

Waste	Version	Update Cycle
BGS Recorded Landfill Sites British Geological Survey - National Geoscience Information Service	June 1996	Not Applicable
Historical Landfill Sites Environment Agency - Thames Region - North East Area	October 2007	As notified
Integrated Pollution Control Registered Waste Sites Environment Agency - Thames Region	October 2007	Quarterly
Licensed Waste Management Facilities (Landfill Boundaries) Environment Agency - Thames Region - North East Area	November 2007	Quarterly
Licensed Waste Management Facilities (Locations) Environment Agency - Thames Region - North East Area	November 2007	Quarterly
Local Authority Landfill Coverage London Borough of Barnet London Borough of Enfield - Environmental Health Department London Borough of Hackney London Borough of Haringey - Planning Department London Borough of Islington - Environmental Health Department London Borough of Redbridge - Environmental Health Department London Borough of Waltham Forest - Environmental Health Department	May 2000 May 2000 May 2000 May 2000 May 2000 May 2000 May 2000	Not Applicable Not Applicable Not Applicable Not Applicable Not Applicable Not Applicable Not Applicable
Local Authority Recorded Landfill Sites London Borough of Enfield - Environmental Health Department London Borough of Barnet London Borough of Hackney London Borough of Haringey - Planning Department London Borough of Islington - Environmental Health Department London Borough of Redbridge - Environmental Health Department London Borough of Waltham Forest - Environmental Health Department	February 2003 May 2000 May 2000 May 2000 May 2000 May 2000 May 2000	Not Applicable Not Applicable Not Applicable Not Applicable Not Applicable Not Applicable Not Applicable
Registered Landfill Sites Environment Agency - Thames Region - North East Area	March 2003	Not Applicable
Registered Waste Transfer Sites Environment Agency - Thames Region - North East Area	March 2003	Not Applicable
Registered Waste Treatment or Disposal Sites Environment Agency - Thames Region - North East Area	March 2003	Not Applicable

Hazardous Substances	Version	Update Cycle
Control of Major Accident Hazards Sites (COMAH) Health and Safety Executive	October 2007	Bi-Annually
Explosive Sites Health and Safety Executive	August 2007	Bi-Annually
Notification of Installations Handling Hazardous Substances (NIHHS) Health and Safety Executive	November 2000	Not Applicable
Planning Hazardous Substance Enforcements London Borough of Barnet London Borough of Enfield - Planning Department London Borough of Hackney London Borough of Haringey London Borough of Waltham Forest - Environmental Services London Borough of Islington London Borough of Redbridge	February 2007 March 2005 March 2007 March 2007 March 2007 May 2007 November 2006	Annual Rolling Update Annual Rolling Update Annual Rolling Update Annual Rolling Update Annual Rolling Update Annual Rolling Update Annual Rolling Update
Planning Hazardous Substance Consents London Borough of Barnet London Borough of Hackney London Borough of Haringey London Borough of Waltham Forest - Environmental Services London Borough of Enfield - Planning Department London Borough of Islington London Borough of Redbridge	February 2007 March 2007 March 2007 March 2007 May 2007 May 2007 October 2006	Annual Rolling Update Annual Rolling Update Annual Rolling Update Annual Rolling Update Annual Rolling Update Annual Rolling Update Annual Rolling Update

Geological	Version	Update Cycle
BGS Recorded Mineral Sites British Geological Survey - National Geoscience Information Service	October 2007	Bi-Annually
BGS 1:625,000 Solid Geology British Geological Survey - National Geoscience Information Service	August 1996	Not Applicable
Brine Compensation Areas Cheshire Brine Subsidence Compensation Board	November 2002	As notified
Coal Mining Affected Areas The Coal Authority - Mining Report Service	January 2006	As notified
Mining Instability Ove Arup & Partners	October 2000	Not Applicable
Natural and Mining Cavities Peter Brett Associates	December 2005	Variable
Potential for Collapsible Ground Stability Hazards British Geological Survey - National Geoscience Information Service	November 2006	Annually
Potential for Compressible Ground Stability Hazards British Geological Survey - National Geoscience Information Service	November 2006	Annually
Potential for Ground Dissolution Stability Hazards British Geological Survey - National Geoscience Information Service	November 2006	Annually
Potential for Landslide Ground Stability Hazards British Geological Survey - National Geoscience Information Service	April 2007	Annually
Potential for Running Sand Ground Stability Hazards British Geological Survey - National Geoscience Information Service	November 2006	Annually
Potential for Shrinking or Swelling Clay Ground Stability Hazards British Geological Survey - National Geoscience Information Service	November 2006	Annually
Radon Potential - Radon Affected Areas British Geological Survey - National Geoscience Information Service	May 2007	Annually
Radon Potential - Radon Protection Measures British Geological Survey - National Geoscience Information Service	May 2007	Annually
Shallow Mining Hazards British Geological Survey - National Geoscience Information Service	August 2002	Not Applicable
Industrial Land Use	Version	Update Cycle
Contemporary Trade Directory Entries Thomson Directories	August 2007	Quarterly
Fuel Station Entries Catalist Ltd - (Fuel Station Data)	October 2007	Quarterly

Sensitive Land Use	Version	Update Cycle
Areas of Adopted Green Belt		
London Borough of Waltham Forest	January 1996	As notified
London Borough of Enfield	March 1994	As notified
London Borough of Haringey	March 1998	As notified
London Borough of Barnet	March 2001	As notified
London Borough of Redbridge	November 2003	As notified
Areas of Unadopted Green Belt		
London Borough of Waltham Forest	April 2003	As notified
London Borough of Enfield	March 1994	As notified
London Borough of Barnet	March 2001	As notified
London Borough of Redbridge	November 2003	As notified
London Borough of Haringey	September 2004	As notified
Areas of Outstanding Natural Beauty		
Natural England (formerly The Countryside Agency)	November 2006	Annually
Environmentally Sensitive Areas		
Department for Environment, Food and Rural Affairs (DEFRA - formerly FRCA)	June 2006	Annually
Forest Parks		
Forestry Commission	April 1997	Not Applicable
Local Nature Reserves		
London Borough of Barnet	September 1999	Variable
London Borough of Hackney	September 1999	Variable
London Borough of Haringey	September 1999	Variable
London Borough of Islington	September 1999	Variable
Marine Nature Reserves		
Natural England	October 2007	Bi-Annually
National Nature Reserves		
Natural England	October 2007	Bi-Annually
National Parks		
Natural England (formerly The Countryside Agency)	October 2006	Annually
Nitrate Sensitive Areas		
Department for Environment, Food and Rural Affairs (DEFRA - formerly FRCA)	December 2003	Not Applicable
Nitrate Vulnerable Zones		
Department for Environment, Food and Rural Affairs (DEFRA - formerly FRCA)	May 2007	Annually
Ramsar Sites		
Natural England	October 2007	Bi-Annually
Sites of Special Scientific Interest		
Natural England	October 2007	Bi-Annually
Special Areas of Conservation		
Natural England	October 2007	Bi-Annually
Special Protection Areas		
Natural England	October 2007	Bi-Annually

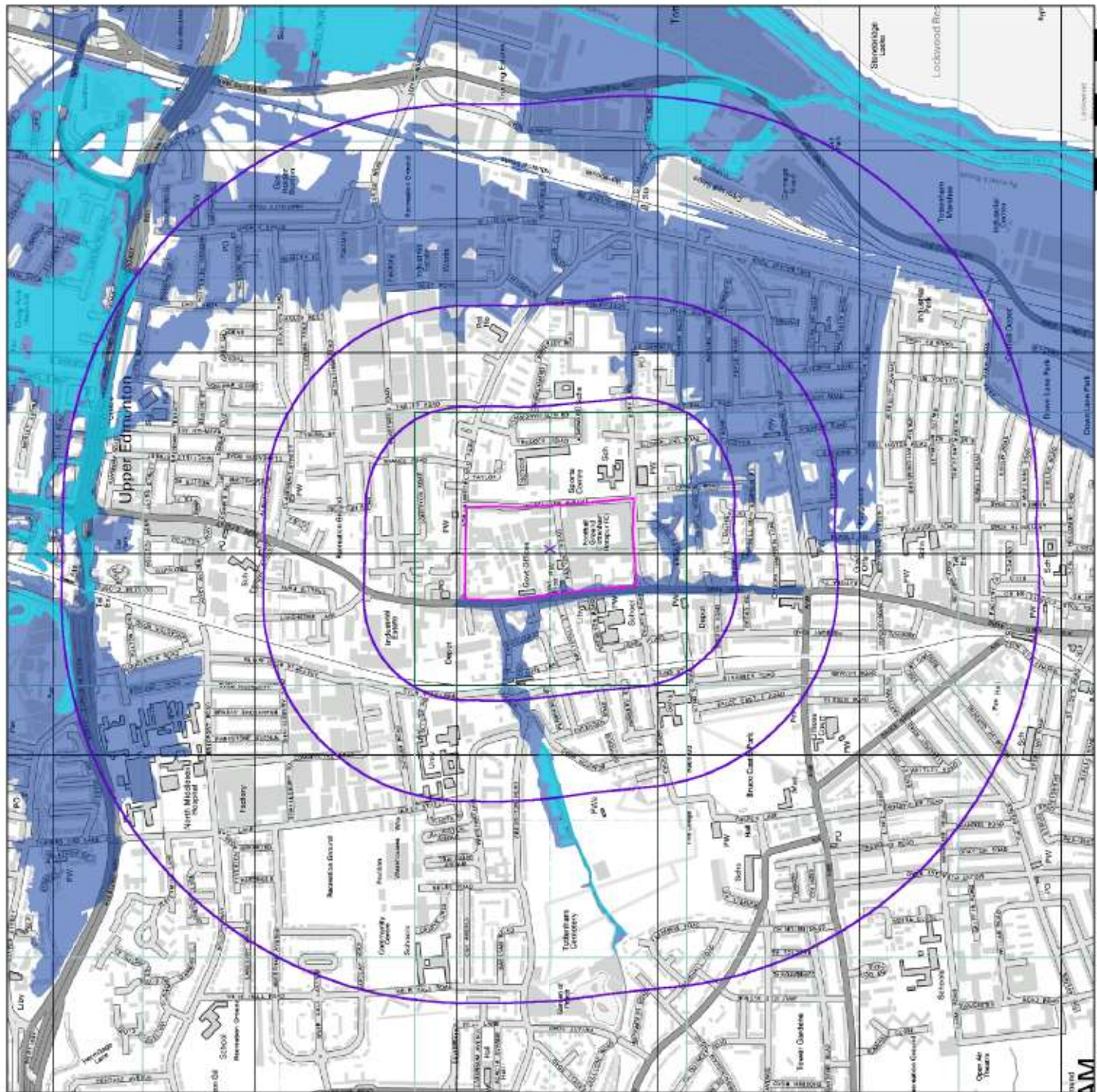
A selection of organisations who provide data within this report

Data Supplier	Data Supplier Logo
Ordnance Survey	
Environment Agency	
Scottish Environment Protection Agency	
The Coal Authority	
British Geological Survey	 British Geological Survey NATURAL ENVIRONMENT RESEARCH COUNCIL
Centre for Ecology and Hydrology	 Centre for Ecology & Hydrology NATURAL ENVIRONMENT RESEARCH COUNCIL
Countryside Council for Wales	 CYNGOR CEFN GWLAD CYMRU COUNTRYSIDE COUNCIL FOR WALES
Scottish Natural Heritage	
Natural England	
Health Protection Agency	
Ove Arup	
Peter Brett Associates	

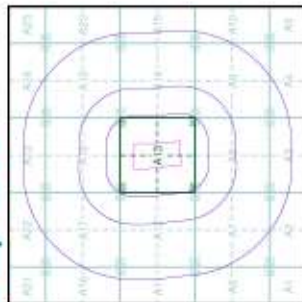
Contact	Name and Address	Contact Details
1	London Borough of Haringey - Planning and Environmental Health 639 High Road, Tottenham, London, N17 8BD	Telephone: 0208 489 5183 Fax: 0208 489 5117 Website: www.haringey.gov.uk
2	London Borough of Enfield - Environmental Health Department Civic Centre, Silver Street, Enfield, Middlesex, EN1 3XH	Telephone: 020 8366 6565 Fax: 020 8982 7088 Website: www.enfield.gov.uk
3	Environment Agency - National Customer Contact Centre (NCCC) PO Box 544, Templeborough, Rotherham, S60 1BY	Telephone: 08708 506 506 Email: enquiries@environment-agency.gov.uk
4	Health and Safety Executive HSE Infoline, Caerphilly Business Park, Caerphilly, CF83 3GG	Telephone: 08701 545500 Fax: 02920 859260 Email: hseinformationservices@natbrit.com Website: www.hse.gov.uk
5	London Borough of Enfield - Planning Department Civic Centre, Silver Street, Enfield, Middlesex, EN1 3XD	Telephone: 0208 366 6565 Fax: 0208 379 3475 Website: www.enfield.gov.uk
6	British Geological Survey - Enquiry Service British Geological Survey, Kingsley Dunham Centre, Keyworth, Nottingham, Nottinghamshire, NG12 5GG	Telephone: 0115 936 3143 Fax: 0115 936 3276 Email: enquiries@bgs.ac.uk Website: www.bgs.ac.uk
7	London Borough of Waltham Forest Chingford Municipal Offices, Ridgeway, London, E4 6PS	Telephone: 020 8496 3000 Fax: 020 8524 8960 Website: www.lbwf.gov.uk
8	London Borough of Haringey 639 High Road, Tottenham, London, N17 8BD	Telephone: 020 8808 1066 Fax: 020 8885 7552 Website: www.haringey.gov.uk
9	Natural England Northminster House, Northminster Road, Peterborough, Cambridgeshire, PE1 1UA	Telephone: 0845 600 3078 Fax: 01733 455103 Email: enquiries@naturalengland.org.uk Website: www.naturalengland.org.uk
10	London Borough of Haringey - Planning Department Civic Centre, 639 High Road, Tottenham, London, N17 8BD	Website: www.haringey.gov.uk
-	Health Protection Agency Chilton, Didcot, Oxfordshire, OX11 0RQ	Telephone: 01235 831600 Fax: 01235 833891 Website: www.hpa.org.uk
-	Landmark Information Group Limited The Smith Centre, Henley On Thames, Oxfordshire, RG9 6AB	Telephone: 0870 850 6670 Fax: 0870 850 6671 Email: customerservices@landmarkinfo.co.uk Website: www.landmarkinfo.co.uk

Please note that the Environment Agency / SEPA have a charging policy in place for enquiries.

- General**
- Site
 - Specified Buffer (m)
 - Shoreline Buffer (m)
- Agency and Hydrological (Flood)**
- Extreme Flooding from Rivers or Sea without Defences (Zone 2)
 - Flooding from Rivers or Sea without Defences (Zone 3)
 - Area Generating Very Flood Upland
 - Flood/Water Storage Areas
 - Flood Defence



Flood Map - Slice A



Order Details

Order Number: 23781205_1_1
Customer Ref: 20088D POSSIBLE
National Grid Reference: 534010, 191270
Site: A
Site Area (Ha): 9.35
Search Buffer (m): 1000

Site Details

Tottenham Hotspur Football Club, London

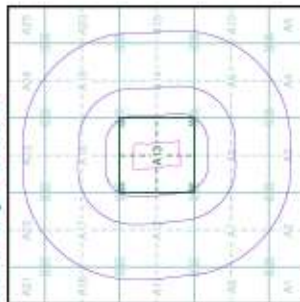
- General**
- Specialist Site
 - Specialist Borehole
 - Drilling Information Point
 - May ID
 - Several of Type at Location

Agency and Hydrological (Boreholes)

- 500 Borehole Depth 1 - 10m
- 500 Borehole Depth 10 - 30m
- 500 Borehole Depth 30m +
- Contaminated
- Other

For Borehole information please refer to the Borehole csv file which accompanied this also.
A copy of the BGS Borehole Ordering Form is available to download from the Support section of www.envirocheck.co.uk

Borehole Map - Slice A

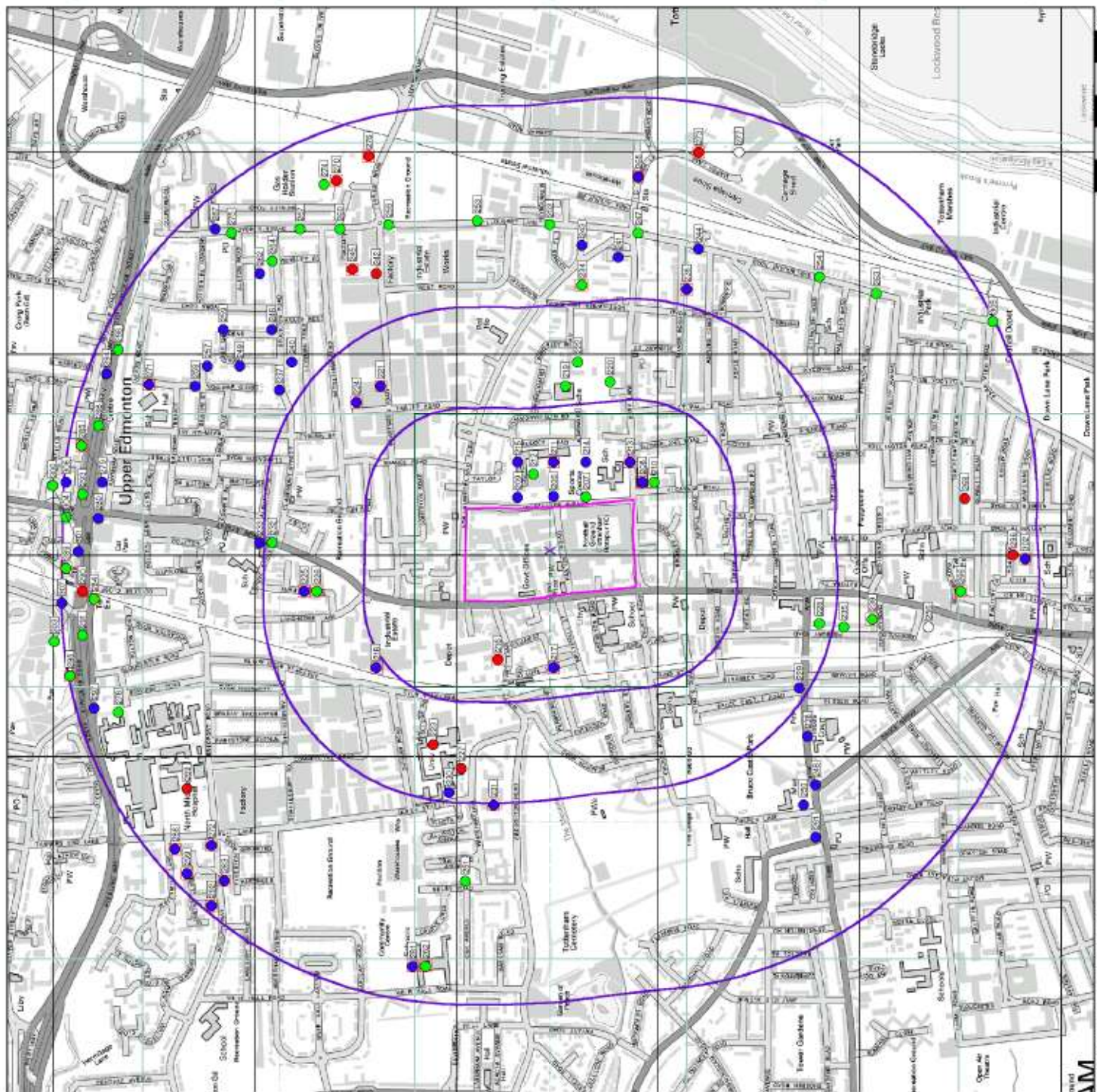


Order Details

Order Number: 23781205_1_1
Customer Ref: 2008BD POSSIBLE
National Grid Reference: 534010, 191270
Slice: A
Site Area (Ha): 9.35
Search Buffer (m): 1000

Site Details

Tottenham Hotspur Football Club, London



Appendix E: Envirocheck Report Geology & BGS Boreholes

Geology 1:10,000 Maps Legends

Artificial Ground and Landslip

Map Colour	Lex Code	Rock Name	Rock Type	Min and Max Age
	WMGR	Infilled Ground	Unknown Lithology	Present Day - Present Day
	MGR	Made Ground (Undivided)	Unknown Lithology	Present Day - Present Day
	WGR	Worked Ground (Undivided)	Unknown Lithology	Present Day - Present Day

Superficial Geology

Map Colour	Lex Code	Rock Name	Rock Type	Min and Max Age
	ALV	Alluvium	Clay	Quaternary - Quaternary
	ESI	Enfield Silt Formation	Silt	Flandrian - Devensian
	KPGR	Kempton Park Gravel Formation	Sand and Gravel	Devensian - Devensian
	TPGR	Taplow Gravel Formation	Sand and Gravel	Wolstonian - Wolstonian

Bedrock and Faults

Map Colour	Lex Code	Rock Name	Rock Type	Min and Max Age
	LC	London Clay Formation	Clay	Eocene - Eocene

Geology 1:10,000 Maps

This report contains geological map extracts taken from the BGS Digital Geological map of Great Britain at 1:10,000 scale and is designed for users carrying out preliminary site assessments who require geological maps for the area around a site. This mapping may be more up to date than previously published paper maps.

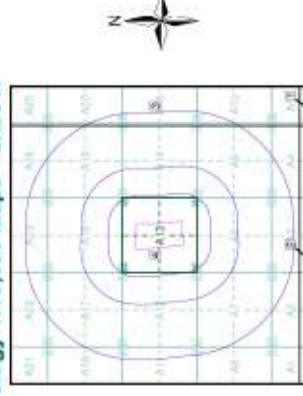
The various geological layers - artificial and landslide deposits, superficial geology and solid (bedrock) geology are displayed in separate maps, but superimposed on the final 'Combined Surface Geology' map. All map legends feature on this page.

Please Note: Not all of the layers have complete nationwide coverage, so availability of data for relevant map sheets is indicated below.

Geology 1:10,000 Maps Coverage

1						2					
Map ID:	Map Name:	Map Date:	Bedrock Geology:	Superficial Geology:	Artificial Geology:	Map ID:	Map Name:	Map Date:	Bedrock Geology:	Superficial Geology:	Artificial Geology:
TQ38NE	1999	Available	Available	Available	Available	TQ38NW	1999	Available	Available	Available	Available
Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available
Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available
3						4					
Map ID:	Map Name:	Map Date:	Bedrock Geology:	Superficial Geology:	Artificial Geology:	Map ID:	Map Name:	Map Date:	Bedrock Geology:	Superficial Geology:	Artificial Geology:
TQ38SE	1999	Available	Available	Available	Available	TQ38SW	1999	Available	Available	Available	Available
Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available
Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available

Geology 1:10,000 Maps - Slice A



Order Details

Order Number: 23781205_1_1
Customer Ref: 2008BD POSSIBLE
National Grid Reference: 534010, 191270
Slice: A
Site Area (Ha): 9.35
Search Buffer (m): 1000

Site Details

Tottenham Hotspur Football Club, London

Artificial Ground and Landslip

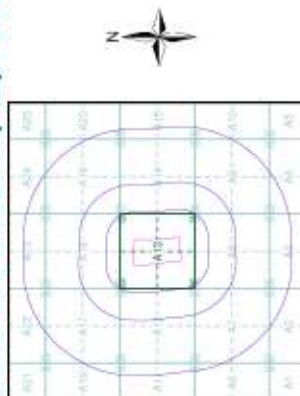
Artificial ground is a term used by BGS for those areas where the ground surface has been significantly modified by human activity. Information about previously developed ground is especially important, as it is often associated with potentially contaminated material, unpredictable engineering conditions and unstable ground.

Artificial ground includes:

- Made ground - man-made deposits such as embankments and spoil heaps on the natural ground surface.
- Worked ground - areas where the ground has been cut away such as quarries and road cuttings.
- Infilled ground - areas where the ground has been cut away then wholly or partially backfilled.
- Landscaped ground - areas where the surface has been reshaped.
- Disturbed ground - areas of ill-defined shallow or near surface mineral workings where it is impracticable to map made and worked ground separately.

Mass movement (landslip) deposits on BGS geological maps are primarily superficial deposits that have moved down slope under gravity to form landslips. These affect bedrock, other superficial deposits and artificial ground. The dataset also includes founded strata, where the ground has collapsed due to subsidence.

Artificial Ground and Landslip Map - Slice A

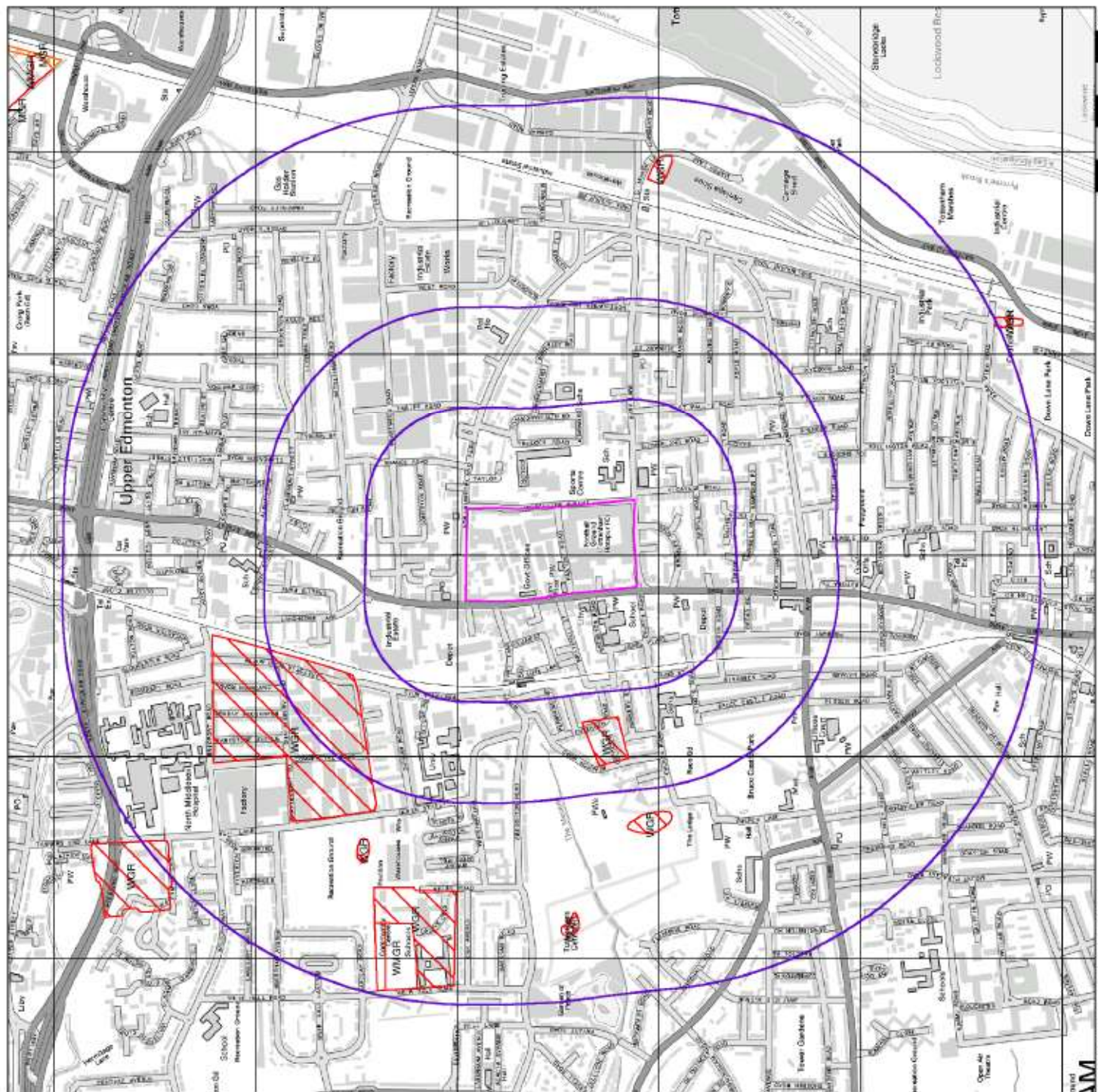


Order Details

Order Number: 23781205_1_1
Customer Ref: 2008BD POSSIBLE
National Grid Reference: 534010, 191270
Slice: A
Site Area (Ha): 9.35
Search Buffer (m): 1000

Site Details

Tottenham Hotspur Football Club, London



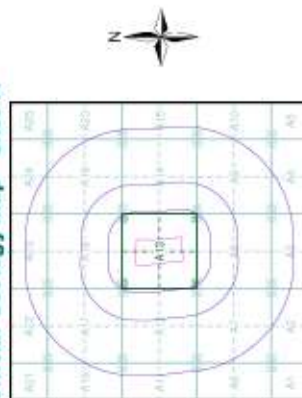
Superficial Geology

BGS 1:10,000 Superficial Deposits are the youngest geological deposits formed during the most recent period of geological time, which extends back about 1.8 million years from the present.

They rest on older deposits or rocks referred to as Bedrock. This dataset contains Superficial deposits that are of natural origin and 'in place'. Other superficial strata may be held in the Mass Movement dataset where they have been moved, or in the Artificial Ground dataset where they are of man-made origin.

Most of these Superficial deposits are unconsolidated sediments such as gravel, sand, silt and clay, and onshore they form relatively thin, often discontinuous patches or larger spreads.

Superficial Geology Map - Slice A

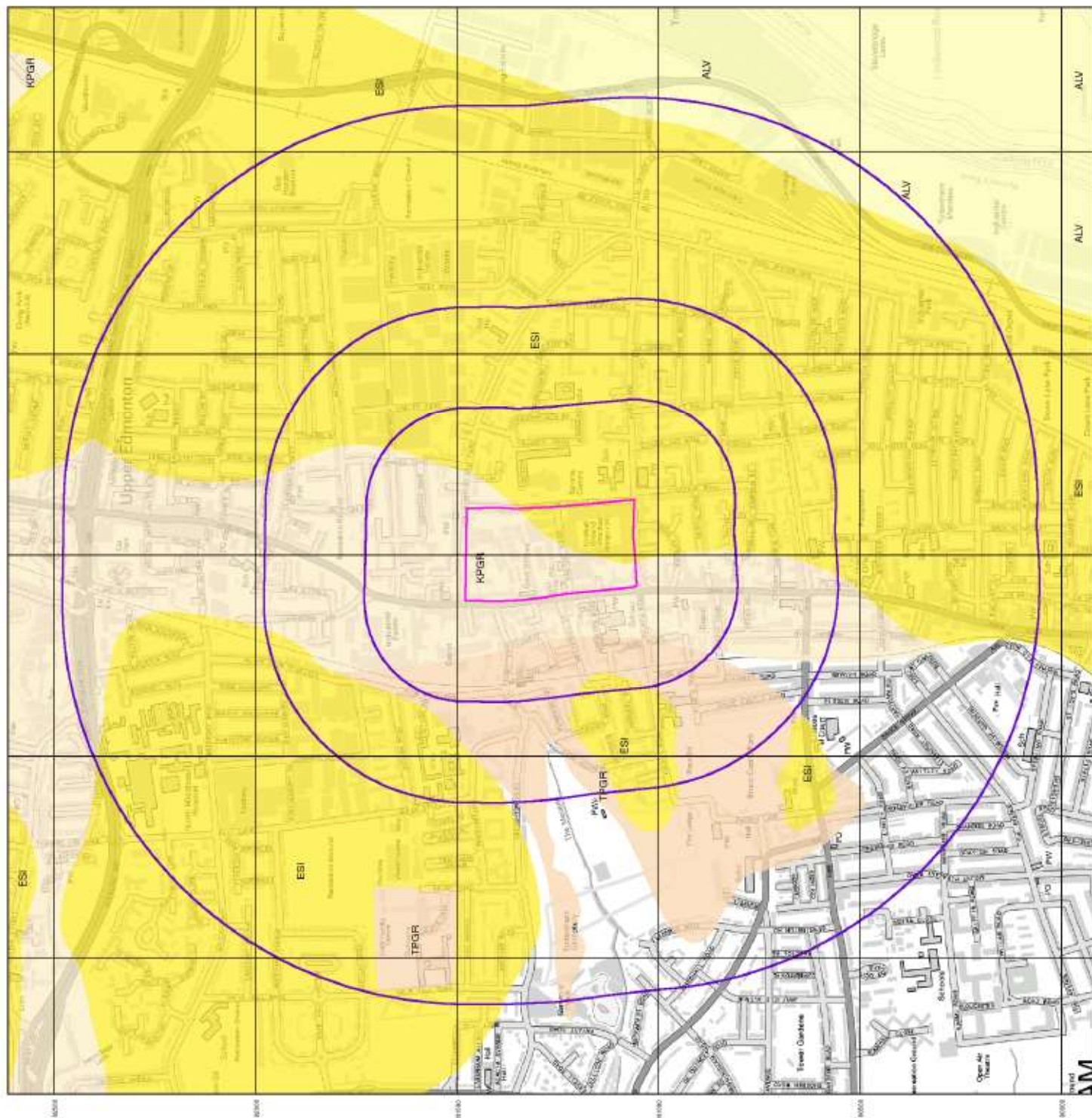


Order Details

Order Number: 23781205_1_1
Customer Ref: 20088D POSSIBLE
National Grid Reference: 534010, 191270
Slice: A
Site Area (Ha): 9.35
Search Buffer (m): 1000

Site Details

Tottenham Hotspur Football Club, London



Bedrock and Faults

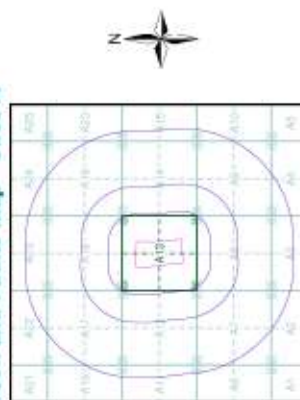
Bedrock geology is a term used for the main mass of rocks forming the Earth and are present everywhere, whether exposed at the surface in outcrops or concealed beneath superficial deposits or water.

The bedrock has formed over vast lengths of geological time ranging from ancient and highly altered rocks of the Proterozoic, some 2500 million years ago, or older, up to the relatively young Pliocene, 1.8 million years ago.

The bedrock geology includes many lithologies, often classified into three types based on origin: igneous, metamorphic and sedimentary.

The BGS Faults and Rock Segments dataset includes geological faults and thin beds mapped as lines such as coal seams and mineral veins. These are not restricted by age and could relate to features of any of the 1-10,000 geology datasets.

Bedrock and Faults Map - Slice A

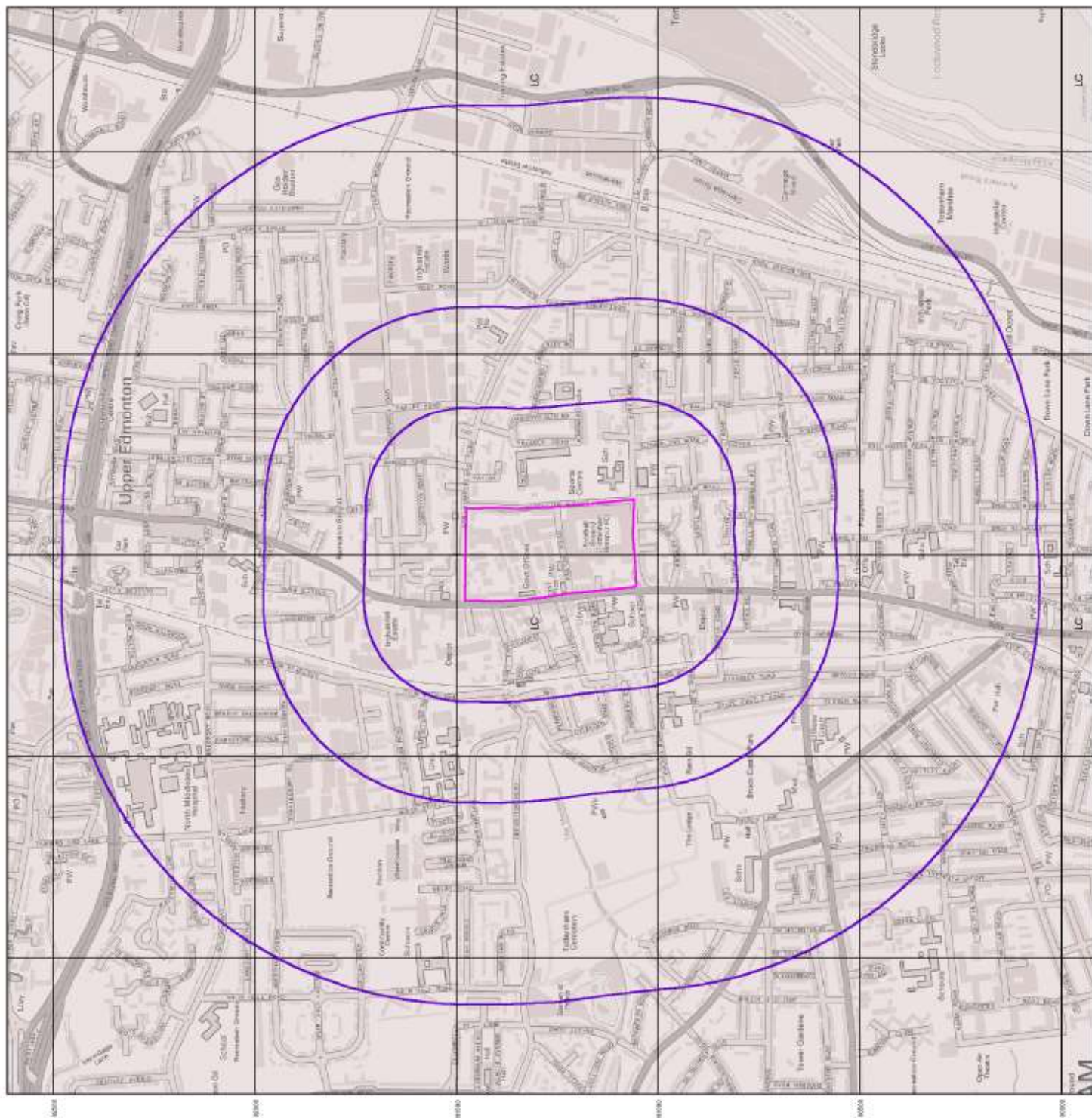


Order Details

Order Number: 23781205_1_1
Customer Ref: 2008BD POSSIBLE
National Grid Reference: 534010, 191270
Slice: A
Site Area (Ha): 9.35
Search Buffer (m): 1000

Site Details

Tottenham Hotspur Football Club, London





GROUND EXPLORATIONS LTD.

BOREHOLE NO. 1 TQ 39SW 374

Contract Name Northumberland Park Report No. 5286/APB/IAB
 Client C.J. Pell, Frischmann and Partners Site Address 3417
 Address 4 Manchester Square, Northumberland Park Primary 9135
 London W1M 6EB Worcester Avenue,
 Haringey, London, N.17.

Standing Water Level 5'0" Method of Boring Shell and auger
 Water Struck 5'0" Diameter 6 inches
 Ground Level 35.66 Start 26.4.71. Finish 26.4.71.
 Remarks

JARS			CORES		BULK	
6949 2'6"			6957 18'6"		6950 4'0"	
6951 7'6"			6959 23'6"		6952 9'0"	
6953 12'6"					6954 14'0"	
6955 17'6"						
6956 18'6"						
6958 23'6"						
6960 25'0"						
6961 water						
Description					Thickness	Depth
Topsoil					1'0"	1'0"
Clay with gravel					3'0"	4'0"
Compact sand and gravel					13'0"	17'0"
Stiff brown clay					1'0"	18'0"
Stiff/very stiff blue clay.					7'0"	25'0"
TOTALS					35'0"	25'0"

- Notes 1. Descriptions are in accordance with B.S. Code of Practice C.P. 2001
 Clients are requested to compare with samples submitted.
 2. Core samples are nominally 4 ins. diameter and 18 ins. long.





British
Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

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[TQ39SW BJ 374.]

GROUND EXPLORATIONS LIMITED
BOREHOLE SECTION SHEET

TQ39SW/5A
3372.9126
256
Page 1 of 2
October, 1951.

CONTRACT NAME: ORCHARD PLACE.
Bored for: The Borough of Tottenham.
Address: The Town Hall, Tottenham, N.15.
Address of Site: Orchard Place, & Love Lane.
District or Town: Tottenham.
Standing Water Level: 13' 4" (4.06m) Below Surface
Water Struck (1): Ft. B.S. (2): 26.10.51. Ft. B.S. (3): 29.10.51.
Boring Commenced: Boring Completed:
Special Remarks:

Jar Samples: 2'6"-5500; 4'6"-6701; 6'0"-6702; 10'6"-6703; 12'0"-6704; 15'6"-6705;
23'0"-6707; 27'0"-6709;

Core Samples: 18'6"-20'0"-6706; 24'6"-26'0"-6708; 28'6"-30'0"-6710;

DESCRIPTION OF STRATA	Thickness		Depth Below Surface	
	Feet	Inches	Feet	Inches
Clients are requested to examine the samples of the Strata submitted, as the descriptions employed below are general terms and responsibility is not accepted for their application to commercial purposes. (A) No. Boring.				
Fill (Brick Rubble)	0.53m	1	9	1 (0.53) 9
Fill (Concrete)	0.08	0	3	2 (0.61) 0
Fill (Brick Rubble)	0.69	2	3	4 (1.20) 3
Topsoil	0.38	1	3	5 (1.68) 6
Stones and Clay	1.37	4	6	10 (3.05) 0
Brown Sandy Clay	0.46	1	6	11 (3.51) 6
Gravel	1.98	6	6	16 (5.49) 0
Blue Clay	3.66	12	0	30 (9.14) 0
TOTAL FROM SURFACE ...	30	0	30	0
	(9.14)		(9.14)	

This form is to be returned to Head Office immediately the borehole is finished.

October, 1951.
Foreman's Signature: Date:

GROUND EXPLORATIONS LIMITED BOREHOLE SECTION SHEET

TQ39SW/5B
3372.9126
256
Page 2 of 2

Date October, 1951.

CONTRACT NAME ORCHARD PLACE.
Bored for: The Borough of Tottenham.
Address: The Town Hall, Tottenham, N.15.
Address of Site: Orchard Place, 3 Love Lane.
District or Town: Tottenham.
Standing Water Level: 11' 6" (4.11 m) Below Surface
Water Struck (1): 11' 6" Ft. B.S. (2): 29. 10. 51. Ft. B.S. (3): Ft. B.S.
Boring Commenced: 29. 10. 51. Boring Completed: 30. 10. 51.
Special Remarks:

ORDER NO. 237.

County: London.

Dia. of Borehole: 6 Inches.

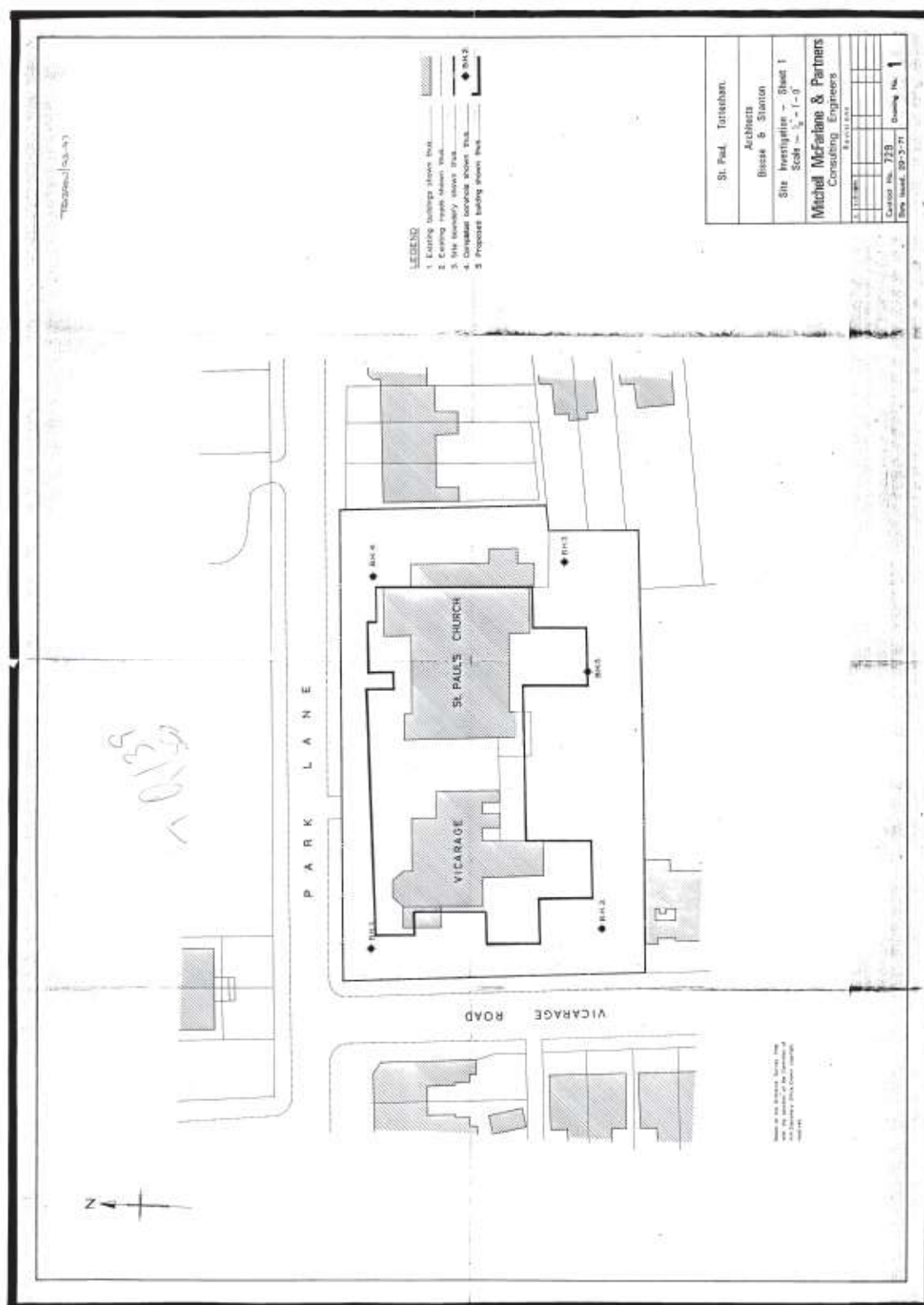
Jar Samples: 1' 0"-6713; 3' 0"-6713; 7' 0"-6715; 11' 0"-6716; 15' 0"-6717; 18' 0"-6718;
22' 6"-6720; 28' 0"-6722; water-6724;

Core Samples: 5' 0"-6' 0"-6714; 17' 0"-20' 6"-6719; 25' 0"-28' 6"-6721; 32' 0"-30' 6"-6723;

DESCRIPTION OF STRATA	Thickness		Depth Below Surface	
	Feet	Inches	Feet	Inches
Clients are requested to examine the samples of the Strata submitted, as the descriptions employed below are general terms and responsibility is not accepted for their application to commercial purposes. (B) No. Boring.				
Fill (ashes and clinkers)	0.91 m	3	0	3
Fill (Clay and Stones)	0.46	1	6	4
Clay and Stones	0.61	2	0	6
Sandy and Stoney Clay	1.68	5	6	12
Sand and Gravel	1.98	6	6	18
Blue Clay	3.66	12	0	30
TOTAL FROM SURFACE ...	9.30 m	6	30	9.30 m

This form is to be returned to Head Office immediately the borehole is finished.

Foreman's Signature: October, 1951.



Tottenham.

161

Mass. Franklin's ^{heavy} ^{5" Middle 12 N.E./W} ²⁰ White Hart Lane (in a brick pit)
O.D. - 10 ft.

Made & commenced by Brown. 1898.

Details in Records London Wells p. 180.

Height 125 ft. Diameter of bore 6 ins.

Water level 50 ft below O.D. Yield 1200 gph.

Strata		Thickness	Sp. ft.
London Clay 64 ft	Blue clay	64	64
	Sand & shells	1	65
	Pebbles	1	66
	Coloured clay	10	76
Woolwich & Reading Sands 35 ft	Sands	4½	80½
	White sand	2½	83
	Sand	9½	92½
	Pebbles	1	93½
	Dead sand	6½	100
Thames Sand 32 ft	Pebbles	2	102
	Dead sand	32	134
Chalk		166	300

Site visited 24/4/47. D.B.

Yield 1500 g.p.d. pumping 12 hrs. per day.
well 150 ground level.

Analysis - 28/11/42. pH 8.0.

Free CO_2	4 parts per 100,000	Alkalinity as CaCO_3	25.5 parts per 100,000
Cl_2 Combined	5.2	Total Hardness	32.0
Sulphate SO_4	10.0	Permanent hardness (calculated from SO_4)	12.0
CaO	1.6	Temporary hardness	20.0
oxide iron + Al	1.6		
Ca O	19.6		
Total solids	61.4		

TQ 39 SW 206

2. WHITE HART LANE, in a brick pit. Messrs. Fremlin's Stores.

40 feet above Ordnance Datum.

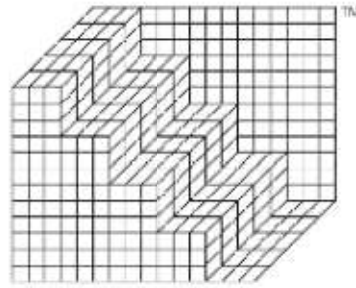
Made and communicated by Messrs. BROWN & SON, 1898.

Shaft 125 feet deep. Diameter of bore 6 inches.

Water-level 50 feet below O.D. Yield 1,200 gallons an hour.

London Map 3, N.E. (s. 1)?

		Thickness.	Depth.
		Ft. In.	Ft. In.
[Woolwich and Reading Beds.]	Blue London Clay	64 0	64 0
	Sand and shells...	1 0	65 0
	Pebbles ...	1 0	66 0
	Coloured clay ...	10 0	76 0
	Coloured sands ...	4 6	80 6
	White marl ...	2 6	83 0
	White sand ...	9 6	92 6
	Pebbles ...	1 0	93 6
	Dead sand ...	6 6	100 0
	Pebbles ...	2 0	102 0
[Thanet Sand.]	Dead sand ...	32 0	134 0
	Chalk ...	166 0	300 0



Buro Happold

**023971 Northumberland
Development Project, Stadium**
Geoenvironmental Interpretative
Report

Job no 023971 October 2010

Revision 00

Revision	Description	Issued by	Date	Checked
00	First Issue	SB	Oct 10	GG

O:\023971 Berwick Park Buildings\F09 - Geotech + SI\03-Ground Investigation\02-Work in Progress\090929
SB 023971 Geotechnical and Geoenvironmental Interpretative Report 00.doc

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October 2010

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October 2010

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Executive Summary

Buro Happold carried out a site investigation and associated risk assessment (GQRA) on the accessible parts of the Phase 2 Northumberland Park Development. The works were designed to identify potential sources of contamination from the site's previous and current uses. The findings from the investigation are summarised here; for full details and limitations reference should be made to Buro Happold's Geoenvironmental Interpretative Report.

The Made Ground was not highly contaminated although, occasional samples recorded slightly elevated concentrations of some determinands [lead and benzo(a)pyrene]. Some localised slightly elevated hydrocarbons were recorded in groundwater in the shallow (Gravel) Aquifer.

Concentrations of ground gas (carbon dioxide) were recorded at slightly elevated concentrations (about 6.5%) but no methane was recorded and flow rates were consistently low. The current proposals envisage ground floor car parking across part of the stadium footprint and therefore no gas protection measures are required in the foundation design for these areas. In habitable areas or small enclosed spaces at ground floor level, gas protection measures would be required. At this stage, a 1200 gauge polythene membrane is already included within the ground floor slab design. As long as all service entries and joints are sealed, this will satisfy the gas protection measures required.

The ground chemistry presents low to very low risks to people occupying the site and to the River Moselle. The potential risks to construction workers, neighbours, and groundwater in the Secondary A Aquifer (Kempton Park Gravels) have been assessed as Moderate/Low. These potential risks are capable of mitigation to acceptably low levels by the adoption of good construction practice along with further investigation of the identified hydrocarbon hotspots and currently inaccessible parts of the site.

The majority of any Made Ground spoil arisings is likely to be classified as Non-Hazardous Waste. However, an allowance should be made for the potential disposal of at least a proportion of any Made Ground spoil as Hazardous Waste. For costing purposes, assuming all Made Ground requires disposal as Hazardous Waste will provide a worst-case cost estimate.

It is recommended that following demolition, the currently inaccessible parts of the site are subject to site investigation. Further investigation of the two areas of residual hydrocarbon contamination is also recommended. All underground storage tanks will require removal as requested by the Environment Agency.

Technical Summary

On behalf of Tottenham Hotspur Property Co Limited, Buro Happold has undertaken a site investigation for the proposed redevelopment of Phase 1 of Northumberland Park Development. This report presents results of a Generic Quantitative Risk Assessment (GQRA) [carried out in accordance with DEFRA / Environment Agency Model Procedures (CLR11)] together with an assessment of waste classification of spoil from the proposed development.

The development site is located in Tottenham, within the London Borough of Haringey, North London. The proposed development includes a new football stadium with podium areas to the north and south providing access to the stadium for spectators. The southern podium will incorporate the Club shop and museum at ground level. Historically the site has been occupied by residential dwellings, orchards and various industrial uses including engineering works, petrol station, bottling stores, garages, piano works, small industrial units, shoe factory, milk depot, and warehouses. Various tanks and an electrical substation are also recorded to have been present. Currently the site is occupied by the existing Tottenham Hotspur Football Stadium, sheet metal works, offices, a place of worship and a large area of hardstanding currently used for additional car parking for the stadium. Vacant, retail and residential properties as well as other commercial properties front onto High Road.

Recent ground investigation confirmed the ground profile as; Made Ground over, a laterally discontinuous layer of gravelly clay, overlying in sequence Kempton Park Gravel (Secondary A Aquifer), London Clay Formation, Lambeth Group and Thanet Sand Formation overlying Upper Chalk (Major Aquifer) at approximately 43m depth. The Made Ground was not highly contaminated; however, occasional samples recorded concentrations of lead and benzo(a)pyrene above residential generic assessment criteria (GAC) and commercial/industrial soil guideline value (SGV). The conservative average (US95) for lead was below the residential and commercial/ industrial SGV, however the US95 for benzo(a)pyrene was above the residential GAC. No asbestos was recorded. Soil leachability is relatively high. Some localised hydrocarbon contamination was recorded in groundwater, however recorded concentrations (TPH and PAH including benzo(a)pyrene) are only marginally elevated.

Concentrations of carbon dioxide were slightly elevated (8.5% v/v) but methane was not recorded above 0.3% v/v. Flow rates were consistently low (<0.5 l/h). The ground gas regime falls within Characteristic Situation 2 (gas protection measures required), however assuming the proposed development remains unchanged (i.e. ground floor level car parking with a 1200 gauge polythene membrane provided in habitable areas) and that all penetrations and joints are sealed, no further gas protection measures are considered necessary.

Based on assumptions and data assessment in line with current guidance, a Generic Quantitative Risk Assessment has been carried out. The ground conditions are considered to present low to very low risks to;

site end users, and to the River Moselle. The potential risks to the construction workers, adjacent site users, and the Secondary A Aquifer have been assessed as Moderate/Low (refer Section 9). However, it is recognised that the site has not yet been fully investigated. Specific recommendations are included in Section 9.2 to mitigate risks related to ground contamination.

Based on the assumptions and data assessment in line with current guidance mentioned above, the majority of Made Ground is likely to be classified as Non-Hazardous Waste. However, an allowance should be made for the potential disposal of soil arisings to a Hazardous Waste landfill facility. There are also portions of the site where no sampling has been carried out, therefore it is recommended that following demolition, soil samples are collected and analysed to confirm the waste classification. Re-use of the material onsite as general fill is a possibility but would require either an Environmental Permit or agreement with the Environment Agency for action in accordance with the CL:AIRE: Development Industry Code of Practice. In either case liaison with the EA regarding the appropriate methodology will be required.

Notwithstanding the above, it is the earthworks contractor's responsibility, in association with the operator/owner of the receiving site, to classify the materials for disposal of spoil arisings in line with current guidance.

1 Introduction

1.1 Commissioned work and objective

Buro Happold Limited was requested by Tottenham Hotspur Property Co Limited to provide geoenvironmental services as part of the proposals for Phase 2 of the Northumberland Park Development Project in Tottenham, London. This report provides a Generic Quantitative Risk Assessment (GQRA) for the site in general accordance with CLR11 – 'Model Procedures (ref 1). The investigation informing this assessment has been carried out in accordance with relevant British Standards (BS5930 and BS10175, ref 3 & 4) and other good practice guidance. The report also presents an assessment of the likely waste classification of the soil arisings from proposed excavations.

The objectives of this report are:

1. To assess the potential for significant risks to both human and environmental receptors from contaminants identified within the manmade and natural ground during construction and for the finished development;
2. To determine the likely waste classes for excavated material; and
3. To determine the need for and scope of further investigation work or any remedial works.

1.2 Site information

This report has been presented, assessed and interpreted from information relating to the site in the following reports which should be read in conjunction with it.

- Buro Happold, November 2008. 023971 Northumberland Park Development Geotechnical Desk Study and Preliminary Geoenvironmental Risk Assessment (ref 5).
- Geotechnics, November 2009. Ground Investigation at Northumberland Park Development, London Factual Report for Tottenham Hotspurs Football & Athletic Club. PC (ref 6).
- Geotechnics, July 2010. Ground Investigation at Northumberland Development Project Phase 2, Factual Report for Tottenham Hotspur Property Co Limited. PC104225 (ref 7).

1.3 Limitations

The scope and design of the site investigation has reflected the known history of site use, the results of previous studies and the development plan, but also constraints on access (i.e. the presence of buildings and services etc). On this basis the spacing of the exploratory holes and the sampling and analysis plan for this investigation is considered to have provided a reasonable level of certainty about the ground conditions. However it is important to recognise that contamination can be both widespread and relatively localised, depending upon its source and nature etc. Furthermore, no investigation has been carried out beneath the

footprint of buildings within the site area or within the Sheet Metal Works site. No investigation, however comprehensive, can be expected to determine absolutely the nature and extent of all the contamination which could be present on any site. There will always be an element of uncertainty about the ground conditions including contamination. This potential for currently undetected contamination to be present must therefore be taken into account not only in the risk assessment presented here but also in consideration of future development activities, for example, , health and safety planning, financial planning and risk management and in the implementation of the below ground works during construction.

2 Site Description and Environmental Setting

A detailed review of the environmental setting for the site is provided in the Desk Study report (ref.5). A summary of this information is presented in the following sections.

2.1 Site location and topography

The development site is located in Tottenham, within the London Borough of Haringey, North London. The approximate Ordnance Survey National Grid Reference for the centre of the site is 534010, 191270. The site occupies some 8 ha and its location is shown in Figure 1.

The Phase 2 area (the site) incorporates the central and lower third of the development site, as outlined in Figure 2. The northern boundary is located within N17 Studios (currently being demolished) and the southern boundary Park Lane. The High Road and Worcester Avenue border the site to the west and east respectively. The site topography is generally flat, ranging from approximately 10.363 m AOD to 15.266m AOD.

2.2 Current site use

The site is occupied by the existing Tottenham Hotspur Football Stadium, sheet metal works, offices, a place of worship and a large area of hardstanding currently used for additional car parking for the stadium. Vacant, retail and residential properties as well as other commercial properties front onto High Road. A former fuel station (776 High Road) which is currently a shop, is understood by the Client to have foam filled underground tanks associated with its previous use, see Figure 3 for location. The petroleum section of the London Fire and Emergency Planning Authority does not hold records on whether these tanks were foam filled or not however does hold plans from September 2006 (ref 5) showing the location of the tanks and indicating previous tanks were to be excavated and removed. Further retail, residential, vacant and other commercial premises front onto the High Road. N17 Studios is present to the north which consisted of offices, studios, light industrial workshops and storage space. This area was being demolished at the time of the ground investigation. A series of listed buildings are located along the western site boundary. The site's surface covering is hardstanding, comprising of concrete and tarmac.

A potential underground storage tank identified from historical maps in the Desk Study (ref 5) is potentially located within the match day car park on Paxton Road. An electrical sub-station is also present within this carpark. An above ground diesel tank is located in the stadium carpark which is used for re-fuelling pitch machinery etc. No evidence of significant leakage was observed. The locations of these tanks and sub-stations are shown in Figure 3.

This study did not consider/assess the potential for asbestos containing materials (ACMs) or other hazardous substances to be present in the building structure as this aspect is outside the scope of this work.

2.3 Proposed site use

The proposed development for this part of the site comprises of a new football stadium with a spectator capacity of 56,250. It will be built at grade, with no basement areas. The pitch will be orientated on a north to south axis. To the north and south of the stadium would be podium areas providing access to the stadium for spectators. The southern podium will incorporate the Club shop and museum at ground level. A hotel and residential development are proposed to the south of the new stadium at a later stage. The residential development has not been included within the risk assessment in Appendix A. This development will require a separate risk assessment once the building has been fully designed.

The development will also include infrastructure, including roads and pavements, car parking areas/buildings, service/ utility installations and drainage systems. No soft landscaping is proposed. The proposed development pattern is shown in Figure 2.

2.4 Previous site use

The site was occupied by orchards and open space since at least 1867. By 1896 the majority of the orchards had been cleared, and buildings constructed along Tottenham High Road. Paxton Road had also been constructed at this time. By 1913, Tottenham Hotspur Football Stadium has been built along with terraced housing fronting Paxton Road to the north and east of the stadium. A number of buildings were also present to the west of the stadium. A brewery and allotment gardens were present to the north of Paxton Road by 1935 along with a mechanical engineering and manufactory to the south-west of the stadium. The terraced housing to the east of the stadium had been demolished. Post war, the site was occupied by various commercial/industrial land uses including, but not limited to, engineering works, bottling stores, garages, piano works, small industrial units, shoe factory, milk depot, warehouses and a tank until reaching its existing condition in 1991.

Numerous commercial/industrial uses have surrounded the site for varying periods since at least 1881 including a gas works (approximately 1km northeast), Great Eastern Railway lines, garages, and various engineering and industrial works.

A more detailed description of the site history is given in Section 3.2 of the Buro Happold Desk Study Report (ref 5).

2.5 Geology, hydrogeology and hydrology

According to the geological map for North London, (Sheet 256, 1:50,000, 2006 ref 8), British Geological Survey (BGS) borehole logs and previous ground investigations (ref 5), the sequence of strata beneath the site comprises Made Ground overlying in sequence Enfield Silt (in the southeast only), Kempton Park Gravel, London Clay Formation, the Woolwich and Reading Beds (Lambeth Group) and Thanet Sand Formation. The Thanet Sand Formation is underlain by the Upper Chalk at approximately 45m depth. The geology and

hydrogeology underlying the site is summarised in Table 2-1. Further detail can be found in the Desk Study Report (ref. 5).

Table 2-1 Summary of geology and hydrogeology

Name	Description	Thickness	Aquifer type
Made Ground	Concrete/ tarmac overlying typically clayey sand and gravel occasionally sandy clay with gravel containing brick, flint, clinker, ash, chalk, glass, slag and china with rare occurrence of organic material i.e. wood.	0.5-3.8m	Unclassified
Enfield Silt (southeast of site only)	Firm to stiff silty CLAY with rare/occasional sand and fine to medium gravel.	0.55 – 1.25	Unclassified
Kempton Park Gravel	Medium dense to dense sand and gravel with some pockets/lenses of firm clay, rare organic matter. Gravels of flint and quartz.	2.2-5.70m	Secondary A Aquifer
London Clay Formation	Stiff to very stiff grey blue closely fissured silty clay with fine sand partings. Occasional pyrite and claystone	14.10-18.35m	Unproductive Strata
Lambeth Group	Generally very stiff grey-blue slightly red-green friable/fissured slightly silty clay. Note limestone (1m thick) and sandstone (1.8m thick) bands at variable depths	~7.5m	Unproductive Strata
Thanet Sand Formation	Very silty fine sand where encountered	~30m	Principal Aquifer
Upper Chalk		~60m	Principal Aquifer

The groundwater table is likely to sit within the Kempton Park Gravel forming an unconfined aquifer, designated by the Environment Agency as a Secondary A Aquifer. A deeper aquifer is also likely to be present within the deposits of the Lambeth Group and Thanet Sand Formation, confined by the overlying London Clay Formation. The Thanet Sand Formation and Upper Chalk are classified by the Environment Agency as a Principal Aquifer. The nearest recorded groundwater abstraction is located approximately 285m north-east of the site at 881 Tottenham High Road. The abstraction license is owned by Cannon Automotive Ltd, with

groundwater utilised for general cooling purposes. The nearest recorded groundwater abstraction licence for potable supply is located 898m east of the site. This license is owned by Thames Water Utilities Limited. The aquifer that both these abstraction licenses penetrate is unknown but is likely to be the Upper Chalk. The majority of the site is located within a Groundwater Source Protection Zone (SPZ) II (Outer Protection Zone).

The nearest surface water feature is the River Moselle. The River becomes culverted approximately 357m to the west of the site boundary, at the junction between White Hart Lane and Beaufoy Road, before running along the western edge of Tottenham High Road, adjacent to the western boundary of the site. At Scotland Green the River bends eastwards towards Tottenham Marshes.

3 Ground Investigation 2009/2010

3.1 Phase 1 site works (2009)

A ground investigation was designed and commissioned by Buro Happold (see Section 1.2 of this report) in July 2009. Contracting services were provided by Geotechnics Limited and contamination testing was undertaken by Envirolab, a specialist analytical soils and groundwater laboratory. Groundwater sampling was undertaken by Buro Happold. No gas monitoring was undertaken. The site works took place between 15 September and 4 November 2009 and comprised the following:

- Drilling of 8 No. boreholes using cable percussive techniques (up to 43.8m deep) with 3 No. groundwater installations within the Kempton Park Gravels;
- Soil logging and sampling from all exploratory holes; and
- Groundwater monitoring and sampling.

The locations of the exploratory holes are shown as Figure 3. Logging and soil sampling was undertaken by a Geotechnics Limited engineer. The ground conditions encountered in all exploratory holes were logged in accordance with BS 5930:1999. Logs for the boreholes and trial pits are provided in the Geotechnics Limited Factual Report (ref 6).

3.2 Phase 2 site works (2010)

The Phase 2 ground investigation was designed and commissioned by Buro Happold (see Section 1.2 of this report) in April 2010 to obtain both geotechnical and geoenvironmental information across the remainder of the proposed Stadium site. The ground investigation design was based upon the known site history, the results of the Phase 1 investigation, and the current masterplan at that time. Contracting services were provided by Geotechnics Limited and contamination testing was undertaken by Envirolab, a specialist analytical soils and groundwater laboratory. Groundwater and gas monitoring and sampling was undertaken by Buro Happold. The site works took place between 11 May and 4 August 2010 and comprised the following:

- Drilling of 14 No. dynamically sampled and hollow stem augured boreholes (up to 7.3m deep) with dual groundwater/ground gas installations within the shallow ground profile (Made Ground and Kempton Park Gravel);
- Drilling of 4 No hollow stem augured boreholes (2.5m deep) with a ground gas installations within the Made Ground and unsaturated Kempton Park Gravel.
- Drilling of 4 No. boreholes using cable percussive techniques (up to 30m deep) with dual groundwater/ground gas installations within the shallow ground profile (Made Ground and Kempton Park Gravel);

- Soil logging and sampling from all exploratory holes; and
- Groundwater and ground gas monitoring and sampling.

The locations of the exploratory holes are shown as Figure 3. Logging and soil sampling was undertaken by a Geotechnics Limited engineer. The ground conditions encountered in all exploratory holes were logged in accordance with Amendment I to BS 5930, dated December 2007 and BS EN ISO 14688-1 (2002) and BS EN ISO 14689-1 (2003). Logs for the boreholes and trial pits are provided in the Geotechnics Limited Factual Report (ref 7).

3.3 Geoenvironmental sampling and testing

Representative disturbed soil samples were obtained from boreholes for examination and laboratory chemical analysis. Samples were taken so as to be representative of each stratum found, with the first sample collected within the top 0.5m. The maximum sampling interval was 1.0m. Additional samples were taken where visual/olfactory evidence of contamination was identified.

Buro Happold scheduled a programme of chemical testing on soil, water and gas samples. All analysis was undertaken by Envirolab. Details of the specific suites of analysis are presented in Table 3-1. Analysis was undertaken using methods approved under the MCERTS performance standard for soils, water and gas where available. The number of samples analysed for each of the analytical suites is given in Table 3-1. The analytical data is presented in Appendix B and discussed in Sections 5 & 6.

Table 3-1 – Number of samples analysed / suites of analysis

Suite	Soil	Groundwater	Gas
General Suite *	34	22	-
TPHCWG	14	-	-
PCB	6	-	-
Leachate suite**	3	-	-
WAC analysis	6	-	-
Bulk gas (methane, carbon dioxide, oxygen, hydrogen sulphide)	-	-	3

* Soil general suite comprised; speciated PAH, moisture content, asbestos screen (fibre screen only), total cyanide, pH, heavy metals, total organic carbon, phenols, % stones greater than 10mm, easily liberated sulphide.

Groundwater general suite comprised; heavy metals, sulphate, ammoniacal nitrogen, total dissolved solids, hardness, phenols, total suspended solids, free cyanide, pH, TPH CWG, speciated PAH.

** Leachate suite comprised; heavy metals and total dissolved solids.

4 Ground Conditions

4.1 Geology

The ground investigation has shown that the natural geology beneath the site is generally as predicted from published geological data (Section 3.5). Table 4-1 presents a summary of this ground. Cross-sections through the site are presented in Figure 4.

Table 4-1 – Summary of ground profile

Stratum	Interface Elevation (m OD)	Stratum Thickness (m)	Interface Depth (m BGL)	General Description of Strata
—————	11.31-12.83		0	
Made Ground		1.2 – 3.5 (ave. 1.88m)		Brown/grey sand and gravel with brick and cobble overlying soft brown grey sometimes orange slightly sandy gravelly clay containing brick, cobbles, ceramics, plastic, clinker, carbonaceous material, concrete, ash pockets, glass and flint.
—————	11.5 to 9.2		1.2-3.5	
Gravelly Clay*		0.1-1.6m (ave 0.8m)		Stiff reddish brown slightly sandy slightly gravelly clay. Laterally discontinuous.
—————	11.4 to 8.4		1.4-3.0	
Kempton Park Gravel		2.6-6.2 (ave 4.05m)		Dense brown sandy gravel of quartz and flint.
—————	8.7 to 4.1		4.6-7.8	
London Clay Formation		11.4-18.3 (ave 15.8)		Stiff, very stiff grey, brownish grey and blueish grey, slightly silty/sandy slightly micaceous clay with occasional silt and sand lenses (becoming more prevalent with depth). Occasional claystone layers, rare carbonised plant remains, rare shell remains.
—————	-8.8 to -16.4		16-20.9	
Lambeth Group		5.3-11.45 (ave 8.04)		Very stiff (recovered as soft/very soft) fissured bluish grey mottled red and brown sandy clay becoming a gravelly sandy clay with depth. Calcareous deposits/concretions (reported as chalk and limestone) and sandstone note with depth.
—————	-18.9 to -27		23.55-27.71	
Thanet Sand Formation		~15m??		Very dense light brown mottled grey fine to medium sand.
—————	-30.46		43.0	
Upper Chalk		Not proven		

* Possibility that gravelly clay layer is part of the Kempton Park Gravel, however there is also potential for this to be part of the Made Ground or Enfield Silt. Chemical analysis (Section 5.3.2) however suggests this material is natural.

4.2 Hydrogeology

Groundwater levels were measured throughout the investigation and during groundwater and gas monitoring visits. Table 5.2 overleaf summarises this data. From observations made in the field and monitoring data, it appears that in some locations water is perched within the Made Ground with the main groundwater body located within the Kempton Park Gravel. Monitoring data suggests that groundwater within the Kempton Park Gravel is flowing in a westerly direction. Figure 5 shows the piezometric surface (as interpreted from groundwater monitoring data) for the 20 May 2010.

Table 4-2 Recorded groundwater levels

Borehole	Screened Interval (mBGL)	Strata	Minimum Level		Maximum Level	
			m bgl	mOD	m bgl	mOD
WS16	1.0-5.0	MG / KPG	2.98	8.79	2.98	8.79
WS17b	1.0-6.0	MG / KPG	2.91	8.92	2.92	8.93
WS18	1.0-6.0	MG / KPG	2.25	9.71	2.31	9.77
WS19	1.0-7.0	MG / KPG	2.44	8.94	2.45	8.95
WS20	2.5-6.5	KPG	3.32	9.215	3.335	9.23
WS21	1.0-6.0	MG / KPG	2.67	9.13	3.01	9.47
WS23	1.0-7.0	MG / KPG	2.695	9.10	2.70	9.105
WS24	1.0-7.3	MG / KPG	2.77	-	2.79	-
WS25	1.0-6.5	MG / KPG	2.72	-	2.745	-
WS26	1.0-5.0	MG / KPG	2.73	9.24	2.74	9.25
WS27	1.0-4.5	MG / KPG	1.92	-	1.98	-
WS28	1.0-5.0	MG / KPG	1.98	-	2.02	-
WS29a	1.0-5.5	MG / KPG	2.65	8.99	2.76	9.1
WS10/01	1.0-6.5	MG / KPG	2.34	8.93	2.38	8.97
BH10/02	1.0-5.0	MG / KPG	2.185	10.29	2.54	10.645
BH10/03	1.0-4.5	MG / KPG	2.51	8.94	2.65	9.08
BH10/05	1.0-5.0	MG / KPG	3.1	8.795	3.105	8.80
BH09/07	1.0-6.0	MG / KPG	2.38	8.94	3.12	9.68
BH09/11	3.0-6.5	KPG	2.68	8.83	3.66	9.61
BH09/12	2.0-5.7	KPG	2.63	8.81	3.25	9.49

As part of the Phase 1 Ground Investigation for the proposed redevelopment of Northumberland Park Development, long term groundwater monitoring has been carried out within the new pitch area in order to determine how quickly the water levels change in response to weather conditions. Water level data loggers were installed within three boreholes (BH09-07, BH09-11 and BH09-12) within the proposed pitch area in October 2009. The water level data for the period October to June has been assessed within the Buro Happold Design Note G-01 (July 2010). In summary, the data shows that groundwater levels within the Taplow Gravels appear to be directly related to rainfall.

4.3 Visual/olfactory evidence

During the intrusive works, a moderate hydrocarbon odour was observed at the approximate water table level in the Kempton Park Gravel within BH09/12, WS16, WS21 and WS22 and in the Made Ground during drilling of BH09/06 and BH010/02. An oily residue was also observed in the Kempton Park Gravel within WS16. A slight hydrocarbon odour was observed within the Kempton Park Gravel within WS10/01. In addition, a moderate hydrocarbon odour and oil sheen was observed on the surface of groundwater purged from BH09-12 and WS21 during sampling.

The source of hydrocarbon observed in soil and groundwater within the vicinity of BH09/12, WS21 and WS22 is likely to be an underground fuel tank identified on historical maps and on Figure 3. The source of hydrocarbon observed within the soil and water within WS16 is likely to be the above ground storage tank (or a former one) located in this area (refer Figure 3).

No distinguishable odour, visible sheen or evidence of light or dense non-aqueous phase liquids (LNAPL/DNAPL) was observed within made ground or natural soil within any of the other exploratory hole locations.

5 Soil and Groundwater Data Assessment

5.1 Contamination risk assessment criteria

5.1.1 Background

A risk-based approach is used for the assessment of contamination, requiring identification of a contaminant source, a receptor and a realistic pathway *via* which the contaminant may reach the receptor. The key receptors considered in this assessment are site end-users and neighbours, construction workers, and controlled waters. In order to perform a generic quantitative risk assessment, the test results have been compared with generic assessment criteria as indicated below.

5.1.2 Risks to human health

Analytical data derived from the investigation has been put into context by comparison with published guidance or derived thresholds values. Current UK guidance published thresholds comprise Soil Guideline Values (SGVs), which are available for a limited number of determinands (ref. 9) and land uses. For contaminants without published SGVs or where soil conditions are different to those assumed for the published SGVs (6% soil organic matter content and sandy loam soil), Generic Assessment Criteria (GAC) have been derived. The derivation of GACs has been carried out based on published statutory guidance documents (ref 1, 2) and with consideration of the most sensitive receptors in the respective CLEA standard land-use scenarios (the 0 to 6 year old child for the residential scenario and the adult for the commercial land-use scenario) using the software model 'CLEA 1.06 and associated handbook (ref. 12 and 13). The software model (CLEA 1.06) was issued by the Environment Agency in October 2009 and replaces all the previously issued software versions.

When deriving generic assessment criteria, contaminant specific model input values have been selected as prescribed by the Environment Agency SGV reports (ref. 9). In the absence of SGV reports, contaminant specific input values have been selected as suggested by the EA publication 'The UK Approach for Evaluating Human Health Risks from Petroleum Hydrocarbons in Soil' (ref. 14) and SC050021/SR7 (ref. 15) together with the EIC/AGS/CL:AIRE (ref. 17) and CIEHLQM report (ref.16).

In the future, assessment criteria for lead are to be derived using the CLEA 1.06 model. However, in the absence of an HCV value for this contaminant, assessment criteria for lead have been adopted as derived and detailed in the old style lead SGV (Soil Guideline Value) report (ref. 18). Lead assessment criteria as detailed in the old style SGV report had been derived on the basis of a response of the blood lead versus soil and dust lead relationship in line with a model developed by the Society for Environmental Geochemistry and Health (residential) and USEPA (commercial) respectively.

Where individual concentrations of contaminants have been found exceeding assessment criteria, the data of the specific contaminant was analysed statistically in line with the 'Guidance on Comparing Soil Contaminant Data with Critical Concentrations' (ref. 19) Where the distribution of data for particular determinands showed evidence of non-normality, the 95% upper confidence limits (US95) were calculated using the Chebychev Theorem in accordance with this recent guidance (ref.12).

There is currently no UK guidance for assessing acute (short term) risks from soil contamination. However, as acute risks are concerned with short-term exposure, consideration should be given to maximum soil concentrations.

5.1.3 Risks to controlled waters

For the soil leachate and groundwater assessment, contaminant concentrations have been compared to UK Drinking Water Standards (ref. 22) as well as Freshwater Environmental Quality Standards (EQS) derived under the requirements of the EC Dangerous Substances Directive (ref. 20). It is recognised that these substances may require further review against site specific thresholds derived using quantitative risk assessment, if a potentially significant risk is identified. In the absence of Drinking Water or Environmental Quality Standards for TPH, hydrocarbon concentrations have been compared with European Council Directive 75/440/EEC (ref 21).

5.2 Risks to plant life

Soil test results with respect to phytotoxic metals have been assessed using values cited in the British Standard for topsoil (ref. 24).

5.3 Sub division of chemical data

5.3.1 Division relevant to receptor

The chemical results have been characterised as made or natural ground and then sub-divided accordingly.

The data has been assessed with respect to;

Chronic risks to human health

Acute risks to human health

Risks to controlled waters

Risks to *flora*

Risks to buildings and services

5.3.2 Reporting of data

Chemical testing results from the ground investigation are described below and presented in Appendix B of this report as follows;

Soil results – Section 5.4 and Appendix B: Table 1

Soil leachate results – Section 5.5.1 and Appendix B: Table 2

Groundwater results – Section 5.5.2 and Appendix B: Table 3

Assessment of gas monitoring results – Section 6 and Appendix B: Table 4

Waste classification – Section 8 and Appendix B: Tables 5 and 6

5.4 Soil data

5.4.1 Made Ground

A total of twenty nine samples of Made Ground were analysed for the inorganic and organic determinands outlined in Section 3.3 and Appendix B - Table 1. Table 5-1 provides a summary of contaminants recorded above respective screening criteria in one or more samples.

Table 5-1 –Determinands recorded above respective screening criteria in Made Ground

Determinand	No of samples	SGV (No of samples > SGV/GAC)		Max	Min	US95 (without outlier)	Outliers
		Resi without plant uptake	Commercial / industrial				
Lead	29	450(4)	750(3)	1520	12	303*	-
Benzo(a)pyrene	29	1 (7)	14 (1)	17.9	<0.01	1.1	-

All concentrations in mg/kg

* calculated using Chebychev

Occasional samples recorded concentrations of lead (14%) and benzo(a)pyrene (24%) above the relevant SGV/GAC for residential (without plant uptake) use in Made Ground. Occasional samples of Made Ground also recorded concentrations of lead (10%) and benzo(a)pyrene (3%) above the SGV/GAC for commercial/industrial landuse. The conservative average (US95) for lead was below both the SGV for residential (without plant uptake) and commercial/industrial landuses. The US95 value for benzo(a)pyrene was marginally above the GAC for residential (without plant uptake) but below the US95 value for commercial/industrial landuse.

TPH and BTEX concentrations were recorded below relevant GACs for residential and commercial/industrial land use.

5.4.2 Natural ground

A total of twelve samples of natural ground (gravelly clay and Kempton Park Gravel) were analysed for the inorganic and organic determinands listed in Appendix B – Table 1. All samples of natural ground recorded contaminant concentrations below relevant SGVs or GAC.

5.4.3 Asbestos

A total of twenty nine samples of Made Ground and five samples of natural ground (gravelly clay and Kempton Park Gravel) were analysed to detect the presence of asbestos. No asbestos was identified in any of the samples analysed.

5.4.4 Acute risks to human health

There are no guidance values for assessing acute risk related to soil contamination. Because such risks are associated with short-term exposure, consideration of maximum concentrations (and not the "average" concentration which is relevant to chronic, or long-term, risk) is required. Comparison of these maximum concentrations has been made with the various SGVs and other screening values which will provide a conservative benchmark for such short-term risks (as the SGVs etc are based upon a long-term exposure).

The maximum values recorded for inorganic and organic determinands within the Made Ground are generally not highly elevated. The maximum recorded concentration of lead was approximately three times the SGV for residential (without plant uptake) land use and twice the SGV for commercial/industrial land use. The next highest lead concentration was approximately 2.5 times the SGV for residential (without plant uptake) and 1.5 times the SGV for commercial/industrial land use.

The maximum value for benzo(a)pyrene was approximately 18 times the GAC for residential (without plant uptake) and 1.3 times the GAC for commercial/industrial land use. The next highest concentration of benzo(a)pyrene was 13 times the GAC for residential (without plant uptake) and below the GAC for commercial/industrial land use.

5.4.5 Risks to *flora*

A total of twenty nine samples of Made Ground and twelve samples of natural ground (gravelly clay and Kempton Park Gravel) were analysed for phytotoxic determinands listed in Appendix B – Table 1. Table 5-2 provides a summary of contaminants recorded above respective screening criteria in one or more samples.

Copper, nickel and zinc concentrations in natural ground were recorded below the relevant BS 3882: 2007 for topsoil. Concentrations of nickel in Made Ground were also below the BS 3882: 2007 for topsoil. Occasional samples of Made Ground recorded concentrations of copper (14%) and zinc (17%) above the BS 3882: 2007 for topsoil. One of these samples was recorded as a statistical outlier; however review of the borehole logs did not highlight any significant differences in the Made Ground at this location to the rest of the site. The US95 value for both copper and zinc in Made Ground exceeded the BS 3882: 2007 for topsoil with the outlier included, but was less than the BS 3882: 2007 for topsoil when it was excluded.

Table 5-2 – Phytotoxic determinands

Strata	Determinand	No of samples	BS3882: 2007	Max	Min	US95 (excluding outlier)	Outliers
Made Ground	Copper	29	200(4)	3440	6	734.4* (127.6*)	WS20 @ 0.5mbgl
Made Ground	Zinc	29	300(5)	2050	18	512.3* (208*)	WS20 @ 0.5mbgl

All concentrations in mg/kg
 * calculated using Chebychev

5.4.6 Buildings/services

Classification of buried concrete against sulphate attack has not been addressed within this report. This will be assessed in the forthcoming geotechnical design note for the stadium development through the assessment of chemical test results on various strata and various levels to the current guidance BRE SD1:2005 (ref 25).

In order to assess the risks to conventional water pipe material from Made Ground found onsite, contaminant concentrations have been compared against threshold values derived by Water Regulations Advisory Scheme (WRAS) (ref 26). Where soil concentrations exceed these threshold values, it is likely that special consideration of material selection will be required. Numerous concentrations of arsenic and pH were elevated above WRAS material selection threshold values in Made Ground. Occasional concentrations of lead, TPH and PAH were also elevated above WRAS threshold values in Made Ground. Arsenic and lead are classed as toxic contaminants, TPH and PAH are organic whereas pH is corrosive. Occasional samples of natural soils also recorded concentrations of arsenic and TPH elevated above WRAS threshold values.

With reference to Table 3 of WRAS Information and Guidance Note: No 9-04-03 (ref 26), suitable pipe materials for toxic and corrosive environments include plastic, plastic coated copper or wrapped iron. Suitable pipe materials for organic contaminants include metallic or polythene/aluminium/polythene. The WRAS Guidance Note however recommends that the laying of water pipes across land where arsenic is identified or suspected is unacceptable without site remediation. However, the WRAS thresholds are known to be highly conservative and not risk based. Approximately 55% of samples recorded arsenic concentrations less than the WRAS threshold and the assessment regarding risks to human health (Section 5.4.1) did not identify widespread/gross contamination of arsenic or other determinands.

5.5 Risks to controlled waters

Potential risks to controlled waters have been assessed by examining soil leachability and groundwater data. Soil leachability and groundwater data from this investigation is presented as Tables 2 and 3 respectively in Appendix B.

5.5.1 Leachability

The leachate from six soil samples of Made Ground was analysed for a number of inorganic determinands as listed in Table 2, Appendix B. Leachable copper (67%) and arsenic (50%) were recorded above Freshwater Environmental Quality Standards (EQS) and the UK Drinking Water Standards (DWS) respectively. Heavy metals within the Made Ground are considered to be reasonably leachable.

5.5.2 Groundwater

Field observations

During groundwater sampling, a moderate hydrocarbon odour and oil sheen was observed on the surface of groundwater purged from BH09-12 and WS21 during sampling. A slight hydrocarbon odour was observed on groundwater purged from WS16 and a very slight sheen was recorded on water purged from WS29a but no odour. No distinguishable odour, visible sheen or evidence of LNAPL/DNAPL was observed on water purged from any of the other boreholes. Groundwater field monitoring sheets are provided in Appendix C.

Kempton Park Gravel

All inorganic and organic determinands were below the relevant Freshwater EQS. Occasional concentrations of nickel, selenium and ammoniacal nitrogen were elevated above UK DWS. Groundwater from a single borehole (BH09-07) recorded concentrations of benzo(a)pyrene and PAH (Drinking Water Four) above UK DWS. The Made Ground at this location recorded elevated TPH concentrations (above Inert Waste Acceptance Criteria) in the near surface soils (0.3m bgl) but did not record elevated TPH, benzo(a)pyrene or PAH below this depth. Black ash and a hydrocarbon odour were recorded by the drillers between 0.2-0.8m bgl at this location. The groundwater purged from this borehole did not contain visual or olfactory evidence of hydrocarbon contamination and TPH concentrations were recorded below the laboratory detection limit. TPH concentrations were slightly elevated (above European Council Directive 75/440/EEC values) in water sampled from BH09-12 (sampled October 2009), WS16 and WS21 (sampled May 2010) at 2601 ug/l, 747 ug/l and 447ug/l respectively. BH09-12 was re-sampled in May 2010, subsequently recording TPH concentrations below the laboratory detection limit. A moderate hydrocarbon odour and sheen was observed on purged water from BH09-12 and WS21 during the initial sampling round, with no odour or sheen recorded in BH09-12 during the second sampling round. The source of TPH at this location is likely to be an underground fuel tank shown on historical maps and on Figure 3. A slight hydrocarbon odour was observed on purged water from WS16. The source of TPH at this location is likely to be the above ground storage tank located in this area (refer Figure 3).

6 Data Assessment – Ground Gas

6.1 Programme

Ground gas monitoring was undertaken at 21 locations across the site on between six and seven separate occasions at weekly intervals between 20 May and 4 August 2010. Field monitoring sheets are provided as Appendix D. Visits were undertaken during both high and low (falling) atmospheric pressure episodes. Gas samples were collected on one occasion from four locations and analysed in the laboratory to confirm the readings recorded on site. Table 4 in Appendix B gives a summary of the results from the investigation.

6.2 Data results

Slightly elevated concentrations of carbon dioxide were recorded (up to 7.7% v/v) and very slightly elevated methane concentrations (up to 0.3% v/v) were recorded over the monitoring period. Elevated concentrations of carbon monoxide were also recorded (up to 59ppm) however these elevated concentrations were not consistent over the entire monitoring period. Consistently low flow rates were observed, up to 0.5l/hr. Ground gas concentrations recorded during field monitoring in boreholes WS17c, WS20, WS23 and WS26 are consistent with laboratory analytical results (Table 6-1).

WS22, located in the area of recorded hydrocarbon contamination, was also sampled and analysed for volatile organic compounds (VOCs). All VOC concentrations were recorded below the laboratory detection limits.

Table 6-1 - Chemical analysis of ground gas compared to field results

Parameter	WS17c		WS20		WS23		WS26	
	3 June 2010		3 June 2010		3 June 2010		3 June 2010	
	Lab	Field	Lab	Field	Lab	Field	Lab	Field
Hydrogen	<0.5	-	<0.5	-	<0.5	-	<0.5	-
Oxygen	21.7	18.7	19.6	18.2	20.3	19	15.2	13.9
Nitrogen	78.3	-	80	-	79.4	-	84.4	-
Carbon Monoxide %	-	-	<0.05	-	<0.05	-	<0.05	-
Methane	<0.05	0.1	<0.05	0.1	<0.05	0	<0.05	0.1
Carbon Dioxide	<0.05	0.2	0.386	0.4	0.271	0.3	0.457	0.4
Hydrogen Sulphide(ppm)	<1	0	<1	0	<1	0	<1	0
Carbon Monoxide (ppm)	<1	1	-	9		6		3

6.3 Data assessment

The gas data has been assessed with reference to CIRIA report C665 (ref 26) and British Standards BS8485 (ref 26). Consideration has therefore been given to both methane and carbon dioxide concentrations as well as emission (flow) rates. The Gas Screening Value (GSV) is defined as the product of gas concentration multiplied by flow rate. The GSV is then considered with other parameters/limiting conditions to define a Characteristic Situation. The Characteristic Situation in turn identifies the need for and scope of any necessary gas protection measures. Assessment of the ground gas results for each monitoring round during the recent investigation is provided in Appendix B as Table 4.

The highest concentration of carbon dioxide (7.7% v/v) and the highest flow rate (0.5 l/hr) recorded on site produce a GSV of 0.04 indicating that the ground gas regime beneath the site falls within Characteristic Situation 1, Very Low Risk (Table 8.5, CIRIA Report C665). However, the guidance also states that if carbon dioxide concentrations are greater than 5% v/v consideration should be given to increasing the Characteristic Situation to CS2. Sites which fall within CS2 are considered to be low risk (ref 26) requiring gas protection measures for commercial/industrial development. Based on the relatively consistent concentrations of gas, the low flow rates and the nature and extent of the Made Ground, the data collected during the investigation is considered to be appropriately reliable and representative of the ground gas regime.

The ground gas regime for the site therefore falls within Characteristic Situation 2 (gas protection measures required). However, assuming the proposed development remains unchanged (i.e. ground floor level car parking with a 1200 gauge polythene membrane provided in habitable areas) and all penetrations and joints are sealed, no further gas protection measures are considered necessary.

7 Contaminated Land Risk Assessment

7.1 General approach

In the UK, the assessment of risk from contamination follows the source-pathway-target approach. If one of these three elements is absent it is considered that there is no risk of harm. If, however, there is considered to be a linkage between any given source and any given target/receptor then a risk-based approach is used to assess the significance or impact of any such linkage.

Source – The contaminants that have the potential to negatively affect human health and/or the health of the environment (i.e. the hazard).

Pathway – The potential route by which a receptor may come into contact with the source.

Receptor – The specific group of human beings or aspect of the environment (e.g. controlled waters) that could be affected by the source.

Risks are defined as the probability of an event occurring combined with the severity of the consequence of that event occurring. Particularly, to assess the risk to site end users posed by any given source, the sensitivity of each receptor is considered. For example, the concentration of contamination acceptable at a site to be developed as a residential property with a garden used to grow vegetables and accessible to young children is set lower than that for a commercial site where soil is exposed in minor areas of landscaping and the only long-term users of the site are adults. Similarly, a site overlying a major aquifer supplying potable water to a large population will be considered more stringently than a site overlying an impermeable geology with only minor seepages of groundwater.

7.2 Conceptual site model

The potential risks posed to human health and the environment by ground contamination at this site have been evaluated using a generic quantitative risk assessment which incorporates the 'source-pathway-receptor' identification and assessment methodology in accordance with CLR 11(ref 1). The risk assessment process therefore involves the identification of each site specific source based on both desk based and chemical information obtained from the site investigation together with identification of each relevant exposure pathway and each potential receptor. The potential risks to the receptor are then assessed by considering the potential effect of the source on the receptor as well as the likelihood of a pathway linking the two, i.e. a pollutant linkage as discussed above.

7.2.1 Potential sources

Based on the desk based and site investigation data obtained to date, the potential sources of contamination that may reasonably affect receptors on the site are summarised in Table 7-1 below.

Table 7-1 Principle sources of contamination

Potential Source(s)	Location	Potential Contaminants of Concern/Comments
Made Ground (demolition debris, historical & current industrial land uses inc. steel metal works, etc)	Onsite	Described as sand and gravel with brick and cobble overlying soft slightly sandy gravelly clay containing brick, cobbles, porcelain, ceramics, plastic, clinker, carbonaceous material, concrete, coal, ash pockets and flint. Occ. concentrations of Pb and B(a)P > residential and commercial/industrial SGVs/GACs. US95 for Pb < residential and commercial/industrial SGV however > residential for B(a)P. No asbestos recorded. Maximum concentrations are elevated. Numerous As & pH values >WRAS threshold. Occ. concentrations of Pb, TPH & PAHs >WRAS threshold value. Not risk based and highly conservative. Soil reasonably leachability. Slightly elevated CO₂ (max 6.5%). Very slightly elevated methane (max 0.3%). Consistently low flow rates (<0.5 l/h). Characteristic Situation 2.
Former Fuel Station	West	A former fuel station at 776 High Road, which is currently a shop, is understood by the Client to have foam filled underground tanks associated with its previous use. A slight hydrocarbon odour was observed in the Kempton Park Gravel at the approximate water table level within WS10/01 on the forecourt. TPH, BTEX and PAH concentrations in soil and groundwater were recorded below relevant screening criteria. Very low concentrations of methane (max 0.2%v/v) and CO₂ (max 0.8% v/v). Consistently low flow rates (0 l/h).
Underground storage tank	East of Paxton Road Carpark	Potential tank identified by historical maps. Moderate hydrocarbon odour and staining observed at water table in soil within WS21, WS22 and BH09-12. A moderate hydrocarbon odour and oil sheen was observed on the surface of groundwater purged from BH09-12 and WS21 during sampling. All TPH, BTEX & PAH concentrations in soil recorded < residential and commercial industrial screening criteria. Elevated TPH concentrations recorded in groundwater sampled from BH09-12 and WS22. BTEX and PAH concentrations < UK DWS. Very low concentrations of methane (max 0.3%v/v) and slightly elevated concentrations of CO₂ (max 6.5% v/v). Consistently low flow rates (0 l/h).

Potential Source(s)	Location	Potential Contaminants of Concern/Comments
Above ground storage tank	Stadium carpark	An above ground diesel tank is located in the stadium carpark. An oily residue and moderate hydrocarbon odour was also observed in the Kempton Park Gravel within WS16. TPH and BTEX concentrations in soil recorded < residential and commercial industrial screening criteria. Benzo(a)pyrene concentrations > residential (without plant uptake) assessment criteria in Made Ground at this location. Elevated TPH concentrations recorded in groundwater. BTEX and PAH concentrations < UK DWS. Very low concentrations of methane (max 0.2%w/v) and slightly elevated concentrations of CO (max 1.5% v/v). Consistently low flow rates (0.1 l/h).
Electrical Substation	On site	No visual/olfactory evidence of PCB contamination observed in soil or groundwater. PCB concentrations recorded below laboratory detection limit in soil samples analysed.

7.3 Potential receptors and pathways

Site specific pathway receptor linkages have been identified for the site (Table 7.2) with respect to the sources outlined above and with respect to anticipated future uses of the site i.e. football stadium as described in Section 2.3.

Table 7.2 Site specific receptors & pathways

Receptor		Pathway
Human Health	Construction and maintenance workers	Direct contact and dermal uptake, soil and dust ingestion.
	Adjacent site users (residential, commercial and the public)	Soil and dust ingestion.
	Site end users (maintenance workers, and the public including children, commercial & hotel users)	Direct contact and dermal uptake, soil and dust ingestion (in limited areas of soft landscaping). Ingestion of contaminated water supplies. Ground gas migration/accumulation.
Controlled Waters	Kempton Park Gravel (Secondary A Aquifer)	Leaching and groundwater transport/surface runoff
	River Moselle	Leaching and groundwater transport/surface runoff
Buildings/Services	On site structures (including water supply pipes)	Direct contact/ permeation of plastic pipe work by contaminants in soil and leachate.

The Upper Chalk Aquifer has not been included as a potential receptor within the risk assessment given its depth (40m bgl) and the significant thickness of impermeable London Clay Formation (20-25m) separating it from the Secondary A Aquifer. There is therefore no plausible pollutant linkage between any near surface contamination and the Upper Chalk Aquifer.

The proposed residential development to the south of the site has not been included within the risk assessment in Appendix A. This development will require a separate risk assessment once the building has been fully designed.

There is no soft landscaping proposed within the development. *Flora* has therefore not been included as a potential receptor within the risk assessment.

7.4 Presentation of risk assessment

The details of the Generic Quantitative Risk Assessment are presented in Appendix A, and the results/ conclusions discussed in Section 9. The conceptual site model is presented in Figure 6.

8 Waste Management

It is understood that the proposed development involves excavation of some 40,000m³ of soils with the possibility of all of this to be re-used as fill onsite. In order to determine the likely waste classification, soil and leachate test results have been assessed using:

- Values indicating Hazardous Waste according the 'Environment Agency (2004) Framework for the Classification of Contaminated Soils as Hazardous Waste, Version 2.2, May 2008 (ref 28);
- Technical Guidance WM2 – Hazardous Waste, Interpretation of the definition and classification of hazardous waste'(ref 29); and
- Waste Acceptance Criteria (WAC) limit values for inert and hazardous waste (ref 30).

Approximately 11% of soil samples (5 out of 44) were classified as Hazardous Waste according to the 'Framework for the Classification of Contaminated Soils as Hazardous Waste' and Technical Guidance WM2 (Table 5, Appendix B) due to elevated concentrations of TPH, metals or pH. These 'hazardous' soil samples were located between 0.3m and 2.0m bgl.

When compared with waste acceptance criteria (WAC) limit values (Table 6 of Appendix B), numerous samples of Made Ground recorded concentrations of leachable antimony above the Inert WAC. A single sample also recorded concentrations of total organic carbon above the Inert WAC.

Based on the assumptions and data assessment in line with current guidance mentioned above, the majority of Made Ground is classified as Non-hazardous. However, an allowance should be made for the potential disposal of a proportion of soil arisings to a Hazardous Waste landfill facility. Soils classified as Non-Hazardous may also be considered acceptable at Inert landfill sites, after treatment and provided they comply with the Inert WAC. There are currently large portions of the site (steel metal works, and the existing stadium) where no sampling has been carried out. Notwithstanding the above, it is the earthworks contractor's responsibility, in association with the operator/owner of the receiving site, to classify the materials for disposal in line with current guidance.

It may be possible for excavated material to be re-used onsite with respect to the conditions of an Environmental Permit or the CLAIRE Definition of Waste: Development Industry Code of Practice (ref 32). In order to be re-used onsite, the material needs to be geotechnically suitable for the proposed use; and the risks to human health and the environment should be acceptable in the proposed area/s of use. In either case liaison with the EA regarding the appropriate methodology will be required.

9 Conclusions and Recommendations

9.1 Conclusions

The findings of this report, based on the investigation carried out to date and the proposed development, indicate that the ground conditions present low to very low risks to; site end users, buildings/services, and to the River Moselle. The potential risks to the construction workers, adjacent site users and the Secondary A Aquifer have been assessed as Moderate/Low (refer below). It is however recognised that the site has not yet been fully investigated.

Human health

The potential risks to construction workers from contaminants within the soil and groundwater across the site have been assessed as Moderate/Low to Low given the short-term exposure duration, the scale of proposed earthworks, the recorded concentrations, and the fact that the site has not been fully investigated. The implementation of an appropriate health & safety regime and use of personal protective equipment (PPE) is recommended to adequately mitigate potential impacts from contaminants at the site.

The potential risks to future site users associated with contaminated soil and groundwater have been assessed as Very Low. This reflects the proposed development being covered entirely in hardstanding breaking the source-pathway-receptor linkage.

The potential risks to adjacent site users associated with contaminated soil and groundwater have been assessed as Moderate/Low to Low. This reflects the recorded contaminant concentrations but also the fact that the site has not been fully investigated, the short term exposure duration and the scale of proposed earthworks. During both demolition and construction phases of work, the implementation of standard construction practices to minimising dust generation is recommended.

The potential risks to construction workers, future site users and adjacent site users associated with soil gas has been assessed as Very Low to Low. This reflects the recorded concentrations, low flow rates recorded and the nature of the proposed development (i.e. the presence of a ground floor car park and 1200g polythene membrane in habitable areas across the footprint of the stadium building).

Further investigation of the site in areas not covered during the recent investigation is required in order to fully assess the risks to human health.

Secondary A Aquifer (Kempton Park Gravel)

Risks to the Kempton Park Gravel Aquifer have been assessed as Moderate/Low to Low given; the recorded concentrations of benzo(a)pyrene, PAH and TPH in the aquifer, the low sensitivity of this receptor at this

location (i.e. Secondary A Aquifer, not utilised with significant thickness of London Clay and Lambeth Group soils separating it from the Principal Aquifer).

From groundwater data collected to date, it is considered unlikely that there are any on-going sources of gross contamination present across the site. However the aquifer does appear to be slightly impacted by residual hydrocarbon contamination (TPH, B(a)P, PAH) associated with underground and above ground storage tanks. Investigation of areas not covered during the recent investigation is required in order to confirm this and to allow a full assessment of the risks to the Secondary A Aquifer to be undertaken.

River Moselle

Risks to the River Moselle have been assessed as Very Low to Low given; the recorded concentrations and distribution of TPH, benzo(a)pyrene and PAH in the Aquifer and the fact that the river is culverted.

Buildings/Services

Risks to buildings and services from contaminants in made ground and natural soils are assessed as Low. This reflects the recorded concentrations of toxic and corrosive contaminants, the absence of any record of tainting to water supply and/ or evidence of structural distress to current foundations attributable to ground conditions and the fact that the site has not been fully investigated.

Consultation with Thames Water should be carried out in order to determine suitable pipe materials for water supply. Specific mixes of concrete could be required for building foundations where the underlying ground conditions are identified as being potentially corrosive to concrete. This will be addressed in the forthcoming geotechnical report to be issued in due course.

Waste classification

Based on the assumptions and data assessment in line with current guidance mentioned above, the majority of Made Ground is likely to be classified as Non-Hazardous Waste. However, an allowance should be made for the potential disposal of soil arisings to a Hazardous Waste landfill facility. There are also portions of the site where no sampling has been carried out (beneath buildings and land not currently owned), it is therefore recommended that following demolition of the site, soil samples are collected and analysed to confirm the waste classification.

Re-use of the material onsite as general fill is a possibility but would require either an Environmental Permit or agreement with the Environment Agency for action in accordance with the CL:AIRE: Development Industry Code of Practice. In either case liaison with the EA regarding the appropriate methodology will be required.

Notwithstanding the above, it is the earthworks contractor's responsibility, in association with the operator/owner of the receiving site, to classify the materials for disposal of spoil arisings in line with current guidance.

9.2 Recommendations

Based on the contaminated land risk assessment, and conclusions outlined in the section above, the following recommendations have been made:

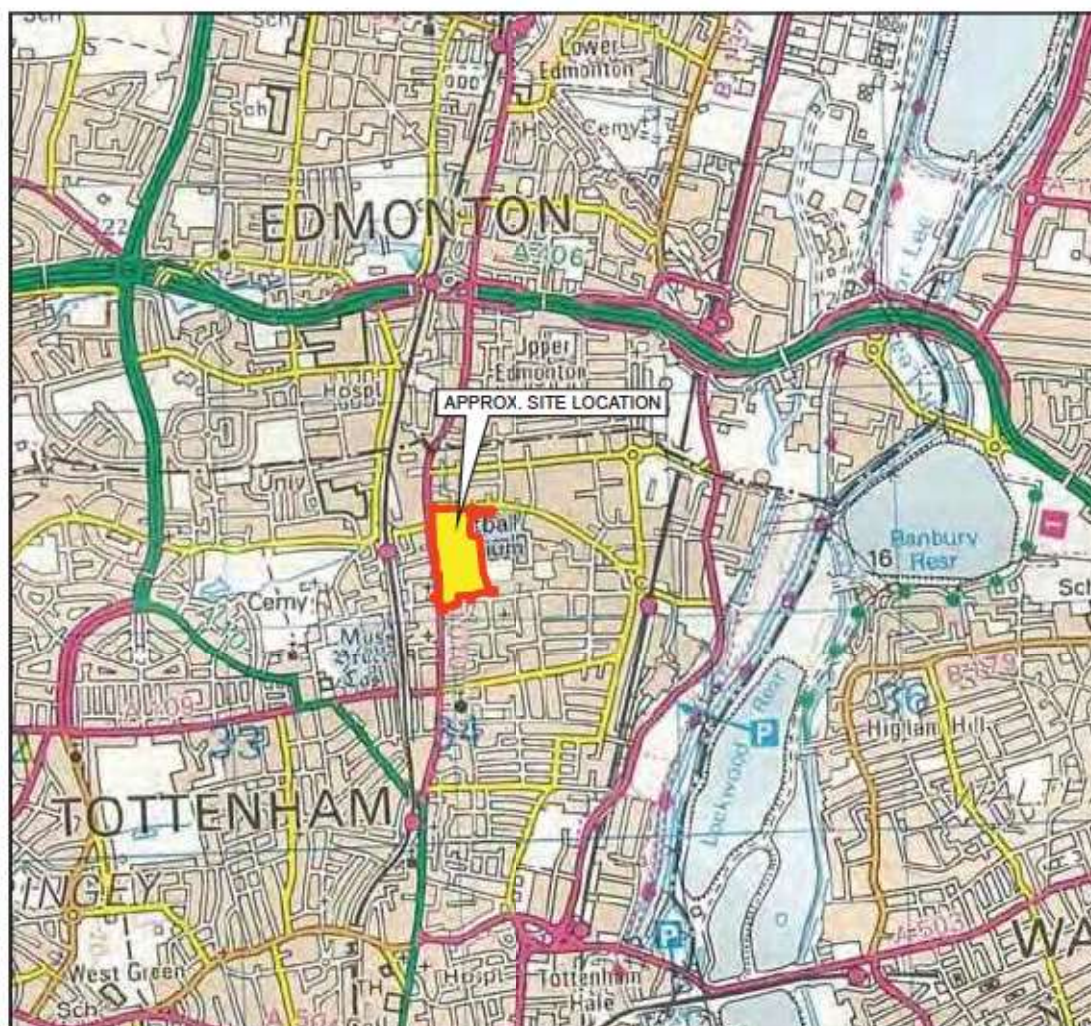
- Further investigation is required across the site where access was not possible during the recent investigation. It is recommended that this is undertaken as a series of trial pits following demolition of the site, to highlight any potential sources of future contamination and to target known hotspots;
- The residual hydrocarbon contamination recorded in the approximate location of the potential underground storage tank identified on historical maps requires further investigation. It is recommended that this is undertaken as a series of trial pits to track the contamination and attempt to identify the tank. Should the tank be uncovered, this will require removal and verification in accordance with CLR11 – 'Model Procedures' and other good practice guidance;
- The underground storage tanks associated with the former fuel station will require removal and verification in accordance with CLR11 – 'Model Procedures' and other good practice guidance;
- The residual hydrocarbon contamination recorded in the location of the above ground storage tank requires further investigation. It is recommended that this is undertaken as a series of trial pits to determine the nature and extent of this contamination and potential requirement for remediation;
- Gas protection measures are not considered necessary in areas where ground level car parking is present beneath the building footprint. In habitable areas, as well as the 1200 gauge polythene membrane included as part of the ground slab design, all joints and penetrations will require sealing;
- Part of the ground floor across the site will be used for car parking. In these areas, it is considered that adequate ventilation will be provided and no further gas protection measures are considered necessary. In habitable areas, the current design for the ground floor slab includes a 1200 gauge polythene membrane. As long as all joints and penetrations are sealed, this would satisfy the requirements of CS2 gas protection measures;
- Thames Water should be consulted in relation to suitable pipe materials for water supply;
- Construction workers should remain vigilant of ground conditions at all times and should report any suspect areas of potential contamination;
- Good standards of construction practice, health & safety and hygiene should be utilised to mitigate any potential risks to people (construction workers, visitors to the site and site neighbours); and
- The data in this report should be supplied to the operator of the potential receiving landfill(s) to ensure appropriate disposal based upon waste classification. Liaison with the EA should be undertaken should the re-use of material onsite be required.

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Figures



REPRODUCED FROM LANDRANGER 1:50,000 MAP BY PERMISSION OF ORDNANCE SURVEY © ON BEHALF OF THE CONTROLLER OF HER MAJESTY'S STATIONARY OFFICE, © CROWN COPYRIGHT 1988, ALL RIGHTS RESERVED, LICENCE NUMBER: AL100005517.

Project: Northumberland Development Project

SITE LOCATION PLAN



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Scale: NTS

Drawn: NG

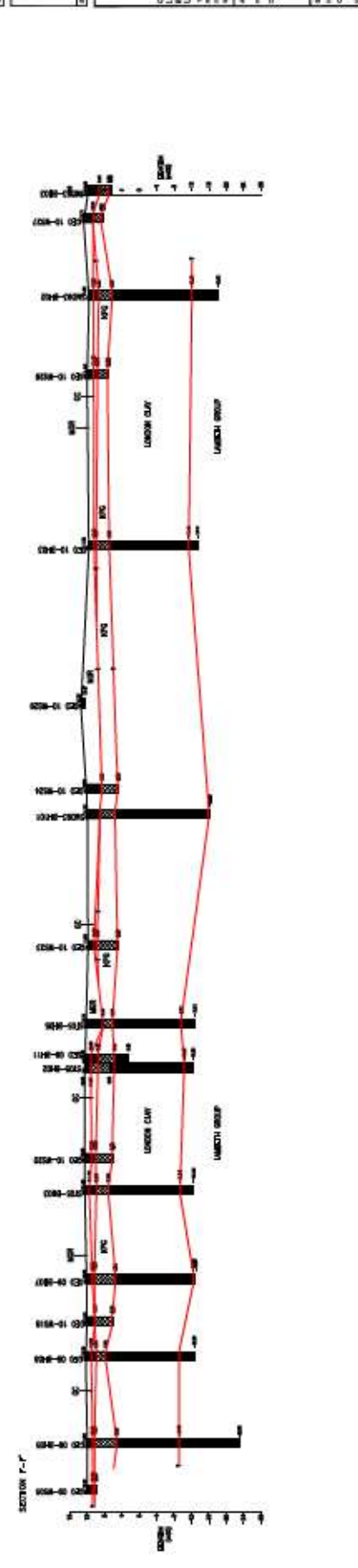
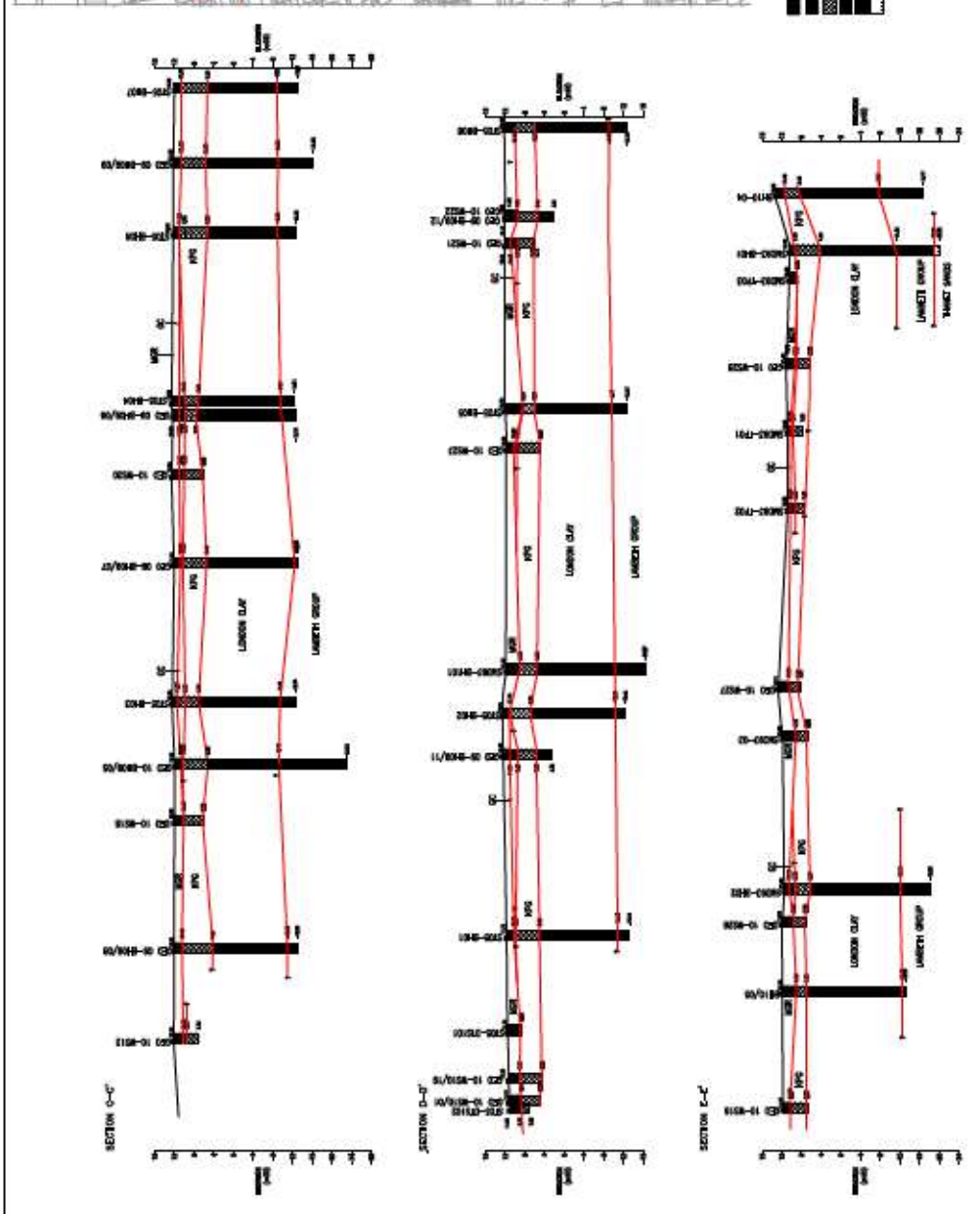
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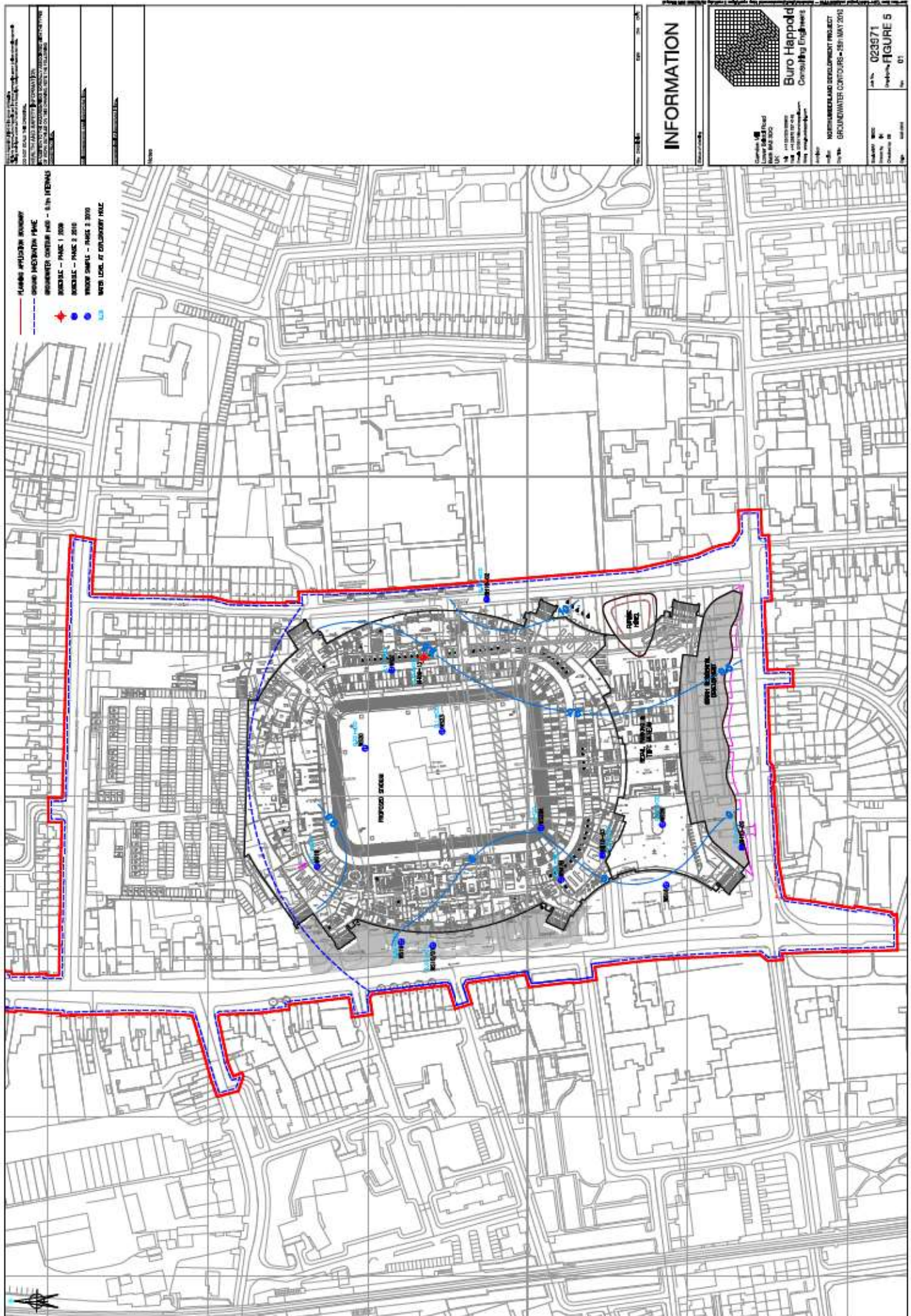
Date: July 2010

Job No: 023971

Drawing No: Figure 1

Rev: 00





PLANES AND ELEVATIONS
GROUNDWATER CONTOUR - 6.7m AHD
MONITORING POINTS - PAGE 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100

INFORMATION

023571
FIGURE 5

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023571
FIGURE 5

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FIGURE 5

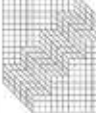
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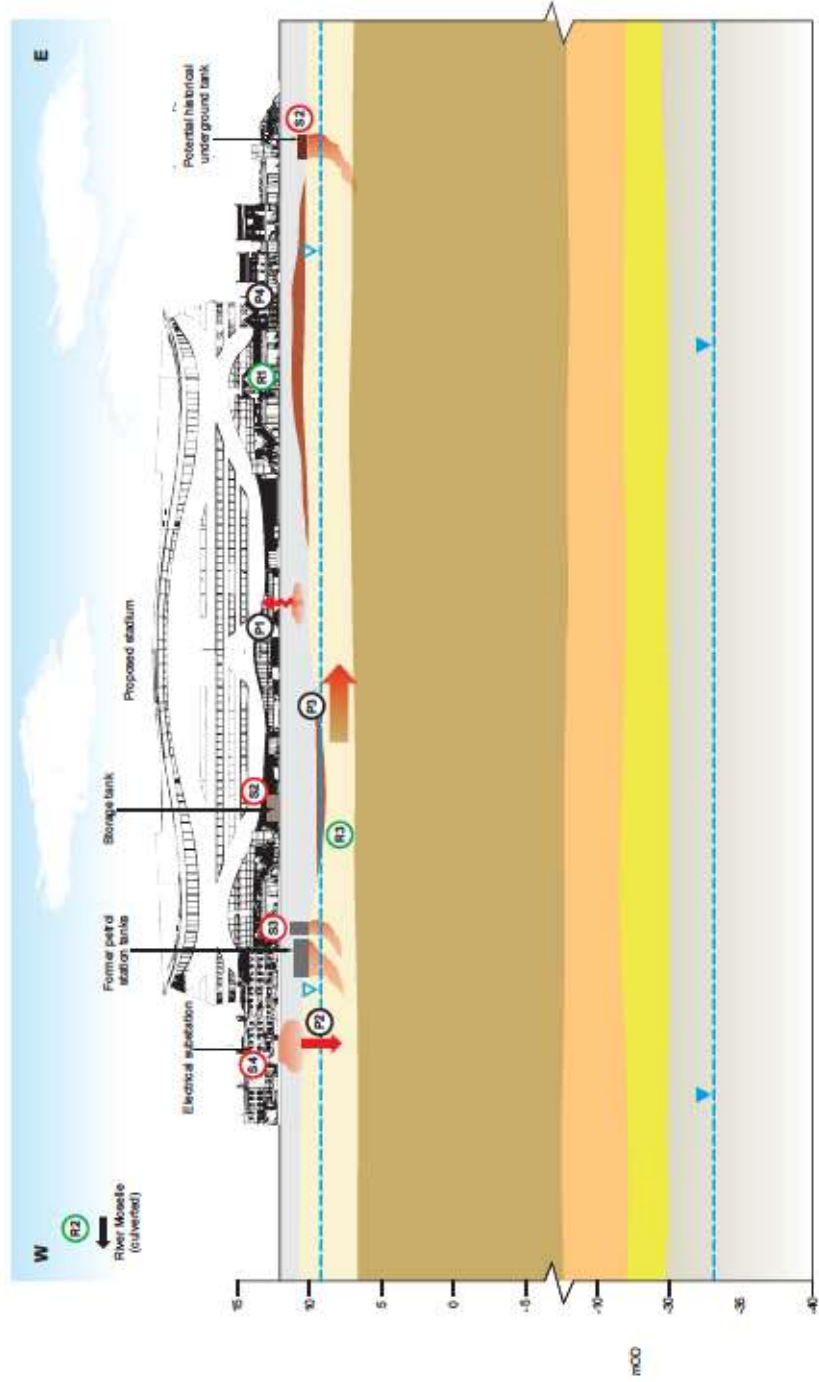
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Project: Northern Ireland Development
Project: CONCEPTUAL SITE MODEL

Scale: A3
Drawn by: NG
Checked by: SB
Date: AUG 2010

Job No.: 023971
Dwg No.: FIGURE 5

Rev: 02



- Made Ground

Gravelly Clay

Kempston Park Gravel

London Clay Formation

Lambeth Group

Thames Sands

Upper Chalk

Groundwater level
- Sources

R1 Made Ground

R2 Tanks

R3 Former fuel station

R4 Electrical substation
- Pathways

P1 Verticalisation/Inhalation

P2 Vertical migration

P3 Lateral migration

P4 Dermal contact/Inhalation
- Receptors

R1 People (site users, construction workers, off-site users)

R2 River Moselle

R3 Groundwater (Secondary Aquifer)

Appendix A: Generic Quantitative Risk Assessment

Source			Receptor	Pathway	Risk assessment following CIRIA C652			Comment
Origin	Zone Affected	Chemicals of Concern			Consequence	Probability	Risk	Description of source (bold text). Comment on hazard material (normal text)
Made Ground	Site wide	Lead, B(a)P & PAH						Described as a sand and gravel overlying soft sandy gravelly clay containing brick, cobbles, porcelain, ceramics, plastic, clinker, concrete, coal, ash and flint. Occ. concentrations of Pb and B(a)P > residential and commercial/industrial SGVs/GACs. US95 for Pb < residential and commercial/industrial SGV however > residential for B(a)P. No asbestos recorded. Maximum concentrations are elevated. Soil reasonably leachability. Site has not been fully investigated due to ownership issues or site constraints.
			Construction Workers	Direct contact, soil / dust ingestion	Medium	Low-likelihood	Moderate/Low	Potential for exposure during excavation/earthworks. Period of exposure relatively limited. Max concentrations highly elevated. Site not fully investigated.
			Future site users	Direct contact and dermal uptake, soil and dust ingestion, dust inhalation.		No Pathway		Entire development will be hard standing breaking source-receptor pathway.
			Adjacent site users	Dust ingestion/inhalation	Medium	Low-likelihood	Moderate/Low (during construction)	Site not fully investigated. Potential for dust generation during excavation/earthworks. Residential landuse located on eastern and western boundaries of the site.
			Minor Aquifer (Kempton Park Gravel)	Migration of dissolved phase contamination via underlying permeable strata/foundations.	Mild	Low-likelihood	Low	The Taplow Gravel is classified as a Secondary A Aquifer and is therefore important both for water supply and in supplying base flow to rivers. The aquifer is however not utilised for water supply within the vicinity of the site. Occasional exceedances of UK DWS for selenium, nickel and ammoniacal nitrogen. B(a)P and PAH concentrations > UK DWS in B4-09-07. Thin layer of laterally discontinuous gravelly clay separates Made Ground from Aquifer. Site not fully investigated, however any unknown contamination is unlikely to be significant/widespread.
			River Moseley	Migration of dissolved phase contamination via groundwater.	Mild	Unlikely	Very Low	River is culverted, running down the western side of the High Road adjacent the site. Groundwater within the Kempton Park Gravel appears to be flowing in a south-westerly direction towards the culverted river. Occasional exceedances of UK DWS for selenium, nickel and ammoniacal nitrogen. B(a)P and PAH concentrations > UK DWS in B4-09-07. Thin layer of laterally discontinuous gravelly clay separates Made Ground from Aquifer. Site not fully investigated, however any unknown contamination is unlikely to be significant/widespread.
		Arsenic, lead, pH, TPH & PAH	Buildings / services	Direct contact/permeation of water supply pipework	Mild	Low-likelihood	Low	Numerous As & pH values >WRAS threshold. Occ. concentrations of Pb, TPH & PAHs >WRAS threshold value. Not risk based and highly conservative. Potential for direct contact. Site not fully investigated however no record of derogation to water supply and/or evidence of structural distress to current foundations attributable to ground conditions.
		Soil gas - carbon dioxide						Slightly elevated CO ₂ (max 6.5%). Very slightly elevated methane (max 0.3%). Consistently low flow rates (<0.5 l/h). Characteristic Situation 2.

Source			Receptor	Pathway	Risk assessment following CIRA C552			Comment
Origin	Zone Affected	Chemicals of Concern			Consequence	Probability	Risk	Description of source (bold text). Comment on hazard mitigation (normal text)
Former Fuel Station	Onsite	TPH and PAH	Construction Workers	Inhalation (outdoor air)	Mild	Unlikely	Very Low	Potential for exposure to low levels of CO ₂ in any confined spaces. Period of exposure relatively limited. Limited potential for accumulation to hazardous concentrations due to relatively consistent low concentrations, low flow rates and the nature/extent of Made Ground.
			Future site users	Inhalation (indoor/outdoor air)	Mild	Low-likelihood	Low	Limited potential for accumulation to hazardous concentrations due to relatively consistent low concentrations, low flow rates, the nature/extent of Made Ground and the proposed development (i.e. ground level car parking with 1200g polythene membrane proposed in habitable areas).
			Adjacent site users	Inhalation (indoor/outdoor air)	Mild	Unlikely	Very Low	Residential properties located on eastern and western site boundaries. Limited potential for accumulation to hazardous concentrations.
								A former fuel station at 776 High Road, which is currently a shop, is understood by the Client to have foam filled underground tanks associated with its previous use.
								A slight hydrocarbon odour was observed in the Kempton Park Gravel at the approximate water table level within WS10/01 on the forecourt. TPH, BTEX and PAH concentrations in soil and groundwater were recorded below relevant screening criteria.
			Construction Workers	Direct contact, soil / dust ingestion	Minor	Low-likelihood	Low	Potential for exposure during excavation/earthworks. Period of exposure relatively limited. Max concentrations not highly elevated.
			Future site users	Direct contact and dermal uptake, soil and dust ingestion, dust inhalation.		No Pathway		Entire development will be hard standing breaking source-receptor pathway
			Adjacent site users	Dust ingestion/inhalation	Minor	Low-likelihood	Low (during construction)	Potential for dust generation during excavation/earthworks. Residential land use located on western side of the High Road opposite the site.
			Minor Aquifer (Taplow Gravel)	Migration of dissolved phase contamination via underlying permeable strata/piled foundations to depth.	Mild	Low-likelihood	Low	The Taplow Gravel is classified as a Secondary A Aquifer and is therefore important both for water supply and in supplying base flow to rivers. The aquifer is however not utilised for water supply within the vicinity of the site.
			River Mole	Migration of dissolved phase contamination via groundwater.	Mild	Unlikely	Very Low	River is culverted, running down the western side of the High Road adjacent the site. Groundwater within the Kempton Park Gravel appears to be flowing in a south-westerly direction towards the culverted river.
		Soil gas - carbon dioxide	Buildings / services	Direct contact/permeation of water supply pipework	Mild	Low-likelihood	Low	Organic contaminant concentrations recorded below the relevant WRAS threshold value.
								Potential for direct contact. No record of derogation to water supply attributable to ground conditions.
								Very low concentrations of methane (max 0.2% v/v) and CO ₂ (max 0.8% v/v). Consistently low flow rates (0 l/h).

Source			Receptor	Pathway	Risk assessment following CIRIA C652			Comment
Origin	Zone Affected	Chemicals of Concern			Consequence	Probability	Risk	Description of source (bold text). Comment on hazard mitigation (normal text)
			Construction Workers	Inhalation (outdoor air)	Mild	Unlikely	Very Low	Period of exposure relatively limited. Limited potential for accumulation to hazardous concentrations due to relatively consistent low concentrations, low flow rates and the nature/extent of contamination.
			Future site users	Inhalation (indoor/outdoor air)	Mild	Low-likelihood	Low	Limited potential for accumulation to hazardous concentrations due to relatively consistent low concentrations, low flow rates, the nature/extent of contamination and the proposed development (i.e. ground level car parking with 1200g polythene membrane proposed in habitable areas).
			Adjacent site users	Inhalation (indoor/outdoor air)	Mild	Unlikely	Very Low	Residential properties located on eastern and western site boundaries. Limited potential for accumulation to hazardous concentrations.
Underground storage tank	Eastern part of Paxton Road Carpark	TPH and PAH						Potential tank identified by historical maps. Moderate hydrocarbon odour and staining observed at water table in soil within WS21, WS22 and BH09-12. A moderate hydrocarbon odour and oil sheen was observed on the surface of groundwater purged from BH09-12 and WS21 during sampling. All TPH, BTEX & PAH concentrations in soil recorded < residential and commercial industrial screening criteria. Elevated TPH concentrations recorded in groundwater sampled from BH09-12 and WS22. BTEX and PAH concentrations < UK DWS. Potential for exposure during excavation/earthworks. Period of exposure relatively limited. Max concentrations in soil not highly elevated.
			Construction Workers	Direct contact, soil / dust ingestion	Medium	Low-likelihood	Moderate/Low	
			Future site users	Direct contact and dermal uptake, soil and dust ingestion, dust inhalation.		No Pathway		Entire development will be hard standing breaking source-receptor pathway
			Adjacent site users	Dust ingestion/inhalation	Medium	Low-likelihood	Moderate/Low (during construction)	Potential for dust generation during excavation/earthworks. Residential land use and school located directly east of tank along Worcester Avenue.
			Minor Aquifer (Taplow Gravel)	Migration of dissolved phase contamination via underlying permeable strata/piped foundations to depth.	Mild	Likely	Moderate/Low	The Taplow Gravel is classified as a Secondary A Aquifer and is therefore important both for water supply and in supplying base flow to rivers. The aquifer is however not utilised for water supply within the vicinity of the site. Elevated concentrations of TPH recorded in groundwater, however contamination is localised and not wide spread.
			River Moselle	Migration of dissolved phase contamination via groundwater.	Mild	Low-likelihood	Low	Elevated concentrations of TPH recorded in groundwater, however contamination is localised and has not migrated towards river. River is culverted, running down the western side of the High Road adjacent the site. Groundwater within the Kempton Park Gravel appears to be flowing in a south-westerly direction towards the culverted river.

Source		Receptor	Pathway	Risk assessment following CIRIA C652			Comment
Origin	Zone Affected	Chemicals of Concern		Consequence	Probability	Risk	Description of source (bold text). Comment on hazard mitigation (normal text)
		Buildings / services	Direct contact/permeation of water supply pipework	Mild	Low-likelihood	Low	Organic contaminant concentrations recorded below the relevant WRAS threshold value. Potential for direct contact. No record of derogation to water supply attributable to ground conditions.
							Very low concentrations of methane (max 0.3% v/v) and slightly elevated concentrations of CO ₂ (max 6.5% v/v). Consistently low flow rates (0 l/h). VOCs recorded below laboratory detection limit.
		Construction Workers	Inhalation (outdoor air)	Mild	Unlikely	Very Low	Period of exposure relatively limited. Limited potential for accumulation to hazardous concentrations due to relatively consistent low concentrations, low flow rates and the nature/extent of contamination.
		Future site users	Inhalation (indoor/outdoor air)	Mild	Low-likelihood	Low	Limited potential for accumulation to hazardous concentrations due to relatively consistent low concentrations, low flow rates, the nature/extent of contamination and the proposed development (i.e. ground level car parking with 1200g polythene membrane proposed in habitable areas).
		Adjacent site users	Inhalation (indoor/outdoor air)	Mild	Unlikely	Very Low	Residential properties located on eastern and western site boundaries. Limited potential for accumulation to hazardous concentrations.
Above ground storage tank	East of Paxton Road Carpark						An above ground diesel tank is located in the stadium carpark. An oily residue and moderate hydrocarbon odour was observed in the Kempton Park Gravel within WS16. TPH and BTEX concentrations in soil recorded < residential and commercial industrial screening criteria. Benzod(a)pyrene concentrations > residential (without plant uptake) assessment criteria in Made Ground at this location. Elevated TPH concentrations recorded in groundwater. BTEX and PAH concentrations < UK DWS.
		Construction Workers	Direct contact, soil / dust ingestion	Medium	Low-likelihood	Moderate/Low	Potential for exposure during excavation/earthworks. Period of exposure relatively limited. Max concentrations in soil not highly elevated.
		Future site users	Direct contact and dermal uptake, soil and dust ingestion, dust inhalation.		No Pathway		Entire development will be hard standing breaking source-receptor pathway
		Adjacent site users	Dust ingestion/inhalation	Medium	Low-likelihood	Moderate/Low [during construction]	Minimal excavation required as part of the proposed development. Potential for dust generation during excavation/earthworks. Residential landuse located on western side of the High Road adjacent the site.

Source			Receptor	Pathway	Risk assessment following CIRIA C652			Comment
Origin	Zone Affected	Chemicals of Concern			Consequence	Probability	Risk	
			Minor Aquifer (Taplow Gravel)	Migration of dissolved phase contamination via underlying permeable strata/piled foundations to depth.	Mild	Likely	Moderate/Low	The Taplow Gravel is classified as a Secondary A Aquifer and is therefore important both for water supply and in supplying base flow to rivers. The aquifer is however not utilised for water supply within the vicinity of the site. Elevated concentrations of TPH recorded in groundwater, however contamination is localised and not wide spread.
			River Moselle	Migration of dissolved phase contamination via groundwater.	Mild	Low-likelihood	Low	Elevated concentrations of TPH recorded in groundwater, however contamination is localised and has not widespread. River is culverted, running down the western side of the High Road adjacent the site. Groundwater within the Kempton Park Gravel appears to be flowing in a south-westerly direction towards the culverted river.
			Buildings / services	Direct contact/permeation of water supply pipework	Mild	Low-likelihood	Low	Organic contaminant concentrations recorded below the relevant WRAS threshold value. Potential for direct contact. No record of derogation to water supply attributable to ground conditions.
		Soil gas – Methane, VOCs						Very low concentrations of methane (max 0.2% v/v) and slightly elevated concentrations of CO ₂ (max 1.5% v/v). Consistently low flow rates (0.1 l/h).
			Construction Workers	Inhalation (outdoor air)	Mild	Unlikely	Very Low	Period of exposure relatively limited. Limited potential for accumulation to hazardous concentrations due to relatively consistent low concentrations, low flow rates and the nature/extent of contamination.
			Future site users	Inhalation (indoor/outdoor air)	Mild	Low-likelihood	Low	Limited potential for accumulation to hazardous concentrations due to relatively consistent low concentrations, low flow rates, the nature/extent of contamination and the proposed development (i.e. ground level car parking with 1200g polythene membrane proposed in habitable areas).
			Adjacent site users	Inhalation (indoor/outdoor air)	Mild	Unlikely	Very Low	Residential properties located on eastern and western site boundaries. Limited potential for accumulation to hazardous concentrations.
Electrical Substation	Paxton Road carpark	PCB oils						No visual/olfactory evidence of PCB contamination observed in soil or groundwater. PCB concentrations recorded below laboratory detection limit in soil samples analysed.
			Construction Workers	Direct contact, soil / dust ingestion	Mild	Low-likelihood	Low	Potential for exposure during excavation/earthworks. Period of exposure relatively limited. Concentrations below detection.
			Future site users	Direct contact and dermal uptake, soil and dust ingestion, dust inhalation.		No Pathway		Entire development will be hard standing breaking source-receptor pathway
			Adjacent site users	Dust ingestion/inhalation	Mild	Low-likelihood	Low	Potential for dust generation during excavation/earthworks. Residential landuse and school located directly east of tank along Worcester Avenue.

Source			Receptor	Pathway	Risk assessment following CIRIA C652			Comment
Origin	Zone Affected	Chemicals of Concern			Consequence	Probability	Risk	Description of source [bold text] Comment on hazard realisation [normal text]
			Minor Aquifer (Taplow Gravel)	Migration of dissolved phase contamination via underlying permeable strata/piled foundations to depth.	Mild	Unlikely	Very Low	The Taplow Gravel is classified as a Secondary A Aquifer and is therefore important both for water supply and in supplying base flow to rivers. The aquifer is however not utilised for water supply within the vicinity of the site. Concentrations below detection.
			River Moselle	Migration of dissolved phase contamination via groundwater.	Mild	Unlikely	Very Low	Concentrations below detection. River is culverted, running down the western side of the High Road adjacent the site. Groundwater within the Kempton Park Gravel appears to be flowing in a south-westerly direction towards the culverted river.

Appendix B – Laboratory Analytical Results

Table 1. Analytical Results for Soil

[illegible][illegible]

*Generic Assessment Criteria (GACs) derived using CLSA 1.06 software published by the EA / Model settings: Lendure: "Residential" between the "consumption of homegrown produce" exposure pathway selected
 *Contaminant specific model input values are based on values from the "contaminant specific model input values" section of the "fast style" Toxic report (CONTAMINANTS IN SOIL: COLLATION OF TOXICOLOGICAL DATA AND INTAKE VALUES FOR HUMANS: WORKINGMAN: CYANIDE)
 *Contaminant specific model input values are in the "contaminant specific model input values" section of the "fast style" Toxic report (CONTAMINANTS IN SOIL: COLLATION OF TOXICOLOGICAL DATA AND INTAKE VALUES FOR HUMANS: WORKINGMAN: CYANIDE)
 *Contaminant specific model input values are in LQM report for respective contaminant
 *Dose approach used: RQM
 *Soil guideline value or LQM number where converted from RQM or LQM report respectively / Otherwise Generic Assessment Criteria (GACs) derived using CLSA 1.06 software published by the EA / Model settings: Lendure: CLSA associated Lendure: "Commercial"

Table 2. Lechate Results

Lab Sample ID	Units	Method	10/01640/2	10/01639/2	10/01655/1	10/01724/1	10/01640/1	10/01640/3	UK DWS ¹	Freshwater EQS ²
Client Sample ID			WS20	WS21	WS19	WS29a	WS16	WS28		
Depth to Top			1.20	0.80	1.20 -1.40	0.7	0.70	1.00		
Depth to Bottom			1.40							
Sample Type			MG	MG	MG	MG	MG	MG		
Sample Matrix Code			7	6A	7	5a	6A	6		
pH (leachable)	pH	A-T-031w	9.6	-	-	-	8.6	8.5	-	-
Total Dissolved Solids (leachable)	mg/l	A-T-035	129	-	-	-	52	99	-	-
Arsenic (leachable)	µg/l	A-T-025	13	4.10	8.14	14.84	25	2	10	50
Boron (leachable)	µg/l	A-T-025	64	-	-	-	-	-	1000	-
Barium	µg/l		-	26.88	10.27	15.88	15	47		
Cadmium (leachable)	µg/l	A-T-025	<1	<1	<1	<1	<1	<1	5	5
Copper (leachable)	µg/l	A-T-025	53	33.9	4.8	25.5	18	8	2000	1-28* (10)
Chromium (leachable)	µg/l	A-T-025	28	0.53	1.23	4.33	3	2	50	5-50* (50)
Lead (leachable)	µg/l	A-T-025	4	7.40	<1	18	62	3	25	4-20* (20)
Mercury (leachable)	µg/l	A-T-025	0.5	0.10	0.10	0.10	0.5	<0.1	1	1
Nickel (leachable)	µg/l	A-T-025	<1	4.61	0.88	2.53	1	<1	20	50-200* (200)
Selenium (leachable)	µg/l	A-T-025	2	<1	1.08	1.93	<1	<1	10	-
Zinc (leachable)	µg/l	A-T-025	3	15.73	13.27	16.12	13	15	-	8-125* (75)

1. UK Drinking Water Inspectorate: Water Supply (Water Quality) Regulations 2000.

2. Environment Agency: Internal Guidance on the Interpretation and Application of Regulation 15 of the Waste Management Licensing Regulations, 1995 (The Protection of Groundwater) with respect to Landfill 1999

3. Environmental Agency Non-Statutory (Operational) Environmental Quality Standards
(Value in brackets) - Based on hardness value for groundwater >244mg/l

Table 5: Weight classification based on soil values

[illegible]

Disclaimer: This spreadsheet does not take risk premium into account that are applicable where an individual substance or the sum of substances exceed 25 % (25000g or 250000g) of the total sample material.

Table 6. Waste Classification

EnviroLab Ref.	10/01639/2	10/01655/1	10/01655/2	10/01639/3	10/01724/1	10/01639/1	Landfill Waste Acceptance Criteria Limits		
Location	WS21	WS19	WS26	WS27	WS29a	BH10/05	Inert Waste Landfill	Stable Non-reactive Hazardous Waste in Non-Hazardous Landfill ²	Hazardous Waste Landfill ³
Depth (m)	0.80	1.20-1.40	1.30-1.50	0.50	0.7	MG	-	>6	-
Sample Ref.	MG	MG	MG	MG	MG	MG	3	5	6
Sample Type	6A	7	6A	7	5a	6A	100	-	-
Sample Matrix Code	6A	7	6A	7	5a	6A	500	-	-
Solid Waste Analysis									
pH (pH Units)	6.80	-	-	12.5	8.40	11.30	-	-	-
Total Organic Carbon (%)	1.86	0.28	1.9	0.8	2.75	4.63	3	5	6
PAH Sum of 17 (mg/kg)	16.2	2.26	6.26	15.3	2.49	6.91	100	-	-
Mineral Oil (mg/kg)	<0.10	<0.10	231	<0.10	<0.10	48.3	500	-	-
Sum of 7 PCBs (mg/kg)	<0.01	<0.01	0.07	<0.01	<0.01	0.01	1	-	-
Sum of BTEX (mg/kg)	<0.01	<0.01	0.72	<0.01	<0.01	<0.01	6	-	-
Eluate Analysis									
							Limit values for compliance leaching test using BS EN 12467-3 at US 10 (kg (mg/kg))		
Arsenic	0.0410	0.0814	0.0462	0.0209	0.1484	0.1270	0.5	2	25
Barium	0.2688	0.1027	0.1302	0.2532	0.1588	0.2028	20	100	300
Cadmium	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.04	1	5
Chromium	0.0053	0.0123	0.0829	0.1172	0.0433	0.1550	0.5	10	70
Copper	0.3392	0.0477	0.5396	0.0620	0.2548	0.1605	2	50	100
Mercury	<0.001	0.0006	<0.001	<0.001	<0.001	<0.001	0.01	0.2	2
Molybdenum	0.0697	0.0173	0.0663	0.0473	0.0950	0.0985	0.5	10	30
Nickel	0.0461	0.0088	0.0279	0.0072	0.0253	0.0283	0.4	10	40
Lead	0.0737	<0.01	<0.01	<0.01	0.1797	0.3513	0.5	10	50
Antimony	0.0428	0.0212	0.0856	0.0985	0.4162	0.1369	0.06	0.7	5
Selenium	<0.01	0.0108	0.0164	0.0007	0.0193	<0.01	0.1	0.5	7
Zinc	0.1573	0.1327	0.2449	0.1092	0.1612	0.4149	4	50	200
Chloride	161	22	30.7016	58.391	31	66.71	800	15000	25000
Fluoride	3.2	1.5	<1	0.1155	2.8	7.92	10	150	500
Sulphate as SO ₄	369	146	137.50	810.64	364	250.52	1000 ⁴	20000	50000
Total Dissolved Solids ⁶	1730	847	2996.77	2553.26	825	916.44	4000	60000	100000
Phenol Index	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	1	-	-
Dissolved Organic Carbon	242	<200	<200	<200	<200	<200	500 ⁵	800	1000

1 - Waste Acceptance Criteria Limiting values for contaminants in inert waste according to the GUIDANCE ON SAMPLING AND TESTING OF WASTES TO MEET LANDFILL WASTE ACCEPTANCE PROCEDURES

2 - Waste Acceptance Criteria Limiting values for contaminants in stable non-reactive hazardous waste in non-hazardous landfill according to the GUIDANCE ON SAMPLING AND TESTING OF WASTES TO MEET LANDFILL WASTE ACCEPTANCE PROCEDURES

3 - Waste Acceptance Criteria Limiting values for contaminants in hazardous waste according to the GUIDANCE ON SAMPLING AND TESTING OF WASTES TO MEET LANDFILL WASTE ACCEPTANCE PROCEDURES

4 - If an inert waste does not meet the SQ_{US10}, alternative limit values of 1500 mgf SQ₄ at C₀ initial eluate from the percolation test

(prCEN/TS 14405:2003) AND 6000mg/kg SQ₄ at US 10 (either from the percolation test or batch test BS EN 12467-3), can be used

to demonstrate compliance with the acceptance criteria for inert wastes.

5 - In the case of solids, ascertained by the Environment Agency at an inert waste landfill, provided the

DOC value of 500 mg/kg, either at the soil's own pH or at a pH value between 7.5 and 8.0

6 - The values for TDS on be used instead of values for Cl and SQ₄

FINAL ANALYTICAL TEST REPORT

Envirolab Job Number: 10/01638
Issue Number: 1

Date: 01 June, 2010

Client: Buro Happold
Camden Mill
Lower Bristol Road
Bath
UK
BA2 3DQ

Project Manager: Sarah Bear
Project Name: Northumberland Park
Project Ref: 023971
Order No: Not specified
Date Samples Received: 19/05/10
Date Instructions Received: 19/05/10
Date Analysis Completed: 01/06/10

Prepared by:



Gill Scott
Laboratory Manager

Approved by:



Iain Haslock
Analytical Consultant

Notes - Soil samples for chemical analysis

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

Stones >10mm are removed from the sample prior to analysis and results corrected where appropriate.

Subscript A indicates analysis performed on the sample as received, D indicates analysis performed on dried & crushed sample.

Superscript M indicates method accredited to MCERTS.

Predominant Matrix Codes - 1 = SAND, 2 = LOAM, 3 = CLAY, 4 = LOAM/SAND, 5 = SAND/CLAY, 6 = CLAY/LOAM, 7 = OTHER.

Samples with Matrix Code 7 are not predominantly a SAND/LOAM/CLAY mix and are not covered by our MCERTS accreditation.

Secondary Matrix Codes - A = contains stones, B = contains construction rubble, C = contains visible hydrocarbons, D = contains glass/metal, E = contains roots/twigs.

Notes - General

Superscript # indicates method accredited to ISO 17025.

Analytical results reflect the quality of the sample at the time of analysis only.

Opinions and interpretations expressed are outside the scope of our accreditation.

IS indicates Insufficient sample for analysis.

NDP indicates No Determination Possible.

Envirolab Job Number: 10/01638

Client Project Name: Northumberland Park

Client Project Ref: 023971

Lab Sample ID	10/01638/2	10/01638/5	10/01638/10	10/01638/13	10/01638/14	10/01638/16	10/01638/17	10/01638/19	Units	Method ref
Client Sample No										
Client Sample ID	BH10/03	BH10/05	WS16	WS17b	WS18	WS18	WS19	WS20		
Depth to Top	1.00	0.50	0.70	0.60	0.50	1.60	0.85	0.50		
Depth To Bottom										
Date Sampled										
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil		
Sample Matrix Code	6A	7	6A	5A	6A	6A	6A	6A		
% Moisture ^g	18.1	9.3	18.3	10.0	12.9	8.5	9.5	16.0		
% Stones >10mm ^g	2.1	<0.1	6.9	10.6	14.6	26.1	20.0	17.6	% w/w	A-T-044
Asbestos Screen _A	No ACM	No ACM	No ACM	No ACM	No ACM	No ACM	No ACM	No ACM		Visual
pH _D ^{MS}	6.8	11.3	8.2	8.4	7.3	7.0	9.8	8.9	pH	A-T-031a
Cyanide (total) _A ^{MS}	<1	<1	<1	<1	<1	<1	<1	<1	mg/kg	A-T-042/TCN
Phenols - Total by HPLC _A	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	mg/kg	A-T-088a
Sulphide _A ^g	<15	<15	<15	<15	<15	<15	<15	<15	mg/kg	A-T-02-e
Total Organic Carbon _D ^{MS}	0.54	1.04	1.63	1.04	3.19	0.05	0.31	2.30	% w/w	A-T-032a
Arsenic _D ^{MS}	14	10	21	10	18	19	10	26	mg/kg	A-T-024
Cadmium _D ^{MS}	<0.5	<0.5	1.6	<0.5	<0.5	<0.5	<0.5	2.7	mg/kg	A-T-024
Copper _D ^{MS}	22	20	211	28	115	17	12	3440	mg/kg	A-T-024
Chromium _D ^{MS}	46	96	24	25	31	40	19	34	mg/kg	A-T-024
Lead _D ^{MS}	46	69	894	110	275	18	64	1520	mg/kg	A-T-024
Mercury _D	0.30	<0.17	2.72	0.21	0.95	<0.17	0.36	1.02	mg/kg	A-T-024
Nickel _D ^{MS}	17	15	18	16	21	29	13	33	mg/kg	A-T-024
Selenium _D ^{MS}	1	1	1	<1	<1	<1	<1	1	mg/kg	A-T-024
Zinc _D ^{MS}	55	56	443	154	128	51	55	2050	mg/kg	A-T-024

Envirolab Job Number: 10/01638

Client Project Name: Northumberland Park

Client Project Ref: 023971

Lab Sample ID	10/01638/2	10/01638/5	10/01638/10	10/01638/13	10/01638/14	10/01638/16	10/01638/17	10/01638/19	Units	Method ref
Client Sample No										
Client Sample ID	BH10/03	BH10/05	WS16	WS17b	WS18	WS18	WS19	WS20		
Depth to Top	1.00	0.50	0.70	0.60	0.50	1.60	0.85	0.50		
Depth To Bottom										
Date Sampled										
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil		
Sample Matrix Code	6A	7	6A	5A	6A	6A	6A	6A		
Speciated TPH										
All >C5-C6 _A [®]	-	-	-	<0.01	-	-	-	-	mg/kg	A-T-022a
All >C6-C8 _A [®]	-	-	-	<0.01	-	-	-	-	mg/kg	A-T-022a
All >C8-C10 _A [®]	-	-	-	<0.01	-	-	-	-	mg/kg	A-T-022a
All >C10-C12 _A [®]	-	-	-	<0.1	-	-	-	-	mg/kg	A-T-022a
All >C12-C16 _A [®]	-	-	-	<0.1	-	-	-	-	mg/kg	A-T-022a
All >C16-C21 _A [®]	-	-	-	<0.1	-	-	-	-	mg/kg	A-T-022a
All >C21-C35 _A [®]	-	-	-	<0.1	-	-	-	-	mg/kg	A-T-022a
Total Aliphatics _A [®]	-	-	-	<0.1	-	-	-	-	mg/kg	A-T-022+22a
Aro >C5-C7 _A [®]	-	-	-	<0.01	-	-	-	-	mg/kg	A-T-022a
Aro >C7-C8 _A [®]	-	-	-	<0.01	-	-	-	-	mg/kg	A-T-022a
Aro >C8-C9 _A [®]	-	-	-	<0.01	-	-	-	-	mg/kg	A-T-022a
Aro >C9-C10 _A [®]	-	-	-	<0.01	-	-	-	-	mg/kg	A-T-022a
Aro >C10-C12 _A [®]	-	-	-	<0.1	-	-	-	-	mg/kg	A-T-022a
Aro >C12-C16 _A [®]	-	-	-	<0.1	-	-	-	-	mg/kg	A-T-022a
Aro >C16-C21 _A [®]	-	-	-	<0.1	-	-	-	-	mg/kg	A-T-022a
Aro >C21-C35 _A [®]	-	-	-	<0.1	-	-	-	-	mg/kg	A-T-022a
Total Aromatics _A [®]	-	-	-	<0.1	-	-	-	-	mg/kg	A-T-022+22a
TPH (All & Aro) _A [®]	-	-	-	<0.1	-	-	-	-	mg/kg	A-T-022+22a
BTEX - Benzene _A [®]	-	-	-	<0.01	-	-	-	-	mg/kg	A-T-022a
BTEX - Toluene _A [®]	-	-	-	<0.01	-	-	-	-	mg/kg	A-T-022a
BTEX - Ethyl Benzene _A [®]	-	-	-	<0.01	-	-	-	-	mg/kg	A-T-022a
BTEX - m & p Xylene _A [®]	-	-	-	<0.01	-	-	-	-	mg/kg	A-T-022a
BTEX - o Xylene _A [®]	-	-	-	<0.01	-	-	-	-	mg/kg	A-T-022a
MTBE _A [®]	-	-	-	<0.01	-	-	-	-	mg/kg	A-T-022a

Envirolab Job Number: 10/01638

Client Project Name: Northumberland Park

Client Project Ref: 023971

Lab Sample ID	10/01638/2	10/01638/5	10/01638/10	10/01638/13	10/01638/14	10/01638/16	10/01638/17	10/01638/19	Units	Method ref
Client Sample No										
Client Sample ID	BH10/03	BH10/05	WS16	WS17b	WS18	WS18	WS19	WS20		
Depth to Top	1.00	0.50	0.70	0.60	0.50	1.60	0.85	0.50		
Depth To Bottom										
Date Sampled										
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil		
Sample Matrix Code	6A	7	6A	5A	6A	6A	6A	6A		
PAH 16										
Acenaphthene ^{MS}	<0.01	0.02	0.07	<0.01	<0.01	<0.01	1.75	0.19	mg/kg	A-T-015a
Acenaphthylene [*]	<0.01	0.03	0.02	<0.01	<0.01	<0.01	0.06	0.06	mg/kg	A-T-015a
Anthracene ^{MS}	<0.01	0.10	0.34	<0.01	0.02	<0.01	3.10	0.79	mg/kg	A-T-015a
Benzo(a)anthracene [*]	<0.01	0.55	0.71	0.03	0.11	<0.01	12	1.32	mg/kg	A-T-015a
Benzo(a)pyrene ^{MS}	<0.01	0.73	1.14	<0.01	<0.01	<0.01	8.86	2.25	mg/kg	A-T-015a
Benzo(b)fluoranthene ^{MS}	<0.01	0.34	0.60	<0.01	<0.01	<0.01	4.53	1.10	mg/kg	A-T-015a
Benzo(ghi)perylene ^{MS}	<0.01	1.61	1.87	<0.01	<0.01	<0.01	6.77	2.61	mg/kg	A-T-015a
Benzo(k)fluoranthene ^{MS}	<0.01	0.56	0.74	<0.01	<0.01	<0.01	4.40	1.37	mg/kg	A-T-015a
Chrysene ^{MS}	<0.01	1.33	2.25	0.08	0.21	<0.01	14.9	4.13	mg/kg	A-T-015a
Dibenzo(ah)anthracene [*]	<0.01	0.14	0.08	<0.01	<0.01	<0.01	1.28	0.13	mg/kg	A-T-015a
Fluoranthene ^{MS}	<0.01	1.14	1.69	0.03	0.11	<0.01	20	3.71	mg/kg	A-T-015a
Fluorene ^{MS}	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	0.83	0.08	mg/kg	A-T-015a
Indeno(123-cd)pyrene [*]	<0.01	0.45	0.40	<0.01	<0.01	<0.01	4.02	1.40	mg/kg	A-T-015a
Napthalene ^{MS}	<0.01	0.02	0.06	<0.01	0.03	<0.01	0.69	0.26	mg/kg	A-T-015a
Phenanthrene ^{MS}	<0.01	0.19	0.80	0.01	0.05	<0.01	10.1	1.80	mg/kg	A-T-015a
Pyrene ^{MS}	<0.01	1.30	1.50	0.01	0.08	<0.01	18.7	3.33	mg/kg	A-T-015a
Total PAH [*]	<0.01	8.52	12.3	0.18	0.62	<0.01	112	24.5	mg/kg	A-T-015a

Envirolab Job Number: 10/01638

Client Project Name: Northumberland Park

Client Project Ref: 023971

Lab Sample ID	10/01638/20	10/01638/25	10/01638/26	10/01638/27	10/01638/28	10/01638/29	10/01638/31	10/01638/32	Units	Method ref
Client Sample No										
Client Sample ID	WS20	WS21	WS21	WS21	WS21	WS22	WS22	WS23		
Depth to Top	1.20	0.80	1.60	2.90	3.50	1.50	2.50	0.30		
Depth To Bottom	1.40									
Date Sampled										
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil		
Sample Matrix Code	7	6A	6	7	5A	6A	6A	6A		
% Moisture ^g	5.4	14.2	13.4	-	-	-	-	14.5		
% Stones >10mm ^g	<0.1	12.0	<0.1	-	-	-	-	11.2	% w/w	A-T-044
Asbestos Screen _A	No ACM	No ACM	No ACM	-	-	-	-	No ACM		Visual
pH _D ^{MS}	11.7	6.8	6.7	-	-	-	-	9.9	pH	A-T-031a
Cyanide (total) _A ^{MS}	<1	<1	<1	-	-	-	-	<1	mg/kg	A-T-042/TCN
Phenols - Total by HPLC _A	<0.2	<0.2	<0.2	-	-	-	-	<0.2	mg/kg	A-T-088a
Sulphide _A ^g	<15	<15	<15	-	-	-	-	<15	mg/kg	A-T-02-e
Total Organic Carbon _D ^{MS}	1.64	1.96	0.79	-	-	-	-	1.47	% w/w	A-T-032a
Arsenic _D ^{MS}	8	15	12	-	-	-	-	17	mg/kg	A-T-024
Cadmium _D ^{MS}	<0.5	<0.5	<0.5	-	-	-	-	0.6	mg/kg	A-T-024
Copper _D ^{MS}	363	97	30	-	-	-	-	101	mg/kg	A-T-024
Chromium _D ^{MS}	24	32	42	-	-	-	-	39	mg/kg	A-T-024
Lead _D ^{MS}	197	277	69	-	-	-	-	1110	mg/kg	A-T-024
Mercury _D	0.36	0.73	0.25	-	-	-	-	0.94	mg/kg	A-T-024
Nickel _D ^{MS}	15	19	15	-	-	-	-	26	mg/kg	A-T-024
Selenium _D ^{MS}	<1	1	1	-	-	-	-	<1	mg/kg	A-T-024
Zinc _D ^{MS}	303	181	76	-	-	-	-	334	mg/kg	A-T-024

Envirolab Job Number: 10/01638

Client Project Name: Northumberland Park

Client Project Ref: 023971

Lab Sample ID	10/01638/20	10/01638/25	10/01638/26	10/01638/27	10/01638/28	10/01638/29	10/01638/31	10/01638/32	Units	Method ref
Client Sample No										
Client Sample ID	WS20	WS21	WS21	WS21	WS21	WS22	WS22	WS23		
Depth to Top	1.20	0.80	1.60	2.90	3.50	1.50	2.50	0.30		
Depth To Bottom	1.40									
Date Sampled										
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil		
Sample Matrix Code	7	6A	6	7	5A	6A	6A	6A		
Speciated TPH										
All >C5-C6 _A [®]	-	-	-	<0.01	<0.05	<0.05	<0.05	-	mg/kg	A-T-022a
All >C6-C8 _A [®]	-	-	-	<0.01	<0.05	<0.05	<0.05	-	mg/kg	A-T-022a
All >C8-C10 _A [®]	-	-	-	<0.01	<0.05	<0.05	<0.05	-	mg/kg	A-T-022a
All >C10-C12 _A [®]	-	-	-	<0.1	42.0	10.7	73.4	-	mg/kg	A-T-022a
All >C12-C16 _A [®]	-	-	-	<0.1	93.3	31.5	151	-	mg/kg	A-T-022a
All >C16-C21 _A [®]	-	-	-	<0.1	62.4	27.8	126	-	mg/kg	A-T-022a
All >C21-C35 _A [®]	-	-	-	<0.1	21.7	9.8	26.2	-	mg/kg	A-T-022a
Total Aliphatics _A [®]	-	-	-	<0.1	220	79.8	377	-	mg/kg	A-T-022+22a
Aro >C5-C7 _A [®]	-	-	-	<0.01	<0.05	<0.05	<0.05	-	mg/kg	A-T-022a
Aro >C7-C8 _A [®]	-	-	-	<0.01	<0.05	<0.05	<0.05	-	mg/kg	A-T-022a
Aro >C8-C9 _A [®]	-	-	-	<0.01	<0.05	<0.05	<0.05	-	mg/kg	A-T-022a
Aro >C9-C10 _A [®]	-	-	-	<0.01	<0.05	<0.05	<0.05	-	mg/kg	A-T-022a
Aro >C10-C12 _A [®]	-	-	-	<0.1	6.7	2.6	8.6	-	mg/kg	A-T-022a
Aro >C12-C16 _A [®]	-	-	-	<0.1	44.2	16.5	40.4	-	mg/kg	A-T-022a
Aro >C16-C21 _A [®]	-	-	-	<0.1	43.8	24.9	45.0	-	mg/kg	A-T-022a
Aro >C21-C35 _A [®]	-	-	-	<0.1	11.2	7.8	9.8	-	mg/kg	A-T-022a
Total Aromatics _A [®]	-	-	-	<0.1	106	51.8	104	-	mg/kg	A-T-022+22a
TPH (All & Aro) _A [®]	-	-	-	<0.1	325	132	481	-	mg/kg	A-T-022+22a
BTEX - Benzene _A [®]	-	-	-	<0.01	<0.05	<0.05	<0.05	-	mg/kg	A-T-022a
BTEX - Toluene _A [®]	-	-	-	<0.01	<0.05	<0.05	<0.05	-	mg/kg	A-T-022a
BTEX - Ethyl Benzene _A [®]	-	-	-	<0.01	<0.05	<0.05	<0.05	-	mg/kg	A-T-022a
BTEX - m & p Xylene _A [®]	-	-	-	<0.01	<0.05	<0.05	<0.05	-	mg/kg	A-T-022a
BTEX - o Xylene _A [®]	-	-	-	<0.01	<0.05	<0.05	<0.05	-	mg/kg	A-T-022a
MTBE _A [®]	-	-	-	<0.01	<0.05	<0.05	<0.05	-	mg/kg	A-T-022a

Envirolab Job Number: 10/01638

Client Project Name: Northumberland Park

Client Project Ref: 023971

Lab Sample ID	10/01638/20	10/01638/25	10/01638/26	10/01638/27	10/01638/28	10/01638/29	10/01638/31	10/01638/32	Units	Method ref
Client Sample No										
Client Sample ID	WS20	WS21	WS21	WS21	WS21	WS22	WS22	WS23		
Depth to Top	1.20	0.80	1.60	2.90	3.50	1.50	2.50	0.30		
Depth To Bottom	1.40									
Date Sampled										
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil		
Sample Matrix Code	7	6A	6	7	5A	6A	6A	6A		
PAH 16										
Acenaphthene ^{MS}	0.35	0.02	<0.01	-	-	-	-	0.01	mg/kg	A-T-015a
Acenaphthylene ^R	0.02	0.02	<0.01	-	-	-	-	0.01	mg/kg	A-T-015a
Anthracene ^{MS}	0.58	0.16	<0.01	-	-	-	-	0.13	mg/kg	A-T-015a
Benzo(a)anthracene ^R	0.82	0.69	<0.01	-	-	-	-	0.27	mg/kg	A-T-015a
Benzo(a)pyrene ^{MS}	0.86	0.92	<0.01	-	-	-	-	0.21	mg/kg	A-T-015a
Benzo(b)fluoranthene ^{MS}	0.39	0.48	<0.01	-	-	-	-	0.28	mg/kg	A-T-015a
Benzo(ghi)perylene ^{MS}	1.08	1.41	<0.01	-	-	-	-	0.46	mg/kg	A-T-015a
Benzo(k)fluoranthene ^{MS}	0.53	0.71	<0.01	-	-	-	-	0.14	mg/kg	A-T-015a
Chrysene ^{MS}	1.73	1.51	<0.01	-	-	-	-	1.18	mg/kg	A-T-015a
Dibenzo(ah)anthracene ^R	0.11	0.06	<0.01	-	-	-	-	<0.01	mg/kg	A-T-015a
Fluoranthene ^{MS}	1.98	1.53	<0.01	-	-	-	-	0.64	mg/kg	A-T-015a
Fluorene ^{MS}	0.12	<0.01	<0.01	-	-	-	-	<0.01	mg/kg	A-T-015a
Indeno(123-cd)pyrene ^R	0.33	0.48	<0.01	-	-	-	-	<0.01	mg/kg	A-T-015a
Napthalene ^{MS}	0.41	0.03	<0.01	-	-	-	-	0.04	mg/kg	A-T-015a
Phenanthrene ^{MS}	1.42	0.43	<0.01	-	-	-	-	0.21	mg/kg	A-T-015a
Pyrene ^{MS}	1.59	1.36	<0.01	-	-	-	-	0.54	mg/kg	A-T-015a
Total PAH ^R	12.3	9.80	<0.01	-	-	-	-	4.13	mg/kg	A-T-015a

Envirolab Job Number: 10/01638

Client Project Name: Northumberland Park

Client Project Ref: 023971

Lab Sample ID	10/01638/34	10/01638/36	10/01638/41	10/01638/43	10/01638/44	10/01638/47	10/01638/50	10/01638/53	Units	Method ref
Client Sample No										
Client Sample ID	WS23	WS24	WS25	WS25	WS26	WS27	WS27	WS28		
Depth to Top	1.50	0.30	0.90	2.00	0.40	0.50	1.80	1.00		
Depth To Bottom	1.70						1.90			
Date Sampled										
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil		
Sample Matrix Code	3	6A	6A	5A	5A	7	3A	6A		
% Moisture ^g	16.7	9.2	11.5	-	9.0	6.5	10.6	15.4	% w/w	A-T-044
% Stones >10mm ^g	<0.1	34.3	19.0	-	27.7	<0.1	15.7	4.4	% w/w	A-T-044
Asbestos Screen _A	No ACM	No ACM	No ACM	-	No ACM	No ACM	No ACM	No ACM		Visual
pH _D ^{MS}	7.1	10.8	11.5	-	10.2	12.5	8.0	7.5	pH	A-T-031a
Cyanide (total) _A ^{MS}	<1	<1	<1	-	<1	<1	<1	<1	mg/kg	A-T-042/TCN
Phenols - Total by HPLC _A	<0.2	<0.2	<0.2	-	<0.2	<0.2	0.2	<0.2	mg/kg	A-T-088a
Sulphide _A ^g	<15	<15	<15	-	<15	<15	<15	<15	mg/kg	A-T-02-e
Total Organic Carbon _D ^{MS}	0.32	1.12	0.97	-	1.57	0.30	0.13	1.86	% w/w	A-T-032a
Arsenic _D ^{MS}	18	18	14	-	21	5	27	9	mg/kg	A-T-024
Cadmium _D ^{MS}	<0.5	<0.5	<0.5	-	0.8	<0.5	<0.5	<0.5	mg/kg	A-T-024
Copper _D ^{MS}	22	44	91	-	138	17	20	35	mg/kg	A-T-024
Chromium _D ^{MS}	57	36	38	-	28	18	51	36	mg/kg	A-T-024
Lead _D ^{MS}	40	140	172	-	292	52	24	142	mg/kg	A-T-024
Mercury _D	0.24	0.84	0.49	-	0.36	0.41	0.27	0.63	mg/kg	A-T-024
Nickel _D ^{MS}	20	25	24	-	28	14	41	17	mg/kg	A-T-024
Selenium _D ^{MS}	1	<1	<1	-	<1	<1	<1	<1	mg/kg	A-T-024
Zinc _D ^{MS}	62	113	119	-	219	52	55	64	mg/kg	A-T-024

Envirolab Job Number: 10/01638

Client Project Name: Northumberland Park

Client Project Ref: 023971

Lab Sample ID	10/01638/34	10/01638/36	10/01638/41	10/01638/43	10/01638/44	10/01638/47	10/01638/50	10/01638/53	Units	Method ref
Client Sample No										
Client Sample ID	WS23	WS24	WS25	WS25	WS26	WS27	WS27	WS28		
Depth to Top	1.50	0.30	0.90	2.00	0.40	0.50	1.80	1.00		
Depth To Bottom	1.70						1.90			
Date Sampled										
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil		
Sample Matrix Code	3	6A	6A	5A	5A	7	3A	6A		
Speciated TPH										
All >C5-C6 _A [®]	-	-	<0.01	<0.01	-	-	-	-	mg/kg	A-T-022a
All >C6-C8 _A [®]	-	-	<0.01	<0.01	-	-	-	-	mg/kg	A-T-022a
All >C8-C10 _A [®]	-	-	<0.01	<0.01	-	-	-	-	mg/kg	A-T-022a
All >C10-C12 _A [®]	-	-	<0.1	<0.1	-	-	-	-	mg/kg	A-T-022a
All >C12-C16 _A [®]	-	-	<0.1	<0.1	-	-	-	-	mg/kg	A-T-022a
All >C16-C21 _A [®]	-	-	<0.1	<0.1	-	-	-	-	mg/kg	A-T-022a
All >C21-C35 _A [®]	-	-	<0.1	<0.1	-	-	-	-	mg/kg	A-T-022a
Total Aliphatics _A [®]	-	-	<0.1	<0.1	-	-	-	-	mg/kg	A-T-022+22a
Aro >C5-C7 _A [®]	-	-	<0.01	<0.01	-	-	-	-	mg/kg	A-T-022a
Aro >C7-C8 _A [®]	-	-	<0.01	<0.01	-	-	-	-	mg/kg	A-T-022a
Aro >C8-C9 _A [®]	-	-	<0.01	<0.01	-	-	-	-	mg/kg	A-T-022a
Aro >C9-C10 _A [®]	-	-	<0.01	<0.01	-	-	-	-	mg/kg	A-T-022a
Aro >C10-C12 _A [®]	-	-	<0.1	<0.1	-	-	-	-	mg/kg	A-T-022a
Aro >C12-C16 _A [®]	-	-	<0.1	<0.1	-	-	-	-	mg/kg	A-T-022a
Aro >C16-C21 _A [®]	-	-	<0.1	<0.1	-	-	-	-	mg/kg	A-T-022a
Aro >C21-C35 _A [®]	-	-	<0.1	<0.1	-	-	-	-	mg/kg	A-T-022a
Total Aromatics _A [®]	-	-	<0.1	<0.1	-	-	-	-	mg/kg	A-T-022+22a
TPH (All & Aro) _A [®]	-	-	<0.1	<0.1	-	-	-	-	mg/kg	A-T-022+22a
BTEX - Benzene _A [®]	-	-	<0.01	<0.01	-	-	-	-	mg/kg	A-T-022a
BTEX - Toluene _A [®]	-	-	<0.01	<0.01	-	-	-	-	mg/kg	A-T-022a
BTEX - Ethyl Benzene _A [®]	-	-	<0.01	<0.01	-	-	-	-	mg/kg	A-T-022a
BTEX - m & p Xylene _A [®]	-	-	<0.01	<0.01	-	-	-	-	mg/kg	A-T-022a
BTEX - o Xylene _A [®]	-	-	<0.01	<0.01	-	-	-	-	mg/kg	A-T-022a
MTBE _A [®]	-	-	<0.01	<0.01	-	-	-	-	mg/kg	A-T-022a

Envirolab Job Number: 10/01638

Client Project Name: Northumberland Park

Client Project Ref: 023971

Lab Sample ID	10/01638/34	10/01638/36	10/01638/41	10/01638/43	10/01638/44	10/01638/47	10/01638/50	10/01638/53	Units	Method ref
Client Sample No										
Client Sample ID	WS23	WS24	WS25	WS25	WS26	WS27	WS27	WS28		
Depth to Top	1.50	0.30	0.90	2.00	0.40	0.50	1.80	1.00		
Depth To Bottom	1.70						1.90			
Date Sampled										
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil		
Sample Matrix Code	3	6A	6A	5A	5A	7	3A	6A		
PAH 16										
Acenaphthene ^{MS}	<0.01	0.23	0.01	-	0.01	0.24	<0.01	<0.01	mg/kg	A-T-015a
Acenaphthylene ^R	<0.01	0.04	0.02	-	0.03	0.03	<0.01	<0.01	mg/kg	A-T-015a
Anthracene ^{MS}	<0.01	0.67	0.06	-	0.11	0.79	<0.01	<0.01	mg/kg	A-T-015a
Benzo(a)anthracene ^R	<0.01	0.51	<0.01	-	0.33	0.80	<0.01	<0.01	mg/kg	A-T-015a
Benzo(a)pyrene ^{MS}	<0.01	0.76	0.23	-	0.38	1.18	<0.01	<0.01	mg/kg	A-T-015a
Benzo(b)fluoranthene ^{MS}	<0.01	0.58	0.33	-	0.23	0.44	<0.01	<0.01	mg/kg	A-T-015a
Benzo(ghi)perylene ^{MS}	<0.01	1.11	0.34	-	0.65	1.44	<0.01	<0.01	mg/kg	A-T-015a
Benzo(k)fluoranthene ^{MS}	<0.01	0.49	0.20	-	0.27	0.92	<0.01	<0.01	mg/kg	A-T-015a
Chrysene ^{MS}	<0.01	2.21	1.08	-	0.96	3.22	0.04	<0.01	mg/kg	A-T-015a
Dibenzo(ah)anthracene ^R	<0.01	<0.01	<0.01	-	<0.01	0.08	<0.01	<0.01	mg/kg	A-T-015a
Fluoranthene ^{MS}	<0.01	2.13	0.72	-	0.43	2.91	0.02	<0.01	mg/kg	A-T-015a
Fluorene ^{MS}	<0.01	0.05	<0.01	-	<0.01	0.08	<0.01	<0.01	mg/kg	A-T-015a
Indeno(123-cd)pyrene ^R	<0.01	<0.01	<0.01	-	<0.01	0.38	<0.01	<0.01	mg/kg	A-T-015a
Napthalene ^{MS}	<0.01	0.05	0.03	-	0.03	0.12	<0.01	<0.01	mg/kg	A-T-015a
Phenanthrene ^{MS}	<0.01	1.56	0.10	-	0.15	2.15	<0.01	<0.01	mg/kg	A-T-015a
Pyrene ^{MS}	<0.01	1.79	0.87	-	0.51	3.10	0.01	<0.01	mg/kg	A-T-015a
Total PAH ^R	<0.01	12.2	3.98	-	4.10	17.9	0.07	<0.01	mg/kg	A-T-015a

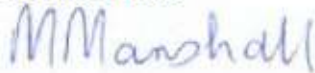
FINAL ANALYTICAL TEST REPORT

Envirolab Job Number: 10/01638
Issue Number: 2
Date: 15 June, 2010

Client: Buro Happold (Bath)
Camden Mill
Lower Bristol Road
Bath
UK
BA2 3DQ

Project Manager: Sarah Bear
Project Name: Northumberland Park
Project Ref: 023971
Order No: Not specified
Date Samples Received: 19/05/10
Date Instructions Received: 02/06/10
Date Analysis Completed: 14/06/10

Prepared by:



Melanie Marshall
Laboratory Coordinator

Approved by:



Iain Haslock
Analytical Consultant

Notes - Soil samples for chemical analysis

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

Stones >10mm are removed from the sample prior to analysis and results corrected where appropriate.

Subscript A indicates analysis performed on the sample as received, D indicates analysis performed on dried & crushed sample.

Superscript M indicates method accredited to MCERTS.

Predominant Matrix Codes - 1 = SAND, 2 = LOAM, 3 = CLAY, 4 = LOAM/SAND, 5 = SAND/CLAY, 6 = CLAY/LOAM, 7 = OTHER.

Samples with Matrix Code 7 are not predominantly a SAND/LOAM/CLAY mix and are not covered by our MCERTS accreditation.

Secondary Matrix Codes - A = contains stones, B = contains construction rubble, C = contains visible hydrocarbons, D = contains glass/metal, E = contains roots/twigs.

Notes - General

Superscript # indicates method accredited to ISO 17025.

Analytical results reflect the quality of the sample at the time of analysis only.

Opinions and interpretations expressed are outside the scope of our accreditation.

IS indicates Insufficient sample for analysis.

NDP indicates No Determination Possible.

Envirolab Job Number: 10/01638

Client Project Name: Northumberland Park

Client Project Ref: 023971

Lab Sample ID	10/01638/2	10/01638/5	10/01638/10	10/01638/13	10/01638/14	10/01638/16	10/01638/17	10/01638/19	Units	Method ref
Client Sample No										
Client Sample ID	BH10/03	BH10/05	WS16	WS17b	WS18	WS18	WS19	WS20		
Depth to Top	1.00	0.50	0.70	0.60	0.50	1.60	0.85	0.50		
Depth To Bottom										
Date Sampled										
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil		
Sample Matrix Code	6A	7	6A	5A	6A	6A	6A	6A		
% Moisture _A [#]	18.1	9.3	18.3	10.0	12.9	8.5	9.5	16.0		
% Stones >10mm _A [#]	2.1	<0.1	6.9	10.6	14.6	26.1	20.0	17.6	% w/w	A-T-044
Asbestos Screen _A	No ACM	No ACM	No ACM	No ACM	No ACM	No ACM	No ACM	No ACM		Visual
pH ₀ ^{WW}	6.8	11.3	8.2	8.4	7.3	7.0	9.8	8.9	pH	A-T-031a
Cyanide (total) _A ^{WW}	<1	<1	<1	<1	<1	<1	<1	<1	mg/kg	A-T-042/TCN
Phenols - Total by HPLC _A	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	mg/kg	A-T-050e
Sulphide _A [#]	<15	<15	<15	<15	<15	<15	<15	<15	mg/kg	A-T-03-e
Total Organic Carbon ₀ ^{WW}	0.54	1.04	1.63	1.04	3.19	0.05	0.31	2.30	% w/w	A-T-032a
Arsenic ₀ ^{WW}	14	10	21	10	18	19	10	26	mg/kg	A-T-024
Cadmium ₀ ^{WW}	<0.5	<0.5	1.6	<0.5	<0.5	<0.5	<0.5	2.7	mg/kg	A-T-024
Copper ₀ ^{WW}	22	20	211	28	115	17	12	3440	mg/kg	A-T-024
Chromium ₀ ^{WW}	46	96	24	25	31	40	19	34	mg/kg	A-T-024
Lead ₀ ^{WW}	46	69	894	110	275	18	64	1520	mg/kg	A-T-024
Mercury ₀	0.30	<0.17	2.72	0.21	0.95	<0.17	0.36	1.02	mg/kg	A-T-024
Nickel ₀ ^{WW}	17	15	18	16	21	29	13	33	mg/kg	A-T-024
Selenium ₀ ^{WW}	1	1	1	<1	<1	<1	<1	1	mg/kg	A-T-024
Zinc ₀ ^{WW}	55	56	443	154	128	51	55	2050	mg/kg	A-T-024

Envirolab Job Number: 10/01638

Client Project Name: Northumberland Park

Client Project Ref: 023971

Lab Sample ID	10/01638/2	10/01638/5	10/01638/10	10/01638/13	10/01638/14	10/01638/16	10/01638/17	10/01638/19	Units	Method ref
Client Sample No										
Client Sample ID	BH10/03	BH10/05	WS16	WS17b	WS18	WS18	WS19	WS20		
Depth to Top	1.00	0.50	0.70	0.60	0.50	1.60	0.85	0.50		
Depth To Bottom										
Date Sampled										
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil		
Sample Matrix Code	6A	7	6A	5A	6A	6A	6A	6A		
Speciated TPH										
All >C5-C6 _A ^g	-	-	-	<0.01	-	-	-	-	mg/kg	A-T-022a
All >C6-C8 _A ^g	-	-	-	<0.01	-	-	-	-	mg/kg	A-T-022a
All >C8-C10 _A ^g	-	-	-	<0.01	-	-	-	-	mg/kg	A-T-022a
All >C10-C12 _A ^g	-	-	-	<0.1	-	-	-	-	mg/kg	A-T-022a
All >C12-C16 _A ^g	-	-	-	<0.1	-	-	-	-	mg/kg	A-T-022a
All >C16-C21 _A ^g	-	-	-	<0.1	-	-	-	-	mg/kg	A-T-022a
All >C21-C35 _A ^g	-	-	-	<0.1	-	-	-	-	mg/kg	A-T-022a
Total Aliphatics _A ^g	-	-	-	<0.1	-	-	-	-	mg/kg	A-T-022+022a
Aro >C5-C7 _A ^g	-	-	-	<0.01	-	-	-	-	mg/kg	A-T-022a
Aro >C7-C8 _A ^g	-	-	-	<0.01	-	-	-	-	mg/kg	A-T-022a
Aro >C8-C9 _A ^g	-	-	-	<0.01	-	-	-	-	mg/kg	A-T-022a
Aro >C9-C10 _A ^g	-	-	-	<0.01	-	-	-	-	mg/kg	A-T-022a
Aro >C10-C12 _A ^g	-	-	-	<0.1	-	-	-	-	mg/kg	A-T-022a
Aro >C12-C16 _A ^g	-	-	-	<0.1	-	-	-	-	mg/kg	A-T-022a
Aro >C16-C21 _A ^g	-	-	-	<0.1	-	-	-	-	mg/kg	A-T-022a
Aro >C21-C35 _A ^g	-	-	-	<0.1	-	-	-	-	mg/kg	A-T-022a
Total Aromatics _A ^g	-	-	-	<0.1	-	-	-	-	mg/kg	A-T-022+022a
TPH (All & Aro) _A ^g	-	-	-	<0.1	-	-	-	-	mg/kg	A-T-022+022a
BTEX - Benzene _A ^g	-	-	-	<0.01	-	-	-	-	mg/kg	A-T-022a
BTEX - Toluene _A ^g	-	-	-	<0.01	-	-	-	-	mg/kg	A-T-022a
BTEX - Ethyl Benzene _A ^g	-	-	-	<0.01	-	-	-	-	mg/kg	A-T-022a
BTEX - m & p Xylene _A ^g	-	-	-	<0.01	-	-	-	-	mg/kg	A-T-022a
BTEX - o Xylene _A ^g	-	-	-	<0.01	-	-	-	-	mg/kg	A-T-022a
MTBE _A ^g	-	-	-	<0.01	-	-	-	-	mg/kg	A-T-022a