

LOGIK DEVELOPMENTS (Arundel Street) Ltd.

**ARUNDEL STREET,
MANCHESTER**

GROUND INVESTIGATION REPORT

Contract: 42028v3

Date: March 2019

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GROUND INVESTIGATION REPORT

carried out at

**ARUNDEL STREET,
MANCHESTER**

Prepared for

**LOGIK DEVELOPMENTS (ARUNDEL STREET) LTD.
76 King Street
Manchester
M2 4NH**

Contract No: 42028v3

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EXECUTIVE SUMMARY

On the instructions of Eckersley O'Callaghan, acting on behalf of Logik Developments (Arundel Street) Ltd. a ground investigation was carried out at a site adjacent to Arundel Street, Manchester.

A new residential led development scheme is proposed for the site. The scheme will comprise a U-shaped building that will step 8 to 9 storeys from Arundel Street to Worsley Street, and 11 to 23 storeys along Mancunian Way. Development will also include the refurbishment and conversion of the existing 4 storey DOT building on the south side of the site.

The ground investigation was carried out to determine ground conditions and to obtain information to enable a contamination risk assessment and a review of gas emissions to be undertaken.

The site comprised an area bound by Mancunian Way to the northeast, Ellesmere Street to the southeast, Arundel Street to the southwest and Worsley Street (pedestrianised) to the northwest.

Geological records indicated that superficial deposits are absent beneath most the site. The southern part of the site is underlain by Glaciofluvial Sheet Deposits described as Sand and Gravel. The bedrock was recorded as sandstone of the Chester Pebble Beds of the Triassic Period.

Site work comprised five cable percussion boreholes, four rotary cored boreholes and three dynamic sampling (windowless) boreholes.

The site work generally confirmed the anticipated geological succession.

Made ground was encountered to depths in the range 0.30 to 3.00m. Superficial deposits were localised, of sand and clay. Sandstone bedrock was encountered across the site at depths between 1.60 and 5.20m.

It is recommended that foundation loads are carried on sandstone bedrock.

Square pad foundations up to 5m wide placed on competent sandstone may adopt a presumed bearing resistance about 500kN/m² for foundations at depths less than 8m. The presumed bearing resistance is based on a serviceability limit of 25mm equivalent to 0.5% of foundation width of 5m.

It is considered that a Design Sulphate Class may be taken as DS-1. An ACEC class for the site of AC-1 would be appropriate.

Soil analysis recorded elevated concentrations of some metals and PAH compounds in made ground noted to contain tarmac, ash and metal. Asbestos was identified as chrysotile in one sample of made ground.

The proposed development will result in the site being covered with buildings and hardstanding.

Based on the nature of the development, the contaminants are not deemed to represent any significant risk to end users.

The presence of asbestos, although not widespread, should be addressed in construction management procedures.

Gas monitoring has indicated a low risk ground gas regime. Basic gas protection measures consistent with Characteristic Situation 2 should be incorporated into design.

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1.0 INTRODUCTION

- 1.1 It is understood that it is proposed to develop the site for a residential scheme. The scheme will provide a total of 357 apartments of 1, 2 and 3 bedrooms.
- 1.2 The scheme proposals are as follows:
 - Clearance of existing industrial units.
 - Refurbishment and conversion of the four storey DOT motorcycle building for mixed commercial / residential use
 - New build to provide ground floor commercial units, residential units and a resident roof garden. This will comprise a U-shaped building that will step 8 to 9 storeys from Arundel Street to Worsley Street, and 11 to 23 storeys along Mancunian Way
- 1.3 On the instructions of Eckersley O'Callaghan Consulting Engineers, on behalf of Logik Developments (Arundel Street) Ltd., a ground investigation was undertaken to determine ground conditions and geotechnical parameters for the design of the development. A contamination risk assessment relating to soils, groundwater and ground gas was also carried out.
- 1.4 A copy of this report may be submitted to the relevant authorities to enable them to carry out their own site assessments and provide any comments.
- 1.5 This report has been prepared for the sole use of the Client for the purpose described and no extended duty of care to any third party is implied or offered. Third parties using any information contained within this report do so at their own risk.
- 1.6 The comments given in this report and the opinions expressed herein are based on the information received, the conditions encountered during site works, and on the results of tests made in the field and laboratory. However, there may be conditions prevailing at the site which have not been disclosed by the investigation and which have not been considered in the report.
- 1.7 The comments on groundwater conditions are based on observations made at the time the site work was carried out. It should be noted that groundwater levels vary owing to seasonal or other effects.

2.0 SITE SETTING

2.1 Site Location

2.1.1 The site is situated approximately 1.5km to the southwest of Manchester City centre and may be located by National Grid Reference SJ 828 973.

2.1.2 A site location plan is included in Appendix 1 as Figure A1.1.

2.2 Site Description

2.1.1 The site extended to 0.5Ha, approximately 75m by 45m, rectangular, elongated northwest to southeast.

2.1.2 The site boundaries comprised Mancunian Way to the northeast, Ellesmere Street to the southeast, Arundel Street to the southwest and Worsley Street (pedestrianised) to the northwest.

2.1.3 The site was sub-divided by Balmforth Street, a tarmac surfaced cul-de-sac extending towards the northeast from Arundel Street.

2.1.4 The northwest part of the site was occupied by a two-storey building in use as a gymnasium.

2.1.5 The southeast part of the site was occupied by two buildings; a two-storey warehouse / store trading as “Manchester Marble” on Balmforth Street and a four-storey building on Ellesmere Street sign written “DOT Motor Cycles.” These buildings were separated by a narrow service yard area.

2.1.6 Tarmac covered pay and display parking was in operation along Balmforth Street and across the front of the Gymnasium building.

2.1.7 The site area was sensibly level. The site encroached onto a grassed bund, with occasional deciduous trees, separating the site area from Mancunian Way. A roughly vegetated strip separated the northern end of the DOT Motorcycle Building from the bund.

2.1.8 The unoccupied surface area of the site generally comprised hardstanding of tarmac with a small band of compacted gravel running along the north side of the gym building.

2.2 Geological Setting

- 2.2.1 Details of the geology underlying the site have been obtained from the British Geological Survey (BGS) map, Sheet No. 85, 'Manchester', solid and drift edition, 1: 50,000 scale, published 2010.
- 2.2.2 The geological map indicates superficial deposits to be absent beneath most the site. The southern part of the site is underlain by Glaciofluvial Sheet Deposits comprised of Sand and Gravel.
- 2.2.3 Bedrock comprises sandstone; part of the Chester Pebble Beds Formation of Triassic age.
- 2.2.4 Although not indicated as present on the site from the geological maps, the history of the site indicates that Made Ground may be present.
- 2.2.5 Historical borehole records near the site have been viewed through the BGS web database as follows:
- SJ89NW122. Located approximately 200m southwest. Total depth – 13.11m.
 - SJ89NW137. Located approximately 40m east. Total depth – 8.53m.
 - SJ89NW230. Located approximately 200m north-northwest. Total depth – 102.57m.
 - SJ89NW231. Located approximately 100m northeast. Total depth – 90.22m.
- 2.2.6 These boreholes generally encountered a thin veneer of made ground over variable drift deposits to depths between 2.74m (SJ89NW137) and 14.02m (SJ89NW231). Bedrock predominantly comprised red sandstone. Marl was noted in SJ89NW231 between about 66 and 70m.
- 2.2.7 Water levels about 8.5 and 4.2m below ground level were recorded in SJ89NW137 and SJ89NW231 respectively.

3.0 SITE WORK

- 3.1 The site work was carried out between 30th January to 6th February 2017.
- 3.2 The proposed locations of exploratory holes were indicated on drawings provided by the Engineer and amended on site subject to access restrictions and underground services.
- 3.3 The site works were carried out on the basis of the practices set out in CLR 4, ref. 9.1, BS 10175:2011, ref. 9.3, BS 5930:2015 ref. 9.4 and ISO 1997:2007, ref 9.5.
- 3.4 Exploratory holes were undertaken at the following locations during site works:

Location	Type & Comments
BHA	Asbestos suspected in base of hand pit. Relocated to BHAA
BHAA	Cable Percussion boring to 4.00m. Metal object detected. Relocated to BHAB
BHAB	Rotary open hole with coring
BHB	Cable percussion boring with rotary coring
BHC	Cable percussion boring with rotary coring
BHD	Hand excavation to 1.20m. Metal object detected. Relocated to BHDA
BHDA	Hand excavation to 0.50m. Service duct encountered. Relocated to BHDB
BHDB	Cable percussion boring with rotary coring
BHE	Cable percussion boring
WS01	Hand excavation to 0.50m. Brick obstruction encountered. Relocated to WS01A
WS01A	Hand excavation to 0.70m. Brick obstruction encountered. No alternative position available
WS02	Dynamic sampling
WS03	Dynamic sampling

- 3.5 The positions of the exploratory holes are shown on Figure A1.2 in Appendix 1.
- 3.6 Boreholes were undertaken under the supervision of a UXO technician. Boreholes were scanned at 1m intervals with a magnetometer during boring.
- 3.7 The depths of exploratory holes, descriptions of strata encountered and comments on groundwater conditions are given in the exploratory hole records in Appendix 2.
- 3.8 Representative disturbed and undisturbed samples were taken at the depths shown on the records and despatched to the laboratory. Standard penetration tests (SPT), ref. 9.5 were carried out in boreholes in the various strata to assess the relative density or consistency. The values of penetration resistance are given in the borehole records.
- 3.9 A photographic record of the rock core is presented in Appendix 8.
- 3.10 Samples for environmental purposes were collected in appropriate containers and kept in a cool box.

- 3.11 Perforated standpipes, surrounded by pea shingle and protected by a stopcock cover were installed in boreholes BHAB, BHB, BHC, BHDB and BHE as detailed in the borehole records.
- 3.12 The ground levels at the borehole and trial pit locations, were determined by survey to National Grid and Ordnance Datum.
- 3.13 Site visits were undertaken after completion of fieldwork to carry out gas and groundwater monitoring. Records of monitoring are presented in Appendix 7.

4.0 LABORATORY TESTS

4.1 Geotechnical Testing

- 4.1.1 Schedules for geotechnical testing were prepared by Ian Farmer Associates and forwarded to the Engineer for amendment and approval.
- 4.1.2 Soil samples for testing were prepared in accordance with BS1377: Part One: 1990 ref. 9.11 and representative sub-samples were taken for testing. The following tests were carried out:
- 5 No. Moisture contents
 - 4 No. Plasticity indices
 - 1 No. Bulk and dry density
 - 4 No. Particle size distribution by wet sieving
 - 1 No Undrained shear strength by triaxial test
- 4.1.3 The results of the soil tests are given in Appendix 3, Test Report 42028/1.
- 4.1.4 Rock samples for geotechnical testing were prepared and tested in accordance with ISRM Suggested Methods ref. 9.12. The following tests were carried out:
- 55 No. Point Load Index Test (PLT)
 - 11 No. Uniaxial Compressive Strength (UCS)
- 4.1.5 Rock test results are presented in Report 42028R/1 in Appendix 3.

4.2 Chemical Testing

4.2.1 Chemical analysis was carried out on soil samples as follows:

- As, Cd, Cr, CrVI, Hg, Pb, Se, Cu, Ni, Zn, free cyanide, monohydric phenol, speciated PAH (16), pH, water soluble sulphate, soil organic matter (SOM), asbestos screen, TPH (TPHCWG)

4.2.2 The results of chemical analysis of soils are presented in reports 631022, 632553 and 635476 in Appendix 4.

4.2.3 Waste Acceptance Criteria testing (WAC) was also carried out on eight samples of soils. The results of these tests are presented in Reports 632134 and 632554 in Appendix 4.

4.2.4 Chemical analysis was carried out on one sample of groundwater as follows:

- Dissolved metals (As, Cd, Cr, Hg, Pb, Se, Cu, Ni, Zn, Ba), ammonia, chloride, hardness, cyanide, monohydric phenol, total organic carbon, speciated PAH (16), pH, sulphate, TPH (TPHCWG)

4.2.5 The results of chemical analysis of water are presented in reports 639433 in Appendix 4.

5.0 GROUND CONDITIONS ENCOUNTERED

5.1 Sequence

5.1.1 The sequence of the strata encountered during the investigation generally confirms the anticipated geology as interpreted from the geological map and historical boreholes.

5.1.2 The sequence encountered generally comprised made ground overlying superficial deposits of clay and sand. These in turn overlie bedrock of sandstone.

5.2 Made Ground

5.2.1 Made ground was encountered at all locations to depths in the range 0.30 to 3.00m.

5.2.2 Made ground generally comprised a thin veneer of surface coverings, tarmac or gravel, over coarse soils.

5.2.3 The soils were generally described as gravelly sand. Locally the soils tended to sandy gravel. A low cobble content was locally noted.

5.2.4 Anthropogenic fragments included brick, concrete, ash, animal bones (BHE) and metal.

5.2.5 Possible asbestos containing material (ACM) was encountered in BHA within the hand excavated pit.

5.2.6 The greatest thickness of made ground, 3.00m, was encountered in BHAA.

5.2.7 BHA, WS01 and WS01A were terminated within made ground at depths of 1.00, 0.50 and 0.70m respectively.

5.2.8 Three SPT 'N' values, of 2, 6 and 9, were recorded in made ground. These values are consistent with very loose and loose soils.

5.2.9 A further SPT 'N' value of 35 was recorded in made ground described as bricks.

5.3 Superficial Deposits

- 5.3.1 Superficial deposits were locally encountered across the site at depths between 0.30 and 3.00m.
- 5.3.2 The base of the superficial deposits was proved at depths between 1.60 and 5.20m.
- 5.3.3 BHAA was terminated in sand at a depth of 4.00m. BHD and BHDA were terminated in clay at depths of 1.20 and 0.50m respectively.
- 5.3.4 The material between 3.70 and 5.20m in BHAB was described as orange brown gravelly sand based on flush returns from rotary drilling. This may in part represent weathered sandstone bedrock.
- 5.3.5 Superficial deposits were absent in BHE and WS03 where made ground rested directly on sandstone.
- 5.3.6 Superficial deposits variably comprised clay, sand and, locally, gravel.
- 5.3.7 Moisture content and Atterberg limit tests on clay may be summarised as follows:

	Number of values	Minimum	Maximum	Mean
Moisture content %	5	9.8	18	14
Plastic limit %	4	15	17	16
Liquid limit %	4	25	34	29
Plastic Index	4	10	17	14

- 5.3.8 Based on these tests the clay may be classified as low plasticity.
- 5.3.9 The results of these tests indicate that the clay is low volume change potential as defined by the National House Building Council, ref 9.17 and other published data, refs 9.18 and 9.19. Changes in moisture content may result in small changes in volume. It is recommended that for design purposes, low volume change potential may be adopted.
- 5.3.10 Bulk densities of 2.17 and 2.22Mg/m³ were recorded on samples of clay with corresponding dry densities of 1.84 and 1.86Mg/m³.
- 5.3.11 One triaxial test on clay recorded an undrained shear strength (Cu) of 104kN/m² in BHDB at 1.20m, consistent with high strength material.
- 5.3.12 Consistencies of clay varied from soft through firm to stiff.
- 5.3.13 Two SPT 'N' values of 8 and 35 were obtained within clay.

- 5.3.14 SPT 'N' values may be used in conjunction with plasticity data to provide an approximation of C_u values in overconsolidated clay (see Appendix 5).
- 5.3.15 Based on the average plastic limit an f_i value about 6 may be used. C_u values about 48 and 216kN/m² may therefore be derived from SPT 'N' values. These values are consistent with medium strength and very high strength material.
- 5.3.16 The characteristic constant volume angle of shearing resistance, $\phi'_{cv,k}$ of fine soil may be estimated from plasticity index I_p . (ref. 9.13).
- 5.3.17 Based on the measured I_p of 14 a value of $\phi'_{cv,k}$ about 27 degrees may be determined. The characteristic constant volume effective cohesion $c'_{cv,k}$ should be taken as zero.
- 5.3.18 Two SPT 'N' values of 10 and 23 were obtained within coarse soils. These values are consistent with medium dense materials.
- 5.3.19 The characteristic constant volume effective angle of shearing resistance, $\phi'_{cv,k}$, for coarse soils may be estimated from the angularity and grading characteristics (ref. 9.13). On this basis a value of $\phi'_{cv,k}$ about 32 degrees may be estimated for coarse soils.

5.4 Sandstone

- 5.4.1 Sandstone bedrock was encountered across the site at depths between 1.60 and 5.20m.
- 5.4.2 BHAB recorded orange brown gravelly sand between 3.70 and 5.20m based on flush returns from rotary drilling. This may in part represent weathered sandstone.
- 5.4.3 Elevations of the top of the sandstone varied from 29.56 to 25.32mAOD. These elevations suggest a fall in the top of the sandstone towards the south and west across the site.
- 5.4.4 The bedrock was generally described as thinly bedded reddish brown sandstone; distinctly weathered.
- 5.4.5 The base of the sandstone was not proven.
- 5.4.6 UCS, PLT and SPT tests were carried out on sandstone.
- 5.4.7 The laboratory and in-situ tests carried out on sandstone may be summarised as follows:

	Number of values	Minimum	Maximum	Mean
UCS MPa	11	3.5	14.6	8.3
SPT 'N'*	7	107	500	331
PLT $I_{s(50)}$ MPa All data	55	0.1	0.4	0.2
PLT $I_{s(50)}$ MPa (Axial)	38	0.1	0.5	0.2
PLT $I_{s(50)}$ MPa (Diametral))	17	0.1	0.4	0.3

*SPT 'N' extrapolated to 300mm penetration

- 5.4.8 The range of UCS values indicate very weak and weak material.
- 5.4.9 PLT values do not appear to indicate a significant difference between the axial and diametral values.
- 5.4.10 PLT $I_{s(50)}$ values may be used to derive UCS values. Correlations of the form $I_{s(50)} \times 20 = \text{UCS}$ are often applied. On this basis the axial $I_{s(50)}$ values may be used to derive UCS values in the range 2 to 10MPa with an average about 4MPa. These values indicate very weak and weak material.
- 5.4.11 A site-specific correlation between UCS and PLT data is not considered appropriate. The test sample requirements for UCS favour more competent material whereas PLT may be carried out on smaller samples from weaker materials.
- 5.4.12 Seven SPT 'N' values in sandstone recorded greater than 50 blows. Full penetration was not achieved on these tests.
- 5.4.13 The unconfined compressive strength of the bedrock may be approximated from SPT 'N' values based on the following relationship:
- $$\sigma_c > 10N \text{ (kN/m}^2\text{)}$$
- where σ_c = unconfined compressive strength (UCS) and
- N = SPT 'N' value
- 5.4.14 This approach is presented in CIRIA Report 143 (ref. 9.20) and is considered to represent a lower bound value of UCS.
- 5.4.15 On this basis, lower bound strengths in the order of 1 to 5MN/m² are indicated for the sandstone. These values indicate very weak and very weak to weak material.
- 5.4.16 Overall the strength data, either obtained from direct measurement or derived from indirect tests, is consistent with very weak and weak rock.

5.4.17 The rock strength data, determined by direct and indirect measurement, is presented against depth in Appendix 1 as Figure A1.3. The data suggests an increase in strength about 8m. The average rock strength increases from about 3.7MPa above 8m to an average about 6.0MPa at depths greater than 8m.

5.5 Groundwater

5.5.1 Groundwater was encountered at depths of 7.50 and 7.60m in BHAB and BHC respectively during site work.

5.5.2 Groundwater was not encountered in the other exploratory holes during the site work period.

5.5.3 Depths to groundwater were recorded during monitoring as follows:

	23/01/2017	10/03/2017	30/03/2017	11/04/2017	20/04/2017	05/05/2017
BHAB	dry	dry	-	dry	2.52	-
BHB	-	7.25	-	7.22	7.26	6.39
BHC	dry	dry	1.65	dry	1.44	dry
BHDB	2.78	2.85	2.71	2.54	2.55	-

5.5.1 Depths to groundwater could not be recorded on all wells on each visit due to parked vehicles.

6.0 GEOTECHNICAL ASSESSMENT AND RECOMMENDATIONS IN RELATION TO THE PROPOSED DEVELOPMENT

6.1 Proposed Development

6.1.1 It is understood that it is proposed to develop the site for a residential led scheme. The scheme proposals are as follows:

- Clearance of existing industrial units
- New build accommodating ground floor commercial units, residential units and a resident roof garden. This will comprise a U-shaped building that will step 8 to 9 storeys from Arundel Street to Worsley Street, and 11 to 23 storeys along Mancunian Way
- Refurbishment and conversion of the four storey DOT motorcycle building for mixed commercial / residential use

6.1.2 The central area of site will form an open courtyard parking area at street level.

6.1.3 Basements will be limited to the area below the eastern corner of the main building.

6.1.4 The proposed ground floor layout has been provided by Deloitte LLP and is presented as Figure A1.4 in Appendix 1.

6.1.5 The comments and discussion below do not fall within the requirements of EC7 (ref. 9.5) and are offered for guidance. The comments and recommendations below should be reviewed as development details become available.

6.2 Foundations and Floor Slabs

6.2.1 The investigation has encountered bedrock of sandstone at shallow depths across most of the site.

6.2.2 It is recommended that foundation loads are carried on sandstone bedrock.

6.2.3 Square pad foundations up to 5m wide placed on competent sandstone may adopt a presumed bearing resistance about 500kN/m² at depths less than 8m.

6.2.4 The presumed bearing resistance is based on a serviceability limit of 25mm equivalent to 0.5% of foundation width of 5m.

6.2.5 Ground floor slabs may be placed on a network of ground beams linked to foundation columns.

6.3 Excavations

- 6.3.1 Based on observations on site, together with the results of in-situ and laboratory tests, it is considered that excavations to less than 1.00m may stand unsupported in the short term. Side support for safety purposes should of course be provided to all excavations which appear unstable, and those more than 1.20m deep, in accordance with Health and Safety Regulations. Deeper excavations may require full support.
- 6.3.2 Excavations will encounter sandstone bedrock beneath the site. Provision should be made for suitable plant to excavate sandstone at depths below about 2m.
- 6.3.3 Groundwater would not be expected in shallow excavations.
- 6.3.4 Inflows may be encountered at shallow depths due to perching on clay layers in made ground or superficial deposits.
- 6.3.5 Groundwater may be encountered at depths below about 2m.
- 6.3.6 Depending on final depth of excavations groundwater control measures may be required.
- 6.3.7 Reference should be made to CIRIA Report C515, ref 9.32, for recommendations concerning control of groundwater.
- 6.3.8 The ground investigation was undertaken in the presence of a UXO supervisor. Metal objects were detected in BHAA and BHD. These metallic anomalies may require further investigation as part of the UXO risk assessment for the construction phase.
- 6.3.9 Construction excavation should consider the risks from UXO and appropriate supervision measures should be in place.

6.4 Permeability

6.4.1 Falling head tests were undertaken in boreholes to assess the permeability characteristics of materials.

6.4.2 The values of permeability obtained are summarised below:

Location	Top depth (m)	Base depth (m)	Permeability (m/s)	Stratum
BHAA	3.00	3.50	5.04×10^{-7}	Drift: Sand
BHB	3.00	3.50	6.75×10^{-7}	Sandstone
BHC	2.00	3.00	8.93×10^{-8}	Sandstone
BHDB	1.20	3.00	4.13×10^{-7}	Drift: Varied Clay / Sand

6.5 Chemical Attack on Buried Concrete

6.5.1 The site has been classified in accordance with BRE Special Digest 1, ref. 9.23, and laboratory testing undertaken accordingly. It is recommended that the guidelines given in BRE Special Digest 1, ref. 9.23, be adopted.

6.5.2 It is recommended that the groundwater should be regarded as mobile.

6.5.3 The results of chemical testing indicate sulphate concentrations with an overall range from <10 and 600mg/l as 2:1 water/soil extract, with pH values between 6.8 and 9.4.

6.5.4 Based on these results a characteristic value for water soluble sulphate content of 430mg/l may be determined.

6.5.5 Based on the laboratory test results it is considered that a Design Sulphate Class may be taken as DS-1. An ACEC class for the site of AC-1 would be appropriate.

7.0 ENVIRONMENTAL RISK ASSESSMENT IN RELATION TO PROPOSED DEVELOPMENT

7.1 Contaminated Land

7.1.1 The definition of ‘contaminated land’, along with the relevant details on legislation and guidance is set out in Appendix 6.

7.2 Site History

7.2.1 The site history has been determined from the Desk Study (ref. 9.1) and is briefly summarised below.

7.2.2 Terraced housing partly covered the site by 1848, predominantly covering the site by 1891. A sand pit may have occupied part of the site about 1848.

7.2.3 An engineering works occupied the southern part of the site by 1891, this building was later occupied by DOT Motorcycles. This building currently remains on site.

7.2.4 Terraced housing remained through the 1950’s.

7.2.5 By 1969 the site had been cleared of housing and was occupied by commercial units. The DOT Motorcycle building remained on site.

7.2.6 The site has been bound to the north by Worsley Street since 1848, bound to the south by Ellesmere Street and to the west by Arundel Street since 1891.

7.2.7 The site was surrounded by a variety of industrial buildings including engineering works, dye works, cotton works and corn mills reflecting the intense industrialisation of the area from the mid 1800’s to the mid 1900’s. These industrial sites were developed in tandem with extensive areas of terraced housing. The Mancunian Way was built adjacent to the site in the early 1960’s and has remained until the present day.

7.3 Risk Assessment – Human Health

7.3.1 The proposed development is residential. The layout indicates that buildings and hardstanding will cover the whole site. This assessment has been based on residential without homegrown produce although the lack of any soft landscaping on site indicates that these values may be quite conservative. Should the proposed development be changed in the future then further risk assessment may be required.

7.3.2 The results of the soil chemical analyses have been processed in accordance with recommendations set out in the CIEH and CL:AIRE document ‘Guidance on Comparing Soil Contamination Data with a Critical Concentration’, ref. 9.33. The results have been compared in the first instance to screening levels

produced in accordance with current and best practice legislation and guidance, as detailed in Appendix 6.

7.3.3 Where the concentrations determined on site are at or below the respective screening level, they are considered not to pose a risk and are removed from further consideration, unless otherwise stated.

7.3.4 Those contaminants with observed concentrations above the screening levels for metals are detailed below:

Location	Depth (m)	Contaminant	Concentration (mg/kg)	Guidance Level (mg/kg)
BHA	0.20	Lead	480	310
BHA	0.50	Lead	380	310
BHAB	0.50	Lead	460	310
BHAB	0.50	Mercury	2.0	1.2

7.3.5 Those contaminants with observed concentrations above the screening levels for PAH compounds are detailed below:

Location	Depth (m)	Contaminant	Concentration (mg/kg)	Guidance Level (mg/kg)*
BHA	0.50	Benzo(b)fluoranthene	7.9	3.9
BHA	0.50	Benzo(a)pyrene	4.5	3.2
BHA	0.50	Dibenzo(ah)anthracene	0.7	0.31
WS01	0.50	Naphthalene	2.7	2.3
WS01	0.50	Benzo(a)anthracene	53	11
WS01	0.50	Chrysene	50	30
WS01	0.50	Benzo(b)fluoranthene	47	3.9
WS01	0.50	Benzo(a)pyrene	39	3.2
WS01	0.50	Dibenzo(ah)anthracene	5.7	0.31
WS02	0.50	Benzo(b)fluoranthene	5.2	3.9
WS02	0.50	Benzo(a)pyrene	4.1	3.2
WS02	0.50	Dibenzo(ah)anthracene	0.6	0.31

*At 1% Soil Organic Matter

7.3.6 All exceedances were recorded in made ground. Made ground included anthropogenic fragments of ash and metal.

7.3.7 The proposed development will result in the site being covered with buildings and hardstanding.

- 7.3.8 Based on the nature of the development, the elevated metals and PAH compounds are not deemed to represent any significant risk to end users and are not considered further.
- 7.3.9 Asbestos was identified as chrysotile in one sample of made ground from WS03 at 0.20m with a moisture content of 20%.
- 7.3.10 Possible asbestos containing material (ACM) was noted in BHA between 0.50 and 1.00m during fieldwork. Laboratory analysis of this material did not detect asbestos.
- 7.3.11 Based on the nature of the development, the presence of asbestos is not deemed to represent any significant risk to end users. The presence of asbestos, although not widespread, should be addressed in construction management procedures.

7.4 Risk Assessment - Controlled Waters

- 7.4.1 The site is located on a Principal Aquifer, is not within a groundwater source protection zone and there are no groundwater abstractions within 1km of the site.
- 7.4.2 The nearest surface watercourse is the Bridgewater Canal, located approximately 33m to the north of the site at its closest point.
- 7.4.3 Sufficient water for analysis could only be obtained from BH B. This monitoring well was installed into sandstone.
- 7.4.4 The groundwater results have been reviewed against the screening levels tabulated and detailed within Appendix 4. As there is no TPH guideline parameter the level of 10µg/l within the Water Supply Regulations 1989, ref. 9.43, has been adopted as a conservative approach.
- 7.4.5 Chromium recorded a concentration of 8µg/l: elevated against the EQS freshwater screening value of 4.7µg/l but below DWS guideline of 50 µg/l.
- 7.4.6 Copper recorded a concentration of 6.3µg/l: elevated against the EQS freshwater screening value of 1µg/l and the DWS guideline of 50 µg/l.
- 7.4.7 Zinc recorded a concentration of 15µg/l: elevated against the EQS freshwater screening value of 11.9µg/l but below DWS guideline of 5000µg/l.
- 7.4.8 There is no evidence within the laboratory testing undertaken on soils of a significant potential on site source for these elevated metal concentrations in groundwater.
- 7.4.9 The urban location of the site, together with the historical industrial site use and the presence of made ground is consistent with slightly elevated concentrations of some contaminants in groundwater. These values may be

representative of a regional groundwater regime and may not be confined to the site.

- 7.4.10 Given the ground conditions encountered at the site, the nature of the proposed development, the conservative nature of the EQS and DWS standards and the results of this contamination assessment, it is considered unlikely that further assessment of the risks to controlled waters may be required.

7.5 Gas Generation

- 7.5.1 Six gas monitoring visits have been undertaken. The results of the gas monitoring are included within Appendix 2.
- 7.5.2 A peak methane concentration, CH₄, of 0.1%v/v has been recorded with a maximum carbon dioxide concentration, CO₂, of 6.8%v/v.
- 7.5.3 A maximum gas flow rate of 0.2l/hr has been recorded.
- 7.5.4 In accordance with the methodology published in CIRIA Document C665, ref. 9.50, the maximum recorded values should be taken to calculate a Gas Screening Value (GSV) for the site.
- 7.5.5 On this basis, approximate GSV values of 0.0136l/hr for CO₂ and 0.0001l/hr for CH₄ may be calculated.
- 7.5.6 Based on the gas screening value for CO₂ the site is consistent with Characteristic Situation 1 – very low risk gas regime. However, an upper limit of 5% CO₂ is normally applied to this classification. An increase to Characteristic Situation 2 is therefore considered appropriate. Basic gas protection measures would therefore be required.
- 7.5.7 The site is not in a radon affected area. Radon protection measures are therefore not required.

7.6 Risk Evaluation

7.6.1 The conceptual model formed within the Phase 1 Desk Study has been updated to reflect the findings of the contamination risk assessment and the revised conceptual model, detailing the relevant pollutant linkages, is tabulated below:

Source	Potential Contaminants of Concern	Potential Pathways	Receptor Group	Risk
Made ground	Metals & PAH in soil	Ingestion of contaminated soil Entry of contaminants by skin or eye contact Inhalation of contaminated dust	Humans • Construction workers • Neighbouring site users	Negligible Negligible ^{1,2} Negligible ²
Asbestos in soil	Asbestos	Inhalation of fibres	Humans • Construction workers ² • Neighbouring site users ²	Very Low ¹
Ground gas in soil	Carbon dioxide	• Migration & ingress into buildings • Inhalation	Humans • Site occupants	Negligible ³
¹ – Assumes adequate risk mitigation measures during construction period ² – Pathway exists only during the construction period ³ – Assumes risk would be mitigated by gas protection measures				

7.7 Waste

7.7.1 WAC testing has been carried out on samples obtained during this investigation.

7.7.2 The threshold for inert waste was exceeded by total organic carbon (TOC) on four samples. The threshold inert waste was exceeded by Total Petroleum Hydrocarbon (TPH) on one sample.

7.7.3 The final classification of waste for disposal rests with the operator of the receiving landfill. The results of analysis should be forwarded to the receiving landfill for final classification.

8.0 MANAGEMENT OF CONTAMINATION

8.1 Remediation and Verification

- 8.1.1 The risk management framework set out in the Model Procedures for the Management of Land Contamination, CLR 11, ref. 9.45, is applicable to the redevelopment of sites that may be affected by contamination.
- 8.1.2 The risk management process set out in the Model Procedures has three main components:
- Risk assessment
 - Options appraisal
 - Implementation
- 8.1.3 Metals and PAH compounds have been identified in made ground. Chrysotile asbestos has also been identified within Made Ground at one location. The proposed development will effectively remove the risk to end users.
- 8.1.4 Since there is no specific requirement for remediation from chemical contamination, validation would not be required unless unexpected contamination is encountered.
- 8.1.5 Gas monitoring has indicated a low risk ground gas regime. Basic gas protection measures consistent with Characteristic Situation 2 (see Appendix 7) should be incorporated into design.

8.2 Management of Unidentified Sources of Contamination

- 8.2.1 There is the possibility that other sources of contamination may be present on the site, which were not detected during the investigation. Should such contamination be identified or suspected during the site clearance or ground works, these should be dealt with accordingly. Several options are available for handling this material, which include:
- The removal from site and disposal to a suitably licensed tip of all material suspected of being contaminated. The material would need to be classified prior to disposal.
 - Short-term storage of the suspected material while undertaking verification testing for potential contamination. The storage area should be a contained area to ensure that contamination does not migrate and affect other areas of the site. Depending upon the amounts of material under consideration, this could be either a skip or a lined area.
 - Having a suitably experienced environmental engineer either on-call or with a watching brief for the visual and olfactory assessment of the material, and sampling for verification purposes.

8.3 Consultation

8.3.1 During the development of a contaminated site, consultation may be required for several reasons with several regulatory Authorities. The following provides an indication as to the most likely Authorities with which consultation may be required.

- **Local Authority.** There may be a planning condition regarding contamination and consultation will be required with a designated Contaminated Land Officer within the Environmental Health Department. The Local Authority is generally concerned with human health risks. Some Authorities now require 'Completion Certificates' to be signed off following remediation works.
- **Environment Agency.** Where a site is within a groundwater protection zone or has been designated as a special site, the Environment Agency is likely to be involved to ensure that controlled waters are protected.

8.3.2 Based on the results of any consultation, there may be specific remediation requirements imposed by one or more of the Authorities.

8.4 Risk Management During Site Works

8.4.1 During ground works, some simple measures may have to be put in place to mitigate the risk of contamination affecting the site workers and the environs. The proposed measures represent good practice for the construction industry and include:

- Informing the site workers of the contamination on site and the potential health effects from exposure.
- Where appropriate, the provision of suitable Personal Protective Equipment (PPE) for workers who may be potentially impacted by working in areas of the contamination.
- Ensuring good hygiene is enforced on site and washing facilities are maintained on the site. Workers are discouraged from smoking, eating or drinking without washing their hands first.
- Dust monitoring, and if necessary, suppression measures should be put into practice where contamination is becoming airborne.
- Site drainage should be prevented from entering any adjacent watercourse, ref 9.46.

8.4.2 Where contaminated materials are being removed from the site they should be disposed of at a suitably licensed landfill, with a 'duty of care' system in place and maintained throughout the disposal operations.

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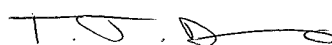
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For and on behalf of Ian Farmer Associates (1998) Limited

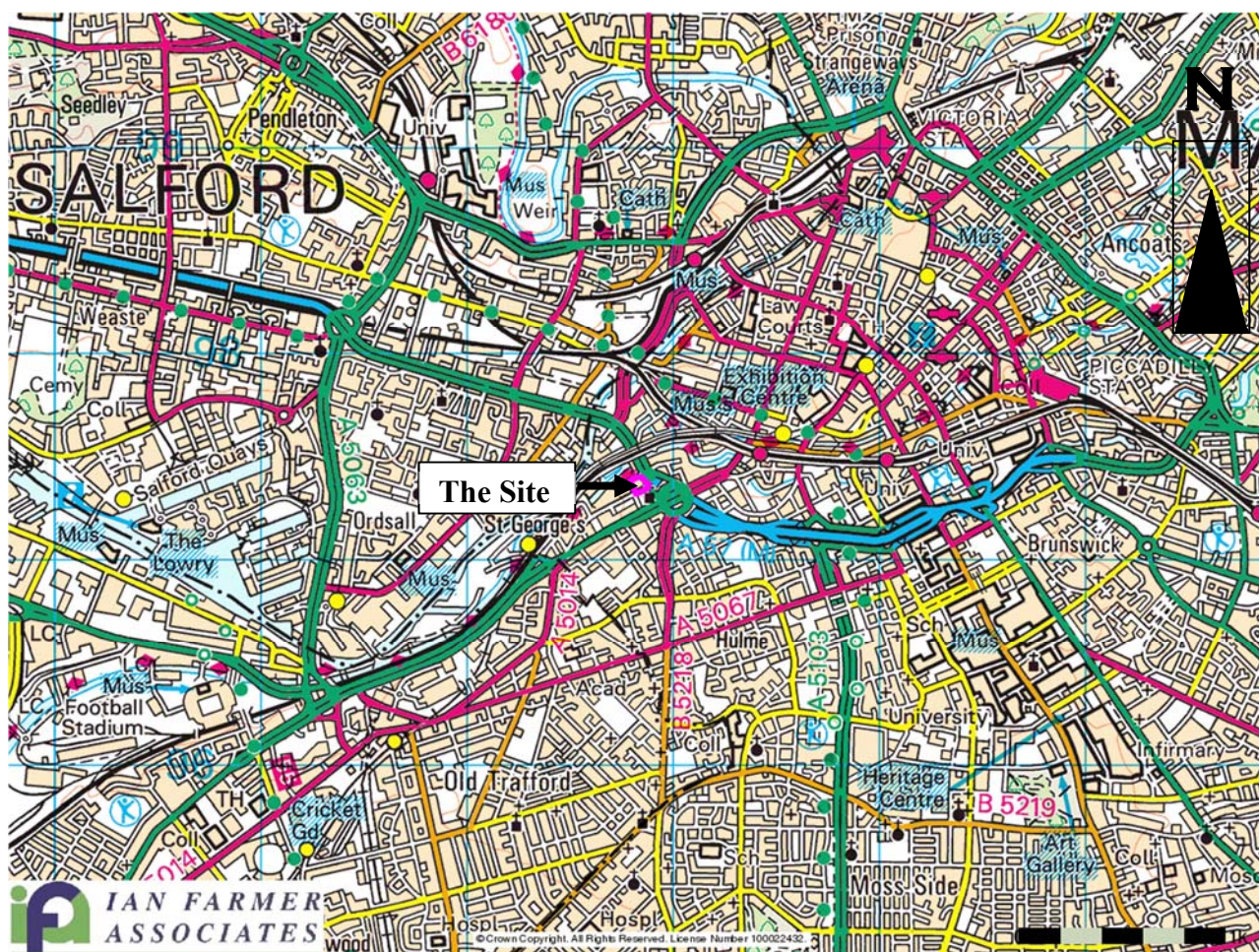


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APPENDIX 1
DRAWINGS



PROJECT: 42028 Arundel Street

FIGURE No. A1.1.

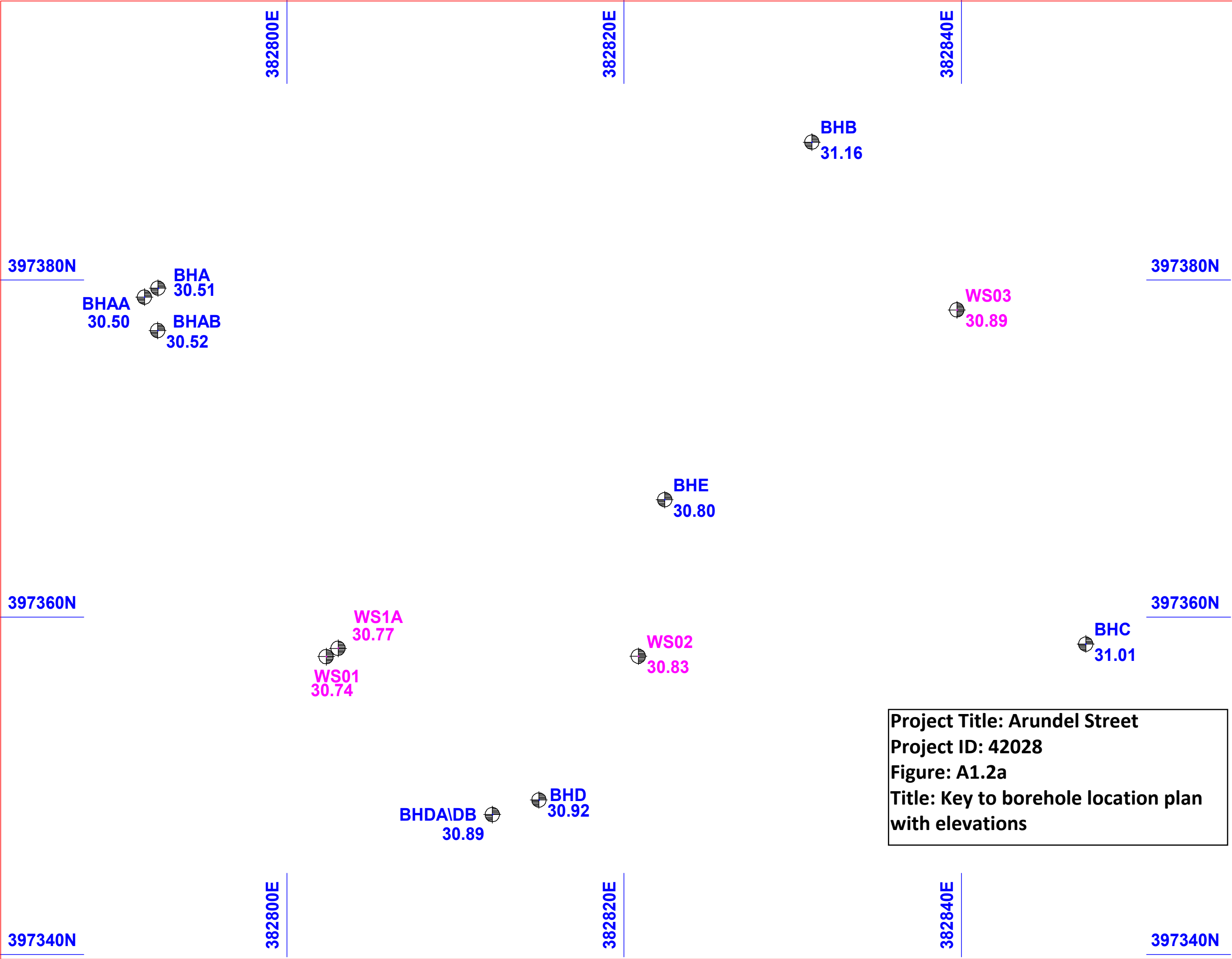
SCALE : As above

TITLE: Site Location Plan

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Geotechnical & Environmental Specialists





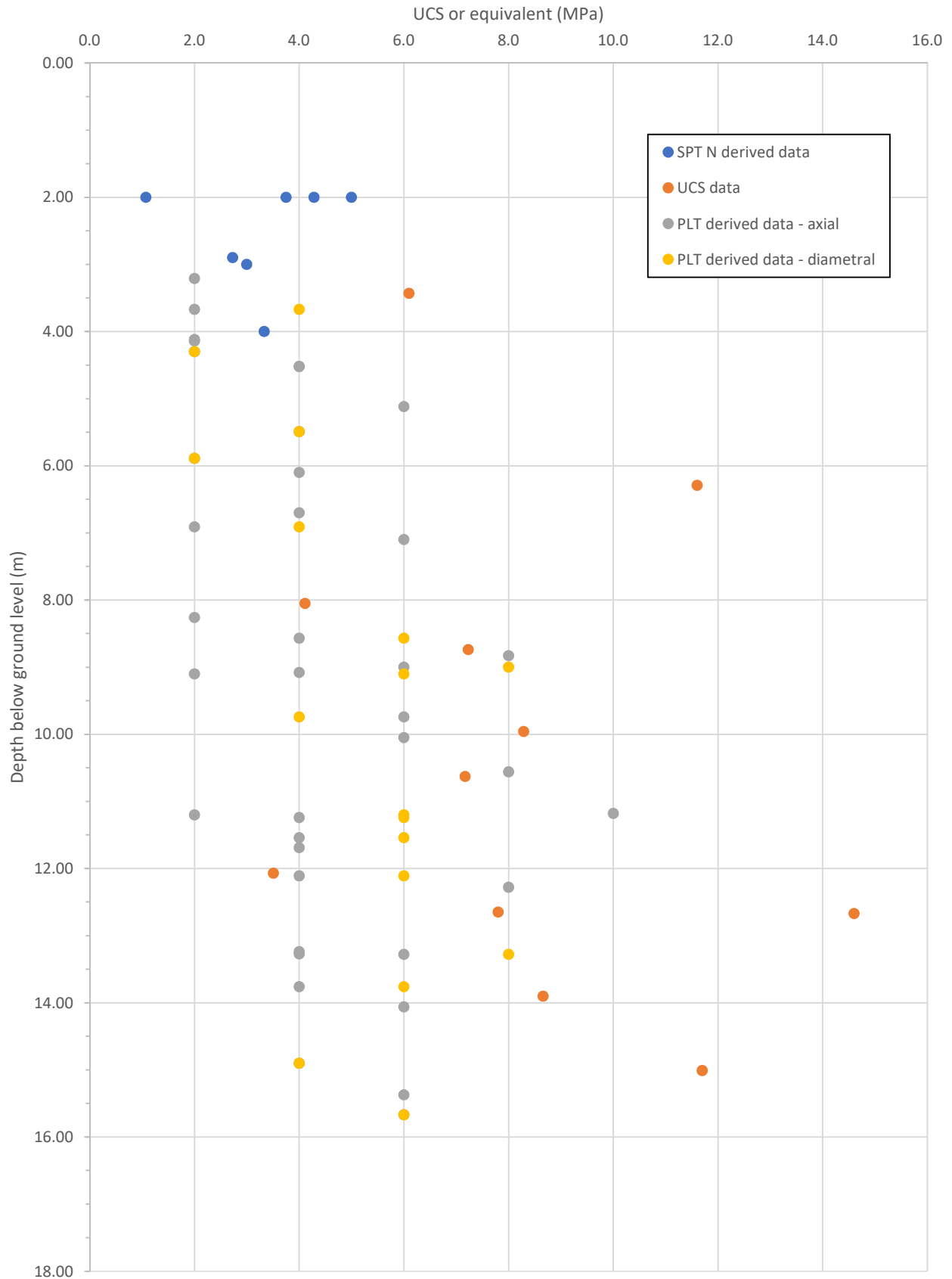
Key: heights refer to code

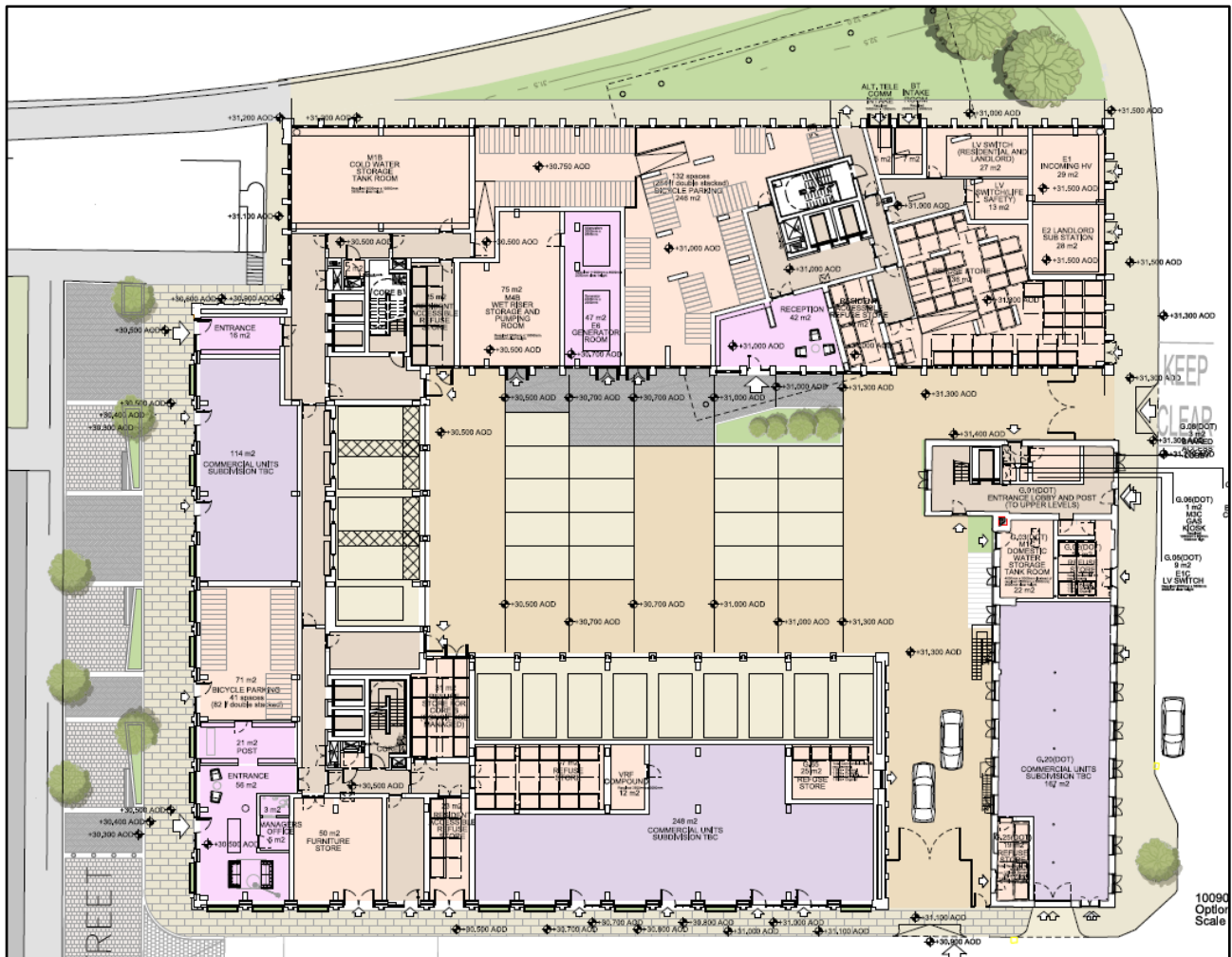
 WS(Window sample)

 BH (Borehole)



42028 Arundel Street
Figure A1.3 Rock Strength Data versus Depth





PROJECT: 42028 Arundel Street

FIGURE No. A1.4

Not to Scale

TITLE: Proposed Ground Floor Layout

APPENDIX 2

SITE WORK

APPENDIX 2

GENERAL NOTES ON SITE WORKS

A2.1 SITE WORK

A2.1.1 General

Site work is carried out in general accordance with the guidelines given in ISO 1997, 9.5 and BS

A2.1.2 Light Cable Percussion Boring

For routine soil exploration to depths in excess of 3m, the light cable percussion rig is generally employed for boring through soils and weak rocks, refs 9.4, 9.5 and 9.6. It consists of a powered winch and tripod frame, with running wheels that are permanently attached so that the rig may be towed behind a suitable vehicle. The rig is towed into position and set up using its own winching system.

The locations of services are checked to make sure the borehole is not situated unacceptably near any services. Regardless of the proximity of services, a CAT scan is undertaken at the borehole location and a trial hole dug to 1.20m by hand.

Boreholes are advanced in soil by the percussive action of the cable tool. The force of the cylindrical tool as it is dropped a short distance cuts a plug of cohesive soil that is removed by the tool.

In non-cohesive soils, the borehole is advanced by a 'shell', otherwise known as a 'bailer' or 'sand pump', which incorporates a clack valve. Material is transferred into the shell and retained by the clack valve. The water level in a borehole is maintained above that in the surrounding granular soil to allow for temporary reductions in the head of water as the shell is withdrawn from the borehole. Water should flow from the borehole into the surrounding soil at all times to prevent 'piping' and loosening the soil at the base of the hole. The casing is always advanced with the borehole in granular soil so that material is drawn from the base rather than the borehole sides.

Obstructions to boring are overcome by fitting a serrated chiselling ring to the base of the percussion tool. For large obstructions, a heavy chisel with a hardened cutting edge may have to be used.

Disturbed samples are taken in polythene bags, jars or tubs that are sealed against air or water loss.

Undisturbed samples are generally taken in cohesive materials at changes in strata and at one metre intervals to 5 metres then at 1.5 metre intervals to the full depths of the borehole. The general purpose open-tube sampler is suitable for firm to stiff clays, but is often used to retrieve disturbed samples of weak rocks, soft or hard clay and also clayey sand or silts. This has been adopted for routine use, and usually consists of a 100mm internal diameter tube (U100), which is capable of taking soil samples up to 450mm in length. The undisturbed samples are sealed at each end using micro-crystalline wax to prevent drying.

Standard penetration tests are generally carried out in non-cohesive soils but also in stiff clays and soft rocks at frequencies similar to that of undisturbed sampling.

A2.1.3 Drive-in Window Sampler

The drive-in window sampler, ref 9.8, consists generally of a track mounted window sampler and a series of cylindrical sample tubes, generally varying in diameter from 98mm to 35mm. A cutting shoe is fitted to the bottom of each tube, while a window, representing about a quarter of the circumference, is cut along the length of the tube. Soil samples are extracted through the window of the tube.

The borehole is extended by using progressively smaller diameter tubes.

Alternatively, undisturbed samples may be collected in plastic liners, known as *windowless sampling*.

A2.2 IN-SITU TESTS

A2.2.1 Standard Penetration Test

The Standard Penetration Test is carried out in accordance with the proposals recommended by ISO 1997, ref 9.5, BS 1377, Part 9, 1990 ref 9.11 and ISO 22476 ref 9.6.

The standard penetration test, **SPT**, covers the determination of the resistance of soils to the penetration of a split barrel sampler. A 50mm diameter split barrel sampler is driven 450mm into the soil using a 63.5kg hammer with a 760mm drop. The penetration resistance is expressed as the number of blows required to obtain 300mm penetration below an initial seating drive of 150mm through any disturbed ground at the bottom of the borehole. The number of blows to achieve the standard penetration of 300mm is reported as the 'N' value.

The test is generally carried out in fine soils, however, it may also be carried out in coarse granular soils, weak rocks and glacial tills using the same procedure as for the SPT but with a 50mm diameter, 60° apex solid cone replacing the split spoon sampler, **CPT**.

When attempting the standard penetration test in very dense material or weathered rocks it may be necessary to terminate the test before completion to prevent damage to the equipment. In these circumstances it is important to distinguish how the blow count relates to the penetration of the sampler. This may be achieved in the following manner:

- Where the seating drive has been completed, the test drive is terminated if 50 blows are reached before the full penetration of 300mm is achieved. The penetration for 50 blows is recorded and an approximate N value obtained by linear extrapolation of the number of blows for the partial test drive.
- If the seating drive of 150mm is not achieved within the first 25 blows, the penetration after 25 blows is recorded and the test drive then commenced.
- For tests in soft rocks, the test drive should be terminated after 100 blows where the penetration of 300mm has not been achieved.

The N-value obtained from the Standard Penetration Test may be used to assess the relative density of sands and gravels as follows:

Term	SPT N-Value : Blows/300mm Penetration
Very Loose	0 - 4
Loose	4 - 10
Medium Dense	10 - 30
Dense	30 - 50
Very Dense	Over 50

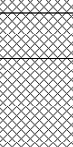
A2.3 SAMPLES

U	represents undisturbed 100mm diameter sample, the number of blows to obtain the sample also recorded.
U fail	indicates undisturbed sample not recovered
HV	represents Hand Vane test with equivalent undrained shear strength in kN/m ² .
PP	represents Pocket Penetrometer test with equivalent undrained shear strength in kN/m ² .
CBR	represents California Bearing Ratio test
B	represents large bulk disturbed samples
D	represents small disturbed sample
A	represents amber jar contamination sample
V	represents vial contamination sample
W	represents water sample
	represents water strike
	represents level to which water rose

A2.4 DESCRIPTION OF SOILS AND ROCKS

A2.4.1 General

The procedures and principles given in ISO 14688 Parts 1 and 2, ref 9.9, and ISO 14689, ref 9.10, supplemented by section 6 of BS 5930, ref. 9.4 have been used in the descriptions of soils and rocks contained within this report.

	Contract Name: Arundel Street, Manchester			Client: Logik Developments Ltd.			Borehole ID: BHA		
	Contract Number: 42028	Date Started: 31/01/2017	Logged By: BL	Checked By: HH	Status: DRAFT				
Cable Percussion Borehole Log	Easting: 382792.4	Northing: 397379.5	Ground Level: 30.51mOD	Plant Used:	Print Date: 09/03/2017	Scale: 1:50			
	Weather:			Termination: Terminated at 1.00m due to possible asbestos.					
Samples & In Situ Testing			Strata Details					Groundwater	
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description		Water Strike	Backfill/ Installation
0.20	D2		30.41	0.10		MADE GROUND: Tarmacadam.		1	
0.20	ES1			(0.30)		MADE GROUND: Black, gravelly, fine to coarse SAND			
0.50	D4		30.11	0.40		Gravel is angular to subangular, fine to coarse including sandstone and brick with regular cobble content of brick.			
0.50	ES3			(0.60)		MADE GROUND: Black, gravelly, fine to coarse SAND.			
0.80 - 1.00	B5					Gravel is angular to subangular, fine to coarse including slate, brick and possible asbestos.			
			29.51	1.00		End of Borehole at 1.00m			
								2	
								3	
								4	
								5	
								6	
								7	
								8	
								9	
								10	
Start & End of Shift Observations			Borehole Diameter		Casing Diameter		Remarks:		
Date	Time	Depth (m)	Casing (m)	Water (m)	Depth (m)	Dia (mm)	Depth (m)	Dia (mm)	Service inspection pit hand excavated from GL to 1.00m. Asbestos suspected in base of hand pit. Relocated to BHAA.
31-01-2017	10:00	1.00							
Chiselling			Installation		Water Strikes				
From (m)	To (m)	Duration	Remarks	Top (m)	Base (m)	Type	Dia (mm)	Strike (m)	Casing (m)
								Sealed (m)	Time (mins)
								Rose to (m)	Remarks
IFA CP Template Issue Number: 5a Issue Date: 30/11/16									

	Contract Name: Arundel Street, Manchester			Client: Logik Developments Ltd.			Borehole ID: BHAA		
	Contract Number: 42028	Date Started: 02/02/2017	Logged By: BL	Checked By: HH	Status: DRAFT				
Cable Percussion Borehole Log	Easting: 382791.6	Northing: 397379.0	Ground Level: 30.50mOD	Plant Used:	Print Date: 09/03/2017	Sheet 1 of 1 Scale: 1:50			
	Weather:		Termination:		SPT Hammer: N/R, Energy Ratio: N/R				
Samples & In Situ Testing			Strata Details					Groundwater	
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description		Water Strike	Backfill/Installation
			30.45	0.05		MADE GROUND: Tarmacadam.			
				(1.15)		MADE GROUND: Black, gravelly, fine to coarse SAND. Gravel is angular to subangular, fine to coarse including brick, slate, ash and metal fragments.		1	
1.20	B1 ES2	SPT(C) N=6 (2,1/2,1,1,2)	29.30	1.20		MADE GROUND: Loose, black, gravelly, fine to coarse SAND. Gravel is angular to subangular, fine to coarse including brick, slate, ash and metal fragments.			
1.20 - 1.65									
1.50									
2.00	B3	SPT(C) N=9 (1,2/2,2,3,2)		(1.80)				2	
2.00 - 2.45									
2.50	ES4								
3.00	B5 D6 D7	SPT(S) N=23 (5,6/6,6,6,5)	27.50	3.00		Medium dense, orangish brown, gravelly SAND.		3	
3.00 - 3.45									
3.00 - 3.45									
3.50				(1.00)					
			26.50	4.00		End of Borehole at 4.00m		4	
								5	
								6	
								7	
								8	
								9	
								10	
Start & End of Shift Observations			Borehole Diameter		Casing Diameter		Remarks:		
Date	Time	Depth (m)	Casing (m)	Water (m)	Depth (m)	Dia (mm)	Depth (m)	Dia (mm)	
02-02-2017	15:00	4.00	3.00		4.00	150	3.00	150	Service inspection pit hand excavated from GL to 1.20m. Metal object detected at 4.00m. Directed to terminate borehole by UXO supervisor.
							Water Strikes		
Chiselling			Installation		Strike (m) Casing (m) Sealed (m) Time (mins) Rose to (m) Remarks				
From (m)	To (m)	Duration	Remarks	Top (m)	Base (m)	Type	Dia (mm)		
IFA CP Template Issue Number: 5a Issue Date: 30/11/16									

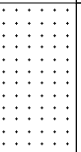
IAN FARMER ASSOCIATES						Contract Name: Arundel Street, Manchester				Client: Logik Developments Ltd.				Borehole ID: BHAB			
Rotary Core Drilling Log						Contract Number: 42028		Date Started: 02/02/2017		Logged By: BL		Checked By: HH		Status: DRAFT		Sheet 1 of 2	
						Easting: 382792.3		Northing: 397377.0		Ground Level: 30.52mOD		Plant Used:		Print Date: 09/03/2017		Scale: 1:50	
Weather:						Termination:											
Coring Details						Strata Details										Groundwater	
Depth	TCR	SCR	RQD	Fracture Spacing	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description						Water Strike	Backfill/ Installation		
					30.47	0.05		MADE GROUND: TARMACADAM MADE GROUND: Black, gravelly, fine to coarse SAND. Gravel is angular to subangular, fine to coarse including brick, slate, ash and metal fragments.									
						(1.75)								1			
					28.72	1.80		Boulder CLAY (Driller's description based on flush return).						2			
						(1.90)								3			
					26.82	3.70		Orangish brown, gravelly SAND (Driller's description based on flush returns).						4			
						(1.50)								5			
					25.32	5.20		Red SANDSTONE (driller's description based on flush returns).									
						(0.80)											
					24.52	6.00		Zone of no recovery. Assumed to be reddish brown SANDSTONE.						6			
						(2.20)								7			
-6.00 - 8.00	0	0	0	NR													
					22.32	8.20		Very weak, thinly bedded, reddish brown, fine and medium grained SANDSTONE. Distinctly weathered with 20-300mm bands of light brown colouration. With rare inclusions of fine and medium , rounded gravel of quartz. Between 8.20m and 8.30m: non intact. Between 8.30m and 8.80m: closely spaced, 45-60 degrees planar smooth, tight to moderately wide, infilled with firm, red brown CLAY and stained grey on fracture surfaces. Between 8.80m and 11.00m: closely spaced 5-20 degrees planar and undulating, rough clean.						8			
														9			
-8.00 - 11.00	92	69	43														
														10			
Start & End of Shift Observations					Borehole Diameter				Casing Diameter				Remarks:				
Date	Time	Depth (m)	Casing (m)	Water (m)	Depth (m)	Dia (mm)	Depth (m)	Dia (mm)	Service inspection pit hand excavated from GL to 1.20m.								
					17.00	92	6.00	121									
									Water Strikes								
									Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks			
									7.50			0					
Flush Information					Installation												
Top (m)	Base (m)	Flush Type	Return	Flush Colour	Top (m)	Base (m)	Type	Dia (mm)									
					0.00	0.50	PLAIN		Fracture spacing as FI or Min, Average and Max in mm. TCR, SCR and RQD reported in %								
					0.50	2.50	SLOTTED		IFA RC Issue Number: 2 Issue Date: 13/07/16								

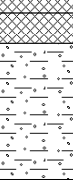
[illegible]

		Contract Name: Arundel Street, Manchester		Client: Logik Developments Ltd.		Borehole ID: BHB								
		Contract Number: 42028	Date Started: 02/02/2017	Logged By: BL	Checked By: HH	Status: DRAFT	Sheet 1 of 2							
Cable Percussion Borehole Log		Easting: 382831.1		Northing: 397388.2		Ground Level: 31.16mOD		Plant Used:		Print Date: 09/03/2017		Scale: 1:50		
		Weather:		Termination:				SPT Hammer: N/R, Energy Ratio: N/R						
Samples & In Situ Testing					Strata Details					Groundwater				
Depth	Sample ID	Test Result			Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description			Water Strike	Backfill/ Installation		
0.20	D2	105 blows. 100% recovery			31.06	0.10		MADE GROUND: Tarmacadam.						
0.20	ES1				30.76	(0.30)		MADE GROUND: Greyish gravelly, fine to coarse SAND. Gravel is angular to subangular, fine to coarse including roadstone.						
0.50	D4				30.76	0.40			MADE GROUND: Black, gravelly, medium and coarse SAND. Gravel is angular to subangular, fine to coarse including brick, concrete and ash.					
0.50	ES3				30.36	(0.40)			Gravel is angular to subangular, fine to coarse including brick, concrete and ash.					
0.50 - 1.00	B5				30.36	0.80			Soft, brown, slightly sandy CLAY.					
1.00	D7				(0.80)	29.56			Red SANDSTONE recovered as red, fine to coarse sand.					
1.00	ES6													
1.20 - 1.65	U8													
1.70	D9				SPT(S) 50 (25 for 50mm/50 for 35mm)	1.60		(1.40)	Very weak, thinly bedded, reddish brown, with occasional light brown bands, fine and medium grained SANDSTONE. Distinctly weathered.					
2.00	B10 D11													
2.00 - 2.08														
2.00 - 2.08														
3.00 - 4.80	88	80	57	NR	28.16	3.00		Assumed as SANDSTONE.						
				27.96	3.20	Between 3.00m and 3.20m: assumed zone of no recovery.								
						Very weak, thinly bedded, reddish brown, with occasional light brown bands, fine and medium grained SANDSTONE. Distinctly weathered.								
						Between 3.20m and 4.80m: closely spaced, 10-15 degrees, planar rough tight clean.								
						Between 4.80m and 5.10m: Extremely closely spaced, 0-10 degrees, undulating, rough, tight clean.								
						Between 5.10m and 7.80m: closely spaced, 10-20 degrees, planar, rough, tight clean.								
4.80 - 7.80	100	95	62	8	(4.60)		Assumed as SANDSTONE.							
												Between 7.80m and 8.00m: assumed zone of no recovery.		
												Weak, thinly bedded, reddish brown, medium and coarse SANDSTONE. Distinctly weathered.		
												Between 8.00m and 8.20m: closely spaced, 35-45 degrees, planar, open infilled with stiff red brown clay.		
												Very weak, and locally weak, thinly bedded, reddish brown, fine and medium grained SANDSTONE. Distinctly weathered.		
												Between 8.20m and 10.60m: closely spaced, 10-25 degrees planar, rough, tight clean.		
7.80 - 10.80	85	69	50	NR	23.36	7.80		Assumed as SANDSTONE.						
				10	23.16	8.00		Weak, thinly bedded, reddish brown, medium and coarse SANDSTONE. Distinctly weathered.						
					22.96	8.20		Between 8.00m and 8.20m: closely spaced, 35-45 degrees, planar, open infilled with stiff red brown clay.						
								Very weak, and locally weak, thinly bedded, reddish brown, fine and medium grained SANDSTONE. Distinctly weathered.						
														
	TCR	SCR	RQD	Fracture										
Start & End of Shift Observations					Borehole Diameter		Casing Diameter		Remarks:					
Date	Time	Depth (m)	Casing (m)	Water (m)	Depth (m)	Dia (mm)	Depth (m)	Dia (mm)						
06-02-2017	08:00	2.09	3.00	2.20	2.09	150	1.70	150	Service inspection pit hand excavated from GL to 1.20m.					
02-02-2017	15:00	2.85	1.70		13.80	92	3.00	121						
									Water Strikes					
									Strike (m) Casing (m) Sealed (m) Time (mins) Rose to (m) Remarks					
Chiselling					Installation									
From (m)	To (m)	Duration	Remarks		Top (m)	Base (								

		Contract Name: Arundel Street, Manchester				Client: Logik Developments Ltd.				Borehole ID: BHB				
		Contract Number: 42028		Date Started: 02/02/2017		Logged By: BL		Checked By: HH				Status: DRAFT		
Rotary Core Drilling Log		Easting: 382831.1		Northing: 397388.2		Ground Level: 31.16mOD		Plant Used:		Print Date: 09/03/2017		Scale: 1:50		
Weather:				Termination:				SPT Hammer: N/R, Energy Ratio: N/R						
Coring Details					Strata Details							Groundwater		
Depth	TCR	SCR	RQD	Fracture Spacing	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description			Water Strike	Backfill/Installation		
				12										
				NR				Between 10.60m and 11.00m: assumed zone of no recovery.						
								Between 11.00m and 13.80m: closely spaced, 5-20 degrees planar, rough, tight clean.			11			
10.80 - 13.80	85	75	42	9		(5.60)					12			
											13			
					17.36	13.80		End of Borehole at 13.80m			14			
											15			
											16			
											17			
											18			
											19			
											20			
Start & End of Shift Observations					Borehole Diameter		Casing Diameter		Remarks:					
Date	Time	Depth (m)	Casing (m)	Water (m)	Depth (m)	Dia (mm)	Depth (m)	Dia (mm)	Service inspection pit hand excavated from GL to 1.20m.					
					2.09	150	1.70	150						
					13.80	92	3.00	121						
									Water Strikes					
									Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks
Flush Information					Installation									
Top (m)	Base (m)	Flush Type	Return	Flush Colour	Top (m)	Base (m)	Type	Dia (mm)						
					0.00	4.00	PLAIN		Fracture spacing as FI or Min, Average and Max in mm. TCR, SCR and RQD reported in %					
					4.00	13.00	SLOTTED		IFA RC Issue Number: 2 Issue Date: 13/07/16					

		Contract Name: Arundel Street, Manchester			Client: Logik Developments Ltd.			Borehole ID: BHC					
		Contract Number: 42028	Date Started: 03/02/2017	Logged By: BL	Checked By: HH	Status: DRAFT	Sheet 1 of 2						
Cable Percussion Borehole Log		Easting: 382847.4	Northing: 397358.4	Ground Level: 31.01mOD	Plant Used:	Print Date: 09/03/2017	Scale: 1:50						
Weather:			Termination:		SPT Hammer: N/R, Energy Ratio: N/R								
Samples & In Situ Testing				Strata Details				Groundwater					
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description	Water Strike	Backfill/ Installation					
0.20	D2	120 blows. 80% recovery	30.91	0.10		MADE GROUND: Tarmacadam.							
0.20	ES1		30.71	0.30		MADE GROUND: Grey, gravelly, medium and coarse SAND. Gravel is angular to subangular, fine to coarse including roadstone.							
0.50	D5		30.41	(0.30)					Brown, gravelly, medium and coarse SAND. Gravel is subrounded to rounded, fine to coarse including mixed lithologies.				
0.50	ES3			0.60						Stiff, brown, slightly sandy CLAY.			
0.50 - 1.00	B4		(1.20)			SANDSTONE recovered as red, fine to coarse sand.							
1.00	D7												
1.00	ES6												
1.20 - 1.65	U8												
1.70	D9	SPT(S) 50 (25 for 35mm/50 for 30mm)	29.21	1.80		Assumed SANDSTONE.							
1.80	D10		(1.20)	Very weak, thinly bedded, reddish brown, fine to coarse grained SANDSTONE. Distinctly weathered. With rare inclusions of fine and medium rounded, quartz gravel.									
2.00	B11 D12												
2.00 - 2.06													
2.00 - 2.06													
3.00 - 5.00	97	75	47	7	(2.93)	Between 3.00m and 3.07m: assumed zone of no recovery.							
						Very weak, thinly bedded, reddish brown, fine to coarse grained SANDSTONE. Distinctly weathered. With rare inclusions of fine and medium rounded, quartz gravel.							
						Between 3.07m and 4.90m: closely spaced, 5-15 degrees, undulating rough, tight to open clean.							
						Between 4.90m and 6.30m: closely spaced, 0-10 degrees, undulating, rough, tight to open clean.							
5.00 - 8.00	79	75	29	5	(5.00)	Very weak, thinly bedded, reddish brown, fine and medium SANDSTONE. Distinctly weathered. With occasional 10-20mm bands of brown colouration.							
						Between 6.30m and 8.00m: closely spaced, 0-15 degrees, planar, strong and smooth, tight clean.							
						Between 8.00m and 8.40m: assumed zone of core loss.							
8.00 - 11.00	100	95	75	NR		Between 8.40m and 11.00m: closely spaced, planar, rough tight clean.							
	TCR	SCR	RQD	Fracture									
Start & End of Shift Observations				Borehole Diameter		Casing Diameter		Remarks:					
Date	Time	Depth (m)	Casing (m)	Water (m)	Depth (m)	Dia (mm)	Depth (m)	Dia (mm)	Service inspection pit hand excavated from GL to 1.20m.				
06-02-2017	08:00	3.00	3.00	1.50	3.00	150	1.70	150					
03-02-2017	15:00	3.00	1.70										
06-02-2017	16:00	8.00	3.00	7.50									
07-02-2017	08:00	8.00	3.00	7.60									
Chiselling				Installation		Water Strikes							
From (m)	To (m)	Duration	Remarks	Top (m)	Base (m)	Type	Dia (mm)	Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks
2.70	3.00	01:00		0.00	0.50	PLAIN		7.60			0		
				0.50	1.50	SLOTTED							
IFA CP Template Issue Number: 5a Issue Date: 30/11/16													

		Contract Name: Arundel Street, Manchester			Client: Logik Developments Ltd.			Borehole ID: BHC							
		Contract Number: 42028	Date Started: 03/02/2017	Logged By: BL	Checked By: HH	Status: DRAFT									
Rotary Core Drilling Log		Easting: 382847.4		Northing: 397358.4		Ground Level: 31.01mOD		Plant Used:		Print Date: 09/03/2017		Scale: 1:50			
Weather:				Termination:				SPT Hammer: N/R, Energy Ratio: N/R							
Coring Details					Strata Details							Groundwater			
Depth	TCR	SCR	RQD	Fracture Spacing	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description				Water Strike	Backfill/ Installation		
11.00 - 13.00	69	65	48	5	20.01	11.00		Very weak, thinly bedded, reddish brown, fine and medium SANDSTONE. Distinctly weathered. With occasional 10-20mm bands of brown colouration.				11			
				NR		Assumed SANDSTONE. Between 11.00m and 11.64m: assumed zone of core loss.									
				12		Very weak, thinly bedded, reddish brown, fine and medium SANDSTONE. Distinctly weathered. Between 11.64m and 12.00m: closely spaced 5-20 degrees, undulating rough, tight to open clean. Between 12.00m and 13.00m: closely spaced 5-10 degrees, planar and undulating, rough tight clean.									
				6											
					18.01	13.00		End of Borehole at 13.00m				13			
												14			
												15			
												16			
												17			
												18			
												19			
												20			
Start & End of Shift Observations					Borehole Diameter		Casing Diameter		Remarks:						
Date	Time	Depth (m)	Casing (m)	Water (m)	Depth (m)	Dia (mm)	Depth (m)	Dia (mm)	Service inspection pit hand excavated from GL to 1.20m.						
					3.00	150	1.70	150							
										Water Strikes					
										Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks
										7.60			0		
Flush Information					Installation										
Top (m)	Base (m)	Flush Type	Return	Flush Colour	Top (m)	Base (m)	Type	Dia (mm)							
					0.00	0.50	PLAIN		Fracture spacing as FI or Min, Average and Max in mm. TCR, SCR and RQD reported in %						
					0.50	1.50	SLOTTED		IFA RC Issue Number: 2 Issue Date: 13/07/16						

	Contract Name: Arundel Street, Manchester				Client: Logik Developments Ltd.			Borehole ID: BHD		
	Contract Number: 42028	Date Started: 30/01/2017	Logged By: BL	Checked By: HH	Status: DRAFT					
	Cable Percussion Borehole Log	Easting: 382814.9	Northing: 397349.2	Ground Level: 1.20mOD	Plant Used:	Print Date: 09/03/2017	Sheet 1 of 1 Scale: 1:50			
Weather:				Termination: BHD Terminated at 1.20m due to positive UXO signal. Relocated as BHDA.						
Samples & In Situ Testing				Strata Details				Groundwater		
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description		Water Strike	Backfill/ Installation	
0.20	ES1		1.10	0.10		MADE GROUND: Tarmacadam.				
0.50	ES2		0.90	0.30		MADE GROUND: Grey, angular to subangular, fine to coarse GRAVEL including roadstone.				
0.50 - 1.00	B3		(0.90)			Soft, brown, slightly gravelly CLAY. Gravel is angular to subangular, fine to coarse including sandstone.				
			0.00	1.20		End of Borehole at 1.20m				
								1		
								2		
								3		
								4		
								5		
								6		
								7		
								8		
								9		
								10		
Start & End of Shift Observations					Borehole Diameter		Casing Diameter		Remarks:	
Date	Time	Depth (m)	Casing (m)	Water (m)	Depth (m)	Dia (mm)	Depth (m)	Dia (mm)	Service inspection pit hand excavated from GL to 1.20m. Metal object detected at 1.20m. Directed to terminate borehole by UXO supervisor. Relocated to BHDA.	
Chiselling					Installation				Water Strikes	
From (m)	To (m)	Duration	Remarks		Top (m)	Base (m)	Type	Dia (mm)	Strike (m)	Casing (m)
									Sealed (m)	Time (mins)
									Rose to (m)	Remarks
IFA CP Template Issue Number: 5a Issue Date: 30/11/16										

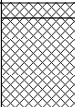
	Contract Name: Arundel Street, Manchester				Client: Logik Developments Ltd.			Borehole ID: BHDA						
	Contract Number: 42028		Date Started: 30/01/2017		Logged By:	Checked By: HH	Status: DRAFT	Sheet 1 of 1						
	Easting: 382812.2		Northing: 397348.3		Ground Level: 30.89mOD		Plant Used:	Print Date: 09/03/2017	Scale: 1:50					
Cable Percussion Borehole Log														
Weather:					Termination:									
Samples & In Situ Testing					Strata Details					Groundwater				
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description				Water Strike	Backfill/Installation			
			30.79	0.10		MADE GROUND: Tarmacadam (driller's description).								
			30.59	0.30		Compact hardcore fill (driller's description).								
			30.39	0.50		Firm, brown, sandy, gravelly CLAY (driller's description).								
						End of Borehole at 0.50m								
										1				
										2				
										3				
										4				
										5				
										6				
										7				
										8				
										9				
										10				
Start & End of Shift Observations					Borehole Diameter		Casing Diameter		Remarks:					
Date	Time	Depth (m)	Casing (m)	Water (m)	Depth (m)	Dia (mm)	Depth (m)	Dia (mm)	Service inspection pit hand excavated from GL to 0.50m. Plastic cable encountered at 0.50m. Pit extended to avoid duct and referenced BHDB.					
Chiselling					Installation				Water Strikes					
From (m)	To (m)	Duration	Remarks		Top (m)	Base (m)	Type	Dia (mm)	Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks
IFA CP Template Issue Number: 5a Issue Date: 30/11/16														

		Contract Name: Arundel Street, Manchester			Client: Logik Developments Ltd.			Borehole ID: BHDB																			
		Contract Number: 42028	Date Started: 30/01/2017	Logged By: BL	Checked By: HH	Status: DRAFT																					
Cable Percussion Borehole Log		Easting: 382812.2		Northing: 397348.3		Ground Level: 30.89mOD		Plant Used:		Print Date: 09/03/2017	Scale: 1:50																
		Weather:		Termination:				SPT Hammer: N/R, Energy Ratio: N/R																			
Samples & In Situ Testing					Strata Details					Groundwater																	
Depth	Sample ID	Test Result			Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description			Water Strike	Backfill/ Installation															
0.90	ES1				30.79	0.10		MADE GROUND: Tarmacadam.																			
					30.59	0.30		MADE GROUND: Grey, angular to subangular, fine to coarse GRAVEL including roadstone.																			
1.20 - 1.65	U2				30.39	0.50		Soft, brown, slightly gravelly CLAY. Gravel is subangular to subrounded, fine to coarse including brick.																			
					(0.40)	Firm, brown, slightly gravelly CLAY. Gravel is subrounded to rounded, fine and medium including sandstone.																					
1.70	D3				29.99	0.90		Brown, sandy, subrounded to rounded, fine and medium GRAVEL including sandstone.			1																
					(0.30)	Stiff, light brown, slightly sandy CLAY.																					
2.00	B4	SPT(S) N=36 (2,4/5,10,10,11)			28.49	2.40		Dense, orangish brown, light grey, slightly silty SAND.			2																
								2.00 - 2.45	D5																		
3.00	B6	SPT(S) 50 (25 for 35mm/50 for 50mm)			27.89	3.00		Red SANDSTONE recovered as medium and coarse sand.			3																
								3.00 - 3.08	D7																		
4.00	B8	SPT(S) 50 (25 for 35mm/50 for 45mm)			26.59	4.30		Assumed SANDSTONE.			4																
								4.00 - 4.08	D9																		
4.30 - 4.50	C4	NR			26.09	4.80		Very weak, thinly bedded, reddish brown, fine and medium SANDSTONE. Distinctly weathered. With closely spaced bands of light brown colouration.			5																
4.30 - 6.80	80	75	39	8	(2.70)		Assumed SANDSTONE.			6																	
6.80 - 9.80	77	95	40	6	(1.35)		Very weak, thinly bedded, reddish brown, fine and medium SANDSTONE. Distinctly weathered. With closely spaced bands of brown colouration.			8																	
				NR	21.64	9.25		Assumed SANDSTONE.			9																
					21.43	9.46		Very weak, thinly bedded, reddish brown with closely spaced bands of light brown, fine and medium SANDSTONE. Distinctly weathered.			10																
TCR					SCR					RQD					Fracture												
Start & End of Shift Observations										Borehole Diameter				Casing Diameter				Remarks:									
Date		Time		Depth (m)		Casing (m)		Water (m)		Depth (m)		Dia (mm)		Depth (m)		Dia (mm)		Service inspection pit hand excavated from GL to 1.20m.									
30-01-2017		16:00		3.00		3.00				4.09		150		4.00		150											
31-01-2017		08:00		3.00		3.00				14.40		92		4.50		121											
02-02-2017		08:00		4.30		4.50																					
Chiselling										Installation				Water Strikes													
From (m)		To (m)		Duration		Remarks		Top (m)		Base (m)		Type		Dia (mm)		Strike (m)		Casing (m)		Sealed (m)		Time (mins)		Rose to (m)		Remarks	
3.80		4.80		01:30				0.20		1.00		PLAIN															
								1.00		3.00		SLOTTED															
IFA CP Template Issue Number: 5a Issue Date: 30/11/16																											

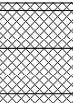
		Contract Name: Arundel Street, Manchester			Client: Logik Developments Ltd.			Borehole ID: BHDB						
		Contract Number: 42028		Date Started: 30/01/2017		Logged By: BL		Checked By: HH		Status: DRAFT				
Rotary Core Drilling Log		Easting: 382812.2		Northing: 397348.3		Ground Level: 30.89mOD		Plant Used:		Print Date: 09/03/2017		Scale: 1:50		
		Weather:			Termination:				SPT Hammer: N/R, Energy Ratio: N/R					
Coring Details					Strata Details							Groundwater		
Depth	TCR	SCR	RQD	Fracture Spacing	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description				Water Strike	Backfill/Installation	
9.80 - 12.80	99	78	39	14		(3.34)	 Very weak, thinly bedded, reddish brown with closely spaced bands of light brown, fine and medium SANDSTONE. Distinctly weathered .					11		
				7										
12.80 - 14.40	95	83	56	NR	18.09	12.80	 Assumed SANDSTONE. Very weak, thinly bedded, reddish brown, fine and medium SANDSTONE. With 10-60mm bands of light brown colouration.					13		
				20	18.02	(0.43)								
				6	17.59	13.30								
				17	(1.10)									
				5										
					16.49	14.40	 Very weak, thinly bedded, light brown, fine and medium SANSTONE. Distinctly weathered.	End of Borehole at 14.40m				14		
												15		
												16		
												17		
												18		
												19		
												20		
Start & End of Shift Observations					Borehole Diameter		Casing Diameter		Remarks:					
Date	Time	Depth (m)	Casing (m)	Water (m)	Depth (m)	Dia (mm)	Depth (m)	Dia (mm)	Service inspection pit hand excavated from GL to 1.20m.					
					4.09	150	4.00	150						
					14.40	92	4.50	121						
									Water Strikes					
									Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks
Flush Information					Installation									
Top (m)	Base (m)	Flush Type	Return	Flush Colour	Top (m)	Base (m)	Type	Dia (mm)						
					0.20	1.00	PLAIN		Fracture spacing as Fl or Min, Average and Max in mm. TCR, SCR and RQD reported in %					
					1.00	3.00	SLOTTED		IFARC Issue Number: 2 Issue Date: 13/07/16					

Contract Name: Arundel Street, Manchester						Client: Logik Developments Ltd.							Borehole ID:																					
									BHE																									
Contract Number: 42028						Date Started: 06/02/2017				Logged By: BL				Checked By: HH				Status: DRAFT				Sheet 1 of 1												
Easting: 382822.4						Northing: 397367.0				Ground Level: 30.80mOD				Plant Used:				Print Date: 09/03/2017				Scale: 1:50												
Weather:						Termination:										SPT Hammer: N/R, Energy Ratio: N/R																		
Samples & In Situ Testing															Strata Details															Groundwater				
Depth		Sample ID		Test Result				Level (mAOD)		Depth (m) (Thickness)		Legend		Strata Description								Water Strike		Backfill/ Installation										
0.20		ES1		SPT(C) N=35 (5,7/7,9,8,11)				29.80		1.00				MADE GROUND: Black, sandy, angular to subangular, fine to coarse GRAVEL with low cobble content includes animal bones, brick and ash with occasional cobble.								1												
0.50 - 1.00		ES3 B4						(1.00)																										
1.00		ES6						29.80		1.00				Compact brick fill (driller's description).								1												
1.20 - 1.65		B7						(0.90)																										
2.00		B8 D9						28.90		1.90				Red SANDSTONE recovered as fine to coarse sand.								2												
2.00 - 2.08 2.00 - 2.08				(1.10)																														
				SPT(S) 50 (25 for 35mm/50 for 40mm)				27.80		3.00				End of Borehole at 3.00m								3												
																						4												
																						5												
																						6												
																						7												
																						8												
																						9												
																						10												
Start & End of Shift Observations															Borehole Diameter				Casing Diameter				Remarks:											
Date	Time	Depth (m)	Casing (m)	Water (m)	Depth (m)	Dia (mm)	Depth (m)	Dia (mm)	Depth (m)	Dia (mm)	Service inspection pit hand excavated from GL to 1.20m.																							
06-02-2017	16:00	1.20	1.20		2.08	150	1.70	150																										
07-02-2017	08:00	1.20	1.20																															
07-02-2017	12:00	2.08	1.70																															
																			Water Strikes															
															Strike (m)		Casing (m)		Sealed (m)		Time (mins)		Rose to (m)		Remarks									
Chiselling					Installation																													
From (m)	To (m)	Duration	Remarks		Top (m)	Base (m)	Type	Dia (mm)																										
2.70	3.00	01:00			0.00	0.50	PLAIN																											
					0.50	1.50	SLOTTED																											
IFA CP Template Issue Number: 5a Issue Date: 30/11/16																																		

	Contract Name: Arundel Street, Manchester			Client: Logik Developments Ltd.			Borehole ID: WS01			
	Contract Number: 42028	Date Started: 01/02/2017	Logged By: BL	Checked By: HH	Status: DRAFT					
Dynamic Sample Borehole Log	Easting: 382802.3		Northing: 397357.6		Ground Level: 30.74mOD		Plant Used:	Print Date: 22/02/2017	Scale: 1:50	
Weather:			Termination: Window samples borehole terminated at 0.50m due to brick obstruction. Relocated to WS01A.							
Samples & In Situ Testing				Strata Details					Groundwater	
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description			Water Strike	Backfill/Installation
0.20	D3		30.73	0.01		MADE GROUND: Tarmacadam.				
0.20	ES1			(0.49)		MADE GROUND: Black, gravelly, fine to coarse SAND of ash with regular cobbles of brick.				
0.20 - 0.50	B2		30.24	0.50		End of Borehole at 0.50m				
0.50	D5									
0.50	ES4									
									1	
									2	
									3	
									4	
									5	
									6	
									7	
									8	
									9	
									10	
Borehole Diameter		Installation				Remarks: Service inspection pit hand excavated from GL to 0.50m. Brick obstruction at 0.50m. Possible old foundation. Relocated to WS01A.				
Depth (m)	Dia (mm)	Depth Top	Base (m)	Dia (mm)	Pipe Type					
Water Strikes										
Depth Strike	Depth Casing	Depth Sealed	Time (mins)	Rose to (m)	Remarks					
IFA DS Template Issue Number: 3 Issue Date: 30-01-16										

		Contract Name: Arundel Street, Manchester			Client: Logik Developments Ltd.		Borehole ID: WS01A		
		Contract Number: 42028	Date Started: 01/02/2017	Logged By: BL	Checked By: HH	Status: DRAFT	Sheet 1 of 1		
Dynamic Sample Borehole Log		Easting: 382803.0	Northing: 397358.2	Ground Level: 30.77mOD	Plant Used:	Print Date: 22/02/2017	Scale: 1:50		
Weather:				Termination: Window sample borehole terminated at 0.70 due to obstruction.					
Samples & In Situ Testing				Strata Details				Groundwater	
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description		Water Strike	Backfill/ Installation
			30.67	0.10		MADE GROUND: Tarmacadam. MADE GROUND: Black, gravelly, fine to coarse SAND with low cobble content. Gravel is angular to subangular, fine to coarse including brick, ash and concrete.			
			30.07	0.70		End of Borehole at 0.70m		1	
								2	
								3	
								4	
								5	
								6	
								7	
								8	
								9	
								10	
Borehole Diameter		Installation		Remarks:					
Depth (m)	Dia (mm)	Depth Top	Base (m)	Dia (mm)	Pipe Type	Service inspection pit hand excavated from GL to 0.70m. Brick obstruction at 0.70m. No alternative position available.			
Water Strikes									
Depth Strike	Depth Casing	Depth Sealed	Time (mins)	Rose to (m)	Remarks				
IFA DS Template Issue Number: 3 Issue Date: 30-01-16									

		Contract Name: Arundel Street, Manchester		Client: Logik Developments Ltd.			Borehole ID: WS02			
		Contract Number: 42028	Date Started: 01/02/2017	Logged By: BL	Checked By: HH	Status: DRAFT				
Dynamic Sample Borehole Log		Easting: 382820.8	Northing: 397357.7	Ground Level: 30.83mOD	Plant Used:	Print Date: 22/02/2017	Sheet 1 of 1 Scale: 1:50			
		Weather:		Termination:		SPT Hammer: N/R, Energy Ratio: N/R				
Samples & In Situ Testing				Strata Details				Groundwater		
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description	Water Strike	Backfill/Installation		
0.30 - 0.50	B1	SPT(S) N=8 (2,2/2,1,2,3)	30.55	0.28		MADE GROUND: Tarmacadam over concrete.	1			
0.50	D3		30.23	0.60		MADE GROUND: Black, gravelly, fine to coarse SAND. Gravel is angular to subangular, fine to coarse including brick and concrete.				
0.50	ES2					Brown, gravelly, medium and coarse SAND with low cobble content. Gravel is subangular to rounded, fine to coarse including sandstone.				
1.00	D5		29.43	1.40		Firm, brown, slightly sandy, slightly gravelly CLAY. Gravel is angular to rounded, fine to coarse including coal, mudstone and sandstone.				
1.00	ES4									
1.20	D6									
1.20	D8									
1.50	ES7		29.03	1.80		Medium dense, reddish brown, fine to coarse SAND with occasional thin bands of grey silt.				
1.50	D9									
1.90	D10		SPT(S) N=13 (2,2/3,3,3,4)	28.53	2.30				Grey, silty, fine to coarse SAND.	
2.00	D11									
2.00	D12									
2.80	D12	SPT(S) 50 (25 for 55mm/50 for 55mm)	28.23	2.60		Red SANDSTONE recovered as brown, fine to coarse sand.				
2.90	D13									
3.00 - 3.11	D13		27.72	3.11		End of Borehole at 3.11m	3			
							4			
							5			
							6			
							7			
							8			
							9			
							10			
Borehole Diameter		Installation		Remarks: Service inspection pit hand excavated from GL to 1.20m. Between 1.20m and 2.00m: recovery = 100%. Between 2.00m and 3.00m: recovery = 80%.						
Depth (m)	Dia (mm)	Depth Top	Base (m)						Dia (mm)	Pipe Type
Water Strikes										
Depth Strike	Depth Casing	Depth Sealed	Time (mins)						Rose to (m)	Remarks
IFA DS Template Issue Number: 3 Issue Date: 30-01-16										

	Contract Name: Arundel Street, Manchester			Client: Logik Developments Ltd.			Borehole ID: WS03		
	Contract Number: 42028	Date Started: 01/02/2017	Logged By:	Checked By: HH	Status: DRAFT	Sheet 1 of 1			
Dynamic Sample Borehole Log	Easting: 382839.7	Northing: 397378.2	Ground Level: 30.89mOD	Plant Used:	Print Date: 22/02/2017	Scale: 1:50			
Weather:		Termination:			SPT Hammer: N/R, Energy Ratio: N/R				
Samples & In Situ Testing				Strata Details				Groundwater	
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description	Water Strike	Backfill/ Installation	
0.10 - 0.30	B1	SPT(S) N=2 (1,0/0,0,0,2)	30.84	0.05		MADE GROUND: Tarmacadam.	1		
0.20	D3		30.59	0.30		MADE GROUND: Black, sandy, angular to subangular, fine and medium GRAVEL including roadstone.			
0.20	ES2		(0.30)	0.60		MADE GROUND: Concrete.			
						MADE GROUND: Loose, brown, angular to subangular, fine to coarse GRAVEL with high cobble content. Gravel includes metal, concrete and brick.			
1.20	D5	SPT(S) 50 (4,15/50 for 140mm)	28.89	(1.40)		Red SANDSTONE, recovered as fine and medium sand.	2		
1.20 - 2.00	D4								
1.20									
2.00 - 2.29	D6		28.60	2.29		End of Borehole at 2.29m	3		
2.00							4		
							5		
							6		
							7		
							8		
							9		
							10		
Borehole Diameter		Installation		Remarks:					
Depth (m)	Dia (mm)	Depth Top	Base (m)	Dia (mm)	Pipe Type	Service inspection pit hand excavated from GL to 1.20m. Between 1.20m and 2.00m: recovery = 5%.			
Water Strikes									
Depth Strike	Depth Casing	Depth Sealed	Time (mins)	Rose to (m)	Remarks				
IFA DS Template Issue Number: 3 Issue Date: 30-01-16									

VARIABLE HEAD PERMEABILITY TEST

Variable Head (Falling) Permeability Test in BHAA

SITE Arundel Street

CONTRACT 42028

BHAA

DEPTH : mBGL

3.50

INITIAL CONDITIONS

Base of Response Zone	3.50	mBGL	Operator	BL
Top of Reponse Zone	3.00	mBGL	Date	02/02/2017
Diameter of casing	150.00	mm	Time	
Height of casing	0.84	mAGL	Weather	
Elevation of Borehole	30.50	mAOD	Calculated	
Groundwater Level	3.50	mBGL	0.50	m

TEST CALCULATION

Elapsed (minutes)	Total seconds	Water Depth (m)	Head (metres)	H/Ho
0.0	0	0.790	3.550	1.000
0.5	30	0.790	3.550	1.000
1.0	60	0.800	3.540	0.997
1.5	90	0.810	3.530	0.994
2.0	120	0.820	3.520	0.992
2.5	150	0.830	3.510	0.989
3.0	180	0.830	3.510	0.989
3.5	210	0.840	3.500	0.986
4.0	240	0.845	3.495	0.985
4.5	270	0.850	3.490	0.983
5.0	300	0.860	3.480	0.980
6.0	360	0.875	3.465	0.976
7.0	420	0.880	3.460	0.975
8.0	480	0.890	3.450	0.972
9.0	540	0.905	3.435	0.968
10.0	600	0.910	3.430	0.966
15.0	900	0.970	3.370	0.949
20.0	1200	1.030	3.310	0.932
25.0	1500	1.065	3.275	0.923
30.0	1800	1.100	3.240	0.913
35.0	2100	1.145	3.195	0.900
40.0	2400	1.210	3.130	0.882
45.0	2700	1.225	3.115	0.877
50.0	3000	1.250	3.090	0.870
55.0	3300	1.285	3.055	0.861
60	3600	1.330	3.010	0.848

Intake Factor, F

$$F = 1.64 \quad (i)$$

Borehole Case d
BS 5930: 1999 Figure 6

Permeability, K

$$K = \frac{A}{F * (t_2 - t_1)} \cdot \ln(H_1/H_2) \quad (ii)$$

L= 0.50 m
D= 0.150 m
L/D= 3.33

t1= 30 s
t2= 3000 s
H1= 3.55 m
H2= 3.09 m

A= 0.01768 m²

F= 1.64 From (i)

K= 5.0435E-07 m/s From (ii)

Remarks

Groundwater level assumed. Borehole dry.

VARIABLE HEAD PERMEABILITY TEST

Variable Head (Falling) Permeability Test in BHB

SITE Arundel Street

CONTRACT 42028

BHB

DEPTH : mBGL

3.5

INITIAL CONDITIONS

Base of Response Zone	3.50	mBGL	Operator	BL
Top of Reponse Zone	3.00	mBGL	Date	02/02/2017
Diameter of casing	150.00	mm	Time	
Height of casing	0.30	mAGL	Weather	
Elevation of Borehole	31.16	mAOD	Calculated	
Groundwater Level	3.50	mBGL	0.50	m

TEST CALCULATION
Intake Factor, F

$$F = 1.64 \quad (i)$$

Borehole Case d
BS 5930: 1999 Figure 6

Permeability, K

$$K = \frac{A}{F * (t_2 - t_1)} \cdot \ln(H_1/H_2) \quad (ii)$$

L= 0.50 m
D= 0.150 m
L/D= 3.33

t1= 30 s
t2= 3600 s
H1= 3.78 m
H2= 3.02 m

A= 0.01768 m²

F= 1.64 From (i)

K= 6.7467E-07 m/s From (ii)

Remarks

Groundwater level assumed. Borehole dry.

Elapsed (minutes)	Total seconds	Water Depth (m)	Head (metres)	H/Ho
0.0	0	0.000	3.800	1.000
0.5	30	0.025	3.775	0.993
1.0	60	0.030	3.770	0.992
1.5	90	0.030	3.770	0.992
2.0	120	0.030	3.770	0.992
2.5	150	0.035	3.765	0.991
3.0	180	0.035	3.765	0.991
3.5	210	0.042	3.758	0.989
4.0	240	0.043	3.757	0.989
4.5	270	0.045	3.755	0.988
5.0	300	0.045	3.755	0.988
6.0	360	0.045	3.755	0.988
7.0	420	0.050	3.750	0.987
8.0	480	0.060	3.740	0.984
9.0	540	0.064	3.736	0.983
10.0	600	0.070	3.730	0.982
15.0	900	0.111	3.689	0.971
20.0	1200	0.194	3.606	0.949
25.0	1500	0.270	3.530	0.929
30.0	1800	0.330	3.470	0.913
35.0	2100	0.410	3.390	0.892
40.0	2400	0.460	3.340	0.879
45.0	2700	0.530	3.270	0.861
50.0	3000	0.610	3.190	0.839
55.0	3300	0.700	3.100	0.816
60	3600	0.780	3.020	0.795

VARIABLE HEAD PERMEABILITY TEST

Variable Head (Falling) Permeability Test in BHC

SITE Arundel Street

CONTRACT 42028

BHC

DEPTH : mBGL

3

INITIAL CONDITIONS

Base of Response Zone	3.00	mBGL	Operator	BL
Top of Reponse Zone	2.00	mBGL	Date	02/02/2017
Diameter of casing	150.00	mm	Time	
Height of casing	0.30	mAGL	Weather	
Elevation of Borehole	31.01	mAOD	Calculated	
Groundwater Level	3.00	mBGL	1.00 m	

TEST CALCULATION
Intake Factor, F

$$F = 2.42 \quad (i)$$

 Borehole Case d
BS 5930: 1999 Figure 6

Permeability, K

$$K = \frac{A}{F * (t_2 - t_1)} \cdot \ln(H_1/H_2) \quad (ii)$$

 L= 1.00 m
D= 0.150 m
L/D= 6.67

 t1= 180 s
t2= 3600 s
H1= 3.30 m
H2= 3.16 m

 A= 0.01768 m²

F= 2.4215 From (i)

K= 8.9305E-08 m/s From (ii)

Remarks

Groundwater level assumed. Borehole dry.

Elapsed (minutes)	Total seconds	Water Depth (m)	Head (metres)	H/Ho
0.0	0	0.000	3.300	1.000
0.5	30	0.000	3.300	1.000
1.0	60	0.000	3.300	1.000
1.5	90	0.000	3.300	1.000
2.0	120	0.000	3.300	1.000
2.5	150	0.005	3.295	0.998
3.0	180	0.005	3.295	0.998
3.5	210	0.007	3.293	0.998
4.0	240	0.008	3.292	0.998
4.5	270	0.010	3.290	0.997
5.0	300	0.020	3.280	0.994
6.0	360	0.025	3.275	0.992
7.0	420	0.030	3.270	0.991
8.0	480	0.030	3.270	0.991
9.0	540	0.034	3.266	0.990
10.0	600	0.035	3.265	0.989
15.0	900	0.050	3.250	0.985
20.0	1200	0.060	3.240	0.982
25.0	1500	0.070	3.230	0.979
30.0	1800	0.083	3.217	0.975
35.0	2100	0.100	3.200	0.970
40.0	2400	0.105	3.195	0.968
45.0	2700	0.110	3.190	0.967
50.0	3000	0.120	3.180	0.964
55.0	3300	0.130	3.170	0.961
60	3600	0.140	3.160	0.958

VARIABLE HEAD PERMEABILITY TEST

Variable Head (Falling) Permeability Test in BHDB

SITE Arundel Street

CONTRACT 42028

BHDB

DEPTH : mBGL

3

INITIAL CONDITIONS

Base of Response Zone	3.00	mBGL	Operator	BL
Top of Reponse Zone	1.20	mBGL	Date	30/01/2017
Diameter of casing	150.00	mm	Time	
Height of casing	0.15	mAGL	Weather	
Elevation of Borehole	30.89	mAOD	Calculated	
Groundwater Level	3.00	mBGL	1.80 m	

TEST CALCULATION

			Elapsed (minutes)	Total seconds	Water Depth (m)	Head (metres)	H/Ho
<u>Intake Factor, F</u>			0.0	0	0.430	2.720	1.000
			0.5	30	0.550	2.600	0.956
			1.0	60	0.680	2.470	0.908
F= 3.56 (i)			1.5	90	0.720	2.430	0.893
			2.0	120	0.810	2.340	0.860
Borehole Case d			2.5	150	0.900	2.250	0.827
BS 5930: 1999 Figure 6			3.0	180	0.960	2.190	0.805
			3.5	210	0.990	2.160	0.794
			4.0	240	1.000	2.150	0.790
			4.5	270	1.010	2.140	0.787
			5.0	300	1.030	2.120	0.779
<u>Permeability, K</u>			6.0	360	1.070	2.080	0.765
K= $\frac{A}{F * (t2 - t1)} \cdot \ln(H1/H2)$ (ii)			7.0	420	1.100	2.050	0.754
			8.0	480	1.160	1.990	0.732
			9.0	540	1.190	1.960	0.721
			10.0	600	1.210	1.940	0.713
			15.0	900	1.310	1.840	0.676
			20.0	1200	1.360	1.790	0.658
			25.0	1500	1.400	1.750	0.643
			30.0	1800	1.440	1.710	0.629
			35.0	2100	1.450	1.700	0.625
			40.0	2400	1.460	1.690	0.621
			45.0	2700	1.490	1.660	0.610
			50.0	3000	1.490	1.660	0.610
			55.0	3300	1.510	1.640	0.603
			60	3600	1.520	1.630	0.599
L= 1.80 m							
D= 0.150 m							
L/D= 12							
t1= 210 s							
t2= 3600 s							
H1= 2.16 m							
H2= 1.63 m							
A= 0.01768 m^2							
F= 3.5582 From (i)							
K= 4.1261E-07 m/s From (ii)							
Remarks							
Groundwater level assumed. Borehole dry.							

>>>> = Flow above detection limit of 30 l/hr, <<< = Negative flow greater than -10 l/hr. >Max = In excess of lower explosive limit.

Gas and Groundwater Monitoring Results

Contract Number:		42028				Gas Monitor:		GA5000				
Contract Name:		Arundel St, Manchester				Readings Taken By:		DM				
Date:		10th March 2017				Checked By:		HH				
Background Readings:		Weather Conditions:				Dull, rain breezy 8c		O ₂ % v/v	CO ₂ % v/v	CH ₄ % v/v	CO ppm	H ₂ S ppm
		Ground Conditions (dry / wet etc):				Wet						
		Atmospheric Pressure (Start):				1019mb		21.3	0.0	0.0	0.0	0.0
		Atmospheric Pressure (Finish):				1018mb						
		Time (Start): 08:15		Time (Finish):		09:30						
Hole No:	VOC ppm	O ₂ % v/v	CO ₂ % v/v	CH ₄ % v/v		CO ppm	H ₂ S ppm	Rel Pressure (mb)	Gas flow Rate (l/hr)	Depth to base of well	SWL	LNAPL or DNAPL
	Steady	Steady	Steady	Peak	Steady	Steady	Steady	Steady	Range	mBGL	mBGL	mBGL
BHAB	0.0	18.7	0.0	0.0	0.0	0	0	-0.24	0.0	2.56	DRY	ND
BHB	0.0	21.1	0.2	0.0	0.0	0	0	-0.02	0.0	12.95	7.25	ND
BHC	0.0	20.1	0.4	0.0	0.0	0	0	-0.36	-0.1	1.70	DRY	ND
BHDB	0.0	20.8	0.2	0.0	0.0	0	0	-0.89	0.0	2.88	2.85	ND
BHE	Car obstructing monitoring position											
>>>> = Flow above detection limit of 30 l/hr, <<< = Negative flow greater than -10 l/hr. >Max = In excess of lower explosive limit.												
Remarks:												

Gas and Groundwater Monitoring Results

Contract Number: 42028						Gas Monitor: GA5000						
Contract Name: Arundel St, Manchester						Readings Taken By: NM						
Date: 30th March 2017						Checked By: HH						
Background Readings:		Weather Conditions:				Dry 12.9 °c		O ₂ %	CO ₂ %	CH ₄ %	CO	H ₂ S
		Ground Conditions (dry / wet etc):				Dry		v/v	v/v	v/v	ppm	ppm
		Atmospheric Pressure (Start):				1011mb		20.8	0.0	0.0	0.0	0.0
		Atmospheric Pressure (Finish):				1011mb						
		Time (Start): 13:15		Time (Finish):		13:55						
Hole No:	VOC ppm	O ₂ % v/v	CO ₂ % v/v	CH ₄ % v/v		CO ppm	H ₂ S ppm	Rel Pressure (mb)	Gas flow Rate (l/hr)	Depth to base of well	SWL	LNAPL or DNAPL
	Steady	Steady	Steady	Peak	Steady	Steady	Steady	Steady	Range	mBGL	mBGL	mBGL
BHAB	Car obstructing monitoring position											
BHB	Car obstructing monitoring position											
BHC	0.0	20.6	0.1	0.0	0.0	0	0	0.00	0.0	1.73	1.65	N/D
BHDB	0.0	20.4	0.3	0.0	0.0	0	0	0.00	0.0	2.90	2.71	N/D
BHE	Car obstructing monitoring position											

>>>> = Flow above detection limit of 30 l/hr, <<< = Negative flow greater than -10 l/hr. >Max = In excess of lower explosive limit.

Remarks:

>>>> = Flow above detection limit of 30 l/hr, <<< = Negative flow greater than -10 l/hr. >Max = In excess of lower explosive limit.

>>>> = Flow above detection limit of 30 l/hr, <<< = Negative flow greater than -10 l/hr. >Max = In excess of lower explosive limit.

>>>> = Flow above detection limit of 30 l/hr, <<< = Negative flow greater than -10 l/hr. >Max = In excess of lower explosive limit.

Remarks:

APPENDIX 3
LABORATORY TESTS

APPENDIX 3

GENERAL NOTES ON LABORATORY TESTS ON SOILS

A3.1 GENERAL

- A3.1.1 Where applicable all tests are carried out in accordance with the relevant British Standard. The laboratory test procedures are as below:

Test Name	Procedures BS1377:1990 Part:Clause
Moisture Content	2:3
Liquid Limit	2:4
Plastic Limit and Plastic Index	2:5
Particle Size Distribution	9:2
Sedimentation	9:4
Sulphate content	3:5
pH Value	3:9
Compaction Test	4:3
California Bearing Ratio	4:7
Consolidation	5:3
Laboratory Vane Tests	7:3*
Triaxial Compression	
Total Stress Single-Stage	7:8
Total Stress Multi-Stage	7:9

Note 1 - BRE Information paper IP4 issued February 1993

* Tests are not included in UKAS accreditation

- A3.1.2 Where an external laboratory carried out testing, their report, including test methods is included in this Appendix.
- A3.1.3 A summary sheet of laboratory test results undertaken by Ian Farmer Laboratories is included, however where copies of the individual test results are required these will be provided on request.
- A3.1.4 Any discussion in this report is based on the values and results obtained from the appropriate tests. Due allowance should be made, when considering any result in isolation, of the possible inaccuracy of any such individual result. Details of the accuracy of results are included in this section, where applicable.

A3.2 MOISTURE CONTENT

- A3.2.1 Unless stated to the contrary, the moisture content of a soil sample was determined by the standard oven drying method, BS 1377, Part 1, Test 3. The result is reported to an accuracy of $\pm 0.5\%$

A3.3 ATTERBERG LIMITS

- A3.3.1 The Liquid Limit, **LL**, is the moisture content at which the soil passes from the liquid to plastic state. Unless stated to the contrary, the Liquid Limit was determined using the four point, cone penetrometer method, Test 4. The value is reported to the nearest whole number, to an accuracy of $\pm 0.5\%$.
- A3.3.2 The Plastic Limit, **PL**, is the moisture content at which soil passes from the plastic to solid state and becomes too dry to remain in a plastic condition. The Plastic Limit was determined using the method described in Test 5. The value is reported to the nearest whole number, to an accuracy of $\pm 0.5\%$.
- A3.3.3 The Plasticity Index, **PI**, is the numerical difference between the liquid and plastic limits, corresponding to the range of moisture contents over which a soil is in a plastic state. The determination of the Plasticity Index is covered by Test 5.

A3.4 SOIL CLASSIFICATION

- A3.4.1 Classification of soils is usually undertaken by means of the Plasticity Classification Chart, sometimes called the A-Line Chart. This is graphical plot of PI against LL with the A-Line defined as $PI = 0.73(LL - 20)$.
- A3.4.2 This line is defined from experimental evidence and does not represent a well defined boundary between soil types, but forms a useful reference datum. When the values of LL and PI for inorganic clays are plotted on the chart they generally lie just above the A-Line in a narrow band parallel to it, while silts and organic clays plot below this line.
- A3.4.3 Clays and silts are divided into five zones of plasticity:
- | | |
|-------------------------------|----------------------|
| Low Plasticity (L) | LL less than 35 |
| Intermediate Plasticity (I) | LL between 35 and 50 |
| High Plasticity (H) | LL between 50 and 70 |
| Very High Plasticity (V) | LL between 70 and 90 |
| Extremely High Plasticity (E) | LL greater than 90 |
- A3.4.4 In general, clays of high plasticity are likely to have a lower permeability, are more compressible and consolidate over a longer period of time under load than clays of low plasticity. Clays of high plasticity are more difficult to compact as fill material.

A3.5 SHEAR STRENGTH TESTS

- A3.5.1 The shear strength tests have been carried out in accordance with the procedures given in BS1377, Part 7.
- The type of test referred to is:
- A3.5.2 U1(100) - Undrained triaxial compression test on single specimen of 100mm diameter at a lateral pressure approximately equal to overburden pressure.
- A3.5.3 UM(100) - Multi-stage undrained triaxial compression test on a specimen of 100mm diameter. An initial low cell pressure is applied and the deviator stress increased until failure is imminent. The cell pressure is then increased and the procedure repeated until the failure stress at three different cell pressures have been determined.
- A3.5.4 U1(38) - Undrained triaxial compression test on a single specimen of 38mm diameter at a lateral pressure approximately equal to overburden pressure.
- A3.5.5 U(38) - Undrained triaxial compression test on set of three specimens of 38mm diameter at three differential lateral pressures.
- A3.5.6 Consolidated undrained triaxial – The Effective Stress Parameters were determined in accordance with the procedure detailed in BS1377: Part 8:1990 Clause 7 and the samples were prepared in accordance with clause 4.
- A3.5.7 Small shearbox – The peak, and in some cases residual, shear stress parameters were determined in accordance with the procedure detailed in BS1377: Part 7: 1990 Clause 4 and the samples were prepared in accordance with clause 4.

A3.6 CHEMICAL TESTS

- A3.6.1 The total sulphate content of soil was determined using the gravimetric method detailed in BS1377: Part 3:1990, Test 5. The results are recorded to an accuracy of $\pm 0.1\%$.
- A3.6.2 The water soluble sulphate content of soil was determined using the gravimetric method detailed in BS1377: Part 3: 1990, Test 5. The results are recorded to an accuracy of $\pm 0.1\text{g/l}$.
- A3.6.3 The sulphate content of groundwater was determined using the gravimetric method detailed in BS1377: Part 3: 1990, Test 5. The results are record to an accuracy of $\pm 0.1\text{g/l}$.
- A3.6.4 The pH value was determined electrometrically using the procedures given in BS 1377: Part 3: 1990, Test 9. The results are recorded to an accuracy of ± 0.1 pH units.
- A3.6.5 The total sulphur content of soil was determined using the ignition in oxygen method detailed in TRL Report 447, Test 4B.
- A3.6.6 The organic content of soil was determined in accordance with the chemical method detailed in BS1377: Part 3:1990 Clause 3. The sample was prepared in accordance with Clause 3.4.2.
- A3.6.7 The organic content of soil was determined in accordance with the loss on ignition method detailed in BS1377: Part 3:1990 Clause 4. The sample was prepared in accordance with Clause 4.3.2.

F.A.O.

Test Report - 42028 /1

Site: Arundel Street, Manchester
Job Number: 42028
Originating Client: Logik Developments Ltd.
Originating Reference: 42028
Date Sampled: Not Given
Date Scheduled: 14/02/2017
Date Testing Started:
Date Testing Finished: 01/03/2017
Remarks:

Authorised By:



Daniel Smith
Laboratory Supervisor

Date: 01/03/2017

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UKAS
TESTING
1464



Site: Arundel Street, Manchester

Job Number: 42028

Client: Logik Developments Ltd.

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Density Tests - Summary of Results

Borehole / Trial Pit	Depth (m)	Sample	Soil Description	Linear Measurement			Remarks
				Bulk density	Dry density	w	
				Mg/m3	Mg/m3	%	
BHB	1.20	U8	Brown sandy gravelly CLAY	2.17	1.84	17.8	

Method of Preparation: BS EN ISO 17892 : Part 1 : 2014 : Clause 5.1. Water content test specimen preparation
BS EN ISO 17892 : Part 2 : 2014 : Clause 5.1. Density by linear measurement method

Method of Test: BS EN ISO 17892 : Part 1 : 2014 : Clause 5.2. Water content test execution
BS EN ISO 17892 : Part 2 : 2014 : Clause 5.1. Density by linear measurement method





Site: Arundel Street, Manchester

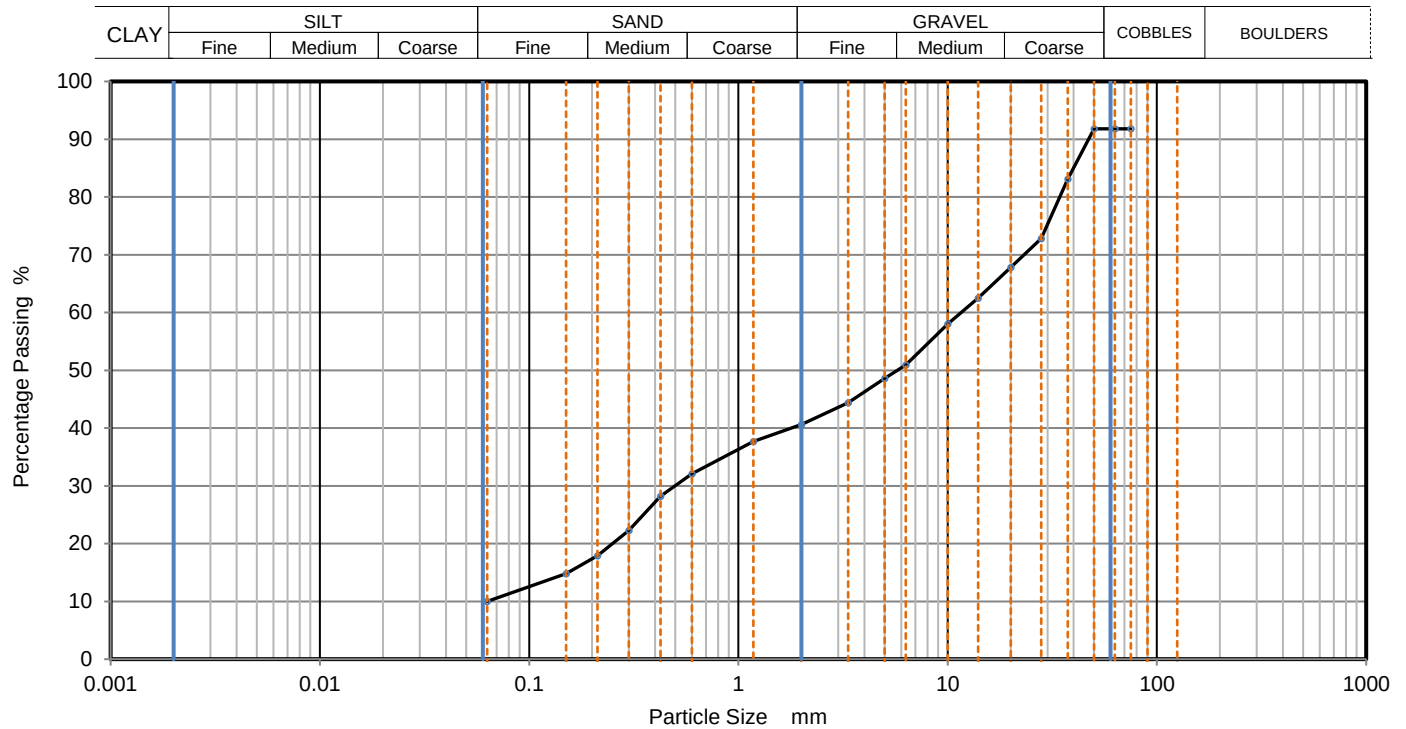
Job Number: 42028

Client: Logik Developments Ltd.

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DETERMINATION OF PARTICLE SIZE DISTRIBUTION

Borehole / Trial Pit	Depth (m)	Sample	Testing Type	Description
BHAA	3.00	B7	Wet Sieve	Brown sandy GRAVEL



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
75	92		
63	92		
50	92		
37.5	83		
28	73		
20	68		
14	63		
10	58		
6.3	51		
5	49		
3.35	44		
2	41		
1.18	38		
0.6	32		
0.425	28		
0.3	22		
0.212	18		
0.15	15		
0.063	10		

Dry Mass of sample, g

7749

Sample Proportions	% dry mass
Very coarse	8
Gravel	51
Sand	31
Fines <0.063mm	10

Grading Analysis	
D100	mm
D60	mm
D30	mm
D10	mm
Uniformity Coefficient	
Curvature Coefficient	

Remarks

Preparation and testing in accordance with BS1377 unless noted below

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

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





Site: Arundel Street, Manchester

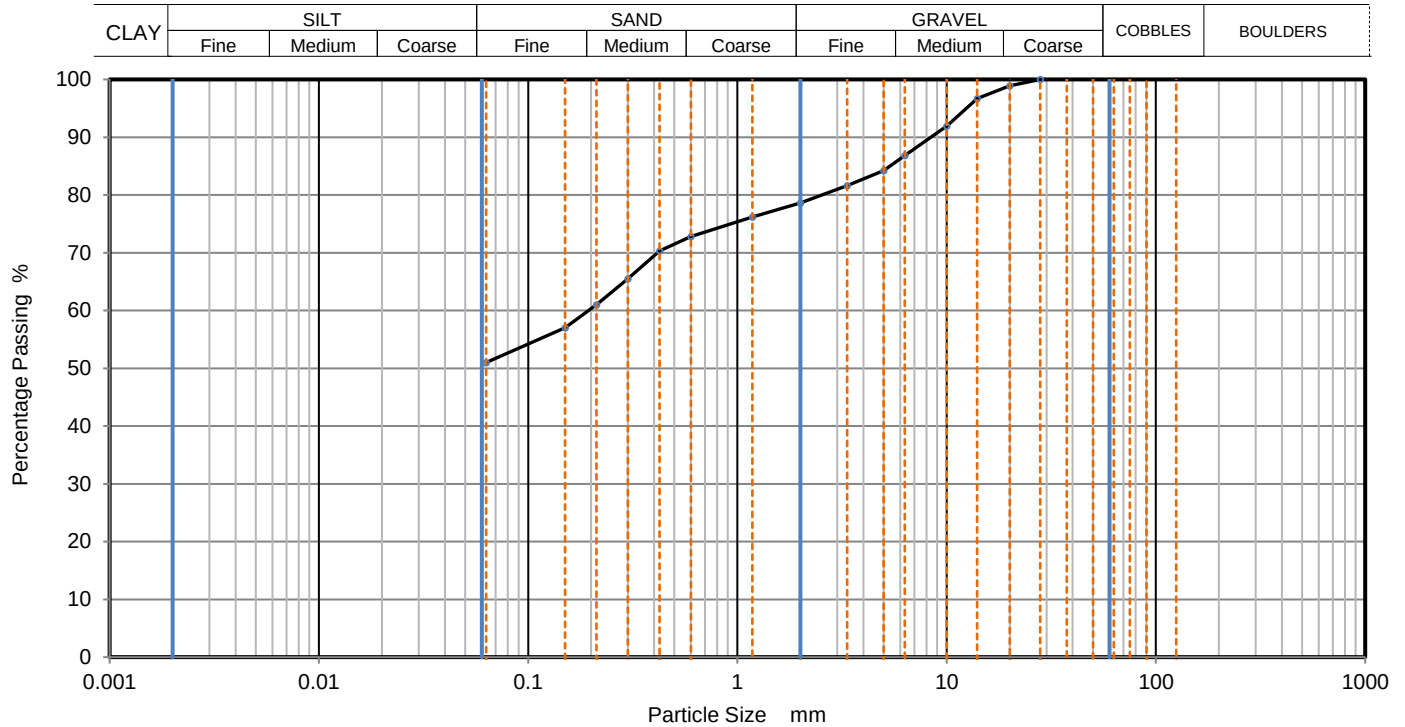
Job Number: 42028

Client: Logik Developments Ltd.

Page: 5

DETERMINATION OF PARTICLE SIZE DISTRIBUTION

Borehole / Trial Pit	Depth (m)	Sample	Testing Type	Description
BHB	0.50	B5	Wet Sieve	Brown sandy gravelly CLAY



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
28	100		
20	99		
14	97		
10	92		
6.3	87		
5	84		
3.35	82		
2	79		
1.18	76		
0.6	73		
0.425	70		
0.3	66		
0.212	61		
0.15	57		
0.063	51		

Dry Mass of sample, g

865

Sample Proportions	% dry mass
Very coarse	0
Gravel	21
Sand	28
Fines <0.063mm	51

Grading Analysis		
D100	mm	28
D60	mm	0.194
D30	mm	
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

Remarks

Preparation and testing in accordance with BS1377 unless noted below

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

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



Site: Arundel Street, Manchester

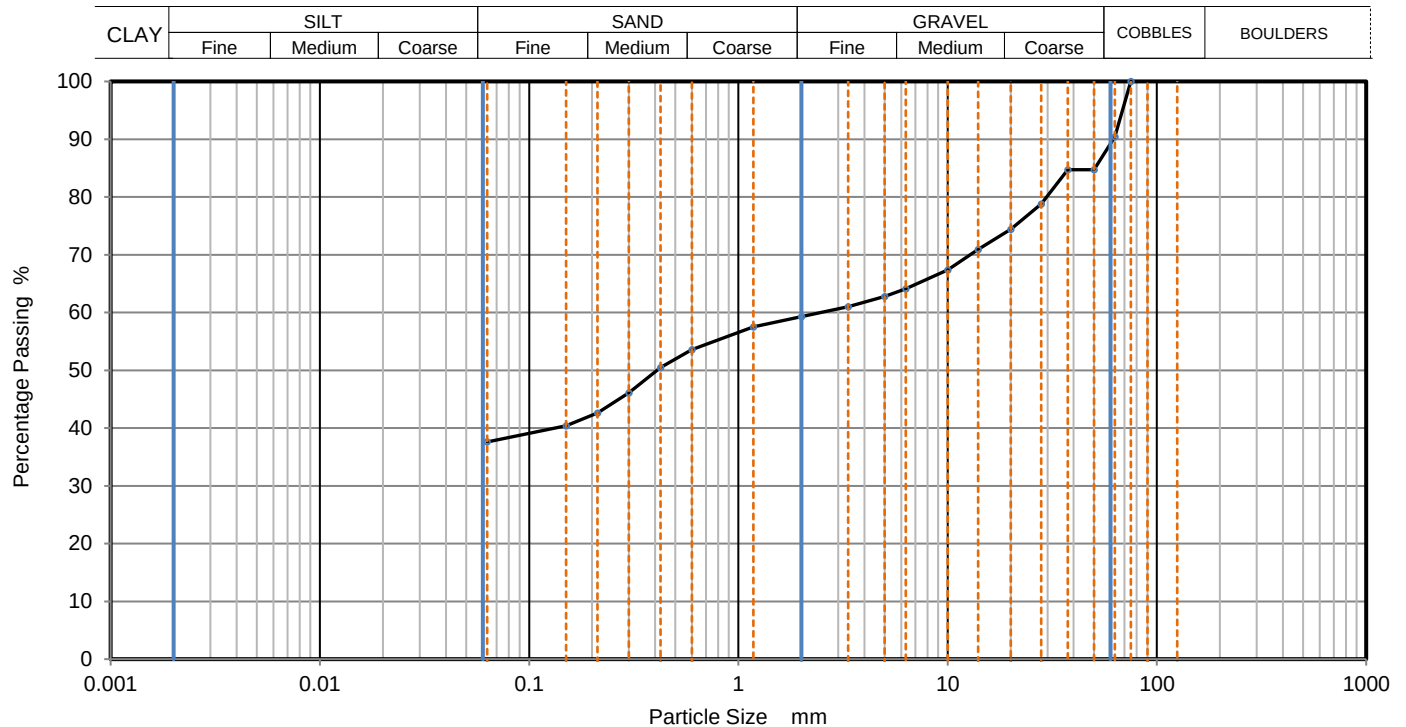
Job Number: 42028

Client: Logik Developments Ltd.

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DETERMINATION OF PARTICLE SIZE DISTRIBUTION

Borehole / Trial Pit	Depth (m)	Sample	Testing Type	Description
BHC	0.50	B4	Wet Sieve	Brown sandy gravelly CLAY



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
75	100		
63	90		
50	85		
37.5	85		
28	79		
20	74		
14	71		
10	67		
6.3	64		
5	63		
3.35	61		
2	59		
1.18	58		
0.6	54		
0.425	51		
0.3	46		
0.212	43		
0.15	40		
0.063	38		

Dry Mass of sample, g

5432

Sample Proportions	% dry mass
Very coarse	10
Gravel	31
Sand	22
Fines <0.063mm	38

Grading Analysis	
D100	mm
D60	mm
D30	mm
D10	mm
Uniformity Coefficient	
Curvature Coefficient	

Remarks

Preparation and testing in accordance with BS1377 unless noted below

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

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



Site: Arundel Street, Manchester

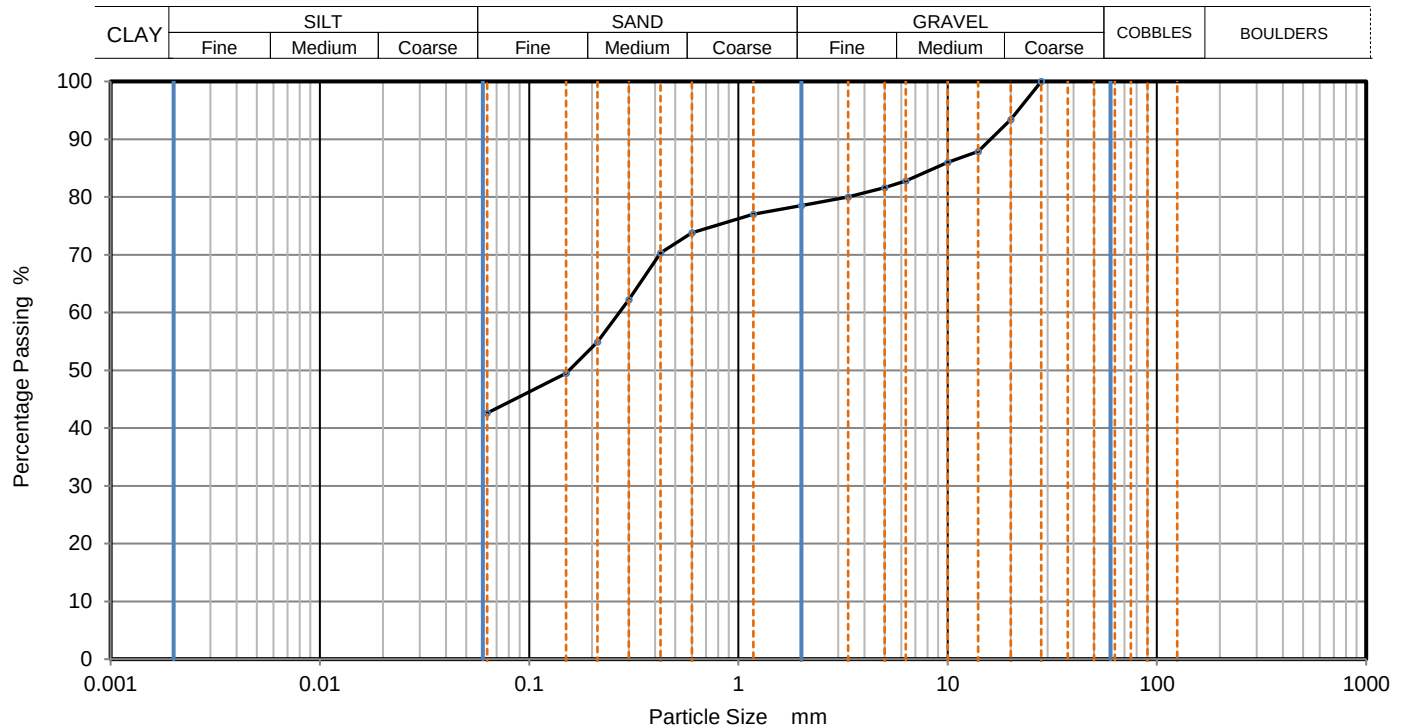
Job Number: 42028

Client: Logik Developments Ltd.

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DETERMINATION OF PARTICLE SIZE DISTRIBUTION

Borehole / Trial Pit	Depth (m)	Sample	Testing Type	Description
BHD	0.50	B3	Wet Sieve	Brown sandy gravelly CLAY



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
28	100		
20	93		
14	88		
10	86		
6.3	83		
5	82		
3.35	80		
2	79		
1.18	77		
0.6	74		
0.425	70		
0.3	62		
0.212	55		
0.15	50		
0.063	43		

Dry Mass of sample, g

1123

Sample Proportions	% dry mass
Very coarse	0
Gravel	22
Sand	36
Fines <0.063mm	43

Grading Analysis		
D100	mm	28
D60	mm	0.27
D30	mm	
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

Remarks

Preparation and testing in accordance with BS1377 unless noted below

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

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

Site: Arundel Street, Manchester

Job Number: 42028

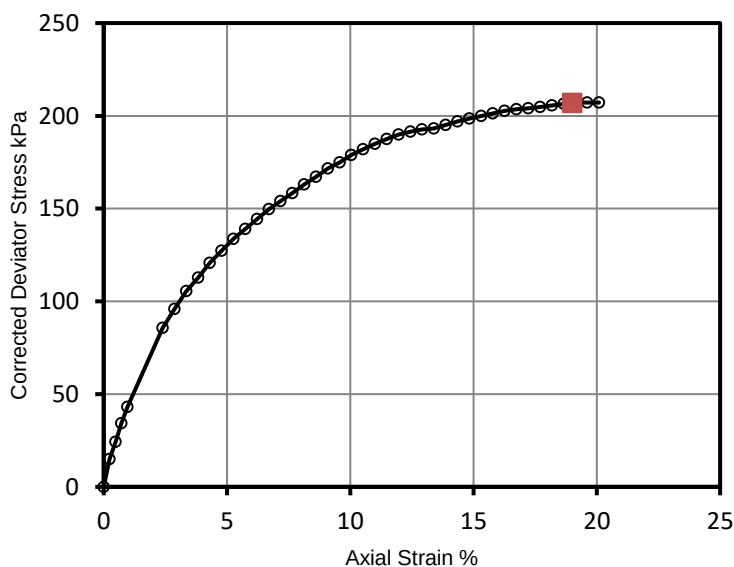
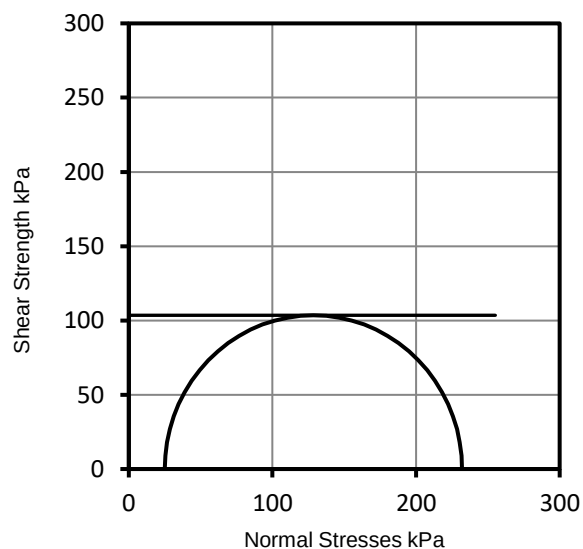
Client: Logik Developments Ltd.

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Unconsolidated Undrained Triaxial Compression Test without measurement of pore pressure - single specimen (Definitive Method)

Borehole / Trial Pit	Depth (m)	Sample	Description
BHDB	1.20	U2	Brown sandy gravelly CLAY

Initial Sample	Test Number	1
	Original Length (mm)	450.00
	Depth from Top (mm)	24.81
	Condition	Undisturbed
	Orientation	Vertical
Length (mm)		209.05
Diameter (mm)		101.03
Moisture Content (%)		19.50
Bulk Density (Mg/m ³)		2.22
Dry Density (Mg/m ³)		1.86
Membrane Thickness (mm)		0.24
Membrane Type		Latex
Rate of Strain (%/min)		1.9
Test Results	Cell Pressure (kPa)	25
	Axial Strain (%)	19
	Membrane Corr. (kPa)	0.88
	Deviator Stress, $(\sigma_1 - \sigma_3) f$ (kPa)	207
	Undrained Shear Strength, $c_u = \frac{1}{2}(\sigma_1 - \sigma_3) f$ (kPa)	104
	Mode of Failure	Plastic

Deviator Stress v Axial Strain

Mohr Circles


Deviator stress corrected for area change and membrane effects

Mohr circles and their interpretation is not covered by BS1377. This is provided for information only.

Method of Preparation:

BS 1377:PT1:1990:8.3 Preparation of undisturbed samples for testing or
BS 1377:PT1:1990:7.7.5.2 Preparation of disturbed samples for testing

Method of Test:

BS 1377:PT2:1990:7.2 Determination of density by linear measurement.
BS 1377:PT7:1990:8.4 Determination of undrained shear strength in triaxial compression without measurement of pore pressure (Definitive method)



Test Report - 42028 /1

Site: Arundel Street, Manchester

Job Number: 42028

Originating Client: Logik Developments Ltd.

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

Date: 01/03/2017

F.A.O.

Test Report - 42028R /2

Site: Arundel Street, Manchester
Job Number: 42028R
Originating Client: Logik Developments Ltd.
Originating Reference: 42028
Date Sampled: Not Given
Date Scheduled: 24/02/2017
Date Testing Started:
Date Testing Finished:
Remarks:

Authorised By:



Laboratory Supervisor
Daniel Smith

Date: 02/03/2017

Page. 1

Site: Arundel Street, Manchester

Job Number: 42028R

Client: Logik Developments Ltd.

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Point Load Strength Index Tests Summary of Results

Borehole No.	Depth m	Sample	Rock Type and Test condition	Test Type see ISRM		Failure Valid (Y/N)	Dimensions				Force P kN	Equivalent diameter, De mm	Point Load Strength Index		Remarks (including water content if measured)
				Type (D, A, I, B)	Direction (L, P or U)		Lne mm	W mm	Dps mm	Dps' mm			Is MPa	Is (50) MPa	
BHAB	8.83	C8	Brown sandstone As received	A	U	NO		85.9	84.0	79.0	1.9	95.8	0.2	0.3	
BHAB	9.00	C9	Brown sandstone As received	D	U	NO	55.6	86.2	86.2	83.2	1.5	86.2	0.2	0.3	
BHAB	9.00	C9	Brown sandstone As received	A	U	YES		86.3	57.0	53.0	2.2	79.1	0.4	0.4	
BHAB	11.18	C11	Brown sandstone As received	A	U	NO		86.5	126.0	111.0	1.6	117.8	0.1	0.2	
BHAB	11.54	C12	Brown sandstone As received	D	U	YES	64.0	85.3	85.3	83.3	1.3	85.3	0.2	0.2	
BHAB	11.54	C12	Brown sandstone As received	A	U	YES		85.3	64.0	61.0	1.3	83.4	0.2	0.2	
BHAB	12.28	C14	Brown sandstone As received	A	U	YES		86.3	75.0	65.0	2.5	90.8	0.3	0.4	
BHAB	13.28	C15	Brown sandstone As received	D	U	YES	72.0	86.4	86.4	84.4	1.6	86.4	0.2	0.3	
BHAB	13.28	C15	Brown sandstone As received	A	U	YES		86.5	71.0	47.0	1.6	88.4	0.2	0.3	
BHAB	14.06	C16	Brown sandstone As received	A	U	NO		86.5	80.0	61.0	1.8	93.9	0.2	0.3	
BHAB	14.90	C17	Brown sandstone As received	D	U	YES	64.7	85.8	85.8	82.8	1.0	85.8	0.1	0.2	
BHAB	14.90	C17	Brown sandstone As received	A	U	NO		86.1	55.0	46.0	1.2	77.7	0.2	0.2	
BHAB	15.37	C19	Brown sandstone As received	A	U	YES		86.7	85.0	79.0	1.8	96.8	0.2	0.3	
BHAB	15.67	C20	Brown sandstone As received	D	U	YES	86.0	86.1	86.1	84.1	1.3	86.1	0.2	0.2	
BHAB	15.67	C20	Brown sandstone As received	A	U	YES		86.4	75.0	67.0	1.7	90.8	0.2	0.3	
BHB	3.21	C12	Brown sandstone As received	A	U	NO		85.2	84.0	70.0	0.8	95.4	0.1	0.1	
BHB	3.67	C13	Brown sandstone As received	D	U	YES	59.1	85.6	85.6	83.6	0.7	85.6	0.1	0.1	
BHB	3.67	C13	Brown sandstone As received	A	U	YES		85.6	61.0	54.0	0.8	81.5	0.1	0.2	
BHB	4.14	C14	Brown sandstone As received	A	U	YES		85.8	71.0	68.0	0.5	88.1	0.1	0.1	
BHB	4.52	C15	Brown sandstone As received	A	U	YES		86.7	95.0	90.0	1.0	102.4	0.1	0.1	

Test Type

D - Diametral, A - Axial, I - Irregular Lump, B - Block

Direction

L - parallel to planes of weakness

P - perpendicular to planes of weakness

U - unknown or random

Dimensions

Dps - Distance between platens (platen separation)

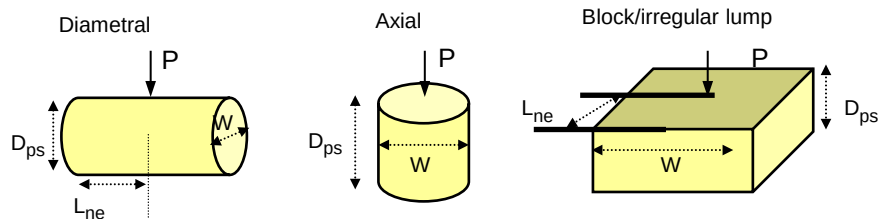
Dps' - at failure (see ISRM note 6)

Lne - Length from platens to nearest free end

W - Width of shortest dimension perpendicular to load, P

Size factor, $F = (De/50)0.45$ for all tests.

Detailed legend for test and dimensions, based on ISRM


Method of Preparation: ISRM 2007 Suggested method for point load strength index (pages 125 - 132)

Method of Test: ISRM 2007 Suggested method for point load strength index (pages 125 - 132)

Site: Arundel Street, Manchester

Job Number: 42028R

Client: Logik Developments Ltd.

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Point Load Strength Index Tests Summary of Results

Borehole No.	Depth m	Sample	Rock Type and Test condition	Test Type see ISRM		Failure Valid (Y/N)	Dimensions				Force P kN	Equivalent diameter, De mm	Point Load Strength Index		Remarks (including water content if measured)
				Type (D, A, I, B)	Direction (L, P or U)		Lne mm	W mm	Dps mm	Dps' mm			Is MPa	Is (50) MPa	
BHB	4.52	C15	Brown sandstone As received	A	U	YES		86.3	86.0	82.0	1.0	97.2	0.1	0.1	
BHB	5.12	C16	Brown sandstone As received	A	U	NO		85.1	121.0	112.0	0.8	114.5	0.1	0.1	
BHB	5.89	C17	Brown sandstone As received	D	U	YES	44.0	84.2	84.2	81.2	0.4	84.2	0.1	0.1	
BHB	5.89	C17	Brown sandstone As received	A	U	YES		84.3	46.0	36.0	0.6	70.2	0.1	0.1	
BHB	6.10	C18	Brown sandstone As received	A	U	NO		85.2	84.0	76.0	0.8	95.5	0.1	0.1	
BHB	6.91	C19	Brown sandstone As received	D	U	YES	43.9	86.6	86.6	83.6	0.8	86.6	0.1	0.1	
BHB	6.91	C19	Brown sandstone As received	A	U	YES		86.7	45.0	40.0	0.7	70.5	0.1	0.2	
BHB	8.26	C21	Brown sandstone As received	A	U	NO		86.7	65.0	32.0	0.5	84.7	0.1	0.1	
BHB	8.57	C22	Brown sandstone As received	D	U	YES	66.7	85.9	85.9	82.9	1.1	85.9	0.2	0.2	
BHB	8.57	C22	Brown sandstone As received	A	U	YES		86.0	70.0	54.0	1.2	87.5	0.2	0.2	
BHB	9.08	C23	Brown sandstone As received	A	U	YES		86.3	80.0	73.0	0.9	93.8	0.1	0.1	
BHB	9.74	C24	Brown sandstone As received	D	U	YES	79.1	86.2	86.2	83.2	0.7	86.2	0.1	0.1	
BHB	9.74	C24	Brown sandstone As received	A	U	YES		85.9	80.0	68.0	1.5	93.6	0.2	0.2	
BHB	10.05	C25	Brown sandstone As received	A	U	YES		86.3	86.0	70.0	1.6	97.2	0.2	0.2	
BHB	11.24	C26	Brown sandstone As received	D	U	YES	60.9	85.6	85.6	82.6	1.2	85.6	0.2	0.2	
BHB	11.24	C26	Brown sandstone As received	A	U	YES		85.7	60.0	56.0	1.1	80.9	0.2	0.2	
BHB	11.69	C27	Brown sandstone As received	A	U	NO		86.2	101.0	85.0	0.9	105.3	0.1	0.1	
BHB	12.11	C28	Brown sandstone As received	D	U	YES	82.2	86.0	86.0	83.0	1.2	86.0	0.2	0.2	
BHB	12.11	C28	Brown sandstone As received	A	U	YES		86.1	80.0	55.0	1.4	93.6	0.2	0.2	
BHB	13.27	C29	Brown sandstone As received	A	U	YES		86.0	63.0	55.0	1.6	83.1	0.2	0.3	

Test Type

D - Diametral, A - Axial, I - Irregular Lump, B - Block

Direction

L - parallel to planes of weakness

P - perpendicular to planes of weakness

U - unknown or random

Dimensions

Dps - Distance between platens (platen separation)

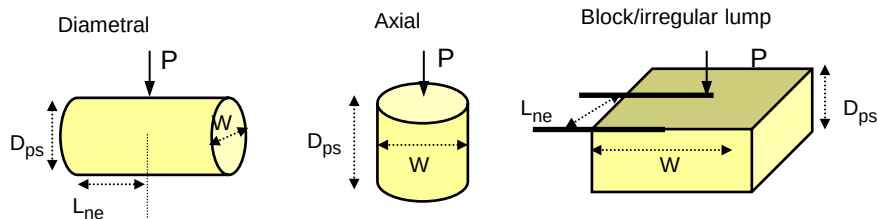
Dps' - at failure (see ISRM note 6)

Lne - Length from platens to nearest free end

W - Width of shortest dimension perpendicular to load, P

Size factor, F = (De/50)0.45 for all tests.

Detailed legend for test and dimensions, based on ISRM


Method of Preparation: ISRM 2007 Suggested method for point load strength index (pages 125 - 132)

Method of Test: ISRM 2007 Suggested method for point load strength index (pages 125 - 132)

Site: Arundel Street, Manchester

Job Number: 42028R

Client: Logik Developments Ltd.

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Point Load Strength Index Tests Summary of Results

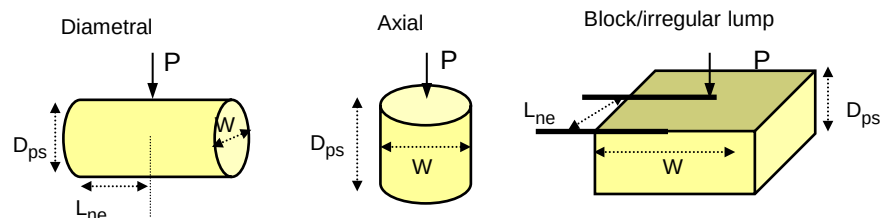
Borehole No.	Depth m	Sample	Rock Type and Test condition	Test Type see ISRM		Failure Valid (Y/N)	Dimensions				Force P kN	Equivalent diameter, De mm	Point Load Strength Index		Remarks (including water content if measured)
				Type (D, A, I, B)	Direction (L, P or U)		Lne mm	W mm	Dps mm	Dps' mm			Is MPa	Is (50) MPa	
BHB	13.76	C30	Brown sandstone As received	D	U	YES	53.4	86.1	86.1	83.1	1.2	86.1	0.2	0.2	
BHB	13.76	C30	Brown sandstone As received	A	U	YES		86.3	52.0	47.0	1.5	75.6	0.3	0.3	
BHC	4.12	C14	Brown sandstone As received	A	U	NO		85.6	85.0	70.0	0.4	96.3	0.0	0.1	
BHC	5.49	C15	Brown sandstone As received	D	U	YES	59.2	85.2	85.2	82.2	0.7	85.2	0.1	0.1	
BHC	5.49	C15	Brown sandstone As received	A	U	YES		85.3	71.0	61.0	1.1	87.8	0.1	0.2	
BHC	7.10	C17	Brown sandstone As received	A	U	NO		85.7	112.0	101.0	1.1	110.5	0.1	0.1	
BHD	4.30	C4	Brown sandstone As received	D	U	NO	92.4	80.3	80.3	77.3	0.2	80.3	0.0	0.0	
BHD	4.30	C4	Brown sandstone As received	A	U	NO		80.3	107.0	75.0	0.6	104.6	0.1	0.1	
BHD	6.70	C5	Brown sandstone As received	A	U	NO		85.3	101.0	70.0	1.2	104.7	0.1	0.2	
BHD	9.10	C7	Brown sandstone As received	D	U	NO	26.7	86.3	86.3	83.3	1.2	86.3	0.2	0.2	
BHD	9.10	C7	Brown sandstone As received	A	U	YES		86.1	35.0	31.0	0.8	62.0	0.2	0.2	
BHD	10.56	C8	Brown sandstone As received	A	U	NO		85.6	115.0	105.0	1.5	111.9	0.1	0.2	
BHD	11.20	C9	Brown sandstone As received	D	U	YES	43.4	85.4	85.4	84.4	1.4	85.4	0.2	0.2	
BHD	11.20	C9	Brown sandstone As received	A	U	YES		85.4	40.0	37.0	0.9	65.9	0.2	0.2	
BHD	13.24	C11	Brown sandstone As received	A	U	YES		85.7	71.0	61.0	1.5	88.0	0.2	0.3	

Test Type
D - Diametral, A - Axial, I - Irregular Lump, B - Block

Direction
L - parallel to planes of weakness
P - perpendicular to planes of weakness
U - unknown or random

Dimensions
Dps - Distance between platens (platen separation)
Dps' - at failure (see ISRM note 6)
Lne - Length from platens to nearest free end
W - Width of shortest dimension perpendicular to load, P
Size factor, $F = (De/50)0.45$ for all tests.

Detailed legend for test and dimensions, based on ISRM



Method of Preparation: ISRM 2007 Suggested method for point load strength index (pages 125 - 132)

Method of Test: ISRM 2007 Suggested method for point load strength index (pages 125 - 132)



Test Report - 42028R /1

Site: Arundel Street, Manchester

Job Number: 42028R

Originating Client: Logik Developments Ltd.

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

Date: 02/03/2017

APPENDIX 4
CHEMICAL TESTS

Certificate of Analysis

Report Number: 631022-1

Date of Report: 15-Feb-2017

Customer: Ian Farmer Associates
14-15 Rufford Court
Hardwick Grange
Warrington
Cheshire
WA1 4RF

Customer Contact: Ms Hannah Hadwin

Customer Job Reference: 42028

Customer Purchase Order: 42231

Customer Site Reference: Arundel Street

Date Job Received at SAL: 30-Jan-2017

Date Analysis Started: 03-Feb-2017

Date Analysis Completed: 15-Feb-2017

The results reported relate to samples received in the laboratory and may not be representative of a whole batch.

Opinions and interpretations expressed herein are outside the scope of UKAS 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

All results have been reviewed in accordance with Section 25 of the SAL Quality Manual



Report checked
and authorised by :
Bianca Prince
Customer Service Manager

Issued by :
Bianca Prince
Customer Service Manager

SAL Reference: 631022								
Project Site: Arundel Street								
Customer Reference: 42028								
Soil			Analysed as Soil					
Heavy Metals(9)								
SAL Reference					631022 010	631022 011	631022 012	631022 013
Customer Sample Reference					BHDB	BHDB	BHA	BHA
Depth					0.50	0.90	0.20	0.50
Date Sampled					30-JAN-2017	30-JAN-2017	30-JAN-2017	30-JAN-2017
Type					Clay	Sandy Soil	Sandy Soil	Sandy Soil
Determinand	Method	Test Sample	LOD	Units				
Arsenic	T6	M40	2	mg/kg	7	8	15	26
Cadmium	T6	M40	1	mg/kg	<1	<1	2	1
Chromium	T6	M40	1	mg/kg	25	12	24	26
Copper	T6	M40	1	mg/kg	24	17	140	130
Lead	T6	M40	1	mg/kg	17	16	480	380
Mercury	T6	M40	1	mg/kg	<1	<1	<1	1
Nickel	T6	M40	1	mg/kg	31	15	24	24
Selenium	T6	M40	3	mg/kg	<3	<3	<3	<3
Zinc	T6	M40	1	mg/kg	61	41	880	620

SAL Reference: 631022							
Project Site: Arundel Street							
Customer Reference: 42028							
Soil				Analysed as Soil			
TPH (CWG) with MTBE, BTEX							
SAL Reference					631022 003	631022 010	631022 013
Customer Sample Reference					WS02	BHDB	BHA
Depth					0.50	0.50	0.50
Date Sampled					01-FEB-2017	30-JAN-2017	30-JAN-2017
Type					Sandy Soil	Clay	Sandy Soil
Determinand	Method	Test Sample	LOD	Units			
Benzene	T209	M105	10	µg/kg	(13) <10	(13) <10	(13) <10
Toluene	T209	M105	10	µg/kg	<10	<10	<10
EthylBenzene	T209	M105	10	µg/kg	<10	<10	<10
M/P Xylene	T209	M105	10	µg/kg	<10	<10	<10
O Xylene	T209	M105	10	µg/kg	<10	<10	<10
Methyl tert-Butyl Ether	T209	M105	10	µg/kg	<10	<10	<10
TPH (C5-C6 aliphatic)	T209	M105	0.100	mg/kg	<0.100	<0.100	<0.100
TPH (C6-C8 aliphatic)	T209	M105	0.10	mg/kg	<0.10	<0.10	<0.10
TPH (C8-C10 aliphatic)	T209	M105	0.10	mg/kg	<0.10	<0.10	<0.10
TPH (C10-C12 aliphatic)	T909	M105	1	mg/kg	(13) <1	(13) <1	(13) <1
TPH (C12-C16 aliphatic)	T909	M105	1	mg/kg	(13) 2	(13) <1	(13) 2
TPH (C16-C21 aliphatic)	T909	M105	1	mg/kg	(13) 3	(13) <1	(13) 4
TPH (C21-C35 aliphatic)	T909	M105	2	mg/kg	(13) 6	(13) <2	(13) 14
TPH (C6-C7 aromatic)	T209	M105	0.10	mg/kg	<0.10	<0.10	<0.10
TPH (C7-C8 aromatic)	T209	M105	0.10	mg/kg	<0.10	<0.10	<0.10
TPH (C8-C10 aromatic)	T209	M105	0.10	mg/kg	0.22	<0.10	<0.10
TPH (C10-C12 aromatic)	T909	M105	2	mg/kg	(13) <2	(13) <2	(13) <2
TPH (C12-C16 aromatic)	T909	M105	1	mg/kg	(13) 15	(13) <1	(13) 7
TPH (C16-C21 aromatic)	T909	M105	1	mg/kg	(13) 56	(13) <1	(13) 35
TPH (C21-C35 aromatic)	T909	M105	1	mg/kg	(13) 80	(13) <1	(13) 80

SAL Reference: 631022										
Project Site: Arundel Street										
Customer Reference: 42028										
Soil					Analysed as Soil					
PAH US EPA 16 (B and K split)										
SAL Reference				631022 002	631022 003		631022 004		631022 006	631022 009
Customer Sample Reference				WS01	WS02		WS02		WS03	BHDB
Depth				0.50	0.50		1.00		0.20	0.20
Date Sampled				01-FEB-2017	01-FEB-2017		01-FEB-2017		01-FEB-2017	30-JAN-2017
Type				Sandy Soil	Sandy Soil		Sandy Soil		Sandy Soil	Sandy Soil
Determinand	Method	Test Sample	LOD	Units						
Naphthalene	T207	M105	0.1	mg/kg	2.7	1.2	0.1	(9) <1.0	(9) <1.0	
Acenaphthylene	T207	M105	0.1	mg/kg	8.9	<0.1	<0.1	(9) <1.0	(9) <1.0	
Acenaphthene	T207	M105	0.1	mg/kg	6.0	2.0	<0.1	(9) <1.0	(9) <1.0	
Fluorene	T207	M105	0.1	mg/kg	9.7	1.5	<0.1	(9) <1.0	(9) <1.0	
Phenanthrene	T207	M105	0.1	mg/kg	85	9.2	0.4	(9) <1.0	(9) <1.0	
Anthracene	T207	M105	0.1	mg/kg	25	2.7	<0.1	(9) <1.0	(9) <1.0	
Fluoranthene	T207	M105	0.1	mg/kg	96	8.2	0.4	(9) <1.0	(9) <1.0	
Pyrene	T207	M105	0.1	mg/kg	89	7.4	0.3	(9) <1.0	(9) <1.0	
Benzo(a)Anthracene	T207	M105	0.1	mg/kg	53	4.6	0.2	(9) <1.0	(9) <1.0	
Chrysene	T207	M105	0.1	mg/kg	50	4.4	0.2	(9) <1.0	(9) <1.0	
Benzo(b)fluoranthene	T207	M105	0.1	mg/kg	47	5.2	0.2	(9) <1.0	(9) <1.0	
Benzo(k)fluoranthene	T207	M105	0.1	mg/kg	19	1.2	<0.1	(9) <1.0	(9) <1.0	
Benzo(a)Pyrene	T207	M105	0.1	mg/kg	39	4.1	0.1	(9) <1.0	(9) <1.0	
Indeno(123-cd)Pyrene	T207	M105	0.1	mg/kg	22	2.2	<0.1	(9) <1.0	(9) <1.0	
Dibenzo(ah)Anthracene	T207	M105	0.1	mg/kg	5.7	0.6	<0.1	(9) <1.0	(9) <1.0	
Benzo(ghi)Perylene	T207	M105	0.1	mg/kg	27	2.6	<0.1	(9) <1.0	(9) <1.0	
PAH(total)	T207	M105	0.1	mg/kg	590	57	1.9	<1.0	<1.0	

SAL Reference: 631022 Project Site: Arundel Street Customer Reference: 42028								
Soil		Analysed as Soil						
PAH US EPA 16 (B and K split)								
SAL Reference					631022 010	631022 011	631022 012	631022 013
Customer Sample Reference					BHDB	BHDB	BHA	BHA
Depth					0.50	0.90	0.20	0.50
Date Sampled					30-JAN-2017	30-JAN-2017	30-JAN-2017	30-JAN-2017
Type					Clay	Sandy Soil	Sandy Soil	Sandy Soil
Determinand	Method	Test Sample	LOD	Units				
Naphthalene	T207	M105	0.1	mg/kg	<0.1	<0.1	⁽⁹⁾ <1.0	0.3
Acenaphthylene	T207	M105	0.1	mg/kg	<0.1	<0.1	⁽⁹⁾ <1.0	<0.1
Acenaphthene	T207	M105	0.1	mg/kg	<0.1	<0.1	⁽⁹⁾ <1.0	0.8
Fluorene	T207	M105	0.1	mg/kg	<0.1	<0.1	⁽⁹⁾ <1.0	0.4
Phenanthrene	T207	M105	0.1	mg/kg	<0.1	<0.1	2.2	5.0
Anthracene	T207	M105	0.1	mg/kg	<0.1	<0.1	⁽⁹⁾ <1.0	1.2
Fluoranthene	T207	M105	0.1	mg/kg	<0.1	<0.1	4.4	8.7
Pyrene	T207	M105	0.1	mg/kg	<0.1	<0.1	3.9	7.8
Benzo(a)Anthracene	T207	M105	0.1	mg/kg	<0.1	<0.1	2.1	4.7
Chrysene	T207	M105	0.1	mg/kg	<0.1	<0.1	2.3	4.6
Benzo(b)fluoranthene	T207	M105	0.1	mg/kg	<0.1	<0.1	3.2	7.9
Benzo(k)fluoranthene	T207	M105	0.1	mg/kg	<0.1	<0.1	⁽⁹⁾ <1.0	0.9
Benzo(a)Pyrene	T207	M105	0.1	mg/kg	<0.1	<0.1	2.1	4.5
Indeno(123-cd)Pyrene	T207	M105	0.1	mg/kg	<0.1	<0.1	1.7	3.1
Dibenzo(ah)Anthracene	T207	M105	0.1	mg/kg	<0.1	<0.1	⁽⁹⁾ <1.0	0.7
Benzo(ghi)Perylene	T207	M105	0.1	mg/kg	<0.1	<0.1	⁽⁹⁾ <1.0	3.7
PAH(total)	T207	M105	0.1	mg/kg	<0.1	<0.1	22	55

Index to symbols used in 631022-1

Value	Description
AR	As Received

M105	Analysis conducted on an "as received" aliquot. Results are reported on a dry weight basis where moisture content was determined by assisted drying of sample at 105C
M40	Analysis conducted on sample assisted dried at no more than 40C. Results are reported on a dry weight basis.
A40	Assisted dried < 40C
N.D.	Not Detected
9	LOD raised due to dilution of sample
13	Results have been blank corrected.
S	Analysis was subcontracted
M	Analysis is MCERTS accredited
U	Analysis is UKAS accredited
N	Analysis is not UKAS accredited

Notes

Asbestos was subcontracted to REC Asbestos
Asbestos in sample 13 is present as hard set lagging and loose fibres

Method Index

Value	Description
T2	Grav
T207	GC/MS (MCERTS)
T909	GCxGC
T209	GC/MS (Head Space)(MCERTS)
T242	2:1 Extraction/ICP/OES (TRL 447 T1)
T6	ICP/OES
T7	Probe
T162	Grav (1 Dec) (105 C)
T21	OX/IR
T27	PLM

Accreditation Summary

Determinand	Method	Test Sample	LOD	Units	Symbol	SAL References
pH	T7	AR			M	002-004,006,009-013
(Water Soluble) SO4 expressed as SO4	T242	AR	0.01	g/l	N	002-004,006,009-013
Asbestos ID	T27	AR			SU	002-004,006,009-010,012-013
Boron (water-soluble)	T6	AR	1	mg/kg	N	002-004,006,009-013
Chromium VI	T6	AR	1	mg/kg	N	002-004,006,009-013
Total Organic Carbon	T21	A40	0.1	%	N	002-004,006,009-013
Phenol	T207	M105	0.1	mg/kg	M	002-004,006,009-013
Retained on 10mm sieve	T2	AR	0.1	%	N	002-004,006,009-013
Moisture @105C	T162	AR	0.1	%	N	002-004,006,009-013
Arsenic	T6	M40	2	mg/kg	M	002-004,006,009-013
Cadmium	T6	M40	1	mg/kg	M	002-004,006,009-013
Chromium	T6	M40	1	mg/kg	M	002-004,006,009-013
Copper	T6	M40	1	mg/kg	M	002-004,006,009-013
Lead	T6	M40	1	mg/kg	M	002-004,006,009-013
Mercury	T6	M40	1	mg/kg	M	002-004,006,009-013
Nickel	T6	M40	1	mg/kg	M	002-004,006,009-013
Selenium	T6	M40	3	mg/kg	M	002-004,006,009-013
Zinc	T6	M40	1	mg/kg	M	002-004,006,009-013
Naphthalene	T207	M105	0.1	mg/kg	M	002-004,006,009-013
Acenaphthylene	T207	M105	0.1	mg/kg	U	002-004,006,009-013
Acenaphthene	T207	M105	0.1	mg/kg	M	002-004,006,009-013
Fluorene	T207	M105	0.1	mg/kg	M	002-004,006,009-013
Phenanthrene	T207	M105	0.1	mg/kg	M	002-004,006,009-013
Anthracene	T207	M105	0.1	mg/kg	U	002-004,006,009-013
Fluoranthene	T207	M105	0.1	mg/kg	M	002-004,006,009-013
Pyrene	T207	M105	0.1	mg/kg	M	002-004,006,009-013
Benzo(a)Anthracene	T207	M105	0.1	mg/kg	M	002-004,006,009-013
Chrysene	T207	M105	0.1	mg/kg	M	002-004,006,009-013
Benzo(b)fluoranthene	T207	M105	0.1	mg/kg	M	002-004,006,009-013
Benzo(k)fluoranthene	T207	M105	0.1	mg/kg	M	002-004,006,009-013
Benzo(a)Pyrene	T207	M105	0.1	mg/kg	M	002-004,006,009-013
Indeno(123-cd)Pyrene	T207	M105	0.1	mg/kg	M	002-004,006,009-013

Determinand	Method	Test Sample	LOD	Units	Symbol	SAL References
Dibenzo(ah)Anthracene	T207	M105	0.1	mg/kg	M	002-004,006,009-013
Benzo(ghi)Perylene	T207	M105	0.1	mg/kg	M	002-004,006,009-013
PAH(total)	T207	M105	0.1	mg/kg	U	002-004,006,009-013
Benzene	T209	M105	10	µg/kg	M	003,010,013
Toluene	T209	M105	10	µg/kg	M	003,010,013
EthylBenzene	T209	M105	10	µg/kg	M	003,010,013
M/P Xylene	T209	M105	10	µg/kg	M	003,010,013
O Xylene	T209	M105	10	µg/kg	M	003,010,013
Methyl tert-Butyl Ether	T209	M105	10	µg/kg	M	003,010,013
TPH (C5-C6 aliphatic)	T209	M105	0.100	mg/kg	N	003,010,013
TPH (C6-C8 aliphatic)	T209	M105	0.10	mg/kg	N	003,010,013
TPH (C8-C10 aliphatic)	T209	M105	0.10	mg/kg	N	003,010,013
TPH (C10-C12 aliphatic)	T909	M105	1	mg/kg	M	003,010,013
TPH (C12-C16 aliphatic)	T909	M105	1	mg/kg	M	003,010,013
TPH (C16-C21 aliphatic)	T909	M105	1	mg/kg	M	003,010,013
TPH (C21-C35 aliphatic)	T909	M105	2	mg/kg	M	003,010,013
TPH (C6-C7 aromatic)	T209	M105	0.10	mg/kg	N	003,010,013
TPH (C7-C8 aromatic)	T209	M105	0.10	mg/kg	N	003,010,013
TPH (C8-C10 aromatic)	T209	M105	0.10	mg/kg	N	003,010,013
TPH (C10-C12 aromatic)	T909	M105	2	mg/kg	M	003,010,013
TPH (C12-C16 aromatic)	T909	M105	1	mg/kg	M	003,010,013
TPH (C16-C21 aromatic)	T909	M105	1	mg/kg	M	003,010,013
TPH (C21-C35 aromatic)	T909	M105	1	mg/kg	M	003,010,013



Scientific Analysis Laboratories Ltd

Certificate of Analysis

Report Number: 632553-1

Date of Report: 22-Feb-2017

Customer: Ian Farmer Associates
14-15 Rufford Court
Hardwick Grange
Warrington
Cheshire
WA1 4RF

Customer Contact: Ms Hannah Hadwin

Customer Job Reference: 42028

Customer Purchase Order: 42264

Customer Site Reference: Arundel Street

Date Job Received at SAL: 08-Feb-2017

Date Analysis Started: 10-Feb-2017

Date Analysis Completed: 22-Feb-2017

The results reported relate to samples received in the laboratory and may not be representative of a whole batch.

Opinions and interpretations expressed herein are outside the scope of UKAS 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

All results have been reviewed in accordance with Section 25 of the SAL Quality Manual



Report checked
and authorised by :
Stefan Kondziela
Project Manager

Issued by :
Stefan Kondziela
Project Manager



SAL Reference: 632553									
Project Site: Arundel Street									
Customer Reference: 42028									
Soil					Analysed as Soil				
MCERTS Preparation									
SAL Reference				632553 005	632553 006	632553 008	632553 010	632553 012	
Customer Sample Reference				BHC	BHC	BHAB	BHB	BHB	
Bottom Depth				0.50	1.00	0.50	0.20	1.00	
Date Sampled				03-FEB-2017	03-FEB-2017	02-FEB-2017	02-FEB-2017	02-FEB-2017	
Type				Sandy Soil	Clay	Sandy Soil	Sandy Soil	Clay	
Determinand	Method	Test Sample	LOD	Units					
Moisture @105C	T162	AR	0.1	%	4.8	19	17	2.7	15
Retained on 10mm sieve	T2	M40	0.1	%	<0.1	<0.1	<0.1	<0.1	<0.1

SAL Reference: 632553 Project Site: Arundel Street Customer Reference: 42028					
Soil		Analysed as Soil			
MCERTS Preparation					
SAL Reference					632553 014
Customer Sample Reference					BHE
Bottom Depth					0.50
Date Sampled					06-FEB-2017
Type					Sandy Soil
Determinand	Method	Test Sample	LOD	Units	
Moisture @105C	T162	AR	0.1	%	4.0
Retained on 10mm sieve	T2	M40	0.1	%	<0.1

SAL Reference: 632553									
Project Site: Arundel Street									
Customer Reference: 42028									
Soil		Analysed as Soil							
Miscellaneous									
SAL Reference					632553 005	632553 006	632553 008	632553 010	632553 012
Customer Sample Reference					BHC	BHC	BHAB	BHB	BHB
Bottom Depth					0.50	1.00	0.50	0.20	1.00
Date Sampled					03-FEB-2017	03-FEB-2017	02-FEB-2017	02-FEB-2017	02-FEB-2017
Type					Sandy Soil	Clay	Sandy Soil	Sandy Soil	Clay
Determinand	Method	Test Sample	LOD	Units					
Asbestos ID	T27	AR			N.D.	-	N.D.	N.D.	-
Boron (water-soluble)	T6	AR	1	mg/kg	<1	<1	<1	<1	<1
Chromium VI	T6	AR	1	mg/kg	<1	<1	<1	<1	<1
pH	T7	AR			7.8	7.9	7.9	8.2	7.9
Phenol	T207	M105	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
(Water Soluble) SO4 expressed as SO4	T242	AR	0.01	g/l	<0.01	0.01	0.60	0.01	0.02
Total Organic Carbon	T21	M40	0.1	%	10	1.0	4.7	5.4	0.6

SAL Reference: 632553 Project Site: Arundel Street Customer Reference: 42028 Soil Analysed as Soil Miscellaneous					
SAL Reference					632553 014
Customer Sample Reference					BHE
Bottom Depth					0.50
Date Sampled					06-FEB-2017
Type					Sandy Soil
Determinand	Method	Test Sample	LOD	Units	
Asbestos ID	T27	AR			N.D.
Boron (water-soluble)	T6	AR	1	mg/kg	<1
Chromium VI	T6	AR	1	mg/kg	<1
pH	T7	AR			6.8
Phenol	T207	M105	0.1	mg/kg	<0.1
(Water Soluble) SO4 expressed as SO4	T242	AR	0.01	g/l	<0.01
Total Organic Carbon	T21	M40	0.1	%	12

SAL Reference: 632553 Project Site: Arundel Street Customer Reference: 42028 Soil Analysed as Soil Heavy Metals(9)									
SAL Reference		632553 005	632553 006	632553 008	632553 010	632553 012			
Customer Sample Reference		BHC	BHC	BHAB	BHB	BHB			
Bottom Depth		0.50	1.00	0.50	0.20	1.00			
Date Sampled		03-FEB-2017	03-FEB-2017	02-FEB-2017	02-FEB-2017	02-FEB-2017			
Type		Sandy Soil	Clay	Sandy Soil	Sandy Soil	Clay			
Determinand	Method	Test Sample	LOD	Units					
Arsenic	T6	M40	2	mg/kg	2	12	39	5	9
Cadmium	T6	M40	1	mg/kg	<1	<1	1	<1	<1
Chromium	T6	M40	1	mg/kg	5	31	28	12	30
Copper	T6	M40	1	mg/kg	4	27	140	15	28
Lead	T6	M40	1	mg/kg	10	16	460	35	25
Mercury	T6	M40	1	mg/kg	<1	<1	2	<1	<1
Nickel	T6	M40	1	mg/kg	4	42	26	10	39
Selenium	T6	M40	3	mg/kg	<3	<3	<3	<3	<3
Zinc	T6	M40	1	mg/kg	28	68	300	83	75

SAL Reference: 632553 Project Site: Arundel Street Customer Reference: 42028 Soil Analysed as Soil Heavy Metals(9)					
SAL Reference					632553 014
Customer Sample Reference					BHE
Bottom Depth					0.50
Date Sampled					06-FEB-2017
Type					Sandy Soil
Determinand	Method	Test Sample	LOD	Units	
Arsenic	T6	M40	2	mg/kg	22
Cadmium	T6	M40	1	mg/kg	1
Chromium	T6	M40	1	mg/kg	26
Copper	T6	M40	1	mg/kg	58
Lead	T6	M40	1	mg/kg	180
Mercury	T6	M40	1	mg/kg	<1
Nickel	T6	M40	1	mg/kg	52
Selenium	T6	M40	3	mg/kg	<3
Zinc	T6	M40	1	mg/kg	140

SAL Reference: 632553 Project Site: Arundel Street Customer Reference: 42028 Soil Analysed as Soil PAH US EPA 16 (B and K split)									
SAL Reference					632553 005	632553 006	632553 008	632553 010	632553 012
Customer Sample Reference					BHC	BHC	BHAB	BHB	BHB
Bottom Depth					0.50	1.00	0.50	0.20	1.00
Date Sampled					03-FEB-2017	03-FEB-2017	02-FEB-2017	02-FEB-2017	02-FEB-2017
Type					Sandy Soil	Clay	Sandy Soil	Sandy Soil	Clay
Determinand	Method	Test Sample	LOD	Units					
Naphthalene	T207	M105	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthylene	T207	M105	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthene	T207	M105	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Fluorene	T207	M105	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Phenanthrene	T207	M105	0.1	mg/kg	<0.1	<0.1	0.8	<0.1	<0.1
Anthracene	T207	M105	0.1	mg/kg	<0.1	<0.1	0.2	<0.1	<0.1
Fluoranthene	T207	M105	0.1	mg/kg	<0.1	<0.1	1.7	<0.1	<0.1
Pyrene	T207	M105	0.1	mg/kg	<0.1	<0.1	1.6	<0.1	<0.1
Benzo(a)Anthracene	T207	M105	0.1	mg/kg	<0.1	<0.1	0.9	<0.1	<0.1
Chrysene	T207	M105	0.1	mg/kg	<0.1	<0.1	1.1	<0.1	<0.1
Benzo(b)fluoranthene	T207	M105	0.1	mg/kg	<0.1	<0.1	1.1	<0.1	<0.1
Benzo(k)fluoranthene	T207	M105	0.1	mg/kg	<0.1	<0.1	0.5	<0.1	<0.1
Benzo(a)Pyrene	T207	M105	0.1	mg/kg	<0.1	<0.1	0.8	<0.1	<0.1
Indeno(123-cd)Pyrene	T207	M105	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dibenzo(ah)Anthracene	T207	M105	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(ghi)Perylene	T207	M105	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
PAH(total)	T207	M105	0.1	mg/kg	<0.1	<0.1	8.6	<0.1	<0.1

SAL Reference: 632553 Project Site: Arundel Street Customer Reference: 42028 Soil Analysed as Soil PAH US EPA 16 (B and K split)					
SAL Reference					632553 014
Customer Sample Reference					BHE
Bottom Depth					0.50
Date Sampled					06-FEB-2017
Type					Sandy Soil
Determinand	Method	Test Sample	LOD	Units	
Naphthalene	T207	M105	0.1	mg/kg	<0.1
Acenaphthylene	T207	M105	0.1	mg/kg	<0.1
Acenaphthene	T207	M105	0.1	mg/kg	<0.1
Fluorene	T207	M105	0.1	mg/kg	<0.1
Phenanthrene	T207	M105	0.1	mg/kg	0.4
Anthracene	T207	M105	0.1	mg/kg	<0.1
Fluoranthene	T207	M105	0.1	mg/kg	0.6
Pyrene	T207	M105	0.1	mg/kg	1.0
Benzo(a)Anthracene	T207	M105	0.1	mg/kg	0.2
Chrysene	T207	M105	0.1	mg/kg	0.5
Benzo(b)fluoranthene	T207	M105	0.1	mg/kg	<0.1
Benzo(k)fluoranthene	T207	M105	0.1	mg/kg	<0.1
Benzo(a)Pyrene	T207	M105	0.1	mg/kg	<0.1
Indeno(123-cd)Pyrene	T207	M105	0.1	mg/kg	<0.1
Dibenzo(ah)Anthracene	T207	M105	0.1	mg/kg	<0.1
Benzo(ghi)Perylene	T207	M105	0.1	mg/kg	<0.1
PAH(total)	T207	M105	0.1	mg/kg	2.6

SAL Reference: 632553 Project Site: Arundel Street Customer Reference: 42028 Soil Analysed as Soil TPH (CWG) with MTBE, BTEX					
SAL Reference				632553 010	
Customer Sample Reference				BHB	
Bottom Depth				0.20	
Date Sampled				02-FEB-2017	
Type				Sandy Soil	
Determinand	Method	Test Sample	LOD	Units	
Benzene	T209	M105	10	µg/kg	⁽¹³⁾ <10
Toluene	T209	M105	10	µg/kg	<10
EthylBenzene	T209	M105	10	µg/kg	<10
M/P Xylene	T209	M105	10	µg/kg	<10
O Xylene	T209	M105	10	µg/kg	<10
Methyl tert-Butyl Ether	T209	M105	10	µg/kg	<10
TPH (C5-C6 aliphatic)	T209	M105	0.100	mg/kg	<0.100
TPH (C6-C8 aliphatic)	T209	M105	0.10	mg/kg	<0.10
TPH (C8-C10 aliphatic)	T209	M105	0.10	mg/kg	<0.10
TPH (C10-C12 aliphatic)	T909	M105	1	mg/kg	⁽¹³⁾ <1
TPH (C12-C16 aliphatic)	T909	M105	1	mg/kg	⁽¹³⁾ <1
TPH (C16-C21 aliphatic)	T909	M105	1	mg/kg	⁽¹³⁾ <1
TPH (C21-C35 aliphatic)	T909	M105	2	mg/kg	⁽¹³⁾ 7
TPH (C6-C7 aromatic)	T209	M105	0.10	mg/kg	<0.10
TPH (C7-C8 aromatic)	T209	M105	0.10	mg/kg	<0.10
TPH (C8-C10 aromatic)	T209	M105	0.10	mg/kg	<0.10
TPH (C10-C12 aromatic)	T909	M105	2	mg/kg	⁽¹³⁾ <2
TPH (C12-C16 aromatic)	T909	M105	1	mg/kg	⁽¹³⁾ <1
TPH (C16-C21 aromatic)	T909	M105	1	mg/kg	⁽¹³⁾ <1
TPH (C21-C35 aromatic)	T909	M105	1	mg/kg	⁽¹³⁾ <1

Index to symbols used in 632553-1

Value	Description
AR	As Received
M40	Analysis conducted on sample assisted dried at no more than 40C. Results are reported on a dry weight basis.
M105	Analysis conducted on an "as received" aliquot. Results are reported on a dry weight basis where moisture content was determined by assisted drying of sample at 105C
N.D.	Not Detected
13	Results have been blank corrected.
S	Analysis was subcontracted
M	Analysis is MCERTS accredited
U	Analysis is UKAS accredited
N	Analysis is not UKAS accredited

Notes

Asbestos was subcontracted to REC Asbestos

Method Index

Value	Description
T6	ICP/OES
T2	Grav
T207	GC/MS (MCERTS)
T242	2:1 Extraction/ICP/OES (TRL 447 T1)
T21	OX/IR
T27	PLM
T209	GC/MS (Head Space)(MCERTS)
T909	GCxGC
T7	Probe

Accreditation Summary

Determinand	Method	Test Sample	LOD	Units	Symbol	SAL References
Asbestos ID	T27	AR			SU	005,008,010,014
Boron (water-soluble)	T6	AR	1	mg/kg	N	005-006,008,010,012,014
Chromium VI	T6	AR	1	mg/kg	N	005-006,008,010,012,014
pH	T7	AR			M	005-006,008,010,012,014
Phenol	T207	M105	0.1	mg/kg	M	005-006,008,010,012,014
(Water Soluble) SO ₄ expressed as SO ₄	T242	AR	0.01	g/l	N	005-006,008,010,012,014
Total Organic Carbon	T21	M40	0.1	%	N	005-006,008,010,012,014
Arsenic	T6	M40	2	mg/kg	M	005-006,008,010,012,014
Cadmium	T6	M40	1	mg/kg	M	005-006,008,010,012,014
Chromium	T6	M40	1	mg/kg	M	005-006,008,010,012,014
Copper	T6	M40	1	mg/kg	M	005-006,008,010,012,014
Lead	T6	M40	1	mg/kg	M	005-006,008,010,012,014
Mercury	T6	M40	1	mg/kg	M	005-006,008,010,012,014
Nickel	T6	M40	1	mg/kg	M	005-006,008,010,012,014
Selenium	T6	M40	3	mg/kg	M	005-006,008,010,012,014
Zinc	T6	M40	1	mg/kg	M	005-006,008,010,012,014
Moisture @105C	T162	AR	0.1	%	N	005-006,008,010,012,014
Retained on 10mm sieve	T2	M40	0.1	%	N	005-006,008,010,012,014
Naphthalene	T207	M105	0.1	mg/kg	M	005-006,008,010,012,014
Acenaphthylene	T207	M105	0.1	mg/kg	U	005-006,008,010,012,014
Acenaphthene	T207	M105	0.1	mg/kg	M	005-006,008,010,012,014
Fluorene	T207	M105	0.1	mg/kg	M	005-006,008,010,012,014
Phenanthrene	T207	M105	0.1	mg/kg	M	005-006,008,010,012,014
Anthracene	T207	M105	0.1	mg/kg	U	005-006,008,010,012,014
Fluoranthene	T207	M105	0.1	mg/kg	M	005-006,008,010,012,014
Pyrene	T207	M105	0.1	mg/kg	M	005-006,008,010,012,014
Benzo(a)Anthracene	T207	M105	0.1	mg/kg	M	005-006,008,010,012,014
Chrysene	T207	M105	0.1	mg/kg	M	005-006,008,010,012,014
Benzo(b)fluoranthene	T207	M105	0.1	mg/kg	M	005-006,008,010,012,014
Benzo(k)fluoranthene	T207	M105	0.1	mg/kg	M	005-006,008,010,012,014
Benzo(a)Pyrene	T207	M105	0.1	mg/kg	M	005-006,008,010,012,014
Indeno(123-cd)Pyrene	T207	M105	0.1	mg/kg	M	005-006,008,010,012,014
Dibenzo(ah)Anthracene	T207	M105	0.1	mg/kg	M	005-006,008,010,012,014
Benzo(ghi)Perylene	T207	M105	0.1	mg/kg	M	005-006,008,010,012,014
PAH(total)	T207	M105	0.1	mg/kg	U	005-006,008,010,012,014
Benzene	T209	M105	10	µg/kg	M	010
Toluene	T209	M105	10	µg/kg	M	010
EthylBenzene	T209	M105	10	µg/kg	M	010
M/P Xylene	T209	M105	10	µg/kg	M	010
O Xylene	T209	M105	10	µg/kg	M	010
Methyl tert-Butyl Ether	T209	M105	10	µg/kg	M	010
TPH (C5-C6 aliphatic)	T209	M105	0.100	mg/kg	N	010
TPH (C6-C8 aliphatic)	T209	M105	0.10	mg/kg	N	010
TPH (C8-C10 aliphatic)	T209	M105	0.10	mg/kg	N	010
TPH (C10-C12 aliphatic)	T909	M105	1	mg/kg	M	010
TPH (C12-C16 aliphatic)	T909	M105	1	mg/kg	M	010
TPH (C16-C21 aliphatic)	T909	M105	1	mg/kg	M	010
TPH (C21-C35 aliphatic)	T909	M105	2	mg/kg	M	010
TPH (C6-C7 aromatic)	T209	M105	0.10	mg/kg	N	010
TPH (C7-C8 aromatic)	T209	M105	0.10	mg/kg	N	010
TPH (C8-C10 aromatic)	T209	M105	0.10	mg/kg	N	010
TPH (C10-C12 aromatic)	T909	M105	2	mg/kg	M	010
TPH (C12-C16 aromatic)	T909	M105	1	mg/kg	M	010
TPH (C16-C21 aromatic)	T909	M105	1	mg/kg	M	010
TPH (C21-C35 aromatic)	T909	M105	1	mg/kg	M	010



SCIENTIFIC ANALYSIS
LABORATORIES
DELIVERING SCIENCE

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Hadfield House, Hadfield Street, Manchester M16 9FE

Scientific Analysis Laboratories Ltd

Certificate of Analysis

Hadfield House
Hadfield Street
Cornbrook
Manchester
M16 9FE
Tel : 0161 874 2400
Fax : 0161 874 2468

Report Number: 635476-1

Date of Report: 28-Feb-2017

Customer: Ian Farmer Associates
14-15 Rufford Court
Hardwick Grange
Warrington
Cheshire
WA1 4RF

Customer Contact: Mr Tim Downes

Customer Job Reference: 42028

Customer Purchase Order: 42268

Customer Site Reference: Arundel Street

Date Job Received at SAL: 06-Feb-2017

Date Analysis Started: 23-Feb-2017

Date Analysis Completed: 28-Feb-2017

The results reported relate to samples received in the laboratory and may not be representative of a whole batch.

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

All results have been reviewed in accordance with Section 25 of the SAL Quality Manual

SCIENTIFIC ANALYSIS
LABORATORIES

Report checked
and authorised by :
Stefan Kondziela
Project Manager

Issued by :
Stefan Kondziela
Project Manager

Scientific Analysis Laboratories Ltd

Certificate of Analysis

Report Number: 632134-2

Date of Report: 22-Feb-2017

Customer: Ian Farmer Associates
14-15 Rufford Court
Hardwick Grange
Warrington
Cheshire
WA1 4RF

Customer Contact: Mr Tim Downes

Customer Job Reference: 42028

Customer Purchase Order: 42268

Customer Site Reference: Arundel Street

Date Job Received at SAL: 06-Feb-2017

Date Analysis Started: 09-Feb-2017

Date Analysis Completed: 22-Feb-2017

The results reported relate to samples received in the laboratory and may not be representative of a whole batch.

Opinions and interpretations expressed herein are outside the scope of UKAS accreditation

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Tests covered by this certificate were conducted in accordance with SAL SOPs

All results have been reviewed in accordance with Section 25 of the SAL Quality Manual



Report checked
and authorised by :
Stefan Kondziela
Project Manager

Issued by :
Stefan Kondziela
Project Manager

Waste Acceptance Criteria

Customer Sample Reference : WS01

SAL Sample Reference : 632134 001

Project Site : Arundel Street

Customer Reference : 42028

Bottom Depth : 0.20

Date Sampled : 01-FEB-2017

Type : Sandy Soil

Soil					Result	Inert Waste Landfill	Stable non reactive	Hazardous Waste Landfill
Determinand	Technique	LOD	Units	Symbol				
Acid Neutralising Capacity (pH 4)	Titration	2	Mol/kg	N	<2			
Acid Neutralising Capacity (pH 7)	Titration	2	Mol/kg	N	<2			
Loss on Ignition	Grav	0.1	%	N	9.3			10.0
pH	Probe			M	8.4		> 6.0	
Total Organic Carbon	OX/IR	0.1	%	N	10	3.0	5.0	6.0
BTEX (Sum)	Calc	0.040	mg/kg	U	<0.040	6.0		
PAH (Sum)	Calc	1.6	mg/kg	N	12	100.0		
PCB EC7 (Sum)	Calc	0.0070	mg/kg	U	⁽⁶²⁾ <0.0070	1.0		
Total Petroleum Hydrocarbons C10-C40 (Sum)	Calc	1	mg/kg	N	⁽¹³⁾ 3900	500.0		

Data for BS EN 12457-2 (10:1)					Result	Inert Waste Landfill	Stable non reactive	Hazardous Waste Landfill
Determinand	Technique	LOD	Units	Symbol				
Antimony	Calc WAC ICP/MS	0.010	mg/kg	N	0.019	0.06	0.7	5.0
Arsenic	Calc WAC ICP/MS	0.0020	mg/kg	N	0.16	0.5	2.0	25.0
Barium	Calc WAC ICP/MS	0.010	mg/kg	N	0.33	20.0	100.0	300.0
Cadmium	Calc WAC ICP/MS	0.00020	mg/kg	N	0.00053	0.04	1.0	5.0
Chromium	Calc WAC ICP/MS	0.010	mg/kg	N	0.026	0.5	10.0	70.0
Copper	Calc WAC ICP/MS	0.0050	mg/kg	N	0.028	2.0	50.0	100.0
Lead	Calc WAC ICP/MS	0.0030	mg/kg	N	0.044	0.5	10.0	50.0
Mercury	Calc WAC ICP/MS	0.00050	mg/kg	N	0.00080	0.01	0.2	2.0
Molybdenum	Calc WAC ICP/MS	0.010	mg/kg	N	0.037	0.5	10.0	30.0
Nickel	Calc WAC ICP/MS	0.010	mg/kg	N	0.013	0.4	10.0	40.0
Selenium	Calc WAC ICP/MS	0.0050	mg/kg	N	<0.0050	0.1	0.5	7.0
Zinc	Calc WAC ICP/MS	0.020	mg/kg	N	0.076	4.0	50.0	200.0
Chloride	Calc (W)	10	mg/kg	N	14	800.0	15000.0	25000.0
Fluoride	Calc (W)	0.50	mg/kg	N	2.5	10.0	150.0	500.0
Sulphate	Calc (W)	5	mg/kg	N	44	1000.0	20000.0	50000.0
Phenols (Total-Mono)	Calc	1.0	mg/kg	N	<1.0	1.0		
Dissolved Organic Carbon	Calc	10	mg/kg	N	84	500.0	800.0	1000.0
Total Dissolved Solids	Calc WAC ICP/MS	1000	mg/kg	N	<1000	4000.0	60000.0	100000.0

Following the recommendation from the Environment Agency (England and Wales)*, the leachate preparation in this report has been carried out to BS EN 12457-2 : One Stage batch test at a liquid to solid ratio of 10 l/kg. This is also compliant with Schedule 10 of the Environmental Permitting Regulations 2010.

Note : This is the minimum amount of testing which is required.

Further testing may be required if :

- evidence of immediately leachable parameters becomes available.
- evidence to indicate that the sample could be classified as hazardous under H1-H14 of the Waste(England and Wales) Regulations 2011(as amended) becomes available.

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* Waste Sampling and Testing for Disposal at Landfill, EBPR1 11507B, Environment Agency (England and Wales) March 2013

Waste Acceptance Criteria

Customer Sample Reference : WS02
 SAL Sample Reference : 632134 002
 Project Site : Arundel Street
 Customer Reference : 42028
 Bottom Depth : 1.50
 Date Sampled : 01-FEB-2017
 Type : Clay

Soil					Result	Inert Waste Landfill	Stable non reactive	Hazardous Waste Landfill
Determinand	Technique	LOD	Units	Symbol				
Acid Neutralising Capacity (pH 4)	Titration	2	Mol/kg	N	<2			
Acid Neutralising Capacity (pH 7)	Titration	2	Mol/kg	N	<2			
Loss on Ignition	Grav	0.1	%	N	3.6			10.0
pH	Probe			M	7.8		> 6.0	
Total Organic Carbon	OX/IR	0.1	%	N	0.8	3.0	5.0	6.0
BTEX (Sum)	Calc	0.040	mg/kg	U	<0.040	6.0		
PAH (Sum)	Calc	1.6	mg/kg	N	<1.6	100.0		
PCB EC7 (Sum)	Calc	0.0070	mg/kg	U	⁽⁶²⁾ <0.0070	1.0		
Total Petroleum Hydrocarbons C10-C40 (Sum)	Calc	1	mg/kg	N	⁽¹³⁾ 200	500.0		

Data for BS EN 12457-2 (10:1)					Result	Inert Waste Landfill	Stable non reactive	Hazardous Waste Landfill
Determinand	Technique	LOD	Units	Symbol				
Antimony	Calc WAC ICP/MS	0.010	mg/kg	N	<0.010	0.06	0.7	5.0
Arsenic	Calc WAC ICP/MS	0.0020	mg/kg	N	0.0027	0.5	2.0	25.0
Barium	Calc WAC ICP/MS	0.010	mg/kg	N	0.056	20.0	100.0	300.0
Cadmium	Calc WAC ICP/MS	0.00020	mg/kg	N	0.00052	0.04	1.0	5.0
Chromium	Calc WAC ICP/MS	0.010	mg/kg	N	0.019	0.5	10.0	70.0
Copper	Calc WAC ICP/MS	0.0050	mg/kg	N	<0.0050	2.0	50.0	100.0
Lead	Calc WAC ICP/MS	0.0030	mg/kg	N	0.0037	0.5	10.0	50.0
Mercury	Calc WAC ICP/MS	0.00050	mg/kg	N	<0.00050	0.01	0.2	2.0
Molybdenum	Calc WAC ICP/MS	0.010	mg/kg	N	<0.010	0.5	10.0	30.0
Nickel	Calc WAC ICP/MS	0.010	mg/kg	N	<0.010	0.4	10.0	40.0
Selenium	Calc WAC ICP/MS	0.0050	mg/kg	N	<0.0050	0.1	0.5	7.0
Zinc	Calc WAC ICP/MS	0.020	mg/kg	N	0.043	4.0	50.0	200.0
Chloride	Calc (W)	10	mg/kg	N	<10	800.0	15000.0	25000.0
Fluoride	Calc (W)	0.50	mg/kg	N	2.9	10.0	150.0	500.0
Sulphate	Calc (W)	5	mg/kg	N	12	1000.0	20000.0	50000.0
Phenols (Total-Mono)	Calc	1.0	mg/kg	N	<1.0	1.0		
Dissolved Organic Carbon	Calc	10	mg/kg	N	51	500.0	800.0	1000.0
Total Dissolved Solids	Calc WAC ICP/MS	1000	mg/kg	N	<1000	4000.0	60000.0	100000.0

Following the recommendation from the Environment Agency (England and Wales)*, the leachate preparation in this report has been carried out to BS EN 12457-2 : One Stage batch test at a liquid to solid ratio of 10 l/kg. This is also compliant with Schedule 10 of the Environmental Permitting Regulations 2010.

Note : This is the minimum amount of testing which is required.

Further testing may be required if :

- evidence of immediately leachable parameters becomes available.
- evidence to indicate that the sample could be classified as hazardous under H1-H14 of the Waste(England and Wales) Regulations 2011(as amended) becomes available.

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* Waste Sampling and Testing for Disposal at Landfill, EBPR1 11507B, Environment Agency (England and Wales) March 2013

Waste Acceptance Criteria

Customer Sample Reference : BHD
 SAL Sample Reference : 632134 003
 Project Site : Arundel Street
 Customer Reference : 42028
 Bottom Depth : 0.50
 Date Sampled : 03-FEB-2017
 Type : Clay

Soil					Result	Inert Waste Landfill	Stable non reactive	Hazardous Waste Landfill
Determinand	Technique	LOD	Units	Symbol				
Acid Neutralising Capacity (pH 4)	Titration	2	Mol/kg	N	<2			
Acid Neutralising Capacity (pH 7)	Titration	2	Mol/kg	N	<2			
Loss on Ignition	Grav	0.1	%	N	3.6			10.0
pH	Probe			M	8.1		> 6.0	
Total Organic Carbon	OX/IR	0.1	%	N	0.6	3.0	5.0	6.0
BTEX (Sum)	Calc	0.040	mg/kg	U	<0.040	6.0		
PAH (Sum)	Calc	1.6	mg/kg	N	<1.6	100.0		
PCB EC7 (Sum)	Calc	0.0070	mg/kg	U	⁽⁶²⁾ <0.0070	1.0		
Total Petroleum Hydrocarbons C10-C40 (Sum)	Calc	1	mg/kg	N	⁽¹³⁾ 69	500.0		

Data for BS EN 12457-2 (10:1)					Result	Inert Waste Landfill	Stable non reactive	Hazardous Waste Landfill
Determinand	Technique	LOD	Units	Symbol				
Antimony	Calc WAC ICP/MS	0.010	mg/kg	N	0.020	0.06	0.7	5.0
Arsenic	Calc WAC ICP/MS	0.0020	mg/kg	N	0.015	0.5	2.0	25.0
Barium	Calc WAC ICP/MS	0.010	mg/kg	N	0.095	20.0	100.0	300.0
Cadmium	Calc WAC ICP/MS	0.00020	mg/kg	N	<0.00020	0.04	1.0	5.0
Chromium	Calc WAC ICP/MS	0.010	mg/kg	N	0.012	0.5	10.0	70.0
Copper	Calc WAC ICP/MS	0.0050	mg/kg	N	<0.0050	2.0	50.0	100.0
Lead	Calc WAC ICP/MS	0.0030	mg/kg	N	<0.0030	0.5	10.0	50.0
Mercury	Calc WAC ICP/MS	0.00050	mg/kg	N	<0.00050	0.01	0.2	2.0
Molybdenum	Calc WAC ICP/MS	0.010	mg/kg	N	0.028	0.5	10.0	30.0
Nickel	Calc WAC ICP/MS	0.010	mg/kg	N	<0.010	0.4	10.0	40.0
Selenium	Calc WAC ICP/MS	0.0050	mg/kg	N	<0.0050	0.1	0.5	7.0
Zinc	Calc WAC ICP/MS	0.020	mg/kg	N	0.10	4.0	50.0	200.0
Chloride	Calc (W)	10	mg/kg	N	<10	800.0	15000.0	25000.0
Fluoride	Calc (W)	0.50	mg/kg	N	6.7	10.0	150.0	500.0
Sulphate	Calc (W)	5	mg/kg	N	10	1000.0	20000.0	50000.0
Phenols (Total-Mono)	Calc	1.0	mg/kg	N	<1.0	1.0		
Dissolved Organic Carbon	Calc	10	mg/kg	N	110	500.0	800.0	1000.0
Total Dissolved Solids	Calc WAC ICP/MS	1000	mg/kg	N	1100	4000.0	60000.0	100000.0

Following the recommendation from the Environment Agency (England and Wales)*, the leachate preparation in this report has been carried out to BS EN 12457-2 : One Stage batch test at a liquid to solid ratio of 10 l/kg. This is also compliant with Schedule 10 of the Environmental Permitting Regulations 2010.

Note : This is the minimum amount of testing which is required.

Further testing may be required if :

- evidence of immediately leachable parameters becomes available.
- evidence to indicate that the sample could be classified as hazardous under H1-H14 of the Waste(England and Wales) Regulations 2011(as amended) becomes available.

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* Waste Sampling and Testing for Disposal at Landfill, EBPR1 11507B, Environment Agency (England and Wales) March 2013

Waste Acceptance Criteria

Customer Sample Reference : BHC
 SAL Sample Reference : 632134 004
 Project Site : Arundel Street
 Customer Reference : 42028
 Date Sampled : 03-FEB-2017
 Bottom Depth : 0.50
 Type : Sandy Soil

Soil					Result	Inert Waste Landfill	Stable non reactive	Hazardous Waste Landfill
Determinand	Technique	LOD	Units	Symbol				
Acid Neutralising Capacity (pH 4)	Titration	2	Mol/kg	N	<2			
Acid Neutralising Capacity (pH 7)	Titration	2	Mol/kg	N	<2			
Loss on Ignition	Grav	0.1	%	N	1.5			10.0
pH	Probe			M	8.4		> 6.0	
Total Organic Carbon	OX/IR	0.1	%	N	0.6	3.0	5.0	6.0
BTEX (Sum)	Calc	0.040	mg/kg	U	<0.040	6.0		
PAH (Sum)	Calc	1.6	mg/kg	N	<1.6	100.0		
PCB EC7 (Sum)	Calc	0.0070	mg/kg	U	⁽⁶²⁾ <0.0070	1.0		
Total Petroleum Hydrocarbons C10-C40 (Sum)	Calc	1	mg/kg	N	⁽¹³⁾ 36	500.0		

Data for BS EN 12457-2 (10:1)					Result	Inert Waste Landfill	Stable non reactive	Hazardous Waste Landfill
Determinand	Technique	LOD	Units	Symbol				
Antimony	Calc WAC ICP/MS	0.010	mg/kg	N	<0.010	0.06	0.7	5.0
Arsenic	Calc WAC ICP/MS	0.0020	mg/kg	N	0.0042	0.5	2.0	25.0
Barium	Calc WAC ICP/MS	0.010	mg/kg	N	0.024	20.0	100.0	300.0
Cadmium	Calc WAC ICP/MS	0.00020	mg/kg	N	0.00047	0.04	1.0	5.0
Chromium	Calc WAC ICP/MS	0.010	mg/kg	N	0.011	0.5	10.0	70.0
Copper	Calc WAC ICP/MS	0.0050	mg/kg	N	<0.0050	2.0	50.0	100.0
Lead	Calc WAC ICP/MS	0.0030	mg/kg	N	<0.0030	0.5	10.0	50.0
Mercury	Calc WAC ICP/MS	0.00050	mg/kg	N	<0.00050	0.01	0.2	2.0
Molybdenum	Calc WAC ICP/MS	0.010	mg/kg	N	0.037	0.5	10.0	30.0
Nickel	Calc WAC ICP/MS	0.010	mg/kg	N	<0.010	0.4	10.0	40.0
Selenium	Calc WAC ICP/MS	0.0050	mg/kg	N	<0.0050	0.1	0.5	7.0
Zinc	Calc WAC ICP/MS	0.020	mg/kg	N	<0.020	4.0	50.0	200.0
Chloride	Calc (W)	10	mg/kg	N	<10	800.0	15000.0	25000.0
Fluoride	Calc (W)	0.50	mg/kg	N	4.5	10.0	150.0	500.0
Sulphate	Calc (W)	5	mg/kg	N	13	1000.0	20000.0	50000.0
Phenols (Total-Mono)	Calc	1.0	mg/kg	N	<1.0	1.0		
Dissolved Organic Carbon	Calc	10	mg/kg	N	96	500.0	800.0	1000.0
Total Dissolved Solids	Calc WAC ICP/MS	1000	mg/kg	N	<1000	4000.0	60000.0	100000.0

Following the recommendation from the Environment Agency (England and Wales)*, the leachate preparation in this report has been carried out to BS EN 12457-2 : One Stage batch test at a liquid to solid ratio of 10 l/kg. This is also compliant with Schedule 10 of the Environmental Permitting Regulations 2010.

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Further testing may be required if :

- evidence of immediately leachable parameters becomes available.
- evidence to indicate that the sample could be classified as hazardous under H1-H14 of the Waste(England and Wales) Regulations 2011(as amended) becomes available.

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* Waste Sampling and Testing for Disposal at Landfill, EBPR1 11507B, Environment Agency (England and Wales) March 2013

Waste Acceptance Criteria

Customer Sample Reference : BHA

SAL Sample Reference : 632134 005

Project Site : Arundel Street

Customer Reference : 42028

Date Sampled : 30-JAN-2017

Bottom Depth : 1.0

Top Depth : 0.5

Type : Sandy Soil

Soil					Result	Inert Waste Landfill	Stable non reactive	Hazardous Waste Landfill
Determinand	Technique	LOD	Units	Symbol				
Acid Neutralising Capacity (pH 4)	Titration	2	Mol/kg	N	<2			
Acid Neutralising Capacity (pH 7)	Titration	2	Mol/kg	N	<2			
Loss on Ignition	Grav	0.1	%	N	8.1			10.0
pH	Probe			M	9.0		> 6.0	
Total Organic Carbon	OX/IR	0.1	%	N	6.2	3.0	5.0	6.0
BTEX (Sum)	Calc	0.080	mg/kg	U	⁽¹¹⁰⁾ <0.080	6.0		
PAH (Sum)	Calc	1.6	mg/kg	N	4.9	100.0		
PCB EC7 (Sum)	Calc	0.0070	mg/kg	U	⁽⁶²⁾ <0.0070	1.0		
Total Petroleum Hydrocarbons C10-C40 (Sum)	Calc	1	mg/kg	N	⁽¹³⁾ 410	500.0		

Data for BS EN 12457-2 (10:1)					Result	Inert Waste Landfill	Stable non reactive	Hazardous Waste Landfill
Determinand	Technique	LOD	Units	Symbol				
Antimony	Calc WAC ICP/MS	0.010	mg/kg	N	0.079	0.06	0.7	5.0
Arsenic	Calc WAC ICP/MS	0.0020	mg/kg	N	0.066	0.5	2.0	25.0
Barium	Calc WAC ICP/MS	0.010	mg/kg	N	0.40	20.0	100.0	300.0
Cadmium	Calc WAC ICP/MS	0.00020	mg/kg	N	0.00032	0.04	1.0	5.0
Chromium	Calc WAC ICP/MS	0.010	mg/kg	N	0.48	0.5	10.0	70.0
Copper	Calc WAC ICP/MS	0.0050	mg/kg	N	0.054	2.0	50.0	100.0
Lead	Calc WAC ICP/MS	0.0030	mg/kg	N	0.23	0.5	10.0	50.0
Mercury	Calc WAC ICP/MS	0.00050	mg/kg	N	0.00096	0.01	0.2	2.0
Molybdenum	Calc WAC ICP/MS	0.010	mg/kg	N	0.032	0.5	10.0	30.0
Nickel	Calc WAC ICP/MS	0.010	mg/kg	N	<0.010	0.4	10.0	40.0
Selenium	Calc WAC ICP/MS	0.0050	mg/kg	N	0.0051	0.1	0.5	7.0
Zinc	Calc WAC ICP/MS	0.020	mg/kg	N	0.079	4.0	50.0	200.0
Chloride	Calc (W)	10	mg/kg	N	33	800.0	15000.0	25000.0
Fluoride	Calc (W)	0.50	mg/kg	N	2.9	10.0	150.0	500.0
Sulphate	Calc (W)	5	mg/kg	N	350	1000.0	20000.0	50000.0
Phenols (Total-Mono)	Calc	1.0	mg/kg	N	<1.0	1.0		
Dissolved Organic Carbon	Calc	10	mg/kg	N	83	500.0	800.0	1000.0
Total Dissolved Solids	Calc WAC ICP/MS	1000	mg/kg	N	1100	4000.0	60000.0	100000.0

Following the recommendation from the Environment Agency (England and Wales)*, the leachate preparation in this report has been carried out to BS EN 12457-2 : One Stage batch test at a liquid to solid ratio of 10 l/kg. This is also compliant with Schedule 10 of the Environmental Permitting Regulations 2010.

Note : This is the minimum amount of testing which is required.

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- evidence to indicate that the sample could be classified as hazardous under H1-H14 of the Waste(England and Wales) Regulations 2011(as amended) becomes available.

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* Waste Sampling and Testing for Disposal at Landfill, EBPR1 11507B, Environment Agency (England and Wales) March 2013

SAL Reference: 632134													
Project Site: Arundel Street													
Customer Reference: 42028													
Soil Analysed as Soil													
MCERTS Preparation													
SAL Reference				632134 001		632134 002		632134 003		632134 004		632134 005	
Customer Sample Reference				WS01		WS02		BHD		BHC		BHA	
Test Sample				AR		AR		AR		AR		AR	
Top Depth												0.5	
Bottom Depth				0.20		1.50		0.50		0.50		1.0	
Date Sampled				01-FEB-2017		01-FEB-2017		03-FEB-2017		03-FEB-2017		30-JAN-2017	
Type				Sandy Soil		Clay		Clay		Sandy Soil		Sandy Soil	
Determinand		Method		LOD	Units	Symbol							
Moisture @105C		Grav (1 Dec) (105 C)		0.1	%	N	5.2	14	13	7.9	19		

SAL Reference: 632134									
Project Site: Arundel Street									
Customer Reference: 42028									
Soil Analysed as Soil									
MCERTS Preparation									
SAL Reference				632134 001	632134 002	632134 003	632134 004	632134 005	
Customer Sample Reference				WS01	WS02	BHD	BHC	BHA	
Test Sample				M40	M40	M40	M40	M40	
Top Depth									0.5
Bottom Depth				0.20	1.50	0.50	0.50		1.0
Date Sampled				01-FEB-2017	01-FEB-2017	03-FEB-2017	03-FEB-2017	30-JAN-2017	
Type				Sandy Soil	Clay	Clay	Sandy Soil	Sandy Soil	
Determinand		Method	LOD	Units	Symbol				
Retained on 10mm sieve		Grav	0.1	%	N	<0.1	<0.1	<0.1	<0.1

SAL Reference: 632134											
Project Site: Arundel Street											
Customer Reference: 42028											
Soil		Analysed as Soil									
BTEX											
SAL Reference		632134 001		632134 002		632134 003		632134 004		632134 005	
Customer Sample Reference		WS01		WS02		BHD		BHC		BHA	
Test Sample		M105		M105		M105		M105		M105	
Top Depth										0.5	
Bottom Depth		0.20		1.50		0.50		0.50		1.0	
Date Sampled		01-FEB-2017		01-FEB-2017		03-FEB-2017		03-FEB-2017		30-JAN-2017	
Type		Sandy Soil		Clay		Clay		Sandy Soil		Sandy Soil	
Determinand	Method	LOD	Units	Symbol							
Benzene	GC/MS (Head Space)(MCERTS)	0.010	mg/kg	M	(13) <0.010	(13) <0.010	(13) <0.010	(13) <0.010	(13,110) <0.020		
Toluene	GC/MS (Head Space)(MCERTS)	0.010	mg/kg	M	<0.010	<0.010	<0.010	<0.010	(110) <0.020		
EthylBenzene	GC/MS (Head Space)(MCERTS)	0.010	mg/kg	M	<0.010	<0.010	<0.010	<0.010	(110) <0.020		
Meta/Para-Xylene	GC/MS (Head Space)(MCERTS)	0.010	mg/kg	M	<0.010	<0.010	<0.010	<0.010	(110) <0.020		
Ortho-Xylene	GC/MS (Head Space)(MCERTS)	0.010	mg/kg	M	<0.010	<0.010	<0.010	<0.010	(110) <0.020		

SAL Reference: 632134									
Project Site: Arundel Street									
Customer Reference: 42028									
Soil Analysed as Soil									
Total and Speciated USEPA16 PAH									
SAL Reference		632134 001	632134 002	632134 003	632134 004	632134 005			
Customer Sample Reference		WS01	WS02	BHD	BHC	BHA			
Test Sample		M105	M105	M105	M105	M105			
Top Depth						0.5			
Bottom Depth		0.20	1.50	0.50	0.50	1.0			
Date Sampled		01-FEB-2017	01-FEB-2017	03-FEB-2017	03-FEB-2017	30-JAN-2017			
Type		Sandy Soil	Clay	Clay	Sandy Soil	Sandy Soil			
Determinand	Method	LOD	Units	Symbol					
Naphthalene	GC/MS (MCERTS)	0.1	mg/kg	M	(100) <1.0	<0.1	<0.1	<0.1	(100) <1.0
Acenaphthylene	GC/MS (MCERTS)	0.1	mg/kg	U	(100) <1.0	<0.1	<0.1	<0.1	(100) <1.0
Acenaphthene	GC/MS (MCERTS)	0.1	mg/kg	M	(100) <1.0	<0.1	<0.1	<0.1	(100) <1.0
Fluorene	GC/MS (MCERTS)	0.1	mg/kg	M	(100) <1.0	<0.1	<0.1	<0.1	(100) <1.0
Phenanthrene	GC/MS (MCERTS)	0.1	mg/kg	M	(100) <1.0	<0.1	<0.1	<0.1	(100) <1.0
Anthracene	GC/MS (MCERTS)	0.1	mg/kg	U	(100) <1.0	<0.1	<0.1	<0.1	(100) <1.0
Fluoranthene	GC/MS (MCERTS)	0.1	mg/kg	M	2.0	<0.1	0.2	<0.1	1.8
Pyrene	GC/MS (MCERTS)	0.1	mg/kg	M	2.1	<0.1	0.3	<0.1	1.7
Benzo(a)Anthracene	GC/MS (MCERTS)	0.1	mg/kg	M	1.5	<0.1	0.2	<0.1	(100) <1.0
Chrysene	GC/MS (MCERTS)	0.1	mg/kg	M	1.7	<0.1	0.2	<0.1	(100) <1.0
Benzo(b/k)Fluoranthene	GC/MS (MCERTS)	0.1	mg/kg	M	2.4	<0.1	0.2	<0.1	1.4
Benzo(a)Pyrene	GC/MS (MCERTS)	0.1	mg/kg	M	1.3	<0.1	0.1	<0.1	(100) <1.0
Indeno(123-cd)Pyrene	GC/MS (MCERTS)	0.1	mg/kg	M	(100) <1.0	<0.1	<0.1	<0.1	(100) <1.0
Dibenzo(ah)Anthracene	GC/MS (MCERTS)	0.1	mg/kg	M	(100) <1.0	<0.1	<0.1	<0.1	(100) <1.0
Benzo(ghi)Perylene	GC/MS (MCERTS)	0.1	mg/kg	M	1.2	<0.1	<0.1	<0.1	(100) <1.0
Coronene	GC/MS	0.1	mg/kg	N	(100) <1.0	<0.1	<0.1	<0.1	(100) <1.0
Phenol	GC/MS (MCERTS)	0.1	mg/kg	M	(100) <1.0	<0.1	<0.1	<0.1	(100) <1.0
Polyaromatic Hydrocarbons (Total)	GC/MS (MCERTS)	0.1	mg/kg	U	12	<0.1	1.2	<0.1	4.9

SAL Reference: 632134 Project Site: Arundel Street Customer Reference: 42028 Soil Analysed as Soil PCB EC7									
SAL Reference				632134 001	632134 002	632134 003	632134 004	632134 005	
Customer Sample Reference				WS01	WS02	BHD	BHC	BHA	
Test Sample				M105	M105	M105	M105	M105	
Top Depth								0.5	
Bottom Depth				0.20	1.50	0.50	0.50	1.0	
Date Sampled				01-FEB-2017	01-FEB-2017	03-FEB-2017	03-FEB-2017	30-JAN-2017	
Type				Sandy Soil	Clay	Clay	Sandy Soil	Sandy Soil	
Determinand	Method	LOD	Units	Symbol					
Polychlorinated biphenyl BZ#28	GC/MS (HR) (MCERTS)	0.0000 5	mg/kg	M	(62) <0.0010	(62) <0.0010	(62) <0.0010	(62) <0.0010	(62) <0.0010
Polychlorinated biphenyl BZ#52	GC/MS (HR) (MCERTS)	0.0000 5	mg/kg	M	(62) <0.0010	(62) <0.0010	(62) <0.0010	(62) <0.0010	(62) <0.0010
Polychlorinated biphenyl BZ#101	GC/MS (HR) (MCERTS)	0.0000 5	mg/kg	M	(62) <0.0010	(62) <0.0010	(62) <0.0010	(62) <0.0010	(62) <0.0010
Polychlorinated biphenyl BZ#118	GC/MS (HR) (MCERTS)	0.0000 5	mg/kg	M	(62) <0.0010	(62) <0.0010	(62) <0.0010	(62) <0.0010	(62) <0.0010
Polychlorinated biphenyl BZ#138	GC/MS (HR) (MCERTS)	0.0000 5	mg/kg	M	(62) <0.0010	(62) <0.0010	(62) <0.0010	(62) <0.0010	(62) <0.0010
Polychlorinated biphenyl BZ#153	GC/MS (HR) (MCERTS)	0.0000 5	mg/kg	M	(62) <0.0010	(62) <0.0010	(62) <0.0010	(62) <0.0010	(62) <0.0010
Polychlorinated biphenyl BZ#180	GC/MS (HR) (MCERTS)	0.0000 5	mg/kg	M	(62) <0.0010	(62) <0.0010	(62) <0.0010	(62) <0.0010	(62) <0.0010

SAL Reference: 632134											
Project Site: Arundel Street											
Customer Reference: 42028											
Soil	Analysed as Soil										
TPH											
SAL Reference		632134 001		632134 002		632134 003		632134 004		632134 005	
Customer Sample Reference		WS01		WS02		BHD		BHC		BHA	
Test Sample		M105		M105		M105		M105		M105	
Top Depth										0.5	
Bottom Depth		0.20		1.50		0.50		0.50		1.0	
Date Sampled		01-FEB-2017		01-FEB-2017		03-FEB-2017		03-FEB-2017		30-JAN-2017	
Type		Sandy Soil		Clay		Clay		Sandy Soil		Sandy Soil	
Determinand		Method	LOD	Units	Symbol						
Total Petroleum Hydrocarbons (C35-C40)		GC/FID	1	mg/kg	N	(13) 1200	(13) 25	(13) 22	(13) 12	(13) 110	
Total Petroleum Hydrocarbons		GC/FID	1	ma/ka	M	(13) 2700	(13) 180	(13) 47	(13) 23	(13) 290	

SAL Reference: 632134									
Project Site: Arundel Street									
Customer Reference: 42028									
Leachate to BS EN 12457-2 (10:1) Analysed as Water									
Waste Acceptance Criteria									
SAL Reference				632134 001	632134 002	632134 003	632134 004	632134 005	
Customer Sample Reference				WS01	WS02	BHD	BHC	BHA	
Test Sample				10:1	10:1	10:1	10:1	10:1	
Top Depth								0.5	
Bottom Depth				0.20	1.50	0.50	0.50	1.0	
Date Sampled				01-FEB-2017	01-FEB-2017	03-FEB-2017	03-FEB-2017	30-JAN-2017	
Type				Sandy Soil	Clay	Clay	Sandy Soil	Sandy Soil	
Determinand	Method	LOD	Units	Symbol					
Antimony (Dissolved)	ICP/MS (Filtered)	1	µg/l	U	2	<1	2	<1	8
Arsenic (Dissolved)	ICP/MS (Filtered)	0.2	µg/l	U	16	0.3	1.5	0.4	6.6
Barium (Dissolved)	ICP/MS (Filtered)	1	µg/l	U	33	6	10	2	40
Cadmium (Dissolved)	ICP/MS (Filtered)	0.02	µg/l	U	0.05	0.05	<0.02	0.05	0.03
Chromium (Dissolved)	ICP/MS (Filtered)	1	µg/l	U	3	2	1	1	48
Copper (Dissolved)	ICP/MS (Filtered)	0.5	µg/l	U	2.8	<0.5	<0.5	<0.5	5.4
Lead (Dissolved)	ICP/MS (Filtered)	0.3	µg/l	U	4.4	0.4	<0.3	<0.3	23
Mercury (Dissolved)	ICP/MS (Filtered)	0.05	µg/l	U	0.08	<0.05	<0.05	<0.05	0.10
Molybdenum (Dissolved)	ICP/MS (Filtered)	1	µg/l	N	4	<1	3	4	3
Nickel (Dissolved)	ICP/MS (Filtered)	1	µg/l	U	1	<1	<1	<1	<1
Selenium (Dissolved)	ICP/MS (Filtered)	0.5	µg/l	U	<0.5	<0.5	<0.5	<0.5	0.5
Zinc (Dissolved)	ICP/MS (Filtered)	2	µg/l	U	8	4	10	<2	8
Chloride	Discrete Analyser	1	mg/l	U	1	<1	<1	<1	3
Fluoride	Discrete Analyser	0.05	mg/l	U	0.25	0.29	0.67	0.45	0.29
Sulphate	Discrete Analyser	0.5	mg/l	U	4.4	1.2	1.0	1.3	35
Phenols (Total-Mono)	Colorimetry	0.1	mg/l	U	<0.1	<0.1	<0.1	<0.1	<0.1
Dissolved Organic Carbon	OX/IR	1	mg/l	N	8	5	11	10	8
Electrical Conductivity	Probe	10	µS/cm	N	74	74	180	68	180
Total Dissolved Solids	Grav	100	mg/l	N	<100	<100	110	<100	110

Index to symbols used in 632134-2

Value	Description
AR	As Received
M105	Analysis conducted on an "as received" aliquot. Results are reported on a dry weight basis where moisture content was determined by assisted drying of sample at 105C
10:1 S	Data for BS EN 12457-2 (10:1)
10:1	Leachate to BS EN 12457-2 (10:1)
M40	Analysis conducted on sample assisted dried at no more than 40C. Results are reported on a dry weight basis.
13	Results have been blank corrected.
110	LOD raised due to low internal standard recovery.
62	LOD was raised due to the method performance of the analytical procedure used
100	LOD determined by sample aliquot used for analysis
M	Analysis is MCERTS accredited
U	Analysis is UKAS accredited
N	Analysis is not UKAS accredited

Certificate of Analysis

Report Number: 632554-1

Date of Report: 22-Feb-2017

Customer: Ian Farmer Associates
14-15 Rufford Court
Hardwick Grange
Warrington
Cheshire
WA1 4RF

Customer Contact: Ms Hannah Hadwin

Customer Job Reference: 42028

Customer Purchase Order: 42264

Customer Site Reference: Arundel Street

Date Job Received at SAL: 02-Feb-2017

Date Analysis Started: 10-Feb-2017

Date Analysis Completed: 21-Feb-2017

The results reported relate to samples received in the laboratory and may not be representative of a whole batch.

Opinions and interpretations expressed herein are outside the scope of UKAS 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

All results have been reviewed in accordance with Section 25 of the SAL Quality Manual



Report checked
and authorised by :
Stefan Kondziela
Project Manager

Issued by :
Stefan Kondziela
Project Manager

Waste Acceptance Criteria

Customer Sample Reference : BHB

SAL Sample Reference : 632554 001

Project Site : Arundel Street

Customer Reference : 42028

Bottom Depth : 0.50

Date Sampled : 02-FEB-2017

Type : Sandy Soil

Soil					Result	Inert Waste Landfill	Stable non reactive	Hazardous Waste Landfill
Determinand	Technique	LOD	Units	Symbol				
Acid Neutralising Capacity (pH 4)	Titration	2	Mol/kg	N	<2			
Acid Neutralising Capacity (pH 7)	Titration	2	Mol/kg	N	<2			
Loss on Ignition	Grav	0.1	%	N	5.2			10.0
pH	Probe			M	7.9		> 6.0	
Total Organic Carbon	OX/IR	0.1	%	N	1.6	3.0	5.0	6.0
BTEX (Sum)	Calc	0.040	mg/kg	U	<0.040	6.0		
PAH (Sum)	Calc	1.6	mg/kg	N	5.8	100.0		
PCB EC7 (Sum)	Calc	0.0070	mg/kg	U	⁽⁶²⁾ <0.0070	1.0		
Total Petroleum Hydrocarbons C10-C40 (Sum)	Calc	1	mg/kg	N	⁽¹³⁾ 43	500.0		

Data for BS EN 12457-2 (10:1)					Result	Inert Waste Landfill	Stable non reactive	Hazardous Waste Landfill
Determinand	Technique	LOD	Units	Symbol				
Antimony	Calc WAC ICP/MS	0.010	mg/kg	N	0.017	0.06	0.7	5.0
Arsenic	Calc WAC ICP/MS	0.0020	mg/kg	N	0.020	0.5	2.0	25.0
Barium	Calc WAC ICP/MS	0.010	mg/kg	N	0.14	20.0	100.0	300.0
Cadmium	Calc WAC ICP/MS	0.00020	mg/kg	N	0.00052	0.04	1.0	5.0
Chromium	Calc WAC ICP/MS	0.010	mg/kg	N	0.027	0.5	10.0	70.0
Copper	Calc WAC ICP/MS	0.0050	mg/kg	N	0.023	2.0	50.0	100.0
Lead	Calc WAC ICP/MS	0.0030	mg/kg	N	0.021	0.5	10.0	50.0
Mercury	Calc WAC ICP/MS	0.00050	mg/kg	N	<0.00050	0.01	0.2	2.0
Molybdenum	Calc WAC ICP/MS	0.010	mg/kg	N	0.17	0.5	10.0	30.0
Nickel	Calc WAC ICP/MS	0.010	mg/kg	N	<0.010	0.4	10.0	40.0
Selenium	Calc WAC ICP/MS	0.0050	mg/kg	N	<0.0050	0.1	0.5	7.0
Zinc	Calc WAC ICP/MS	0.020	mg/kg	N	0.18	4.0	50.0	200.0
Chloride	Calc (W)	10	mg/kg	N	<10	800.0	15000.0	25000.0
Fluoride	Calc (W)	0.50	mg/kg	N	7.8	10.0	150.0	500.0
Sulphate	Calc (W)	5	mg/kg	N	61	1000.0	20000.0	50000.0
Phenols (Total-Mono)	Calc	1.0	mg/kg	N	<1.0	1.0		
Dissolved Organic Carbon	Calc	10	mg/kg	N	130	500.0	800.0	1000.0
Total Dissolved Solids	Calc WAC ICP/MS	1000	mg/kg	N	<1000	4000.0	60000.0	100000.0

Following the recommendation from the Environment Agency (England and Wales)*, the leachate preparation in this report has been carried out to BS EN 12457-2 : One Stage batch test at a liquid to solid ratio of 10 l/kg. This is also compliant with Schedule 10 of the Environmental Permitting Regulations 2010.

Note : This is the minimum amount of testing which is required.

Further testing may be required if :

- evidence of immediately leachable parameters becomes available.
- evidence to indicate that the sample could be classified as hazardous under H1-H14 of the Waste(England and Wales) Regulations 2011(as amended) becomes available.

Acceptance of waste at landfill is always at the discretion of the Landfill Operator.

* Waste Sampling and Testing for Disposal at Landfill, EBPR1 11507B, Environment Agency (England and Wales) March 2013

Waste Acceptance Criteria

Customer Sample Reference : BHAA
 SAL Sample Reference : 632554 002
 Project Site : Arundel Street
 Customer Reference : 42028
 Bottom Depth : 1.50
 Date Sampled : 02-FEB-2017
 Type : Sandy Soil

Soil					Result	Inert Waste Landfill	Stable non reactive	Hazardous Waste Landfill
Determinand	Technique	LOD	Units	Symbol				
Acid Neutralising Capacity (pH 4)	Titration	2	Mol/kg	N	<2			
Acid Neutralising Capacity (pH 7)	Titration	2	Mol/kg	N	<2			
Loss on Ignition	Grav	0.1	%	N	7.8			10.0
pH	Probe			M	8.3		> 6.0	
Total Organic Carbon	OX/IR	0.1	%	N	9.8	3.0	5.0	6.0
BTEX (Sum)	Calc	0.040	mg/kg	U	<0.040	6.0		
PAH (Sum)	Calc	1.6	mg/kg	N	10	100.0		
PCB EC7 (Sum)	Calc	0.0070	mg/kg	U	⁽⁶²⁾ <0.0070	1.0		
Total Petroleum Hydrocarbons C10-C40 (Sum)	Calc	1	mg/kg	N	⁽¹³⁾ 62	500.0		

Data for BS EN 12457-2 (10:1)					Result	Inert Waste Landfill	Stable non reactive	Hazardous Waste Landfill
Determinand	Technique	LOD	Units	Symbol				
Antimony	Calc WAC ICP/MS	0.010	mg/kg	N	0.062	0.06	0.7	5.0
Arsenic	Calc WAC ICP/MS	0.0020	mg/kg	N	0.12	0.5	2.0	25.0
Barium	Calc WAC ICP/MS	0.010	mg/kg	N	0.34	20.0	100.0	300.0
Cadmium	Calc WAC ICP/MS	0.00020	mg/kg	N	0.0014	0.04	1.0	5.0
Chromium	Calc WAC ICP/MS	0.010	mg/kg	N	0.089	0.5	10.0	70.0
Copper	Calc WAC ICP/MS	0.0050	mg/kg	N	0.14	2.0	50.0	100.0
Lead	Calc WAC ICP/MS	0.0030	mg/kg	N	0.24	0.5	10.0	50.0
Mercury	Calc WAC ICP/MS	0.00050	mg/kg	N	0.0055	0.01	0.2	2.0
Molybdenum	Calc WAC ICP/MS	0.010	mg/kg	N	0.099	0.5	10.0	30.0
Nickel	Calc WAC ICP/MS	0.010	mg/kg	N	0.013	0.4	10.0	40.0
Selenium	Calc WAC ICP/MS	0.0050	mg/kg	N	0.010	0.1	0.5	7.0
Zinc	Calc WAC ICP/MS	0.020	mg/kg	N	0.20	4.0	50.0	200.0
Chloride	Calc (W)	10	mg/kg	N	31	800.0	15000.0	25000.0
Fluoride	Calc (W)	0.50	mg/kg	N	4.1	10.0	150.0	500.0
Sulphate	Calc (W)	5	mg/kg	N	610	1000.0	20000.0	50000.0
Phenols (Total-Mono)	Calc	1.0	mg/kg	N	<1.0	1.0		
Dissolved Organic Carbon	Calc	10	mg/kg	N	80	500.0	800.0	1000.0
Total Dissolved Solids	Calc WAC ICP/MS	1000	mg/kg	N	1700	4000.0	60000.0	100000.0

Following the recommendation from the Environment Agency (England and Wales)*, the leachate preparation in this report has been carried out to BS EN 12457-2 : One Stage batch test at a liquid to solid ratio of 10 l/kg. This is also compliant with Schedule 10 of the Environmental Permitting Regulations 2010.

Note : This is the minimum amount of testing which is required.

Further testing may be required if :

- evidence of immediately leachable parameters becomes available.
- evidence to indicate that the sample could be classified as hazardous under H1-H14 of the Waste(England and Wales) Regulations 2011(as amended) becomes available.

Acceptance of waste at landfill is always at the discretion of the Landfill Operator.

* Waste Sampling and Testing for Disposal at Landfill, EBPR1 11507B, Environment Agency (England and Wales) March 2013

Waste Acceptance Criteria

Customer Sample Reference : BHC
 SAL Sample Reference : 632554 003
 Project Site : Arundel Street
 Customer Reference : 42028
 Bottom Depth : 0.50
 Date Sampled : 03-FEB-2017
 Type : Sandy Soil

Soil					Result	Inert Waste Landfill	Stable non reactive	Hazardous Waste Landfill
Determinand	Technique	LOD	Units	Symbol				
Acid Neutralising Capacity (pH 4)	Titration	2	Mol/kg	N	<2			
Acid Neutralising Capacity (pH 7)	Titration	2	Mol/kg	N	<2			
Loss on Ignition	Grav	0.1	%	N	1.2			10.0
pH	Probe			M	8.5		> 6.0	
Total Organic Carbon	OX/IR	0.1	%	N	10	3.0	5.0	6.0
BTEX (Sum)	Calc	0.040	mg/kg	U	<0.040	6.0		
PAH (Sum)	Calc	1.6	mg/kg	N	<1.6	100.0		
PCB EC7 (Sum)	Calc	0.0070	mg/kg	U	⁽⁶²⁾ <0.0070	1.0		
Total Petroleum Hydrocarbons C10-C40 (Sum)	Calc	1	mg/kg	N	⁽¹³⁾ 65	500.0		

Data for BS EN 12457-2 (10:1)					Result	Inert Waste Landfill	Stable non reactive	Hazardous Waste Landfill
Determinand	Technique	LOD	Units	Symbol				
Antimony	Calc WAC ICP/MS	0.010	mg/kg	N	<0.010	0.06	0.7	5.0
Arsenic	Calc WAC ICP/MS	0.0020	mg/kg	N	0.0045	0.5	2.0	25.0
Barium	Calc WAC ICP/MS	0.010	mg/kg	N	0.57	20.0	100.0	300.0
Cadmium	Calc WAC ICP/MS	0.00020	mg/kg	N	0.0024	0.04	1.0	5.0
Chromium	Calc WAC ICP/MS	0.010	mg/kg	N	0.030	0.5	10.0	70.0
Copper	Calc WAC ICP/MS	0.0050	mg/kg	N	0.024	2.0	50.0	100.0
Lead	Calc WAC ICP/MS	0.0030	mg/kg	N	<0.0030	0.5	10.0	50.0
Mercury	Calc WAC ICP/MS	0.00050	mg/kg	N	<0.00050	0.01	0.2	2.0
Molybdenum	Calc WAC ICP/MS	0.010	mg/kg	N	1.1	0.5	10.0	30.0
Nickel	Calc WAC ICP/MS	0.010	mg/kg	N	<0.010	0.4	10.0	40.0
Selenium	Calc WAC ICP/MS	0.0050	mg/kg	N	<0.0050	0.1	0.5	7.0
Zinc	Calc WAC ICP/MS	0.020	mg/kg	N	0.044	4.0	50.0	200.0
Chloride	Calc (W)	10	mg/kg	N	<10	800.0	15000.0	25000.0
Fluoride	Calc (W)	0.50	mg/kg	N	1.3	10.0	150.0	500.0
Sulphate	Calc (W)	5	mg/kg	N	13	1000.0	20000.0	50000.0
Phenols (Total-Mono)	Calc	1.0	mg/kg	N	<1.0	1.0		
Dissolved Organic Carbon	Calc	10	mg/kg	N	52	500.0	800.0	1000.0
Total Dissolved Solids	Calc WAC ICP/MS	1000	mg/kg	N	<1000	4000.0	60000.0	100000.0

Following the recommendation from the Environment Agency (England and Wales)*, the leachate preparation in this report has been carried out to BS EN 12457-2 : One Stage batch test at a liquid to solid ratio of 10 l/kg. This is also compliant with Schedule 10 of the Environmental Permitting Regulations 2010.

Note : This is the minimum amount of testing which is required.

Further testing may be required if :

- evidence of immediately leachable parameters becomes available.
- evidence to indicate that the sample could be classified as hazardous under H1-H14 of the Waste(England and Wales) Regulations 2011(as amended) becomes available.

Acceptance of waste at landfill is always at the discretion of the Landfill Operator.

* Waste Sampling and Testing for Disposal at Landfill, EBPR1 11507B, Environment Agency (England and Wales) March 2013

SAL Reference: 632554									
Project Site: Arundel Street									
Customer Reference: 42028									
Soil Analysed as Soil									
MCERTS Preparation									
SAL Reference				632554 001		632554 002		632554 003	
Customer Sample Reference				BHB		BHAA		BHC	
Test Sample				AR		AR		AR	
Bottom Depth				0.50		1.50		0.50	
Date Sampled				02-FEB-2017		02-FEB-2017		03-FEB-2017	
Type				Sandy Soil		Sandy Soil		Sandy Soil	
Determinand		Method		LOD		Units		Symbol	
Moisture @105C		Grav (1 Dec) (105 C)		0.1		%		N	
						12		19	
								2.6	

SAL Reference: 632554							
Project Site: Arundel Street							
Customer Reference: 42028							
Soil							

SAL Reference: 632554							
Project Site: Arundel Street							
Customer Reference: 42028							
Soil		Analysed as Soil					
BTEX							
SAL Reference					632554 001	632554 002	632554 003
Customer Sample Reference					BHB	BHAA	BHC
Test Sample					M105	M105	M105
Bottom Depth					0.50	1.50	0.50
Date Sampled					02-FEB-2017	02-FEB-2017	03-FEB-2017
Type					Sandy Soil	Sandy Soil	Sandy Soil
Determinand	Method	LOD	Units	Symbol			
Benzene	GC/MS (Head Space)(MCERTS)	0.010	mg/kg	M	(13) <0.010	(13) <0.010	(13) <0.010
Toluene	GC/MS (Head Space)(MCERTS)	0.010	mg/kg	M	<0.010	<0.010	<0.010
EthylBenzene	GC/MS (Head Space)(MCERTS)	0.010	mg/kg	M	<0.010	<0.010	<0.010
Meta/Para-Xylene	GC/MS (Head Space)(MCERTS)	0.010	mg/kg	M	<0.010	<0.010	<0.010
Ortho-Xylene	GC/MS (Head Space)(MCERTS)	0.010	mg/kg	M	<0.010	<0.010	<0.010

SAL Reference: 632554							
Project Site: Arundel Street							
Customer Reference: 42028							
Soil							

SAL Reference: 632554 Project Site: Arundel Street Customer Reference: 42028								
Soil		Analysed as Soil						
PCB EC7								
SAL Reference					632554 001	632554 002	632554 003	
Customer Sample Reference					BHB	BHAA	BHC	
Test Sample					M105	M105	M105	
Bottom Depth					0.50	1.50	0.50	
Date Sampled					02-FEB-2017	02-FEB-2017	03-FEB-2017	
Type					Sandy Soil	Sandy Soil	Sandy Soil	
Determinand	Method	LOD	Units	Symbol				
Polychlorinated biphenyl BZ#28	GC/MS (HR) (MCERTS)	0.0000 5	mg/kg	M	(62) <0.0010	(62) <0.0010	(62) <0.0010	
Polychlorinated biphenyl BZ#52	GC/MS (HR) (MCERTS)	0.0000 5	mg/kg	M	(62) <0.0010	(62) <0.0010	(62) <0.0010	
Polychlorinated biphenyl BZ#101	GC/MS (HR) (MCERTS)	0.0000 5	mg/kg	M	(62) <0.0010	(62) <0.0010	(62) <0.0010	
Polychlorinated biphenyl BZ#118	GC/MS (HR) (MCERTS)	0.0000 5	mg/kg	M	(62) <0.0010	(62) <0.0010	(62) <0.0010	
Polychlorinated biphenyl BZ#138	GC/MS (HR) (MCERTS)	0.0000 5	mg/kg	M	(62) <0.0010	(62) <0.0010	(62) <0.0010	
Polychlorinated biphenyl BZ#153	GC/MS (HR) (MCERTS)	0.0000 5	mg/kg	M	(62) <0.0010	(62) <0.0010	(62) <0.0010	
Polychlorinated biphenyl BZ#180	GC/MS (HR) (MCERTS)	0.0000 5	mg/kg	M	(62) <0.0010	(62) <0.0010	(62) <0.0010	

SAL Reference: 632554									
Project Site: Arundel Street									
Customer Reference: 42028									
Soil		Analysed as Soil							
TPH WAC									
SAL Reference				632554 001		632554 002		632554 003	
Customer Sample Reference				BHB		BHAA		BHC	
Test Sample				M105		M105		M105	
Bottom Depth				0.50		1.50		0.50	
Date Sampled				02-FEB-2017		02-FEB-2017		03-FEB-2017	
Type				Sandy Soil		Sandy Soil		Sandy Soil	
Determinand			Method	LOD	Units	Symbol			
Total Petroleum Hydrocarbons (C35-C40)			GC/FID	1	mg/kg	N	(13) 7	(13) 14	(13) 23
Total Petroleum Hydrocarbons			GC/FID	1	ma/ka	M	(13) 37	(13) 48	(13) 42

SAL Reference: 632554								
Project Site: Arundel Street								
Customer Reference: 42028								
Leachate to BS EN 12457-2 (10:1)		Analysed as Water						
Waste Acceptance Criteria								
SAL Reference					632554 001		632554 002	632554 003
Customer Sample Reference					BHB		BHAA	BHC
Test Sample					10:1		10:1	10:1
Bottom Depth					0.50		1.50	0.50
Date Sampled					02-FEB-2017		02-FEB-2017	03-FEB-2017
Type					Sandy Soil		Sandy Soil	Sandy Soil
Determinand		Method	LOD	Units	Symbol			
Antimony (Dissolved)		ICP/MS (Filtered)	1	µg/l	U	2	6	<1
Arsenic (Dissolved)		ICP/MS (Filtered)	0.2	µg/l	U	2.0	12	0.5
Barium (Dissolved)		ICP/MS (Filtered)	1	µg/l	U	14	34	57
Cadmium (Dissolved)		ICP/MS (Filtered)	0.02	µg/l	U	0.05	0.14	0.24
Chromium (Dissolved)		ICP/MS (Filtered)	1	µg/l	U	3	9	3
Copper (Dissolved)		ICP/MS (Filtered)	0.5	µg/l	U	2.3	14	2.4
Lead (Dissolved)		ICP/MS (Filtered)	0.3	µg/l	U	2.1	24	<0.3
Mercury (Dissolved)		ICP/MS (Filtered)	0.05	µg/l	U	<0.05	0.55	<0.05
Molybdenum (Dissolved)		ICP/MS (Filtered)	1	µg/l	N	17	10	110
Nickel (Dissolved)		ICP/MS (Filtered)	1	µg/l	U	<1	1	<1
Selenium (Dissolved)		ICP/MS (Filtered)	0.5	µg/l	U	<0.5	1.0	<0.5
Zinc (Dissolved)		ICP/MS (Filtered)	2	µg/l	U	18	20	4
Chloride		Discrete Analyser	1	mg/l	U	<1	3	<1
Fluoride		Discrete Analyser	0.05	mg/l	U	0.78	0.41	0.13
Sulphate		Discrete Analyser	0.5	mg/l	U	6.1	61	1.3
Phenols (Total-Mono)		Colorimetry	0.1	mg/l	U	<0.1	<0.1	<0.1
Dissolved Organic Carbon		OX/IR	1	mg/l	N	13	8	5
Electrical Conductivity		Probe	10	µS/cm	N	130	220	47
Total Dissolved Solids		Grav	100	mg/l	N	<100	170	<100

Index to symbols used in 632554-1

Value	Description
M40	Analysis conducted on sample assisted dried at no more than 40C. Results are reported on a dry weight basis.
AR	As Received
10:1 S	Data for BS EN 12457-2 (10:1)
M105	Analysis conducted on an "as received" aliquot. Results are reported on a dry weight basis where moisture content was determined by assisted drying of sample at 105C
10:1	Leachate to BS EN 12457-2 (10:1)
62	LOD was raised due to the method performance of the analytical procedure used
13	Results have been blank corrected.
M	Analysis is MCERTS accredited
U	Analysis is UKAS accredited
N	Analysis is not UKAS accredited

Concept Life Sciences

Certificate of Analysis

Hadfield House
Hadfield Street
Cornbrook
Manchester
M16 9FE
Tel : 0161 874 2400
Fax : 0161 874 2468

Report Number: 639433-1

Date of Report: 23-Mar-2017

Customer: Ian Farmer Associates
14-15 Rufford Court
Hardwick Grange
Warrington
Cheshire
WA1 4RF

Customer Contact: Ms Hannah Hadwin

Customer Job Reference: 42028

Customer Purchase Order: 42411

Customer Site Reference: Arundle Street

Date Job Received at Concept: 10-Mar-2017

Date Analysis Started: 13-Mar-2017

Date Analysis Completed: 23-Mar-2017

The results reported relate to samples received in the laboratory and may not be representative of a whole batch.

Opinions and interpretations expressed herein are outside the scope of UKAS 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 Concept SOPs



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Report checked
and authorised by :
Stefan Kondziela
Project Manager

Issued by :
Stefan Kondziela
Project Manager



Concept Reference: 639433 Project Site: Arundle Street Customer Reference: 42028 Water Analysed as Water Miscellaneous					
Concept Reference					639433 001
Customer Sample Reference					BH B
Date Sampled					10-MAR-2017
Determinand	Method	Test Sample	LOD	Units	
Ammonia expressed as NH3	T686	F	0.05	mg/l	1.1
Ba (Dissolved)	T281	AR	1	µg/l	87
Chloride	T686	F	1	mg/l	43
Cyanide(Total)	T4	AR	0.05	mg/l	<0.05
Hardness expressed as CaCO3	T6	AR	10	mg/l	410
pH	T7	AR			7.2
Phenols(Mono)	T4	AR	0.1	mg/l	<0.1
Sulphate	T686	F	0.5	mg/l	87
Total Organic Carbon	T21	AR	1	mg/l	69

Concept Reference: 639433 Project Site: Arundle Street Customer Reference: 42028 Water Analysed as Water Heavy Metals(9) dissolved					
Concept Reference					639433 001
Customer Sample Reference					BH B
Date Sampled					10-MAR-2017
Determinand	Method	Test Sample	LOD	Units	
As (Dissolved)	T281	AR	0.2	µg/l	0.8
Cd (Dissolved)	T281	AR	0.02	µg/l	0.07
Cr (Dissolved)	T281	AR	1	µg/l	8
Cu (Dissolved)	T281	AR	0.5	µg/l	6.3
Pb (Dissolved)	T281	AR	0.3	µg/l	<0.3
Hg (Dissolved)	T281	AR	0.05	µg/l	<0.05
Ni (Dissolved)	T281	AR	1	µg/l	3
Se (Dissolved)	T281	AR	0.5	µg/l	4.6
Zn (Dissolved)	T281	AR	2	µg/l	15

Concept Reference: 639433 Project Site: Arundle Street Customer Reference: 42028 Water Analysed as Water PAH US EPA 16 (B and K split)					
Concept Reference					639433 001
Customer Sample Reference					BH B
Date Sampled					10-MAR-2017
Determinand	Method	Test Sample	LOD	Units	
Naphthalene	T149	AR	0.01	µg/l	(13) <0.01
Acenaphthylene	T149	AR	0.01	µg/l	(13) <0.01
Acenaphthene	T149	AR	0.01	µg/l	(13) <0.01
Fluorene	T149	AR	0.01	µg/l	(13) <0.01
Phenanthrene	T149	AR	0.01	µg/l	(13) <0.01
Anthracene	T149	AR	0.01	µg/l	(13) 0.01
Fluoranthene	T149	AR	0.01	µg/l	(13) <0.01
Pyrene	T149	AR	0.01	µg/l	(13) 0.01
Benzo(a)Anthracene	T149	AR	0.01	µg/l	(13) <0.01
Chrysene	T149	AR	0.01	µg/l	(13) <0.01
Benzo(b)fluoranthene	T149	AR	0.01	µg/l	(13) <0.01
Benzo(k)fluoranthene	T149	AR	0.01	µg/l	(13) <0.01
Benzo(a)Pyrene	T149	AR	0.01	µg/l	(13) <0.01
Indeno(123-cd)Pyrene	T149	AR	0.01	µg/l	(13) <0.01
Dibenzo(ah)Anthracene	T149	AR	0.01	µg/l	(13) <0.01
Benzo(ghi)Perylene	T149	AR	0.01	µg/l	(13) <0.01
PAH(total)	T149	AR	0.01	µg/l	0.02

Concept Reference: 639433 Project Site: Arundle Street Customer Reference: 42028 Water Analysed as Water TPH (CWG) with MTBE, BTEX					
Concept Reference					639433 001
Customer Sample Reference					BH B
Date Sampled					10-MAR-2017
Determinand	Method	Test Sample	LOD	Units	
Benzene	T54	AR	1	µg/l	(13) <1
Toluene	T54	AR	1	µg/l	<1
EthylBenzene	T54	AR	1	µg/l	<1
M/P Xylene	T54	AR	1	µg/l	<1
O Xylene	T54	AR	1	µg/l	<1
Methyl tert-Butyl Ether	T54	AR	1	µg/l	<1
TPH (C5-C6 aliphatic)	T215	AR	0.010	mg/l	<0.010
TPH (C6-C8 aliphatic)	T215	AR	0.010	mg/l	<0.010
TPH (C8-C10 aliphatic)	T215	AR	0.010	mg/l	<0.010
TPH (C10-C12 aliphatic)	T910	AR	0.01	mg/l	(13) <0.01
TPH (C12-C16 aliphatic)	T910	AR	0.01	mg/l	(13) <0.01
TPH (C16-C21 aliphatic)	T910	AR	0.01	mg/l	(13) <0.01
TPH (C21-C35 aliphatic)	T910	AR	0.01	mg/l	(13) <0.01
TPH (C6-C7 aromatic)	T215	AR	0.010	mg/l	<0.010
TPH (C7-C8 aromatic)	T215	AR	0.010	mg/l	<0.010
TPH (C8-C10 aromatic)	T215	AR	0.010	mg/l	<0.010
TPH (C10-C12 aromatic)	T910	AR	0.01	mg/l	(13) <0.01
TPH (C12-C16 aromatic)	T910	AR	0.01	mg/l	(13) <0.01
TPH (C16-C21 aromatic)	T910	AR	0.01	mg/l	(13) <0.01
TPH (C21-C35 aromatic)	T910	AR	0.01	mg/l	(13) <0.01

Index to symbols used in 639433-1

Value	Description
F	Filtered
AR	As Received
13	Results have been blank corrected.

U	Analysis is UKAS accredited
N	Analysis is not UKAS accredited

Method Index

Value	Description
T215	GC/MS (Headspace)(LV)
T281	ICP/MS (Filtered)
T686	Discrete Analyser
T4	Colorimetry
T7	Probe
T54	GC/MS (Headspace)
T910	GCxGC (LV)
T21	OX/IR
T149	GC/MS (SIR)
T6	ICP/OES

Accreditation Summary

Determinand	Method	Test Sample	LOD	Units	Symbol	Concept References
Ammonia expressed as NH ₃	T686	F	0.05	mg/l	U	001
Ba (Dissolved)	T281	AR	1	µg/l	U	001
Chloride	T686	F	1	mg/l	U	001
Cyanide(Total)	T4	AR	0.05	mg/l	U	001
Hardness expressed as CaCO ₃	T6	AR	10	mg/l	N	001
pH	T7	AR			U	001
Phenols(Mono)	T4	AR	0.1	mg/l	U	001
Sulphate	T686	F	0.5	mg/l	U	001
Total Organic Carbon	T21	AR	1	mg/l	U	001
Benzene	T54	AR	1	µg/l	U	001
Toluene	T54	AR	1	µg/l	U	001
EthylBenzene	T54	AR	1	µg/l	U	001
M/P Xylene	T54	AR	1	µg/l	U	001
O Xylene	T54	AR	1	µg/l	U	001
Methyl tert-Butyl Ether	T54	AR	1	µg/l	U	001
TPH (C5-C6 aliphatic)	T215	AR	0.010	mg/l	N	001
TPH (C6-C8 aliphatic)	T215	AR	0.010	mg/l	N	001
TPH (C8-C10 aliphatic)	T215	AR	0.010	mg/l	N	001
TPH (C10-C12 aliphatic)	T910	AR	0.01	mg/l	N	001
TPH (C12-C16 aliphatic)	T910	AR	0.01	mg/l	N	001
TPH (C16-C21 aliphatic)	T910	AR	0.01	mg/l	N	001
TPH (C21-C35 aliphatic)	T910	AR	0.01	mg/l	N	001
TPH (C6-C7 aromatic)	T215	AR	0.010	mg/l	N	001
TPH (C7-C8 aromatic)	T215	AR	0.010	mg/l	N	001
TPH (C8-C10 aromatic)	T215	AR	0.010	mg/l	N	001
TPH (C10-C12 aromatic)	T910	AR	0.01	mg/l	N	001
TPH (C12-C16 aromatic)	T910	AR	0.01	mg/l	N	001
TPH (C16-C21 aromatic)	T910	AR	0.01	mg/l	N	001
TPH (C21-C35 aromatic)	T910	AR	0.01	mg/l	N	001
As (Dissolved)	T281	AR	0.2	µg/l	U	001
Cd (Dissolved)	T281	AR	0.02	µg/l	U	001
Cr (Dissolved)	T281	AR	1	µg/l	U	001
Cu (Dissolved)	T281	AR	0.5	µg/l	U	001
Pb (Dissolved)	T281	AR	0.3	µg/l	U	001
Hg (Dissolved)	T281	AR	0.05	µg/l	U	001
Ni (Dissolved)	T281	AR	1	µg/l	U	001
Se (Dissolved)	T281	AR	0.5	µg/l	U	001
Zn (Dissolved)	T281	AR	2	µg/l	U	001
Naphthalene	T149	AR	0.01	µg/l	U	001
Acenaphthylene	T149	AR	0.01	µg/l	U	001
Acenaphthene	T149	AR	0.01	µg/l	U	001
Fluorene	T149	AR	0.01	µg/l	U	001
Phenanthrene	T149	AR	0.01	µg/l	U	001
Anthracene	T149	AR	0.01	µg/l	U	001
Fluoranthene	T149	AR	0.01	µg/l	U	001
Pyrene	T149	AR	0.01	µg/l	U	001
Benzo(a)Anthracene	T149	AR	0.01	µg/l	U	001
Chrysene	T149	AR	0.01	µg/l	U	001
Benzo(b)fluoranthene	T149	AR	0.01	µg/l	U	001

Determinand	Method	Test Sample	LOD	Units	Symbol	Concept References
Benzo(k)fluoranthene	T149	AR	0.01	µg/l	U	001
Benzo(a)Pyrene	T149	AR	0.01	µg/l	U	001
Indeno(123-cd)Pyrene	T149	AR	0.01	µg/l	U	001
Dibenzo(ah)Anthracene	T149	AR	0.01	µg/l	U	001
Benzo(ghi)Perylene	T149	AR	0.01	µg/l	U	001
PAH(total)	T149	AR	0.01	µg/l	U	001



APPENDIX 5
DESIGN CONSIDERATIONS

APPENDIX 5

GEOTECHNICAL DESIGN CONSIDERATIONS

A5.1 ASSESSMENT OF GRANULAR SOIL CONDITION

- A5.1.1 SPT 'N' values reported on the borehole logs are as measured in the field with no corrections applied.
- A5.1.2 However for general design in sands the 'N' values should be normalised to 60% by the following equation:-
- A5.1.3 $N_{60} = E_r/60.N$ where:-
- N is the blow count and
- E_r is the energy ratio of the specific test equipment
- A5.1.4 Further corrections for rod length and overburden pressure in sands may be applied in accordance with BS EN ISO 22476-3, ref 9.6.

A5.2 ASSESSMENT OF COHESIVE SOIL CONDITION

- A5.2.1 In accordance with BS EN ISO 22475-1, ref. 9.8, and BS5930, ref.9.4, the thick walled U100 sample is considered as a Class B sampling technique and will only produce Class 3 to 5 quality samples in accordance with EN 1997-2:2007, ref.9.5.
- A5.2.2 Laboratory strength and consolidation testing should only be carried out on Class 1 quality samples, which can be obtained from a Class A sampling technique, ref. 9.5. This is due to possible disturbance during sampling, giving a weaker strength in testing.
- A5.2.3 Therefore laboratory test values for c_u and m_v obtained from thick walled U100 samples should only be used as guidance and not used as absolute values for the shear strength and compressibility properties of the clay and only used to provide guidance to descriptive strength on the borehole records.
- A5.2.4 Work undertaken by Stroud, ref. 9.15 determined a relationship between SPT 'N' values, plasticity undrained shear strength and compressibility of many over-consolidated clays. Further work by Stroud and Butler, ref.9.16, in which data was analysed from sites covering a wide range of glacial deposits, confirmed there to be a correlation between the 'N' value plasticity undrained shear strength and compressibility.
- A5.2.5 The relationship was of the form:
- $$C_u = f_1 \times N$$
- and
- $$m_v = 1/(f_2 \times N)$$
- Where
- c_u = Un-drained shear strength
- m_v = Coefficient of compressibility
- f_1 and f_2 = Factors
- A5.2.6 It was determined by Stroud that f_1 varied between 4kPa for material of high plasticity and 6kPa for material of low plasticity. Similarly f_2 varied between 400kPa and 600kPa.

APPENDIX 6
CONTAMINATION ASSESSMENT

APPENDIX 6

GENERAL NOTES ON CONTAMINATION ASSESSMENT

A6.1 STATUTORY FRAMEWORK AND DEFINITIONS

A6.1.1 The statutory definition of contaminated land is defined in the Environmental Protection Act 1990, ref. 9.25, as;

‘Land which appears to the local authority in whose area it is situated to be in such a condition, by reason of substances in, on or under the land, that –

(a) significant harm is being caused or there is a significant possibility of such harm being caused; or

(b) pollution of controlled waters is being, or is likely to be, caused.’

A6.1.2 The UK guidance on the assessment of contaminated has developed as a direct result of the introduction of these two Acts. The technical guidance supporting the new legislation has been summarised in a number of key documents collectively known as the Contaminated Land Reports (CLRs), a proposed series of twelve documents. Seven were originally published in March 1994, four more were published in April 2002, while the last remaining guidance document, CLR 11, ref. 9.45 was published in 2004. In 2008 CLR reports 7 to 10 were withdrawn by DEFRA and the Environment Agency and updated version of CLR 9 and 10 were produced in the form of Science Reports SR2, ref. 9.39 and SR3, ref. 9.28.

A6.1.3 In establishing whether a site fulfils the statutory definition of ‘contaminated land’ it is necessary to identify, whether a pollutant linkage exists in respect of the land in question and whether the pollutant linkage:

- is resulting in significant harm being caused to the receptor in the pollutant linkage,
- presents a significant possibility of significant harm being caused to that receptor,
- is resulting in the pollution of the controlled waters which constitute the receptor, or
- is likely to result in such pollution.

A6.1.4 A ‘*pollutant linkage*’ may be defined as the link between a contaminant ‘*source*’ and a ‘*receptor*’ by means of a ‘*pathway*’.

A6.2 ASSESSMENT METHODOLOGY

A6.2.1 The guidance proposes a four-stage assessment process for identifying potential pollutant linkages on a site. These stages are set out in the table below:

No.	Process	Description
1	Hazard Identification	Establishing contaminant sources, pathways and receptors (the conceptual model).
2	Hazard Assessment	Analysing the potential for unacceptable risks (what linkages could be present, what could be the effects).
3	Risk Estimation	Trying to establish the magnitude and probability of the possible consequences (what degree of harm might result and to what receptors, and how likely is it).
4	Risk Evaluation	Deciding whether the risk is unacceptable.

A6.2.2 Stages 1 and 2 develop a '*conceptual model*' based upon information collated from desk based studies, and frequently a walkover of the site. The walkover survey should be conducted in general accordance with CLR 2, ref. 9.47. The formation of a conceptual model is an iterative process and as such, it should be updated and refined throughout each stage of the project to reflect any additional information obtained.

A6.2.3 The extent of the desk studies and enquiries to be conducted should be in general accordance with CLR 3, ref.9.27. The information from these enquiries is presented in a desk study report with recommendations, if necessary, for further work based upon the conceptual model. CLR 8, ref. 9.40, together with specific DoE 'Industry Profiles' provides guidance on the nature of contaminants relating to specific industrial processes. Although CLR 8 has been withdrawn, no replacement guidance has been published that lists the contaminants likely to be present on contaminated sites and as such the guidance relating to this issue of CLR 8 is considered to still be relevant.

A6.2.4 If potential pollutant linkages are identified within the conceptual model, a Phase 2 site investigation and report will be recommended. The investigation should be planned in general accordance with CLR 4, ref. 9.1. The number of exploratory holes and samples collected for analysis should be consistent with the size of the site and the level of risk envisaged. This will enable a contamination risk assessment to be conducted, at which point the conceptual model can be updated and relevant pollutant linkages can be identified.

A6.2.5 A two-stage investigation may be more appropriate where time constraints are less of an issue. The first stage investigation being conducted as an initial assessment for the presence of potential sources, a second being a more refined investigation to delineate wherever possible the extent of the identified contamination.

A6.2.6 All site works should be in general accordance with the British Standards, BS 5930:2015, ref. 9.4, ISO 1997, ref. 9.5 and BS 10175:2011, ref. 9.3.

A6.2.7 The generic contamination risk assessment screens the results of the chemical analysis against generic guidance values which are dependent on the proposed end-use of the development.

A6.2.8 The end-use may be defined as one of the following ref. 9.37;

- Residential with homegrown produce – domestic low rise and low density housing with gardens where vegetable may be grown for home consumption
- Residential without homegrown produce – domestic low density and low density housing where no gardens are present.

- Allotments – specific areas where vegetables are grown for home consumption.
- Public open space in close proximity to residential housing – includes the predominantly grassed area adjacent to high density housing and the central green area around which houses are developed. This land-use includes the smaller areas commonly incorporated in newer developments as informal grassed areas or more formal landscaped areas with a mixture of open space and covered soil with planting.
- Public open space in use as general parkland – provided for recreational use and may be used for family visits and picnics, children's play area, sports grounds and dog walking.
- Commercial – industrial premises where there is limited exposure to soil.

A6.2.9 Exposure pathways for each type of end-use are given below:

Standard Land Use	Oral Routes			Dermal Routes		Inhalation Routes			
	Direct soil & dust ingestion	Consumption of homegrown produce	Soil attached to homegrown produce	Indoor	Outdoor	Indoor dust	Outdoor dust	Indoor vapour	Outdoor vapour
Residential with homegrown produce	✓	✓	✓	✓	✓	✓	✓	✓	✓
Residential without homegrown produce	✓	X	X	✓	✓	✓	✓	✓	✓
Allotments	✓	✓	✓	X	✓	X	✓	✓	✓
Public open space – adjacent to dwellings	✓	X	X	✓	✓	✓	✓	X	✓
Public open space – parkland	✓	X	X	X	✓	X	✓	X	✓
Commercial	✓	X	X	✓	X	✓	X	✓	X

A6.2.1 In the first instance, soils will be compared to Suitable 4 Use Levels (S4ULs) published by LQM ref. 9.30. Screening levels for lead are taken from guidance published by DEFRA as no S4UL has been derived, ref. 9.37. Where no S4UL or C4SL is available, the assessment criteria (AC) may be generated using the Contaminated Land Exposure Assessment (CLEA) Software Version 1.07, ref. 9.32. Toxicological and physico-chemical/fate and transport data used to generate the AC will be derived from a hierarchy of data sources as follows:

1. Environment Agency or Department of Environment Food and Rural Affairs (DEFRA) documents;
2. Other documents produced by UK Government or state organisations;
3. European institution documents;
4. International organisation documents;

5. Foreign government institutions.

- A6.2.2 Where appropriate, input data has been drawn from the relevant SGV where available, or existing toxicological reports published by the Environment Agency which have not yet been withdrawn/replaced. Fate and transport data has been derived in the first instance from Environment Agency (2008), ref 9.48.
- A6.2.3 Individual concentrations are compared to the selected screening levels to identify concentrations of contaminants that are above the selected screening criteria. If appropriate, a statistical analysis of the results is conducted, as detailed in CIEH and CL:AIRE 'Guidance on Comparing Soil Contamination Data with a Critical Concentration', ref 9.33.
- A6.2.4 Initially the distribution of the data set is tested using the Shapiro-Wilk normality test to determine if the data set is, or is not, normally distributed. Where the distribution of the data is shown to be normal, the mean value test is applied to determine whether the mean characteristics of the selected soil unit present a significant possibility of significant harm to human health. Where the data is not normally distributed a method based on the Chebychev Theorem can be applied to test the same hypothesis. The significance of the data is further tested using the maximum value test. This determines whether the highest recorded contaminant concentrations are from the same statistical distribution or whether they may represent a 'hot spot'.
- A6.2.5 Where the risk estimation identifies significant concentrations of one or more contaminants, a further risk evaluation needs to be undertaken.
- A6.2.6 The risk evaluation will address the potential pollutant linkages between an identified source of contamination and the likely receptors both on and off site.
- A6.2.7 The potential receptors include:
- 1) Humans – current site occupants, construction workers, future site users and neighbouring site users.
 - 2) Controlled Waters – surface water and groundwater resources
 - 3) Plants – current and future site vegetation
 - 4) Building materials
- A6.2.8 The potential hazards to be considered in relation to contamination are:
- a) Ingestion and inhalation.
 - b) Uptake of contaminants via cultivated vegetables.
 - c) Dermal contact
 - d) Phytotoxicity (the prevention or inhibition of plant growth)
 - e) Contamination of water resources
 - f) Chemical attack on building materials and services
 - g) Fire and explosion
- A6.2.9 Dependent on the outcome of the initial, generic contamination risk assessment, further detailed assessment of the identified risks may be required.

A6.3 Generic Guidance Values Used Within Contamination Risk Assessment

Residential End Use without Homegrown Produce

Residential without Homegrown Produce	Determinant	Guidance Value (mg/kg)	Guidance Value (mg/kg)	Guidance Value (mg/kg)	Primary Data Source
		1% SOM	2.5% SOM	6% SOM	
PAH	Acenaphthene	3000(57.0)	4700(141)	6000(336)	LQM/CIEH S4UL
	Acenaphthylene	2900(86.1)	4600(212)	6000(506)	LQM/CIEH S4UL
	Anthracene	31000(1.17)	35000	37000	LQM/CIEH S4UL
	Benzo(a)anthracene	11	14	15	LQM/CIEH S4UL
	Benzo(a)pyrene	3.2	3.2	3.2	LQM/CIEH S4UL
	Benzo(b)fluoranthene	3.9	4	4	LQM/CIEH S4UL
	Benzo(ghi)perylene	360	360	360	LQM/CIEH S4UL
	Benzo(k)fluoranthene	110	110	110	LQM/CIEH S4UL
	Chrysene	30	31	32	LQM/CIEH S4UL
	Dibenzo(ah)anthracene	0.31	0.32	0.32	LQM/CIEH S4UL
	Fluoranthene	1500	1600	1600	LQM/CIEH S4UL
	Fluorene	2800(30.9)	3800(76.5)	4500(183)	LQM/CIEH S4UL
	Indeno(123-cd)pyrene	45	46	46	LQM/CIEH S4UL
	Naphthalene	2.3	5.6	13	LQM/CIEH S4UL
	Phenanthrene	1300(36.0)	1500	1500	LQM/CIEH S4UL
	Pyrene	3700	3800	3800	LQM/CIEH S4UL
Other Organics	Phenol	750	1300	2300	LQM/CIEH S4UL
Metals	Arsenic	40	40	40	LQM/CIEH S4UL
	Beryllium	1.7	1.7	1.7	LQM/CIEH S4UL
	Boron	11000	11000	11000	LQM/CIEH S4UL
	Cadmium	85	85	85	LQM/CIEH S4UL
	Chromium (III)	910	910	910	LQM/CIEH S4UL
	Chromium (VI)	21	21	21	LQM/CIEH S4UL
	Copper	7100	7100	7100	LQM/CIEH S4UL
	Lead	310	310	310	EA C4SL
	Mercury	1.2	1.2	1.2	LQM/CIEH S4UL
	Nickel	180	180	180	LQM/CIEH S4UL
	Selenium	430	430	430	LQM/CIEH S4UL
	Vanadium	1200	1200	1200	LQM/CIEH S4UL
	Zinc	40000	40000	40000	LQM/CIEH S4UL

Generic Assessment Criteria for Petroleum Hydrocarbons

Residential without Homegrown Produce	Guidance Value (mg/kg)	Guidance Value (mg/kg)	Guidance Value (mg/kg)	Primary Data Source
	1% SOM	2.5% SOM	6% SOM	
Aliphatic				
EC 5-6	42	78	160	LQM/CIEH S4UL
EC >6-8	100	230	530	LQM/CIEH S4UL
EC >8-10	27	65	150	LQM/CIEH S4UL
EC >10-12	130 (48)	330 (118)	760 (283)	LQM/CIEH S4UL
EC >12-16	1100 (24)	2400 (59)	4300 (142)	LQM/CIEH S4UL
EC >16-35	65000 (8.48)	92000 (21)	110000	LQM/CIEH S4UL
EC >35-44	65000 (8.48)	92000 (21)	110000	LQM/CIEH S4UL
Aromatic				
EC 5-7 (benzene)	370	690	1400	LQM/CIEH S4UL
EC >7-8 (toluene)	860	1800	3900	LQM/CIEH S4UL
EC >8-10	47	110	270	LQM/CIEH S4UL
EC >10-12	250	590	1200	LQM/CIEH S4UL
EC >12-16	1800	2300 (419)	2500	LQM/CIEH S4UL
EC >16-21	1900	1900	1900	LQM/CIEH S4UL
EC >21-35	1900	1900	1900	LQM/CIEH S4UL
EC >35-44	1900	1900	1900	LQM/CIEH S4UL
Aliphatic and Aromatic				
EC >44-70	1900	1900	1900	LQM/CIEH S4UL
BTEX				
Benzene	0.38	0.70	1.4	LQM/CIEH S4UL
Toluene	880	1900	3900	LQM/CIEH S4UL
Ethylbenzene	83	190	440	LQM/CIEH S4UL
m Xylenes	79	180	430	LQM/CIEH S4UL
p Xylenes				
o Xylene	88	210	480	LQM/CIEH S4UL

SOM = Soil Organic Matter

Values in brackets indicate the vapour saturation limit where this is exceeded by the GAC or SGV

APPENDIX 7
GAS GENERATION

APPENDIX 7

GENERAL NOTES ON GAS GENERATION

A7.1 GENERAL

- A7.1.1 In the past, a series of guidance documents were published by CIRIA, ref. 9.49, providing advice on hazards associated with methane. This earlier guidance was consolidated in CIRIA Document C659 to provide a risk based approach to gas contaminated land. This was subsequently re-issued as CIRIA Document C665, ref 9.50. In 2007, British Standard, BS8485, ref 9.51, dealing with ground gas was published. It is recommended that guidance in C665 and BS8485 is adopted to provide a consistent approach in dealing with ground gas contamination, the principal details being as follows.
- A7.1.2 This guidance is based on a similar approach to that for dealing with contaminated soil. The presence of hazardous gases could be deemed to be the 'source' in a 'pollutant linkage' that could lead to the conclusion that significant harm is or could be caused to people, buildings or the environment. In such circumstances the land could be deemed 'contaminated', ref. 9.25.
- A7.1.3 Should a potential source of gas be identified in the conceptual model, a gas risk assessment should be carried out, sufficient to demonstrate to the local authority that the proposals mitigate any hazards associated with ground gas. The authority enforces compliance with Approved Document Part C of the Building Regulations, ref. 9.52.

A7.2 APPROACH

- A7.2.1 A flow chart detailing the approach to assessing a site is given in CIRIA document C665, Figure 1.1. This may be summarised as follows.
- Carry out Phase 1 desk study, including initial conceptual model
 - Assess site, potential presence of gas / potential unacceptable risk / identify further action, if necessary
 - Monitor gas concentrations
 - Assessment of Risk
 - Recommendations / remediation
 - Validation

A7.3 POLLUTANT LINKAGE ASSESSMENT

- A7.3.1 A pollutant linkage assessment is presented in Appendix 3 of the Phase 1 Desk Study Report.
- A7.3.2 Using the risk model in the desk study, the pollutant linkage can be identified and a preliminary estimate of risk undertaken. If there is no relevant pollutant linkage identified there is no risk. If there is a very low risk, it is likely that no further assessment is required. If further assessment is necessary, then gas monitoring is required.

A7.4 SITE MONITORING

A7.4.1 For sites with low generation potential, giving consistently low concentrations of soil gas under the worst-case conditions, a limited programme of monitoring would be appropriate. Where high or variable concentrations are anticipated or recorded, an extended programme of monitoring would be appropriate. The following guideline has been proposed, ref. 9.54.

Table A7.1

Sensitivity of development	Generation potential of source					
		Very low	Low	Moderate	High	Very high
	Low (Commercial)	4/1	6/2	6/3	12/6	12/12
	Moderate (Flats)	6/2	6/3	9/6	12/12	24/24
	High (Residential with gardens)	6/3*	9/6	12/6	24/12	24/24

Notes

1. First number is minimum number of readings and second number is minimum period in months, for example 4/1 – Four sets of readings over 1 month.
2. At least two sets of readings must be at low and falling atmospheric pressure (but not restricted to periods below <1000mb) known as worst case conditions (see Boyle and Witherington, 2006).
3. The frequency and period stated are considered to represent typical minimum requirements. Depending on specific circumstances fewer or additional readings may be required (e.g. any such variation subject to site specific justification). * The NHBC guidance is also recommending these periods/frequency of monitoring (Boyle and Witherington, 2006)
4. Historical data can be used as part of the data set.
5. Not all sites will require gas monitoring however, this would need to be confirmed with demonstrable evidence.
6. Placing high sensitivity end use on a high hazard site is not normally acceptable unless the source is removed or treated to reduce its gassing potential. Under such circumstances long-term monitoring may not be appropriate or required.

A7.4.2 Before taking any readings, zero the instrument, record atmospheric pressure and temperature.

A7.4.3 Gas flow should be recorded, giving the range of pressures, ensuring positive or negative flow is recorded.

A7.4.4 Record gas levels, recording peak and steady. Where steady state not obtained within 3 minutes, record change in concentration, where concentrations are decreasing, always record peak value. For very high concentrations, record for longer period of up to 10 minutes.

A7.5 ASSESSMENT OF RISK AND RECOMMENDATIONS

A7.5.1 The main method of characterising a site is the method described by Wilson and Card, ref. 9.55 and is termed Situation A. This can be used for all types of development except conventional low-rise housing with suspended ground floor and ventilated underfloor void.

A7.5.2 Low rise housing, Situation B, was developed by Boyle and Witherington, ref. 9.56 and was developed for the NHBC for classifying gassing sites for houses with suspended ground floor slab with ventilated void.

A7.5.3 Although the Code of Practice, ref 9.51, assesses the characteristic gas situation as CIRIA recommend for Situation A, see Table A7.2 below, their solution for gas protection systems is different, see section A7.10.

A7.6 SITUATION A - ASSESSMENT

A7.6.1 This system proposed by Wilson and Card, ref. 9.55 was originally developed in CIRIA Report 149, ref. 9.49.

A7.6.2 The method uses both gas concentrations and borehole flow rate for methane and carbon dioxide to define a Characteristic Situation for a site.

A7.6.3 Gas Screening Value (litre/hr) = borehole flow rate (litre/hr) x gas concentration (%). The GSV is determined for methane and carbon dioxide and the worst case adopted. The Characteristic Situation can then be determined from the table below. The GSV can be exceeded if the conceptual model indicates it is safe to do so, and other factors may lead to a change in the Characteristic Situation.

Table A7.2

Characteristic Situation	Risk Classification	Gas screening value (CH ₄ or CO ₂ (l/hr) ¹	Additional factors	Typical source of generation
1	Very low risk	<0.07	Typically methane ≤1% and/or carbon dioxide ≤5%. Otherwise consider increase to Situation 2	Natural soils with low organic content “Typical” Made Ground
2	Low risk	<0.7	Borehole air flow rate not to exceed 70l/hr. Otherwise consider increase to Characteristic Situation 3	Natural soil, high peat/organic content. “Typical” Made Ground
3	Moderate risk	<3.5		Old landfill, inert waste, mineworking flooded
4	Moderate to high risk	<15	Quantitative risk assessment required to evaluate scope of protective measures	Mineworking – susceptible to flooding, completed landfill (WMP 26B criteria)
5	High risk	<70		Mineworking unflooded inactive with shallow workings near surface
6	Very high risk	>70		Recent landfill site

1. Site characterisation should be based on gas monitoring of concentrations and borehole flow rates for the minimum periods defined in Table A7.1
2. Source of gas and generation potential/performance must be identified.
3. If there is no detectable flow use the limit of detection of the instrument.

A7.7 SITUATION A – SOLUTION

A7.7.1 The Characteristic Situation can be used to define the scope of gas protective measures required.

A7.7.2 The CIRIA approach uses the characteristic situation to define the level of gas protection as follows:

Table A7.3

Characteristic situation	Residential building (Not low-rise traditional housing)		Office/commercial/industrial development	
	Number of levels of protection	Typical scope of protective measures	Number of levels of protection	Typical scope of protective measures
1	None	No special precautions	None	No special precautions
2	2	a) Reinforced concrete cast in situ floor slab (suspended non-suspended or raft) with at least 1200g DPM and underfloor venting b) Beam and block or pre-cast concrete and 2000g DPM / reinforced gas membrane and underfloor venting All joints and penetrations sealed	1 to 2	a) Reinforced concrete cast in-situ floor slab (suspended non-suspended or raft) with at least 1200g DPM b) Beam and block or pre-cast concrete slab and minimum 2000g DPM/reinforced gas membrane c) Possibly underfloor venting or pressurisation in combination with a) and b) depending on use All joints and penetrations sealed
3	2	All types of floor slab as above. All joints and penetrations sealed. Proprietary gas resistant membrane and passively ventilated or positively pressurised underfloor sub-space	1 to 2	All types of floor slab as above. All joints and penetrations sealed. Minimum 2000g/reinforced gas proof membrane and passively ventilated underfloor sub-space or positively pressurised underfloor sub-space
4	3	All types of floor slab as above. All joints and penetrations sealed. Proprietary gas resistant membrane and passively ventilated underfloor subspace or positively pressurised underfloor sub-space, oversite capping or blinding and in	2 to 3	All types of floor slab as above. All joints and penetration sealed. Proprietary gas resistant membrane and passively ventilated or positively pressurised underfloor sub-space with monitoring facility

Characteristic situation	Residential building (Not low-rise traditional housing)		Office/commercial/industrial development	
		ground venting layer		
5	4	Reinforced concrete cast in situ floor slab (suspended, non-suspended or raft). All joints and penetrations sealed. Proprietary gas resistant membrane and ventilated or positively pressurised underfloor sub-space, oversite capping and in ground venting wells or barriers	3 to 4	Reinforced concrete cast in-situ floor slab (suspended, non-suspended or raft). All joints and penetrations sealed. Proprietary gas resistant membrane and passively ventilated or positively pressurised underfloor sub-space with monitoring facility. In ground venting wells or barriers
6	5	Not suitable unless gas regime is reduced first and quantitative risk assessment carried out to assess design of protection measures in conjunction with foundation design	4 to 5	Reinforced concrete cast in-situ floor slab (suspended, non-suspended or raft). All joints and penetrations sealed. Proprietary gas resistant membrane and actively ventilated or positively pressurised underfloor sub-space with monitoring facility, with monitoring. In ground venting wells and reduction of gas regime.

1. Typical scope of protective measures may be rationalised for specific developments on the basis of quantitative risk assessments.
2. Note the type of protection is given for illustration purposes only. Information on the detailing and construction of passive protection measures is given in BR414, ref. 9.53.
3. In all cases there should be minimum penetration of ground slabs by services and minimum number of confined spaces such as cupboards above the ground slab. Any confined spaces should be ventilated.
4. Foundation design must minimise differential settlement particularly between structural elements and ground-bearing slabs.
5. Commercial buildings with basement car parks, provided with ventilation in accordance with the Building Regulations, may not require gas protection for characteristic situations 3 and 4.
6. Floor slabs should provide an acceptable formation on which to lay the gas membrane. If a block and beam floor is used it should be well detailed so it has no voids in it that membranes have to span, and all holes for service penetrations should be filled. The minimum density of the blocks should be 600kg/m³ and the top surface should have a 4:1 sand cement grout brushed into all joints before placing any membrane (this is also good practice to stabilise the floor and should be carried out regardless of the need for gas membrane).
7. The gas-resistant membrane can also act as the damp-proof membrane.

A7.8 SITUATION B -ASSESSMENT

- A7.8.1 The NHBC has developed a characterisation system that is similar to Situation A but is specific to low-rise housing development with a clear ventilated underfloor void. The gas emission rates are compared to generic 'Traffic Lights'.
- A7.8.2 The Traffic Lights include a Typical Maximum Concentration that is used for initial screening purposes. Where the Typical Maximum Concentration is exceeded the risk-based Gas Screening Value, GSV, should be adopted. The GSVs are determined for the 'model' low rise development and where they differ from this model, the GSV should be reassessed, ref. 9.50.
- A7.8.3 The calculations should be made for both methane and carbon dioxide, and the worst case adopted. The GSV is only a guideline.

Table A7.4

Traffic light	Methane		Carbon dioxide	
	Typical maximum concentration ² (% v/v)	Gas screening value (GSV) ³ (litres per hour)	Typical maximum concentration ² (% v/v)	Gas screening value (GSV) ^{1,2} (litres per hour)
Green	1	0.16	5	0.78
Amber 1				
Amber 2	5	0.63	10	1.56
Red	20	1.56	30	3.13

- Generic GSVs are based on guidance contained within latest revision of Department of the Environment and the Welsh Office (2004 edition) "The Building Regulations: Approved Document C" and used a sub-floor void of 150mm thickness.
- The Typical Maximum Concentrations can be exceeded in certain circumstances should the conceptual site model indicate it is safe to do so. This is where professional judgement will be required, based on a thorough understanding of the gas-regime identified at the site where monitoring in the worst temporal conditions has occurred.
- The GSV thresholds should not generally be exceeded without completion of a detailed gas risk assessment taking into account site-specific conditions.

A7.9 SITUATION B – SOLUTION

A7.9.1 On the basis of this Traffic Light classification the following protection should be applied to low-rise housing.

Table A7.5

Traffic Light Classification	Protection measures required
Green	Negligible gas regime identified and gas protection measures are not considered necessary.
Amber 1	Low to intermediate gas regime identified, which requires low-level gas protection measures, comprising a membrane and ventilated sub-floor void to create a permeability contrast to limit the ingress of gas into buildings. Gas protection measures should be as prescribed in BRE Report 414. Ventilation of the sub-floor void should facilitate a minimum of one complete volume change per 24 hours.
Amber 2	Intermediate to high gas regime identified, which requires high-level gas protection measures, comprising a membrane and ventilated sub-floor void to create a permeability contrast to prevent the ingress of gas into buildings. Gas protection measures should be as prescribed in BRE Report 414. A specialist contractor should always fit membranes. As with Amber 1, ventilation of the sub-floor void should facilitate a minimum of one complete volume change per 24 hours. Certification that these passive protection measures have been installed correctly should be provided.
Red	High gas regime identified. It is considered that standard residential housing would not normally be acceptable without a further Gas Risk Assessment and/or possible remedial mitigation measures to reduce and/or remove the source of gas.

A7.10 CODE OF PRACTICE – SOLUTIONS

- A7.10.1 The Characteristic Gas Situation is determined in a similar manner to that recommended by CIRIA, see Table A7.2 above.
- A7.10.2 Having selected the Characteristic Gas Situation, the appropriate gas protection could be selected for the building. The tables below give a guide as to the relative performance of the various designs and systems.
- A7.10.3 A guidance value for the required gas protection, in the range 0 to 7 should be obtained from Table A7.6 below. Then, a combination of ventilation and/or barrier system should be chosen from Table A7.7 to meet that requirement.

Table A7.6

Characteristic gas situation, CS	NHBC traffic light	Required gas protection			
		Non-managed property, e.g. private housing	Public building ^{A)}	Commercial buildings	Industrial buildings ^{B)}
1	Green	0	0	0	0
2	Amber 1	3	3	2	1 ^{C)}
3	Amber 2	4	3	2	2
4	Red	6 ^{D)}	5 ^{D)} 6 ^{E)}	4 5 7	3 4 6

NOTE: Traffic light indications are taken from NHBC Report no.: 10627-R01 (04) [3] and are mainly applicable to low-rise residential housing. These are for comparative purposes but the boundaries between the traffic light indications and CS values do not coincide.

- A) Public buildings include, for example, managed apartments, schools and hospitals.
 B) Industrial buildings are generally open and well ventilated. However, areas such as office pods might require a separate assessment and may be classified as commercial buildings and require a different scope of gas protection to the main building.
 C) Maximum methane concentration 20% otherwise consider an increase to CS3.
 D) Residential building on higher traffic light/CS sites is not recommended unless the type of construction or site circumstances allow additional levels of protection to be incorporated, e.g. high-performance ventilation or pathway intervention measures, and an associated sustainable system of management of maintenance of the gas control system, e.g. in institutional and/or fully serviced contractual situations.
 E) Consideration of issues such as ease of evacuation and how false alarms will be handled are needed when completing the design specification of any protection scheme.

A7.10.4 Having determined the appropriate guidance value from Table A7.6, an element or combination of elements from a), b), c) or d) in Table A7.7, should be chosen to achieve the required level of protection .

Table A7.7

PROTECTION ELEMENT/SYSTEM		SCORE	COMMENTS
a) Venting/dilution			
Passive sub floor ventilation (venting layer can be a clear void or formed using gravel, geocomposites, polystyrene void formers, etc.) ^{A)}	Very good performance	2.5	<i>Ventilation performance in accordance with Annex A, ref. 9.51</i>
	Good performance	1	<i>If passive ventilation is poor this is generally unacceptable and some form of active system will be required</i>
Subfloor ventilation with active abstraction/pressurization (venting layer can be a clear void or formed using gravel, geocomposites, polystyrene void formers, etc.) ^{A)}		2.5	<i>There have to be robust management systems in place to ensure the continued maintenance of any ventilation system. Active ventilation can always be designed to meet good performance. Mechanically assisted systems come in two main forms: extraction and positive pressurization.</i>

PROTECTION ELEMENT/SYSTEM	SCORE	COMMENTS
Ventilated car park (basement or undercroft)	4	Assumes car park is vented to deal with car exhaust fumes, designed to Building Regulations Document F and IstructE guidance
b) Barriers		
Floor slabs		
Block and beam floor slab	0	It is good practice to install ventilation in all foundation systems to effect pressure relief as a minimum. Breached in floor slabs such as joints have to be effectively sealed against gas ingress in order to maintain these performances
Reinforced concrete ground bearing floor slab	0.5	
Reinforced concrete ground bearing foundation raft with limited service penetrations that are cast into slab	1.5	
Reinforced concrete cast in situ suspended slab with minimal service penetrations and water bars around all slab penetrations and at joints	1.5	
Fully tanked basement	2	
c) Membranes		
Taped and sealed membrane to reasonable levels of workmanship/in line with current good practice with validation ^{B), C)}	0.5	The performance of membranes is heavily dependent on the quality and design of the installation, resistance to damage after installation, and the integrity of joints
Proprietary gas resistant membrane to reasonable levels of workmanship/in line with current good practice under independent inspection (CQA) ^{B), C)}	1	
Proprietary gas resistant membrane installed to reasonable levels of workmanship/in line with current good practice under CQA with integrity testing and independent validation	2	
d) Monitoring and detection (not applicable to non-managed property, or in isolation)		
Intermittent monitoring using hand held equipment	0.5	Where fitted, permanent monitoring systems ought to be installed in the underfloor venting/dilution system in the first instance but can also be provided within the occupied space as a fail safe.
Permanent monitoring and alarm system ^{A)}	2	
Installed in the underfloor venting/dilution system	1	
Installed in the building		
e) Pathway intervention		
Pathway intervention	-	This can consist of site protection measures for off-site or on-site sources (see Annex A, ref. 9.51)
NOTE: In practice the choice of materials might well rely on factors such as construction method and the risk of damage after installation. It is important to ensure that the chosen combination gives an appropriate level of protection		

A) It is possible to test ventilation systems by installing monitoring probes for post installation validation.

B) If a 1200 g DPM material is to function as a gas barrier it should be installed according to BRE 414, ref. 9.53 being taped and sealed to all penetrations.

C) Polymeric Materials >1200g can be used to improve confidence in the barrier. Remember that their gas resistance is little more than the standard 1200g (proportional to thickness) but their physical properties mean that they are more robust and resistant to site damage.

APPENDIX 8
PHOTOGRAPHS OF ROCK CORE

Core Photographs BHAB



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Core Photographs BHAB



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