular to sub-angular fine to coarse of sandstone, mudstone, brick and clinker. Cobbles are angular of sandstone and brick. | |
| 1.00 | B<br>ES | 1.00<br>1.00 - 1.20 | | 1.20 | (0.30) | | Firm to stiff medium strength greyish brown slightly sandy clayey SILT.<br>1.10m: HSV 56/24, 50/12, 62/22 kPa<br>1.20m: Slow inflow<br>END OF TRIAL PIT | |

Sample Types: D = Small disturbed sample; B = Bulk disturbed sample; J = Small disturbed sample (glass jar); T = Small disturbed sample (plastic tub); W = Water sample.

| | | | | | |
|---|---|---|---|---|---|
| Co-ordinates: | | Elevation (m) | | Trial Pit Width (m) 0.70 | Trial Pit Length (m) 1.60 |
| Trial Pit Side Stability: | Stable | | | Logged By: AH | Checked By: RA |
| Groundwater Observations: | 1.20 | | | Direction of Face A (degrees from N): 40 | Excavator D A C B |
| General Remarks: | Machine excavated pit G.L. – 1.20m. Carry out soakaway test. Backfill with arisings on completion. | | | | |

# Trial Pit Log Sheet

**TP No:** TP6

**Site:** Cowbridge Primary School

**Job Number:** 2071724

**Sheet 1 of 1**

**Client:** Morgan Sindall

**Date:** 07/04/2021

**Machine Type:** JCB 3cx

**Vertical Scale:** 1:10

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Bristol
BS11 9HF

| Depth (m) | Samp Ref | Test / Sample Depth (m) | Test Results | Depth (m) | Thickness (m) | Legend | Description of Strata | Reduced Level (m.O.D) |
|---|---|---|---|---|---|---|---|---|
| | | | | | (0.15) | | MADE GROUND: Grass over firm slightly sandy slightly gravelly clayey SILT with many rootlets. Gravel is angular to sub-rounded fine to medium of sandstone and mudstone. | |
| | | | | 0.15 | | | MADE GROUND: Firm light brown to brown slightly sandy gravelly clayey SILT with medium cobble content. Gravel is angular to sub-rounded fine to coarse of sandstone, mudstone, brick, clinker and concrete. Cobbles are angular of sandstone and brick. | |
| | B ES | 0.40 0.40 - 0.60 | | | | | | |
| 0.50 | | | | | (0.65) | | | |
| | B ES | 0.80 0.80 - 1.00 | | 0.80 | | | | |
| | | | | | (0.15) | | MADE GROUND: Dark grey to black slightly silty slightly sandy angular to sub-angular fine to coarse GRAVEL of clinker, mudstone and slag. | |
| | | | | 0.95 | | | Stiff to very stiff medium to high strength greyish brown slightly sandy CLAY with occasional roots. | |
| 1.00 | | | | | | | | |
| | | | | | (0.55) | | | |
| | | | | | | | 1.30m: HSV 60/28, 76/24, 80/20 kPa | |
| 1.50 | | | | 1.50 | | | 1.50m: Seepage | |
| | | | | | | | END OF TRIAL PIT | |

Sample Types: D = Small disturbed sample; B = Bulk disturbed sample; J = Small disturbed sample (glass jar); T = Small disturbed sample (plastic tub); W = Water sample.

| | | | | | |
|---|---|---|---|---|---|
| Co-ordinates: | | Elevation (m) | | Trial Pit Width (m) 0.70 | Trial Pit Length (m) 1.75 |
| Trial Pit Side Stability: | Stable | | | Logged By: AH | Checked By: RA |
| Groundwater Observations: | 1.50m: Seepage | | | Direction of Face A (degrees from N): 45 | Excavator D A C B |
| General Remarks: | Machine excavated pit G.L. – 1.50m. Carry out soakaway test. Backfill with arisings on completion. | | | | |

CJAssociates

# IN SITU TEST RESULTS

CJAssociates

Portview Road,
Avonmouth, Bristol,
BS11 9JE

T 0117 9821473

Email admin@cjageo.co.uk

| | | |
|---|---|---|
| **REPORT No.** | : | 2071724 |
| **CLIENT** | : | Morgan Sindall |
| **SITE** | : | Cowbridge Primary School |
| **MATERIAL DESCRIPTION** | : | Topsoil and clay |
| **DATE TESTED** | : | 07 April 2021 |
| **TESTING REQUIRED** | : | 6 No. TRL DCP Tests |
| **RELEVANT SPECIFICATION** | : | BS 1377 : Part 9 : 1990<br>IAN 73/06 (supercedes HD 25/94) |
| **TEST METHOD** | : | BS1377 & TRL |
| **TEST RESULTS** | : | See Pages 3 – 8 |

CJAssociates

Portview Road,
Avonmouth, Bristol,
BS11 9JE

T 0117 9821473

Email admin@cjageo.co.uk

| | | |
|---|---|---|
| **REPORT No.** | : | 2071724 |
| **CLIENT** | : | Morgan Sindall |
| **SITE** | : | Cowbridge Primary School |
| **TEST LOCATION** | : | At locations as directed by Client and detailed on Client's records |
| **DEPTH ( m )** | : | See individual tests |
| **TEST RESULTS** | : | See over |

**COMMENTS**

**CHECKED BY:** Richard Anstee **DATE:** 08.04.21

# DYNAMIC CONE PENETROMETER TEST RESULTS

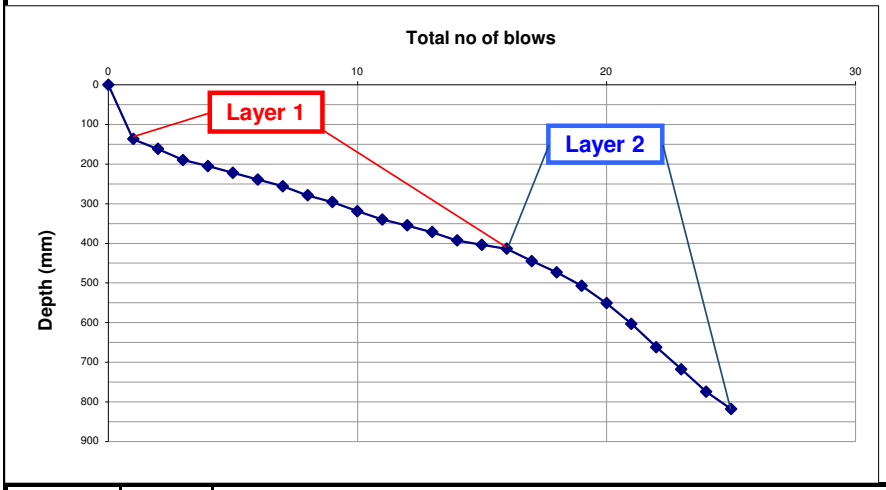
| | | | |
|---|---|---|---|
| Client Name | Morgan Sindall | Date | 07/04/2021 |
| Job Name | Cowbridge Primary School | Job No. | 2071724 |
| | | Zero Reading | 116 |
| | | Test No. | 1 |

CJAssociates

Depth (mm): 0

Locn: DCP01

| Total No. of Blows | Depth Reading (mm) | Total depth (mm) | Mean penetration per blow (mm) | Layer | Top of layer (mm) | Base of layer (mm) | Blows at top of layer | Blows at base of layer | Mean penetration per blow (mm) | CBR of layer (%) |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 116 | 0 | 0 | | | | | | | |
| 1 | 253 | 137 | 137.00 | Layer 1 | 137 | 414 | 1 | 16 | 18.5 | **14** |
| 2 | 278 | 162 | 25.00 | | | | | | | |
| 3 | 306 | 190 | 28.00 | | | | | | | |
| 4 | 321 | 205 | 15.00 | Layer 2 | 414 | 818 | 16 | 25 | 44.9 | **5.4** |
| 5 | 338 | 222 | 17.00 | | | | | | | |
| 6 | 355 | 239 | 17.00 | | | | | | | |
| 7 | 372 | 256 | 17.00 | | | | | | | |
| 8 | 395 | 279 | 23.00 | | | | | | | |
| 9 | 412 | 296 | 17.00 | | | | | | | |
| 10 | 435 | 319 | 23.00 | | | | | | | |
| 11 | 456 | 340 | 21.00 | | | | | | | |
| 12 | 471 | 355 | 15.00 | | | | | | | |
| 13 | 488 | 372 | 17.00 | | | | | | | |
| 14 | 509 | 393 | 21.00 | | | | | | | |
| 15 | 520 | 404 | 11.00 | | | | | | | |
| 16 | 530 | 414 | 10.00 | | | | | | | |
| 17 | 561 | 445 | 31.00 | | | | | | | |
| 18 | 589 | 473 | 28.00 | | | | | | | |
| 19 | 623 | 507 | 34.00 | | | | | | | |
| 20 | 667 | 551 | 44.00 | | | | | | | |
| 21 | 719 | 603 | 52.00 | | | | | | | |
| 22 | 778 | 662 | 59.00 | | | | | | | |
| 23 | 834 | 718 | 56.00 | | | | | | | |
| 24 | 890 | 774 | 56.00 | | | | | | | |
| 25 | 934 | 818 | 44.00 | | | | | | | |




| | | | |
|---|---|---|---|
| Remarks: | BS 1377 : Part 9 : 1990, IAN 73/06 (supercedes HD 25/94). Test started at existing ground level. | | |
| Particles >20mm | Yes | Weather | Dry |
| Operators | AH/ME | | Sheet 3 of 8 |

# DYNAMIC CONE PENETROMETER TEST RESULTS

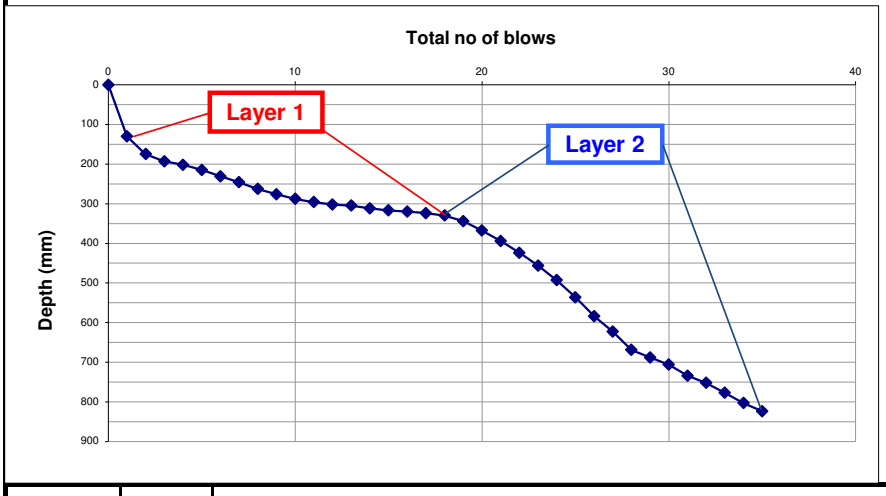
| | | | |
|---|---|---|---|
| Client Name | Morgan Sindall | Date | 07/04/2021 |
| Job Name | Cowbridge Primary School | Job No. | 2071724 |
| | | Zero Reading | 126 |
| | | Test No. | 2 |

CJAssociates

Depth (mm): 0

Locn: DCP02

| Total No. of Blows | Depth Reading (mm) | Total depth (mm) | Mean penetration per blow (mm) | Layer | Top of layer (mm) | Base of layer (mm) | Blows at top of layer | Blows at base of layer | Mean penetration per blow (mm) | CBR of layer (%) |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 126 | 0 | 0 | | | | | | | |
| 1 | 256 | 130 | 130.00 | Layer 1 | 130 | 330 | 1 | 18 | 11.8 | **22** |
| 2 | 301 | 175 | 45.00 | | | | | | | |
| 3 | 319 | 193 | 18.00 | | | | | | | |
| 4 | 328 | 202 | 9.00 | Layer 2 | 330 | 824 | 18 | 35 | 29.1 | **8.6** |
| 5 | 341 | 215 | 13.00 | | | | | | | |
| 6 | 357 | 231 | 16.00 | | | | | | | |
| 7 | 372 | 246 | 15.00 | | | | | | | |
| 8 | 389 | 263 | 17.00 | | | | | | | |
| 9 | 402 | 276 | 13.00 | | | | | | | |
| 10 | 414 | 288 | 12.00 | | | | | | | |
| 11 | 422 | 296 | 8.00 | | | | | | | |
| 12 | 428 | 302 | 6.00 | | | | | | | |
| 13 | 431 | 305 | 3.00 | | | | | | | |
| 14 | 438 | 312 | 7.00 | | | | | | | |
| 15 | 443 | 317 | 5.00 | | | | | | | |
| 16 | 446 | 320 | 3.00 | | | | | | | |
| 17 | 450 | 324 | 4.00 | | | | | | | |
| 18 | 456 | 330 | 6.00 | | | | | | | |
| 19 | 470 | 344 | 14.00 | | | | | | | |
| 20 | 494 | 368 | 24.00 | | | | | | | |
| 21 | 520 | 394 | 26.00 | | | | | | | |
| 22 | 550 | 424 | 30.00 | | | | | | | |
| 23 | 582 | 456 | 32.00 | | | | | | | |
| 24 | 619 | 493 | 37.00 | | | | | | | |
| 25 | 662 | 536 | 43.00 | | | | | | | |
| 26 | 710 | 584 | 48.00 | | | | | | | |
| 27 | 749 | 623 | 39.00 | | | | | | | |
| 28 | 795 | 669 | 46.00 | | | | | | | |
| 29 | 814 | 688 | 19.00 | | | | | | | |
| 30 | 832 | 706 | 18.00 | | | | | | | |
| 31 | 860 | 734 | 28.00 | | | | | | | |
| 32 | 878 | 752 | 18.00 | | | | | | | |
| 33 | 903 | 777 | 25.00 | | | | | | | |
| 34 | 929 | 803 | 26.00 | | | | | | | |
| 35 | 950 | 824 | 21.00 | | | | | | | |




| | | | |
|---|---|---|---|
| Remarks: | BS 1377 : Part 9 : 1990, IAN 73/06 (supercedes HD 25/94). Test started at existing ground level. | | |
| Particles >20mm | Yes | Weather | Dry |
| Operators | AH/ME | Sheet | 4 of 8 |

# DYNAMIC CONE PENETROMETER TEST RESULTS

| | | | |
|---|---|---|---|
| Client Name | Morgan Sindall | Date | 07/04/2021 |
| Job Name | Cowbridge Primary School | Job No. | 2071724 |
| | | Zero Reading | 126 |
| | | Test No. | 3 |

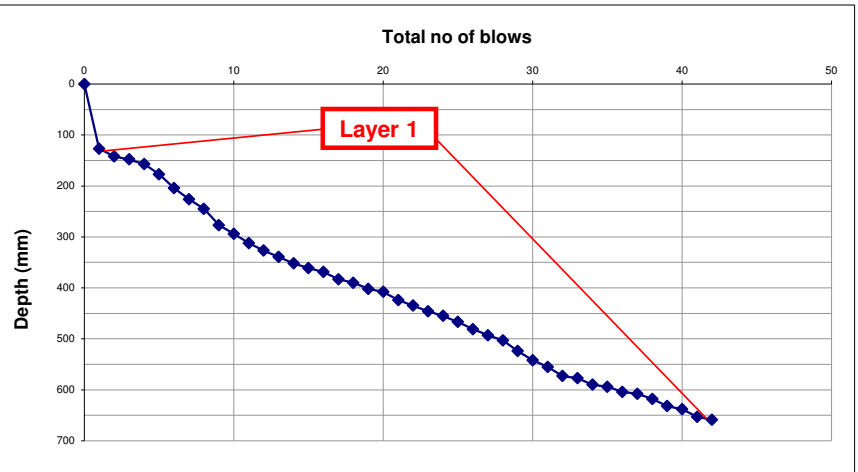
CJAssociates

Depth (mm): 0

Locn: DCP03

| Total No. of Blows | Depth Reading (mm) | Total depth (mm) | Mean penetration per blow (mm) | Layer | Top of layer (mm) | Base of layer (mm) | Blows at top of layer | Blows at base of layer | Mean penetration per blow (mm) | CBR of layer (%) |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 126 | 0 | 0 | | | | | | | |
| 1 | 253 | 127 | 127.00 | Layer 1 | 127 | 659 | 1 | 42 | 13.0 | **20** |
| 2 | 268 | 142 | 15.00 | | | | | | | |
| 3 | 274 | 148 | 6.00 | | | | | | | |
| 4 | 283 | 157 | 9.00 | | | | | | | |
| 5 | 303 | 177 | 20.00 | | | | | | | |
| 6 | 330 | 204 | 27.00 | | | | | | | |
| 7 | 352 | 226 | 22.00 | | | | | | | |
| 8 | 371 | 245 | 19.00 | | | | | | | |
| 9 | 403 | 277 | 32.00 | | | | | | | |
| 10 | 420 | 294 | 17.00 | | | | | | | |
| 11 | 438 | 312 | 18.00 | | | | | | | |
| 12 | 453 | 327 | 15.00 | | | | | | | |
| 13 | 465 | 339 | 12.00 | | | | | | | |
| 14 | 478 | 352 | 13.00 | | | | | | | |
| 15 | 487 | 361 | 9.00 | | | | | | | |
| 16 | 495 | 369 | 8.00 | | | | | | | |
| 17 | 509 | 383 | 14.00 | | | | | | | |
| 18 | 516 | 390 | 7.00 | | | | | | | |
| 19 | 528 | 402 | 12.00 | | | | | | | |
| 20 | 534 | 408 | 6.00 | | | | | | | |
| 21 | 550 | 424 | 16.00 | | | | | | | |
| 22 | 561 | 435 | 11.00 | | | | | | | |
| 23 | 572 | 446 | 11.00 | | | | | | | |
| 24 | 581 | 455 | 9.00 | | | | | | | |
| 25 | 593 | 467 | 12.00 | | | | | | | |
| 26 | 607 | 481 | 14.00 | | | | | | | |
| 27 | 619 | 493 | 12.00 | | | | | | | |
| 28 | 629 | 503 | 10.00 | | | | | | | |
| 29 | 650 | 524 | 21.00 | | | | | | | |
| 30 | 668 | 542 | 18.00 | | | | | | | |
| 31 | 681 | 555 | 13.00 | | | | | | | |
| 32 | 699 | 573 | 18.00 | | | | | | | |
| 33 | 703 | 577 | 4.00 | | | | | | | |
| 34 | 716 | 590 | 13.00 | | | | | | | |
| 35 | 720 | 594 | 4.00 | | | | | | | |
| 36 | 730 | 604 | 10.00 | | | | | | | |
| 37 | 734 | 608 | 4.00 | | | | | | | |
| 38 | 744 | 618 | 10.00 | | | | | | | |
| 39 | 758 | 632 | 14.00 | | | | | | | |
| 40 | 764 | 638 | 6.00 | | | | | | | |
| 41 | 779 | 653 | 15.00 | | | | | | | |
| 42 | 785 | 659 | 6.00 | | | | | | | |

Test terminated early due to badly deflected rods.




| | | | |
|---|---|---|---|
| Remarks: | BS 1377 : Part 9 : 1990, IAN 73/06 (supercedes HD 25/94). Test started at existing ground level. | | |
| Particles >20mm | Yes | Weather | Dry |
| Operators | AH/ME | | Sheet 5 of 8 |

# DYNAMIC CONE PENETROMETER TEST RESULTS

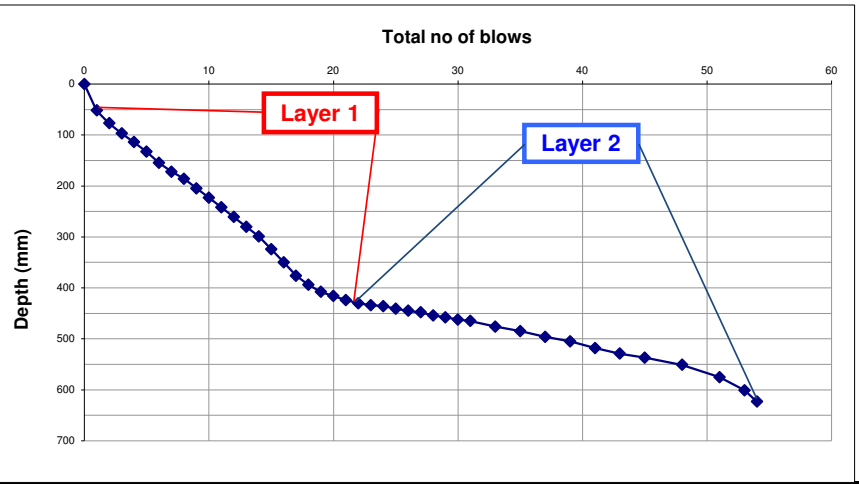
| | | | |
|---|---|---|---|
| Client Name | Morgan Sindall | Date | 07/04/2021 |
| Job Name | Cowbridge Primary School | Job No. | 2071724 |
| | | Zero Reading | 126 |
| | | Test No. | 4 |

CJAssociates

Depth (mm): 0

Locn: DCP04

| Total No. of Blows | Depth Reading (mm) | Total depth (mm) | Mean penetration per blow (mm) | Layer | Top of layer (mm) | Base of layer (mm) | Blows at top of layer | Blows at base of layer | Mean penetration per blow (mm) | CBR of layer (%) |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 126 | 0 | 0 | | | | | | | |
| 1 | 178 | 52 | 52.00 | Layer 1 | 52 | 430 | 1 | 22 | 18.0 | **14** |
| 2 | 203 | 77 | 25.00 | | | | | | | |
| 3 | 223 | 97 | 20.00 | | | | | | | |
| 4 | 240 | 114 | 17.00 | Layer 2 | 430 | 623 | 22 | 54 | 6.0 | **45** |
| 5 | 259 | 133 | 19.00 | | | | | | | |
| 6 | 281 | 155 | 22.00 | | | | | | | |
| 7 | 298 | 172 | 17.00 | | | | | | | |
| 8 | 312 | 186 | 14.00 | | | | | | | |
| 9 | 331 | 205 | 19.00 | | | | | | | |
| 10 | 349 | 223 | 18.00 | | | | | | | |
| 11 | 368 | 242 | 19.00 | | | | | | | |
| 12 | 387 | 261 | 19.00 | | | | | | | |
| 13 | 406 | 280 | 19.00 | | | | | | | |
| 14 | 425 | 299 | 19.00 | | | | | | | |
| 15 | 450 | 324 | 25.00 | | | | | | | |
| 16 | 476 | 350 | 26.00 | | | | | | | |
| 17 | 502 | 376 | 26.00 | | | | | | | |
| 18 | 520 | 394 | 18.00 | | | | | | | |
| 19 | 534 | 408 | 14.00 | | | | | | | |
| 20 | 542 | 416 | 8.00 | | | | | | | |
| 21 | 550 | 424 | 8.00 | | | | | | | |
| 22 | 556 | 430 | 6.00 | | | | | | | |
| 23 | 560 | 434 | 4.00 | | | | | | | |
| 24 | 562 | 436 | 2.00 | | | | | | | |
| 25 | 567 | 441 | 5.00 | | | | | | | |
| 26 | 571 | 445 | 4.00 | | | | | | | |
| 27 | 574 | 448 | 3.00 | | | | | | | |
| 28 | 580 | 454 | 6.00 | | | | | | | |
| 29 | 584 | 458 | 4.00 | | | | | | | |
| 30 | 588 | 462 | 4.00 | | | | | | | |
| 31 | 591 | 465 | 3.00 | | | | | | | |
| 33 | 602 | 476 | 5.50 | | | | | | | |
| 35 | 611 | 485 | 4.50 | | | | | | | |
| 37 | 622 | 496 | 5.50 | | | | | | | |
| 39 | 631 | 505 | 4.50 | | | | | | | |
| 41 | 644 | 518 | 6.50 | | | | | | | |
| 43 | 655 | 529 | 5.50 | | | | | | | |
| 45 | 663 | 537 | 4.00 | | | | | | | |
| 48 | 677 | 551 | 4.67 | | | | | | | |
| 51 | 701 | 575 | 8.00 | | | | | | | |
| 53 | 727 | 601 | 13.00 | | | | | | | |
| 54 | 749 | 623 | 22.00 | | | | | | | |




| | | | | | |
|---|---|---|---|---|---|
| Remarks: | | BS 1377 : Part 9 : 1990, IAN 73/06 (supercedes HD 25/94). Test started at existing ground level. | | | |
| Particles >20mm | | Yes | | Weather | Dry |
| Operators | | AH/ME | | | Sheet 6 of 8 |

# DYNAMIC CONE PENETROMETER TEST RESULTS

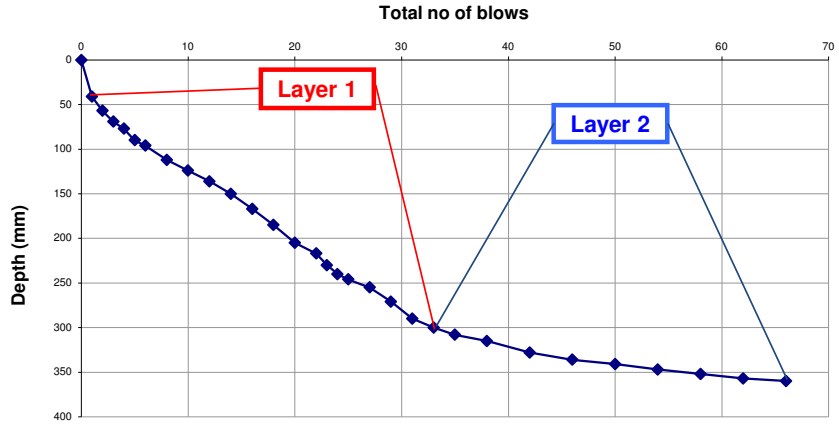
| | | | |
|---|---|---|---|
| Client Name | Morgan Sindall | Date | 07/04/2021 |
| Job Name | Cowbridge Primary School | Job No. | 2071724 |
| | | Zero Reading | 173 |
| | | Test No. | 5 |

CJAssociates

Depth (mm): 0

Locn: DCP05

| Total No. of Blows | Depth Reading (mm) | Total depth (mm) | Mean penetration per blow (mm) | Layer | Top of layer (mm) | Base of layer (mm) | Blows at top of layer | Blows at base of layer | Mean penetration per blow (mm) | CBR of layer (%) |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 173 | 0 | 0 | | | | | | | |
| 1 | 214 | 41 | 41.00 | Layer 1 | 41 | 300 | 1 | 33 | 8.1 | **33** |
| 2 | 230 | 57 | 16.00 | | | | | | | |
| 3 | 242 | 69 | 12.00 | | | | | | | |
| 4 | 250 | 77 | 8.00 | Layer 2 | 300 | 360 | 33 | 66 | 1.8 | **>100** |
| 5 | 263 | 90 | 13.00 | | | | | | | |
| 6 | 269 | 96 | 6.00 | | | | | | | |
| 8 | 285 | 112 | 8.00 | | | | | | | |
| 10 | 297 | 124 | 6.00 | | | | | | | |
| 12 | 309 | 136 | 6.00 | | | | | | | |
| 14 | 323 | 150 | 7.00 | | | | | | | |
| 16 | 340 | 167 | 8.50 | | | | | | | |
| 18 | 358 | 185 | 9.00 | | | | | | | |
| 20 | 378 | 205 | 10.00 | | | | | | | |
| 22 | 390 | 217 | 6.00 | | | | | | | |
| 23 | 403 | 230 | 13.00 | | | | | | | |
| 24 | 413 | 240 | 10.00 | | | | | | | |
| 25 | 419 | 246 | 6.00 | | | | | | | |
| 27 | 428 | 255 | 4.50 | | | | | | | |
| 29 | 444 | 271 | 8.00 | | | | | | | |
| 31 | 463 | 290 | 9.50 | | | | | | | |
| 33 | 473 | 300 | 5.00 | | | | | | | |
| 35 | 481 | 308 | 4.00 | | | | | | | |
| 38 | 488 | 315 | 2.33 | | | | | | | |
| 42 | 501 | 328 | 3.25 | | | | | | | |
| 46 | 509 | 336 | 2.00 | | | | | | | |
| 50 | 514 | 341 | 1.25 | | | | | | | |
| 54 | 520 | 347 | 1.50 | | | | | | | |
| 58 | 525 | 352 | 1.25 | | | | | | | |
| 62 | 530 | 357 | 1.25 | | | | | | | |
| 66 | 533 | 360 | 0.75 | | | | | | | |




| | | | | | |
|---|---|---|---|---|---|
| Remarks: | | BS 1377 : Part 9 : 1990, IAN 73/06 (supercedes HD 25/94). Test started at existing ground level. | | | |
| Particles >20mm | | Yes | | Weather | Dry |
| Operators | | AH/ME | | | Sheet 7 of 8 |

# DYNAMIC CONE PENETROMETER TEST RESULTS

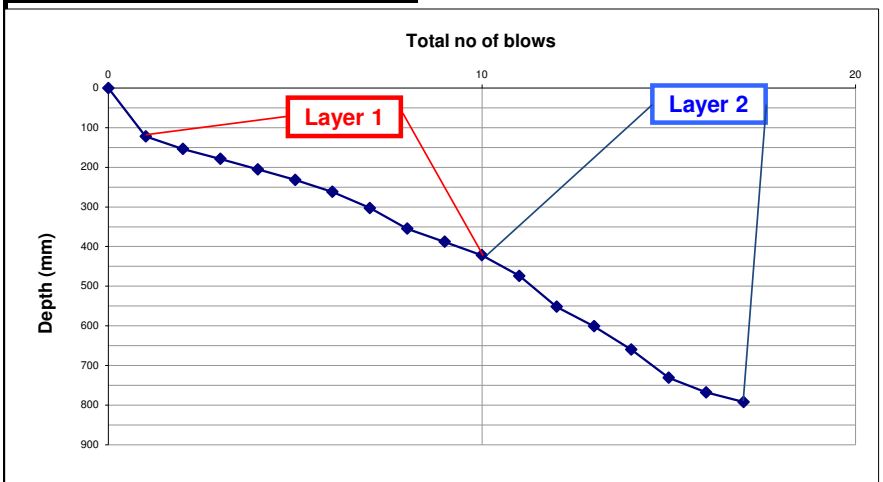
| | | | |
|---|---|---|---|
| Client Name | Morgan Sindall | Date | 07/04/2021 |
| Job Name | Cowbridge Primary School | Job No. | 2071724 |
| | | Zero Reading | 151 |
| | | Test No. | 6 |

CJAssociates

Depth (mm): 0

Locn: DCP06

| Total No. of Blows | Depth Reading (mm) | Total depth (mm) | Mean penetration per blow (mm) | Layer | Top of layer (mm) | Base of layer (mm) | Blows at top of layer | Blows at base of layer | Mean penetration per blow (mm) | CBR of layer (%) |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 151 | 0 | 0 | | | | | | | |
| 1 | 273 | 122 | 122.00 | Layer 1 | 122 | 422 | 1 | 10 | 33.3 | **7.4** |
| 2 | 305 | 154 | 32.00 | | | | | | | |
| 3 | 330 | 179 | 25.00 | | | | | | | |
| 4 | 356 | 205 | 26.00 | Layer 2 | 422 | 792 | 10 | 17 | 52.9 | **4.6** |
| 5 | 383 | 232 | 27.00 | | | | | | | |
| 6 | 413 | 262 | 30.00 | | | | | | | |
| 7 | 454 | 303 | 41.00 | | | | | | | |
| 8 | 506 | 355 | 52.00 | | | | | | | |
| 9 | 539 | 388 | 33.00 | | | | | | | |
| 10 | 573 | 422 | 34.00 | | | | | | | |
| 11 | 625 | 474 | 52.00 | | | | | | | |
| 12 | 703 | 552 | 78.00 | | | | | | | |
| 13 | 752 | 601 | 49.00 | | | | | | | |
| 14 | 811 | 660 | 59.00 | | | | | | | |
| 15 | 882 | 731 | 71.00 | | | | | | | |
| 16 | 919 | 768 | 37.00 | | | | | | | |
| 17 | 943 | 792 | 24.00 | | | | | | | |




| | | | | | |
|---|---|---|---|---|---|
| Remarks: | | BS 1377 : Part 9 : 1990, IAN 73/06 (supercedes HD 25/94). Test started at existing ground level. | | | |
| Particles >20mm | | Yes | | Weather | Dry |
| Operators | | AH/ME | | | Sheet 8 of 8 |

CJAssociates

**SOIL INFILTRATION RATE TEST**

See B.R.E. Digest 365, 2016, Soakaway Design.

| | | | | | |
|---|---|---|---|---|---|
| Site | Cowbridge Primary School | | Trial Pit Number | SA1 | |
| Job Number | 2071724 | | Length | 1.80 | m |
| Client | Morgan Sindall | | Width | 0.65 | m |
| Date of Test | 07/04/2021 | | Depth | 1.20 | m |
| | | | Groundwater Level | Damp | |

Remarks -
Logged by CJA on site. For strata descriptions, refer to TP1 log.

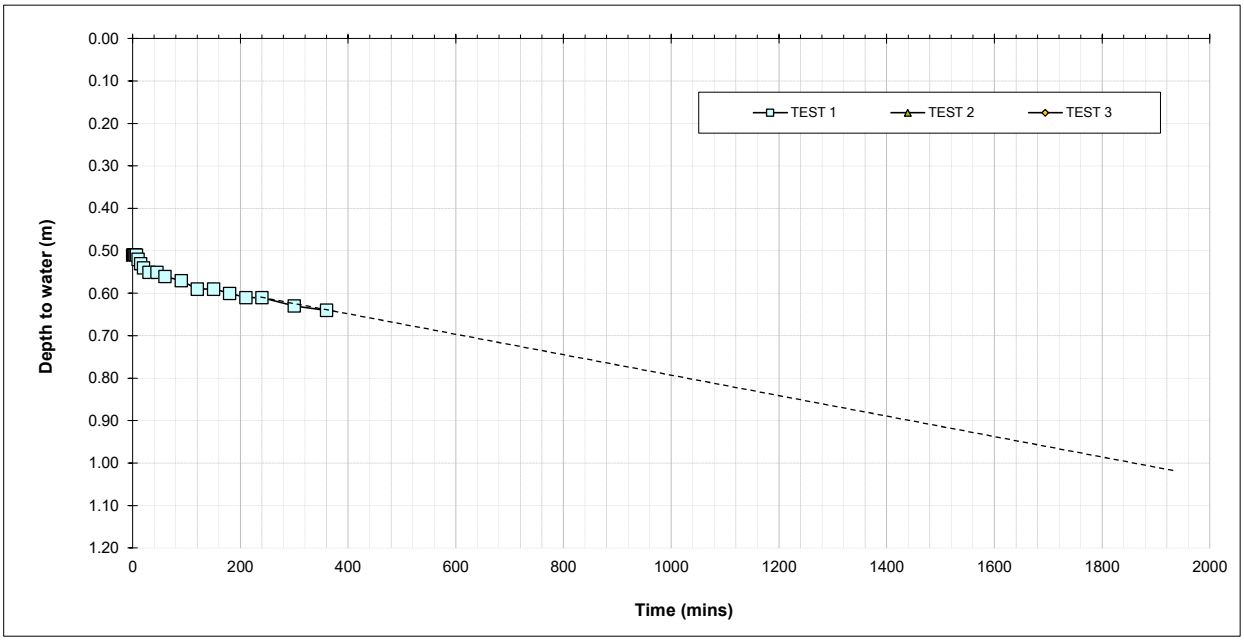
Approx outflow time from water tank was 1 minute.

Soil Infiltration rate calculated using extrapolated data.

| TEST 1 | | TEST 2 | | TEST 3 | |
|---|---|---|---|---|---|
| Time(min) | Depth to Water (m) | Time(min) | Depth to Water (m) | Time(min) | Depth to Water (m) |
| 0 | 0.51 | 0 | | 0 | |
| 1 | 0.51 | 1 | | 1 | |
| 2 | 0.51 | 2 | | 2 | |
| 3 | 0.51 | 3 | | 3 | |
| 4 | 0.51 | 4 | | 4 | |
| 5 | 0.51 | 5 | | 5 | |
| 7 | 0.51 | 7 | | 7 | |
| 10 | 0.52 | 10 | | 10 | |
| 15 | 0.53 | 15 | | 15 | |
| 20 | 0.54 | 20 | | 20 | |
| 30 | 0.55 | 30 | | 30 | |
| 45 | 0.55 | 45 | | 45 | |
| 60 | 0.56 | 60 | | 60 | |
| 90 | 0.57 | 90 | | 90 | |
| 120 | 0.59 | 120 | | 120 | |
| 150 | 0.59 | 150 | | 150 | |
| 180 | 0.60 | 180 | | 180 | |
| 210 | 0.61 | 210 | | 210 | |
| 240 | 0.61 | 240 | | 240 | |
| 300 | 0.63 | 300 | | 300 | |
| 360 | 0.64 | 360 | | 360 | |

| | | TEST 1 | TEST 2 | TEST 3 |
|---|---|---|---|---|
| Effective Storage Depth | m | 0.69 | | |
| 75% Effective Storage Depth | m | 0.52 | | |
| (i.e. depth below GL) | m | 0.68 | | |
| 25% Effective Storage Depth | m | 0.17 | | |
| (i.e. depth below GL) | m | 1.03 | | |
| Effective Storage Depth 75%-25% | m | 0.35 | | |
| Time to fall to 75% effective depth | mins | 560.00 | | |
| Time to fall to 25% effective depth | mins | 1860.00 | | |
| V (75%-25%) | m3 | 0.40 | | |
| a (50%) | m2 | 2.86 | | |
| t (75%-25%) | mins | 1300.00 | | |
| **SOIL INFILTRATION RATE** | m/s | **1.81E-06** | | |

**DESIGN SOIL INFILTRATION RATE, f** **1.81E-06**



CJAssociates

**SOIL INFILTRATION RATE TEST**
See B.R.E. Digest 365, 2016, Soakaway Design.

| | |
|---|---|
| Site | Cowbridge Primary School |
| Job Number | 2071724 |
| Client | Morgan Sindall |
| Date of Test | 07/04/2021 |

| | | |
|---|---|---|
| Trial Pit Number | SA2 | |
| Length | 1.60 | m |
| Width | 0.70 | m |
| Depth | 1.30 | m |
| Groundwater Level | Seepage | |

Remarks -
Logged by CJA on site. For strata descriptions, refer to TP2 log.

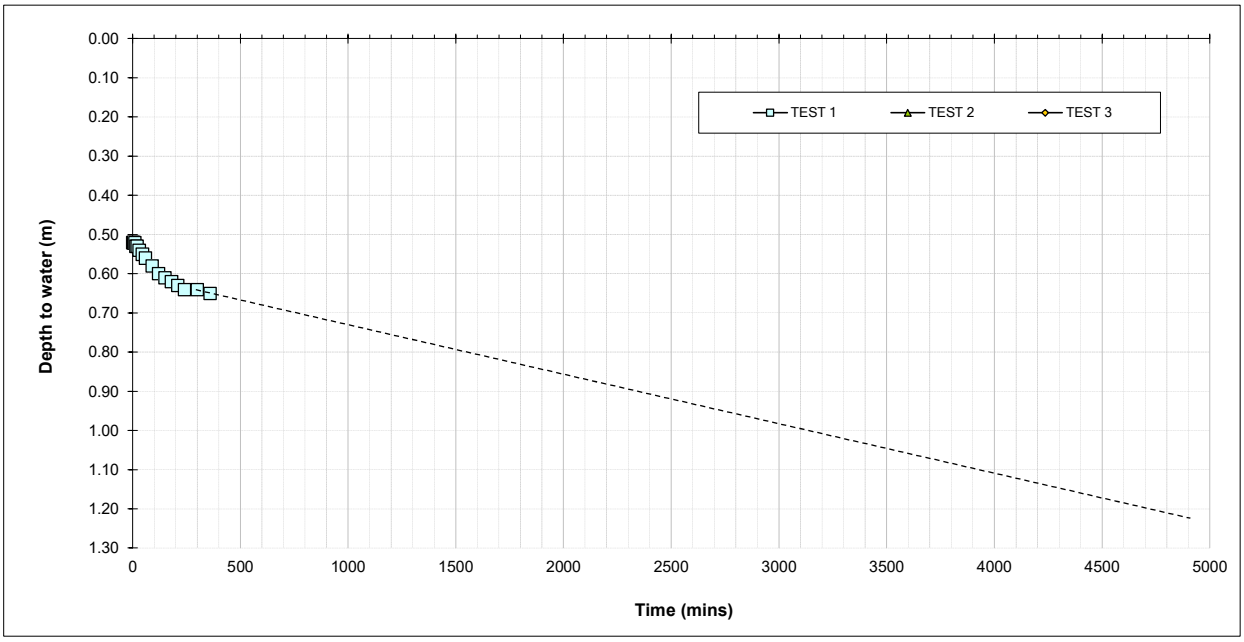
Approx outflow time from water tank was 1 minute.

Soil Infiltration rate calculated using extrapolated data.

| TEST 1 | | TEST 2 | | TEST 3 | |
|---|---|---|---|---|---|
| Time(min) | Depth to Water (m) | Time(min) | Depth to Water (m) | Time(min) | Depth to Water (m) |
| 0 | 0.52 | 0 | | 0 | |
| 1 | 0.52 | 1 | | 1 | |
| 2 | 0.52 | 2 | | 2 | |
| 3 | 0.52 | 3 | | 3 | |
| 4 | 0.52 | 4 | | 4 | |
| 5 | 0.52 | 5 | | 5 | |
| 7 | 0.52 | 7 | | 7 | |
| 10 | 0.52 | 10 | | 10 | |
| 15 | 0.53 | 15 | | 15 | |
| 20 | 0.53 | 20 | | 20 | |
| 30 | 0.54 | 30 | | 30 | |
| 45 | 0.55 | 45 | | 45 | |
| 60 | 0.56 | 60 | | 60 | |
| 90 | 0.58 | 90 | | 90 | |
| 120 | 0.60 | 120 | | 120 | |
| 150 | 0.61 | 150 | | 150 | |
| 180 | 0.62 | 180 | | 180 | |
| 210 | 0.63 | 210 | | 210 | |
| 240 | 0.64 | 240 | | 240 | |
| 300 | 0.64 | 300 | | 300 | |
| 360 | 0.65 | 360 | | 360 | |

| | | |
|---|---|---|
| Effective Storage Depth | m | 0.78 |
| 75% Effective Storage Depth | m | 0.59 |
| (i.e. depth below GL) | m | 0.72 |
| 25% Effective Storage Depth | m | 0.20 |
| (i.e. depth below GL) | m | 1.11 |
| Effective Storage Depth 75%-25% | m | 0.39 |
| Time to fall to 75% effective depth | mins | 800.00 |
| Time to fall to 25% effective depth | mins | 3950.00 |
| V (75%-25%) | m3 | 0.44 |
| a (50%) | m2 | 2.91 |
| t (75%-25%) | mins | 3150.00 |
| **SOIL INFILTRATION RATE** | m/s | **7.93E-07** |

**DESIGN SOIL INFILTRATION RATE, f** **7.93E-07**



CJAssociates

**SOIL INFILTRATION RATE TEST**

See B.R.E. Digest 365, 2016, Soakaway Design.

| | | | | | |
|---|---|---|---|---|---|
| Site..... | Cowbridge Primary School | | Trial Pit Number..... | SA3 | |
| Job Number..... | 2071724 | | Length..... | 1.70 | m |
| Client..... | Morgan Sindall | | Width..... | 0.70 | m |
| Date of Test..... | 07/04/2021 | | Depth..... | 1.50 | m |
| | | | Groundwater Level..... | Damp | |

Remarks -
Logged by CJA on site. For strata descriptions, refer to TP3 log.

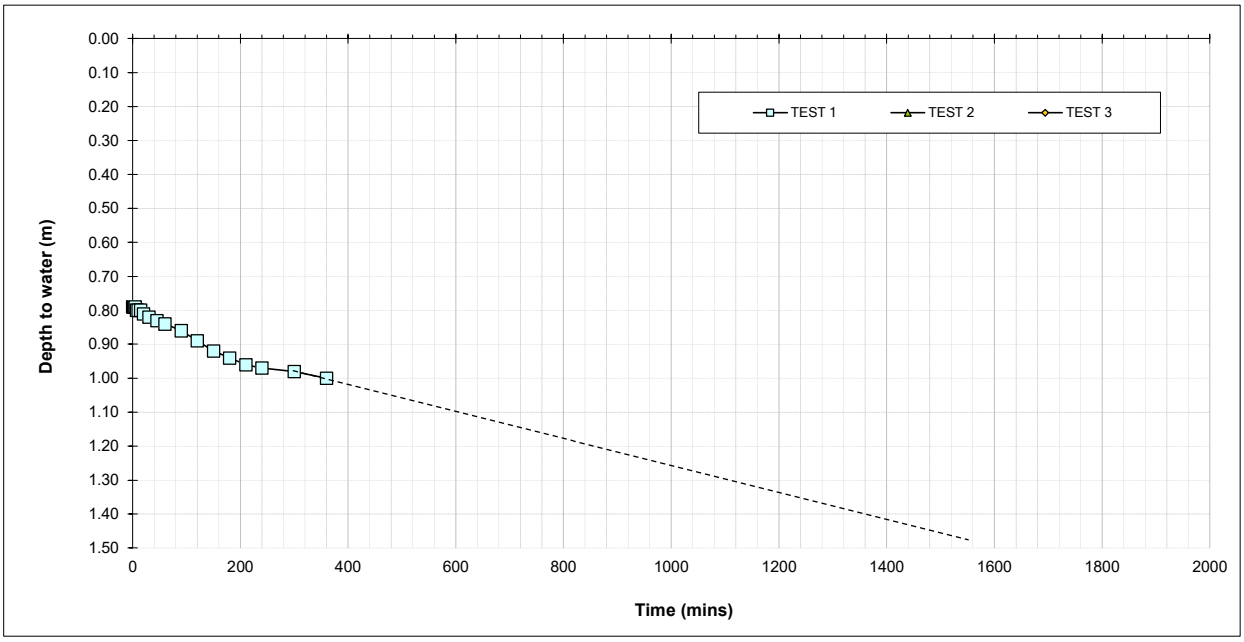
Approx outflow time from water tank was 1 minutes.

Soil Infiltration rate calculated using extrapolated data.

| TEST 1 | | TEST 2 | | TEST 3 | |
|---|---|---|---|---|---|
| Time(min) | Depth to Water (m) | Time(min) | Depth to Water (m) | Time(min) | Depth to Water (m) |
| 0 | 0.79 | 0 | | 0 | |
| 1 | 0.79 | 1 | | 1 | |
| 2 | 0.79 | 2 | | 2 | |
| 3 | 0.79 | 3 | | 3 | |
| 4 | 0.79 | 4 | | 4 | |
| 5 | 0.79 | 5 | | 5 | |
| 7 | 0.80 | 7 | | 7 | |
| 10 | 0.80 | 10 | | 10 | |
| 15 | 0.80 | 15 | | 15 | |
| 20 | 0.81 | 20 | | 20 | |
| 30 | 0.82 | 30 | | 30 | |
| 45 | 0.83 | 45 | | 45 | |
| 60 | 0.84 | 60 | | 60 | |
| 90 | 0.86 | 90 | | 90 | |
| 120 | 0.89 | 120 | | 120 | |
| 150 | 0.92 | 150 | | 150 | |
| 180 | 0.94 | 180 | | 180 | |
| 210 | 0.96 | 210 | | 210 | |
| 240 | 0.97 | 240 | | 240 | |
| 300 | 0.98 | 300 | | 300 | |
| 360 | 1.00 | 360 | | 360 | |

| | | | | |
|---|---|---|---|---|
| Effective Storage Depth | m | 0.71 | | |
| 75% Effective Storage Depth | m | 0.53 | | |
| (i.e. depth below GL) | m | 0.97 | | |
| 25% Effective Storage Depth | m | 0.18 | | |
| (i.e. depth below GL) | m | 1.32 | | |
| Effective Storage Depth 75%-25% | m | 0.36 | | |
| Time to fall to 75% effective depth | mins | 240.00 | | |
| Time to fall to 25% effective depth | mins | 1160.00 | | |
| V (75%-25%) | m3 | 0.42 | | |
| a (50%) | m2 | 2.89 | | |
| t (75%-25%) | mins | 920.00 | | |
| **SOIL INFILTRATION RATE** | m/s | **2.64E-06** | | |

**DESIGN SOIL INFILTRATION RATE, f** **2.64E-06**



CJAssociates

**SOIL INFILTRATION RATE TEST**

See B.R.E. Digest 365, 2016, Soakaway Design.

| | |
|---|---|
| Site | Cowbridge Primary School |
| Job Number | 2071724 |
| Client | Morgan Sindall |
| Date of Test | 07/04/2021 |

| | | |
|---|---|---|
| Trial Pit Number | SA4 | |
| Length | 1.80 | m |
| Width | 0.70 | m |
| Depth | 1.40 | m |
| Groundwater Level | Damp | |

Remarks -
Logged by CJA on site. For strata descriptions, refer to TP4 log.

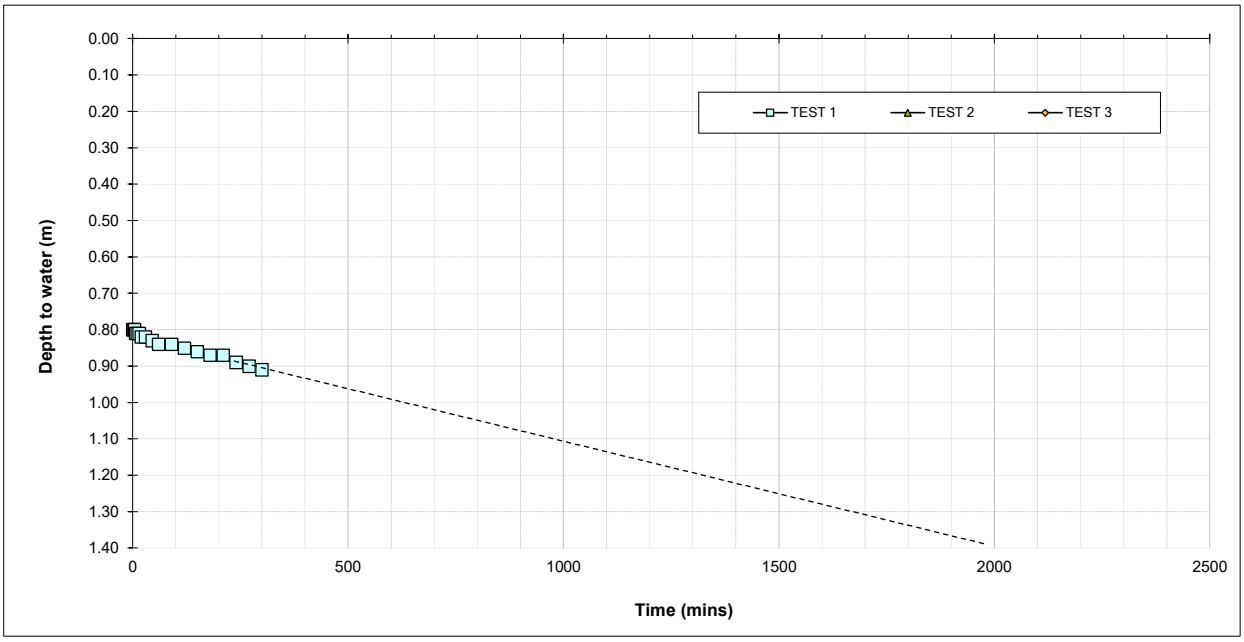
Approx outflow time from water tank was 1 minutes.

Soil Infiltration rate calculated using extrapolated data.

| TEST 1 | | TEST 2 | | TEST 3 | |
|---|---|---|---|---|---|
| Time(min) | Depth to Water (m) | Time(min) | Depth to Water (m) | Time(min) | Depth to Water (m) |
| 0 | 0.80 | 0 | | 0 | |
| 1 | 0.80 | 1 | | 1 | |
| 2 | 0.80 | 2 | | 2 | |
| 3 | 0.80 | 3 | | 3 | |
| 4 | 0.80 | 4 | | 4 | |
| 5 | 0.80 | 5 | | 5 | |
| 7 | 0.81 | 7 | | 7 | |
| 10 | 0.81 | 10 | | 10 | |
| 15 | 0.81 | 15 | | 15 | |
| 20 | 0.82 | 20 | | 20 | |
| 30 | 0.82 | 30 | | 30 | |
| 45 | 0.83 | 45 | | 45 | |
| 60 | 0.84 | 60 | | 60 | |
| 90 | 0.84 | 90 | | 90 | |
| 120 | 0.85 | 120 | | 120 | |
| 150 | 0.86 | 150 | | 150 | |
| 180 | 0.87 | 180 | | 180 | |
| 210 | 0.87 | 210 | | 210 | |
| 240 | 0.89 | 240 | | 240 | |
| 270 | 0.90 | 300 | | 300 | |
| 300 | 0.91 | 360 | | 360 | |

| | | | | |
|---|---|---|---|---|
| Effective Storage Depth | m | 0.60 | | |
| 75% Effective Storage Depth | m | 0.45 | | |
| (i.e. depth below GL) | m | 0.95 | | |
| 25% Effective Storage Depth | m | 0.15 | | |
| (i.e. depth below GL) | m | 1.25 | | |
| Effective Storage Depth 75%-25% | m | 0.30 | | |
| Time to fall to 75% effective depth | mins | 450.00 | | |
| Time to fall to 25% effective depth | mins | 1500.00 | | |
| V (75%-25%) | m3 | 0.38 | | |
| a (50%) | m2 | 2.76 | | |
| t (75%-25%) | mins | 1050.00 | | |
| **SOIL INFILTRATION RATE** | m/s | **2.17E-06** | | |

| | |
|---|---|
| **DESIGN SOIL INFILTRATION RATE, f** | **2.17E-06** |



CJAssociates

**SOIL INFILTRATION RATE TEST**

See B.R.E. Digest 365, 2016, Soakaway Design.

| | | | | | |
|---|---|---|---|---|---|
| Site | Cowbridge Primary School | | Trial Pit Number | SA5 | |
| Job Number | 2071724 | | Length | 1.60 | m |
| Client | Morgan Sindall | | Width | 0.70 | m |
| Date of Test | 07/04/2021 | | Depth | 1.20 | m |
| | | | Groundwater Level | Slow Inflow | |

Remarks -
Logged by CJA on site. For strata descriptions, refer to TP5 log.

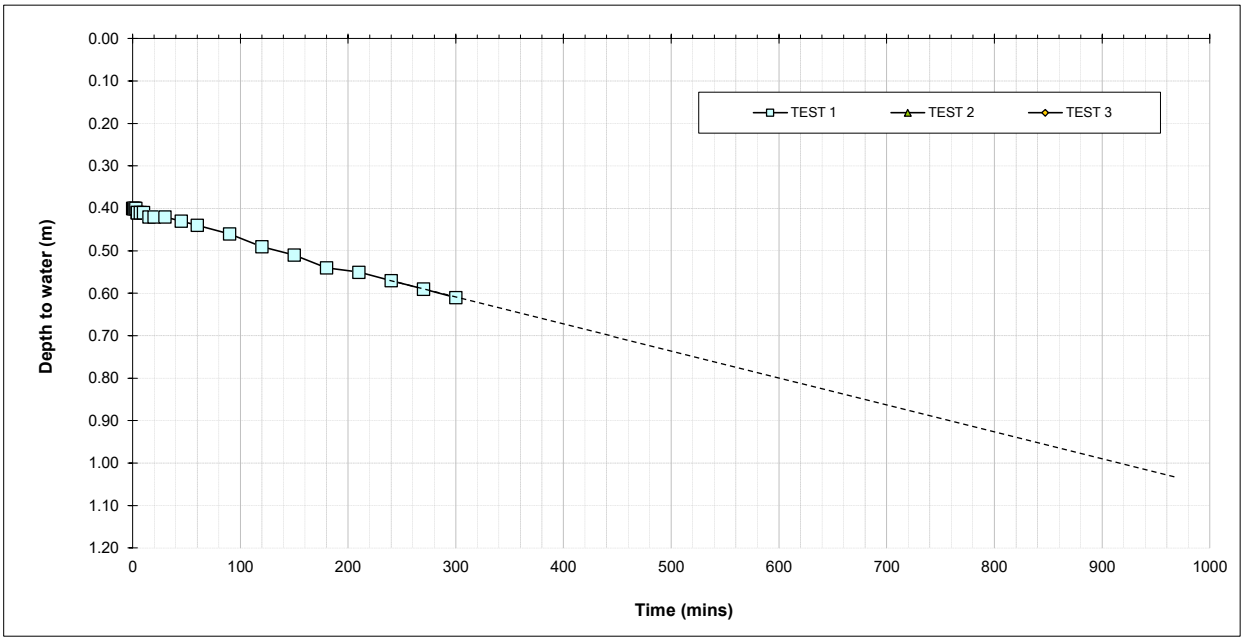
Approx outflow time from water tank was 1 minutes.

Soil Infiltration rate calculated using extrapolated data.

| TEST 1 | | TEST 2 | | TEST 3 | |
|---|---|---|---|---|---|
| Time(min) | Depth to Water (m) | Time(min) | Depth to Water (m) | Time(min) | Depth to Water (m) |
| 0 | 0.40 | 0 | | 0 | |
| 1 | 0.40 | 1 | | 1 | |
| 2 | 0.40 | 2 | | 2 | |
| 3 | 0.40 | 3 | | 3 | |
| 4 | 0.41 | 4 | | 4 | |
| 5 | 0.41 | 5 | | 5 | |
| 7 | 0.41 | 7 | | 7 | |
| 10 | 0.41 | 10 | | 10 | |
| 15 | 0.42 | 15 | | 15 | |
| 20 | 0.42 | 20 | | 20 | |
| 30 | 0.42 | 30 | | 30 | |
| 45 | 0.43 | 45 | | 45 | |
| 60 | 0.44 | 60 | | 60 | |
| 90 | 0.46 | 90 | | 90 | |
| 120 | 0.49 | 120 | | 120 | |
| 150 | 0.51 | 150 | | 150 | |
| 180 | 0.54 | 180 | | 180 | |
| 210 | 0.55 | 210 | | 210 | |
| 240 | 0.57 | 240 | | 240 | |
| 270 | 0.59 | 300 | | 300 | |
| 300 | 0.61 | 360 | | 360 | |

| | | | | |
|---|---|---|---|---|
| Effective Storage Depth | m | 0.80 | | |
| 75% Effective Storage Depth | m | 0.60 | | |
| (i.e. depth below GL) | m | 0.60 | | |
| 25% Effective Storage Depth | m | 0.20 | | |
| (i.e. depth below GL) | m | 1.00 | | |
| Effective Storage Depth 75%-25% | m | 0.40 | | |
| Time to fall to 75% effective depth | mins | 300.00 | | |
| Time to fall to 25% effective depth | mins | 900.00 | | |
| V (75%-25%) | m3 | 0.45 | | |
| a (50%) | m2 | 2.96 | | |
| t (75%-25%) | mins | 600.00 | | |
| **SOIL INFILTRATION RATE** | m/s | **4.20E-06** | | |

| | |
|---|---|
| **DESIGN SOIL INFILTRATION RATE, f** | **4.20E-06** |



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**SOIL INFILTRATION RATE TEST**

See B.R.E. Digest 365, 2016, Soakaway Design.

| | |
|---|---|
| Site | Cowbridge Primary School |
| Job Number | 2071724 |
| Client | Morgan Sindall |
| Date of Test | 07/04/2021 |

| | | |
|---|---|---|
| Trial Pit Number | SA6 | |
| Length | 1.75 | m |
| Width | 0.70 | m |
| Depth | 1.50 | m |
| Groundwater Level | Seepage | |

Remarks -
Logged by CJA on site. For strata descriptions, refer to TP6 log.

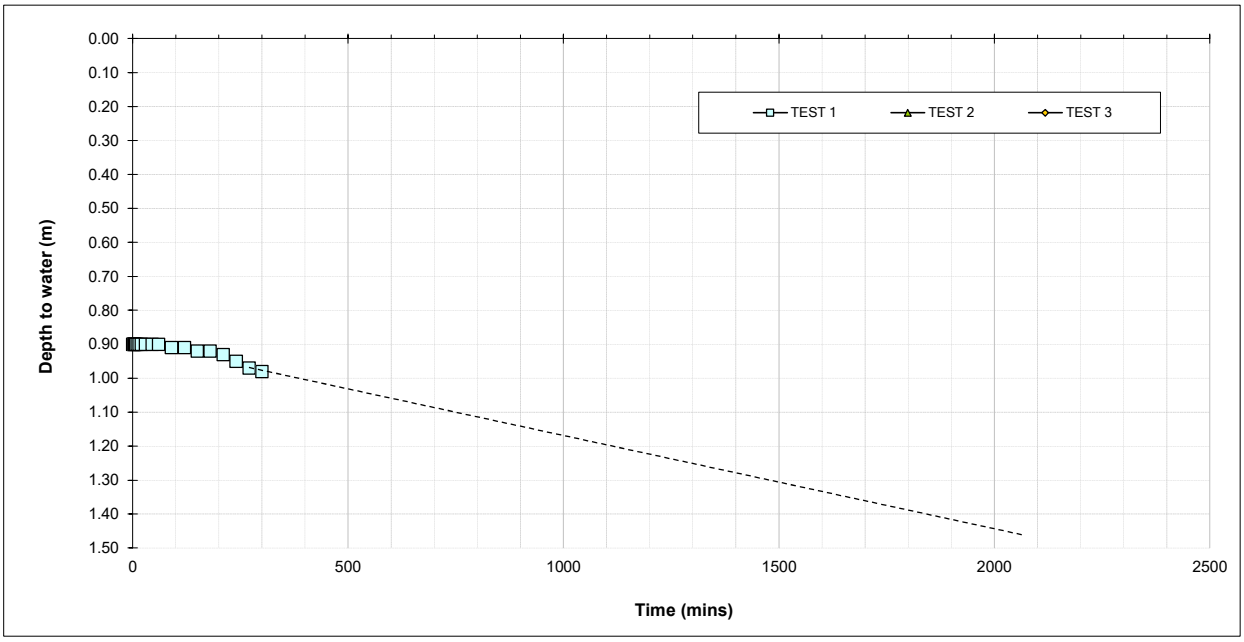
Approx outflow time from water tank was 1 minutes.

Soil Infiltration rate calculated using extrapolated data.

| TEST 1 | | TEST 2 | | TEST 3 | |
|---|---|---|---|---|---|
| Time(min) | Depth to Water (m) | Time(min) | Depth to Water (m) | Time(min) | Depth to Water (m) |
| 0 | 0.90 | 0 | | 0 | |
| 1 | 0.90 | 1 | | 1 | |
| 2 | 0.90 | 2 | | 2 | |
| 3 | 0.90 | 3 | | 3 | |
| 4 | 0.90 | 4 | | 4 | |
| 5 | 0.90 | 5 | | 5 | |
| 7 | 0.90 | 7 | | 7 | |
| 10 | 0.90 | 10 | | 10 | |
| 15 | 0.90 | 15 | | 15 | |
| 20 | 0.90 | 20 | | 20 | |
| 30 | 0.90 | 30 | | 30 | |
| 45 | 0.90 | 45 | | 45 | |
| 60 | 0.90 | 60 | | 60 | |
| 90 | 0.91 | 90 | | 90 | |
| 120 | 0.91 | 120 | | 120 | |
| 150 | 0.92 | 150 | | 150 | |
| 180 | 0.92 | 180 | | 180 | |
| 210 | 0.93 | 210 | | 210 | |
| 240 | 0.95 | 240 | | 240 | |
| 270 | 0.97 | 300 | | 300 | |
| 300 | 0.98 | 360 | | 360 | |

| | | | | |
|---|---|---|---|---|
| Effective Storage Depth | m | 0.60 | | |
| 75% Effective Storage Depth | m | 0.45 | | |
| (i.e. depth below GL) | m | 1.05 | | |
| 25% Effective Storage Depth | m | 0.15 | | |
| (i.e. depth below GL) | m | 1.35 | | |
| Effective Storage Depth 75%-25% | m | 0.30 | | |
| Time to fall to 75% effective depth | mins | 550.00 | | |
| Time to fall to 25% effective depth | mins | 1650.00 | | |
| V (75%-25%) | m3 | 0.37 | | |
| a (50%) | m2 | 2.70 | | |
| t (75%-25%) | mins | 1100.00 | | |
| **SOIL INFILTRATION RATE** | m/s | **2.07E-06** | | |

| | |
|---|---|
| **DESIGN SOIL INFILTRATION RATE, f** | **2.07E-06** |



cjassociates

# MONITORING RESULTS

# GAS AND GROUNDWATER MONITORING RESULTS

Project: Cowbridge Primary School Job no: 2071724 Date: 16/04/2021 Visit 1

Time of start of visit: 8.00
Time of end of visit: 9.00

Barometric pressure start of visit:..... 1033 mb
Barometric pressure end of visit:..... 1033 mb

Barometric pressure trend - preceding 24 hrs: Rising

Weather conditions: Dry

Ground conditions: Dry

Remarks: Comments: Steady state value are taken when there is no change for 1 minute.
All measurements taken from the current ground level.

| Monitoring Point | | Methane (% vol) $CH_4$ | Carbon Dioxide (% vol) $CO_2$ | Hydrogen Sulphide (ppm) $H_2S$ | Oxygen (% vol) $O_2$ | Carbon Monoxide (ppm) CO | PID (ppm) | Free Phase Product (mm) | Gas flow average (l/hr) | Borehole Pressure (Pa) | Water Depth (mbgl) | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ambient | | 0.0 | 0.0 | 0 | 20.8 | 0 | 0.0 | | | | | |
| WS1 | Peak | 0 | 0.2 | 0 | 18.7 | 0 | 0.0 | None detected | 0.00 | 0.00 | 1.64 | |
| | Steady | 0 | 0.2 | 0 | 18.8 | 0 | 0.0 | | | | | |
| WS4 | Peak | 0 | 2.0 | 0 | 19.2 | 0 | 0.0 | None detected | 0.00 | 0.00 | 1.18 | |
| | Steady | 0 | 1.2 | 0 | 19.6 | 0 | 0.0 | | | | | |
| WS6 | Peak | 0 | 0.2 | 0 | 19.6 | 0 | 0.0 | None detected | 0.00 | 0.00 | 1.63 | |
| | Steady | 0 | 0.1 | 0 | 19.9 | 0 | 0.0 | | | | | |
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# GAS AND GROUNDWATER MONITORING RESULTS

Project: Cowbridge Primary School Job no: 2071724 Date: 27/04/2021 Visit 2

Time of start of visit: 8.00
Time of end of visit: 9.00

Barometric pressure start of visit:……1009mb
Barometric pressure end of visit:……1009 mb

Barometric pressure trend - preceding 24 hrs: Steady

Weather conditions: Dry

Ground conditions: Dry

Remarks: Comments: Steady state value are taken when there is no change for 1 minute.
All measurements taken from the current ground level.

| Monitoring Point | | Methane (% vol) $CH_4$ | Carbon Dioxide (% vol) $CO_2$ | Hydrogen Sulphide (ppm) $H_2S$ | Oxygen (% vol) $O_2$ | Carbon Monoxide (ppm) CO | PID (ppm) | Free Phase Product (mm) | Gas flow average (l/hr) | Borehole Pressure (Pa) | Water Depth (mbgl) | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ambient | | 0.0 | 0.0 | 0 | 20.6 | 0 | 0.0 | | | | | |
| WS1 | Peak | 0.0 | 0.3 | 0 | 19.0 | 0 | 0.0 | None detected | 0.00 | 0.00 | 1.69 | |
| | Steady | 0.0 | 0.3 | 0 | 19.0 | 0 | 0.0 | | | | | |
| WS4 | Peak | 0.0 | 1.8 | 0 | 19.6 | 0 | 0.0 | None detected | 0.00 | 0.00 | 1.26 | |
| | Steady | 0.0 | 1.5 | 0 | 19.3 | 0 | 0.0 | | | | | |
| WS6 | Peak | 0.0 | 0.4 | 0 | 19.8 | 0 | 0.0 | None detected | 0.00 | 0.00 | 1.68 | |
| | Steady | 0.0 | 0.2 | 0 | 19.5 | 0 | 0.0 | | | | | |
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# GAS AND GROUNDWATER MONITORING RESULTS

Project: Cowbridge Primary School Job no: 2071724 Date: 11/05/2021 Visit 3

Time of start of visit: 12.30
Time of end of visit: 13.30

Barometric pressure start of visit:..... 1005 mb
Barometric pressure end of visit:..... 1005 mb

Barometric pressure trend - preceding 24 hrs: Steady

Weather conditions: Overcast/Raining

Ground conditions: Damp/Wet

Remarks: Comments: Steady state value are taken when there is no change for 1 minute.
All measurements taken from the current ground level.

| Monitoring Point | | Methane (% vol) $CH_4$ | Carbon Dioxide (% vol) $CO_2$ | Hydrogen Sulphide (ppm) $H_2S$ | Oxygen (% vol) $O_2$ | Carbon Monoxide (ppm) CO | PID (ppm) | Free Phase Product (mm) | Gas flow average (l/hr) | Borehole Pressure (Pa) | Water Depth (mbgl) | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ambient | | 0.0 | 0.0 | 0 | 20.4 | 0 | 0.0 | | | | | |
| WS1 | Peak | 0.0 | 0.3 | 0 | 18.9 | 0 | 0.0 | None detected | 0.00 | 0.00 | 1.60 | |
| | Steady | 0.0 | 0.2 | 0 | 19.0 | 0 | 0.0 | | | | | |
| WS4 | Peak | 0.0 | 1.5 | 0 | 19.3 | 0 | 0.0 | None detected | 0.00 | 0.00 | 1.23 | |
| | Steady | 0.0 | 1.3 | 0 | 19.5 | 0 | 0.0 | | | | | |
| WS6 | Peak | 0.0 | 0.3 | 0 | 19.8 | 0 | 0.0 | None detected | 0.00 | 0.00 | 1.58 | |
| | Steady | 0.0 | 0.1 | 0 | 20.0 | 0 | 0.0 | | | | | |
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CJAssociates

# LABORATORY TESTS

# Laboratory Test Certificate

cjassociates

| | |
|---|---|
| Site | Cowbridge Primary School |
| Client | Morgan Sindall |
| Job Number | 2071724 |
| Lab Number | L14879 |
| Order Number | - |
| F.A.O. | Aled Henry |

| | | |
|---|---|---|
| Number of samples submitted for testing: | 15 | sample (s) |

| | | |
|---|---|---|
| Natural Moisture Content | 12 | test(s) |
| Atterberg Limit | 12 | test(s) |
| Particle Size Distribution - Coarse | 4 | test(s) |
| Particle Size Distribution - Fine | 1 | test(s) |
| pH | 5 | test(s) |
| Water Soluble Sulphate | 5 | test(s) |

* Non UKAS Accredited Test

| | | |
|---|---|---|
| Date (s) sample (s) received at laboratory: | 14 | Apr-21 |
| Date of receipt of testing instructions | 14 | Apr-21 |
| Date testing started: | 19 | Apr-21 |
| Date of issue: | 5 | May-21 |

Please note that we will keep the sample (s) for one month after submission of our report and will then dispose of them without notice unless you ask us to store them. We will then make a separate charge for this.

UKAS TESTING
1429

Approved by :
Lisa Maiden



C.J. Associates Geotechnical Ltd
Portview Road
Avonmouth - Bristol BS11 9JE
Tel: 0117 982 1473 Fax: 0117 982 8200

cjassociates

# Summary of Classification Test Results

| Project No. | Project Name |
|---|---|
| 2071724 | Cowbridge Primary School |

| Hole No. | Sample | | | | Soil Description | Density bulk / dry Mg/m3 | | *w* % | Passing 425µm % | LL % | PL % | PI % | Particle density Mg/m3 | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Ref | Top | Base | Type | | | | | | | | | | |
| TP1 | 4 | 0.90 | 1.10 | B | Refer to Logs | | | 25.0 | 98 | 42 | 17 | 25 | | AL Prep:1 |
| TP3 | 4 | 1.20 | 1.40 | B | Refer to Logs | | | 21.6 | 100 | 39 | 18 | 21 | | AL Prep:1 |
| TP4 | 4 | 0.90 | 1.10 | B | Refer to Logs | | | 17.6 | 100 | 35 | 16 | 19 | | AL Prep:1 |
| WS1 | 4 | 1.00 | 2.00 | B | Refer to Logs | | | 19.7 | 100 | 47 | 17 | 30 | | AL Prep:1 |
| WS1 | 5 | 2.00 | 3.00 | B | Refer to Logs | | | 23.5 | 100 | 35 | 16 | 19 | | AL Prep:1 |
| WS2 | 4 | 1.00 | 3.00 | B | Refer to Logs | | | 23.0 | 100 | 36 | 16 | 20 | | AL Prep:1 |
| WS2 | 5 | 3.00 | 4.30 | B | Refer to Logs | | | 22.2 | 100 | 31 | 16 | 15 | | AL Prep:1 |
| WS3 | 4 | 1.30 | 3.00 | B | Refer to Logs | | | 21.5 | 100 | 42 | 16 | 26 | | AL Prep:1 |
| WS3 | 5 | 3.00 | 4.30 | B | Refer to Logs | | | 24.2 | 100 | 31 | 16 | 15 | | AL Prep:1 |
| WS4 | 4 | 1.00 | 3.00 | B | Refer to Logs | | | 24.2 | 100 | 47 | 17 | 30 | | AL Prep:1 |
| WS5 | 4 | 0.90 | 3.00 | B | Refer to Logs | | | 19.2 | 100 | 26 | 14 | 12 | | AL Prep:1 |
| WS6 | 4 | 0.85 | 2.00 | B | Refer to Logs | | | 28.6 | 100 | 68 | 32 | 36 | | AL Prep:1 |
| | | | | | | | | | | | | | | |
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All tests performed in accordance with BS1377:1990 unless specified otherwise
Water Content Performed in accordance with BS EN ISO 17892-1 : 2014

Key

Density test
Linear measurement unless
wd - water displacement
wi - immersion in water

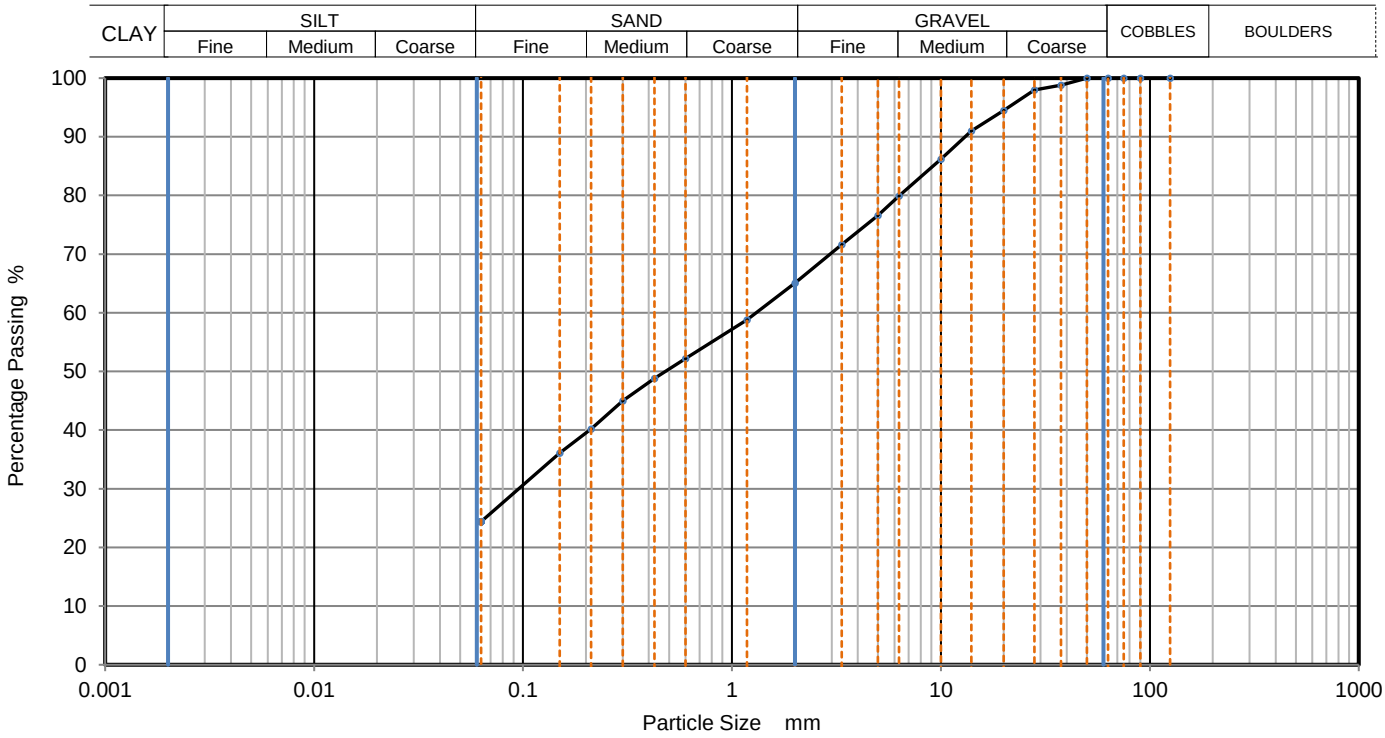
Liquid Limit
4pt cone unless :
cas - Casagrande method
1pt - single point test

Atterberg Prep
1. in natural condition
2. after >425um removed by hand
3. after washing to remove >425um

Particle density
sp - small pyknom
gj - gas jar

| Date Printed | Approved By | Table |
|---|---|---|
| 29/04/2021 | Lisa Maiden | 1 |
| | | sheet 1 |

| cjassociates | PARTICLE SIZE DISTRIBUTION | | | Job Ref | 2071724 |
|---|---|---|---|---|---|
| | | | | Borehole/Pit No. | TP6 |
| Site Name | Cowbridge Primary School | | | Sample No. | 3 |
| Soil Description | | | | Depth, m | 0.80 |
| Specimen Reference | | Specimen Depth | m | Sample Type | B |
| Test Method | BS1377:Part 2:1990, clause 9.2 | | | KeyLAB ID | CJA_2021041418 |




| Sieving | | Sedimentation | |
|---|---|---|---|
| Particle Size mm | % Passing | Particle Size mm | % Passing |
| 125 | 100 | | |
| 90 | 100 | | |
| 75 | 100 | | |
| 63 | 100 | | |
| 50 | 100 | | |
| 37.5 | 99 | | |
| 28 | 98 | | |
| 20 | 95 | | |
| 14 | 91 | | |
| 10 | 86 | | |
| 6.3 | 80 | | |
| 5 | 77 | | |
| 3.35 | 72 | | |
| 2 | 65 | | |
| 1.18 | 59 | | |
| 0.6 | 52 | | |
| 0.425 | 49 | | |
| 0.3 | 45 | | |
| 0.212 | 40 | | |
| 0.15 | 36 | | |
| 0.063 | 24 | | |

| Dry Mass of sample, g | 3993 |
|---|---|

| Sample Proportions | % dry mass |
|---|---|
| Very coarse | 0 |
| Gravel | 35 |
| Sand | 41 |
| | |
| Fines <0.063mm | 24 |

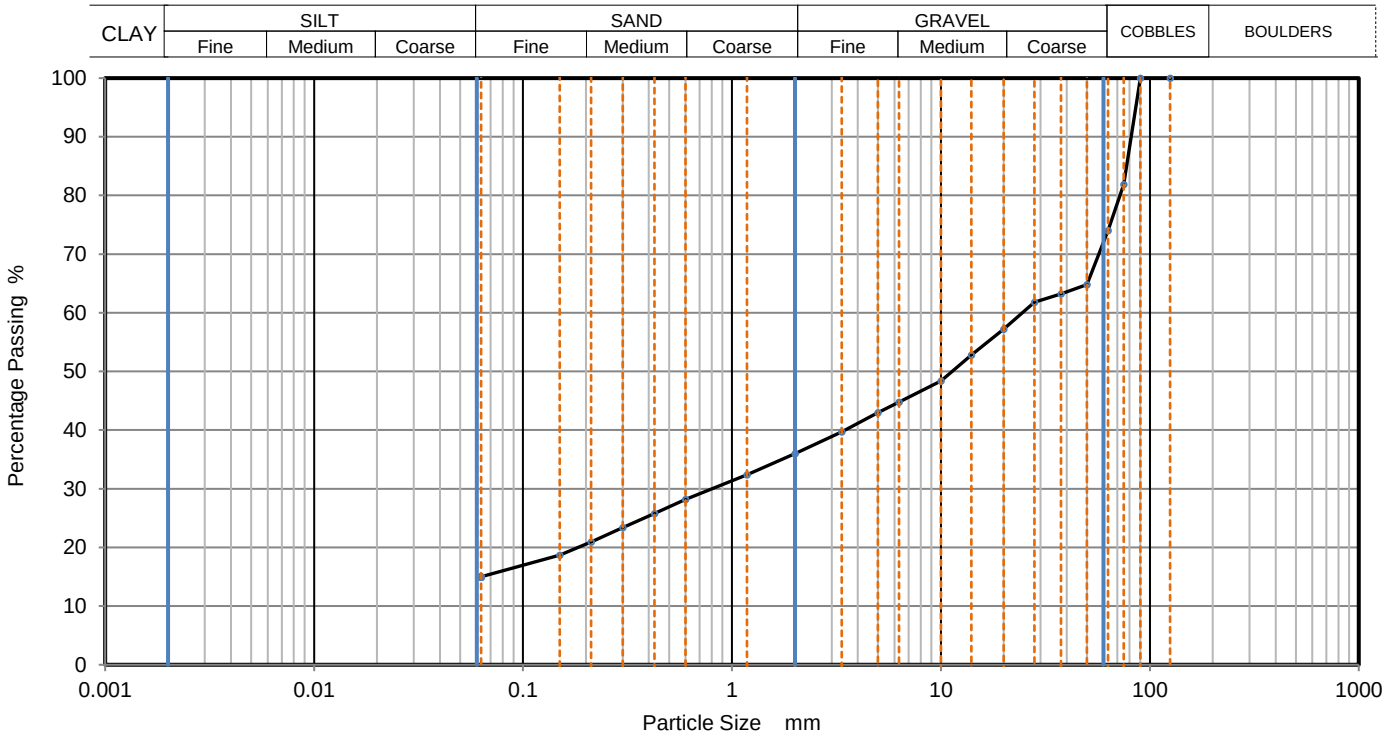
| Grading Analysis | | |
|---|---|---|
| D100 | mm | |
| D60 | mm | 1.31 |
| D30 | mm | 0.0955 |
| D10 | mm | |
| Uniformity Coefficient | | |
| Curvature Coefficient | | |

Remarks

Preparation and testing in accordance with BS1377 unless noted below

| Operator | Checked | Approved | Sheet printed | Fig 1 |
|---|---|---|---|---|
| | | Lisa Maiden | 29/04/2021 12:25 | Sheet |

| cjassociates | PARTICLE SIZE DISTRIBUTION | | | Job Ref | 2071724 |
|---|---|---|---|---|---|
| | | | | Borehole/Pit No. | WS1 |
| Site Name | Cowbridge Primary School | | | Sample No. | 2 |
| Soil Description | | | | Depth, m | 0.30 |
| Specimen Reference | | Specimen Depth | m | Sample Type | B |
| Test Method | BS1377:Part 2:1990, clause 9.2 | | | KeyLAB ID | CJA_2021041419 |




| Sieving | | Sedimentation | |
|---|---|---|---|
| Particle Size mm | % Passing | Particle Size mm | % Passing |
| 125 | 100 | | |
| 90 | 100 | | |
| 75 | 82 | | |
| 63 | 74 | | |
| 50 | 65 | | |
| 37.5 | 63 | | |
| 28 | 62 | | |
| 20 | 57 | | |
| 14 | 53 | | |
| 10 | 48 | | |
| 6.3 | 45 | | |
| 5 | 43 | | |
| 3.35 | 40 | | |
| 2 | 36 | | |
| 1.18 | 32 | | |
| 0.6 | 28 | | |
| 0.425 | 26 | | |
| 0.3 | 23 | | |
| 0.212 | 21 | | |
| 0.15 | 19 | | |
| 0.063 | 15 | | |

| Dry Mass of sample, g | 5009 |
|---|---|

| Sample Proportions | % dry mass |
|---|---|
| Very coarse | 26 |
| Gravel | 38 |
| Sand | 21 |
| | |
| Fines <0.063mm | 15 |

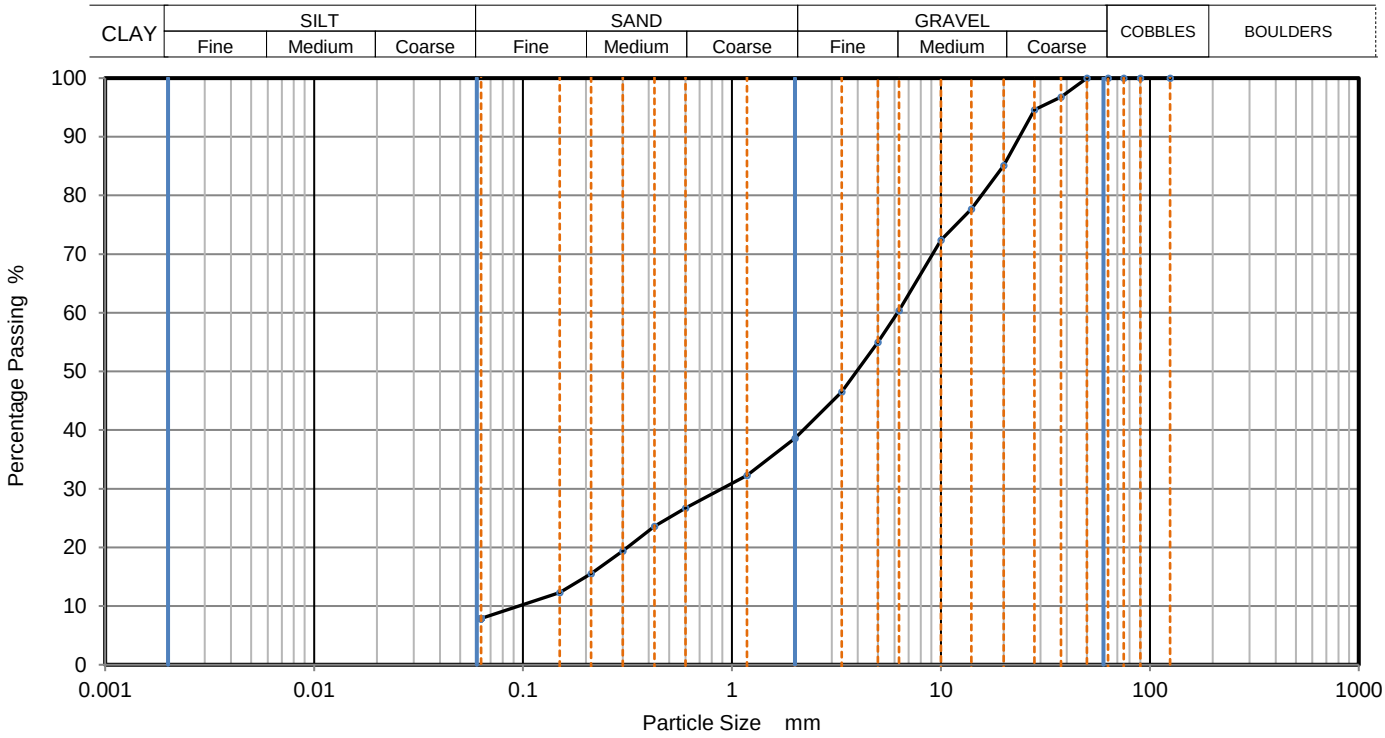
| Grading Analysis | | |
|---|---|---|
| D100 | mm | |
| D60 | mm | 24.6 |
| D30 | mm | 0.801 |
| D10 | mm | |
| Uniformity Coefficient | | |
| Curvature Coefficient | | |

Remarks

Preparation and testing in accordance with BS1377 unless noted below

| Operator | Checked | Approved | Sheet printed | Fig 1 |
|---|---|---|---|---|
| | | Lisa Maiden | 29/04/2021 12:25 | Sheet |

| cjassociates | PARTICLE SIZE DISTRIBUTION | | | Job Ref | 2071724 |
|---|---|---|---|---|---|
| | | | | Borehole/Pit No. | WS2 |
| Site Name | Cowbridge Primary School | | | Sample No. | 2 |
| Soil Description | | | | Depth, m | 0.25 |
| Specimen Reference | | Specimen Depth | m | Sample Type | B |
| Test Method | BS1377:Part 2:1990, clause 9.2 | | | KeyLAB ID | CJA_2021041422 |




| Sieving | | Sedimentation | |
|---|---|---|---|
| Particle Size mm | % Passing | Particle Size mm | % Passing |
| 125 | 100 | | |
| 90 | 100 | | |
| 75 | 100 | | |
| 63 | 100 | | |
| 50 | 100 | | |
| 37.5 | 97 | | |
| 28 | 95 | | |
| 20 | 85 | | |
| 14 | 78 | | |
| 10 | 72 | | |
| 6.3 | 60 | | |
| 5 | 55 | | |
| 3.35 | 47 | | |
| 2 | 39 | | |
| 1.18 | 32 | | |
| 0.6 | 27 | | |
| 0.425 | 24 | | |
| 0.3 | 19 | | |
| 0.212 | 16 | | |
| 0.15 | 12 | | |
| 0.063 | 8 | | |

Dry Mass of sample, g: 5154

| Sample Proportions | % dry mass |
|---|---|
| Very coarse | 0 |
| Gravel | 61 |
| Sand | 31 |
| | |
| Fines <0.063mm | 8 |

| Grading Analysis | | |
|---|---|---|
| D100 | mm | |
| D60 | mm | 6.19 |
| D30 | mm | 0.89 |
| D10 | mm | 0.0947 |
| Uniformity Coefficient | | 65 |
| Curvature Coefficient | | 1.4 |

Remarks

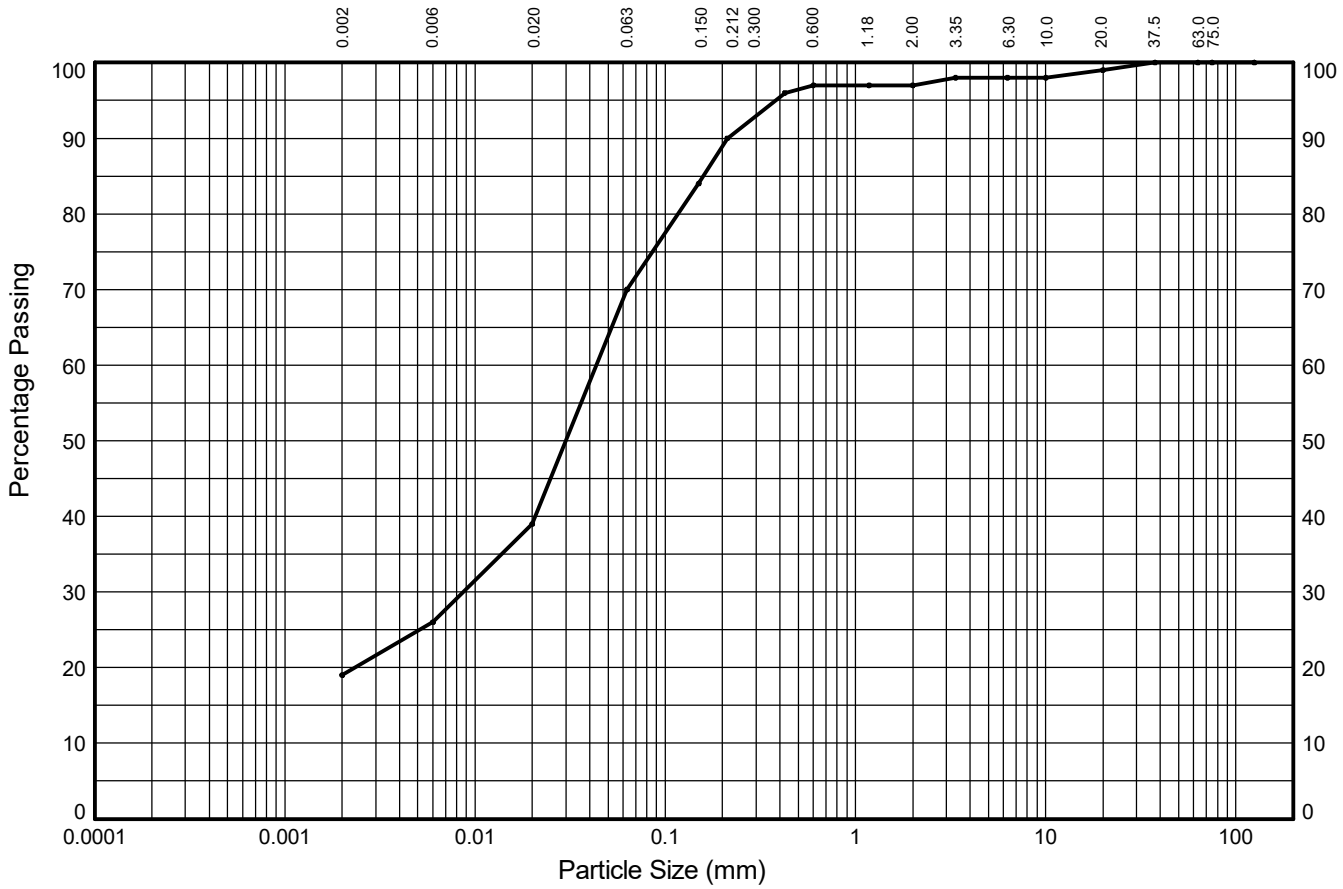
Preparation and testing in accordance with BS1377 unless noted below

| Operator | Checked | Approved | Sheet printed | Fig 1 |
|---|---|---|---|---|
| | | Lisa Maiden | 29/04/2021 12:25 | Sheet |

# PARTICLE SIZE DISTRIBUTION TEST

In accordance with clauses 9.2, 9.5 of BS1377:Part 2:1990

Window Sample: **WS5** Sample Ref: **4** Sample Type: **B** Depth (m): **0.90**




| CLAY | fine | medium | coarse | fine | medium | coarse | fine | medium | coarse | COBBLES |
|---|---|---|---|---|---|---|---|---|---|---|
| | 7% | 13% | 31% | 19% | 8% | 0% | 1% | 1% | 1% | |
| | SILT | | | SAND | | | GRAVEL | | | |
| 19% | 51% | | | 27% | | | 3% | | | 0% |

| Test Sieve (mm) | Percent Passing (%) |
|---|---|
| 125.0 | **100** |
| 75.0 | **100** |
| 63.0 | **100** |
| 37.5 | **100** |
| 20.0 | **99** |
| 10.0 | **98** |
| 6.30 | **98** |
| 3.35 | **98** |
| 2.00 | **97** |
| 1.18 | **97** |
| 0.600 | **97** |
| 0.425 | **96** |
| 0.212 | **90** |
| 0.150 | **84** |
| 0.063 | **70** |

| Particle Diameter (mm) | Percent Passing (%) |
|---|---|
| 0.02 | **39** |
| 0.006 | **26** |
| 0.002 | **19** |

Sedimentation sample was not pre-treated

| Coefficients | |
|---|---|
| $D_{10}$ (mm) | **NA** |
| $D_{15}$ (mm) | **NA** |
| $D_{30}$ (mm) | **0.009** |
| $D_{50}$ (mm) | **0.030** |
| $D_{60}$ (mm) | **0.044** |
| $D_{85}$ (mm) | **0.159** |
| $D_{90}$ (mm) | **0.212** |
| $C_U$ | **NA** |
| $C_C$ | **NA** |

Soil Description:

**Brown slightly gravelly slightly sandy clayey SILT**

Key: $C_U$ = Uniformity coefficient. $C_C$ = Coefficient of curvature as defined in BS EN ISO 14688-2


STRUCTURAL SOILS
1a Princess Street
Bedminster
Bristol
BS3 4AG


| Compiled By | Date |
|---|---|
| **DAISY RICHARDS** | **04/05/21** |

Contract: **Cowbridge Primary School**

Contract Ref: **750049**

AGS

envirolab
Units 7 & 8 Sandpits Business Park
Mottram Road, Hyde, Cheshire, SK14 3AR

# FINAL ANALYTICAL TEST REPORT

**Envirolab Job Number:** 21/04194
**Issue Number:** 1 **Date:** 05 May, 2021

**Client:**
CJ Associates (Bridgend)
Unit 1-3, Block 6, Newlands Avenue
Brackla Industrial Estate
Bridgend
Mid Glamorgan
CF31 2DA

**Project Manager:** Admin/Lisa Maiden
**Project Name:** Cowbridge Primary School
**Project Ref:** 2071724-L14879-S8419
**Order No:** N/A
**Date Samples Received:** 21/04/21
**Date Instructions Received:** 21/04/21
**Date Analysis Completed:** 04/05/21

**Prepared by:**

Melanie Marshall
Laboratory Coordinator

**Approved by:**

Sophie France
Client Service Manager

**Envirolab Job Number: 21/04194**

**Client Project Name: Cowbridge Primary School**

**Client Project Ref: 2071724-L14879-S8419**

| Lab Sample ID | 21/04194/1 | 21/04194/2 | 21/04194/3 | 21/04194/4 | 21/04194/5 | | | Units | Limit of Detection | Method ref |
|---|---|---|---|---|---|---|---|---|---|---|
| Client Sample No | 4 | 4 | 4 | 4 | 4 | | | | | |
| Client Sample ID | WS1 | WS2 | WS3 | WS5 | WS6 | | | | | |
| Depth to Top | 1.00 | 1.00 | 1.30 | 0.90 | 0.85 | | | | | |
| Depth To Bottom | 2.00 | 3.00 | 3.00 | 3.00 | 2.00 | | | | | |
| Date Sampled | | | | | | | | | | |
| Sample Type | Soil - B | Soil - B | Soil - B | Soil - B | Soil - B | | | | | |
| Sample Matrix Code | 3A | 3AE | 3A | 3A | 3A | | | | | |
| % Stones >10mm$_A$ | <0.1 | <0.1 | <0.1 | <0.1 | 0.8 | | | % w/w | 0.1 | A-T-044 |
| $pH_D^{M\#}$ | 7.76 | 8.31 | 7.97 | 7.94 | 6.65 | | | pH | 0.01 | A-T-031s |
| Sulphate (water sol 2:1)$_D^{M\#}$ | 0.02 | <0.01 | <0.01 | 0.02 | 0.02 | | | g/l | 0.01 | A-T-026s |

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Analytical results reflect the quality of the sample at the time of analysis only.
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The Client Sample No, Client Sample ID, Depth to Top, Depth to Bottom and Date Sampled were all provided by the client.

**Soil chemical analysis:**
All results are reported as dry weight (<40°C).
For samples with Matrix Codes 1 - 6 natural stones, brick and concrete fragments >10mm and any extraneous material (visible glass, metal or twigs) are removed and excluded from the sample prior to analysis and reported results corrected to a whole sample basis. This is reported as '% stones >10mm'.
For samples with Matrix Code 7 the whole sample is dried and crushed prior to analysis and this supersedes any “A” subscripts
All analysis is performed on the sample as received for soil samples which are positive for asbestos or the client has informed asbestos may be present and/or if they are from outside the European Union and this supersedes any "D" subscripts.

**TPH analysis of water by method A-T-007:**
Free and visible oils are excluded from the sample used for analysis so that the reported result represents the dissolved phase only.

**Electrical Conductivity of water by Method A-T-037:**
Results greater than 12900µS/cm @ 25°C / 11550µS/cm @ 20°C fall outside the calibration range and as such are unaccredited.

**Asbestos:**
Asbestos in soil analysis is performed on a dried aliquot of the submitted sample and cannot guarantee to identify asbestos if only present in small numbers as discrete fibres/fragments in the original sample.
Stones etc. are not removed from the sample prior to analysis.
Quantification of asbestos is a 3 stage process including visual identification, hand picking and weighing and fibre counting by sedimentation/phase contrast optical microscopy if required. If asbestos is identified as being present but is not in a form that is suitable for analysis by hand picking and weighing (normally if the asbestos is present as free fibres) quantification by sedimentation is performed. Where ACMs are found a percentage asbestos is assigned to each with reference to 'HSG264, Asbestos: The survey guide' and the calculated asbestos content is expressed as a percentage of the dried soil sample aliquot used.

**Predominant Matrix Codes:**
1 = SAND, 2 = LOAM, 3 = CLAY, 4 = LOAM/SAND, 5 = SAND/CLAY, 6 = CLAY/LOAM, 7 = OTHER, 8 = Asbestos bulk ID sample.
Samples with Matrix Code 7 & 8 are not predominantly a SAND/LOAM/CLAY mix and are not covered by our BSEN 17025 or MCERTS accreditations, with the exception of bulk asbestos which are BSEN 17025 accredited.
**Secondary Matrix Codes:**
A = contains stones, B = contains construction rubble, C = contains visible hydrocarbons, D = contains glass/metal, E = contains roots/twigs.

**Key:**
IS indicates Insufficient Sample for analysis.
US indicates Unsuitable Sample for analysis.
NDP indicates No Determination Possible.
NAD indicates No Asbestos Detected.
N/A indicates Not Applicable.
Superscript # indicates method accredited to ISO 17025.
Superscript "M" indicates method accredited to MCERTS.
Subscript "A" indicates analysis performed on the sample as received.
Subscript "D" indicates analysis performed on the dried sample, crushed to pass a 2mm sieve

Please contact us if you need any further information.

# Envirolab Deviating Samples Report

Units 7&8 Sandpits Business Park, Mottram Road, Hyde, SK14 3AR
Tel. 0161 368 4921 email. ask@envlab.co.uk

**Client:** CJ Associates (Bridgend), Unit 1-3, Block 6, Newlands Avenue, Brackla Industrial Estate, Bridgend, Mid Glamorgan, CF31 2DA

**Project:** Cowbridge Primary School

**Clients Project No:** 2071724-L14879-S8419

**Project No:** 21/04194

**Date Received:** 21/04/2021 (am)

**Cool Box Temperatures (°C):** 10.6

| Lab Sample ID | 21/04194/1 | 21/04194/2 | 21/04194/3 | 21/04194/4 | 21/04194/5 |
|---|---|---|---|---|---|
| Client Sample No | 4 | 4 | 4 | 4 | 4 |
| Client Sample ID/Depth | WS1 1.00-2.00m | WS2 1.00-3.00m | WS3 1.30-3.00m | WS5 0.90-3.00m | WS6 0.85-2.00m |
| Date Sampled | | | | | |
| Deviation Code | | | | | |
| E (no date) | ✓ | ✓ | ✓ | ✓ | ✓ |

*Key*
*E (no date)* *No sampling date provided (all results affected if not provided)*

*If, at any point before reaching the laboratory, the temperature of the samples has breached those set in published standards, e.g. BS-EN 5667-3, ISO 18400-102:2017, then the concentration of any affected analytes may differ from that at the time of sampling.*

envirolab
Units 7 & 8 Sandpits Business Park
Mottram Road, Hyde, Cheshire, SK14 3AR

# FINAL ANALYTICAL TEST REPORT

**Envirolab Job Number:** 21/03915
**Issue Number:** 1 **Date:** 28 April, 2021

**Client:**
CJ Associates
Portview Road
Avonmouth
Bristol
BS11 9JE

**Project Manager:** Admin/Aled Henry (Based Bringend)
**Project Name:** Cowbridge Primary School
**Project Ref:** 2071724
**Order No:** N/A
**Date Samples Received:** 09/04/21
**Date Instructions Received:** 15/04/21
**Date Analysis Completed:** 27/04/21

**Prepared by:**

Melanie Marshall
Laboratory Coordinator

**Approved by:**

Sophie France
Client Service Manager

**Envirolab Job Number: 21/03915**

**Client Project Name: Cowbridge Primary School**

**Client Project Ref: 2071724**

| Lab Sample ID | 21/03915/3 | 21/03915/5 | 21/03915/6 | 21/03915/12 | | | | Units | Limit of Detection | Method ref |
|---|---|---|---|---|---|---|---|---|---|---|
| Client Sample No | | | | | | | | | | |
| Client Sample ID | TP2 | TP3 | TP3 | TP6 | | | | | | |
| Depth to Top | 0.60 | 0.50 | 1.30 | 0.80 | | | | | | |
| Depth To Bottom | | | | | | | | | | |
| Date Sampled | 07-Apr-21 | 07-Apr-21 | 07-Apr-21 | 07-Apr-21 | | | | | | |
| Sample Type | Soil - ES | Soil - ES | Soil - ES | Soil - ES | | | | | | |
| Sample Matrix Code | 6AE | 3A | 6AE | 6AE | | | | | | |
| % Stones >10mm$_A$ | 2.9 | 16.4 | <0.1 | 1.5 | | | | % w/w | 0.1 | A-T-044 |
| pH$_D^{M\#}$ | 7.87 | 8.27 | 7.14 | 8.02 | | | | pH | 0.01 | A-T-031s |
| Sulphate (acid soluble)$_D^{M\#}$ | <200 | <200 | 800 | 530 | | | | mg/kg | 200 | A-T-028s |
| Cyanide (free)$_A^{M\#}$ | <1 | <1 | <1 | <1 | | | | mg/kg | 1 | A-T-042sFCN |
| Cyanide (total)$_A^{M\#}$ | <1 | <1 | <1 | <1 | | | | mg/kg | 1 | A-T-042sTCN |
| Thiocyanate$_A$ | <5 | <5 | 9 | <5 | | | | mg/kg | 5 | A-T-041s |
| Phenols - Total by HPLC$_A$ | <0.2 | <0.2 | <0.2 | <0.2 | | | | mg/kg | 0.2 | A-T-050s |
| Sulphide$_A$ | <5 | <5 | <5 | <5 | | | | mg/kg | 5 | A-T-S2-s |
| Sulphur (elemental)$_D^{M\#}$ | <5 | <5 | <5 | <5 | | | | mg/kg | 5 | A-T-029s |
| Organic matter$_D^{M\#}$ | 0.8 | 3.1 | 10.2 | 20.4 | | | | % w/w | 0.1 | A-T-032 OM |
| Arsenic$_D^{M\#}$ | 5 | 3 | 4 | 4 | | | | mg/kg | 1 | A-T-024s |
| Beryllium$_D^{\#}$ | 0.8 | 0.8 | 0.7 | 0.6 | | | | mg/kg | 0.5 | A-T-024s |
| Boron (water soluble)$_D$ | <1.0 | <1.0 | <1.0 | <1.0 | | | | mg/kg | 1 | A-T-027s |
| Cadmium$_D^{M\#}$ | 0.9 | 0.7 | 0.8 | 0.6 | | | | mg/kg | 0.5 | A-T-024s |
| Copper$_D^{M\#}$ | 11 | 9 | 13 | 17 | | | | mg/kg | 1 | A-T-024s |
| Chromium$_D^{M\#}$ | 25 | 21 | 24 | 19 | | | | mg/kg | 1 | A-T-024s |
| Chromium (hexavalent)$_D$ | <1 | <1 | <1 | <1 | | | | mg/kg | 1 | A-T-040s |
| Lead$_D^{M\#}$ | 89 | 39 | 80 | 50 | | | | mg/kg | 1 | A-T-024s |
| Mercury$_D$ | <0.17 | <0.17 | <0.17 | <0.17 | | | | mg/kg | 0.17 | A-T-024s |
| Nickel$_D^{M\#}$ | 23 | 20 | 18 | 24 | | | | mg/kg | 1 | A-T-024s |
| Selenium$_D^{M\#}$ | <1 | <1 | <1 | <1 | | | | mg/kg | 1 | A-T-024s |
| Vanadium$_D^{M\#}$ | 30 | 23 | 31 | 25 | | | | mg/kg | 1 | A-T-024s |
| Zinc$_D^{M\#}$ | 100 | 64 | 98 | 75 | | | | mg/kg | 5 | A-T-024s |
| TPH total (>C6-C40)$_A^{M\#}$ | <10 | - | - | - | | | | mg/kg | 10 | A-T-007s |

**Envirolab Job Number: 21/03915**

**Client Project Name: Cowbridge Primary School**

**Client Project Ref: 2071724**

| Lab Sample ID | 21/03915/3 | 21/03915/5 | 21/03915/6 | 21/03915/12 | | | | Units | Limit of Detection | Method ref |
|---|---|---|---|---|---|---|---|---|---|---|
| Client Sample No | | | | | | | | | | |
| Client Sample ID | TP2 | TP3 | TP3 | TP6 | | | | | | |
| Depth to Top | 0.60 | 0.50 | 1.30 | 0.80 | | | | | | |
| Depth To Bottom | | | | | | | | | | |
| Date Sampled | 07-Apr-21 | 07-Apr-21 | 07-Apr-21 | 07-Apr-21 | | | | | | |
| Sample Type | Soil - ES | Soil - ES | Soil - ES | Soil - ES | | | | | | |
| Sample Matrix Code | 6AE | 3A | 6AE | 6AE | | | | | | |
| **Asbestos in Soil (inc. matrix)** | | | | | | | | | | |
| Asbestos in soil$_D^{\#}$ | NAD | NAD | NAD | NAD | | | | | | A-T-045 |
| Asbestos ACM - Suitable for Water Absorption Test?$_D$ | N/A | N/A | N/A | N/A | | | | | | A-T-045 |

**Envirolab Job Number: 21/03915**

**Client Project Name: Cowbridge Primary School**

**Client Project Ref: 2071724**

| Lab Sample ID | 21/03915/3 | 21/03915/5 | 21/03915/6 | 21/03915/12 | | | | Units | Limit of Detection | Method ref |
|---|---|---|---|---|---|---|---|---|---|---|
| Client Sample No | | | | | | | | | | |
| Client Sample ID | TP2 | TP3 | TP3 | TP6 | | | | | | |
| Depth to Top | 0.60 | 0.50 | 1.30 | 0.80 | | | | | | |
| Depth To Bottom | | | | | | | | | | |
| Date Sampled | 07-Apr-21 | 07-Apr-21 | 07-Apr-21 | 07-Apr-21 | | | | | | |
| Sample Type | Soil - ES | Soil - ES | Soil - ES | Soil - ES | | | | | | |
| Sample Matrix Code | 6AE | 3A | 6AE | 6AE | | | | | | |
| PAH-16MS | | | | | | | | | | |
| Acenaphthene$_{A}^{M\#}$ | <0.01 | <0.01 | <0.01 | 0.01 | | | | mg/kg | 0.01 | A-T-019s |
| Acenaphthylene$_{A}^{M\#}$ | <0.01 | <0.01 | <0.01 | <0.01 | | | | mg/kg | 0.01 | A-T-019s |
| Anthracene$_{A}^{M\#}$ | <0.02 | <0.02 | <0.02 | <0.02 | | | | mg/kg | 0.02 | A-T-019s |
| Benzo(a)anthracene$_{A}^{M\#}$ | <0.04 | 0.09 | <0.04 | <0.04 | | | | mg/kg | 0.04 | A-T-019s |
| Benzo(a)pyrene$_{A}^{M\#}$ | <0.04 | 0.07 | <0.04 | <0.04 | | | | mg/kg | 0.04 | A-T-019s |
| Benzo(b)fluoranthene$_{A}^{M\#}$ | <0.05 | 0.09 | <0.05 | 0.06 | | | | mg/kg | 0.05 | A-T-019s |
| Benzo(ghi)perylene$_{A}^{M\#}$ | <0.05 | <0.05 | <0.05 | <0.05 | | | | mg/kg | 0.05 | A-T-019s |
| Benzo(k)fluoranthene$_{A}^{M\#}$ | <0.07 | <0.07 | <0.07 | <0.07 | | | | mg/kg | 0.07 | A-T-019s |
| Chrysene$_{A}^{M\#}$ | <0.06 | 0.10 | <0.06 | 0.08 | | | | mg/kg | 0.06 | A-T-019s |
| Dibenzo(ah)anthracene$_{A}^{M\#}$ | <0.04 | <0.04 | <0.04 | <0.04 | | | | mg/kg | 0.04 | A-T-019s |
| Fluoranthene$_{A}^{M\#}$ | <0.08 | 0.17 | <0.08 | 0.11 | | | | mg/kg | 0.08 | A-T-019s |
| Fluorene$_{A}^{M\#}$ | <0.01 | <0.01 | <0.01 | <0.01 | | | | mg/kg | 0.01 | A-T-019s |
| Indeno(123-cd)pyrene$_{A}^{M\#}$ | <0.03 | <0.03 | <0.03 | <0.03 | | | | mg/kg | 0.03 | A-T-019s |
| Naphthalene $_{A}^{M\#}$ | <0.03 | <0.03 | <0.03 | <0.03 | | | | mg/kg | 0.03 | A-T-019s |
| Phenanthrene$_{A}^{M\#}$ | <0.03 | 0.08 | <0.03 | 0.08 | | | | mg/kg | 0.03 | A-T-019s |
| Pyrene$_{A}^{M\#}$ | <0.07 | 0.12 | <0.07 | <0.07 | | | | mg/kg | 0.07 | A-T-019s |
| Total PAH-16MS$_{A}^{M\#}$ | <0.08 | 0.72 | <0.08 | 0.34 | | | | mg/kg | 0.01 | A-T-019s |

**Envirolab Job Number: 21/03915**

**Client Project Name: Cowbridge Primary School**

**Client Project Ref: 2071724**

| Lab Sample ID | 21/03915/3 | 21/03915/5 | 21/03915/6 | 21/03915/12 | | | | Units | Limit of Detection | Method ref |
|---|---|---|---|---|---|---|---|---|---|---|
| Client Sample No | | | | | | | | | | |
| Client Sample ID | TP2 | TP3 | TP3 | TP6 | | | | | | |
| Depth to Top | 0.60 | 0.50 | 1.30 | 0.80 | | | | | | |
| Depth To Bottom | | | | | | | | | | |
| Date Sampled | 07-Apr-21 | 07-Apr-21 | 07-Apr-21 | 07-Apr-21 | | | | | | |
| Sample Type | Soil - ES | Soil - ES | Soil - ES | Soil - ES | | | | | | |
| Sample Matrix Code | 6AE | 3A | 6AE | 6AE | | | | | | |
| **TPH CWG** | | | | | | | | | | |
| Ali >C5-C6$_A^{\#}$ | - | <0.01 | <0.01 | <0.01 | | | | mg/kg | 0.01 | A-T-022s |
| Ali >C6-C8$_A^{\#}$ | - | <0.01 | <0.01 | <0.01 | | | | mg/kg | 0.01 | A-T-022s |
| Ali >C8-C10$_A$ | - | <1 | <1 | <1 | | | | mg/kg | 1 | A-T-055s |
| Ali >C10-C12$_A^{M\#}$ | - | <1 | <1 | <1 | | | | mg/kg | 1 | A-T-055s |
| Ali >C12-C16$_A^{M\#}$ | - | <1 | <1 | 1 | | | | mg/kg | 1 | A-T-055s |
| Ali >C16-C21$_A^{M\#}$ | - | <1 | 7 | 3 | | | | mg/kg | 1 | A-T-055s |
| Ali >C21-C35$_A^{M\#}$ | - | 2 | 68 | 18 | | | | mg/kg | 1 | A-T-055s |
| Total Aliphatics$_A$ | - | 2 | 74 | 21 | | | | mg/kg | 1 | A-T-055s |
| Aro >C5-C7$_A^{\#}$ | - | <0.01 | <0.01 | <0.01 | | | | mg/kg | 0.01 | A-T-022s |
| Aro >C7-C8$_A^{\#}$ | - | <0.01 | <0.01 | <0.01 | | | | mg/kg | 0.01 | A-T-022s |
| Aro >C8-C10$_A$ | - | <1 | <1 | 1 | | | | mg/kg | 1 | A-T-055s |
| Aro >C10-C12$_A$ | - | <1 | <1 | <1 | | | | mg/kg | 1 | A-T-055s |
| Aro >C12-C16$_A$ | - | <1 | <1 | 3 | | | | mg/kg | 1 | A-T-055s |
| Aro >C16-C21$_A^{M\#}$ | - | <1 | 8 | 4 | | | | mg/kg | 1 | A-T-055s |
| Aro >C21-C35$_A^{M\#}$ | - | 3 | 42 | 30 | | | | mg/kg | 1 | A-T-055s |
| Total Aromatics$_A$ | - | 3 | 50 | 38 | | | | mg/kg | 1 | A-T-055s |
| TPH (Ali & Aro >C5-C35)$_A$ | - | 4 | 125 | 59 | | | | mg/kg | 1 | A-T-055s |
| BTEX - Benzene$_A^{\#}$ | - | <0.01 | <0.01 | <0.01 | | | | mg/kg | 0.01 | A-T-022s |
| BTEX - Toluene$_A^{\#}$ | - | <0.01 | <0.01 | <0.01 | | | | mg/kg | 0.01 | A-T-022s |
| BTEX - Ethyl Benzene$_A^{\#}$ | - | <0.01 | <0.01 | <0.01 | | | | mg/kg | 0.01 | A-T-022s |
| BTEX - m & p Xylene$_A^{\#}$ | - | <0.02 | <0.02 | <0.02 | | | | mg/kg | 0.01 | A-T-022s |
| BTEX - o Xylene$_A^{\#}$ | - | <0.01 | <0.01 | <0.01 | | | | mg/kg | 0.01 | A-T-022s |
| MTBE$_A^{\#}$ | - | <0.01 | <0.01 | <0.01 | | | | mg/kg | 0.01 | A-T-022s |

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**Key:**
IS indicates Insufficient Sample for analysis.
US indicates Unsuitable Sample for analysis.
NDP indicates No Determination Possible.
NAD indicates No Asbestos Detected.
N/A indicates Not Applicable.
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Superscript "M" indicates method accredited to MCERTS.
Subscript "A" indicates analysis performed on the sample as received.
Subscript "D" indicates analysis performed on the dried sample, crushed to pass a 2mm sieve

Please contact us if you need any further information.

# Envirolab Deviating Samples Report

Units 7&8 Sandpits Business Park, Mottram Road, Hyde, SK14 3AR
Tel. 0161 368 4921 email. ask@envlab.co.uk

**Client:** CJ Associates, Portview Road, Avonmouth, Bristol, BS11 9JE

**Project No:** 21/03915

**Date Received:** 15/04/2021 (am)

**Project:** Cowbridge Primary School

**Cool Box Temperatures (°C):** 7.2 & 7.8

**Clients Project No:** 2071724

| Lab Sample ID | 21/03915/3 | 21/03915/5 | 21/03915/6 | 21/03915/12 |
|---|---|---|---|---|
| Client Sample No | | | | |
| Client Sample ID/Depth | TP2 0.60m | TP3 0.50m | TP3 1.30m | TP6 0.80m |
| Date Sampled | 07/04/21 | 07/04/21 | 07/04/21 | 07/04/21 |
| Deviation Code | | | | |
| F | ✓ | ✓ | ✓ | ✓ |

*Key*
*F* *Maximum holding time exceeded between sampling date and analysis for analytes listed below*

## HOLDING TIME EXCEEDANCES

| Lab Sample ID | 21/03915/3 | 21/03915/5 | 21/03915/6 | 21/03915/12 |
|---|---|---|---|---|
| Client Sample No | | | | |
| Client Sample ID/Depth | TP2 0.60m | TP3 0.50m | TP3 1.30m | TP6 0.80m |
| Date Sampled | 07/04/21 | 07/04/21 | 07/04/21 | 07/04/21 |
| Cyanide (free) | ✓ | ✓ | ✓ | ✓ |
| Cyanide (total) | ✓ | ✓ | ✓ | ✓ |
| Sulphide | ✓ | ✓ | ✓ | ✓ |

If, at any point before reaching the laboratory, the temperature of the samples has breached those set in published standards, e.g. BS-EN 5667-3, ISO 18400-102:2017, then the concentration of any affected analytes may differ from that at the time of sampling.

envirolab
Units 7 & 8 Sandpits Business Park
Mottram Road, Hyde, Cheshire, SK14 3AR

# FINAL ANALYTICAL TEST REPORT

**Envirolab Job Number:** 21/03916
**Issue Number:** 1 **Date:** 28 April, 2021

**Client:**
CJ Associates (Bridgend)
Unit 1-3, Block 6, Newlands Avenue
Brackla Industrial Estate
Bridgend
Mid Glamorgan
CF31 2DA

**Project Manager:** Admin/Aled Henry
**Project Name:** Cowbridge Primary School
**Project Ref:** 2071724
**Order No:** N/A
**Date Samples Received:** 14/04/21
**Date Instructions Received:** 15/04/21
**Date Analysis Completed:** 27/04/21

**Prepared by:**

Melanie Marshall
Laboratory Coordinator

**Approved by:**

Sophie France
Client Service Manager

**Envirolab Job Number: 21/03916**

**Client Project Name: Cowbridge Primary School**

**Client Project Ref: 2071724**

| Lab Sample ID | 21/03916/1 | 21/03916/3 | 21/03916/6 | | | | | Units | Limit of Detection | Method ref |
|---|---|---|---|---|---|---|---|---|---|---|
| Client Sample No | | | | | | | | | | |
| Client Sample ID | WS1 | WS3 | WS6 | | | | | | | |
| Depth to Top | 0.50 | 0.50 | 0.40 | | | | | | | |
| Depth To Bottom | | | | | | | | | | |
| Date Sampled | 12-Apr-21 | 12-Apr-21 | 12-Apr-21 | | | | | | | |
| Sample Type | Soil - ES | Soil - ES | Soil - ES | | | | | | | |
| Sample Matrix Code | 6AE | 3A | 6ABE | | | | | | | |
| % Stones >10mm$_A$ | 34.0 | <0.1 | 17.1 | | | | | % w/w | 0.1 | A-T-044 |
| pH$_D$$^{M\#}$ | 9.02 | 8.22 | 8.20 | | | | | pH | 0.01 | A-T-031s |
| Sulphate (acid soluble)$_D$$^{M\#}$ | 500 | <200 | 330 | | | | | mg/kg | 200 | A-T-028s |
| Cyanide (free)$_A$$^{M\#}$ | <1 | <1 | <1 | | | | | mg/kg | 1 | A-T-042sFCN |
| Cyanide (total)$_A$$^{M\#}$ | <1 | <1 | <1 | | | | | mg/kg | 1 | A-T-042sTCN |
| Thiocyanate$_A$ | <5 | <5 | <5 | | | | | mg/kg | 5 | A-T-041s |
| Phenols - Total by HPLC$_A$ | <0.2 | <0.2 | <0.2 | | | | | mg/kg | 0.2 | A-T-050s |
| Sulphide$_A$ | 76 | 100 | 60 | | | | | mg/kg | 5 | A-T-S2-s |
| Sulphur (elemental)$_D$$^{M\#}$ | <5 | <5 | <5 | | | | | mg/kg | 5 | A-T-029s |
| Organic matter$_D$$^{M\#}$ | 7.4 | 0.5 | 13.1 | | | | | % w/w | 0.1 | A-T-032 OM |
| Arsenic$_D$$^{M\#}$ | 2 | 3 | 5 | | | | | mg/kg | 1 | A-T-024s |
| Beryllium$_D$$^{\#}$ | <0.5 | 0.6 | <0.5 | | | | | mg/kg | 0.5 | A-T-024s |
| Boron (water soluble)$_D$ | <1.0 | <1.0 | 1.1 | | | | | mg/kg | 1 | A-T-027s |
| Cadmium$_D$$^{M\#}$ | <0.5 | 0.7 | <0.5 | | | | | mg/kg | 0.5 | A-T-024s |
| Copper$_D$$^{M\#}$ | 11 | 9 | 17 | | | | | mg/kg | 1 | A-T-024s |
| Chromium$_D$$^{M\#}$ | 14 | 23 | 12 | | | | | mg/kg | 1 | A-T-024s |
| Chromium (hexavalent)$_D$ | <1 | <1 | <1 | | | | | mg/kg | 1 | A-T-040s |
| Lead$_D$$^{M\#}$ | 18 | 57 | 35 | | | | | mg/kg | 1 | A-T-024s |
| Mercury$_D$ | 0.20 | <0.17 | 0.37 | | | | | mg/kg | 0.17 | A-T-024s |
| Nickel$_D$$^{M\#}$ | 13 | 22 | 19 | | | | | mg/kg | 1 | A-T-024s |
| Selenium$_D$$^{M\#}$ | <1 | <1 | <1 | | | | | mg/kg | 1 | A-T-024s |
| Vanadium$_D$$^{M\#}$ | 17 | 24 | 17 | | | | | mg/kg | 1 | A-T-024s |
| Zinc$_D$$^{M\#}$ | 38 | 86 | 50 | | | | | mg/kg | 5 | A-T-024s |
| TPH total (>C6-C40)$_A$$^{M\#}$ | 41 | <10 | - | | | | | mg/kg | 10 | A-T-007s |

**Envirolab Job Number: 21/03916**

**Client Project Name: Cowbridge Primary School**

**Client Project Ref: 2071724**

| Lab Sample ID | 21/03916/1 | 21/03916/3 | 21/03916/6 | | | | | Units | Limit of Detection | Method ref |
|---|---|---|---|---|---|---|---|---|---|---|
| Client Sample No | | | | | | | | | | |
| Client Sample ID | WS1 | WS3 | WS6 | | | | | | | |
| Depth to Top | 0.50 | 0.50 | 0.40 | | | | | | | |
| Depth To Bottom | | | | | | | | | | |
| Date Sampled | 12-Apr-21 | 12-Apr-21 | 12-Apr-21 | | | | | | | |
| Sample Type | Soil - ES | Soil - ES | Soil - ES | | | | | | | |
| Sample Matrix Code | 6AE | 3A | 6ABE | | | | | | | |
| **Asbestos in Soil (inc. matrix)** | | | | | | | | | | |
| Asbestos in soil$_{D}^{\#}$ | NAD | NAD | NAD | | | | | | | A-T-045 |
| Asbestos ACM - Suitable for Water Absorption Test?$_{D}$ | N/A | N/A | N/A | | | | | | | A-T-045 |

**Envirolab Job Number: 21/03916**

**Client Project Name: Cowbridge Primary School**

**Client Project Ref: 2071724**

| Lab Sample ID | 21/03916/1 | 21/03916/3 | 21/03916/6 | | | | | Units | Limit of Detection | Method ref |
|---|---|---|---|---|---|---|---|---|---|---|
| Client Sample No | | | | | | | | | | |
| Client Sample ID | WS1 | WS3 | WS6 | | | | | | | |
| Depth to Top | 0.50 | 0.50 | 0.40 | | | | | | | |
| Depth To Bottom | | | | | | | | | | |
| Date Sampled | 12-Apr-21 | 12-Apr-21 | 12-Apr-21 | | | | | | | |
| Sample Type | Soil - ES | Soil - ES | Soil - ES | | | | | | | |
| Sample Matrix Code | 6AE | 3A | 6ABE | | | | | | | |
| **PAH-16MS** | | | | | | | | | | |
| Acenaphthene$_A^{M\#}$ | 0.04 | <0.01 | 0.01 | | | | | mg/kg | 0.01 | A-T-019s |
| Acenaphthylene$_A^{M\#}$ | <0.01 | <0.01 | <0.01 | | | | | mg/kg | 0.01 | A-T-019s |
| Anthracene$_A^{M\#}$ | 0.08 | <0.02 | <0.02 | | | | | mg/kg | 0.02 | A-T-019s |
| Benzo(a)anthracene$_A^{M\#}$ | 0.30 | 0.06 | 0.13 | | | | | mg/kg | 0.04 | A-T-019s |
| Benzo(a)pyrene$_A^{M\#}$ | 0.18 | <0.04 | 0.14 | | | | | mg/kg | 0.04 | A-T-019s |
| Benzo(b)fluoranthene$_A^{M\#}$ | 0.26 | <0.05 | 0.18 | | | | | mg/kg | 0.05 | A-T-019s |
| Benzo(ghi)perylene$_A^{M\#}$ | 0.08 | <0.05 | 0.07 | | | | | mg/kg | 0.05 | A-T-019s |
| Benzo(k)fluoranthene$_A^{M\#}$ | 0.09 | <0.07 | 0.08 | | | | | mg/kg | 0.07 | A-T-019s |
| Chrysene$_A^{M\#}$ | 0.30 | <0.06 | 0.18 | | | | | mg/kg | 0.06 | A-T-019s |
| Dibenzo(ah)anthracene$_A^{M\#}$ | <0.04 | <0.04 | <0.04 | | | | | mg/kg | 0.04 | A-T-019s |
| Fluoranthene$_A^{M\#}$ | 0.54 | <0.08 | 0.22 | | | | | mg/kg | 0.08 | A-T-019s |
| Fluorene$_A^{M\#}$ | 0.04 | <0.01 | 0.01 | | | | | mg/kg | 0.01 | A-T-019s |
| Indeno(123-cd)pyrene$_A^{M\#}$ | 0.10 | <0.03 | 0.08 | | | | | mg/kg | 0.03 | A-T-019s |
| Naphthalene $_A^{M\#}$ | <0.03 | <0.03 | <0.03 | | | | | mg/kg | 0.03 | A-T-019s |
| Phenanthrene$_A^{M\#}$ | 0.31 | <0.03 | 0.09 | | | | | mg/kg | 0.03 | A-T-019s |
| Pyrene$_A^{M\#}$ | 0.38 | <0.07 | 0.18 | | | | | mg/kg | 0.07 | A-T-019s |
| Total PAH-16MS$_A^{M\#}$ | 2.70 | <0.08 | 1.37 | | | | | mg/kg | 0.01 | A-T-019s |

**Envirolab Job Number: 21/03916**

**Client Project Name: Cowbridge Primary School**

**Client Project Ref: 2071724**

| Lab Sample ID | 21/03916/1 | 21/03916/3 | 21/03916/6 | | | | | Units | Limit of Detection | Method ref |
|---|---|---|---|---|---|---|---|---|---|---|
| Client Sample No | | | | | | | | | | |
| Client Sample ID | WS1 | WS3 | WS6 | | | | | | | |
| Depth to Top | 0.50 | 0.50 | 0.40 | | | | | | | |
| Depth To Bottom | | | | | | | | | | |
| Date Sampled | 12-Apr-21 | 12-Apr-21 | 12-Apr-21 | | | | | | | |
| Sample Type | Soil - ES | Soil - ES | Soil - ES | | | | | | | |
| Sample Matrix Code | 6AE | 3A | 6ABE | | | | | | | |
| **TPH CWG** | | | | | | | | | | |
| Ali >C5-C6$_{A}^{\#}$ | - | - | <0.01 | | | | | mg/kg | 0.01 | A-T-022s |
| Ali >C6-C8$_{A}^{\#}$ | - | - | <0.01 | | | | | mg/kg | 0.01 | A-T-022s |
| Ali >C8-C10$_{A}$ | - | - | <1 | | | | | mg/kg | 1 | A-T-055s |
| Ali >C10-C12$_{A}^{M\#}$ | - | - | <1 | | | | | mg/kg | 1 | A-T-055s |
| Ali >C12-C16$_{A}^{M\#}$ | - | - | 3 | | | | | mg/kg | 1 | A-T-055s |
| Ali >C16-C21$_{A}^{M\#}$ | - | - | 5 | | | | | mg/kg | 1 | A-T-055s |
| Ali >C21-C35$_{A}^{M\#}$ | - | - | 18 | | | | | mg/kg | 1 | A-T-055s |
| Total Aliphatics$_{A}$ | - | - | 26 | | | | | mg/kg | 1 | A-T-055s |
| Aro >C5-C7$_{A}^{\#}$ | - | - | <0.01 | | | | | mg/kg | 0.01 | A-T-022s |
| Aro >C7-C8$_{A}^{\#}$ | - | - | <0.01 | | | | | mg/kg | 0.01 | A-T-022s |
| Aro >C8-C10$_{A}$ | - | - | <1 | | | | | mg/kg | 1 | A-T-055s |
| Aro >C10-C12$_{A}$ | - | - | <1 | | | | | mg/kg | 1 | A-T-055s |
| Aro >C12-C16$_{A}$ | - | - | 3 | | | | | mg/kg | 1 | A-T-055s |
| Aro >C16-C21$_{A}^{M\#}$ | - | - | 4 | | | | | mg/kg | 1 | A-T-055s |
| Aro >C21-C35$_{A}^{M\#}$ | - | - | 14 | | | | | mg/kg | 1 | A-T-055s |
| Total Aromatics$_{A}$ | - | - | 22 | | | | | mg/kg | 1 | A-T-055s |
| TPH (Ali & Aro >C5-C35)$_{A}$ | - | - | 48 | | | | | mg/kg | 1 | A-T-055s |
| BTEX - Benzene$_{A}^{\#}$ | - | - | <0.01 | | | | | mg/kg | 0.01 | A-T-022s |
| BTEX - Toluene$_{A}^{\#}$ | - | - | <0.01 | | | | | mg/kg | 0.01 | A-T-022s |
| BTEX - Ethyl Benzene$_{A}^{\#}$ | - | - | <0.01 | | | | | mg/kg | 0.01 | A-T-022s |
| BTEX - m & p Xylene$_{A}^{\#}$ | - | - | 0.04 | | | | | mg/kg | 0.01 | A-T-022s |
| BTEX - o Xylene$_{A}^{\#}$ | - | - | 0.01 | | | | | mg/kg | 0.01 | A-T-022s |
| MTBE$_{A}^{\#}$ | - | - | <0.01 | | | | | mg/kg | 0.01 | A-T-022s |

## REPORT NOTES

**General**
This report shall not be reproduced, except in full, without written approval from Envirolab.
The results reported herein relate only to the material supplied to the laboratory.
The residue of any samples contained within this report, and any received with the same delivery, will be disposed of six weeks after initial scheduling. For samples tested for Asbestos we will retain a portion of the dried sample for a minimum of six months after the initial Asbestos testing is completed.
Analytical results reflect the quality of the sample at the time of analysis only.
Opinions and interpretations expressed are outside the scope of our accreditation.
If results are in italic font they are associated with an AQC failure, these are not accredited and are unreliable.
A deviating samples report is appended and will indicate if samples or tests have been found to be deviating. Any test results affected may not be an accurate record of the concentration at the time of sampling and, as a result, may be invalid.
The Client Sample No, Client Sample ID, Depth to Top, Depth to Bottom and Date Sampled were all provided by the client.

**Soil chemical analysis:**
All results are reported as dry weight (<40°C).
For samples with Matrix Codes 1 - 6 natural stones, brick and concrete fragments >10mm and any extraneous material (visible glass, metal or twigs) are removed and excluded from the sample prior to analysis and reported results corrected to a whole sample basis. This is reported as '% stones >10mm'.
For samples with Matrix Code 7 the whole sample is dried and crushed prior to analysis and this supersedes any “A” subscripts
All analysis is performed on the sample as received for soil samples which are positive for asbestos or the client has informed asbestos may be present and/or if they are from outside the European Union and this supersedes any "D" subscripts.

**TPH analysis of water by method A-T-007:**
Free and visible oils are excluded from the sample used for analysis so that the reported result represents the dissolved phase only.

**Electrical Conductivity of water by Method A-T-037:**
Results greater than 12900µS/cm @ 25°C / 11550µS/cm @ 20°C fall outside the calibration range and as such are unaccredited.

**Asbestos:**
Asbestos in soil analysis is performed on a dried aliquot of the submitted sample and cannot guarantee to identify asbestos if only present in small numbers as discrete fibres/fragments in the original sample.
Stones etc. are not removed from the sample prior to analysis.
Quantification of asbestos is a 3 stage process including visual identification, hand picking and weighing and fibre counting by sedimentation/phase contrast optical microscopy if required. If asbestos is identified as being present but is not in a form that is suitable for analysis by hand picking and weighing (normally if the asbestos is present as free fibres) quantification by sedimentation is performed. Where ACMs are found a percentage asbestos is assigned to each with reference to 'HSG264, Asbestos: The survey guide' and the calculated asbestos content is expressed as a percentage of the dried soil sample aliquot used.

**Predominant Matrix Codes:**
1 = SAND, 2 = LOAM, 3 = CLAY, 4 = LOAM/SAND, 5 = SAND/CLAY, 6 = CLAY/LOAM, 7 = OTHER, 8 = Asbestos bulk ID sample.
Samples with Matrix Code 7 & 8 are not predominantly a SAND/LOAM/CLAY mix and are not covered by our BSEN 17025 or MCERTS accreditations, with the exception of bulk asbestos which are BSEN 17025 accredited.
**Secondary Matrix Codes:**
A = contains stones, B = contains construction rubble, C = contains visible hydrocarbons, D = contains glass/metal, E = contains roots/twigs.

**Key:**
IS indicates Insufficient Sample for analysis.
US indicates Unsuitable Sample for analysis.
NDP indicates No Determination Possible.
NAD indicates No Asbestos Detected.
N/A indicates Not Applicable.
Superscript # indicates method accredited to ISO 17025.
Superscript "M" indicates method accredited to MCERTS.
Subscript "A" indicates analysis performed on the sample as received.
Subscript "D" indicates analysis performed on the dried sample, crushed to pass a 2mm sieve

Please contact us if you need any further information.

# Envirolab Deviating Samples Report

Units 7&8 Sandpits Business Park, Mottram Road, Hyde, SK14 3AR
Tel. 0161 368 4921 email. ask@envlab.co.uk

**Client:** CJ Associates (Bridgend), Unit 1-3, Block 6, Newlands Avenue, Brackla Industrial Estate, Bridgend, Mid Glamorgan, CF31 2DA

**Project:** Cowbridge Primary School

**Clients Project No:** 2071724

**Project No:** 21/03916

**Date Received:** 15/04/2021 (am)

**Cool Box Temperatures (°C):** 7.2

| Lab Sample ID | 21/03916/1 | 21/03916/3 | 21/03916/6 |
|---|---|---|---|
| Client Sample No | | | |
| Client Sample ID/Depth | WS1 0.50m | WS3 0.50m | WS6 0.40m |
| Date Sampled | 12/04/21 | 12/04/21 | 12/04/21 |
| Deviation Code | | | |
| F | ✓ | ✓ | ✓ |

*Key*
*F* *Maximum holding time exceeded between sampling date and analysis for analytes listed below*

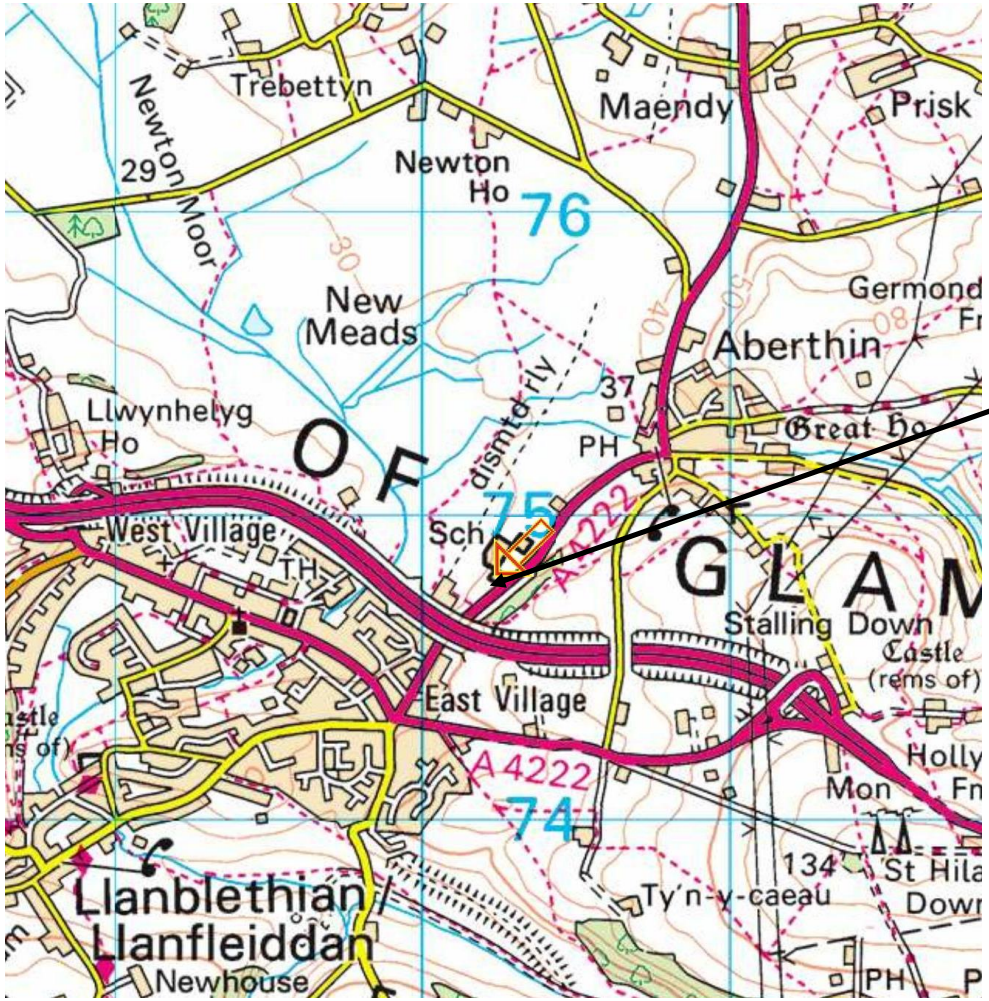
## HOLDING TIME EXCEEDANCES

| Lab Sample ID | 21/03916/1 | 21/03916/3 | 21/03916/6 |
|---|---|---|---|
| Client Sample No | | | |
| Client Sample ID/Depth | WS1 0.50m | WS3 0.50m | WS6 0.40m |
| Date Sampled | 12/04/21 | 12/04/21 | 12/04/21 |
| Sulphide | ✓ | ✓ | ✓ |

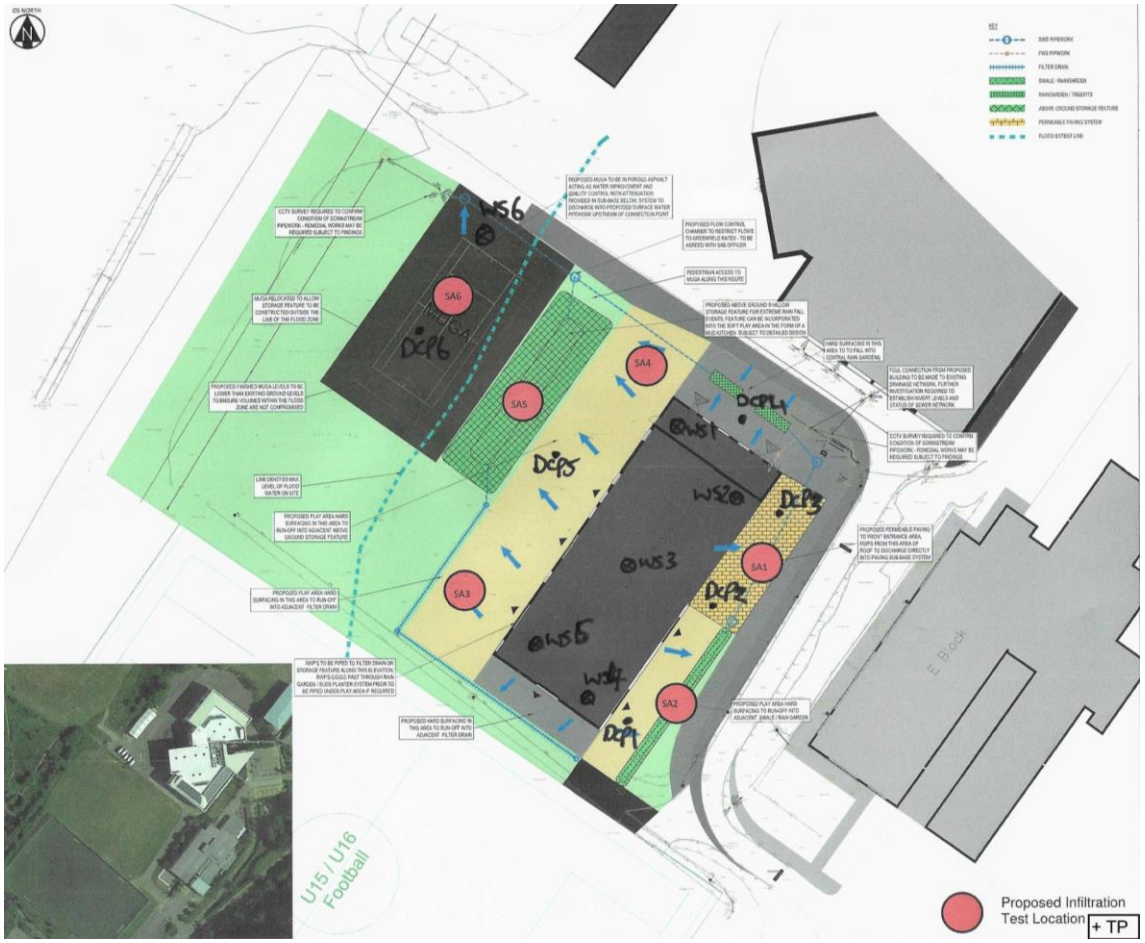
If, at any point before reaching the laboratory, the temperature of the samples has breached those set in published standards, e.g. BS-EN 5667-3, ISO 18400-102:2017, then the concentration of any affected analytes may differ from that at the time of sampling.

CJAssociates

# DRAWINGS

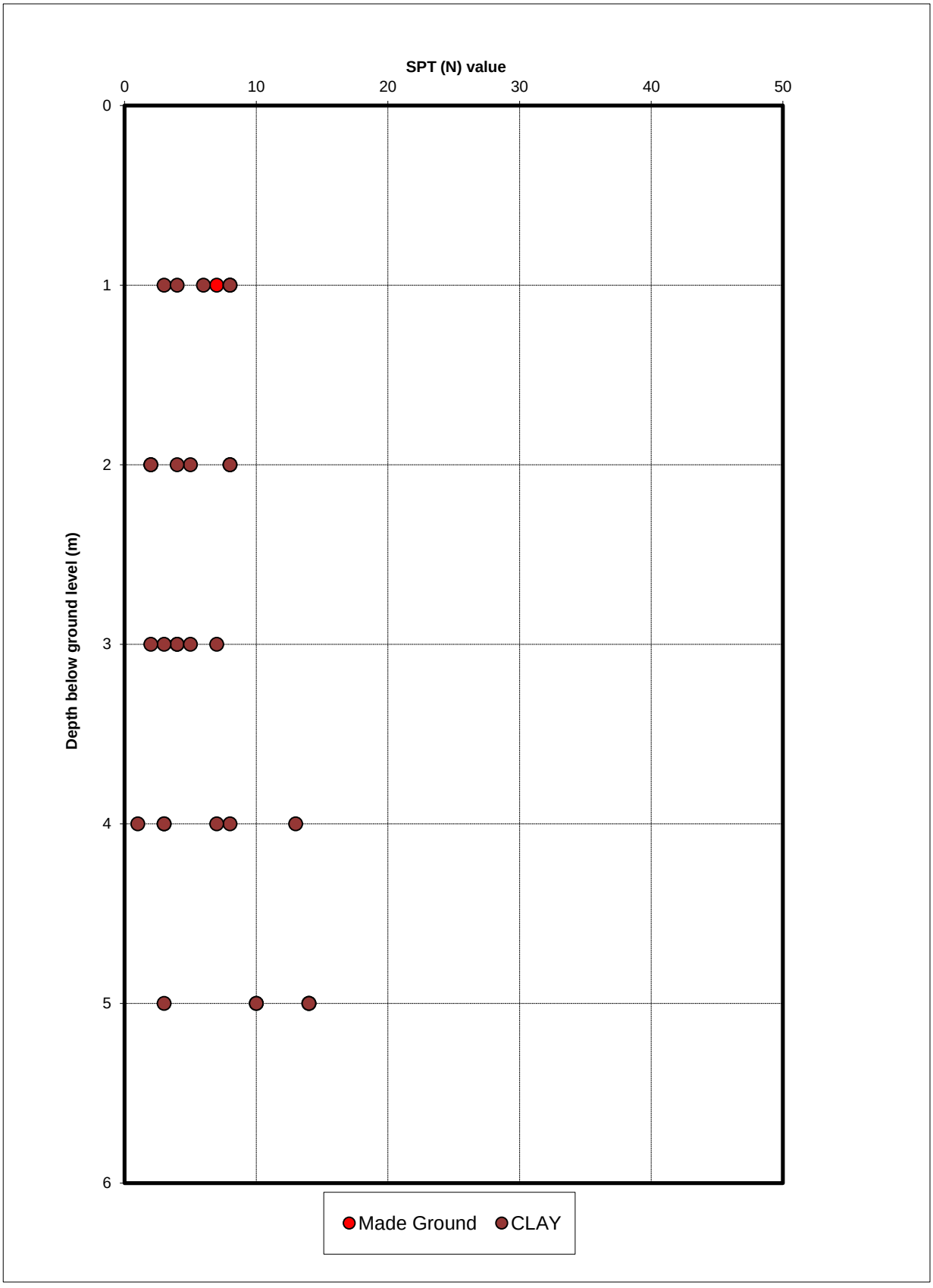



| | | | | |
|---|---|---|---|---|
| CJAssociates<br>Portview Road, Avonmouth, BS11 9JE<br>Tel 0117 982 1473 | **Site Location Plan - Cowbridge Primary School**<br>Reproduced from Ordnance Survey Maps, with permission of the Controller of HMSO. Crown copyright reserved License No. 100005301 | | | |
| | **Job No. 2071724** | **Drawn by: SL** | **Date: May 2021** | **Scale: NTS** |



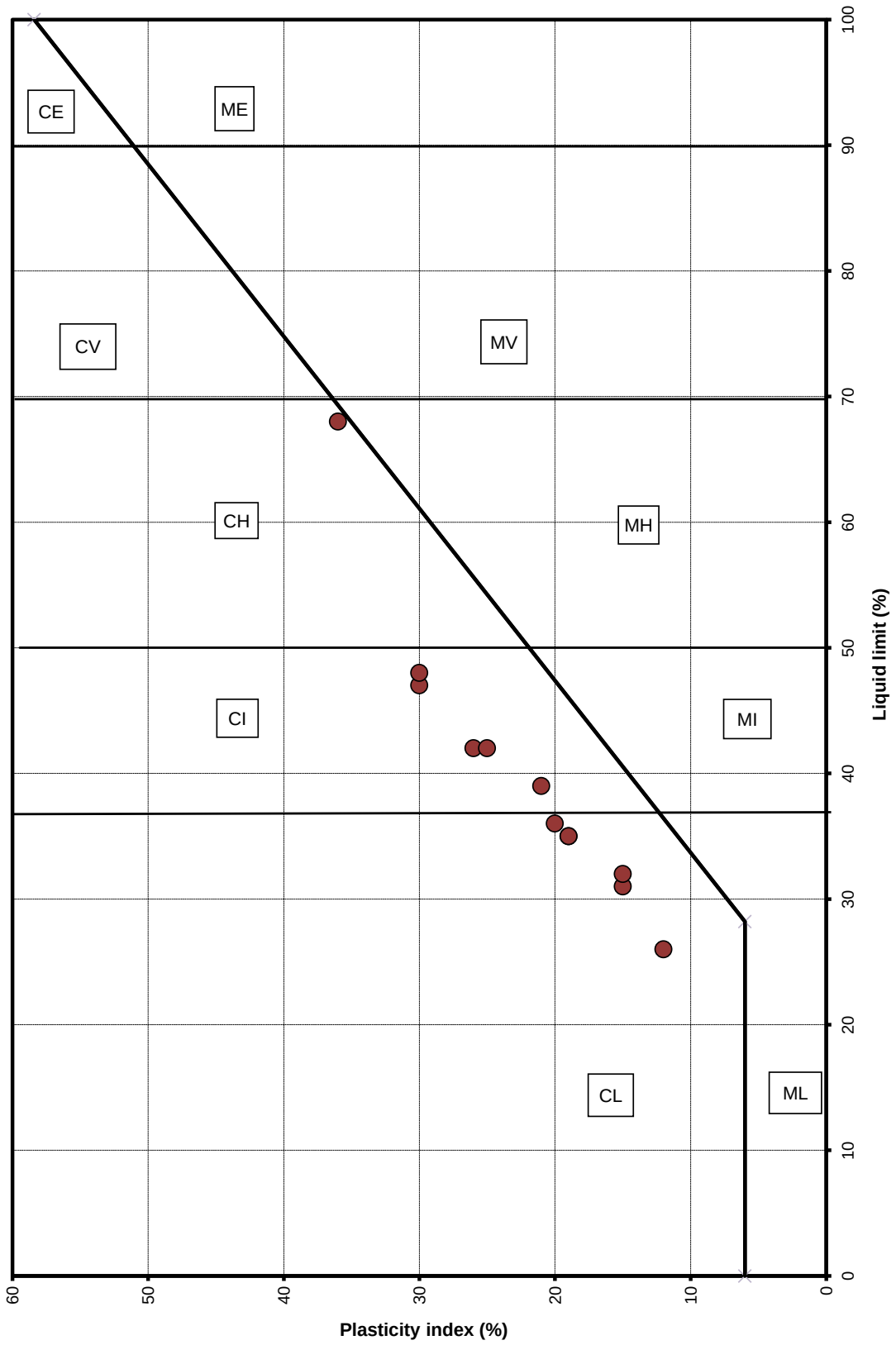

| | | | | |
|---|---|---|---|---|
| CJAssociates<br>Portview Road, Avonmouth, BS11 9JE<br>Tel 0117 982 1473 | Exploratory Hole Location Plan - Cowbridge Primary School | | | |
| | Job No. 2071724 | Drawn by: SL | Date: May 2021 | Scale: NTS |

# PLOT OF SPT 'N' VALUE AGAINST DEPTH




| | | |
|---|---|---|
| CJAssociates<br>Portview Road, Avonmouth, BS11 9JE<br>Tel 0117 982 1473 | Project<br>COWBRIDGE PRIMARY SCHOOL | Drawing Title<br>SPT v Depth |
| | Client<br>MORGAN SINDALL | Project No.<br>2071724 |

# Plasticity Chart




| | | |
|---|---|---|
| CJAssociates<br>Portview Road, Avonmouth, BS11 9JE<br>Tel 0117 982 1473 | Project<br>COWBRIDGE PRIMARY SCHOOL | Drawing Title<br>Plasticity Chart |
| | Client<br>MORGAN SINDALL | Project No.<br>2071724 |