1.0 Ground Investigations

An Environmental and Geotechnical Consultant has undertaken a desk-top review of ground investigations which were carried out during previous developments on the site of the Academy. The development works which the Consultant has taken into consideration include the construction of the new buildings in the late 2000's and a subsequent extension to the buildings in the late 2010's.

The Environmental and Geotechnical Consultant has prepared a report based on the findings of his review, a copy of which is provided.

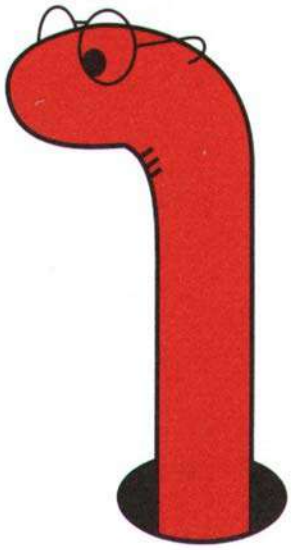
Based on the recommendations within the Environmental and Geotechnical Consultant's report, it is proposed to implement the protection measures identified in the report, during construction and installation of the modular building.

The report concludes that the site of the modular building should be characterised as situation 2 and the following gas protection measures are suggested:

- A well-constructed, ground bearing, concrete raft.
- Visqueen gas barrier (blue with foil layer).
- Mesh to be used around the base of the classroom block to maintain ventilation.

A full copy of the Environmental and Geotechnical Consultant's report follows.

Electronic Report



WORMS EYE

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BB9 4HS

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Our Ref: Plant Hill Road/M9 0WQ/2024
Date: 9 August 2024

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Lea Hough Chartered Surveyors
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Blakewater Road
Blackburn
BB1 5QR

Gary.Newton@leahough.co.uk

CO-OPERATIVE ACADEMY, PLANT HILL ROAD, HIGHER BACKLEY MANCHESTER, M9 0WQ
Previous Report Review

INTRODUCTION

A classroom block is proposed. Following previous investigations, by others, instructions were to review previous reports and consider contamination and landfill gas implications on the site.

SITE LOCATION

The Co-operative Academy school campus is located to the northwest of Plant Hill Road in Manchester and at OS Grid Reference 385371, 403678. The area of the proposed classroom block is at the northeast of the campus and comprises a section of car park, about 10 by 15m.

PROPOSED DEVELOPMENT

It is proposed to build a standalone classroom block. This will be created using modular buildings which will be raised above ground level. The floor void is expected to have external cladding to precent access.

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PREVIOUS INVESTIGATIONS

WYG – March 2016

A Desk Study was prepared by WYG in March 2016 as part of a development to extend the school buildings. The site was open space until developed as a school in the 1960s (replaced by a new school in the early 2000s). Prior to this landfilling had occurred on the west of the site.

Potential Hazard Sources

- Made ground associated with previous development phases (however, soil previously investigated and validated for school end-use).
- Sports pitch cover (however, soil previously validated as suitable for use).
- Landfill materials (potential to be present outside area previously investigated).
- Ground gases and vapours.

Summary of Risk Assessment

- Extension – low to moderate risk for human health and high risk for ground gases.
- Car Park – Low risk for human health and moderate risk for ground gases.
- Running Track/Sports Ground – moderate risk for human health and ground gas risk.

Preliminary Stage Remedial Works

- Gas mitigation for buildings and/or drainage/service runs.
- Cover system for hard-standing.
- Geotextile for land stability of new running track.
- Validation of soils for reuse and/or classification for disposal off-site.

SKM - 2007

The site was investigated by SKM circa 2007 prior to construction of the existing school buildings. The investigation comprised 3 cable percussion boreholes, 20 window sampler boreholes and installation of 8 gas monitoring wells. This was supplemented by 3 cable percussion boreholes, 19 window sampler boreholes and associated chemical testing and gas monitoring.

Ground Conditions

Made ground in excess of 5m was seen in the area of former refuse tips, with a previous investigation showing up to 7.5m of made ground. Elsewhere made ground was recorded up to a maximum 2m thickness. The made ground was underlain by very stiff clay and loose to dense silty sand.

Human Health Risk

Chemical testing showed elevated levels of heavy metals, PAHs, a small number of VOCs and SVOCs and one sample contained asbestos fibres in the former landfill area. The results show risks to human health are unlikely to be significant given the proposed development.

Previous Report Re-Cap Continued

Buried Concrete

- Within the landfill area buried concrete to DS-3 and AC-3 is proposed.
- Outside the landfill area buried concrete to DS-1 and AC-1 would be appropriate.

Ground Gas

Ground gas monitoring showed elevated levels of ground gases with maximum 19% methane, 21,5% carbon dioxide and >30 l/hr outflow. The site was classified as a Characteristic Situation 4.

The following is a summary of the gas monitoring results.

Borehole	Methane (%)	Carbon Dioxide (%)	Oxygen (%)	Hydrogen Sulphide	Flow (l/hr)	Characteristic Situation (CIRIA)
BH1	0.0 – 3.8	0.0 – 5.5	2.8 – 21.5	0.0	>30	3
BH2	0.0 – 6.0	0.0 – 12.0	0.8 – 21.3	0.0	>30	4
BH3	0.0 – 19.0	0.0 – 3.4	3.7 – 21.6	0.0	>30	4
WS1	0.0 – 17.0	1.2 – 8.1	4.2 – 19.8	0.0	0.3	2
WS4	0.0	3.0 – 5.6	16.0 – 19.5	0.0	0.0	2
WS16	0.0	0.7 – 3.9	18.6 – 20.8	0.0	1.1	1
WS19	0.0	4.4 – 9.8	11.4 – 18.6	0.0	1.9	2

Under Situation 4, for commercial properties, 3 of the 4 following precautions are required:

- Reinforced concrete cast in-situ floor slab (suspended, non-suspended or raft).
- Gas membrane with all joints and penetrations sealed.
- Passively ventilated or positively pressurised underfloor sub-space with monitoring.
- In ground venting wells or barriers.

Remediation Strategy

The remediation strategy included:

- Topsoil strip across the whole site.
- Cut and fill to include re-use of soil from excavations for foundations, drainage, piling.
- Placing cover materials (including topsoil) with soft landscaping and turfed sports pitches.
- 600mm thick soil cover for the sports pitch.
- Ground gas migration measures to comprise a geo-composite venting blanket with ground level vents at 8m centres, and a lapped/taped geomembrane incorporated beneath the suspended floor slab.

End of Previous Reports Re-Cap

DISCUSSION

The following comments are based on a review of the previous investigations.

Contaminated Soils

The findings from the previous investigations suggested no risk to site users in the area of the site. Furthermore, the site will be hard-surfaced on completion, preventing direct contact with surface soils. Therefore, it is considered there is no risk to end-users and no further action is considered necessary.

Previous investigations indicate there are no risks to buried concrete outside the landfill area which is at the west of the campus, and away from the proposed classroom block. Therefore, based on the previous investigation, concrete to DS-1 and AC-1 is considered appropriate for the classroom block.

Ground Gas

The previous investigation classed the school campus as situation 4 based on gas monitoring wells on the landfill. This shows a maximum 19% methane, 21,5% carbon dioxide and >30 l/hr outflow. The area of the classroom block is 200m from the landfill and gas levels would be expected to be lower, as seen in monitoring from boreholes away from the landfill was a gas situation 2 was seen.

However, the nearest monitoring well to the site was WS19, where results show methane 0%, carbon dioxide 9.8%, outflow 1.9 l/hr, giving a carbon dioxide GSV of 0.186 l/hr. Taking into account the previous investigations it is considered that there is sufficient data to characterise the site as a situation 2 and gas protection measures are required.

For a Characteristic Situation 2 BS 8485 (2015) indicates a gas protection score of 2.5 is required commercial buildings, considered appropriate for the school. Whilst this might typically comprise a membrane with either concrete slab or ventilated sub-floor void, the proposal is for a modular building where there is no opportunity to incorporate a membrane into the floor construction.

Although the proposal is for a modular building, with good air floor beneath, it is expected that cladding will be installed around the base to prevent access below the building which may reduce the air flow and precautions are required to ensure that air flow beneath the building is maintained. Therefore it is recommended that, to prevent access and maintain airflow, a mesh is used rather than a solid cladding.

BREAKING PATHWAYS

Construction Workers

Site workers should be made aware of the hazards of working with contaminated soils, and appropriate procedures and PPE adopted to ensure the health and safety of the site operative. All site personnel should be briefed on the discovery strategy in the watching brief and what actions they must take in the event that further evidence of contamination is identified or suspected.

Normal precautions for an urban renewal type project are required. These would include the use of gloves and the provision of washing facilities to avoid ingestion of contaminants.

Watching Brief

A watching brief for unexpected contaminants should be maintained. If unexpected contaminants (e.g. asbestos, oily material, unusual smells) are seen, especially during excavations, work should cease and the consultant be notified and the site inspected.

We suggest taking regular photographs (daily or more frequent) to include in the validation report.

Landfill/Ground Gases

It is considered, based on previous investigations, the site can be classed as a situation 2 which requires a gas protection score of 2. The following measures are considered suitable and give a protection score of at least 4:

- Ventilation of confined spaces within building.
- A well-constructed, ground bearing, concrete raft - score 0.5 to 1.5.
- Visqueen gas barrier (blue with foil layer - resists methane, carbon dioxide) – score 2.
- Joints to be lapped and sealed.
- Sub-floor ventilation to be maintained by using a mesh around the base of the classroom block to maintain air flow – score 1.5 to 2.5.
- Minimum penetration of ground slab by services.

Each membrane should be used with the appropriate matching service duct ‘top hat’.

Validation of gas membrane will require:

- Summary of gas risk assessment.
- Details of who carried out installation.
- Details of who carried out verification and inspection regime.
- Description of protection measures installed, including photographs.
- Details of non-conformances and how they were rectified (if any).
- Completed gas measures inspection proforma confirming that the gas protection measures were installed as agreed, the membrane was free from tears and punctures, lapped and sealed as agreed at joints around services. This to be included in the Verification Report.

Validation

A validation report will be required on completion, this will require but not necessarily be limited to:

- Tickets from waste removal contractor and receiving landfill is soils are removed from site.
- Independent inspection of gas membrane and report.
- Inspection of concrete slab.
- Inspection of mesh around building base.

This report is usually a collaboration between the contractor, who will collect the above documentation and Worms Eye, who can assist in preparing the Validation Report

CONCLUSION

Contaminated Soils

Previous investigations suggest no risk to site users of the classroom block and the site will be hard-surfaced on completion. There is no risk to site users and no further action is considered necessary.

Previous reports suggest sulphate resistant concrete is not required.

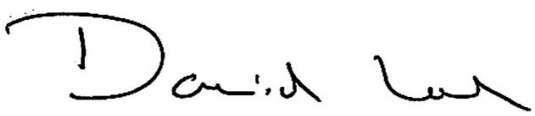
Ground Gas

Previous testing shows the nearest monitoring well to the site had methane 0%, carbon dioxide 9.8%, outflow 1.9 l/hr, giving a carbon dioxide GSV of 0.186 l/hr. It is considered there is sufficient data to characterise the site as a situation 2 and gas the following protection measures are suggested:

- A well-constructed, ground bearing, concrete raft.
- Visqueen gas barrier (blue with foil layer).
- Mesh to be used around the base of the classroom block to maintain ventilation.

The gas membrane will require independent inspection and the concrete raft and mesh will also need to be inspected.

Yours faithfully
on behalf of Worms Eye Ltd



David Lord
BSc (Hons)
FGS, MIEnvSc, AIEMA

CO-OPERATIVE ACADEMY, PLANT HILL ROAD, HIGHER BACKLEY

LIST OF APPENDICES – Previous Report Review

Proposed Site Plan

Previous Gas Monitoring

Previous Reports

ABBREVIATIONS

Chemical	BAP	Benzo(a)pyrene
	BTEX	Benzene, toluene, ethylbenzene, xylene
	DAHA	Dibenzo(ah)anthracene
	MTBE	Methyl tertiaryt-butyl ether (additive to petrol)
	EPH	Extractable Petroleum Hydrocarbons (formerly Diesel Range Organics – DRO)
	NFD	No fibres detected (asbestos test)
	PAH	Polycyclic aromatic hydrocarbons
	PCB	Polychlorinated biphenyls
	PID	Photo ionisation detector
	PRO/GRO	Petrol range organics/gasoline range organics
	SVOC	Semi-volatile organic compounds
	TCE	Trichloroethylene
	TPH	Total petroleum hydrocarbons
	VOC	Volatile organic compounds
Other	AGS	Association of Geotechnical Specialists
	BGS	British Geological Survey
	BRE	Building Research Establishment
	CBR	California Bearing Ratio
	CIEH	Chartered Institute of Environmental Health
	CIRIA	Construction Industry Research and Information Association
	CLEA	Contaminated Land Exposure Assessment (Environment Agency)
	CLR 8	Contaminated Land Research Report 8 (Environment Agency)
	DWQ	Drinking water quality
	EA	Environment Agency
	EQS	Environmental quality standards
	ICRCL	Inter-departmental Commission for the Reclamation of Contaminated Land
	LQM	Land Quality Management Ltd (Land and Environmental Consultancy)
	NHBC	National House Builders Council
	SGV	Soil Guideline Values
	SPT	Standard penetration test
	TPHWG	TPH Working Group

1. This report should be considered in relation to the objectives agreed between Worms Eye and the Client, outlined in the introduction.

2. For the work, reliance has been placed on publicly available data, obtained from the sources identified in the report. The information is not exhaustive and further information may be available from other sources. When using the information it has been assumed it is correct, and no attempt has been made to verify the information.

3. This report has been produced in accordance with current UK policy and guidelines, for land and groundwater contamination, enforced by the Local Authority and the Environment Agency.

4. During the site walkover, reasonable effort was made to obtain an overview of the site. However, no attempt was made to enter areas that are unsafe, a risk to health and safety, locked, barricaded, overgrown, or areas not made accessible.

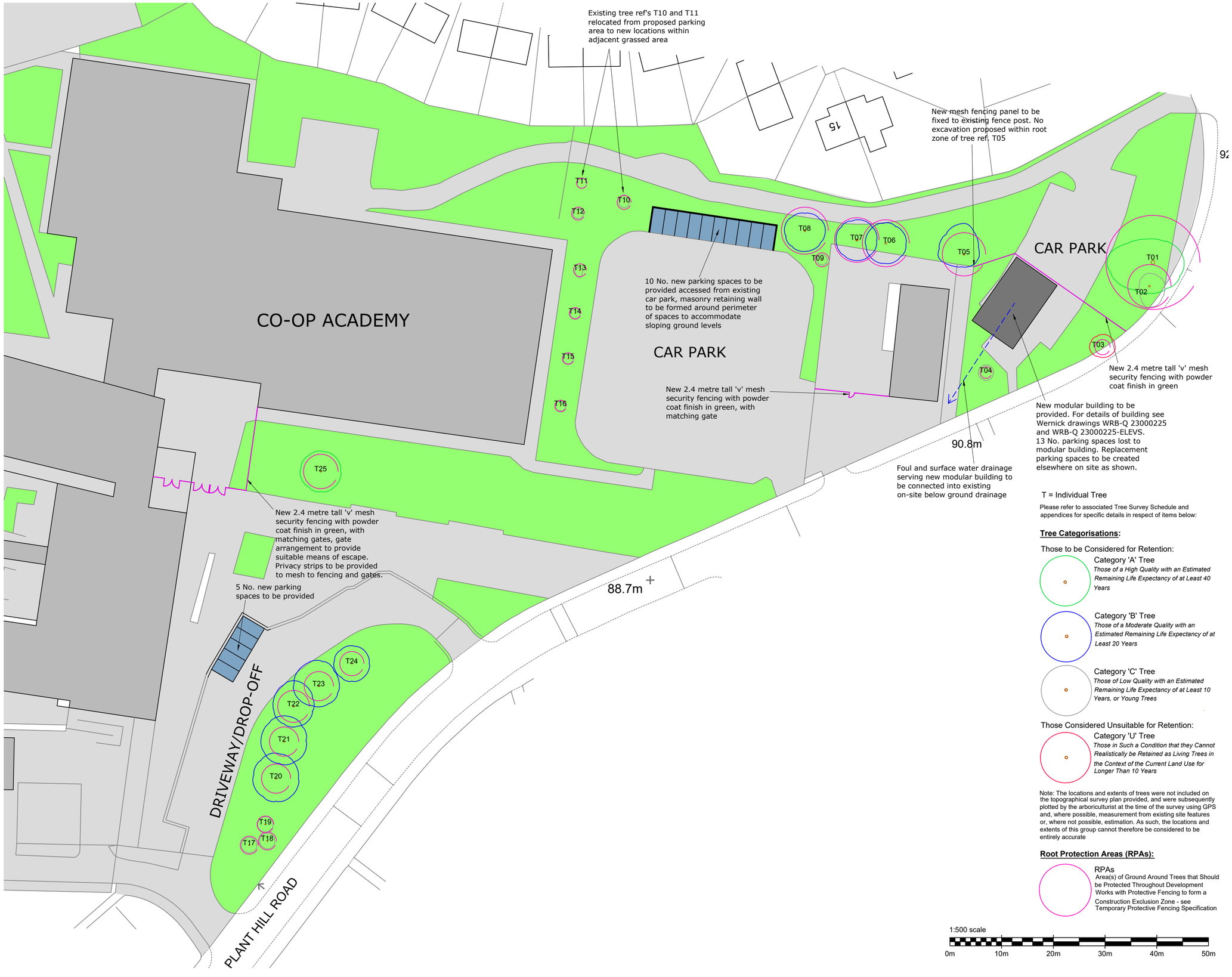
5. Access, the presence of services and activities on the site, limited locations where sampling could be carried out and the techniques that could be used.

6. Assessments are based on available information at the time of writing and are ultimately for the decision of the regulatory authorities.

7. The conclusions and recommendations provide an overview and guidance only and should not be specifically relied upon without considering the context of the report in full.

8. Worms Eye cannot be held responsible for any use of the report or its contents for any purpose other than that for which it was prepared. The copyright of this report, and other plans or documents prepared by Worms Eye, is owned by them, and no such plans or documents may be reproduced, published or adapted without written consent. Complete copies may be made and distributed by the client, as expected, in dealing with matters related to its commission. Should the client pass copies of the report to other parties for information, the whole report should be copied, but no professional liability, or warranties, shall be extended to other parties by Worms Eye, without their written agreement.

9. New information, revised practices, or changes in legislation, may necessitate the re-interpretation of the report, in whole or in part.



T = Individual Tree

Please refer to associated Tree Survey Schedule and appendices for specific details in respect of items below:

Tree Categorisations:

Those to be Considered for Retention:

Category 'A' Tree
Those of a High Quality with an Estimated Remaining Life Expectancy of at Least 40 Years

Category 'B' Tree
Those of a Moderate Quality with an Estimated Remaining Life Expectancy of at Least 20 Years

Category 'C' Tree
Those of Low Quality with an Estimated Remaining Life Expectancy of at Least 10 Years, or Young Trees

Those Considered Unsuitable for Retention:

Category 'U' Tree
Those in Such a Condition that they Cannot Realistically be Retained as Living Trees in the Context of the Current Land Use for Longer Than 10 Years

Note: The locations and extents of trees were not included on the topographical survey plan provided, and were subsequently plotted by the arboriculturist at the time of the survey using GPS and, where possible, measurement from existing site features or, where not possible, estimation. As such, the locations and extents of this group cannot therefore be considered to be entirely accurate

Root Protection Areas (RPAs):

RPAs
Area(s) of Ground Around Trees that Should be Protected Throughout Development Works with Protective Fencing to form a Construction Exclusion Zone - see Temporary Protective Fencing Specification

1:500 scale

0m 10m 20m 30m 40m 50m

NOTES

The copyright of this drawing is held by Lea Hough & Co Chartered Surveyors LLP.

Do not scale from this drawing. All dimensions must be checked and verified by the contractor prior to works commencing on site.

REVISIONS

REV	DESCRIPTION	DATE	AMENDED
A	Proposed new parking areas amended. Existing trees added.	19.06.2024	GN
B	Demarcation of 4 no. proposed parking spaces to existing area of tarmacadam omitted	27.06.2024	GN

LeaHough
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Survey Valuation Design Planning Sales

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Web: www.leahough.co.uk

RICS

CLIENT:
Co-operative Academy of Manchester
Plant Hill Road
Higher Blackley
Manchester
M9 0WQ

PROJECT ADDRESS:
Co-operative Academy of Manchester
Plant Hill Road
Higher Blackley
Manchester
M9 0WQ

PROJECT TITLE:
Proposed Modular Building, Fencing & Parking

DRAWING TITLE:
Proposed Site Plan

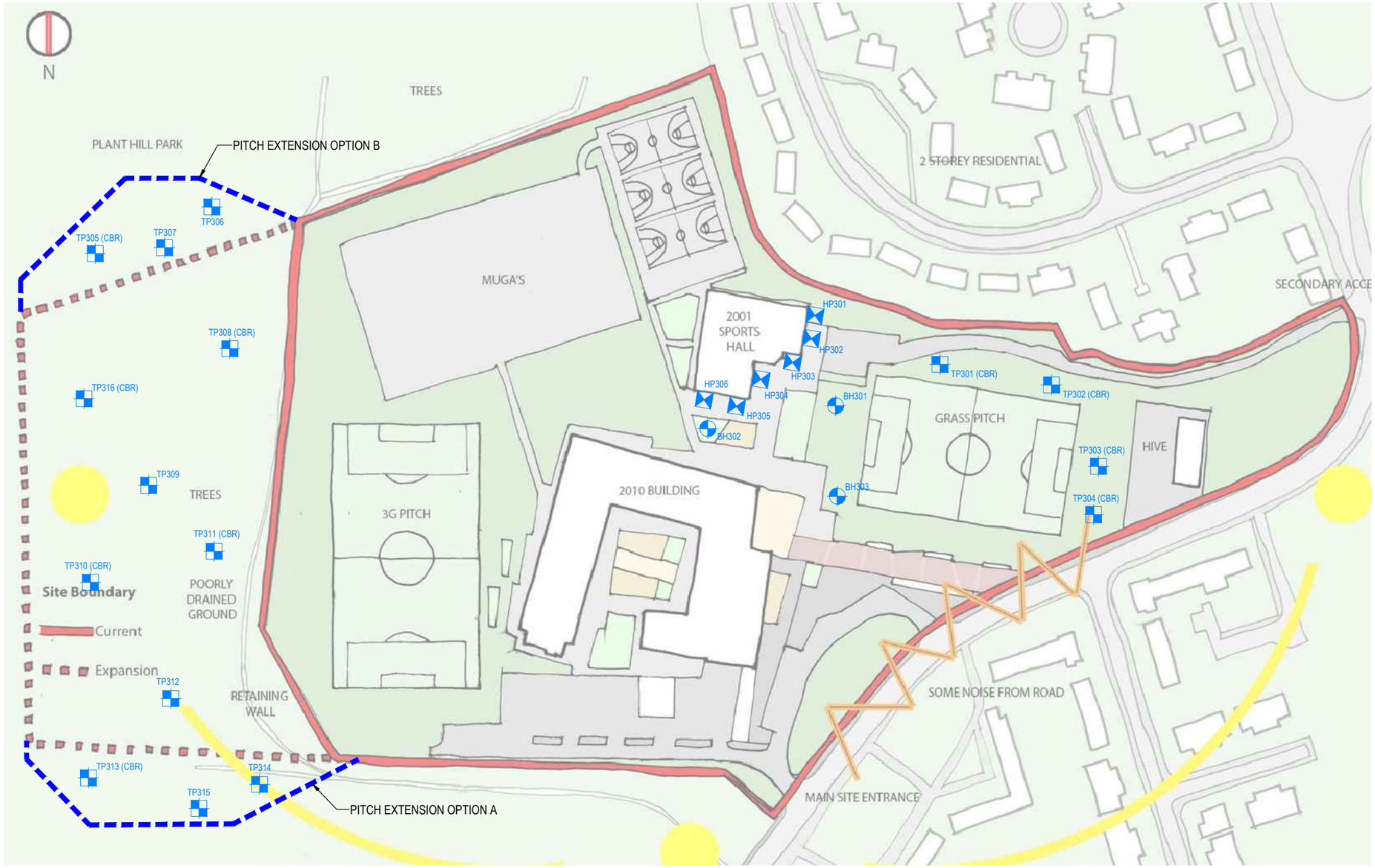
PAPER SIZE:	DRAWING NUMBER:	REV
A2	BS.23-276-03	B
SCALE:	DATE:	DRAWN BY
1:500	June 2024	GN

DO NOT SCALE: CONTRACTOR TO CHECK ALL DIMENSIONS AND REPORT ANY OMISSIONS OR ERRORS

KEY

- TRIAL PIT
- BOREHOLE
- HAND PIT

NOTE:
EXPLORATORY HOLE POSITIONS ARE INDICATIVE ONLY AND DO NOT TAKE INTO ACCOUNT LOCATION OF SERVICES. ANY EXCAVATIONS SHOULD BE CARRIED OUT IN ACCORDANCE WITH HSG47 'AVOIDING UNDERGROUND SERVICES'.



REV	DESCRIPTION	BY	CHK	APP	DATE

Client:

QUAY WEST at MediaCity UK
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e-mail: manchester@wyg.com

Project: A096213

THE CO OPERATIVE ACADEMY OF MANCHESTER
HIGHER BLACKLEY

Drawing Title:

PROPOSED EXPLORATORY HOLE LOCAITON PLAN

Scale @ A3	Drawn Date	Checked Date	Approved Date
N.T.S	CM 15.03.16		

Project No.	Office	Type	Drawing No.	Revision
A096213	MAN	N	02	

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NOTES

LEGEND

- WINDOW SAMPLE BOREHOLE
- CABLE PERCUSSION BOREHOLE
- INFERRED BOUNDARY OF LANDFILL

No	DATE	DRAWN BY	CHECKED BY	AMENDMENT

DRAWING STATUS

PRELIMINARY ISSUE

SKM
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Telephone: (+44) 0161 828 4000
Facsimile: (+44) 0161 828 4701

CLIENT

PROJECT

Co-operative Academy
Manchester

DRAWN BY SA | ENGINEER

TITLE

FIGURE 3
SITE PLAN SHOWING INFERRED BOUNDARY OF FORMER LANDFILL

SCALE	DRAWING No	AMDT
NTS	NE12105 - SK001	P1

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GEA Geotechnical & Environmental Associates

Tyttenhanger House
Coursers Road
St Albans
AL4 0PG

Site Plan

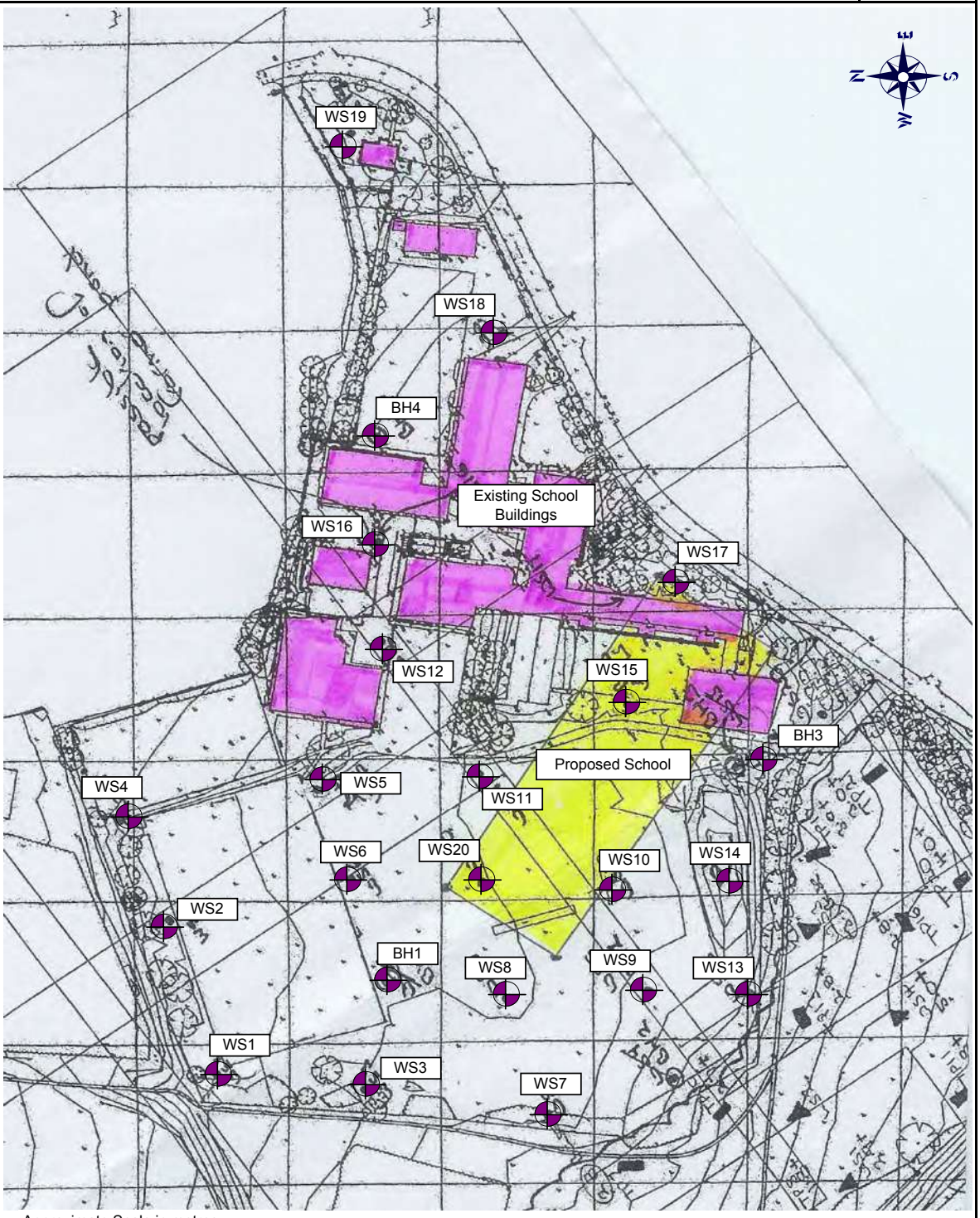
Site :Plant Hill High School, Plant Hill Road, Higher Blackley, Manchester

Client : Balfour Beatty Construction Limited

Engineer : Cundall Johnston and Partners LLP

Job Number J06365

Sheet 1 / 1



Approximate Scale in metres

0 25 50 75

Table 1: Summary of Ground Gas Monitoring Data

Borehole Number	Date	Methane (% v/v)	Carbon Dioxide (% v/v)	Oxygen (% v/v)	Atmos. Pressure (mb)	Flow (l/hr)
BH3	17/01/07	<0.1	4.6	15.2	998	<0.1
	29/01/07	<0.1	1.9	18.1	1015	0.3
	21/02/07	<0.1	7.5	6.5	0991	<0.1
	05/03/07	<0.1	7.3	12.7	0994	<0.1
	22/03/07	<0.1	7.1	16.9	1012	<0.1
WS1	17/01/07	18.4	14.2	12.1	998	0.8
	29/01/07	21.1	13.4	2.8	1015	0.2
	21/02/07	22.4	13.0	0.6	0991	<0.1
	26/02/07	22.2	14.4	2.2	1000	<0.1
	05/03/07	23.8	16.3	0.6	0994	<0.1
	22/03/07	20.2	13.9	3.2	1012	0.1
WS4	17/01/07	<0.1	0.6	17.6	998	0.2
	29/01/07	<0.1	0.6	17.4	1015	<0.1
	21/02/07	<0.1	0.4	18.3	0990	<0.1
	26/02/07	0.1	5.0	12.2	1000	<0.1
	05/03/07	<0.1	2.1	18.9	0994	<0.1
	22/03/07	<0.1	0.7	19.7	1012	<0.1
WS7	17/01/07	<0.1	<0.1	19.4	998	<0.1
	29/01/07	<0.1	<0.1	19.4	1015	<0.1
	21/02/07*	10.7	19.0	2.0	0991	<0.1
	26/02/07	5.4	4.1	13.0	1000	<0.1
	05/03/07	<0.1	<0.1	19.4	0994	<0.1
	22/03/07	0.4	0.5	18.6	1012	<0.1
WS10	17/01/07	<0.1	<0.1	19.5	998	<0.1
	29/01/07	<0.1	<0.1	19.6	1015	<0.1
	21/02/07	<0.1	<0.1	19.0	0992	<0.1
	26/02/07	-	-	-	-	-
	05/03/07	<0.1	0.1	20.4	0994	<0.1
	22/03/07	<0.1	0.1	20.7	1012	<0.1
WS13	17/01/07	<0.1	0.1	19.4	998	<0.1
	29/01/07	<0.1	12.1	5.5	1015	<0.1
	21/02/07	0.2	8.9	3.3	0991	<0.1
	26/02/07	1.6	13.5	0.2	1000	<0.1
	05/03/07	<0.1	<0.1	20.7	0994	<0.1
	22/03/07	<0.1	<0.1	20.7	1012	<0.1
WS16	17/01/07	<0.1	<0.1	19.5	998	<0.1
	29/01/07	<0.1	<0.1	19.4	1015	<0.1
	21/02/07	<0.1	<0.1	19.0	0991	<0.1
	26/02/07	<0.1	1.8	18.5	0999	<0.1
	05/03/07	<0.1	<0.1	19.1	0994	<0.1
	22/03/07	<0.1	2.3	19.7	1012	<0.1
WS19	17/01/07	<0.1	<0.1	19.3	998	<0.1
	29/01/07	<0.1	<0.1	19.6	1015	<0.1
	21/02/07	0.1	0.8	17.8	0991	0.1
	26/02/07	<0.1	0.9	17.9	1000	<0.1
	05/03/07	<0.1	<0.1	20.2	0994	<0.1
	22/03/07	<0.1	<0.1	20.4	1012	<0.1

*Gas tap was blocked therefore measured from well.

Table 2: Summary of Groundwater Monitoring Data

Borehole Number	Date	Response Zone (m)	Depth to Base (m bcl) [i]	Depth to Water (m bcl) [i]
BH3	17/01/07		5.00	4.44
	29/01/07		4.90	0.85
	21/02/07		4.92	3.70
	26/02/07		4.94	3.67
	05/03/07		4.90	3.77
	22/03/07		4.90	3.70
WS1	17/01/07		7.80	6.96
	29/01/07		7.79	7.01
	21/02/07		7.80	7.10
	26/02/07		7.80	7.20
	05/03/07		7.80	7.21
	22/03/07		7.79	7.07
WS4	17/01/07		3.70	1.39
	29/01/07		3.65	1.44
	21/02/02		3.70	1.67
	26/02/07		3.68	1.63
	05/03/07		3.70	1.67
	22/03/07		3.63	1.51
WS7	17/01/07		4.00	2.71
	29/01/07		4.00	2.74
	21/02/07		4.03	1.82
	26/02/07		4.02	2.12
	05/03/07		4.00	2.68
	22/03/07			
WS10	17/01/07		4.70	4.12
	29/01/07		4.71	3.96
	21/02/07		4.72	4.13
	26/02/07		-	-
	05/03/07		4.70	3.14
	22/03/07		4.74	3.51
WS13	17/01/07		3.20	0.49
	29/01/07		3.14	0.65
	21/02/07		3.14	1.50
	26/02/07		4.70	4.00
	05/03/07		4.90	4.09
	22/03/07		4.66	4.52

Borehole Number	Date	Response Zone (m)	Depth to Base (m bcl) [i]	Depth to Water (m bcl) [i]
WS16*	17/01/07		-	-
	29/01/07		-	-
	21/02/07		3.95	2.13
	26/02/07		3.88	2.11
	05/03/07		3.90	2.11
	22/03/07		3.85	2.23
WS19	17/01/07		3.90	1.03
	29/01/07		3.90	1.01
	21/02/07		3.90	1.00
	26/02/07		3.85	0.92
	05/03/07		3.81	0.84
	22/03/07		3.78	2.18

*Bung Wedged-unable to take water level reading.

Co-Operative Academy

Project No: PN081814

SINCLAIR KNIGHT MERZ

Hole No.: WS4

Date	Depth to Base (m)	Depth to Water (m bgl)	Explosive Gas CH4 (% LEL)	Peak Explosive Gas CH4 (% VOL)	Carbon Dioxide CO2 (% VOL)	Oxygen O2 (%VOL)	Nitrogen N2 (% VOL)	Hydrogen Sulphide H2S (ppm)	Carbon Monoxide CO (ppm)	Barometric Pressure (l/hr)	Flow (l/hr)
10/06/2008	3.64	2.40	0.0	0.0	4.3	18.4	77.2	0.0	0.0	1015	0.0
17/06/2008	3.64	2.50	0.0	0.0	3.0	19.5	77.4	0.0	0.0	999	-0.1
24/06/2008	3.64	2.46	0.0	0.0	4.2	18.7	77.0	0.0	0.0	1004	0.0
30/06/2008	3.65	2.22	0.0	0.0	4.2	17.3	78.4	0.0	0.0	1008	0.0
07/07/2008	3.65	3.04	0.0	0.0	5.3	16.0	78.6	0.0	0.0	985	0.0
15/07/2008	3.65	2.32	0.0	0.0	4.8	16.6	78.5	0.0	0.0	1012	0.0
29/08/2008	3.65	2.27	0.0	0.0	5.6	17.0	77.3	0.0	0.0	999	0.0
18/08/2008	3.65	1.83	0.0	0.0	4.8	16.6	78.5	0.0	0.0	987	0.0

Co-Operative Academy

Project No: PN081814

SINCLAIR KNIGHT MERZ

Hole No.: WS16

Date	Depth to Base (m)	Depth to Water (m bgl)	Explosive Gas CH4 (% LEL)	Peak Explosive Gas CH4 (% VOL)	Carbon Dioxide CO2 (% VOL)	Oxygen O2 (%VOL)	Nitrogen N2 (% VOL)	Hydrogen Sulphide H2S (ppm)	Carbon Monoxide CO (ppm)	Barometric Pressure (l/hr)	Flow (l/hr)
10/06/2008	3.87	2.2	0.0	0.0	2.5	19.9	77.5	0.0	0.0	1015	1.1
17/06/2008	3.87	2.26	0.0	0.0	1.6	20.7	77.6	0.0	0.0	999	0.0
24/062008	3.87	2.36	0.0	0.0	0.7	20.8	78.4	0.0	0.0	1004	0.0
30/06/2008	3.87	2.34	0.0	0.0	2.8	19.9	77.2	0.0	0.0	1008	0.0
07/07/2008	3.87	2.23	0.0	0.0	3.3	19.2	77.4	0.0	0.0	985	0.0
15/07/2008	3.88	2.3	0.0	0.0	2.9	19.1	77.9	0.0	0.0	1012	0.0
29/07/2008	3.88	2.27	0.0	0.0	2.8	19.2	77.9	0.0	0.0	999	0.0
18/08/2008	3.87	2.15	0.0	0.0	3.9	18.6	77.4	0.0	0.0	987	0.0

Co-Operative Academy

Project No: PN081814

SINCLAIR KNIGHT MERZ

Hole No.: WS19

Date	Depth to Base (m)	Depth to Water (m bgl)	Explosive Gas CH4 (% LEL)	Peak Explosive Gas CH4 (% VOL)	Carbon Dioxide CO2 (% VOL)	Oxygen O2 (%VOL)	Nitrogen N2 (% VOL)	Hydrogen Sulphide H2S (ppm)	Carbon Monoxide CO (ppm)	Barometric Pressure (l/hr)	Flow (l/hr)
17/06/2008	3.8	1.64	0.0	0.0	5.8	18.6	75.5	0.0	0.0	999	0.0
24/06/2008	3.24	1.33	0.0	0.0	7.1	15.8	77.0	0.0	0.0	1004	0.1
30/06/2008	3.74	1.02	0.0	0.0	7.8	16.0	76.1	0.0	0.0	1008	0.0
07/07/2008	3.24	0.95	0.0	0.0	8.6	14.1	77.2	0.0	0.0	985	1.9
15/07/2008	3.74	0.95	0.0	0.0	4.4	17.8	77.7	0.0	0.0	1012	-9.7
29/07/2008	3.2	1.08	0.0	0.0	9.3	12.3	78.3	0.0	0.0	999	0.0
18/08/2008	3.74	0.93	0	0	9.8	11.4	78.7	0.0	0.0	987.0	0.0

WYG Environment
part of the WYG group

The Co-operative Academy of Manchester

Proposed Extension and Alterations

Phase 1 Geo-Environmental Desk Top Study

March 2016

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Contents

Page

1.0 EXECUTIVE SUMMARY 1

2.0 INTRODUCTION 2

3.0 ENVIRONMENTAL SETTING 3

4.0 REVIEW OF PREVIOUS REPORTS 5

5.0 SITE HISTORY 9

6.0 GEOLOGY, HYDROGEOLOGY AND HYDROLOGY 10

7.0 PRELIMINARY CONTAMINATION RISK ASSESSMENT 14

8.0 CONCLUSIONS & RECOMMENDATIONS 22

Figures

Drawing 01 - Site Location Plan

Drawing 02 – Proposed Exploratory Hole Location Plan

Appendices

Appendix A – Report Conditions

Appendix B – Previous Reports (CD Copy)

1.0 EXECUTIVE SUMMARY

Current Site Status	The Co-operative Academy site comprises approx. 6.9ha occupied by the current secondary school and open space to the west in Higher Blackley, Manchester. The school was recently redeveloped (replacing the previous main building) and it is proposed to construct an extension incorporating this and a sports hall with the creation of car parking in the east and a running track/sports ground in the west. The site is surrounded by residential properties.
Site History	The site was historically open space until development as a school in the 1960's. Prior to this landfilling had occurred in the west of the site.
Conceptual Site Model (CSM)	The site area proposed for the new building development and car parking is underlain by Made Ground with landfilled material in the west beneath the proposed running track/sports ground, in turn underlain by Glacial Till (Secondary Undifferentiated Aquifer) with bedrock of the Chester Pebble Beds (Principal Aquifer) or Manchester Marls (Secondary B Aquifer) to the south Perched shallow groundwater may be present within the Made Ground/Landfill on top of the superficial clay or within sand horizons within the Till which may provide base flow to local surface waters with deeper groundwater within the aquifer. The presence of Glacial Till clay may limit the mobility of contaminants but the thickness and the presence of preferential pathways (sand bands) is unknown, specifically beneath the west of the site. The nearest surface water is approx. 100m south. The site is not located in a groundwater SPZ.
PRA, Conclusions and Recommendations	The following potential contaminative sources were identified specific to the proposed development areas: Made Ground, landfilled material and ground gases. Overall, the Preliminary Risk Assessment (PRA) has indicated that the site poses a low to high risk associated with future development receptors due to different proposed development areas with different potential contaminative sources and receptor pathways. Of note are the following potential unacceptable risk which requires further investigations and/or mitigation: • A low to moderate risk associated with future users of the building extension. • A high risk associated with ground gases associated with future users of the building extension. • A moderate risk associated with ground gases associated with any confined spaces (services) for the proposed car park. • A moderate risk associated with future users of the running track/sports ground. • A moderate risk associated with the risk to the principal aquifer associated with the west of the site. • A moderate risk associated with ground gases associated with any confined spaces (services) for the running track/sports ground. At this preliminary stage remedial works are likely to include: • Gas mitigation for buildings and/or drainage/service runs, • Cover system or hardstanding, • Geotextile for land stability of new running track, • Validation of soils for re-use; and/or, • Classification of soils for off-site disposal (potentially non hazardous/hazardous). It is considered that a ground investigation would be required at the site to refine the Conceptual Site Model (CSM) and PRA to inform the proposed development of the site.

2.0 INTRODUCTION

2.1 Instruction

WYG Environment Planning Transport Ltd (WYG) has been commissioned by WYG Engineering on behalf of The Co-operative Academy of Manchester to undertake a Phase 1 Geo-Environmental Desk Top Study in connection with a planned expansion of the Academy facilities located in Higher Blackley, Manchester. A site location plan is presented as Drawing 01.

The development site is mostly within the existing Academy grounds. It is proposed to construct a new two storey extension to the existing school building. Provision has also been made for new sports pitches, car parking areas and soft landscaping. Multiple development options are under consideration.

2.2 Objectives

The primary objective of this report is to understand the ground conditions (land contamination and geotechnical) through preliminary desk based researches, to develop a robust Conceptual Site Model (CSM) and land contamination preliminary risk assessment (PRA) to inform the design of a physical stage of site investigation.

2.3 Scope of Services

In order to achieve the above objectives, the following scope of works has been determined:

- A review of historical third party reports produced for the site,
- A review of relevant web-based information,
- A discussion of the environmental setting of the site,
- A discussion of the history of the site,
- A discussion of the anticipated ground and groundwater conditions,
- A preliminary Risk Assessment/Conceptual Site Model in line with current guidance for the assessment of land contamination for the proposed development.

2.4 Report Conditions

Attention is drawn to the report conditions included in Appendix A.

3.0 ENVIRONMENTAL SETTING

3.1 Site Setting

The site is located approximately 6km north of Manchester city centre in Higher Blackley. The location of the site is shown on Figure 1 and further details provided in Table 3.1 below.

Table 3.1 Site Details

Site Address	Co-operative Academy, Plant Hill Road, Higher Blackley, Manchester, M9 0WQ
Grid Reference	Site is centered upon 385371, 403678
Site Area	~ 6.9 ha.
Elevation	~ 90m Above Ordnance Datum (AOD)

The site is currently occupied by a number of school buildings, a sports hall, playing fields, football pitch, tennis courts, inclusion centre and car parking. Access to the site is via a driveway off Plant Hill Road at the eastern end of the site and also via an entrance to the main car park at the front of the school buildings. The site also encompasses an additional area of recreational land with footpaths to the west of the current school boundary. A site layout plan is provided as Figure 2.

The site is bounded primarily by recreational land and residential properties. Table 3.2 describes land usages adjacent to the development site.

Table 3.2 Site Surrounding Land Uses

Boundary	Description
North	Open space and residential properties
South	Recreational land and school
East	Plant Hill Road and residential properties
West	Recreational land

3.2 Environmentally Sensitive Areas

According to www.magic.gov.uk, there are no Special Protection Areas (SPAs), Sites of Special Scientific Interest (SSSI) or Special Areas of Conservation (SAC) on the site or immediately surrounding it; however, woodlands are present to the north and west.

According to the Environment Agency website, the site is located in a Nitrate Vulnerable Zone (NVZ) for surface water.

4.0 REVIEW OF PREVIOUS REPORTS

Previous reports are available associated with planning permission for the replacement school building constructed c. 2013. The following reports have been reviewed:

1. Co-operative Academy, Manchester Phase II Geo-Environmental Investigation Site Investigation Report, final, SKM, November 2008 (which included a review of a Desk Study by MCC - not provided but also included reference to other previous investigations - and a site investigation by GEA in February 2007, included as an appendix).
2. Co-operative Academy, Manchester; Remediation Strategy, SKM, Final, July 2009.
3. Co-operative Academy, Manchester; Validation Report, Draft, SKM, November 2016.

4.1 SKM Site Investigation Report

The report includes a review of previous reports, a desk study summary and the findings of a site investigation associated with the redevelopment of the school (as per the current layout excluding the inclusion centre and sports hall). Relevant information is provided below and where appropriate, included in the relevant desk study section.

4.1.1 Site Investigation Works

Site investigations undertaken by GEA in 2007 comprised 3 no. cable percussive boreholes, 20 no. window sample holes, SPTs, installation of 8 no. wells and ground gas monitoring on 5 no. occasions.

Site investigation works undertaken by Geotechnics for SKM in 2008 comprised 3 no. cable percussive boreholes with SPTs, 19 no. window sample holes with chemical/geotechnical laboratory testing, in-situ soil permeability tests and gas and groundwater monitoring (8 no. occasions over 3 months). Chemical analysis of soils was undertaken for metals including hexavalent chromium, total and free cyanide, sulphide, sulphur, sulphate, phenols, pH, Speciated TPH including BTEX and MTBE, speciated PAHs, VOCs and SVOCs, leachability, Waste Acceptance Criteria (WAC) testing and asbestos.

From the above, 4 no. exploratory locations (BH1 – with monitoring well, WS11, WS12 & WS16 GEA) are located beneath the proposed building extension. The western part of the site (beyond the

current school boundary) proposed for a running track/sports pitch has not been investigated previously.

4.1.2 Ground Conditions

Ground conditions encountered in 2008 comprised 0.2m to 0.7m of topsoil (outside former landfill area), Made Ground up to 2m thick in the west and between 1m and up to 7.5m proven thickness in the former landfill area, in turn underlain by glacial sandy gravelly Clay interbedded with silty/clayey Sand.

Groundwater monitoring during both investigations highlighted a shallow water (between 0.1m and 0.5m bgl). Monitoring wells were installed in 4 no. locations drilled in 2008. Monitoring was undertaken of these and 4 no. GEA installations. Installations were predominantly installed in the Glacial deposits (some strata for wells recorded as unknown). Groundwater monitored levels varied between approximately 1m and 15m below ground level (bgl).

Potential contaminative sources listed by SKM comprised the former landfill and fuel oil storage associated with the school.

Aggressive ground class was determined by SKM as DS-3, AC-3 for proposed buried concrete but reduced to DS-1, AC-1 for locations out-with the worst case area including the former landfill.

4.1.3 Human Health Risk

The Tier 1 contamination assessment by SKM of both sets of investigation results were compared to screening values for a residential without plant uptake end use. Soils from the former landfill area showed elevated arsenic, lead, mercury, nickel, sulphate, pH, some TPH fractions, some PAHs and some VOCs, SVOCs elevated above laboratory detection limits. Elevated arsenic, benzo(a)pyrene and 2 no. samples for which VOCS were elevated against laboratory detection limits were identified for the remainder of the site. Statistical analysis and a DQRA were undertaken to derive more appropriate screening values for the proposed end-use. This did not produce any elevated contaminants of concern.

1 no. location from the previous GEA investigation reported the presence of asbestos (area of the former landfill). It was considered that this was in an area of a proposed sports pitch and provision of a cover layer would mitigate the risk.

4.1.4 Controlled Waters Risk

The risk to controlled waters was determined through soil leachable results (metals and hydrocarbons) and 5 no. groundwater samples analysed in 2008. Some elevated potential contaminants were highlighted when compared to UK Drinking Water Standards. Some minor exceedances were reported but due to the site's non sensitive location with respect to controlled waters, it was not considered that a significant risk was associated with the site.

4.1.5 Ground Gas

Ground gas monitoring reported by SKM for the works in 2008 highlighted elevated ground gases (max. methane 19%, carbon dioxide 21.5%) with high flow rates (>30l/hr). The site was classified as Characteristic Situation (CS) 4 in accordance with CIRIA R149 (now superseded by CIRIA C665 and other guidance). Similar gas concentrations were also recorded during monitoring undertaken by GEA. Monitoring for VOCs was not undertaken during either investigation.

4.1.6 Summary of Findings

The inferred extent of the former landfill based on the SKM report does not encroach beneath the current building footprints where as the landfill boundary given on the Environment Agency web based information does.

Recommendations by SKM for the development of the school built in 2013 included 300mm 'clean' cover with a geotextile for new playing fields, ground gas mitigation measures for buildings, appropriate new supply pipe construction and validation of the re-use or import of soils. WAC testing indicated that the samples tested would be classified as inert or non hazardous.

4.2 SKM Remediation Strategy

The proposed works were given as a topsoil strip across the whole site, cut and fill operations (including re-use of soil from foundation excavations, drainage, piling), emplacement of cover materials (including topsoil) within soft landscaping and turfed sports pitches, construction of a 2-3 storey secondary school/post-16 building within the central area and subsequent demolition of the existing school. A further inclusion unit was to be located in the north-east (outside the SKM scope of works). The sports hall and adult education centre were to be retained.

The remediation strategy included the following provisions:

- A 600mm thick soil cover for the sports pitch. This was to be made up of 300mm inert material (re-used clay, replacing the need for a geotextile), 250mm topsoil and 50mm of topsoil/sand mix.
- Validation of soil suitability for the above cover layer, by testing 1 sample per 250m^3 or 1 per 1000m^3 (dependant on source) for metals, cyanide, sulphate, pH, phenols, PAHs, TPH and asbestos. The test results were to be compared against site specific target levels (SSTLs).
- Surplus soil to be disposed of off-site.
- Ground gas mitigation measures comprising a geo-composite venting blanket with ground level vents at 8m centres and a lapped/taped geomembrane incorporated beneath the suspended floor slab.

The remediation strategy was approved by MCC in November 2010.

4.3 Validation Report

The report provides validation of the creation of the cover system for the sports pitches, reinstatement of the contractor's compound in line with MCC stipulations using surplus material from the main works and results of validation soil testing below:

- It was confirmed that the sports pitch was provided with the required 600mm cover layer.
- A total of 3000m^3 of site won topsoil and 5000m^3 of site won clay were validated and no exceedances of SSTLs were recorded. The soil was re-used as the sports pitch cover.
- A total of 500m^3 of site won topsoil and 2000m^3 of site won clay were validated and no exceedances of SSTLs were recorded. The soil was re-used for the contractor's compound.
- A total of 800m^3 of imported topsoil was validated and no exceedances of SSTLs were recorded. The soil was used in soft landscaping.
- A total of 8719m^3 of imported aggregates was used during the construction works.
- A total of 180m^3 of former landfill soil was excavated as part of the cut for the sports pitch (north-west of the site). Tests reported elevated lead and PAHs. The soil was re-used beneath the cover systems.
- Validation samples described above were obtained from stockpiles on 19/03/09.
- Gas protection measures were installed as per measures outlined in the remediation strategy.

5.0 SITE HISTORY

Publically available extracts of historical Ordnance Survey (OS) maps, previous reports and the Environment Agency website were used to research the history of the site and the surrounding area.

The earliest map reviewed (1848) indicates that the site was fields with some ponds and a watercourse (flowing south) to the west (this is no longer annotated on development plans of the school). Circa 1893 a reformatory (later including cottages) was located to the south of the site including a watercourse (current watercourse 110m south of the site) and ponds.

By 1922, the site was indicated to be part of a golf course.

By 1951, a garage (later a works) is present to the south of the site (location of former reformatory).

The maps from the late 1950's/early 1960's show possible land raising to the west of the site with the Plant Hill Comprehensive School present c. 1963 in the eastern part of the site (with tennis court). During this time mound-like structures are annotated as refuse tips to the west of the site and beyond to the north-west and south-west.

The Environment Agency website indicates the refuse tips to be an historical recorded landfill (Land at Tweedle Hill). The Environment Agency website does not provide any further information.

Publically available web based information indicates that Tweedle Hill covers 9 ha and is an old clay pit used as a landfill until the 1960's. It was assessed for community woodland in 1997 and is currently maintained by Red Rose Forest.

From the 1960's residential properties have been constructed surrounding the site. A further landfill is located within 250m south of the site (Land at Pike Fold Lane). The Environment Agency website does not provide any further information.

The site remained predominantly unaltered until the 1990's when a sports hall was constructed and more recently a new school developed followed by demolition of the old school, re-landscaping and creation of sports grounds. An inclusion centre is also present in the east.

6.0 GEOLOGY, HYDROGEOLOGY AND HYDROLOGY

6.1 Geology

Details of the geology underlying the site have been obtained from the following sources:

- BGS Sheet No. 85 (Manchester) 1:50,000 map solid and drift editions,
- BGS website (Geology of Britain Map Viewer),
- Previous reports (see Section 4),
- BR211 Guidance on the Construction of new buildings (2007); and,
- Indicative Radon Map Number 13 Northern Welsh Marches and Liverpool, Health Protection Agency and British Geological Survey (2007).

6.1.1 Made Ground

Previous investigations have confirmed that Made Ground is present across the site with landfilled material being encountered in the west (associated with the recorded landfill). The Made Ground has been recorded up to 7.5m thick. The site has been subject to recent development involving cut and fill and creation of a soil cover to sports pitches. Some landfilled soil was re-used beneath the sports pitch cover in the north-west of the site.

The previous investigations indicated that the landfill material is present further west than the boundary given on the Environment Agency website.

6.1.2 Superficial Geology

The geological map indicates that the site is underlain by Glacial Till.

Previous investigations report Glacial Till comprising sandy gravelly clays interbedded with silty sands up to approximately 20m thick.

6.1.3 Solid Geology

The geological map indicates that the solid geology at depth consists of the Chester Pebble Bed Formation.

A fault intersects the southern boundary of the site running east to west. South of this lies the Manchester Marl Formation.

The site is not located in an area at risk from mining hazards.

6.1.4 Radon

The site is in an area where 1-3% of homes are above the action level.

The indicative radon map indicates that the site is in an area where no radon protection measures are required within the construction of new dwellings or extensions.

6.2 Hydrogeology

Details of the hydrogeology underlying the site have been obtained from the following:

- Environment Agency website; and,
- Previous reports (See Section 4).

6.2.1 Groundwater Classification

The superficial deposits (Till) are designated as a Secondary Undifferentiated Aquifer on the Environment Agency website. This has been assigned in cases where it has not been possible to attribute either a Secondary A or B aquifer to the rock type due to the variable characteristics.

The Chester Pebble Beds are designated as a Principal Aquifer; these are layers of rock or drift deposits that have high intergranular and/or fracture permeability - meaning they usually provide a high level of water storage. They may support water supply and/or river base flow on a strategic scale.

The Manchester Marl Formation is classified as a Secondary B Aquifer; these are predominantly lower permeability layers which may store and yield limited amounts of groundwater due to localised features such as fissures, thin permeable horizons and weathering.

6.2.2 Groundwater Abstractions

The site is not located within a Source Protection Zone (SPZ) for a potable groundwater drinking supply.

Previous reports have indicated that there is one groundwater abstraction approximately 900m from the site.

6.2.3 Site Characteristics

Previous investigations have encountered groundwater within the Glacial Till (predominantly associated with sand horizons) during drilling; however, some near surface groundwater was noted with monitored levels between approximately 0.9 and 15m bgl.

It is considered that there may be a perched groundwater table within the Made Ground/landfill and/or sand horizons within the Glacial till with a deeper groundwater table within the Principal Aquifer.

6.3 Hydrology

Details of the hydrology of the area have been obtained from the following sources:

- The Environment Agency website.

6.3.1 Watercourses

The nearest surface water course issues approximately 110m south of the site boundary with a further spring and watercourse issuing approximately 350m southwest of the site. It is presumed these flow to or are tributaries of the River Irk located approximately 900m south of the site boundary.

6.3.2 Surface Water Abstractions

The Environment Agency website indicates that there no active surface water abstractions at or within 250m of the site.

6.3.3 Flood Risk

The site is not located in an area at risk from flooding from rivers but the southern section of the site is designated as at low risk of surface water flooding.

7.0 PRELIMINARY CONTAMINATION RISK ASSESSMENT

The site is being considered for future school development and has been assessed in line with current UK guidance including the National Planning Policy Framework (NPPF), March 2012. This assessment relates to the proposed development comprising new building extension, proposed car parking and proposed running track/sports ground.

For a risk of pollution or environmental harm to occur as a result of ground contamination, all of the following elements must be present:

- A source, i.e. a substance that is capable of causing pollution or harm;
- A receptor (or target), i.e. something which could be adversely affected by the contaminant; and
- A pathway, i.e. a route by which the contaminant can reach the receptor.

If one of these elements is absent there can be no significant risk. If all are present then the magnitude of the risk is a function of the magnitude and mobility of the source, the sensitivity of the receptor and the nature of the migration pathway.

7.1 Conceptual Site Model (CSM)

The site area proposed for the new building development and car parking is underlain by Made Ground with landfilled material in the west beneath the proposed running track/sports ground, in turn underlain by Glacial Till (Secondary Undifferentiated Aquifer) with bedrock of the Chester Pebble Beds (Principal Aquifer) or Manchester Marls (Secondary B Aquifer) to the south Perched shallow groundwater may be present within the Made Ground/landfill on top of the superficial clay or within sand horizons within the Till which may provide base flow to local surface waters with deeper groundwater within the Principal Aquifer. The presence of Glacial Till clay may limit the mobility of contaminants but the thickness and the presence of preferential pathways (sand bands) is unknown, specifically beneath the west of the site.

7.2 Source-Pathway-Receptor Model

7.2.1 Potential On-site Hazard Sources

Based on the preliminary information, the following potentially contaminative uses have been identified:

Proposed Extension

- Made Ground associated with previous development phases (however, soil previously investigated and validated as suitable for school end-use)
- Landfill Materials (potential to be present out-with area previously investigated)
- Ground gases and vapours.

Proposed Car Parking

- Made Ground associated with previous development phases (however, soil previously investigated and validated as suitable for school end-use),
- Sports Pitch Cover (however, soil previously validated as suitable for use),
- Ground gases and vapours,

Proposed Running Track/Sports Ground

- Landfill materials
- Ground gases and vapours.

7.2.2 Potential Off-Site Hazard Sources

Based on historical uses identified surrounding the site it is considered that there potential off-site contamination sources include landfilling beyond the western boundary. This source is assessed as the same as the on-site landfill source in relation to mobile contaminants and ground gas generation.

7.3 Contamination Pathways

Potential contamination pathways are listed below for a proposed school and sports end use:

- Dermal contact,
- Inhalation of vapours or dusts,
- Ingestion of soil and dusts,
- Leaching to surface run-off/drainage,
- Leaching to groundwater;
- Lateral and vertical migration of groundwater,
- Ground gas generation/accumulation; and,
- Migration along/into service conduits and pipe work.

At this stage, the landscape masterplan has not been provided, it has been assumed that horticulture is not undertaken associated with the proposed development options. As such, associated pathways have not been considered.

7.4 Contamination Receptors

Receptors that may be affected by potential contamination for the future development are considered to be:

- Future site users (school end use),
- Construction/maintenance workers,
- Surface waters (110m south),
- Principal Aquifer,
- Buildings / Services; and,
- Adjacent properties and land users.

7.5 Ground Contamination Preliminary Risk Assessment (PRA)

By considering the sources, pathways and receptors, a preliminary assessment of the environmental risk has been made with reference to the significance and degree of the risk. This assessment is based on consideration of whether the source contamination can reach a receptor and hence whether it is of significance (CIRIA C552).

The risk assessment has been carried out by assessing the severity of the potential consequence, the sensitivity of the target and the likelihood of occurrence, based on the categories given below (Tables 7.1 to 7.3).

A summary of the preliminary risk assessment for both on-site and off-site sources is given in Table 7.4.

Table 7.1 Potential Hazard Severity Definition

Category	Definition
Severe	Acute risks to human health, catastrophic damage to buildings/property, major pollution of controlled waters
Medium	Chronic risk to human health, pollution of sensitive controlled waters, significant effects on sensitive ecosystems or species.
Mild	Pollution of non sensitive waters, significant damage to buildings or structures
Minor	Requirement for protective equipment during site works to mitigate health effects, damage to non sensitive ecosystems or species, minor damage to buildings or structures

The likelihood of an event (probability) takes into account both the presence of the hazard and target and the integrity of the pathway and has been assessed based on the categories given below.

Table 7.2 Probability of Risk Definition

Category	Definition
High likelihood	Pollutant linkage may be present, and risk is almost certain to occur in long term, or there is evidence of harm to the receptor
Likely	Pollutant linkage may be present, and it is probable that the risk will occur over the long term
Low likelihood	Pollutant linkage may be present, and there is a possibility of the risk occurring, although there is no certainty that it will do so
Unlikely	Pollutant linkage may be present, but the circumstances under which harm would occur are improbable

The potential severity of the risk and the probability of the risk occurring have been combined in accordance with the following matrix in order to give a level of risk for each potential hazard.

Table 7.3 Level of Risk for Potential Hazard Definition

		Potential Severity			
		Severe	Medium	Mild	Minor
Probability of Risk	High Likelihood	High	High	Moderate	Low/ Moderate
	Likely	High	Moderate	Low/Moderate	Low
	Low Likelihood	Moderate	Low/Moderate	Low	Low
	Unlikely	Low/Moderate	Low	Low	Low

7.6 Summary of Risk Assessment

The Preliminary Risk Assessment (PRA) for the proposed development options is summarised as Table 7.4a (extension), 7.4b (car park) and 7.4c (running track/sports ground).

Proposed Extension

The contamination risk posed to future site users is considered to be **Low to Moderate** for Human Health and **High** associated with ground gases. The risk to other receptors considered to be **Low**.

Proposed Car Park

The contamination risk posed to future site users and other receptors is considered to be **Low** for Human Health and **Moderate** associated with ground gases.

Proposed Running Track/Sports Ground

The contamination risk posed to future site users (Human Health), associated with ground gases and the risk to the Principal Aquifer is considered to be **Moderate**. The risk to other receptors is considered to be **Low to Moderate**.

Table 7.4a Preliminary Contaminated Land Risk Assessment – Proposed Building Extension

ON SITE SOURCES						
Source	**Pathway**	**Receptor**	**Justification**	**Severity**	**Probability**	**Risk**
Ground Conditions – Possible presence of Made Ground/Landfill material with contaminants related to previous development stages and/or landfilling	Dermal contact, ingestion and/or inhalation of vapours or dusts	Human Health – Future site users (School)	Previous investigations have indicated that site soils do not pose a significant risk to human health, however, there is potential that landfill or elevated contaminants out-with the previously investigated area may be present.	Medium	Low	Low to Moderate
		Human Health – Construction Workers equipped with PPE	The risk rating is based on the above with mitigation measures in place such as good working practices and PPE, hence the minor severity.	Minor	Low	Low
	Leaching, and lateral and vertical migration of surface and ground waters	Controlled Waters (surface waters)	Previous investigations did not identify a significant risk to controlled waters	Mild	Low	Low
		Controlled Waters (Principal Aquifer)	The presence of Glacial Till may reduce the mobility of potential contaminants into the aquifer.	Medium	Unlikely	Low
		Adjacent Properties and Land Users	The risk rating is based on the potential for mobile (hydrocarbons) to be present associated with historical use and the proximity of residential properties.	Medium	Unlikely	Low
	Migration along/into service conduits and pipework	Buildings and services	The risk rating is based on the low potential for mobile contaminants. The aggressive ground conditions associated with the Made Ground are unlikely based on previous reports.	Mild	Low	Low
Ground gas – Possible presence of Made Ground & Volatile Contaminants	Generation and migration / accumulation of ground gases	Human Health – Future site users	Previous reports have indicated significantly elevated ground gases and flows (CS4)	Severe (Asphyxiation & Explosion)	Likely	High
		Buildings and services		Severe (Explosion)	Likely	High

Table 7.4b Preliminary Contaminated Land Risk Assessment – Proposed Car Park

ON SITE SOURCES						
Source	**Pathway**	**Receptor**	**Justification**	**Severity**	**Probability**	**Risk**
Ground Conditions – Possible presence of Made Ground related to previous development stages	Dermal contact, ingestion and/or inhalation of vapours or dusts	Human Health – Future site users (School)	Previous investigations have indicated that site soils do not pose a significant risk to human health and exposure would be limited due to presence of hardstanding.	Medium	Unlikely	Low
		Human Health – Construction Workers equipped with PPE	The risk rating is based on the above with mitigation measures in place such as good working practices and PPE, hence the minor severity.	Minor	Low	Low
	Leaching, and lateral and vertical migration of surface and ground waters	Controlled Waters (surface waters)	Previous investigations did not identify a significant risk to controlled waters	Mild	Low	Low
		Controlled Waters (Principal Aquifer)	The presence of Glacial Till may reduce the mobility of potential contaminants into the aquifer.	Medium	Unlikely	Low
		Adjacent Properties and Land Users	The risk rating is based on the potential for mobile (hydrocarbons) to be present associated with historical use and the proximity of residential properties.	Medium	Unlikely	Low
	Migration along/into service conduits and pipework	Buildings and services	The risk rating is based on the low potential for mobile contaminants. The aggressive ground conditions associated with the Made Ground are unlikely based on previous reports.	Mild	Low	Low
Ground gas – Possible presence of Made Ground & Volatile Contaminants	Generation and migration / accumulation of ground gases	Human Health – Future site users	Previous reports have indicated significantly elevated ground gases and flows (CS4); however, there are no occupied structures proposed but there may be associated service and drainage runs for ground gas to accumulate in.	Severe (Asphyxiation & Explosion)	Low	Moderate
		Buildings and services		Severe (Explosion)	Low	Moderate

Table 7.4c Preliminary Contaminated Land Risk Assessment – Proposed Running Track/Sports Ground

ON SITE SOURCES						
Source	**Pathway**	**Receptor**	**Justification**	**Severity**	**Probability**	**Risk**
Ground Conditions – Landfill material	Dermal contact, ingestion and/or inhalation of vapours or dusts	Human Health – Future site users (School)	The concentrations of potential contaminants are unknown but may be significant due to the presence of landfill material	Medium	Likely	Moderate
		Human Health – Construction Workers equipped with PPE	The risk rating is based on the above with mitigation measures in place such as good working practices and PPE, hence the minor severity.	Minor	Likely	Low
	Leaching, and lateral and vertical migration of surface and ground waters	Controlled Waters (surface waters)	The presence of potential contaminants is unknown and a previous watercourse was present historically.	Mild	Likely	Low to Moderate
		Controlled Waters (Principal Aquifer)	The presence of Glacial Till may reduce the mobility of potential contaminants into the aquifer but there may be preferential pathways.	Medium	Low	Moderate
		Adjacent Properties and Land Users	The risk rating is based on the potential for mobile contaminants to be present. However, use to the west is open space also within the landfill.	Mild	Likely	Low to Moderate
	Migration along/into service conduits and pipework	Buildings and services	The risk rating is based on the potential for mobile contaminants and the aggressive ground conditions based on previous reports.	Mild	Likely	Low to Moderate
Ground gas – Possible presence of Made Ground & Volatile Contaminants	Generation and migration / accumulation of ground gases	Human Health – Future site users	Previous reports have indicated significantly elevated ground gases and flows (CS4); however, there are no occupied structures proposed but there may be associated service and drainage runs for ground gas to accumulate in.	Severe (Asphyxiation & Explosion)	Low	Moderate
		Buildings and services		Severe (Explosion)	Low	Moderate

8.0 CONCLUSIONS & RECOMMENDATIONS

8.1 Conclusions

The preliminary CSM for the proposed development options has indicated that the site is underlain by Made Ground (from previous development or associated with recent cut/fill and remediation of sports pitches) in addition to landfill materials in the west, in turn underlain by Glacial Till (with sand horizons) and Chester Pebble Beds/Manchester Marls at depth. There are surface waters present approximately 110m south of the site but it is unknown whether shallow perched groundwater may provide base flow to these from shallow groundwater in the Made Ground/Landfill and in the Glacial Till. The Chester Pebble Beds are a Principal Aquifer which is not in a SPZ.

Potential contaminative sources predominantly associated the presence of Made Ground/Landfill materials have been identified, with significant ground gases (and possibly vapours) being generated from the site.

Overall, the PRA has indicated that the site poses a low to high risk associated with future development receptors due to different proposed development areas with different potential contaminative sources and receptor pathways. Of note is the following potential unacceptable risk which requires further investigations:

- A low to moderate risk associated with future users of the proposed building extension.
- A high risk associated with ground gases associated with future users of the building extension.
- A moderate risk associated with ground gases associated with any confined spaces (services) for the proposed car park.
- A moderate risk associated with future users of the running track/sports ground.
- A moderate risk associated with the risk to the Principal Aquifer associated with the west of the site.
- A moderate risk associated with ground gases associated with any confined spaces (services) for the running track/sports ground.

At this preliminary stage of assessment, remedial works are likely to include:

- Gas mitigation for buildings and/or drainage/service runs,
- Cover system or hardstanding,
- Geotextile for land stability of new running track
- Validation of soils for re-use,
- Classification of soils for off-site disposal (potentially non hazardous/hazardous)

8.2 Recommendations

The following ground information gaps have been identified:

- No previous investigation of the area of proposed running track/sports ground.
- Limited ground gas information associated with current site conditions and associated with Made Ground beneath the proposed building footprint.
- Limited measurement of vapour concentrations associated with previous ground gas monitoring.
- Land contamination and geotechnical information beneath the proposed building extension.

It is recommended that the following ground investigation be undertaken to refine the risks and provide development design information:

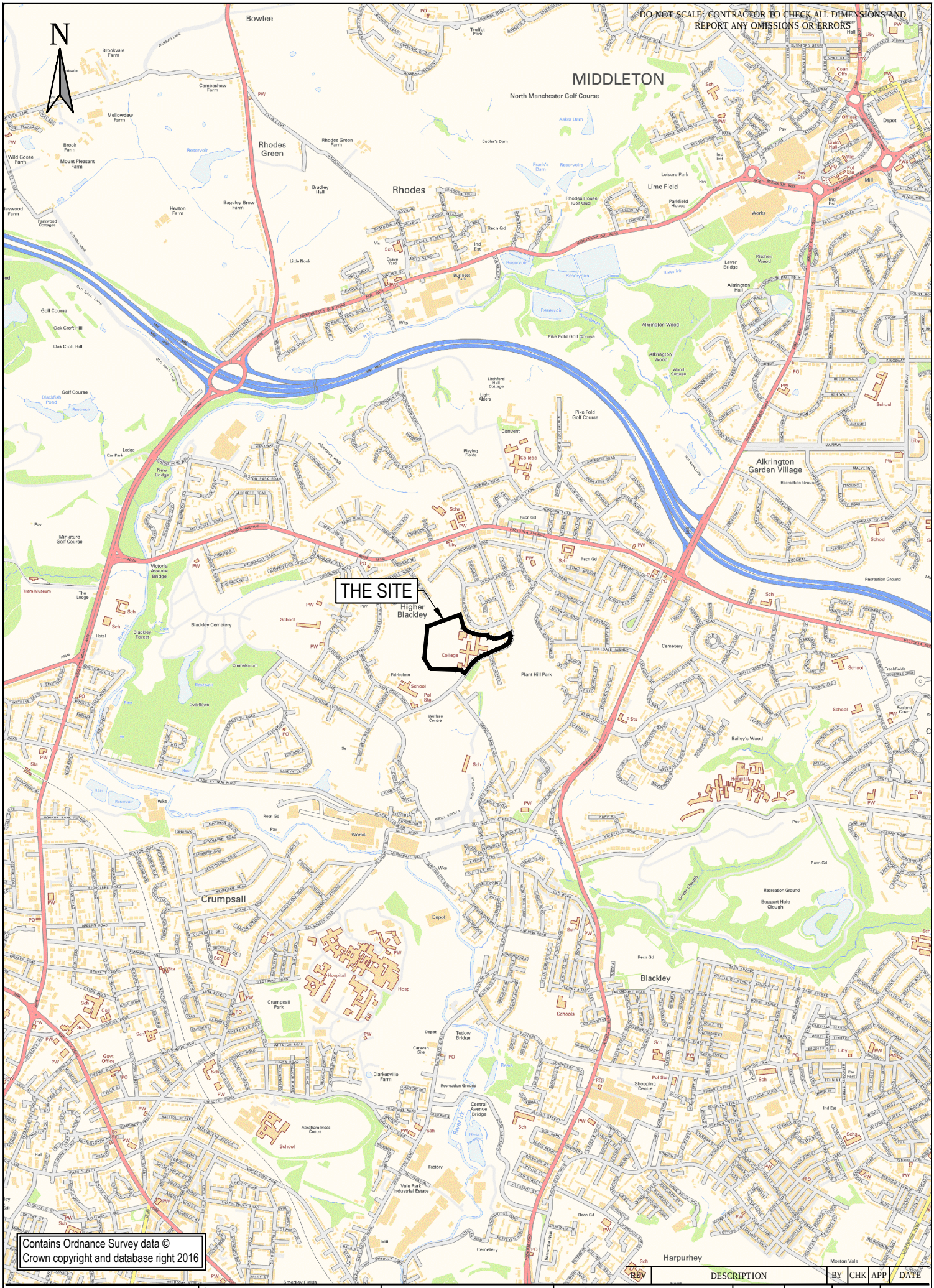
- 3 no. cable percussive boreholes with in-situ SPTs beneath the proposed building footprint.
- Installation of 3 no. gas/groundwater monitoring wells in the above holes.
- 1 day trial pitting within the area of the proposed car park.
- 2 days' trial pitting within the area of the proposed running track/sports ground.
- G eotechnical laboratory testing of soil samples.
- Full time Engineer supervision to log strata and take samples.
- Chemical analysis of soil, soil-leachate and groundwater samples for site specific suite of potential contaminants.
- Four ground gas and groundwater sampling monitoring visits.

The proposed exploratory hole locations are shown on Drawing 02.

In addition, the following should be undertaken associated with the proposed development:

- Hand dug foundation inspection pits around the sports hall to aid in the extension foundation and gas mitigation design.
- In-situ CBR testing for the proposed running track/sports ground and car park areas .

Drawings



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Drawing Title:
SITE LOCATION PLAN

Scale @ A4	Drawn	Date	Checked	Date	Approved	Date
1:20,000	CM	17.03.16				

Project No.	Office	Type	Drawing No.	Revision
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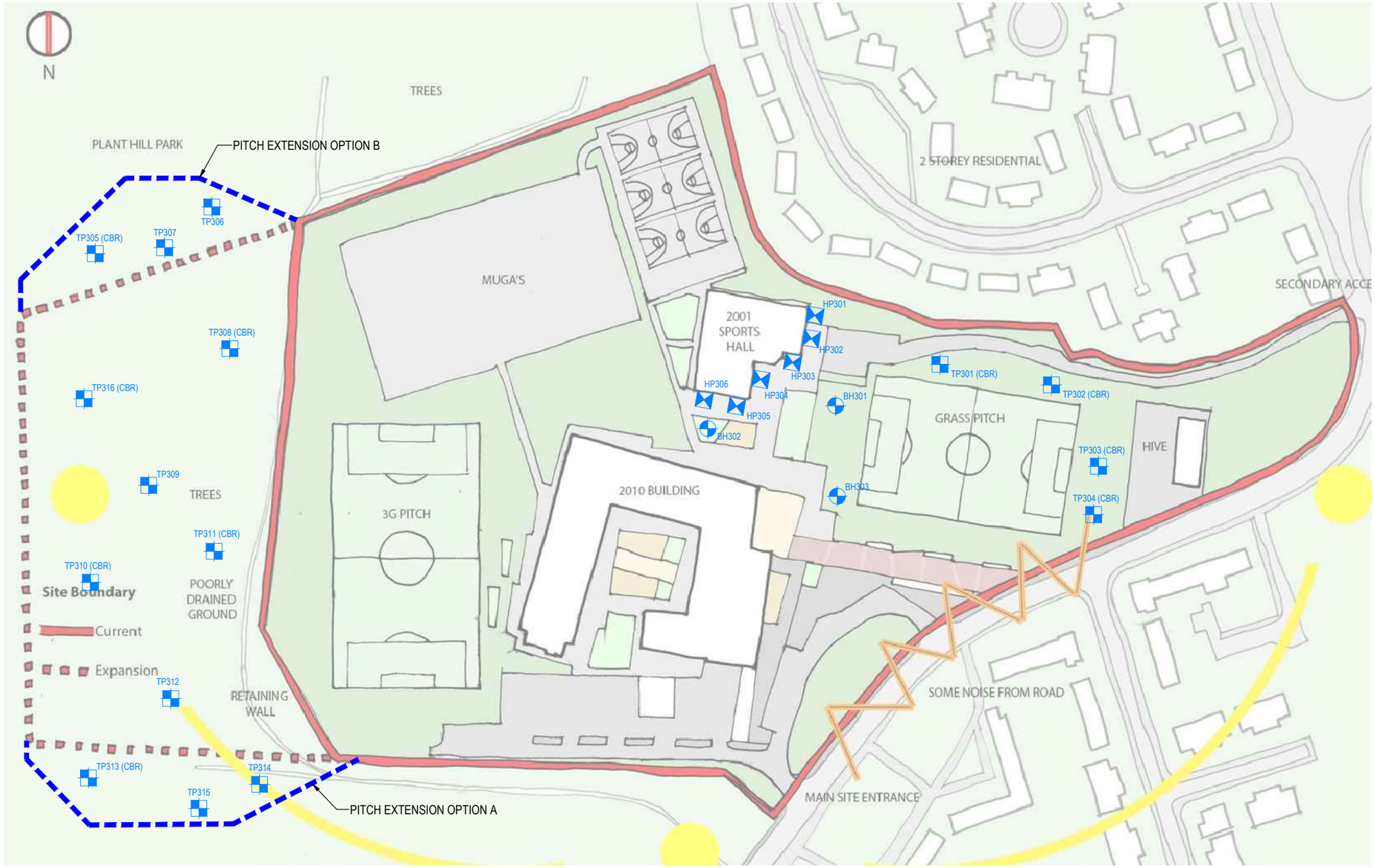
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KEY

- TRIAL PIT
- BOREHOLE
- HAND PIT

NOTE:
EXPLORATORY HOLE POSITIONS ARE INDICATIVE ONLY AND DO NOT TAKE INTO ACCOUNT LOCATION OF SERVICES. ANY EXCAVATIONS SHOULD BE CARRIED OUT IN ACCORDANCE WITH HSG47 'AVOIDING UNDERGROUND SERVICES'.



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PROPOSED EXPLORATORY HOLE LOCAITON PLAN

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N.T.S	CM 15.03.16		

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A096213	MAN	N	02	

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Appendices

Appendix A – Report Conditions

WYG ENVIRONMENT

C1 - REPORT CONDITIONS
(Environmental Assessment)

This report is produced solely for the benefit of **The Co-operative Academy of Manchester** and no liability is accepted for any reliance placed on it by any other party unless specifically agreed in writing otherwise.

This report is prepared for the proposed uses stated in the report and should not be used in a different context without reference to WYG. In time improved practices, fresh information or amended legislation may necessitate a re-assessment. Opinions and information provided in this report are on the basis of WYG using due skill and care in the preparation of the report.

This report refers, within the limitations stated, to the environment of the site in the context of the surrounding area at the time of the inspections. Environmental conditions can vary and no warranty is given as to the possibility of changes in the environment of the site and surrounding area at differing times.

This report is limited to those aspects reported on, within the scope and limits agreed with the client under our appointment. It is necessarily restricted and no liability is accepted for any other aspect. It is based on the information sources indicated in the report. Some of the opinions are based on unconfirmed data and information and are presented as the best obtained within the scope for this report.

Reliance has been placed on the documents and information supplied to WYG by others but no independent verification of these has been made and no warranty is given on them. No liability is accepted or warranty given in relation to the performance, reliability, standing etc of any products, services, organisations or companies referred to in this report.

Whilst skill and care have been used, no investigative method can eliminate the possibility of obtaining partially imprecise, incomplete or not fully representative information. Any monitoring or survey work undertaken as part of the commission will have been subject to limitations, including for example timescale, seasonal and weather related conditions.

Although care is taken to select monitoring and survey periods that are typical of the environmental conditions being measured, within the overall reporting programme constraints, measured conditions may not be fully representative of the actual conditions. Any predictive or modelling work, undertaken as part of the commission will be subject to limitations including the representativeness of data used by the model and the assumptions inherent within the approach used. Actual environmental conditions are typically more complex and variable than the investigative, predictive and modelling approaches indicate in practice, and the output of such approaches cannot be relied upon as a comprehensive or accurate indicator of future conditions.

The potential influence of our assessment and report on other aspects of any development or future planning requires evaluation by other involved parties.

The performance of environmental protection measures and of buildings and other structures in relation to acoustics, vibration, noise mitigation and other environmental issues is influenced to a large extent by the degree to which the relevant environmental considerations are incorporated into the final design and specifications and the quality of workmanship and compliance with the specifications on site during construction. WYG accept no liability for issues with performance arising from such factors

November 2008
WYG Environment Planning Transport Ltd

Appendix B – Previous Reports (CD Copy)

CO-OPERATIVE ACADEMY, MANCHESTER

PHASE II GEO-ENVIRONMENTAL INVESTIGATION

- Site Investigation Report
- FINAL
- November 2008
- ASITE reference: PH_SKM_RP_034

CO-OPERATIVE ACADEMY, MANCHESTER

PHASE II GEO-ENVIRONMENTAL INVESTIGATION

- Site Investigation Report
- FINAL
- November 2008

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Executive Summary

Site Location	The site is located approximately 6km south of Manchester City centre at National Grid Reference (NGR) 385400, 403700 and is bound by residential housing and recreational land to the north, Plant Hill Road to the east and recreational land to the south and west.
Site Description and Proposed Use	The site occupies an area of approximately 5 hectares and is currently occupied by a number of school buildings, sports hall, playing fields, football pitch, tennis courts and staff car parking. Access to the site is via a driveway off Plant Hill Road at the eastern end of the site and also via an entrance to the main car park to the frontage of the school buildings. The topography of the site falls to the southeast with an overall fall of approximately 11m across the site. It is proposed that a new three to four story educational facility is to be constructed adjacent to the existing school building. Provision has also been made for new sports pitches, car parking areas and soft landscaping.
Site Geology **Local Hydrogeology** **Local Hydrology**	Published geological (BGS) mapping indicates that the site is underlain by Glacial Till which is in turn underlain by Sherwood Sandstone of Permo-Triassic age. The Sherwood Sandstone present beneath the site is classed as a Major-Aquifer. The nearest surface water feature to the site is small tributary of the River Irk, located approximately 110m to the south east.
Site History	The site was initially developed in the early 1960's as Plant Hill Comprehensive School. At the same time, a number of refuse tips were also present adjacent to the western part of the site, which was later infilled with unknown material. The land use at the site has changed little since. Surrounding land use has generally comprised residential properties.
Ground Investigation Summary	The SKM ground investigation encountered Made Ground in excess of 5m in depth within the area of the former refuse tips, with the GEA investigation recording up to 7.5m. Elsewhere across the site the Made Ground was recorded as being up to a maximum of 2m in thickness. The Made Ground was underlain by Glacial deposits comprising variable drift materials from soft to very stiff clays and loose to dense silty sands. Groundwater was encountered within two of the cable percussive boreholes during the investigation and is considered to consist of localised, discontinuous perched systems within the Glacial Deposits.
Chemical Testing Results Summary	Chemical testing of the soils collected from beneath the former landfill area of the site recorded elevated heavy metals and PAH's, and the presence of a small number of VOC's and SVOCs. In addition the GEA report also encountered a cement bound fragment of asbestos at one location within the former landfill. The remaining area of the site recorded elevated concentrations of arsenic, PAH and SVOC's. A detailed quantitative risk assessment (DQRA) was carried out to determine the potential risks to human health (given the proposed development) posed by the contamination encountered in the landfill area and elsewhere on site. The results of the DQRA indicate that risks to human health are not likely to be significant (given the proposed development). Soil leachate and groundwater testing has indicated that there is a low risk with respect to controlled waters in the vicinity of the site.
Environmental Conclusions & Recommendations	The contamination assessment has concluded that no further investigation or assessment is required at the site. Given the nature of shallow Made Ground, which includes anthropogenic materials including metal, glass and other material, the presence of a bound fragment of asbestos at depth and the requirement for the new sports pitches to conform to Sports England standards it is recommended that the pitches incorporate a geotextile to minimise soil mixing and 300mm of clean inert topsoil. This should mitigate any potential risks to site end users from construction within the location of the former landfill. A remedial strategy will need to be prepared detailing how the works will be managed and validated. Characteristic Situation 4 gas mitigation measures are likely to be required at the site. Final gas mitigation detail will need to be agreed with the Local Authority.
Geotechnical Conclusions & Recommendations	It is considered that a piled foundation solution would be most practicable for the proposed structure, with piles designed to mobilise the majority of their strength through skin friction with an allowance for some end bearing resistance within the Glacial Till. As a piled foundation solution is considered most appropriate a suspended ground floor slab is recommended to prevent differential settlement between the slab and the buildings.

Contents

Executive Summary i

1. Introduction 1

2. Site Description and Proposed Development 2

2.1 Site Description 2
2.1 Proposed Development 3

3. Objectives and Scope of Investigation 4

3.1 Objectives 4
3.2 Scope of Investigation 4

4. Desk Top Review 5

4.1 Site History 5
4.2 Environmental Context 5
4.3 Geology 5
4.4 Hydrogeology 6
4.5 Leaching Potential of Soil 6
4.6 Hydrology 6
4.7 Regulatory Information 6

5. Site Investigation Methodology 7

5.1 Introduction 7
5.2 Scope of Works 7
5.3 Rationale for Exploratory Hole Positions 7
5.4 Chemical Analysis 7
5.5 Geotechnical Testing (laboratory) 8
5.6 Geotechnical Testing (In-situ) 9

6. Summary of Ground Conditions and Geotechnical Parameters 10

6.1 Generalised Stratigraphy 10
6.2 Geotechnical Parameters 10
6.2.1 Moisture Conditions 11
6.2.2 Dry Density / Moisture Content Relationship 11
6.2.3 Particle Size Distribution (PSD) 11
6.2.4 Quick Undrained Triaxial 12
6.2.5 Coefficient of Consolidation & Compressibility 12
6.2.6 California Bearing Ratio (CBR) 12
6.2.7 In Situ Testing (SPT) 12
6.3 Comparison with Previous Ground Investigation 13
6.4 Groundwater 14

7. Qualitative Environmental Risk Assessment 16

7.1 UK Framework 16

7.2 Risk Assessment Approach 16
7.3 Potential Sources of Contamination Identified at the Site 17
7.4 Potential Sources of Contamination Adjacent to the Site 17
7.5 Potential Pathways 17
7.6 Receptors 18

8. Risk Assessment – Human Health 20

8.1 Introduction 20
8.2 UK Framework 20
8.3 Results of Tier 1 Assessment 21
8.3.1 Former Landfill Area 21
8.3.2 Remaining Site Area 24
8.4 Asbestos 24
8.5 Summary of Tier 1 Semi Quantitative Assessment 25
8.5.1 Former Landfill Area 25
8.5.2 Remaining Site Area 25
8.6 Detailed Quantitative Risk Assessment 26

9. Risks to Controlled Waters 28

9.1 Introduction 28
9.2 Site Hydrogeology 28
9.3 Laboratory Analysis 28
9.3.1 Leachate 28
9.3.2 Groundwater 29
9.4 Controlled Waters Summary 31

10. Risks to Building, Structures, Services and Landscaping 32

10.1 Risk to Buildings and Structures 32
10.2 Risks to Services 33
10.3 Risks to Landscaping 33

11. Ground Gas Risk Assessment 34

11.1.1 Sources and Pathways 34
11.1.2 Receptors 34
11.1.3 Gas Assessment 34
11.1.4 Summary 36

12. Waste Classification 37

12.1 Introduction 37
12.2 Waste Acceptance Criteria Testing 37

13. Geotechnical Assessment 38

13.1 Introduction 38
13.2 Geotechnical Hazard Summary 38
13.3 Foundations 39

13.4 Floor Slabs 41
13.5 Trees 41
13.6 Access Roads and Car Parks 41
13.7 Excavations and Dewatering 41
13.8 Drainage 42

14. Conclusions and Recommendations 43

14.1 Conclusions 43
14.1.1 Introduction 43
14.1.2 Ground Conditions 43
14.1.3 Environmental Results 43
14.1.4 Geotechnical Results 44
14.2 Recommendations 44

15. Bibliography 46

Figure 1 Proposed Development Layout
Figure 2 Exploratory Hole Location Plan
Figure 3 Drawing showing approximate location of former landfill

Appendix A GEA Report
Appendix B Geotechnics Factual Report
Appendix C Detailed Quantitative Risk Assessment

Document history and status

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1. Introduction

Sinclair Knight Merz was commissioned by Laing O'Rourke Northern Limited to undertake a geo-environmental investigation for a proposed new Co-operative Academy at Plant Hill High School, Higher Blackley, Manchester (the 'Site'). The purpose of the investigation was to provide information on the contaminative status of the site and to provide data in order to enable geotechnical design. The investigation forms part of the Manchester Building Schools for the Future (BSF) scheme.

The conclusions drawn from this report are based on the following information:

- Review of Desk Top Study by MCC and previous site investigation report undertaken by Geotechnical & Environmental Associates (GEA) (dated February 2007) provided by Laing O'Rourke.
- Review of geological and hydrogeological maps.
- Site walkover survey by an SKM Geo-Environmental Engineer.
- Intrusive investigation by Geotechnics in May 2008 on behalf of Laing O'Rourke.

The conclusions drawn from this report are based upon information obtained from the above sources, analysis of soil and water samples and ground gas monitoring from exploratory locations at the site. However, SKM draw all parties' attention to the fact that the reliance of the conclusions are based on the accuracy of the above information sources and that ground conditions and contamination between these points may vary from the values reported in this investigation.

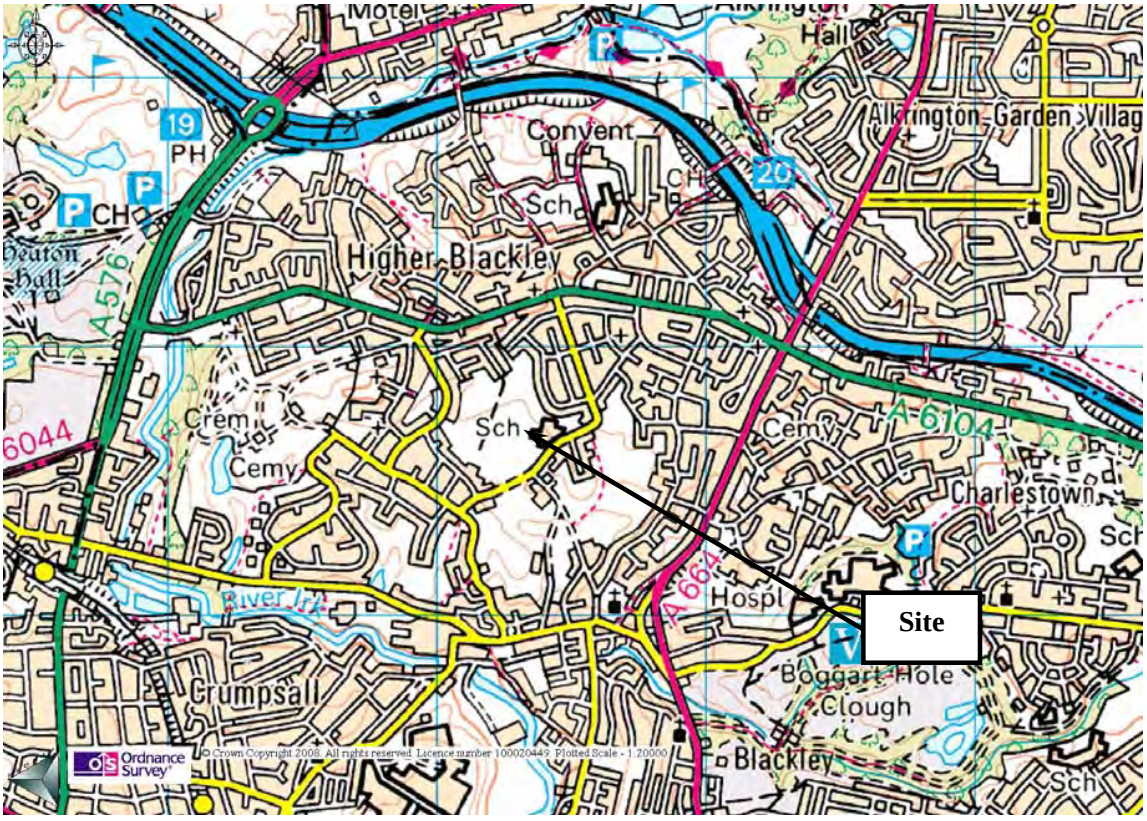
The range of potential contaminants for which tests have been undertaken are clearly set out in this report and SKM draw all parties' attention to the fact that other potential contaminants may be present that have not been specifically tested for. Reliance on the findings of this report must be limited accordingly.

This report has been produced for Laing O'Rourke Northern Limited. We confirm to all parties that we have exercised all the reasonable skill and care normally expected of environmental consultants in undertaking this commission. SKM draw attention to all parties that there may have been activities undertaken at the site that have not been recorded, and that reliance on the findings of this report must be limited accordingly.

2. Site Description and Proposed Development

The site is located approximately 6km north of Manchester City centre at National Grid Reference (NGR) 385400, 403700 and occupies an area of approximately 5 hectares. The site location is shown in **Figure 2-1**, below.

- **Figure 2-1 Site Location**



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2.1 Site Description

The site description is based on desk top information and a site walkover completed in conjunction with the site investigation works.

The site is bound by:

- Residential housing and recreational land to the north.
- Plant Hill Road, beyond which lies residential housing and Plant Hill Park to the east.
- Recreational land, beyond which lies residential housing to the west.
- Plant Hill Road (beyond which lies residential housing) and recreational land to the south.

The site currently comprises a complex of largely interconnected, two to three storey, pre-fabricated school buildings located within the central and eastern parts of the site. A sports hall, of relatively recent construction, is located to the north east of the school buildings. The western half of the site is occupied by playing fields and a tarmacadam sports pitch / tennis courts. Access to the site is via a driveway off Plant Hill Road at the eastern end of the site and also via an entrance to the main car park at the frontage of the school buildings. An Adult Learning Centre and caretaker's residence are also present at the eastern end of the site.

The topography of the site falls from the north east corner towards the south west, with an overall drop of approximately 11m across the site.

2.1 Proposed Development

Current development proposals for the site comprise the construction of a new 2-3 storey school building within the central area of the site and subsequent demolition of the existing school building. A further new inclusion unit, to be located adjacent to the northeast corner of the new school building is also proposed. It is understood that the Sports Hall and Adult Education Centre are to be retained. The new school building will include flexible learning zones, standard classrooms for various departments, catering facilities, an assembly hall, administration and a post-16 facility amongst other accommodation required by Manchester City Council's brief. Provision has also been made for three new sports pitches, car parking areas and soft landscaping.

It is understood that estimated column working loads for the structure are 1300kN for internal columns and 1000kN for external columns.

Proposed development plans are presented as **Figure 1**.

3. Objectives and Scope of Investigation

3.1 Objectives

The objectives of the investigation are as follows:

- To review the environmental setting of the site, including the geology, hydrogeology and hydrology and site history, from the MCC Desk Top Study and GEA reports and published data.
- To assess the results of the chemical data from the SKM and GEA investigation in order to assess the risk to site end users and controlled waters.
- To review the geotechnical data from the investigation in order to assess the ground conditions and make recommendations with regards to appropriate foundation types and founding depths.

3.2 Scope of Investigation

The scope of the investigation included the following:

- Review of desk top study report undertaken by Manchester City Council.
- Review of previous site investigation report by GEA.
- Review of geological and hydrogeological maps.
- Site walkover survey by an SKM Geo-Environmental Engineer.
- Intrusive investigation by Geotechnics in May 2008 on behalf of Laing O'Rourke.

4. Desk Top Review

4.1 Site History

The site history has been summarised based on the Desk Top Study undertaken by MCC and historical Ordnance Survey maps provided by Laing O'Rourke.

A review of the historical information has indicated that the site remained undeveloped, comprising open farmland until the late 1950's / early 1960's, when Plant Hill School was developed. At the same time, a number of refuse tips were indicated immediately adjacent to and encroaching the western parts of the site, which were later infilled. With the exception of the construction of a new sports hall in the northern part of the site around 1999, little other changes have been noted to the site.

The surrounding area has generally been developed as residential housing. An engineering works was present to the south of the site immediately beyond Plant Hill Road in the latter part of the 20th century.

4.2 Environmental Context

4.3 Geology

Geology on the site was interpreted from the 1:50,000 *British Geological Survey Map (Sheet 85 Manchester* and information presented within the MCC Desk Top Study report. The drift geology beneath the site comprises Glacial Till (Boulder Clay). The Glacial Till is noted as being approximately 5m in thickness in the area of the site, overlying Glacial Sands up to 5m in thickness.

Solid geology beneath the site comprises Sherwood Sandstone (formerly known as Bunter Sandstone) of Permo-Triassic age. A geological fault lies approximately 300m to the south of site, trending northwest - southeast and downthrows to the northeast. To the southwest of the fault lies the Manchester Marl Formation.

A Coal Authority report obtained as part of the desk study report indicated that the site is not within the zone of likely physical influence on the surface from past, present or proposed future underground coal workings.

The previous GEA ground investigation recorded Made Ground up to 7.5m in thickness in the western and northern areas of the site, associated with the former refuse tips. Glacial deposits were identified beneath and Made Ground and from near ground level in the remaining areas, these were noted as comprising stiff sandy clays interbedded with horizons of sand. The GEA report is presented in **Appendix A**.

4.4 Hydrogeology

The Sherwood Sandstone Formation underlying the site is classified as a Major Aquifer by the Environment Agency. Major aquifers are defined as highly permeable formations usually with a

known or probable presence of significant fracturing. Major aquifers may be highly productive and able to support large abstractions for public water supply and other purposes.

The site is not classified by the Environment Agency as lying within a Source Protection Zone (SPZ).

4.5 Leaching Potential of Soil

The leaching potential of the soil has not been classified by the Soil Survey of England and Wales, and therefore the worst case scenario of high leaching potential must be assumed for the site.

4.6 Hydrology

The nearest surface water feature to the site is a small tributary of the River Irk, located approximately 110m to the south east of the site. The River Irk itself is located approximately 750m south of the site boundary. No fluvial flood risk at the site is noted on EA flood maps.

A separate detailed Flood Risk Assessment (FRA) has been undertaken by SKM (Report No.NE12105fin-rep-FRA)

4.7 Regulatory Information

A summary of the regulatory information provided within the Desk Top Study by MCC and Envirocheck report is provided below:

- With reference to the Envirocheck report, the nearest landfill site is noted as being a registered facility (operated by the Department of Transport), located 866m to the northwest of the site. It should be noted however that historical evidence and previous site investigation has highlighted the presence of the former refuse tips in the western area of the site.
- The nearest groundwater abstraction point is reported as being located 878m to the southwest of the site. The abstraction is noted as being operated by Avecia Ltd, for general cooling purposes. A further two abstraction points are recorded within 1km of the site.
- The Envirocheck report describes twelve consents for discharge between 500m and 1km of the site.
- No pollution incidents are recorded within 500m of the site.
- There are two active contemporary trade directory entries between 250m and 500m of the site and a further twenty six between 500m to 1km described in the Envirocheck report.
- There are no fuel station entries recorded within 500m of the site.
- No Air Pollution Control enforcements are noted within 500m of the site; however three are listed as being located between 500m and km of the site.

5. Site Investigation Methodology

5.1 Introduction

The site investigation was undertaken between 29th and 30th May 2008. The sampling locations are presented on **Figure 2** and the exploratory logs are included in **Appendix B**.

5.2 Scope of Works

The site investigation works were undertaken by Geotechnics Ltd, and were designed and supervised by SKM. The investigation consisted of the following:

- 3 no. cable percussion boreholes (BH1-BH3),
- 19 no. window sampling probeholes (WS1- WS19),
- A suite of chemical analyses in order to assess the contaminative status of the shallow geology and groundwater,
- Undertake in-situ and laboratory analysis for geotechnical purposes,
- Undertake in-situ permeability testing,
- A programme of gas and groundwater monitoring.

5.3 Rationale for Exploratory Hole Positions

The cable percussive boreholes were positioned in order to provide representative information to aid geotechnical design of the proposed new school building. The probehole locations were positioned to further assess the extent of the former landfill in the western area of the site and also to provide further, general coverage of the site.

The rationale considered the work previously undertaken by GEA in their earlier investigation.

5.4 Chemical Analysis

A total of 41 no. soil samples, were submitted for the following chemical analysis suites as part of the investigation:

- **Table 5-1 Chemical testing on soils**

Test Description
Metals including arsenic, boron, cadmium, chromium (total and hexavalent), copper, mercury, nickel, lead, selenium and zinc
Total and free cyanide
Sulphide, elemental sulphur and total sulphate
Phenols
pH
Speciated Total Petroleum Hydrocarbons (TPH) including Benzene, Toluene, Ethylbenzene and Xylenes and Methyl-tertiary-Butyl-Ether

Test Description
Speciated Polycyclic Aromatic Hydrocarbons (PAH)
Volatile and Semi-Volatile Hydrocarbons (VOC's and SVOC's)
Asbestos fibre screening
Leachability analysis
Waste Acceptance Criteria testing

The chemical analytical results are presented in the Geotechnics factual report in **Appendix B**.

5.5 Geotechnical Testing (laboratory)

The following geotechnical testing was undertaken by the approved laboratory during the investigation:

- **Table 5-2 Geotechnical testing on soils**

BS 1377 (1990) Test Number	Test Description
Part 2	
3.2	Moisture Content Determination
4.3 and 5.3	Liquid and Plastic Limit Determination (Atterberg Limits)
9.2 and 9.3	Particle Size Distribution - Sieving
9.4	Particle Size Distribution - Sedimentation
Part 3	
5.3 and 5.5	2:1 Water Extractable Sulphate Determination
9.5	pH Determination
Part 4	
3.3	Optimum Moisture Content / Dry Density Determination using 2.5 kg rammer for soils with particles up to medium-gravel size
7	Determination of the California Bearing Ratio (CBR)
Part 5	
3	Determination of the one-dimensional consolidation properties
Part 7	
9	Determination of the undrained shear strength in triaxial compression with multistage loading and without measurement of pore pressure

In addition pH and sulphate testing was undertaken as part of the chemical testing suite for contaminated land assessment purposes to enable the mix design requirements for buried concrete to be determined.

The geotechnical testing results are presented in the Geotechnics factual report in **Appendix B**.

5.6 Geotechnical Testing (In-situ)

Soils encountered within the exploratory holes were also subjected to in-situ geotechnical testing as outlined below:

- **Table 5-3 In-situ Geotechnical analysis**

Document Reference	Test Number / Section	Test Description
BS: 1377-9 (1990)	3.3	Standard Penetration Test (SPT)

The SPT results are presented on the relevant exploratory hole logs in **Appendix B** and have been used to finalise relative density descriptions for the granular deposits.

6. Summary of Ground Conditions and Geotechnical Parameters

6.1 Generalised Stratigraphy

The stratigraphy encountered during the SKM intrusive investigation is summarised in **Table 6-1** below.

- **Table 6-1 Summary of Ground Conditions**

Stratum	General Description	Encountered Depths (m bgl)			
		Top		Base	
		Min	Max	Min	Max
Made Ground (Topsoil)	Topsoil described as gravelly, clayey, silty sand was noted as present at the ground surface at locations WS2, WS15, WS17 (outside the area of the former landfill).	0.0	0.0	0.20	0.70
Made Ground (reworked sands & clays)	Clayey, gravelly fine to coarse sands and sandy, gravelly clays with gravels consisting of brick, concrete, glass, clinker, sandstone and coal.	0.0	0.0	0.20	2.00
Made Ground (potential landfill material)	Occasionally clayey, gravelly sands and sandy gravels (with gravels consisting of brick, coal, clinker, ceramic, glass, metal, plastic, paper and timber) were encountered at a number of exploratory locations within the western area of the site including WS3-WS6A, WS8, WS10, WS16 and WS18.	0.0	0.20	0.90	>5.00
Glacial Deposits	Very soft to very stiff slightly sandy gravelly CLAYS interbedded with horizons of loose to dense slightly gravelly occasionally silty and /or clayey SANDS. A firm to very stiff sandy SILT was recorded at BH3.	0.0	>5.00	>20.45	>20.45

The main body of the landfill is inferred from BH logs to lie to the west of WS4, WS16, WS7, and WS8 and to the south of WS18 and WS10. In these areas Made Ground thickens from around 1m to >5m thick (the GEA report indicates Made Ground is 7.5m thick on site). **Figure 3** shows the inferred boundary of the landfill based on the SKM and GEA investigations.

6.2 Geotechnical Parameters

The geotechnical parameters for the geological sequences described in this report are summarised below. These parameters were derived from laboratory geotechnical testing and from published literature.

- **Table 6-2 Geotechnical Parameter Summary Table**

Parameter	Unit	Strata		
		Made Ground	Glacial Sands	Glacial Clays
Natural Moisture Content	%	-	-	12 - 33
Plastic Limit	%	-	-	11 - 19
Liquid Limit	%	-	-	21 - 36
Plasticity Index	%	-	-	8 - 18
CBR Value	%	19	-	
Optimum Moisture Content	%	15	9.8	12
Maximum Dry Density	Mg/m^3	1.84	1.93	1.93
Moisture Differential	%	-	-	-
Shear Strength	kN/m^2	-	-	29 - 74

6.2.1 Moisture Conditions

Twenty samples of the Glacial Clays / Silts were analysed for natural moisture content and Atterberg limits.

Using the moisture classification test given in **Table 6-2** the cohesive materials tested were generally assessed as being clays of “Low” plasticity.

The plasticity indices obtained indicates that these clays generally have a corresponding “low volume change potential” in accordance with the NHBC Standards Chapter 4.2 “Building Near Trees”.

6.2.2 Dry Density / Moisture Content Relationship

Single samples of the Made Ground, Glacial Clay and Glacial Sand were tested for their Dry Density / Moisture Content Relationship to help with compaction assessments.

The Made Ground indicated a dry density value of $1.84Mg/m^3$ with an optimum moisture content of 15% compared to its natural moisture content of 21%.

The Glacial Clay indicated a dry density value of $1.93\ Mg/m^3$ with an optimum moisture content of 12% compared to its natural moisture content of 16%.

The Glacial Sand indicated a dry density value of $1.93Mg/m^3$ with an optimum moisture content of 9.8% compared to its natural moisture content of 25%.

6.2.3 Particle Size Distribution (PSD)

Six samples of the material described as sand and three of silt were selected for particle size distribution analysis, by wet sieving methods.

The results indicated two of the samples described as sand were predominantly silt. With this exception, the testing generally confirmed the sample descriptions and indicate medium to poorly graded slightly silty sands with some occasional gravel. The tests undertaken on silt samples confirmed the sample descriptions and indicated a medium graded slightly clayey sandy silt. The granular descriptions on the draft driller's logs have subsequently been amended where necessary.

6.2.4 Quick Undrained Triaxial

Six undisturbed samples of clay retrieved during the investigation were subjected to quick undrained triaxial testing to determine their shear strength by multi stage test. One of the tests failed due the integrity of the sample.

The five remaining tests resulted in undrained shear strengths (c_u) of between 29kN/m^2 (soft) and 74kN/m^2 (firm). The Glacial Clay strength descriptions on the draft driller's logs have subsequently been amended where necessary.

6.2.5 Coefficient of Consolidation & Compressibility

Undisturbed samples of material were tested by one dimensional consolidation for their coefficient of volume compressibility (m_v) and coefficient of consolidation (c_v).

To allow for an assessment of the consolidation to take place it is assumed that the foundations will be designed to impose no more than 150kN/m^2 and therefore under the expected loading conditions the representative samples tested exhibit the following m_v and c_v values:

Table 6-3 Summary of Coefficient of Consolidation Properties

Sample	m_v (m^2/MN)	c_{v50} (m^2/yr)	c_{v90} (m^2/yr)
BH1 (3.00 – 3.45m)	0.13	2.38	9.49
BH1 (5.00 – 5.45m)	0.11	1.76	7.49
BH2 (2.00 – 2.65m)	0.04	-	-
BH2 (6.50 – 6.95m)	0.22	3.16	13.08
BH2 (11.00 – 11.45m)	0.18	-	-
BH3 (7.00 – 7.45m)	0.22	-	-

These results indicate the clay to be of very low to medium compressibility.

6.2.6 California Bearing Ratio (CBR)

Two samples of the Made Ground have been subjected to CBR analysis. These gave CBR values of 1.9 and 3.5%.

6.2.7 In Situ Testing (SPT)

In situ SPT testing was undertaken within the made ground, sand, clay and silt deposits. The results are displayed in the **Table 6-4** below.

- **Table 6-4 Summary of SPT 'N' Values for each strata**

Strata	No of tests	Range of values	Average value* 'N'	Lower Quartile 'N'
Made Ground	2	3 to 8	5.5	-
Sand	17	9 to >50	29.88	19
Clay	17	8 to >50	29.29	18
Silt	9	7 to 36	21.67	15

N = 50 taken as max value

Overall the results suggest the sand would classify as medium dense whilst silt and clay would classify as high strength. However, the sand, silt and clay all typically display a profile of lower 'N' values closer to ground level that increase with depth.

6.3 Comparison with Previous Ground Investigation

The results from the geotechnical laboratory testing reported by GEA [1] have also been reviewed. In general, the testing produced similar results when compared against the findings from the recent ground investigation, with the following exceptions:

- A single sample of Glacial Clay produced a slightly lower moisture content value of 11%,
- Two sample of Glacial Clay produced slightly higher Liquid Limit values of 37 and 38%,
- Three samples of glacial clay produced slightly higher plastic limit values of 20, 21 and 23%,
- Three single stage undrained triaxial tests indicated higher undrained shear strength values of 163, 354, 84 kN/m^2.

No compaction, CBR or consolidation testing was scheduled by GEA.

SPT 'N' values obtained during the GEA investigation are shown in the below table

- **Table 6-5 Summary of SPT 'N' Values for each strata (GEA report)**

Strata	No of tests	Range of values	Average value* 'N'	Lower Quartile 'N'
Made Ground	16	0 to 14	5.94	3.00
Sand	32	4 to 34	16.47	12.00
Clay	58	0 to >50	19.05	12.25
Silt	No testing undertaken			

N = 50 taken as max value

[1] GEA, Plant Hill High School, Ground Investigation Report, February 2007.

Overall this suggests the GEA investigation produced a slightly higher strength value for the Made Ground and lower strength values for the Glacial Clay and sand.

The GEA report suggests groundwater was encountered in a number of exploratory holes generally within to the Made Ground and sand layers within the Glacial Till. This is consistent with the findings of the recent ground investigation.

6.4 Groundwater

Groundwater strikes were recorded in boreholes BH2 and BH3 during the investigation:

Groundwater monitoring wells were installed in all cable percussive boreholes and one of the window sample probeholes as part of the investigation. In addition the GEA investigation also included a number of combined gas / groundwater monitoring installations which where possible were monitored as part of the SKM investigation. A number of the GEA monitoring installations could not be located or had been destroyed. Groundwater monitoring of the installed exploratory holes has been undertaken eight times over a 3 month period, in conjunction with the gas monitoring. Groundwater samples have been retrieved as part of the investigation.

A summary of the hydrogeological conditions encountered are presented below in **Table 6-6**.

Table 6-6 Summary of Hydrogeological Conditions

Exploratory location	Screened Unit	Groundwater Strike Depth (m)	Standing water Levels (m bgl)
BH1	Glacial Sand	-	15-15.16
BH2	Glacial Clay	16.90 19.50	13.24-13.45
BH3	Glacial Sand	1.6 3.2 9.9 14.8	8.85-10
WS1	Glacial Clay	Not encountered	1.88-3.45
WS4 (GEA)	Glacial Clay / Sand	Not encountered	1.83-3.04
WS16 (GEA)	Response zone not annotated on log	Not encountered	2.15-2.36
WS19 (GEA)	Response zone not annotated on log	2.6m	0.93-1.64

Notes

"-" groundwater not encountered

Groundwater monitoring results are presented in **Appendix B**.

Groundwater strikes were recorded in the Glacial Sand and Clay deposits. Groundwater monitoring has recorded standing water within each of the borehole installations with depths ranging between 0.10m and 6.90m bgl recorded to date. This supports the findings of the GEA report, standing groundwater levels were given as lying between 0.5mbgl (WS13) to 7mbgl (WS1).

The prevalence of impermeable Glacial Clay and permeable sands across the site is likely to result in discrete groundwater flow pathways in the sands. The site hydrogeology is considered to consist of localised, discontinuously perched groundwater within the Glacial Deposits.

7. Qualitative Environmental Risk Assessment

7.1 UK Framework

Part IIA of the Environmental Protection Act (EPA) 1990 governs current UK contaminated land legislation. This was retrospectively inserted by Section 57 of the Environment Act 1995.

The Environmental Protection Act introduces the concept of ensuring contaminated sites are "suitable for use" and where necessary remedial action is undertaken where unacceptable risks to human health or the environment are identified, taking in to account the use of the land and environmental setting of the site.

The legislation provides a definition of contaminated land as; "any land which appears to the Local Authority in whose area it is situated to be in a condition, by reason of substances in, on or under the land, that -

1. ***significant harm*** is being caused or there is a ***significant possibility*** of such harm being caused, or

2. ***significant*** pollution of controlled waters is being, or is likely to be caused

In order to determine whether significant harm is being caused a pollutant linkage must be established using a source-pathway receptor model. The model comprises the following elements:

- **Source** – the main pollutant hazard / hazards associated with the site
- **Pathway** – the way in which the contaminant reaches the receptor
- **Receptor** – the key target at risk from the source

In order for a risk to be realised there needs to be a contaminant capable of causing harm, a pathway and a receptor sensitive to the contaminant.

7.2 Risk Assessment Approach

There are two types of risk assessment, these being (1) qualitative and (2) quantitative. A qualitative assessment determines the potential risk through development of the source-pathway-receptor model, a risk cannot be realised unless a plausible pollutant pathway exists.

Various levels of quantitative risk assessment may be undertaken including

1) The comparison of land quality data with appropriate assessment criteria (often referred to as 'Tier 1' screening values and incorporating CLEA Soil Guideline Values).
2) The derivation of site-specific assessment criteria using appropriate risk assessment modelling tools

A 'Tier 1 & 2' risk assessment has been carried out; risk assessment criteria are discussed in further detail with the relevant sections.

In order to begin to evaluate the risk of potential contaminants to the environment and human health the source, pathway and receptor linkages need to be established. The conceptual model presented here is based upon assumptions made from the available desk study information and the intrusive site investigations.

7.3 Potential Sources of Contamination Identified at the Site

The desk study has indicated that the site was initially developed in the early 1960's as Plant Hill School. At the same time, refuse tips were present adjacent to and encroaching the western area of the site.

The primary potential source of contamination at the site is considered to be the former landfill / refuse tips. Landfill materials can potentially contain a wide range of contaminants including heavy metals, hydrocarbons, Volatile and Semi-volatile Organic Compounds and PAH's and also present a significant potential source of hazardous ground gases.

Further potential sources of contamination may include Made Ground materials associated with the construction of buildings at the site. Made Ground may include a wide range of contaminants including heavy metals, asbestos, Polycyclic Aromatic Hydrocarbons (PAH) and also hazardous ground gases.

Any fuel oil stored at the site associated with central heating systems may also present a further potential source of hydrocarbon contamination; however no visual indications of fuel storage were apparent during the site inspection.

7.4 Potential Sources of Contamination Adjacent to the Site

Surrounding existing land use includes the following potential sources of contamination all of which lie within 250m of the site:

- Landfill site
- Engineering Works

7.5 Potential Pathways

Potential pathways for which contamination may cause a risk to specific receptors include:

Human Health:

- Inhalation of soils through dust
- Ingestion of soil through handling
- Dermal absorption through handling
- Inhalation of vapours from soils and / or groundwater

Environmental:

- Lateral movement of perched groundwater and ground gas.
- Migration of groundwater from the site contributing to contamination of surrounding soils and surface waters and groundwater users.

7.6 Receptors

Potential on and off site receptors include:

- **Human Health**

– **Site users which may include the general public.** Indoor inhalation of vapours and gases is a risk for site users. Outdoor inhalation of vapours and dust is also a risk for site users. There may also be some potential for ingestion or dermal exposure to soils, within landscaped areas and playing fields.

– **Adjacent properties / workers.** These receptors are potentially at risk from migration of airborne contaminants and migration of contamination and ground gases through Made Ground.

– **Construction Workers**. Outdoor inhalation of vapours and dust is a risk for construction workers. Level of exposure is potentially greater than other groups but over a greatly reduced exposure period.

- **Controlled Waters**:

– **Sherwood Sandstone Formation (Major Aquifer).** The site is underlain by the Sherwood Sandstone Formation which is classified as a Major Aquifer. Any Made Ground or contaminated landfill materials at the site may present a potential risk of leachable contamination migrating downwards into the major aquifer. However, the presence of the overlying low permeability Glacial Drift deposits will afford a considerable degree of protection to the aquifer, the GEA report states that these deposits are approximately 40m thick.

– **Surface water (River Irk tributary)**. The nearest surface water feature is located 110m to the south east of the site. Given the laterally discontinuous and perched nature of groundwater at the site it is considered unlikely that the river is in direct hydraulic connection with groundwater at the site.

– **Building Materials / Structures.**

– Materials may absorb potential contaminants or potential contaminants may degrade materials both stored on-site or in-situ.

- **Landscaping**

– Potential plant uptake of toxic contaminants may inhibit the growth of certain plant species, advance bioaccumulation and damage the ecosystem of the area.

Table 7-1 provides a summary of the potential source-pathway-receptor linkages.

Table 7-1 Conceptual Model Used for On-site Risk Management

Receptor	Pathway	Soil	Leachate	Gas	Surface Water
Human Health	Dermal contact with soil by site users	✓			
	Ingestion / inhalation of contaminated soil by site users	✓			
	Ingestion / inhalation by construction / maintenance workers	✓			
	Soil gases enter structure			✓	
Controlled Waters	Leachate entering shallow groundwater		✓		
	Surface water run-off into nearby watercourse		X		
	Contaminated groundwater and / or leachate migrating in to nearby surface waters		X		
Building Materials	Contact with contaminated soil and or leachate	✓	✓		
Landscaping	Plant uptake	✓			

8. Risk Assessment – Human Health

8.1 Introduction

A qualitative risk assessment has been undertaken for the site for those contaminants where generic risk assessment criteria exist. The chemical analytical data from soil and groundwater samples are assessed including where appropriate statistical analysis in accordance with current UK guidance.

8.2 UK Framework

DEFRA has developed the Contaminated Land Exposure Assessment (CLEA) model which is a generic quantitative model for the assessment of chronic risks to human health from contaminated soils. The model is detailed in the following reports, CLR7, CLR8, CLR9 and CLR 10 which detail the legal framework, approach to deriving the guideline values in soils and toxicological; data and guidance on identifying priority contaminants. Soil Guideline Values (SGV's) have been calculated based on four end uses these being – residential with plant uptake, residential without plant uptake, allotments and commercial / industrial for a total of ten contaminants at the present time.

This methodology is currently in the process of being revised by DEFRA and the EA:

In 2006 DEFRA published a consultation paper entitled "*Soil Guideline values: The way forward*". This was followed up in 2008 by a paper entitled "*Improvements to contaminated land guidance. Outcome of the 'way forward' exercise*". The result of this period of consultation was that DEFRA decided that the CLR reports are to be replaced with revised versions. The Environment Agency has since produced revised reports as follows:

- *Environment Agency (2008); Updated technical background to the CLEA model, Science Report SC050021/SR3.* This report updates and replaces CLR10 (2002) and CLEA Briefing Notes 1-4 (2004, 2005).
- *Environment Agency (2008); A review of body weight and height data used within the contaminated land exposure assessment model (CLEA), Project SC050021/Technical Review 1*. This document forms one of a series of proposed technical documents to support the CLEA methodology. Updated body weights and heights are given based on the revised age classes given in SC050021/SR3.
- *Environment Agency (2008); Human health toxicological assessment of contaminants in soil, science report SC050021/SR2*. This document is the replacement for the toxicological framework document CLR9.

Recommendations made in these updated reports have been considered as part of this assessment.

Where no SGV is present screening has been undertaken using the ATRISK values. These soil screening values have been calculated using RISC Workbench 4.0 (sometimes referred to as BP RISC) by virtue of the algorithms incorporated within it and because it is a scientifically robust and

peer reviewed quantitative human health risk assessment tool. The database has been modified to ensure the model was consistent with the UK approach (previous CLR methodology).

The process was subject to rigorous quality control and assurance procedures. The validity of this approach was proven by running the BP RISC 4.0 model in parallel on two computers.

A summary of the critical assumptions incorporated into the ATRISK soil guideline values, which follows a reasonable maximum exposure approach, is available upon request to provide technical backup to the use of the values

In order to begin to evaluate the risk of potential contaminants to the environment and human health the source, pathway and receptor linkages need to be established. The conceptual model presented here is based upon assumptions made from the available desk study information and the intrusive site investigation

8.3 Results of Tier 1 Assessment

The results from the soil chemical analysis from the current site investigation and previous GEA investigation have been summarised and contaminants which have recorded direct exceedances of the relevant screening criteria are shown in **Table 8-1** and **Table 8-4**. For the purposes of this assessment, the soil chemical testing data for the historical landfill area and the remaining site area have been screened separately. A drawing showing the inferred landfill boundary is presented in **Figure 3.**

The site has been assessed according to the CLEA Soil Guideline Values for a residential without plant uptake end use, as these are considered the most suitable Level 1 screening values given the final end use. In the absence of SGVs, ATRISK Values have been used.

8.3.1 Former Landfill Area

The results from the soil chemical analysis for the former landfill area encroaching on the site have been summarised and contaminants which have recorded direct exceedances of the relevant screening criteria are shown in **Table 8-1** below.

- **Table 8-1 Chemical Analysis Results Summary for Soils – Landfill Area**

Determinand	Min	Max	Relevant Guideline Value	No. of Exceedances
Arsenic	<3	180	20	12
Lead[1]	0.78	3.34	2.65	9
Mercury	0.4	41	15	1
Nickel	4.9	150	75	8
Sulphate	100	5300	2400^	3
PH (pH units)	6.21	10.83	5-9^	2
TPH Aliphatic C12-C16	0.005	67	20*	1
TPH Aromatic C21-C35	0.041	1300	422*	1

Determinand	Min	Max	Relevant Guideline Value	No. of Exceedances
Benz(a)anthracene	0.02	22	8.47*	1
Benzo(a)pyrene	0.012	23	0.85*	5
Benzo(b)fluoranthene	0.016	25	8.47*	2
Dibenzo(ah)anthracene	0.008	4	0.85*	2
Naphthalene	0.01	17	4.4*	1

Concentrations are measured in mg/kg unless otherwise noted.

1 – Values indicated are logarithmic as described in methodology presented in CLEA R&D Publication CLR10.

No Asterisk – CLEA Soil Guideline Value – residential without plant uptake end use.

** ATRISK Soil values. It should be noted that the ATRISK screening values may over or underestimate risk based on the depth of the contaminant.*

^ Professional judgement based on previous guideline values.

As indicated above, exceedances of the Tier I guidelines have been recorded for a number of heavy metals, hydrocarbons and PAH's. In addition a small number of elevated concentrations of VOC's and SVOC's have been recorded which do not have screening criteria. Elevated pH and Sulphate are primarily a risk to buildings and structures. Recommendations regarding risks to buildings, structures, services and landscaping are included within **Section 10.0**.

8.3.1.1 Statistical Analysis – Maximum Value Test

The maximum value test as set out in CLR 7 is used to determine whether the maximum value in any data set can be considered to be from the same population as the rest of the results or can be classified as a statistical outlier. The test was applied to samples tested with concentrations that exceeded the generic soil acceptance criteria.

Where maximum value tests have identified the presence of an outlier, additional iterations were undertaken until all outliers were identified. A summary of outliers in excess of the Tier 1 screening guidelines is given in **Table 8-2** below.

- **Table 8-2 Summary of Outliers**

Location	Depth (mbgl)	Contaminant	Relevant Guideline Value (mg/kg)	Concentration (mg/kg)
WS1 (GEA)	6.6	Mercury	15	41
WS18	0.3-1.0	Nickel	75	150

Concentrations are measured in mg/kg unless otherwise noted.

8.3.1.2 Statistical Analysis – Mean Value Test

In accordance with the guidance in CLR 7, where more than one direct exceedance of the relevant screening criteria is identified, the mean value test has been carried out. The mean value test is a

statistical test, which provides a given level of confidence (95%) that the population mean is less than the appropriate screening level. As this test is a function of the variation within the data set, the number of data points and the data set mean value it affords a more appropriate assessment of the data.

As discussed above, where outliers in the dataset have been identified they have been removed prior to the mean test being undertaken.

The results are summarised in **Table 8-3** below:

- **Table 8-3 Mean Value Test Results**

Determinand	Relevant Guideline Value	US 95 value	Exceedance of Guideline Value (Y/ N)
Arsenic	20	68.8	Y
Lead[1]	2.65	2.49	N
Mercury	15	5.16	N
Nickel	75	66.3	N
TPH Aliphatic C12-C16	20*	16.5	N
TPH Aromatic C21-C35	422*	313	N
Benz(a)anthracene	8.47*	4.88	N
Benzo(a)pyrene	0.85*	5.07	Y
Benzo(b)fluoranthene	8.47*	5.61	N
Dibenzo(ah)anthracene	0.85*	0.934	Y
Naphthalene	4.4*	3.54	N

Concentrations are measured in mg/kg unless otherwise noted.

1 – Values indicated are logarithmic as described in methodology presented in CLEA R&D Publication CLR10.

No Asterisk – CLEA Soil Guideline Value – residential without plant uptake end use.

** ATRISK Soil values*

The results in **Table 8-3** show that the US95 values for Arsenic, Benzo(a)pyrene and Dibenzo(ah)anthracene exceed the Tier 1 screening values.

The following contaminants were detected, but were not screened (due to the absence of a suitable Tier 1 screening guideline): dibenzofuran, carbazole, chloromethane, 2-methylnaphthalene, bis (2-ethyl-hexyl) phthalate, tetrachloroethene.

8.3.2 Remaining Site Area

The results from the soil chemical analysis have been summarised and contaminants which have recorded direct exceedances of the relevant screening criteria are shown in **Table 8-4** below.

- **Table 8-4 Chemical Analysis Results Summary for Soils – Remaining Site Area**

Determinand	Min	Max	Relevant Guideline Value	No. of Exceedances
Arsenic	<3	82	20	3
Benzo(a)pyrene	0.012	2.4	0.85*	2
Chloromethane	0.022	0.022	No Tier 1 Screening Value Available	-
Tetrachloroethene	0.002	0.008	No Tier 1 Screening Value Available	-

Concentrations are measured in mg/kg unless otherwise noted.

No Asterisk – CLEA Soil Guideline Value – residential without plant uptake end use.

** ATRISK Soil values. It should be noted that the ATRISK screening values may over or underestimate risk based on the depth of the contaminant.*

^ Professional judgement based on previous guideline values.

8.3.2.1 Statistical Analysis – Maximum Value Test

No outliers were noted within any of the datasets which recorded elevated contaminants.

8.3.2.2 Statistical Analysis – Mean Value Test

As previously discussed, where outliers in the dataset have been identified they have been removed prior to the mean test being undertaken.

The results are summarised in **Table 8-5** below:

- **Table 8-5 Mean Value Test Results**

Determinand	Relevant Guideline Value	US 95 value	Exceedance of Guideline Value (Y/ N)
Arsenic	20	15.7	N
Benzo(a)pyrene	0.85*	0.54	N

Concentrations are measured in mg/kg unless otherwise noted.

No Asterisk – CLEA Soil Guideline Value – residential without plant uptake end use.

** ATRISK Soil values*

The results in **Table 8-5** show that the US95 value for Arsenic and Benzo(a)pyrene do not exceed the Tier 1 screening value.

8.4 Asbestos

Testing for the presence of asbestos fibres has been undertaken due to the fact that asbestos can irreparably damage the human respirator system. No visual evidence of asbestos products or fibres was recorded in any of the exploratory locations. Fourteen samples were tested for the presence of asbestos fibres, none of which returned a positive result. It is noted however that a positive identification for asbestos was recorded as part of the previous GEA investigation. This was recorded within the Made Ground at location WS09 at a depth of 0.9m within the area of the

former landfill in the western part of the site. The laboratory reports this as cement sheet therefore this is anticipated to be an isolated fragment of asbestos.

8.5 Summary of Tier 1 Semi Quantitative Assessment

8.5.1 Former Landfill Area

The results of the Tier 1 assessment have indicated that the calculated mean (US95) values for the following contaminants are elevated within the former landfill area of the site:

- Arsenic
- Benzo(a)pyrene
- Dibenzo(ah)anthracene

The assessment also recorded statistical outliers or contamination 'hot spots' at two locations within the former landfill area:

- A hotspot of Mercury (41mg/kg) was identified at GEA window sample location WS1 at a depth of 6.6m. The two shallower soil results in this location did not record exceedances of the screening criteria. Therefore given the depth of the exceedance and fact that dermal contact and ingestion will not be possible this hot spot is not considered to pose a risk to human health and remedial action is not deemed necessary.
- A hotspot of Nickel (150mg/kg) was identified at WS18 from a sample taken between 0.3m to 1.0m depth. Nickel is phytotoxic and not at a concentration great enough to present a risk to site to human health.

The contaminant exceedances recorded for Arsenic, Benzo(a)pyrene and Dibenzo(ah)anthracene within the former landfill area of the site are considered to pose a potential risk to human health. Further assessment of the potential risk to human health from these contaminants is outlined within the detailed quantitative risk assessment in **Section 8.6**.

Trace concentrations of dibenzofuran, carbazole, chloromethane, 2-methylnaphthalene, bis (2-ethyl-hexyl) phthalate and tetrachloroethene were also detected, however no screening guidelines exist for these determinands and therefore detailed risk assessment will be required in order to provide appropriate screening values and hence assess the risk from these contaminants (see **Section 8.6**).

8.5.2 Remaining Site Area

The calculated mean (US95) values for contaminant concentrations across the remaining area of the site were all below the Tier 1 screening guidelines. Tetrachloroethene and chloromethane were detected above the laboratory detection limit. However no screening guidelines exist for these determinands and therefore these contaminants have been assessed within the detailed quantitative risk assessment in **Section 8.6** below.

8.6 Detailed Quantitative Risk Assessment

Given that exceedences of the generic screening guideline values were recorded for a number of contaminant species a detailed quantitative risk assessment (DQRA) was carried out by SKM so that site specific screening criteria could be generated. The DQRA is given in full in **Appendix C**.

The laboratory testing results were re-screened against the derived site specific target levels (from DQRA) to assess the nature and significance of potential risks to human health at the site. The results of the screening are given below in **Table 8-6**.

- **Table 8-6 Mean Value Test Results landfill area**

Determinand	Relevant Guideline Value	Number of exceedences	US 95 value	US 95 value exceeds?
Arsenic	227	0	68.84	N
Benzo(a)pyrene	11.5	0	5.07	N
Dibenzo(ah)anthracene	2.3	1	0.94	N
Chloromethane	0.96	0	0.027	N
Dibenzofuran	234	0	0.17	N
Bis (2-ethyl-hexyl) phthalate	1550	0	0.95	N
Tetrachloroethene	408	0	0.022	N
Carbazole	343	0	0.17	N
2-Methylnaphthalene	561	0	0.17*	N

- **Table 8-7 Mean Value Test Results non landfill area**

Determinand	Relevant Guideline Value	Number of exceedences	US 95 value	US 95 value exceeds?
Arsenic	227	0	15.73	N
Benzo(a)pyrene	11.5	0	0.54	N
Chloromethane	0.96	0	0.022*	N
Tetrachloroethene	408	0	0.008*	N

*Maximum value

Table 8-6 and **8-7** show that the US95 value for all contaminants in both the landfill and non landfill areas lies below the relevant screening threshold as derived from DQRA. The level of risk posed to human health as a result of the development going ahead is thus not likely to be significant, and remediation is unlikely to be required (on the basis of risk to human health only).

The presence of asbestos at 0.9m in location WS09 (GEA) is considered to be an isolated fragment of cement bound asbestos and unlikely to present a risk to site end users given that it is to remain at depth post construction. Furthermore given the type of materials encountered at shallow depth e.g. wire, glass, metal etc. and the requirement for the pitches to conform with Sports England standards it will be further capped with 300mm of clean material. It is considered that this will negate any potential exposure pathway and hence risk to site end users.

It is understood that the existing hard surfaced sports pitch to the north of the playing fields is to be retained and it is considered that providing the tarmaccadam hardstanding remains in-situ, no measures are considered necessary for this area with respect to human health risk mitigation.

9. Risks to Controlled Waters

9.1 Introduction

The risk to controlled waters is assessed in accordance with the recommendations within the Environment Agency (2006) '*Remedial Targets Methodology: hydrogeological risk assessment for land contamination*". This guidance outlines the framework for the evaluation of pollution risk to controlled waters in the UK, advocating a levelled approach of increasing certainty/complexity. 'Level 1' comprises comparison of either pore water concentrations in contaminated soils or groundwater against appropriate guideline values, 'Level 2' considers dilution, and 'Levels 3 and 4' consider more complex processes, including detailed quantitative hydrological or hydrogeological modelling if required.

9.2 Site Hydrogeology

Groundwater strikes were encountered within two of the cable percussive boreholes during the site investigation, although the depths of the strikes were inconsistent between the two locations. It is therefore considered that groundwater exists as perched, discontinuous systems within the Glacial drift. The GEA report suggests that the site is underlain by approximately 40m of glacial drift. Groundwater is also anticipated to lie at depth within the Sherwood Sandstone although it is considered unlikely given the thickness of the drift deposits that a hydraulic link exists.

9.3 Laboratory Analysis

Ten soils from the site were tested from the SKM site investigation in accordance with the BSEN leach test protocol. Samples were analysed for a variety of determinands related to former land use, including metals and hydrocarbons.

Five groundwater samples from the site were also analysed as part of the investigation for a similar range of determinands.

No samples were scheduled for either leachability or groundwater analysis as part of the GEA investigation.

9.3.1 Leachate

Leachate laboratory results are compared with UK Drinking Water Standards (DWSs). DWS's are mainly derived directly from European Community (EC) guideline values but some UK standards are more stringent.

DWSs are considered to be very conservative, that is, they incorporate an order of magnitude safety margin.

Leachability analysis results are presented in **Table 9-1** below.

- **Table 9-1 Leachate Laboratory Analysis Results Summary**

Determinant	Min	Max	Drinking Water Standard	No. of Exceedances
Arsenic	<0.75	4.15	10	0
Boron	<20	1100	1000	1
Cadmium	<0.22	3.25	5	0
Chromium	1	3	50	0
Copper	<1.6	12	2000	0
Lead	<0.4	3.6	25	0
Mercury	<0.01	0.03	1	0
Nickel	<1.5	7	20	0
Selenium	<1	4	10	0
Zinc	<5	140	5000	0
Total cyanide	<50	<50	50*	0
Total phenol	<350	<350	50*	8
PAH^	<0.08	0.096	0.1	1
TPH	<1	<1	10*	0
Benzene	<10	<10	1	8
Ethylbenzene	<10	<10	20*	0
Toluene	<10	<10	50*	0
Xylene	<10	<10	30*	0

Concentrations are measured in µg/l unless otherwise noted.

** Environmental Quality Standard (EQS) adopted as no UK DWS.*

^ Sum of four PAH's as stipulated in UK DWS.

Results are summarised below:

- The majority of the determinands were either below laboratory detection limits or were detected, below relevant DWS guideline concentrations.
- A single exceedance of Boron was recorded within soil leachate at WS3 at 0.4-0.6m.
- A single exceedance of Total PAH was recorded within soil leachate at WS11A at 0.1-0.4m.
- Exceedences of the guideline concentrations were recorded for Total Phenol and Benzene due to the magnitude of the detection limits.

9.3.2 Groundwater

The groundwater laboratory results are compared with UK Drinking Water Standards (DWS).

Four groundwater samples from the site were analysed as part of the current investigation. The groundwater analysis results are presented in **Table 9-2** below.

- **Table 9-2 Groundwater Laboratory Analysis Results Summary**

Determinand	Min	Max	Drinking Water Standard	No. of Exceedances
Arsenic	<0.75	11	10	1
Boron	<20	41	1000	0
Cadmium	<0.22	1.5	5	0
Chromium	1	8	50	0
Copper	<1.6	26	2000	0
Lead	<0.4	1.7	25	0
Mercury	<0.01	<0.01	1	0
Nickel	3.8	21	20	1
Selenium	<1	23	10	1
Zinc	<5	130	5000	0
Potassium	900	3300	12000	0
Sodium	8100	27000	200000	0
Chloride	11000	56000	250000	0
Ammoniacal Nitrogen	<200	13000	15*	5
Total Cyanide	<50	<50	50	0
PAH [Total]	<0.08	0.129	0.1^	1
TPH	<10	<10	10*	0
Phenol	<1	<1	30*	0
Benzene	<10	<10	1	0
Ethylbenzene	<1	<1	20*	0
Toluene	<1	46	50*	0
Xylene	<1	<1	30*	0
4-Methylphenol	<1	2	100*	0
Di-n-butyl phthalate	<1	1	8*	0
Bis-(2-ethylhexyl) phthalate	<2	2	-	-

Concentrations are measured in µg/l unless otherwise noted.

** Environmental Quality Standard (EQS) adopted as no UK DWS.*

^ Sum of four PAH's as stipulated in UK DWS

Results are summarised below:

- The majority of the determinands were either below laboratory detection limits or where detected, below relevant DWS guideline concentrations.

- Single exceedances of the guideline threshold concentrations were recorded for Arsenic (11ug/l), Nickel (21ug/l), Selenium (23ug/l) and Total PAH (0.129ug/l) within groundwater at WS1.
- Exceedances were recorded within each of the samples for Ammoniacal Nitrogen.
- Trace concentrations of Bis-(2-ethylhexyl) phthalate (for which no screening guidelines exist) were recorded within groundwater at WS1.

9.4 Controlled Waters Summary

Single exceedances of the DWS were recorded for Boron and Total PAH in samples scheduled for leachability analysis at locations WS3 and WS11A respectively. Groundwater analysis recorded exceedances of the DWS for Arsenic, Nickel, Selenium and Total PAH at location WS1.

Minor exceedances of the DWS were recorded for Arsenic, Nickel, Selenium and total PAH within groundwater at WS1. In addition all samples recorded an exceedance of the screening criteria for ammonical nitrogen.

With regards to the detected concentration of Bis(2-ethylhexyl)phthalate, the concentration recorded is well below the published EQS values for the five potentially most harmful Phthalate compounds, therefore the risk is considered to be negligible.

Although a limited number of exceedances of the DWS were also recorded for soil leachate and groundwater, given that the site is not located within a groundwater source protection zone (SPZ) and there are no groundwater abstraction points located within 1km of the site, this risk posed to groundwater is considered to be low. Furthermore, it is noted that no significant soil leachate exceedances were recorded within the landfill materials indicating the material to be of limited leaching potential. The presence of low permeability drift deposits which are recorded as being up to 40m in thickness will also afford a degree of protection to the underlying Major Aquifer.

Given the distance to the nearest surface water receptor (a stream located 110m southeast of the site) the discontinuous nature of the encountered groundwater and taking into account dilution effects, the contaminant concentrations recorded are not considered to pose a potential risk to surface waters.

10. Risks to Building, Structures, Services and Landscaping

10.1 Risk to Buildings and Structures

As part of the chemical testing program, soil samples were tested for water soluble sulphate and pH. The chemical testing results are summarised in **Table 10-1** below.

Table 10-1 Summary of Concrete Classification Determinands

Determinand	Data Range					
	Soil			Groundwater		
	Max	Min	No Tested	Max	Min	No Tested
pH Value (pH units)	8.55	6.31	56	8.83	6.64	5
Soluble Sulphate (SO4) (mg/l)	2200	20	12	73	15	5
Total Sulphate (%)	0.53	0.01	35	-	-	-

This data has been used to ascertain the appropriate concrete classification for buried concrete with reference to BRE Special Digest 1 - Concrete in Aggressive Ground (2005). In accordance with this document, the assessment has:

- Assumed 'brownfield' ground conditions, due to the historical use of the site.
- Assumed generally 'mobile' groundwater conditions, given that groundwater was encountered.
- As 'not' considered to contain pyrite.
- Where between 5 and 9 results are available then the mean of the two highest values obtained should be taken to obtain the characteristic value.
- BRE Special Digest 1 indicates that in a dataset of >10 samples the mean of the highest 20% of the results should be taken as the characteristic value.

Table 10-2 Characteristic Values of Concrete Classification Determinands

Determinand	Characteristic Value	
	Soil	Groundwater
pH Value (pH units)	6.24	6.64
Soluble Sulphate (SO4) (mg/l)	1666	73

Based on the above, it is considered that a Design Sulphate Class and Aggressive Chemical Environment for Concrete (ACEC) Classification of DS-3 and AC-3 would be appropriate for proposed buried concrete.

The above classification is based upon a conservative approach and assumes a 'worst case' scenario for the site as it encompasses the chemical data for the whole site i.e. including the former landfill area. Given that no concrete structures are proposed within this area it is considered that these values can be removed from the dataset to provide a more representative classification for the design sulphate class.

Re-assessment of the results on this basis indicates that a Design Sulphate Class and Aggressive Chemical Environment for Concrete (ACEC) Classification of DS-1 and AC-1 would be appropriate for proposed buried concrete outside the area of the landfill.

10.2 Risks to Services

Screening of the chemical analysis results according to United Utilities Contaminated Land Pipe Material Selection document was undertaken against the maximum determinand concentrations ('worse case scenario'). Exceedances of PAH against the action level of 5.0 mg/kg were recorded.

Where concentrations of chemicals within the soils exceed the United Utilities trigger and action levels, appropriate health and safety procedures should be enforced during the installation of pipes, and suitable materials for pipes that are not affected by the contaminant should be selected, for example ductile iron or copper. It should be noted that should ductile iron be selected all joints must be wrapped to avoid the rubber gasket being affected by elevated concentrations of PAH.

10.3 Risks to Landscaping

Elevated concentrations of phytotoxic contaminants have been recorded in the area of the proposed sport pitches. The chemical data from the investigation should be passed to the landscape architect for their comment.

Given the requirement for new sports pitches to conform with Sports England standards it is understood that 300mm of clean material will be imported for construction of the pitches.

11. Ground Gas Risk Assessment

11.1.1 Sources and Pathways

Material containing either biodegradable or organic content e.g. domestic refuse, peat, and coal seams have the potential to produce landfill type gases (carbon dioxide, methane and hydrogen sulphide) and the reduction of oxygen. If not appropriately monitored and managed landfill gas can give rise to flammability, toxicity and asphyxiation hazards as well as vegetation die back.

Potential sources of gas identified at the site are the Made Ground and former landfill site / refuse tip.

Made Ground or other permeable deposits may permit the migration of landfill type gases as may service trenches and other preferential pathways.

11.1.2 Receptors

Receptors at the proposed development include staff, students, general public and construction workers. The principal risk from landfill gases are to human health and buildings.

11.1.3 Gas Assessment

The following guidelines have been produced for the management or assessment of landfill gas contaminated sites:

- Wilson and Card, “Reliability and Risk in Gas Protection Design”, 1999
- CIRIA Report 149 “Protecting Development from Methane,”1995
- CIRIA Report 151 “Interpreting Measurements of Gas in Ground,” 1995
- CIRIA Report 152 “Risk Assessment for Methane and Other Gases From Ground,” 1995
- Waste Management Paper 27, Department of the Environment, “Landfill Gas”
- Waste Management Paper 26A, Department of the Environment “Landfill Completion”
- The Building Regulations, Department of the Environment, Part C2, “Site Preparation and Resistance to Contaminants”
- CIRIA Report C665 “Assessing Risks Posed by Hazardous Ground Gases to Buildings,” 2007

In order to interpret the gas regime an understanding of the gas production processes and means of emission from the ground is required. Surface emission rate is therefore considered to be the most important factor in assessing the risk that gas poses to a development.

CIRIA Report C665 “Assessing Risks Posed by Hazardous Ground Gases to Buildings” includes a table of Characteristic Situations (Table 8.5) which ranks the risks posed from gas generation and the required mitigation measures according to the risk level of the source, pathway, receptor linkage defined in the Phase I desk study. The sensitivity of the site was determined to be as follows:

- **Table 11-1 Ground Gas Sensitivity**

Site	End Use	Ground Gas Generation Potential	Sensitivity
Co-operative Academy	Tertiary Education	High due to the presence of historical landfill.	Low to moderate

The ground gas has been monitored at the borehole locations installed as part of the current investigation and three of the previous (GEA) borehole locations on eight occasions between 10th June and 18th August 2008.

The SKM gas monitoring results from the investigation is presented in **Table 11-2** below.

- **Table 11-2 Gas Monitoring Results Summary**

Borehole	Response Zone	Methane (% volume in air)	Carbon Dioxide (% volume in air)	Oxygen (% volume in air)	Hydrogen Sulphide (ppm)	Maximum Flow Rate (l/hr)	Characteristic Situation (CIRIA R149)
BH1	Glacial Clay / Sand	0.0 – 3.8	0.0 – 5.5	2.8 – 21.5	0.0	>30.0	3
BH2	Glacial Clay	0.0 – 6.0	0.0 – 12.0	0.8 – 21.3	0.0	>30.0	4
BH3	Glacial Sand	0.0 – 19.0	0.0 – 3.4	3.7 – 21.6	0.0	>30.0	4
WS1	Glacial Clay	0.0 – 17.0	1.2 – 8.1	4.2 – 19.8	0.0	0.3	2
WS4 (GEA)	Glacial Clay / Sand	0.0	3.0 – 5.6	16.0 – 19.5	0.0	0.0	2
WS16 (GEA)	Response zone not annotated on log	0.0	0.7 – 3.9	18.6 – 20.8	0.0	1.1	1
WS19 (GEA)	Response zone not annotated on log	0.0	4.4 – 9.8	11.4 – 18.6	0.0	1.9	2

Results of the gas monitoring undertaken by SKM are presented within **Appendix B**.

As part of the GEA investigation, six gas monitoring visits were undertaken. The GEA report summarised that methane was recorded in five of the probeholes (WS1, WS4, WS7, WS13 and WS19), although the only significant readings were recorded within the monitoring installations located in the main body of the landfill. A maximum concentration of 23.8% of methane was recorded at WS1 and carbon dioxide was recorded at concentrations up to 19.0% (also within the area of the former landfill). A maximum flow rate of 0.8l/hr was recorded at WS1.

11.1.4 Summary

The monitoring results recorded to date have identified a maximum methane concentration of 19.0% (BH3), a maximum carbon dioxide concentration of 12.0% by volume (BH2) and a maximum flow rate of >30.0 l/hr (BH's 1-3).

Taking the maximum methane reading of 19.0% from BH3 along with the maximum flow rate of 30.0 l/hr, the Gas Screening Value (GSV) equates to 5.7 l/hr which falls under CIRIA Characteristic Situation 4.

In accordance with CIRIA R149, Characteristic Situation 4 for commercial properties requires 3 to 4 of the following precautions with respect to ground gas:

- Reinforced concrete cast in situ floor slab (suspended, non suspended or raft),
- Proprietary gas membrane and passively ventilated or positively pressurised underfloor sub-space with monitoring facility,
- All joints and penetrations sealed,
- In ground venting wells or barriers.

It is recommended that a specialist contractor is engaged to determine the exact requirement for gas mitigation based on the proposed structure and ground gas conditions.

It is recommended that early discussions with the Local Authority are carried out in order to determine practical protective measures.

12. Waste Classification

12.1 Introduction

The Landfill Regulations (England & Wales) 2002 Ref SI 2002 No. 1559 prohibit the 'co-disposal' of hazardous and non-hazardous waste in the same landfill. A new system for the classification of waste materials has been introduced defining wastes as inert, non-hazardous and hazardous. Wastes defined as hazardous under the European Waste Catalogue (EWC) must be pre-treated prior to disposal to reduce their volume and hazard prior to landfilling. On July 16th 2005 Waste Acceptance Criteria (WAC) 'limit values' were introduced for certain parameters, which are obtained from leachability analysis.

Inert wastes may be defined by testing in accordance with BSEN 12457 Part 3 and then compared against the Waste Acceptance Criteria for inert wastes. Certain materials are automatically defined as inert for example concrete, brick and glass.

The methodology for assessing waste and the appropriate threshold values are detailed in the Environment Agency document 'Technical Guidance WM2 Hazardous Waste – Interpretation of the Definition and Classification of Hazardous Waste'

A site-specific assessment may prove that a material is suitable for the appropriate end use. However, once this material is excavated and sent for disposal the material becomes subject to waste management regulations. The two systems do not directly correlate. It should be noted that should a material be classified as hazardous once excavated it does not necessarily immediately become unsuitable for use.

12.2 Waste Acceptance Criteria Testing

One sample of material from the spoil mound located in the south western of the site (exploratory location WS10) was scheduled in accordance with BSEN 12457 Part 3, and tested for the waste acceptance criteria analytes. Results are presented with the chemical data in **Appendix B**.

The results indicated that the sample did not exceed the waste acceptance criteria for inert waste; therefore it is considered that this material can be disposed within an inert landfill. Further assessment may however be required pending clarification of the final volume of material requiring removal and disposal.

A detailed waste assessment has not been undertaken as part of the investigation as it is understood that the earthworks balance means little material is to be removed from site. It has been assumed that there will be no provision for removal of arisings originating from the former landfill area. Arisings from beneath the proposed structure are anticipated to be classified as inert or non-hazardous.

13. Geotechnical Assessment

13.1 Introduction

It is understood that the development proposals comprise the construction of a new two to three storey college building located within the central southern part of the site.

13.2 Geotechnical Hazard Summary

Geotechnical hazards anticipated due to the ground conditions at or adjacent to proposed building location are presented in **Table 13-1**.

Table 13-1 Geotechnical Hazards Summary Table

Hazard Description.	Is hazard likely to be present / affect the site? (H / M / L / N / ?)	Possible engineering requirements if hazard present.
Variable lateral ground conditions	H	Likely to affect foundation solution and ground engineering.
Shallow variable vertical ground conditions	H	Likely to affect foundation solution, floor slab design and ground engineering.
Made Ground	L / M	Likely to affect foundation solution, floor slab design and ground engineering.
Voids	N	No related hazards considered.
Shrinkable clays	L	Foundations to be designed in accordance with NHBC Chapter 4.2. Low risk but may need advice from an aboriculturalist to be taken.
High water table or perched water table	L	May affect excavation works if groundwater is encountered, however this is considered unlikely given the findings of the ground investigation.
Highly compressible / low bearing capacity soils (inc peat and soft clays)	L / M	Likely to affect foundation solution and ground engineering.
High silt content soils, liable to rapid strength loss in wet conditions	M	Likely to affect foundation solution and ground engineering. May affect excavations works, temporary and permanent.
Dissolution features	N	No related hazards considered.
Faulting / geological boundaries	L	May affect foundation solution and ground engineering. Pile lengths might vary depending on precise location of any recorded faults.
Underground mineral extraction. (e.g. Coal mining)	N	No related hazards considered.
Existing sub structures (tunnels, services etc)	N	No related hazards considered.
Obstructions (i.e. old foundations)	L	Likely to affect foundation solution and ground engineering.
Elevated hazardous ground gas (i.e. CO_2, CH_4, radon etc)	H*	May affect ground floor slab selection.

Hazard Description.	Is hazard likely to be present / affect the site? (H / M / L / N / ?)	Possible engineering requirements if hazard present.
Adverse chemical conditions (i.e. SO_4, pH etc).	N	Specialist concrete not considered to be required.
Slope stability issues	N	No related hazards considered.
Flooding	L	May affect engineering solutions adopted including floor slabs and foundations. See SKM Report NE12105fin-rep-FRA.

Key

H – Proven by the work undertaken by SKM to be of a High concern

M - Proven by the work undertaken by SKM to be of a Medium concern

L - Proven by the work undertaken by SKM to be of a Low concern

N – Not found to be of a concern by the work undertaken by SKM

? – No conclusive evidence gained by the work undertaken by SKM to indicate if this is a concern.

** - To be confirmed following receipt of remaining monitoring data.*

13.3 Foundations

At the time of writing, definitive column loadings had not been specified for the structure however is understood that worst case loadings of 550kN and 1350kN for internal columns for the 2 and 3 storey blocks respectively and 750kN for external columns are expected. A new plant/ boiler room is also proposed to the south of the new school building.

As the structure is two to three stories high, and given the vertically and laterally variable ground conditions, it is considered unlikely that the loads will be supported by conventional pad and strip foundations on the upper levels of the Glacial Till and /or Made Ground. The testing results indicated that upper layers are typically soft or firm clays and silts or loose and medium dense sands.

Given the ground conditions encountered and the worst case loadings, it is considered that pile foundations will be required. It is considered that driven piles would be best suited to the lateral and vertical variation in ground conditions. However, consideration will need to be given to the impact of noise and vibration on the surrounding land use, which may preclude this option. As an alternative, an augured displacement piling system would include many of the advantages of driven piles but offer low noise and vibration levels. In addition installation of augured displacement pile is quicker and does not generate the amount of spoil connected with traditional augured piles. It is suggested that Continuous Flight Auger (CFA) piles may experience difficulties due to the variability of the ground and will need to be conservatively designed in relation to weaker expected ground conditions, namely the soft clays and silts. As the depth to bedrock has not been proven by the boreholes, piled foundations should be designed to mobilise the majority of their strength through skin friction, with an allowance for end bearing resistance within the Glacial Till.

The recommended range of design parameters for the drift deposits encountered is indicated in **Table 13-2** below.

- **Table 13-2 Recommended Design Parameters Summary Table**

Description	Saturated unit weight (γ sat, kN/m^3)	Shear Strength (Cu, kN/m^2) or Angle of shearing resistance Φ	Coefficient of Compressibility (M_v, m^2/MN)
Made Ground	18 – 20	N/A	N/A
Glacial Clay	20 – 22	40 – 75 kN/m^2	0.05 – 0.25*
Glacial Sand	18 – 22	29° – 31°	N/A
Glacial Silt	16 – 20	30 - 60 kN/m^2	N/A

*As recorded over 0-400kN/m^2 stress range

It is recommended that the advice of a suitably experienced and qualified piling contractor should be sought. All piling methodologies and designs should be done in accordance with the Environment Agency's document "Piling and Penetrative Ground Improvement Methods on Land".

Foundations and/or buried services are not widely anticipated. However, any obstructions would need to be removed prior to the installation of any foundations. This enabling work may increase the depth of Made Ground currently present on site.

If piles are proposed in any areas of significant made ground or landfilled areas, an allowance should be made for negative skin friction in the pile design, due to settlement and consolidation of any such material. Consideration should be given to the nature of pile installation with relation to minimising contamination migration pathways if made ground or contaminated material is encountered. It is suggested that driven cast *in-situ* piles offer the better protection against this than other piling methodologies whilst minimising the amount of spoil to be handles at the surface. All piling methodologies and designs should be undertaken in accordance with the relevant British Standards and CIRIA guidance documents.

Any piling works undertaken from existing ground levels or floor of the excavation will require a suitable piling platform constructed in accordance with BRE report 470 "Working platforms for tracked plant: good practice guide to the design, installation, maintenance and repair of ground-supported working platforms".

With respect to the proposed new plant room, it is considered that a raft foundation solution formed upon the Glacial Clay would be appropriate. From the findings of site investigation undertaken in the vicinity of the proposed structure, it is assumed that the Glacial Clay at a depth of 1m will

afford a bearing capacity of approximately 60kN/m^2. It is however noted that the location of the proposed plant room is relatively close to the inferred boundary of the landfill area (see **Figure 3**) and therefore the formation level should be inspected following the site strip and prior construction. Should made ground material be present, the founding solution / floor slab requirement would need re-assessing.

13.4 Floor Slabs

Made Ground and / or topsoil thickness has been found to vary between 0.15m and 2.0m depth across the area of the proposed new building. Given that a piled foundation solution is considered to be most appropriate for the new structure, a suspended ground floor slab is recommended to prevent differential settlement between the floor slab and the building. In such circumstances the floor loadings would need to be accounted for within the pile design.

Providing the final formation level is compatible with there being less than 600mm of underfloor fill, a ground bearing floor slab incorporating a gas proof membrane would be considered the most appropriate floor slab solution for the proposed plant room.

13.5 Trees

It is understood there are currently no trees adjacent to the proposed site. From review of the proposed landscaping scheme it is considered that the trees should have no significant impact on the proposed new structure given their distance to the building and the low shrinkage potential of the clays. The modified plasticity index test results for the silt have indicated they generally exhibit a low volume change potential in accordance with the NHBC Standards Chapter 4.2 "Building Near Trees". If it is intended to plant trees adjacent to the proposed structure, the guidance in this document should be followed, and included in the foundation design.

13.6 Access Roads and Car Parks

It is anticipated that unless cut operations on site remove the Made Ground and / or topsoil, a Californian Bearing Ratio (CBR) value of 2% should be adopted for design. Such a value would also be typical for the clays if encountered at formation level during construction.

It is recognised however that proof rolling of any backfilled granular material is likely to provide a CBR value in excess of 5%, however it would be prudent to allow for CBR testing of the final formations to assure the design process during construction.

13.7 Excavations and Dewatering

Instability of excavations through the Made Ground and glacial sand should be anticipated especially during periods of adverse weather conditions. Excavations through the soft and firm clay and silts should be stable to approximately 1m assuming that the water table is not encountered and that the excavations are undertaken in good weather. Deeper excavations or those carried out during and immediately after prolonged periods of heavy rainfall may require support.

During prolonged periods of adverse weather exposed strata should also be protected to prevent wash out and instability of any sands. All excavations should be carried out in accordance with CIRIA Report 97 'Trenching Practice'.

Although the current investigation has revealed limited ingress of shallow groundwater, caution should be exercised due to the high permeability of any shallow natural sand bands. Should the water table be encountered within any excavations at shallow depth then dewatering methods may prove necessary. It is likely that sump and pump methods would be sufficient for this.

13.8 Drainage

Given the encountered geology, comprising both Made Ground and wide spread shallow Glacial Clays, it is unlikely that soakaway drainage would be a viable means of removing surface water from impervious areas of the site. The Made Ground would not be considered suitable as a soakaway medium, due to the potential for leachate generation and groundwater contamination.

The Glacial Sand horizons are potentially suitable strata for soakaway drainage however; their depth and lateral and vertical consistency may affect this. Discharge points would need to be suitably screened through any Made Ground encountered and emplaced within the deeper Glacial Sand deposits. The results of permeability testing within both the Glacial Clays and Glacial Sands have indicated low permeability values of 1.3×10^{-8} and 6.8×10^{-7} m/s respectively.

On the basis of this permeability test data it is considered unlikely that an appropriate discharge rate will be achieved for the soils present at this site. The final feasibility of soakaways could be confirmed using suitable on site testing in accordance with BRE Digest 365 at the precise soakaway locations and it is also emphasised that early discussions should be held with the Local Authority in the unlikely event that this approach is considered to be necessary.

14. Conclusions and Recommendations

14.1 Conclusions

14.1.1 Introduction

Sinclair Knight Merz was commissioned by Laing O'Rourke to undertake a Phase II Geo-Environmental Investigation for a proposed new Co-operative Academy at Plant Hill School, Higher Blackley, Manchester (the 'Site'). The purpose of the investigation was to provide information on the contaminative status of the site and to provide data in order to enable geotechnical design. The report also included review and interpretation of data from a previous investigation undertaken by Geotechnical & Environmental Associates. The investigation forms part of the Manchester Building Schools for the Future (BSF) scheme.

It is understood that current development proposals for the site include the construction of a new 2-3 storey school building within the central area of the site (prior to demolition of the existing school building) and provision for three new sports pitches, car parking areas and soft landscaping.

14.1.2 Ground Conditions

The findings of the site investigation are summarised below:

- Ground conditions were found to consist of Made Ground comprising landfill type materials in excess of 5.0m depth within the western area of the site during the SKM investigation and up to 7.5m in the GEA investigation. Elsewhere across the site, the Made Ground was typically less than 2m in thickness. Glacial deposits comprising very soft to very stiff slightly sandy gravelly clays and silts interbedded with horizons of loose to dense slightly gravelly sands were proved to a maximum depth of 20.45m bgl.
- Groundwater strikes were encountered at borehole locations BH2 and BH3 within the Glacial deposits. Groundwater was noted as perched discontinuous systems within the drift which are considered unlikely to be in hydraulic continuity with the major aquifer given the thick laterally continuous layer of low permeability Glacial Deposits beneath the site.

14.1.3 Environmental Results

- The Tier 1 chemical screening assessment recorded elevated soil contaminant concentrations for heavy metals and PAH's, VOC's and SVOC's within the former landfill area. The GEA investigation also recorded asbestos in a single sample although it is noted that was recorded at depth (0.9m) and was cement bound. Elevated concentrations of arsenic, PAH and SVOC's were recorded within the proposed location of the new school building and elsewhere on site. As such detailed risk assessment was undertaken to establish if site end users could be at risk. The risk assessment recorded no exceedances of the site specific target levels and there is therefore not considered to be a risk to site end users in the location of the former landfill (proposed playing fields) or on the remainder of the site. However given the nature of the fill encountered and the requirement for the pitches to fulfil Sports England standards it would be

prudent to incorporate a minimal thickness of clean cover and a geotextile to minimise soil mixing.

- Soil leachate and groundwater analysis undertaken as part of the chemical analysis identified a limited number of exceedances of the relevant guideline thresholds, however the risks to controlled waters are considered to be low.
- In accordance with CIRIA Report 149, the ground gas regime at the site is classified as being Characteristic Situation 4.
- Suitable materials for pipes that are not affected by the contaminant should be selected given the exceedances of the United Utilities trigger and action levels.
- A full waste assessment has not been undertaken, however the limited analysis indicates materials requiring off site disposal is likely to b classed as either inert or non-hazardous.

14.1.4 Geotechnical Results

- Conventional pad or strip foundations are not considered to be feasible given the lateral variability of the ground conditions. It is therefore considered that a piled foundation solution should be adopted. Piled foundations should be designed to disperse loading predominantly through skin friction, with an allowance for some end bearing resistance within the Glacial Till.
- Given that a piled foundation solution is considered appropriate for the new structure, and the potential gas mitigation measures a suspended ground floor slab would be recommended to prevent differential settlement between the floor slab and the building. In such circumstances the floor loadings would need to be accounted for within the pile design.
- Where Made Ground deposits and/or soft clays occur at formation level a CBR value of no more than 2% should be adopted for all site access roads and car parking. Following proof rolling of any granular formations a CBR value in excess of 5% is likely to be obtained. Testing of final formations and engineering supervision would enable the most economic solution to be proposed.
- Design sulphate Class DS-1 and ACEC Class AC-1 conditions are considered appropriate for the new structure.
- Soakaway drainage is not considered suitable for use at the site.

14.2 Recommendations

Based on the site investigation works the following recommendations are made:

- It is recommended that a 300mm of clean inert material is used in the construction of the new playing fields combined with a geotextile to minimise soil mixing.
- Given that there is potential for ground gas generation at the site, it is recommended that minimum ground gas protection measures should include 3 to 4 of the following measures:
  - Reinforced concrete cast in situ floor slab (suspended, non suspended or raft),
  - Proprietary gas membrane and passively ventilated or positively pressurised underfloor sub-space with monitoring facility,

  - All joints and penetrations sealed,
  - In ground venting wells or barriers.
- Gas mitigation measures will require confirmation with the Local Authority.
- A remedial strategy will be required detailing the works to be undertaken at the site and how they will be validated on completion.
- Appropriate health and safety procedures should be enforced during the installation of pipes, and suitable materials for pipes that are not affected by the contaminants should be selected.
- Any materials which are to be re-used will require confirmatory sampling to demonstrate that it is suitable for use. Second generation (recycled) materials should be tested at a rate of one sample per 250m^3 and first generation (virgin) materials tested at a rate of one sample per 1000m^3.

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Figure 1 Proposed Development Layout

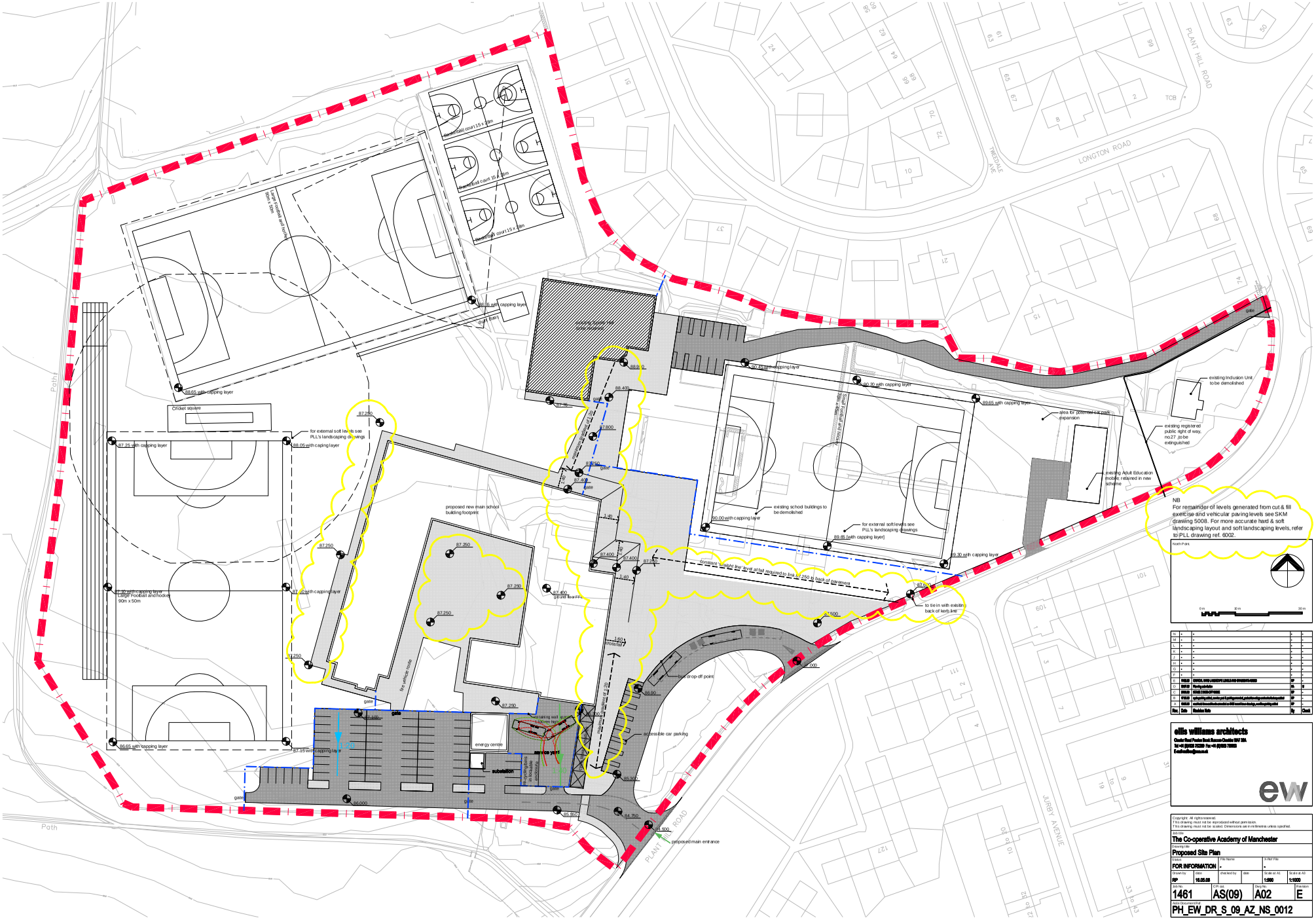
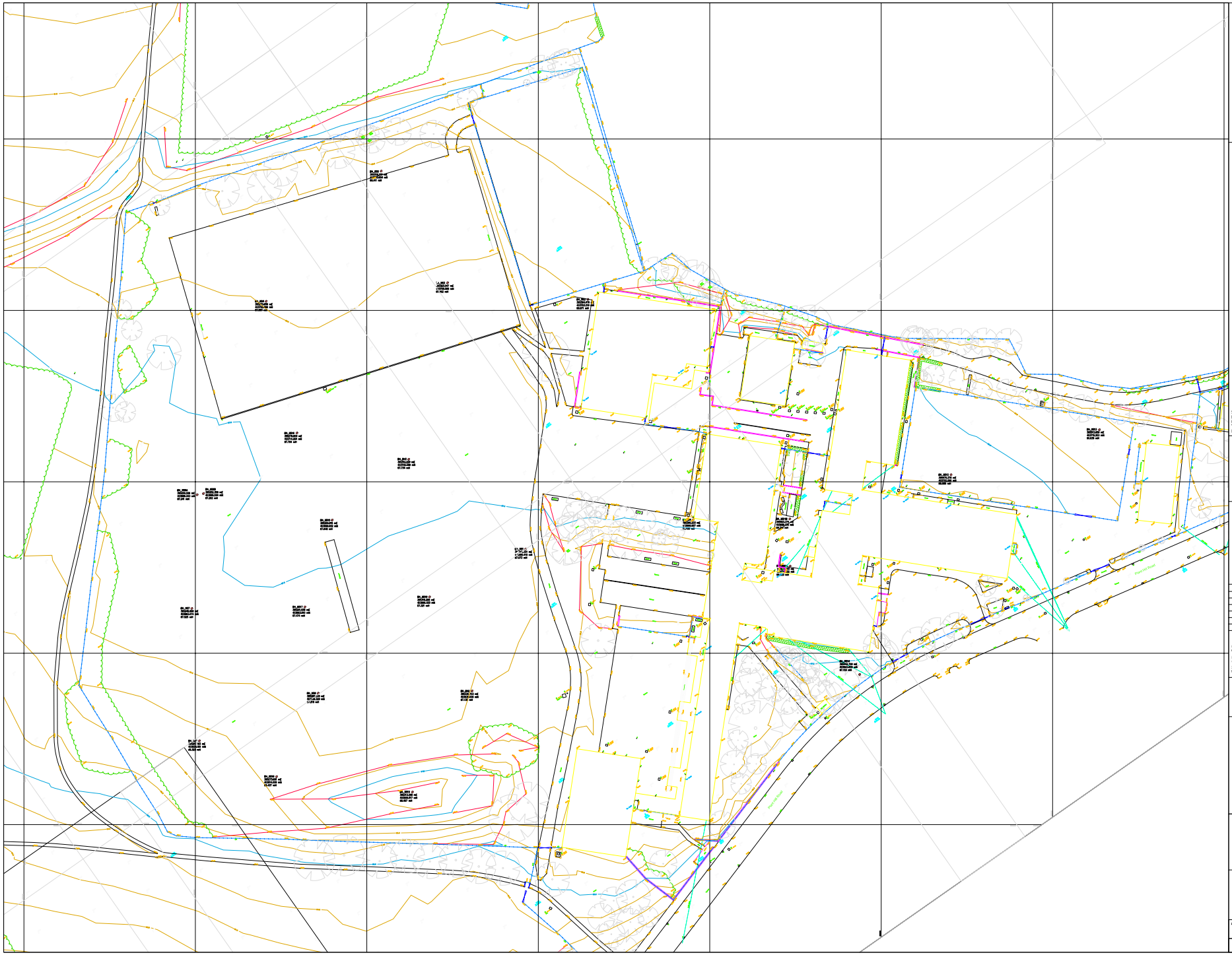

PLANT HILL ROAD
LONGTON ROAD
TREDALE AVE
JURBY AVENUE
Path
Cricket square
Large football and hockey 90m x 50m
Basketball court 15 x 28m
Basketball court 15 x 28m
Basketball court 15 x 28m
existing school buildings to be demolished
proposed new main school building footprint
existing Adult Education modular retained in new scheme
existing inclusion Unit to be demolished
existing registered public right of way, no.27 ,to be extinguished
area for potential car park expansion
for external soft levels see PLL's landscaping drawings
energy centre
substation
accessible car parking
bus drop-off point
proposed main entrance
gate
NB
For remainder of levels generated from cut & fill exercise and vehicular paving levels see SKM drawing 5008. For more accurate hard & soft landscaping layout and soft landscaping levels, refer to PLL drawing ref. 6002.
ellis williams architects
The Co-operative Academy of Mancheste
Proposed Site Plan
FOR INFORMATION
1461
AS(09)
A02
E
PH_EW_DR_S_09_AZ_NS_0012

Figure 2 Exploratory Hole Location Plan



Site Grid North

N
W E
S

Symbols/Abbreviations (Where Applicable):

- AV: AIR VALVE
- BB: BELISHA BEACON
- BH: BOREHOLE
- BM: BENCHMARK
- BOL: BOLLARD
- B/S: BUS STOP
- CAM: CAMERA
- CS: CABLE STAY
- CATV: C.A.T.V INSPECTION CHAMBER
- CBOX: ELECTRICITY BOX, CABLE BOX, ETC.
- CCTV: C.C.T.V CAMERA
- C.PIT: CATCH PIT
- EP: ELECTRICITY POLE
- ER: EARTH ROD
- FH: FIRE HYDRANT
- FP: FLAG POLE
- G: GULLY
- G: GULLY (ROUND)
- GV: GAS VALVE
- IC: INSPECTION COVER
- IC(R): INSPECTION COVER (ROUND)
- IL: INVERT LEVEL
- KO: KERB OUTLET
- LB: LETTER BOX
- LC: LIGHTING COLUMN
- LP: LAMP POST
- LP/BS: LAMP POST/BUS STOP
- MH: MANHOLE
- MH: MANHOLE (ROUND)
- MKR: MARKER
- P: POST
- RE: RODDING EYE
- R/S: ROAD SIGN
- S/P: SIGN POST
- SNP: STREET NAME PLATE
- ST: STOP TAP
- SV: STOP VALVE
- TCB: TELEPHONE CALL BOX
- TL: TRAFFIC LIGHT
- TS: TELEGRAPH POLE
- TP/EP: TELEGRAPH POLE/ELECTRIC POLE
- WO: WATER OUTLET
- WM: WATER METER
- GATE
- DEFINED POINT
- CONTROL POINT
- TREE (CONIFEROUS)
- TREE (DECIDUOUS)
- FOLIAGE
- HEDGE

SL 99.99m SOFFIT LEVEL
EL 99.99m EAVES LEVEL
RL 99.99m RIDGE LEVEL
TL 99.99m THRESHOLD LEVEL
DPC 99.99m DAMP PROOF COURSE LEVEL

FENCE DESCRIPTIONS:

- C/B: CLOSE BOARDED FENCE
- C/BARRIER: CRASH BARRIER
- C/P: CHESTNUT PALING FENCE
- CONC/P: CONCRETE PANEL FENCE
- I/R: IRON RAILING FENCE
- P/R: POST AND RAIL FENCE
- P/W: POST AND WIRE FENCE
- P/C: POST AND CHAIN FENCE
- S/PAL: STEEL PALISADE FENCE
- T/PAL: TIMBER PALISADE FENCE
- B/W: BARBED WIRE FENCE

Revision Information

Rev	Date	Description
A	17/06/08	BH W5N Moved to correct location

INFORMATION

1) Ordnance Survey co-ordinates and level are derived from OS5N63 and OS0M02, transformed from W3584.

2) Only services located during this site survey are shown on this plan. Further investigation may be required to ascertain the full extent of the site services.

3) Copyright of this drawing remains the property of PM Surveys UK Ltd. Do not scale from this drawing. In the event of any discrepancy, refer query to PM Surveys UK Ltd.

NOTES

1) All co-ordinates and levels are related to notional grid.

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Project

Boreholes
Plant Hill School
Manchester

Project No	Sheet: A1	Surveyed By: N. Lamprell
PMS08151	Scale: 1:500	Drawn By: D.Shipton
		Approved By: JMT
Dwg PMS08151-01		Issued: 11/06/08

Figure 3 Drawing showing approximate location of former landfill



NOTES

LEGEND

- WINDOW SAMPLE BOREHOLE
- CABLE PERCUSSION BOREHOLE
- INFERRED BOUNDARY OF LANDFILL

No	DATE	DRAWN BY	CHECKED BY	AMENDMENT

DRAWING STATUS

PRELIMINARY ISSUE

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CLIENT

PROJECT

Co-operative Academy
Manchester

DRAWN BY SA | ENGINEER

TITLE

FIGURE 3
SITE PLAN SHOWING INFERRED BOUNDARY OF FORMER LANDFILL

SCALE	DRAWING No	AMDT
NTS	NE12105 - SK001	P1

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Appendix A GEA Report

Document Control

Project title	Plant Hill High School, Plant Hill Rd, Higher Blackley, Manchester	**Project ref**	J06365
Report prepared by	Martin Cooper BEng CEng MICE		
Report checked and approved for issue by	Steve Branch BSc MSc CGeol FGS FRGS MIEnvSc		

Issue No	Status	Date	Approved for Issue
1	Final	23rd February 2007	

This report has been issued by the GEA office indicated below. Any enquiries regarding the report should be directed to the office indicated or to Steve Branch in our Herts office.

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CONTENTS

EXECUTIVE SUMMARY

Part 1: INVESTIGATION REPORT

1.0 INTRODUCTION 1
1.1 Proposed Development 1
1.2 Purpose of Work 1
1.3 Scope of Work 1
1.4 Limitations 2

2.0 THE SITE 2
2.1 Site Description 2
2.2 Previous Reports 2
2.3 Other Information 3
2.4 Preliminary Risk Assessment 3

3.0 EXPLORATORY WORK 3
3.1 Sampling Strategy 4

4.0 GROUND CONDITIONS 4
4.1 Made Ground 4
4.2 Glacial Deposits 5
4.3 Groundwater 6
4.4 Soil Contamination 6
4.5 Soil Gas 8

Part 2: DESIGN BASIS REPORT

5.0 INTRODUCTION 9

6.0 GROUND MODEL 9
6.1 Contaminants of Concern 9

7.0 ADVICE & RECOMMENDATIONS 10
7.1 Piled Foundations 11
7.2 Spread Foundations 12
7.3 Excavations 12
7.4 Ground Floor Slabs 12
7.5 Effect of Sulphates 12
7.6 Retaining Walls 13
7.7 Pavement Design 13
7.8 Contamination Conceptual Model 13
7.8.1 Groundwater 14
7.8.2 End Users 14
7.8.2.1 Direct Contact 14
7.8.2.2 Vapours 15
7.8.3 Site Workers 15
7.9 Soil Gas 15
7.10 Waste Disposal 16

8.0 FURTHER WORK 16

APPENDIX

EXECUTIVE SUMMARY

This executive summary contains an overview of the key findings and conclusions. No reliance should be placed on any part of the executive summary until the whole of the report has been read. Other sections of the report may contain information that puts into context the findings that are summarised in the executive summary.

BRIEF

This report describes the findings of a ground investigation carried out by Geotechnical and Environmental Associates Limited (GEA) on the instructions of Cundall Johnston and Partners, on behalf of Balfour Beatty Construction Limited, with respect to the redevelopment of this site by the construction of a new four storey school. The purpose of the investigation has been to assess the ground conditions, investigate the presence of contamination and to provide information for the design of piled foundations. A desk study has previously been carried out by Manchester City Council and a copy of the report has been provided.

DESK STUDY FINDINGS

The desk study indicated that the site had not been developed prior to the construction of the existing school between 1956 and 1963. At that time however landfilled refuse tips are shown to the west and north of the site. Previous ground investigations by Northern Foundations and by Strata Surveys Limited indicated made ground over glacial deposits of sandy clay and clayey fine sand. These previous investigation reports indicated significant depths of landfill immediately beyond the northern and western boundaries. Significant concentrations of both methane and carbon dioxide were measured within the borehole standpipes.

GROUND CONDITIONS

Boreholes in the north and west of the site have revealed made ground to depths of up to 7.5 m, comprising ashy sand with much refuse which was underlain by sandy clay. Within the central area of the site the made ground was generally less than 1.0 m in thickness and was underlain by Glacial Till comprising firm sandy clay and then medium dense clayey sand. The sand was underlain at depths of around 17 m by very stiff sandy slightly gravelly clay which extended to the full depth of the investigation. In the southern and southeastern part of the site the made ground extended to generally less than 0.5 m and was found to be underlain by firm becoming stiff brown sandy clay with layers of medium dense brown fine sand. Groundwater was encountered within some of the granular layers although subsequent monitoring has revealed the depths to groundwater to vary between 0.49 m (85.21 m OD) and 7.01 m (81.19 m OD).

RECOMMENDATIONS

Spread foundations would not be appropriate for the ground conditions encountered and column loads proposed; therefore recourse to a piled solution should be sought. Driven piles would avoid the need for the disposal of potentially contaminated arisings and would be appropriate for the sand layers. As an alternative, continuous flight augered bored piles bearing within the very stiff clay of the glacial till or the medium dense sand could also prove suitable although consideration would need to be given to the disposal of potentially contaminated pile arisings and likely increased concrete overbreak and loss within the variable and loose made ground. A preliminary pile design suggests that an approximately 13 m long 370 mm driven cast in situ pile may provide a working load of 500 kN whilst a 450 mm diameter CFA pile, founding at a depth of 15 m, could provide a working load of around 460 kN and a factor of safety of 3, although not taking account of negative skin friction effects. On the basis of the buildings being piled and over the former landfill, a fully suspended ground floor slab construction should be anticipated together with the installation of full gas protection measures.

Metallic contamination and asbestos have been found within the landfill such that further site specific risk assessment will be required for playing field areas. When beneath the proposed building or hardstanding potential pathways to that material are likely to be broken. Elsewhere on the site a single elevated concentration of arsenic has been measured but is not considered to pose a significant risk to health.

Part 1: INVESTIGATION REPORT

This section of the report details the objectives of the investigation, the work that has been carried out to meet these objectives and the results of the investigation. Interpretation of the findings is presented in Part 2.

1.0 INTRODUCTION

Geotechnical and Environmental Associates (GEA) has been commissioned by Balfour Beatty Construction and in consultation with Cundall Johnston and Partners LLP, to carry out a ground investigation at Plant Hill High School, Plant Hill Road in Higher Blackley, Manchester. A desk study was undertaken by Manchester City Council and the report was supplied to GEA with the enquiry documents.

1.1 Proposed Development

It is proposed to redevelop this site through the construction of a new four storey structure along with the provision of car parking and soft landscaping; the latter including a 'natural habitat'.

This report is specific to the proposed development and the advice herein should be reviewed if the development proposals are amended.

1.2 Purpose of Work

The principal technical objectives of the work carried out were as follows.

- to establish whether a landfill that is known from previous work to be adjacent to the site, also encroaches onto this site;
- to determine the ground conditions and their engineering properties;
- to provide information to assist in the design of piled foundations and retaining walls;
- to provide site specific information in respect of ground gas;
- provide information for use in the design of pavements; and
- to investigate the presence of contamination.

1.3 Scope of Work

In order to meet the above objectives, a ground investigation was carried out and comprised, in summary, the following activities:

- three cable percussion boreholes advanced to a maximum depth of 20.5 m;
- a series of 20 small diameter open-drive boreholes advanced to a maximum depth of 9.0 m;
- installation and subsequent monitoring of eight gas and groundwater standpipes;
- testing of selected soil samples for geotechnical and contamination purposes; and

- provision of a report presenting and interpreting the above data, together with our advice and recommendations with respect to the proposed development.

1.4 Limitations

The conclusions and recommendations made in this report are limited to those that can be made on the basis of the investigation. The results of the work should be viewed in the context of the range of data sources consulted, the number of locations where the ground was sampled and the number of soil, gas or groundwater samples tested; no liability can be accepted for information in other data sources or conditions not revealed by the sampling or testing. Any comments made on the basis of information obtained from the client or other third parties are given in good faith on the assumption that the information is accurate; no independent validation of such information has been made by GEA.

2.0 THE SITE

2.1 Site Description

The site, which is in use as a high school with an annexed adult learning facility, is located within the suburb of Higher Blackley and lies some 6 km north of Manchester city centre. The site is bounded to the southeast and east by Plant Hill Road and to the north partially by the residential properties of Longton Road. Beyond the remainder of the northern, the western and southwestern boundaries lies open grassland. The site may additionally be located by National Grid Reference 385380 403690.

The site is irregular in shape and is of approximate maximum dimensions 375 m north to south by 200 m east to west.

The northernmost third of the site area is currently in use as playing fields, predominantly set to grass but with an approximately 90 m by 60 m tarmac surfaced area in the northeast. This part of the site slopes gently down to the west from a level of about 89.2 m OD to 85.7 m OD over approximately 200 m. The perimeter of this area is interspersed with small trees and rough shrubs. In addition a raised grassed mound, approximately 30 m by 10 m in area and 2.5 m in height lies along the western boundary.

The central part of the site is occupied by the existing school buildings. These comprise a range of single, two and three storey concrete and masonry structures with external areas surfaced in tarmac, paving slabs and concrete. These buildings lie at levels of between about 89.9 m OD and 87.5 m OD with a series of retaining walls and steps accounting for the level differences. The rough tarmac surfaced main school car park lies south of the school buildings. A number of mature deciduous trees are present between the school buildings and Plant Hill Road.

The remaining southern part of the site is occupied by the caretaker's house and a masonry adult education building and surrounded by soft landscaping at levels of between roughly 92.6 m OD around the caretaker's house and 87.7 m OD in front of the school.

2.2 Previous Site Investigation Reports

A desk study report, by Manchester City Council Structural Engineer's Group but with no reference, was supplied along with historical maps and environmental data obtained in 2004 from the Landmark Information Group. The desk study was specific to a new school development under the BSF framework and is therefore considered relevant to this report. This information was provided as part of the enquiry documentation along with three previous site investigation reports, two of which, by Strata Surveys Limited (ref 10022, dated December 1999) and Northern Foundations (Investigations) Limited (ref SI 7693, dated June 2000) relate to the site. The third, relating to the land immediately beyond the northern and western boundaries was prepared by Geotechnics (ref PN050930, dated October 2005).

The desk study report indicates that the site had, from at least the mid-1800s, been undeveloped farmland. The surrounding area is noted to have been subject to residential development from 1932. The maps dated from 1893 to 1956 show a watercourse flowing in the southwest of the site with two ponds being identified in the northeast. Plant Hill School is shown to have been built between 1956 and 1963 with the whole of the open land to the northwest of the site being identified as having been a refuse tip on the 1963 map. Subsequent maps show little change to the site to the present day, with the exception of the construction of the sports hall north of the main buildings since 1999.

The superficial geology beneath the site is indicated by the previous investigations to be Glacial Till, predominantly comprising sandy clay to a depth of around 5 m, overlying bodies of sand of up to 5 m in thickness. The solid geology is indicated to comprise Sherwood Sandstone, a major aquifer of high (urban) leaching potential which is expected to be present at a depth of around 40 m. A search of Coal Authority records reportedly indicated that the site is not within the zone of influence of past underground coal workings.

Passing reference to is made previous landfill sites and the Envirocheck search indicates the presence of two such sites, between 500 m and 1000 m from the site. An additional drawing provided with the desk study is thought to be Manchester City Council's record of landfill sites. This plan is appended and indicates that almost all of the area of Plant Hill School's playing field is a landfill site and that the entire school to be within a 250 m zone of influence.

The previous site investigation reports record largely similar ground conditions on the site, with firm and stiff sandy clay found to overlie sand which was proved to the relatively limited depths investigated.

The Geotechnics report on the land beyond the northern and western boundaries indicates a thin clay cover beneath which lies made ground comprising domestic refuse to a depth of some 3.9 m.

2.3 Other Information

Discussion with members of staff at the school has indicated that significant problems with settlement of the school playing fields have occurred in the past such that pitches have had to be relaid, to the extent that part of the area was hard covered with tarmac.

2.4 Preliminary Risk Assessment

The desk study report concludes that there is a low risk to receptors from the proposed development although notes that the two landfill sites in the vicinity are likely to impact the proposed development.

3.0 EXPLORATORY WORK

In order to meet the objectives described in Section 1.2, three cable percussion boreholes, Borehole Nos 1, 3 and 4, were advanced through the fill materials and into the natural soils to depths of up to 20.5 m. The extremely soft condition of the playing fields did not allow access to the location of Borehole No 2 and following consultation with the consulting engineer this borehole was, for the present time, deleted.

In addition, a series of 20 shallow boreholes, Borehole Nos WS1 to WS20, were advanced using a tracked open-drive sampling rig.

Standard Penetration Tests (SPTs) were carried out at regular intervals within the cable tool boreholes and some of the open-drive boreholes.

Eight combined soil-gas and groundwater monitoring standpipes were installed to depths of between 3.0 m and 7.0 m at locations specified by the consulting engineer.

Disturbed and undisturbed samples were recovered from the boreholes at regular intervals for subsequent geotechnical and contamination analyses. A programme of gas and groundwater monitoring is currently underway and the results obtained thus far are appended; those for subsequent visits will be reported as an addendum to this report.

The borehole records and the results of the laboratory analyses are appended, together with a site plan indicating the borehole locations. The nomenclature and locations of the boreholes were specified by the consulting engineer. Borehole levels have been interpolated from spot heights and contours on an electronic drawing (ref: Plant Hill Topo survey.dwg) which was supplied by the client.

3.1 Sampling Strategy

It is understood that the borehole locations were selected to give an indication of the ground conditions in the area of the proposed building and elsewhere to address particular items of concern in relation to the possible encroachment of the landfill sites onto the proposed development. The recovered soil samples were selected for geotechnical purposes and to provide a general view of the soluble sulphate concentrations.

Additionally 14 samples of the made ground were recovered at selected depths to investigate the degree of contamination within the made ground and to investigate if those contaminants were widespread throughout the site and a single sample was also screened for asbestos. These selected samples have been subjected to chemical analyses to determine concentrations of a range of typical soil contamination indicative parameters. For this investigation the analytical suite included a range of metals, speciated total petroleum hydrocarbons (TPH), polycyclic aromatic hydrocarbons (PAH), total cyanide, and monohydric phenols. The contamination analyses were carried out at an MCERTs accredited laboratory with the majority of the testing suite accredited to MCERTS standards. Details of the accreditation and test methods are summarised in the Appendix together with the analytical results; full MCERTS details are available upon request.

4.0 GROUND CONDITIONS

The exploratory holes have indicated that the western and northern parts of the site are underlain by made ground up to 7.5 m in thickness whilst the central, southern and southeastern parts are apparently generally underlain by glacial deposits, encountered as stiff sandy clay with layers of sand, which were proved to the maximum depth of investigation of 20.5 m.

4.1 Made Ground

Beneath the surfacing of grass or tarmac, made ground was encountered at each location and was found to extend to depths of between 0.2 m and 7.5 m. The depths and composition of the made ground were found to vary across the site, but some consistency was observed within three areas.

The western and northern area of the site encompasses Borehole Nos WS1, WS3, WS7, WS9, WS13, WS14 and Borehole Nos 1 and 3 and is considered to represent the part of the site onto which the landfill encroaches. Within this broadly crescent-shaped area towards the boundaries of the site, made ground was found to extend to depths of between approximately 4 m and 7.5 m and was found to comprise black and dark grey sandy ash with clinker, wood, rubber, plastic, concrete, wire, glass and paper. Pockets of the material were extremely malodorous with anoxic hydrocarbon odours noted. In addition a sample of cement sheet suspected to contain asbestos was identified within Borehole No WS9. SPTs within the material were highly variable with N-values varying between 2 and 20.

The central area of the site encompasses Borehole Nos WS2 in the north, through WS4, WS5, WS6, WS8, WS10 to WS13, and WS20 and is considered to represent the area peripheral to the landfill. Within this area the depth of made ground was generally less than 1.0 m and was found to reduce in thickness approaching the current buildings. The made ground was found to comprise generally dark brown humic sandy clay with traces of brick, ash, clinker and coal although refuse as above was found within Borehole No WS 8.

The third area comprises the eastern and southeastern part of the site, including Borehole Nos WS17 to 19 and Borehole No 4 and is predominantly occupied by the current buildings and car parking areas. In this area, made ground comprising sandy clay with fragments of coal, ash and clinker was encountered and found to be typically less than 0.5 m in thickness.

Coal, ash and clinker were observed to be generally present within the made ground across all of the site. These materials and the malodourous materials within the refuse, are considered to suggest the presence of possible contamination; with ash and clinker being commonly rich in metallic elements whilst the associated ash and unburnt coal are typically high in PAH. The sample of cement sheeting from Borehole No WS9 has been screened for and found to contain 'white' crysotile asbestos.

A total of 14 samples of the made ground have been tested for the presence of contamination and the results are discussed in Section 4.4.

4.2 Glacial Deposits

Within the central, northern and western parts of the site, generally firm brown and brownish grey sandy clay was found to extend to depths of between 0.3 m and 9.0 m. This material was found to contain layers of medium dense pale brown clayey silty fine to medium sand of between 0.2 m and 1.2 m in thickness. A more substantial layer of similar sand was encountered within the clay between depths of 5.0 m and 10.8 m within Borehole No 1 and from 7.0 m to 9.1 m and 11.3 m to 16.6 m within Borehole No 3. Beneath the sand layers stiff becoming very stiff sandy clay with

occasional fine to medium gravel, thought to represent glacial till, was encountered at depths of around 17.0 m and extended to the maximum depth investigated at 20.5 m.

In the southern and southeastern part of the site the made ground extended to generally less than 0.5 m and was found to be underlain by firm becoming stiff brown sandy clay with layers of medium dense brown fine sand. Within Borehole No 4 this sandy clay was underlain by medium dense brown clayey silty fine to medium sand, which extended to the maximum depth investigated of 20.5 m. The soils revealed within Borehole No WS16 are considered to reflect the view that the localised area may have contained a backfilled pond as soft humic clay was found to extend to a depth of 3.2 m.

With the exception of a single sample of the soft silty clay within Borehole No WS16 which was identified as having medium volume change potential, the laboratory tests have shown the sandy clay to be of low shrinkability.

Generally no visual or olfactory evidence of contamination was identified in the natural soils, However black silt partings were noted within Borehole No WS1 within the clay encountered beneath the made ground; the staining extending from 7.5 m to 8.6 m depth.

4.3 Groundwater

Groundwater was encountered as a slow inflow close to the base of the made ground at a depth of 4.0 m within Borehole Nos 1 and 3 rising to 3.9 m and 3.7 m respectively in 20 minutes. Further ingress was recorded within the fine to medium sand layers at depths of 12.5 m and 16.5 m within Borehole Nos 1 and 3 respectively, again only rising by 0.5 m within 20 minutes. Within Borehole No 4, it was necessary to add water to assist boring of the sand at depths of 14 m and 17 m. This would appear to suggest that groundwater is generally to be found within sand lenses within the overall soil profile.

During subsequent gas monitoring the depths to groundwater were measured to vary between the shallowest at 0.49 m (85.21 m OD) within Borehole No WS13 and the deepest at 7.01 m (81.19 m OD) within Borehole No WS1. Where encountered at relatively shallow depth the groundwater is considered to represent perched conditions with groundwater existing within lenses of sand separated by layers of clay.

4.4 Soil Contamination

Part IIA of the Environmental Protection Act 1990, which was inserted into that Act by Section 57 of the Environment Act 1995, provides the main regulatory regime for the identification and remediation of contaminated land. The determination of contaminated sites is based on a "suitable for use" approach which involves managing the risks posed by contaminated land by making risk-based decisions. This risk assessment is carried out on the basis of a source-pathway-receptor approach.

The use of a risk-based approach, which is presented in Part 2 of this report, means that it is not appropriate to determine the significance of contamination test results by simply comparing individual contaminant concentrations to a single "trigger" or "target" concentration.

The significance of the results is therefore considered in more detail in Part 2, whilst the tables below set out the values measured within the samples; the first table for samples taken from the landfill and the second for samples recovered remote from the landfill area.

Samples taken from the landfill area:

Determinant	Maximum Concentration Recorded (mg/kg)	Minimum Concentration Recorded (mg/kg)	Number of samples below detection limit	Normalised upper bound US_{95}
Arsenic	180	32	None	138
Cadmium	10	<1.0	1	5
Chromium	120	26	None	85
Copper	1500	180	None	931
Lead	2200	170	None	1504
Mercury	41	<1	5	14
Nickel	110	36	None	98
Selenium	<2	<2	All	<2
Zinc	2600	510	None	1815
Total Cyanide	7	<1	5	5
Total Phenols	<1	<1	All	<1
Sulphide	200	<10	3	89
Sulphate Total	6.6 %	0.3 %	None	3.8 %
Soluble Chloride	<50 mg/l	<50 mg/l	All	<50 mg/l
PAH	21	1.8	None	14
TPH (C8-C10)	<10	<1	All	7
TPH (C10-C12)	38	<1	4	18
TPH (C12-C16)	150	2	4	62
TPH (C16-C21)	840	9	None	337
TPH (C21-C35)	840	71	None	2960
Total Organic Carbon	33 %	4 %	None	23 %
pH	7.9	6.4	-	-

Note: The use of the normalised upper bound for 95th percentile confidence aims to remove some of the uncertainty associated with calculation of an arithmetic sample mean of a relatively small number of samples. The US95 value is the upper bound of the range within which it can be stated with 95% confidence that the true mean concentration of the data set will fall.

Samples taken outside the landfill area:

Determinant	Maximum Concentration Recorded (mg/kg)	Minimum Concentration Recorded (mg/kg)	Number of samples below detection limit	Normalised upper bound US_{95}
Arsenic	24	6	None	22
Cadmium	<1.0	<1.0	9	<1.0
Chromium	22	8	None	20
Copper	88	21	None	79
Lead	140	10	None	126
Mercury	<1	<1	All	<1
Nickel	33	9	None	28
Selenium	<2	<2	All	<2
Zinc	170	33	None	154
Total Cyanide	<1	<1	All	<1
Total Phenols	<1	<1	All	<1
Sulphide	21	<10	All	17
Sulphate Total	0.29 %	0.02 %	None	0.25 %
Soluble Chloride	<50 mg/l	<50 mg/l	All	<50 mg/l
PAH	9	0.03	None	7
TPH (C8-C10)	<1	<1	All	<1
TPH (C10-C12)	<1	<1	All	<1
TPH (C12-C16)	3	<1	All	3
TPH (C16-C21)	15	<1	2	12
TPH (C21-C35)	56	<1	2	43
Total Organic Carbon	16 %	0.2 %	None	12 %
pH	8.3	6.4	-	-

Note: The use of the normalised upper bound for 95th percentile confidence aims to remove some of the uncertainty associated with calculation of an arithmetic sample mean of a relatively small number of samples. The US95 value is the upper bound of the range within which it can be stated with 95% confidence that the true mean concentration of the data set will fall.

4.5 Soil Gas

Measurements of soil gas concentrations of up to 5.7 % vol methane and up to 20.0 % vol carbon dioxide were reported by Geotechnics, although no measurable flow appears to have been recorded.

Within the current investigation, two visits to monitor methane, carbon dioxide and oxygen have been undertaken as part of a regime of six visits. The results are presented within the appendix. Thus far, measurable concentrations of methane have only been recorded within Borehole No WS1, in which the made ground was found to extend to a depth of 7.5 m. In this borehole, methane concentrations of 18.4 % vol and 21.1 % vol have been measured in conjunction with flows of 0.8 l / hr and 0.2 l/hr respectively. Carbon dioxide has been measured at concentrations of generally between 'less than 0.1' % vol and 4.6 % vol. Higher concentrations of carbon dioxide were recorded within Borehole Nos WS1 and WS13, at 14.2 % vol and 12.1 % vol respectively; both of these boreholes contained significant depths of made ground deriving from the adjacent landfill. The implications of these results are discussed in Part 2 of this report.

Part 2: DESIGN BASIS REPORT

This section of the report provides an interpretation of the findings detailed in Part 1, in the form of a ground model, and then provides advice and recommendations for foundations and other aspects of the development.

5.0 INTRODUCTION

Consideration is being given to the redevelopment of this site through the construction of a new school building. The layout and structures have not yet been finalised but for the purposes of this investigation, a four storey concrete framed structure has been proposed on the existing school fields as shown on the appended site plan. Areas of car parking and soft landscaping are also proposed, the soft landscaping to include a natural habitat area. Loadings have been indicated by the Engineer to be generally in the in the range of 3000 kN to 5000 kN for columns, 100 kN/m to 250 kN/m for load-bearing walls and 15 kN/m^2 for ground floor slabs.

6.0 GROUND MODEL

The previous desk study has shown the site to have had an uncontaminative history. On the basis of the investigation, the ground conditions at this site can be characterised as follows.

- Areas of made ground extending to depths of up to7.5 m are present in the northern and eastern parts of the site associated with a landfill dating from the 1960s;
- in the remaining areas of the site the made ground was found to extend to depths of generally less than 1.0 m;
- beneath the made ground, glacial deposits comprising generally firm and stiff sandy slightly gravelly clay was found to extend to a depth of 20.5 m;
- the clay contains lenses and substantial layers of clayey silty fine and medium sand; and
- groundwater was encountered at most locations on the site and has subsequently been measured in standpipes at depths of between 0.5 m and 7.0 m (85.2 m OD and 81.2 m OD).

6.1 Contaminants of Concern

The use of a risk-based approach has been adopted to provide an initial screening of the test results to assess the need for subsequent site-specific risk assessments. To this end the tables below indicate those contaminants of concern that have US95 values in excess of a generic human health risk based guideline value which is either that of the CLEA[1] Soil Guideline Value where available, or is a Generic Guideline Value calculated using the CLEA UK Beta Version 1.0 software assuming a residential end use without plant uptake, as the proposed landscaping is understood not to be used for produce. Where contaminant concentrations are measured in excess of these values it is considered that there is a potential for there to be some risk to human health

1 CLR 7 (2002) *Assessment of risks to human health from land contamination: an overview of the development of soil guideline values and related research;* CLR8 (2002) *Priority contaminants for the assessment of land;* CLR 9 (2002) *Contaminants in soil: collation of toxicological data and intake values;* CLR10 (2002) *The contaminated land exposure model (CLEA): technical basis and algorithms,* and reports CLR TOX1-25 and CLR SGV1-10,15 and 16; all DEFRA and Environment Agency.

and hence site specific risk assessment, soil remediation or risk management may be required. Values measured at concentrations below these values are not deemed to require further consideration with regard to human health.

The tables of generic screening values derived by GEA and an explanation of how each value has been derived are included in the Appendix.

The table below details the contaminants of concern within samples of the landfill.

Contaminant of Concern	Maximum concentration recorded (mg/kg)	Minimum concentration recorded (mg/kg)	Normalised upper bound US_{95}	Generic Risk-Based Screening Value
Arsenic	180	32	138	20
Lead	2200	170	1504	450
Mercury	41	<1	14	15
Nickel	110	36	98	75
Total Organic Carbon	33 %	4 %	23 %	6 %

The concentrations of these metallic contaminants, together with the asbestos which was contained within cement sheeting, are considered to be indicative of the general contamination within the landfill material beneath part of this site. The source of the materials is likely to have derived from general industrial and domestic refuse and according to the historical maps was placed during the 1960s.

The table below details the contaminants of concern within the made ground which does not include the landfill.

Contaminant of Concern	Maximum concentration recorded (mg/kg)	Minimum concentration recorded (mg/kg)	Normalised upper bound US_{95}	Generic Risk-Based Screening Value
Arsenic	24	6	22	20

The US95 values calculated indicate that the single concentration of arsenic that is in excess of the risk based screening value is from the made ground. This concentration is considered to derive from the ash and clinker recorded within the borehole.

The implications of the contaminants of concern are assessed in detail in the developed conceptual site model in Section 7.6.

7.0 ADVICE AND RECOMMENDATIONS

The current Development Option 2 locates the proposed building largely in the central area of the site but with its extremities entering the deeper areas of made ground near Borehole Nos 1 and 3. Considering the relatively high column loads associated with a four-storey concrete framed building, located in part over the area of deep made ground, spread foundations are not considered to be appropriate for such ground conditions and therefore recourse to a piled solution should be sought. For possible smaller structures in the south and east of the site, shallow spread foundations may be considered.

7.1 Piled Foundations

Piles bearing within the stiff or very stiff clay or the medium dense sand of the Glacial Till are considered to provide a suitable foundation solution. Although both bored and driven piles could be suitable, the ground conditions and the presence of the landfill appear to favour a driven pile scheme.

Driven piles would avoid the need for the disposal of potentially contaminated arisings and are considered appropriate for the relatively thick layers of sand encountered. It is considered that a working load in the order of 500 kN could be achieved by a 370 mm diameter driven cast-in-situ pile in such ground conditions. The depth of such a pile would vary, dependent on the thickness and relative density of the sand layers but could be anticipated to generally be in the range from 11 m to 15 m.

Further investigation is recommended to provide a more complete view of the sand layer within the proposed building layout and therefore to provide an indication of whether the sand layer thins out such that the possibility of piles overstressing the Glacial Till beneath becomes a problem. In this regard further cable tool boreholes and dynamic cone penetrometer plots could prove useful.

Pre-cast concrete driven piles could also be considered; however the possibility may remain of creating a pathway for contaminants to penetrate the natural soils beneath the made ground. Since a driven cast-in-situ pile is formed by wet concrete filling any space on withdrawal of the piling tube, such a pile would prevent such a pathway from being formed and is therefore likely to be the most suitable type.

A cased rotary open bored pile is unlikely to prove economical due to water bearing granular soils at depth. It is therefore considered that bored piles constructed using a continuous flight auger could prove suitable with the positive rotation of the auger flighting any potentially contaminated soils to the surface, reducing the potential downward movement of contamination.

Consideration will need to be given to the disposal of potentially contaminated soils, which would by nature of the CFA process be mixed with the natural soils during the concreting phase of pile construction possibly rendering all of the pile spoil as possibly contaminated. Further, increased concrete over-break and loss within the variable and potentially very loose made ground should be anticipated and therefore be considered when costing the piling options.

As a further alternative, some form of rotary displacement pile could be considered with the associated saving of spoil disposal costs whilst taking maximum advantage of the bearing capacity of the granular deposits. Piling specialists should be consulted in respect of their proprietary methods and design methodology for such a technique.

The following parameters, based upon the ground conditions revealed in the boreholes are considered suitable for the preliminary design of straight-shafted bored piles.

Ultimate Skin Friction		***kN/m²***
Made Ground	GL to 4.0 m	Ignore
Glacial Till	4 m to 7 m	50
Glacial Sand	below 7 m	70
Ultimate End Bearing		***kN/m²***

Glacial Sand	below 12 m	3000

It is standard practice to apply a factor of safety of between 1.5 and 3.0 to the above parameters in the computation of working loads of individual piles. If piles are to penetrate areas of landfill it is likely that negative skin friction loading will be induced into the pile by the settlement of the landfill as it degrades and this will need to be taken into account in the final design.

A preliminary pile design suggests that a 450 mm diameter CFA pile, founding at a depth of 15 m, could provide a working load of around 460 kN and a factor of safety of 3, although not taking account of negative skin friction effects. For the larger column loads a 600 mm diameter pile providing a working load in the order of 685 kN could be anticipated.

The examples given above are for guidance and preliminary design only. The advice of a specialist piling contractor should be sought in respect of the particular type of pile which should be considered in the ground conditions encountered and with the site constraints that will apply.

Attention is drawn to the soft and variable surface conditions on the school field. These conditions, albeit in winter, should be considered in relation to the layout of the proposed buildings and the anticipated need for a relatively thick piling mat.

7.2 Spread Foundations

It is not currently proposed to construct new buildings in the area of the existing school in the east and south of the site. However in these areas, where firm clay was encountered at relatively shallow depth, spread foundations bearing at a minimum depth of 0.75 m, could be designed to apply a net allowable bearing pressure of 125 kN/m^2.

7.3 Excavations

It is difficult to assess the potential stability of excavations from boreholes. However, on the basis of the observations of the materials on site it is anticipated that excavations in the made ground and glacial till are unlikely to remain dry and stable in the short to medium term. Where excavations penetrate sand layers and the made ground, water ingress may be anticipated. Such inflows should generally be adequately controllable with conventional sump pumping techniques although groundwater from within the landfill is unlikely to be suitable for direction into the main drainage system.

Where personnel are required to enter excavations, a risk assessment should be carried out and temporary lateral support or battering of the excavation sides provided in order to comply with normal safety requirements.

In view of the elevated gas measurements it is recommended that all excavations be monitored for soil gas concentrations and particularly if man-entry is required. At this stage consideration should be given to forced ventilation and the provision of gas monitors and alarms for relevant personnel.

7.4 Ground Floor Slabs

On the basis of the main building being piled and partially over the former landfill; a fully suspended ground floor slab construction should be adopted. The results of the gas monitoring results to date indicate that gas protection measures are likely to be required. Further monitoring

is currently underway and the results, together with recommendations will be issued as an addendum.

7.5 Effect of Sulphates

Chemical analyses of selected soil samples have revealed moderate to elevated concentrations of total and soluble sulphate corresponding to concrete class DS-3 of Table C2 of BRE Special Digest 1: SD1 Third Edition (2005). The elevated values are generally attributable to the made ground, with which pile and foundation concrete may come into contact. The measured pH conditions are such that with mobile groundwater conditions assumed for concrete, an ACEC classification of AC-4 may be adopted.

The guidelines contained in the above digest should be followed in the design of foundation concrete.

7.6 Retaining Walls

It is understood that there may be a requirement to retain soils within the southern and eastern parts of the site during reprofiling and following demolition. Such retaining walls are likely to be formed as gravity structures bearing onto the glacial till and for the design of such the following parameters are considered appropriate.

Stratum	Bulk Density (kg/m^3)	Effective Cohesion (c' – kN/m^2)	Effective Friction Angle (Φ' – degrees)
Made Ground (non-landfill)	1800	Zero	25
Stiff sandy clay	2000	Zero	28
Medium dense sand	1900	Zero	32

7.7 Pavement Design

The proposed areas of car parking are understood to be in the west of the site and almost totally over the deep and variable made ground. A substantial construction thickness would be required beneath the asphalt surfacing to minimise significant differential settlement. It is understood that a 450mm layer of a capping material (6F2) incorporating a geo-grid (Tensar) is to be allowed for beneath the nominal 150mm sub-base of MOT type 1. Even with such a construction, further settlement may occur and it would be prudent to set a strategy in place for periodic repair and / or replacement over the proposed lifetime of the surfaces.

Alternatively relocating the car park to the site of the current buildings is likely to reduce the thickness of material required although CBR testing will be required when the levels and layouts of pavements and car parks have been established.

7.8 Contamination Conceptual Model

The results of the contamination tests have generally confirmed the presence of arsenic contamination across the site within the made ground which is considered to probably be a result of the inclusions of ash and clinker. In addition the PAH and TPH are likely to derive from coal, clinker and probably lubricating mineral oil within the colliery waste.

The following tables summarises the Conceptual Model for the site and provides indication where pollution linkages may occur for which remedial action may be required.

SOURCE	RECEPTOR	PATHWAY	COMMENTS
Arsenic contamination within near surface soils; material NOT deriving from landfill	groundwater	percolation	percolation is not considered to pose a risk due to the depths of essentially impermeable glacial till which protect the underlying Coal Measures aquifer.
		groundwater	the metallic contaminants appear to be largely present within the made ground which is above and therefore isolated from the current groundwater where it exists within perched sand layers.
	end users	direct contact	end users will be effectively isolated from contaminants by new buildings and hardstanding areas. On the school fields there is a risk of ingestion and skin contact through games lessons and sports activities.
		ingestion of contaminated soil or dust	on the school fields during dry spells there is a risk of inhalation of wind blown dust and skin contact through games lessons and sports activities.
	site workers during construction	ingestion of contaminated soil or dust, skin contact, inhalation	appropriate protective equipment and working practices will be required during groundworks; however once the hard coverage of the site is in place dusting of the contaminated soils will not occur
	vegetation	uptake via soil, groundwater or vapour	landscaped areas are proposed along the eastern boundary. Appropriate thickness of clean imported topsoil to be laid to break any pathway.
Metallic contamination and asbestos within made ground comprising Landfill	groundwater	percolation	the cover thickness to be assessed across the landfill area. Percolation is not considered to pose a risk in areas of hardstanding or beneath the new buildings
		groundwater	the metallic contaminants are to be present within the made ground which is above and therefore isolated from the current groundwater where it exists within sand layers.
	end users	direct contact	end users will be effectively isolated from contaminants by new buildings and hardstanding areas. On the school fields there is a risk of ingestion and skin contact through games lessons and sports activities. A site specific risk assessment is proposed in these areas.
		ingestion of contaminated soil or dust	on the school fields during dry spells there is a risk of inhalation of wind blown dust and skin contact through games lessons and sports activities. Site specific risk assessment is proposed.
	site workers during construction	ingestion of contaminated soil or dust, skin contact, inhalation	appropriate protective equipment and working practices will be required during groundworks if the landfill materials are uncovered. However once the hard coverage of the site, or further capping material is in place dusting of the contaminated soils will not occur.
	vegetation	uptake via soil, groundwater or vapour	landscaped areas are still to be defined and will require further consideration and appropriate thickness of clean imported topsoil to be laid to break any pathway.

Each of the potential pollution linkages is considered in more detail below.

7.8.1 Groundwater

The groundwater is apparently present within layers of sand within the Glacial Deposits, and is therefore thought likely to be perched within the largely impermeable clay, with the main aquifer within the Sherwood Sandstone reportedly at a considerable depth beneath the surface. The till may generally be considered to protect the groundwater from the vertical migration of contaminants from the made ground above. This protection will be enhanced by the hard covering of the site in the areas of car parking and playground as well as the area covered by the proposed buildings.

7.8.2 End Users

7.8.2.1 Direct Contact

End users will be effectively isolated from direct contact with the identified contaminants by the extent of buildings and areas of external hardstanding. Areas of soft landscaping have yet to be defined and will require further consideration in due course. An appropriate depth of clean topsoil will be required prior to planting in areas of former landfill.

On the playing fields there is a limited risk that children could come into contact with the arsenic. The arsenic is, however contained within the made ground which contained ash and clinker. The risk is perceived to be in skin contact and in dusting during summer periods. In the field area over the landfill the cover appears to be of between 0.25 m and 0.35 m in thickness. Further site specific risk assessment should be undertaken in respect of the measured contaminants and the depth of cover together with the likely exposure times for each age group. Such a quantitative assessment would indicate whether or not clean material would be required to cover the playing fields following construction of the school.

7.8.2.2 Vapours

Concentrations of PAH are unlikely to pose a risk of vapours within the proposed buildings, however the measures proposed for the soil gas will more than adequately deal with moderate vapour concentrations should they arise.

7.8.3 Site Workers

Concentrations of metals and asbestos have been measured in the soils within this investigation. Site workers should be made aware of the contamination and a programme of working should be identified to protect workers handling any soil. The method of site working should be in accordance with guidelines set out by HSE[2] and CIRIA[3] and the requirements of the Local Authority Environmental Health Officer. Further if workers were to complain of skin or eye irritation or nausea then work should be suspended pending further investigation.

2 HSE (1992) HS(G)66 *Protection of workers and the general public during the development of contaminated land* HMSO

3 CIRIA (1996) *A guide for safe working on contaminated sites* Report 132, Construction Industry Research and Information Association

7.9 Soil Gas

On the basis of previous investigations, the current readings and the nature of the made ground, significant concentrations of methane and carbon dioxide can be expected within the soil gas. At this stage, the requirement for full gas protection measures including a positively vented layer should be anticipated. Although the detail would require further development it may be possible to incorporate such a layer within the piling mat construction and therefore gain some economical benefit.

If the proposed buildings were to be moved away from the former landfill area and closer to the south-eastern corner of the site it is considered possible that the gas protection measures required could be reduced, or, for example, a vertical gas protection barrier installed between the landfill and the new structures.

It would be prudent to investigate ground gas mitigation within the existing sports hall building. This should include a review of the current protection measures and assessment of whether a retro-fit method of protection is required. Further monitoring is currently underway and the results will be drawn together in an addendum to this report in due course. The above recommendations will therefore be reviewed at that stage.

7.10 Waste Disposal

Any spoil arising from excavations or landscaping works will need to be disposed of to a licensed tip. Under the European Waste Directive landfills are classified as accepting inert, non-hazardous or hazardous wastes in accordance with the EU waste Directive. The classification of soils discarded during the development of this site as Inert or Hazardous waste which are to be disposed of at landfill may need to be established by comparison with the Waste Acceptance Criteria (WAC) based upon the results of CEN method bulk leaching tests or percolation tests. Such tests should be carried out upon representative samples from the waste stream once the extent of the materials to be discarded has been established.

Based upon the results of the analyses carried out and the technical guidance provided by the Environment Agency[4] it is considered likely that the made ground deriving from the landfill would be classified as Hazardous and natural soils from this site would be generally classified as Non-hazardous. Further more, the asbestos discovered within Borehole No WS09 is likely to put material from that area into the Hazardous waste category. This classification should be confirmed by the receiving landfill once the soils to be discarded have been defined. In order to finalise this classification it may be necessary to carry out further analyses including WAC CEN method bulk leaching tests should an inert waste classification be sought.

8.0 FURTHER WORK

It is understood that this investigation is to be followed in due course by a targeted ground investigation when the layout and extent of peripheral works have been defined.

The next phase of investigation would be expected to include further boreholes to refine the pile design and to establish the extent of the landfill with greater confidence. Such investigation is recommended to provide a more complete view of the sand layer within the proposed building layout. In this regard further cable tool boreholes and dynamic cone penetrometer plots could

[4] Environment Agency 2003. *Hazardous Waste: Interpretation of the definition and classification of hazardous waste.* Technical Guidance WM2

prove most useful.

The depth of cover to the landfill which exists beneath the school playing fields should be established and a detailed quantitative risk assessment undertaken to provide recommendations over the depth of cover to the made ground in the light of the contaminant concentrations beneath.

When the levels and layout of landscaping has been finalised CBR testing could be undertaken to establish design parameters for pavements and other car parking.

APPENDIX

Borehole Records

SPT Summary

Laboratory Test Results
: Summary of Geotechnical Results
Particle Size Distribution Test Results

Chemical Test Results

Generic Guideline Values

Gas Monitoring Results

Historical Maps

Site Plan

GEA Geotechnical & Environmental Associates	Tyttenhanger House Coursers Road St Albans AL4 0PG	**Site** Plant Hill High School, Plant Hill Road, Higher Blackley, Manchester	**Borehole Number** **BH01**
Boring Method Cable Percussion	**Casing Diameter** 150mm cased to 17.00m	**Ground Level (mOD)** 87.50	**Client** Balfour Beatty Construction Limited	**Job Number** J06365
	Location	**Dates** 06/12/2006- 07/12/2006	**Engineer** Cundall Johnston and Partners LLP	**Sheet** 1/3

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
						(0.40)	Made Ground (Brown humic sandy clay)		
0.40-0.50	D1				87.10	0.40	Made Ground (Dark grey and black sand, ash, timber, steel wire, paper, pottery and plastic)		
1.00-1.45 1.00-1.45	SPT N=9 S2			1,1/1,1,1,6		(1.60)			
1.50-1.60	D3								
2.00-2.45 2.00-2.45	SPT N=7 S4	1.80 1.80		1,1/1,1,3,2	85.50	2.00	No recovery, loose drilling		
3.00-3.45	SPT N=7	3.00		1,1/2,1,2,2		(2.20)			
3.50-3.60	D5	3.00							
4.00-4.45	d6	4.00	3.90	Water strike(1) at 4.00m, rose to 3.90m in 20 mins, sealed at 4.50m.	83.30	4.20	Soft yellow brown silty CLAY with layers of fine to medium sand		▼1 ▽1
4.00-4.45 4.50-4.60	SPT N=3 D7	4.00	3.90	0,0/0,1,1,1		(1.40)			
5.00-5.45 5.00-5.45	SPT N=5 S8	4.80 4.80		0,1/1,1,1,2					
5.50-5.60	D9				81.90	5.60	Medium dense pale brown silty fine to medium SAND with thin layers of clay		
6.50-6.95 6.50-6.95	SPT N=21 S10	6.00 6.00		3,3/4,5,6,6		(2.40)			
7.00-7.50	B11								
8.00-8.45 8.00-8.45	SPT N=19 S12	7.80 7.80		2,3/3,4,6,6	79.50	8.00	Firm brown silty CLAY becoming pale brown silty fine sand		
8.50-9.00	B13								
9.40-9.50	D14					(2.80)			
9.50-9.95 9.50-9.95	SPT N=17 S15	9.00 9.00		3,3/4,4,4,5					

Remarks
Borehole backfilled with arisings from 20.5 m to 10.0 m and with bentonite from 10.0 m to ground level.

Scale (approx)	Logged By
1:50	MC

Figure No.
J06365.BH01

Produced by the GEOtechnical DAtabase SYstem (GEODASY) (C) all rights reserved

Geotechnical & Environmental Associates	Tyttenhanger House Coursers Road St Albans AL4 0PG	**Site** Plant Hill High School, Plant Hill Road, Higher Blackley, Manchester	**Borehole Number** **BH01**

Boring Method	**Casing Diameter**	**Ground Level (mOD)**	**Client**	**Job Number**
Cable Percussion	150mm cased to 17.00m	87.50	Balfour Beatty Construction Limited	J06365
	Location	**Dates** 06/12/2006- 07/12/2006	**Engineer** Cundall Johnston and Partners LLP	**Sheet** 2/3

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
10.00-10.10	D16					(2.80)			
10.80-10.90	D17				76.70	10.80			
11.00-11.45	SPT N=16	10.50		3,4/4,4,4,4			Stiff brown laminated CLAY with thin laminations of pale brown fine sand		
11.00-11.45	S18	10.50							
11.90-12.00	D19								▼2
12.50-12.95	S20	12.30	12.00	Water strike(2) at 12.50m, rose to 12.00m in 20 mins.					▽2
12.50-12.95	SPT N=14	12.30	12.00	2,2/3,3,4,4					
12.90-13.00	D21					(4.50)			
13.90-14.00	D22								
14.00-14.45	SPT N=14	13.50	13.00	1,2/3,3,4,4					
14.00-14.45	S23	13.50	13.00						
14.90-15.00	D24								
15.30-15.40	D25				72.20	15.30			
15.50-15.95	SPT N=28	15.30	14.70	3,5/6,7,7,8			Stiff to very stiff dark greyish brown sandy CLAY with occasional gravel and cobbles		
15.50-15.95	S26	15.30	14.70						
16.40-16.50	D27								
17.00-17.45	SPT N=31	16.80	16.50	5,6/7,7,8,9					
17.00-17.45	S28	16.80	16.50						
17.40-17.50	D29					(5.20)			
18.40-18.50	D30								
18.50-18.95	SPT N=33	17.00		5,6/7,8,8,10					
18.50-18.95	S31	17.00							
19.50-19.60	D32								
20.05-20.50	SPT N=39	17.00		6,7/8,9,10,12					

Remarks
Chiselling from 18.10m to 18.30m for 1/2 hour.

Scale (approx)	**Logged By**
1:50	MC

Figure No.
J06365.BH01

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GEA Geotechnical & Environmental Associates	Tyttenhanger House Coursers Road St Albans AL4 0PG	**Site** Plant Hill High School, Plant Hill Road, Higher Blackley, Manchester	**Borehole Number** **BH01**

Boring Method	**Casing Diameter**	**Ground Level (mOD)**	**Client**	**Job Number**
Cable Percussion	150mm cased to 17.00m	87.50	Balfour Beatty Construction Limited	J06365
	Location	**Dates** 06/12/2006- 07/12/2006	**Engineer** Cundall Johnston and Partners LLP	**Sheet** 3/3

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
20.05-20.50	S33	17.00				(5.20)			
					67.00	20.50	Complete at 20.50m		

Remarks

Scale (approx)	**Logged By**
1:50	MC

Figure No.
J06365.BH01

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GEA Geotechnical & Environmental Associates Tyttenhanger House Coursers Road St Albans AL4 0PG	**Site** Plant Hill High School, Plant Hill Road, Higher Blackley, Manchester	**Borehole Number** **BH03**	
Boring Method Cable Percussion	**Casing Diameter** 150mm cased to 17.00m	**Ground Level (mOD)** 85.90	**Client** Balfour Beatty Construction Limited	**Job Number** J06365
	Location	**Dates** 08/12/2006- 13/12/2006	**Engineer** Cundall Johnston and Partners LLP	**Sheet** 1/3

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
							Made Ground (Greyish brown very sandy clay)		
0.20-0.30	D1					(0.60)			
					85.30	0.60			
0.60-0.70	D2						Made Ground (Sandy ash, brick, stone, timber, glass, rubber with pockets of soft to firm grey to brown sand and clay)		
1.20-1.65	SPT N=7			1,2/2,2,2,1					
1.20-1.65	S3								
1.70-1.80	D4								
2.00-2.45	SPT N=9	1.80		1,0/1,2,2,4					
2.00-2.45	S								
2.50-2.60	D5					(3.90)			
3.00-3.45	SPT N=6	2.80		1,1/1,2,1,2					
3.00-3.45	S6								
3.50-3.60	D7								▼1
4.00-4.45	S			1(1) at 4.00m, rose to 3.70m in 20 mins.					▽1
4.00-4.45	SPT N=8	3.80		1,0/1,2,2,3					
4.40-4.50	D8				81.40	4.50			
4.50-4.60	D9						Firm dark brown and brown sandy CLAY		
5.00-5.45	SPT N=15	4.80		1,2/2,3,4,6					
5.00-5.45	S10								
5.50-5.60	D11					(2.50)			
6.40-6.50	D12								
6.50-6.95	U13			42 blows					
6.95-7.00	D14				78.90	7.00			
							Medium dense brownish grey very clayey medium SAND		
7.50-7.60	D15								
8.00-8.45	SPT N=16	7.50		2,3/3,4,4,5		(2.10)			
8.00-8.45	S16								
8.40-8.50	D17								
8.50-9.00	B18								
9.10-9.20	D19				76.80	9.10			
							Stiff brownish grey very sandy CLAY		
9.50-9.95	U20			68 blows					

Remarks
50 mm combined gas and groundwater monitoring standpipe installed to a depth of 5.0 m with a response zone from 1.0 m to 5.0 m

Scale (approx)	Logged By
1:50	MC

Figure No.
J06365.BH03

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Geotechnical & Environmental Associates	Tyttenhanger House Coursers Road St Albans AL4 0PG	**Site** Plant Hill High School, Plant Hill Road, Higher Blackley, Manchester	**Borehole Number** **BH03**
Boring Method Cable Percussion	**Casing Diameter** 150mm cased to 17.00m	**Ground Level (mOD)** 85.90	**Client** Balfour Beatty Construction Limited	**Job Number** J06365
	Location	**Dates** 08/12/2006-13/12/2006	**Engineer** Cundall Johnston and Partners LLP	**Sheet** 2/3

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
9.95-10.00	D21								
10.50-10.60	D22					(2.40)			
11.00-11.45	SPT N=47			4,5/5,9,13,20					
11.00-11.45	S23								
					74.40	11.50			
11.50-11.60	D24						Dense greyish brown silty fine SAND		
11.60-12.10	B25					(0.80)			
12.30-12.40	D26				73.60	12.30			
12.50-12.95	SPT N=31	12.00		4,5/7,7,8,9			Stiff dark greyish brown sandy CLAY with occasional mudstone gravel		
12.50-12.95	S27								
13.50-13.60	D28								
14.00-14.45	SPT N=31	13.50		3,4/6,7,8,10					
14.00-14.45	S29								
14.50-14.60	D30					(4.30)			
15.40-15.50	D31								
15.50-15.95	SPT N=29	15.00		3,5/6,6,8,9					
15.50-15.95	S32								▼2
				Water strike(2) at 16.50m, rose to 16.00m in 20 mins, sealed at 17.00m.					▽2
16.60-16.70	D33				69.30	16.60	Stiff dark greyish brown laminated sandy CLAY with occasional mudstone gravel and laminations of fine brown sand		
17.00-17.45	SPT N=27	17.00	16.50	4,5/6,6,7,8					
17.00-17.45	S34								
17.50-17.60	D35					(2.80)			
18.40-18.50	D36								
18.50-18.95	SPT N=34	17.00		3,5/7,8,9,10					
18.50-18.95	S37								
					66.50	19.40			
19.40-19.50	D38								
20.05-20.50	SPT N=40			5,7/8,9,11,12					

Remarks

Scale (approx)	Logged By
1:50	MC

Figure No.
J06365.BH03

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Geotechnical & Environmental Associates	Tyttenhanger House Coursers Road St Albans AL4 0PG	**Site** Plant Hill High School, Plant Hill Road, Higher Blackley, Manchester	**Borehole Number** **BH03**

Boring Method	**Casing Diameter**	**Ground Level (mOD)**	**Client**	**Job Number**
Cable Percussion	150mm cased to 17.00m	85.90	Balfour Beatty Construction Limited	J06365
	Location	**Dates** 08/12/2006- 13/12/2006	**Engineer** Cundall Johnston and Partners LLP	**Sheet** 3/3

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
20.05-20.50	S39						Complete at 20.50m		

Remarks	**Scale (approx)**	**Logged By**
	1:50	MC
	Figure No.	
	J06365.BH03	

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Geotechnical & Environmental Associates	Tyttenhanger House Coursers Road St Albans AL4 0PG	**Site** Plant Hill High School, Plant Hill Road, Higher Blackley, Manchester	**Borehole Number** **BH04**
Boring Method Cable Percussion	**Casing Diameter** 150mm cased to 12.00m	**Ground Level (mOD)** 89.90	**Client** Balfour Beatty Construction Limited	**Job Number** J06365
	Location	**Dates** 14/12/2006-15/12/2006	**Engineer** Cundall Johnston and Partners LLP	**Sheet** 1/3

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					89.85	(0.05)	Made Ground (Tarmac)		
0.10-0.20	D1					0.05			
0.30-0.40	D2					(0.55)	Made Ground (Firm brown and grey mottled very sandy clay with traces of brick, coal, roots, charcoal and wood)		
					89.30	0.60			
0.60-0.70	D3						Soft pale orange brown and pale grey mottled very silty very sandy CLAY		
1.00-1.45	U4			32 blows					
						(1.40)			
1.45-1.50	D5								
					87.90	2.00			
2.00-2.45	SPT N=16	1.80	1.70	1,2/3,4,4,5			Firm greyish brown sandy CLAY with occasional fine mudstone gravel		
2.00-2.45	S6	1.80	1.70						
2.50-2.60	D7								
						(1.40)			
3.00-3.45	SPT N=12	2.80		1,2/3,3,3,3					
3.00-3.45	S8	2.80							
					86.50	3.40			
3.50-3.60	D9						Medium dense greyish brown fine SAND		
4.00-4.45	U10	4.00		28 blows					
						(1.80)			
4.45-4.50	D11								
5.00-5.45	SPT N=32	4.70		3,5/7,7,8,10					
5.00-5.45	S12	4.70			84.70	5.20			
5.20-5.30	D13						Firm greyish brown sandy CLAY with occasional fine mudstone gravel and thin sand layers		
5.80-5.90	D14								
						(1.90)			
6.30-6.40	D151								
6.50-6.83	SPT 50/180			5,9/15,22,13					
6.50-6.95	S6								
6.50-7.00	D17								
7.00-7.10	D18				82.80	7.10	Stiff greyish brown sandy CLAY with layers of fine silty sand		
7.60-7.70	D19								
						(1.75)			
8.00-8.45	SPT N=12	7.80		2,3/3,3,3,3					
8.00-8.45	S20	7.80							
8.50-8.60	D21								
					81.05	8.85			
					80.90	(0.15) 9.00	Medium dense brown fine to medium SAND with occasional gravel		
							Medium dense and locally dense greyish brown very silty fine to medium SAND		
9.40-9.50	D22								
9.50-9.95	SPT N=18	9.00		2,3/4,4,5,5					
9.50-9.95	S23	9.00							

Remarks
Chiselling from 6.70m to 7.00m for .75 hours.

Scale (approx)	Logged By
1:50	MC

Figure No.
J06365.BH04

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GEA Geotechnical & Environmental Associates	Tyttenhanger House Coursers Road St Albans AL4 0PG	**Site** Plant Hill High School, Plant Hill Road, Higher Blackley, Manchester	**Borehole Number** **BH04**

Boring Method	**Casing Diameter**	**Ground Level (mOD)**	**Client**	**Job Number**
Cable Percussion	150mm cased to 12.00m	89.90	Balfour Beatty Construction Limited	J06365
	Location	**Dates** 14/12/2006- 15/12/2006	**Engineer** Cundall Johnston and Partners LLP	**Sheet** 2/3

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
10.00-10.50	B24								
10.50-10.60	D25								
11.00-11.45	SPT N=22	10.80		3,4/4,5,6,7					
11.00-11.45	S26	10.80							
11.50-11.60	D27								
12.40-12.50	D28								
12.50-12.95	SPT N=23			3,4/5,5,6,7					
12.50-12.95	S29								
13.50-13.60	D30								
14.00-14.45	SPT N=26	14.00	13.50	4,5/6,6,7,7					
14.00-14.45	S31	14.00	13.50						
14.50-14.60	D32								
						(11.50)			
15.40-15.50	D33								
15.50-15.95	SPT N=34	15.40	14.50	4,5/7,8,9,10					
15.50-15.95	S34	15.40	14.50						
16.40-16.50	D35								
17.00-17.45	SPT N=28	16.80	16.00	4,5/6,7,7,8					
17.00-17.45	S36	16.80	16.00						
17.50-17.60	D37								
18.40-18.50	D38								
18.50-18.95	SPT N=23	18.50		3,4/4,5,6,8					
18.50-18.95	S39	18.50							
19.50-19.60	D40								
20.05-20.50	SPT N=26	20.00		3,4/5,6,7,8					

Remarks
Water added from 13.50m to 13.60m.

Scale (approx)	**Logged By**
1:50	MC

Figure No.
J06365.BH04

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Geotechnical & Environmental Associates	Tyttenhanger House Coursers Road St Albans AL4 0PG	**Site** Plant Hill High School, Plant Hill Road, Higher Blackley, Manchester	**Borehole Number** **BH04**

Boring Method	**Casing Diameter**	**Ground Level (mOD)**	**Client**	**Job Number**
Cable Percussion	150mm cased to 12.00m	89.90	Balfour Beatty Construction Limited	J06365
	Location	**Dates** 14/12/2006- 15/12/2006	**Engineer** Cundall Johnston and Partners LLP	**Sheet** 3/3

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
20.05-20.50	S41	20.00				(11.50)			
					69.40	20.50	Complete at 20.50m		

Remarks

Scale (approx)	**Logged By**
1:50	MC

Figure No.
J06365.BH04

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GEA Geotechnical & Environmental Associates	Tyttenhanger House Coursers Road St Albans AL4 0PG	**Site** Plant Hill High School, Plant Hill Road, Higher Blackley, Manchester	**Number** **WS01**
Excavation Method Open drive lined percussive sampler	**Dimensions**	**Ground Level (mOD)** 88.20	**Client** Balfour Beatty Construction Limited	**Job Number** J06365
	Location	**Dates** 06/12/2006	**Engineer** Cundall Johnston and Partners LLP	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
				88.00	(0.20) 0.20	Made Ground (Dark brown humic sandy clay)		
					(0.60)	Made Ground (Dark brown and black slightly clayey humic sand with fragments of brick, concrete, gravel and rootlets)		
0.60	D1			87.40	0.80			
1.00-1.45	CPT N=9		1,2/0,0,1,8	87.20	(0.20) 1.00	Made Ground (Broken concrete and brick)		
1.60	62					Made Ground (Black fragments of ash, brick, glass, pottery, wood, metal and plastic)		
2.00-2.45	CPT N=1		1,0/0,0,1,0					
2.60	D3							
3.00-3.45	CPT N=14		2,4/6,4,3,1					
3.60	D4							
4.00-4.45	CPT N=0		1,1/0,0,0,0		(6.50)			
4.60	D5							
5.00-5.45	CPT N=6		1,1/2,1,1,2					
5.60	D6							
6.00-6.45	CPT N=2		2,3/1,1,0,0					
6.60	D7							
7.00-7.45	CPT N=4		1,1/1,1,1,1					
				80.70	7.50	Soft dark grey and dark brown mottled sandy silty CLAY with black silt partings		
8.30	D8				(1.10)			
8.80	D9			79.60	8.60	Firm pale orange-brown and pale grey mottled sandy CLAY		
				79.20	(0.40) 9.00	Complete at 9.00m		

Remarks
50 mm combined gas and groundwater monitoring standpipe installed to a depth of 8.0 m with a response zone from 1.0 m to 8.0 m
Cased to 5.0 m
Groundwater not encountered

Scale (approx)	Logged By
1:50	EMA

Figure No.
J06365.WS01

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GEA Geotechnical & Environmental Associates Tyttenhanger House Coursers Road St Albans AL4 0PG	**Site** Plant Hill High School, Plant Hill Road, Higher Blackley, Manchester		**Number** **WS02**
Excavation Method Open drive lined percussive sampler	**Dimensions**	**Ground Level (mOD)** 88.30	**Client** Balfour Beatty Construction Limited	**Job Number** J06365
	Location	**Dates** 05/12/2006	**Engineer** Cundall Johnston and Partners LLP	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
				88.20	(0.10)	Made Ground (Dark brown humic silty sandy clay)		
					0.10			
0.20	D1				(0.40)	Made Ground (Reddish-brown clayey sand and gravel with fragments of wood and rootlets)		
				87.80	0.50			
						Pale orange-brown medium SAND with occasional fine to medium gravel, becoming darker with depth		
0.90	D2							
1.00-1.45	SPT N=13		1,2/2,3,4,4					
					(2.00)			
1.50	D3							
2.00-2.45	SPT N=23		4,4/5,5,6,7					
				85.80	2.50			
						Medium dense orange-brown slightly clayey medium SAND with occasional fine to medium gravel, becoming paler with depth		
3.00-3.45	CPT N=11		3,4/3,3,3,2		(1.20)			
				84.60	3.70			
3.90	D4					Firm brown slightly sandy CLAY		▽1
			Water strike(1) at 4.00m.		(0.75)			
4.00-4.45	CPT N=10		1,1/2,2,3,3					
				83.85	4.45			
						Complete at 4.45m		

Remarks
Groundwater standing at a depth of 4.0 m on withdrawal of casing on completion of the borehole

Scale (approx)	Logged By
1:50	EMA

Figure No.
J06365.WS02

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GEA Geotechnical & Environmental Associates Tyttenhanger House Coursers Road St Albans AL4 0PG	**Site** Plant Hill High School, Plant Hill Road, Higher Blackley, Manchester		**Number** **WS03**
Excavation Method Open drive lined percussive sampler	**Dimensions**	**Ground Level (mOD)** 87.70	**Client** Balfour Beatty Construction Limited	**Job Number** J06365
	Location	**Dates** 04/12/2006	**Engineer** Cundall Johnston and Partners LLP	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
				87.45	(0.25) 0.25	Made Ground (Dark brown humic clayey sand with roots and fragments of glass)		
0.20	D1							
0.50	D2				(0.60)	Made Ground (Brown sandy clay with fragments of coarse sand sized ash and occasional medium gravel)		
				86.85 86.80	0.85 (0.05)	Made Ground (Black shredded rubber)		
					0.90	Made Ground (Fragments of wood, brick, concrete, pottery, plastic, textile and glass with occasional fragments of ash)		
1.20	D3							
					(6.10)			
6.90	D4			80.70	7.00			
						Complete at 7.00m		

Remarks
Groundwater not encountered

Scale (approx)	Logged By
1:50	EMA

Figure No.
J06365.WS03

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GEA Geotechnical & Environmental Associates	Tyttenhanger House Coursers Road St Albans AL4 0PG	**Site** Plant Hill High School, Plant Hill Road, Higher Blackley, Manchester	**Number** **WS04**
Excavation Method Open drive lined percussive sampler	**Dimensions**	**Ground Level (mOD)** 89.20	**Client** Balfour Beatty Construction Limited	**Job Number** J06365
	Location	**Dates** 04/12/2006	**Engineer** Cundall Johnston and Partners LLP	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.25)	Made Ground (Dark brown humic sandy clay with gravel sized fragments of concrete, brick, clinker and fragments of ash and coal)		
0.20	J1			88.95	0.25			
0.50	D2				(0.45)	Made Ground (Yellowish-brown and pale grey mottled sandy clay, sandy layers and fragments of yellowish-brown sandstone)		
0.90	D3			88.50	0.70			
1.00-1.45	CPT N=15		1,3/3,4,4,4		(0.50)	Medium dense pale greyish-brown and orange-brown mottled very clayey slightly gravelly SAND		
1.50	D4			88.00	1.20	Firm pale brown and pale grey mottled very sandy CLAY with laminations of very dark fine silty sand		
2.00-2.45	SPT N=9		2,3/2,2,2,3		(1.90)			
2.50	D5							
3.00-3.45	SPT N=13		1,2/2,2,4,5	86.10	3.10	Firm greyish-brown silty CLAY with occasional fragments of mudstone and siltstone		
3.70	D6				(1.20)			
4.00-4.45	SPT N=23		5,6/6,6,5,6					
				84.90	4.30	Medium dense pale brown fine to medium SAND with occasional gravel		
4.80-5.00	D7				(0.70)			
5.00-5.45	CPT N=4		1,1/1,1,1,1	84.20	5.00	Complete at 5.45m		

Remarks
Groundwater not encountered
50 mm combined gas and groundwater monitoring standpipe installed to a depth of 4.0 m with a response zone from 1.0 m to 4.0 m

Scale (approx)	Logged By
1:50	MC

Figure No.
J06365.WS04

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GEA Geotechnical & Environmental Associates	Tyttenhanger House Coursers Road St Albans AL4 0PG	**Site** Plant Hill High School, Plant Hill Road, Higher Blackley, Manchester	**Number** **WS05**
Excavation Method Open drive lined percussive sampler	**Dimensions**	**Ground Level (mOD)**	**Client** Balfour Beatty Construction Limited **Job Number** J06365
	Location	**Dates** 05/12/2006	**Engineer** Cundall Johnston and Partners LLP **Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.20)	Made Ground (Dark brown silty clayey sand with occasional gravel and fragments of brick, rootlets and plastic)		
0.30	D1				0.20 (0.20)	Made Ground (Gravel in a dark brown sandy clay matrix)		
					0.40	Firm reddish-brown sandy CLAY with occasional gravel and fine gravel sized coal fragments		
0.90	D2		Water strike(1) at 0.90m.					▽1
1.00-1.45	SPT N=11		2,2/2,3,3,3					
					(2.00)			
2.00-2.45	SPT N=16		2,3/3,3,5,5					
					2.40 (0.10)	Orange-brown medium sized SAND		
					2.50 (0.20)	Soft to firm orange-brown very sandy CLAY		
3.00-3.45	CPT N=5		1,1/1,2,1,1		2.70	Loose orange-brown SAND with occasional black partings of coal fragments		
3.20	D3				(1.30)			
4.00-4.45	CPT N=12		1,1/1,2,2,7		4.00	Complete at 4.00m		

Remarks
Groundwater standing at a depth of 0.9 m on withdrawal of casing on completion of the borehole

Scale (approx)	**Logged By**
1:50	EMA

Figure No.
J06365.WS05

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GEA Geotechnical & Environmental Associates	Tyttenhanger House Coursers Road St Albans AL4 0PG	**Site** Plant Hill High School, Plant Hill Road, Higher Blackley, Manchester	**Number** **WS06**
Excavation Method Open drive lined percussive sampler	**Dimensions**	**Ground Level (mOD)** 87.80	**Client** Balfour Beatty Construction Limited	**Job Number** J06365
	Location	**Dates** 05/12/2006	**Engineer** Cundall Johnston and Partners LLP	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
				87.70	(0.10)	Made Ground (Dark brown and black humic silty clay)		
				87.60	0.10			
0.30	D1				(0.10)	Made Ground (Sandy gravel sub-base)		
				87.30	0.20			
					(0.30)	Made Ground (Dark brown silty sandy clay with a gravel of dark glassy fragments at 0.3 m)		
					0.50			
0.90	D2		Water strike(1) at 1.00m.			Medium dense and locally loose orange-brown fine and medium SAND with occasional pale yellowish-brown, grey and black mottling becoming slightly clayey with depth		▽1
1.00-1.45	SPT N=12		3,4/2,3,3,4					
1.90	D3							
2.00-2.45	SPT N=13		1,2/3,3,4,3					
					(3.95)			
3.00-3.45	CPT N=9		1,2/2,2,2,3					
4.00-4.45	CPT N=21		2,4/4,4,6,7					
				83.35	4.45	Complete at 4.45m		

Remarks
Groundwater standing at a depth of 1.0 m on withdrawal of casing on completion of the borehole

Scale (approx)	Logged By
1:50	EMA

Figure No.
J06365.WS06

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GEA Geotechnical & Environmental Associates	Tyttenhanger House Coursers Road St Albans AL4 0PG	**Site** Plant Hill High School, Plant Hill Road, Higher Blackley, Manchester	**Number** **WS07**
Excavation Method Open drive lined percussive sampler	**Dimensions**	**Ground Level (mOD)** 87.20	**Client** Balfour Beatty Construction Limited	**Job Number** J06365
	Location	**Dates** 07/12/2006	**Engineer** Cundall Johnston and Partners LLP	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.30)	Made Ground (Dark brown humic clayey sand with rootlets and occasional brick fragments)		
0.20	D1			86.90	0.30			
0.60	D2				(0.70)	Made Ground (Pale brown, pale grey and pale orange mottled slightly sandy clay)		
				86.20	1.00			
					(2.25)	Made Ground (Black fragments of glass, plastic, wood, brick, gravel, metal and ash)		
2.80	D3							
				83.95	3.25			
3.40	D4				(0.75)	Firm becoming stiff reddish-brown slightly sandy CLAY with occasional fine gravel of coal		
				83.20	4.00			
						Complete at 4.00m		

Remarks
Groundwater not encountered
50 mm combined gas and groundwater monitoring standpipe installed to a depth of 4.0 m with a response zone from 1.0 m to 4.0 m

Scale (approx)	Logged By
1:50	EMA

Figure No.
J06365.WS07

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GEA Geotechnical & Environmental Associates Tyttenhanger House Coursers Road St Albans AL4 0PG	**Site** Plant Hill High School, Plant Hill Road, Higher Blackley, Manchester	**Number** **WS08**	
Excavation Method Open drive lined percussive sampler	**Dimensions**	**Ground Level (mOD)** 87.60	**Client** Balfour Beatty Construction Limited	**Job Number** J06365
	Location	**Dates** 11/12/2006	**Engineer** Cundall Johnston and Partners LLP	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
				87.35	(0.25) 0.25	Made Ground (Dark brown very sandy humic clay with rootlets and traces of brick)		
				87.15	(0.20) 0.45	Made Ground (Firm pale yellowish-brown silty very sandy clay)		
0.70	J1		Water strike(1) at 0.80m.	86.60	(0.55) 1.00	Made Ground (Dark brown, greyish brown and black silty gravelly sand with fragments of coal, ash, clinker, soot and brick)		▽1
1.20 1.30	D2 D5			86.25	(0.35) 1.35	Pale grey and very pale brown very silty very sandy CLAY with dark grey speckling		
1.60	D3					Firm becoming stiff pale reddish-brown and pale grey mottled sandy CLAY		
2.30	D4			84.60	(1.65) 3.00			
						Complete at 3.00m		

Remarks
Groundwater standing at a depth of 0.8 m on withdrawal of casing on completion of the borehole

Scale (approx)	Logged By
1:50	MC

Figure No.
J06365.WS08

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GEA Geotechnical & Environmental Associates Tyttenhanger House Coursers Road St Albans AL4 0PG	**Site** Plant Hill High School, Plant Hill Road, Higher Blackley, Manchester		**Number** **WS09**
Excavation Method Open drive lined percussive sampler	**Dimensions**	**Ground Level (mOD)** 87.00	**Client** Balfour Beatty Construction Limited	**Job Number** J06365
	Location	**Dates** 11/12/2006	**Engineer** Cundall Johnston and Partners LLP	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
				86.80	(0.20) 0.20	Made Ground (Dark brown very sandy humic clay with rootlets and traces of brick)		
				86.60	(0.20) 0.40	Made Ground (Pale yellowish-brown silty very sandy clay)		
					(1.10)	Made Ground (Dark brown, greyish brown and black silty gravelly sand with fragments of coal, ash, clinker and brick)		
				85.50	1.50			
					(0.60)	Firm pale grey and very pale brown very silty very sandy CLAY with dark grey speckling		
2.00-2.45	SPT N=10		0,1/1,2,3,4	84.90	2.10			
3.00-3.45	SPT N=10		2,2/2,2,3,3		(1.90)	Firm becoming stiff pale reddish-brown and pale grey mottled sandy CLAY with thin layers of pale brown fine sand		
4.00-4.45	SPT N=13		2,1/3,3,3,4	83.00	4.00			
					(0.45)	Medium dense pale brown fine to medium SAND		
				82.55	4.45			
						Complete at 4.45m		

Remarks
Groundwater not encountered

Scale (approx)	Logged By
1:50	MC

Figure No.
J06365.WS09

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GEA Geotechnical & Environmental Associates Tyttenhanger House Coursers Road St Albans AL4 0PG	**Site** Plant Hill High School, Plant Hill Road, Higher Blackley, Manchester	**Number** **WS10**	
Excavation Method Open drive lined percussive sampler	**Dimensions**	**Ground Level (mOD)** 87.20	**Client** Balfour Beatty Construction Limited	**Job Number** J06365
	Location	**Dates** 11/12/2006	**Engineer** Cundall Johnston and Partners LLP	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.30)	Made Ground (Dark brown humic sandy clay with fragments of clinker, coal, rootlets and tin can)		
0.20	J1			86.90	0.30	Firm pale brown very sandy CLAY		
0.80	D2				(1.20)			
1.00-1.45	SPT N=15		1,3/3,3,4,5					
1.30	D3			85.70	1.50	Stiff greyish brown sandy CLAY with occasional fine gravel and layers of pale brown fine to medium sand		
2.00-2.45	SPT N=16		1,1/2,4,4,6					
2.20	D4				(2.95)			
3.00-3.45	SPT N=15		2,2/3,3,4,5					
3.20	D5							
4.00-4.45	SPT N=22		1,3/4,4,7,7					
4.20	D6			82.75	4.45	Complete at 4.45m		

Remarks
50 mm combined gas and groundwater monitoring standpipe installed to a depth of 5.0 m with a response zone from 1.0 m to 5.0 m
Layers of sand were observed to be wet from 1.5 m

Scale (approx)	Logged By
1:50	MC

Figure No.
J06365.WS10

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GEA Geotechnical & Environmental Associates Tyttenhanger House Coursers Road St Albans AL4 0PG	**Site** Plant Hill High School, Plant Hill Road, Higher Blackley, Manchester		**Number** **WS11**
Excavation Method Open drive lined percussive sampler	**Dimensions**	**Ground Level (mOD)** 87.50	**Client** Balfour Beatty Construction Limited	**Job Number** J06365
	Location	**Dates** 05/12/2006	**Engineer** Cundall Johnston and Partners LLP	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
				87.40	(0.10) 0.10	Made Ground (Dark brown sandy clay)		
0.50	D1				(0.70)	Made Ground (Fragments of gravel, brick, concrete, geotextile, clinker and ash)		
				86.70	0.80			
				86.50	(0.20) 1.00	Made Ground (Yellowish-brown sandy clay)		
1.00-1.45	SPT N=10		1,1/2,3,2,3			Firm orange-brown sandy CLAY with occasional pale grey mottling and black partings		
					(1.00)			
1.60	D2							
2.00-2.45	SPT N=5		0,0/0,0,2,3	85.50	2.00	Soft pale grey and pale brown mottled silty CLAY becoming dark grey with depth and rare coal fragments		
					(1.00)			
2.90	D3							
3.00-3.45	SPT N=11		0,2/1,2,3,5	84.50 84.45	3.00 (0.05)	Very soft dark grey and brown humic CLAY		
					3.05	Soft dark grey slightly silty CLAY becoming dark grey with depth and rare coal fragments		
3.50	D4				(0.75)			
				83.70	3.80			
3.90	D5			83.50	(0.20) 4.00	Medium dense orange-brown SAND with coal fragments		
4.00-4.45	SPT N=17		4,5/3,5,3,6					
						Complete at 4.45m		

Remarks
Groundwater not encountered

Scale (approx)	Logged By
1:50	EMA

Figure No.
J06365.WS11

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GEA Geotechnical & Environmental Associates Tyttenhanger House Coursers Road St Albans AL4 0PG	**Site** Plant Hill High School, Plant Hill Road, Higher Blackley, Manchester		**Number** **WS12**
Excavation Method Open drive lined percussive sampler	**Dimensions**	**Ground Level (mOD)** 88.80	**Client** Balfour Beatty Construction Limited	**Job Number** J06365
	Location	**Dates** 12/12/2006	**Engineer** Cundall Johnston and Partners LLP	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
				88.75	(0.05) 0.05	Made Ground (Tarmac)		
0.50	J1				(0.85)	Made Ground (Grey slightly clayey very fine to coarse sandy silty gravel)		
1.00-1.45	SPT N=16		1,3/4,4,4,4	87.90	0.90	Stiff reddish-brown very sandy CLAY with occasional sand layers		
1.50	D2				(0.90)			
2.00-2.45	SPT N=19		3,3/4,5,6,4	87.00	1.80	Medium dense reddish-brown medium SAND		
2.45-2.55	D3				(1.25)			
3.00-3.45	SPT N=16		2,4/3,4,5,4	85.75	3.05	Stiff greyish brown sandy CLAY with occasional fine gravel		
3.50	D4				(1.15)			
4.00-4.45	SPT N=14		1,2/2,3,4,5	84.60	4.20	Complete at 4.45m		

Remarks
Groundwater not encountered

Scale (approx)	Logged By
1:50	MC

Figure No.
J06365.WS12

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GEA Geotechnical & Environmental Associates Tyttenhanger House Coursers Road St Albans AL4 0PG	**Site** Plant Hill High School, Plant Hill Road, Higher Blackley, Manchester		**Number** **WS13**
Excavation Method Open drive lined percussive sampler	**Dimensions**	**Ground Level (mOD)** 85.70	**Client** Balfour Beatty Construction Limited	**Job Number** J06365
	Location	**Dates** 07/12/2006	**Engineer** Cundall Johnston and Partners LLP	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
				85.45	(0.25) 0.25	Made Ground (Brown sandy clay with fragments of ash, rootlets and occasional gravel)		
0.35	D2			85.30	(0.15) 0.40	Made Ground (Dark brown sandy clay with rootlets)		
0.80	D3					Made Ground (Dark reddish-brown fragments of ash, clinker, pottery, glass, bricks and wood, becoming darker below 1.8 m)		
					(4.30)			
3.00	J1							
				81.00	4.70			
4.80	D4				(0.30)	Pale brown fine to medium SAND		
				80.70	5.00			
						Complete at 5.00m		

Remarks
50 mm combined gas and groundwater standpipe installed to a depth of 3.5 m with a response zone from 0.5 m to 3.5 m
Groundwater not encountered
Borehole backfilled with bentonite

Scale (approx)	Logged By
1:50	EMA

Figure No.
J06365.WS13

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GEA Geotechnical & Environmental Associates Tyttenhanger House Coursers Road St Albans AL4 0PG	**Site** Plant Hill High School, Plant Hill Road, Higher Blackley, Manchester		**Number** **WS14**
Excavation Method Open drive lined percussive sampler	**Dimensions**	**Ground Level (mOD)** 88.30	**Client** Balfour Beatty Construction Limited	**Job Number** J06365
	Location	**Dates** 07/12/2006	**Engineer** Cundall Johnston and Partners LLP	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
				88.20	(0.10)	Made Ground (Dark brown clay with fragments of brick, glass and coal)		
0.20	D1				0.10			
				87.80	(0.40)	Made Ground (Pale orange-brown and pale grey mottled sandy clay with rootlets and coal fragments)		
0.80	D2				0.50	Made Ground (Black gravel of brick, ash and coal with pockets of orange-brown sandy clay)		
				86.90	(0.90)			
					1.40	Made Ground (Reddish-brown and black sandy clay with occasional brick fragments)		
1.60	D3			86.60	(0.30)			
				86.50	1.70	Made Ground (concrete)		
1.90	D4			86.30	(0.10)			
					1.80	Made Ground (Firm grey and dark brown mottled clay)		
					(0.20)			
					2.00	Terminated at 2.00m		

Remarks
Borehole backfilled with bentonite
Groundwater not encountered
Sampler refused at 2.0 m

Scale (approx)	Logged By
1:50	EMA

Figure No.
J06365.WS14

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GEA Geotechnical & Environmental Associates	Tyttenhanger House Coursers Road St Albans AL4 0PG	**Site** Plant Hill High School, Plant Hill Road, Higher Blackley, Manchester	**Number** **WS15**
Excavation Method Open drive lined percussive sampler	**Dimensions**	**Ground Level (mOD)** 88.40	**Client** Balfour Beatty Construction Limited	**Job Number** J06365
	Location	**Dates** 12/12/2006	**Engineer** Cundall Johnston and Partners LLP	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.30)	Made Ground (Dark brown humic sandy clay with rootlets and occasional gravel)		
0.30	J1			88.10	0.30	Firm brown and pale grey mottled silty sandy CLAY		
0.60	D2							
1.00-1.45	SPT N=9		0,1/1,2,3,3		(1.30)			
				86.80	1.60			
1.60	D3			86.60	(0.20)	Stiff pale brownish-grey silty sandy CLAY		
2.00-2.45	SPT N=17		0,2/5,5,4,3		1.80	Stiff pale yellowish-brown sandy silty CLAY		
2.40	D4			86.00	(0.60)			
				85.80	2.40	Medium dense pale brown finr to medium SAND		
2.90	D5				(0.20)			
3.00-3.45	SPT N=19		2,3/3,5,5,6		2.60	Stiff greyish brown sandy CLAY with occasional fine to medium gravel		
					(1.85)			
4.00-4.45	SPT N=28		2,3/6,8,7,7					
4.20	D6			83.95	4.45			
						Complete at 4.45m		

Remarks
Groundwater not encountered

Scale (approx)	Logged By
1:50	MC

Figure No.
J06365.WS15

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GEA Geotechnical & Environmental Associates	Tyttenhanger House Coursers Road St Albans AL4 0PG	**Site** Plant Hill High School, Plant Hill Road, Higher Blackley, Manchester	**Number** **WS16**
Excavation Method Open drive lined percussive sampler	**Dimensions**	**Ground Level (mOD)** 89.50	**Client** Balfour Beatty Construction Limited	**Job Number** J06365
	Location	**Dates** 12/12/2006	**Engineer** Cundall Johnston and Partners LLP	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
				89.45	(0.05)	Made Ground (Tarmac)		
					0.05			
				89.10	(0.35)	Made Ground (Tarmac fragments with black ash, clinker and sand)		
					0.40			
				88.80	(0.30)	Made Ground (Yellowish-brown sandy silty gravel)		
					0.70			
0.80	J1			88.50	(0.30)	Made Ground (Broken brick and brick fragments with sandy clay and dark grey ashy sand)		
1.00-1.45	SPT N=3		0,0/0,0,1,2		1.00			
1.40	D2				(0.90)	Made Ground (Pale brown mottled pale grey sandy clay)		
				87.60	1.90	Soft humic very silty very sandy CLAY with occasional roots		
2.00-2.45	SPT N=0		0,0/0,0,0,0		(1.00)			
2.60	D3							
2.90	D4			86.60	2.90	Loose pale brown silty fine SAND		
3.00-3.45	SPT N=6		1,1/1,1,2,2		(0.30)			
3.10	D5			86.30	3.20	Stiff greyish brown sandy CLAY with occasional fine to medium gravel		
3.60	D6				(1.25)			
4.00-4.45	SPT N=12		1,1/2,3,3,4					
4.30	D7			85.05	4.45	Complete at 4.45m		

Remarks
Groundwater not encountered

Scale (approx)	Logged By
1:50	MC

Figure No.
J06365.WS16

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Geotechnical & Environmental Associates	Tyttenhanger House Coursers Road St Albans AL4 0PG	**Site** Plant Hill High School, Plant Hill Road, Higher Blackley, Manchester	**Number** **WS17**
Excavation Method Open drive lined percussive sampler	**Dimensions**	**Ground Level (mOD)** 87.30	**Client** Balfour Beatty Construction Limited	**Job Number** J06365
	Location	**Dates** 13/12/2006	**Engineer** Cundall Johnston and Partners LLP	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
				87.10	(0.20) 0.20	Made Ground (Dark brown humic sandy clay with roots and rootlets)		
0.40	D1			86.80	(0.30) 0.50	Stiff pale orange-brown and pale grey mottled silty sandy CLAY		
0.80	D2			86.70	(0.10) 0.60	Pale brown medium SAND		
1.00-1.45	SPT N=14		1,1/2,3,4,5	86.35	(0.35) 0.95	Dark orange brown and grey mottled silty sandy CLAY		
1.10	D3			86.15	(0.20) 1.15	Medium dense orange-brown medium SAND		
1.80	D4					Firm becoming stiff greyish brown sandy CLAY with occasional fine and medium gravel of dark grey mudstone		
2.00-2.45	SPT N=14		2,2/3,3,4,4					
2.60	D5							
3.00-3.45	SPT N=13		1,2/3,3,3,4					
3.60	D6				(5.30)			
4.00-4.45	SPT N=15		2,2/3,4,4,4					
4.60	D7							
5.00-5.45	SPT N=18		1,2/3,5,4,6					
5.60	D8							
6.00-6.45	SPT N=25		2,3/5,6,6,8					
6.20	D9			80.85	6.45	Complete at 6.45m		

Remarks
Groundwater not encountered

Scale (approx)	Logged By
1:50	MC

Figure No.
J06365.WS17

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GEA Geotechnical & Environmental Associates Tyttenhanger House Coursers Road St Albans AL4 0PG	**Site** Plant Hill High School, Plant Hill Road, Higher Blackley, Manchester	**Number** **WS18**	
Excavation Method Open drive lined percussive sampler	**Dimensions**	**Ground Level (mOD)** 89.90	**Client** Balfour Beatty Construction Limited	**Job Number** J06365
	Location	**Dates** 13/12/2006	**Engineer** Cundall Johnston and Partners LLP	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.30)	Made Ground (Tarmac and tarmac fragments, gravel, ash, clinker, brick fragments and hydrocarbon odour)		
0.25	J1			89.60	0.30	Soft dark orange brown very sandy CLAY with occasional gravel and roots		
0.60	D2				(0.80)			
1.00-1.45	SPT N=15		2,2/3,4,3,5	88.80	1.10	Stiff greyish brown sandy CLAY with occasional fine and medium mudstone gravel		
1.40	D3				(0.60)			
1.80	D4			88.20	1.70	Greyish brown firm silty SAND		
2.00-2.45	SPT N=22		2,3/5,6,5,6		(1.00)	very clayey to 2.6m		
			Water strike(1) at 2.40m.					▽1
2.80	D5			87.20	2.70	Stiff greyish brown sandy CLAY with occasional fine and medium mudstone gravel		
3.00-3.45	SPT N=25		1,2/4,7,6,8		(0.80)			
				86.40	3.50	Greyish brown firm silty SAND		
				86.10	(0.30) 3.80			
3.90	D6			85.90	(0.20) 4.00	Stiff greyish brown sandy CLAY with occasional fine and medium mudstone gravel		
4.00-4.45	SPT N=16		1,2/2,4,4,6	85.80	(0.10) 4.10	Greyish brown firm silty SAND		
				85.45	(0.35) 4.45	Stiff greyish brown sandy CLAY with occasional fine and medium mudstone gravel		
						Complete at 4.45m		

Remarks
Groundwater standing at a depth of 2.4 m on withdrawal of casing on completion of the borehole

Scale (approx)	Logged By
1:50	MC

Figure No.
J06365.WS18

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GEA Geotechnical & Environmental Associates Tyttenhanger House Coursers Road St Albans AL4 0PG	**Site** Plant Hill High School, Plant Hill Road, Higher Blackley, Manchester		**Number** **WS19**
Excavation Method Open drive lined percussive sampler	**Dimensions**	**Ground Level (mOD)** 92.60	**Client** Balfour Beatty Construction Limited	**Job Number** J06365
	Location	**Dates** 12/12/2006	**Engineer** Cundall Johnston and Partners LLP	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.35)	Made Ground (Dark brown humic sandy clay with brick fragments at 0.3 m)		
0.30	J1			92.25	0.35			
0.50	D2				(0.30)	Soft pale brown and pale grey mottled very silty sandy CLAY		
				91.95	0.65			
					(0.65)	Medium dense pale brown and pale grey mottled silty clayey fine to medium SAND		
1.00-1.45	SPT N=10		1,1/1,3,3,3					
1.20	D3			91.30	1.30			
					(0.50)	Stiff reddish-brown and pale grey mottled silty very sandy CLAY with black speckling and occasional fine to medium gravel		
1.60	D4			90.80	1.80			
2.00-2.45	SPT N=29		2,4/5,6,8,10			Stiff greyish brown sandy CLAY with occasional fine and medium mudstone gravel		
2.20	D5				(0.70)			
				90.10	2.50			▽1
			Water strike(1) at 2.60m.			Pale brown fine to medium clayey SAND		
					(0.70)			
3.00-3.45	SPT N=14		1,2/3,3,3,5					
3.20	D6			89.40	3.20			
						Stiff greyish brown very sandy CLAY with occasional fine and medium mudstone gravel		
3.80	D7				(1.25)			
4.00-4.45	SPT N=9		2,1/2,2,2,3					
				88.15	4.45			
						Complete at 4.45m		

Remarks
Groundwater standing at a depth of 2.6 m on withdrawal of casing on completion of the borehole

Scale (approx)	Logged By
1:50	MC

Figure No.
J06365.WS19

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GEA Geotechnical & Environmental Associates Tyttenhanger House Coursers Road St Albans AL4 0PG	**Site** Plant Hill High School, Plant Hill Road, Higher Blackley, Manchester	**Number** **WS20**	
Excavation Method Open drive lined percussive sampler	**Dimensions**	**Ground Level (mOD)** 87.60	**Client** Balfour Beatty Construction Limited	**Job Number** J06365
	Location	**Dates** 11/12/2006	**Engineer** Cundall Johnston and Partners LLP	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.30)	Made Ground (Dark brown humic very sandy clay with rootlets)		
0.10	J1			87.30	0.30			
0.40	D2		Water strike(1) at 0.40m.		(0.20)	Pale greyish-brown and orange-brown mottled very sandy CLAY		
0.50	J3			87.10	0.50			
0.50-0.70	D4				(0.30)			
				86.80	0.80	Pale reddish-brown medium SAND		
					(0.30)			
1.00-1.45	SPT N=17		1,4/4,5,4,4	86.50	1.10	Stiff reddish-brown with black speckling very sandy CLAY with occasional coarse gravel and fragments of charcoal		
1.10	D5					Medium dense greyish brown fine SAND		
1.60	D6							
2.00-2.45	SPT N=12		1,1/2,2,3,5					
					(2.65)			
2.60	D7							
3.00-3.45	SPT N=13		1,1/2,3,4,4					
3.50	D8							
				83.85	3.75	Stiff greyish-brown sandy CLAY with occasional fine gravel of dark grey mudstone		
4.00-4.45	SPT N=20		2,2/3,4,5,8		(0.70)			
4.20	D9							
				83.15	4.45	Complete at 4.45m		

Remarks
Groundwater standing at a depth of 0.4 m on withdrawal of casing on completion of the borehole

Scale (approx)	Logged By
1:50	MC

Figure No.
J06365.WS20

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St Albans
AL4 0PG

Standard Penetration Test Results

Site : Plant Hill High School, Manchester

Client : Balfour Beatty Construction Limited

Engineer : Cundall

Job Number J06365

Sheet 1 / 3

Borehole Number	Base of Borehole (m)	End of Seating Drive (m)	End of Test Drive (m)	Test Type	Seating Blows per 75mm		Blows for each 75mm penetration				Result	Comments
					1	2	1	2	3	4		
BH01	1.00	1.15	1.45	SPT	1	1	1	1	1	6	N=9	
BH01	2.00	2.15	2.45	SPT	1	1	1	1	3	2	N=7	
BH01	3.00	3.15	3.45	SPT	1	1	2	1	2	2	N=7	
BH01	4.00	4.15	4.45	SPT	0	0	0	1	1	1	N=3	
BH01	5.00	5.15	5.45	SPT	0	1	1	1	1	2	N=5	
BH01	6.50	6.65	6.95	SPT	3	3	4	5	6	6	N=21	
BH01	8.00	8.15	8.45	SPT	2	3	3	4	6	6	N=19	
BH01	9.50	9.65	9.95	SPT	3	3	4	4	4	5	N=17	
BH01	11.00	11.15	11.45	SPT	3	4	4	4	4	4	N=16	
BH01	12.50	12.65	12.95	SPT	2	2	3	3	4	4	N=14	
BH01	14.00	14.15	14.45	SPT	1	2	3	3	4	4	N=14	
BH01	15.50	15.65	15.95	SPT	3	5	6	7	7	8	N=28	
BH01	17.00	17.15	17.45	SPT	5	6	7	7	8	9	N=31	
BH01	18.50	18.65	18.95	SPT	5	6	7	8	8	10	N=33	
BH01	20.05	20.20	20.50	SPT	6	7	8	9	10	12	N=39	
BH03	1.20	1.35	1.65	SPT	1	2	2	2	2	1	N=7	
BH03	2.00	2.15	2.45	SPT	1	0	1	2	2	4	N=9	
BH03	3.00	3.15	3.45	SPT	1	1	1	2	1	2	N=6	
BH03	4.00	4.15	4.45	SPT	1	0	1	2	2	3	N=8	
BH03	5.00	5.15	5.45	SPT	1	2	2	3	4	6	N=15	
BH03	8.00	8.15	8.45	SPT	2	3	3	4	4	5	N=16	
BH03	11.00	11.15	11.45	SPT	4	5	5	9	13	20	N=47	
BH03	12.50	12.65	12.95	SPT	4	5	7	7	8	9	N=31	
BH03	14.00	14.15	14.45	SPT	3	4	6	7	8	10	N=31	
BH03	15.50	15.65	15.95	SPT	3	5	6	6	8	9	N=29	
BH03	17.00	17.15	17.45	SPT	4	5	6	6	7	8	N=27	
BH03	18.50	18.65	18.95	SPT	3	5	7	8	9	10	N=34	
BH03	20.05	20.20	20.50	SPT	5	7	8	9	11	12	N=40	
BH04	2.00	2.15	2.45	SPT	1	2	3	4	4	5	N=16	
BH04	3.00	3.15	3.45	SPT	1	2	3	3	3	3	N=12	
BH04	5.00	5.15	5.45	SPT	3	5	7	7	8	10	N=32	
BH04	6.50	6.65	6.83	SPT	5	9	15	22	13		50/180mm	
BH04	8.00	8.15	8.45	SPT	2	3	3	3	3	3	N=12	
BH04	9.50	9.65	9.95	SPT	2	3	4	4	5	5	N=18	
BH04	11.00	11.15	11.45	SPT	3	4	4	5	6	7	N=22	
BH04	12.50	12.65	12.95	SPT	3	4	5	5	6	7	N=23	
BH04	14.00	14.15	14.45	SPT	4	5	6	6	7	7	N=26	
BH04	15.50	15.65	15.95	SPT	4	5	7	8	9	10	N=34	
BH04	17.00	17.15	17.45	SPT	4	5	6	7	7	8	N=28	
BH04	18.50	18.65	18.95	SPT	3	4	4	5	6	8	N=23	
BH04	20.05	20.20	20.50	SPT	3	4	5	6	7	8	N=26	
WS01	1.00	1.15	1.45	CPT	1	2	0	0	1	8	N=9	
WS01	2.00	2.15	2.45	CPT	1	0	0	0	1	0	N=1	

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Coursers Road
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Standard Penetration Test Results

Site : Plant Hill High School, Manchester

Client : Balfour Beatty Construction Limited

Engineer : Cundall

Job Number J06365

Sheet 2 / 3

Borehole Number	Base of Borehole (m)	End of Seating Drive (m)	End of Test Drive (m)	Test Type	Seating Blows per 75mm		Blows for each 75mm penetration				Result	Comments
					1	2	1	2	3	4		
WS01	3.00	3.15	3.45	CPT	2	4	6	4	3	1	N=14	
WS01	4.00	4.15	4.45	CPT	1	1	0	0	0	0	N=0	
WS01	5.00	5.15	5.45	CPT	1	1	2	1	1	2	N=6	
WS01	6.00	6.15	6.45	CPT	2	3	1	1	0	0	N=2	
WS01	7.00	7.15	7.45	CPT	1	1	1	1	1	1	N=4	
WS02	1.00	1.15	1.45	SPT	1	2	2	3	4	4	N=13	
WS02	2.00	2.15	2.45	SPT	4	4	5	5	6	7	N=23	
WS02	3.00	3.15	3.45	CPT	3	4	3	3	3	2	N=11	
WS02	4.00	4.15	4.45	CPT	1	1	2	2	3	3	N=10	
WS04	1.00	1.15	1.45	CPT	1	3	3	4	4	4	N=15	
WS04	2.00	2.15	2.45	SPT	2	3	2	2	2	3	N=9	
WS04	3.00	3.15	3.45	SPT	1	2	2	2	4	5	N=13	
WS04	4.00	4.15	4.45	SPT	5	6	6	6	5	6	N=23	
WS04	5.00	5.15	5.45	CPT	1	1	1	1	1	1	N=4	
WS05	1.00	1.15	1.45	SPT	2	2	2	3	3	3	N=11	
WS05	2.00	2.15	2.45	SPT	2	3	3	3	5	5	N=16	
WS05	3.00	3.15	3.45	CPT	1	1	1	2	1	1	N=5	
WS05	4.00	4.15	4.45	CPT	1	1	1	2	2	7	N=12	
WS06	1.00	1.15	1.45	SPT	3	4	2	3	3	4	N=12	
WS06	2.00	2.15	2.45	SPT	1	2	3	3	4	3	N=13	
WS06	3.00	3.15	3.45	CPT	1	2	2	2	2	3	N=9	
WS06	4.00	4.15	4.45	CPT	2	4	4	4	6	7	N=21	
WS06	5.00	5.15	5.45	CPT	4	3	4	2	3	3	N=12	
WS09	2.00	2.15	2.45	SPT	0	1	1	2	3	4	N=10	
WS09	3.00	3.15	3.45	SPT	2	2	2	2	3	3	N=10	
WS09	4.00	4.15	4.45	SPT	2	1	3	3	3	4	N=13	
WS10	1.00	1.15	1.45	SPT	1	3	3	3	4	5	N=15	
WS10	2.00	2.15	2.45	SPT	1	1	2	4	4	6	N=16	
WS10	3.00	3.15	3.45	SPT	2	2	3	3	4	5	N=15	
WS10	4.00	4.15	4.45	SPT	1	3	4	4	7	7	N=22	
WS11	1.00	1.15	1.45	SPT	1	1	2	3	2	3	N=10	
WS11	2.00	2.15	2.45	SPT	0	0	0	0	2	3	N=5	
WS11	3.00	3.15	3.45	SPT	0	2	1	2	3	5	N=11	
WS11	4.00	4.15	4.45	SPT	4	5	3	5	3	6	N=17	
WS12	1.00	1.15	1.45	SPT	1	3	4	4	4	4	N=16	
WS12	2.00	2.15	2.45	SPT	3	3	4	5	6	4	N=19	
WS12	3.00	3.15	3.45	SPT	2	4	3	4	5	4	N=16	
WS12	4.00	4.15	4.45	SPT	1	2	2	3	4	5	N=14	
WS15	1.00	1.15	1.45	SPT	0	1	1	2	3	3	N=9	
WS15	2.00	2.15	2.45	SPT	0	2	5	5	4	3	N=17	

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GEA Geotechnical & Environmental Associates

Tyttenhanger House
Coursers Road
St Albans
AL4 0PG

Standard Penetration Test Results

Site : Plant Hill High School, Manchester

Client : Balfour Beatty Construction Limited

Engineer : Cundall

Job Number J06365

Sheet 3 / 3

Borehole Number	Base of Borehole (m)	End of Seating Drive (m)	End of Test Drive (m)	Test Type	Seating Blows per 75mm		Blows for each 75mm penetration				Result	Comments
					1	2	1	2	3	4		
WS15	3.00	3.15	3.45	SPT	2	3	3	5	5	6	N=19	
WS15	4.00	4.15	4.45	SPT	2	3	6	8	7	7	N=28	
WS16	1.00	1.15	1.45	SPT	0	0	0	0	1	2	N=3	
WS16	2.00	2.15	2.45	SPT	0	0	0	0	0	0	N=0	
WS16	3.00	3.15	3.45	SPT	1	1	1	1	2	2	N=6	
WS16	4.00	4.15	4.45	SPT	1	1	2	3	3	4	N=12	
WS17	1.00	1.15	1.45	SPT	1	1	2	3	4	5	N=14	
WS17	2.00	2.15	2.45	SPT	2	2	3	3	4	4	N=14	
WS17	3.00	3.15	3.45	SPT	1	2	3	3	3	4	N=13	
WS17	4.00	4.15	4.45	SPT	2	2	3	4	4	4	N=15	
WS17	5.00	5.15	5.45	SPT	1	2	3	5	4	6	N=18	
WS17	6.00	6.15	6.45	SPT	2	3	5	6	6	8	N=25	
WS18	1.00	1.15	1.45	SPT	2	2	3	4	3	5	N=15	
WS18	2.00	2.15	2.45	SPT	2	3	5	6	5	6	N=22	
WS18	3.00	3.15	3.45	SPT	1	2	4	7	6	8	N=25	
WS18	4.00	4.15	4.45	SPT	1	2	2	4	4	6	N=16	
WS19	1.00	1.15	1.45	SPT	1	1	1	3	3	3	N=10	
WS19	2.00	2.15	2.45	SPT	2	4	5	6	8	10	N=29	
WS19	3.00	3.15	3.45	SPT	1	2	3	3	3	5	N=14	
WS19	4.00	4.15	4.45	SPT	2	1	2	2	2	3	N=9	
WS20	1.00	1.15	1.45	SPT	1	4	4	5	4	4	N=17	
WS20	2.00	2.15	2.45	SPT	1	1	2	2	3	5	N=12	
WS20	3.00	3.15	3.45	SPT	1	1	2	3	4	4	N=13	
WS20	4.00	4.15	4.45	SPT	2	2	3	4	5	8	N=20	

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PROJECT NO:	**GEO/10981**

Date	31/01/2007
Approved	*JSturges*
Page	3 of 4

Sample details					Classification Tests					Density Tests		Undrained Triaxial Compression Tests			Chemical Tests			
BH/WS No.	Depth (m)	No.	Type	Description	MC (%)	LL (%)	PL (%)	PI (%)	<425 mic (%)	Bulk (Mg/m³)	Dry (Mg/m³)	Cell Pressure (kPa)	Deviator Stress (kPa)	Shear Stress (kPa)	pH	2:1 W/S SO4 (g/l)	Organic Content (%)	Other tests and comments
BH04	19.50	D4	D	Brown clayey silty fine SAND														Particle Size Distribution Test
WS06	0.90	D2	D	Brown slightly clayey fine to coarse SAND with occasional fine to medium gravel	18	NP	NP	NP	92									Sample is Non-plastic
WS08	1.20	D2	D												6.3	0.07		
WS08	1.60	D3	D	Mottled brown sandy silty CLAY with traces of fine gravel	22	33	17	16	98									
WS09	1.80	D2	D	Mottled brown and black sandy slightly organic silty CLAY with traces of fine gravel	23	34	17	17	98									
WS10	0.80	D2	D	Mottled brown and grey sandy silty CLAY with traces of fine to medium gravel	22	27	15	12	98									
WS12	1.50	D2	D	Brown very silty sandy CLAY														Particle Size Distribution Test
WS13	4.80	D4	D												7.5	0.07		
WS15	2.40	D4	D	Brown slightly sandy silty CLAY with traces of fine to medium gravel	26	32	20	12	97									
WS16	1.40	D2	D	Mottled brown silty CLAY with traces of brick fragments	31	45	23	22	99								1.9	
WS16	3.60	D6	D	Brown silty CLAY with traces of fine gravel	20	34	18	16	99									
WS17	0.40	D1	D	Mottled brown and grey sandy silty CLAY with traces of fine gravel and rootlets	16	31	17	14	98									

SUMMARY OF GEOTECHNICAL TESTING

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Page	2 of 4

Sample details					Classification Tests					Density Tests		Undrained Triaxial Compression Tests			Chemical Tests			
BH/WS No.	Depth (m)	No.	Type	Description	MC (%)	LL (%)	PL (%)	PI (%)	<425 mic (%)	Bulk (Mg/m³)	Dry (Mg/m³)	Cell Pressure (kPa)	Deviator Stress (kPa)	Shear Stress (kPa)	pH	2:1 W/S SO4 (g/l)	Organic Content (%)	Other tests and comments
BH03	11.60	B25	B	Brown CLAY / SILT and fine SAND														
BH03	15.50	S32	S												8.8	0.05		
BH03	17.50	D35	D	Brown very silty CLAY	21	37	21	16	100									
BH04	1.00	U4	U	Soft mottled brown and grey sandy silty CLAY	22					2.14	1.75	20	168	84				
BH04	1.45	D5	D	Mottled brown sandy silty CLAY	18	29	19	10	100									
BH04	3.00	S8	S	Brown grey CLAY / SILT with abundant fine sand														Particle Size Distribution Test
BH04	4.00	U10	U	Soft fissured slightly sandy silty CLAY with traces of fine to medium gravel	18					2.26	1.91	75	113	57	8.7	0.06		
BH04	6.50	D17	D	Brown fine to coarse SAND with occasional fine gravel	4.5	NP	NP	NP	43									Sample is Non-plastic
BH04	8.50	D21	D	Brown clayey silty fine to coarse SAND with occasional fine to coarse gravel														Particle Size Distribution Test
BH04	11.50	D27	D												8.3	0.31		
BH04	12.40	D28	D	Brown clayey silty fine SAND														Particle Size Distribution Test
BH04	16.40	S34	S	Brown clayey silty fine SAND														Particle Size Distribution Test

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Sample details					Classification Tests					Density Tests		Undrained Triaxial Compression Tests			Chemical Tests			
BH/WS No.	Depth (m)	No.	Type	Description	MC (%)	LL (%)	PL (%)	PI (%)	<425 mic (%)	Bulk (Mg/m³)	Dry (Mg/m³)	Cell Pressure (kPa)	Deviator Stress (kPa)	Shear Stress (kPa)	pH	2:1 W/S SO4 (g/l)	Organic Content (%)	Other tests and comments
BH01	1.50	D3	D												8.4	1.41		
BH01	4.50	D7	D	Mottled brown slightly sandy silty CLAY with traces of fine gravel and rootlets	21	32	19	13	99									
BH01	7.00	B11	B	Brown clayey silty fine to coarse SAND														Particle Size Distribution Test
BH01	8.50	B13	B	Brown clayey silty fine to medium SAND														Particle Size Distribution Test
BH01	11.90	D19	D	Brown very sandy silty CLAY	21	NP	NP	NP	100									
BH01	14.00	S23	S												7.9	<0.05		
BH01	19.50	D32	D	Brown sandy silty CLAY	14	25	14	11	100									
BH03	0.60	D2	D												7.8	1.47		
BH03	6.40	D12	D												8.0	<0.05		
BH03	6.50	U13	U	Firm dark brown CLAY with traces of fine to medium gravel	17					2.21	1.89	125	327	163				
BH03	8.50	B18	B	Brown clayey silty fine to coarse SAND with occasional fine to coarse gravel														Particle Size Distribution Test
BH03	9.50	U20	U	Stiff dark brown fine sandy silty CLAY with occasional fine to medium sandstone fragments	11					2.28	2.05	130	708	354				

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Sample details					Classification Tests					Density Tests		Undrained Triaxial Compression Tests			Chemical Tests			
BH/WS No.	Depth (m)	No.	Type	Description	MC (%)	LL (%)	PL (%)	PI (%)	<425 mic (%)	Bulk (Mg/m³)	Dry (Mg/m³)	Cell Pressure (kPa)	Deviator Stress (kPa)	Shear Stress (kPa)	pH	2:1 W/S SO4 (g/l)	Organic Content (%)	Other tests and comments
WS17	1.10	D3	D												7.0	<0.05		
WS17	1.80	D4	D	Brown slightly sandy silty CLAY with occasional fine to medium gravel	14	30	20	10	88									
WS18	0.60	D2	B	Brown sandy silty CLAY with traces of fine gravel and brick fragments	15	30	16	14	99									
WS18	1.40	D3	B	Brown sandy silty CLAY with traces of fine to medium gravel	14	27	14	13	99									
WS19	0.50	D2	D	Mottled brown sandy very silty CLAY with traces of fine to medium gravel	22	38	23	15	100									
WS19	1.20	D3	S	Brown very sandy very silty CLAY	26	NP	NP	NP	100									Sample is Non-plastic
WS20	0.70	D4	D	Brown clayey silty fine to medium SAND														Particle Size Distribution Test

SUMMARY OF GEOTECHNICAL TESTING

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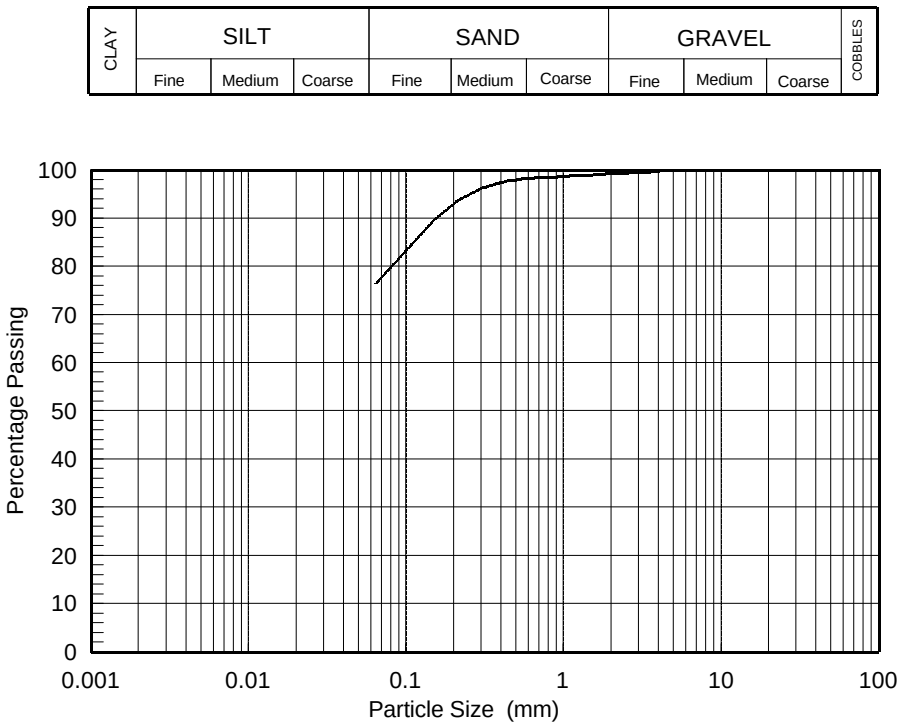
Determination of Particle Size Distribution

Window Sample:	WS12
Sample Number:	D2
Depth (m):	1.50

Description:
Brown very silty sandy CLAY

BS1377 : Part 2 : Clause 9.2 : 1990 Wet Sieving Method

SIEVE	
Sieve	% pass
200 mm	100
125 mm	100
90 mm	100
75 mm	100
63 mm	100
50 mm	100
37.5 mm	100
28 mm	100
20 mm	100
14 mm	100
10 mm	100
6.3 mm	100
5 mm	100
3.35 mm	100
2 mm	99
1.18 mm	99
600 µm	98
425 µm	98
300 µm	96
212 µm	94
150 µm	90
63 µm	76



Particle Proportions		
Cobbles	0.0	%
Gravel	0.7	%
Sand	23.0	%
Silt & Clay	76.3	%

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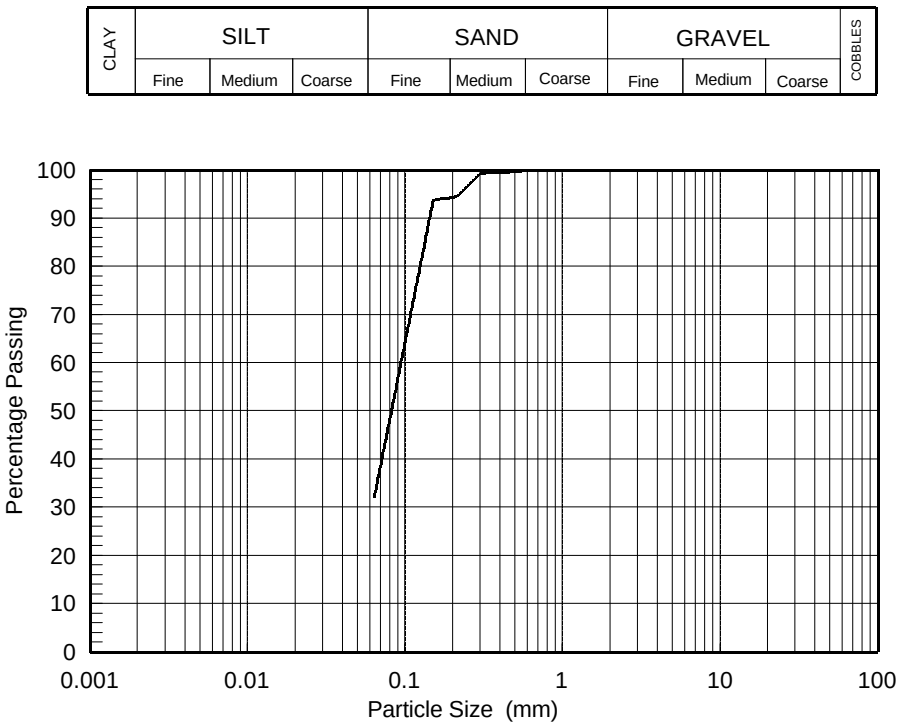
Determination of Particle Size Distribution

Borehole Number:	BH4
Sample Number:	D40
Depth (m):	19.50

Description:
Brown clayey silty fine SAND

BS1377 : Part 2 : Clause 9.2 : 1990 Wet Sieving Method

SIEVE	
Sieve	% pass
200 mm	100
125 mm	100
90 mm	100
75 mm	100
63 mm	100
50 mm	100
37.5 mm	100
28 mm	100
20 mm	100
14 mm	100
10 mm	100
6.3 mm	100
5 mm	100
3.35 mm	100
2 mm	100
1.18 mm	100
600 µm	100
425 µm	100
300 µm	99
212 µm	94
150 µm	94
63 µm	32



Particle Proportions		
Cobbles	0.0	%
Gravel	0.0	%
Sand	68.1	%
Silt & Clay	31.9	%

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Initials: JS

Date: 31/01/2007

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Project Name:

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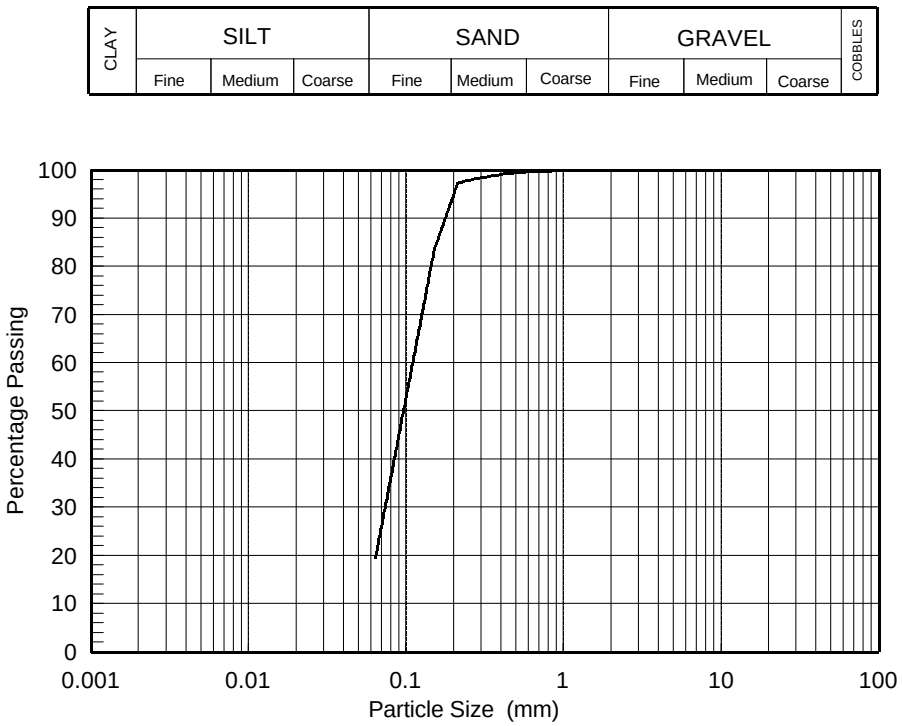
Determination of Particle Size Distribution

Borehole Number:	BH4
Sample Number:	D35
Depth (m):	16.40

Description:
Brown clayey silty fine SAND

BS1377 : Part 2 : Clause 9.2 : 1990 Wet Sieving Method

SIEVE	
Sieve	% pass
200 mm	100
125 mm	100
90 mm	100
75 mm	100
63 mm	100
50 mm	100
37.5 mm	100
28 mm	100
20 mm	100
14 mm	100
10 mm	100
6.3 mm	100
5 mm	100
3.35 mm	100
2 mm	100
1.18 mm	100
600 µm	100
425 µm	99
300 µm	98
212 µm	97
150 µm	83
63 µm	19



Particle Proportions		
Cobbles	0.0	%
Gravel	0.0	%
Sand	80.8	%
Silt & Clay	19.2	%

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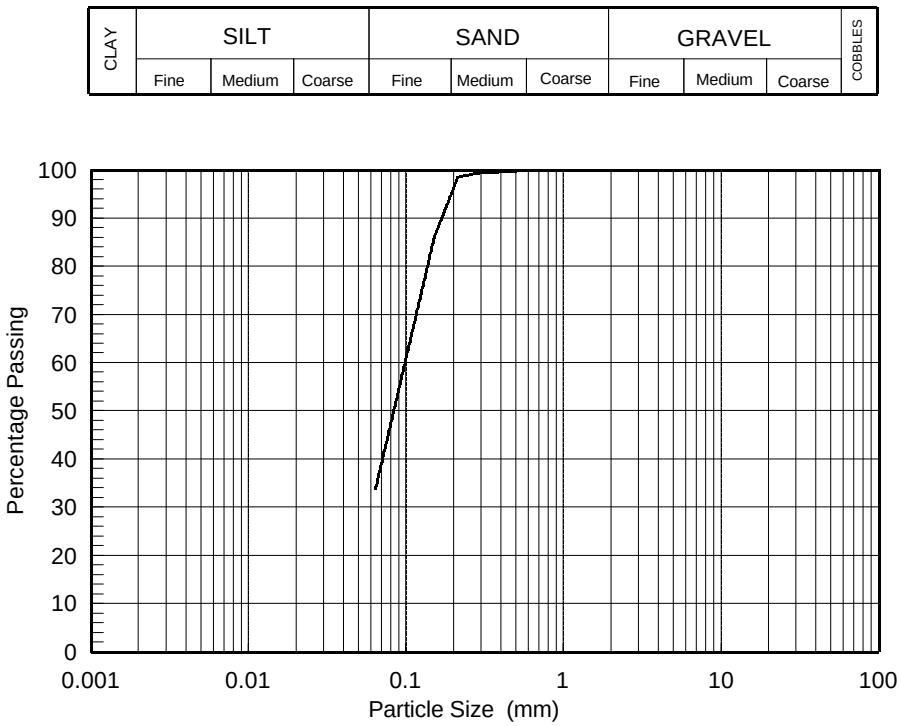
BS1377 : Part 2 : Clause 9 : 1990

Determination of Particle Size Distribution

Borehole Number: BH4 Sample Number: D28 Depth (m): 12.40	Description: Brown clayey silty fine SAND

BS1377 : Part 2 : Clause 9.2 : 1990 Wet Sieving Method

SIEVE	
Sieve	% pass
200 mm	100
125 mm	100
90 mm	100
75 mm	100
63 mm	100
50 mm	100
37.5 mm	100
28 mm	100
20 mm	100
14 mm	100
10 mm	100
6.3 mm	100
5 mm	100
3.35 mm	100
2 mm	100
1.18 mm	100
600 µm	100
425 µm	100
300 µm	99
212 µm	99
150 µm	86
63 µm	34



Particle Proportions		
Cobbles	0.0	%
Gravel	0.0	%
Sand	66.4	%
Silt & Clay	33.6	%

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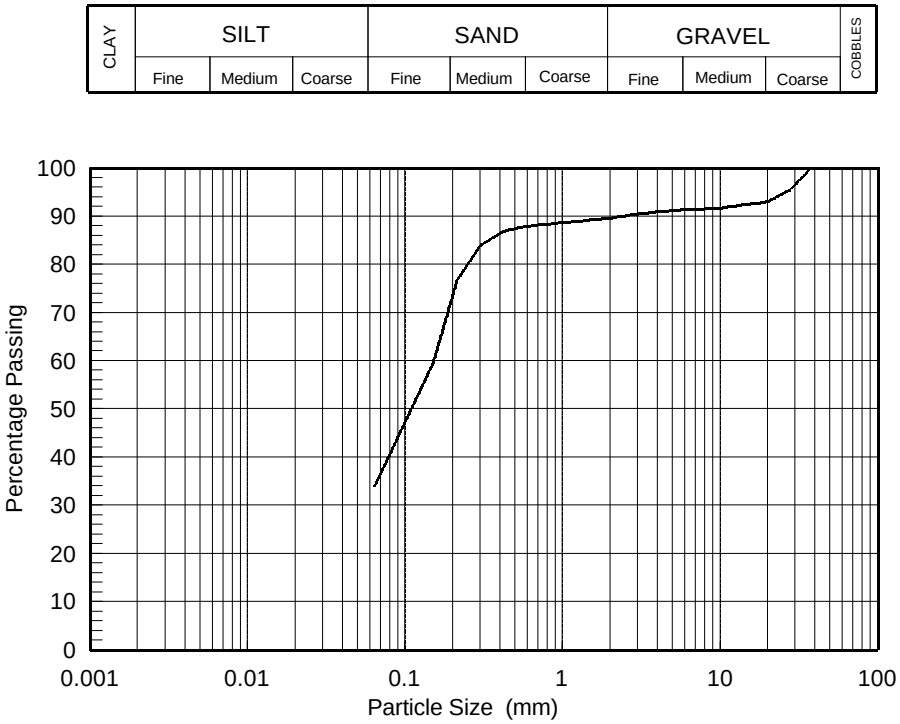
Determination of Particle Size Distribution

Borehole Number:	BH4
Sample Number:	D21
Depth (m):	8.50

Description:
Brown clayey silty fine to coarse SAND
with occasional fine to coarse gravel

BS1377 : Part 2 : Clause 9.2 : 1990 Wet Sieving Method

SIEVE	
Sieve	% pass
200 mm	100
125 mm	100
90 mm	100
75 mm	100
63 mm	100
50 mm	100
37.5 mm	100
28 mm	96
20 mm	93
14 mm	92
10 mm	92
6.3 mm	91
5 mm	91
3.35 mm	91
2 mm	90
1.18 mm	89
600 µm	88
425 µm	87
300 µm	84
212 µm	77
150 µm	60
63 µm	34



Particle Proportions		
Cobbles	0.0	%
Gravel	10.4	%
Sand	55.9	%
Silt & Clay	33.7	%

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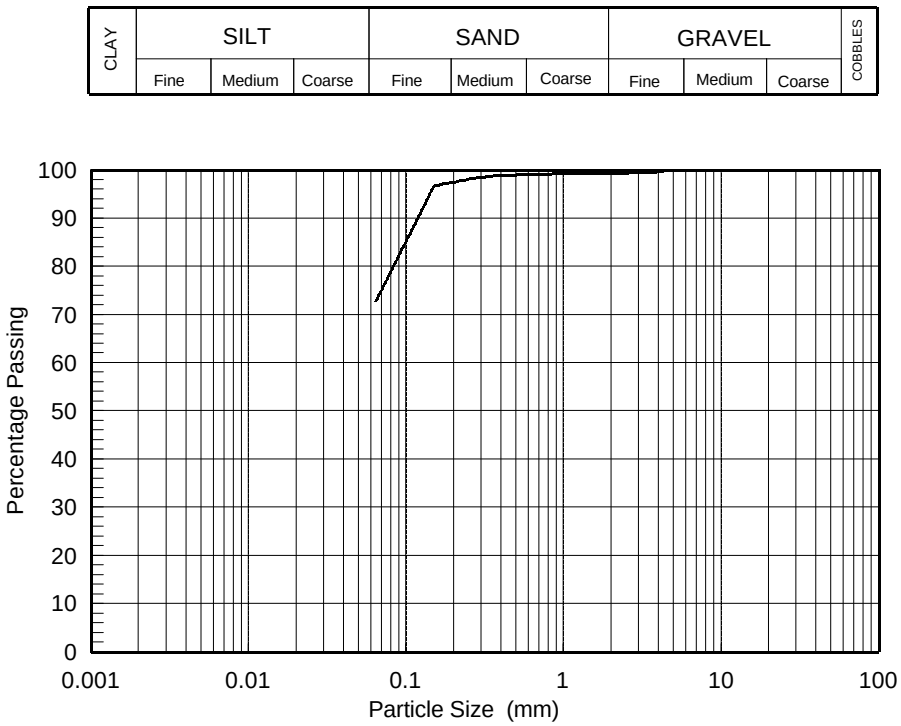
Determination of Particle Size Distribution

Borehole Number:	BH4
Sample Number:	S8
Depth (m):	3.00

Description:
Brown grey CLAY / SILT with abundant fine sand

BS1377 : Part 2 : Clause 9.2 : 1990 Wet Sieving Method

SIEVE	
Sieve	% pass
200 mm	100
125 mm	100
90 mm	100
75 mm	100
63 mm	100
50 mm	100
37.5 mm	100
28 mm	100
20 mm	100
14 mm	100
10 mm	100
6.3 mm	100
5 mm	100
3.35 mm	99
2 mm	99
1.18 mm	99
600 µm	99
425 µm	99
300 µm	99
212 µm	98
150 µm	97
63 µm	73



Particle Proportions		
Cobbles	0.0	%
Gravel	0.6	%
Sand	26.8	%
Silt & Clay	72.5	%

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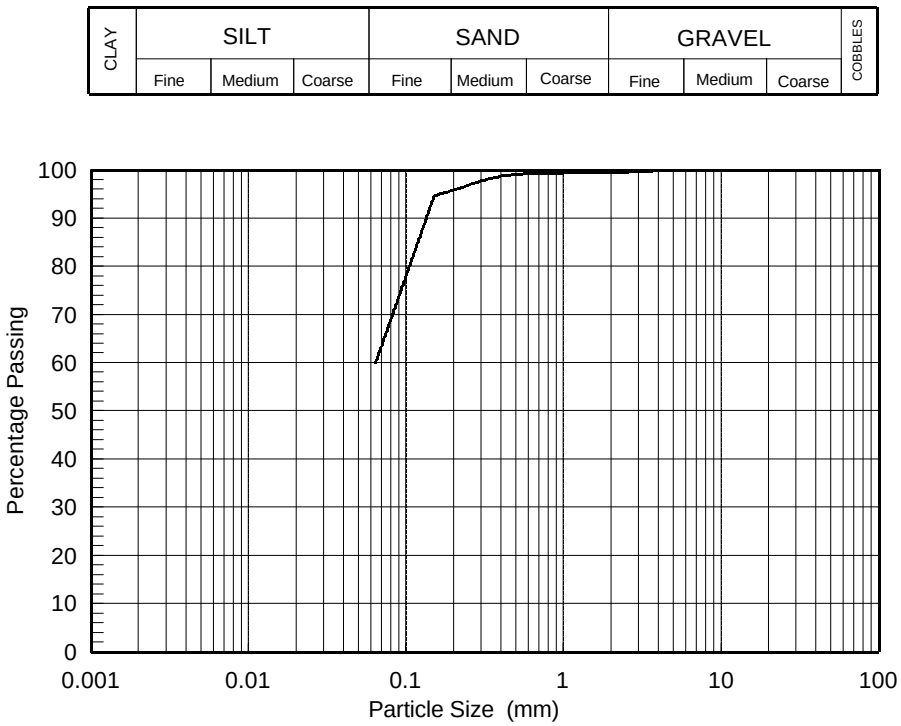
BS1377 : Part 2 : Clause 9 : 1990

Determination of Particle Size Distribution

Borehole Number: BH3 Sample Number: B25 Depth (m): 11.60	Description: Brown CLAY / SILT and fine SAND

BS1377 : Part 2 : Clause 9.2 : 1990 Wet Sieving Method

SIEVE	
Sieve	% pass
200 mm	100
125 mm	100
90 mm	100
75 mm	100
63 mm	100
50 mm	100
37.5 mm	100
28 mm	100
20 mm	100
14 mm	100
10 mm	100
6.3 mm	100
5 mm	100
3.35 mm	100
2 mm	100
1.18 mm	100
600 µm	99
425 µm	99
300 µm	98
212 µm	96
150 µm	95
63 µm	60



Particle Proportions		
Cobbles	0.0	%
Gravel	0.4	%
Sand	39.9	%
Silt & Clay	59.8	%

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BS1377 : Part 2 : Clause 9 : 1990

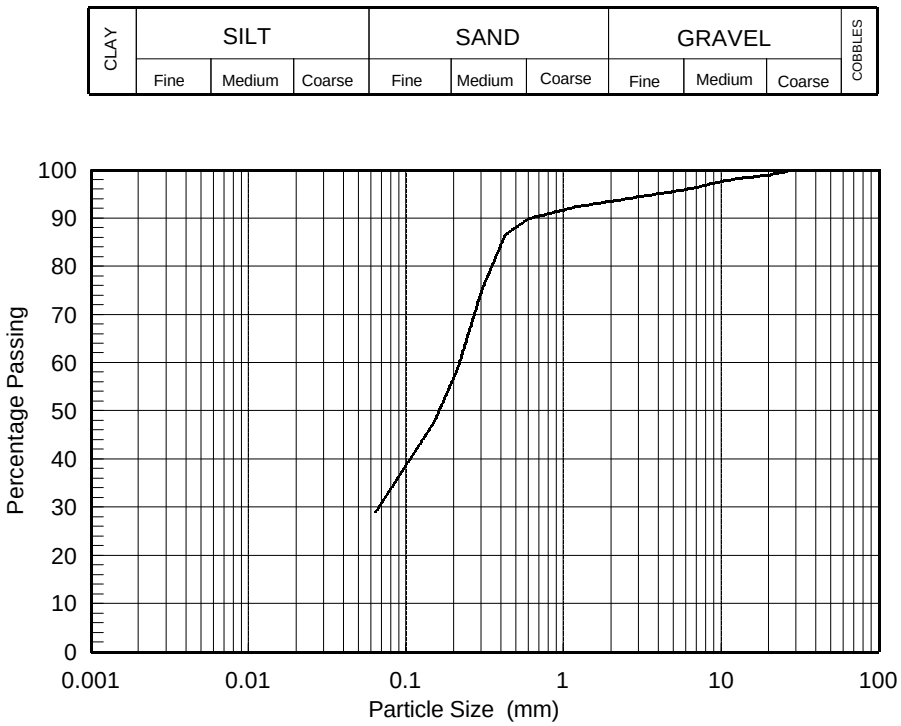
Determination of Particle Size Distribution

Borehole Number:	BH3
Sample Number:	B18
Depth (m):	8.50

Description:
Brown clayey silty fine to coarse SAND
with occasional fine to coarse gravel

BS1377 : Part 2 : Clause 9.2 : 1990 Wet Sieving Method

SIEVE	
Sieve	% pass
200 mm	100
125 mm	100
90 mm	100
75 mm	100
63 mm	100
50 mm	100
37.5 mm	100
28 mm	100
20 mm	99
14 mm	99
10 mm	98
6.3 mm	96
5 mm	96
3.35 mm	95
2 mm	94
1.18 mm	92
600 µm	90
425 µm	87
300 µm	75
212 µm	59
150 µm	48
63 µm	29



Particle Proportions		
Cobbles	0.0	%
Gravel	6.5	%
Sand	64.6	%
Silt & Clay	28.9	%

Checked and Approved
Initials: JS
Date: 31/01/2007

Project Number:
GEO / 10981
Project Name:
PLANT HILL HIGH SCHOOL, MANCHESTER

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BS1377 : Part 2 : Clause 9 : 1990

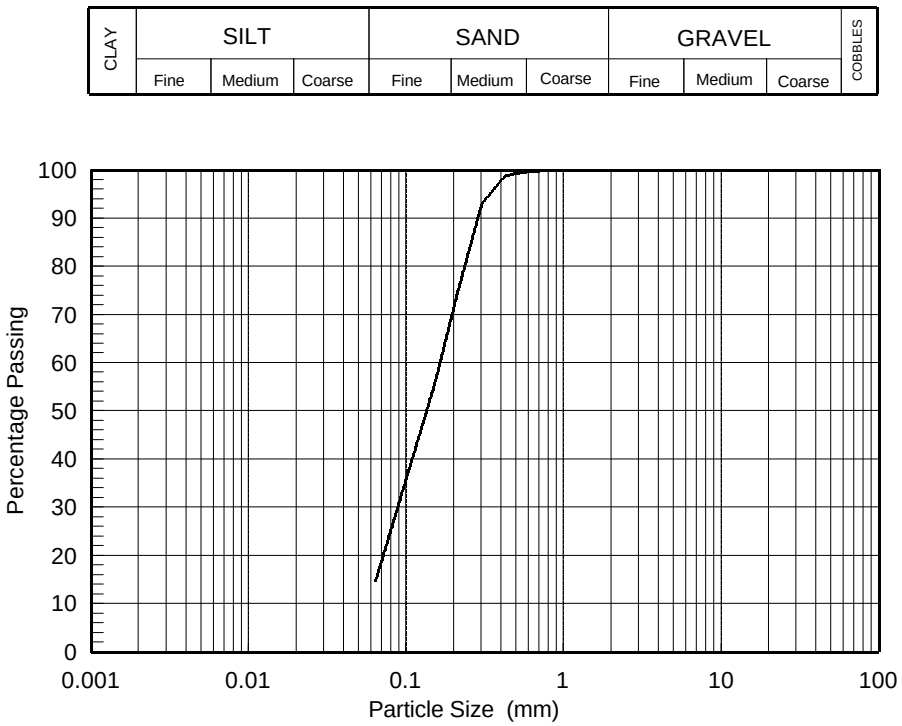
Determination of Particle Size Distribution

Borehole Number:	BH1
Sample Number:	B13
Depth (m):	8.50

Description:
Brown clayey silty fine to medium SAND

BS1377 : Part 2 : Clause 9.2 : 1990 Wet Sieving Method

SIEVE	
Sieve	% pass
200 mm	100
125 mm	100
90 mm	100
75 mm	100
63 mm	100
50 mm	100
37.5 mm	100
28 mm	100
20 mm	100
14 mm	100
10 mm	100
6.3 mm	100
5 mm	100
3.35 mm	100
2 mm	100
1.18 mm	100
600 µm	100
425 µm	99
300 µm	93
212 µm	75
150 µm	55
63 µm	14



Particle Proportions		
Cobbles	0.0	%
Gravel	0.0	%
Sand	85.5	%
Silt & Clay	14.5	%

Checked and Approved
Initials: JS
Date: 31/01/2007

Project Number:
GEO / 10981
Project Name:
PLANT HILL HIGH SCHOOL, MANCHESTER

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BS1377 : Part 2 : Clause 9 : 1990

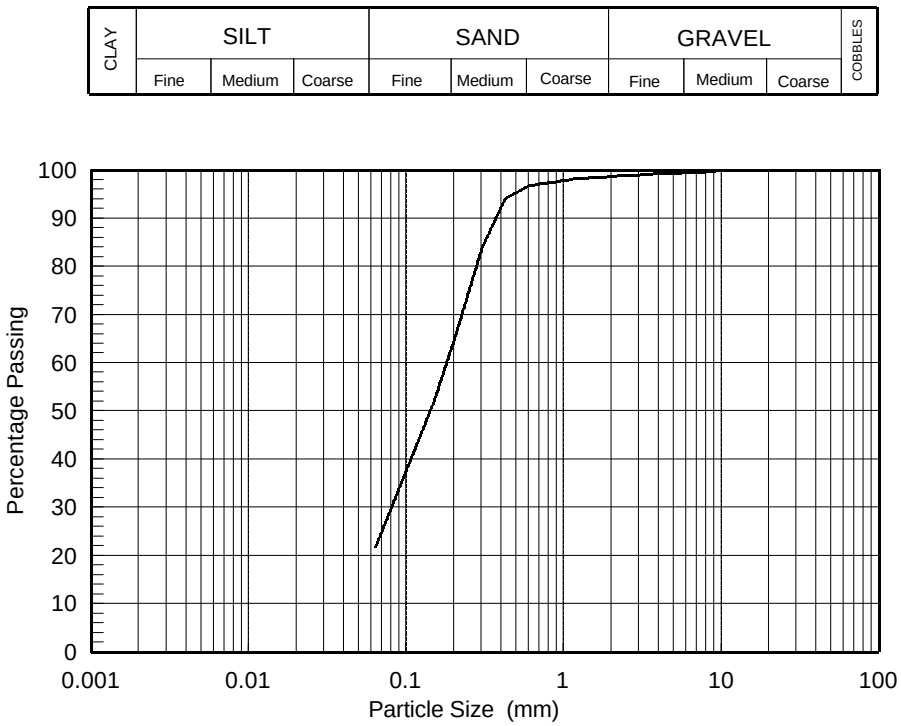
Determination of Particle Size Distribution

Borehole Number:	BH1
Sample Number:	B11
Depth (m):	7.00

Description:
Brown clayey silty fine to coarse SAND

BS1377 : Part 2 : Clause 9.2 : 1990 Wet Sieving Method

SIEVE	
Sieve	% pass
200 mm	100
125 mm	100
90 mm	100
75 mm	100
63 mm	100
50 mm	100
37.5 mm	100
28 mm	100
20 mm	100
14 mm	100
10 mm	100
6.3 mm	100
5 mm	99
3.35 mm	99
2 mm	99
1.18 mm	98
600 µm	97
425 µm	94
300 µm	84
212 µm	67
150 µm	52
63 µm	21



Particle Proportions		
Cobbles	0.0	%
Gravel	1.3	%
Sand	77.2	%
Silt & Clay	21.5	%

Checked and Approved
Initials: JS
Date: 31/01/2007

Project Number:
GEO / 10981
Project Name:
PLANT HILL HIGH SCHOOL, MANCHESTER

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Client: Geotechnical & Environmental Associates Limited, Unit 1, Church Farm, Gotham Road, Kingston-on-Soar, Nottinghamshire NG11 0DE

BS1377 : Part 2 : Clause 9 : 1990

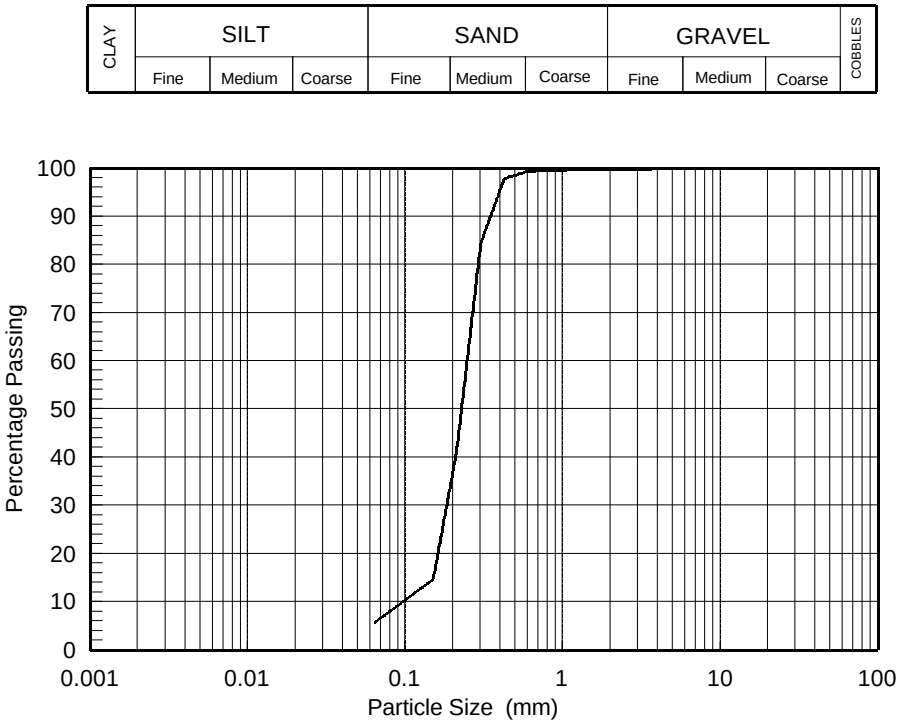
Determination of Particle Size Distribution

Window Sample:	WS20
Sample Number:	D4
Depth (m):	0.70

Description:
Brown clayey silty fine to medium SAND

BS1377 : Part 2 : Clause 9.2 : 1990 Wet Sieving Method

SIEVE	
Sieve	% pass
200 mm	100
125 mm	100
90 mm	100
75 mm	100
63 mm	100
50 mm	100
37.5 mm	100
28 mm	100
20 mm	100
14 mm	100
10 mm	100
6.3 mm	100
5 mm	100
3.35 mm	100
2 mm	100
1.18 mm	100
600 µm	99
425 µm	98
300 µm	84
212 µm	42
150 µm	15
63 µm	6



Particle Proportions		
Cobbles	0.0	%
Gravel	0.2	%
Sand	94.2	%
Silt & Clay	5.6	%

Checked and Approved
Initials: JS
Date: 31/01/2007

Project Number:
GEO / 10981
Project Name:
PLANT HILL HIGH SCHOOL, MANCHESTER

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Client: Geotechnical & Environmental Associates Limited, Unit 1, Church Farm, Gotham Road, Kingston-on-Soar, Nottinghamshire NG11 0DE

Scientific Analysis Laboratories

Report Number:	92684 compiled
Date of Report:	30/01/07
Client:	Geotechnical and Environmental Associates Unit 1 Church Farm Gotham Road Kingston on Soar Notts NG11 0DE
Client Contact:	Martin Cooper
Client Job Reference:	Plant Hill
Date Job Received at SAL:	08/01/07
Date Analysis Started:	16/01/07
Date Analysis Completed:	30/01/07

The results reported relate to samples received at the laboratory
Opinions and interpretations expressed herein are outside the scope of UKAS or MCERTS accreditation
This report should not be reproduced except in full without the written approval of the laboratory
Tests covered by this certificate were conducted in accordance with SAL SOPs

Key to symbols used on this report:

W: Analysis was performed at another SAL laboratory
S: Analysis was subcontracted
N: Analysis is not UKAS accredited
U: Analysis is UKAS accredited
M: Analysis is MCERTS accredited

Report written by:

Helen Ashpool
Senior Project Manager

Report checked and authorised by:

Ross Walker
Project Manager

1549 1549
Group

Report Number: 92684 compiled
Client Job Reference: Plant Hill

SAL Ref:	92684 001	92684 002	92684 003	92684 004	92684 005	92684 007
Client Ref:	WS1 D3 2.6	WS1 D5 4.6	WS1 D7 6.6	WS3 D3 1.2	WS6 D1 0.3	WS8 J1 0.7
Depth m	2.6	4.6	6.6	1.2	0.3	0.7
Date Sampled	-	-	-	-	-	-
Type	Topsoil	Topsoil	Topsoil	Topsoil	Topsoil	Topsoil
Matrix	Soil	Soil	Soil	Soil	Soil	Soil

Determinand	Method	Units	LOD	Analysis	Symbol						
Cyanide (Total)	Colorimetry	mg/kg	1	AR	U	5	<1	5	5	<1	7
Phenols (Total-Mono)	Colorimetry	mg/kg	1	AR	U	<1	<1	<1	<1	<1	<1
Sulphide	Colorimetry	mg/kg	10	AR	N	28	40	200	95	21	19
Total Petroleum Hydrocarbons (C8-C10)	GC/FID	mg/kg	1	AR	U	3	2	<10 *	<10 *	<1	<1
Total Petroleum Hydrocarbons (C10 - C12)	GC/FID	mg/kg	1	AR	U	17	16	38	<10 *	<1	<1
Total Petroleum Hydrocarbons (C12-C16)	GC/FID	mg/kg	1	AR	U	21	19	150	59	2	3
Total Petroleum Hydrocarbons (C16-C21)	GC/FID	mg/kg	1	AR	U	280	33	840	170	8	17
Total Petroleum Hydrocarbons (C21-C35)	GC/FID	mg/kg	1	AR	U	1600	440	6500	4100	23	87
Total Petroleum Hydrocarbons (C8-C10 aliphatic)	GC/FID	mg/kg	1	AR	N	2	-	<10 *	<10 *	-	-
Total Petroleum Hydrocarbons (C8-C10 aromatic)	GC/FID	mg/kg	1	AR	N	<1	-	<10 *	<10 *	-	-
Total Petroleum Hydrocarbons (C10-C12 aliphatic)	GC/FID	mg/kg	1	AR	N	8	-	11	<10 *	-	-
Total Petroleum Hydrocarbons (C10-C12 aromatic)	GC/FID	mg/kg	1	AR	N	<1	-	<10 *	<10 *	-	-
Total Petroleum Hydrocarbons (C12-C16 aliphatic)	GC/FID	mg/kg	1	AR	N	5	-	61	36	-	-
Total Petroleum Hydrocarbons (C12-C16 aromatic)	GC/FID	mg/kg	1	AR	N	<1	-	<10 *	<10 *	-	-
Total Petroleum Hydrocarbons (C16-C21 aliphatic)	GC/FID	mg/kg	1	AR	N	150	-	400	110	-	-
Total Petroleum Hydrocarbons (C16-C21 aromatic)	GC/FID	mg/kg	1	AR	N	10	-	80	16	-	-
Total Petroleum Hydrocarbons (C21-C35 aliphatic)	GC/FID	mg/kg	1	AR	N	910	-	2500	3000	-	-
Total Petroleum Hydrocarbons (C21-C35 aromatic)	GC/FID	mg/kg	1	AR	N	41	-	790	170	-	-
Polyaromatic Hydrocarbons (Total)	GC/MS (SIR)	mg/kg	0.01	AR	U	6.9	17	12	11	3.5	7.3
Moisture	Grav (1 Dec) (105 C)	%	0.1	AR	N	21	26	34	32	24	36
Moisture	Grav (1 Dec) (40 C)	%	0.1	AR	N	25	24	30	43	22	33
Arsenic	ICP/OES	mg/kg	2	A40	M	140	150	97	100	24	95
Cadmium	ICP/OES	mg/kg	1	A40	M	2	3	3	10	<1	2
Chromium	ICP/OES	mg/kg	1	A40	M	37	49	51	94	18	59
Copper	ICP/OES	mg/kg	1	A40	M	420	790	330	1000	88	420
Lead	ICP/OES	mg/kg	1	A40	M	1200	1200	1600	1200	140	1000
Mercury	ICP/OES	mg/kg	1	A40	M	1	<1	41	5	<1	<1

Report Number: 92684 compiled
Client Job Reference: Plant Hill

SAL Ref:	92684 001	92684 002	92684 003	92684 004	92684 005	92684 007
Client Ref:	WS1 D3 2.6	WS1 D5 4.6	WS1 D7 6.6	WS3 D3 1.2	WS6 D1 0.3	WS8 J1 0.7
Depth m	2.6	4.6	6.6	1.2	0.3	0.7
Date Sampled	-	-	-	-	-	-
Type	Topsoil	Topsoil	Topsoil	Topsoil	Topsoil	Topsoil
Matrix	Soil	Soil	Soil	Soil	Soil	Soil

Determinand	Method	Units	LOD	Analysis	Symbol						
Nickel	ICP/OES	mg/kg	1	A40	M	88	93	70	110	18	81
Selenium	ICP/OES	mg/kg	2	A40	M	<2	<2	<2	<2	<2	<2
Sulphate (Total)	ICP/OES	%	0.01	A40	N	2.4	2.2	4.6	3.7	0.29	0.79
Sulphate(2:1)	ICP/OES	g/l	0.1	AR	N	1.5	-	2.2	1.3	-	-
Zinc	ICP/OES	mg/kg	1	A40	M	930	2000	1500	2600	170	1200
Total Organic Carbon	OX/IR	%	0.1	A40	N	16	17	33	16	5	22
pH	Probe			AR	M	7.1	7.5	7.3	7	7.7	6.9
Chloride (2:1)	Titration	mg/l	50	AR	N	<50	<50	<50	<50	<50	<50

*** LOD raised due to dilution of sample**

AR- Analysis carried out on sample As received

A40- Analysis carried out on Dried and Ground sample (40°C)

Report Number: 92684 compiled
Client Job Reference: Plant Hill

SAL Ref:	92684 008	92684 010	92684 011	92684 012	92684 013
Client Ref:	WS9 J1 0.9	WS13 D3 0.8	WS13 J1 3.0	WS14 D3 1.6	WS15 J1 0.3
Depth m	0.9	0.8	3.0	1.6	0.3
Date Sampled	-	-	-	-	-
Type	Topsoil	Topsoil	Topsoil	Topsoil	Topsoil
Matrix	Soil	Soil	Soil	Soil	Soil

Determinand	Method	Units	LOD	Analysis	Symbol					
Cyanide (Total)	Colorimetry	mg/kg	1	AR	U	<1	<1	<1	<1	<1
Phenols (Total-Mono)	Colorimetry	mg/kg	1	AR	U	<1	<1	<1	<1	<1
Sulphide	Colorimetry	mg/kg	10	AR	N	<10	<10	46	<10	<10
Total Petroleum Hydrocarbons (C8-C10)	GC/FID	mg/kg	1	AR	U	<10 *	<1	<1	<1	<1
Total Petroleum Hydrocarbons (C10 - C12)	GC/FID	mg/kg	1	AR	U	<10 *	<1	<1	<1	<1
Total Petroleum Hydrocarbons (C12-C16)	GC/FID	mg/kg	1	AR	U	27	7	4	2	<1
Total Petroleum Hydrocarbons (C16-C21)	GC/FID	mg/kg	1	AR	U	130	49	17	9	<1
Total Petroleum Hydrocarbons (C21-C35)	GC/FID	mg/kg	1	AR	U	990	130	71	81	<1
Total Petroleum Hydrocarbons (C8-C10 aliphatic)	GC/FID	mg/kg	1	AR	N	<10 *	-	-	-	-
Total Petroleum Hydrocarbons (C8-C10 aromatic)	GC/FID	mg/kg	1	AR	N	<10 *	-	-	-	-
Total Petroleum Hydrocarbons (C10-C12 aliphatic)	GC/FID	mg/kg	1	AR	N	<10 *	-	-	-	-
Total Petroleum Hydrocarbons (C10-C12 aromatic)	GC/FID	mg/kg	1	AR	N	<10 *	-	-	-	-
Total Petroleum Hydrocarbons (C12-C16 aliphatic)	GC/FID	mg/kg	1	AR	N	17	-	-	-	-
Total Petroleum Hydrocarbons (C12-C16 aromatic)	GC/FID	mg/kg	1	AR	N	<10 *	-	-	-	-
Total Petroleum Hydrocarbons (C16-C21 aliphatic)	GC/FID	mg/kg	1	AR	N	75	-	-	-	-
Total Petroleum Hydrocarbons (C16-C21 aromatic)	GC/FID	mg/kg	1	AR	N	34	-	-	-	-
Total Petroleum Hydrocarbons (C21-C35 aliphatic)	GC/FID	mg/kg	1	AR	N	550	-	-	-	-
Total Petroleum Hydrocarbons (C21-C35 aromatic)	GC/FID	mg/kg	1	AR	N	140	-	-	-	-
Polyaromatic Hydrocarbons (Total)	GC/MS (SIR)	mg/kg	0.01	AR	U	4.3	21	8.7	1.8	0.53
Moisture	Grav (1 Dec) (105 C)	%	0.1	AR	N	22	22	30	15	19
Moisture	Grav (1 Dec) (40 C)	%	0.1	AR	N	21	21	40	16	18
Arsenic	ICP/OES	mg/kg	2	A40	M	42	130	180	32	14
Cadmium	ICP/OES	mg/kg	1	A40	M	2	2	3	<1	<1
Chromium	ICP/OES	mg/kg	1	A40	M	120	58	69	26	22
Copper	ICP/OES	mg/kg	1	A40	M	270	1000	1500	180	46
Lead	ICP/OES	mg/kg	1	A40	M	540	2200	1200	170	60
Mercury	ICP/OES	mg/kg	1	A40	M	<1	<1	1	<1	<1

Report Number: 92684 compiled

Client Job Reference: Plant Hill

SAL Ref:	92684 008	92684 010	92684 011	92684 012	92684 013
Client Ref:	WS9 J1 0.9	WS13 D3 0.8	WS13 J1 3.0	WS14 D3 1.6	WS15 J1 0.3
Depth m	0.9	0.8	3.0	1.6	0.3
Date Sampled	-	-	-	-	-
Type	Topsoil	Topsoil	Topsoil	Topsoil	Topsoil
Matrix	Soil	Soil	Soil	Soil	Soil

Determinand	Method	Units	LOD	Analysis	Symbol					
Nickel	ICP/OES	mg/kg	1	A40	M	40	99	110	36	22
Selenium	ICP/OES	mg/kg	2	A40	M	<2	<2	<2	<2	<2
Sulphate (Total)	ICP/OES	%	0.01	A40	N	0.3	0.33	6.6	0.82	0.11
Sulphate(2:1)	ICP/OES	g/l	0.1	AR	N	-	-	1.3	-	-
Zinc	ICP/OES	mg/kg	1	A40	M	960	1100	1900	510	110
Total Organic Carbon	OX/IR	%	0.1	A40	N	5.3	16	25	3.9	2.2
pH	Probe			AR	M	7.9	7.3	6.4	7.1	7.7
Chloride (2:1)	Titration	mg/l	50	AR	N	<50	<50	<50	<50	<50

*** LOD raised due to dilution of sample**

AR- Analysis carried out on sample As received

A40- Analysis carried out on Dried and Ground sample (40°C)

Report Number: 92684 compiled
Client Job Reference: Plant Hill

SAL Ref:	92684 014	92684 017
Client Ref:	WS16 J1 0.8	WS20 J3 0.5
Depth m	0.8	0.5
Date Sampled	-	-
Type	Topsoil	Topsoil
Matrix	Soil	Soil

Determinand	Method	Units	LOD	Analysis	Symbol		
Cyanide (Total)	Colorimetry	mg/kg	1	AR	U	<1	<1
Phenols (Total-Mono)	Colorimetry	mg/kg	1	AR	U	<1	<1
Sulphide	Colorimetry	mg/kg	10	AR	N	<10	<10
Total Petroleum Hydrocarbons (C8-C10)	GC/FID	mg/kg	1	AR	U	<1	<1
Total Petroleum Hydrocarbons (C10 - C12)	GC/FID	mg/kg	1	AR	U	<1	<1
Total Petroleum Hydrocarbons (C12-C16)	GC/FID	mg/kg	1	AR	U	3	<1
Total Petroleum Hydrocarbons (C16-C21)	GC/FID	mg/kg	1	AR	U	15	<1
Total Petroleum Hydrocarbons (C21-C35)	GC/FID	mg/kg	1	AR	U	56	<1
Total Petroleum Hydrocarbons (C8-C10 aliphatic)	GC/FID	mg/kg	1	AR	N	-	-
Total Petroleum Hydrocarbons (C8-C10 aromatic)	GC/FID	mg/kg	1	AR	N	-	-
Total Petroleum Hydrocarbons (C10-C12 aliphatic)	GC/FID	mg/kg	1	AR	N	-	-
Total Petroleum Hydrocarbons (C10-C12 aromatic)	GC/FID	mg/kg	1	AR	N	-	-
Total Petroleum Hydrocarbons (C12-C16 aliphatic)	GC/FID	mg/kg	1	AR	N	-	-
Total Petroleum Hydrocarbons (C12-C16 aromatic)	GC/FID	mg/kg	1	AR	N	-	-
Total Petroleum Hydrocarbons (C16-C21 aliphatic)	GC/FID	mg/kg	1	AR	N	-	-
Total Petroleum Hydrocarbons (C16-C21 aromatic)	GC/FID	mg/kg	1	AR	N	-	-
Total Petroleum Hydrocarbons (C21-C35 aliphatic)	GC/FID	mg/kg	1	AR	N	-	-
Total Petroleum Hydrocarbons (C21-C35 aromatic)	GC/FID	mg/kg	1	AR	N	-	-
Polyaromatic Hydrocarbons (Total)	GC/MS (SIR)	mg/kg	0.01	AR	U	5.4	0.03
Moisture	Grav (1 Dec) (105 C)	%	0.1	AR	N	21	14
Moisture	Grav (1 Dec) (40 C)	%	0.1	AR	N	12	13
Arsenic	ICP/OES	mg/kg	2	A40	M	17	6
Cadmium	ICP/OES	mg/kg	1	A40	M	<1	<1
Chromium	ICP/OES	mg/kg	1	A40	M	14	8
Copper	ICP/OES	mg/kg	1	A40	M	68	21
Lead	ICP/OES	mg/kg	1	A40	M	40	10
Mercury	ICP/OES	mg/kg	1	A40	M	<1	<1

Report Number: 92684 compiled

Client Job Reference: Plant Hill

SAL Ref:	92684 014	92684 017
Client Ref:	WS16 J1 0.8	WS20 J3 0.5
Depth m	0.8	0.5
Date Sampled	-	-
Type	Topsoil	Topsoil
Matrix	Soil	Soil

Determinand	Method	Units	LOD	Analysis	Symbol		
Nickel	ICP/OES	mg/kg	1	A40	M	33	9
Selenium	ICP/OES	mg/kg	2	A40	M	<2	<2
Sulphate (Total)	ICP/OES	%	0.01	A40	N	0.19	0.02
Sulphate(2:1)	ICP/OES	g/l	0.1	AR	N	-	-
Zinc	ICP/OES	mg/kg	1	A40	M	150	33
Total Organic Carbon	OX/IR	%	0.1	A40	N	16	0.2
pH	Probe			AR	M	8.3	6.4
Chloride (2:1)	Titration	mg/l	50	AR	N	<50	<50

*** LOD raised due to dilution of sample**

AR- Analysis carried out on sample As received

A40- Analysis carried out on Dried and Ground sample (40°C)

Report Number: 92684 compiled
Client Job Reference: Plant Hill

SAL Ref:	92684 006
Client Ref:	WS7 D1 0.2
Depth m	0.2
Date Sampled	-
Type	Fill #
Matrix	Soil

Determinand	Method	Units	LOD	Analysis	Symbol	
Cyanide (Total)	Colorimetry	mg/kg	1	AR	U	<1
Phenols (Total-Mono)	Colorimetry	mg/kg	1	AR	U	<1
Sulphide	Colorimetry	mg/kg	10	AR	N	<10
Total Petroleum Hydrocarbons (C8-C10)	GC/FID	mg/kg	1	AR	U	<1
Total Petroleum Hydrocarbons (C10 - C12)	GC/FID	mg/kg	1	AR	U	<1
Total Petroleum Hydrocarbons (C12-C16)	GC/FID	mg/kg	1	AR	U	2
Total Petroleum Hydrocarbons (C16-C21)	GC/FID	mg/kg	1	AR	U	6
Total Petroleum Hydrocarbons (C21-C35)	GC/FID	mg/kg	1	AR	U	25
Polyaromatic Hydrocarbons (Total)	GC/MS (SIR)	mg/kg	0.01	AR	U	8.9
Moisture	Grav (1 Dec) (105 C)	%	0.1	AR	N	8.3
Moisture	Grav (1 Dec) (40 C)	%	0.1	AR	N	26
Arsenic	ICP/OES	mg/kg	2	A40	U	17
Cadmium	ICP/OES	mg/kg	1	A40	U	<1
Chromium	ICP/OES	mg/kg	1	A40	U	14
Copper	ICP/OES	mg/kg	1	A40	U	52
Lead	ICP/OES	mg/kg	1	A40	U	120
Mercury	ICP/OES	mg/kg	1	A40	U	<1
Nickel	ICP/OES	mg/kg	1	A40	U	16
Selenium	ICP/OES	mg/kg	2	A40	U	<2
Sulphate (Total)	ICP/OES	%	0.01	A40	N	0.15
Zinc	ICP/OES	mg/kg	1	A40	U	96
Total Organic Carbon	OX/IR	%	0.1	A40	N	5.1
pH	Probe			AR	U	7.5
Chloride (2:1)	Titration	mg/l	50	AR	N	<50

AR- Analysis carried out on sample As received
A40- Analysis carried out on Dried and Ground sample (40°C)
 # Sample is outside the scope of MCERTS accreditation. Results are UKAS only

Report Number: **92684 compiled**
Client Job Reference: **Plant Hill**

SAL Ref.	**92684 018**
Client Ref.	**WS9 0.9 ASBESTOS**
Type	**Cement Sheet**

Determinand	**Method**	**Units**	**Symbol**	
Element	PLM	-	WN	Cement Sheet
Asbestos Type	PLM	-	WU	Chrysotile
Asbestos Level	PLM	%	WN	Typically 10-25
Comments	PLM	-	WN	-

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Generic Risk-Based Soil Guideline Values

INORGANICS

	Residential Usage with plant uptake			Commercial	Structures / Services	Comment
	pH 6	pH7	pH 8			
pH		-		-	<5.0 to >8.0	WRAS
Arsenic		20		500	(10)	SGV1 (WRAS)
Cadmium	1	2	8	1,400	(3)	SGV3 (WRAS)
Chromium		130		5,000	(600)	SGV4 (WRAS)
Copper	100	135	200	Limited toxicity		SLG
Lead		450		750	(500)	SGV10 (WRAS)
Mercury		8		480	(1)	SGV5 (WRAS)
Nickel		50		5,000		SGV7
Selenium		35		8,000	(3)	SGV9 (WRAS)
Zinc	250	300	450	Limited toxicity		SLG
Soluble Sulphate (2:1) mg/l	Limited toxicity			Limited toxicity	0	BRE/WRAS
Sulphide	Limited toxicity			Limited toxicity	250	WRAS
Chloride	Limited Toxicity			Limited toxicity	370	BRE

Notes:

Concentrations measured below the above values may be considered to represent 'uncontaminated conditions' which do not pose a risk to human health. Concentrations measured in excess of these values indicate a potential risk, and thus require further, site specific risk assessment.

SGV Soil Guide Line Value - Derived from the CLEA model and published by DEFRA

SLG Sludge (Use in Agriculture) Regulations 1989, as amended: Maximum permissible concentrations of potentially toxic elements (PTEs) in soil (0-25 cm)1 after application of sewage sludge waste and maximum annual rates of addition

BRE Building Research Establishment Special Publication 1:2005 - Concrete in Aggressive Ground

WRAS Water Regulations Advisory Scheme - The selection of materials for water supply pipes to be laid in contaminated land No 9-04-03 Oct 2002

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Generic Risk-Based Soil Guideline Values

ORGANICS

	Residential Usage with plant uptake			Commercial	Structures / Services	Comment
	SOM 1%	SOM 2.5%	SOM 5%			
Total Organic Carbon		6		10		Potential for Methanogenesis
Total Cyanide		140		12,000	(250)	GGV (WRAS)
Total Mono Phenols	78	150	280	21,900	(5)	SGV8 (WRAS)
Benzene	0.024	0.056	0.109	1.7 - 7.3		SGV12
Toluene	3	7	14	150		SGV15
Ethyl Benzene	9	21	41	48,000		SGV16
Xylene	6	15	30	340		SGV18
Total Petroleum Hydrocarbons	500			500		Trigger for speciated testing
PRO (C5-C10)	129	300	590	530,000	(50)	GGV Speciation Dependent (WRAS)
DRO (C12-C28)	20,000			580,000	(50)	GGV Speciation Dependent (WRAS)
Lube Oil (C28- 40)	140,000			Limited Toxicity	(50)	GGV Speciation Dependent (WRAS)
Aliphatic C5-C6	12	22	39	537		GGV
Aliphatic C6-C8	30	67	130	156,000		GGV
Aliphatic C8-C10	8	18	40	156,000		GGV
Aliphatic C10-C12	45	110	219	156,000		GGV
Aliphatic C12-C16	5,900	7,140	6,110	156,000		GGV
Aliphatic C16-C35	130,000			Limited Toxicity		GGV
Aromatic C6-C7	2.5	5.4	10	124		GGV
Aromatic C7-C8	6.4	15	30	339		GGV
Aromatic C8-C10	8.4	21	41	522		GGV
Aromatic C10-C12	17	41	83	62,200		GGV
Aromatic C12-C16	23	55	112	62,300		GGV
Aromatic C16-C21	14	34	69	46,700		GGV
Aromatic C21-C35	1,230	1,280	1,140	46,700		GGV

Notes: Concentrations measured below the above values may be considered to represent 'uncontaminated conditions' which do not pose a risk to human health. Concentrations measured in excess of these values indicate a potential risk, and thus require further, site specific risk assessment.

SGV Soil Guide Line Value - Derived from the CLEA model and published by DEFRA

GGV Generic Guideline Value - Calculated using the CLEA UK Software Beta Version 1.0 (2005) using the data from the appropriate TOX report published by DEFRA where available

SLG Sludge (Use in Agriculture) Regulations 1989, as amended: Maximum permissible concentrations of potentially toxic elements (PTEs) in soil (0-25 cm)1 after application of sewage sludge waste and maximum annual rates of addition

BRE Building Research Establishment Special Publication 1:2005 - Concrete in Aggressive Ground

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Generic Risk-Based Soil Guideline Values

POLY AROMATIC HYDROCARBONS

	Residential Usage with plant uptake			Commercial	Structures / Services	Comment
	SOM 1%	SOM 2.5%	SOM 5%			
Total PAH	35			1,120	(50)	GGV[1] / (WRAS)
Naphthalene	7	17	34	290-1400		SGV 19
Acenaphthylene	32	84	239	87,900		GGV
Acenaphthene	48	124	239	87,900		GGV
Fluorene	37	96	185	58,600		GGV
Phenanthrene	1,140	9,610	Limited Toxicity	440,000		GGV
Anthracene	44,200	Limited Toxicity	Limited Toxicity	440,000		GGV
Fluoranthene	60	Limited Toxicity	Limited Toxicity	58,600		GGV
Pyrene	45	Limited Toxicity	Limited Toxicity	43,900		GGV
Benzo(a) Anthracene	10			280		TEF GGV
Chrysene	100			2,800		TEF GGV
Benzo(b) Fluoranthene	10			280		TEF GGV
Benzo(k) Fluoranthene	10			280		TEF GGV
Benzo(a) pyrene	1.00			30		GGV[2]
Indeno(1 2 3 cd) Pyrene	10			280		TEF GGV
Dibenzo(a h) Anthracene	2.5			71		TEF GGV
Benzo (g h i) Perylene	3970	Limited Toxicity	Limited Toxicity	44,000		GGV

Notes:

Concentrations measured below the above values may be considered to represent 'uncontaminated conditions' which do not pose a risk to human health. Concentrations measured in excess of these values indicate a potential risk, and thus require further, site specific risk assessment.

SGV Soil Guide Line Value - Derived from the CLEA model and published by DEFRA

GGV Generic Guideline Value - Calculated using the CLEA UK Software Beta Version 1.0 (2005) using the data from the appropriate TOX report published by DEFRA where available or from the USEPA IRIS database where UK TOX data unavailable

GGV[1] Generic Guideline Value - Based on typical ratio of total PAH to individual species in our experience and used as a trigger for PAH speciation; individual species GGVs derived using the CLEA UK Software Beta Version 1.0 (2005) using the data from the appropriate TOX reports

GGV[2] Generic Guideline Value for oral exposure to Benzo (a) Pyrene - Calculated using the CLEA UK Software Beta Version 1.0 (2005) using the data from the TOX 2 report published by DEFRA

TEF GGV Toxic Equivalent Factored Generic Guideline Value - Calculated using toxic equivalent values for Benzo (a) pyrene calculated using the CLEA UK Software Beta Version 1.0 (2005) and the TOX report published by DEFRA

WRAS Water Regulations Advisory Scheme - The selection of materials for water supply pipes to be laid in contaminated land No 9-04-03 Oct 2002

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Gas Monitoring

Site	Plant Hill High School, Plant Hill Road, Higher Blackley, Manchester	**Job Number** J06365
Client	Balfour Beatty Construction Limited	**Sheet** 1 of 8
Engineer	Cundall Johnston and Partners LLP	

Date	17/01/2007	29/01/2007						
Air Temperature °C								
Barometric Pressure mB	998	1015						
Visit No	1	2	3	4	5	6		
Borehole No	BH3							
Condition of Standpipe	Good	Good						
Combustible gas (CH4) % LEL	Nil	Nil						
Combustible gas (CH4) % vol	<0.1	<0.1						
Combustible gas (CH4) ppm	<1000	<1000						
Carbon Dioxide % vol	4.6	1.9						
Oxygen % vol	15.2	18.1						
Flow Rate (max) l/hr	<0.1	0.3						
Relative Downhole Pressure mb	N/R	N/R						
Downhole Temperature °C								
Water Level m	4.44	0.85						
Remarks								

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Site	Plant Hill High School, Plant Hill Road, Higher Blackley, Manchester	**Job Number** J06365
Client	Balfour Beatty Construction Limited	**Sheet** 2 of 8
Engineer	Cundall Johnston and Partners LLP	

Date	17/01/2007	29/01/2007						
Air Temperature °C								
Barometric Pressure mB	998	1015						
Visit No	1	2	3	4	5	6		
Borehole No	WS1							
Condition of Standpipe	Good	Good						
Combustible gas (CH4) % LEL	Nil	Nil						
Combustible gas (CH4) % vol	18.4	21.1						
Combustible gas (CH4) ppm	18400	21100						
Carbon Dioxide % vol	14.2	13.4						
Oxygen % vol	12.1	2.8						
Flow Rate (max) l/hr	0.8	0.2						
Relative Downhole Pressure mb	N/R	N/R						
Downhole Temperature °C								
Water Level m	6.96	7.01						
Remarks								

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Gas Monitoring

Site	Plant Hill High School, Plant Hill Road, Higher Blackley, Manchester	**Job Number** J06365
Client	Balfour Beatty Construction Limited	**Sheet** 3 of 8
Engineer	Cundall Johnston and Partners LLP	

Date	17/01/2007	29/01/2007						
Air Temperature °C								
Barometric Pressure mB	998	1015						
Visit No	1	2	3	4	5	6		
Borehole No	WS4							
Condition of Standpipe	Good	Good						
Combustible gas (CH4) % LEL	Nil	Nil						
Combustible gas (CH4) % vol	<0.1	<0.1						
Combustible gas (CH4) ppm	<1000	<1000						
Carbon Dioxide % vol	0.6	0.6						
Oxygen % vol	17.6	17.4						
Flow Rate (max) l/hr	0.2	<0.1						
Relative Downhole Pressure mb	N/R	N/R						
Downhole Temperature °C								
Water Level m	1.39	1.44						
Remarks								

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Site	Plant Hill High School, Plant Hill Road, Higher Blackley, Manchester	**Job Number** J06365
Client	Balfour Beatty Construction Limited	**Sheet** 4 of 8
Engineer	Cundall Johnston and Partners LLP	

Date	17/01/2007	29/01/2007						
Air Temperature °C								
Barometric Pressure mB	998	1015						
Visit No	1	2	3	4	5	6		
Borehole No	WS7							
Condition of Standpipe	Good	Good						
Combustible gas (CH4) % LEL	Nil	Nil						
Combustible gas (CH4) % vol	<0.1	<0.1						
Combustible gas (CH4) ppm	<1000	<1000						
Carbon Dioxide % vol	<0.1	<0.1						
Oxygen % vol	19.4	19.4						
Flow Rate (max) l/hr	<0.1	<0.1						
Relative Downhole Pressure mb	N/R	N/R						
Downhole Temperature °C								
Water Level m	2.71	2.74						
Remarks								

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Gas Monitoring

Site	Plant Hill High School, Plant Hill Road, Higher Blackley, Manchester	**Job Number** J06365
Client	Balfour Beatty Construction Limited	**Sheet** 5 of 8
Engineer	Cundall Johnston and Partners LLP	

Date	17/01/2007	29/01/2007						
Air Temperature °C								
Barometric Pressure mB	998	1015						
Visit No	1	2	3	4	5	6		
Borehole No	WS10							
Condition of Standpipe	Good	Good						
Combustible gas (CH4) % LEL	Nil	Nil						
Combustible gas (CH4) % vol	<0.1	<0.1						
Combustible gas (CH4) ppm	<1000	<1000						
Carbon Dioxide % vol	<0.1	<0.1						
Oxygen % vol	19.5	19.6						
Flow Rate (max) l/hr	<0.1	<0.1						
Relative Downhole Pressure mb	N/R	N/R						
Downhole Temperature °C								
Water Level m	4.12	3.96						
Remarks								

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Gas Monitoring

Site	Plant Hill High School, Plant Hill Road, Higher Blackley, Manchester	**Job Number** J06365
Client	Balfour Beatty Construction Limited	**Sheet** 6 of 8
Engineer	Cundall Johnston and Partners LLP	

Date	17/01/2007	29/01/2007						
Air Temperature °C								
Barometric Pressure mB	998	1015						
Visit No	1	2	3	4	5	6		
Borehole No	WS13							
Condition of Standpipe	Good	Good						
Combustible gas (CH4) % LEL	Nil	Nil						
Combustible gas (CH4) % vol	<0.1	<0.1						
Combustible gas (CH4) ppm	<1000	<1000						
Carbon Dioxide % vol	0.1	12.1						
Oxygen % vol	19.4	5.5						
Flow Rate (max) l/hr	<0.1	<0.1						
Relative Downhole Pressure mb	N/R	N/R						
Downhole Temperature °C								
Water Level m	0.49	0.65						
Remarks								

Geotechnical & Environmental Associates	Tyttenhanger House Coursers Road St Albans AL4 0PG	**Gas Monitoring**

Site	Plant Hill High School, Plant Hill Road, Higher Blackley, Manchester	**Job Number** J06365
Client	Balfour Beatty Construction Limited	**Sheet** 7 of 8
Engineer	Cundall Johnston and Partners LLP	

Date	17/01/2007	29/01/2007						
Air Temperature °C								
Barometric Pressure mB	998	1015						
Visit No	1	2	3	4	5	6		
Borehole No	WS16							
Condition of Standpipe	Good	Good						
Combustible gas (CH4) % LEL	Nil	Nil						
Combustible gas (CH4) % vol	<0.1	<0.1						
Combustible gas (CH4) ppm	<1000	<1000						
Carbon Dioxide % vol	<0.1	<0.1						
Oxygen % vol	19.5	19.4						
Flow Rate (max) l/hr	<0.1	<0.1						
Relative Downhole Pressure mb	N/R	N/R						
Downhole Temperature °C								
Water Level m	N/R	N/R						
Remarks	Water level not recorded as bung could not be removed from standpipe							

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Gas Monitoring

Site	Plant Hill High School, Plant Hill Road, Higher Blackley, Manchester	**Job Number** J06365
Client	Balfour Beatty Construction Limited	**Sheet** 8 of 8
Engineer	Cundall Johnston and Partners LLP	

Date	17/01/2007	29/01/2007						
Air Temperature °C								
Barometric Pressure mB	998	1015						
Visit No	1	2	3	4	5	6		
Borehole No	WS19							
Condition of Standpipe	Good	Good						
Combustible gas (CH4) % LEL	Nil	Nil						
Combustible gas (CH4) % vol	<0.1	<0.1						
Combustible gas (CH4) ppm	<1000	<1000						
Carbon Dioxide % vol	<0.1	<0.1						
Oxygen % vol	19.3	19.6						
Flow Rate (max) l/hr	<0.1	<0.1						
Relative Downhole Pressure mb	N/R	N/R						
Downhole Temperature °C								
Water Level m	1.03	1.01						
Remarks								

Table 1: Summary of Ground Gas Monitoring Data

Borehole Number	Date	Methane (% v/v)	Carbon Dioxide (% v/v)	Oxygen (% v/v)	Atmos. Pressure (mb)	Flow (l/hr)
BH3	17/01/07	<0.1	4.6	15.2	998	<0.1
	29/01/07	<0.1	1.9	18.1	1015	0.3
	21/02/07	<0.1	7.5	6.5	0991	<0.1
	05/03/07	<0.1	7.3	12.7	0994	<0.1
	22/03/07	<0.1	7.1	16.9	1012	<0.1
WS1	17/01/07	18.4	14.2	12.1	998	0.8
	29/01/07	21.1	13.4	2.8	1015	0.2
	21/02/07	22.4	13.0	0.6	0991	<0.1
	26/02/07	22.2	14.4	2.2	1000	<0.1
	05/03/07	23.8	16.3	0.6	0994	<0.1
	22/03/07	20.2	13.9	3.2	1012	0.1
WS4	17/01/07	<0.1	0.6	17.6	998	0.2
	29/01/07	<0.1	0.6	17.4	1015	<0.1
	21/02/07	<0.1	0.4	18.3	0990	<0.1
	26/02/07	0.1	5.0	12.2	1000	<0.1
	05/03/07	<0.1	2.1	18.9	0994	<0.1
	22/03/07	<0.1	0.7	19.7	1012	<0.1
WS7	17/01/07	<0.1	<0.1	19.4	998	<0.1
	29/01/07	<0.1	<0.1	19.4	1015	<0.1
	21/02/07*	10.7	19.0	2.0	0991	<0.1
	26/02/07	5.4	4.1	13.0	1000	<0.1
	05/03/07	<0.1	<0.1	19.4	0994	<0.1
	22/03/07	0.4	0.5	18.6	1012	<0.1
WS10	17/01/07	<0.1	<0.1	19.5	998	<0.1
	29/01/07	<0.1	<0.1	19.6	1015	<0.1
	21/02/07	<0.1	<0.1	19.0	0992	<0.1
	26/02/07	-	-	-	-	-
	05/03/07	<0.1	0.1	20.4	0994	<0.1
	22/03/07	<0.1	0.1	20.7	1012	<0.1
WS13	17/01/07	<0.1	0.1	19.4	998	<0.1
	29/01/07	<0.1	12.1	5.5	1015	<0.1
	21/02/07	0.2	8.9	3.3	0991	<0.1
	26/02/07	1.6	13.5	0.2	1000	<0.1
	05/03/07	<0.1	<0.1	20.7	0994	<0.1
	22/03/07	<0.1	<0.1	20.7	1012	<0.1
WS16	17/01/07	<0.1	<0.1	19.5	998	<0.1
	29/01/07	<0.1	<0.1	19.4	1015	<0.1
	21/02/07	<0.1	<0.1	19.0	0991	<0.1
	26/02/07	<0.1	1.8	18.5	0999	<0.1
	05/03/07	<0.1	<0.1	19.1	0994	<0.1
	22/03/07	<0.1	2.3	19.7	1012	<0.1
WS19	17/01/07	<0.1	<0.1	19.3	998	<0.1
	29/01/07	<0.1	<0.1	19.6	1015	<0.1
	21/02/07	0.1	0.8	17.8	0991	0.1
	26/02/07	<0.1	0.9	17.9	1000	<0.1
	05/03/07	<0.1	<0.1	20.2	0994	<0.1
	22/03/07	<0.1	<0.1	20.4	1012	<0.1

*Gas tap was blocked therefore measured from well.

Table 2: Summary of Groundwater Monitoring Data

Borehole Number	Date	Response Zone (m)	Depth to Base (m bcl) [i]	Depth to Water (m bcl) [i]
BH3	17/01/07		5.00	4.44
	29/01/07		4.90	0.85
	21/02/07		4.92	3.70
	26/02/07		4.94	3.67
	05/03/07		4.90	3.77
	22/03/07		4.90	3.70
WS1	17/01/07		7.80	6.96
	29/01/07		7.79	7.01
	21/02/07		7.80	7.10
	26/02/07		7.80	7.20
	05/03/07		7.80	7.21
	22/03/07		7.79	7.07
WS4	17/01/07		3.70	1.39
	29/01/07		3.65	1.44
	21/02/02		3.70	1.67
	26/02/07		3.68	1.63
	05/03/07		3.70	1.67
	22/03/07		3.63	1.51
WS7	17/01/07		4.00	2.71
	29/01/07		4.00	2.74
	21/02/07		4.03	1.82
	26/02/07		4.02	2.12
	05/03/07		4.00	2.68
	22/03/07			
WS10	17/01/07		4.70	4.12
	29/01/07		4.71	3.96
	21/02/07		4.72	4.13
	26/02/07		-	-
	05/03/07		4.70	3.14
	22/03/07		4.74	3.51
WS13	17/01/07		3.20	0.49
	29/01/07		3.14	0.65
	21/02/07		3.14	1.50
	26/02/07		4.70	4.00
	05/03/07		4.90	4.09
	22/03/07		4.66	4.52

Borehole Number	Date	Response Zone (m)	Depth to Base (m bcl) [i]	Depth to Water (m bcl) [i]
WS16*	17/01/07		-	-
	29/01/07		-	-
	21/02/07		3.95	2.13
	26/02/07		3.88	2.11
	05/03/07		3.90	2.11
	22/03/07		3.85	2.23
WS19	17/01/07		3.90	1.03
	29/01/07		3.90	1.01
	21/02/07		3.90	1.00
	26/02/07		3.85	0.92
	05/03/07		3.81	0.84
	22/03/07		3.78	2.18

*Bung Wedged-unable to take water level reading.

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Site Plan

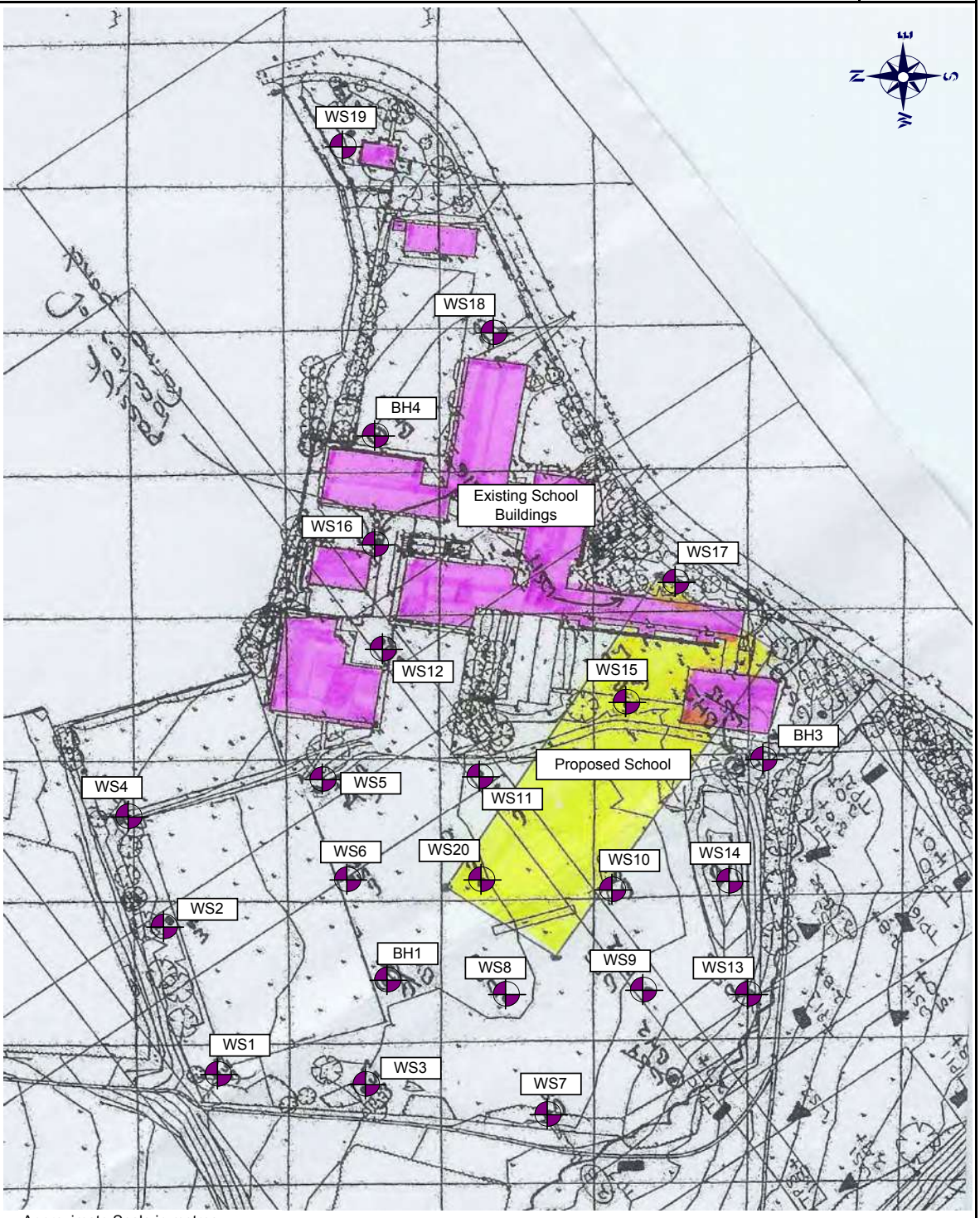
Site :Plant Hill High School, Plant Hill Road, Higher Blackley, Manchester

Client : Balfour Beatty Construction Limited

Engineer : Cundall Johnston and Partners LLP

Job Number J06365

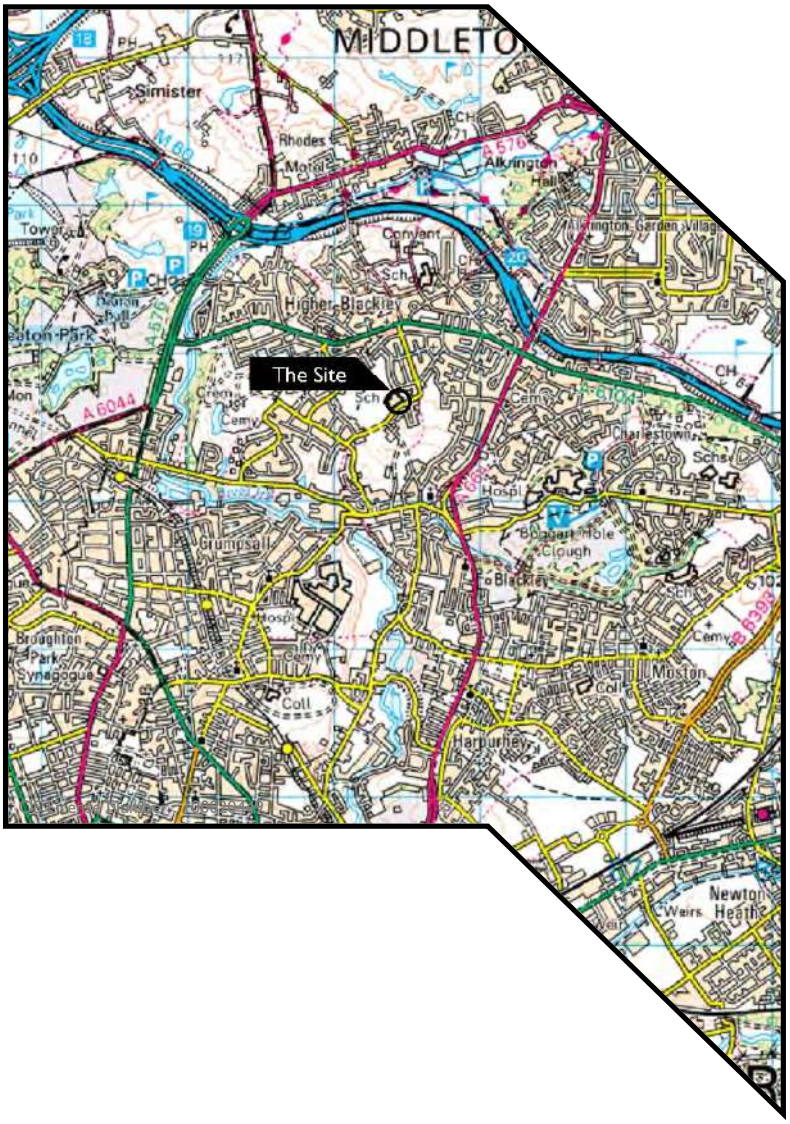
Sheet 1 / 1



Approximate Scale in metres

0 25 50 75

Appendix B Geotechnics Factual Report



Ground Investigation at

Co-Operative Academy, Blackley, Manchester

Factual Report

for

Laing O'Rourke Northern Ltd.

Engineer : Sinclair Knight Merz

Project Number : PN081814

July 2008

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Ground Investigation
at

Factual Report

CO-OPERATIVE ACADEMY, BLACKLEY, MANCHESTER

for
Laing O'Rourke Northern Ltd.

Engineer :
Sinclair Knight Merz

Project No:
PN081814
July 2008

CONTENTS

LIST OF CONTENTS

		Page No
1.0	INTRODUCTION	1
2.0	OBJECT AND SCOPE OF THE INVESTIGATION	1
3.0	PRESENTATION	1
4.0	THE SITE	1
	4.1 Location	
	4.2 Description	
5.0	PROCEDURE	1 - 2
	5.1 Commissioning	
	5.2 General	
	5.3 Boreholes	
	5.4 Window Sample Boreholes	
	5.5 Instrumentation and Monitoring	
6.0	LABORATORY TESTING	2 - 3
	6.1 Geotechnical	
	6.2 Contamination	

APPENDICES

APPENDIX 1	Site Location Plan
APPENDIX 2	Borehole Records
APPENDIX 3	Window Sample Borehole Records
APPENDIX 4	Laboratory Test Results - Geotechnical
APPENDIX 5	Laboratory Test Results - Contamination
APPENDIX 6	Monitoring Results
APPENDIX 7	Exploratory Hole Location Plan
APPENDIX 8	Investigation Techniques and General Notes

1.0 INTRODUCTION

A geotechnical and geoenvironmental investigation was undertaken by Geotechnics Ltd at the site of a proposed new school. The investigation was carried out to the instructions of the Engineer, Sinclair Knight Merz on behalf of the Client, Laing O'Rourke Northern Limited. This report describes the work undertaken and presents the data obtained.

2.0 OBJECT AND SCOPE OF THE INVESTIGATION

The object of the investigation was to obtain information on the ground and groundwater conditions relating to the design of the proposed works within the limitations posed by trial hole numbers, locations, depths, methods adopted and the scope of approved in situ and laboratory testing. The investigation comprised of Boreholes and Window Sample Boreholes, in situ and laboratory testing and reporting. A geotechnical and geoenvironmental interpretation and evaluation of the data obtained was not commissioned.

3.0 PRESENTATION

A description of the site and a summary of the procedures followed during the investigation process are presented in Sections 4 to 6. The factual data so obtained are presented in Appendices 2 to 7 of this report.

Attention is drawn to the General Notes and Investigation Procedures presented in Appendix 8 to aid an understanding of the procedures followed and the context in which the report should be read.

4.0 THE SITE

4.1 Location

The site is located in Blackley, North Manchester approximately 1.5km south east of junction 19 of the M60 motorway. The approximate Ordnance Survey National Grid Reference for the site is SD 853 036 and an extract from the relevant 1:50,000 Scale O.S. Map (Sheet No. 109) is included as Appendix 1.

4.2 Description

The site is currently occupied by a school building and playing fields which are due for demolition. The building is a large concrete construction, built in the 1950's. The playing fields consist of hard standing and grassed areas.

The site is an irregular shape and approximately 350m by 200m in size and generally flat. The site is bounded to the south and east by Plant Hill Road and grassed common ground to the north and west.

Access to the site is along the school service road off Plant Hill Road opposite a children's play area.

5.0 PROCEDURE

5.1 Commissioning

The work was awarded following submission of a tender for work designed by the Client's advisers for ground investigation of the site in accordance with the Client's requirements.

5.2 General

The procedures followed in this site investigation are based on *BS 5930 (1999) - Code of Practice for Site Investigations*. The Borehole and Window Sample Records are included in Appendices 2 and 3 and their approximate positions are shown on the Exploratory Hole Location Plan in Appendix 7.

The Exploratory Hole locations were selected by the Engineer.

5.3 Boreholes

Three (3 No.), 200mm and 150mm diameter

boreholes (numbered BH1 to BH3) were sunk by Cable Percussion Tool techniques to depths varying between 20m and 20.45m below ground level. The work was carried out between the 29th May and 30th May 2008. An inspection pit was excavated at each borehole location using hand tools to a depth not exceeding 1.20m below ground level to check for the presence of underground services.

Representative disturbed (D and B) and undisturbed (U100) samples of the soils encountered were obtained at regular intervals and Standard Penetration Tests (SPTs) undertaken in appropriate deposits, in order to allow inspection and obtain a measure of the engineering properties of the proved strata. In addition, environmental samples were recovered at the depths indicated on the Borehole Records, in Appendix 2.

On encountering groundwater, boring operations were suspended for 20 minutes in order to record any rise in water level. Full details of groundwater observations during site work are included on the Borehole Records.

On completion standpipes were installed in Boreholes BH1, 2, & 3 (see Section 5.5).

5.4 Window Sample Boreholes

Nineteen (19 No.) Window Sample Boreholes (numbered WS1 to WS19) were undertaken at the site to depths varying between 0.95m and 5.00m below ground level. The work was carried out between 29th May and 30th May 2008. An inspection pit was excavated at certain borehole locations (as specified by the Engineer) using hand tools to a depth not exceeding 1.20m below ground level to check for the presence of underground services.

The Window Samples were taken using super-heavy Dynamic Probe apparatus which drives lined steel tubes into the ground in 1m lengths. Samples are retrieved in the plastic liners taken direct from the sampling tube and placed in Jars. The hole is not cased and progress depends on the nature of the strata penetrated. Window Sample Boreholes are included in Appendix 3.

On completion standpipes were installed in Window Sample Borehole, WS1 (see Section 5.5).

5.5 Instrumentation and Monitoring

Long term monitoring of the gas and groundwater levels was made possible by the installation of standpipes as follows:

Exploratory Hole	Standpipe Slotted pipe & Filter Zone (m)
BH1	10.00 to 15.50
BH2	11.50 to 17.50
BH3	8.00 to 10.00
WS1	1.00 to 5.00

Monitoring of the gas and groundwater levels at the site commenced on the 10th June 2008 and comprised 8 No. visits on the 10th June, 17th June, 24th June, 30th June, 7th July, 15th July and ……..

Three (3 No.) Window Sample Boreholes with standpipes (WS4, WS16 and WS19) which were excavated by others during a previous phase of investigation were also monitored at the request of the Engineer.

At each position a record of the groundwater level in each instrument was taken. In the standpipes where water was recorded, water samples were obtained on the first and second visit following a purging of 3 volumes of water in the standpipe.

In addition to the groundwater levels the following parameters were measured and recorded in each standpipe using a Gas Data LMSxi Gas Analyser:-

- Concentrations (% Vol) of CH_4, O_2, CO_2, along with (% LEL) CH_4, H_2S , CO
- Flow Rate
- Barometric Pressure

The results of the monitoring are presented in Appendix 6.

6.0 LABORATORY TESTING

6.1 Geotechnical

The laboratory testing schedule was specified by the Engineer in order to relate to the proposed development. The tests, where appropriate, conform *to BS 1377 - Methods of Test for Soils for Civil Engineering Purposes (1990)* and were carried out in Geotechnics Limited's UKAS accredited Laboratory (Testing No. 1365). Any descriptions, opinions and

interpretations are outside the scope of UKAS accreditation.

The tests undertaken can be summarised as follows:-

BS 1377 (1990) Test No.		Test Description
Part 2		
3.2	15 No.	Moisture Content Determination
4.3 & 5.3	15 No.	Liquid and Plastic Limit Determination
9.2 & 9.3	9 No.	Mechanical Analysis - Sieving
9.4	7 No.	Mechanical Analysis - Sedimentation
Part 3		
3.0	1 No.	Organic Matter Content
4.0	1 No.	Mass Loss on Ignition Determination
5.3, 5.5	6 No.	Sulphate Analysis - Water Extract
9.5	6 No.	pH Determination
Part 4		
3.3	3 No.	Dry Density/Moisture Content Relationship determination. Compaction Test - British Standard (2.5 kg Hammer)
7.0	2 No.	California Bearing Ratio (CBR) Measurement - undisturbed (2.5kg)
Part 5		
3.0	6 No.	One-Dimensional Consolidation Properties Determination. Consolidation Test
Part 7		
9.0	5 No.	Shear Strength Measurement - 100mm diameter (Multi-Stage) Quick Undrained Triaxial Compression Test.

The results of these tests are presented in Appendix 4.

6.2 Contamination

Selected samples of soil and groundwater were tested at the laboratories of Alcontrol Laboratories for a number of determinands in order to check on potential site contamination. The determinands were specified by the Engineer.

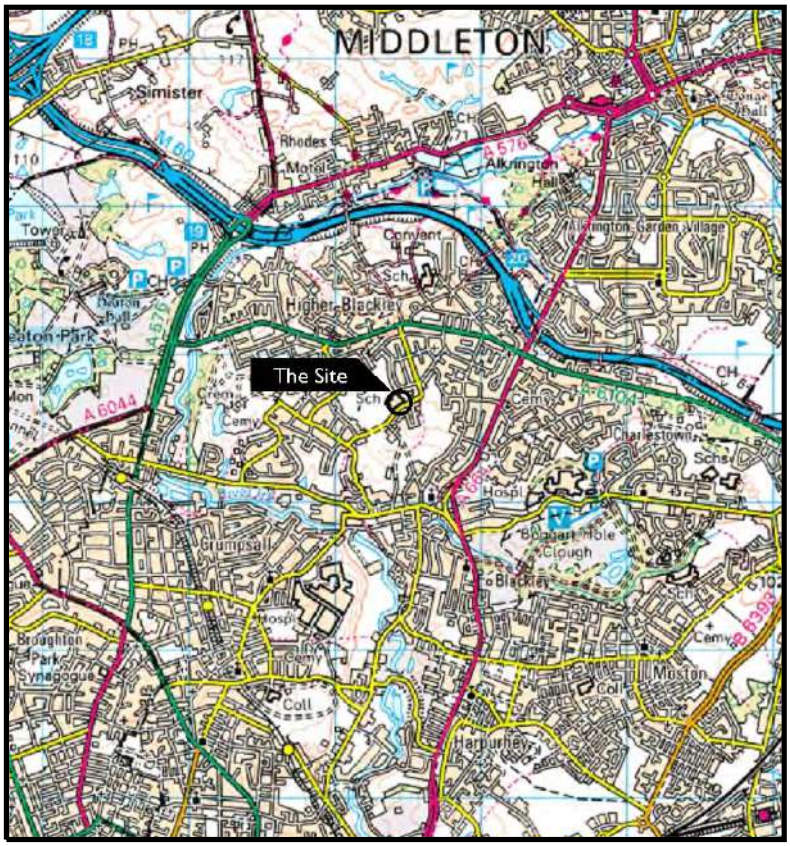
The results are tabulated in Appendix 5.

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APPENDIX I
Site Location Plan

SITE LOCATION PLAN



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Ground Investigation
at
Co-Operative Academy, Blackley, Manchester
for
Laing O'Rourke Northern Ltd.

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APPENDIX 2
Borehole Records

DATA SHEET - Symbols and Abbreviations used on Records

Sample Types

B	Bulk disturbed sample
BLK	Block sample
C	Core sample
D	Small disturbed sample (tub/jar)
E	Environmental test sample
ES	Environmental soil sample
EW	Environmental water sample
G	Gas sample
L	Liner sample
P	Piston sample (PF - failed piston sample)
TW	Thin walled push in sample
U -	Open Tube - 102mm diameter with blows to take sample. (UF - failed U sample)
V	Vial sample
W	Water sample
#	Sample Not Recovered

Insitu Testing / Properties

S	Standard Penetration Test (SPT)
C	SPT with cone
VN	Strength from Insitu Vane
HV	Strength from Hand Vane
PP	Strength from Pocket Penetrometer
	(All other strengths from undrained triaxial testing)
w%	Water content
N	SPT Result
-/-	Blows/penetration (mm) after 150mm seating.
-*/- (mm)	Total blows/penetration
( )	Extrapolated value

Rotary Core

RQD — Rock Quality Designation (% of intact core >100mm)

FRACTURE INDEX — Fractures/metre

FRACTURE SPACING (mm)	Maximum
	Minimum
NI	Non-intact core
NR	No core recovery

(where core recovery is unknown it is assumed to be at the base of the run)

Groundwater

Water Strike

Depth Water Rose To

Instrumentation

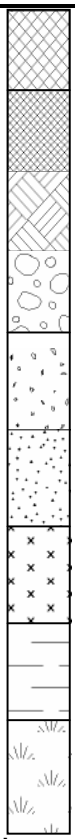


Seal

Filter

Seal

Strata



Made Ground Type 1

Type 2

Topsoil

Cobbles and Boulders

Gravel

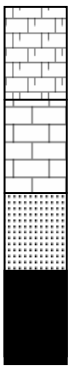
Sand

Silt

Clay

Peat

Note: Composite soil types shown by combined symbols



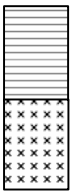
Chalk

Limestone

Sandstone

Coal

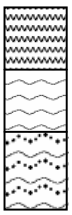
Strata, Continued



Mudstone

Siltstone

Metamorphic Rock

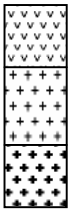


Fine Grained

Medium Grained

Coarse Grained

Igneous Rock



Fine Grained

Medium Grained

Coarse Grained

Backfill Materials



Arisings

Bentonite Seal

Concrete

Fine Gravel Filter

General Fill

Gravel Filter

Grout

Sand Filter

Tarmacadam

BOREHOLE RECORD - Cable Percussion

Project	CO-OPERATIVE ACADEMY	Engineer	SINCLAIR KNIGHT MERZ	Borehole / Project No	BH1 / PN081814
Client	LAING O'ROURKE CONSTRUCTION NORTH LTD	National Grid Coordinates	385395.203E 403688.927N	Ground Level	88.10 m OD

Sampling | Properties | Strata — Scale 1:50

Depth	Sample Type	Depth Cased & (to Water)	Strength kPa	w %	SPT	Description	Depth	Legend	Level m OD
							G.L.		88.10
						Grass over MADE GROUND: Brownish black slightly clayey slightly gravelly fine to coarse sand. Gravel is fine to coarse angular to subangular of various lithologies and brick.	0.10		88.00
0.20	D								
0.20	D								
0.20	ES								
0.20			PID=0.						
0.30- 0.60	B			23		MADE GROUND: Firm brown slightly sandy slightly gravelly clay. Gravel is fine to coarse angular to subangular of various lithologies and brick. Rootlets present.			
0.50	D								
0.50	D								
0.50	ES								
0.50			PID=0.						
0.80- 1.20	B			21					
1.00	D								
1.00	D								
1.00	ES								
1.00			PID=0.				1.80		86.30
1.20- 1.65	B					Loose brown slightly clayey slightly gravelly fine to coarse SAND. Gravel is fine to coarse angular to subrounded of various lithologies.			
1.20- 1.65	D						2.10		86.00
1.20- 1.65					S8				
1.90	D								
1.90	D					Soft to firm brown slightly sandy slightly gravelly CLAY. Gravel is fine to coarse angular to subrounded of limestone and siltstone.			
1.90			PID=0.						
2.00- 2.45	B			16					
2.00- 2.45	D								
2.00	ES					At 3.00m, low strength			
2.00- 2.45		1.80			S12				
2.90	D								
2.90	D						3.40		84.70
2.90			PID=0.			Brown slightly clayey slightly gravelly fine to coarse SAND. Gravel is fine to coarse angular to subrounded of various lithologies including coal.			
3.00	ES								
3.00- 3.45	U		29	16					
3.50	D								
3.90	D						4.00		84.10
3.90	D					Firm brown slightly sandy slightly gravelly CLAY. Gravel is fine to coarse angular to subrounded of mudstone and sandstone.			
3.90			PID=0.						
4.00- 4.45	B								
4.00- 4.45	D								
4.00- 4.45		3.50			S8				
4.50	ES								
4.90	D					At 5.00m, medium strength			
4.90	D								
4.90			PID=0.						
5.00- 5.45	U		74	16					
5.50	D								
6.00- 6.45	B								
6.00- 6.45	D								
6.00	ES								
6.00- 6.45		6.00			S8				
6.50	D								
6.50	D								
6.50			PID=0.						
							6.80		81.30
7.10- 7.55	B			22		Stiff orangish brown slightly sandy slightly gravelly CLAY. Gravel is fine to coarse angular to subrounded of various lithologies including coal.			
7.10- 7.55	D								
7.10- 7.55		7.00			S17				
7.50	D	(6.80)							
7.50	D								
7.50	ES								
7.50			PID=0.						
8.00- 8.45	B								
8.00- 8.45	D								
8.00- 8.45		8.00 (6.80)			S24				
8.60- 9.00	B						8.60		79.50
9.00- 9.45	B					Stiff brown slightly sandy slightly gravelly CLAY. Gravel is fine to coarse angular to subrounded of mudstone and sandstone.			
9.00	D								
9.00	D								
9.00- 9.45	D								
9.00	ES								
9.00- 9.45		9.00 (8.50)			S20				
9.00			PID=0.						
10.00-10.45	B								

Boring | Progress | Groundwater

Depth	Hole Dia	Technique	Crew	Depth of Hole	Depth Cased	Depth to Water	Date	Time	Depth Struck	Depth Cased	Rose to	in Mins	Depth Sealed	Remarks on Groundwater
1.20	0.40	Inspection Pit	LC&NK	G.L.	200		29/05/08	08:00						None encountered during boring.
7.50	0.20	Cable Percussion	LC&NK	13.50	150	11.40	29/05/08	17:00						
20.00	0.15	Cable Percussion	LC&NK	13.50	150		30/05/08	08:00						
				20.00	150		30/05/08	18:00						

Remarks

Inspection pit hand excavated to 1.20m depth.
Borehole backfilled with arisings/cement-bentonite grout on completion.
Water was added to assist boring.
E Sample = 1 x 258g amber jar and 1 x 60g amber jar.
A 50mm standpipe was installed to 15.00m with a geowrapped slotted section from 10.00m to 15.00m and with flush lockable protective cover. Detail as follows from base of hole: bentonite seal up to 15.00m, gravel filter up to 10.00m, bentonite seal up to 0.30m, concrete up to ground level.

Symbols and abbreviations are explained on the accompanying key sheet.

All dimensions are in metres.

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Figure 1 of 2

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BOREHOLE RECORD - Cable Percussion

Project	CO-OPERATIVE ACADEMY	Engineer	SINCLAIR KNIGHT MERZ	Borehole / Project No	BH1 / PN081814
Client	LAING O'ROURKE CONSTRUCTION NORTH LTD	National Grid Coordinates	385395.203E 403688.927N	Ground Level	88.10 m OD

Scale 1:50

Depth	Sample Type	Depth Cased & (to Water)	Strength kPa	w %	SPT	Description	Depth	Legend	Level m OD
10.00-10.45	D								
10.00-10.45		10.00 (9.00)			S21				
10.50	D						10.50		77.60
10.50	D					Medium dense orangish brown sandy SILT.			
10.50	ES								
10.50			PID=0.						
11.00-11.45	B			33					
11.00-11.45	D								
11.00-11.45		11.00 (10.10)			S22				
12.00-12.45	B						12.00		76.10
12.00	D					Medium dense orangish brown slightly gravelly silty fine to medium SAND. Gravel is fine angular of coal.			
12.00	D								
12.00-12.45	D								
12.00	ES								
12.00-12.45		12.00 (10.80)			S21				
12.00			PID=0.						
13.00-13.45	B								
13.00-13.45	D								
13.00-13.39		13.40 (11.10)			S50/ 240				
13.50	D						13.50		74.60
13.50	D					Dense brown very silty fine to coarse SAND.			
13.50	ES								
13.50			PID=0.						
14.00-14.45	B								
14.00-14.45	D								
14.00-14.38		14.00 (12.00)			S50/ 225				
15.00-15.45	B								
15.00-15.45	D								
15.00	ES								
15.00-15.35		15.00 (13.10)			S50/ 195				
16.00-16.45	B								
16.00-16.45	D								
16.00-16.34		16.00 (13.80)			S50/ 190				
16.50	ES								
17.00-17.45	B								
17.00-17.45	D								
17.00-17.39		17.00 (14.10)			S50/ 235				
18.00-18.45	B								
18.00-18.45	D								
18.00	ES								
18.00-18.38		18.00 (15.00)			S50/ 225				
19.00-19.45	B						19.00		69.10
19.00-19.45	D					Very stiff brownish grey slightly sandy slightly gravelly CLAY. Gravel is fine to coarse angular of various lithologies.			
19.00-19.37		18.00 (15.80)			S50/ 215				
19.50	ES								
						End of Borehole	20.00		68.10

Boring

Depth	Hole Dia	Technique	Crew

Progress

Depth of Hole	Depth Cased	Depth to Water	Date	Time

Groundwater

Depth Struck	Depth Cased	Rose to	in Mins	Depth Sealed	Remarks on Groundwater

Remarks

Symbols and abbreviations are explained on the accompanying key sheet.

All dimensions are in metres.

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Figure 2 of 2

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BOREHOLE RECORD - Cable Percussion

Project	CO-OPERATIVE ACADEMY	Engineer	SINCLAIR KNIGHT MERZ	Borehole	BH2
				Project No	PN081814
Client	LAING O'ROURKE CONSTRUCTION NORTH LTD	National Grid Coordinates	185330.703E 403636.006N	Ground Level	87.13 m OD

Scale 1:50

Depth	Sample Type	Depth Cased & (to Water)	Strength kPa	w %	SPT	Description	Depth	Legend	Level m OD
							G.L.		87.13
0.00- 0.50	B					Grass over MADE GROUND: Brown slightly clayey slightly gravelly fine to coarse sand. Gravel is			
0.10	D								
0.20	ES					fine to coarse angular to subangular of various	0.30		86.83
0.20			PID=0.			lithologies, brick and concrete. Rootlets present.			
0.50	B			19					
0.50	ES					MADE GROUND: Soft brown slightly sandy slightly			
0.50			PID=0.			gravelly clay. Gravel is fine to coarse angular to			
1.00	ES					subangular including brick.			
1.00			PID=0.						
1.20- 1.65	D								
1.20- 1.65	D								
1.20- 1.65	D								
1.20- 1.65					S3				
1.90	ES						2.00		85.13
2.00			PID=0.			Very soft brownish grey sandy slightly gravelly			
2.20- 2.65	U		32	21		SILT. Gravel is fine to medium angular of various lithologies.			
						At 2.20m, low strength	2.45		84.68
2.70	D					Firm brown slightly sandy slightly gravelly CLAY. Gravel is fine to coarse angular to subangular of			
2.90	ES					various lithologies.			
3.00			PID=0.			At 3.20m: Clay becomes stiff.			
3.20- 4.20	B								
3.20- 3.65	D								
3.20- 3.65					S17				
3.70	D						3.70		83.43
3.90	ES					Stiff greyish brown slightly sandy CLAY.			
4.20- 4.65	B			20					
4.20- 4.65	U37								
4.90	ES								
5.20- 6.50	B								
5.20- 5.65	D								
5.20- 5.65					S23				
6.50	ES					At 6.50m: Firm.			
6.50- 6.95	U		41	15		At 6.50m, medium strength			
7.00	D								
7.50	ES								
							7.80		79.33
8.00- 8.45	B					Medium dense orangish brown clayey slightly			
8.00- 8.45	D					gravelly fine to coarse SAND. Gravel is fine to			
8.00- 8.45					S27	medium angular to subangular of various lithologies.			
9.00	ES								
9.50- 9.95	B								
9.50-11.00	B								

Boring

Depth	Hole Dia	Technique	Crew
1.20	0.50	Inspection Pit	JB
20.45	0.15	Cable Percussion	JB

Progress

Depth of Hole	Depth Cased	Depth to Water	Date	Time
G.L.			29/05/08	08:00
15.10			29/05/08	18:00
15.10			30/05/08	08:00
20.45			30/05/08	18:00

Groundwater

Depth Struck	Depth Cased	Rose to	in Mins	Depth Sealed	Remarks on Groundwater
16.90	16.50	16.70	20		
19.50	19.00	18.60	20		

Remarks

AGS

Inspection pit hand excavated to 1.20m depth.
E sample = 1 x 258g amber jar, 1 x 60g amber jar.
A 50mm standpipe was installed to 17.00m with a geowrapped slotted section from 11.50m to 17.00m and with flush lockable protective cover. Detail as follows from base of hole: bentonite seal up to 17.00m, gravel filter up to 11.50m, bentonite seal up to 0.20m, concrete up to ground level.

Symbols and abbreviations are explained on the accompanying key sheet.

All dimensions are in metres.

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Figure 1 of 3

16/07/2008

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BOREHOLE RECORD - Cable Percussion

Project	CO-OPERATIVE ACADEMY	Engineer	SINCLAIR KNIGHT MERZ	Borehole / Project No	BH2 / PN081814
Client	LAING O'ROURKE CONSTRUCTION NORTH LTD	National Grid Coordinates	185330.703E 403636.006N	Ground Level	87.13 m OD

Sampling | Properties | Strata | Scale 1:50

Depth	Sample Type	Depth Cased & (to Water)	Strength kPa	w %	SPT	Description	Depth	Legend	Level m OD
							10.20		76.93
10.50	ES					Very stiff brownish grey slightly sandy slightly gravelly CLAY. Gravel is fine to medium angular of various lithologies.			
11.00-11.45	U								
11.50	D					Between 11.50-13.00m: Occasional bands of brownish orange fine to coarse sand.			
11.50	D								
12.00	ES								
12.50-14.00	B								
12.50-12.95	D								
12.50-12.95					S41				
13.50	ES								
14.00-15.50	B								
14.00-14.45	D								
14.00-14.45					S36				
15.50-17.00	B								
15.50-15.95	D								
15.50-15.95					S51				
17.00-18.50	B								
17.00-17.40	D								
17.00	D								
17.00-17.39					S55/ 236				
18.50-20.00	B								
18.50-18.90	D								
18.50	D								
18.50-18.89					S50/ 236				
20.00-20.45	D								
20.00-20.45					S50				

Boring | Progress | Groundwater

Depth	Hole Dia	Technique	Crew	Depth of Hole	Depth Cased	Depth to Water	Date	Time	Depth Struck	Depth Cased	Rose to	in Mins	Depth Sealed	Remarks on Groundwater

Remarks

Symbols and abbreviations are explained on the accompanying key sheet.

All dimensions are in metres.

Logged in accordance with Amendment 1 published December 2007 to BS5930:1999

Logged by KF

Figure 2 of 3

16/07/2008

geotechnics

BOREHOLE RECORD - Cable Percussion

Project	CO-OPERATIVE ACADEMY	Engineer	SINCLAIR KNIGHT MERZ	Borehole / Project No	BH2 / PN081814
Client	LAING O'ROURKE CONSTRUCTION NORTH LTD	National Grid Coordinates	185330.703 E, 403636.006 N	Ground Level	87.13 m OD

Sampling | Properties | Strata — Scale 1:50

Depth	Sample Type	Depth Cased & (to Water)	Strength kPa	w %	SPT	Description	Depth	Legend	Level m OD
						End of Borehole	20.45		66.68

Boring | Progress | Groundwater

Depth	Hole Dia	Technique	Crew	Depth of Hole	Depth Cased	Depth to Water	Date	Time	Depth Struck	Depth Cased	Rose to	in Mins	Depth Sealed	Remarks on Groundwater

Remarks

Symbols and abbreviations are explained on the accompanying key sheet.

All dimensions are in metres.

Logged in accordance with Amendment 1 published December 2007 to BS5930:1999

Logged by KF

Figure 3 of 3

16/07/2008

geotechnics

BOREHOLE RECORD - Cable Percussion

Project	CO-OPERATIVE ACADEMY	Engineer	SINCLAIR KNIGHT MERZ	Borehole	BH3
				Project No	PN081814
Client	LAING O'ROURKE CONSTRUCTION NORTH LTD	National Grid Coordinates	385312.229E 403706.589N	Ground Level	87.73 m OD

Sampling			Properties			Strata			Scale 1:50
Depth	Sample Type	Depth Cased & (to Water)	Strength kPa	w %	SPT	Description	Depth	Legend	Level m OD
							G.L.		87.73
0.20	E					Grass over MADE GROUND: Brown slightly clayey slightly gravelly fine to coarse sand. Gravel is fine to coarse angular to subrounded of various lithologies.	0.20		87.53
0.20			0.0						
0.30	D								
0.50	E								
0.50			0.0			Firm brown mottled grey and black slightly sandy slightly gravelly CLAY. Gravel is fine and rounded of various lithologies.			
0.60- 1.00	B								
1.00	E								
1.00			0.0						
1.20- 1.65	B			17					
1.20- 1.65	D								
1.20- 1.65		1.20			S10				
2.00- 2.45	B			25		At 2.00m: Becoming soft and dark brown.			
2.00- 2.45	D								
2.00	E								
2.00- 2.45		1.70			S7				
2.00			0.0						
2.70	D								
3.00- 3.45	B			25			3.00		84.73
3.00- 3.45	D					Loose orangish brown slightly silty slightly gravelly medium-coarse SAND. Gravel is fine to coarse angular to rounded of various lithologies.			
3.00	E								
3.00- 3.45		2.80			S9				
3.00			0.0						
3.70	D								
4.00- 4.45	B								
4.00	D								
4.00- 4.45		3.80			S9				
4.50	E								
4.50			0.0						
4.70	D								
5.00- 5.45	B					At 5.00m: Becomes medium dense.			
5.00- 5.45	D								
5.00- 5.45		4.70			S19				
5.70	D								
6.00- 6.45	B						6.00		81.73
6.00- 6.45	D					Firm to stiff dark brown slightly gravelly sandy CLAY. Gravel is fine to medium rounded to sub-angular of various lithologies.			
6.00	E								
6.00- 6.45		5.80			S18				
6.00			0.0						
6.70	D								
7.00- 7.45	U55		64	14		At 7.00m, medium strength			
7.45- 7.60	D								
7.50	E								
7.50			0.0						
7.80	D								
8.00- 8.45	B						8.00		79.73
8.00- 8.45	D					Medium dense orangish brown silty gravelly medium to coarse SAND. Gravel is fine to coarse subrounded of sandstone.			
8.00- 8.45		7.70			S19				
8.70	D								
9.00- 9.45	B								
9.00- 9.45	D								
9.00	E								
9.00- 9.45		8.80			S24				
9.00			0.0						
9.70	D								
10.00-10.45	B								

Boring

Depth	Hole Dia	Technique	Crew
1.20	0.50	Inspection Pit	GC
20.45	0.15	Cable Percussion	GC

Progress

Depth of Hole	Depth Cased	Depth to Water	Date	Time
G.L.			29/05/08	08:00
10.50	9.70	9.70	29/05/08	18:00
10.50	9.70		30/05/08	08:00
20.45	19.60		30/05/08	18:00

Groundwater

Depth Struck	Depth Cased	Rose to	in Mins	Depth Sealed	Remarks on Groundwater
1.60	1.20	1.60	20	2.00	Slow**
3.20	2.90	2.90	20	6.00	Slow**
9.90	9.60	9.80	20		Slow**
14.80	14.50	14.40	20	16.90	Slow**

Remarks

Inspection pit hand excavated to 1.20m depth.
E sample = 1 x 250g amber jar and 1 x 60g amber jar.
** Drillers description.
A 50mm standpipe was installed to 10.00m with a geowrapped slotted section from 8.00m to 10.00m and with flush lockable protective cover. Detail as follows from base of hole: bentonite seal up to 10.00m, gravel filter up to 8.00m, bentonite seal up to 0.50m, concrete up to ground level.

Logged by JH

Figure 1 of 3
16/07/2008

Symbols and abbreviations are explained on the accompanying key sheet.

All dimensions are in metres.

Logged in accordance with Amendment 1 published December 2007 to BS5930:1999

geotechnics

BOREHOLE RECORD - Cable Percussion

Project	CO-OPERATIVE ACADEMY	Engineer	SINCLAIR KNIGHT MERZ	Borehole / Project No	BH3 / PN081814
Client	LAING O'ROURKE CONSTRUCTION NORTH LTD	National Grid Coordinates	385312.229E 403706.589N	Ground Level	87.73 m OD

Sampling			Properties			Strata			Scale 1:50
Depth	Sample Type	Depth Cased & (to Water)	Strength kPa	w %	SPT	Description	Depth	Legend	Level m OD
10.00-10.45	D								
10.00-10.45		9.70			S17				
10.50	E								
10.50			0.0						
11.00-11.45	B								
11.00-11.45	D					Stiff brown slightly sandy CLAY	11.00		76.73
11.00-11.45		10.70			S18				
12.00-12.45	B								
12.00-12.45	D			26					
12.00	E								
12.00-12.45		11.70			S18				
12.00			0.0						
13.00-13.45	B								
13.00-13.45	D								
13.00-13.45		12.90			S19				
13.50			0.0						
14.00-14.45	B								
14.00-14.45	D								
14.00-14.45		13.70			S15				
15.00-15.45	B			25					
15.00-15.45	D						15.00		72.73
15.00	E					Firm brown sandy SILT			
15.00-15.45		14.90 (14.60)			S15				
15.00			0.0						
16.00-16.45	B					At 16.00m: Becomes stiff.			
16.00-16.45	D			25					
16.00-16.38		15.20			S20				
16.50	D								
16.50			0.0						
17.00-17.45	B								
17.00-17.45	D								
17.00-17.45		16.70			S28				
18.00-18.45	B					At 18.00m: becomes slightly sandy.			
18.00-18.45	D			14					
18.00	E								
18.00-18.45		17.90			S29				
18.00			0.0						
19.00-19.45	B					At 19.00m: Becomes very stiff.			
19.00-19.45	D								
19.00-19.45		18.90			S32				
19.50	E								
19.50			0.0						
20.00-20.45	D								
20.00-20.45		19.60			S36				

Boring				Progress					Groundwater					
Depth	Hole Dia	Technique	Crew	Depth of Hole	Depth Cased	Depth to Water	Date	Time	Depth Struck	Depth Cased	Rose to	in Mins	Depth Sealed	Remarks on Groundwater

Remarks

Symbols and abbreviations are explained on the accompanying key sheet.

All dimensions are in metres.

Logged in accordance with Amendment 1 published December 2007 to BS5930:1999

Logged by JH

Figure 2 of 3

16/07/2008

geotechnics

BOREHOLE RECORD - Cable Percussion

Project	CO-OPERATIVE ACADEMY	Engineer	SINCLAIR KNIGHT MERZ	Borehole / Project No	BH3 / PN081814
Client	LAING O'ROURKE CONSTRUCTION NORTH LTD	National Grid Coordinates	385312.229 E, 403706.589 N	Ground Level	87.73 m OD

Sampling | Properties | Strata — Scale 1:50

Depth	Sample Type	Depth Cased & (to Water)	Strength kPa	w %	SPT	Description	Depth	Legend	Level m OD
						End of Borehole	20.45		67.28

Boring | Progress | Groundwater

Depth	Hole Dia	Technique	Crew	Depth of Hole	Depth Cased	Depth to Water	Date	Time	Depth Struck	Depth Cased	Rose to	in Mins	Depth Sealed	Remarks on Groundwater

Remarks

Symbols and abbreviations are explained on the accompanying key sheet.

All dimensions are in metres.

Logged in accordance with Amendment 1 published December 2007 to BS5930:1999

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Figure 3 of 3

16/07/2008

geotechnics

APPENDIX 3
Window Sample Borehole Records

DATA SHEET - Symbols and Abbreviations used on Records

Sample Types

B	Bulk disturbed sample
BLK	Block sample
C	Core sample
D	Small disturbed sample (tub/jar)
E	Environmental test sample
ES	Environmental soil sample
EW	Environmental water sample
G	Gas sample
L	Liner sample
P	Piston sample (PF - failed piston sample)
TW	Thin walled push in sample
U -	Open Tube - 102mm diameter with blows to take sample. (UF - failed U sample)
V	Vial sample
W	Water sample
#	Sample Not Recovered

Insitu Testing / Properties

S	Standard Penetration Test (SPT)
C	SPT with cone
VN	Strength from Insitu Vane
HV	Strength from Hand Vane
PP	Strength from Pocket Penetrometer
	(All other strengths from undrained triaxial testing)
w%	Water content
N	SPT Result
-/-	Blows/penetration (mm) after 150mm seating.
-*/- (mm)	Total blows/penetration
( )	Extrapolated value

Rotary Core

RQD — Rock Quality Designation (% of intact core >100mm)

FRACTURE INDEX — Fractures/metre

FRACTURE SPACING (mm)	Maximum
	Minimum
NI	Non-intact core
NR	No core recovery

(where core recovery is unknown it is assumed to be at the base of the run)

Groundwater

Water Strike

Depth Water Rose To

Instrumentation

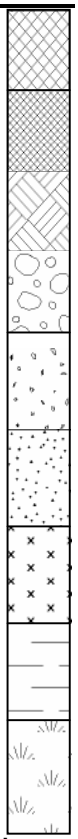


Seal

Filter

Seal

Strata



Made Ground Type 1

Type 2

Topsoil

Cobbles and Boulders

Gravel

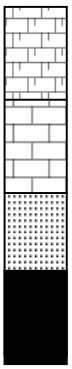
Sand

Silt

Clay

Peat

Note: Composite soil types shown by combined symbols



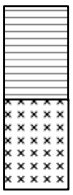
Chalk

Limestone

Sandstone

Coal

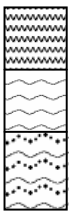
Strata, Continued



Mudstone

Siltstone

Metamorphic Rock

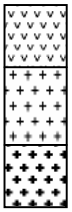


Fine Grained

Medium Grained

Coarse Grained

Igneous Rock



Fine Grained

Medium Grained

Coarse Grained

Backfill Materials



Arisings

Bentonite Seal

Concrete

Fine Gravel Filter

General Fill

Gravel Filter

Grout

Sand Filter

Tarmacadam

BOREHOLE RECORD – Windowless Sampler

Project	CO-OPERATIVE ACADEMY	Engineer	SINCLAIR KNIGHT MERZ	Borehole / Project No	WS1 / PN081814
Client	LAING O'ROURKE CONSTRUCTION NORTH LTD	National Grid Coordinates	385346.301E 403680.410N	Ground Level	87.07 m OD

Scale 1:50

Sampling: Depth	Sample Type	Depth Cased & (to Water)	Properties: Strength kPa	w %	Strata: Description	Depth	Legend	Level m OD
						G.L.		87.07
0.00- 0.20	B				Grass over MADE GROUND: Brown slightly clayey slightly gravelly fine to coarse sand. Gravel is fine to coarse angular to subrounded of sandstone, brick and concrete.	0.20		86.87
0.20- 0.50	B							
0.50- 1.00	B				Soft brown slightly sandy slightly gravelly CLAY. Gravel is fine to coarse angular to subrounded of various lithologies including coal.			
1.00- 2.00	B							
1.00- 2.00	D							
2.00- 3.00	B							
2.00- 3.00	D							
3.00- 4.00	B							
3.00- 4.00	D							
4.00- 5.00	B							
4.00- 5.00	D							
					End of Borehole	5.00		82.07

Boring

Depth	Hole Dia	Technique	Crew
1.20		Inspection Pit	WB
5.00		Windowless Sampler	WB

Progress

Depth of Hole	Depth Cased	Depth to Water	Date	Time
G.L.			29/05/08	08:00
5.00			29/05/08	18:00

Groundwater

Depth Struck	Depth Cased	Rose to	in Mins	Depth Sealed	Remarks on Groundwater
					None encountered during boring.

Remarks

Inspection pit hand excavated to 1.20m depth.
Window Sample Borehole backfilled with arisings bentonite on completion.
A 50mm standpipe was installed to 5.00m with a geowrapped slotted section from 1.00m to 5.00m and with flush lockable protective cover. Detail as follows from base of hole: general fill up to 1.00m, bentonite seal up to 0.20m, concrete up to ground level.

Logged by KF

Figure 1 of 1

16/07/2008

Symbols and abbreviations are explained on the accompanying key sheet.

All dimensions are in metres.

Logged in accordance with Amendment 1 published December 2007 to BS5930:1999

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BOREHOLE RECORD – Windowless Sampler

Project	CO-OPERATIVE ACADEMY	Engineer	SINCLAIR KNIGHT MERZ	Borehole	WS2
				Project No	PN081814
Client	LAING O'ROURKE CONSTRUCTION NORTH LTD	National Grid Coordinates	385364.479E 403753.219N	Ground Level	88.87 m OD

Sampling			Properties		Strata			
Depth	Sample Type	Depth Cased & (to Water)	Strength kPa	w %	Description	Depth	Legend	Level m OD
						G.L.		88.87
0.10- 0.20	B				Grass over TOPSOIL: Brownish black slightly silty slightly gravelly fine to coarse sand with low cobble content. Gravel is fine to coarse and subrounded to angular of various lithologies.			
0.20	D							
0.20	ES							
0.20			PID=0.					
0.30- 0.50	B							
0.50- 1.00	B				Firm greyish brown slightly gravelly CLAY. Gravel is fine to coarse and subangular to subrounded of various lithologies.	0.70		88.17
0.50	D							
0.50	ES							
0.50			PID=0.					
1.00	D							
1.00	ES							
1.00			PID=0.					
1.20- 2.00	B							
1.40- 1.60	D							
2.00- 3.00	B				Firm dark brownish grey slightly gravelly organic CLAY. Gravel is fine to coarse and angular to subrounded of sandstone and coal.	1.90		86.97
2.40- 2.60	D							
3.00- 4.00	B				Brown slightly gravelly silty fine to medium SAND. Gravel is fine to coarse and angular to subrounded of sandstone and coal.	3.10		85.77
3.50- 3.70	D							
4.00- 5.00	D							
					End of Borehole	5.00		83.87

Boring				Progress					Groundwater					
Depth	Hole Dia	Technique	Crew	Depth of Hole	Depth Cased	Depth to Water	Date	Time	Depth Struck	Depth Cased	Rose to	in Mins	Depth Sealed	Remarks on Groundwater
1.20	0.40	Inspection Pit	JB	G.L.			30/05/08	08:00						None encountered during boring.
5.00	0.09	Windowless Sampler	JB	5.00	5.00	DRY	30/05/08	18:00						

Remarks Inspection pit hand excavated to 1.20m depth.
Window Sample Borehole backfilled with arisings and bentonite grout on completion.

Logged by DS

Figure 1 of 1
16/07/2008

Symbols and abbreviations are explained on the accompanying key sheet.

All dimensions are in metres.

Logged in accordance with Amendment 1 published December 2007 to BS5930:1999

geotechnics

BOREHOLE RECORD – Windowless Sampler

Project	CO-OPERATIVE ACADEMY	Engineer	SINCLAIR KNIGHT MERZ	Borehole / Project No	WS3 / PN081814
Client	LAING O'ROURKE CONSTRUCTION NORTH LTD	National Grid Coordinates	385523.547E 403758.068N	Ground Level	87.96 m OD

Scale 1:50

Sampling: Depth	Sample Type	Depth Cased & (to Water)	Properties: Strength kPa	w %	Strata: Description	Depth	Legend	Level m OD
						G.L.		87.96
0.20- 0.30	B				MADE GROUND: Grey slightly clayey sandy fine to coarse subangular to subrounded gravel of various lithologies. Plastic and organic material present.			
0.20	ES							
0.20			PID=0.					
0.40- 0.60	B					0.60		87.36
0.50	ES				MADE GROUND: Soft to firm brownish grey slightly sandy slightly gravelly clay. Gravel is fine medium and coarse of various lithologies. Glass, plastic, rubber, timber and wool.			
0.50			PID=0.					
0.90- 1.20	B							
1.00	ES							
1.00			PID=0.					
1.20- 2.00	B							
1.20- 1.40	D							
1.40- 1.60	D					1.60		86.36
2.00- 3.00	B				Orange mottled grey slightly clayey slightly gravelly fine to coarse SAND. Gravel is fine medium and coarse subangular to subrounded of various lithologies including coal			
2.00- 2.20	D							
3.00- 4.00	B							
3.20- 3.40	D							
4.00- 5.00	B							
4.20- 4.40	D							
					End of Borehole	5.00		82.96

Boring

Depth	Hole Dia	Technique	Crew
1.20	0.40	Inspection Pit	JB
5.00	0.09	Windowless Sampler	JB

Progress

Depth of Hole	Depth Cased	Depth to Water	Date	Time
G.L.			29/05/08	08:00
5.00			29/05/08	18:00

Groundwater

Depth Struck	Depth Cased	Rose to	in Mins	Depth Sealed	Remarks on Groundwater
					None encountered during boring.

Remarks

AGS

Inspection pit hand excavated to 1.20m depth.
Window Sample Borehole backfilled with arisings and bentonite grout on completion.

Symbols and abbreviations are explained on the accompanying key sheet.

All dimensions are in metres.

Logged in accordance with Amendment 1 published December 2007 to BS5930:1999

Figure 1 of 1
16/07/2008

geotechnics

BOREHOLE RECORD – Windowless Sampler

Project	CO-OPERATIVE ACADEMY	Engineer	SINCLAIR KNIGHT MERZ	Borehole / Project No	WS4 / PN081814
Client	LAING O'ROURKE CONSTRUCTION NORTH LTD	National Grid Coordinates	385270.659E 403752.666N	Ground Level	87.99 m OD

Scale 1:50

Sampling: Depth	Sample Type	Depth Cased & (to Water)	Properties: Strength kPa	w %	Strata: Description	Depth	Legend	Level m OD
						G.L.		87.99
0.20- 0.30	B				MADE GROUND: Grey slightly clayey gravelly fine to coarse sand. Gravel is fine to coarse subangular to angular including brick, glass and coal.			
0.20	D							
0.20	ES							
0.20			PID=0.					
0.50	D							
0.50	ES							
0.50			PID=0.		From 1.00m: Becoming blackish brown.			
0.60- 0.90	B							
0.90- 1.20	B							
1.00	D							
1.00	ES					1.50		86.49
1.00			PID=0.		End of Borehole			
1.20- 1.50	B							

Boring

Depth	Hole Dia	Technique	Crew
1.20	0.40	Inspection Pit	JB
1.50	0.09	Windowless Sampler	JB

Progress

Depth of Hole	Depth Cased	Depth to Water	Date	Time
G.L.			29/05/08	08:00
1.50			29/05/08	18:00

Groundwater

Depth Struck	Depth Cased	Rose to	in Mins	Depth Sealed	Remarks on Groundwater
					None encountered during boring.

Remarks

Inspection pit hand excavated to 1.20m depth.
Window Sample Borehole backfilled with arisings and bentonite grout on completion.
The Window Sample Borehole was terminated at a depth of 1.50m due to the presence of an obstruction.

Symbols and abbreviations are explained on the accompanying key sheet.

All dimensions are in metres.

Logged in accordance with Amendment 1 published December 2007 to BS5930:1999

Figure 1 of 1
16/07/2008

geotechnics

BOREHOLE RECORD - Windowless Sampler

Project	CO-OPERATIVE ACADEMY	Engineer	SINCLAIR KNIGHT MERZ	Borehole	WS5
				Project No	PN081814
Client	LAING O'ROURKE CONSTRUCTION NORTH LTD	National Grid Coordinates	385304.199 E 40370.654 N	Ground Level	88.41

Sampling			Properties		Strata			Scale 1:50
Depth	Sample Type	Depth Cased & (to Water)	Strength kPa	w %	Description	Depth	Legend	Level
						G.L.		88.41
0.10- 0.20	B				Grass over MADE GROUND: Blackish brown slightly clayey gravelly fine to medium sand. Gravel is fine to coarse and angular to subrounded of various lithologies.	0.20		88.21
0.10			PID=0.					
0.20	D							
0.20	ES							
0.40- 0.70	B							
0.50	D				MADE GROUND: Blackish brown gravelly fine to medium sand. Gravel is fine to coarse and angular to subrounded of various lithologies including glass, brick, metal and plastic.	0.90		87.51
0.50	ES							
0.50			PID=0.					
0.90- 1.20	B							
1.00	D							
1.00	ES				Brownish orange slightly gravelly fine to medium SAND. Gravel is fine to coarse and subangular to subrounded of various lithologies.			
1.00			PID=0.					
1.20- 2.00	B							
1.50- 1.70	D							
2.00- 3.00	B				Brownish grey fine SAND.	1.90		86.51
2.40- 2.60	D							
3.00- 4.00	B							
3.40- 3.65	D				Brownish grey slightly silty fine SAND.	3.50		84.91
4.00- 5.00	B							
4.60- 4.80	D				Firm brown slightly silty slightly gravelly CLAY. Gravel is fine to medium and subangular to subrounded of mixed lithologies.	4.60		83.81
						5.00		83.41
					End of Borehole			

Boring				Progress					Groundwater					
Depth	Hole Dia	Technique	Crew	Depth of Hole	Depth Cased	Depth to Water	Date	Time	Depth Struck	Depth Cased	Rose to	in Mins	Depth Sealed	Remarks on Groundwater
1.20	0.40	Inspection Pit	JB	G.L.			30/05/08	08:00						None encountered during boring.
5.00	0.09	Windowless Sampler	JB	5.00	5.00	DRY	30/05/08	18:00						

Remarks
Inspection pit hand excavated to 1.20m depth.
Window Sample Borehole backfilled with arisings and bentonite grout on completion.

Logged by DS

Figure 1 of 1
16/07/2008

Symbols and abbreviations are explained on the accompanying key sheet.

All dimensions are in metres.

Logged in accordance with Amendment 1 published December 2007 to BS5930:1999

geotechnics

BOREHOLE RECORD – Windowless Sampler

Project	CO-OPERATIVE ACADEMY	Engineer	SINCLAIR KNIGHT MERZ	Borehole / Project No	WS6 / PN081814
Client	LAING O'ROURKE CONSTRUCTION NORTH LTD	National Grid Coordinates	385250.526E 403696.243N	Ground Level	87.24 m OD

Sampling | Properties | Strata | Scale 1:50

Depth	Sample Type	Depth Cased & (to Water)	Strength kPa	w %	Description	Depth	Legend	Level m OD
						G.L.		87.24
0.00- 0.50	B				MADE GROUND: Dark brown slightly gravelly sandy silt. Gravel is fine to medium subangular to rounded of various lithologies			
0.20	ES					0.40		86.84
0.20			PID=0.		MADE GROUND: Firm to stiff dark orangish brown slightly sandy gravelly clay. Gravel is fine medium and coarse angular to subrounded of various lithologies, brick and glass.			
0.50- 1.00	B					1.00		86.24
0.50	ES				End of Borehole			
0.50			PID=0.					

Boring | Progress | Groundwater

Depth	Hole Dia	Technique	Crew	Depth of Hole	Depth Cased	Depth to Water	Date	Time	Depth Struck	Depth Cased	Rose to	in Mins	Depth Sealed	Remarks on Groundwater
1.00	0.40	Inspection Pit	WB	G.L.			29/05/08	08:00						None encountered
				1.00			29/05/08	18:00						during boring.

Remarks: The Window Sample Borehole was terminated at a depth of 1.00m due to the presence of an obstruction and the hole moved to WS6A.

Symbols and abbreviations are explained on the accompanying key sheet.

All dimensions are in metres.

Logged in accordance with Amendment 1 published December 2007 to BS5930:1999

Figure 1 of 1

16/07/2008

geotechnics

BOREHOLE RECORD – Windowless Sampler

Project	CO-OPERATIVE ACADEMY	Engineer	SINCLAIR KNIGHT MERZ	Borehole / Project No	WS6A / PN081814
Client	LAING O'ROURKE CONSTRUCTION NORTH LTD	National Grid Coordinates	385252.359E 403696.584N	Ground Level	87.28 m OD

Sampling | Properties | Strata | Scale 1:50

Depth	Sample Type	Depth Cased & (to Water)	Strength kPa	w %	Description	Depth	Legend	Level m OD
0.00- 1.00	B				MADE GROUND: Dark brown slightly gravelly sandy silt. Gravel is fine to medium subangular to rounded of various lithologies	G.L.		87.28
0.20	ES							
0.20			PID=0.					
0.50	D				MADE GROUND: Firm to stiff dark orangish brown slightly sandy gravelly clay. Gravel is fine medium and coarse angular to subrounded of various lithologies, brick and glass	0.50		86.78
0.50	ES							
0.50			PID=0.			1.00		86.28
					End of Borehole			

Boring | Progress | Groundwater

Depth	Hole Dia	Technique	Crew	Depth of Hole	Depth Cased	Depth to Water	Date	Time	Depth Struck	Depth Cased	Rose to	in Mins	Depth Sealed	Remarks on Groundwater
1.00	0.40	Inspection Pit	WB	G.L. 1.00			29/05/08 29/05/08	08:00 18:00						None encountered during boring.

Remarks AGS The Window Sample Borehole was terminated at a depth of 1.00m due to the presence of an obstruction.

Symbols and abbreviations are explained on the accompanying key sheet.

All dimensions are in metres.

Logged in accordance with Amendment 1 published December 2007 to BS5930:1999

Figure 1 of 1
16/07/2008

geotechnics

BOREHOLE RECORD – Windowless Sampler

Project	CO-OPERATIVE ACADEMY	Engineer	SINCLAIR KNIGHT MERZ	Borehole / Project No	WS7 / PN081814
Client	LAING O'ROURKE CONSTRUCTION NORTH LTD	National Grid Coordinates	385248.969E 403663.074N	Ground Level	87.52 m OD

Scale 1:50

Depth	Sample Type	Depth Cased & (to Water)	Strength kPa	w %	Description	Depth	Legend	Level m OD
						G.L.		87.52
0.00- 1.00	B				Grass over MADE GROUND: Brown slightly clayey slightly gravelly fine to coarse sand. Gravel is fine to coarse angular to subangular of various lithologies	0.25		87.27
0.20	ES							
0.20			PID=0.					
0.70	ES				MADE GROUND: Firm to Stiff dark orange slightly sandy gravelly clay. Gravel is fine to medium subangular to subrounded of various lithologies including coal. From 0.55m to 1.00: Becoming blackish grey mottled orange.	1.00		86.52
0.70			PID=0.					
0.80	D							
1.00- 2.00	B							
1.20- 1.40	D							
1.20	ES							
1.20			PID=0.					
2.00- 3.00	B				MADE GROUND: Firm dark brown slightly sandy gravelly clay with low cobble content. Gravel is fine to medium subangular to subrounded including brick. Cobbles are subangular to subrounded of various lithologies. Between 1.60-1.80m: Becoming light brown mottled orangish brown.	1.80		85.72
2.20- 2.40	D							
3.00- 4.00	B				Firm to Stiff orangish brown mottled light grey slightly sandy slightly gravelly CLAY. Gravel is fine to medium subangular to subrounded of various lithologies.	2.79		84.73
3.20- 3.40	D				Stiff dark brown mottled light grey slightly sandy slightly gravelly CLAY. Gravel is fine medium coarse subangular to angular Between 3.80-4.00m: Lenses of orange fine to coarse sand.			
4.00- 5.00	B				Dark brown sandy SILT.	4.00		83.52
					End of Borehole	5.00		82.52

Boring

Depth	Hole Dia	Technique	Crew
1.20	0.40	Inspection Pit	WB
5.00	0.09	Windowless Sampler	WB

Progress

Depth of Hole	Depth Cased	Depth to Water	Date	Time
G.L.			30/05/08	08:00
5.00			30/05/08	18:00

Groundwater

Depth Struck	Depth Cased	Rose to	in Mins	Depth Sealed	Remarks on Groundwater
					None encountered during boring.

Remarks AGS Window Sample Borehole backfilled with arisings and bentonite grout on completion.

Symbols and abbreviations are explained on the accompanying key sheet.

All dimensions are in metres.

Logged in accordance with Amendment 1 published December 2007 to BS5930:1999

Figure 1 of 1
16/07/2008

geotechnics

BOREHOLE RECORD – Windowless Sampler

Project	CO-OPERATIVE ACADEMY	Engineer	SINCLAIR KNIGHT MERZ	Borehole	WS8
				Project No	PN081814
Client	LAING O'ROURKE CONSTRUCTION NORTH LTD	National Grid Coordinates	385251.193E 403624.451N	Ground Level	86.32 m OD

Scale 1:50

Sampling Depth	Sample Type	Depth Cased & (to Water)	Properties Strength kPa	w %	Strata Description	Depth	Legend	Level m OD
						G.L.		86.32
0.20- 0.50	B				MADE GROUND: Brownish black slightly gravelly silty fine to coarse sand. Gravel is fine to medium subangular to subrounded of various lithologies.			
0.20	ES							
0.20			PID=0.					
0.50- 1.00	B							
0.50	ES							
0.50			PID=0.					
						1.00		85.32
1.20	D				MADE GROUND: Blackish brown slightly clayey gravelly fine to coarse sand. Gravel is fine to coarse subangular to subrounded including brick, ceramics and glass.			
1.20	ES							
1.20			PID=0.					
						1.70		84.62
1.80	ES				MADE GROUND: Blackish brown slightly clayey gravelly fine to coarse sand. Gravel is fine to coarse subangular to subrounded including brick, coal and tin.			
1.80			PID=0.			2.00		84.32
2.00- 3.00	B							
2.50	ES				MADE GROUND: Grey slightly clayey gravelly fine to coarse sand with low cobble content. Gravel is fine medium and coarse angular to subangular including brick and plastic. Paper present.			
2.50			PID=0.			2.70		83.62
3.00- 4.00	D				MADE GROUND: Blackish brown slightly clayey gravelly fine to coarse sand with low cobble content. Gravel is fine to coarse and subangular to subrounded including brick, glass and timber. Paper present.			
4.00- 5.00	D							
						4.40		81.92
4.70	ES				MADE GROUND: Light reddish brown sandy fine medium and coarse angular to subangular gravel including brick.	4.60		81.72
4.70			PID=5.					
					MADE GROUND: Blackish brown slightly clayey gravelly fine to coarse sand with low cobble content. Gravel is fine to medium subangular to subrounded including glass and timber.	5.00		81.32
					End of Borehole			

Boring

Depth	Hole Dia	Technique	Crew
5.00	0.09	Windowless Sampler	WB

Progress

Depth of Hole	Depth Cased	Depth to Water	Date	Time
G.L.			29/05/08	08:00
5.00			29/05/08	18:00

Groundwater

Depth Struck	Depth Cased	Rose to	in Mins	Depth Sealed	Remarks on Groundwater
					None encountered during boring.

Remarks
Inspection pit hand excavated to 1.20m depth.
Window Sample Borehole backfilled with arisings/cement-bentonite grout on completion.

Symbols and abbreviations are explained on the accompanying key sheet.

All dimensions are in metres.

Logged in accordance with Amendment 1 published December 2007 to BS5930:1999

Figure 1 of 1
16/07/2008

geotechnics

BOREHOLE RECORD – Windowless Sampler

Project	CO-OPERATIVE ACADEMY	Engineer	SINCLAIR KNIGHT MERZ	Borehole / Project No	WS9 / PN081814
Client	LAING O'ROURKE CONSTRUCTION NORTH LTD	National Grid Coordinates	385285.808E 403638.329N	Ground Level	87.21 m OD

Sampling			Properties		Strata			Scale 1:50
Depth	Sample Type	Depth Cased & (to Water)	Strength kPa	w %	Description	Depth	Legend	Level m OD
0.00- 0.20	B				Grass over MADE GROUND: Brown slightly clayey slightly gravelly fine to coarse sand. Gravel is fine to coarse angular to subangular of clinker and sandstone.	G.L.		87.21
0.20- 0.50	B					0.20		87.01
0.50- 1.00	B				Soft light brown mottled grey slightly sandy slightly gravelly CLAY. Gravel is fine to medium angular to rounded of sandstone and coal.			
1.00- 1.20	D							
1.30- 2.00	B				Between 1.50-2.00m: Firm.			
2.00- 3.00	B				At 2.40m: Becomes firm. Between 2.60-2.80m: Band of fine to coarse sand.			
2.50- 2.70	D							
3.00- 3.60	D							
3.00- 3.60	D							
					Brown slightly clayey slightly gravelly fine to coarse SAND.	3.50		83.71
4.00- 5.00	B							
4.00- 5.00	D							
					End of Borehole	5.00		82.21

Boring				Progress					Groundwater					
Depth	Hole Dia	Technique	Crew	Depth of Hole	Depth Cased	Depth to Water	Date	Time	Depth Struck	Depth Cased	Rose to	in Mins	Depth Sealed	Remarks on Groundwater
1.20		Inspection Pit	WB	G.L.			29/05/08	08:00						None encountered during boring.
5.00		Windowless Sampler	WB	5.00			29/05/08	18:00						

Remarks: Inspection pit hand excavated to 1.20m depth.
Window Sample Borehole backfilled with arisings and bentonite on completion.

Logged by KF

Figure 1 of 1
16/07/2008

Symbols and abbreviations are explained on the accompanying key sheet.

All dimensions are in metres.

Logged in accordance with Amendment 1 published December 2007 to BS5930:1999

geotechnics

BOREHOLE RECORD – Windowless Sampler

Project	CO-OPERATIVE ACADEMY	Engineer	SINCLAIR KNIGHT MERZ	Borehole / Project No	WS10 / PN081814
Client	LAING O'ROURKE CONSTRUCTION NORTH LTD	National Grid Coordinates	385313.298E 403609.517N	Ground Level	88.40 m OD

Scale 1:50

Depth	Sample Type	Depth Cased & (to Water)	Strength kPa	w %	Description	Depth	Legend	Level m OD
						G.L.		88.40
0.00- 0.50	B				MADE GROUND: Dark orangish brown slightly clayey gravelly fine to coarse sand. Gravel is fine medium coarse subangular to subrounded including brick and timber.			
0.20	ES							
0.20			PID=0.					
0.50- 1.00	B							
0.50	ES							
0.50			PID=0.					
1.00- 2.00	B					1.00		87.40
1.20	D				MADE GROUND: Soft to firm reddish brown mottled grey slightly gravelly slightly sandy clay. Gravelly is fine to coarse angular subrounded including brick, ceramics, coal, plastic and timber. Paper present.			
2.00- 3.00	B				Between 2.30-2.60m: Lenses of orangish brown fine to coarse sand.			
2.60	D							
3.00- 3.50	B							
3.50- 4.00	D				Between 3.50-3.80m:Becomes fine to coarse SAND.			
4.00- 5.00	D							
						5.00		83.40
					End of Borehole			

Boring

Depth	Hole Dia	Technique	Crew
1.20	0.40	Inspection Pit	WB
5.00	0.09	Windowless Sampler	WB

Progress

Depth of Hole	Depth Cased	Depth to Water	Date	Time
G.L.			30/05/08	08:00
5.00			30/05/08	18:00

Groundwater

Depth Struck	Depth Cased	Rose to	in Mins	Depth Sealed	Remarks on Groundwater
					None encountered during boring.

Remarks

Inspection pit hand excavated to 1.20m depth.
Window Sample Borehole backfilled with arisings and bentonite grout on completion.

Symbols and abbreviations are explained on the accompanying key sheet.

All dimensions are in metres.

Logged in accordance with Amendment 1 published December 2007 to BS5930:1999

Figure 1 of 1
16/07/2008

geotechnics

BOREHOLE RECORD – Windowless Sampler

Project	CO-OPERATIVE ACADEMY	Engineer	SINCLAIR KNIGHT MERZ	Borehole / Project No	WS11 / PN081814
Client	LAING O'ROURKE CONSTRUCTION NORTH LTD	National Grid Coordinates	385423.374E 403689.176N	Ground Level	88.71 m OD

Sampling | Properties | Strata — Scale 1:50

Depth	Sample Type	Depth Cased & (to Water)	Strength kPa	w %	Description	Depth	Legend	Level m OD
0.10- 0.40	B				MADE GROUND: Reddish brown slightly clayey gravelly fine to coarse sand. Gravel is fine subangular to subrounded of various lithologies	G.L.		88.71
0.40- 0.80	B							
						0.95		87.76
					End of Borehole			

Boring | Progress | Groundwater

Depth	Hole Dia	Technique	Crew	Depth of Hole	Depth Cased	Depth to Water	Date	Time	Depth Struck	Depth Cased	Rose to	in Mins	Depth Sealed	Remarks on Groundwater
0.95	0.40	Inspection Pit	JB	G.L. 0.95			30/05/08 30/05/08	08:00 18:00						None encountered during boring.

Remarks

Window Sample Borehole backfilled with arisings and bentonite grout on completion.
The Window Sample Borehole was terminated at a depth of 0.95m due to the presence of an obstruction and the rig moved to WS11A.

Symbols and abbreviations are explained on the accompanying key sheet.

All dimensions are in metres.

Logged in accordance with Amendment 1 published December 2007 to BS5930:1999

Figure 1 of 1
16/07/2008

geotechnics

BOREHOLE RECORD – Windowless Sampler

Project	CO-OPERATIVE ACADEMY	Engineer	SINCLAIR KNIGHT MERZ	Borehole / Project No	WS11A / PN081814
Client	LAING O'ROURKE CONSTRUCTION NORTH LTD	National Grid Coordinates	385423.133E 403675.432N	Ground Level	88.92 m OD

Sampling			Properties		Strata			Scale 1:50
Depth	Sample Type	Depth Cased & (to Water)	Strength kPa	w %	Description	Depth	Legend	Level m OD
						G.L.		88.92
0.10- 0.40	B				MADE GROUND: Blackish brown slightly clayey slightly gravelly fine to coarse sand. Gravel is fine to medium subangular to subrounded including brick.			
0.20	ES							
0.20			PID=0.			0.40		88.52
0.50- 0.80	B							
0.50	ES							
0.50			PID=0.		MADE GROUND: Stiff orangish brown mottled light grey slightly sandy slightly gravelly clay. Gravel is fine to medium subangular to subrounded including brick.			
0.90- 1.20	B							
1.00	ES							
1.00			PID=0.					
1.20- 2.00	B					1.40		87.52
					Orange slightly silty slightly gravelly fine and medium SAND. Gravel is fine to medium subangular to subrounded of various lithologies.	1.60		87.32
1.80	D							
2.00- 3.00	B				Light orangish brown mottled light grey sandy SILT.			
						2.10		86.82
2.20	D				Firm to stiff brownish grey sandy CLAY.			
						2.55		86.37
					Reddish brown slightly gravelly silty fine to medium SAND. Gravel is fine to medium subangular to subrounded of various lithologies.	2.70		86.22
2.80	D							
3.00- 4.00	B					3.00		85.92
					Brownish grey slightly gravelly sandy SILT. Gravel is fine to medium subangular subrounded of various lithologies	3.30		85.62
3.80	D				Orangish brown slightly silty slightly gravelly fine to coarse SAND. Gravel is fine medium and coarse subangular to angular of various lithologies including coal.			
4.00- 5.00	B							
4.60	D				Greyish brown slightly gravelly fine to coarse SAND. Gravel is fine to medium angular to subangular of various lithologies. Between 3.30-4.40m: Lenses of greyish brown silt. Between 3.80-4.40m: Lenses of orangish brown fine to coarse sand.			
						5.00		83.92
					End of Borehole			

Boring				Progress					Groundwater					
Depth	Hole Dia	Technique	Crew	Depth of Hole	Depth Cased	Depth to Water	Date	Time	Depth Struck	Depth Cased	Rose to	in Mins	Depth Sealed	Remarks on Groundwater
1.20	0.40	Inspection Pit		G.L.			30/05/08	08:00						None encountered during boring.
5.00	0.09	Windowless Sampler		5.00			30/05/08	18:00						

Remarks AGS Inspection pit hand excavated to 1.20m depth.
Window Sample Borehole backfilled with arisings and bentonite grout on completion.

Symbols and abbreviations are explained on the accompanying key sheet.

All dimensions are in metres.

Logged in accordance with Amendment 1 published December 2007 to BS5930:1999

Figure 1 of 1
16/07/2008

geotechnics

BOREHOLE RECORD – Windowless Sampler

Project	CO-OPERATIVE ACADEMY	Engineer	SINCLAIR KNIGHT MERZ	Borehole / Project No	WS12 / PN081814
Client	LAING O'ROURKE CONSTRUCTION NORTH LTD	National Grid Coordinates	385470.378E 403702.066N	Ground Level	89.58 m OD

Scale 1:50

Depth	Sample Type	Depth Cased & (to Water)	Strength kPa	w %	Description	Depth	Legend	Level m OD
						G.L.		89.58
0.05- 0.25	B				MADE GROUND: Blackish brown sandy fine to coarse subangular to subrounded gravel including brick	0.25		89.33
0.20	ES							
0.20			PID=0.					
0.50- 0.80	B				MADE GROUND: Firm to stiff orangish dark brown mottled light grey slightly gravelly slightly sandy CLAY. Gravel is fine medium and coarse angular to subrounded including brick			
0.50	ES							
0.50			PID=0.					
0.90- 1.20	B							
1.00	ES							
1.00			PID=0.					
1.20- 2.00	B							
1.40	D							
2.00- 3.00	B				Reddish brown clayey fine to coarse SAND Between 2.00-2.10m: Reddish brown clayey fine to coarse sand.	2.00		87.58
2.40	D					2.10		87.48
3.00- 4.00	B				Firm to stiff dark orangish brown mottled light grey slightly gravelly slightly sandy CLAY. Gravel is fine medium and coarse angular to subrounded of various lithologies	2.60		86.98
4.00- 5.00	B				Firm to stiff reddish brown sandy CLAY			
4.40	D							
					End of Borehole	5.00		84.58

Boring

Depth	Hole Dia	Technique	Crew
1.20	0.40	Inspection Pit	JB
5.00	0.09	Windowless Sampler	JB

Progress

Depth of Hole	Depth Cased	Depth to Water	Date	Time
G.L.			30/05/08	08:00
5.00			30/05/08	18:00

Groundwater

Depth Struck	Depth Cased	Rose to	in Mins	Depth Sealed	Remarks on Groundwater
					None encountered during boring.

Remarks

Inspection pit hand excavated to 1.20m depth.
Window Sample Borehole backfilled with arisings and bentonite grout on completion.

Symbols and abbreviations are explained on the accompanying key sheet.

All dimensions are in metres.

Logged in accordance with Amendment 1 published December 2007 to BS5930:1999

Figure 1 of 1
16/07/2008

geotechnics

BOREHOLE RECORD – Windowless Sampler

Project	CO-OPERATIVE ACADEMY	Engineer	SINCLAIR KNIGHT MERZ	Borehole	WS13
				Project No	PN081814
Client	LAING O'ROURKE CONSTRUCTION NORTH LTD	National Grid Coordinates	385513.659E 403715.203N	Ground Level	90.83 m OD

Sampling			Properties		Strata			Scale 1:50
Depth	Sample Type	Depth Cased & (to Water)	Strength kPa	w %	Description	Depth	Legend	Level m OD
						G.L.		90.83
0.20	D				Brownish black slightly clayey gravelly fine to coarse SAND. Gravel is fine to coarse angular to subangular of various lithologies.	0.20		90.63
0.20	ES							
0.20			PID=0.					
0.50	D				Firm orangish brown mottled grey slightly gravelly sandy CLAY. Gravel is fine to medium subangular to subrounded of various lithologies.			
0.50	ES							
0.50			PID=0.					
1.00- 2.00	B					1.00		89.83
1.00	D				Firm to stiff reddish brown slightly gravelly sandy CLAY with low cobble content. Gravel is fine to coarse subangular to subrounded of various lithologies including coal. Cobbles are subangular to subrounded of various lithologies.			
1.00	ES							
1.00			PID=0.					
1.20	D							
2.00- 3.00	B					2.00		88.83
2.20	D				Reddish brown and dark grey slightly gravelly silty fine to medium SAND. Gravel is fine to medium subangular to subrounded of various lithologies including coal.			
3.00- 4.00	B							
3.20	D							
						3.40		87.43
					Firm to stiff dark brown slightly gravelly sandy CLAY. Gravel is fine medium and coarse subangular to subrounded of various lithologies.			
4.00- 4.50	D					4.00		86.83
4.50- 5.00	D				Reddish brown and dark grey slightly gravelly silty fine to medium SAND. Gravel is fine to medium subangular to subrounded of various lithologies including coal.			
						5.00		85.83
					End of Borehole			

Boring				Progress					Groundwater					
Depth	Hole Dia	Technique	Crew	Depth of Hole	Depth Cased	Depth to Water	Date	Time	Depth Struck	Depth Cased	Rose to	in Mins	Depth Sealed	Remarks on Groundwater
1.20	0.40	Inspection Pit	JB	G.L.			30/05/08	08:00						None encountered during boring.
5.00	0.09	Windowless Sampler	JB	5.00			30/05/08	18:00						

Remarks Inspection pit hand excavated to 1.20m depth.
Window Sample Borehole backfilled with arisings and bentonite grout on completion.

Symbols and abbreviations are explained on the accompanying key sheet.

All dimensions are in metres.

Logged in accordance with Amendment 1 published December 2007 to BS5930:1999

Figure 1 of 1
16/07/2008

geotechnics

BOREHOLE RECORD – Windowless Sampler

Project	CO-OPERATIVE ACADEMY	Engineer	SINCLAIR KNIGHT MERZ	Borehole / Project No	WS14 / PN081814
Client	LAING O'ROURKE CONSTRUCTION NORTH LTD	National Grid Coordinates	385443.709E 403643.809N	Ground Level	87.15 m OD

Sampling | Properties | Strata | Scale 1:50

Depth	Sample Type	Depth Cased & (to Water)	Strength kPa	w %	Description	Depth	Legend	Level m OD
						G.L.		87.15
0.20	ES				MADE GROUND: Blackish brown slightly gravelly slightly clayey sand. Gravel is fine to coarse angular to subrounded including brick.	0.20		86.95
0.20			PID=0.					
0.50- 0.80	B							
0.50	ES				MADE GROUND: Brown slightly clayey very gravelly fine to coarse sand. Gravel is fine to coarse angular to subrounded including brick.			
0.50			PID=0.					
0.90- 1.20	B							
1.00	ES							
1.00			PID=0.			1.20		85.95
1.20- 2.00	B				MADE GROUND: Firm to stiff reddish brown mottled light grey slightly gravelly sandy clay. Gravel is fine to coarse angular to subrounded including brick and coal.			
1.70	D							
2.00- 2.20	D							
2.20- 2.40	D				At 2.40m: Lenses of orange fine to coarse sand.			
						2.50		84.65
					Firm reddish brown slightly gravelly sandy CLAY. Gravel is fine to coarse subangular to subrounded of various lithologies including coal			
3.00- 4.00	B							
3.20- 3.40	D							
4.00- 5.00	B					4.00		83.15
					Firm greyish brown slightly gravelly sandy CLAY. Gravel is fine to medium subangular to subrounded of various lithologies.			
4.40- 4.80	D							
						5.00		82.15
					End of Borehole			

Boring | Progress | Groundwater

Depth	Hole Dia	Technique	Crew	Depth of Hole	Depth Cased	Depth to Water	Date	Time	Depth Struck	Depth Cased	Rose to	in Mins	Depth Sealed	Remarks on Groundwater
1.20	0.40	Inspection Pit	JB	G.L.			30/05/08	08:00						None encountered during boring.
5.00	0.09	Concrete core	JB	5.00			30/05/08	18:00						

Remarks
Inspection pit hand excavated to 1.20m depth.
Window Sample Borehole backfilled with arisings and bentonite grout on completion.

Symbols and abbreviations are explained on the accompanying key sheet.

All dimensions are in metres.

Logged in accordance with Amendment 1 published December 2007 to BS5930:1999

Figure 1 of 1
16/07/2008

geotechnics

BOREHOLE RECORD – Windowless Sampler

Project	CO-OPERATIVE ACADEMY	Engineer	SINCLAIR KNIGHT MERZ	Borehole	WS15
				Project No	PN081814
Client	LAING O'ROURKE CONSTRUCTION NORTH LTD	National Grid Coordinates	385289.915E 403688.852N	Ground Level	87.64 m OD

Sampling			Properties		Strata			Scale 1:50
Depth	Sample Type	Depth Cased & (to Water)	Strength kPa	w %	Description	Depth	Legend	Level m OD
						G.L.		87.64
0.00- 0.55	B				TOPSOIL: Blackish brown gravelly silty fine to medium sand. Gravel is fine to medium subangular to subrounded of various lithologies.	0.25		87.39
0.20	ES							
0.20			PID=0.					
0.25	D							
0.55- 1.00	B				Reddish brown slightly gravelly fine to coarse SAND. Gravel is fine to medium subangular to subrounded of various lithologies including coal.	0.55		87.09
0.70	D							
					Stiff reddish brown speckled black slightly gravelly sandy CLAY. Gravel is fine to medium subangular to subrounded of various lithologies including coal.	1.00		86.64
1.60- 2.00	B							
					Reddish brown slightly clayey slightly gravelly fine to coarse SAND. Gravel is fine to medium angular to subangular of various lithologies including coal fragments.	2.00		85.64
2.00- 3.00	D							
					Reddish brown slightly clayey slightly gravelly fine to coarse SAND. Gravel is fine to medium angular to subangular of various lithologies including coal fragments.			
3.00- 3.50	D				At 3.00m: Becomes dark grey.			
3.50- 4.00	B					3.50		84.14
					Dark grey slightly gravelly clayey fine to coarse SAND. Gravel is fine to medium angular to subangular of various lithologies.	3.70		83.94
4.00- 5.00	B							
					Firm dark grey slightly gravelly sandy CLAY. Gravel is fine medium coarse subangular to subrounded of various lithologies.	4.00		83.64
					Reddish brown clayey fine to coarse SAND.			
					End of Borehole	5.00		82.64

Boring				Progress					Groundwater					
Depth	Hole Dia	Technique	Crew	Depth of Hole	Depth Cased	Depth to Water	Date	Time	Depth Struck	Depth Cased	Rose to	in Mins	Depth Sealed	Remarks on Groundwater
5.00	0.09	Windowless Sampler	WB	G.L. 5.00			30/05/08 30/05/08	08:00 18:00						None encountered during boring.

Remarks AGS Window Sample Borehole backfilled with arisings and bentonite grout on completion.

Symbols and abbreviations are explained on the accompanying key sheet.

All dimensions are in metres.

Logged in accordance with Amendment 1 published December 2007 to BS5930:1999

Figure 1 of 1
16/07/2008

geotechnics

BOREHOLE RECORD - Windowless Sampler

Project **CO-OPERATIVE ACADEMY** Engineer **SINCLAIR KNIGHT MERZ** **Borehole** **WS16**
Project No **PN081814**

Client **LAING O'ROURKE CONSTRUCTION NORTH LTD**

Scale 1:50

Sampling			Properties		Strata		
Depth	Sample Type	Depth Cased & (to Water)	Strength kPa	w %	Description	Depth	Legend
0.00- 1.00	B				MADE GROUND: Brownish black slightly gravelly clayey fine to coarse sand. Gravel is fine to coarse subangular to subrounded of various lithologies including glass Between 0.50-1.00m: Medium cobble content.	G.L.	
0.20	ES						
0.20			PID=0.				
0.40	D						
0.50	ES						
0.50			PID=0.				
					MADE GROUND: Orangish brown slightly gravelly slightly clayey fine to coarse sand. Gravel is fine to coarse subangular to subrounded including glass and ceramics	1.00	
					End of Borehole	2.00	

Boring				Progress					Groundwater					
Depth	Hole Dia	Technique	Crew	Depth of Hole	Depth Cased	Depth to Water	Date	Time	Depth Struck	Depth Cased	Rose to	in Mins	Depth Sealed	Remarks on Groundwater
2.00	0.09	Windowless Sampler	WB	G.L. 2.00			30/05/08 30/05/08	08:00 18:00						None encountered during boring.

Remarks **Window Sample Borehole backfilled with arisings/cement-bentonite grout on completion. The Window Sample Borehole was terminated at a depth of 2.00m due to the presence of an obstruction and the rig moved to WS16A.**

Symbols and abbreviations are explained on the accompanying key sheet.

All dimensions are in metres.

Logged in accordance with Amendment 1 published December 2007 to BS5930:1999

Figure **1 of 1**
16/07/2008

geotechnics

BOREHOLE RECORD – Windowless Sampler

Project	CO-OPERATIVE ACADEMY	Engineer	SINCLAIR KNIGHT MERZ	Borehole / Project No	WS16A / PN081814
Client	LAING O'ROURKE CONSTRUCTION NORTH LTD	National Grid Coordinates	385279.609E 403714.254N	Ground Level	87.70 m OD

Scale 1:50

Sampling: Depth	Sample Type	Depth Cased & (to Water)	Properties: Strength kPa	w %	Strata: Description	Depth	Legend	Level m OD
0.00- 1.00	B				MADE GROUND: Brownish black slightly gravelly clayey fine to coarse sand. Gravel is fine to coarse subangular to subrounded including glass.	G.L.		87.70
0.20	ES							
0.20			PID=0.					
0.50	ES							
0.50			PID=0.					
0.60	D							
					MADE GROUND: Orangish brown slightly gravelly slightly clayey fine to coarse sand. Gravel is fine to coarse subangular to subrounded including glass and ceramics	1.00		86.70
					End of Borehole	2.00		85.70

Boring

Depth	Hole Dia	Technique	Crew
2.00	0.09	Windowless Sampler	WB

Progress

Depth of Hole	Depth Cased	Depth to Water	Date	Time
G.L.			30/05/08	08:00
2.00			30/05/08	18:00

Groundwater

Depth Struck	Depth Cased	Rose to	in Mins	Depth Sealed	Remarks on Groundwater
					None encountered during boring.

Remarks

AGS

Window Sample Borehole backfilled with arisings/cement-bentonite grout on completion.
The Window Sample Borehole was terminated at a depth of 2.00m due to the presence of an obstruction.

Symbols and abbreviations are explained on the accompanying key sheet.

All dimensions are in metres.

Logged in accordance with Amendment 1 published December 2007 to BS5930:1999

Figure 1 of 1
16/07/2008

geotechnics

BOREHOLE RECORD – Windowless Sampler

Project	CO-OPERATIVE ACADEMY	Engineer	SINCLAIR KNIGHT MERZ	Borehole / Project No	WS17 / PN081814
Client	LAING O'ROURKE CONSTRUCTION NORTH LTD	National Grid Coordinates	385281.938E 403663.510N	Ground Level	87.47 m OD

Scale 1:50

Depth	Sample Type	Depth Cased & (to Water)	Strength kPa	w %	Description	Depth	Legend	Level m OD
						G.L.		87.47
0.00- 0.60	B				TOPSOIL: Brownish black slightly gravelly very clayey fine to coarse sand. Gravel is fine medium coarse subangular to subrounded of various lithologies.	0.20		87.27
0.20	ES							
0.20			PID=0.					
0.40	D							
0.50	ES					0.60		86.87
0.50			PID=0.		Stiff orangish brown slightly gravelly sandy CLAY. Gravel is fine medium coarse subangular to subrounded of various lithologies.			
1.00- 2.00	B				Reddish brown slightly gravelly clayey fine to coarse SAND. Gravel is fine to coarse subangular to subrounded of various lithologies.			
2.00- 3.00	B					2.00		85.47
					Orangish brown slightly gravelly fine to coarse SAND. Gravel is fine to coarse subangular to subrounded of various lithologies			
2.50	D							
3.00- 4.00	B					3.00		84.47
					Firm reddish brown slightly sandy SILT.			
3.40	D							
4.00- 5.00	B					4.00		83.47
					Reddish brown slightly gravelly slightly clayey fine to coarse SAND. Gravel is fine to coarse subangular to subrounded of various lithologies.			
						5.00		82.47
					End of Borehole			

Boring

Depth	Hole Dia	Technique	Crew
5.00	0.09	Windowless Sampler	WB

Progress

Depth of Hole	Depth Cased	Depth to Water	Date	Time
G.L.			30/05/08	08:00
5.00			30/05/08	18:00

Groundwater

Depth Struck	Depth Cased	Rose to	in Mins	Depth Sealed	Remarks on Groundwater
					None encountered during boring.

Remarks AGS Window Sample Borehole backfilled with arisings and bentonite grout on completion.

Symbols and abbreviations are explained on the accompanying key sheet.

All dimensions are in metres.

Logged in accordance with Amendment 1 published December 2007 to BS5930:1999

Figure 1 of 1

16/07/2008

geotechnics

BOREHOLE RECORD – Windowless Sampler

Project	CO-OPERATIVE ACADEMY	Engineer	SINCLAIR KNIGHT MERZ	Borehole	WS18
				Project No	PN081814
Client	LAING O'ROURKE CONSTRUCTION NORTH LTD	National Grid Coordinates	385273.68 E 403614.00 N	Ground Level	86.43 m OD

Sampling			Properties			Strata			Scale 1:50
Depth	Sample Type	Depth Cased & (to Water)	Strength kPa	w %		Description	Depth	Legend	Level m OD
							G.L.		86.43
0.00- 1.00	B					Grass over MADE GROUND: Brown slightly clayey slightly gravelly fine to coarse sand. Gravel is fine to coarse angular to subangular of glass, brick, concrete and clinker. Rootlets present	0.25		86.18
0.00- 0.25	D								
0.20	ES								
0.20			PID=0.						
0.30- 1.00	D					MADE GROUND: Brown slightly clayey slightly gravelly fine to coarse sand. Gravel is fine to coarse angular to subangular including glass, brick, concrete, plastic, clinker and metal. Paper and cloth present.			
0.30- 1.00	D								
0.30- 1.00	D								
0.30- 1.00	ES								
0.30- 1.00			PID=0.						
1.00- 2.00	B								
1.00- 1.50	D								
1.00- 1.50	ES								
1.00- 1.50			PID=0.						
1.70- 2.30	D						1.70		84.73
2.00- 3.00	B					Firm brown mottled light grey slightly sandy slightly gravelly CLAY. Gravel is fine to medium angular to subangular of various lithologies. Occasional fine to coarse sand bands present.			
							2.80		83.63
3.00- 4.00	B					Brown very clayey fine to coarse SAND			
3.00- 3.30	D								
3.30- 3.80	D								
						End of Borehole	4.00		82.43

Boring				Progress					Groundwater					
Depth	Hole Dia	Technique	Crew	Depth of Hole	Depth Cased	Depth to Water	Date	Time	Depth Struck	Depth Cased	Rose to	in Mins	Depth Sealed	Remarks on Groundwater
4.00	0.09	Windowless Sampler	WB	G.L. 4.00			29/05/08 29/05/08	08:00 18:00						None encountered during boring.

Remarks

Window Sample Borehole backfilled with arisings and bentonite on completion.
The Window Sample Borehole was terminated at a depth of 4.00m due to the presence of an obstruction.

Logged by KF

Figure 1 of 1
16/07/2008

Symbols and abbreviations are explained on the accompanying key sheet.

All dimensions are in metres.

Logged in accordance with Amendment 1 published December 2007 to BS5930:1999

geotechnics

BOREHOLE RECORD - Windowless Sampler

Project	CO-OPERATIVE ACADEMY	Engineer	SINCLAIR KNIGHT MERZ	Borehole	WS19
				Project No	PN081814
Client	LAING O'ROURKE CONSTRUCTION NORTH LTD	National Grid Coordinates	385318.298E 403666.433N	Ground Level	87.32 m OD

Scale 1:50

Depth	Sample Type	Depth Cased & (to Water)	Strength kPa	w %	Description	Depth	Legend	Level m OD
						G.L.		87.32
0.20	D				TOPSOIL: Blackish brown slightly gravelly clayey fine to coarse sand. Gravel is fine to coarse subangular to subrounded of various lithologies	0.20		87.12
0.20	ES							
0.20			PID=0.					
0.50	D				Stiff orangish brown mottled light grey slightly gravelly sandy CLAY. Gravel is fine to medium subangular to subrounded of various lithologies			
0.50	ES							
0.50			PID=0.					
1.00- 2.00	B							
1.20- 1.60	D							
1.60- 2.00	D							
2.00- 3.00	B					2.00		85.32
2.00- 3.00	D				Stiff greyish brown slightly gravelly sandy CLAY. Gravel is fine medium coarse subangular to subrounded of various lithologies			
3.00- 4.00	B				At 3.00m:Lenses of orange fine to coarse sand.			
					At 3.60m: Lenses of orange fine to coarse sand.			
3.70	D							
4.00- 4.50	D							
4.50- 5.00	D							
					End of Borehole	5.00		82.32

Boring

Depth	Hole Dia	Technique	Crew
5.00	0.09	Windowless Sampler	WB

Progress

Depth of Hole	Depth Cased	Depth to Water	Date	Time
G.L.			30/05/08	08:00
5.00			30/05/08	18:00

Groundwater

Depth Struck	Depth Cased	Rose to	in Mins	Depth Sealed	Remarks on Groundwater
					None encountered during boring.

Remarks AGS Window Sample Borehole backfilled with arisings and bentonite grout on completion.

Symbols and abbreviations are explained on the accompanying key sheet.

All dimensions are in metres.

Logged in accordance with Amendment 1 published December 2007 to BS5930:1999

Figure 1 of 1
16/07/2008

geotechnics

APPENDIX 4
Laboratory Test Results - Geotechnical

Classification and Strength

Symbol **C - Clay** **M - Silt**
(0 - containing organic matter)
Plasticity L - Low
I - Intermediate
H - High
V - Very High
E - Extremely High

Ip	Plasticity Index
%	% Retained on 425 µm sieve, shown under Ip value
w_L	Liquid Limit
w_P	Plastic Limit
NP	Non-Plastic
w	Moisture Content
p_d	Particle Density
Test	**Quick undrained triaxial tests** SS Single stage - 102mm diameter. S3 Single stage - set of 3 38mm diameter. MS Multistage - 102mm diameter. D Drained Test HV Hand Vane PP Pocket Penetrometer (kg/cm²) UT Unsuitable for Test
γ_b	Bulk Density
σ_3	Triaxial Cell Pressure
$\sigma_1 - \sigma_3$	Deviator Stress
##	Excessive Strain
c_u	Undrained Cohesion
c	Cohesion Intercept
ϕ	Angle of Shearing Resistance
Linear Shrink	Linear Shrinkage

Consolidation

m_v	Coefficient of Volume Compressibility
c_{v50}	Coefficient of Consolidation - Log t
c_{v90}	Coefficient of Consolidation - $\sqrt{t}$

Chemical Analysis

Acid Soluble	Total sulphate in specimen, expressed as SO_3 %, value in brackets expressed as SO_4 %
Water Soluble	Soluble sulphate in 2:1 water : soil extract, expressed as SO_3 g/l, value in brackets expressed as SO_4 g/l
In Water	Sulphate content of groundwater, expressed as SO_3 g/l, value in brackets expressed as SO_4 g/l
pH	pH value
Organic content	Organic content expressed as a percentage of dry weight
Chloride	Chloride Ion content expressed as a percentage of dry weight

MCV, Compaction, CBR

MCV	Moisture Condition Value at natural moisture content
MCC	Moisture Condition Calibration
CCV	Chalk Crushing Value

Compaction

Type	2.5	=	BS 2.5 kg Rammer
	4.5	=	BS 4.5 kg Rammer
	V	=	BS Vibrating Hammer

γ_b	Bulk Density
γ_d	Dry Density

CBR California Bearing Ratio

Type	2.5	=	Test on Specimen Recompacted using BS 2.5 kg Rammer
	4.5	=	As above but using BS 4.5 kg Rammer
	V	=	As above but using BS Vibrating Hammer
	M	=	Test on open drive mould specimen cut in field
	S	=	Soaked Specimen

Top	CBR at top of mould
Bottom	CBR at bottom of mould
ND	None Detected

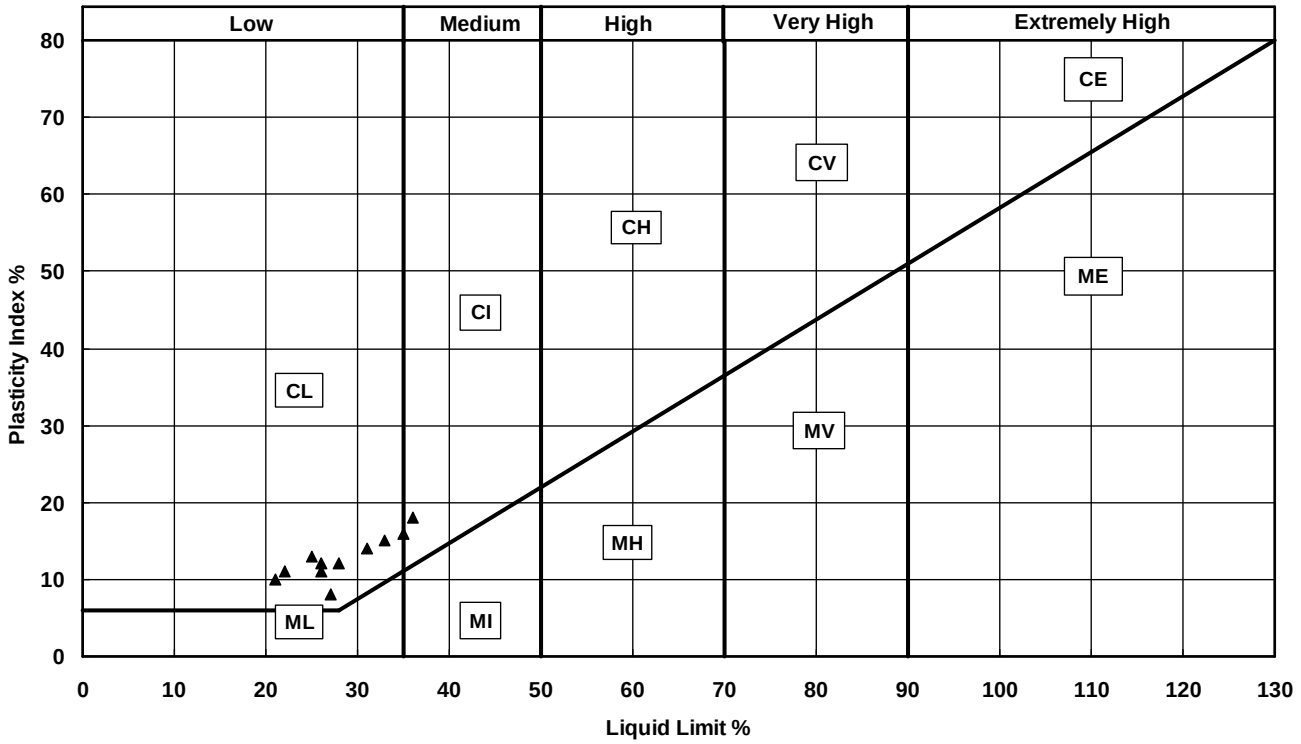
All tests performed in accordance with BS 1377 : Parts 1-9 : 1990 incorporating amendments where appropriate.

LABORATORY RESULTS - *Casagrande Classification Chart*

Project: CO-OPERATIVE ACADEMY

Project No: PN081814

PLOT OF PLASTICITY INDEX AGAINST LIQUID LIMIT
for all items tested



Soil Type		Plasticity Characterisics	
C	Clay	L	Low
		I	Intermediate
M	Silt	H	High
		V	Very High
		E	Extremely High

Table of Soil Types and Plasticity Characteristics from BS 5930 : 1981

Remarks

16/07/2008

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LABORATORY RESULTS - Classification and Strength

Project CO-OPERATIVE ACADEMY **Project No:** PN081814

Sample					Classification					Strength					
Hole	Depth (Specimen Depth) m	Type	Sample Ref	Description	Symbol	I_p (>425) %	w_L %	w_p %	w (p_d) %	Test	γ_b (γ_d) Mg/m^3	σ_3 kN/m^2	$\sigma_1-\sigma_3$ kN/m^2	c_u kN/m^2	c_{Avg} kN/m^2
BH 1	0.30-0.60 (0.30-0.60)	B	N12552	MADE GROUND: Firm brown slightly sandy slightly gravelly clay.					23						
BH 1	0.80-1.20 (0.80-1.20)	B	N12553	MADE GROUND: Firm brown slightly sandy slightly gravelly clay.					21						
BH 1	2.00-2.45 (2.00-2.45)	B	N12554	Firm brown slightly sandy slightly gravelly CLAY.					16						
BH 1	3.00-3.45 (3.00-3.45)	U	N12555	Soft to firm brown slightly sandy slightly gravelly CLAY. PP = 1.25, 1.00	CL	12 (5%)	26	14	16 16 16	MS	2.21 2.21 2.21	60 120 240	52 59 62	26 30 31	29
BH 1	5.00-5.45 (5.00-5.45)	U	N12556	Firm brown slightly sandy slightly gravelly CLAY.	CI	18 (NAT 0%)	36	18	16 16 16	MS	2.18 2.18 2.18	100 200 400	148	74 ##	74
BH 1	7.10-7.55 (7.10-7.55)	B	N12557	Stiff orangish brown slightly sandy CLAY.	CL	11 (NAT 0%)	22	11	22						
BH 1	11.00-11.45 (11.00-11.45)	B	N12558	Orangish brown sandy SILT. (See Test Remarks Sheet for further information)		(NAT 0%)	27	NP	33						
BH2	0.50 (0.50)	B	N12560	MADE GROUND: soft brown slightly sandy slightly gravelly clay.					19						
BH2	2.20-2.65 (2.20-2.65)	U	N12563	Soft greyish brown SILT. (See Test Remarks Sheet for further information)		(NAT 0%)	30	NP	21 21 21	MS	2.00 2.00 2.00	40 80 160	64	32 ##	32
BH2	4.20-4.65 (4.20-4.65)	B	N12564	Stiff greyish brown slightly sandy CLAY.	CL	13 (25%)	25	12	20						
BH2	6.50-6.95 (6.50-6.95)	U	N12565	Firm greyish brown slightly sandy CLAY.	CL	12 (NAT 0%)	28	16	15 15 15	MS	2.08 2.08 2.08	120 240 480	82	41 ##	41
BH2	11.00-11.45 (11.00-11.45)	U	N12567	Very stiff greyish brown slightly sandy slightly gravelly CLAY. PP = 2.0, 2.0	CL	8 (NAT 0%)	27	19	12 12 12	MS	UT		UT		

Remarks AGS Tests performed in accordance with BS 1377: 1990

geotechnics

LABORATORY RESULTS - Classification and Strength

Project CO-OPERATIVE ACADEMY **Project No:** PN081814

Sample					Classification					Strength					
Hole	Depth (Specimen Depth) m	Type	Sample Ref	Description	Symbol	I_p (>425) %	w_L %	w_p %	w (p_d) %	Test	γ_b (γ_d) Mg/m^3	σ_3 kN/m^2	$\sigma_1-\sigma_3$ kN/m^2	c_u kN/m^2	c_{Avg} kN/m^2
BH3	1.20-1.65 (1.20-1.65)	B	N12569	Firm brown mottled grey and black slightly sandy slightly gravelly CLAY.	CL	14 (NAT 0%)	31	17	17						
BH3	2.00-2.45 (2.00-2.45)	B	N12570	Soft brown mottled grey and black slightly sandy CLAY.	CI	16 (NAT 0%)	35	19	25						
BH3	3.00-3.45 (3.00-3.45)	B	N12572	Orangish brown slightly silty slightly gravelly SAND.					25						
BH3	7.00-7.45 (7.00-7.45)	U	N12574	Firm to stiff dark brown slightly gravelly sandy CLAY.	CL	11 (11%)	26	15	14 14 14	MS	2.13 2.13 2.13	140 280 560	128	64 ##	64
BH3	12.00-12.45 (12.00-12.45)	D	N12576	Stiff brown slightly sandy CLAY.	CL	15 (NAT 0%)	33	18	26						
BH3	15.00-15.45 (15.00-15.45)	B	N12577	Firm brown slightly sandy SILT.		(NAT 0%)	26	NP	25						
BH3	16.00-16.45 (16.00-16.45)	D	N12578	Firm brown slightly sandy SILT		(0%)	27	NP	25						
BH3	18.00-18.45 (18.00-18.45)	D	N12579	Firm brown slightly sandy CLAY.	CL	10 (3%)	21	11	14						

Remarks AGS Tests performed in accordance with BS 1377: 1990

geotechnics

LABORATORY RESULTS - Test Remarks

Project CO-OPERATIVE ACADEMY **Project No:** PN081814

Sample					Laboratory Remark
Hole	Depth (Specimen Depth) m	Type	Sample Ref	Description	
BH 1	11.00-11.45 (11.00-11.45)	B	N12558	Brown sandy CLAY* (See Test Remarks Sheet for further information)	Atterberg Limit Test - 1-point cone
BH2	2.20-2.65 (2.20-2.65)	U	N12563	Brown mottled grey slightly sandy CLAY PP = 0.25, 1.75* (See Test Remarks Sheet for further information)	Atterberg Limit Test - 1-point cone

Remarks

geotechnics

LABORATORY RESULTS - Chemical Analysis

Project CO-OPERATIVE ACADEMY **Project No:** PN081814

Sample					Sulphate			pH	Organic Content	Loss on Ignition	Chloride		
					In Soil		In Water				In Soil		In Water
Hole	Depth (Specimen Depth) m	Type	Sample Ref	Description	Acid Soluble %	Water Soluble g/l	g/l		%	%	Acid Soluble %	Water Soluble g/l	g/l
BH 1	0.80-1.20 (0.80-1.20)	B	N12553	MADE GROUND: Firm brown slightly sandy slightly gravelly clay.		0.025 (0.03)		7.87					
BH 1	5.00-5.45 (5.00-5.45)	U	N12556	Firm brown slightly sandy slightly gravelly CLAY.		0.026 (0.03)		8.50					
BH2	1.20-1.65 (1.20-1.65)	D	N12561	MADE GROUND: Soft brown slightly sandy slightly gravelly clay.						2.87			
BH2	1.20-1.65 (1.20-1.65)	D	N12562	MADE GROUND: Soft brown slightly sandy slightly gravelly clay.		0.070 (0.08)		6.31					
BH2	8.00-8.45 (8.00-8.45)	B	N12566	Orangish brown slightly gravelly silty SAND.		0.014 (0.02)		8.55					
BH3	0.60-1.00 (0.60-1.00)	B	N12568	Firm brown mottled grey and black slightly sandy slightly gravelly CLAY.					1.19				
BH3	2.00-2.45 (2.00-2.45)	D	N12571	Soft brown mottled grey and black slightly sandy slightly gravelly CLAY.		0.054 (0.06)		8.32					
BH3	8.00-8.45 (8.00-8.45)	B	N12575	Orangish brown very silty gravelly SAND.		0.040 (0.05)		8.24					

Remarks Tests performed in accordance with BS 1377: Part 3: 1990
Sulphate reported as SO3, results in brackets reported as SO4

geotechnics

LABORATORY RESULTS - MCV, Compaction, CBR

Project CO-OPERATIVE ACADEMY **Project No:** PN081814

Sample					MCV		Compaction					CBR				
Hole	Depth (Specimen Depth) m	Type	Sample Ref	Description	MCV	w %	Type	w (Opt) %	ρ_d Mg/m^3	γ_b Mg/m^3	γ_d (Max) Mg/m^3	Type	Top		Bottom	
													CBR %	w %	CBR %	w %
BH 1	0.30-0.60 (0.30-0.60)	B	N12552	MADE GROUND: Firm brown slightly sandy slightly gravelly clay.						2.06	1.73	2.5kg	3.5	19	3.9	19
BH 1	0.80-1.20 (0.80-1.20)	B	N12553	MADE GROUND: Firm brown slightly sandy slightly gravelly clay.			2.5kg	(15) 23 6.4 13 17 21	2.75a	 2.01 1.85 2.06 2.16 2.09	(1.84) 1.63 1.74 1.83 1.84 1.72					
BH 1	2.00-2.45 (2.00-2.45)	B	N12554	Firm brown slightly sandy slightly gravelly CLAY.			2.5kg	(12) 15 4.2 7.7 12 16	2.75a	 2.18 1.91 2.03 2.14 2.17	(1.93) 1.90 1.83 1.89 1.91 1.87					
BH2	0.50 (0.50)	B	N12560	MADE GROUND: soft brown slightly sandy slightly gravelly clay.						2.03	1.71	2.5kg	1.9	19	2.2	19
BH3	3.00-3.45 (3.00-3.45)	B	N12572	Orangish brown slightly silty slightly gravelly SAND.			2.5kg	(9.8) 23 5.3 10 15 19	2.65a	 2.02 1.93 2.12 2.14 2.08	(1.93) 1.65 1.83 1.92 1.87 1.75					

Remarks Particle Density - a=assumed, m=measured
Tests performed in accordance with BS 1377: 1990

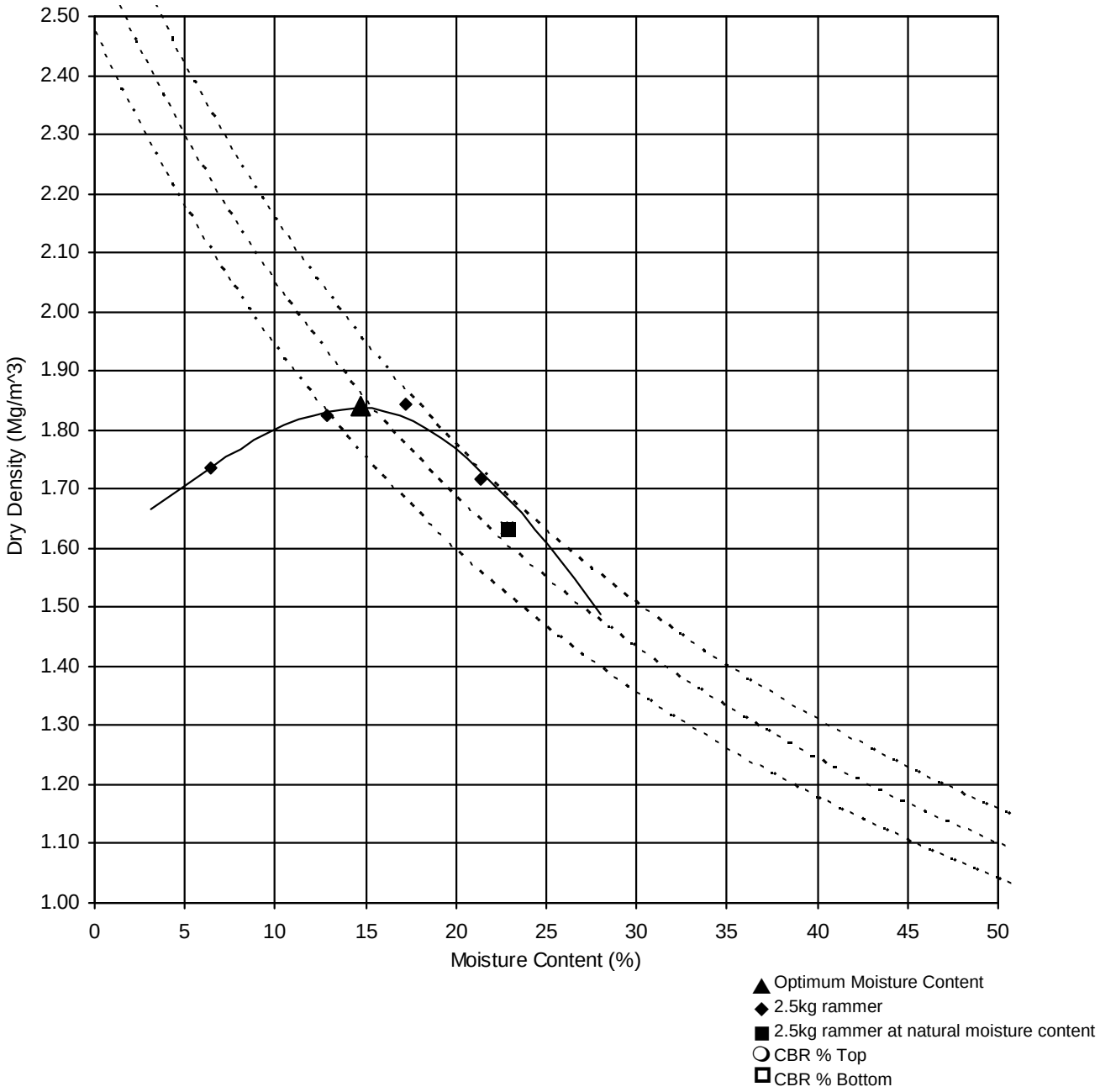
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LABORATORY RESULTS - Compaction

Project: CO-OPERATIVE ACADEMY

Project No: PN081814

Hole	BH 1
Sample Depth	0.80-1.20m
Sample Type	B
Sample Ref	N12553



Optimum Moisture Content	15
Maximum Dry Density	1.84 Mg/m^3

Gravel retained on

37.5mm sieve	4 %
20mm sieve	1 %

Particle Density 2.75 (Assumed)

Preparation 2.5kg

Description MADE GROUND: Firm brown slightly sandy slightly gravelly clay.

Remarks Test performed in accordance with BS 1377: Part 4: 1990

16/07/2008

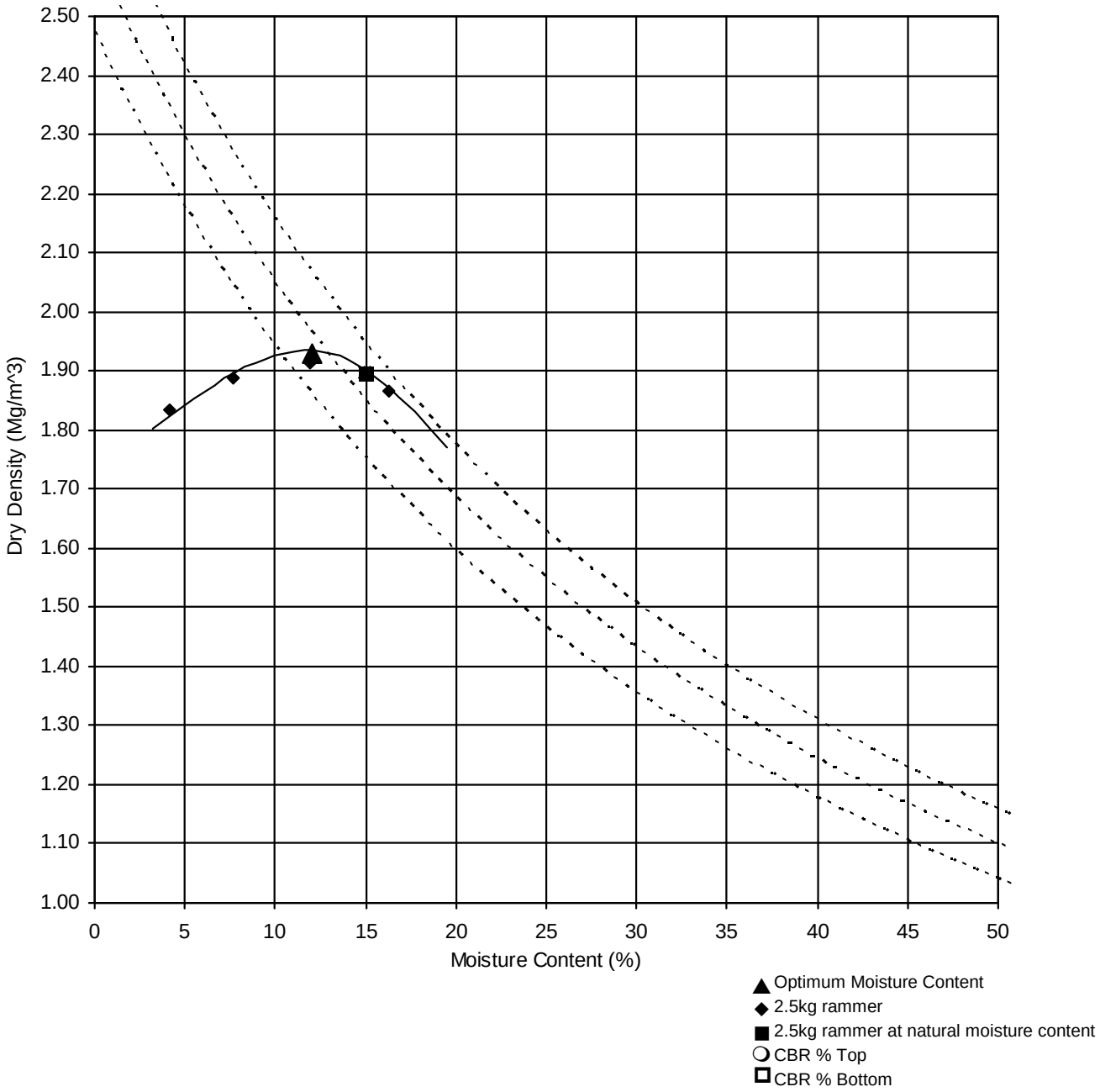
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LABORATORY RESULTS - Compaction

Project: CO-OPERATIVE ACADEMY

Project No: PN081814

Hole	BH 1
Sample Depth	2.00-2.45m
Sample Type	B
Sample Ref	N12554



Optimum Moisture Content	12
Maximum Dry Density	1.93 Mg/m^3

Gravel retained on

37.5mm sieve	0 %
20mm sieve	0 %

Particle Density 2.75 (Assumed)

Preparation 2.5kg

Description Firm brown slightly sandy slightly gravelly CLAY.

Remarks Test performed in accordance with BS 1377: Part 4: 1990

16/07/2008

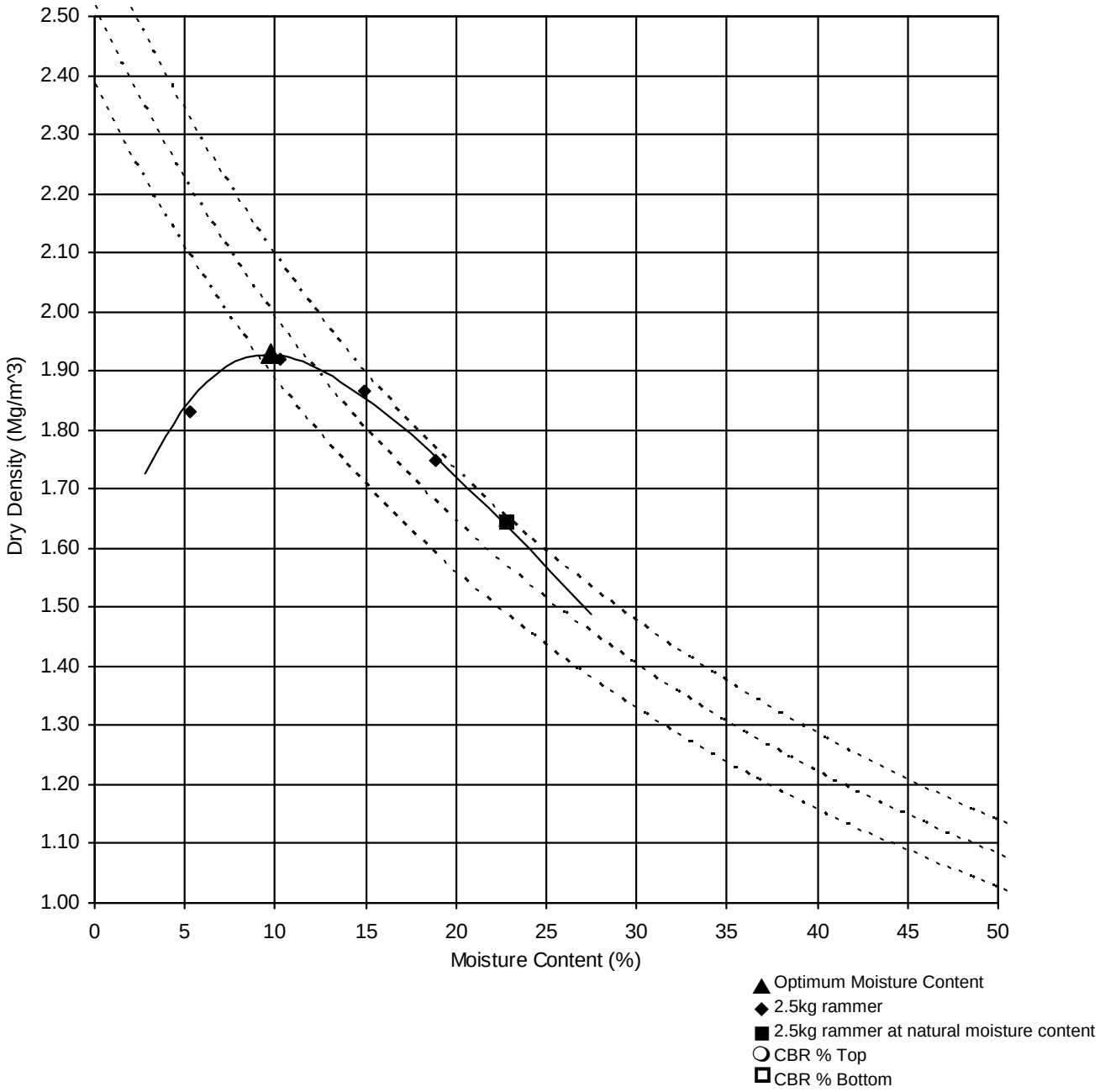
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LABORATORY RESULTS - Compaction

Project: CO-OPERATIVE ACADEMY

Project No: PN081814

Hole	BH3
Sample Depth	3.00-3.45m
Sample Type	B
Sample Ref	N12572



Optimum Moisture Content	9.8
Maximum Dry Density	1.93 Mg/m^3

Gravel retained on

37.5mm sieve	0 %
20mm sieve	0 %

Particle Density 2.65 (Assumed)

Preparation 2.5kg

Description Orangish brown slightly silty slightly gravelly SAND.

Remarks Test performed in accordance with BS 1377: Part 4: 1990

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LABORATORY RESULTS - Particle Size Distribution

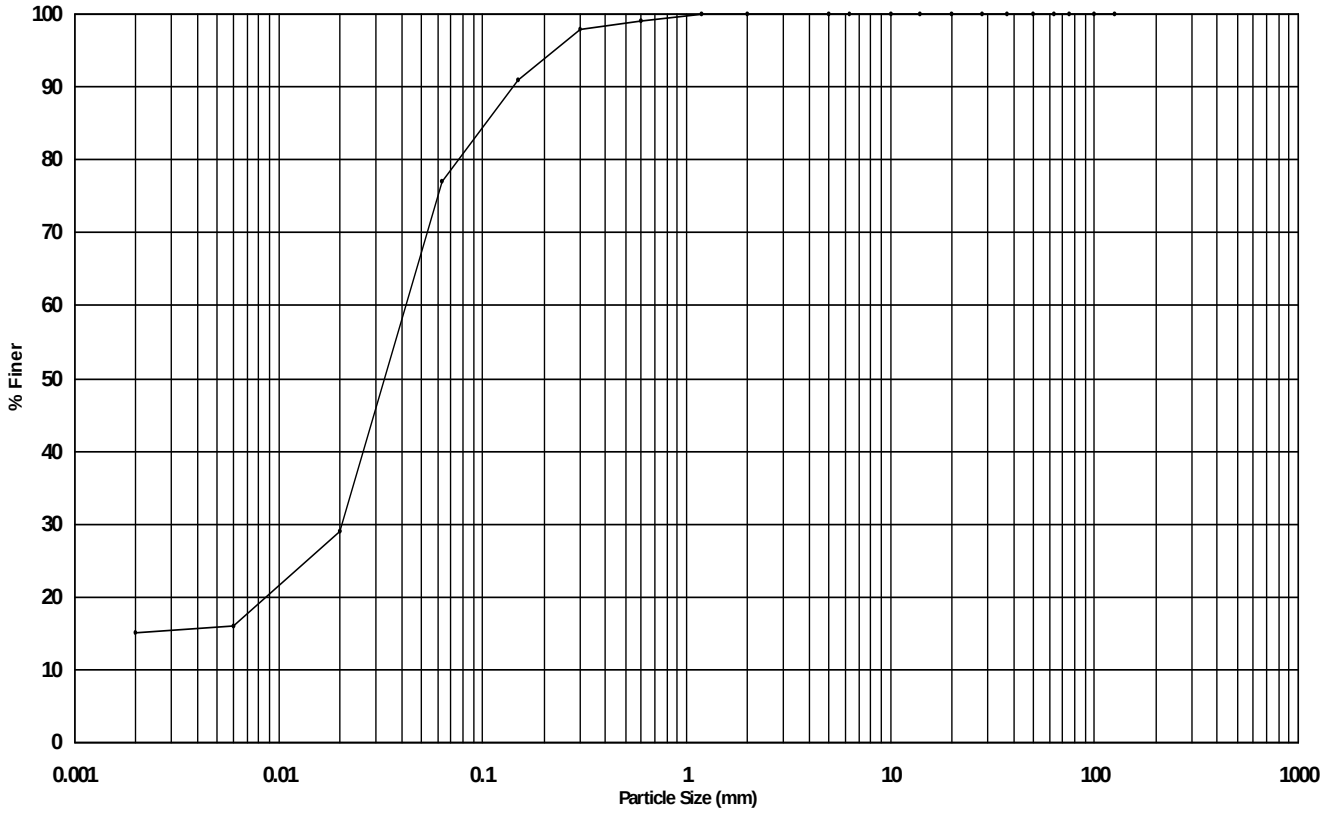
Project: CO-OPERATIVE ACADEMY

Project No: PN081814

Hole BH 1
Sample Depth 7.10-7.55m
Sample Type B
Sample Ref N12557

Sample Description

Stiff orangish brown slightly sandy CLAY.



Classification		Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	Cobbles	Boulders
	CLAY	SILT			SAND			Gravel				

Classification	% of each
CLAY	15
SILT	62
SAND	23
GRAVEL	0
COBBLES	0
BOULDERS	0

Size	Percentage Finer
125mm	100
100mm	100
75mm	100
63mm	100
50mm	100
37.5mm	100
28mm	100
20mm	100
14mm	100
10mm	100
6.3mm	100
5mm	100
3.35mm	-

Size	Percentage Finer
2mm	100
1.18mm	100
600µm	99
425µm	-
300µm	98
212µm	-
150µm	91
75µm	-
63µm	77
20µm	29
6µm	16
2µm	15

Uniformity Coefficient	
Not Available	
Sieving Method	
Wet sieve	
Fine Particle Analysis	
Method	Pipette
Pre-treated with	Hydrogen Peroxide
% loss on Pre-treatment	0.13
Particle Density	2.65 (Assumed)

Remarks Test performed in accordance with BS 1377: Part 2: 1990
Silt and clay proportions taken as all material smaller than 0.063mm.

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LABORATORY RESULTS - Particle Size Distribution

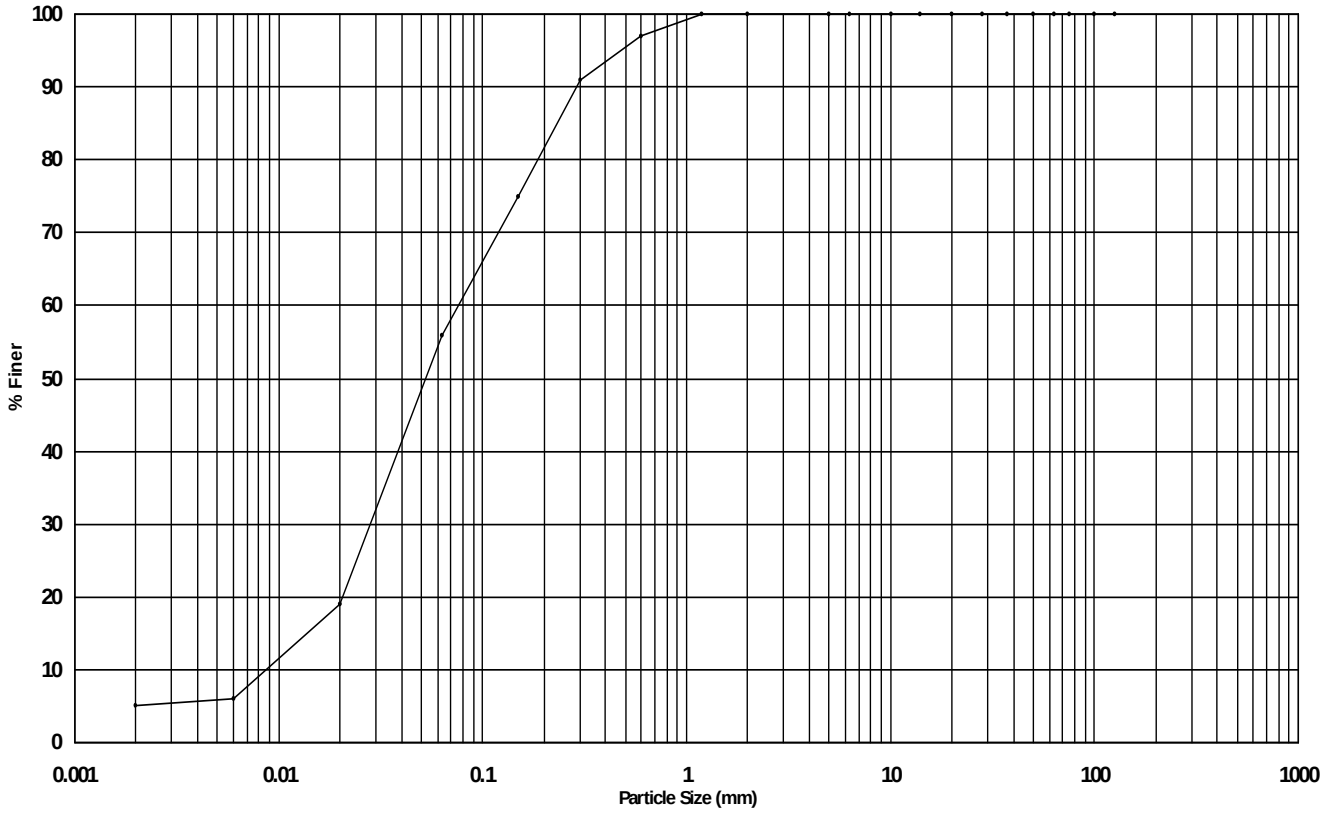
Project: CO-OPERATIVE ACADEMY

Project No: PN081814

Hole BH 1
Sample Depth 11.00-11.45m
Sample Type B
Sample Ref N12558

Sample Description

Orangish brown sandy SILT.



Classification	CLAY	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	Cobbles	Boulders
		SILT			SAND			Gravel				

Classification	% of each
CLAY	5
SILT	51
SAND	44
GRAVEL	0
COBBLES	0
BOULDERS	0

Size	Percentage Finer
125mm	100
100mm	100
75mm	100
63mm	100
50mm	100
37.5mm	100
28mm	100
20mm	100
14mm	100
10mm	100
6.3mm	100
5mm	100
3.35mm	-

Size	Percentage Finer
2mm	100
1.18mm	100
600μm	97
425μm	-
300μm	91
212μm	-
150μm	75
75μm	-
63μm	56
20μm	19
6μm	6
2μm	5

Uniformity Coefficient	
7.47	
Sieving Method	
Wet sieve	
Fine Particle Analysis	
Method	Pipette
Pre-treated with	Hydrogen Peroxide
% loss on Pre-treatment	0.25
Particle Density	2.65 (Assumed)

Remarks Test performed in accordance with BS 1377: Part 2: 1990
Silt and clay proportions taken as all material smaller than 0.063mm.

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LABORATORY RESULTS - Particle Size Distribution

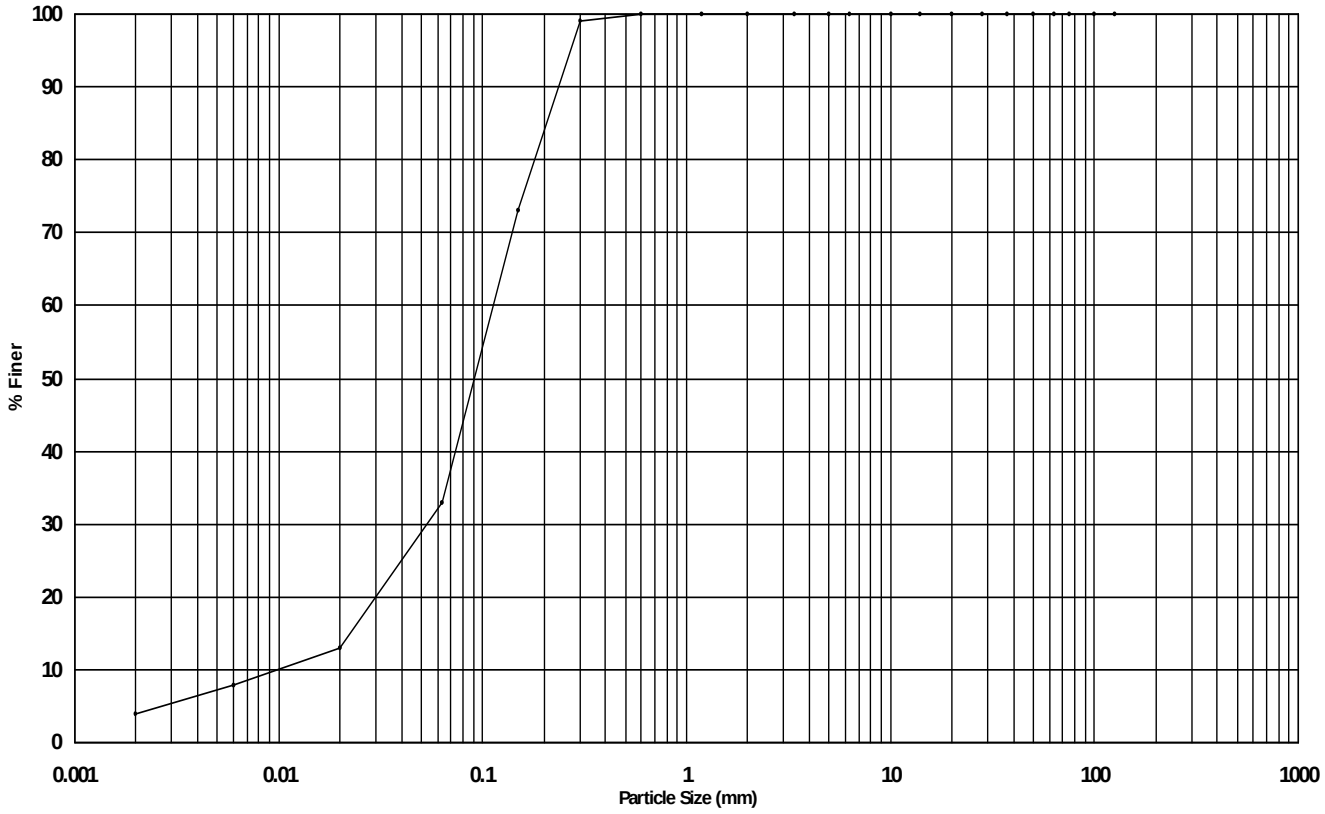
Project: CO-OPERATIVE ACADEMY

Project No: PN081814

Hole BH 1
Sample Depth 14.00-14.45m
Sample Type B
Sample Ref N12559

Sample Description

Brown very silty SAND.



Classification		Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	Cobbles	Boulders
	CLAY	SILT			SAND			Gravel				

Classification	% of each
CLAY	4
SILT	29
SAND	67
GRAVEL	0
COBBLES	0
BOULDERS	0

Size	Percentage Finer
125mm	100
100mm	100
75mm	100
63mm	100
50mm	100
37.5mm	100
28mm	100
20mm	100
14mm	100
10mm	100
6.3mm	100
5mm	100
3.35mm	100

Size	Percentage Finer
2mm	100
1.18mm	100
600µm	100
425µm	-
300µm	99
212µm	-
150µm	73
75µm	-
63µm	33
20µm	13
6µm	8
2µm	4

Uniformity Coefficient	
7.09	
Sieving Method	
Wet sieve	
Fine Particle Analysis	
Method	Pipette
Pre-treated with	Hydrogen Peroxide
% loss on Pre-treatment	0.66
Particle Density	2.65 (Assumed)

Remarks Test performed in accordance with BS 1377: Part 2: 1990
Silt and clay proportions taken as all material smaller than 0.063mm.

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LABORATORY RESULTS - Particle Size Distribution

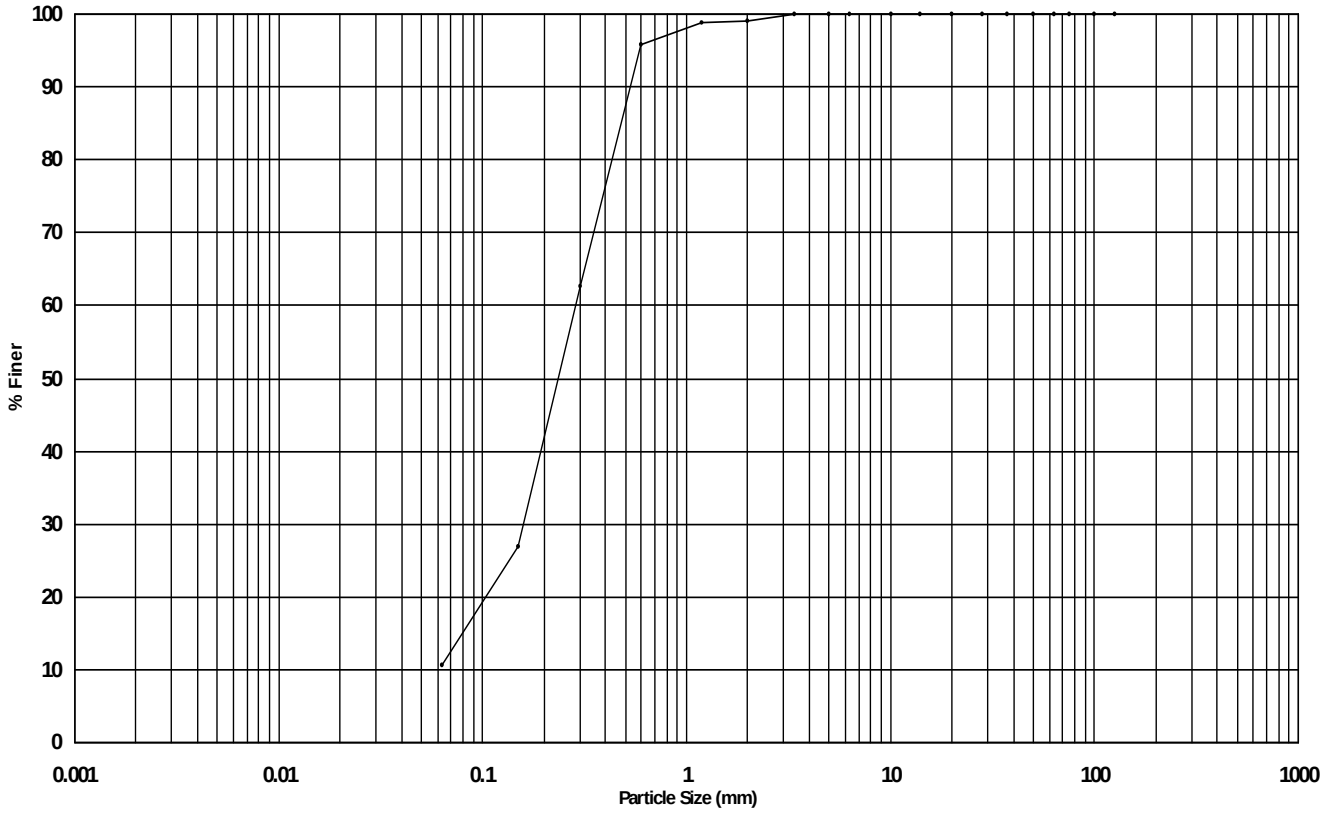
Project: CO-OPERATIVE ACADEMY

Project No: PN081814

Hole	BH2
Sample Depth	8.00-8.45m
Sample Type	B
Sample Ref	N12566

Sample Description

Orangish brown slightly gravelly silty SAND.



Classification	CLAY	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	Cobbles	Boulders
		SILT			SAND			Gravel				

Classification	% of each
SILT (including CLAY)	11
SAND	88
GRAVEL	1
COBBLES	0
BOULDERS	0

Size	Percentage Finer
125mm	100
100mm	100
75mm	100
63mm	100
50mm	100
37.5mm	100
28mm	100
20mm	100
14mm	100
10mm	100
6.3mm	100
5mm	100
3.35mm	100

Size	Percentage Finer
2mm	99
1.18mm	99
600µm	96
425µm	-
300µm	63
212µm	-
150µm	27
75µm	-
63µm	11
20µm	-
6µm	-
2µm	-

Uniformity Coefficient
Not Available
Sieving Method
Wet sieve
Fine Particle Analysis

Method	
Pre-treated with	
% loss on Pre-treatment	
Particle Density	

Remarks Test performed in accordance with BS 1377: Part 2: 1990

Silt and clay proportions taken as all material smaller than 0.063mm.

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LABORATORY RESULTS - Particle Size Distribution

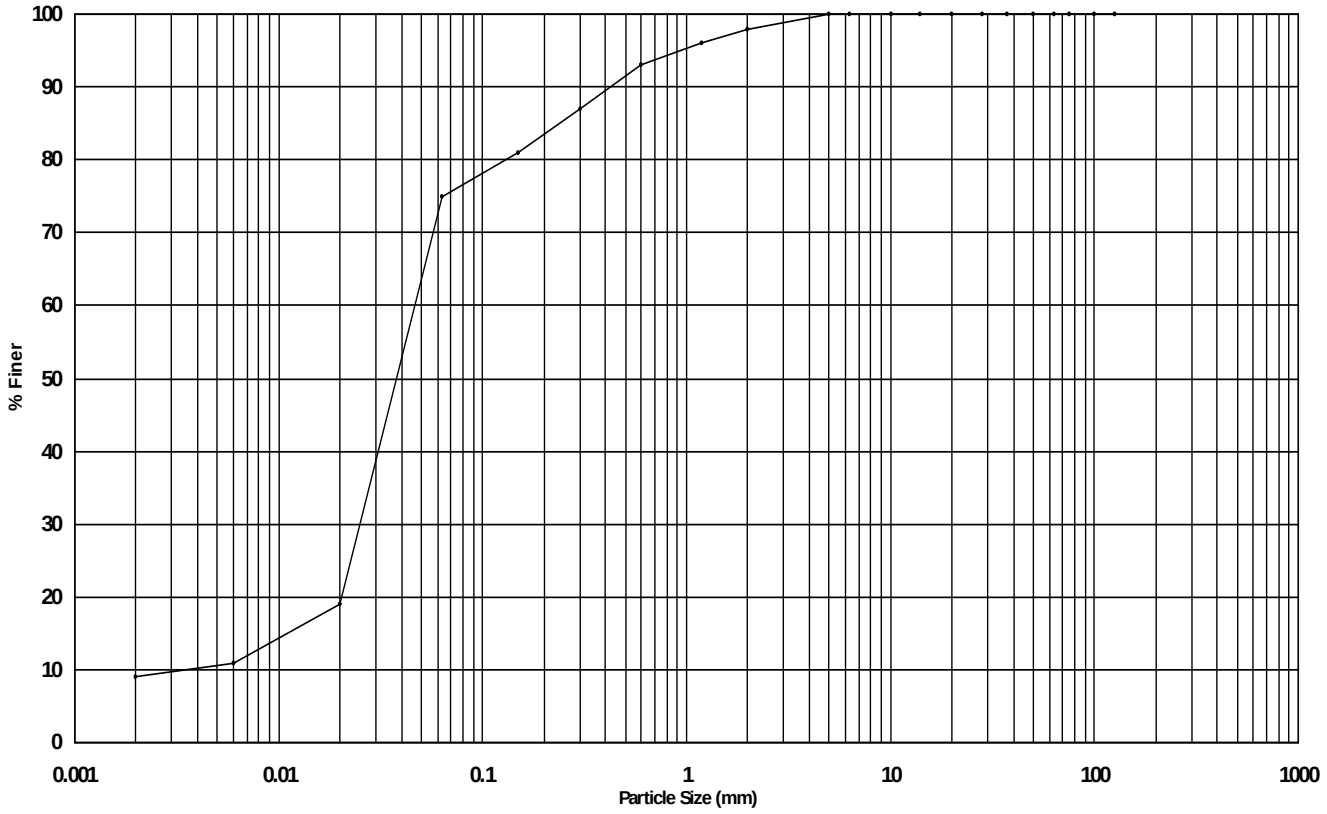
Project: CO-OPERATIVE ACADEMY

Project No: PN081814

Hole BH3
Sample Depth 1.20-1.65m
Sample Type B
Sample Ref N12569

Sample Description

Firm brown mottled grey and black slightly sandy slightly gravelly CLAY.



Classification	CLAY	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	Cobbles	Boulders
		SILT			SAND			Gravel				

Classification	% of each
CLAY	9
SILT	66
SAND	23
GRAVEL	2
COBBLES	0
BOULDERS	0

Size	Percentage Finer
125mm	100
100mm	100
75mm	100
63mm	100
50mm	100
37.5mm	100
28mm	100
20mm	100
14mm	100
10mm	100
6.3mm	100
5mm	100
3.35mm	-

Size	Percentage Finer
2mm	98
1.18mm	96
600µm	93
425µm	-
300µm	87
212µm	-
150µm	81
75µm	-
63µm	75
20µm	19
6µm	11
2µm	9

Uniformity Coefficient	
14.49	
Sieving Method	
Wet sieve	
Fine Particle Analysis	
Method	Pipette
Pre-treated with	Hydrogen Peroxide
% loss on Pre-treatment	0.10
Particle Density	2.65 (Assumed)

Remarks Test performed in accordance with BS 1377: Part 2: 1990
Silt and clay proportions taken as all material smaller than 0.063mm.

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LABORATORY RESULTS - Particle Size Distribution

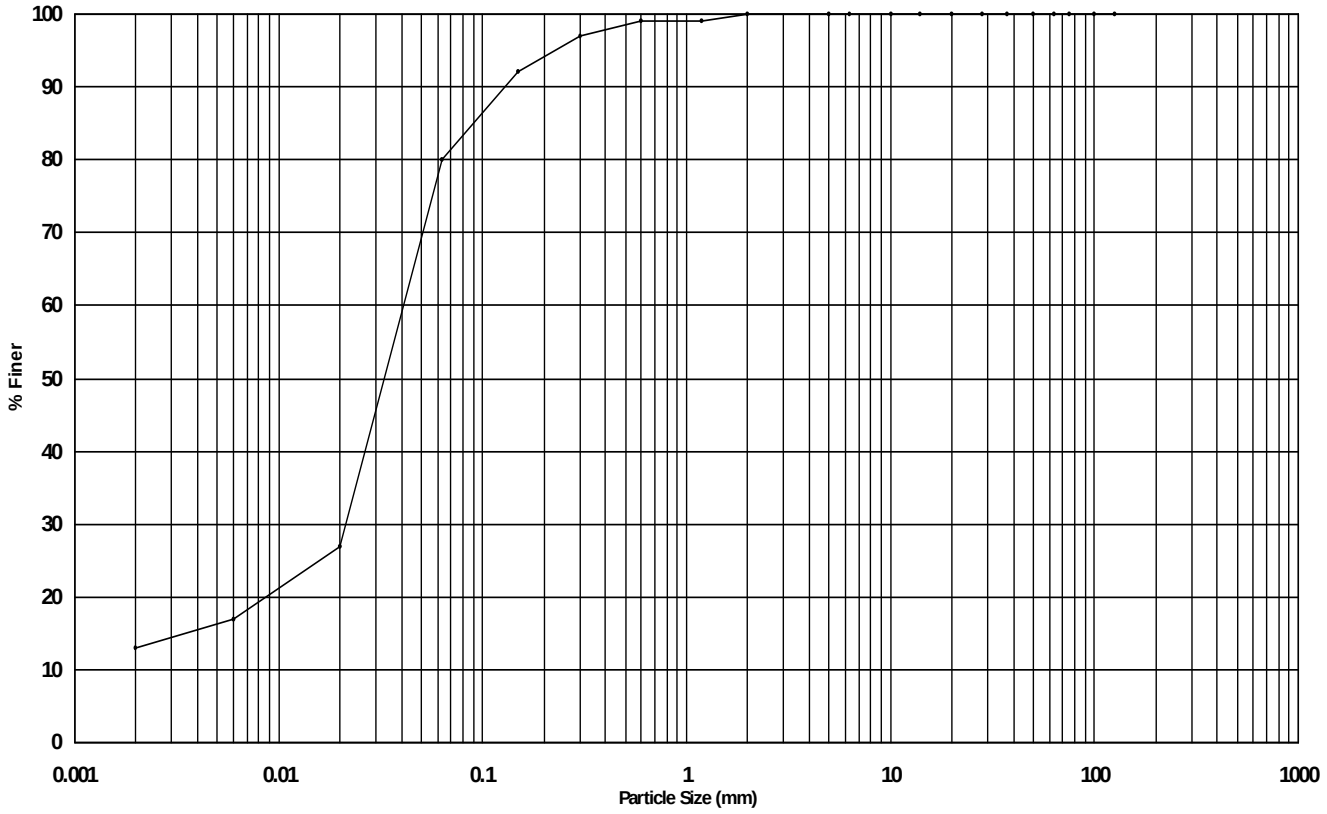
Project: CO-OPERATIVE ACADEMY

Project No: PN081814

Hole BH3
Sample Depth 2.00-2.45m
Sample Type B
Sample Ref N12570

Sample Description

Soft brown mottled grey and black slightly sandy CLAY.



Classification	CLAY	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	Cobbles	Boulders
		SILT			SAND			Gravel				

Classification	% of each
CLAY	13
SILT	67
SAND	20
GRAVEL	0
COBBLES	0
BOULDERS	0

Size	Percentage Finer
125mm	100
100mm	100
75mm	100
63mm	100
50mm	100
37.5mm	100
28mm	100
20mm	100
14mm	100
10mm	100
6.3mm	100
5mm	100
3.35mm	-

Size	Percentage Finer
2mm	100
1.18mm	99
600µm	99
425µm	-
300µm	97
212µm	-
150µm	92
75µm	-
63µm	80
20µm	27
6µm	17
2µm	13

Uniformity Coefficient	
Not Available	
Sieving Method	
Wet sieve	
Fine Particle Analysis	
Method	Pipette
Pre-treated with	Hydrogen Peroxide
% loss on Pre-treatment	0.14
Particle Density	2.65 (Assumed)

Remarks Test performed in accordance with BS 1377: Part 2: 1990
Silt and clay proportions taken as all material smaller than 0.063mm.

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LABORATORY RESULTS - Particle Size Distribution

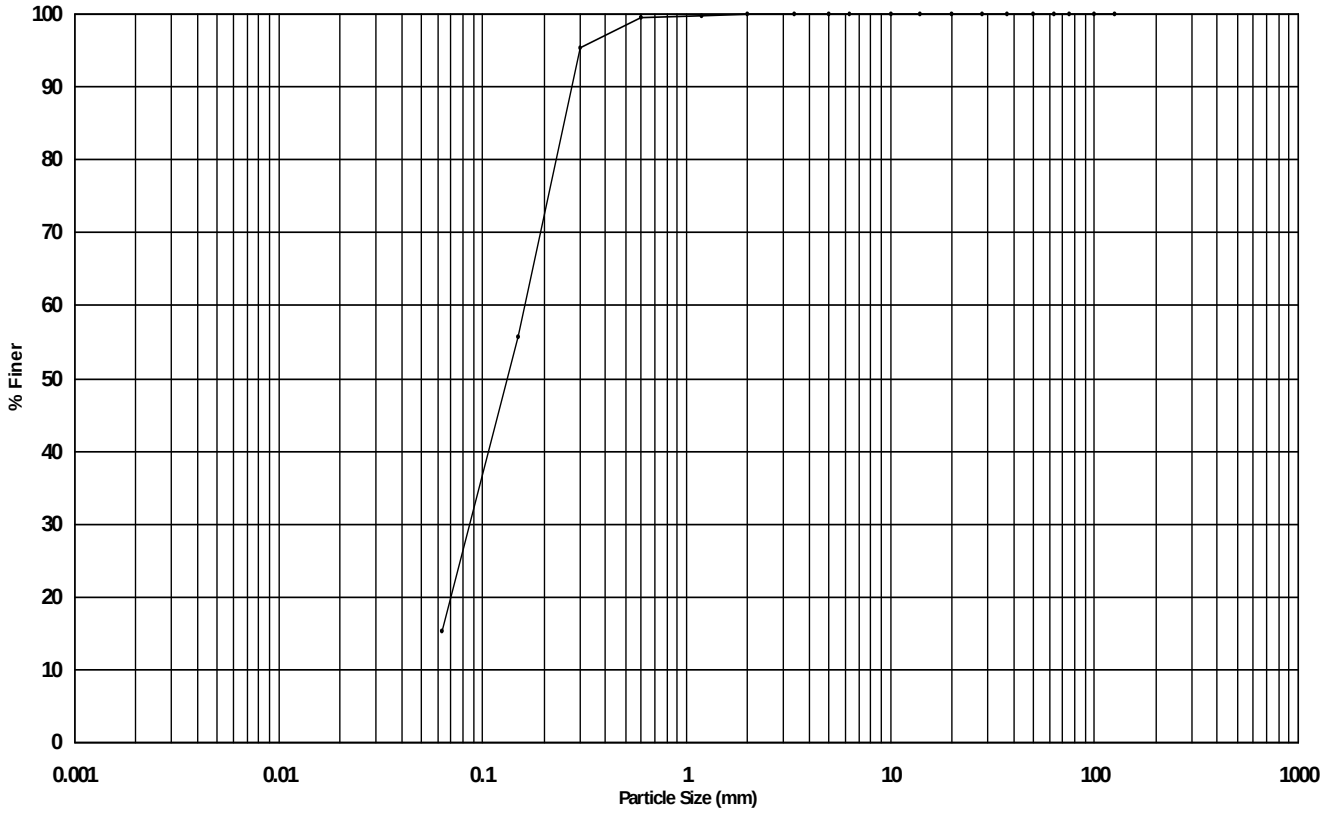
Project: CO-OPERATIVE ACADEMY

Project No: PN081814

Hole	BH3
Sample Depth	4.00-4.45m
Sample Type	B
Sample Ref	N12573

Sample Description

Orangish brown silty SAND.



Classification	CLAY	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	Cobbles	Boulders
		SILT			SAND			Gravel				

Classification	% of each
SILT (including CLAY)	15
SAND	85
GRAVEL	0
COBBLES	0
BOULDERS	0

Size	Percentage Finer
125mm	100
100mm	100
75mm	100
63mm	100
50mm	100
37.5mm	100
28mm	100
20mm	100
14mm	100
10mm	100
6.3mm	100
5mm	100
3.35mm	100

Size	Percentage Finer
2mm	100
1.18mm	100
600μm	100
425μm	-
300μm	95
212μm	-
150μm	56
75μm	-
63μm	15
20μm	-
6μm	-
2μm	-

Uniformity Coefficient
Not Available
Sieving Method
Wet sieve
Fine Particle Analysis

Method	
Pre-treated with	
% loss on Pre-treatment	
Particle Density	

Remarks Test performed in accordance with BS 1377: Part 2: 1990

Silt and clay proportions taken as all material smaller than 0.063mm.

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LABORATORY RESULTS - Particle Size Distribution

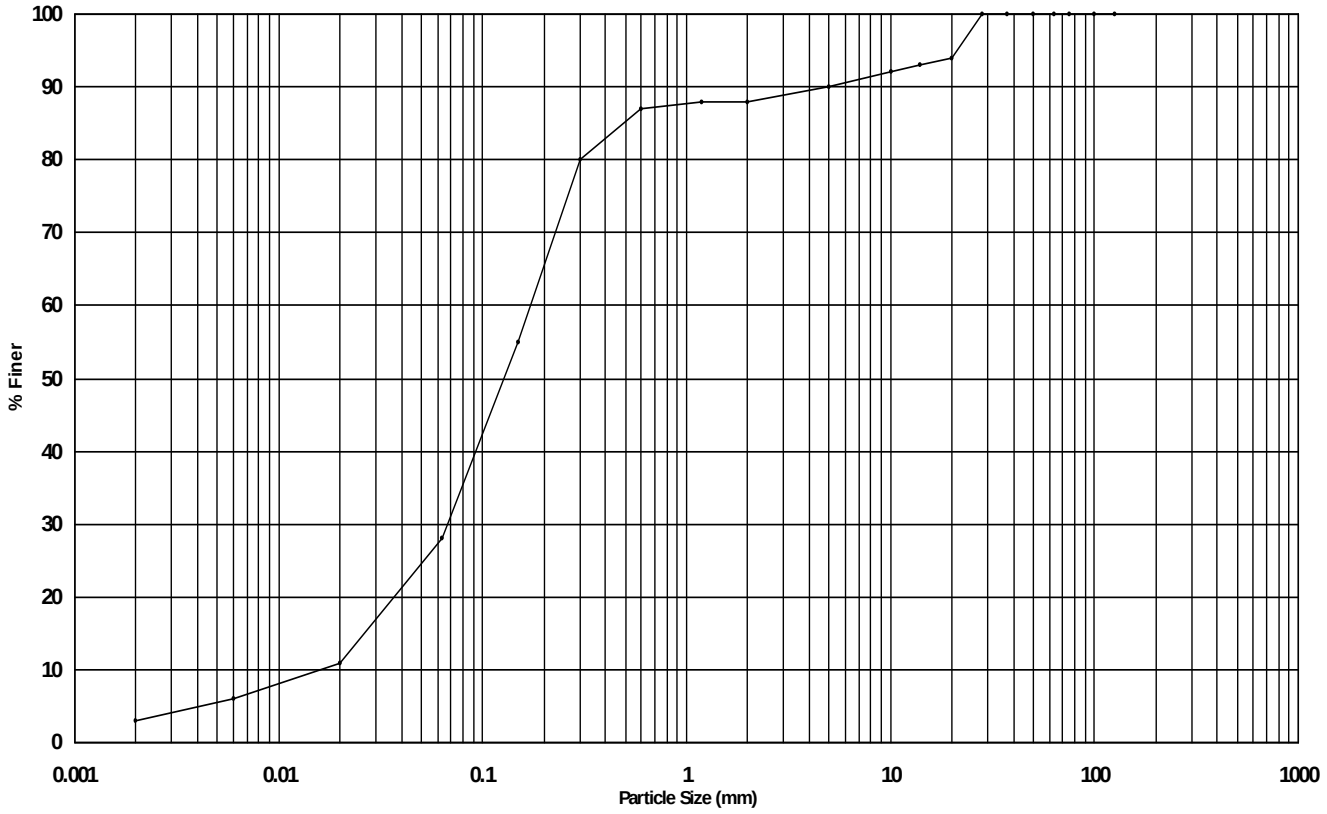
Project: CO-OPERATIVE ACADEMY

Project No: PN081814

Hole	BH3
Sample Depth	8.00-8.45m
Sample Type	B
Sample Ref	N12575

Sample Description

Orangish brown very silty gravelly SAND.



Classification		Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	Cobbles	Boulders
	CLAY	SILT			SAND			Gravel				

Classification	% of each
CLAY	3
SILT	25
SAND	60
GRAVEL	12
COBBLES	0
BOULDERS	0

Size	Percentage Finer
125mm	100
100mm	100
75mm	100
63mm	100
50mm	100
37.5mm	100
28mm	100
20mm	94
14mm	93
10mm	92
6.3mm	-
5mm	90
3.35mm	-

Size	Percentage Finer
2mm	88
1.18mm	88
600µm	87
425µm	-
300µm	80
212µm	-
150µm	55
75µm	-
63µm	28
20µm	11
6µm	6
2µm	3

Uniformity Coefficient	
10.21	
Sieving Method	
Wet sieve	
Fine Particle Analysis	
Method	Pipette
Pre-treated with	Hydrogen Peroxide
% loss on Pre-treatment	0.15
Particle Density	2.65 (Assumed)

Remarks Test performed in accordance with BS 1377: Part 2: 1990

Silt and clay proportions taken as all material smaller than 0.063mm.

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LABORATORY RESULTS - Particle Size Distribution

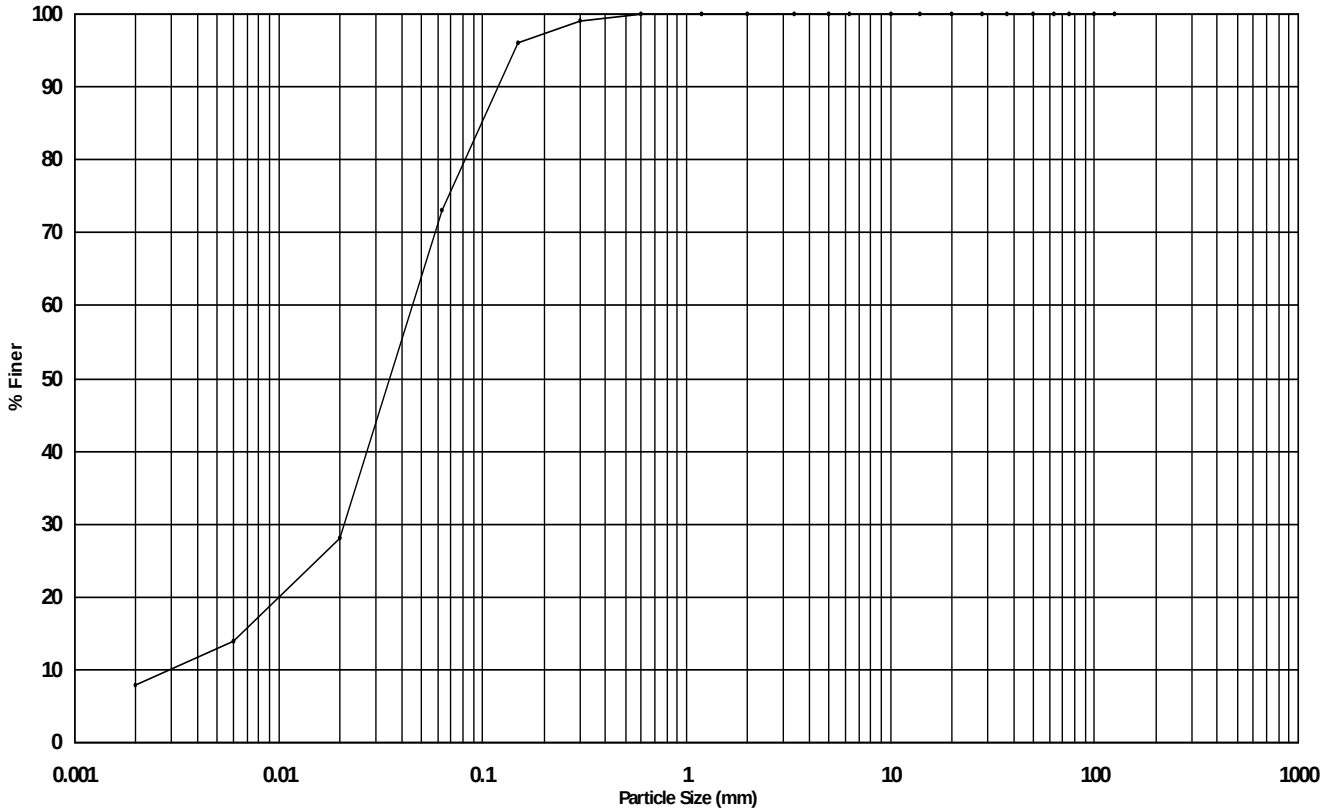
Project: CO-OPERATIVE ACADEMY

Project No: PN081814

Hole BH3
Sample Depth 15.00-15.45m
Sample Type B
Sample Ref N12577

Sample Description

Firm brown slightly sandy SILT.



Classification	CLAY	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	Cobbles	Boulders
		SILT			SAND			Gravel				

Classification	% of each
CLAY	8
SILT	65
SAND	27
GRAVEL	0
COBBLES	0
BOULDERS	0

Size	Percentage Finer
125mm	100
100mm	100
75mm	100
63mm	100
50mm	100
37.5mm	100
28mm	100
20mm	100
14mm	100
10mm	100
6.3mm	100
5mm	100
3.35mm	100

Size	Percentage Finer
2mm	100
1.18mm	100
600µm	100
425µm	-
300µm	99
212µm	-
150µm	96
75µm	-
63µm	73
20µm	28
6µm	14
2µm	8

Uniformity Coefficient	
14.76	
Sieving Method	
Wet sieve	
Fine Particle Analysis	
Method	Pipette
Pre-treated with	Hydrogen Peroxide
% loss on Pre-treatment	0.24
Particle Density	2.65 (Assumed)

Remarks Test performed in accordance with BS 1377: Part 2: 1990
Silt and clay proportions taken as all material smaller than 0.063mm.

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LABORATORY RESULTS - *Consolidation e/logp Plot*

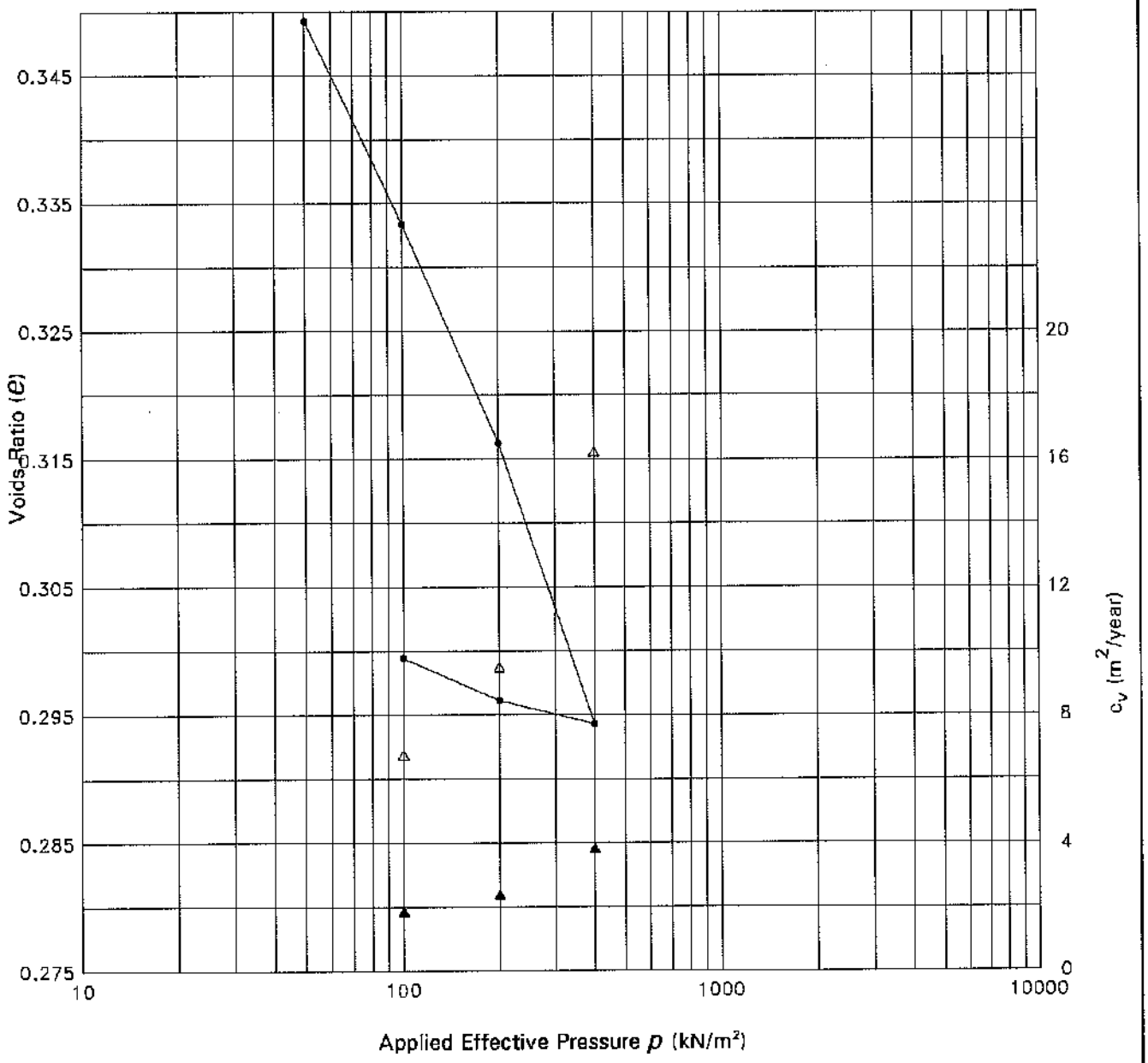
Project COOPERATIVE ACADEMY

Client

Project No PN081814
Borehole 1
Sample Depth 3.00 - 3.45 m
Sample Type U

The determination of one dimensional consolidation properties in accordance with Clause 3 of BS1377: Part 5: 1990

Symbols: Voids Ratio •, c_{v50} ▲, c_{v90} △



Applied Pressure kN/m²	0-50	50-100	100-200	200-400	400-200	200-100				
m_v m²/MN	0.54	0.24	0.13	0.08	0.01	0.03				
c_{v50} Log Time m²/yr	-	1.85	2.38	3.83	-	-				
c_{v90} Root Time m²/yr	-	6.76	9.49	16.22	-	-				
Voids Ratio	0.349	0.333	0.316	0.294	0.296	0.299				

Description
N12555 Brown slightly gravelly CLAY

Specimen Diameter	75.090	mm
Initial Height	18.920	mm
Particle Density	2.65 Assumed	
Initial Voids Ratio	0.387	

Initial Water Content	15.72	%
Final Water Content	13.92	%
Initial Saturation	100	%
Initial Bulk Density	2.21	Mg/m³
Initial Dry Density	1.91	Mg/m³

Remarks Laboratory temperature 20°C ± 4°C
Specimen cut vertically from top
Small inclusions removed

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LABORATORY RESULTS - *Consolidation e/logp Plot*

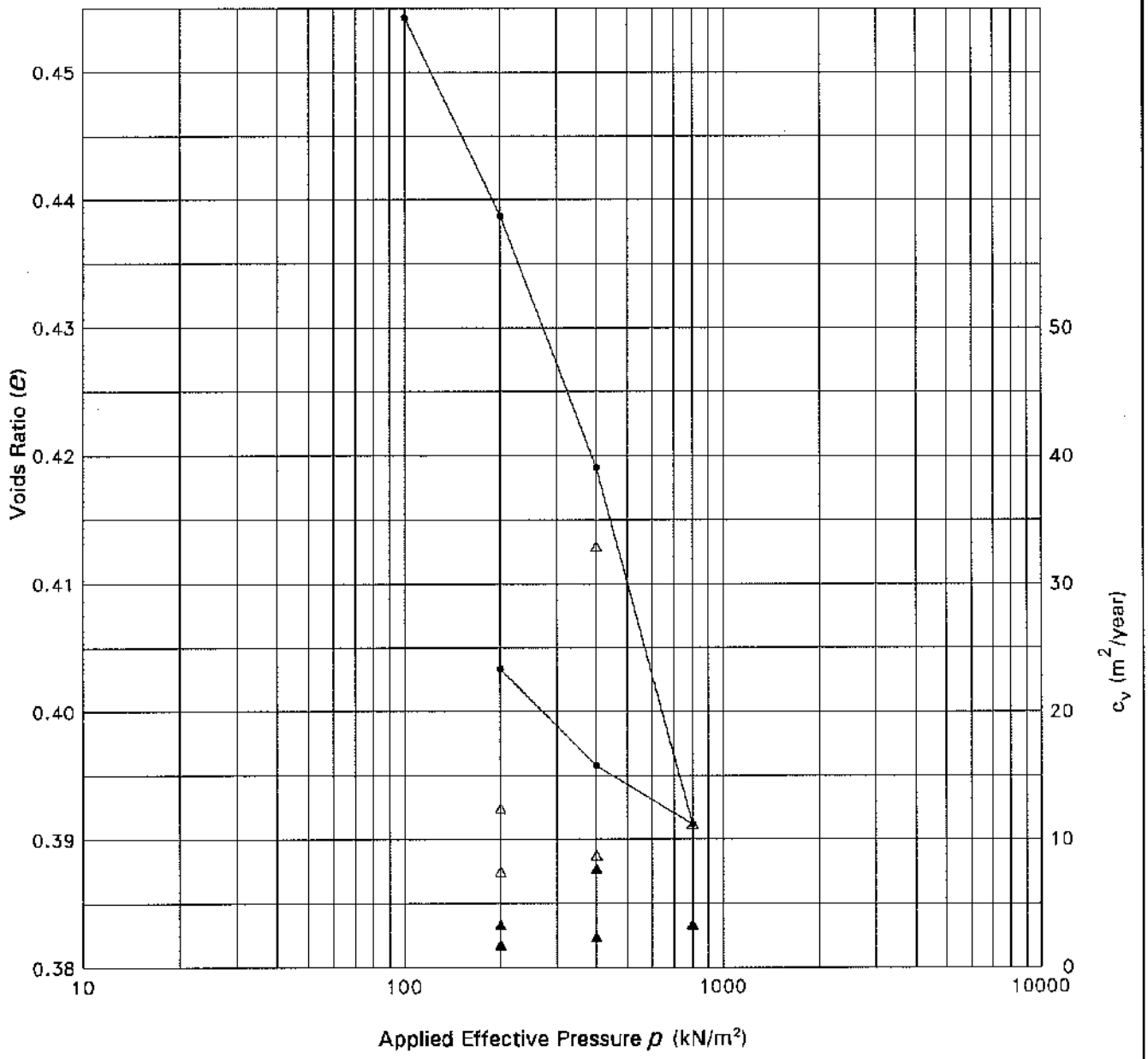
Project COOPERATIVE ACADEMY

Client

Project No PN081814
Borehole 1
Sample Depth 5.00 - 5.45 m
Sample Type U

The determination of one dimensional consolidation properties in accordance with Clause 3 of BS1377: Part 5: 1990

Symbols: Voids Ratio •, c_{v50} ▲, c_{v90} △



Applied Pressure kN/m²	0-100	100-200	200-400	400-800	800-400	400-200				
m_v m²/MN	0.16	0.11	0.07	0.05	0.01	0.03				
c_{v50} Log Time m²/yr	-	1.76	2.34	3.33	7.71	3.31				
c_{v90} Root Time m²/yr	-	7.49	8.74	11.19	32.91	12.41				
Voids Ratio	0.454	0.439	0.419	0.391	0.396	0.403				

Description
N12556 Brown slightly gravelly CLAY

Specimen Diameter	74.580	mm
Initial Height	18.710	mm
Particle Density	2.65 Assumed	
Initial Voids Ratio	0.478	

Initial Water Content	19.13	%
Final Water Content	18.12	%
Initial Saturation	100	%
Initial Bulk Density	2.14	Mg/m³
Initial Dry Density	1.79	Mg/m³

Remarks Laboratory temperature 20°C ± 4°C
Specimen cut vertically from base of sample
Small inclusions removed

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