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GROUND INVESTIGATION REPORT

PROPOSED MODULAR WARDS

HILLINGDON HOSPITAL

PIELD HEATH ROAD

UXBRIDGE

(Factual)

Report Reference No. C14947

On behalf of:-

Hillingdon Hospitals NHS Foundation Trust
c/o CampbellReith Hill LLP
15 Bermondsey Square
London
SE1 3UN

January 2020

HILLINGDON HOSPITALS NHS FOUNDATION TRUST

CAMPBELLREITH HILL LLP

CONSULTING ENGINEERS

FACTUAL REPORT ON A GROUND INVESTIGATION

PROPOSED MODULAR WARDS

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INTRODUCTION

Hillingdon Hospitals NHS Foundation Trust, the client, intends to construct new structures within their existing hospital grounds on Pield Heath Road, Uxbridge. The redevelopment is yet to be finalised but is expected to include single-storey modular ward buildings, a four-storey block of wards and the demolition of a vacant former Paediatric Ward.

Ground Engineering Limited was commissioned by the client, under the guidance of consulting engineers CampbellReith Hill LLP, to carry out a ground investigation and produce a factual report. The investigation was to determine the nature and geotechnical properties of the underlying soils in addition to environmental sampling, monitoring and analysis.

LOCATION, TOPOGRAPHY AND GEOLOGY OF THE SITE

Hillingdon Hospital is located on the southern side of Pield Heath Road, between Royal Lane and Colham Green Road, some 2.5km south-south-east of the centre of Uxbridge. The site is centred at approximate National Grid Reference TQ 0682 8182. A site location plan is presented in Appendix 1.

The irregular site is approximately 0.3km wide along the eastern side of Royal Lane, from where it extends eastwards for up to 0.5km along the southern side of Pield Heath Road and south-west side of Colham Green Road. A housing estate is to the immediate south of the southern site boundary.

At the time of the investigation the areas of the proposed structures included two asphalt-surfaced car parks, located near centrally and in the southern part of the hospital grounds, immediately south of the Nightingale Centre and Bevan Ward, respectively. These two car parks were separated by a compound, containing liquid oxygen tanks, two 10,000 litre diesel tanks and oil storage tanks in a brick-lined bund with an associated generator. The vacant Paediatric Ward building, to be demolished, was to the south of these two car parks and was surrounded by grass verges and landscaped gardens. This building was a single-storey brick structure with an extension adjoining its south-west elevation. A disused gravel-surfaced car park in the eastern part of the hospital, immediately south of the existing Maternity Building, also formed part of the areas for possible redevelopment. The remaining hospital grounds generally comprised further ward buildings, office blocks, ancillary structures, car parks, bin storage areas, access roadways, grass verges and peripheral soft landscaping.

Various trees were within the verges and peripheral landscaping, including semi-mature to mature Ash, Horse Chestnut, London Plane, Oak and Sycamore.

A partly culverted, straightened tributary stream flows south-westwards across the site, close to the south-east corner of the existing Paediatric Ward, and joins the southward flowing River Pinn some 0.4km west of the site.

The site and surroundings generally slope down to the south-west, towards the River Pinn. The ground levels across the areas of the proposed redevelopment fall between approximately 38.5mOD near the Maternity Ward to some 36.5mOD to the south of the Paediatric Ward.

The 2005 geological map for the area of Beaconsfield at 1:50,000 scale, Sheet 255, shows the site to be covered by a superficial deposit of Boyn Hill Gravel and underlain by the solid geology London Clay. Superficial deposits of Langley Silt (Brickearth) over Lynch Hill Gravel are indicated across lower ground to the south-west of the site, and a ribbon of Alluvium is marked along the course of the River Pinn.

SITE WORK

The investigation was undertaken following the protocols detailed in British Standards (BS) 'Code of Practice for Site Investigations' (BS5930:2015) and 'Methods of test for soils for engineering purposes' (BS1377:1990). The exploratory hole positions are depicted on an exploratory hole location plan in Appendix 1. The locations of the intrusive works were agreed on site with the Engineer during a pre-start meeting.

All of the intrusive works were undertaken under the supervision of a Geo-environmental Engineer. Due to the perceived risk of unexploded ordnance (UXO) a specialist EOD engineer was in attendance during the investigation to undertake toolbox talks and magnetometer checks in the exploratory holes to check for the presence/absence of UXO.

The works were carried out making due reference to generic and site specific risk assessments, and method statements. The working areas were delineated by Heras fencing and acoustic barriers where appropriate.

Prior to commencement of intrusive works all available statutory service plans were provided to Ground Engineering Limited and consulted, and a cable avoidance tool (CAT) was used to confirm the absence of buried services at each exploratory hole position. The site work was carried out making due reference to generic and site specific risk assessments.

The exploratory hole records are presented in Appendix 2 and give the descriptions and depths of the various strata encountered, details of all samples taken, results of the in-situ tests, installation details and the groundwater conditions observed during boring/excavation and on completion.

The ground levels at each exploratory hole position were related to Ordnance Datum (OD) using levelling equipment and the National Grid co-ordinates for each position were calculated from on-site measurements, as presented on the exploratory hole records.

Cable Percussive Boreholes

Two boreholes (BH1 & BH2) were undertaken by a standard cable percussive boring rig between 9th and 13th December 2019. Prior to boring, at each position starter pits were dug to 1.20m below ground level using hand tools, in order to ensure the absence of buried services. A hydraulic breaker was employed to remove the surface asphalt at BH1. The boreholes were then advanced using weighted shell and claycutter tools, working initially within 150mm diameter casing. Both boreholes were successfully completed at the intended depth of 20.00m below ground level.

Representative small (D) and bulk (B) disturbed samples of soil were taken from the boring tools at regular intervals throughout the depth of the boreholes. The supervising Geo-environmental Engineer also took environmental samples (ES) in polycarbonate pots, glass jars and vials at regular intervals within made ground and in the surface layer of the underlying naturally deposited soil.

Samples of near surface soils were also screened on-site for volatile organic compounds, by head space testing, using a Photoionization Detector (PID). The results are presented in the remarks section on the exploratory hole records.

Standard penetration tests were undertaken in order to give an indication of the in-situ relative density/shear strength of the soils encountered at the instructed intervals. The test was made by driving a 50mm diameter solid cone point (C) or similar diameter open shoe and split spoon sampler (S) into the soil at the base of the borehole by means of an automatic trip hammer weighing 63.50kg falling freely through 760mm. The penetration resistance was determined as the number of blows (N) required to drive the tool the final 300mm of a total penetration of 450mm into the soil ahead of the borehole. Where the full penetration was not achieved the actual penetration and the number of blows was recorded. The SPT results are tabulated to the rear of the borehole records. The calibration certificate for the SPT hammer referenced as GE01 (Er=65%), used by the cable percussion rig is also presented to the rear of the borehole records.

Undisturbed samples (U) nominally 100mm in diameter were taken in clay, using thin wall steel samplers (UT100s), at the instructed intervals. The ends of the samples were

capped and sealed to maintain them in as representative condition as possible during transit to the laboratory.

Falling head permeability tests were undertaken at 3.20m depth in BH1 and BH2. Water was added to the boreholes and the test water level was monitored for a period of 1 hour. The permeability results are presented with the respective borehole records.

On completion, a gas monitoring standpipe, 50mm diameter, was installed to 1.50m depth in BH1. A gravel response zone was installed from 0.50m to 1.50m as instructed by the Engineer. A gas tap was installed in the top of the standpipe and protective stopcock cover was concreted into the ground flush with the surface over the installations. Below the installation, BH1 was backfilled with bentonite. Borehole BH2 was also backfilled with bentonite.

The site was cleaned to the satisfaction of the hospital facilities management team and the excess spoil was removed from the site in skips to be disposed of at a suitably licenced facility.

Window Sample Boreholes

Nine boreholes were undertaken by a window sampling (dynamic percussion) rig, WS1 to WS9, between 9th and 12th December 2020. Prior to window sampling at each position, a starter pit was dug to 1.20m depth using hand tools in order to ensure the absence of buried services. Diamond drilling equipment with a 220mm diameter core barrel and a hydraulic breaker were employed to remove the surface asphalt where required (WS1 to WS4). The window sample boreholes were then formed by a small track-mounted window sampling and super heavy dynamic probing rig. Casing was installed where required to maintain hole stability to 3.00m depth in WS1. The window sample boreholes were all completed at 5.45m depth.

The window sampling equipment consisted of drive-in sample tubes of specially constructed and strengthened steel, lined with a plastic core-liner. The barrels were initially of 87mm internal diameter and were reduced in diameter with successive barrels with increasing depth. Upon extraction, a continuous profile of the soil was obtained within the plastic liners.

The plastic liners recovered from the holes were logged and sampled on-site by the supervising Geo-environmental Engineer. Representative small disturbed (D) samples of soil were taken at regular intervals throughout the depth of each borehole. Environmental samples (ES) were taken in polycarbonate pots and glass jars at regular intervals within made ground and into the top layer of the underlying naturally deposited soils. Samples of near surface soils were also screened on-site for volatile organic compounds, by head space testing, using a Photoionization Detector (PID). The results are presented in the remarks section on the exploratory hole records.

An immediate assessment of the apparent soil cohesion was undertaken at regular intervals where possible using a Pilcon hand shear vane (V) in clay soils. The hand vane results are presented on the respective window sample hole records.

Standard penetration tests (SPTs) were undertaken at regular intervals in order to give an indication of the in-situ density or strength of the material. Each test was made by driving a 50mm diameter solid cone (C) or similar diameter open shoe and split spoon sampler (S) into the soil at the base of the borehole by means of an automatic trip hammer weighing 63.50kg falling freely through 750mm. The penetration resistance was determined as the number of blows required to drive the tool the final 300mm of a total penetration of 450mm into the soil ahead of the window sample hole. The tabulated SPT results are presented to the rear of the window sample hole records, together with the calibration certificate for the SPT hammer used by the window sample rig (referenced as 110.82, Er=75%).

On completion, 50mm diameter gas or groundwater monitoring standpipes were installed in WS1 to WS4, WS6 and WS9 to depths between 1.70m and 3.10m with gravel response zone as instructed by the Engineer. Above and below this, the boreholes were backfilled with bentonite. A gas tap was installed in the top of each standpipe and protective stopcock cover was concreted into the ground flush with the surface over the installations. The remaining window sample holes (WS5, WS7 & WS8) were backfilled with bentonite and the surfaces were reinstated.

Foundation Inspection Pits

Two foundation inspection pits were excavated using long-handled hand digging equipment to depths of 1.50m (FIP1) and 2.45m (FIP2) on 10th December 2019. These were located by the Engineer in the southern part of the site to expose foundations of the existing Paediatric Ward. The surface layer of paving slabs at FIP1 were carefully lifted and placed to one side pending reinstatement.

The exposed strata were logged and the soils sampled by the supervising Geo-environmental Engineer.

Representative small (D) and bulk (B) disturbed samples of soil were taken at regular intervals. Environmental samples (ES) were taken in polycarbonate pots, glass jars and vials at regular intervals or selected depths as agreed with the client within made ground and the underlying naturally deposited soil. Samples of near surface soils were also screened on-site for volatile organic compounds, by head space testing, using a Photoionization Detector (PID). The results are presented in the remarks section on the exploratory hole records.

An immediate assessment of the apparent soil cohesion was undertaken at regular intervals where possible using a Pilcon hand shear vane (V) in clay soils.

Photographs of excavations were taken by the supervising Geo-environmental Engineer and are presented with the respective foundation inspection pit records, together with sketches of the foundations exposed. On completion, the spoil was returned to the excavations and placed in layers, which were recompactd. The surface paving slabs at FIP1 were reinstated.

Gas and Water Monitoring and Sampling

Three return visits were made on 17th December 2019, 10th and 14th January 2020 to monitor methane, carbon dioxide and oxygen gas levels in the standpipes using a GasData GFM 436 series gas monitor. Ambient pressures and flow rates were also recorded. A MiniRAE

3000 photo-ionisation detector (PID) was used to monitor for volatile organic compounds (VOCs). The groundwater levels in the standpipes and piezometers were also recorded.

An interface dip meter was employed to confirm the absence of dense and light non-aqueous phase liquids (DNAPLs/LNAPLs) in the standpipe installations and at two surface water sample locations (SW1 & SW2, marked on the exploratory hole location plan) along the course of the tributary stream. A YSI Pro Quatro Water Quality Meter was also employed to record the concentration of dissolved oxygen, conductivity, pH and water temperature at these surface water and standpipe positions.

Groundwater samples were obtained from the 50mm diameter standpipes, where possible (WS1 to WS4 & WS9), and surface water samples were obtained (SW1 and SW2) using nominated bailers during each visit, and were sealed within 1 litre glass bottles, plastic bottles and small glass vials.

The results of the monitoring visits are presented in Appendix 3.

Falling head permeability tests were undertaken during the second return monitoring visit in the WS1, WS3 and WS4 standpipes. Water was added to the standpipes and the test water level was monitored for a period of up to 2 hours. The permeability results are presented with the respective borehole records.

LABORATORY TESTING

The samples were inspected in the laboratory and assessments of the soil characteristics have been taken into account during preparation of the exploratory hole records. The soils have been described in accordance with BS5930:2015. The geotechnical and chemical testing schedules were devised by the Engineer. The testing was completed within UKAS accredited laboratories.

The geotechnical test results are presented in Appendix 4 whilst the results of the chemical tests are presented in Appendix 5.

Geotechnical Laboratory Testing

The samples recovered from the exploratory holes were tested in accordance with the recommendations of British Standard BS1377:1990 'Methods of tests for soils for civil engineering purposes' with the exceptions of water contents that were undertaken in accordance with BS EN ISO 17892-1 and concrete classification tests in accordance with BRE Special Digest 1 (SD1:2005).

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

The organic contents of selected samples were determined.

The particle size distributions of selected samples were obtained by sieve analysis. The particle size distribution passing the 63 μ m sieve was obtained for selected samples by pipette sedimentation. Results of these tests are given as particle size distribution curves at the end of this report. Where sieve analysis and sedimentation were carried out on the same sample, the results are presented as a single combined distribution curve.

Immediate undrained triaxial compression tests were made on selected undisturbed samples at single confining cell pressures specified by the Engineer. The moisture content and bulk density of the specimens were also determined.

Selected samples of soil and water were analysed to determine the concentration of soluble sulphates. The pH values were determined using an electrometric method. Selected samples of soil were also tested for total sulphur and acid soluble sulphate.

Chemical Laboratory Testing

The UKAS MCERTs accredited laboratory, Chemtest, was used for the analysis of soil and water samples recovered during the site work and subsequent monitoring visits.

Thirteen soil samples were tested for a suite that comprised arsenic, beryllium, boron, cadmium, chromium, nickel, lead, mercury, selenium, copper, vanadium, zinc, moisture content, speciated polycyclic aromatic hydrocarbons (PAH, USEPA 16), extractable petroleum hydrocarbons (EPH, banded >C6-C8, >C8-C10, >C10-C12, >C12-C16, >C16-C21 and >C21), total petroleum hydrocarbons (TPH >C6-C40), sulphate (total), sulphide, phenols monohydric (total of phenol, cresol and xylene), total cyanide and pH.

Twelve soil samples were tested for total organic carbon (TOC).

Twenty-two soil samples were also screened for the presence/absence of asbestos. Where detected in a single soil sample, asbestos identification and quantification was undertaken. Two soil samples were tested for speciated TPH Criteria Working Group (CWG).

Three soil samples were also tested for a Waste Acceptance Criteria (WAC) leachate suite and a full WAC solid soils suite.

Six water samples obtained during the first return visit (groundwater from WS1, WS2, WS4, WS9 and surface water from SW1 & SW2) and a single groundwater sample obtained during the second return visit (WS3) were tested for a suite that included arsenic, cadmium, chromium, copper, nickel, zinc, lead, mercury, boron, selenium, hexavalent chromium, total and free cyanide, thiocyanate, total PAH total TPH, total phenol, sulphate, sulphide, sulphur and pH.

Two surface water samples from the second visit (SW1 & SW2) were also tested for dissolved organic carbon (DOC), calcium and pH.

GROUND ENGINEERING LIMITED

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Appendix 1

Site Location Plan

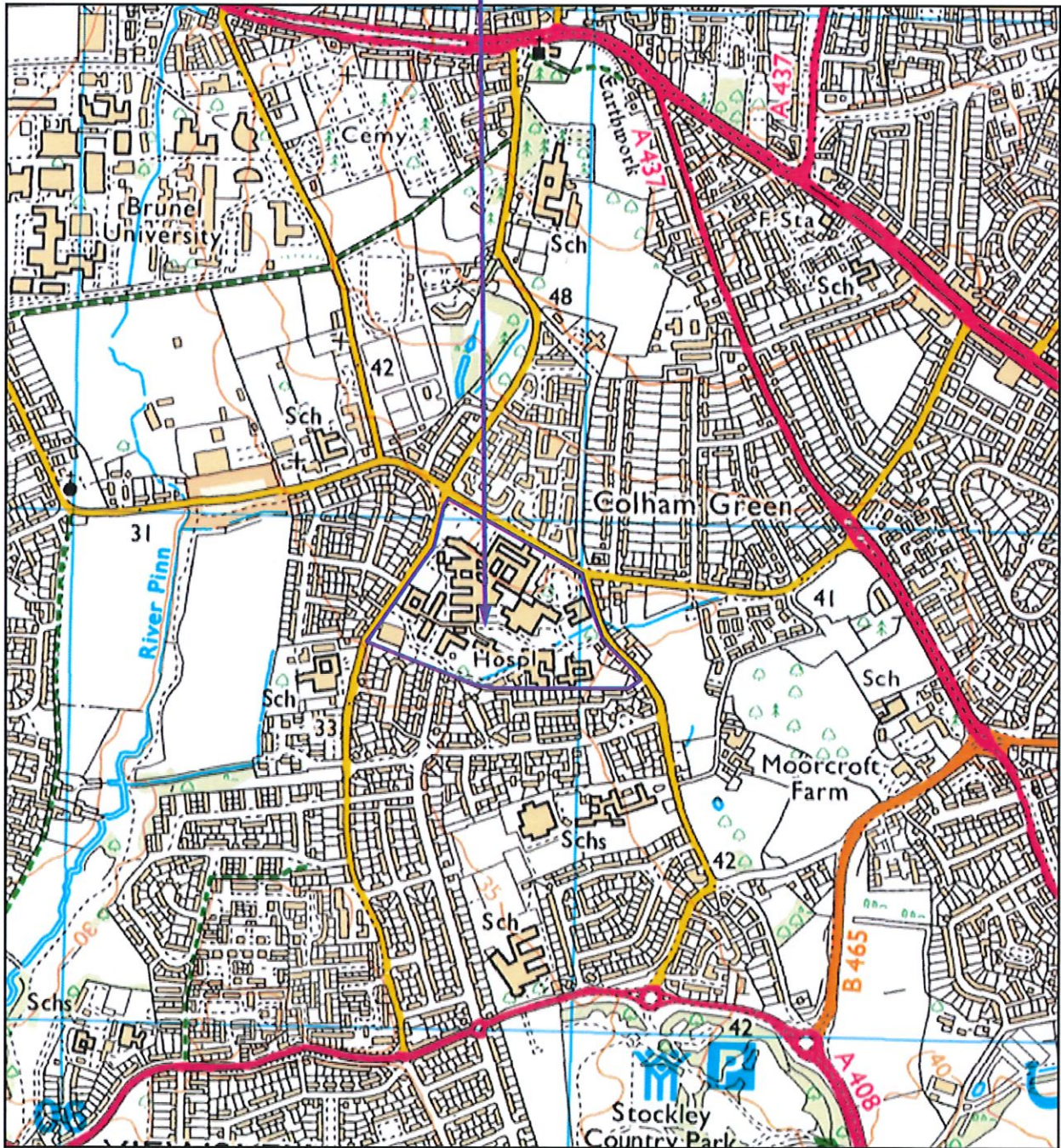
Exploratory Hole Location Plan

Site Location Plan

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SITE



Not to Scale

Project: Modular Wards, Hillingdon Hospital

Client: The Hillingdon Hospitals NHS Foundation Trust

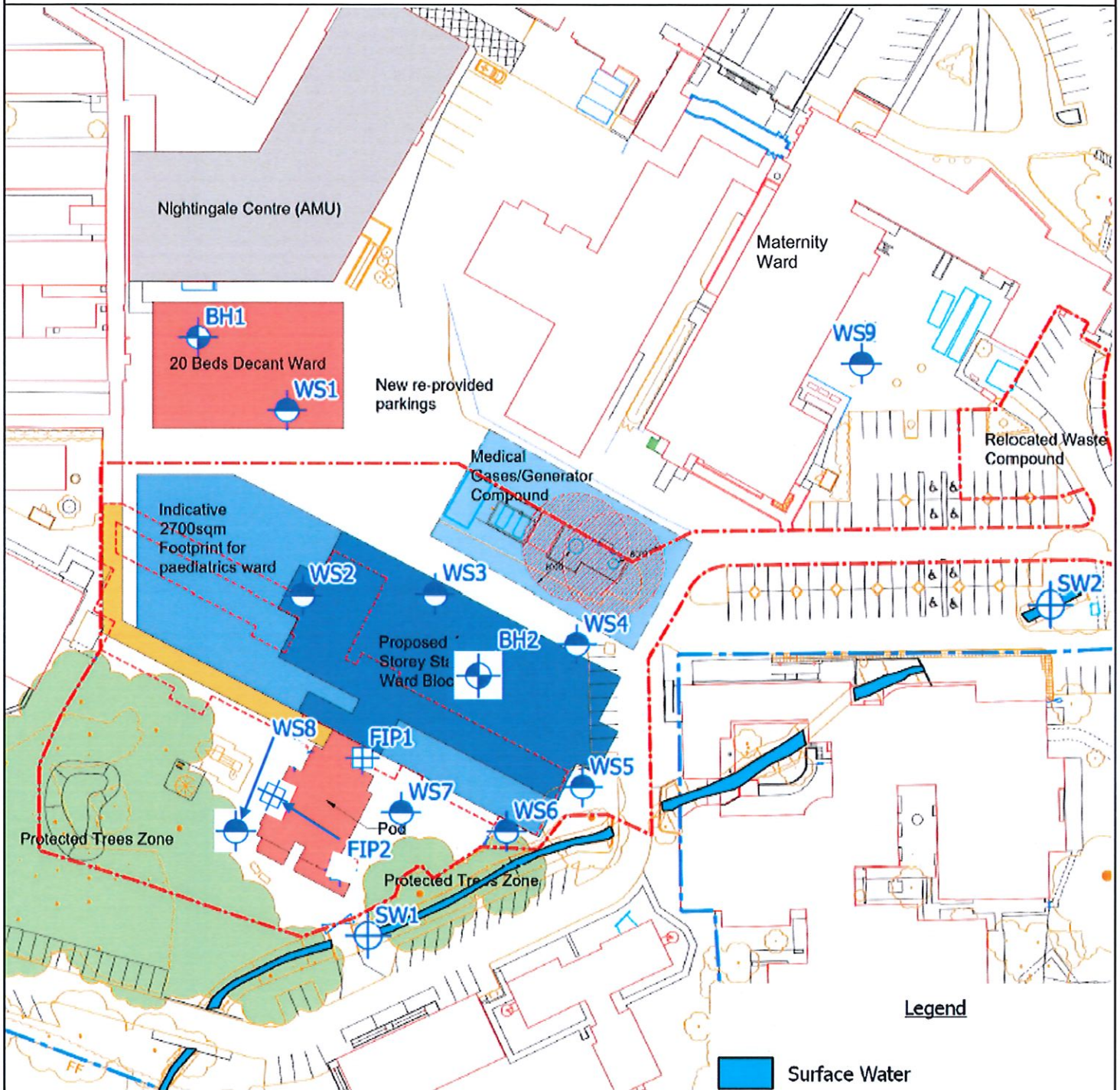
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Project No.
C14947

Exploratory Hole Location Plan

(Reproduced from a plan provided by the Engineer)



Legend



Surface Water

Proposed Exploratory Hole Locations



Borehole



Surface Water Sample



Window Sample



Foundation Inspection Pit



Not to Scale

Project: Modular Wards, Hillingdon Hospital
Client: The Hillingdon Hospitals NHS Foundation Trust

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Project No.
C14947

Appendix 2

Exploratory Hole Records

Falling Head Test Results

Tabulated SPT Results

SPT Calibration Certificates

Foundation Pit Sketches & Photographs

GROUND ENGINEERING LIMITED Tel: 01733-566566 www.groundengineering.co.uk			Site: MODULAR WARDS, HILLINGDON HOSPITAL				BOREHOLE BH1					
Date: 09/12/19 to 10/12/19			Hole Size: 150mm dia to 20.00m				506798 mE 181806 mN Ground Level: 37.20m. O.D.					
Samples and in-situ Tests			(Date)	Inst.	Description of Strata		Legend	Depth m	O.D. Level m			
Depth m	Type	Blows	Casing									
0.15-0.30	B1	N6	1.20		MADE GROUND - ASPHALT.			0.15	37.05			
0.20	ES1				MADE GROUND - CONCRETE.			0.30	36.90			
0.30	D1				MADE GROUND - Soft, brown, dark brown and orange brown mottled, slightly sandy, slightly gravelly, silty CLAY. Gravel of fine to coarse, angular to rounded flint, clinker, quartz, quartzite, concrete, glass and ash.							
0.40-0.80	B2											
0.50	ES2											
0.80-1.20	B3											
0.90	ES3	60	1.50		Stiff, brown, orange brown and grey mottled, slightly sandy, slightly gravelly, silty CLAY. Gravel of fine to coarse, angular to rounded flint, quartz and quartzite.			1.50	35.70			
1.20-1.50	B4											
1.35-1.65	C											
1.40	ES4											
1.50-1.70	B5											
1.70-2.10	U1							2.20	35.00			
2.20	D2	N10	1.50		Firm, becoming stiff, fissured, brown CLAY with occasional blue grey stained fissure planes, dead root traces, sand size selenite crystals and orange brown silt partings.							
2.70-3.20	B6											
2.85-3.15	S											
3.15	D3											
3.70-4.10	U2											
4.20	D4											
4.70-5.20	B7	N10	1.50									
4.85-5.15	S											
5.15	D5											
5.70	D6											
6.20-6.60	U3											
6.70	D7											
7.20	D8	N14	1.50									
7.70-8.20	B8											
7.85-8.15	S											
8.15	D9											
8.70	D10											
9.20-9.60	U4											
9.70	D11	65	1.50									
								10.00	27.20			
REMARKS 1. Excavating a pit from 0.00m to 1.20m for 1.50 hours 2. No live roots observed 3. Borehole cased to 1.50m depth 4. Head space testing ES2 to ES4 <0.1ppm VOCs 5. Gas monitoring standpipe installed to 1.50m depth with bentonite backfill below								Project No 14947				
								Scale 1:50	Page 1/2			
KEY			Groundwater Strikes				Groundwater Observations					
N/* - SPT Blows for 0.3m or given penetration			Depth m				Depth m					
D - Disturbed Sample			No	Struck	Rose to	Rate	Cased	Sealed	Date	Hole	Casing	Water
B - Bulk Sample ES - Environmental Sample			1	16.70		seepage	1.50	not	09/12/19	3.20	1.50	dry
U - Undisturbed Sample V - Vane Shear Test									10/12/19	3.20	1.50	dry
W - Water Sample Cohesion () kPa									10/12/19	20.00	1.50	dry
S/C - SPT Spoon/Cone									10/12/19	20.00	0.00	dry
Water Strike c/w Level casing withdrawn									17/12/19	1.50	0.50	dry
Water Rise w/s Standpipe Level												

GROUND ENGINEERING L I M I T E D Tel: 01733-566566 www.groundengineering.co.uk			Site: MODULAR WARDS, HILLINGDON HOSPITAL				BOREHOLE BH1					
			Date: 09/12/19 to 10/12/19		Hole Size: 150mm dia to 20.00m		506798 mE 181806 mN Ground Level: 37.20m. O.D.					
Samples and in-situ Tests			(Date)	Inst.	Description of Strata	Legend	Depth m	O.D. Level m				
Depth m	Type	Blows	Casing									
10.20	D12				Stiff, locally very stiff, fissured, brown grey CLAY with occasional grey silt partings. Gravel size pyrite nodule at 11.15m depth.		10.00	27.20				
10.70-11.20 10.85-11.15	B9 S	N16	1.50									
11.15	D13											
11.70	D14											
12.20-12.60	U5	65	1.50									
12.70	D15											
13.20	D16											
13.70-14.20 13.85-14.15	B10 S	N16	1.50									
14.15	D17											
14.70	D18											
15.20-15.60	U6	65	1.50		Stiff, fissured, brown grey, silty CLAY with occasional grey silt and fine sand partings.		16.70	20.50				
15.70	D19											
16.20	D20											
16.70-17.20 16.85-17.15	B11 S	N20	1.50									
17.15	D21											
17.70	D22											
18.20-18.60	U7	70	1.50									
18.70	D23											
19.20	D24											
19.50-20.00	B12											
19.65-20.15	S	N21	1.50				20.00	17.20				
19.95	D25											
REMARKS: Borehole completed at 20.00m depth						Project No 14947		Scale 1:50	Page 2/2			
KEY D - Disturbed Sample B - Bulk Sample U - Undisturbed Sample W - Water Sample S/C - SPT Spoon/Cone Water Strike Water Rise			N/* - SPT Blows for 0.3m or given penetration ES - Environmental Sample V - Vane Shear Test Cohesion () kPa Level on completion Level casing withdrawn Standpipe Level			Groundwater Strikes			Groundwater Observations			
						Depth m			Depth m			
						No	Struck	Rose to	Rate	Cased	Sealed	Date
						10/01/20	1.50	0.50	dry			
						14/01/20	1.50	0.00	dry			

Site MODULAR WARDS, HILLINGDON HOSPITAL

Client HILLINGDON HOSPITALS NHS FOUNDATION TRUST

Date 10/12/19

Type of Test Falling Head

Level
mOD

Depth of borehole during test, a : 3.20 m

Depth to equilibrium watertable, b : 3.20 m Assumed

Height of casing above ground level, c : 0.10 m

Depth of casing below ground level, d : 1.50 m

Length of response zone, Z : 1.70 m

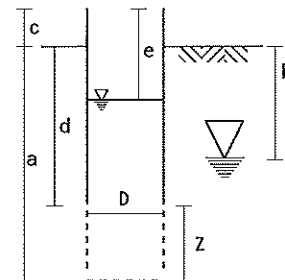
Diameter of response zone, D : 0.15 m

Intake factor, F : 3.4204

(From Condition D of fig. 7 BS5930:1981)

Soil Type at test level

Firm, brown and grey mottled CLAY



PERMEABILITY(after Hvorslev 1951)

Basic Time Lag Approach

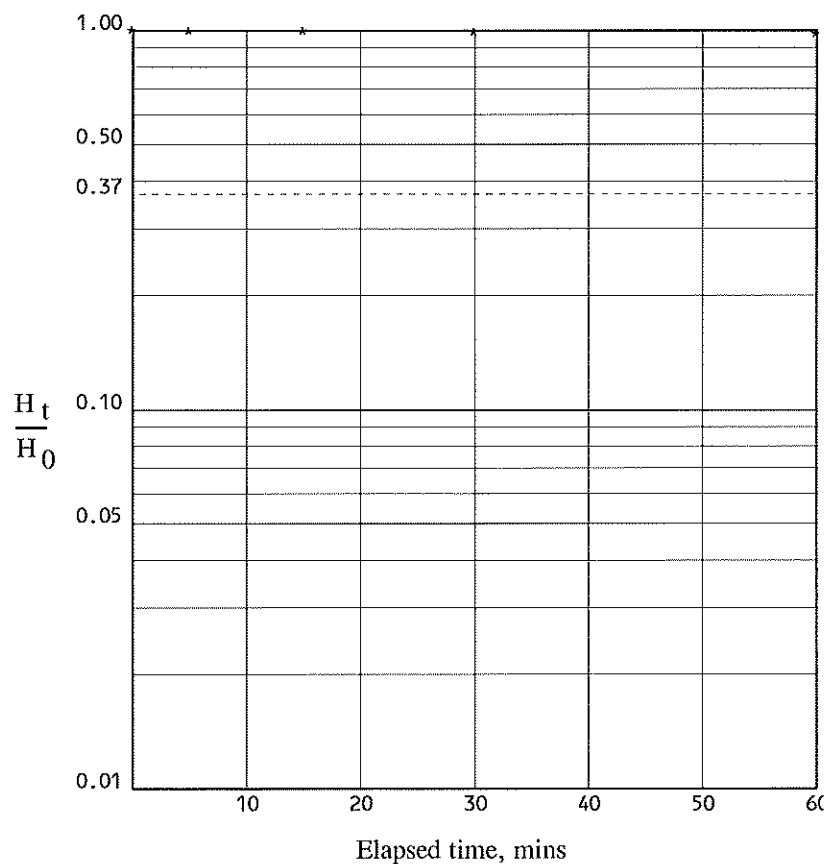
Plot $\log \frac{H_t}{H_0}$ v t *-----*

then

$$k = \frac{A}{60FT} \text{ m/s}$$

$$k = 5.47E-8 \text{ m/s}$$

Elapsed time, t mins	Depth to water, e m	Head of water, H m	Ht/Ho
0.00	0.00	3.30	1.000
5.00	0.02	3.29	0.997
15.00	0.03	3.28	0.994
30.00	0.05	3.25	0.985
60.00	0.08	3.22	0.976



REMARKS:

14947

In-Situ Permeability Test

Bh No

Fig No

BH1

GROUND ENGINEERING

L I M I T E D

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GROUND ENGINEERING			Site: MODULAR WARDS, HILLINGDON HOSPITAL				BOREHOLE BH2					
L I M I T E D Tel: 01733-566566 www.groundengineering.co.uk			Date: 11/12/19 to 13/12/19		Hole Size: 150mm dia to 20.00m		506851 mE 181745 mN Ground Level: 36.70m. O.D.					
Samples and in-situ Tests			(Date)	Description of Strata			Legend	Depth m	O.D. Level m			
Depth m	Type	Blows	Casing									
0.10 0.10 0.20 0.20 0.30-0.80 0.50 0.80-1.20 1.00	D1 ES1 D2 ES2 B1 ES3 B2 ES4			MADE GROUND - Firm, friable, dark brown, slightly gravelly, sandy, organic CLAY. Gravel of fine to coarse angular to sub-angular flint, brick and ash. MADE GROUND - Firm, locally soft, brown, dark brown and orange brown mottled, slightly sandy, gravelly, silty, slightly organic CLAY. Gravel of fine to coarse, angular to rounded flint, quartz, quartzite, brick, clinker and ash.				0.15	36.55			
1.20-1.70 1.35-1.65	B3 C	N5	1.20					1.70	35.00			
1.70 1.80-2.00 1.95-2.25 2.00-2.30 2.00 2.25 2.50-2.90	D3 B4 S B5 ES5 D4 U1	N9 55	1.50 2.50	Firm, locally soft, brown, grey and dark brown mottled, slightly gravelly, sandy, silty, slightly organic CLAY. Gravel of fine to coarse, angular to sub-rounded flint and quartzite.								
3.00 3.25 3.50-4.00 3.65-3.95	D5 D6 B6 C	 N9	 2.50	...Occasional dark green grey organic patches and organic odour below 3.00m depth.								
4.25 4.50-4.90	D7 U2	55	2.50	Firm, locally stiff, fissured, brown CLAY with occasional blue grey stained fissure planes, sand size selenite crystals and orange brown silt partings.				4.25	32.45			
5.00 5.50	D8 D9											
6.00-6.50 6.15-6.45 6.45	B7 S D10	N10	2.50									
7.00 7.50-7.80	D11 U3	60	2.50									
7.90 8.50	D12 D13			Stiff, fissured, brown grey CLAY with occasional grey silt partings.				8.00	28.70			
9.00-9.50 9.15-9.45 9.45	B8 S D14	N13	2.50									
10.00	D15							10.00	26.70			
REMARKS 1. Excavating a pit from 0.00m to 1.20m for 1 hour 2. Borehole cased to 2.50m depth 3. Head space testing ES1 to ES5 <0.1ppm VOCs 4. Borehole backfilled with bentonite on completion								Project No 14947				
								Scale 1:50	Page 1/2			
KEY			Groundwater Strikes				Groundwater Observations					
N/* - SPT Blows for 0.3m or given penetration			Depth m				Depth m					
D - Disturbed Sample B - Bulk Sample U - Undisturbed Sample W - Water Sample S/C - SPT Spoon/Cone ▽ Water Strike ▽ Water Rise			No	Struck	Rose to	Rate	Cased	Sealed	Date	Hole	Casing	Water
ES - Environmental Sample V - Vane Shear Test Cohesion () kPa Level on completion Level casing withdrawn Standpipe Level			1	3.50		seepage	2.50	not	11/12/19	12.50	2.50	dry
			2	5.50		seepage	2.50	not	12/12/19	12.50	2.50	9.00
			3	8.50		seepage	2.50	not	12/12/19	20.00	2.50	dry
			4	10.50		seepage	2.50	not	12/12/19	20.00	0.00	dry
			5	16.50		seepage	2.50	not				

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Date: 11/12/19
to 13/12/19

506851 mE 181745 mN
Ground
Level: 36.70m. O.D.

REMARKS	Borehole completed at 20.00m depth	Project No 14947	
		Scale 1:50	Page 2/2

[illegible]

Site MODULAR WARDS, HILLINGDON HOSPITAL			
Client HILLINGDON HOSPITALS NHS FOUNDATION TRUST			
Date 11/12/19	Type of Test Falling Head		Level mOD

Depth of borehole during test, a : 3.20 m

Depth to equilibrium watertable, b : 3.20 m Assumed

Height of casing above ground level, c : 0.40 m

Depth of casing below ground level, d : 1.10 m

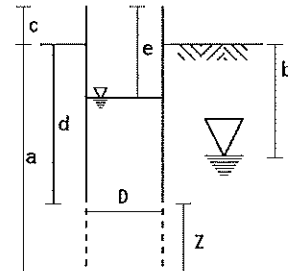
Length of response zone, Z : 2.10 m

Diameter of response zone, D : 0.15 m

Intake factor, F : 3.9582
(From Condition D of fig. 7 BS5930:1981)

Soil Type at test level

Firm, brown and grey mottled, slightly gravelly CLAY.



PERMEABILITY(after Hvorslev 1951)

Basic Time Lag Approach

Plot $\log \frac{H_t}{H_0}$ v t *-----*

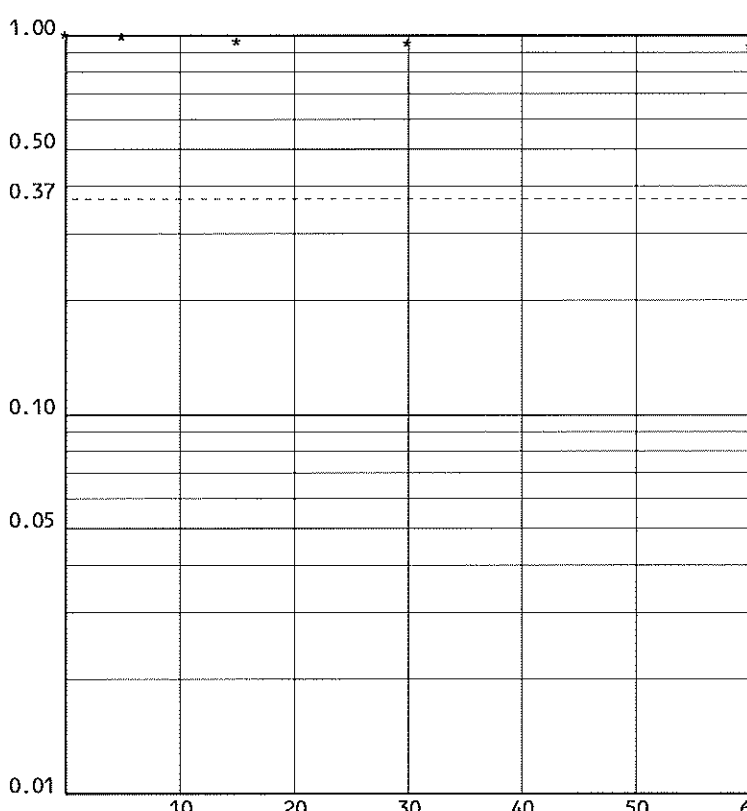
then

$$k = \frac{A}{60FT} \text{ m/s}$$

$k = 1.36E-7 \text{ m/s}$

Elapsed time, t mins	Depth to water, e m	Head of water, H m	Ht/Ho
0.00	0.00	3.60	1.000
5.00	0.05	3.55	0.986
15.00	0.14	3.46	0.961
30.00	0.18	3.42	0.950
60.00	0.25	3.35	0.931

$\frac{H_t}{H_0}$



REMARKS:	14947
In-Situ Permeability Test	Bh No BH2 Fig No .

Borehole Number	Depth (m)	Casing Depth (m)	Depth to Water (m)	Type of Test *	Seating Drive Blows/ Penetration (mm)	Test Drive: 300mm Blows for each successive 75 mm Penetration				N Value	Extra-polated Value
BH1	1.20 - 1.65	1.20		C	2/150	1	0	2	3	6	
	2.70 - 3.15	1.50		S	2/150	2	2	3	3	10	
	4.70 - 5.15	1.50		S	3/150	2	2	3	3	10	
	7.70 - 8.15	1.50		S	3/150	3	3	4	4	14	
	10.70 - 11.15	1.50		S	3/150	3	4	4	5	16	
	13.70 - 14.15	1.50		S	4/150	3	4	4	5	16	
	16.70 - 17.15	1.50		S	4/150	4	5	5	6	20	
	19.50 - 20.15	1.50		S	5/150	4	5	6	6	21	
BH2	1.20 - 1.65	1.20		C	2/150	1	1	1	2	5	
	1.80 - 2.25	1.50		S	2/150	1	2	3	3	9	
	3.50 - 3.95	2.50		C	2/150	2	2	3	2	9	
	6.00 - 6.45	2.50		S	2/150	2	2	3	3	10	
	9.00 - 9.45	2.50		S	3/150	2	3	4	4	13	
	12.00 - 12.45	2.50		S	3/150	3	3	4	5	15	
	15.00 - 15.45	2.50		S	3/150	3	3	4	5	15	
	18.00 - 18.45	2.50		S	3/150	4	4	5	6	19	

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* C denotes test using a solid cone
S denotes test using a split barrel sampler

Results of Standard/Cone Penetration Tests

14947

Table No

MODULAR WARDS, HILLINGDON HOSPITAL



SPT Hammer Energy Test Report

in accordance with BSEN ISO 22476-3:2005

Borehole Calibration & Testing Ltd
Unit 8
Orton Enterprise Centre
Orton Southgate
Peterborough
PE2 6XU

SPT Hammer Ref: GE01
Test Date: 25/04/2019
Report Date: 25/04/2019
File Name: GE01.spt
Test Operator: CR

Instrumented Rod Data

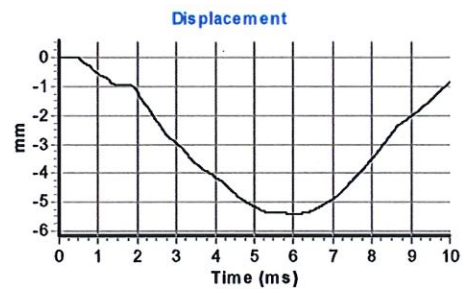
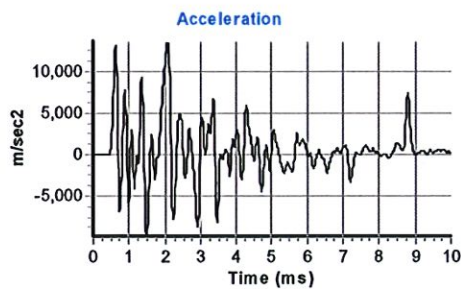
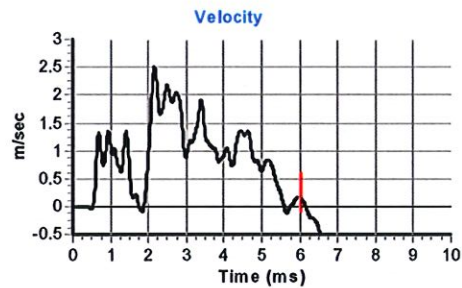
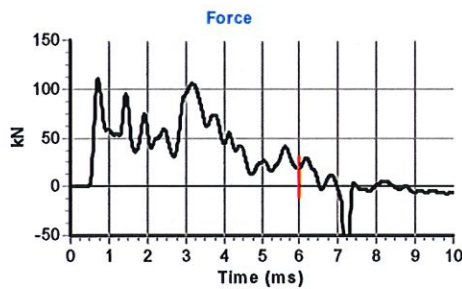
Diameter d_r (mm): 54
Wall Thickness t_r (mm): 6.3
Assumed Modulus E_a (GPa): 208
Accelerometer No.1: 11941
Accelerometer No.2: 11942

SPT Hammer Information

Hammer Mass m (kg): 63.5
Falling Height h (mm): 760
SPT String Length L (m): 15.0

Comments / Location

Recommended calibration interval is 6 months



Calculations

Area of Rod A (mm²): 944
Theoretical Energy E_{theor} (J): 473
Measured Energy E_{meas} (J): 308

Energy Ratio E_r (%):

65

CR

Signed: CR

Title: Operator

GROUND ENGINEERING LIMITED Tel: 01733-566566 www.groundengineering.co.uk			Site: MODULAR WARDS, HILLINGDON HOSPITAL			WINDOW SAMPLE WS1 506816 mE 181792 mN Ground Level: 36.80m. O.D.				
Samples and in-situ Tests			Date: 11/12/19			Hole Size: 87mm dia to 2.00m 67mm dia to 4.00m 57mm dia to 5.45m				
			(Date)	Inst.	Description of Strata		Legend	Depth m	O.D. Level m	
Depth m	Type	Result	Water							
0.30	D1				MADE GROUND - ASPHALT.			0.10	36.70	
0.30	ES1				MADE GROUND - Brown, slightly silty SAND AND GRAVEL. Gravel of fine to coarse, angular brick, concrete, asphalt and limestone.			0.40	36.40	
0.60	D2				MADE GROUND - Dark brown and brown, clayey SAND AND GRAVEL. Gravel of fine to coarse, angular to sub-rounded flint, brick, concrete, quartz, quartzite and ash.			0.70	36.10	
0.60	ES2				Grey, very clayey, sandy, slightly organic GRAVEL. Gravel of fine to coarse, angular to sub-rounded flint, brick, concrete, quartz, quartzite and ash.			1.00	35.80	
0.90	D3				Grey, very clayey, sandy, slightly organic GRAVEL. Gravel of fine to coarse, angular to rounded flint, quartz and quartzite.					
0.90	ES3				Medium dense, brown, grey and orange brown, clayey, sandy GRAVEL. Gravel of fine to coarse, angular to rounded flint, quartz and quartzite.					
1.20	D4									
1.20-2.00	U1									
1.35-1.65	C	N20								
2.15-2.45	C	N12	2.00							
2.55	V1	(89)			Stiff, brown, orange brown and grey mottled, slightly sandy, slightly gravelly, silty CLAY. Gravel of fine to coarse angular to rounded flint, quartz and quartzite			2.50	34.30	
2.70	V2	(90)								
2.90	V3	(80)								
3.00	D5									
3.00-4.00	U2									
3.15-3.45	S	N16	3.00							
3.50	D6									
3.50	V4	(45)								
3.70	V5	(96)								
3.90	V6	(93)								
4.00	D7									
4.00-5.00	U3				Firm, becoming stiff, fissured, brown CLAY with occasional blue grey stained fissure planes, dead root traces, sand size selenite crystals and orange brown silt partings.					
4.15-4.45	V7	(93)								
4.50	S	N19	3.00							
4.50	D8									
4.50	V8	(60)								
5.00	D9									
5.15-5.45	S	N18	3.00							
					Hole completed at 5.45m depth			5.45	31.35	

Site MODULAR WARDS, HILLINGDON HOSPITAL

Client HILLINGDON HOSPITALS NHS FOUNDATION TRUST

Date 10/01/20

Type of Test Falling Head

Level
mOD 36.80

Depth of borehole during test, a : 2.50 m

Depth to equilibrium watertable, b : 0.92 m Measured

Height of casing above ground level, c : 0.00 m

Depth of casing below ground level, d : 1.00 m

Length of response zone, Z : 1.50 m

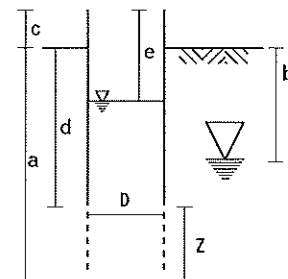
Diameter of response zone, D : 0.09 m

Intake factor, F : 2.6871

(From Condition D of fig. 7 BS5930:1981)

Soil Type at test level

Medium dense, brown, grey and orange brown,
clayey, sandy GRAVEL.



PERMEABILITY(after Hvorslev 1951)

Basic Time Lag Approach

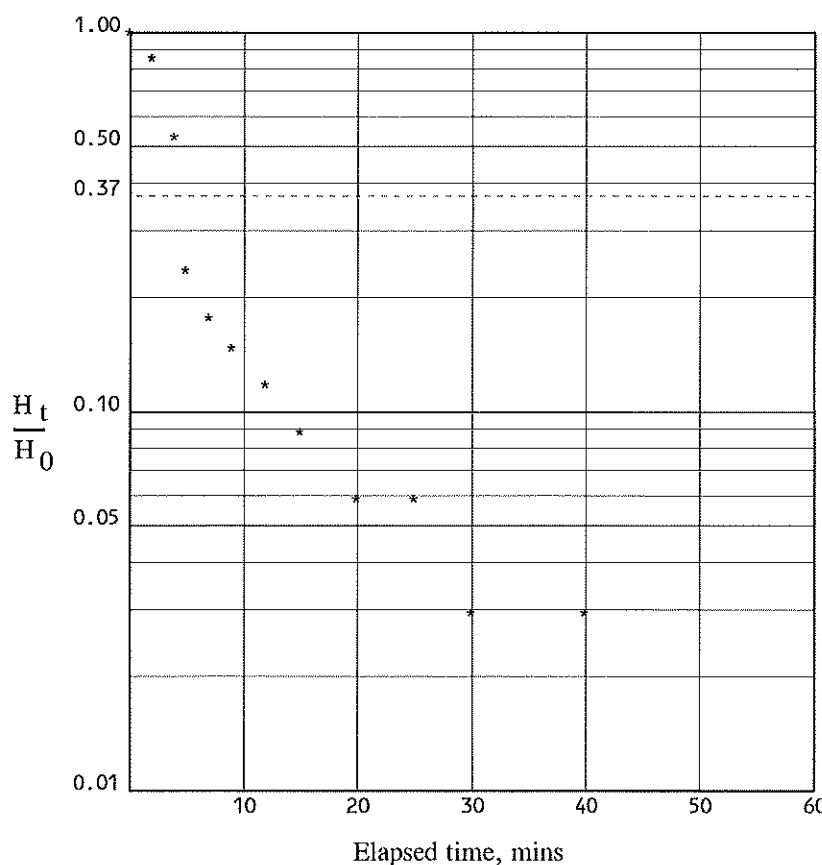
Plot $\log \frac{H_t}{H_0}$ v t *-----*

then

$$k = \frac{A}{60FT} \text{ m/s}$$

$$k = 8.77E-6 \text{ m/s}$$

Elapsed time, t mins	Depth to water, e m	Head of water, H m	Ht/Ho
0.00	0.58	0.34	1.000
2.00	0.63	0.29	0.853
4.00	0.74	0.18	0.529
5.00	0.84	0.08	0.235
7.00	0.86	0.06	0.176
9.00	0.87	0.05	0.147
12.00	0.88	0.04	0.118
15.00	0.89	0.03	0.088
20.00	0.90	0.02	0.059
25.00	0.90	0.02	0.059
30.00	0.91	0.01	0.029
40.00	0.91	0.01	0.029
50.00	0.92	0.00	0.000
60.00	0.92	0.00	0.000



REMARKS: Falling head test undertaken in standpipe

14947

In-Situ Permeability Test

Bh No

Fig No

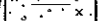
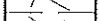
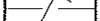
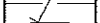
WS1

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GROUND ENGINEERING LIMITED Tel: 01733-566566 www.groundengineering.co.uk			Site: MODULAR WARDS, HILLINGDON HOSPITAL				WINDOW SAMPLE WS2					
Date: 12/12/19			Hole Size: 87mm dia to 2.00m 67mm dia to 4.00m 57mm dia to 5.45m				506820 mE 181758 mN Ground Level: 36.70m. O.D.					
Samples and in-situ Tests			(Date)	Inst.	Description of Strata	Legend	Depth m	O.D. Level m				
Depth m	Type	Result	Water									
0.30	D1			1	MADE GROUND - ASPHALT.		0.10	36.60				
0.30	ES1				MADE GROUND - Grey and red brown, slightly silty, sandy GRAVEL. Gravel of fine to coarse, angular asphalt, brick, concrete and flint.		0.50	36.20				
0.60	D2				MADE GROUND - Firm, becoming soft, brown, grey and dark brown mottled, slightly gravelly, sandy, silty, slightly organic CLAY. Gravel of fine to coarse, angular to sub-rounded brick, clinker, flint, quartz and quartzite.		0.70	36.00				
0.60	ES2						1.00	35.70				
0.90	D3											
0.90	ES3											
1.10	D4											
1.20	D5											
1.20-2.00	U1											
1.35-1.65	S	N22										
2.00-3.00	U2											
2.15-2.45	C	N11					2.20	34.50				
2.50	D6				Firm, brown, grey and orange brown mottled, slightly sandy, slightly gravelly CLAY. Gravel of fine to medium, angular flint.		2.60	34.10				
2.70	V1	(68)			Firm, locally stiff, fissured, brown CLAY with occasional blue grey stained fissure planes, dead roots traces, sand size selenite crystals and orange brown silt partings.							
2.90	V2	(64)										
3.00	D7											
3.00-4.00	U3											
3.15-3.45	S	N10	2.00									
3.50	D8											
3.60	V3	(70)										
3.75	V4	(90)										
3.90	V5	(80)										
4.00	D9											
4.00-5.00	U4											
4.15-4.45	S	N15	2.00									
4.30	V6	(60)										
4.50	D10											
4.50	V7	(70)										
4.70	V8	(74)										
4.90	V9	(58)										
5.00	D11											
5.15-5.45	S	N16	2.00				5.45	31.25				
					Hole completed at 5.45m depth							
REMARKS												
1. Starter pit excavated from 0.00m to 1.20m depth												
2. Borehole cased to 2.00m depth												
3. No live roots observed												
4. Head space testing on ES1 to ES3 <0.1ppm VOCs												
5. Groundwater monitoring standpipe installed to 2.70m depth												
							Project No 14947					
							Scale 1:50	Page 1/1				
KEY			Groundwater Strikes				Groundwater Observations					
D - Disturbed Sample			Depth m				Depth m					
B - Bulk Sample			No	Struck	Rose to	Rate	Cased	Sealed	Date	Hole	Casing	Water
U - Undisturbed Sample												
W - Water Sample												
WS Water Strike												
WC Depth to Water on completion												
J - Jar Sample												
M - Mackintosh Probe												
V - Vane Shear Test												
Cohesion () kPa												
P() - Hand Penetrometer												
Cohesion () kPa												
S Standpipe Level												
			1	1.50		seepage			12/12/19	5.45	2.00	dry
									12/12/19	5.45	0.00	dry
									17/12/19	2.70	1.00	1.35
									17/12/19	2.70	1.00	1.47
									14/01/19	2.70	1.00	1.47

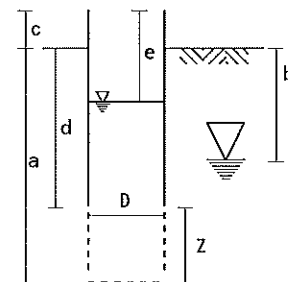
Site MODULAR WARDS, HILLINGDON HOSPITAL

Client HILLINGDON HOSPITALS NHS FOUNDATION TRUST

Date 10/01/20 Type of Test Falling Head

Level
mod 36.70

Depth of borehole during test, a : 2.70 m
Depth to equilibrium watertable, b : 1.47 m Measured
Height of casing above ground level, c : 0.00 m
Depth of casing below ground level, d : 1.00 m
Length of response zone, Z : 1.70 m
Diameter of response zone, D : 0.09 m



Intake factor, F : 2.9406
(From Condition D of fig. 7 BS5930:1981)

Soil Type at test level

Medium dense, orange brown and grey, clayey,
sandy GRAVEL.

PERMEABILITY(after Hvorslev 1951)

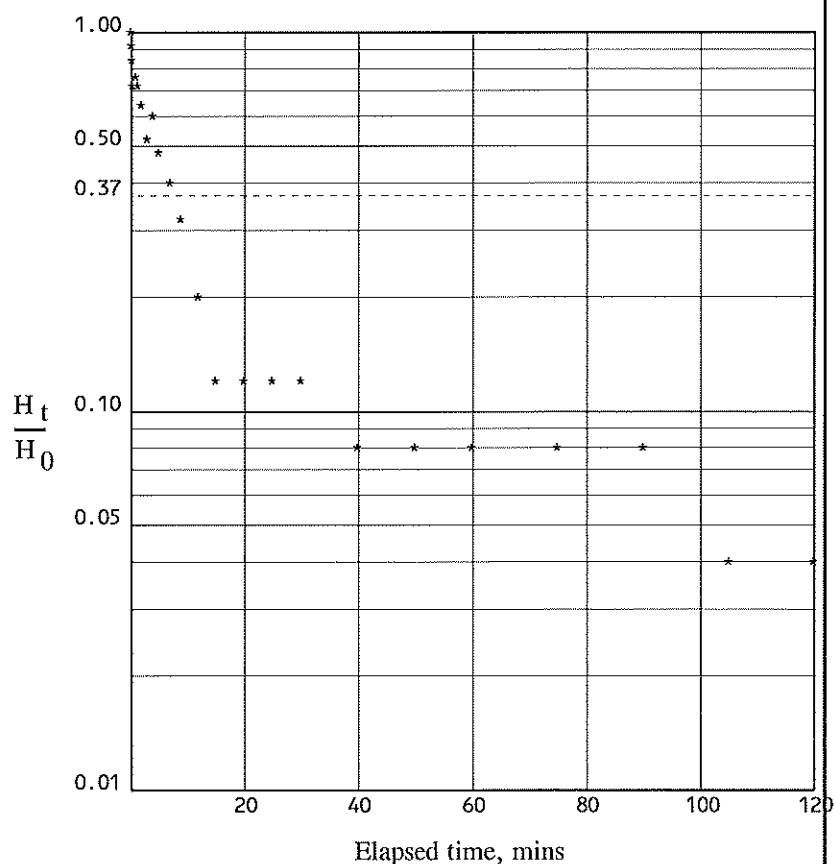
Basic Time Lag Approach

Plot $\log \frac{H_t}{H_0}$ v t *-----*

then
 $k = \frac{A}{60FT} \text{ m/s}$

$k = 3.43E-6 \text{ m/s}$

Elapsed time, t mins	Depth to water, e m	Head of water, H m	Ht/Ho
0.10	1.22	0.25	1.000
0.20	1.24	0.23	0.920
0.30	1.26	0.21	0.840
0.45	1.29	0.18	0.720
1.00	1.28	0.19	0.760
1.30	1.29	0.18	0.720
2.00	1.31	0.16	0.640
3.00	1.34	0.13	0.520
4.00	1.32	0.15	0.600
5.00	1.35	0.12	0.480
7.00	1.37	0.10	0.400
9.00	1.39	0.08	0.320
12.00	1.42	0.05	0.200
15.00	1.44	0.03	0.120
20.00	1.44	0.03	0.120
25.00	1.44	0.03	0.120
30.00	1.44	0.03	0.120
40.00	1.45	0.02	0.080
50.00	1.45	0.02	0.080
60.00	1.45	0.02	0.080
75.00	1.45	0.02	0.080
90.00	1.45	0.02	0.080
105.00	1.46	0.01	0.040
120.00	1.46	0.01	0.040



REMARKS: Falling head test undertaken in standpipe

14947

In-Situ Permeability Test

Bh No

Fig No

WS2

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Date: 12/12/19

Hole Size: 87mm dia to 2.00m
67mm dia to 4.00m
57mm dia to 5.45m

506840 mE 181758 mN
Ground
Level: 37.20m. O.D.

REMARKS	1. Starter pit excavated from 0.00m to 1.20m depth 2. No live roots observed 3. Head space testing ES1 to ES5 <0.1ppm VOCs 4. Gas monitoring standpipe installed to 1.70m depth 5. Standpipe not monitored on 14/01/20 due to badly parked car covering installation	Project No 14947	
		Scale 1:50	Page 1/1

KEY		Groundwater Strikes						Groundwater Observations			
		Depth m						Depth m			
		No	Struck	Rose to	Rate	Cased	Sealed	Date	Hole	Casing	Water
D - Disturbed Sample	J - Jar Sample										
B - Bulk Sample	M - Mackintosh Probe										
U - Undisturbed Sample	V - Vane Shear Test										
W - Water Sample	Cohesion () kPa										
⊘ Water Strike	P() - Hand Penetrometer										
▼c Depth to Water on completion	Cohesion () kPa										
	Standpipe Level										

GROUND ENGINEERING LIMITED Tel: 01733-666566 www.groundengineering.co.uk			Site: MODULAR WARDS, HILLINGDON HOSPITAL			WINDOW SAMPLE WS4				
Date: 11/12/19			Hole Size: 87mm dia to 2.00m 67mm dia to 4.00m 57mm dia to 5.45m			506868 mE 181755 mN Ground Level: 37.05m. O.D.				
Samples and in-situ Tests			(Date)	Inst.	Description of Strata	Legend	Depth m	O.D. Level m		
Depth m	Type	Result	Water							
0.30	D1				MADE GROUND - ASPHALT.		0.40	36.65		
0.30	ES1									
0.50	D2									
0.50	ES2									
0.80	D3									
0.80	ES3									
1.10	D4									
1.10	ES4									
1.20	D5									
1.20-2.00	U1						1.20	35.85		
1.35-1.65	S	N5								
1.50	D6									
1.70	V1	(46)								
1.90	V2	(41)								
2.00	D7									
2.00-3.00	U2									
2.15-2.45	S	N6								
2.50	D8									
2.60	V3	(57)								
2.80	V4	(59)								
3.00	D9									
3.00-4.00	U3									
3.15-3.45	S	N8								
3.50	D10									
3.50	V5	(61)								
3.60	V6	(70)								
3.80	V7	(90)								
4.00	D11									
4.00-5.00	U4									
4.15-4.45	S	N15								
4.50	D12									
4.60	V8	(89)								
4.80	V9	(117)								
4.90	V10	(116)								
5.00	D13									
5.15-5.45	S	N20								
							5.45	31.60		
					Hole completed at 5.45m depth					
REMARKS								Project No		
1. Starter pit excavated from 0.00m to 1.20m depth								14947		
2. Groundwater monitoring standpipe installed to 3.10m depth										
3. No live roots observed										
4. Head space testing ES1 to ES4 <0.1ppm VOCs										
								Scale		
								1:50		
								Page		
								1/1		
KEY			Groundwater Strikes				Groundwater Observations			
D - Disturbed Sample			J - Jar Sample				Date			
B - Bulk Sample			M - Mackintosh Probe				Hole			
U - Undisturbed Sample			V - Vane Shear Test				Casing			
W - Water Sample			Cohesion () kPa				Water			
⚡ Water Strike			P () - Hand Penetrometer							
⚡c Depth to Water on completion			Cohesion () kPa							
			⚡s Standpipe Level							
			No Struck							
			Rose to							
			Rate							
			Cased							
			Sealed							
			1				3.00			
			seepage							
			11/12/19				5.45			
			17/12/19				3.10			
			10/01/20				3.10			
			14/01/20				3.10			
							dry			
							0.43			
							0.25			
							0.19			

Site MODULAR WARDS, HILLINGDON HOSPITAL

Client HILLINGDON HOSPITALS NHS FOUNDATION TRUST

Date 10/01/20

Type of Test Falling Head

Level
mOD 37.05

Depth of borehole during test, a : 3.10 m

Depth to equilibrium watertable, b : 0.19 m Measured

Height of casing above ground level, c : 0.00 m

Depth of casing below ground level, d : 1.00 m

Length of response zone, Z : 2.10 m

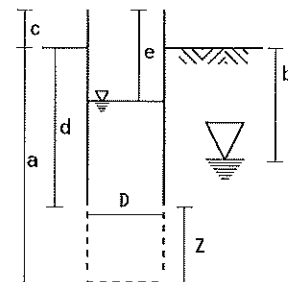
Diameter of response zone, D : 0.09 m

Intake factor, F : 3.433

(From Condition D of fig. 7 BS5930:1981)

Soil Type at test level

Firm, brown and orange brown mottled, slightly sandy, slightly gravelly CLAY.



PERMEABILITY(after Hvorslev 1951)

Basic Time Lag Approach

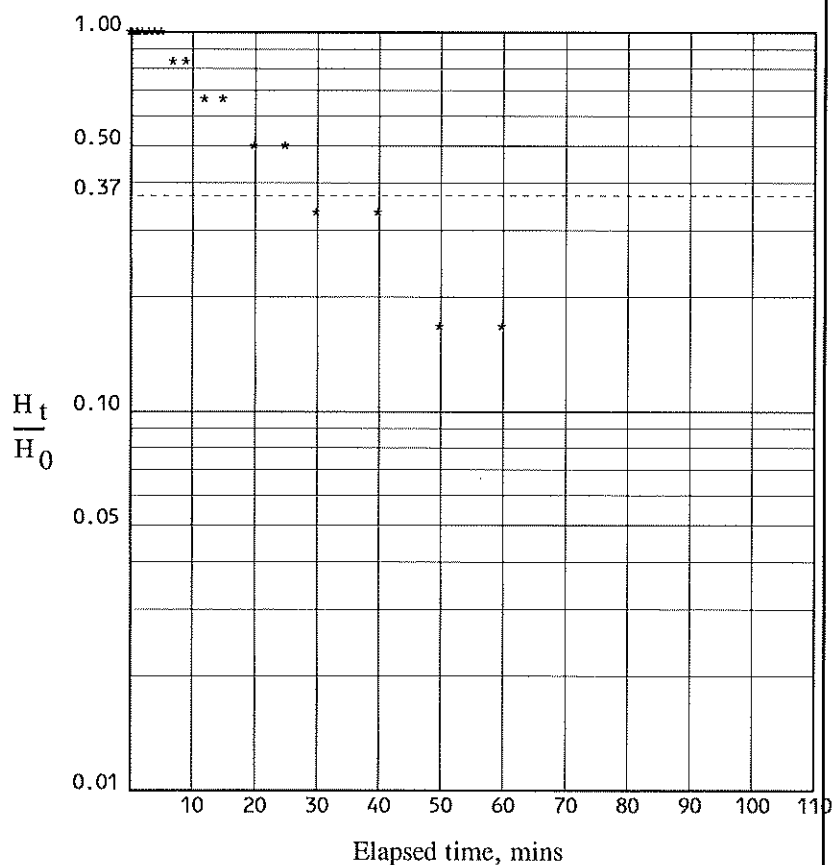
Plot $\log \frac{H_t}{H_0}$ v t *-----*

then

$$k = \frac{A}{60FT} \text{ m/s}$$

$$k = 1.10E-6 \text{ m/s}$$

Elapsed time, t mins	Depth to water, e m	Head of water, H m	Ht/Ho
0.10	0.13	0.06	1.000
0.20	0.13	0.06	1.000
0.30	0.13	0.06	1.000
0.45	0.13	0.06	1.000
1.00	0.13	0.06	1.000
1.30	0.13	0.06	1.000
2.00	0.13	0.06	1.000
3.00	0.13	0.06	1.000
4.00	0.13	0.06	1.000
5.00	0.13	0.06	1.000
7.00	0.14	0.05	0.833
9.00	0.14	0.05	0.833
12.00	0.15	0.04	0.667
15.00	0.15	0.04	0.667
20.00	0.16	0.03	0.500
25.00	0.16	0.03	0.500
30.00	0.17	0.02	0.333
40.00	0.17	0.02	0.333
50.00	0.18	0.01	0.167
60.00	0.18	0.01	0.167
75.00	0.19	0.00	0.000
90.00	0.19	0.00	0.000
105.00	0.19	0.00	0.000



REMARKS: Falling head test undertaken in standpipe.

14947

In-Situ Permeability Test

Bh No

Fig No

WS4

GROUND ENGINEERING

L I M I T E D

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www.aroundanengineerina.co.uk

GROUND ENGINEERING LIMITED Tel: 01733-566566 www.groundengineering.co.uk			Site: MODULAR WARDS, HILLINGDON HOSPITAL				WINDOW SAMPLE WS5					
			Date: 11/12/19		Hole Size: 87mm dia to 2.00m 77mm dia to 3.00m 57mm dia to 5.45m		506869 mE 181725 mN Ground Level: 36.75m. O.D.					
Samples and in-situ Tests			(Date) Water	Description of Strata	Legend	Depth m	O. D. Level m					
Depth m	Type	Result										
0.20 0.20 0.50 0.50	D1 ES1 D2 ES2			MADE GROUND - Soft, friable, dark brown and grey mottled, slightly sandy, slightly gravelly, silty CLAY. Gravel of fine to coarse, angular to sub-angular flint, brick and ash.		0.30	36.45					
0.90 0.90 1.20 1.20-2.00 1.35-1.65 1.50 1.70	D3 ES3 D4 U1 S D5 V1	N17 (86)		MADE GROUND - Soft, locally firm, brown, slightly sandy, slightly gravelly, silty CLAY. Gravel of fine to coarse, angular to rounded flint, quartz, quartzite, clinker, brick, chalk, wood fragments and ash.		1.30	35.45					
1.90 1.90 2.00-3.00 2.00 2.15-2.45 2.60	D6 V2 U2 D7 S V3	(52)		Stiff, brown, orange brown and dark brown mottled, slightly gravelly, sandy, silty, slightly organic to organic CLAY with occasional black organic patches. Gravel of fine to medium, angular to sub-rounded flint.		1.85	34.90					
				Firm, brown, slightly sandy, gravelly CLAY. Gravel of fine to coarse, angular to rounded flint, quartz and quartzite.		2.00	34.75					
				Stiff, fissured, brown CLAY with occasional blue grey stained fissure planes, dead root traces, sand size selenite crystals and orange brown silt partings.								
2.90 3.00-4.00 3.00 3.15-3.45 3.30 3.50	D8 U3 D9 S V4 D10	N17 (102)										
3.80 3.90 4.00-5.00 4.00 4.15-4.45 4.50 4.50	V5 D11 U4 D12 S D13 V6	(94)										
4.90 4.95 5.00 5.15-5.45	D14 V7 D15 S	(106)				5.45	31.30					
				Hole completed at 5.45m depth								
REMARKS 1. Starter pit excavated from 0.00m to 1.20m depth 2. Live roots observed to 1.30m depth 3. Head space testing ES1 to ES3 <0.1ppm VOCs							Project No 14947					
							Scale 1:50	Page 1/1				
KEY D - Disturbed Sample J - Jar Sample B - Bulk Sample M - Mackintosh Probe U - Undisturbed Sample V - Vane Shear Test W - Water Sample Cohesion () kPa ∇ Water Strike P () - Hand Penetrometer ∇c Depth to Water Cohesion () kPa on completion ∇s Standpipe Level			Groundwater Strikes				Groundwater Observations					
			Depth m						Depth m			
			No	Struck	Rose to	Rate	Cased	Sealed	Date	Hole	Casing	Water
						11/12/19	5.45		dry			

GROUND ENGINEERING LIMITED Tel: 01733-566566 www.groundengineering.co.uk			Site: MODULAR WARDS, HILLINGDON HOSPITAL			WINDOW SAMPLE WS6						
Date: 09/12/19			Hole Size: 87mm dia to 2.00m 77mm dia to 3.00m 57mm dia to 5.45m			506856 mE 181717 mN Ground Level: 36.75m. O.D.						
Samples and in-situ Tests			(Date)	Inst.	Description of Strata	Legend	Depth m	O.D. Level m				
Depth m	Type	Result	Water									
0.20	D1				MADE GROUND - CONCRETE paving slab.		0.05	36.70				
0.20	ES1				MADE GROUND - Orange brown SAND.		0.10	36.65				
0.45	D2				MADE GROUND - Soft, brown and yellow brown mottled, slightly sandy, slightly gravelly CLAY. Gravel of fine to coarse, angular to rounded flint, quartz, quartzite, brick and ash.		0.40	36.35				
0.45	ES2				MADE GROUND - Soft, brown, sandy, gravelly, clayey SILT with occasional cobbles of brick and concrete.		1.00	35.75				
0.75	D3				Gravel of fine to coarse, angular to rounded flint, quartz, quartzite, brick, concrete and ash.		1.20	35.55				
0.75	ES3				... Boulder of concrete at 0.60m depth.							
0.90	D4				Stiff, friable, brown, dark brown and grey mottled, slightly gravelly, sandy, silty, slightly organic clay with occasional dead roots. Gravel of fine to coarse, angular to sub-rounded flint and quartzite.		2.00	34.75				
0.90	ES4				Medium dense, brown, orange brown and light brown, clayey, sandy GRAVEL. Gravel of fine to coarse, angular to rounded flint, quartz and quartzite.							
1.10	D5				Very stiff, brown, orange brown and grey mottled, slightly sandy, gravelly CLAY. Gravel of fine to coarse, angular to rounded flint, quartz and quartzite.		2.90	33.85				
1.20	D6											
1.20-2.00	U1											
1.35-1.65	S	N28										
2.00-3.00	U2											
2.15-2.45	C	N31										
2.20	D7											
2.50	D8											
2.60	V1	(130+)										
2.80	D9											
2.95	D10											
3.00-4.00	U3											
3.00	D11											
3.15-3.45	S	N17										
3.50	D12											
3.50	V2	(114)										
3.90	D13											
3.95	V3	(109)										
4.00-5.00	U4											
4.00	D14											
4.15-4.45	S	N19										
4.10	D15											
4.50	D16											
4.50	V4	(105)										
4.90	D17											
4.95	V5	(112)										
5.00	D18											
5.15-5.45	S	N20					5.45	31.30				
					Hole completed at 5.45m depth							
REMARKS								Project No				
1. Starter pit excavated from 0.00m to 1.20m depth								14947				
2. Live roots observed to 1.00m depth												
3. Head space testing ES1 to ES4 <0.1ppm VOCs												
4. Groundwater monitoring standpipe installed to 2.20m depth												
								Scale				
								1:50				
								Page				
								1/1				
KEY			Groundwater Strikes				Groundwater Observations					
D - Disturbed Sample			Depth m				Depth m					
B - Bulk Sample			No	Struck	Rose to	Rate	Cased	Sealed	Date	Hole	Casing	Water
U - Undisturbed Sample												
W - Water Sample												
Water Strike												
Depth to Water on completion												
J - Jar Sample												
M - Mackintosh Probe												
V - Vane Shear Test												
Cohesion () kPa												
P() - Hand Penetrometer												
Cohesion () kPa												
Standpipe Level												
									09/12/19	5.00		
									17/12/19	2.20	1.00	dry
									10/01/20	2.20	1.00	dry
									14/01/20	2.20	1.00	dry

GROUND ENGINEERING LIMITED Tel: 01733-566566 www.groundengineering.co.uk			Site: MODULAR WARDS, HILLINGDON HOSPITAL				WINDOW SAMPLE WS7					
Date: 11/12/19			Hole Size: 87mm dia to 2.00m 67mm dia to 4.00m 57mm dia to 5.45m				506837 mE 181721 mN Ground Level: 36.80m. O.D.					
Samples and in-situ Tests			(Date)	Description of Strata			Legend	Depth m	O.D. Level m			
Depth m	Type	Result	Water									
0.05 0.05	D1 ES1			MADE GROUND - Soft, friable, dark brown and black mottled, slightly gravelly, sandy, silty CLAY. Gravel of fine to coarse, angular brick, flint, clinker and abundant ash. MADE GROUND - Firm, brown, orange brown and dark brown mottled, slightly sandy, gravelly CLAY with occasional cobbles of brick and concrete. Gravel of fine to coarse, angular to rounded brick, concrete, flint, quartz, quartzite and ash.				0.05	36.75			
0.50 0.50	D2 ES2											
0.90 0.90	D3 ES3											
1.20 1.20	D4 U1											
1.20-2.00 1.20	ES4 S	N10										
1.35-1.65 1.50	D5											
2.00 2.00-3.00	D6 U2											
2.15-2.45 2.15-2.45	S	N22										
2.70 2.70	D7 V1	(95)									2.10	34.70
3.00 3.00	D8 U3											
3.00-4.00 3.15-3.45	S	N14										
3.50 3.50	D9											
3.70 3.70	V2	(78)										
4.00 4.00-5.00	D10 U4											
4.15-4.45 4.50	S	N18										
4.70 4.70	D11 V3	(100)										
5.00 5.00	D12											
5.15-5.45 5.15-5.45	S	N21			5.45	31.35						
Hole completed at 5.45m depth												
REMARKS								Project No 14947				
1. Starter pit excavated from 0.00m to 1.20m depth 2. Live roots observed to 3.00m depth 3. Head space testing ES1 to ES4 <0.1ppm VOCs								Scale 1:50	Page 1/1			
KEY D - Disturbed Sample B - Bulk Sample U - Undisturbed Sample W - Water Sample ∇ - Water Strike ∇c - Depth to Water on completion J - Jar Sample M - Mackintosh Probe V - Vane Shear Test Cohesion () kPa P() - Hand Penetrometer Cohesion () kPa ∇s - Standpipe Level			Groundwater Strikes				Groundwater Observations					
			Depth m						Depth m			
			No	Struck	Rose to	Rate	Cased	Sealed	Date	Hole	Casing	Water
									11/12/19	5.45		dry

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Date: 11/12/19

Hole Size: 87mm dia to 2.00m
67mm dia to 4.00m
57mm dia to 5.45m

506833 mE 181711 mN
Ground
Level: 36.70m. O.D.

REMARKS	1. Starter pit excavated from 0.00m to 1.20m depth 2. Live roots observed to 0.90m depth 3. Head space testing ES1 to ES5 <0.1ppm VOCs	Project No 14947	
		Scale 1:50	Page 1/1

KEY	Groundwater Strikes						Groundwater Observations			
	Depth m						Date	Depth m		
	No	Struck	Rose to	Rate	Cased	Sealed		Hole	Casing	Water
D - Disturbed Sample B - Bulk Sample U - Undisturbed Sample W - Water Sample ∇ Water Strike ∇c Depth to Water on completion J - Jar Sample M - Mackintosh Probe V - Vane Shear Test Cohesion () kPa P () - Hand Penetrometer Cohesion () kPa ∇s Standpipe Level							11/12/19	5.45		dry

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Date: 11/12/19

Hole Size: 87mm dia to 2.00m
67mm dia to 4.00m
57mm dia to 5.45m

506920 mE 181804 mN
Ground
Level: 38.40m. O.D.

REMARKS	1. Starter pit excavated from 0.00m to 1.20m depth 2. Live roots observed to 0.60m depth 3. Groundwater monitoring standpipe installed to 2.30m depth 4. Head space testing ES1 to ES4 <0.1ppm VOCs	Project No 14947	
		Scale 1:50	Page 1/1

KEY		Groundwater Strikes						Groundwater Observations			
		Depth m						Date	Depth m		
		No	Struck	Rose to	Rate	Cased	Sealed		Hole	Casing	Water
D - Disturbed Sample	J - Jar Sample							12/12/19	5.45		dry
U - Bulk Sample	M - Mackintosh Probe										
B - Undisturbed Sample	V - Vane Shear Test										
W - Water Sample	Cohesion () kPa										
☒ Water Strike	P () - Hand Penetrometer										
▼c Depth to Water on completion	Cohesion () kPa										
	▼s Standpipe Level										

Borehole Number	Depth (m)	Casing Depth (m)	Depth to Water (m)	Type of Test *	Seating Drive Blows/ Penetration (mm)	Test Drive: 300mm Blows for each successive 75 mm Penetration				N Value	Extra-polated Value
WS1	1.20 - 1.65		1.10	C	6/150	5	5	5	5	20	
	2.00 - 2.45	2.00		C	7/150	3	3	3	3	12	
	3.00 - 3.45	3.00		S	4/150	4	4	4	4	16	
	4.00 - 4.45	3.00		S	5/150	4	6	4	5	19	
	5.00 - 5.45	3.00	2.70	S	5/150	4	4	5	5	18	
WS2	1.20 - 1.65			S	6/150	4	5	6	7	22	
	2.00 - 2.45			C	6/150	3	2	2	4	11	
	3.00 - 3.45	2.00		S	3/150	2	2	3	3	10	
	4.00 - 4.45	2.00		S	5/150	3	4	4	4	15	
	5.00 - 5.45	2.00		S	6/150	4	4	3	5	16	
WS3	1.20 - 1.65			S	2/150	1	2	2	1	6	
	2.00 - 2.45			S	8/150	1	1	1	1	4	
	3.00 - 3.45			S	2/150	2	2	3	3	10	
	4.00 - 4.45			S	4/150	2	2	4	4	12	
	5.00 - 5.45			S	5/150	4	3	4	5	16	
WS4	1.20 - 1.65			S	3/150	1	1	2	1	5	
	2.00 - 2.45			S	1/150	1	1	2	2	6	
	3.00 - 3.45			S	3/150	2	1	2	3	8	
	4.00 - 4.45			S	5/150	3	4	4	4	15	
	5.00 - 5.45			S	6/150	4	4	6	6	20	
WS5	1.20 - 1.65			S	5/150	3	4	5	5	17	
	2.00 - 2.45			S	3/150	3	3	4	4	14	
	3.00 - 3.45			S	4/150	4	4	4	5	17	
	4.00 - 4.45			S	6/150	4	5	4	6	19	
	5.00 - 5.45			S	5/150	4	4	5	5	18	
WS6	1.20 - 1.65			S	8/150	7	6	6	9	28	
	2.00 - 2.45			C	6/150	5	6	8	12	31	
	3.00 - 3.45			S	5/150	3	4	5	5	17	
	4.00 - 4.45			S	6/150	4	4	6	5	19	
	5.00 - 5.45			S	6/150	4	5	5	6	20	
WS7	1.20 - 1.65			S	4/150	5	3	1	1	10	
	2.00 - 2.45			S	6/150	7	7	5	3	22	
	3.00 - 3.45			S	3/150	3	3	4	4	14	
	4.00 - 4.45			S	5/150	4	4	4	6	18	
	5.00 - 5.45			S	8/150	4	6	6	5	21	
WS8	1.20 - 1.65			S	1/150	2	1	1	2	6	
	2.00 - 2.45			S	7/150	4	3	1	2	10	
	3.00 - 3.45			S	3/150	2	3	2	3	10	
	4.00 - 4.45			S	7/150	4	4	5	5	18	
	5.00 - 5.45			S	6/150	8	6	5	7	26	
WS9	1.20 - 1.65			S	2/150	2	1	1	1	5	
	2.00 - 2.45			S	2/150	9	10	18	19	56	
	3.00 - 3.45			S	9/150	5	3	2	3	13	

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* C denotes test using a solid cone
S denotes test using a split barrel sampler

Results of Standard/Cone Penetration Tests

14947

Table No

MODULAR WARDS, HILLINGDON HOSPITAL

.1

Borehole Number	Depth (m)	Casing Depth (m)	Depth to Water (m)	Type of Test *	Seating Drive Blows/ Penetration (mm)	Test Drive: 300mm Blows for each successive 75 mm Penetration				N Value	Extra-polated Value
WS9	4.00 - 4.45			S	6/150	4	4	4	6	18	
	5.00 - 5.45			S	5/150	4	3	4	4	15	

* C denotes test using a solid cone
S denotes test using a split barrel sampler

Results of Standard/Cone Penetration Tests

14947

MODULAR WARDS, HILLINGDON HOSPITAL

Table No

.1

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Hammer Energy Test Report

in accordance with BSEN ISO 22476-3:2005

Dynamic sampling uk ltd
6-8 victory parkway
victory road
Derby
DE24 8ZF

Hammer Ref: 110.82
Test Date: 31/05/2017
Report Date: 31/05/2017
File Name: 110.82.spt
Test Operator: TP

Instrumented Rod Data

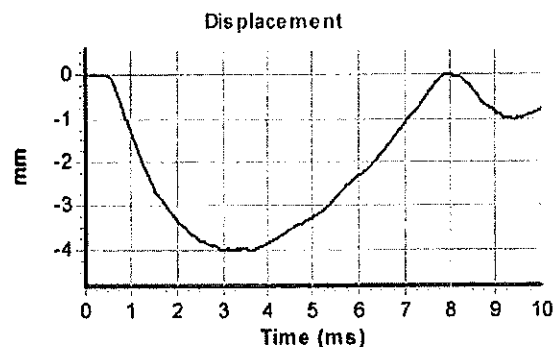
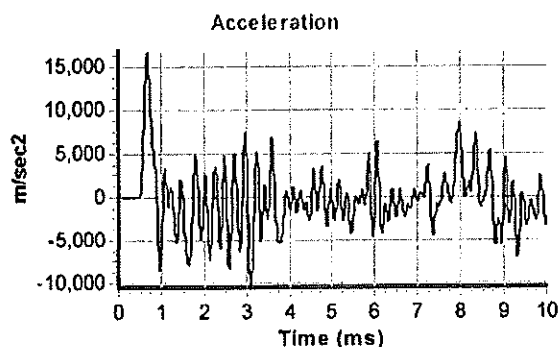
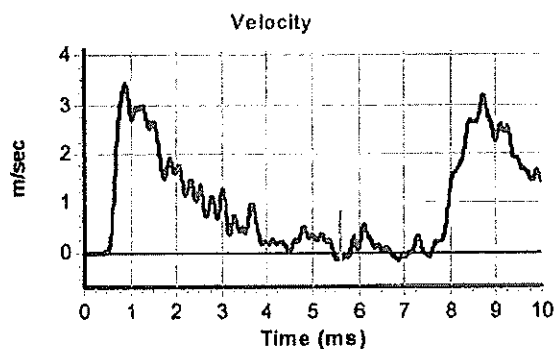
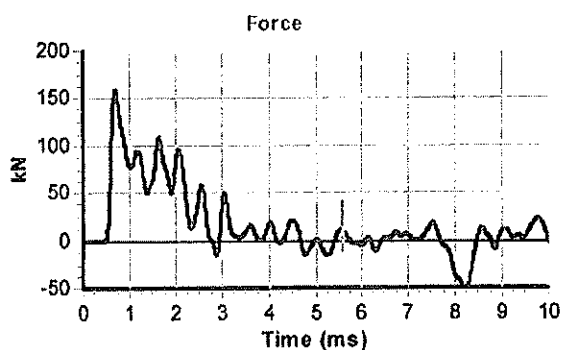
Diameter d_r (mm): 54
Wall Thickness t_r (mm): 6.9
Assumed Modulus E_a (GPa): 208
Accelerometer No.1: 6455
Accelerometer No.2: 6457

Hammer Information

Hammer Mass m (kg): 63.5
Falling Height h (mm): 760
String Length L (m): 15.0

Comments / Location

Ground engineering hammer tested at
Dynamic samplings yard.



Calculations

Area of Rod A (mm^2): 1021
Theoretical Energy E_{theor} (J): 473
Measured Energy E_{meas} (J): 354

Energy Ratio E_r (%):

75

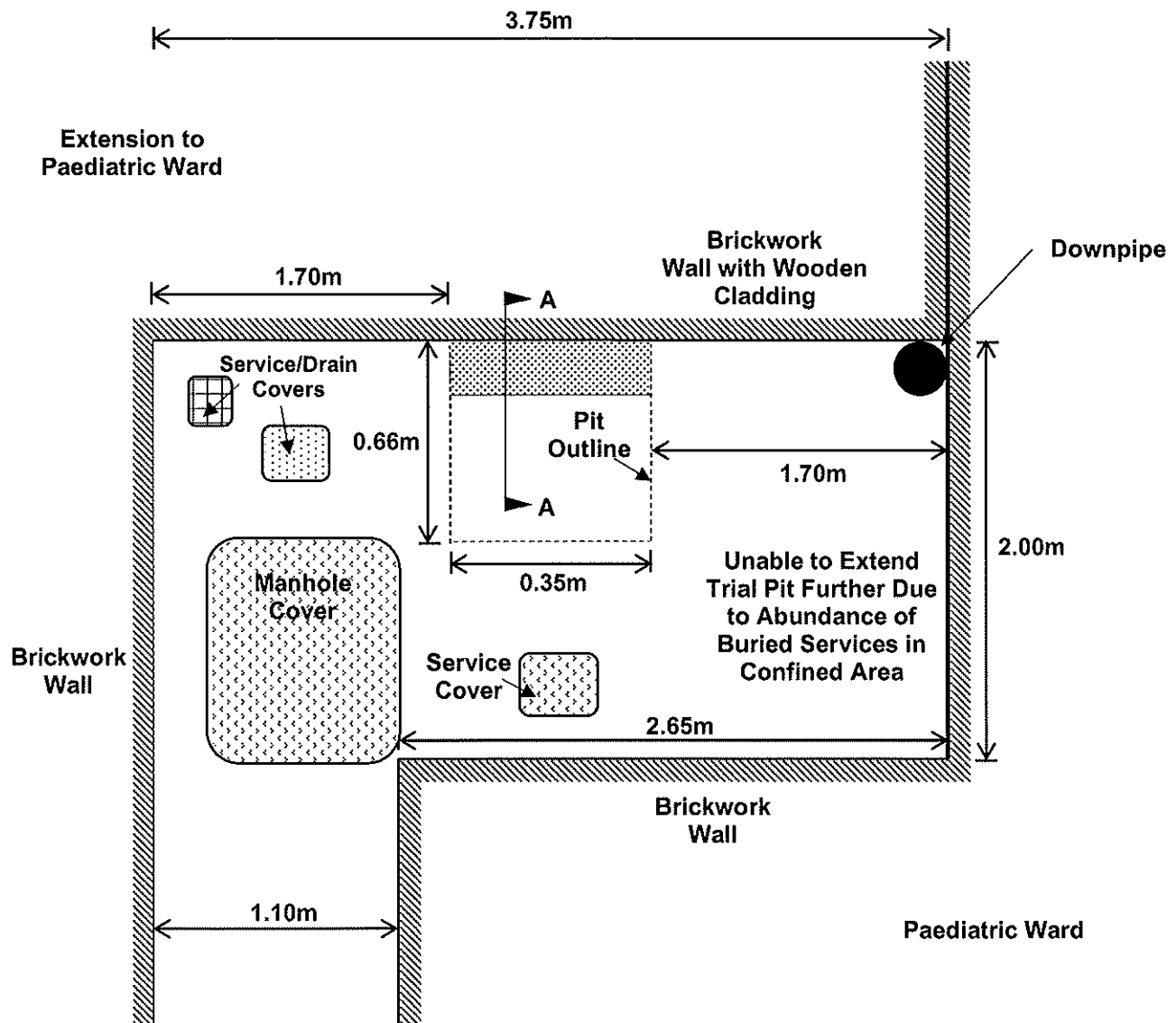
Signed: A.parker.

Title: Associate Director.

The recommended calibration interval is 12 months

GROUND ENGINEERING LIMITED Tel: 01733-566566 www.groundengineering.co.uk			Site: MODULAR WARDS, HILLINGDON HOSPITAL		TRIAL PIT FIP1		
Date: 10/12/19			Pit Size: 0.66m L x 0.35m W x 1.50m D.		506830 mE 181730 mN Ground Level: 36.75m. O.D.		
Samples and in-situ Tests			(Date) Water	Description of Strata	Legend	Depth m	O.D. Level m
Depth m	Type	Result					
0.15	D1	(80)		MADE GROUND - CONCRETE paving slabs.		0.05	36.70
0.15	ES1			MADE GROUND - Yellow brown, slightly silty SAND.		0.10	36.65
0.45	D2			MADE GROUND - Grey and red brown, silty SAND AND GRAVEL with abundant cobbles of concrete. Gravel of fine to coarse, angular granite and concrete.			
0.45	ES2						
0.55	D3						
0.55	ES3						
0.80	D4			MADE GROUND - Very soft, grey brown, slightly sandy, slightly gravelly, silty CLAY with occasional cobbles of concrete. Gravel of fine to coarse, angular to rounded flint, quartz, quartzite, concrete, wood, textile and ceramic drainage pipe fragments.		0.50	36.25
0.80	ES4						
1.20	D5			Soft, blue grey, sandy, silty, organic CLAY with occasional fragments of part decayed vegetation and dead roots.		1.10	35.65
1.20	ES5						
1.30	V1		Stiff, brown, orange brown and grey mottled, slightly sandy, slightly gravelly CLAY. Gravel of fine to medium, angular to sub-angular flint.		1.25	35.50	
1.50	D6						
			Pit completed at 1.50m depth			1.50	35.25
KEY D - Disturbed Sample B - Bulk Sample U - Undisturbed Sample R - Root Sample W - Water Sample ES - Environmental Sample  Water Strike  Water Rise  Level on completion MP - Mackintosh Probe P() - Hand Penetrometer Cohesion () kPa V - Vane Shear Test Cohesion () kPa			REMARKS 1. No live roots observed 2. Pit dry 3. Pit sides stable 4. Head space testing ES1 to ES5 <0.1ppm VOCs				
						Project No 14947	
						Scale 1:25	Page 1/1

Trial Pit FIP1 Plan View



Not to Scale

Project : Modular Wards, Hillingdon Hospital

Client : The Hillingdon Hospitals NHS Foundation Trust

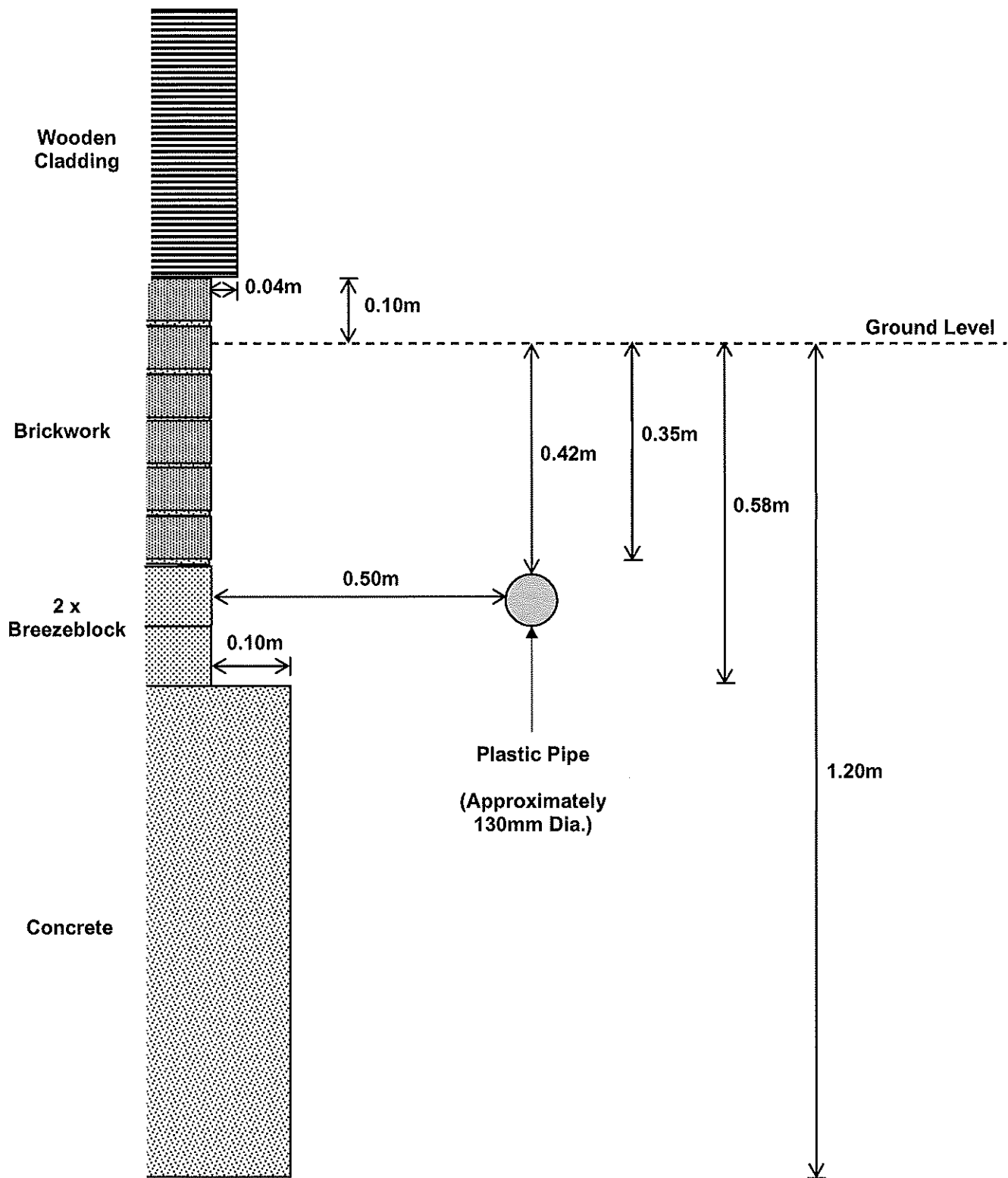
**GROUND
ENGINEERING
LIMITED**

Peterborough Tel : 01733 566566

Project No.

C14947

Trial Pit FIP1 A-A



Not to Scale

Project : Modular Wards, Hillingdon Hospital

Client : The Hillingdon Hospitals NHS Foundation Trust

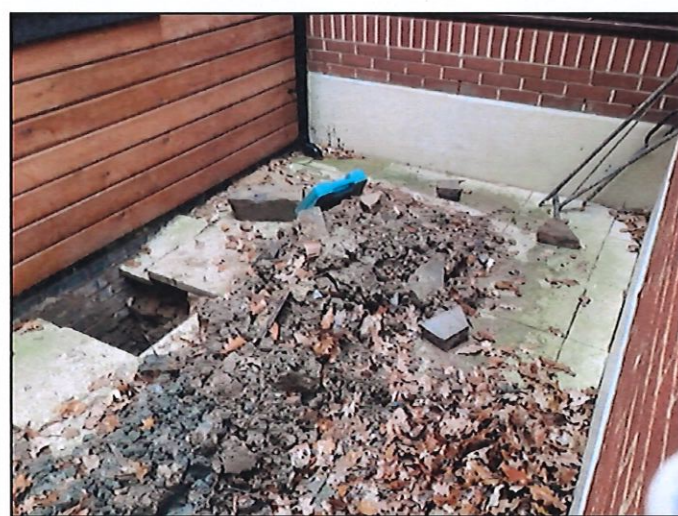
**GROUND
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Project No.

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Foundation Inspection Pit FIP1 Photographs



Project : Modular Wards, Hillingdon Hospital

Client : The Hillingdon Hospitals NHS Foundation Trust

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Site: MODULAR WARDS, HILLINGDON HOSPITAL

TRIAL PIT
FIP2

Date: 10/12/19

Pit Size: 1.70m L x 1.10m W x 2.45m D.

506826 mE 181710 mN
Ground Level: 36.85m. O.D.

Samples and in-situ Tests			(Date)	Description of Strata	Legend	Depth m	O. D. Level m
Depth m	Type	Result	Water				
0.15 0.15	D1 ES1			MADE GROUND - Soft, friable, brown and dark brown mottled, slightly gravelly, sandy, silty CLAY. Gravel of fine to medium, angular flint and ash.		0.30	36.55
0.50 0.50	D2 ES2			MADE GROUND - Soft, becoming firm, brown, orange brown and light brown, slightly gravelly, sandy, silty CLAY. Gravel of fine to coarse, angular flint, brick and ash.			
0.80 0.80	D3 ES3					1.00	35.85
1.00 1.10	D4 ES4			MADE GROUND - Firm, locally soft, blue grey and brown mottled, slightly gravelly, sandy, silty, organic CLAY. Gravel of fine to coarse, angular brick and flint.			
1.30	D5					1.90	34.95
1.50 1.50 1.10	D6 V1 V2	(65) (70)					
1.70	D7					2.10	34.75
2.00	D8			Grey, silty, sandy GRAVEL. Gravel of fine to coarse, angular to rounded flint, quartz and quartzite.			
2.30 2.30	D9 V3	(78)		Stiff, brown, orange brown and grey mottled, slightly sandy, slightly gravelly CLAY. Gravel of fine to coarse, angular to rounded flint.		2.45	34.40
				Pit completed at 2.45m depth			

KEY

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

REMARKS

1. Live roots observed to 1.60m depth
2. Pit dry
3. Pit sides stable
4. Head space testing ES1 to ES4 <0.1ppm VOCs

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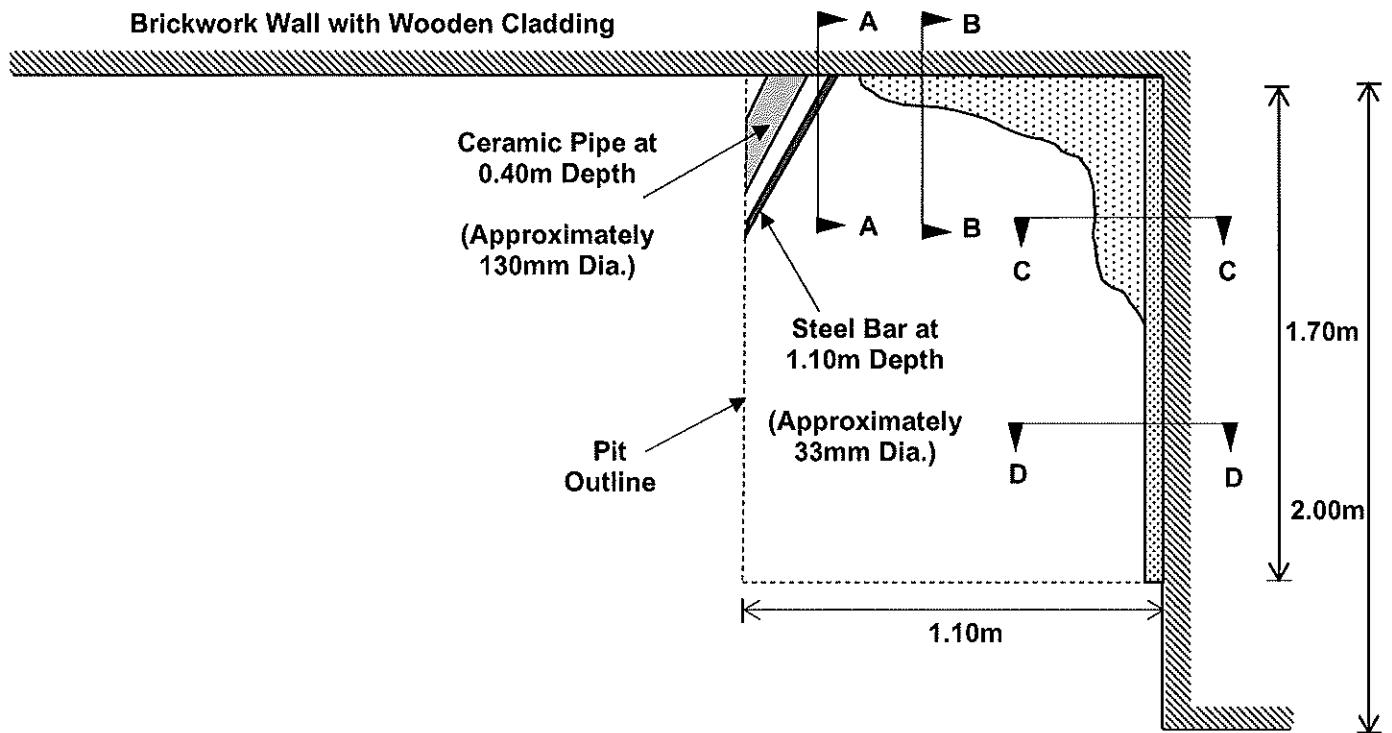
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Page
1/1

Trial Pit FIP2 Plan View



Extension to
Paediatric Ward



Not to Scale

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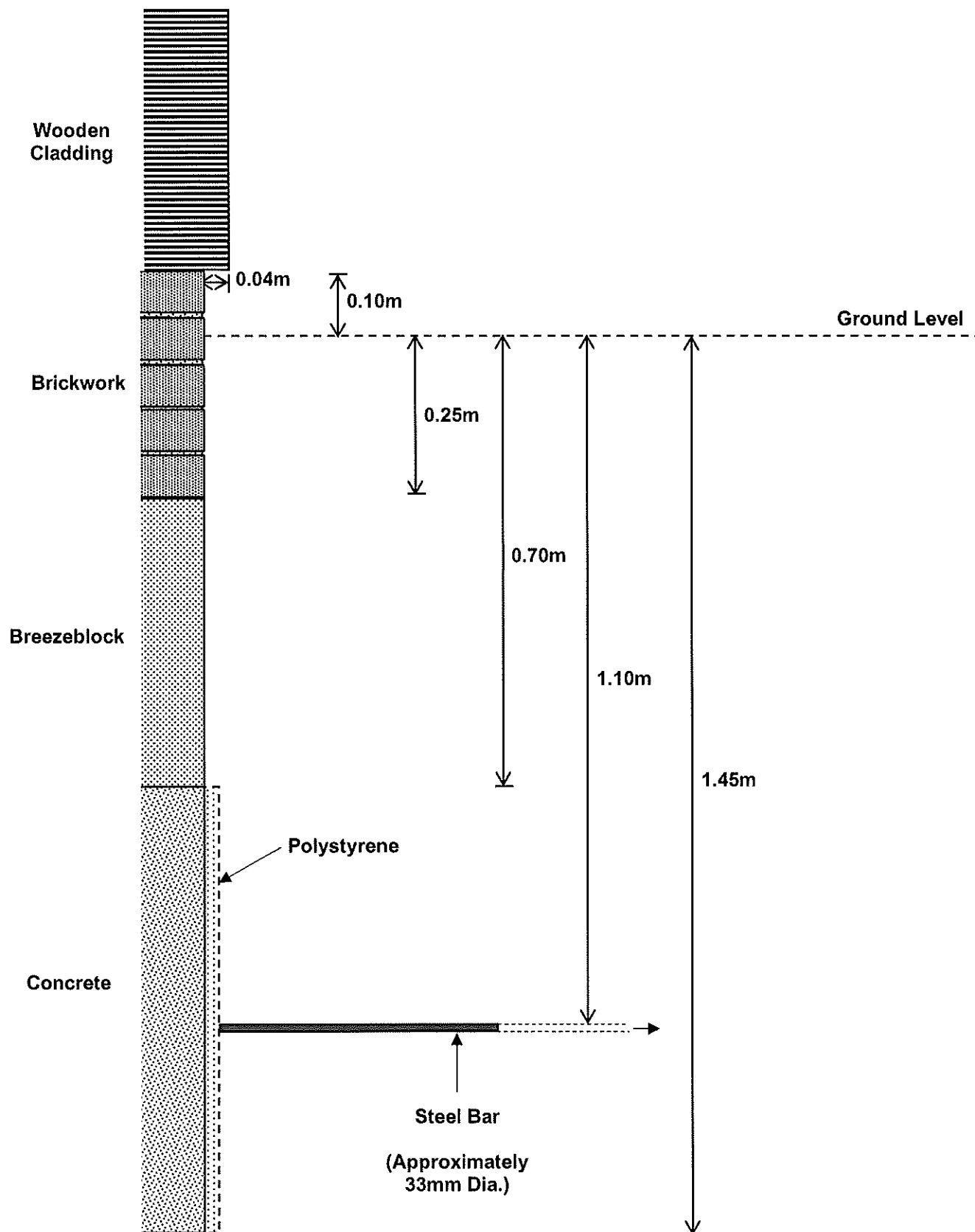
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Trial Pit FIP2 A-A



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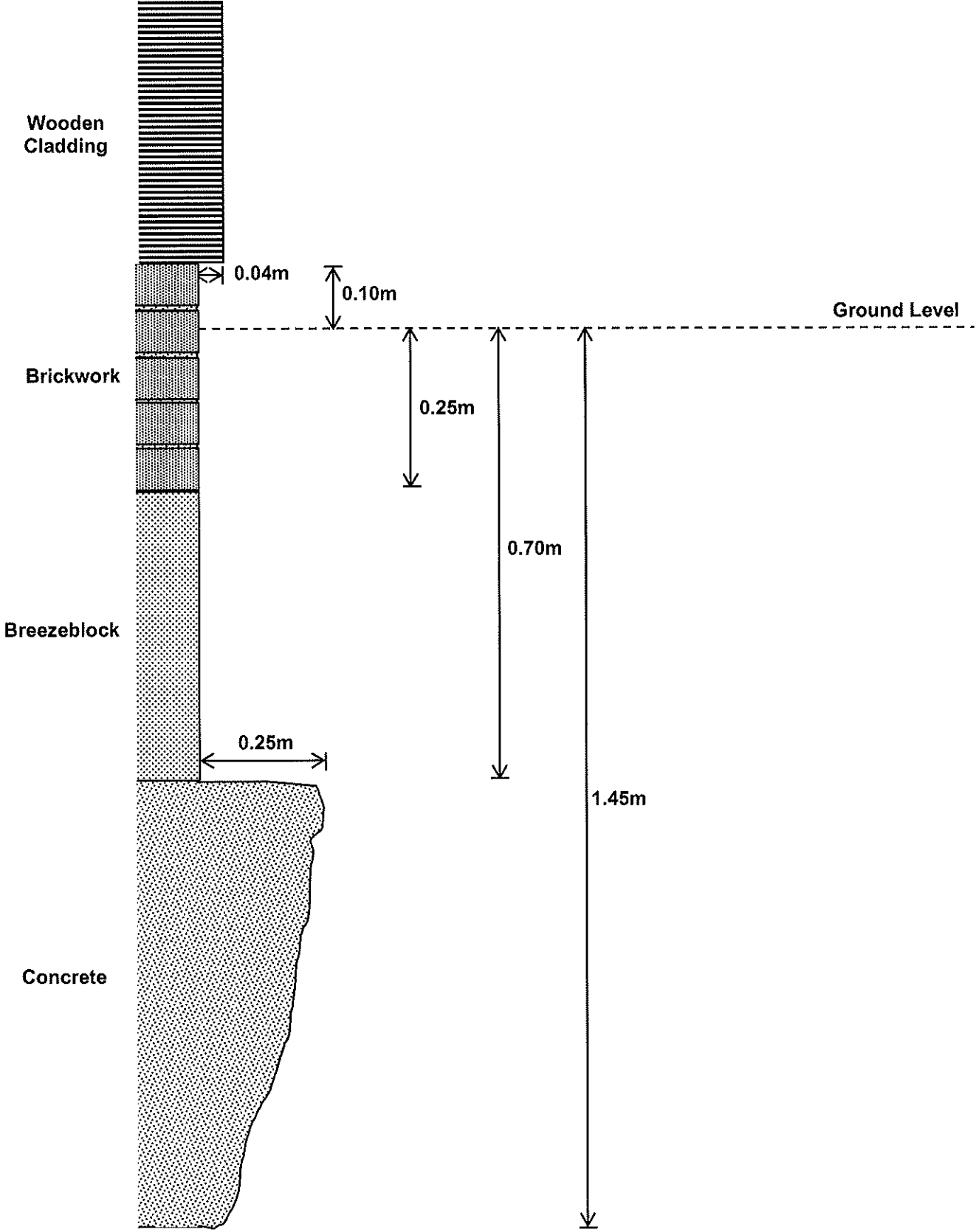
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**Trial Pit FIP2
B-B**



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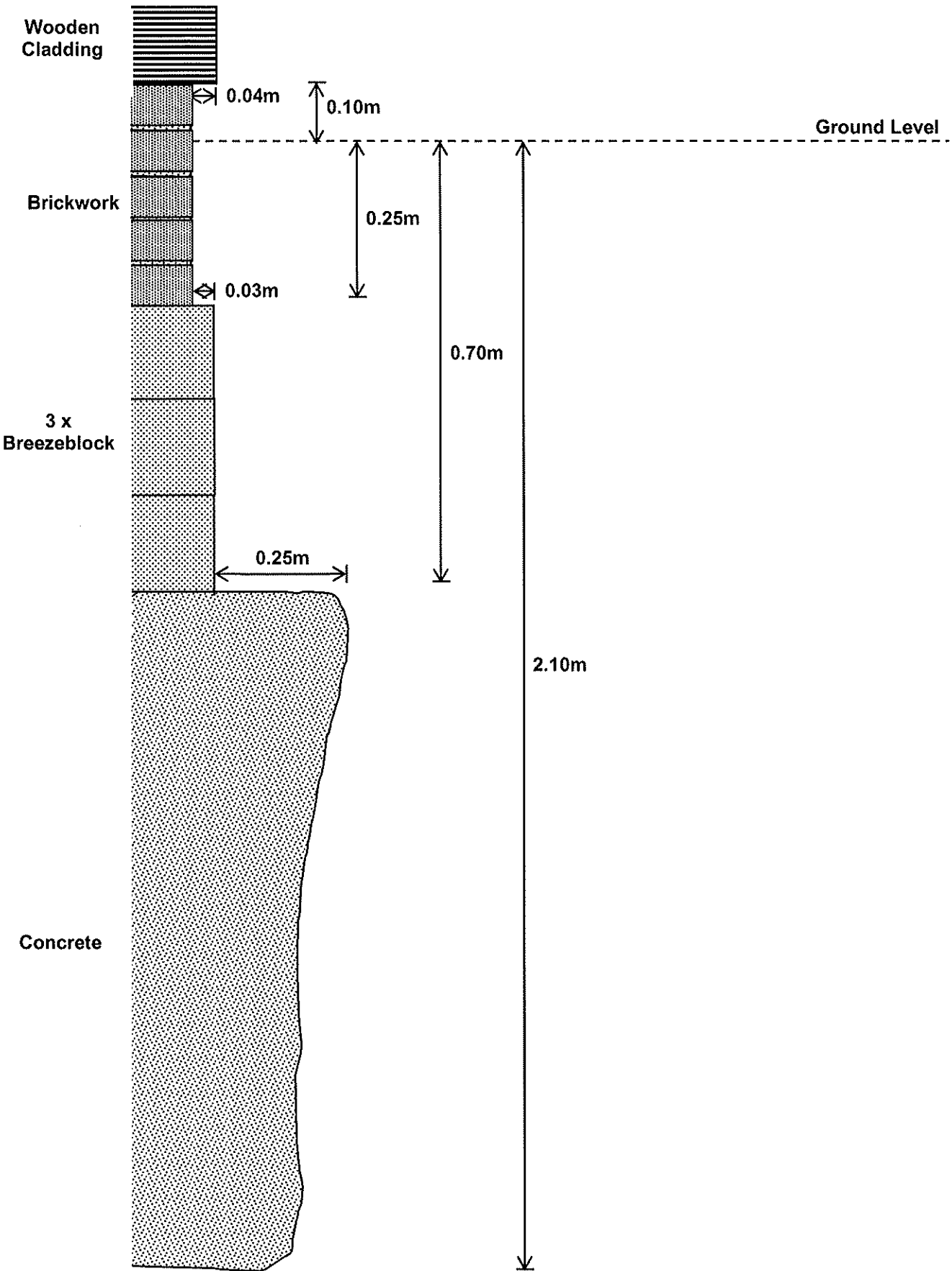
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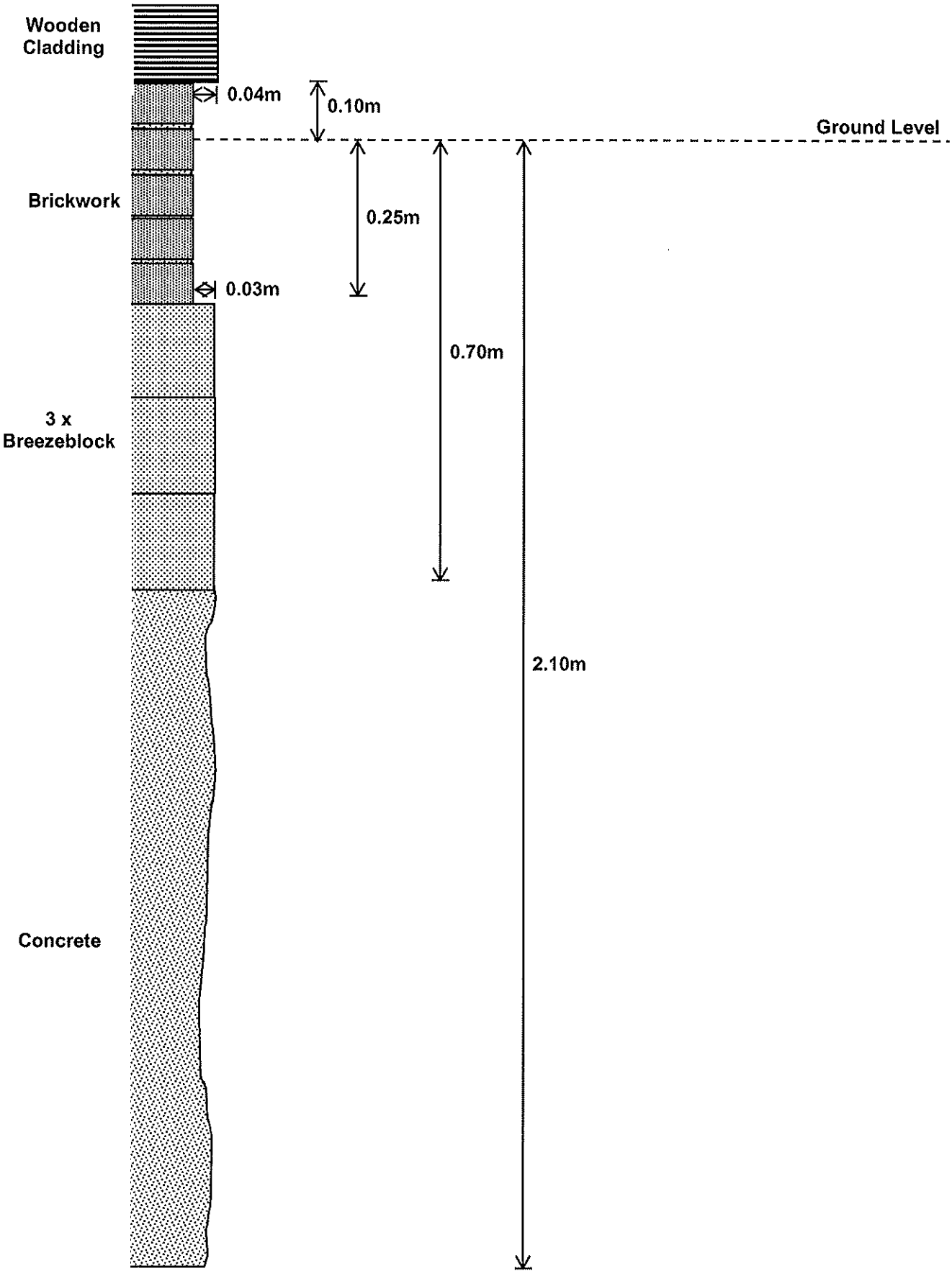
**Trial Pit FIP2
C-C**



Not to Scale

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**Trial Pit FIP2
D-D**



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