Draft Tier 2 Geotechnical and Geoenvironmental Report

Site: Wolf's Castle Public House, Llanishen, Cardiff

Prepared For: Cardiff City Council

Issue Date: April 2025

Job No: TF-24-310

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REPORT TITLE : **Draft Tier 2 Geoenvironmental and Geotechnical Report: Proposed Residential Development, Wolf's Castle Public House, Llanishen, Cardiff**

JOB NUMBER : **TF-24-310**

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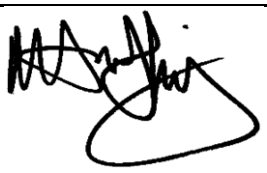
Checked	**Michael Watkins** MESci, FGS **Engineering Geologist**	
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Executive Summary

Site Location and Proposed Development	*Cardiff City Council (the Client) is proposing the construction of a new residential development at Wolf's Castle Public House on the corner of Templeton Avenue and Wolf's Castle Avenue in Llanishen, Cardiff, CF14 5JS. The proposed development will consist of 12No. apartments contained within a low rise building, 13No. semi-detached and terrace houses, and associated infrastructure including access road, car parking, soft landscaping and gardens*
Radon	*Basic radon protective measures are required for new developments constructed at ground level on the investigation site.*
Ground Conditions	<table><tr><th colspan="3">Depth (m)</th><th>Thickness (m)</th><th>Stratum</th></tr><tr><td>0.05</td><td>-</td><td>0.05/0.5</td><td>0.05-0.5</td><td>Soft dark brown slightly sandy organic CLAY with abundant rootlets (MADE GROUND) or TARMAC</td></tr><tr><td>0.05/0.5</td><td>-</td><td>0.25/3.5</td><td>Absent to 3.33m</td><td>Very soft to firm reddish brown slightly sandy gravelly CLAY with ash, concrete, tarmac, and brick fragments. (MADE GROUND). Occasional gravel lenses of brick and concrete.</td></tr><tr><td>0.5/3.5</td><td>-</td><td>>5.00</td><td>Unconfirmed</td><td>Very soft to stiff reddish brown sandy slightly gravelly CLAY (DEVENSIAN TILL).</td></tr></table>
Contamination of Concern	*Naphthalene, Dibenz(a,h)Anthracene, Benzo[a]anthracene, Benzo[b]fluoranthene, Indeno(1,2,3-c,d)Pyrene, Benzo[a]pyrene, Lead, Aromatic EPH >C21-C35, Aromatic EPH >C16-C21*
Ground Gas Risk Assessment	*Due to the presence of made ground of up to 3.5m thickness, additional assessment is required to determine whether ground gas protection measures are required in the proposed dwellings.*
Foundation Solution	*It is recommended a piled foundation solution is used. The length and capacity of the piles should be informed by rotary percussive boreholes drilled at least 5m into competent bedrock.* *The estimated working pile loads, pile type and lengths should be confirmed by a specialist piling contractor and it may be prudent to test drive/install piles at selected locations.*
Recommended Further Works	1. *Rotary percussive drilling with at least 5m coring of competent bedrock and SPTs carried out at regular intervals to inform pile design* 2. *Additional geotechnical inspection and geoenvironmental testing of soils beneath the footprint of the existing building following its demolition.* 3. *Additional soil testing across the site to gain a better understanding of the risk to human health from organic compounds, with particular focus on Naphthalene, which was detected above GAC in one of the shallow samples of made ground.* 4. *Due to the unexpected thickness of made ground at the site, further assessment of the risk from ground gas is recommended. In the first instance this should involve trial pitting to allow a forensic description of the made ground. Samples should be taken at 0.5m intervals and tested for Total Organic Carbon and Dissolved Organic Carbon. An assessment carried out in accordance with CL:AIRE Research Bulletin 17 "A Pragmatic Approach to Ground Gas Risk Assessment" will determine whether gas protection measures are required, or whether a programme of gas monitoring should be carried out*

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SECTION 1 Introduction & Proposed Development

1.1 Background

Cardiff City Council (the Client) is proposing the construction of a new residential development at Wolf's Castle Public House on the corner of Templeton Avenue and Wolf's Castle Avenue in Llanishen, Cardiff, CF14 5JS. The proposed development will consist of 12No. apartments contained within a low rise building, 13No. semi-detached and terrace houses, and associated infrastructure including access road, car parking, soft landscaping and gardens. The proposed layout can be seen within the red line boundary on **Figure 1.1**.

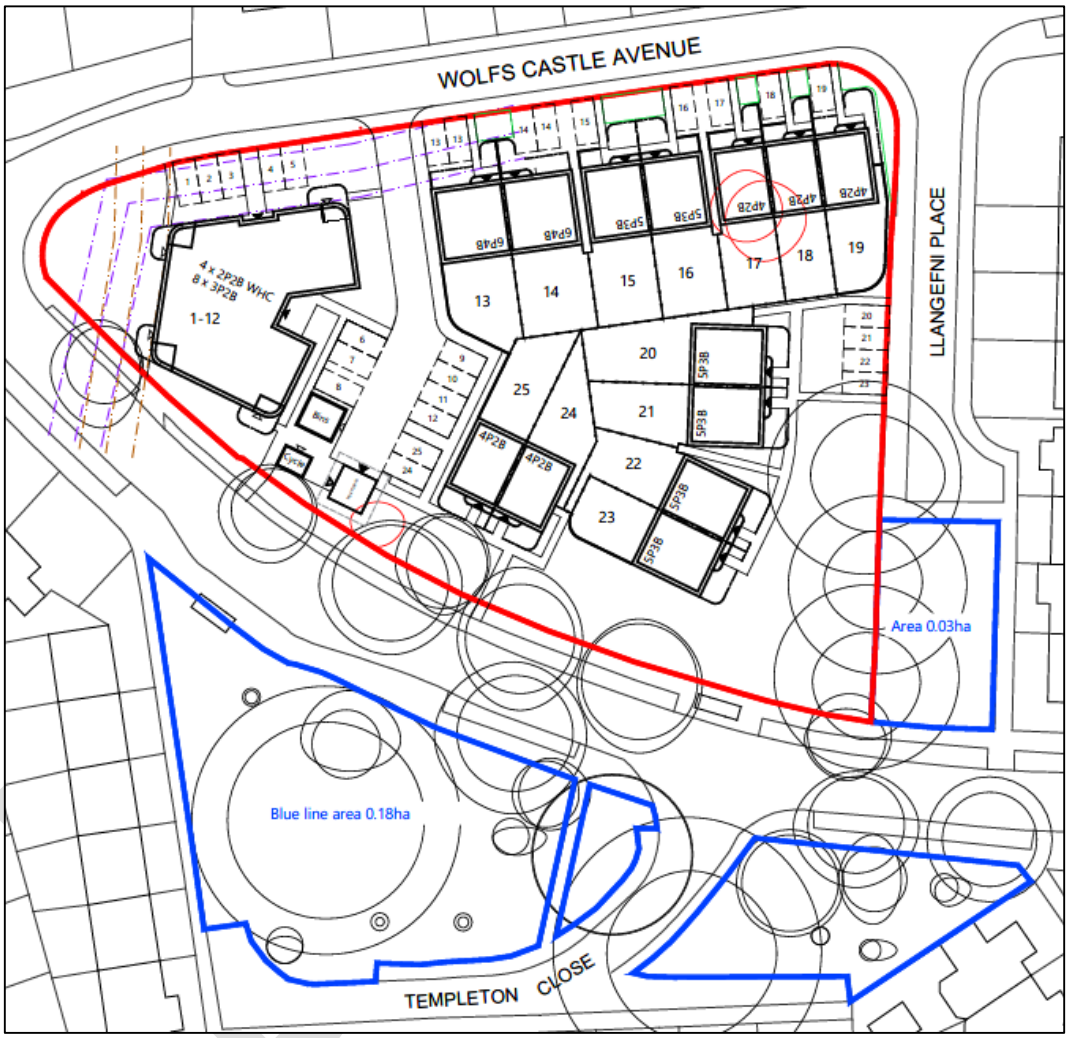

Figure 1.1 Proposed Site Layout

Powell Dobson is the Architect for the project.

TFW Group Ltd (Terra Firma) have been commissioned by the Client to undertake a Geotechnical and Geoenvironmental Report

A Tier 1 (Desk Study) including a Preliminary Geoenvironmental and Geotechnical Risk Assessment was completed by Terra Firma. The findings of the Tier 1 Assessment are summarised in Section 2 of this report.

This report contains a Tier 2 assessment (Site Investigation) including a Generic Quantitative Geoenvironmental Risk Assessment and Geotechnical Ground Investigation.

1.2 Objectives

Land Contamination Risk Management (LCRM) guidance provided by the Environment Agency advocates using a tiered approach. This comprises Tier 1; the Preliminary Risk Assessment, Tier 2; the Generic Quantitative Risk Assessment and Tier 3; the Detailed Quantitative Risk Assessment. As each tier is completed a decision is made whether it is necessary to advance to the next tier.

In addition to LCRM, geotechnical aspects of the development also need to be considered and are approached in a similar manner, with the risks identified in the preliminary assessment, and then investigated through subsequent phase of investigation.

1.2.1 Tier 2

The main objectives of the Tier 2 Generic Quantitative Geoenvironmental Risk Assessment programme are:

- investigate the potential human health and environmental liabilities at the site associated with any contamination; and
- provide a summary of the human health and environmental conditions at the site, together with any necessary further intrusive works and / or remediation works to render the site fit for its intended use.

The main objectives of the Geotechnical Site Investigation are:

- investigate the type, strength and bearing characteristics of the shallow superficial and underlying solid geology;
- investigate the risk, if any, from historical shallow underground mining features;
- provide engineering foundation and floor slab recommendations for the proposed development;
- provide infiltration rates and stormwater drainage viability; and
- provide recommendations regarding any other geotechnical aspects pertaining to the development.

In order to achieve the above objectives, Terra Firma carried out an assessment programme a review of existing data, followed by a field investigation to collect geotechnical and geoenvironmental data from selected locations.

The scope of the works including the schedule for in-situ and laboratory testing was determined by Terra Firma.

1.3 Geotechnical Category

In accordance with BS EN 1997-1:2004+A1:2013, the proposed development comprises the following geotechnical category:

Geotechnical Category 2: conventional types of structures and foundation with no exceptional risk of difficult soil or loading conditions (e.g., spread, raft & pile foundations; retaining structures; excavations; earthworks and ground anchors).

1.4 Information Sources

The following sources of information have been referenced in support of this assessment:

- client provided information, plans etc. (**Figure 1.1**); and

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- Tier 1 Assessment (TF-24-310-01).

1.5 Roles & Responsibilities

Table 1.1 Roles and Responsibilities

Role	Organisation	Contact Details
Client/Developer	Cardiff City Council	beverley.bailey2@caerdydd.gov.uk
Geotechnical/Geoenvironmental Consultant	TFW Group Limited	cardiff@tfwgroup.co.uk
Architect/Engineer	Powell Dobson	cardiff@powelldobson.com
Local Authority	Cardiff City Council	development@cardiff.gov.uk

1.6 Limitations & Exceptions of Investigation

The Client has requested that a Tier 2 Geoenvironmental and Geotechnical Report (GGR) be undertaken to enable the outlined main objectives.

The GGR was conducted, and this report has been prepared for the sole internal reliance of the Client and their design and construction team. This report shall not be relied upon or transferred to any other parties without the express written authorisation of TFW Group Ltd. If an unauthorised third party comes into possession of this report, they rely on it at their peril and the authors owe them no duty of care and skill. The report represents the findings and opinions of experienced geoenvironmental and geotechnical consultants. TFW Group Ltd does not provide legal advice and the advice of lawyers may be required.

The subsurface geological profiles, any contamination and other plots are generalised by necessity and have been based on the information found at the locations of the exploratory holes and depths sampled and tested.

Human health and environmental risk assessment outcomes may not take into account the potential for the creation of new contaminant linkages as a result of variation to the proposed development and recommended engineering solutions. It is therefore imperative that the Client engages a geoenvironmental consultant to re-visit the conceptual site model and potential risks upon completion of final designs, prior to development.

Whilst this report assesses the suitability of soils in respect to human health and the environment, it is beyond the scope of this report to determine the legal status of imported and re-used soils/aggregates. It is the responsibility of the Client to confirm imported and re-used soils/aggregates have reached ‘Non-Waste’ status.

The investigation was limited by the following site constraints:

- the presence of underground services and utilities;
- the presence of existing buildings, structures and/or hard standing;
- the presence of access restrictions to the required locations;

1.7 Quality Assurance

The quality, health, safety and environmental aspects of the assessment comply with Terra Firma business management system which is UKAS accredited and complies with the requirements of BS EN ISO 9001:2015, BS EN ISO 14001:2015 and BS EN ISO 45001:2018 standards.

SECTION 2 Tier 1 Assessment

The site has been the subject of a previous Tier1 Geoenvironmental Desk Study:

- *Terra Firma, Tier 1 Geoenvironmental & Geotechnical Report* T1GGR-080425-TF-24-310-01 *dated April 2025.*

The salient points of the Tier 1 Assessment are summarised in **Section 2.1**.

2.1 Summary of Tier 1 Assessment

The findings of the Tier 1 Assessment are summarised in **Table 2.1**.

Table 2.1 Summary of Tier 1 Assessment

Site History	*The earliest map dated 1873 shows the site occupied by the buildings and grounds of Llanishen Fawr. Changes to the building footprints began sometime between 1940 and 1960. The buildings then became occupied by a public house around the same time as significant residential development in the surrounding area. The site has remained mainly unaltered until present day, although the pub is no longer operational.*
Geology	*Till overlies red sandstones of Llanishen Conglomerate.*
Radon	*Basic radon protective measures are required for new developments constructed at ground level on the investigation site.*
Coal Mining	*The site situates outside the South Wales coal fields.*
Anticipated Ground Conditions	***Stratum*** / ***Depth (m)*** *Made ground* / *<1.0m* *Till deposits (sandy gravelly clay with cobbles)* / *>5.0* *St Maughan's Group* / *~5.0-7.0*
Possible Contamination Sources	1. *Made Ground (metals, metalloids, asbestos, TPH, PAH, cyanide, and phenol)* 2. *Radon*
Anticipated Foundation Solution	*Based upon the desk study information, it is likely that traditional shallow spread foundations will be feasible for low rise development on site.*
Recommended Further Works	*It is recommended that an intrusive investigation is undertaken to inspect the ground conditions, and to take soil samples for laboratory chemical and geotechnical testing.* *It is perceived a combination of trial pitting, and dynamically sampled boreholes will be suitably to investigate the site.* *Soakaway testing should also be carried out to aid drainage design.*

SECTION 3 Field Investigation

3.1 Site Works

A geotechnical and geoenvironmental site investigation comprising 8No. windowless sample boreholes and 4No. trial pits was undertaken between the 5th and 7th of February.

The fieldwork was supervised by Terra Firma, who logged the exploratory holes to the requirements of BS 5930:2015+A1:2020. The proposed locations of the exploratory holes were determined by Terra Firma in general accordance with BS 10175:2011+A2:2017 in order to assess the findings of the preliminary conceptual site model.

Trial pits referenced TP01 to TP04, were formed using a JCB 3CX excavator with a 0.60m wide bucket.

Breaking out of the hardstanding in the car park was required at trial pit TP01 prior to excavation.

On completion all trial pits were backfilled with materials arisings compacted in layers using the excavator bucket.

The trial pit logs are presented in **Annex A**.

Soakaway tests were carried out in trial pits SA01 to SA04 in general accordance with BRE DG 365:2016. The excavation sides were squared using the excavator bucket and dimensions recorded within the test section. The trial pit was partially filled with clean water using a dedicated bowser with a 75mm diameter outlet and the fall in level recorded against time. The results are presented in **Annex B**.

The boreholes referenced WS01 to WS08, were formed using a Terrier 2000 rig. Dynamic sampling techniques were employed from surface to produce a continuous disturbed sample.

Standard penetration tests (SPT) were carried out at regular intervals in general accordance with BS1377: Part 9:1990:3.3. SPT results summarised as N values are presented on the borehole log.

Boreholes were monitored for groundwater ingress as drilling proceeded.

Representative disturbed samples were taken and retained in airtight containers for environmental and geotechnical testing.

The windowless sample borehole logs are presented in **Annex C**.

On completion WS01 to WS08 were backfilled with materials arising/ bentonite pellets/ gravel/ cementitious grout and the surface reinstated.

Exploratory hole locations are shown on **Drawing 01**.

3.2 Ground Conditions

The ground conditions encountered by the exploratory holes can in general be summarised as shown in **Table 3.1**.

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Table 3.1 Summary of Typical Ground Conditions

Depth (m)			Thickness (m)	Stratum
0.05	-	0.05/0.5	0.05-0.5	Soft dark brown slightly sandy organic CLAY with abundant rootlets (**MADE GROUND**) or TARMAC
0.05/0.5	-	0.25/3.5	Absent to 3.33m	Very soft to firm reddish brown slightly sandy gravelly **CLAY** with ash, concrete, tarmac, and brick fragments. (**MADE GROUND**). Occasional gravel lenses of brick and concrete.
0.5/3.5	-	>5.00	Unconfirmed	Very soft to stiff reddish brown sandy slightly gravelly **CLAY (DEVENSIAN TILL)**.

3.3 Groundwater

Groundwater information recorded during the site investigation period is summarised in **Table 3.2**.

Table 3.2 Groundwater Summary

Location	Depth (m)	Details
WS05	4.00	Slow inflow. Rose to 2.70m after 20 minutes.

3.4 Stability & Obstructions

Trial pits and borehole walls remained stable and vertical during excavation.

3.5 Laboratory Chemical Testing

3.5.1 Sampling Strategy

Soil sampling locations were selected on a non-targeted basis to characterise the contamination status of the site. A herringbone sampling pattern was adopted.

Sample locations, depths and suspected/known contamination source targets are summarised in **Table 3.3**:

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Table 3.3 Sample Locations and Targets

Location	Depth (m)	Type	Soil Type Targets
SA01	0.9	Soil	Made ground
SA01	2.5	Soil	Clay
SA02	0.1	Soil	Made ground
SA02	1.0	Soil	Clay
SA03	0.2	Soil	Made ground
SA03	1.2	Soil	Made ground
WS01	2.0	Soil	Made ground
WS02	0.5	Soil	Made ground
WS02	2.5	Soil	Clay
WS03	1.5	Soil	Made ground
WS03	3.0	Soil	Clay
WS04	0.3	Soil	Made ground
WS04	1.0	Soil	Made ground
WS05	0.2	Soil	Made ground
WS05	2.1	Soil	Clay
WS06	0.8	Soil	Made ground
WS07	0.2	Soil	Made ground
WS07	1.0	Soil	Made ground
WS08	0.1	Soil	Made ground
WS08	1.80	Soil	Clay

3.5.2 Sample Analysis

During the site investigation works soil/groundwater samples were collected and despatched under a chain of custody to the accredited laboratories of Eurofins Chemtest for chemical analysis. A summary of testing is listed in **Table 3.4**.

A copy of the test results is provided in **Annex D**.

Table 3.4 Laboratory Analysis

Metals & Metalloids	In-Organics	Organics	Others
Arsenic	Cyanide	Phenols	pH (acidity)
Cadmium	Sulphate	PAH	Asbestos
Chromium III		Petroleum Hydrocarbons	
Chromium VI			
Copper			
Lead			
Mercury			
Nickel			
Selenium			
Zinc			

3.6 Soil Property Testing

3.6.1 In-situ Permeability Testing (Soakaways)

Soakaway test results are summarised in **Table 3.5**.

Table 3.5 Summary of Soakaway Results

Trial Pit	Depth Range of Test (m)	Geology Description	Infiltration Rate (ms^{-1})
SA01	2.2	Clay	Insufficient infiltration
SA02	0.9	Clay	Insufficient infiltration
SA03	0.7	Clay	Insufficient infiltration
SA04	0.9	Clay	Insufficient infiltration

The test results and calculation sheets may be found in **Annex B**.

3.6.2 Laboratory Geotechnical Testing

A schedule of laboratory tests was prepared by Terra Firma and samples were despatched to the accredited laboratories of GSTL. A summary of the testing carried out is presented in **Table 3.6**.

Table 3.6 Summary of Geotechnical Testing

Geotechnical Test	No. Samples Tested
Moisture Content	20
4 Point Liquid and Plastic Limit	10
BRE SD1 (Concrete classification)	9

The geotechnical test results are presented in **Annex E**.

3.7 Hand Excavation of Possible Underground Services

An underground utility survey was conducted at the site prior to the site investigation works. Several linear anomalies were reported. Consequently, Terra Firma were commissioned to carry out an investigation of these linear anomalies by hand excavation. No underground utilities consistent with these features were recorded. However, some of the linear anomalies did coincide with tree roots and cobbles in the ground.

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SECTION 4 Evaluation of Geoenvironmental Analytical Results

4.1 Assessment Methodology

4.1.1 Soils

An assessment of the analytical results has been made with comparison with the following generic assessment criteria with preference in most onerous order:

- Land Quality Management (LQM) and the Chartered Institute of Environmental Health (CIEH) Suitable 4 Use Levels (S4UL) (Nathanail, CP *et al.*:2015);
- Category 4 Screening Levels (C4SL) provided by the Department for Environment, Food and Rural Affairs (DEFRA:2014);
- Soil Guideline Values (SGV) by the Environment Agency (2009);
- Generic Assessment Criteria (GAC) provided by EIC/AGS/CL:AIRE (2010); and
- Generic Assessment Criteria (GAC) derived in-house.

In the absence of generic assessment criteria, the laboratory limit of detection has been used for comparison, in order to establish the presence/absence of determinands and for initial screening purposes.

Soils subjected to a UK Water Industry Research (UKWIR) suite of testing have been compared with guidelines set out in UKWIR Guidance for the Selection of Water Supply Pipes to be Used in Brownfield Sites, published in 2010.

4.2 Soil Test Results

A summary of the chemical test results which include the regulatory soil guideline values used in a **residential setting with plant uptake** are given in the following tables. The complete results can be found in **Annex D**.

4.2.1 Inorganics

Twenty samples were tested for a standard suite of inorganics, pH and organic matter. The summarised results are in **Table 4.1**.

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Table 4.1 Summary of Soil Chemical Test Results – Inorganics

Determinand	Threshold Value (mg/kg)	Source	Measured Concentrations (mg/kg)		Number of Exceedances
			Minimum	Maximum	
Arsenic	37	LQM/CIEH	4.30	29.00	0
Cadmium	11	LQM/CIEH	0.38	1.90	0
Chromium III	910	LQM/CIEH	12.00	41.00	0
Chromium VI	6	LQM/CIEH	< 0.50	< 0.50	0
Copper	2400	LQM/CIEH	7.70	55.00	0
Lead	200	C4SL	34.00	250.00	4
Mercury (inorganic)	40	LQM/CIEH	0.05	0.32	0
Nickel	180	LQM/CIEH	10.00	50.00	0
Selenium	250	LQM/CIEH	0.34	2.30	0
Zinc	3700	LQM/CIEH	59.00	270.00	0
Cyanide	-	-	< 0.50	2.20	-
Boron	290	LQM/CIEH	< 0.40	0.87	0
Organic Matter (%)	-	-	0.50	6.90	-
pH	-	-	6.70	8.70	-

Notes:
- No available guideline

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4.2.2 Organics

Twenty samples were tested for speciated polycyclic aromatic hydrocarbons (PAH). The summarised results are in **Table 4.2**.

Table 4.2 Summary of Soil Chemical Test Results – Speciated PAH

Determinand	Threshold Value (mg/kg)	Source	Measured Concentrations (mg/kg)		Number of Exceedances
			Minimum	Maximum	
Naphthalene	2.3	LQM/CIEH	< 0.10	4.50	1
Acenaphthylene	170	LQM/CIEH	< 0.10	1.00	0
Acenaphthene	210	LQM/CIEH	< 0.10	7.70	0
Fluorene	170	LQM/CIEH	< 0.10	11.00	0
Phenanthrene	95	LQM/CIEH	< 0.10	73.00	0
Anthracene	2400	LQM/CIEH	< 0.10	25.00	0
Fluoranthene	280	LQM/CIEH	< 0.10	140.00	0
Pyrene	620	LQM/CIEH	< 0.10	98.00	0
Benzo(a)anthracene	7.2	LQM/CIEH	< 0.10	73.00	2
Chrysene	15	LQM/CIEH	< 0.10	72.00	0
Benzo(b)fluoranthene	2.6	LQM/CIEH	< 0.10	120.00	5
Benzo(k)fluoranthene	77	LQM/CIEH	< 0.10	36.00	0
Benzo(a)pyrene	2.2	LQM/CIEH	< 0.10	75.00	2
Indeno(123cd)pyrene	27	LQM/CIEH	< 0.10	49.00	1
Dibenzo(ah)anthracene	0.24	LQM/CIEH	< 0.10	19.00	5
Benzo(ghi)perylene	320	LQM/CIEH	< 0.10	47.00	0
Total PAH	-	-	< 0.10	850.00	-

Notes:
Thresholds based on 1.0% soil organic matter
- No available guidelines

Twenty samples were tested for petroleum hydrocarbon. The summarised results are shown in **Table 4.3**.

Table 4.3 Summary of Soil Chemical Test Results – Petroleum Hydrocarbons

Determinand	Threshold Value (mg/kg)	Source	Measured Concentrations (mg/kg)		Number of Exceedances
			Minimum	Maximum	
PH C5 – C6 Ali	42	LQM/CIEH	< 0.05	< 0.05	0
PH C6 – C8 Ali	100	LQM/CIEH	< 0.10	< 0.10	0
PH C8 – C10 Ali	27	LQM/CIEH	< 0.10	0.12	0
PH C10 – C12 Ali	130	LQM/CIEH	< 0.10	3.70	0
PH C12 – C16 Ali	1100	LQM/CIEH	< 1.0	< 1.0	0
PH C16 – C21 Ali	65000*	LQM/CIEH	< 2.0	4.70	0
PH C21 – C35 Ali	65000*	LQM/CIEH	< 3.0	49.00	0
PH C35 – C44 Ali	65000	LQM/CIEH	< 10	180.00	0
Aromatic					
PH C5 – C7 Arom	70	LQM/CIEH	< 0.05	< 0.05	0
PH C7 – C8 Arom	130	LQM/CIEH	< 0.05	< 0.05	0
PH C8 – C10 Arom	34	LQM/CIEH	< 0.05	< 0.05	0
PH C10 – C12 Arom	74	LQM/CIEH	< 1.0	< 1.0	0
PH C12 – C16 Arom	140	LQM/CIEH	< 1.0	67.00	0
PH C16 – C21 Arom	260	LQM/CIEH	< 2.0	520.00	1
PH C21 – C35 Arom	1100	LQM/CIEH	< 2.0	1300.00	1
PH C35 – C44 Arom	1100	LQM/CIEH	< 1.0	390.00	0

Notes:
PH – Petroleum Hydrocarbon
Ali – Aliphatic
Arom – Aromatic
Thresholds based on 1.0% soil organic matter
* – Ali C16-21 and C21-C35 based on criteria for Ali EC >16-35

4.2.3 Asbestos Testing

All soil samples were scheduled for asbestos screening. Asbestos was not detected

SECTION 5 Generic Quantitative Risk Assessment

5.1 Contaminants of Concern

Contaminants of concern identified as part of the investigation are summarised in **Table 5.1**, along with an interpretation of the likely contamination source. Where applicable, the contaminant, source relationship is based on the inferences made in the preliminary conceptual site model.

Table 5.1 Contaminants of Concern

Location	Depth	Contaminant	Source
SA01	0.9m	Dibenz(a,h)Anthracene, Benzo[b]fluoranthene	S1 – Made Ground
SA03	1.2m	Lead	S1 – Made Ground
WS01	2.0m	Dibenz(a,h)Anthracene, Benzo[b]fluoranthene, Benzo[a]anthracene, Benzo[a]pyrene	S1 – Made Ground
WS02	0.5m	Dibenz(a,h)Anthracene, Benzo[b]fluoranthene	S1 – Made Ground
WS04	0.3m	Naphthalene, Dibenz(a,h)Anthracene, Benzo[a]anthracene, Benzo[b]fluoranthene, Indeno(1,2,3-c,d)Pyrene Benzo[a]pyrene, Lead, Aromatic EPH >C21-C35 Aromatic EPH >C16-C21	S1 – Made Ground
WS04	1.0m	Dibenz(a,h)Anthracene, Benzo[b]fluoranthene	S1 – Made Ground
WS06	0.8m	Lead	S1 – Made Ground
WS07	0.2m	Lead	S1 – Made Ground

5.2 Contaminant Linkages

Based on the findings of the intrusive site investigation and identified contaminants, the preliminary conceptual site model has been revised. Remaining contaminant linkages are tabulated in the refined conceptual site model **Table 5.2**. Identified contaminant linkages may require further investigation, detailed risk assessment and appropriate mitigation or remedial measures.

Table 5.2 Refined Conceptual Site Model

Source	Pathway	Receptor
S1 - Made Ground	P1 - Direct soil and dust ingestion P2 - Plant uptake & consumption of home grown produce P3 - Dermal contact P4 - Inhalation of dust and vapours P9 - Horizontal and vertical migration of ground gasses and vapours	R1 - Construction and maintenance workers R2 - Future site users (residents) R3 - Passers-by or neighbouring site users
S2- Radon Gas	P9 - Horizontal and vertical migration of ground gasses and vapours	R2 - Future site users (residents)

5.3 Conclusions of the Generic Quantitative Risk Assessment

Made Ground was found to contain several contaminants above generic assessment criteria for a residential setting.

Given the recorded concentrations of contamination and limited access to parts of the site, it is recommended that a Tier 3 Assessment is completed before moving onto a Stage 2 Options Appraisal and Remediation Strategy. The objectives of the Tier 3 assessment is to:

- Investigate the extent of made ground and contamination within the made ground
- Investigate areas previously inaccessible or restricted
- Derive site specific assessment criteria
- Assess the risk posed by the made ground and update the conceptual site model

5.4 Likely Remediation Solution

The following sections outline the likely mitigation and remedial measures suitable for the identified contamination and proposed development. Detailed methodology to achieve the measures must be prescribed in a Remediation Strategy Report and the results presented in a Validation Report upon their completion.

5.4.1 Human Health

Given the low level of contamination, a cap and cover system is likely to be suitable for the affected areas of the site. This should be confirmed following the recommended Tier 3 assessment in line with LCRM.

All imported soils must be validated as clean and suitable for use in accordance with ‘Requirements for the Chemical Testing of Imported Soils for Various End Uses and Validation Cover Systems’.

If during earthworks ground conditions are encountered that are markedly different to those found during the investigation, then the ground must be subject to additional sampling and testing and any necessary remedial measures designed and implemented before continuing with the works.

Elevated concentrations of naphthalene were recorded in the made ground. The Tier 3 assessment should allow a greater understanding of whether mitigation measures are required to prevent vapours entering the proposed buildings.

5.4.1.1 Radon

To mitigate against the risk to future site users from radon gas, basic protection measures will be required in all structures. Reference should be made to guidance publication BR 211:2023 for further details on required protection elements. Specialist design, specification and verification of the installed protection measures is recommended.

Terra Firma offer a comprehensive in-house ground gas protection system design, specification and verification service. For further details on how we may assist your project needs, please get in touch.

5.4.1.2 Ground Gas

Due to the unexpected thickness of made ground at the site, further assessment of the risk from ground gas is recommended. In the first instance this should involve trial pitting to allow

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a forensic description of the made ground. Samples should be taken at 0.5m intervals and tested for Total Organic Carbon and Dissolved Organic Carbon. An assessment carried out in accordance with CL:AIRE Research Bulletin 17 “A Pragmatic Approach to Ground Gas Risk Assessment” will determine whether gas protection measures are required, or whether a programme of gas monitoring should be carried out.

5.4.2 Aquatic Environment

Polycyclic Aromatic Hydrocarbon (PAH) determinands in exceedance are considered to have a very low potential mobility ranking. This means that they have a propensity to bind to soils and are relatively immobile.

Additionally, the impact of the contamination is likely to be rendered insignificant with the effects of attenuation and dilution.

The above conclusions should be revisited following the recommended additional investigation.

During the construction period, there is a risk to the environment/adjacent sites from de-watering, digging foundations, moving contaminated soil, drainage misconnections, discharges to local surface waters or the ground, runoff from construction materials and/or exposed ground, wheel washings and oil or chemical spills.

The risk is considered to be negligible as any adverse effects will be easily preventable by due diligence to good construction practise and housekeeping in preventing surface runoff and the spillage of materials.

The basic measures that must be taken are as follows:

- Prepare a drainage plan and mark the manholes to prevent pollutants accidently reaching the surface water sewers;
- Carry out any activities that could cause pollution in a designated, bunded area, away from rivers or boreholes. Where possible it should drain to the foul sewer;
- Use settlement ponds to remove silty water;
- Store all oils and chemicals in a fully bunded area to prevent leaks or spills;
- Get advice on whether you need an environmental permit and apply in good time

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SECTION 6 Laboratory Geotechnical Testing Results Analysis

Laboratory geotechnical testing results are summarised in the following sections and presented in their entirety in **Annex E,** unless otherwise stated.

6.1 Soil Testing

6.1.1 Plasticity & Moisture Content Testing

During the investigation ten samples of the shallow cohesive material was obtained and submitted for plasticity and moisture content testing. The test results are summarised in **Table 6.1**.

Table 6.1 Plasticity & Moisture Content Test Results

Location	Depth (m)	Geological Description	Moisture Content (%)	Plasticity Index (%)	Passing 425µm Sieve (%)	Modified Plasticity Index (%)	Volume Change Potential
SA01	0.50	Brown fine to medium gravelly silty CLAY	18	29	86	24.94	Medium
SA02	1.00	Brown fine to medium gravelly silty sandy CLAY	15	23	85	19.55	Low
SA03	0.40	Brown fine to medium gravelly silty sandy CLAY	15	20	87	17.4	Low
WS01	2.50	Brown fine to medium gravelly silty CLAY	13	16	80	12.8	Low
WS02	0.80	Brown fine to medium gravelly silty sandy CLAY	17	17	88	14.96	Low
WS03	0.50	Brown fine to medium gravelly silty CLAY	21	24	87	20.88	Medium
WS03	2.00	Brown fine to medium gravelly silty sandy CLAY	18	26	89	23.14	Medium
WS05	3.10	Brown fine to medium gravelly silty sandy CLAY	10	14	87	12.18	Low
WS07	1.50	Brown fine to medium gravelly sandy silty CLAY	14	20	85	17	Low
WS08	3.50	Brown fine to medium gravelly sandy silty CLAY	18	30	84	25.2	Medium

In line with the NHBC:2024 (Chapter 4.2), the modified plasticity index for each sample was calculated.

For design purposes the shallow soils on site must be considered to have a medium volume change potential.

The plasticity index (PI), derived from the liquid and plastic limits, indicates the soil's susceptibility to shrink-swell behaviour in response to moisture fluctuations. Given these factors, appropriate foundation design considerations and drainage measures should be implemented to mitigate potential ground movement and associated structural risks.

6.1.2 Concrete Classification Testing

Nine samples were subject to testing for concrete classification in accordance with BRE SD1:2015. The results are summarised in **Table 6.2**

Table 6.2 BRE SD1 Testing Summary

Location	Depth (m)	2:1 Water/Soil Extract		Total Sulphur (%)	pH	Total Potential Sulphate (%)	Acid Soluble Sulphate (%)	Oxidisable Sulphides (%)
		SO_4 (mg/l)	Mg (mg/l)					
SA01	0.9	10.00	230	0.010	7.9	0.03	0.022	0.008
SA02	0.1	10.00	260	0.050	7.3	0.15	0.078	0.072
SA03	0.2	15.00	63	0.080	7.0	0.24	0.030	0.21
WS02	0.5	10.00	170	0.060	8.0	0.18	0.096	0.084
WS03	1.5	10.00	250	0.010	7.7	0.03	0.020	0.01
WS05	0.2	10.00	350	0.010	7.3	0.03	0.039	-0.009
WS06	0.8	10.00	340	0.11	7.6	0.33	0.074	0.256
WS07	0.2	10.00	490	0.060	7.5	0.18	0.048	0.132
WS08	0.1	10.00	390	0.060	6.7	0.18	0.067	0.113

Notes:
The following stoichiometric equation was employed to determine the Total Potential Sulphate (TPS). TPS (% as SO4) = 3.0 x Total Sulphur (TS % as S).
The Oxidisable Sulphide (OS as %SO4) concentration has been conservatively calculated by the following equation. OS = TPS – Acid Soluble Sulphate (AS).

Based on results obtained, the characteristic values are provided below.

Sulphate (2:1 Water Soluble) as SO4: 15.00mg/l
pH: 8.00
Total Potential Sulphate (TPS): 0.33%

The initial classification for the site based on sulphate (2:1 Water Soluble) as SO4 is Design Sulphate (DS) Class DS-1. The Aggressive Chemical Environment for Concrete (ACEC) Class for the site based on sulphate (2:1 Water Soluble) as SO4, mobile water and pH is AC-1s.

As no oxidisable sulphides are recorded above 0.3%, Total Potential Sulphate does not need to be considered further in this assessment.

Based on the above assessment the DS Class for the site is determined as DS-1, and the ACEC Class is AC-1.

The test results can be found in **Annex D**.

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SECTION 7 Engineering Recommendations

7.1 Preparation of Site

Remaining structures, including foundations, and associated areas of hard standing over granular sub-base materials must be stripped and removed from beneath the proposed development area.

Areas of vegetation including all roots must be stripped and removed from beneath the proposed development site.

Allowances should be made for any temporary/permanent support works to any existing adjacent structure necessary as a result of the proposed works.

Contingencies should be made for the protection/diversion of any underground/overhead services present beneath/above the site brought about as a result of the proposed works.

Any reduced levels should be brought up to the required levels with suitable inert mainly granular materials. Department for Transport (DfT) type 2 sub-base or similar should be used and compacted in layers to the requirements of the Specification for Highway Works.

Allowances must also be made for the excavation of any soft spots/areas and their replacement with well compacted imported granular materials.

In accordance with EC Regulation 1272/2008 (Ref) and Environment Agency Guidance WM3 soils and other materials destined for off-site disposal must be classified on the basis of their hazard phrases prior to disposal. Soils are classified as a mirror entry waste and must be classified on the basis of their specific chemical properties. Terra Firma offer this service if required.

7.2 Foundation & Floor Slab Solution

The proposed development will comprise the construction of 13No. houses of masonry/timber construction and a low-rise building containing 12No. residential apartments.

From approximately 1.0m depth, the ground investigation recorded very soft to stiff reddish brown sandy slightly gravelly CLAY. At 2.0m to 3.0m depth, N-values ranged from 2 to 19. Given the variability of ground conditions, a shallow spread foundation is not considered viable due to the potential excessive and damaging settlements.

7.2.1 Recommended Foundation Solution

It is recommended a piled foundation solution is used. The length and capacity of the piles should be informed by rotary percussive boreholes drilled at least 5m into competent bedrock.

Measurements should be put in place to monitor vibrations during pile installation. If vibrations exceed guideline levels, then measures should also be taken to dampen such vibrations. If, however, vibrations exceed permissible values then consideration should be given to an alternative solution.

The estimated working pile loads, pile type and lengths should be confirmed by a specialist piling contractor and it may be prudent to test drive/install piles at selected locations.

Allowances should be made for the removal of any ‘soft spots’ and their replacement with well-compacted granular materials. Department for Transport (DfT) Type 2 materials or similar could be used and should be compacted in layers to the specification for Highway Works.

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All foundation formations should be inspected by a suitably qualified Geotechnical Engineer before being concreted.

7.2.2 Ground Floor Slabs

Current building control regulations require that where infilled ground is present to depths in excess of 600mm or where the sub-stratum is variable in terms of the structure and settlement potential or where clay soils are present within the influence of existing or proposed trees, a suspended floor slab is required.

In this instance it is considered that for the majority of substructures, the underlying stratum would be clay of medium volume change potential, and given the presence of made ground exceeding 600mm thickness the use of a suspended floor slab would be required.

7.3 Excavations & Formations

Most of the shallow excavations will be possible with normal soil excavating machinery.

Allowances for a breaker attachment will be required when dealing with areas of hard standing and buried obstructions / bedrock.

Shallow perched water and groundwater flows were encountered during the investigation. Any water inflows together with rainwater infiltration should be dealt with by conventional pumping techniques. However, it should be noted that during times of heavy rainfall a higher water table will be encountered.

The sides of any excavations deeper than 1.20m, or shallower if unstable, should be supported by planking and strutting or other proprietary means.

The sub-formations/formations are likely to be susceptible to loosening, softening and deterioration by exposure to weather (rain, frost and drying conditions), the action of water (flood water or removal of groundwater) and site traffic.

Formations should never be left unprotected and continuously exposed to rain causing degradation, or left exposed/uncovered overnight, unless permitted by a qualified engineer.

Construction plant and other vehicular traffic should not be operated on unprotected formations.

As a minimum the formation/excavation surfaces must be protected by blinding concrete immediately after exposure.

Allowances should be made for the removal of soft spots/areas and their replacement with well compacted granular materials.

Allowances should also be made for special precautions to prevent formation deterioration in addition to the above.

7.4 Protection of Buried Concrete

When the results are compared with Table C2 of BRE Digest 1:2005, it indicates that buried concrete should generally conform to Design Sulphate Class DS-1, ACEC Class AC-1.

7.5 Storm Water Drainage

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Soakaway tests were carried out in general accordance with BRE DG 365:2016. The soakaway tests were carried out in trial pits SA01-SA04 within natural materials.

The soakaway test recorded insufficient infiltration and were subsequently terminated early. It is considered that given the negligible rates of infiltration and the cohesive soils at the site, traditional soakaway drainage is unsuitable for the site.

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SECTION 8 Recommended Further Work

It is recommended that the following additional investigation is carried out.

1. Rotary percussive drilling with at least 5m coring of competent bedrock and SPTs carried out at regular intervals to inform pile design
2. Additional geotechnical inspection and geoenvironmental testing of soils beneath the footprint of the existing building following its demolition.
3. Additional soil testing across the site to gain a better understanding of the risk to human health from organic compounds, with particular focus on Naphthalene, which was detected above GAC in one of the shallow samples of made ground.
4. Due to the unexpected thickness of made ground at the site, further assessment of the risk from ground gas is recommended. In the first instance this should involve trial pitting to allow a forensic description of the made ground. Samples should be taken at 0.5m intervals and tested for Total Organic Carbon and Dissolved Organic Carbon. An assessment carried out in accordance with CL:AIRE Research Bulletin 17 “A Pragmatic Approach to Ground Gas Risk Assessment” will determine whether gas protection measures are required, or whether a programme of gas monitoring should be carried out.

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in BS8332:2015 (Ref) and BS8601:2013

EC Regulation 1272/2008 and Environment Agency Guidance WM3

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ANNEX A
Trial Pit Logs

terra firma earth matters

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Borehole No.

SA01

Sheet 1 of 1

Project Name	**Project No.**	**Date**	**Hole Type**
Wolfcastle Pub	24-310	05/02/2025 to 05/02/2025	TP
Client	**Co-ords**	**Water Strike Details**	**Logged By**
Cardiff City Council	E:	Depth Strike / Remarks	FL
Contractor / **Plant Used**	N:		**Approved By**
TFW Group Ltd / JCB 3CX	L:		MW
			Scale 1:50

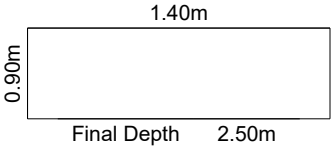
Samples and Results			Depth, (Thickness)	Level	Stratum Description	Legend
Results	Type	Depth				
			(0.15)		TARMAC **(Made Ground)**	
			0.15			
			(0.15)		Loose reddish brown silty sandy fine to coarse angular to subangular GRAVEL of sandstone and mudstone. Occasional medium to fine brick fragments present. **(Made Ground)**	
			0.30		Firm reddish brown slightly sandy slightly gravelly CLAY. Gravels are fine to medium of sandstone (possible reworked natural) **(Made Ground)**	
	ES	0.50				
			(0.70)			
	ES	0.90				
			1.00		Soft reddish brown sandy slightly gravelly CLAY. Gravels are fine to medium of various lithologies. **(Till, Devensian)**	
			(1.50)			
	ES	2.50	2.50		End of Trial Pit at 2.50m	

Remarks

1] Consistency, strength and density indicators are based upon field judgement. 2] Density indicator is in brackets and is for guidance only, and is not in accordance with BS 5930:2015. 3] Trial pit terminated to perform infiltration test. 4] Trial pit backfilled with arisings on completion of test.

Pit Stability: Spalling

Notes: For all symbols and abbreviations please see key sheet. All depths and measurements in metres. Stratum thicknesses given in brackets.



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Borehole No.

SA02

Sheet 1 of 1

Project Name	Project No.	Date	Hole Type
Wolfcastle Pub	24-310	05/02/2025 to 05/02/2025	TP

Client	Co-ords	Water Strike Details		Logged By
Cardiff City Council	E:	Depth Strike	Remarks	FL

Contractor	Plant Used		Approved By
TFW Group Ltd	JCB 3CX	N: L:	MW

Scale 1:50

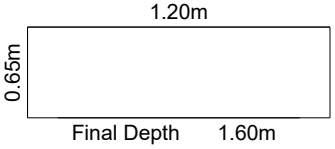
Samples and Results			Depth, (Thickness)	Level	Stratum Description	Legend
Results	Type	Depth				
	ES	0.10			Soft dark brown organic sandy slightly gravelly CLAY. Gravels are fine of various lithologies. Large tree roots and vegetation present in the top 0.6m. **(Made Ground)**	
			(0.50)		*0.20 to 0.30m - Brick wall encounted crossing trench so orientation changed.*	
			0.50		Firm reddish brown slightly sandy slightly gravelly CLAY. Gravels are fine to medium of various lithologies. **(Till, Devensian)**	
			(0.30)			
			0.80		Soft reddish brown sandy slightly gravelly CLAY. Sand is medium to coarse. Gravels are fine to medium of various lithologies. **(Till, Devensian)**	
	D	1.00	1			
	ES	1.00				
			(0.80)			
			1.60		End of Trial Pit at 1.60m	
			2			
			3			
			4			

Remarks

1] Consistency, strength and density indicators are based upon field judgement. 2] Density indicator is in brackets and is for guidance only, and is not in accordance with BS 5930:2015. 3] Trial pit terminated to perform infiltration test. 4] Trial pit backfilled with arisings on completion of test.

Pit Stability: Stable

Notes: For all symbols and abbreviations please see key sheet. All depths and measurements in metres. Stratum thicknesses given in brackets.



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Borehole No.

SA03

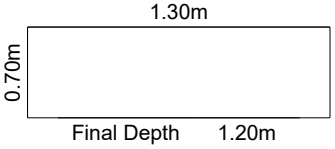
Sheet 1 of 1

Project Name	**Project No.**	**Date**	**Hole Type**
Wolfcastle Pub	24-310	05/02/2025 to 05/02/2025	TP
Client	**Co-ords**	**Water Strike Details**	**Logged By**
Cardiff City Council	E:	Depth Strike / Remarks	FL
Contractor / **Plant Used**	N:		**Approved By**
TFW Group Ltd / JCB 3CX	L:		MW
			Scale 1:50

Samples and Results			Depth, (Thickness)	Level	Stratum Description	Legend
Results	Type	Depth				
	ES	0.20	(0.30)		Soft dark brown organic sandy slightly gravelly CLAY. Gravels are fine of mudstone and sandstone. Vegetation present in the top 0.2m (possible reworked natural) **(Made Ground)**	
	D	0.40	0.30		Soft reddish brown sandy slightly gravelly CLAY. Sand is medium to coarse. Gravels are fine to medium of sandstone (Possible reworked natural) **(Made Ground)**	
			(0.90)			
			1			
	ES	1.20	1.20		End of Trial Pit at 1.20m	
			2			
			3			
			4			

Remarks

1] Consistency, strength and density indicators are based upon field judgement. 2] Density indicator is in brackets and is for guidance only, and is not in accordance with BS 5930:2015. 3] Trial pit terminated to perform infiltration test. 4] Trial pit backfilled with arisings on completion of test.



Pit Stability: Stable

Notes: For all symbols and abbreviations please see key sheet. All depths and measurements in metres. Stratum thicknesses given in brackets.

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Borehole No.

SA04

Sheet 1 of 1

Project Name	Project No.	Date	Hole Type
Wolfcastle Pub	24-310	06/02/2025 to 06/02/2025	TP

Client	Co-ords	Water Strike Details		Logged By
Cardiff City Council	E:	Depth Strike	Remarks	FL

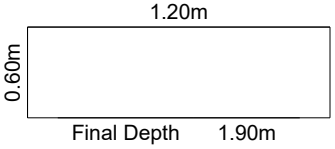
Contractor	Plant Used			Approved By
TFW Group Ltd	JCB 3CX	N:		MW
		L:		Scale 1:50

Samples and Results			Depth, (Thickness)	Level	Stratum Description	Legend
Results	Type	Depth				
	ES	0.20			Soft dark brown organic sandy slightly gravelly CLAY. Gravels are fine of sub angular sandstone. Vegetation present in the top 0.2m. **(Till, Devensian)**	
			(0.80)			
			0.80		Firm reddish brown slightly sandy slightly gravelly CLAY. Gravels are fine to medium of various lithologies. **(Till, Devensian)**	
			1 (0.40)			
	ES	1.20	1.20		Soft reddish brown sandy slightly gravelly CLAY. Gravels are fine to medium of various lithologies. **(Till, Devensian)**	
			(0.70)			
			1.90		End of Trial Pit at 1.90m	
			2			
			3			
			4			

Remarks

1] Consistency, strength and density indicators are based upon field judgement. 2] Density indicator is in brackets and is for guidance only, and is not in accordance with BS 5930:2015. 3] Trial pit terminated to perform infiltration test. 4] Trial pit backfilled with arisings on completion of test.

Pit Stability: Stable



Notes: For all symbols and abbreviations please see key sheet. All depths and measurements in metres. Stratum thicknesses given in brackets.

ANNEX B
Soakaway Test Results

SOAKAWAY TEST

terra firma
Geotechnical & Geoenvironmental Specialists

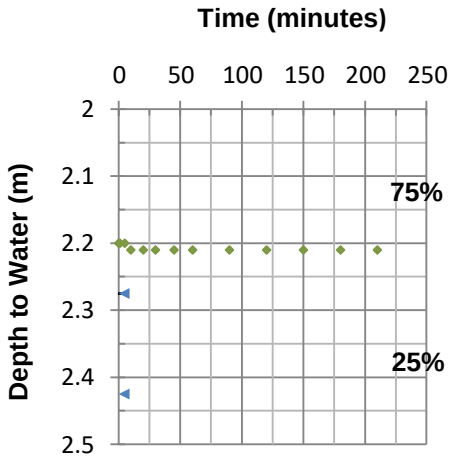
Site Name: Wolfs Castle Pub
Project Number: TF-24-310-CA
Date:
Engineer: Florence Linklater

TEST - SA01

Length	1.40	m
Width	0.90	m
Depth	2.50	m
Fill Level	2.20	m

V_{p75-25}	0.189	m^3
a_{p50}	1.95	m^2
t_{p75-25}	0	minutes

Soil Infiltration Rate, f **#DIV/0!** **ms^{-1}**

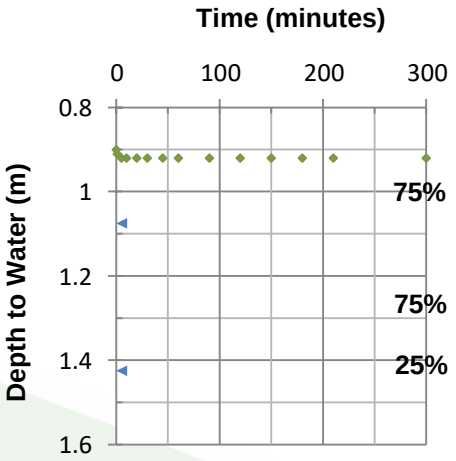


TEST 2 - SA02

Length	1.20	m
Width	0.65	m
Depth	1.60	m
Fill Level	0.90	m

V_{p75-25}	0.273	m^3
a_{p50}	2.075	m^2
t_{p75-25}	0	minutes

Soil Infiltration Rate, f **#DIV/0!** **ms^{-1}**



REMARKS:
Test carried out in accordance with BRE Digest 365 (2016)

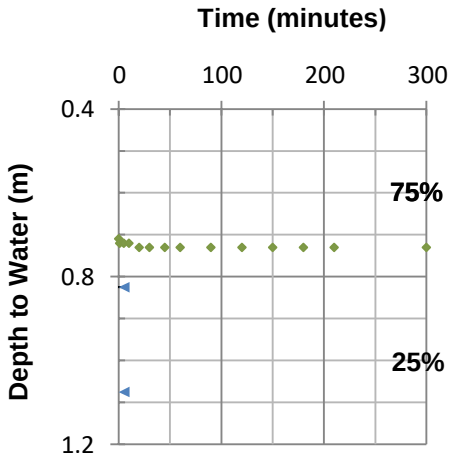
SOAKAWAY TEST

terra firma
Geotechnical & Geoenvironmental Specialists

Site Name: Wolfs Castle Pub
Project Number: TF-24-310-CA
Date:
Engineer: Florence Linklater

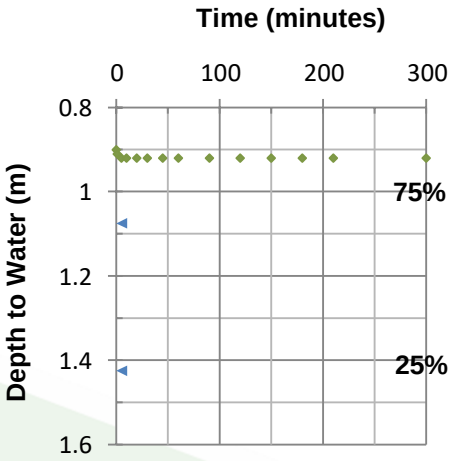
TEST - SA03

Length	1.30	m
Width	0.70	m
Depth	1.20	m
Fill Level	0.70	m
V_{p75-25}	0.2275	m^3
a_{p50}	1.91	m^2
t_{p75-25}	0	minutes
Soil Infiltration Rate, f	**#DIV/0!**	**ms^{-1}**



TEST 2 - SA04

Length	1.20	m
Width	0.60	m
Depth	1.60	m
Fill Level	0.90	m
V_{p75-25}	0.252	m^3
a_{p50}	1.98	m^2
t_{p75-25}	0	minutes
Soil Infiltration Rate, f	**#DIV/0!**	**ms^{-1}**



REMARKS:
Test carried out in accordance with BRE Digest 365 (2016)

ANNEX C
Windowless Sample Borehole Logs

terra firma earth matters

Consulting Geotechnical, Geo-Environmental Engineers & Site Investigation Contractors

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Portsmouth Office: Technopole, Kingston Crescent, North End, Portsmouth, PO2 8FA

Borehole No. **WS01** Sheet 1 of 1

Project Name	Project No.	Date	Hole Type
Wolfcastle Pub	24-310	06/02/2025 to 06/02/2025	WS

Client	Co-ords	Water Strike Details			Logged By
		Depth Strike	After 20 mins	Remarks	SW
Cardiff City Council	E:				
Contractor / **Plant Used**	N:				Approved By: MW
TFW Group Ltd / Dando Terrier 2002	L:				Scale 1:50

Samples and Results			Depth, (Thickness)	Level	Stratum Description	Legend	Well
Results	Type	Depth					
			(0.05)		TARMAC **(Made Ground)**		
			0.05		Black ashy sandy GRAVEL. Gravel is fine to coarse sub angular to angular of ash concrete and tarmac. **(Made Ground)**		
			(0.13)				
			0.18		Soft reddish brown gravelly slightly sandy CLAY. Gravel is fine to coarse sub angular to angular of brick fragments and sandstone. **(Made Ground)**		
			(0.19)				
			0.37		Black ashy GRAVEL. Gravel is fine to coarse sub angular to angular of brick fragments, sandstone and concrete. **(Made Ground)**		
			(0.17)				
			0.54		Soft reddish brown slightly sandy slightly gravelly CLAY. Gravel is fine to coarse sub angular to angular of brick fragments and sandstone. **(Made Ground)**		
			(0.46)				
N=7 (1,1/1,2,2,2)	SPT(C)	1.00	1 1.00		Soft reddish brown slightly sandy slightly gravelly CLAY. Gravel is fine to coarse sub angular to angular of sandstone, brick fragments, concrete and ash. **(Made Ground)**		
			(1.60)				
N=10 (1,1/2,2,3,3)	ES	2.00	2		*2.00 to 2.45m - Becoming firm from 2.0m*		
	SPT(C)	2.00					
	D	2.50					
			2.60		Firm reddish brown slightly sandy slightly gravelly CLAY. Gravel is fine to coarse sub angular to angular of sandstone. **(Till, Devensian)**		
			(0.40)				
N=5 (1,0/1,2,1,1)	SPT(C)	3.00	3 3.00		Soft reddish brown silty slightly sandy CLAY. Occasional gravel of sandstone. **(Till, Devensian)**		
N=10 (2,1/2,3,2,3)	SPT(C)	4.00	4 (2.00)		*4.00 to 5.00m - Becoming firm from 4.0m.*		
N=12 (1,2/2,2,4,4)	SPT(C)	5.00	5 5.00		End of Borehole at 5.00m		
			6				

Remarks

1] Borehole terminated at 5.0m depth. 2] On completion borehole backfilled with arisings. 3] No groundwater recorded.

Borehole Diameter	
Base Depth	Diameter

Notes: For all symbols and abbreviations please see key sheet. All depths and measurements in metres. Stratum thicknesses given in brackets.

terra firma earth matters

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Borehole No. **WS02** Sheet 1 of 1

Project Name	Project No.	Date	Hole Type
Wolfcastle Pub	24-310	06/02/2025 to 06/02/2025	WS

Client	Co-ords	Water Strike Details			Logged By
		Depth Strike	After 20 mins	Remarks	SW
Cardiff City Council	E:				
Contractor	**Plant Used**	N:			**Approved By** MW
TFW Group Ltd	Dando Terrier 2002	L:			Scale 1:50

Samples and Results			Depth, (Thickness)	Level	Stratum Description	Legend	Well
Results	Type	Depth					
			(0.05)		TARMAC **(Made Ground)**		
			0.05		Dark brown mottled black sandy GRAVEL. Gravel is fine to coarse sub angular to angular of ash, concrete and tarmac. **(Made Ground)**		
			(0.20)				
			0.25		Light grey GRAVEL of sub angular to angular fine to coarse concrete. **(Made Ground)**		
			(0.26)				
	ES	0.50	0.51		Soft brownish red sandy slightly gravelly CLAY. Gravel is fine to coarse sub angular to angular of sandstone, brick fragments and concrete. **(Made Ground)**		
	D	0.80	(0.49)				
N=3 (1,0/0,1,0,2)	SPT(C)	1.00	1.00		Very soft reddish brown slightly sandy slightly gravelly CLAY. Gravel is fine to coarse sub angular to angular of sandstone. **(Till, Devensian)**		
			(0.47)				
			1.47		Firm reddish brown slightly sandy slightly gravelly CLAY. Gravel is fine to coarse sub angular to angular of sandstone. **(Till, Devensian)**		
N=14 (1,2/3,3,4,4)	SPT(C)	2.00					
	ES	2.50					
N=11 (1,4/3,3,3,2)	SPT(C)	3.00					
			(3.53)				
N=12 (3,3/3,3,3,3)	SPT(C)	4.00					
N=22 (3,4/4,5,6,7)	SPT(C)	5.00	5.00		End of Borehole at 5.00m		

Remarks

1] Borehole terminated at 5.0m depth. 2] On completion borehole backfilled with arisings. 3] No groundwater recorded.

Borehole Diameter

Base Depth	Diameter

Notes: For all symbols and abbreviations please see key sheet. All depths and measurements in metres. Stratum thicknesses given in brackets.

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Borehole No. **WS03**

Sheet 1 of 1

Project Name	Project No.	Date	Hole Type
Wolfcastle Pub	24-310	06/02/2025 to 06/02/2025	WS

Client	Co-ords	Water Strike Details			Logged By
		Depth Strike	After 20 mins	Remarks	SW
Cardiff City Council	E:				
Contractor	**Plant Used**	N:			**Approved By** MW
TFW Group Ltd	Dando Terrier 2002	L:			Scale 1:50

Samples and Results			Depth, (Thickness)	Level	Stratum Description	Legend	Well
Results	Type	Depth					
			(0.05) 0.05		TARMAC **(Made Ground)**		
			(0.20) 0.25		Dark brown mottled black sandy GRAVEL. Gravel is fine to coarse sub angular to angular of ash, concrete and tarmac. **(Made Ground)**		
			(0.30)		Light grey GRAVEL of sub angular to angular fine to coarse concrete. **(Made Ground)**		
	D	0.50	0.55				
			(0.08) 0.63		Soft reddish brown slightly sandy slightly gravelly CLAY. Gravel is fine to coarse sub angular to angular of brick fragments, concrete and sandstone. Occasional concrete cobble. **(Made Ground)**		
N=9 (1,1/2,2,3,2)	SPT(C)	1.00	1 (0.68)		Soft to firm reddish brown slightly sandy slightly gravelly CLAY. Gravel is fine to coarse sub angular to angular of sandstone and concrete. **(Made Ground)**		
			1.31				
	ES	1.50			Firm reddish brown slightly sandy slightly gravelly CLAY. Gravel is fine to coarse sub angular to angular of sandstone and concrete. **(Made Ground)**		
			(0.69)				
N=13 (1,4/4,3,3,3)	D	2.00	2 2.00				
	SPT(C)	2.00			Firm reddish brown slightly sandy slightly gravelly CLAY. Gravel is fine to coarse sub angular to angular of sandstone. **(Till, Devensian)**		
N=10 (1,2/2,2,3,3)	ES	3.00	3				
	SPT(C)	3.00					
			(3.00)				
N=13 (2,1/2,3,3,5)	SPT(C)	4.00	4				
N=35 (6,6/8,8,9,10)	SPT(C)	5.00	5 5.00				
					End of Borehole at 5.00m		
			6				

Remarks

1] Borehole terminated at 5.0m depth. 2] On completion borehole backfilled with arisings. 3] No groundwater recorded.

Borehole Diameter

Base Depth	Diameter

Notes: For all symbols and abbreviations please see key sheet. All depths and measurements in metres. Stratum thicknesses given in brackets.

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Borehole No.

WS04

Sheet 1 of 1

Project Name	Project No.	Date	Hole Type
Wolfcastle Pub	24-310	06/02/2025 to 06/02/2025	WS

Client	Co-ords	Water Strike Details			Logged By
		Depth Strike	After 20 mins	Remarks	
Cardiff City Council	E:				SW
Contractor	**Plant Used**	N:			**Approved By**
TFW Group Ltd	Dando Terrier 2002	L:			MW
					Scale 1:50

Samples and Results			Depth, (Thickness)	Level	Stratum Description	Legend	Well
Results	Type	Depth					
			(0.17)		Soft dark brown organic slightly sandy CLAY with abundant rootlets. **(Made Ground)**		
			0.17				
	ES	0.30	(0.39)		Black slightly sandy GRAVEL. Gravel is fine to coarse sub angular to angular of ash, concrete and clinker. **(Made Ground)**		
			0.56				
					Very soft dark brown slightly sandy slightly gravelly CLAY. Gravel is fine to coarse sub angular to angular of brick fragments, concrete and sandstone. **(Made Ground)**		
			(0.74)				
N=1 (0,0/0,0,1,0)	ES	1.00	1				
	SPT(C)	1.00					
			1.30				
					Very loose orange GRAVEL of brick. **(Made Ground)**		
			(0.30)				
			1.60				
					Soft dark brownish red gravelly slightly sandy CLAY. Gravel is fine to coarse sub angular to angular of brick fragments, concrete and sandstone. **(Made Ground)**		
			(0.50)				
N=8 (1,1/2,2,2,2)	SPT(C)	2.00	2				
			2.10				
					Soft to firm reddish brown gravelly slighlty sandy CLAY. Gravel is fine to coarse sub angular to angular of brick fragments, concrete and sandstone. **(Made Ground)**		
			(1.40)				
N=15 (3,4/3,4,4,4)	SPT(C)	3.00	3		*3.00 to 3.45m - Becoming firm to stiff from 3.0m*		
			3.50				
					Soft to firm reddish brown gravelly slighlty sandy CLAY. Gravel is fine to coarse sub angular to angular of sandstone. **(Till, Devensian)**		
N=5 (3,2/2,1,1,1)	SPT(C)	4.00	4		*4.00 to 4.45m - Becoming soft from 4.0m.*		
			(1.50)				
N=9 (2,3/2,2,2,3)	SPT(C)	5.00	5	5.00	End of Borehole at 5.00m		
			6				

Remarks

1] Borehole terminated at 5.0m depth. 2] On completion borehole backfilled with arisings. 3] No groundwater recorded.

Borehole Diameter

Base Depth	Diameter

Notes: For all symbols and abbreviations please see key sheet. All depths and measurements in metres. Stratum thicknesses given in brackets.

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Borehole No.

WS05

Sheet 1 of 1

Project Name	Project No.	Date	Hole Type
Wolfcastle Pub	24-310	06/02/2025 to 06/02/2025	WS

Client	Co-ords	Water Strike Details			Logged By
		Depth Strike	After 20 mins	Remarks	SW
Cardiff City Council	E:	4.00	2.70	1	Approved By
	N:				MW
	L:				Scale 1:50

Contractor	Plant Used
TFW Group Ltd	Dando Terrier 2002

Samples and Results			Depth, (Thickness)	Level	Stratum Description	Legend	Well
Results	Type	Depth					
			(0.15)		Soft dark brown organic slightly sandy CLAY with abundant rootlets. **(Made Ground)**		
	ES	0.20	0.15		Soft reddish brown gravelly slighlty sandy CLAY. Gravel is fine to coarse sub angular to angular of sandstone ash and brick fragments. **(Made Ground)**		
			(0.39)				
			0.54		Firm reddish brown sandy slightly gravelly CLAY. Gravel is fine to coarse sub angular to angular of sandstone. **(Till, Devensian)**		
			(0.46)				
N=11 (1,2/2,2,3,4)	SPT(C)	1.00	1 1.00		Firm brownish red sandy gravelly CLAY. Gravel is fine to coarse sub angular to angular of sandstone. **(Till, Devensian)**		
N=4 (1,1/1,1,1,1)	SPT(C)	2.00	2 (1.97)		*2.00 to 2.45m - Becoming very soft to soft from 2.0m.*		
	ES	2.10					
N=13 (3,3/3,2,3,5)	SPT(C)	3.00	3 2.97		Firm brownish red sandy gravelly CLAY. Gravel is fine to coarse sub angular to angular of sandstone. **(Till, Devensian)**		
	D	3.10					
N=7 (2,2/2,2,1,2)	SPT(C)	4.00	4 (2.03)		*4.00 to 4.45m - Becoming soft from 4.0m.*		
N=10 (2,2/3,3,2,2)	SPT(C)	5.00	5 5.00		End of Borehole at 5.00m		
			6				

Remarks

1] Borehole terminated at 5.0m depth. 2] On completion borehole backfilled with arisings. 3] Groundwater inflow recorded at 4.0m.

Borehole Diameter	
Base Depth	Diameter

Notes: For all symbols and abbreviations please see key sheet. All depths and measurements in metres. Stratum thicknesses given in brackets.

terra firma earth matters

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Borehole No.

WS06

Sheet 1 of 1

Project Name	Project No.	Date	Hole Type
Wolfcastle Pub	24-310	07/02/2025 to 07/02/2025	WS

Client	Co-ords	Water Strike Details			Logged By
		Depth Strike	After 20 mins	Remarks	SW
Cardiff City Council	E:				
Contractor	**Plant Used**	N:			Approved By
TFW Group Ltd	Dando Terrier 2002	L:			MW
					Scale 1:50

Samples and Results			Depth, (Thickness)	Level	Stratum Description	Legend	Well
Results	Type	Depth					
			(0.15) 0.15		Soft dark brown mottled black organic slightly sandy CLAY with abundant rootlets. **(Made Ground)**		
			(0.17) 0.32		Soft reddish brown gravelly slightly sandy CLAY. Gravel is fine to coarse sub angular to angular of sandstone with occasional brick fragments. **(Made Ground)**		
					Very soft reddish brown gravelly slightly sandy CLAY. Gravel is fine to coarse sub angular to angular of sandstone ash and brick fragments. **(Made Ground)**		
	ES	0.80					
N=2 (0,0/0,0,1,1)	SPT(C)	1.00	1 (1.68)				
N=3 (0,1/0,1,1,1)	SPT(C)	2.00	2 2.00		Very soft reddish brown sandy slightly sandy CLAY. Gravel is fine to coarse sub angular to angular of sandstone. **(Till, Devensian)**		
N=14 (1,2/3,3,4,4)	SPT(C)	3.00	3 (3.00)		*3.00 to 3.45m - Becoming firm from 3.0m to 3.45m.*		
N=12 (2,3/3,2,3,4)	SPT(C)	4.00	4				
N=13 (2,2/3,3,3,4)	SPT(C)	5.00	5 5.00		End of Borehole at 5.00m		
			6				

Remarks

1] Borehole terminated at 5.0m depth. 2] On completion borehole backfilled with arisings. 3] No groundwater recorded.

Borehole Diameter

Base Depth	Diameter

Notes: For all symbols and abbreviations please see key sheet. All depths and measurements in metres. Stratum thicknesses given in brackets.

terra firma earth matters

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Borehole No. **WS07** Sheet 1 of 1

Project Name	Project No.	Date	Hole Type
Wolfcastle Pub	24-310	07/02/2025 to 07/02/2025	WS

Client	Co-ords	Water Strike Details			Logged By
		Depth Strike	After 20 mins	Remarks	SW
Cardiff City Council	E:				
Contractor	**Plant Used**	N:			**Approved By** MW
TFW Group Ltd	Dando Terrier 2002	L:			Scale 1:50

Samples and Results			Depth, (Thickness)	Level	Stratum Description	Legend	Well
Results	Type	Depth					
			(0.15)		Soft dark brown mottled black organic slightly sandy CLAY with abundant rootlets. **(Made Ground)**		
	ES	0.20	0.15 (0.11) 0.26		Black slightly sandy GRAVEL. Gravel is fine to coarse sub angular to angular of ash, concrete and clinker. **(Made Ground)**		
			(0.74)		Soft reddish brown gravelly slightly sandy CLAY. Gravel is fine to coarse sub angular to angular of sandstone with occasional brick fragments. **(Made Ground)**		
N=4 (0,0/1,0,1,2)	ES	1.00	1 1.00		Very soft to soft reddish brown sandy slightly gravelly CLAY. Gravel is fine to coarse sub angular to angular of sandstone **(Till, Devensian)**		
	SPT(C)	1.00					
	D	1.50					
N=6 (1,0/1,1,2,2)	SPT(C)	2.00	2		*2.00 to 2.45m - Becoming soft from 2.0m*		
N=19 (3,2/2,3,6,8)	SPT(C)	3.00	3 (4.00)		*3.00 to 3.45m - Becoming stiff from 3.0m.*		
N=17 (2,3/3,4,4,6)	SPT(C)	4.00	4				
N=21 (4,5/5,6,5,5)	SPT(C)	5.00	5 5.00		End of Borehole at 5.00m		
			6				

Remarks

1] Borehole terminated at 5.0m depth. 2] On completion borehole backfilled with arisings. 3] No groundwater recorded.

Borehole Diameter	
Base Depth	Diameter

Notes: For all symbols and abbreviations please see key sheet. All depths and measurements in metres. Stratum thicknesses given in brackets.

terra firma earth matters

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Borehole No.

WS08

Sheet 1 of 1

Project Name	Project No.	Date	Hole Type
Wolfcastle Pub	24-310	07/02/2025 to 07/02/2025	WS

Client	Co-ords	Water Strike Details			Logged By
		Depth Strike	After 20 mins	Remarks	SW
Cardiff City Council	E:				
Contractor	**Plant Used**	N:			Approved By
TFW Group Ltd	Dando Terrier 2002	L:			MW
					Scale 1:50

Samples and Results			Depth, (Thickness)	Level	Stratum Description	Legend	Well
Results	Type	Depth					
	ES	0.10	(0.15) 0.15		Soft blackish brown organic slightly sandy CLAY with abundant rootlets. **(Made Ground)**		
			(0.35) 0.50		Soft reddish brown gravelly slightly sandy CLAY. Gravel is fine to coarse sub angular to angular of ash concrete and tarmac. **(Made Ground)**		
N=7 (0,1/2,2,2,1)	SPT(C)	1.00	1		Soft reddish brown sandy slightly gravelly CLAY. Gravel is fine to coarse sub angular to angular of sandstone. **(Till, Devensian)**		
	ES	1.80	(2.62)				
N=2 (0,0/1,0,0,1)	SPT(C)	2.00	2		*2.00 to 2.45m - Becoming very soft from 2.0m.*		
N=7 (1,0/0,2,2,3)	SPT(C)	3.00	3		*3.00 to 3.45m - Becoming soft from 3.0m.*		
			3.12		Stiff reddish brown sandy slightly gravelly CLAY. Gravel is fine to coarse sub angular to angular of sandstone. **(Till, Devensian)**		
	D	3.50					
N=17 (2,2/3,4,5,5)	SPT(C)	4.00	4 (1.88)		*4.00 to 4.45m - Becoming stiff from 4.0m.*		
N=22 (6,5/5,6,6,5)	SPT(C)	5.00	5 5.00		End of Borehole at 5.00m		
			6				

Remarks

1] Borehole terminated at 5.0m depth. 2] On completion borehole backfilled with arisings. 3] No groundwater recorded.

Borehole Diameter

Base Depth	Diameter

Notes: For all symbols and abbreviations please see key sheet. All depths and measurements in metres. Stratum thicknesses given in brackets.

ANNEX D
Laboratory Soil Chemical Test Results

Eurofins Chemtest Ltd
Depot Road
Newmarket
CB8 0AL
Tel: 01638 606070
Email: info@chemtest.com

Final Report

Report No.:	25-04683-1
Initial Date of Issue:	05-Mar-2025
Re-Issue Details:	
Client	Terra Firma
Client Address:	5 Deryn Court Wharfedale Road Pentwyn Cardiff CF23 7HA
Contact(s):	s.williams@tfwgroup.co.uk
Project	Wolfcastle

Quotation No.:		**Date Received:**	11-Feb-2025
Order No.:	310	**Date Instructed:**	11-Feb-2025
No. of Samples:	20		
Turnaround (Wkdays):	10	**Results Due:**	24-Feb-2025
Date Approved:	05-Mar-2025		

Approved By:

Details: David Smith, Technical Director

For details about application of accreditation to specific matrix types, please refer to the Table at the back of this report

Results - Soil

Project: Wolfcastle

Client: Terra Firma				**Chemtest Job No.:**		25-04683	25-04683	25-04683	25-04683	25-04683	25-04683	25-04683
Quotation No.:				**Chemtest Sample ID.:**		1930722	1930723	1930724	1930725	1930726	1930727	1930728
Order No.: 310				Client Sample Ref.:		1	1	1	1	1	1	1
				Client Sample ID.:		SA03	SA02	SA02	SA01	SA03	SA01	WS08
				Sample Location:		SA03	SA02	SA02	SA01	SA03	SA01	WS08
				Sample Type:		SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
				Top Depth (m):		1.2	1.0	0.1	2.5	0.2	0.9	0.1
				Date Sampled:		06-Feb-2025	06-Feb-2025	06-Feb-2025	06-Feb-2025	06-Feb-2025	06-Feb-2025	06-Feb-2025
				Time Sampled:		12:00	12:00	12:00	12:00	12:00	12:00	12:00
				Asbestos Lab:		DURHAM	DURHAM	DURHAM	DURHAM	DURHAM	DURHAM	DURHAM
Determinand	**HWOL Code**	**Accred.**	**SOP**	**Units**	**LOD**							
ACM Type		N	2192		N/A	-	-	-	-	-	-	-
Asbestos Identification		U	2192		N/A	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected
ACM Detection Stage		U	2192		N/A	-	-	-	-	-	-	-
Moisture		N	2030	%	0.020	14	13	23	11	28	14	35
Soil Colour		N	2040		N/A	Brown	Brown	Brown	Brown	Brown	Brown	Brown
Other Material		N	2040		N/A	Stones and	Stones and	Stones, Roots and	Stones and	Stones, Roots and	Stones and	Stones, Roots and
Soil Texture		N	2040		N/A	Clay	Clay	Clay	Clay	Clay	Clay	Clay
Total Potential Sulphate as SO4		N	2175	%	0.030			0.15		0.24	0.030	0.18
pH at 20C		M	2010		4.0	7.1	7.6	7.3	8.1	7.0	7.9	6.7
Boron (Hot Water Soluble)		M	2120	mg/kg	0.40	0.60	< 0.40	0.65	< 0.40	0.87	0.50	< 0.40
Sulphate (2:1 Water Soluble) as SO4		M	2120	g/l	0.010			< 0.010		0.015	< 0.010	< 0.010
Total Sulphur		U	2175	%	0.010			0.050		0.080	0.010	0.060
Cyanide (Total)		M	2300	mg/kg	0.50	0.90	< 0.50	0.80	< 0.50	0.70	< 0.50	1.8
Magnesium (Extractable)		N	2400	mg/l	2.0			260		63	230	390
Sulphate (Acid Soluble)		U	2430	%	0.010	0.034	0.012	0.078	0.026	0.030	0.022	0.067
Arsenic		M	2455	mg/kg	0.5	27	8.7	8.2	6.5	12	14	9.6
Cadmium		M	2455	mg/kg	0.10	0.99	0.77	0.41	0.73	0.36	1.9	0.33
Chromium		M	2455	mg/kg	0.5	41	25	15	25	13	36	12
Mercury Low Level		N	2450	mg/kg	0.05	0.21	0.07	0.27	< 0.05	0.11	0.09	0.08
Copper		M	2455	mg/kg	0.50	35	13	18	11	16	17	13
Nickel		M	2455	mg/kg	0.50	43	31	14	35	12	47	10
Lead		M	2455	mg/kg	0.50	250	64	160	43	140	99	70
Selenium		M	2455	mg/kg	0.25	1.1	0.55	0.38	0.57	0.34	0.76	0.37
Zinc		M	2455	mg/kg	0.50	230	99	91	87	110	180	97
Chromium (Trivalent)		N	2490	mg/kg	1.0	41	25	15	25	13	36	12
Chromium (Hexavalent)		N	2490	mg/kg	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Aliphatic VPH >C5-C6	HS_2D_AL	U	2780	mg/kg	0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Aliphatic VPH >C6-C7	HS_2D_AL	U	2780	mg/kg	0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Aliphatic VPH >C7-C8	HS_2D_AL	U	2780	mg/kg	0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Aliphatic VPH >C6-C8 (Sum)	HS_2D_AL	N	2780	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Aliphatic VPH >C8-C10	HS_2D_AL	U	2780	mg/kg	0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Total Aliphatic VPH >C5-C10	HS_2D_AL	U	2780	mg/kg	0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
Aliphatic EPH >C10-C12 MC	EH_2D_AL_#1	M	2690	mg/kg	2.00	< 2.0	3.7	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Aliphatic EPH >C12-C16 MC	EH_2D_AL_#1	M	2690	mg/kg	1.00	< 1.0	6.7	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0

Results - Soil

Project: Wolfcastle

Client: Terra Firma				**Chemtest Job No.:**		25-04683	25-04683	25-04683	25-04683	25-04683	25-04683	25-04683
Quotation No.:				**Chemtest Sample ID.:**		1930722	1930723	1930724	1930725	1930726	1930727	1930728
Order No.: 310				Client Sample Ref.:		1	1	1	1	1	1	1
				Client Sample ID.:		SA03	SA02	SA02	SA01	SA03	SA01	WS08
				Sample Location:		SA03	SA02	SA02	SA01	SA03	SA01	WS08
				Sample Type:		SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
				Top Depth (m):		1.2	1.0	0.1	2.5	0.2	0.9	0.1
				Date Sampled:		06-Feb-2025	06-Feb-2025	06-Feb-2025	06-Feb-2025	06-Feb-2025	06-Feb-2025	06-Feb-2025
				Time Sampled:		12:00	12:00	12:00	12:00	12:00	12:00	12:00
				Asbestos Lab:		DURHAM	DURHAM	DURHAM	DURHAM	DURHAM	DURHAM	DURHAM
Determinand	**HWOL Code**	**Accred.**	**SOP**	**Units**	**LOD**							
Aliphatic EPH >C16-C21 MC	EH_2D_AL_#1	M	2690	mg/kg	2.00	< 2.0	4.7	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Aliphatic EPH >C21-C35 MC	EH_2D_AL_#1	M	2690	mg/kg	3.00	< 3.0	9.5	4.5	< 3.0	5.8	< 3.0	8.4
Aliphatic EPH >C35-C40 MC	EH_2D_AL_#1	N	2690	mg/kg	10.00	< 10	< 10	< 10	< 10	< 10	< 10	< 10
Total Aliphatic EPH >C10-C35 MC	EH_2D_AL_#1	M	2690	mg/kg	5.00	< 5.0	25	< 5.0	< 5.0	5.8	< 5.0	8.6
Total Aliphatic EPH >C10-C40 MC	EH_2D_AL_#1	N	2690	mg/kg	10.00	< 10	25	< 10	< 10	< 10	< 10	< 10
Aromatic VPH >C5-C7	HS_2D_AR	U	2780	mg/kg	0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Aromatic VPH >C7-C8	HS_2D_AR	U	2780	mg/kg	0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Aromatic VPH >C8-C10	HS_2D_AR	U	2780	mg/kg	0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Total Aromatic VPH >C5-C10	HS_2D_AR	U	2780	mg/kg	0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
Aromatic EPH >C10-C12 MC	EH_2D_AR_#1	U	2690	mg/kg	1.00	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic EPH >C12-C16 MC	EH_2D_AR_#1	U	2690	mg/kg	1.00	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic EPH >C16-C21 MC	EH_2D_AR_#1	U	2690	mg/kg	2.00	4.7	2.6	3.0	2.5	3.6	2.5	3.6
Aromatic EPH >C21-C35 MC	EH_2D_AR_#1	U	2690	mg/kg	2.00	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	3.8
Aromatic EPH >C35-C40 MC	EH_2D_AR_#1	N	2690	mg/kg	1.00	3.7	5.4	2.8	2.3	2.2	1.7	1.7
Total Aromatic EPH >C10-C35 MC	EH_2D_AR_#1	U	2690	mg/kg	5.00	< 5.0	< 5.0	< 5.0	< 5.0	5.3	< 5.0	7.4
Total Aromatic EPH >C10-C40 MC	EH_2D_AR_#1	N	2690	mg/kg	10.00	< 10	< 10	< 10	< 10	< 10	< 10	< 10
Total VPH >C5-C10	HS_2D_Total	U	2780	mg/kg	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Total EPH >C10-C35 MC	EH_2D_Total_#1	U	2690	mg/kg	10.00	< 10	29	< 10	< 10	11	< 10	16
Total EPH >C10-C40 MC	EH_2D_Total_#1	N	2690	mg/kg	10.00	< 10	35	< 10	< 10	13	< 10	18
Naphthalene		M	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Acenaphthylene		M	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Acenaphthene		M	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Fluorene		M	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Phenanthrene		M	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	0.34	0.31	0.45
Anthracene		M	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	0.20	0.10
Fluoranthene		M	2700	mg/kg	0.10	< 0.10	< 0.10	0.29	0.48	0.66	7.9	0.87
Pyrene		M	2700	mg/kg	0.10	< 0.10	< 0.10	0.48	0.62	0.69	12	0.81
Benzo[a]anthracene		M	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	0.32	1.6	0.49
Chrysene		M	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	0.84	2.5	1.0
Benzo[b]fluoranthene		M	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	0.77	2.8	1.0
Benzo[k]fluoranthene		M	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	0.60	1.1	0.79
Benzo[a]pyrene		M	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	0.47	1.2	0.73
Indeno(1,2,3-c,d)Pyrene		M	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	0.32	1.0	0.55
Dibenz(a,h)Anthracene		M	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	0.11	0.24	< 0.10
Benzo[g,h,i]perylene		M	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	1.4	1.2	1.4
Total Of 16 PAH's		M	2700	mg/kg	2.0	< 2.0	< 2.0	< 2.0	< 2.0	6.5	32	8.2

Results - Soil

Project: Wolfcastle

Client: Terra Firma			**Chemtest Job No.:**			25-04683	25-04683	25-04683	25-04683	25-04683	25-04683	25-04683
Quotation No.:			**Chemtest Sample ID.:**			1930722	1930723	1930724	1930725	1930726	1930727	1930728
Order No.: 310					Client Sample Ref.:	1	1	1	1	1	1	1
					Client Sample ID.:	SA03	SA02	SA02	SA01	SA03	SA01	WS08
					Sample Location:	SA03	SA02	SA02	SA01	SA03	SA01	WS08
					Sample Type:	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
					Top Depth (m):	1.2	1.0	0.1	2.5	0.2	0.9	0.1
					Date Sampled:	06-Feb-2025	06-Feb-2025	06-Feb-2025	06-Feb-2025	06-Feb-2025	06-Feb-2025	06-Feb-2025
					Time Sampled:	12:00	12:00	12:00	12:00	12:00	12:00	12:00
					Asbestos Lab:	DURHAM	DURHAM	DURHAM	DURHAM	DURHAM	DURHAM	DURHAM
Determinand	**HWOL Code**	**Accred.**	**SOP**	**Units**	**LOD**							
Total Phenols		M	2920	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	0.13	< 0.10	0.12
Organic Matter BS1377		N	2930	%	0.10	3.7	0.80	3.4	1.3	6.9	0.70	6.5

Results - Soil

Project: Wolfcastle

Client: Terra Firma				**Chemtest Job No.:**		25-04683	25-04683	25-04683	25-04683	25-04683	25-04683	25-04683
Quotation No.:				**Chemtest Sample ID.:**		1930729	1930730	1930731	1930732	1930733	1930734	1930735
Order No.: 310				Client Sample Ref.:		1	1	1	1	1	1	1
				Client Sample ID.:		WS05	WS07	WS06	WS04	WS07	WS08	WS05
				Sample Location:		WS05	WS07	WS06	WS04	WS07	WS08	WS05
				Sample Type:		SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
				Top Depth (m):		2.1	0.2	0.8	1.0	1.0	1.80	0.2
				Date Sampled:		06-Feb-2025	06-Feb-2025	06-Feb-2025	06-Feb-2025	06-Feb-2025	06-Feb-2025	06-Feb-2025
				Time Sampled:		12:00	12:00	12:00	12:00	12:00	12:00	12:00
				Asbestos Lab:		DURHAM	DURHAM	DURHAM	DURHAM	DURHAM	DURHAM	DURHAM
Determinand	**HWOL Code**	**Accred.**	**SOP**	**Units**	**LOD**							
ACM Type		N	2192		N/A	-	-	-	-	-	-	-
Asbestos Identification		U	2192		N/A	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected
ACM Detection Stage		U	2192		N/A	-	-	-	-	-	-	-
Moisture		N	2030	%	0.020	11	20	21	18	14	13	16
Soil Colour		N	2040		N/A	Brown	Brown	Brown	Brown	Brown	Brown	Brown
Other Material		N	2040		N/A	Stones, Roots and	Stones, Roots and	Stones, Roots and	Stones, Roots and	Stones and	Stones, Roots and	Stones, Roots and
Soil Texture		N	2040		N/A	Clay	Clay	Clay	Clay	Clay	Clay	Clay
Total Potential Sulphate as SO4		N	2175	%	0.030		0.18	0.33				0.030
pH at 20C		M	2010		4.0	8.7	7.5	7.6	8.2	8.0	7.9	7.3
Boron (Hot Water Soluble)		M	2120	mg/kg	0.40	< 0.40	0.70	0.67	0.51	< 0.40	< 0.40	0.42
Sulphate (2:1 Water Soluble) as SO4		M	2120	g/l	0.010		< 0.010	< 0.010				< 0.010
Total Sulphur		U	2175	%	0.010		0.060	0.11				0.010
Cyanide (Total)		M	2300	mg/kg	0.50	< 0.50	2.2	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Magnesium (Extractable)		N	2400	mg/l	2.0		490	340				350
Sulphate (Acid Soluble)		U	2430	%	0.010	0.011	0.048	0.074	0.075	0.027	0.020	0.039
Arsenic		M	2455	mg/kg	0.5	4.3	29	14	17	7.3	5.6	6.3
Cadmium		M	2455	mg/kg	0.10	0.47	1.4	0.92	0.72	0.54	0.66	0.47
Chromium		M	2455	mg/kg	0.5	16	29	35	35	22	19	26
Mercury Low Level		N	2450	mg/kg	0.05	< 0.05	0.16	0.26	0.17	0.06	0.07	0.05
Copper		M	2455	mg/kg	0.50	7.7	32	32	38	12	9.6	10
Nickel		M	2455	mg/kg	0.50	22	31	35	50	27	25	21
Lead		M	2455	mg/kg	0.50	42	200	200	83	53	34	39
Selenium		M	2455	mg/kg	0.25	0.39	0.97	0.95	0.86	0.40	0.49	0.52
Zinc		M	2455	mg/kg	0.50	59	270	130	120	94	75	82
Chromium (Trivalent)		N	2490	mg/kg	1.0	16	29	35	35	22	19	26
Chromium (Hexavalent)		N	2490	mg/kg	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Aliphatic VPH >C5-C6	HS_2D_AL	U	2780	mg/kg	0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Aliphatic VPH >C6-C7	HS_2D_AL	U	2780	mg/kg	0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Aliphatic VPH >C7-C8	HS_2D_AL	U	2780	mg/kg	0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Aliphatic VPH >C6-C8 (Sum)	HS_2D_AL	N	2780	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Aliphatic VPH >C8-C10	HS_2D_AL	U	2780	mg/kg	0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Total Aliphatic VPH >C5-C10	HS_2D_AL	U	2780	mg/kg	0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
Aliphatic EPH >C10-C12 MC	EH_2D_AL_#1	M	2690	mg/kg	2.00	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Aliphatic EPH >C12-C16 MC	EH_2D_AL_#1	M	2690	mg/kg	1.00	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0

Results - Soil

Project: Wolfcastle

Client: Terra Firma						**Chemtest Job No.:**	25-04683	25-04683	25-04683	25-04683	25-04683	25-04683
Quotation No.:						**Chemtest Sample ID.:**	1930729	1930730	1930731	1930732	1930733	1930734	1930735
Order No.: 310						Client Sample Ref.:	1	1	1	1	1	1	1
						Client Sample ID.:	WS05	WS07	WS06	WS04	WS07	WS08	WS05
						Sample Location:	WS05	WS07	WS06	WS04	WS07	WS08	WS05
						Sample Type:	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
						Top Depth (m):	2.1	0.2	0.8	1.0	1.0	1.80	0.2
						Date Sampled:	06-Feb-2025	06-Feb-2025	06-Feb-2025	06-Feb-2025	06-Feb-2025	06-Feb-2025	06-Feb-2025
						Time Sampled:	12:00	12:00	12:00	12:00	12:00	12:00	12:00
						Asbestos Lab:	DURHAM	DURHAM	DURHAM	DURHAM	DURHAM	DURHAM	DURHAM
Determinand	**HWOL Code**	**Accred.**	**SOP**	**Units**	**LOD**								
Aliphatic EPH >C16-C21 MC	EH_2D_AL_#1	M	2690	mg/kg	2.00		< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Aliphatic EPH >C21-C35 MC	EH_2D_AL_#1	M	2690	mg/kg	3.00		< 3.0	7.7	< 3.0	< 3.0	< 3.0	< 3.0	5.1
Aliphatic EPH >C35-C40 MC	EH_2D_AL_#1	N	2690	mg/kg	10.00		< 10	< 10	< 10	< 10	< 10	< 10	< 10
Total Aliphatic EPH >C10-C35 MC	EH_2D_AL_#1	M	2690	mg/kg	5.00		< 5.0	8.1	< 5.0	< 5.0	< 5.0	< 5.0	5.1
Total Aliphatic EPH >C10-C40 MC	EH_2D_AL_#1	N	2690	mg/kg	10.00		< 10	< 10	< 10	< 10	< 10	< 10	< 10
Aromatic VPH >C5-C7	HS_2D_AR	U	2780	mg/kg	0.05		< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Aromatic VPH >C7-C8	HS_2D_AR	U	2780	mg/kg	0.05		< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Aromatic VPH >C8-C10	HS_2D_AR	U	2780	mg/kg	0.05		< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Total Aromatic VPH >C5-C10	HS_2D_AR	U	2780	mg/kg	0.25		< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
Aromatic EPH >C10-C12 MC	EH_2D_AR_#1	U	2690	mg/kg	1.00		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic EPH >C12-C16 MC	EH_2D_AR_#1	U	2690	mg/kg	1.00		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic EPH >C16-C21 MC	EH_2D_AR_#1	U	2690	mg/kg	2.00		2.5	3.2	4.1	3.5	3.1	2.2	2.7
Aromatic EPH >C21-C35 MC	EH_2D_AR_#1	U	2690	mg/kg	2.00		< 2.0	2.4	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Aromatic EPH >C35-C40 MC	EH_2D_AR_#1	N	2690	mg/kg	1.00		< 1.0	< 1.0	1.2	< 1.0	1.0	< 1.0	2.0
Total Aromatic EPH >C10-C35 MC	EH_2D_AR_#1	U	2690	mg/kg	5.00		< 5.0	5.6	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Total Aromatic EPH >C10-C40 MC	EH_2D_AR_#1	N	2690	mg/kg	10.00		< 10	< 10	< 10	< 10	< 10	< 10	< 10
Total VPH >C5-C10	HS_2D_Total	U	2780	mg/kg	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Total EPH >C10-C35 MC	EH_2D_Total_#1	U	2690	mg/kg	10.00		< 10	14	< 10	< 10	< 10	< 10	< 10
Total EPH >C10-C40 MC	EH_2D_Total_#1	N	2690	mg/kg	10.00		< 10	14	< 10	< 10	< 10	< 10	< 10
Naphthalene		M	2700	mg/kg	0.10		< 0.10	0.61	< 0.10	0.39	< 0.10	< 0.10	< 0.10
Acenaphthylene		M	2700	mg/kg	0.10		< 0.10	0.11	< 0.10	0.17	< 0.10	< 0.10	< 0.10
Acenaphthene		M	2700	mg/kg	0.10		< 0.10	0.17	< 0.10	0.69	< 0.10	< 0.10	< 0.10
Fluorene		M	2700	mg/kg	0.10		< 0.10	0.19	< 0.10	1.1	< 0.10	< 0.10	< 0.10
Phenanthrene		M	2700	mg/kg	0.10		< 0.10	1.4	< 0.10	5.5	< 0.10	< 0.10	< 0.10
Anthracene		M	2700	mg/kg	0.10		< 0.10	0.26	< 0.10	1.5	< 0.10	< 0.10	< 0.10
Fluoranthene		M	2700	mg/kg	0.10		< 0.10	1.8	< 0.10	6.0	< 0.10	< 0.10	< 0.10
Pyrene		M	2700	mg/kg	0.10		< 0.10	1.6	< 0.10	4.8	< 0.10	< 0.10	< 0.10
Benzo[a]anthracene		M	2700	mg/kg	0.10		< 0.10	0.76	< 0.10	2.8	< 0.10	< 0.10	< 0.10
Chrysene		M	2700	mg/kg	0.10		< 0.10	1.5	< 0.10	4.8	< 0.10	< 0.10	< 0.10
Benzo[b]fluoranthene		M	2700	mg/kg	0.10		< 0.10	0.87	< 0.10	3.4	< 0.10	< 0.10	< 0.10
Benzo[k]fluoranthene		M	2700	mg/kg	0.10		< 0.10	0.27	< 0.10	1.3	< 0.10	< 0.10	< 0.10
Benzo[a]pyrene		M	2700	mg/kg	0.10		< 0.10	0.56	< 0.10	2.1	< 0.10	< 0.10	< 0.10
Indeno(1,2,3-c,d)Pyrene		M	2700	mg/kg	0.10		< 0.10	0.44	< 0.10	1.4	< 0.10	< 0.10	< 0.10
Dibenz(a,h)Anthracene		M	2700	mg/kg	0.10		< 0.10	0.13	< 0.10	0.48	< 0.10	< 0.10	< 0.10
Benzo[g,h,i]perylene		M	2700	mg/kg	0.10		< 0.10	0.66	< 0.10	1.4	< 0.10	< 0.10	< 0.10
Total Of 16 PAH's		M	2700	mg/kg	2.0		< 2.0	11	< 2.0	38	< 2.0	< 2.0	< 2.0

Results - Soil

Project: Wolfcastle

Client: Terra Firma			**Chemtest Job No.:**			25-04683	25-04683	25-04683	25-04683	25-04683	25-04683	25-04683
Quotation No.:			**Chemtest Sample ID.:**			1930729	1930730	1930731	1930732	1930733	1930734	1930735
Order No.: 310					Client Sample Ref.:	1	1	1	1	1	1	1
					Client Sample ID.:	WS05	WS07	WS06	WS04	WS07	WS08	WS05
					Sample Location:	WS05	WS07	WS06	WS04	WS07	WS08	WS05
					Sample Type:	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
					Top Depth (m):	2.1	0.2	0.8	1.0	1.0	1.80	0.2
					Date Sampled:	06-Feb-2025	06-Feb-2025	06-Feb-2025	06-Feb-2025	06-Feb-2025	06-Feb-2025	06-Feb-2025
					Time Sampled:	12:00	12:00	12:00	12:00	12:00	12:00	12:00
					Asbestos Lab:	DURHAM	DURHAM	DURHAM	DURHAM	DURHAM	DURHAM	DURHAM
Determinand	**HWOL Code**	**Accred.**	**SOP**	**Units**	**LOD**							
Total Phenols		M	2920	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Organic Matter BS1377		N	2930	%	0.10	0.70	6.0	3.4	1.2	0.80	1.7	1.8

Results - Soil

Project: Wolfcastle

Client: Terra Firma			**Chemtest Job No.:**			25-04683	25-04683	25-04683	25-04683	25-04683	25-04683
Quotation No.:			**Chemtest Sample ID.:**			1930736	1930737	1930738	1930739	1930740	1930741
Order No.: 310			Client Sample Ref.:			1	1	1	1	1	1
			Client Sample ID.:			WS04	WS03	WS01	WS02	WS02	WS03
			Sample Location:			WS04	WS03	WS01	WS02	WS02	WS03
			Sample Type:			SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
			Top Depth (m):			0.3	3.0	2.0	0.5	2.5	1.5
			Date Sampled:			06-Feb-2025	07-Feb-2025	07-Feb-2025	07-Feb-2025	07-Feb-2025	07-Feb-2025
			Time Sampled:			12:00	12:00	12:00	12:00	12:00	12:00
			Asbestos Lab:			DURHAM	DURHAM	DURHAM	DURHAM	DURHAM	DURHAM
Determinand	**HWOL Code**	**Accred.**	**SOP**	**Units**	**LOD**						
ACM Type		N	2192		N/A	-	-	-	-	-	-
Asbestos Identification		U	2192		N/A	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected
ACM Detection Stage		U	2192		N/A	-	-	-	-	-	-
Moisture		N	2030	%	0.020	12	11	12	14	13	11
Soil Colour		N	2040		N/A	Brown	Brown	Brown	Brown	Brown	Brown
Other Material		N	2040		N/A	Stones, Roots and	Stones, Roots and	Stones and	Stones and	Stones and	Stones and
Soil Texture		N	2040		N/A	Clay	Clay	Clay	Clay	Clay	Clay
Total Potential Sulphate as SO4		N	2175	%	0.030				0.18		0.030
pH at 20C		M	2010		4.0	8.0	7.9	8.0	8.0	7.7	7.7
Boron (Hot Water Soluble)		M	2120	mg/kg	0.40	0.77	< 0.40	0.61	0.71	< 0.40	< 0.40
Sulphate (2:1 Water Soluble) as SO4		M	2120	g/l	0.010				< 0.010		< 0.010
Total Sulphur		U	2175	%	0.010				0.060		0.010
Cyanide (Total)		M	2300	mg/kg	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Magnesium (Extractable)		N	2400	mg/l	2.0				170		250
Sulphate (Acid Soluble)		U	2430	%	0.010	0.11	0.019	0.023	0.096	0.011	0.020
Arsenic		M	2455	mg/kg	0.5	24	6.3	8.2	15	5.6	11
Cadmium		M	2455	mg/kg	0.10	0.79	0.75	0.95	0.38	0.86	1.3
Chromium		M	2455	mg/kg	0.5	34	17	25	21	24	26
Mercury Low Level		N	2450	mg/kg	0.05	0.32	0.06	0.05	0.14	< 0.05	0.10
Copper		M	2455	mg/kg	0.50	55	11	15	18	9.0	18
Nickel		M	2455	mg/kg	0.50	37	26	34	21	27	38
Lead		M	2455	mg/kg	0.50	200	80	59	93	50	100
Selenium		M	2455	mg/kg	0.25	2.3	0.35	0.61	0.54	0.42	0.64
Zinc		M	2455	mg/kg	0.50	250	87	95	84	88	140
Chromium (Trivalent)		N	2490	mg/kg	1.0	34	17	25	21	24	26
Chromium (Hexavalent)		N	2490	mg/kg	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Aliphatic VPH >C5-C6	HS_2D_AL	U	2780	mg/kg	0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Aliphatic VPH >C6-C7	HS_2D_AL	U	2780	mg/kg	0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Aliphatic VPH >C7-C8	HS_2D_AL	U	2780	mg/kg	0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Aliphatic VPH >C6-C8 (Sum)	HS_2D_AL	N	2780	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Aliphatic VPH >C8-C10	HS_2D_AL	U	2780	mg/kg	0.05	0.12	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Total Aliphatic VPH >C5-C10	HS_2D_AL	U	2780	mg/kg	0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
Aliphatic EPH >C10-C12 MC	EH_2D_AL_#1	M	2690	mg/kg	2.00	< 2.0	< 2.0	< 2.0	< 2.0	2.4	< 2.0
Aliphatic EPH >C12-C16 MC	EH_2D_AL_#1	M	2690	mg/kg	1.00	< 1.0	< 1.0	< 1.0	< 1.0	2.7	< 1.0

Results - Soil

Project: Wolfcastle

Client: Terra Firma			**Chemtest Job No.:**			25-04683	25-04683	25-04683	25-04683	25-04683	25-04683
Quotation No.:			**Chemtest Sample ID.:**			1930736	1930737	1930738	1930739	1930740	1930741
Order No.: 310				Client Sample Ref.:		1	1	1	1	1	1
				Client Sample ID.:		WS04	WS03	WS01	WS02	WS02	WS03
				Sample Location:		WS04	WS03	WS01	WS02	WS02	WS03
				Sample Type:		SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
				Top Depth (m):		0.3	3.0	2.0	0.5	2.5	1.5
				Date Sampled:		06-Feb-2025	07-Feb-2025	07-Feb-2025	07-Feb-2025	07-Feb-2025	07-Feb-2025
				Time Sampled:		12:00	12:00	12:00	12:00	12:00	12:00
				Asbestos Lab:		DURHAM	DURHAM	DURHAM	DURHAM	DURHAM	DURHAM
Determinand	**HWOL Code**	**Accred.**	**SOP**	**Units**	**LOD**						
Aliphatic EPH >C16-C21 MC	EH_2D_AL_#1	M	2690	mg/kg	2.00	< 2.0	< 2.0	4.6	< 2.0	2.2	< 2.0
Aliphatic EPH >C21-C35 MC	EH_2D_AL_#1	M	2690	mg/kg	3.00	49	< 3.0	6.9	< 3.0	< 3.0	< 3.0
Aliphatic EPH >C35-C40 MC	EH_2D_AL_#1	N	2690	mg/kg	10.00	180	< 10	< 10	< 10	< 10	< 10
Total Aliphatic EPH >C10-C35 MC	EH_2D_AL_#1	M	2690	mg/kg	5.00	50	< 5.0	12	< 5.0	8.7	< 5.0
Total Aliphatic EPH >C10-C40 MC	EH_2D_AL_#1	N	2690	mg/kg	10.00	230	< 10	12	< 10	< 10	< 10
Aromatic VPH >C5-C7	HS_2D_AR	U	2780	mg/kg	0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Aromatic VPH >C7-C8	HS_2D_AR	U	2780	mg/kg	0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Aromatic VPH >C8-C10	HS_2D_AR	U	2780	mg/kg	0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Total Aromatic VPH >C5-C10	HS_2D_AR	U	2780	mg/kg	0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
Aromatic EPH >C10-C12 MC	EH_2D_AR_#1	U	2690	mg/kg	1.00	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic EPH >C12-C16 MC	EH_2D_AR_#1	U	2690	mg/kg	1.00	67	< 1.0	8.6	< 1.0	< 1.0	< 1.0
Aromatic EPH >C16-C21 MC	EH_2D_AR_#1	U	2690	mg/kg	2.00	520	2.4	59	7.3	< 2.0	< 2.0
Aromatic EPH >C21-C35 MC	EH_2D_AR_#1	U	2690	mg/kg	2.00	1300	< 2.0	86	9.7	< 2.0	< 2.0
Aromatic EPH >C35-C40 MC	EH_2D_AR_#1	N	2690	mg/kg	1.00	390	6.5	3.9	1.2	2.5	2.4
Total Aromatic EPH >C10-C35 MC	EH_2D_AR_#1	U	2690	mg/kg	5.00	1800	< 5.0	150	17	< 5.0	< 5.0
Total Aromatic EPH >C10-C40 MC	EH_2D_AR_#1	N	2690	mg/kg	10.00	2200	< 10	160	18	< 10	< 10
Total VPH >C5-C10	HS_2D_Total	U	2780	mg/kg	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Total EPH >C10-C35 MC	EH_2D_Total_#1	U	2690	mg/kg	10.00	1900	< 10	170	19	11	< 10
Total EPH >C10-C40 MC	EH_2D_Total_#1	N	2690	mg/kg	10.00	2500	< 10	170	20	13	< 10
Naphthalene		M	2700	mg/kg	0.10	4.5	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Acenaphthylene		M	2700	mg/kg	0.10	1.0	< 0.10	0.50	< 0.10	< 0.10	< 0.10
Acenaphthene		M	2700	mg/kg	0.10	7.7	< 0.10	5.9	< 0.10	< 0.10	< 0.10
Fluorene		M	2700	mg/kg	0.10	11	< 0.10	3.3	< 0.10	< 0.10	< 0.10
Phenanthrene		M	2700	mg/kg	0.10	73	< 0.10	13	0.84	< 0.10	< 0.10
Anthracene		M	2700	mg/kg	0.10	25	< 0.10	6.1	0.29	< 0.10	< 0.10
Fluoranthene		M	2700	mg/kg	0.10	140	< 0.10	32	2.8	< 0.10	0.18
Pyrene		M	2700	mg/kg	0.10	98	< 0.10	30	3.3	< 0.10	0.26
Benzo[a]anthracene		M	2700	mg/kg	0.10	73	< 0.10	9.6	1.5	< 0.10	< 0.10
Chrysene		M	2700	mg/kg	0.10	72	< 0.10	10	1.9	< 0.10	< 0.10
Benzo[b]fluoranthene		M	2700	mg/kg	0.10	120	< 0.10	11	2.7	< 0.10	< 0.10
Benzo[k]fluoranthene		M	2700	mg/kg	0.10	36	< 0.10	3.9	0.85	< 0.10	< 0.10
Benzo[a]pyrene		M	2700	mg/kg	0.10	75	< 0.10	8.1	2.0	< 0.10	< 0.10
Indeno(1,2,3-c,d)Pyrene		M	2700	mg/kg	0.10	49	< 0.10	5.1	1.7	< 0.10	< 0.10
Dibenz(a,h)Anthracene		M	2700	mg/kg	0.10	19	< 0.10	1.6	0.55	< 0.10	< 0.10
Benzo[g,h,i]perylene		M	2700	mg/kg	0.10	47	< 0.10	5.7	1.5	< 0.10	< 0.10
Total Of 16 PAH's		M	2700	mg/kg	2.0	850	< 2.0	150	20	< 2.0	< 2.0

Results - Soil

Project: Wolfcastle

Client: Terra Firma			**Chemtest Job No.:**			25-04683	25-04683	25-04683	25-04683	25-04683	25-04683
Quotation No.:			**Chemtest Sample ID.:**			1930736	1930737	1930738	1930739	1930740	1930741
Order No.: 310					Client Sample Ref.:	1	1	1	1	1	1
					Client Sample ID.:	WS04	WS03	WS01	WS02	WS02	WS03
					Sample Location:	WS04	WS03	WS01	WS02	WS02	WS03
					Sample Type:	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
					Top Depth (m):	0.3	3.0	2.0	0.5	2.5	1.5
					Date Sampled:	06-Feb-2025	07-Feb-2025	07-Feb-2025	07-Feb-2025	07-Feb-2025	07-Feb-2025
					Time Sampled:	12:00	12:00	12:00	12:00	12:00	12:00
					Asbestos Lab:	DURHAM	DURHAM	DURHAM	DURHAM	DURHAM	DURHAM
Determinand	**HWOL Code**	**Accred.**	**SOP**	**Units**	**LOD**						
Total Phenols		M	2920	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Organic Matter BS1377		N	2930	%	0.10	5.6	1.3	0.90	2.2	0.50	0.70

Test Methods

SOP	Title	Parameters included	Method summary	Water Accred.
2010	pH Value of Soils	pH at 20°C	pH Meter	
2030	Moisture and Stone Content of Soils(Requirement of MCERTS)	Moisture content	Determination of moisture content of soil as a percentage of its as received mass obtained at <30°C.	
2040	Soil Description(Requirement of MCERTS)	Soil description	As received soil is described based upon BS5930	
2120	Water Soluble Boron, Sulphate, Magnesium & Chromium	Boron; Sulphate; Magnesium; Chromium	Aqueous extraction / ICP-OES	
2175	Total Sulphur in Soils	Total Sulphur	Determined by high temperature combustion under oxygen, using an Eltra elemental analyser.	
2192	Asbestos	Asbestos	Polarised light microscopy / Gravimetry	
2300	Cyanides & Thiocyanate in Soils	Free (or easy liberatable) Cyanide; total Cyanide; complex Cyanide; Thiocyanate	Allkaline extraction followed by colorimetric determination using Automated Flow Injection Analyser.	
2400	Cations	Cations	ICP-MS	
2430	Total Sulphate in soils	Total Sulphate	Acid digestion followed by determination of sulphate in extract by ICP-OES.	
2450	Acid Soluble Metals in Soils	Metals, including: Arsenic; Barium; Beryllium; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Vanadium; Zinc	Acid digestion followed by determination of metals in extract by ICP-MS.	
2455	Acid Soluble Metals in Soils	Metals, including: Arsenic; Barium; Beryllium; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Vanadium; Zinc	Acid digestion followed by determination of metals in extract by ICP-MS.	
2490	Hexavalent Chromium in Soils	Chromium [VI]	Soil extracts are prepared by extracting dried and ground soil samples into boiling water. Chromium [VI] is determined by 'Aquakem 600' Discrete Analyser using 1,5-diphenylcarbazide.	
2690	EPH A/A Split	Aliphatics: >C10–C12, >C12–C16, >C16–C21, >C21– C35, >C35– C40 Aromatics: >C10–C12, >C12–C16, >C16–C21, >C21– C35, >C35– C40	Acetone/Heptane extraction / GCxGC FID detection	
2700	Speciated Polynuclear Aromatic Hydrocarbons (PAH) in Soil by GC-FID	Acenaphthene; Acenaphthylene; Anthracene; Benzo[a]Anthracene; Benzo[a]Pyrene; Benzo[b]Fluoranthene; Benzo[ghi]Perylene; Benzo[k]Fluoranthene; Chrysene; Dibenz[ah]Anthracene; Fluoranthene; Fluorene; Indeno[123cd]Pyrene; Naphthalene; Phenanthrene; Pyrene	Dichloromethane extraction / GC-FID (GC-FID detection is non-selective and can be subject to interference from co-eluting compounds)	
2780	VPH A/A Split	Aliphatics: >C5–C6, >C6–C7,>C7–C8,>C8-C10 Aromatics: >C5–C7,>C7-C8,>C8–C10	Water extraction / Headspace GCxGC FID detection	
2920	Phenols in Soils by HPLC	Phenolic compounds including Resorcinol, Phenol, Methylphenols, Dimethylphenols, 1-Naphthol and TrimethylphenolsNote: chlorophenols are excluded.	60:40 methanol/water mixture extraction, followed by HPLC determination using electrochemical detection.	
2930	Organic Matter	Organic Matter	Acid Dichromate digestion/Titration	

Report Information

Key	
U	UKAS accredited
M	MCERTS and UKAS accredited
N	Unaccredited
S	This analysis has been subcontracted to a UKAS accredited laboratory that is accredited for this analysis
SN	This analysis has been subcontracted to a UKAS accredited laboratory that is not accredited for this analysis
T	This analysis has been subcontracted to an unaccredited laboratory
I/S	Insufficient Sample
U/S	Unsuitable Sample
N/E	not evaluated
<	"less than"
>	"greater than"
SOP	Standard operating procedure
LOD	Limit of detection

This report shall not be reproduced except in full, and only with the prior approval of the laboratory.
Any comments or interpretations are outside the scope of UKAS accreditation.
The Laboratory is not accredited for any sampling activities and reported results relate to the samples 'as received' at the laboratory.
Uncertainty of measurement for the determinands tested are available upon request .
None of the results in this report have been recovery corrected.
All results are expressed on a dry weight basis.

The following tests were analysed on samples 'as received' and the results subsequently corrected to a dry weight basis EPH, VPH, TPH, BTEX, VOCs, SVOCs, PCBs, Phenols.

For all other tests the samples were dried at ≤ 30°C prior to analysis.
All Asbestos testing is performed at the indicated laboratory .
Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1.

NEW_ASB	Eurofins Chemtest Limited, 11 Depot Road, Newmarket, CB8 0AL
DURHAM	Eurofins Chemtest Limited, Unit A North Wing, Prospect Business Park, Crookhall Lane, Consett, Co Durham, DH8 7PW

Sample Deviation Codes

As a result of any of the below deviations applying, the test results may be unreliable

A - Date of sampling not supplied
B - Sample age exceeds stability time (sampling to extraction)
C - Sample not received in appropriate containers
D - Broken Container
E - The required amount of sample for analysis was not received
H - Appropriate cooling measures were not taken for sample transportation

Sample Retention and Disposal

All soil samples will be retained for a period of 30 days from the date of receipt.
All water samples will be retained for 14 days from the date of receipt.
Charges may apply to extended sample storage.

Report Information

Water Sample Category Key for Accreditation

DW - Drinking Water
GW - Ground Water
LE - Land Leachate
NA - Not Applicable
PL - Prepared Leachate
PW - Processed Water
RE - Recreational Water
SA - Saline Water
SW - Surface Water
TE - Treated Effluent
TS - Treated Sewage
UL - Unspecified Liquid

Clean Up Codes

NC - No Clean Up
MC - Mathematical Clean Up
FC - Florisil Clean Up

HWOL Acronym System

HS - Headspace analysis
EH - Extractable hydrocarbons – i.e. everything extracted by the solvent
CU - Clean-up – e.g. by Florisil, silica gel
1D - GC – Single coil gas chromatography
Total - Aliphatics & Aromatics
AL - Aliphatics only
AR - Aromatic only
2D - GC-GC – Double coil gas chromatography
#1 - EH_2D_Total but with humics mathematically subtracted
#2 - EH_2D_Total but with fatty acids mathematically subtracted
+ - Operator to indicate cumulative e.g. EH+EH_Total or EH_CU+HS_Total

Asbestos Tests LOD = LOQ

Limit of Detection = Limit of Quantification for asbestos results only

If you require extended retention of samples, please email your requirements to:
customerservices@chemtest.com

ANNEX E
Geotechnical Test Results

Laboratory Report

UKAS TESTING 2788

GSTL GEOTECHNICAL SITE & TESTING LABORATORIES A PHENNA GROUP COMPANY

Contract Number: 77094

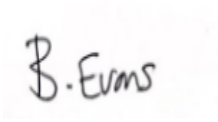
Client Ref: **310**
Client PO: **310**

Client: **Terrafirma Wales Ltd**

Contract Title: **Wolfcastle**
For the attention of: **Sam Williams**

Date Received: **12-02-2025**
Date Completed: **23-02-2025**
Report Date: **23-02-2025**

This report has been checked and approved by:



Brendan Evans
Office Administrator

Description	Qty
Moisture Content BS 1377:1990 - Part 2 : 3.2 - * UKAS	10
1 Point Liquid & Plastic Limit BS 1377:1990 - Part 2 : 4.4 & 5.3 - * UKAS	10

Notes: **Observations and Interpretations are outside the UKAS Accreditation**
*** - denotes test included in laboratory scope of accreditation**
 # - denotes test carried out by approved contractor
@ - denotes non accredited tests

This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service. The results reported herein relate only to the material supplied to the laboratory. This test report/certificate shall not be reproduced except in full, without the approval of GEO Site & Testing Services Ltd. Any opinions or interpretations stated - within this report/certificate are excluded from the laboratories UKAS accreditation.

Approved Signatories:
Brendan Evans (Office Administrator) - Darren Bourne (Quality Senior Technician) - Paul Evans (Director)
Richard John (Quality/Technical Manager) - Shaun Jones (Laboratory manager) - Shaun Thomas (Site Manager)
Wayne Honey (HR & HSE Manager)

GEO Site & Testing Services Ltd
Unit 3-4 Heol Aur, Dafen Ind Est, Llanelli, Carmarthenshire SA14 8QN
Tel: 01554 784 040 Fax: 01554 784 040 info@gstl.co.uk https://gstl.co.uk

GSTL
GEOTECHNICAL SITE & TESTING LABORATORIES

NATURAL MOISTURE, LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX
(BS 1377:1990 - Part 2 : 4.4 & 5.3)

Contract Number	77094
Project Name	Wolfcastle
Date Tested	18/02/2025

DESCRIPTIONS

Sample/Hole Reference	Sample Number	Sample Type	Depth (m)			Descriptions
SA02		D	1.00	-		Brown fine to medium gravelly silty sandy CLAY
SA01		D	0.50	-		Brown fine to medium gravelly silty CLAY
SA03		D	0.40	-		Brown fine to medium gravelly silty sandy CLAY
WS08		D	3.50	-		Brown fine to medium gravelly sandy silty CLAY
WS02		D	0.80	-		Brown fine to medium gravelly silty sandy CLAY
WS05		D	3.10	-		Brown fine to medium gravelly silty sandy CLAY
WS03		D	0.50	-		Brown fine to medium gravelly silty CLAY
WS03		D	2.00	-		Brown fine to medium gravelly silty sandy CLAY
WS01		D	2.50	-		Brown fine to medium gravelly silty CLAY
WS07		D	1.50	-		Brown fine to medium gravelly sandy silty CLAY
				-		
				-		
				-		
				-		
				-		
				-		
				-		
				-		
				-		
				-		
				-		
				-		
				-		
				-		

Operator
Clayton Jenkins

GSTL GEOTECHNICAL SITE & TESTING LABORATORIES	NATURAL MOISTURE, LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX (BS 1377:1990 - Part 2 : 4.4 & 5.3)	
Contract Number	77094	
Project Name	Wolfcastle	
Date Tested	18/02/2025	

Sample/Hole Reference	Sample Number	Sample Type	Depth (m)			Moisture Content %	Liquid Limit %	Plastic Limit %	Plasticity index %	Passing 0.425mm %	Remarks
SA02		D	1.00	-		15	36	13	23	85	CI Intermediate Plasticity
SA01		D	0.50	-		18	46	17	29	86	CI Intermediate Plasticity
SA03		D	0.40	-		15	33	13	20	87	CL Low Plasticity
WS08		D	3.50	-		18	45	15	30	84	CI Intermediate Plasticity
WS02		D	0.80	-		17	31	14	17	88	CL Low Plasticity
WS05		D	3.10	-		10	28	14	14	87	CL Low Plasticity
WS03		D	0.50	-		21	41	17	24	87	CI Intermediate Plasticity
WS03		D	2.00	-		18	42	16	26	89	CI Intermediate Plasticity
WS01		D	2.50	-		13	30	14	16	80	CL Low Plasticity
WS07		D	1.50	-		14	33	13	20	85	CL Low Plasticity
				-							
				-							
				-							
				-							
				-							
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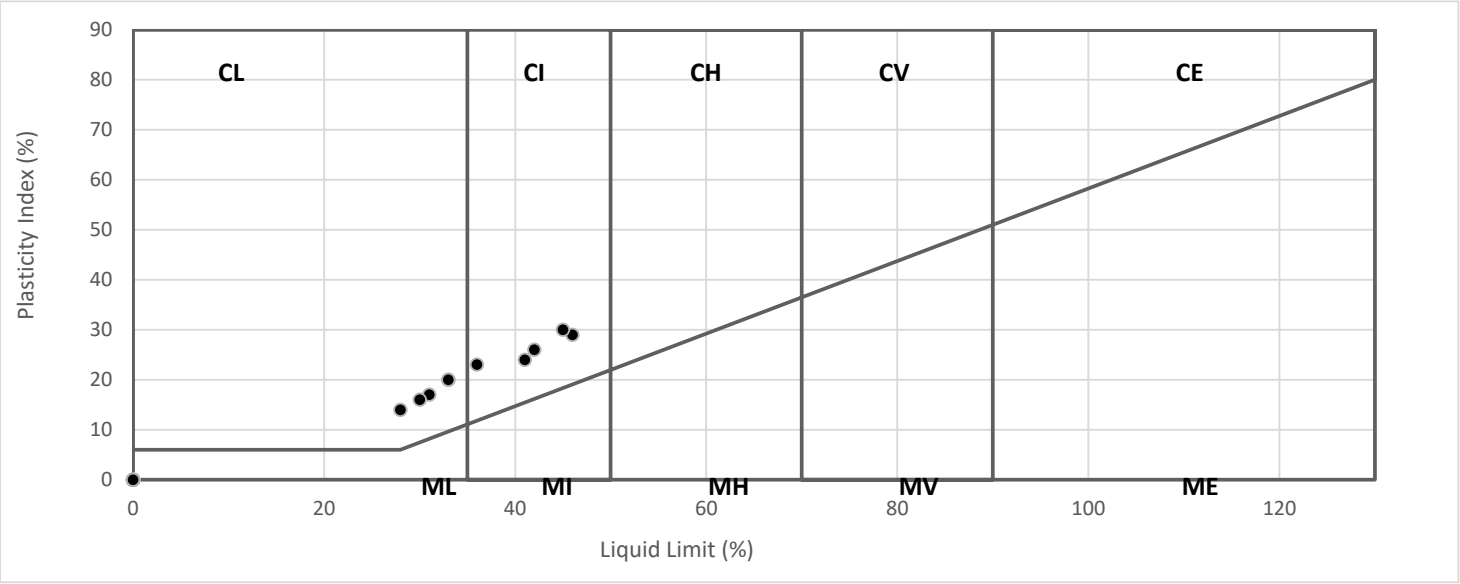
				-							
				-							

Symbols: NP : Non Plastic # : Liquid Limit and Plastic Limit Wet Sieved

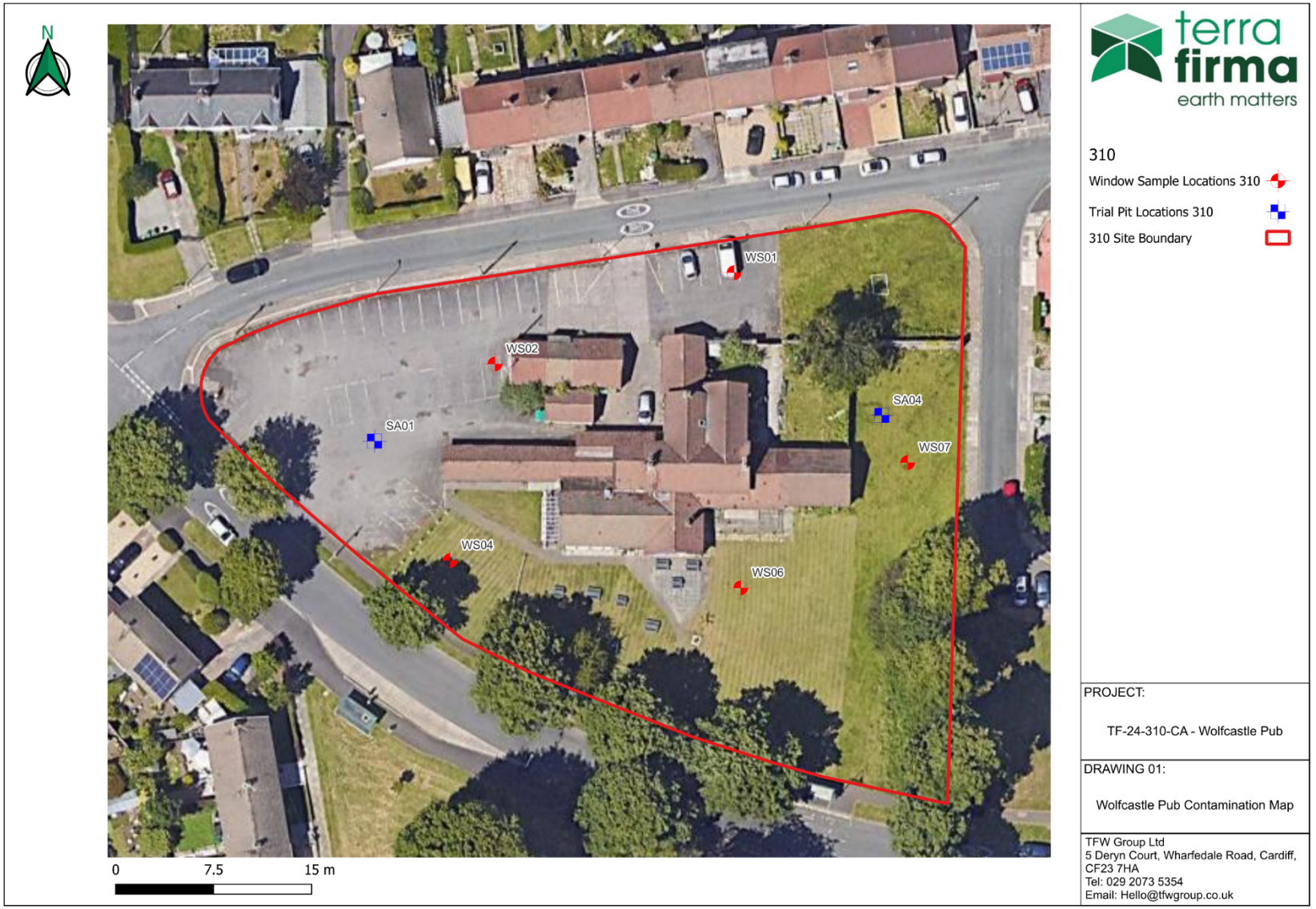
PLASTICITY CHART FOR CASAGRANDE CLASSIFICATION
BS 5930:2015+A1:2020



Operator
Clayton Jenkins

DRAWINGS


N
WS01
WS02
WS03
WS04
WS05
WS06
WS07
WS08
SA01
SA02
SA03
SA04
0
7.5
15 m
terra firma earth matters
Window Sample Locations 310
Trial Pit Locations 310
310 Site Boundary
PROJECT:
TF-24-310-CA - Wolfcastle Pub
DRAWING 01:
310 Map
TFW Group Ltd
5 Deryn Court, Wharfedale Road, Cardiff, CF23 7HA
Tel: 029 2073 5354
Email: Hello@tfwgroup.co.uk


N
WS01
WS02
SA01
SA04
WS07
WS04
WS06
0
7.5
15 m
terra firma earth matters
310
Window Sample Locations 310
Trial Pit Locations 310
310 Site Boundary
PROJECT:
TF-24-310-CA - Wolfcastle Pub
DRAWING 01:
Wolfcastle Pub Contamination Map
TFW Group Ltd
5 Deryn Court, Wharfedale Road, Cardiff, CF23 7HA
Tel: 029 2073 5354
Email: Hello@tfwgroup.co.uk

terra firma

Geotechnical & Geoenvironmental Specialists

TFW Group Ltd, 5 Deryn Court, Wharfedale Road, Pentwyn, Cardiff. CF23 7HA

Tel: 033 022 36380 **Email**: hello@tfwgroup.co.uk **www.tfwgroup.co.uk**