

FINAL ANALYTICAL TEST REPORT SUPPLEMENT TO TEST REPORT 25/05505/1

Amendments: Request for Additional Analysis

Envirolab Job Number: 25/05505
Issue Number: 2

Date: 09 July, 2025

Client: Curtins Consulting (Manchester)
Merchant Exchange
17-19 Whitworth Street
Manchester
UK
M1 5WG

Project Manager: Niall Farnworth/Rebecca Baksh-Jones
Project Name: Whitefield
Project Ref: B087132
Order No: 23604
Date Samples Received: 23/05/25
Date Instructions Received: 27/05/25
Date Analysis Completed: 30/06/25

Approved by:

A handwritten signature in black ink, appearing to read "Richard Wong".

Richard Wong
Client Manager

Envirolab Job Number: 25/05505

Client Project Name: Whitefield

Client Project Ref: B087132

Lab Sample ID	25/05505/1	25/05505/2	25/05505/3	25/05505/4	25/05505/5	25/05505/6	25/05505/7	Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	HP101	HP103	HP104	WS101	WS102	WS101	WS102			
Depth to Top	0.15	0.20	0.12	0.35	0.25	2.10	1.50			
Depth To Bottom										
Date Sampled	22-May-25	22-May-25	23-May-25	22-May-25	22-May-25	22-May-25	22-May-25			
Sample Type	SOLID	SOIL - ES	SOIL - ES	SOIL - ES	SOIL - ES	SOIL - D	SOIL - D			
Sample Matrix Code	7	4AE	4ABE	4ABE	6A	5A	3A			
% Moisture at <40C _A	3.6	12.9	7.6	10.2	11.4	-	-	% w/w	0.1	A-T-044
% Stones >10mm _A	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	% w/w	0.1	A-T-044
pH _D ^{M#}	9.05 ^U	9.93	9.37	10.78	6.28	-	-	pH	0.01	A-T-031s
pH BRE _D ^{M#}	-	-	-	-	-	5.93	4.89	pH	0.01	A-T-031s
Sulphate (water sol 2:1) _D ^{M#}	0.03 ^U	0.34	0.14	0.52	0.03	-	-	g/l	0.01	A-T-026s
Sulphate BRE (water sol 2:1) _D ^{M#}	-	-	-	-	-	96	<10	mg/l	10	A-T-026s
Cyanide (total) _A ^{M#}	<1 ^U	<1	<1	<1	<1	-	-	mg/kg	1	A-T-042sTCN
Phenols - Total by HPLC _A	<0.2	<0.2	<0.2	<0.2	<0.2	-	-	mg/kg	0.2	A-T-050s
Organic Matter _D ^{M#}	0.22 ^U	11.4	9.18	9.32	0.61	-	-	% w/w	0.14	A-T-032s
Arsenic _D ^{M#}	<1 ^U	10	2	2	3	-	-	mg/kg	1	A-T-024s
Boron (water soluble) _D ^{M#}	<1.0 ^U	<1.0	<1.0	<1.0	<1.0	-	-	mg/kg	1	A-T-027s
Cadmium _D ^{M#}	<0.5 ^U	<0.5	<0.5	<0.5	<0.5	-	-	mg/kg	1	A-T-024s
Copper _D ^{M#}	5 ^U	31	26	15	17	-	-	mg/kg	1	A-T-024s
Chromium _D ^{M#}	7 ^U	9	23	16	17	-	-	mg/kg	1	A-T-024s
Chromium (hexavalent) _D	<1	<1	<1	<1	<1	-	-	mg/kg	1	A-T-040s
Lead _D ^{M#}	9 ^U	73	33	32	10	-	-	mg/kg	1	A-T-024s
Mercury _D	<0.17	<0.17	<0.17	<0.17	<0.17	-	-	mg/kg	0.17	A-T-024s
Nickel _D ^{M#}	5 ^U	17	20	13	14	-	-	mg/kg	1	A-T-024s
Selenium _D ^{M#}	<1 ^U	<1	<1	<1	<1	-	-	mg/kg	1	A-T-024s
Zinc _D ^{M#}	51 ^U	59	48	51	30	-	-	mg/kg	1	A-T-024s
(1.02) Item 2.4 4 Point Liquid & Plastic Limit by Cone Penetrometer _A [#]	-	-	-	-	-	Appended	Appended			Subcon IFA
(1.01) Item 1a Moisture Content of Soil (Oven Dried Method) _A [#]	-	-	-	-	-	Appended	Appended			Subcon IFA

Envirolab Job Number: 25/05505

Client Project Name: Whitefield

Client Project Ref: B087132

Lab Sample ID	25/05505/1	25/05505/2	25/05505/3	25/05505/4	25/05505/5	25/05505/6	25/05505/7	Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	HP101	HP103	HP104	WS101	WS102	WS101	WS102			
Depth to Top	0.15	0.20	0.12	0.35	0.25	2.10	1.50			
Depth To Bottom										
Date Sampled	22-May-25	22-May-25	23-May-25	22-May-25	22-May-25	22-May-25	22-May-25			
Sample Type	SOLID	SOIL - ES	SOIL - ES	SOIL - ES	SOIL - ES	SOIL - D	SOIL - D			
Sample Matrix Code	7	4AE	4ABE	4ABE	6A	5A	3A			
Asbestos in Soil (inc. matrix)										
Asbestos in soil [#]	NAD ^U	NAD	NAD	NAD	NAD	-	-			A-T-045
Asbestos Matrix (visual) _D	-	-	-	-	-	-	-			A-T-045
Asbestos Matrix (microscope) _D	-	-	-	-	-	-	-			A-T-045
Asbestos ACM - Suitable for Water Absorption Test? _D	N/A	N/A	N/A	N/A	N/A	-	-			A-T-045

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Lab Sample ID	25/05505/1	25/05505/2	25/05505/3	25/05505/4	25/05505/5	25/05505/6	25/05505/7	Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	HP101	HP103	HP104	WS101	WS102	WS101	WS102			
Depth to Top	0.15	0.20	0.12	0.35	0.25	2.10	1.50			
Depth To Bottom										
Date Sampled	22-May-25	22-May-25	23-May-25	22-May-25	22-May-25	22-May-25	22-May-25			
Sample Type	SOLID	SOIL - ES	SOIL - ES	SOIL - ES	SOIL - ES	SOIL - D	SOIL - D			
Sample Matrix Code	7	4AE	4ABE	4ABE	6A	5A	3A			
PAH-16MS										
Acenaphthene _A ^{M#}	1.35 ^U	<0.01	<0.10	<0.10	<0.01	-	-	mg/kg	0.01	A-T-019s
Acenaphthylene _A ^{M#}	<0.01 ^U	<0.01	<0.10	<0.10	<0.01	-	-	mg/kg	0.01	A-T-019s
Anthracene _A ^{M#}	2.47 ^U	<0.02	<0.20	<0.20	<0.02	-	-	mg/kg	0.02	A-T-019s
Benzo(a)anthracene _A ^{M#}	4.08 ^U	<0.04	<0.40	<0.40	<0.04	-	-	mg/kg	0.04	A-T-019s
Benzo(a)pyrene _A ^{M#}	3.66 ^U	<0.04	<0.40	<0.40	<0.04	-	-	mg/kg	0.04	A-T-019s
Benzo(b)fluoranthene _A ^{M#}	4.50 ^U	<0.05	<0.50	<0.50	<0.05	-	-	mg/kg	0.05	A-T-019s
Benzo(ghi)perylene _A ^{M#}	2.15 ^U	<0.05	<0.50	<0.50	<0.05	-	-	mg/kg	0.05	A-T-019s
Benzo(k)fluoranthene _A ^{M#}	1.64 ^U	<0.07	<0.70	<0.70	<0.07	-	-	mg/kg	0.07	A-T-019s
Chrysene _A ^{M#}	4.85 ^U	<0.06	<0.60	<0.60	<0.06	-	-	mg/kg	0.06	A-T-019s
Dibenzo(ah)anthracene _A ^{M#}	<0.04 ^U	<0.04	<0.40	<0.40	<0.04	-	-	mg/kg	0.04	A-T-019s
Fluoranthene _A ^{M#}	12.7 ^U	<0.08	<0.80	<0.80	<0.08	-	-	mg/kg	0.08	A-T-019s
Fluorene _A ^{M#}	1.02 ^U	<0.01	<0.10	<0.10	<0.01	-	-	mg/kg	0.01	A-T-019s
Indeno(123-cd)pyrene _A ^{M#}	2.15 ^U	<0.03	<0.30	<0.30	<0.03	-	-	mg/kg	0.03	A-T-019s
Naphthalene _A ^{M#}	<0.03 ^U	<0.03	<0.30	<0.30	<0.03	-	-	mg/kg	0.03	A-T-019s
Phenanthrene _A ^{M#}	10.9 ^U	<0.03	<0.30	<0.30	<0.03	-	-	mg/kg	0.03	A-T-019s
Pyrene _A ^{M#}	10.2 ^U	<0.07	<0.70	<0.70	<0.07	-	-	mg/kg	0.07	A-T-019s
Total PAH-16MS _A ^{M#}	61.7 ^U	<0.08	<0.80	<0.80	<0.08	-	-	mg/kg	0.01	A-T-019s

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Lab Sample ID	25/05505/1	25/05505/2	25/05505/3	25/05505/4	25/05505/5	25/05505/6	25/05505/7	Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	HP101	HP103	HP104	WS101	WS102	WS101	WS102			
Depth to Top	0.15	0.20	0.12	0.35	0.25	2.10	1.50			
Depth To Bottom										
Date Sampled	22-May-25	22-May-25	23-May-25	22-May-25	22-May-25	22-May-25	22-May-25			
Sample Type	SOLID	SOIL - ES	SOIL - ES	SOIL - ES	SOIL - ES	SOIL - D	SOIL - D			
Sample Matrix Code	7	4AE	4ABE	4ABE	6A	5A	3A			
TPH CWG with Clean Up										
Ali >C5-C6 _A	<0.01	<0.01	<0.01	<0.01	<0.01	-	-	mg/kg	0.01	A-T-022s
Ali >C6-C8 _A	<0.01	<0.01	<0.01	<0.01	<0.01	-	-	mg/kg	0.01	A-T-022s
Ali >C8-C10 _A	<1	<1	<10	<10	<1	-	-	mg/kg	1	A-T-055s
Ali >C10-C12 _A ^{M#}	<1 ^U	<1	<10	<10	<1	-	-	mg/kg	1	A-T-055s
Ali >C12-C16 _A ^{M#}	<1 ^U	<1	13	<10	<1	-	-	mg/kg	1	A-T-055s
Ali >C16-C21 _A ^{M#}	<1 ^U	1	19	<10	<1	-	-	mg/kg	1	A-T-055s
Ali >C21-C35 _A ^{M#}	12 ^U	7	515	158	<1	-	-	mg/kg	1	A-T-055s
Total Aliphatics _A	12	8	548	158	<1	-	-	mg/kg	1	Calc-As Recd
Aro >C5-C7 _A [#]	<0.01 ^U	<0.01	<0.01	<0.01	<0.01	-	-	mg/kg	0.01	A-T-022s
Aro >C7-C8 _A [#]	<0.01 ^U	<0.01	<0.01	<0.01	<0.01	-	-	mg/kg	0.01	A-T-022s
Aro >C8-C10 _A	<1	<1	<10	43	<1	-	-	mg/kg	1	A-T-055s
Aro >C10-C12 _A	<1	<1	<10	<10	<1	-	-	mg/kg	1	A-T-055s
Aro >C12-C16 _A	2	3	16	<10	<1	-	-	mg/kg	1	A-T-055s
Aro >C16-C21 _A ^{M#}	9 ^U	5	32	16	<1	-	-	mg/kg	1	A-T-055s
Aro >C21-C35 _A ^{M#}	24 ^U	6	210	70	<1	-	-	mg/kg	1	A-T-055s
Total Aromatics _A	35	14	259	129	<1	-	-	mg/kg	1	Calc-As Recd
TPH (Ali & Aro >C5-C35) _A	48	22	806	287	<1	-	-	mg/kg	1	Calc-As Recd
BTEX - Benzene _A [#]	<0.01 ^U	<0.01	<0.01	<0.01	<0.01	-	-	mg/kg	0.01	A-T-022s
BTEX - Toluene _A [#]	<0.01 ^U	<0.01	<0.01	<0.01	<0.01	-	-	mg/kg	0.01	A-T-022s
BTEX - Ethyl Benzene _A [#]	<0.01 ^U	<0.01	<0.01	<0.01	<0.01	-	-	mg/kg	0.01	A-T-022s
BTEX - m & p Xylene _A [#]	<0.01 ^U	<0.01	<0.01	<0.01	<0.01	-	-	mg/kg	0.01	A-T-022s
BTEX - o Xylene _A [#]	<0.01 ^U	<0.01	<0.01	<0.01	<0.01	-	-	mg/kg	0.01	A-T-022s
MTBE _A [#]	<0.01 ^U	<0.01	<0.01	<0.01	<0.01	-	-	mg/kg	0.01	A-T-022s

Envirolab Job Number: 25/05505

Client Project Name: Whitefield

Client Project Ref: B087132

Lab Sample ID	25/05505/8	25/05505/9	25/05505/10					Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	WS102	WS101	WS102							
Depth to Top	2.50	3.00	3.00							
Depth To Bottom	2.60	4.00	4.00							
Date Sampled	22-May-25	22-May-25	22-May-25							
Sample Type	SOIL - D	SOIL - B	SOIL - B							
Sample Matrix Code	5A	5	1A							
% Stones >10mm _A	<0.1	<0.1	<0.1					% w/w	0.1	A-T-044
pH BRE _D ^{M#}	7.92	7.78	8.58					pH	0.01	A-T-031s
Sulphate BRE (water sol 2:1) _D ^{M#}	17	35	13					mg/l	10	A-T-026s
(1.02) Item 2.4 4 Point Liquid & Plastic Limit by Cone Penetrometer _A [#]	Appended	-	-							Subcon IFA
(1.01) Item 1a Moisture Content of Soil (Oven Dried Method) _A [#]	Appended	-	-							Subcon IFA
(1.10a) Item 12a Particle Size Distribution (Wet Sieving Method) _A [#]	-	Appended	Appended							Subcon IFA

Report Notes

General

- This report shall not be reproduced, except in full, without written approval from Envirolab.
- The client Sample No, Client Sample ID, Depth to top, Depth to Bottom and Date Sampled are all provided by the client and can affect the validity of results.
- The results reported herein relate only to the material supplied to the laboratory.
- The residue of any samples contained within this report, and any received within the same delivery, will be disposed of **four weeks** after the initial scheduling. For samples tested for Asbestos we will retain a portion of the dried sample for a minimum of **six months** after the initial Asbestos testing is completed.
- Analytical results reflect the quality of the sample at the time of analysis only.
- Opinions and Interpretations expressed are outside our scope of accreditation.
- A deviating sample report is appended and will indicate if samples or tests have been found to be deviating. Any test results affected may not be an accurate record of the concentration at the time of sampling and, as a result, may be invalid.
- If a sample is outside of the calibration range or affected by interferences then it may need diluting. This will result in the limit of detection (LOD) being raised.
- Subcontracted Analysis: Please see the appended report for any deviations, current LODs and accreditation status of the test.

Key

Superscript “#”	Accredited to ISO 17025
Superscript “M”	Accredited to MCertS
Superscript “U”	Individual result not accredited
None of the above symbols	Analysis unaccredited
Subscript “A”	Analysis performed on as-received Sample
Subscript “D”	Analysis performed on the dried sample, crushed to pass 2mm sieve.
Subscript “D” on Asbestos	Analysis performed on a dried aliquot of sample provided.
Subscript “A”	Analysis has dependant options against results. Details appear in the comments of your Sample receipt
IS	Insufficient Sample for analysis
US	Unsuitable Sample for analysis
NDP	No Determination Possible
NAD	No Asbestos Detected
Trace	Asbestos found not suitable for Gravimetric Quantification – not enough to accurately weigh.
N/A	Not applicable

Asbestos

Identification: Asbestos in soil analysis is performed on a dried aliquot of the submitted sample and cannot guarantee to identify asbestos if only present in small numbers as discrete fibres/fragments in the original sample.

Stones etc. are not removed from the sample prior to analysis

“Trace Asbestos Identified” will be reported if there is not enough present to verify the type.

Assigned Matrix Codes

1	SAND	6	CLAY/LOAM	A	Contains Stones
2	LOAM	7	OTHER	B	Contains Construction Rubble
3	CLAY	8	Asbestos Bulk (Only Asbestos ID accredited)	C	Contains visible hydrocarbons
4	LOAM/SAND	9	Incinerator Ash (some Metals accredited)	D	Contains glass / metal
5	SAND/CLAY			E	Contains roots / twigs
Note: 7,8,9 matrices are not covered by our ISO 17025 or MCertS accreditation, unless stated above.					

Soil Chemical Analysis:

All results are reported as dry weight (<40°C).

For samples with Matrix Codes 1 - 6 natural stones, brick and concrete fragments >10mm and any extraneous material (visible glass, metal or twigs) are removed and excluded from the sample prior to analysis and reported results corrected to a whole sample basis. This is reported as “% stones >10mm”.

For samples with Matrix Code 7 the whole sample is dried and crushed prior to analysis and this supersedes any “A” subscripts

All analysis is performed on the sample as received for soil samples which are positive for asbestos or the client has informed asbestos may be present and/or if they are from outside the European Union and this supersedes any “D” subscripts.

TPH by method A-T-007:

For waters, free and visible oils are excluded from the sample used for analysis, so the reported result represents the dissolved phase only.

Results “with Clean up” indicates samples cleaned up with Silica during extraction.

EPH CWG (method A-T-055) from TPH CWG:

EPH CWG results have humics mathematically subtracted through instrument calculation.

Where these humic substances have been identified in any IDs from “TPH CWG with clean up” please note that the concentration is **NOT** included in the quantified results but present in the ID for information.

Electrical Conductivity of water by method A-T-037:

Results greater than 12900µS/cm @ 25°C / 11550µS/cm @ 20°C fall outside the calibration range and as such are unaccredited.

Please contact your client manager if you require any further information.

Envirolab Deviating Samples Report

Hattersley Science & Technology Park, Stockport Road, Hattersley, SK14 3QU
Tel. 0161 368 4921 email. ask@envlab.co.uk

Client:	Curtins Consulting (Manchester), Merchant Exchange, 17-19 Whitworth Street , Manchester, UK, M1 5WG	Project No:	25/05505
Project:	Whitefield	Date Received:	27/05/2025 (am)
Clients Project No:	B087132	Cool Box Temperatures (°C):	14.4 & 15.5

NO DEVIATIONS IDENTIFIED with respect to sampling dates or containers received.

Note: If, at any point before reaching the laboratory, the temperature of the samples has breached those set in published standards, e.g. BS-EN 5667-3 (for water samples $5 \pm 3^{\circ}\text{C}$), ISO 18400-105:2017, then the concentration of any affected analytes may differ from that at the time of sampling.

Envirolab Analysis Dates

Lab Sample ID	25/05505/1	25/05505/2	25/05505/3	25/05505/4	25/05505/5	25/05505/6	25/05505/7	25/05505/8	25/05505/9	25/05505/10
Client Sample No										
Client Sample ID/Depth	HP101 0.15m	HP103 0.20m	HP104 0.12m	WS101 0.35m	WS102 0.25m	WS101 2.10m	WS102 1.50m	WS102 2.50- 2.60m	WS101 3.00- 4.00m	WS102 3.00- 4.00m
Date Sampled	22/05/25	22/05/25	23/05/25	22/05/25	22/05/25	22/05/25	22/05/25	22/05/25	22/05/25	22/05/25
A-T-019s	05/06/2025	05/06/2025	05/06/2025	05/06/2025	05/06/2025					
A-T-022s	30/05/2025	30/05/2025	30/05/2025	30/05/2025	30/05/2025					
A-T-024s	02/06/2025	02/06/2025	02/06/2025	02/06/2025	02/06/2025					
A-T-026s	30/05/2025	30/05/2025	30/05/2025	30/05/2025	30/05/2025	20/06/2025	20/06/2025	20/06/2025	20/06/2025	20/06/2025
A-T-027s	30/05/2025	30/05/2025	30/05/2025	30/05/2025	30/05/2025					
A-T-031s	30/05/2025	30/05/2025	30/05/2025	30/05/2025	30/05/2025	19/06/2025	19/06/2025	19/06/2025	19/06/2025	19/06/2025
A-T-032s	30/05/2025	30/05/2025	30/05/2025	30/05/2025	30/05/2025					
A-T-040s	30/05/2025	30/05/2025	30/05/2025	30/05/2025	30/05/2025					
A-T-042sTCN	30/05/2025	30/05/2025	30/05/2025	30/05/2025	30/05/2025					
A-T-044	30/05/2025	30/05/2025	30/05/2025	30/05/2025	30/05/2025	18/06/2025	18/06/2025	18/06/2025	18/06/2025	18/06/2025
A-T-045	28/05/2025	28/05/2025	28/05/2025	28/05/2025	28/05/2025					
A-T-050s	30/05/2025	30/05/2025	30/05/2025	30/05/2025	30/05/2025					
A-T-055s	02/06/2025	03/06/2025	02/06/2025	03/06/2025	03/06/2025					
Calc-As Recd	02/06/2025	03/06/2025	02/06/2025	03/06/2025	03/06/2025					

The above dates are the analysis completion dates, please note that these are not necessarily the date that the analysis was weighed/extracted.

End of Report

Appendix E – Geotechnical Laboratory Test Results and CBR Results

Envirolab
Envirolab Ltd
Housesteads
Off Stockport Road
Hattersley
SK14 3QU
F.A.O.

Final Test Report - 2282543 / 1

Site: Whitefield
Job Number: 2282543
Originating Client: Envirolab
Originating Reference: 2282543
Date Sampled: 22/05/2025
Date Scheduled: 18/06/2025
Date Testing Started: 19/06/2025
Date Testing Finished: 27/06/2025

Previous Reports		Amendments	Date Issued

Amendments:

Authorised By:



Tim Robinson
Quality Supervisor

Report Issue Date: 27/06/2025

Job Number: 2282543

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Borehole / Trial Pit	Depth (m)	Sample	Natural Moisture Content %	Natural - Stones removed by hand Sieved - Washed on 425 µm sieve			Liquid Limit %	Plastic Limit %	Plasticity Index %	Liquidity Index	Class	Description / Remarks
				Natural / Sieved	Percentage Passing %	Moisture Content %						
WS101	2.10	D	23	Natural	100	23	25	18	7	0.71	CL	Grey slightly sandy, silty CLAY
WS102	1.50	D	16	Natural	100	16	31	14	17	0.12	CL	Brown slightly gravelly, slightly sandy, silty CLAY
WS102	2.50	D	18	Natural	100	18	26	14	12	0.33	CL	Brown slightly sandy, silty CLAY

Method of Test: BS 1377 : Part 2 : 1990 : Clause 3.2 Determination of moisture content
BS 1377 : Part 2 : 1990 : Clause 4.3 or 4.4 Determination of the liquid limit
BS 1377 : Part 2 : 1990 : Clause 5.3 Determination of the plastic limit and plasticity index



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Results reported relate only to the samples tested.

Site: Whitefield

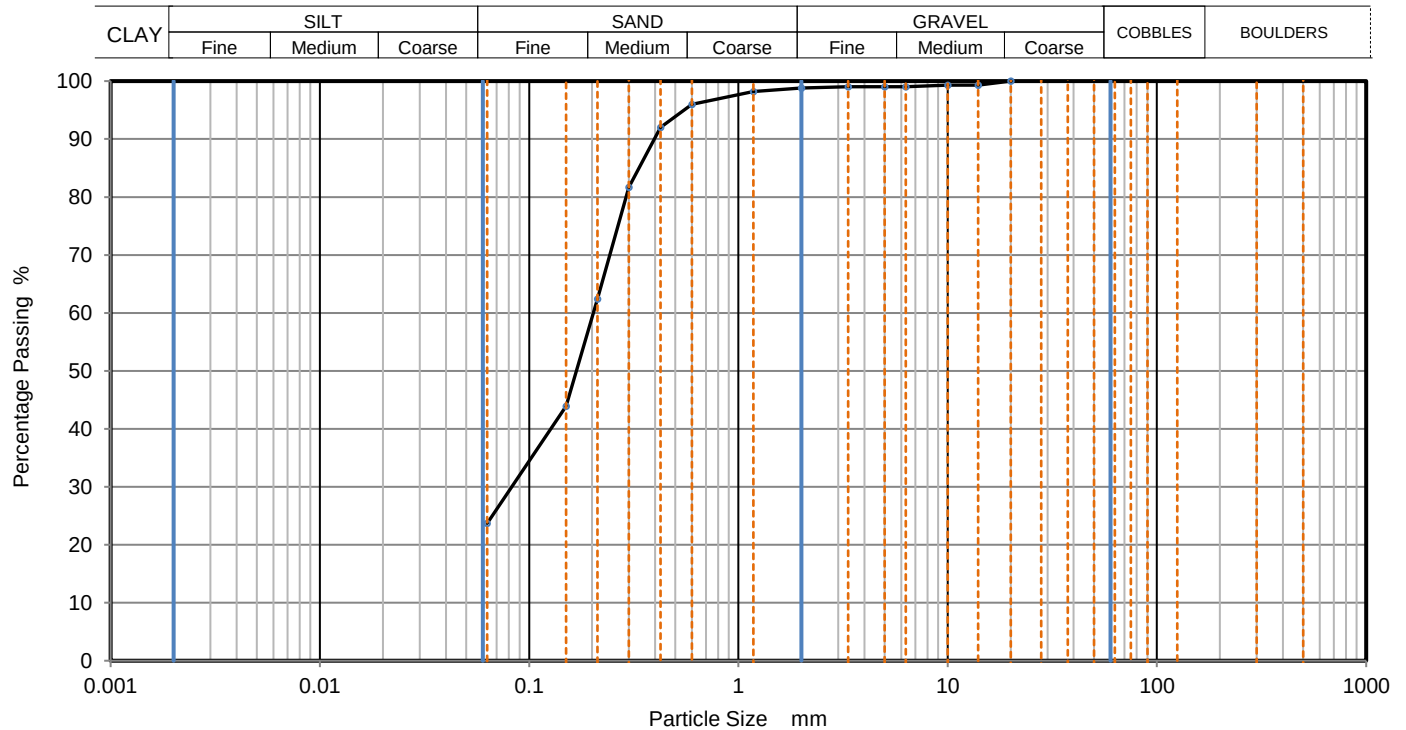
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Client: Envirolab

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DETERMINATION OF PARTICLE SIZE DISTRIBUTION

Borehole / Trial Pit	Depth (m)	Sample	Testing Type	Description
WS101	3.00	B	Wet Sieve	Brown silty SAND



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
20	100		
14	99		
10	99		
6.3	99		
5	99		
3.35	99		
2	99		
1.18	98		
0.6	96		
0.425	92		
0.3	82		
0.212	62		
0.15	44		
0.063	24		

Dry Mass of sample, g
1742

Sample Proportions	% dry mass
Very coarse	0
Gravel	1
Sand	75
Fines <0.063mm	24

Grading Analysis		
D100	mm	20
D60	mm	0.203
D30	mm	0.0825
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

Remarks

Preparation and testing in accordance with BS1377 unless noted below

Method of Preparation: BS 1377:Part 1:1990, clause 7.3 Initial preparation
BS 1377:Part 1:1990, clause 7.4.5 Preparation of particle size tests

Method of Test: BS1377:Part 2:1990, clause 9.2 Determination of particle size distribution by wet sieving method

Site: Whitefield

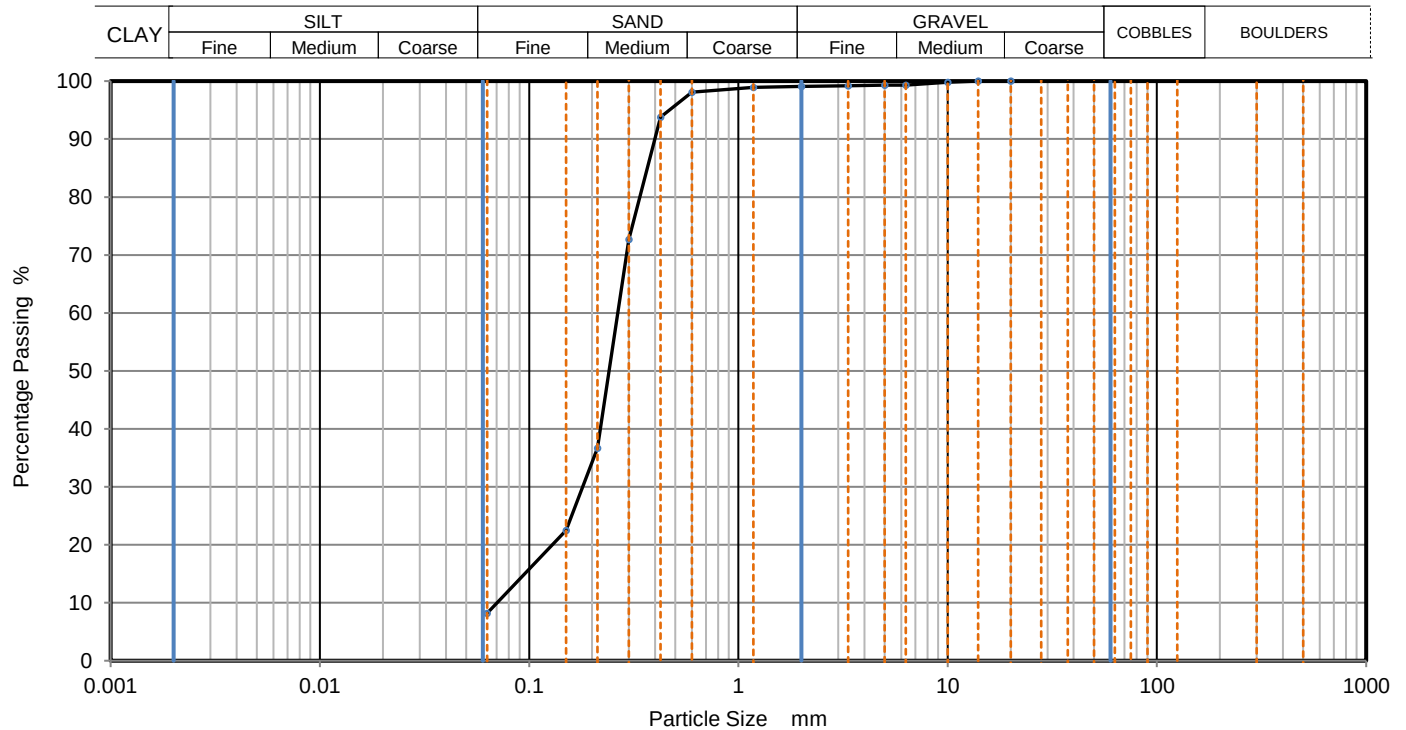
Job Number: 2282543

Client: Envirolab

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DETERMINATION OF PARTICLE SIZE DISTRIBUTION

Borehole / Trial Pit	Depth (m)	Sample	Testing Type	Description
WS102	3.00	B	Wet Sieve	Brown slightly clayey SAND



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
20	100		
14	100		
10	100		
6.3	99		
5	99		
3.35	99		
2	99		
1.18	99		
0.6	98		
0.425	94		
0.3	73		
0.212	37		
0.15	23		
0.063	8		

Dry Mass of sample, g
1417

Sample Proportions	% dry mass
Very coarse	0
Gravel	1
Sand	91
Fines <0.063mm	8

Grading Analysis		
D100	mm	14
D60	mm	0.265
D30	mm	0.18
D10	mm	0.0702
Uniformity Coefficient		3.8
Curvature Coefficient		1.7

Remarks

Preparation and testing in accordance with BS1377 unless noted below

Method of Preparation: BS 1377:Part 1:1990, clause 7.3 Initial preparation
BS 1377:Part 1:1990, clause 7.4.5 Preparation of particle size tests

Method of Test: BS1377:Part 2:1990, clause 9.2 Determination of particle size distribution by wet sieving method



Final Test Report - 2282543 / 1

Site: Whitefield

Job Number: 2282543

Originating Client: Envirolab

All opinions and interpretations contained within this report are outside of our Scope of Accreditation.

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Samples will be retained for 28 days from date of issue of the final test report before being disposed of, unless we receive written instruction to the contrary.

Report End

Report Issue Date: 27/06/2025



RESULTS OF DYNAMIC CONE PENETROMETER (DCP) TESTING

Project:	Whitefield				Date of Test:	23-May-25
Project No.	B087132		Soil type:	Cohesive		
Test No.	CBR1		Soil condition:	Unsaturated		
			Operator:	RBJ		

Blow count	Penetration (mm)	Penetration (m)	Penetration Index (DPI) mm/blow	log DPI	log CBR	Estimated CBR1 (%) ¹	log CBR	Estimated CBR2 (%) ²
0	265	0.265						
1	275	0.275	10.0	1.000	1.340	21.9	1.423	26
1	285	0.285	10.0	1.000	1.340	21.9	1.423	26
3	300	0.300	5.0	0.699	1.677	47.6	1.741	55
3	320	0.320	6.7	0.824	1.537	34.5	1.609	41
2	330	0.330	5.0	0.699	1.677	47.6	1.741	55
1	350	0.350	20.0	1.301	1.003	10.1	1.105	13
2	360	0.360	5.0	0.699	1.677	47.6	1.741	55
1	370	0.370	10.0	1.000	1.340	21.9	1.423	26
2	380	0.380	5.0	0.699	1.677	47.6	1.741	55
2	400	0.400	10.0	1.000	1.340	21.9	1.423	26
2	425	0.425	12.5	1.097	1.231	17.0	1.321	21
1	430	0.430	5.0	0.699	1.677	47.6	1.741	55
1	480	0.480	50.0	1.699	0.557	3.6	0.684	5
1	510	0.510	30.0	1.477	0.806	6.4	0.919	8
2	540	0.540	15.0	1.176	1.143	13.9	1.237	17
2	570	0.570	15.0	1.176	1.143	13.9	1.237	17
2	610	0.610	20.0	1.301	1.003	10.1	1.105	13
2	630	0.630	10.0	1.000	1.340	21.9	1.423	26
1	650	0.650	20.0	1.301	1.003	10.1	1.105	13
1	670	0.670	20.0	1.301	1.003	10.1	1.105	13
1	690	0.690	20.0	1.301	1.003	10.1	1.105	13
1	710	0.710	20.0	1.301	1.003	10.1	1.105	13
1	730	0.730	20.0	1.301	1.003	10.1	1.105	13
1	750	0.750	20.0	1.301	1.003	10.1	1.105	13
2	780	0.780	15.0	1.176	1.143	13.9	1.237	17
1	800	0.800	20.0	1.301	1.003	10.1	1.105	13
1	820	0.820	20.0	1.301	1.003	10.1	1.105	13
1	850	0.850	30.0	1.477	0.806	6.4	0.919	8

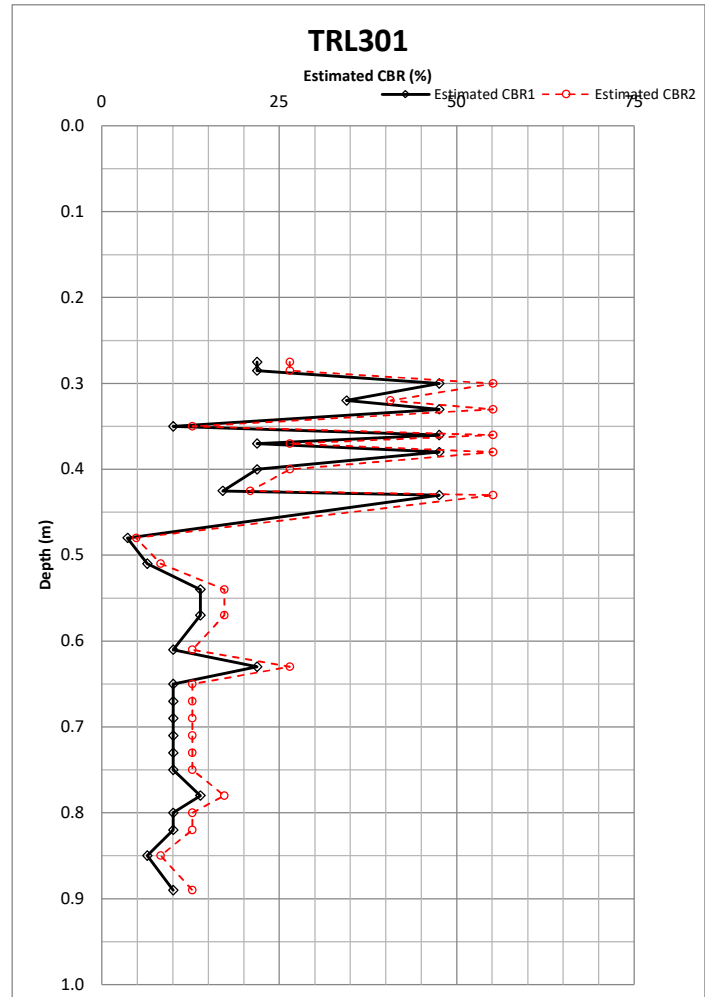
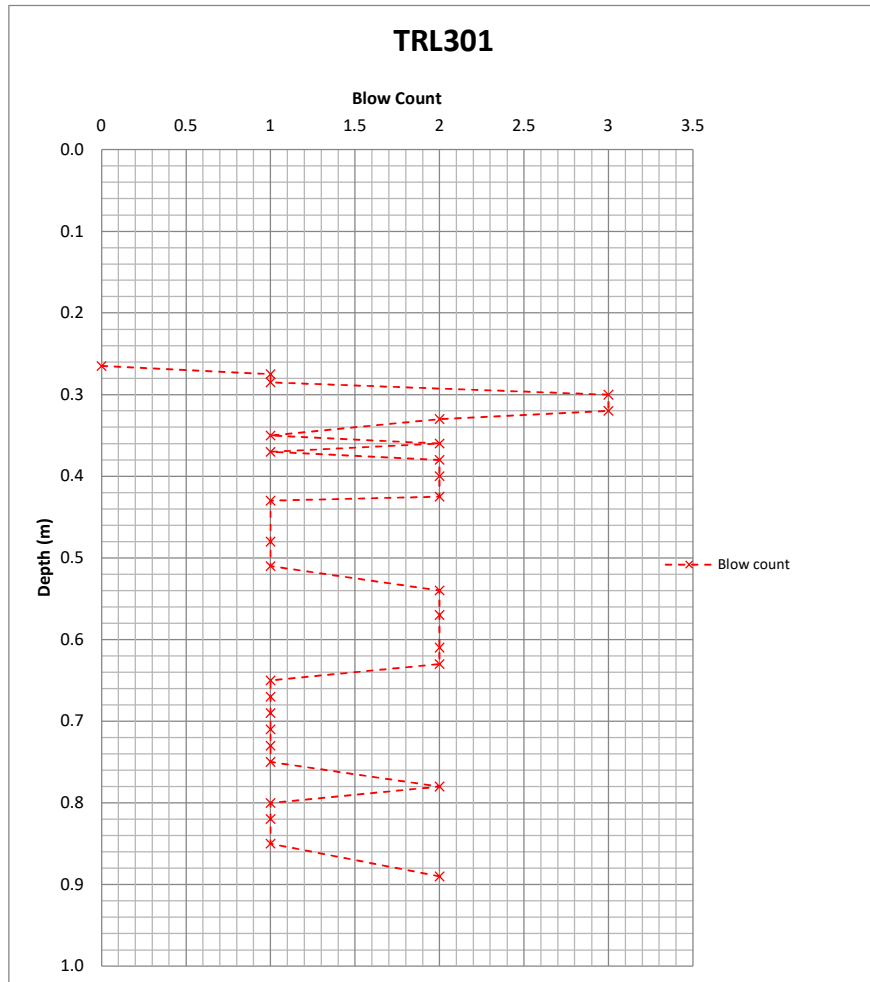
2	890	0.890	20.0	1.301	1.003	10.1	1.105	13
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Notes:

1. CBR calculated based on Webster et al, 1992.
2. CBR calculated based on DMRB, 2008.

Reference:

- Webster S, Grau R and Williams T. 1992. Description and Application of Dual Mass Dynamic Cone Penetrometer. Dept of Army Waterways Equipment Station, Instruction rpt GL-92-3.
- Highways Agency, 2008. Design Manual for Roads and Bridges (DMRB), Data for Pavement Assessment. HD29/08.





RESULTS OF DYNAMIC CONE PENETROMETER (DCP) TESTING

Project:	Whitefield				Date of Test:	23-May-25
Project No.	B087132		Soil type:	Granular		
Test No.	CBR2		Soil condition:	Unsaturated		
			Operator:	RBJ		

Blow count	Penetration (mm)	Penetration (m)	Penetration Index (DPI) mm/blow	log DPI	log CBR	Estimated CBR1 (%) ¹	log CBR	Estimated CBR2 (%) ²
0	280	0.280						
1	295	0.295	15.0	1.176	1.143	13.9	1.237	17
1	310	0.310	15.0	1.176	1.143	13.9	1.237	17
2	320	0.320	5.0	0.699	1.677	47.6	1.741	55
1	330	0.330	10.0	1.000	1.340	21.9	1.423	26
2	345	0.345	7.5	0.875	1.480	30.2	1.555	36
2	365	0.365	10.0	1.000	1.340	21.9	1.423	26
2	375	0.375	5.0	0.699	1.677	47.6	1.741	55
2	385	0.385	5.0	0.699	1.677	47.6	1.741	55
4	400	0.400	3.8	0.574	1.817	65.6	1.873	75
10	410	0.410	1.0	0.000	2.460	288.4	2.480	302
10	425	0.425	1.5	0.176	2.263	183.1	2.294	197
10	430	0.430	0.5	-0.301	2.797	626.8	2.798	628
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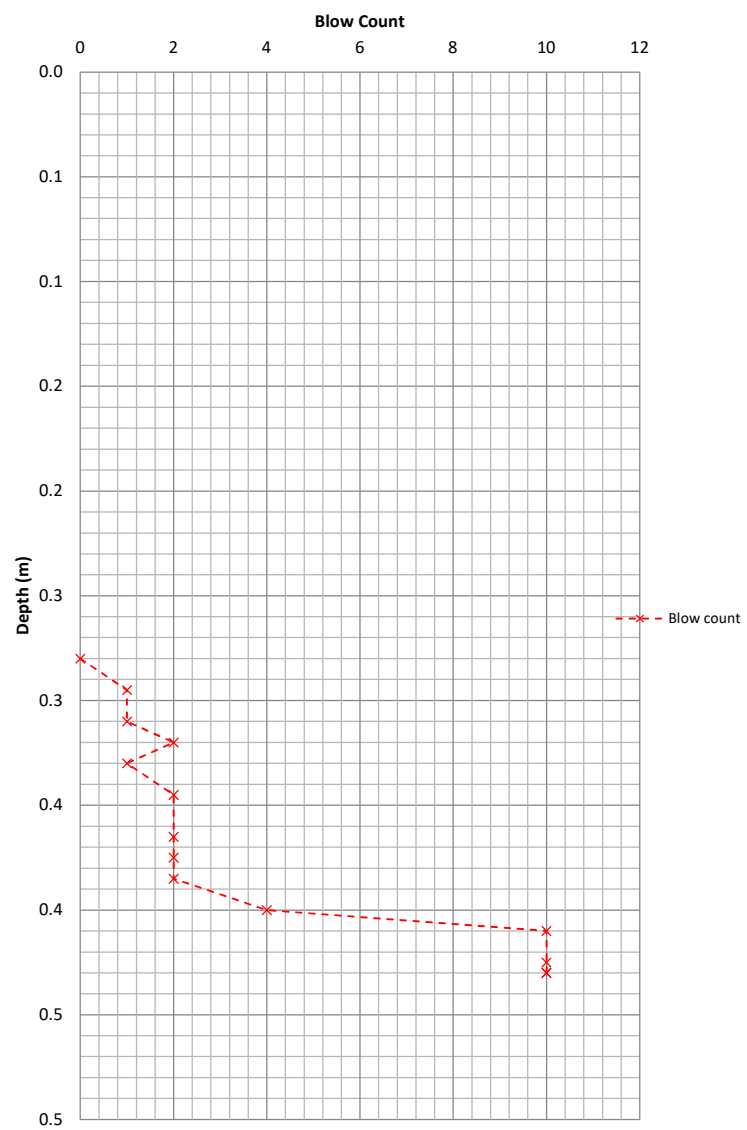
Notes:

1. CBR calculated based on Webster et al, 1992.
2. CBR calculated based on DMRB, 2008.

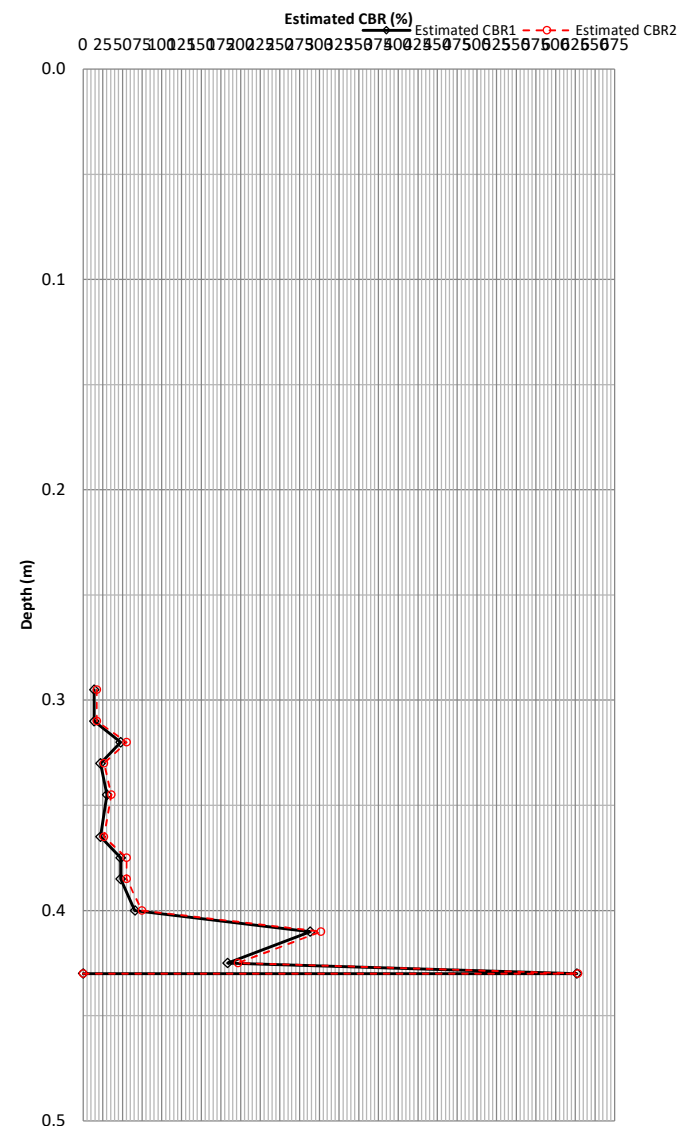
Reference:

- Webster S, Grau R and Williams T. 1992. Description and Application of Dual Mass Dynamic Cone Penetrometer. Dept of Army Waterways Equipment Station, Instruction rpt GL-92-3.
- Highways Agency, 2008. Design Manual for Roads and Bridges (DMRB), Data for Pavement Assessment. HD29/08.

TRL301



TRL301





RESULTS OF DYNAMIC CONE PENETROMETER (DCP) TESTING

Project:	Whitefield				Date of Test:	23-May-25
Project No.	B087132		Soil type:	Granular		
Test No.	CBR3		Soil condition:	Unsaturated		
			Operator:	RBJ		

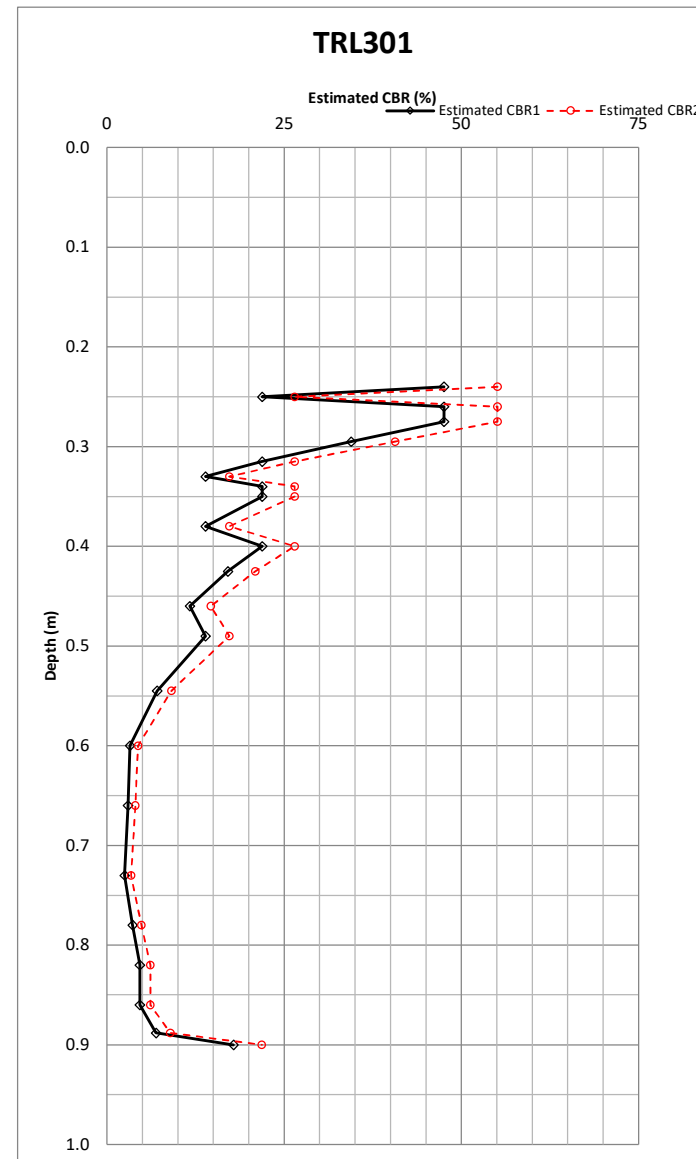
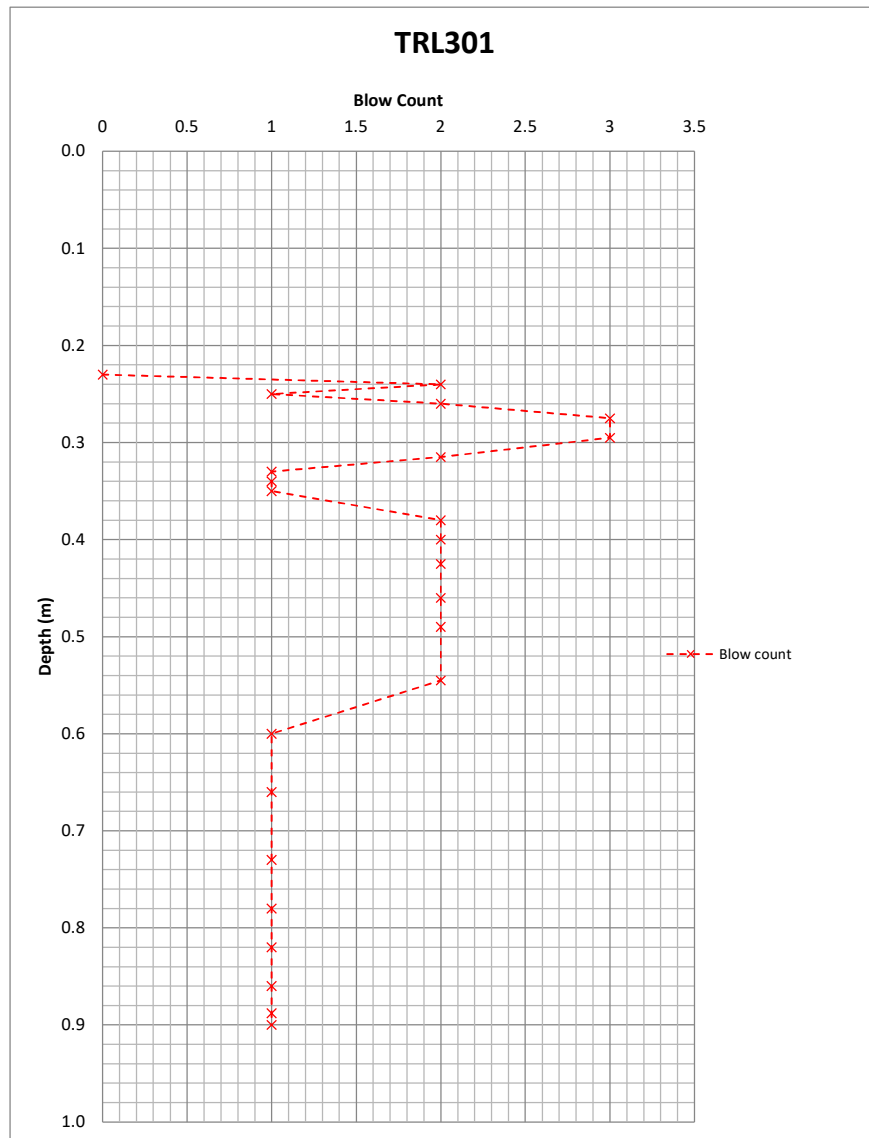
Blow count	Penetration (mm)	Penetration (m)	Penetration Index (DPI) mm/blow	log DPI	log CBR	Estimated CBR1 (%) ¹	log CBR	Estimated CBR2 (%) ²
0	230	0.230						
2	240	0.240	5.0	0.699	1.677	47.6	1.741	55
1	250	0.250	10.0	1.000	1.340	21.9	1.423	26
2	260	0.260	5.0	0.699	1.677	47.6	1.741	55
3	275	0.275	5.0	0.699	1.677	47.6	1.741	55
3	295	0.295	6.7	0.824	1.537	34.5	1.609	41
2	315	0.315	10.0	1.000	1.340	21.9	1.423	26
1	330	0.330	15.0	1.176	1.143	13.9	1.237	17
1	340	0.340	10.0	1.000	1.340	21.9	1.423	26
1	350	0.350	10.0	1.000	1.340	21.9	1.423	26
2	380	0.380	15.0	1.176	1.143	13.9	1.237	17
2	400	0.400	10.0	1.000	1.340	21.9	1.423	26
2	425	0.425	12.5	1.097	1.231	17.0	1.321	21
2	460	0.460	17.5	1.243	1.068	11.7	1.166	15
2	490	0.490	15.0	1.176	1.143	13.9	1.237	17
2	545	0.545	27.5	1.439	0.848	7.0	0.959	9
1	600	0.600	55.0	1.740	0.511	3.2	0.640	4
1	660	0.660	60.0	1.778	0.468	2.9	0.600	4
1	730	0.730	70.0	1.845	0.393	2.5	0.530	3
1	780	0.780	50.0	1.699	0.557	3.6	0.684	5
1	820	0.820	40.0	1.602	0.666	4.6	0.787	6
1	860	0.860	40.0	1.602	0.666	4.6	0.787	6
1	888	0.888	28.0	1.447	0.839	6.9	0.950	9
1	900	0.900	12.0	1.079	1.251	17.8	1.339	22

Notes:

1. CBR calculated based on Webster et al, 1992.

2. CBR calculated based on DMRB, 2008.

- Reference:**
- Webster S, Grau R and Williams T. 1992. Description and Application of Dual Mass Dynamic Cone Penetrometer. Dept of Army Waterways Equipment Station, Instruction rpt GL-92-3.
 - Highways Agency, 2008. Design Manual for Roads and Bridges (DMRB), Data for Pavement Assessment. HD29/08.





RESULTS OF DYNAMIC CONE PENETROMETER (DCP) TESTING

Project:	Whitefield				Date of Test:	23-May-25
Project No.	B087132		Soil type:	Granular		
Test No.	CBR4		Soil condition:	Unsaturated		
			Operator:	RBJ		

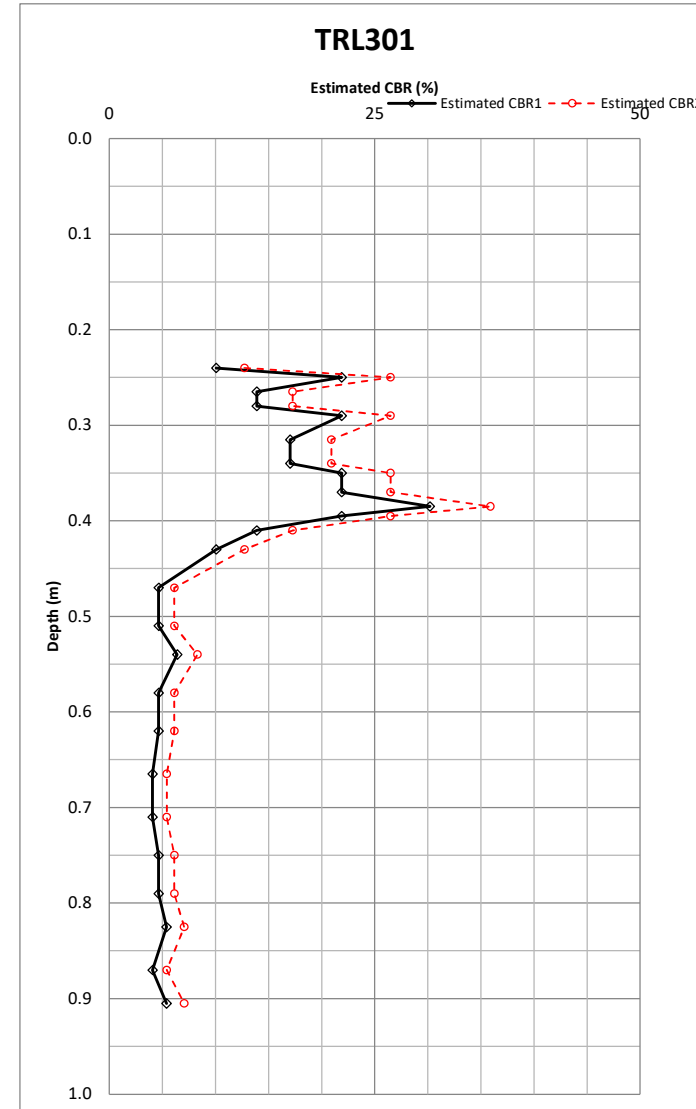
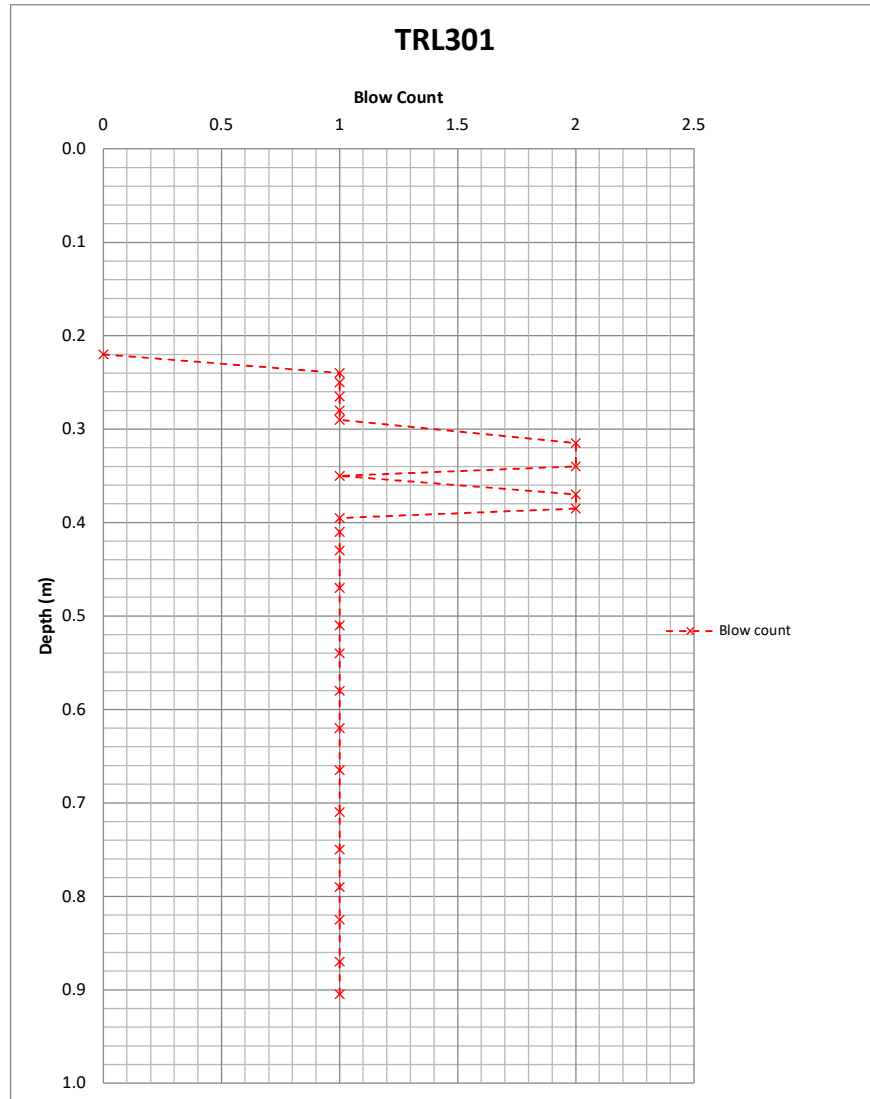
Blow count	Penetration (mm)	Penetration (m)	Penetration Index (DPI) mm/blow	log DPI	log CBR	Estimated CBR1 (%) ¹	log CBR	Estimated CBR2 (%) ²
0	220	0.220						
1	240	0.240	20.0	1.301	1.003	10.1	1.105	13
1	250	0.250	10.0	1.000	1.340	21.9	1.423	26
1	265	0.265	15.0	1.176	1.143	13.9	1.237	17
1	280	0.280	15.0	1.176	1.143	13.9	1.237	17
1	290	0.290	10.0	1.000	1.340	21.9	1.423	26
2	315	0.315	12.5	1.097	1.231	17.0	1.321	21
2	340	0.340	12.5	1.097	1.231	17.0	1.321	21
1	350	0.350	10.0	1.000	1.340	21.9	1.423	26
2	370	0.370	10.0	1.000	1.340	21.9	1.423	26
2	385	0.385	7.5	0.875	1.480	30.2	1.555	36
1	395	0.395	10.0	1.000	1.340	21.9	1.423	26
1	410	0.410	15.0	1.176	1.143	13.9	1.237	17
1	430	0.430	20.0	1.301	1.003	10.1	1.105	13
1	470	0.470	40.0	1.602	0.666	4.6	0.787	6
1	510	0.510	40.0	1.602	0.666	4.6	0.787	6
1	540	0.540	30.0	1.477	0.806	6.4	0.919	8
1	580	0.580	40.0	1.602	0.666	4.6	0.787	6
1	620	0.620	40.0	1.602	0.666	4.6	0.787	6
1	665	0.665	45.0	1.653	0.608	4.1	0.733	5
1	710	0.710	45.0	1.653	0.608	4.1	0.733	5
1	750	0.750	40.0	1.602	0.666	4.6	0.787	6
1	790	0.790	40.0	1.602	0.666	4.6	0.787	6
1	825	0.825	35.0	1.544	0.731	5.4	0.848	7
1	870	0.870	45.0	1.653	0.608	4.1	0.733	5
1	905	0.905	35.0	1.544	0.731	5.4	0.848	7

Notes:

1. CBR calculated based on Webster et al, 1992.

2. CBR calculated based on DMRB, 2008.

- Reference:**
- Webster S, Grau R and Williams T. 1992. Description and Application of Dual Mass Dynamic Cone Penetrometer. Dept of Army Waterways Equipment Station, Instruction rpt GL-92-3.
 - Highways Agency, 2008. Design Manual for Roads and Bridges (DMRB), Data for Pavement Assessment. HD29/08.





RESULTS OF DYNAMIC CONE PENETROMETER (DCP) TESTING

Project:	Whitefield				Date of Test:	23-May-25
Project No.	B087132		Soil type:	Granular		
Test No.	CBR5		Soil condition:	Unsaturated		
			Operator:	RBJ		

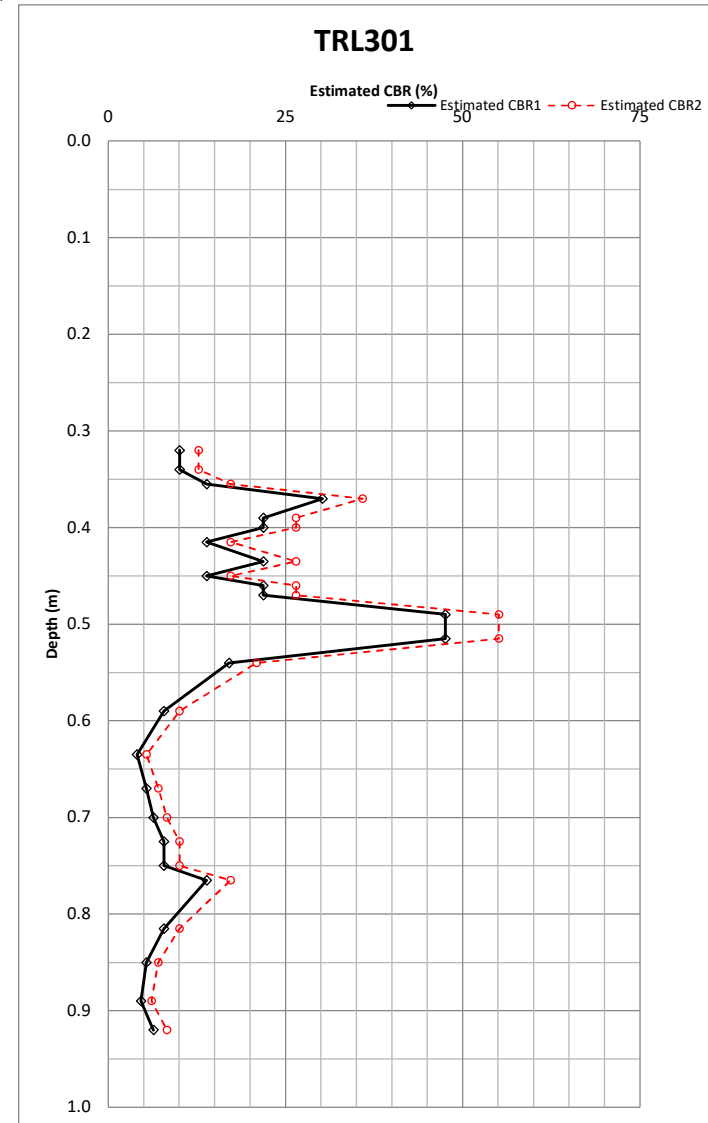
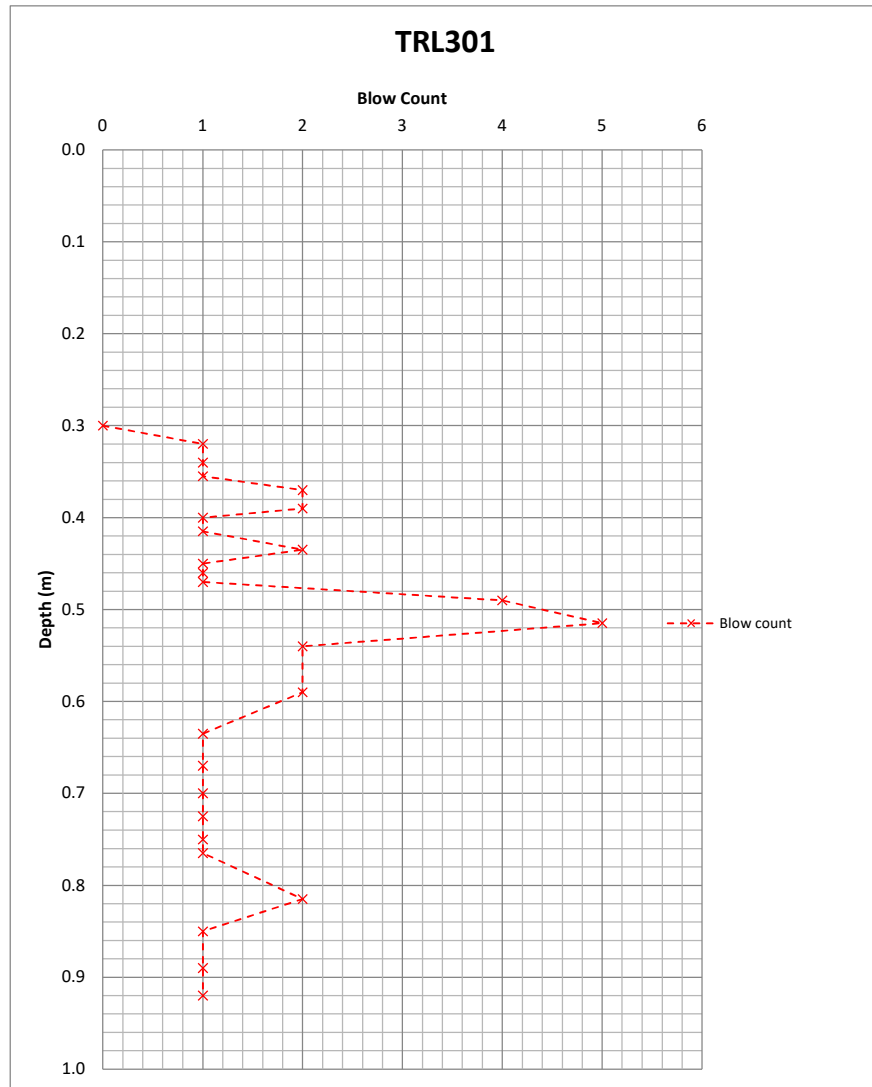
Blow count	Penetration (mm)	Penetration (m)	Penetration Index (DPI) mm/blow	log DPI	log CBR	Estimated CBR1 (%) ¹	log CBR	Estimated CBR2 (%) ²
0	300	0.300						
1	320	0.320	20.0	1.301	1.003	10.1	1.105	13
1	340	0.340	20.0	1.301	1.003	10.1	1.105	13
1	355	0.355	15.0	1.176	1.143	13.9	1.237	17
2	370	0.370	7.5	0.875	1.480	30.2	1.555	36
2	390	0.390	10.0	1.000	1.340	21.9	1.423	26
1	400	0.400	10.0	1.000	1.340	21.9	1.423	26
1	415	0.415	15.0	1.176	1.143	13.9	1.237	17
2	435	0.435	10.0	1.000	1.340	21.9	1.423	26
1	450	0.450	15.0	1.176	1.143	13.9	1.237	17
1	460	0.460	10.0	1.000	1.340	21.9	1.423	26
1	470	0.470	10.0	1.000	1.340	21.9	1.423	26
4	490	0.490	5.0	0.699	1.677	47.6	1.741	55
5	515	0.515	5.0	0.699	1.677	47.6	1.741	55
2	540	0.540	12.5	1.097	1.231	17.0	1.321	21
2	590	0.590	25.0	1.398	0.894	7.8	1.002	10
1	635	0.635	45.0	1.653	0.608	4.1	0.733	5
1	670	0.670	35.0	1.544	0.731	5.4	0.848	7
1	700	0.700	30.0	1.477	0.806	6.4	0.919	8
1	725	0.725	25.0	1.398	0.894	7.8	1.002	10
1	750	0.750	25.0	1.398	0.894	7.8	1.002	10
1	765	0.765	15.0	1.176	1.143	13.9	1.237	17
2	815	0.815	25.0	1.398	0.894	7.8	1.002	10
1	850	0.850	35.0	1.544	0.731	5.4	0.848	7
1	890	0.890	40.0	1.602	0.666	4.6	0.787	6
1	920	0.920	30.0	1.477	0.806	6.4	0.919	8

Notes:

1. CBR calculated based on Webster et al, 1992.

2. CBR calculated based on DMRB, 2008.

- Reference:**
- Webster S, Grau R and Williams T. 1992. Description and Application of Dual Mass Dynamic Cone Penetrometer. Dept of Army Waterways Equipment Station, Instruction rpt GL-92-3.
 - Highways Agency, 2008. Design Manual for Roads and Bridges (DMRB), Data for Pavement Assessment. HD29/08.





RESULTS OF DYNAMIC CONE PENETROMETER (DCP) TESTING

Project:	Whitefield				Date of Test:	23-May-25
Project No.	B087132		Soil type:	Granular		
Test No.	CBR6		Soil condition:	Unsaturated		
			Operator:	RBJ		

Blow count	Penetration (mm)	Penetration (m)	Penetration Index (DPI) mm/blow	log DPI	log CBR	Estimated CBR1 (%) ¹	log CBR	Estimated CBR2 (%) ²
0	60	0.060						
1	70	0.070	10.0	1.000	1.340	21.9	1.423	26
1	80	0.080	10.0	1.000	1.340	21.9	1.423	26
1	90	0.090	10.0	1.000	1.340	21.9	1.423	26
1	100	0.100	10.0	1.000	1.340	21.9	1.423	26
1	110	0.110	10.0	1.000	1.340	21.9	1.423	26
1	120	0.120	10.0	1.000	1.340	21.9	1.423	26
1	130	0.130	10.0	1.000	1.340	21.9	1.423	26
1	140	0.140	10.0	1.000	1.340	21.9	1.423	26
1	155	0.155	15.0	1.176	1.143	13.9	1.237	17
1	170	0.170	15.0	1.176	1.143	13.9	1.237	17
2	180	0.180	5.0	0.699	1.677	47.6	1.741	55
10	190	0.190	1.0	0.000	2.460	288.4	2.480	302
10	210	0.210	2.0	0.301	2.123	132.7	2.162	145
10	240	0.240	3.0	0.477	1.926	84.3	1.976	95
10	290	0.290	5.0	0.699	1.677	47.6	1.741	55
8	380	0.380	11.3	1.051	1.283	19.2	1.369	23
1	400	0.400	20.0	1.301	1.003	10.1	1.105	13
1	420	0.420	20.0	1.301	1.003	10.1	1.105	13
1	430	0.430	10.0	1.000	1.340	21.9	1.423	26
1	440	0.440	10.0	1.000	1.340	21.9	1.423	26
1	455	0.455	15.0	1.176	1.143	13.9	1.237	17
1	460	0.460	5.0	0.699	1.677	47.6	1.741	55
1	475	0.475	15.0	1.176	1.143	13.9	1.237	17
1	485	0.485	10.0	1.000	1.340	21.9	1.423	26
1	495	0.495	10.0	1.000	1.340	21.9	1.423	26
1	505	0.505	10.0	1.000	1.340	21.9	1.423	26
1	520	0.520	15.0	1.176	1.143	13.9	1.237	17
1	530	0.530	10.0	1.000	1.340	21.9	1.423	26

1	545	0.545	15.0	1.176	1.143	13.9	1.237	17
1	560	0.560	15.0	1.176	1.143	13.9	1.237	17
1	570	0.570	10.0	1.000	1.340	21.9	1.423	26
1	585	0.585	15.0	1.176	1.143	13.9	1.237	17
1	600	0.600	15.0	1.176	1.143	13.9	1.237	17
1	620	0.620	20.0	1.301	1.003	10.1	1.105	13
1	635	0.635	15.0	1.176	1.143	13.9	1.237	17
1	650	0.650	15.0	1.176	1.143	13.9	1.237	17
2	670	0.670	10.0	1.000	1.340	21.9	1.423	26
3	700	0.700	10.0	1.000	1.340	21.9	1.423	26
2	740	0.740	20.0	1.301	1.003	10.1	1.105	13
1	750	0.750	10.0	1.000	1.340	21.9	1.423	26
2	770	0.770	10.0	1.000	1.340	21.9	1.423	26
1	780	0.780	10.0	1.000	1.340	21.9	1.423	26
3	830	0.830	16.7	1.222	1.092	12.3	1.189	15
1	850	0.850	20.0	1.301	1.003	10.1	1.105	13
1	870	0.870	20.0	1.301	1.003	10.1	1.105	13

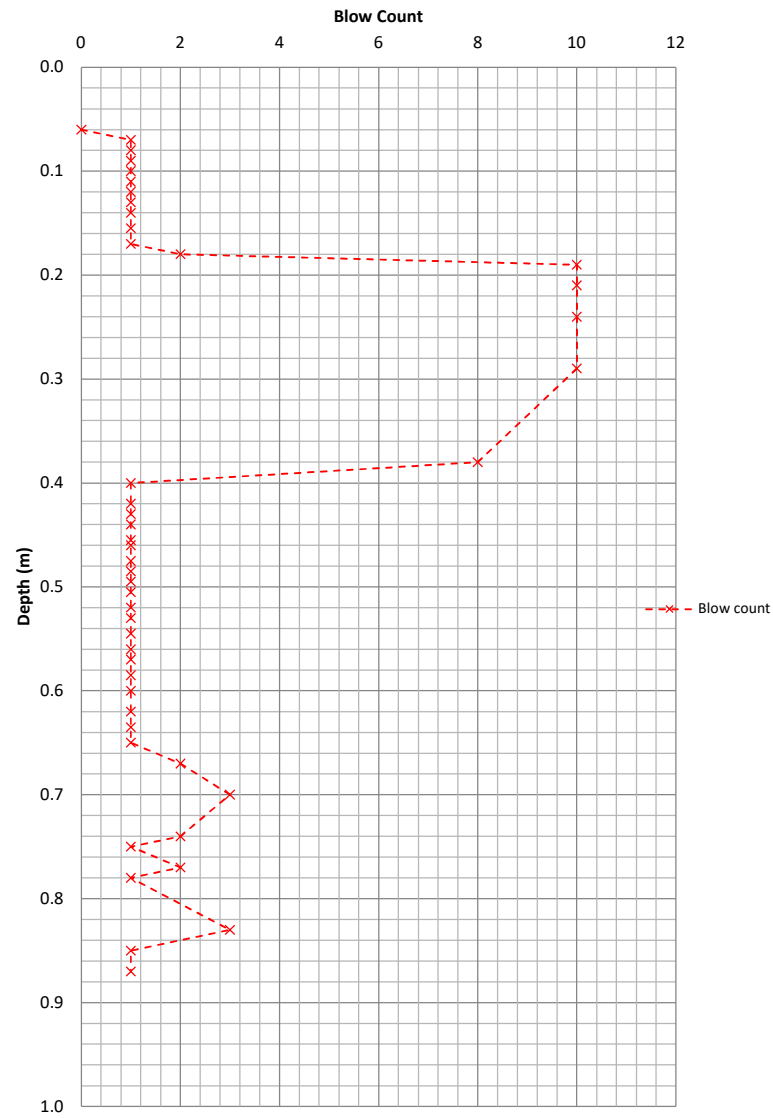
Notes:

1. CBR calculated based on Webster et al, 1992.
2. CBR calculated based on DMRB, 2008.

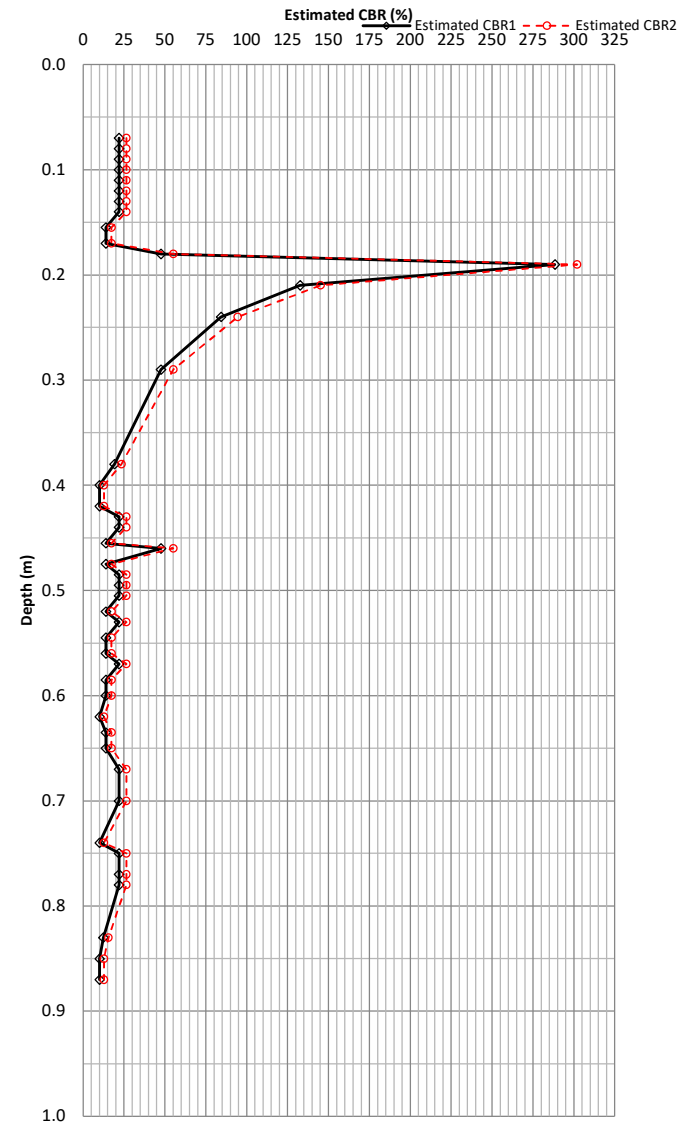
Reference:

- Webster S, Grau R and Williams T. 1992. Description and Application of Dual Mass Dynamic Cone Penetrometer. Dept of Army Waterways Equipment Station, Instruction rpt GL-92-3.
- Highways Agency, 2008. Design Manual for Roads and Bridges (DMRB), Data for Pavement Assessment. HD29/08.

TRL301



TRL301





RESULTS OF DYNAMIC CONE PENETROMETER (DCP) TESTING

Project:	Whitefield				Date of Test:	23-May-25
Project No.	B087132		Soil type:	Granular		
Test No.	CBR7		Soil condition:	Unsaturated		
			Operator:	RBJ		

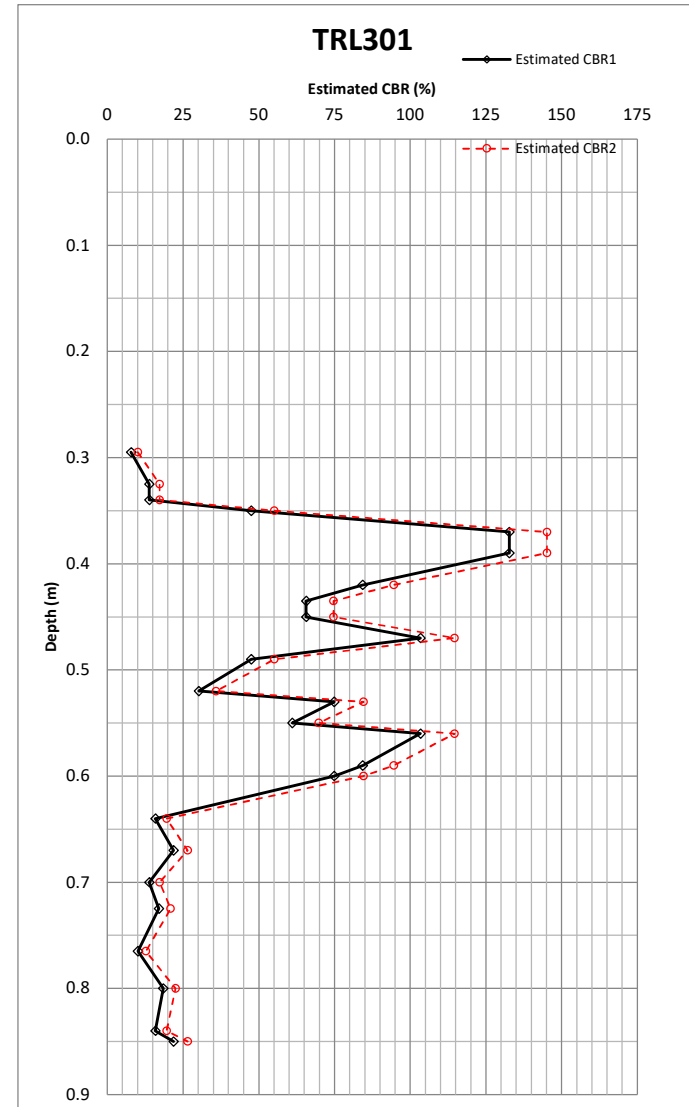
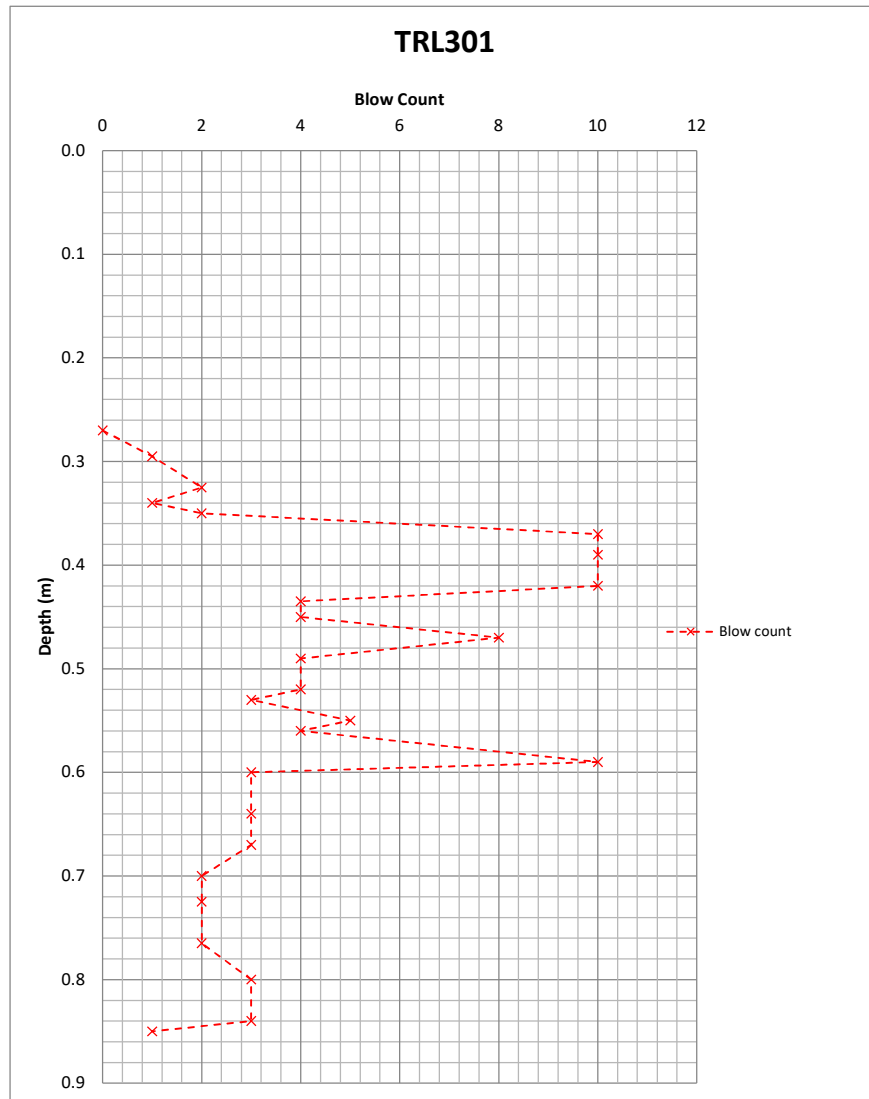
Blow count	Penetration (mm)	Penetration (m)	Penetration Index (DPI) mm/blow	log DPI	log CBR	Estimated CBR1 (%) ¹	log CBR	Estimated CBR2 (%) ²
0	270	0.270						
1	295	0.295	25.0	1.398	0.894	7.8	1.002	10
2	325	0.325	15.0	1.176	1.143	13.9	1.237	17
1	340	0.340	15.0	1.176	1.143	13.9	1.237	17
2	350	0.350	5.0	0.699	1.677	47.6	1.741	55
10	370	0.370	2.0	0.301	2.123	132.7	2.162	145
10	390	0.390	2.0	0.301	2.123	132.7	2.162	145
10	420	0.420	3.0	0.477	1.926	84.3	1.976	95
4	435	0.435	3.8	0.574	1.817	65.6	1.873	75
4	450	0.450	3.8	0.574	1.817	65.6	1.873	75
8	470	0.470	2.5	0.398	2.014	103.3	2.059	115
4	490	0.490	5.0	0.699	1.677	47.6	1.741	55
4	520	0.520	7.5	0.875	1.480	30.2	1.555	36
3	530	0.530	3.3	0.523	1.874	74.9	1.927	85
5	550	0.550	4.0	0.602	1.786	61.1	1.844	70
4	560	0.560	2.5	0.398	2.014	103.3	2.059	115
10	590	0.590	3.0	0.477	1.926	84.3	1.976	95
3	600	0.600	3.3	0.523	1.874	74.9	1.927	85
3	640	0.640	13.3	1.125	1.200	15.9	1.291	20
3	670	0.670	10.0	1.000	1.340	21.9	1.423	26
2	700	0.700	15.0	1.176	1.143	13.9	1.237	17
2	725	0.725	12.5	1.097	1.231	17.0	1.321	21
2	765	0.765	20.0	1.301	1.003	10.1	1.105	13
3	800	0.800	11.7	1.067	1.265	18.4	1.352	23
3	840	0.840	13.3	1.125	1.200	15.9	1.291	20
1	850	0.850	10.0	1.000	1.340	21.9	1.423	26

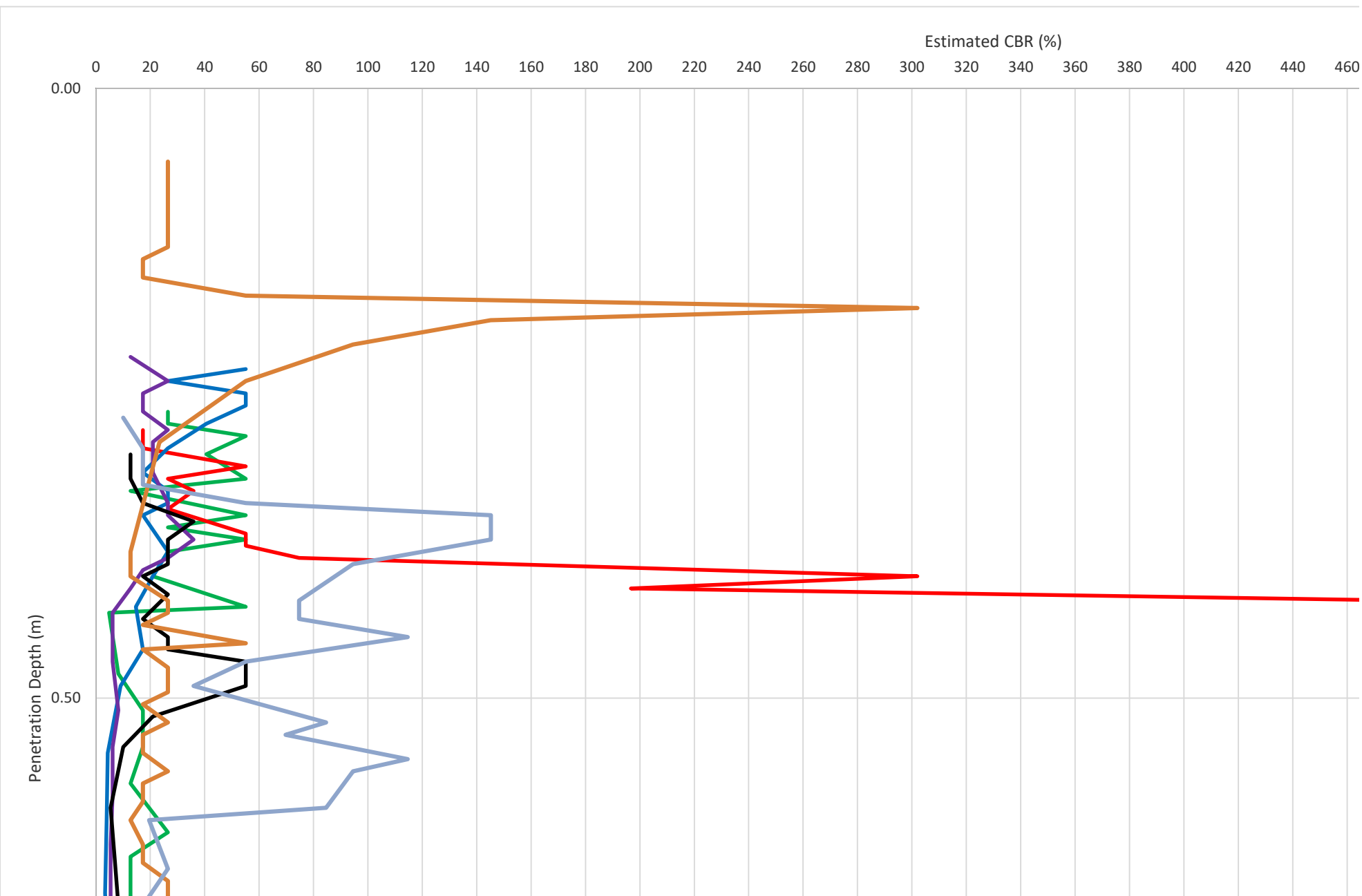
Notes:

1. CBR calculated based on Webster et al, 1992.

2. CBR calculated based on DMRB, 2008.

- Reference:**
- Webster S, Grau R and Williams T. 1992. Description and Application of Dual Mass Dynamic Cone Penetrometer. Dept of Army Waterways Equipment Station, Instruction rpt GL-92-3.
 - Highways Agency, 2008. Design Manual for Roads and Bridges (DMRB), Data for Pavement Assessment. HD29/08.





Appendix F – Groundwater Monitoring Results



GROUNDWATER MONITORING LOG SHEET

Project: Whitefield Medical Centre
Job Number: B087132
Client: NHS Properties
Barometric State: Falling

Date: 04/06/2025
Visit: 1
Weather: Sun/Overcast
Ground Conditions: Dry

Borehole Reference	Water Level m bgl	Borehole Base m bgl	Note
WS101	1.50	2.83	
WS102	2.39	3.13	

Notes _____

Logged by _____
RBJ



GROUNDWATER MONITORING LOG SHEET

Project: Whitefield Medical Centre
Job Number: B087132
Client: NHS Properties
Barometric State: Rising

Date: 18/06/2025
Visit: 2
Weather: Sunny
Ground Conditions: Dry

Borehole Reference	Water Level m bgl	Borehole Base m bgl	Note
WS101	1.40	2.95	
WS102	2.41	3.14	

Notes _____

Logged by _____

RBJ

Appendix G – GAC Screening Thresholds

Human Health GQRA Rationale and Hierarchy

Background

Detailed guidance on human health risk assessment is available within several documents, published by both the Environment Agency, Defra, CL:AIRE, LQM/CIEH and Public Health England as referenced below (references a-h).

A Generic Quantitative Risk Assessment (GQRA) is carried out for the Potential Contaminant Linkages (PCLs) investigated by screening of soil contamination data against relevant Generic Assessment Criteria where available.

Generic Assessment Criteria are available for a range of different land use scenarios, soil organic matter (SOM) and soil types. Curtins have adopted available GACs for a sandy loam soil at 1%, 2.5% and 6% SOM using various sources.

GAC Hierarchy

A summary of and hierarchy for adopted GACs is identified below:

- i) **Category 4 Screening Levels (C4SLs):** In March 2014 Defra published C4SLs for arsenic, benzene, benzo(a)pyrene, cadmium, hexavalent chromium, and lead as part of the 'Phase 1 Project'. These values were derived to support the revised Part 2A Statutory Guidance issued in 2012 in which four categories of contaminated land are included, ranging from Category 1 (significant/high risk) to Category 4 (low risk). In 2018 the 'Phase 2 Project' commenced which aims to develop C4SLs for a range of further contaminants. Currently available Phase 2 C4SLs include vinyl chloride, trichloroethene, tetrachloroethene, naphthalene, cis-1,2 dichloroethene, trans 1, 2 dichloroethene and per / polyfluoroalkyl substances (PFAS) . Where contaminant concentrations do not exceed C4SLs, there is no risk that the land poses a significant possibility of significant harm (SPoSH) or the level of risk is low, as such land can be demonstrated to be in Category 4 and cannot be determined as contaminated land. The C4SLs are proposed to be more pragmatic (whilst still strongly precautionary) in comparison with SGVs and S4UL's outlined below.
- ii) **Suitable for Use Levels (S4ULs):** In 2015 LQM and the Chartered Institute of Environmental Health published generic assessment criteria for 89 substances including metals, BTEX, TPH, polycyclic aromatic hydrocarbons, phenols, chlorinated solvents and other volatile organic compounds. The S4ULs represent a minimal risk to long term human health, derived using health criteria values. The methodology for deriving the S4ULs is based on the Environment Agency CLEA model with consideration of developments in UK human health exposure assessment, in particular the additional land uses and exposure assumptions.
- iii) **Other Supplementary Screening Criteria:** In addition to those developed by LQM/CIEH (outlined above), other third party organisations have derived SSVs for a wider range of contaminants and land uses using the CLEA Model. Curtins have adopted these numbers where applicable, including those developed EIC/AGS/CL:AIRE and SoBRA published thresholds.

Alternative Assessment Approaches

PAH – Benzo(a)pyrene Surrogate Marker Assessment

In September 2017 Public Health England (PHE) (Ref. h) published guidance for the use of a surrogate marker approach to assess the risk posed by soil contamination with the genotoxic polycyclic aromatic hydrocarbons (PAHs). The guidance indicates that the use of a marker compound, such as Benzo(a)pyrene, provides a consistent indicator of the amount of 7 other genotoxic PAHs commonly tested for in soil including benz(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene, dibenzo(a,h)anthracene, indeno(123cd)pyrene and benzo(ghi)perylene.

Where PAH concentrations of these 8 no. PAHs are present within pre-determined ratios in soil, provided in the guidance, this approach is used, comparing soil concentrations of the marker compound with a Category 4 Screening Level, or site specific assessment criteria. An individual compound assessment is carried out for other PAH compounds not considered in the PHE guidance.

An individual compound assessment is carried out for all PAH compounds where pre-determined ratios are not met for the surrogate marker approach.

Notes

Curtins Generic Assessment Criteria provide further information and notes to be read in conjunction with this assessment rationale.

Human Health GQRA Rationale and Hierarchy



References

- a) Environmental Agency. (2009) Contaminated Land Exposure Assessment (CLEA) v1.071 model.
- b) Environment Agency. (2009) Human Health Toxicological Assessment of Contaminants in Soil (report no. SC050021/SR2).
- c) Environment Agency. (2009) Updated Technical Background to the CLEA Model (report no.SC050021/SR3).
- d) Environment Agency (2005) The UK Approach for Evaluating Human Health Risks from Petroleum Hydrocarbons in Soils Science Report P5-080/TR3.
- e) Department of Environment Food and Rural Affairs (DEFRA). (2012) Environmental Protection Act 1990: Part 2A Contaminated Land Statutory Guidance (report no. PB13735).
- f) CL:AIRE (2014) Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination, SP1010 Rev 2.
- g) LQM & CIEH (2015) S4ULs for Human Health Risk Assessment.
- h) Public Health England (2017) Contaminated Land Information Sheet: Risk Assessment Approaches for Polycyclic Aromatic Hydrocarbons (PAHs)

Contaminants	Residential with Home Grown Produce	Residential Without Home Grown Produce	Allotments	Commercial	Public open space (Residential)	Public park POS _{park}	Solubility Saturation Limit (mg/kg)	Vapour Satuation Limit (mg/kg)
Metals, Semi-Metals & non-metals								
Antimony	-	550	-	7500	-	-		
Arsenic	37	40	49	640	79	170		
Beryllium	1.7	1.7	35	12	2.2	63		
Boron	290	11000	45	240000	21000	46000		
Cadmium	22	150	3.9	410	220	880		
Chromium III	910	910	18000	8600	1500	33000		
Chromium VI	21	21	170	49	21	250		
Copper	2400	7100	520	68000	12000	44000		
Lead	200	310	80	2300	630	1300		
Mercury (elemental)	1.2	1.2	21	58	16	30		25.8
Mercury (inorganic)	40	56	19	1100	120	240		
Methylmercury	11	15	6	320	40	68		
Nickel	130	180	53	980	230	800		
Selenium	250	430	88	12000	1100	1800		
Vanadium	410	1200	91	9000	2000	5000		
Zinc	3700	40000	620	730000	81000	170000		
Inorganic Compounds								
Cyanide	24	24	24	1400	24	24		
Organic contaminants								
Aliphatic Risk Banded Hydrocarbons - TPH CWG method								
Aliphatic EC5 - EC6 TPHs	42	42	730	3200	570000	95000	304	
Aliphatic EC>6 - EC8 TPHs	100	100	2300	7800	600000	150000	144	
Aliphatic EC>8 - EC10 TPHs	27	27	320	2000	13000	14000	78	
Aliphatic EC>10-EC12 TPHs	130	130	2200	9700	13000	21000	48	
Aliphatic EC>12-EC16 TPHs	1100	1100	11000	59000	13000	25000	24	
Aliphatic EC>16 - EC35 TPHs	65000	65000	260000	1600000	250000	450000	8.48	
Aliphatic EC>35 - EC44 TPHs	65000	65000	260000	1600000	250000	450000	8.48	
Aromatic Risk Banded Hydrocarbons - TPH CWG method								
Aromatic EC5 - EC7 TPHs	70	370	13	26000	56000	76000	1220	
Aromatic EC>7 - EC8 TPHs	130	860	22	56000	56000	87000		869
Aromatic EC>8 - EC10 TPHs	34	47	8.6	3500	5000	7200		613
Aromatic EC10 - EC12 TPHs	74	250	13	16000	5000	9200	364	
Aromatic EC12 - EC16 TPHs	140	1800	23	36000	5100	10000	169	
Aromatic EC>16 - EC21 TPHs	260	1900	46	28000	3800	7600		
Aromatic EC>21 - EC35 TPHs	1100	1900	370	28000	3800	7800		
Aromatic EC>35 - EC44 TPHs	1100	1900	370	28000	3800	7800		
Long Chain Aliphatic and Aromatic Hydrocarbons								
Aliphatic and Aromatic EC >44-70	1600	1900	1200	28000	3800	7800		
Aromatic Hydrocarbons								
Benzene	0.2	0.89	0.039	27	140	190		
Ethyl benzene	47	83	16	5700	24000	17000		518
Toluene	130	880	22	56000	56000	87000		869
Xylene	56	79	28	5900	41000	17000	478 (o-xylene) 576 (p-xylene)	625 (m-xylene)
MTBE	49	73	23	7900			20400	
Phenol	280	750	66	760	760	760		
Polycyclic Aromatic Hydrocarbons (PAH) - Benzo(a)pyrene Surrogate Marker Approach, with reference to C4SL PAH Surrogate Marker Check Sheet where appropriate								
Benzo(a)Pyrene (C4SL Surrogate Marker Approach)	5	5.3	5.7	77	10	21		
Naphthalene	15	15	65	1600	11000	800	76.4	
Acenaphthylene	170	2900	28	83000	15000	29000	86.1	
Acenaphthene	210	3000	34	84000	15000	29000	57	
Fluorene	170	2800	27	63000	9900	20000	30.9	
Phenanthrene	95	1300	15	22000	3100	6200	36	
Anthracene	2400	31000	380	520000	74000	150000		1.17
Fluoranthene	280	1500	52	23000	3100	6300		
Pyrene	620	3700	110	54000	7400	15000		
Polycyclic Aromatic Hydrocarbons (PAH) - Individual Compound Assessment								
Naphthalene	15	15	65	1600	11000	800	76.4	
Acenaphthylene	170	2900	28	83000	15000	29000	86.1	
Acenaphthene	210	3000	34	84000	15000	29000	57	
Fluorene	170	2800	27	63000	9900	20000	30.9	
Phenanthrene	95	1300	15	22000	3100	6200	36	
Anthracene	2400	31000	380	520000	74000	150000		1.17
Fluoranthene	280	1500	52	23000	3100	6300		
Pyrene	620	3700	110	54000	7400	15000		
Benzo(a)anthracene	7.2	11	2.9	170	29	49		
Chrysene	15	30	4.1	350	57	93		
Benzo(b)fluoranthene	2.6	3.9	0.99	44	7.1	13		
Benzo(k)fluoranthene	77	110	37	1200	190	370		
Benzo(a)pyrene (only)	2.2	3.2	0.97	35	5.7	11		
Indeno(123cd)pyrene	27	45	9.5	500	82	150		
Dibenzo(ah)anthracene	0.24	0.31	0.14	3.5	0.57	1.1		
Benzo(ghi)perylene	320	360	290	3900	640	1400		
Chlorinated Aliphatic Hydrocarbons								
Chloroethene (Vinyl chloride)	0.0064	0.015	0.0017	1.1	7.8	18		
1,1-Dichloroethene (DCE)	0.23	0.23	2.8	26			2230	
Cis 1,2, Dichloroethene (DCE)	0.46	0.5	0.89	38	3800	2800	3940	
Trans 1,2, Dichloroethene (DCE)	0.9	0.93	3.7	69	13000	5600	3420	
Trichloroethene (TCE)	0.0093	0.0097	0.032	0.73	76	41		
Tetrachloroethene (PCE)	0.31	0.32	2	24	3200	1400		
1,1,1,2 Tetrachloroethane	1.2	1.5	0.79	110	1400	1500		
1,1,1 Trichloroethane	8.8	9	48	660	140000	57000		1425
1,2-Dichloroethane (Ethylene Dichloride)	0.11	0.16	0.054	12	300	300		
Tetrachloromethane	0.026	0.026	0.45	2.9	890	190		
Trichloromethane (Chloroform)	0.91	1.2	0.42	99	2500	2600		
Per- and Polyfluoroalkyl Substances (PFAS)								
Perfluorooctanoic Acid (PFOA)	0.0076	0.041	0.0014	0.6	0.079	0.17		
Perfluorononanoic Acid (PFNA)	0.013	0.041	0.0027	0.6	0.079	0.17		
Perfluorohexane Sulfonic Acid (PFHxS)	0.0081	0.041	0.0015	0.6	0.079	0.17		
Perfluorooctane Sulfonic Acid (PFOS)	0.0073	0.041	0.0013	0.6	0.079	0.17		

Contaminants	Residential with Home Grown Produce	Residential Without Home Grown Produce	Allotments	Commercial	Public open space (Residential)	Public park POS _{park}	Solubility Saturation Limit (mg/kg)	Vapour Satuation Limit (mg/kg)
Metals, Semi-Metals & non-metals								
Antimony		550		7500				
Arsenic	37	40	49	640	79	170		
Beryllium	1.7	1.7	35	12	2.2	63		
Boron	290	11000	45	240000	21000	46000		
Cadmium	22	150	3.9	410	220	880		
Chromium III	910	910	18000	8600	1500	33000		
Chromium VI	21	21	170	49	21	250		
Copper	2400	7100	520	68000	12000	44000		
Lead	200	310	80	2300	630	1300		
Mercury (elemental)	1.2	1.2	21	58	16	30		25.8
Mercury (inorganic)	40	56	19	1100	120	240		
Methylmercury	11	15	6	320	40	68		
Nickel	130	180	53	980	230	800		
Selenium	250	430	88	12000	1100	1800		
Vanadium	410	1200	91	9000	2000	5000		
Zinc	3700	40000	620	730000	81000	170000		
Inorganic Compounds								
Cyanide	24	24	24	1400	24	24		
Organic contaminants								
Aliphatic Risk Banded Hydrocarbons - TPH CWG method								
Aliphatic EC5 - EC6 TPHs	78	78	1700	5900	590000	130000	558	
Aliphatic EC>6 - EC8 TPHs	230	230	5600	17000	610000	220000	322	
Aliphatic EC>8 - EC10 TPHs	65	65	770	4800	13000	18000		190
Aliphatic EC>10-EC12 TPHs	330	330	4400	23000	13000	23000		118
Aliphatic EC>12-EC16 TPHs	2400	2400	13000	82000	13000	25000	59	
Aliphatic EC>16 - EC35 TPHs	92000	92000	270000	1700000	250000	480000	21	
Aliphatic EC>35 - EC44 TPHs	92000	92000	270000	1700000	250000	480000	21	
Aromatic Risk Banded Hydrocarbons - TPH CWG method								
Aromatic EC5 - EC7 TPHs	140	690	27	46000	56000	84000	2260	
Aromatic EC>7 - EC8 TPHs	290	1800	51	110000	56000	95000	1920	
Aromatic EC>8 - EC10 TPHs	83	110	21	8100	5000	8500		1500
Aromatic EC10 - EC12 TPHs	180	590	31	28000	5000	9700	899	
Aromatic EC12 - EC16 TPHs	330	2300	57	37000	5100	10000	419	
Aromatic EC>16 - EC21 TPHs	540	1900	110	28000	3800	7700		
Aromatic EC>21 - EC35 TPHs	1500	1900	820	28000	3800	7800		
Aromatic EC>35 - EC44 TPHs	1500	1900	820	28000	3800	7800		
Long Chain Aliphatic and Aromatic Hydrocarbons								
Aliphatic and Aromatic EC >44-70	1800	1900	2100	28000	3800	7800		
Aromatic Hydrocarbons								
Benzene	0.17	0.7	0.034	47	72	100		
Ethyl benzene	110	190	39	13000	24000	22000		1220
Toluene	290	1900	51	110000	56000	95000		1920
Xylene	130	180	67	14000	42000	23000	1120	1470
MTBE	84	120	44	13000			33100	
Phenol	550	1300	140	1500	1500	1500		
Polycyclic Aromatic Hydrocarbons (PAH) - Benzo(a)pyrene Surrogate Marker Approach, with reference to C4SL PAH Surrogate Marker Check Sheet where appropriate								
Benzo(a)Pyrene (C4SL Surrogate Marker Approach)	5	5.3	5.7	77	10	21		
Naphthalene	36	36	130	3700	15000	1200	183	
Acenaphthylene	420	4600	69	97000	15000	30000	212	
Acenaphthene	510	4700	85	97000	15000	30000	141	
Fluorene	400	3800	67	68000	9900	20000	76.5	
Phenanthrene	220	1500	38	22000	3100	6200		
Anthracene	5400	35000	950	540000	74000	150000		
Fluoranthene	560	1600	130	23000	3100	6300		
Pyrene	1200	3800	270	54000	7400	15000		
Polycyclic Aromatic Hydrocarbons (PAH) - Individual Compound Assessment								
Naphthalene	36	36	130	3700	15000	1200	183	
Acenaphthylene	420	4600	69	97000	15000	30000	212	
Acenaphthene	510	4700	85	97000	15000	30000	141	
Fluorene	400	3800	67	68000	9900	20000	76.5	
Phenanthrene	220	1500	38	22000	3100	6200		
Anthracene	5400	35000	950	540000	74000	150000		
Fluoranthene	560	1600	130	23000	3100	6300		
Pyrene	1200	3800	270	54000	7400	15000		
Benzo(a)anthracene	11	14	6.5	170	29	56		
Chrysene	22	31	9.4	350	57	110		
Benzo(b)fluoranthene	3.3	4	2.1	44	7.2	15		
Benzo(k)fluoranthene	93	110	75	1200	190	410		
Benzo(a)pyrene (only)	2.7	3.2	2	35	5.7	12		
Indeno(123cd)pyrene	36	46	21	510	82	170		
Dibenzo(ah)anthracene	0.28	0.32	0.27	3.6	0.57	1.3		
Benzo(ghi)perylene	340	360	470	4000	640	1500		
Chlorinated Aliphatic Hydrocarbons								
Chloroethene (Vinyl chloride)	0.01	0.019	0.0031	1.4	7.8	19		
1,1-Dichloroethene (DCE)	0.4	0.41	5.6	46			3940	
Cis 1,2, Dichloroethene (DCE)	0.78	0.84	1.7	64	3800	2400	6610	
Trans 1,2, Dichloroethene (DCE)	1.6	1.7	0.75	120	13000	7000	6170	
Trichloroethene (TCE)	0.02	0.02	0.072	1.5	78	54		
Tetrachlorethene (PCE)	0.7	0.71	4.8	55	3300	1900		
1,1,1,2 Tetrachlorethane	2.8	3.5	1.9	250	1400	1800		
1,1,1 Trichlorethane	18	18	110	1300	140000	76000		2915
1,2-Dichloroethane (Ethylene Dichloride)	0.18	0.24	0.1	17	210	330		
Tetrachloromethane	0.056	0.056	1	6.3	920	270		
Trichloromethane	1.7	2.1	0.83	170	2500	2800		
PFAS								
Perfluorooctanoic Acid (PFOA)	0.0076	0.041	0.0014	0.6	0.079	0.17		
Perfluorononanoic Acid (PFNA)	0.013	0.041	0.0027	0.6	0.079	0.17		
Perfluorohexane Sulfonic Acid (PFHxS)	0.0081	0.041	0.0015	0.6	0.079	0.17		
Perfluorooctane Sulfonic Acid (PFOS)	0.0073	0.041	0.0013	0.6	0.079	0.17		

Contaminants	Residential with Home Grown Produce	Residential Without Home Grown Produce	Allotments	Commercial	Public open space (Residential)	Public park POS _{park}	Solubility Saturation Limit (mg/kg)	Vapour Satuation Limit (mg/kg)
Metals, Semi-Metals & non-metals								
Antimony		550		7500				
Arsenic	37	40	49	640	79	170		
Beryllium	1.7	1.7	35	12	2.2	63		
Boron	290	11000	45	240000	21000	46000		
Cadmium	22	150	3.9	410	220	880		
Chromium III	910	910	18000	8600	1500	33000		
Chromium VI	21	21	170	49	21	250		
Copper	2400	7100	520	68000	12000	44000		
Lead	200	310	80	2300	630	1300		
Mercury (elemental)	1.2	1.2	21	58	16	30		25.8
Mercury (inorganic)	40	56	19	1100	120	240		
Methylmercury	11	15	6	320	40	68		
Nickel	130	180	53	980	230	800		
Selenium	250	430	88	12000	1100	1800		
Vanadium	410	1200	91	9000	2000	5000		
Zinc	3700	40000	620	730000	81000	170000		
Inorganic Compounds								
Cyanide	24	24	24	1400	24	24		
Organic Compounds								
Aliphatic Risk Banded Hydrocarbons - TPH CWG method								
Aliphatic EC5 - EC6 TPHs	160	160	3900	12000	600000	180000	1150	
Aliphatic EC>6 - EC8 TPHs	530	530	13000	40000	620000	320000	736	
Aliphatic EC>8 - EC10 TPHs	150	150	1700	11000	13000	21000		451
Aliphatic EC>10-EC12 TPHs	760	770	7300	47000	13000	24000		283
Aliphatic EC>12-EC16 TPHs	4300	4400	13000	90000	13000	26000	142	
Aliphatic EC>16 - EC35 TPHs	110000	110000	270000	1800000	250000	490000		
Aliphatic EC>35 - EC44 TPHs	110000	110000	270000	1800000	250000	490000		
Aromatic Risk Banded Hydrocarbons - TPH CWG method								
Aromatic EC5 - EC7 TPHs	300	1400	57	86000	56000	92000	4710	
Aromatic EC>7 - EC8 TPHs	660	3900	120	180000	56000	100000		4360
Aromatic EC>8 - EC10 TPHs	190	270	51	17000	5000	9300		3590
Aromatic EC10 - EC12 TPHs	380	1200	74	34000	5000	10000	2150	
Aromatic EC12 - EC16 TPHs	660	2500	130	38000	5000	10000		
Aromatic EC>16 - EC21 TPHs	930	1900	260	28000	3800	7800		
Aromatic EC>21 - EC35 TPHs	1700	1900	1600	28000	3800	7900		
Aromatic EC>35 - EC44 TPHs	1700	1900	1600	28000	3800	7900		
Long Chain Aliphatic and Aromatic Hydrocarbons								
Aliphatic and Aromatic EC >44-70	1900	1900	3000	28000	3800	7900		
Aromatic Hydrocarbons								
Benzene	0.87	3.3	0.18	98	140	230		
Ethyl benzene	260	440	91	27000	25000	27000		2840
Toluene	690	3900	120	180000	56000	100000		4360
Xylene	310	430	160	30000	43000	31000	2620	
MTBE	160	220	90	24000			62700	
Phenol	420	2300	280	3200	3200	3200		
Polycyclic Aromatic Hydrocarbons (PAH) - Benzo(a)pyrene Surrogate Marker Approach, with reference to C4SL PAH Surrogate Marker Check Sheet where appropriate								
Benzo(a)Pyrene (C4SL Surrogate Marker Approach)	5	5.3	5.7	77	10	21		
Naphthalene	85	85	200	8400	17000	1900	432	
Acenaphthylene	920	6000	160	100000	15000	30000	506	
Acenaphthene	1100	6000	200	100000	15000	30000	336	
Fluorene	860	4500	160	71000	9900	20000	183	
Phenanthrene	440	1500	90	23000	3100	6300		
Anthracene	11000	37000	2200	540000	74000	150000		
Fluoranthene	890	1600	290	23000	3100	6400		
Pyrene	2000	3800	620	54000	7400	15000		
Polycyclic Aromatic Hydrocarbons (PAH) - Individual Compound Assessment								
Naphthalene	85	85	200	8400	17000	1900	432	
Acenaphthylene	920	6000	160	100000	15000	30000	506	
Acenaphthene	1100	6000	200	100000	15000	30000	336	
Fluorene	860	4500	160	71000	9900	20000	183	
Phenanthrene	440	1500	90	23000	3100	6300		
Anthracene	11000	37000	2200	540000	74000	150000		
Fluoranthene	890	1600	290	23000	3100	6400		
Pyrene	2000	3800	620	54000	7400	15000		
Benzo(a)anthracene	13	15	13	180	29	62		
Chrysene	27	32	19	350	57	120		
Benzo(b)fluoranthene	3.7	4	3.9	45	7.2	16		
Benzo(k)fluoranthene	100	110	130	1200	190	440		
Benzo(a)pyrene (only)	3	3.2	3.5	36	5.7	13		
Indeno(123cd)pyrene	41	46	39	510	82	180		
Dibenzo(ah)anthracene	0.3	0.32	0.43	3.6	0.58	1.4		
Benzo(ghi)perylene	350	360	640	4000	640	1600		
Chlorinated Aliphatic Hydrocarbons								
Chloroethene (Vinyl chloride)	0.017	0.029	0.0058	2.2	7.8	19		
1,1-Dichloroethene (DCE)	0.82	0.82	12	92			7940	
Cis 1,2, Dichloroethene (DCE)	1.5	1.6	3.6	120	3900	3100	12900	
Trans 1,2, Dichloroethene (DCE)	3.3	3.4	16	260	13000	9100	12600	
Trichloroethene (TCE)	0.043	0.045	0.16	3.4	79	69		
Tetrachloroethene (PCE)	1.6	1.6	11	130	3400	2500		
1,1,1,2 Tetrachloroethane	6.4	8.2	4.4	560	1400	2100		
1,1,1 Trichloroethane	39	40	240	3000	140000	100000		6392
1,2-Dichloroethane (Ethylene Dichloride)	0.31	0.41	0.19	29	310	380		
Tetrachloromethane	0.13	0.13	2.4	14	950	400		
Trichloromethane	3.4	4.2	1.7	350	2500	3100		
PFAS								
Perfluorooctanoic Acid (PFOA)	0.0076	0.041	0.0014	0.6	0.079	0.17		
Perfluorononanoic Acid (PFNA)	0.013	0.041	0.0027	0.6	0.079	0.17		
Perfluorohexane Sulfonic Acid (PFHxS)	0.0081	0.041	0.0015	0.6	0.079	0.17		
Perfluorooctane Sulfonic Acid (PFOS)	0.0073	0.041	0.0013	0.6	0.079	0.17		

- 1) All Values are in mg/kg, reported to 2 significant figures.
- 2) Numbers in bold are C4SLs, Numbers in italics are S4ULs, Numbers underlined are EIC/AGS/CL:AIRE GACs, Numbers in red are SoBRA Acute Generic Assessment Criteria.
- 3) Assumptions and key notes made when deriving the Generic Assessment Criteria are contained within the relevant guidance documents, references:
 - a) Contaminated Land: Applications in Real Environments (2014) SP1010 - Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination, Final Project Report (Revision 2b)
 - b) Land Quality Management Ltd. (2015) The LQM/CIEH S4ULs for Human Health Risk Assessment.
 - c) CL:AIRE, EIC, AGS (2010) Soil Generic Assessment Criteria for Human Health Risk Assessment.
 - d) Society of Brownfield Risk Assessment (2020) Development of Acute Generic Assessment Criteria for Assessing Risks to Human Health from Contaminants in Soil.
 - e) Environment Agency (2009) Human Health Toxicological Assessment of Contaminants in Soil, Science Report - SC050021/SR2.
- 4) Generic Assessment Criteria listed in the following order of preference: C4SLs, S4ULs, CL:AIRE/AGS/EIC Generic Assessment Criteria, Other relevant Generic Assessment Criteria where GACS associated with the prioritised GACs are not available as outlined further in Curtins Rationale and Hierarchy notes.
- 5) To use Benzo(a)pyrene as a surrogate marker for PAH contamination, the assumptions set out in the relevant C4SL documentation must be met. A C4SL PAH surrogate marker checklist is appended.
- 6) Naphthalene is a volatile PAH. The C4SL values are derived on the basis of chronic exposure and risks to human health, and do not explicitly account for acute risks (e.g. a one off ingestion of a significant amount of soil by a young child) where the inhalation pathway is the main risk driver. Further consideration of the acute risk may be required in external settings (POS_{park} and POS_{resi}) where the GAC is substantially greater than the residential equivalent, to account for the possibility of acute exposure to the ingestion of naphthalene. The theoretical solubility saturation limit of naphthalene in soil is substantially lower than the GAC value, and therefore it is likely that free phase contamination would be present where the GAC is exceeded. In such a situation, it is unlikely that the product would remain in-situ untreated, and consideration of remediation / mitigation methods would be required.
- 7) Where the C4SL surrogate marker checklist indicates the PAH ratios are not suitable, individual PAH compounds must be assessed individually against the relevant contaminant specific assessment criteria.
- 8) Risk associated with additive effects of TPH contamination needs to be assessed in addition to the individual bandings, using the following equation:

$$HI = \sum HQ_i = \sum \frac{\text{Measured concentration, } Fi \text{ (mg/kg)}}{\text{Relevant GAC (mg/kg)}} Fi$$

Where:

HI = Hazard Index

HQ = Hazard Quotient

Fi = Fraction i

Where the HI > 1, there may be a risk to human health.

- 9) Exposure to all xylene isomers to be considered together. Values detailed in this table are the lowest (most conservative) of o-, m- and p- xylene isomers.
- 10) PFAS assessment also uses a hazard index approach to ensure the total exposure from all four PFAS compounds combined does not exceed the LLTC_{oral}. Where the hazard index exceeds 1, further consideration or assessment of the risk is required, even where none of the individual C4SL values are exceeded.
- 11) PFAS C4SL values are interim. The C4SL has been derived using the sum of the four PFAS compounds as the basis of the low level of toxicological concern. The term interim reflects concerns raised by the Committee on Toxicity (COT) and the fact that further work by the COT and others may result in the need for the LLTC to be updated.
- 12) Generic Assessment Criteria assume no free phase contamination is present. Where free phase contamination is present, further assessment may be required.
- 13) Solubility Saturation Limit and Vapour Saturation Limit are provided in accordance with relevant guidance documents. Where these values are exceeded, and the vapour pathway is an important contributing pathway to exposure, then the following should be considered:
 - Free phase contamination may be present
 - Exposure from vapour pathways will be over predicted.
 - Where the vapour pathway is >90% of exposure then it is unlikely that the relevant HCV will be exceeded at soil concentrations at least a factor of ten higher than the relevant HCV.

Additional assessment should be undertaken where this is the case, with consideration that:

- Exposure is unlikely to reach the relevant HCV and the risk based on the assumed conceptual model is likely to be negligible.
- Vapour pathway exposure should be calculated using algorithms suitable for free phase or NAPL sources
- Screening could be considered using the lower saturation limit, which is the approach adopted by the USEPA. However, this may not be practical in many cases because of very low limits and is in any case highly conservative.

Where the vapour pathway is the only exposure pathway considered then effective assessment criteria should be derived manually in accordance with guidance outlined in CLEA Science Report SC050021/SR4

Appendix H – Risk Assessment Rationale

The site-specific risk assessment, presented in this report, follows the principle of establishing whether there is a viable linkage between a contaminant source to a potential receptor, via an exposure pathway.

The risk assessment corresponds with the total site area and incorporates both descriptive (qualitative) and, where available, numerical (quantitative) lines of evidence.

Risk assessment is the process of collating known information on a hazard or set of hazards to estimate actual or potential risk to receptors. The receptor may be humans, a water resource, a sensitive local ecosystem, or future construction materials. Receptors can be connected to the source by one or several exposure pathways such as direct contact for example. Risks are managed by isolating the receptor or intercepting the exposure pathway or by isolating or removing the hazard.

Without the three essential components of a source, pathway, and receptor there can be no risk. Therefore, the presence of contaminant source on a site does not necessarily mean there is a risk.

The risk assessment considers the likelihood of a particular event taking place (accounting for the presence of the source and receptor and the viability of the exposure pathway) in conjunction with the severity of the potential consequence (accounting for the potential severity of the hazard and the sensitivity of the receptor).

In the risk assessment the consequence of the hazard has been classified as severe, medium, mild, or minor and the probability (likelihood) of the circumstances occurring classified as high likelihood or low likelihood or unlikely.

The consequences and probabilities are subsequently cross correlated to give a qualitative estimation of the risk using Department of the Environment risk classifications as detailed in the table below and as referenced in CIRIA C552.

		Consequence			
		Severe	Medium	Mild	Minor
Probability (Likelihood)	High Likelihood	Very High Risk	High Risk	Moderate Risk	Moderate/Low Risk
	Likely	High Risk	Moderate Risk	Moderate/Low Risk	Low Risk
	Low Likelihood	Moderate Risk	Moderate/Low Risk	Low Risk	Very Low Risk
	Unlikely	Moderate/Low Risk	Low Risk	Very Low Risk	Very Low Risk

In accordance with DoE guidance, the following categorisation of **consequence** has been developed.

Classification	Definition	Examples
Severe	Short-term (acute) risk to human health likely to result in “significant harm” as defined by the Environment Protection Act 1990, Part IIA. Short-term risk of pollution of sensitive water resource. Catastrophic damage to buildings/property. A short-term risk to an ecosystem or organisation forming part of such ecosystem.	High concentrations of cyanide on the surface of an informal recreation area. Major spillage of contaminants from site into controlled water. Explosion, causing building collapse (can also equate to a short-term human health risk if buildings are occupied).
Medium	Chronic damage to Human Health. Pollution of sensitive water resources. A significant change in an ecosystem or organism forming part of such ecosystem.	Concentration of a contaminant from site exceeds the generic or site-specific assessment criteria. Leaching of contaminants from a site to a Principal or Secondary A aquifer. Death of a species within a designated nature reserve. Lesser toxic and asphyxiate effects
Mild	Pollution of non-sensitive water resources. Significant damage to crops, buildings, structures, and services. Damage to sensitive buildings/structures/services or the environment.	Pollution of non-classified groundwater (Inc. Secondary B aquifers). Damage to building rendering it unsafe to occupy (e.g. foundation damage resulting in instability).
Minor	Harm, although not necessarily significant harm, which may result in a financial loss or expenditure to resolve. Non-permanent health effects to human health (easily prevented by means such as personal protective clothing, etc). Easily repairable effects of damage to buildings, structures, and services.	The presence of contaminants at such concentrations that protective equipment is required during site works. The loss of plants in a landscaping scheme. Discoloration of concrete.

In accordance with DoE guidance, the following categorisation of **probability** has been developed.

Classification	Definition
High Likelihood	There is a pollution linkage and an event that either appears very likely in the short term and almost inevitable over the long term or there is evidence at the receptor of harm or pollution.
Likely	There is a pollution linkage and all the elements are present and in the right place, which means that it is probable that an event will occur. Circumstances are such that an event is not inevitable, but possible in the short term and over the long term.
Low Likelihood	There is a pollution linkage and circumstances are possible under which an event could occur. However, it is by no means certain that even over a longer period such event would take place and is less likely in the shorter term.
Unlikely	There is a pollution linkage, but circumstances are such that it is improbable that an event would occur even in the very long term.

In accordance with DoE guidance, the following categorisation of **risk** has been developed.

Classification	Definition
Very High Risk	There is a <i>high probability</i> that <i>severe harm</i> could arise to a designated receptor from an identified hazard at the site without appropriate further action.
High Risk	<i>Harm is likely to arise</i> to a designated receptor from an identified hazard at the site without appropriate further action.
Moderate Risk	<i>It is possible</i> that without appropriate further action <i>harm could arise</i> to a designated receptor. It is relatively <i>unlikely</i> that any such harm would be <i>severe</i> , and if any harm were to occur it is <i>more likely</i> that such harm would be <i>relatively mild</i> .
Low Risk	<i>It is possible</i> that <i>harm could arise</i> to a designated receptor from an identified hazard. It is <i>likely</i> that, at worst, if any harm was realised any effects would be <i>mild</i> .
Negligible Risk	The presence of an identified hazard does not give rise to the potential to cause harm to a designated receptor.

The term 'risk' in this instance refers to the risk that the source, pathway, receptor linkage for a given source of contamination is complete. It does not refer to immediate risk to individuals or features present on the site from potential contaminants and is intended to be used as a tool to assess the necessity of further investigation.