CCG-C-18-10433

ADDENDUM GROUND INVESTIGATION FOR MONSALL ROAD, MANCHESTER

SEPTEMBER 2018



By:

CC GEOTECHNICAL LTD
Units 1 & 2 Deltic Place
Deltic Way
Knowsley Industrial Estate
Liverpool
L33 7BA

Telephone: 0151 545 2750
Facsimile: 0151 548 7892

Prepared for:

MANGROVE ESTATES
11 Warwick Road
Old Trafford
Manchester
M16 0QQ

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Main Author:	Graham Rooney BEng (Hons)
Signature:	
Reviewed by:	Chris Bolan MSc CEng MICE CEnv
Signature:	
Approved for Issue by:	Chris Bolan MSc CEng MICE CEnv
Signature	
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1.0 INTRODUCTION

CC GEOTECHNICAL LIMITED (***CCG***) is providing consultancy services to services to ***MANGROVES ESTATES LTD*** in connection with the proposed redevelopment of land located at the junction of Monsall Road and Emmett Street East in Manchester.

It is proposed that a 3-storey block be constructed providing a total of 18nr 1-bed and 2-bed apartments. External works include car parking spaces, hardstandings, peripheral soft landscaped beds and a soft landscaped communal lawn. The elevations of the block will be formed by glazing, facing brick and cladding panels.

The proposed site layout, floor plans and elevations are presented on the drawings by ***GRAYS ARCHITECTURE*** in Appendix A.

The development site was previously investigated by ***CCG*** in 2012 when a Phase II GI was reported under ref. no. *CCG-C-12-6768*. The scope of investigation was based upon the findings of a 2008 Phase I Desk Study by ***Trevena Blake & Associates***. The investigations covered a wider development area that extended further to the north and west, including areas proposed for the construction of 16nr terraced houses with associated driveways and gardens. Since the initial construction phase of the houses was completed, the design and arrangement of the apartment block has been revised, requiring a new planning application to be made to ***MANCHESTER CITY COUNCIL (MCC)*** under ref. no. 118945/FO/2018, and some additional intrusive investigation works to be carried out.

This report collates the findings of the 2018 additional investigation works and the findings of the 2012 Phase II investigation and was required to secure the discharge of Planning Condition 7. The report should be read in conjunction with the aforementioned 2012 reports which will be made available to ***MCC*** by the Client's planning agent.

2.0 PURPOSE & AIMS OF THE INVESTIGATION

The main purpose of the intrusive Investigation was to confirm the conclusions of the Desk Study, and to supplement the previous Phase II investigation, with particular reference to:

- The assessment of the nature and extent of contamination in relation to potential risks to human health for the apartment block end users and construction workers
- The assessment of the nature and extent of contamination in relation to potential risks to the fabric of buildings and services
- The refinement of the Preliminary Conceptual Model confirming if any pollution linkages have been demonstrated to be present on site
- The identification of feasible remediation measures to remove or break any identified pollution linkages
- The characterisation of made ground for the purpose of waste disposal
- The provision of factual information and interpretative comment on ground conditions and existing foundations in relation to the selection, design and construction of the new apartment block foundations

3.0 SITE DATA

3.1 Site Location

The proposed development is located at the junction of Monsall Street and Emmett Street East in Newton Heath, East Manchester. The site lies approximately 320m north of the A62 Oldham Road as shown on Drawing No. 18/10433/1 presented

in Appendix A.

The site is situated within a mixed-use context, with both residential and commercial/light industrial buildings within the vicinity. Vehicle and pedestrian access to the site is via the recently constructed Mangrove Close off Emmett Street East, which serves the completed houses from the first phase of development.

The Ordnance Survey grid reference for the approximate site centre is 386498E, 400450N.

3.2 Site Description & Walkover Observations

A full description of the site is contained in the 2012 Phase I Desk Study. A summary of information obtained during a site walkover survey before further works commenced in July 2018 is summarised in Table 1 hereunder.

Table 1: Summary of Walkover Observations

FEATURE		OBSERVATION
Current Use of Land		Derelict / vacant brownfield land
Context		Mixed residential and commercial / light industrial use
Surfaces		Black asphalt and stone with sporadic vegetation to west, becoming overgrown to east
Topography		Generally flat, sloping slightly upwards to north
Dimensions		Approx. 34m x 28m main area, with proposed car park extending by further 16m x 9m approx.
Access		Pedestrian and vehicle access on Mangrove Close off Emmett Street East (development area behind Heras fence)
Buildings Adjacent to the Site		New build terraced houses to north and west Commercial / light industrial buildings to south and east
Services		Assumed full set of services serving adjacent new housing
Boundary	North	Side gable and garden fence of adjacent houses
	West	Side gable and garden fence of adjacent houses
	South	Emmett Street East
	East	Monsall Road
Material storage		None observed – site securely fenced off
Waste disposal		None observed – site securely fenced off
Potential contamination		None observed
Ecology*		No fauna observed within site boundaries. Flora comprised sporadic common weeds, bushes and flowers

**Comments on ecology are to provide an initial preliminary assessment only, based on observations undertaken by a person who is a trained ecologist but who has not undertaken a comprehensive Phase I Habitat Survey or similar (and comments should not be relied upon as such)*

4.0 DOCUMENTED GEOLOGY

The geology of the site was researched by reference to the 1:50000 scale British Geological Survey (BGS) online digital mapping service. Drift deposits at the site are recorded as Devensian Till – Diamicton from the Quaternary period. The underlying solid geology is documented as Pennine Middle Coal Measures Formation – Mudstone, Siltstone and Sandstone from the Carboniferous period.

As the site has been previously developed, imported made ground deposits of an unknown composition and thickness will be present at the surface.

A Coal Authority mining report (No. 007.0002262735001) obtained as part of the Phase I Desk Study indicates that the site is not located within the zone of influence of any past or present ground workings.

Consultation with digital Radon mapping on ukradon.org shows the site is not in a Radon Affected Area, as less than 1% of properties are above the Action Level, and therefore radon protective measures are not required.

5.0 PRELIMINARY CONCEPTUAL MODEL (TIER 1)

As a conclusion to the Phase I Desk Study, the following PCM was constructed.

Table 2: Preliminary Conceptual Model (PCM)

SOURCE	METALS	NON-METALS	ORGANICS	GASES	OTHER	PATHWAY	RECEPTORS	RISK RATING
Made ground associated with the development of the site & adjoining area	Cd, Cr (total and VI), Ni, Cu, Pb, Hg,	Se, As, Sulphates	TPH's, BTEX, PAH's	-	pH	Oral ingestion, dermal contact	Construction workers, future occupants	Moderate
Former usage of site as works and car park	Cd, Cr (total and VI), Ni, Cu, Pb, Hg,	Se, As, Sulphates	TPH's, BTEX, PAH's	-	pH	Oral ingestion, dermal contact	Construction workers, future occupants	Moderate
Asbestos / ACM in made ground soils	-	-	-	-	Asbestos	Dust inhalation	Construction workers, future occupants	Moderate
New water mains laid in potentially contaminated soil	-	-	TPH's, BTEX,	-	pH	Drinking water from mains laid in contaminated soils	Future occupants	Moderate
Ground gases associated with infilled ponds	-	-	-	CO_2, CH_4, CO, H_2S	-	-	-	Low Risk
Summary Suite	Cd, Cr (total and VI), Ni, Cu, Pb, Hg,	Se, As, Sulphates	TPH's, BTEX, PAH's	-	pH, Asbestos			

6.0 SCOPE OF INTRUSIVE INVESTIGATION

Based on the findings of the Phase I desk study, the 2012 G.I. report and the 2018 site walkover, an intrusive investigation was planned taking account of the potential presence of pollution linkages. The scope of investigation provided for boreholes to be sunk through made ground into the underlying natural strata to allow for sampling of soils and groundwater (if present) and the monitoring of ground gas composition. The primary objectives of the investigation were to obtain enough soil and groundwater contamination data to reliably assess risks to human and environmental receptors. Additionally, geotechnical data was required to enable an engineering assessment of the site and inform foundation design.

7.0 FIELDWORK

7.1 Introduction

A programme of fieldwork investigation was undertaken in August 2018 comprising the following:

- The sinking of 4nr light dynamic sampling boreholes
- The installation of 2nr ground gas / groundwater monitoring standpipes

Fieldwork was planned in accordance with BS10175: 2011, and carried out in accordance with BS10175: 2011 and BS5930: 1999, and the sampling and monitoring methodologies employed by ***CCG*** as presented in Appendix D.

The investigation layout is illustrated on drawing ref. no. 18/10433/2 presented in Appendix A.

7.2 Light Dynamic Sampling Boreholes

4nr boreholes (WS1, WS2, WS3 & WS4) were sunk by light dynamic sampling methods using a Dando Terrier rig.

The boreholes were required for soil sampling to enable chemical analyses and for in-situ testing to assist in geotechnical assessment of the development.

Each borehole was positioned clear of any observed service covers and scanned using a CAT service detector before and during manual excavation of a service clearance pit from ground level to 1.2mbgl.

In the dynamic sampling method of investigation, relatively undisturbed samples are recovered by the driving of a series of 1m long progressively reducing diameter steel tubes, each of which contains a perspex liner. The liners are extracted from each section of recovery, and are longitudinally split, allowing the soil section to be described, scanned by PID and subsampled for engineering and/or chemical testing.

Boreholes WS1 & WS3 terminated at depths of 4.0mbgl and 5.0mbgl, respectively. Positions WS2 & WS4 were terminated on buried concrete slabs at depths of 0.3mbgl and 1.5mbgl, respectively. Attempts to core through the buried slab using a coring attachment on the Dando Terrier rig were unsuccessful, as were attempts to break through with a hydraulic jackhammer. As such, it was not possible to advance boreholes WS2 & WS4 to greater depth.

Ground gas and groundwater monitoring standpipes were planned for 3nr positions, but due to the presence of buried obstructions at WS2 & WS4, could only be installed at WS1 & WS3. As such, a surviving standpipe from the 2012 investigation (BH01) was included in the monitoring programme.

The 2018 borehole logs annotated with sampling details and standpipe construction are presented in Appendix E.

A copy of the 2012 borehole log (BH01) annotated with sampling details, standpipe construction and dynamic probe test result is also presented in Appendix F.

6.4 Monitoring Installations

Standpipes comprising 50mm diameter HDPE plain and slotted tube set in bentonite and non-limestone pea gravel surrounds were installed in 2nr of the 4nr 2018 boreholes, WS1 & WS3. A standpipe of the same general construction was installed at BH01 in 2012. Each standpipe was fitted with a gas valve, and was protected by a flush, lockable cover set in concrete.

Details of standpipe construction are provided on the individual borehole logs in Appendices E & F and are summarised in the tabulation hereunder:

Table 3: Borehole Installation Details

BOREHOLE	DEPTH OF BOREHOLE [mbgl]	DEPTH OF STANDPIPE [mbgl]	RESPONSE ZONE	
			FROM [mbgl]	TO [mbgl]
WS1	4.00	3.50	0.50	3.50
WS3	5.00	4.00	1.00	4.00
BH01	5.00	5.00	1.50	5.00

The standpipe installations were periodically monitored for flow rate and composition of ground gas using a Geotechnical Instruments GA 2000 infrared analyser. The installations were also monitored for standing water levels with an electronic dipmeter.

8.0 OBSERVED GROUND CONDITIONS

8.1 Stratigraphy

The stratigraphy of the trial pit excavations and boreholes was generally consistent with the documented geology. The succession is summarised in the tabulation hereunder:

Table 4: Observed Stratigraphy

Location	STRATIGRAPHY
WS1	Brown very gravelly slightly silty SAND (MADE GROUND) to 0.7mbgl, brown slightly sandy slightly gravelly silty CLAY (MADE GROUND) to 1.0mbgl, brown very clayey very sandy GRAVEL (MADE GROUND) to 1.5mbgl and firm becoming stiff brown slightly sandy slightly gravelly silty CLAY proven to termination at 4.0mbgl.
WS2	Grey slightly sandy GRAVEL (MADE GROUND) to 0.3mbgl. Borehole terminated on CONCRETE obstruction at 0.35mbgl.
WS3	Brown/grey very gravelly silty SAND (MADE GROUND) to 2.0mbgl, brown very clayey very gravelly SAND (MADE GROUND) to 2.7mbgl, brown slightly sandy slightly gravelly silty CLAY (MADE GROUND) to 3.2mbgl and firm brown slightly sandy slightly gravelly silty CLAY proven to termination at 5.0mbgl
WS4	Grey slightly sandy GRAVEL (MADE GROUND) to 1.0mbgl and CONCRETE slab to 1.5mbgl. Borehole terminated in CONCRETE at 1.5mbgl.
TP01 / BH01 (2012)	Asphalt to 0.1mbgl, grey silty GRAVEL (MADE GROUND) to 0.5mbgl, reinforced CONCRETE to 0.7mbgl, brown clayey gravelly SAND (MADE GROUND) to 1.6mbgl, firm becoming stiff brown/grey slightly sandy slightly gravelly silty CLAY to 2.7mbgl, brown very clayey gravelly SAND to 3.3mbgl and stiff brown slightly sandy slightly gravelly silty CLAY proven to sampling termination at 5.0mbgl. Dynamic probe refused at 8.4mbgl.

There was no visual and/or olfactory evidence of contamination affecting the made ground sub-soils at any sampling position.

8.2 Groundwater Regime

Groundwater was recorded to stand at levels of approx. 1 – 1.5mbgl during the standpipe monitoring programme.

9.0 LABORATORY TESTING

9.1 Soil Engineering Classification Testing

The following programme of geotechnical engineering classification testing was undertaken on soil samples at ***CCG***'s UKAS accredited laboratory:

- Determination of Moisture Content in accordance with BS 1377-2: 1990
- Determination of Atterberg Limits in accordance with BS 1377-2: 1990

The soil classification test results are presented in Appendix G.

9.2 Soil Chemical Analyses

The following programme of chemical analysis was undertaken at a UKAS / MCERTS accredited laboratory:

- 3nr subsamples of made ground soils were analysed to a broad range of contaminants including metals, non-metals, speciated PAH's, TPHCWG & BTEX
- 3nr subsamples of made ground soils were screened for identification of Asbestos contaminants
- 3nr subsamples of made ground soils were analysed for pH & Sulphate levels
- 1nr groundwater sample was analysed to a broad range of contaminants

The soil chemical lab test results and are presented on the certificates in Appendix H.

10.0 RISK ASSESSMENT FOR THE PROTECTION OF HUMAN HEALTH

10.1 Generic Quantitative Risk Assessment (Tier 2 / GQRA)

An assessment of the soil analysis data was carried out in accordance with the guidance presented in CLR11 and in accordance with current guidance and legislation.

The Human Health Risk Assessment was carried out in accordance with the ***CCG*** methodology for assessing soil contamination data as contained in Appendix B, and since it is proposed that the site be redeveloped for residential ground floor land use with communal landscaping and no private garden areas, the assessment was based on criteria contained in publication LQM/CIEH S4UL's for Human Health Risk Assessment (2015) (CCG licence S4UL3233), applicable to the 'Residential with homegrown produce' land use scenario. This document does not provide criteria for Lead, for which the results were compared to the C4SL published by DEFRA SP1010 Development of Category 4 Screening Levels.

10.2 Assessment of Chemical Data

The assessment of the soil data was carried out using threshold values for an average Soil Organic Matter content of 1.0% as summarised hereunder and presented on the worksheets in Appendix I.

10.2.1 Assessment of Metal Data

The assessment of the metal data concluded that no contaminant exceeded its respective guideline criteria and, therefore, no potential risk to human health is indicated.

10.2.2 Assessment of Non-Metal Data

The assessment of the non-metal data concluded that no contaminant exceeded its respective guideline criteria and, therefore, no potential risk to human health is indicated.

10.2.3 Assessment of Polycyclic Aromatic Hydrocarbon Data

The assessment of the Polycyclic Aromatic Hydrocarbon (PAH's) data found that select contaminants exceeded their respective guideline criteria. A summary of the risk assessment is presented on the tabulation below:

Table 5: Assessment of PAH Soil Chemical Data

Contaminant	Maximum (mg/kg)	S4UL / C4SL (mg/kg)	Exceedances (mg/kg)	Location
Acenapthene	0.8	210	-	-
Acenapthylene	0.1	170	-	-
Anthracene	1.7	2400	-	-
Benz(a)anthracene	4.9	7.2	-	-
Benzo(a)pyrene	**5.1**	**2.2**	**5.1**	**WS3**
Benzo(b)fluoranthene	**5.6**	**2.6**	**5.6**	**WS3**
Benzo(ghi)perylene	3.0	320	-	-
Benzo(k)fluoranthene	5.2	77	-	-
Chrysene	6.1	15	-	-
Dibenzo(ah)anthracene	**0.8**	**0.24**	**0.8**	**WS3**
Fluoranthene	11.0	280	-	-
Fluorene	0.6	170	-	-
Indeno(123-cd)pyrene	3.2	27	-	-
Napthalene	0.5	2.3	-	-
Phenanthrene	6.1	95	-	-
Pyrene	10.6	620	-	-

The assessment indicates a potential risk to human health arising from elevtaed concentrations of Benzo(a)pyrene, Benzo(b)fluoranthene and Dibenzo(ah)anthracene at WS3 only.

10.2.4 Assessment of Petroleum Hydrocarbon Data

The assessment of Petroleum Hydrocarbon (TPH) data concluded that no contaminant exceeded its respective guideline criteria and, therefore, no potential risk to human health is indicated.

10.2.5 Assessment of BTEX Data

All BTEX compounds were below their limit of detection (LOD) and, therefore, no potential risk to human health is indicated.

10.2.6 Assessment of Asbestos Data

Asbestos screening confirms that asbestos containing materials (ACM) were not present in any sample analysed and, therefore, no potential risk to human health is indicated.

10.2.6 Assessment of PCB Data

All 7nr ICES Congeners were below their limit of detection (LOD) and, therefore, no potential risk to human health from PCB contamination is indicated.

10.2.8 Summary of Human Health Risk Assessment

Based on the above assessment, it is concluded that no contaminant exceeded its respective guideline criterion for the 'Residential with plant uptake' land use scenario, with the exception of select PAH's at WS3. Therefore, a potential risk to human health is indicated and this conclusion is carried forward to the Conceptual Model in Section 12.0.

11.0 CONTROLLED WATERS RISK ASSESSMENT

11.1 Assessment of Leachable Metals, Non-Metals, PAH & TPH Data

A groundwater sample obtained during standpipe monitoring at WS3 was analysed for a broad range of contaminants at a UKAS / MCERTS accredited laboratory.

Contaminant concentrations were assessed against EQS threshold values as presented on the tabulation below. The groundwater chemical test certificates are presented in Appendix H.

Table 6: Assessment of Groundwater Chemical Data

Contaminant	Max Hardness	Maximum (ug/l)	EQS (ug/l)	Exceedances (mg/kg)	Location
Lead	202	<1	250	-	-
Nickel		<5	200	-	-
Copper		20	40	-	-
Zinc		<5	1000	-	-
Boron		11	1000	-	-
Mercury		<0.1	1	-	-
Cadmium		<1	5	-	-
Chromium		5	250	-	-
pH		**11.7**	**6.0 – 9.0**	**11.7**	**WS3**

The assessment concludes that concentrations of all pertinent contaminants were below their respective EQS guideline criteria, with the exception of the pH level which is of higher alkalinity than recommended. However, it is the opinion of ***CCG*** that the pH level does not pose any serious potential risk to controlled waters. As such, no remedial measures are recommended.

12.0 POST INVESTIGATION CONCEPTUAL MODEL

Based on the findings of the investigation, a post investigation conceptual model has been constructed as tabulated hereunder:

Table 7: Conceptual Model

Potential Receptor	Risk Present? (Y/N)	Source	Pathway	Remedial Options
Human Health via Contaminated Soil Exposure	N	Soil concentrations of Benzo(a)pyrene, Benzo(b)fluoranthene and Dibenzo(ah)anthracene are above their respective C4SL / S4UL guideline criteria at WS3 only. Chemical risk assessment of samples from WS1 & WS4 (targeting soft landscaped amenities) found all concentrations to be below their respective C4SL / S4UL / GAC criteria	None present due to the building footprint, hard standing and car parking covering WS3	Not required
Human Health via Ground Gas	N	None. Site classifies as Characteristic Situation 1 with maximum GSV of 0.0001l/hr for CO_2.	None present	Not required under Characteristic Situation 1
Human Health via Asbestos Exposure	N	None. Asbestos was not identified as being present in any of the 3nr soil analyses samples.	None present	Not required
Building Fabric	N	None. pH & Sulphate analyses classify soils as Design Sulphate Class of DS-1 and ACEC Class of AC-1s	None present	Not required – use regular DC-1 concrete mixes
Potable Water Supply	Y	EC10 – EC16 TPH concentrations exceed the UUW threshold value	New water supply to commercial unit and apartments	Adopt PE/Al/PE barrier pipe mains e.g. Protecta Line products

Controlled Waters	N	None. Risk assessment concluded that concentrations of all pertinent contaminants were below their respective EQS guideline criteria with the exception of the pH level, but this is not considered to pose a serious risk to controlled waters	None present	Not required

13.0 ASSESSMENT OF RISKS TO THE BUILT ENVIRONMENT

13.1 Buried Concrete Specification

Chemical analyses data obtained from 6nr made ground soil samples was assessed against the guidance given in BRE Special Digest 1: 2005, as summarised hereunder:

Table 8: Design Chemical Class Based on Soil Data

CONCRETE SPECIFICATION DATA SHEET		
Is the site Brownfield or Greenfield?	Brownfield	
Is the water table Static or Mobile?	Static	
Highest Water-Soluble Sulphate results	350mg/l	Design Sulphate Class of DS-1 Class of AC-1s
Lowest pH Result	11.4	
Intended Working Life	100 years	Adopt Design Chemical Classification of DC-1

On the basis of the foregoing soil chemical assessment, concrete in the ground should be specified to conform to the compositional requirements of Design Chemical Class DC-1, as defined in BRE Special Digest 1: 2005.

13.2 Ground Gases

3nr standpipes were constructed such that response zones included permeable made ground strata. Using the data gathered in the monitoring programme, a gas risk assessment was undertaken in accordance with the ground gas risk assessment methodology (see Appendix C) employed by ***CCG***. The risk assessment methodology conforms to current UK guidance on the assessment of risks posed by ground gases.

In accordance with the guidance contained in CIRIA publication C665 'Assessing Risks Posed by Hazardous Ground Gases to Buildings', the sources of gas risk were identified as being of 'Very Low' potential and the proposed commercial ground floor development usage was identified as being of 'Low' sensitivity. Therefore, in accordance with Tables 5.5a & 5.5b of the guidance, standpipe installations should be monitored on a recommended 6nr occasions over a minimum period of 3 months for gas composition and flow rate.

To date, 4nr rounds of monitoring have been completed, monitoring each of the standpipe installations over a 1-month period. The gas monitoring results are presented in Appendix K.

A gas risk assessment was undertaken in accordance with current UK guidelines set out in CIRCA C665 2007 "Assessing Risk Posed by Hazardous Gases to Buildings". The CIRIA risk assessment methodology uses typical maximum soil gas concentrations and worse case borehole flow rates to define a "Characteristic Situation" for the shallow gas regime.

The volumetric gas flow rate used by the risk assessment is termed "Gas Screening Value (GSV)" in the guidance and is defined as *GSV (litres/hr) = borehole flow rate (litres/hr) x gas concentration.*

A summary of the gas monitoring data is presented hereunder:

Table 8: Summary of Gas Monitoring Data

Position	WS1	WS3	BH01
No Monitoring Visits	4	4	4
Max CH_4 (%)	Nil	Nil	Nil
Max CO_2 (%)	Nil	Nil	0.1
Min O_2 (%)	18.6	20.1	20.0
H_2S (ppm)	Nil	Nil	Nil
CO (ppm)	Nil	Nil	Nil
Flow (l/hr)	<0.1	<0.1	<0.1
Water Levels (m)	0.86	1.59	1.15
PID response	Nil	Nil	Nil
Pressure Range (mb)	1008 – 1017		

Based on these results, a maximum Gas Screening Value (GSV) of 0.0001 l/hrs is calculated for CO_2.

Using this GSV value, the risk to the proposed development was assessed in line with Situation A as defined in CIRIA C665, and on this basis, the site classified as Characteristic Situation 1 (CS1). Gas protection measures are not required for CS1 sites.

Given the CS1 result of the 2018 assessment above, and the CS1 result of the previous 2012 assessment (6 visits over 3 months) covering the wider development site, it is considered that a comprehensive bank of data has been compiled and the resulting gas risk assessment undertaken is robust. Therefore, it is the opinion of ***CCG*** that continuation of the monitoring programme (2 additional visits over a further 2 months) is not necessary.

14.0 NEW WATER MAINS SUPPLY

Assessment of the soil chemical data to specify the construction of new water mains at the development site was based on the criteria specified in Paper 10/WM/03/21 'Guidance for the selection of Water Supply Pipes to be used in Brownfield Sites' January 2011 published by UK Water Industry Research (UKWIR) and the supplementary guidance UUENG/RL/V2/July 2011 published by United Utilities Water (UUW).

Concentrations of the EC10 – EC16 aliphatic and aromatic hydrocarbon soil contaminants were found to exceed the respective threshold value recommended under UUW guidance at two locations – WS3 and WS4. On this basis, new water mains must be specified as PE / Al barrier pipe construction e.g. Protecta-Line products.

Pipes should be laid in accordance with BS EN 12201-2 'Plastic piping systems for water supply, and for drainage and sewerage under pressure – Polyethylene (PE)' as stated in UKWIR guidance. It is good practice for PE water mains to be laid in a remediated alignment comprising of clean granular fill extending to 600mm + pipe diameter and to 300mm below the pipe underside.

Notwithstanding the above preliminary assessment, the developer should contact the local water supplier (UUW) to obtain concurrence with the recommendations given above. The supplier may require the developer to return a completed UUW Risk Assessment document.

15.0 SITE WASTE MANAGEMENT

A preliminary waste classification exercise was undertaken in relation to potential off-site disposal of excavation spoil generated during site construction activities. The preliminary classification was carried out using data from the 3nr broad-spectrum soil chemical analyses discussed in Section 10.0 above. The data was input to the HazWasteOnline (HWO) computer program. The program generates a baseline 'Hazardous' or 'Non-Hazardous' preliminary waste classification of soils. The output data from the HWO assessment is provided in Appendix J.

The output data originally classified 2 of the 3nr samples as 'Hazardous' waste due to the elevated pH level of 11.5. However, it is the opinion of ***CCG*** that the high pH level was caused by the crushed concrete gravels observed within the made ground soil samples. It was therefore decided to run a second HWO assessment with pH excluded.

Output data from the second assessment classified all 3nr samples as '*Non-Hazardous Waste'*. Notwithstanding this, it should be noted that the final decision on waste classification is at the discretion of the accepting waste disposal facility operator who may wish to inspect stockpiled spoil for concrete gravel content. It is recommended that consultation with facility operators be undertaken by the Principal Contractor during development of the site waste management plan, in advance of groundworks commencing.

In addition, it may be beneficial to undertake additional chemical analyses to a full Waste Acceptance Criteria (WAC) suite to determine the final classification. WAC testing may reduce the Non-Hazardous classification to 'Inert' thus allowing for disposal cost savings.

16.0 GEOTECHNICAL DISCUSSION

16.1 Introduction

It is assumed that the new 3-storey apartment block will be of traditional masonry construction with elevations comprising facing brick, glazing and cladding panels.

16.2 Ground Conditions

The observed ground conditions at WS1, WS3 & BH01 found made ground to vary from depths of 1.5mbgl – 3.2mbgl. At WS2 & WS4, remnant concrete slabs of unknown thickness were found to be present commencing at depths of 0.3mbgl and 1.0mbgl, respectively. A 200mm thick slab was present from 0.5 – 0.7mbgl at BH01.

The made ground soils observed at WS1 & WS3 were succeeded by a firm becoming stiff natural CLAY stratum proven to a maximum termination depth of 5.0mbgl. The BH01 dynamic probe test result refused at 8.4mbgl, which is the presumed sandstone bedrock level.

16.3 Foundations

The in-ground concrete slabs observed at WS2, WS4 & BH01 will require grubbing out before any form of foundation construction commences.

Given the significant depths of made ground, and the further disturbance that will result from the removal of buried slabs, adoption of traditional shallow spread foundations is precluded due to the risk of large total settlement and/or differential settlement.

Consideration may be given to pad or reinforced strip foundations bearing on ground improved by the installation of vibro displacement stone columns. Ground improved by this method can yield Allowable Bearing capacities of up to 120kN/m^2. The advice of specialist contractors should be obtained as to the suitability of this process in the observed ground conditions and environmental context.

Piled foundations would provide a suitable solution. The preferred solution is for driven piles. However, noise and vibrational effects must be considered in the context of adjoining residential properties. Suitable pile types include top driven thick wall steel tubular piles, top driven pre-cast concrete piles or bottom driven cast in-situ reinforced concrete mini piles.

For the purposes of preliminary design, the carrying capacity of single isolated bottom driven RC mini-piles may be taken by the Client's Engineer as:

Table 9: Notional Pile Capacities

PILE DIAMETER (mm)	CARRYING CAPACITY (kN)
150	140
220	250

Piles should be driven through the made ground soils into the underlying natural clay and onto the bedrock, terminating upon refusal or upon achievement of a set calculated for the Structural Engineer's SWL. The indications of the dynamic probing carried out from the base of BH01 is that piles will terminate at around 8mbgl.

16.4 Excavations

Excavations may be undertaken in the observed soils by light hydraulic excavators. Breaker attachments will be needed to grub out remnant concrete slabs observed at WS2, WS4 & BH01.

16.5 Groundwater Management

Groundwater was found to stand at levels of approx. 1.0 – 1.5mbgl, during the standpipe monitoring programme. Contractors should therefore allow for pumping operations to maintain dry working conditions during excavations, foundation construction and/or service installations, especially during periods of heavy precipitation.

17.0 CONCLUSIONS & RECOMMENDATIONS

The conclusions and recommendations hereunder are based on the salient sections of the report and should not be referred to in isolation of the relevant sections of the text. All recommendations are subject to Regulatory Authority review.

Table 10: Conclusions & Recommendations

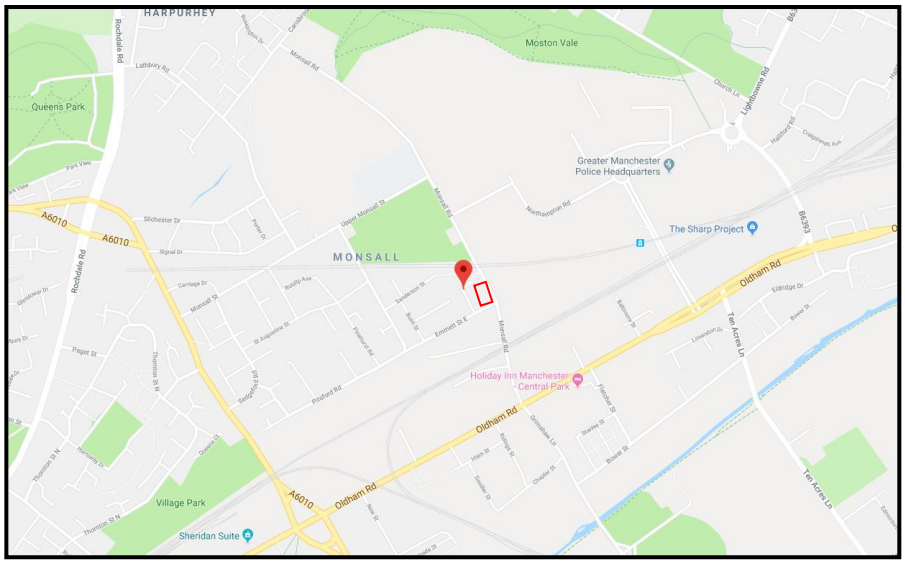
Soil Contamination	Soil concentrations of Benzo(a)pyrene, Benzo(b)fluoranthene and Dibenzo(ah)anthracene are above their respective C4SL / S4UL guideline criteria at WS3 only. However, it is considered that no potential pathway is present to link the contamination source and end users due to the building footprint, hard standing and car parking surrounding WS3. Therefore, no remedial works are required.
Concrete Specification	Concrete in the ground should be specified to conform to the compositional requirements of Design Chemical Class DC-1, as defined in BRE Special Digest 1: 2005. See Section 12.0 for full details.
Water Mains	Concentrations of the EC10 – EC16 aliphatic and aromatic hydrocarbon soil contaminants were found to exceed the respective threshold value recommended under UUW guidance at two locations – WS3 and WS4. On this basis, new water mains must be specified as PE / Al barrier pipe construction e.g. Protecta-Line products. Pipes should be laid in accordance with BS EN 12201-2. Notwithstanding the above preliminary assessment, the developer should contact the local water supplier (UUW) to obtain concurrence with the recommendations given above. The supplier may require the developer to return a completed UUW Risk Assessment document.
Gas Risk	A maximum Gas Screening Value (GSV) of 0.0001 l/hrs is calculated for CO_2. Using this GSV value, the risk to the proposed development was assessed in line with Situation A as defined in CIRIA C665, and on this basis, the site classified as Characteristic Situation 1 (CS1). Gas protection measures are not required for CS1 sites.
Waste Classification	The HazWasteOnline (HWO) output data originally classified 2 of the 3nr samples as 'Hazardous' waste due to the elevated pH level of 11.5. However, it is the opinion of CCG that the high pH level was caused by the crushed concrete gravels observed within the made ground soil samples. It was therefore decided to run a second HWO assessment with pH excluded. Output data from the second assessment classified all 3nr samples as '*Non-Hazardous Waste*'. Notwithstanding this, it should be noted that the final decision on waste classification is at the discretion of the accepting waste disposal facility operator who may wish to inspect stockpiled spoil for concrete gravel content. It is recommended that consultation with facility operators be undertaken by the Principal Contractor during development of the site waste management plan, in advance of groundworks commencing.
Foundations	Piled foundations are recommended in the observed ground conditions. See Section 16.0 for full discussion.
Excavations	Excavations may be undertaken in the observed soils by light hydraulic excavators. Breaker attachments will be needed to grub out remnant concrete slabs observed at WS2, WS4 & BH01.
Groundwater Management	Groundwater was found to stand at levels of approx. 1.0 – 1.5mbgl, during the standpipe monitoring programme. Contractors should therefore allow for pumping operations to maintain dry working conditions during excavations, foundation construction and/or service installations, especially during periods of heavy precipitation.

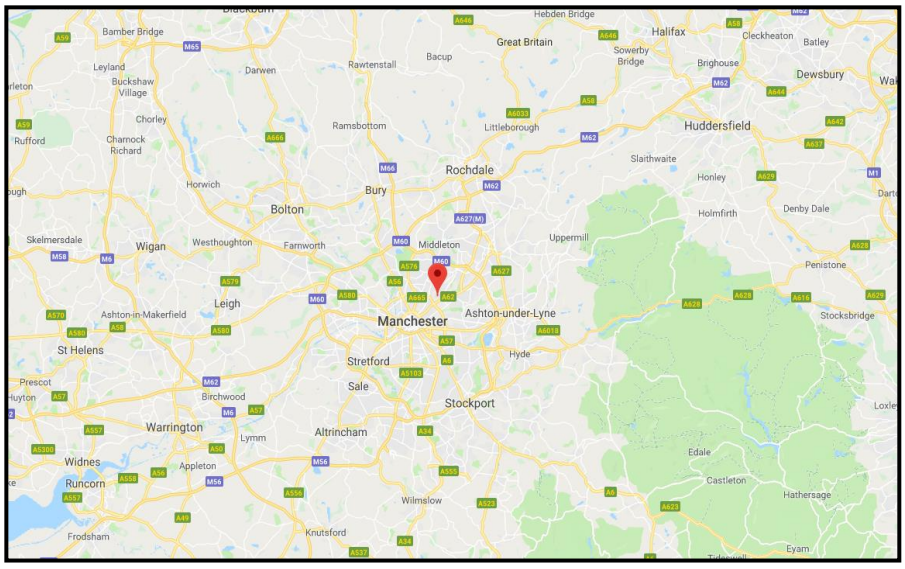
APPENDIX A

DRAWINGS

CC GEOTECHNICAL LTD

N





Drawing Number:	18/10433/1
Site Location:	Monsall Road, Newton Heath, Manchester
Map Information:	Site Location

Mapping reproduced from Google Maps

Copyright - Google 2018

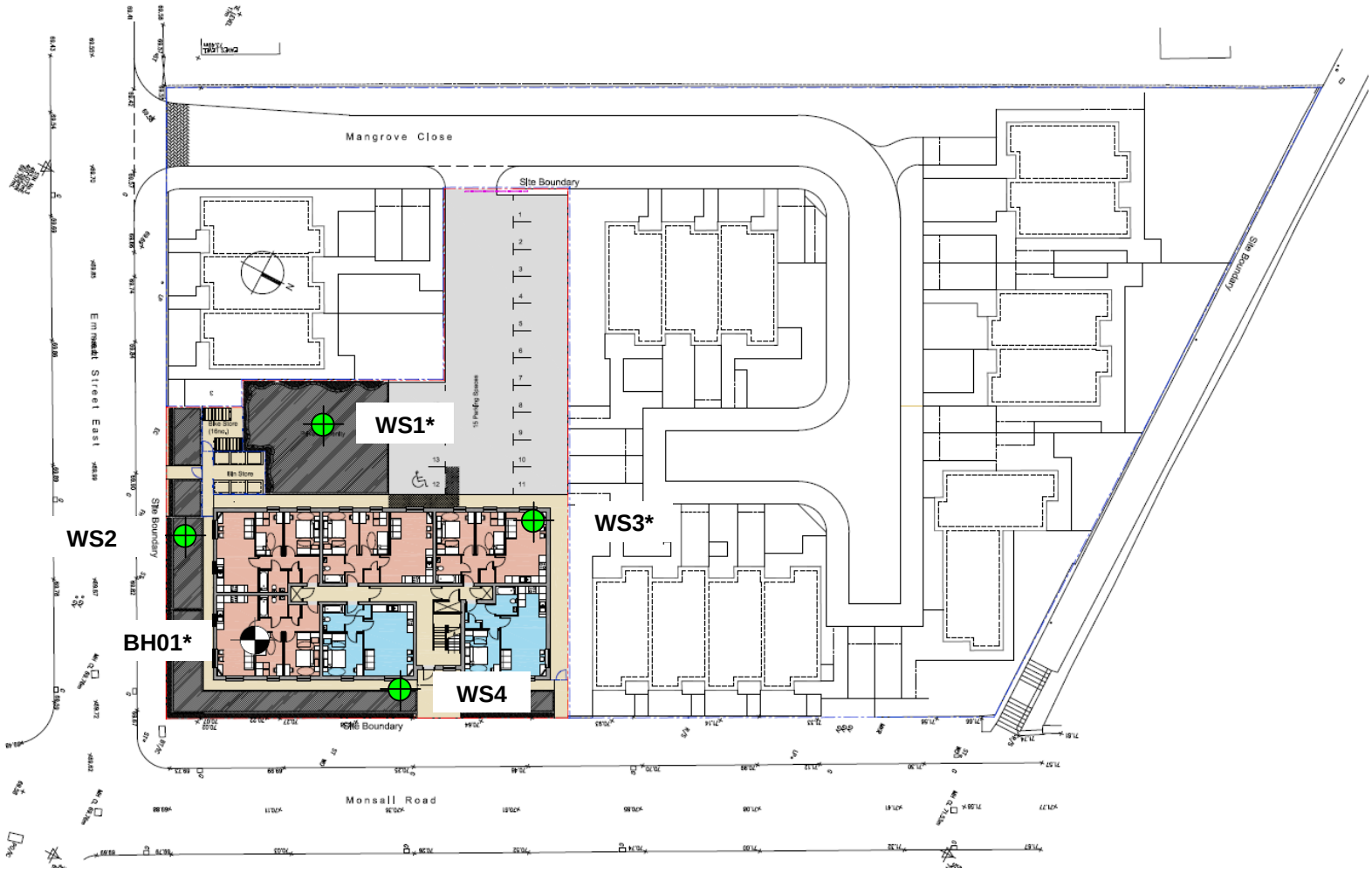
Units 1 & 2 Deltic Place, Deltic Way, Knowsley Industrial Estate. L33 7BU
TEL: 0151 545 2750 FAX: 0151 548 7892

LEGEND:

2012 Borehole

2018 Borehole

Standpipe Installations
Denoted By Asterisk



Consulting Geotechnical and Geoenvironmental Engineers

CC GEOTECHNICAL LTD

Units 1 & 2 Deltic Way
Knowsley Industrial Estate
Liverpool
Merseyside
L33 7BA
e: enquiries@ccgeotechnical.co.uk w: www.ccgeotechnical.co.uk

Drawing Number:	18/10433/2
Site Location:	Monsall Road, Manchester
Map Information:	G.I. Layout on Proposed Development Layout
Scale:	NTS

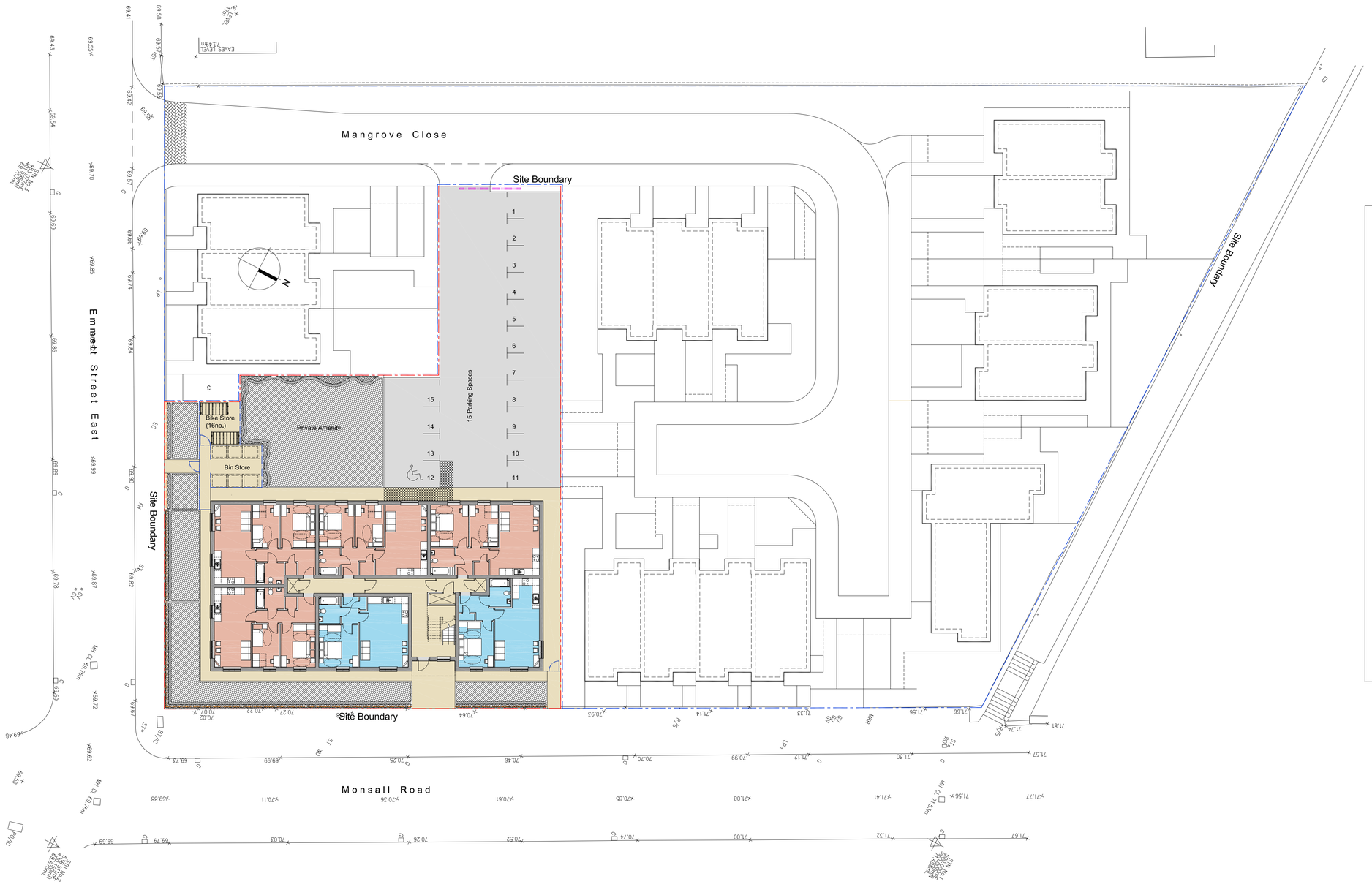
All dimensions are to be checked on site, any discrepancies are to be reported to the Architect before work commences. Do not scale from this drawing.

This drawing is to be read in conjunction with all relevant consultants and specialists drawings / documents, any discrepancies are to be reported to the Architect before the affected work commences.

All structural components shown are indicative only. Details / calculations of structural members are to be provided by the Structural Engineer.

This drawing is copyright.

A	Redrawn	18/12/2017
B	Issued for planning	23/01/2018
C	Amendments as discussed with SCP 28/03/2018	28/03/2018
D	Boundary treatments included	12/04/2018
E	Redrawn	06/06/2018



Key

- Proposed 1,2m high railings with concrete pin upstand
- Proposed 1,8m high close boarded timber fence
- Proposed 2,1m high close boarded timber fence
- Proposed 2,1m high black metal open fence with concrete pin upstand
- Proposed 2,1m high green weldmesh fence
- Proposed timber vehicular gates 1,2m high
- Proposed timber vehicular gates 1,8m high
- Proposed concertina vehicular gates 1,8m high
- Proposed 1.2m high hoop top pedestrian gates
- Proposed 1.8m high timber pedestrian gate
- Proposed 2,1m High timber pedestrian gate
- Proposed Concrete flag paving
- Proposed Black Tarmac surfacing to access road parking court and driveways
- Proposed tumbled concrete sett paving
- Proposed Lawn
- Proposed native shrub planting
- Proposed native Hedge planting
- Proposed rotary drier
- Proposed timber bike store
- Proposed refuse, garden waste, paper and glass bins

0 5 10 15 20(metres)

Grays Architecture Limited

Northwood House (N1)
Greenwood Business Centre,
Manchester, M5 4QH

Tel : 0161 848 7263
e-mail: mail@graysarchitecture.co.uk

Client:
Magrove Estates Ltd / Adactus Housing

Project:
Monsall Road, Newton Heath, Manchester, M40 8WN

Drawing Title:
Proposed Site Plan

Scale: 1:200 @ A1

Date: November 2016

Drawing No: 4209/101

Revision: E

APPENDIX B

NOTES ON LIMITATIONS

Notes on Limitations
For
Geoenvironmental and Geotechnical Consultancy Services

General

This document has been prepared by CC GEOTECHNICAL LTD within the terms of the contract, scope of work, and resources agreed in writing with the client. The limitations of liability of CC GEOTECHNICAL LTD for the contents of this document have been agreed with the Client, as set out in the terms and conditions of offer and related contract documentation.

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The findings and opinions provided in this document are made in good faith and are subject to the limitations imposed by employing site assessment methods and techniques, appropriate to the time of investigation and within the limitations and constraints defined in this document.

The findings and opinions are relevant to the dates when the assessment was undertaken, but should not necessarily be relied upon to represent conditions at a substantially later date. In particular, seasonal groundwater levels, with the effects of precipitation, may affect the conditions found during the investigation. The report should be read in conjunction with the further Notes on Limitations included in Appendix A.

Where opinions expressed in this report are based on current available guidance and legislation, no liability can be accepted by CC GEOTECHNICAL LTD for the effects of any future changes to such guidelines and legislation. Additional information, improved practices, new guidance, changes in legislation, or amendments to design proposals, may necessitate this report having to be reviewed in whole or in part after that date. Opinions and interpretations are not accredited by UKAS.

Factual data contained in this report may have been obtained from enquiries with reputable third parties, the results of which are relied on unless indicated to be inaccurate by contradictory information.

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1. the consequences of this document being used for any purpose or project other than for which it was commissioned

and/or

2. the consequences of use of this document by any party with whom an agreement has not been executed.

Phase I Environmental Audits / Desk Studies

The work undertaken to provide the basis of a Phase 1 Desk Study report comprises a study of available documented information from a variety of sources (including the client), together with (where appropriate) a brief walk over inspection of the site and meetings and discussions with relevant authorities and other interested parties. The opinions given in a Desk Study report have been dictated by finite data on which they are based and are relevant only to the purpose for which the report was commissioned. The information reviewed should not be considered exhaustive and has been accepted in good faith as providing true and representative data pertaining to site conditions. Should additional information become available which may affect the opinions expressed in the report, CC GEOTECHNICAL LTD reserves the right to review such information and to modify the opinions accordingly.

It should be noted that any risks identified in this report are perceived risks based on the information reviewed; actual risks can only be assessed following a physical investigation of the site.

Phase II Environmental Audits

The investigation of the site has been carried out with the intention of providing sufficient information concerning the type and degree of contamination, and ground and groundwater conditions to allow a reasonable risk assessment to be made. The objectives of the investigation have been limited to establishing the risks associated to potential human targets, building materials, the environment (including adjacent land), and surface and groundwater.

The amount of exploratory work and chemical testing undertaken may have been restricted by the timescale available, and the locations of the exploratory holes may have been restricted to areas unoccupied by the building(s) on the site, and further restricted by the existence of buried services. A more comprehensive investigation may be required if the site is to be redeveloped as, in addition to risk assessment, a number of important engineering and environmental issues may need to be resolved.

For those reasons, if costs have been included in relation to site remediation these must be considered as tentative only and must, in any event, be confirmed by a qualified quantity surveyor.

The exploratory holes undertaken, investigate only a small volume of the ground in relation to the size of the site, and can only provide a general indication of site conditions. The number of sampling points and the methods of sampling and testing do not preclude the existence of localised “hotspots” of contamination where concentrations may be significantly higher than those actually encountered.

Geoenvironmental Ground Investigations

The investigation of the site has been carried out to provide sufficient information within the agreed scope of the investigation, under the general headings of type and degree of contamination, geotechnical characteristics, and ground and groundwater conditions, to provide a reasonable assessment of the environmental risks together with engineering and development implications.

If costs have been included in relation to the site remediation, these must be confirmed by a qualified quantity surveyor.

The exploratory holes undertaken, investigate only a small volume of the ground in relation to the size of the site, and can only provide a general indication of the site conditions. The opinions provided and recommendations given in this report are based on the ground conditions apparent at the site of each of the exploratory holes. There may be ground conditions present on the site which have not been disclosed by this investigation, and which have therefore not been taken into account in this report.

The comments made on groundwater conditions are based on observations made at the time that site work was carried out. It should be noted that groundwater levels will vary owing to seasonal, tidal, weather, or other effects.

The risk assessment and opinions provided, inter alia, take into consideration currently available guidance relating to acceptable contamination concentrations; no liability can be accepted for the retrospective effects of any future changes or amendments to these values.

APPENDIX C

RISK ASSESSMENT GUIDANCE & METHODOLOGIES

CURRENT CONTAMINATED LAND LEGISLATION / GUIDANCE & ENVIRONMENTAL RISK ASSESSMENT METHODLOGY

LEGISLATION OVERVIEW

This report includes hazard identification and risk assessment in line with the risk-based methods referred to in relevant UK legislation and guidance. Government environmental policy is based upon a "suitable for use approach". When considering the current use of land, Part IIA of the Environment Protection Act 1990 (EPA 1990) provides the regulatory regime, which was introduced by Section 57 of the Environment Act 1995, which came into force in England on 1 April 2000. The main objective of introducing the Part IIA regime is to provide an improved system for the identification and remediation of land where contamination is causing unacceptable risks to human health or the wider environment given the current use and circumstances of the land.

Part IIA provides a statutory definition of contaminated land under Section 78A(2) as:

"any land which appears to the Local Authority in whose area it is situated to be in such a condition, by reason of substances in, on, or under the land, that:

(a) Significant harm is being caused or there is a significant possibility of such harm being caused;
or
(b) Pollution of controlled waters is being, or is likely to be, caused."

Part IIA provides a statutory definition of the pollution of controlled waters under Section 78A(9) as:

*"the entry into controlled waters of **any** poisonous, noxious or polluting matter or **any** solid waste matter"*.

In order to assist in establishing if there is a "significant possibility of significant harm" there must be a "significant pollutant linkage" for potential harm to exist. That means there must be a source(s) of contamination, sensitive receptors present and a connection or pathway between the two. This combination of source-pathway-receptor is termed a "pollutant linkage or SPR linkage."

Part IIA of The Environmental Protection Act 1990 is supported by a substantial quantity of guidance and other Regulations, especially DEFRA Circular 01/2006 Contaminated Land (this replaces DETR Circular 02/2000). Part IIA defines the duties of Local Authorities in dealing with it. With the exception of situations of very high pollution risk, Part IIA places contaminated land responsibility on thee planning and redevelopment process. In situations where there is very high pollution risk direct action from the Local Authority is usually necessary. Planning Policy Statement 23 (PPS23) provides guidance on the planning process and requires that sites which have been developed shall not be capable of being determined "contaminated land" under Part IIA.

The criteria for assessing levels of pollutants and hence determining whether a site represents a hazard are based on a range of techniques, models and guidance. Within this context it is relevant to note that Government objectives are:

(a) to identify and remove unacceptable risks to human health and the environment;
(b) to seek to bring damaged land back into beneficial use;
(c) to seek to ensure that the cost burdens faced by individuals, companies and society as a whole are proportionate, manageable and economically sustainable.

These three objectives underlie the "suitable for use" approach to remediation of contaminated land. The "suitable for use" approach focuses on the risks caused by land contamination. The approach recognises that the risks presented by any given level of contamination will vary greatly according to the use of the land and a wide range of other factors, such as the underlying geology of the site. Risks therefore should be assessed on a site-by-site basis.

The "suitable for use" approach then consists of three elements:

(a) ensuring that land is suitable for its current use - in other words, identifying any land where contamination is causing unacceptable risks to human health and the environment, assessed on the basis of the current use and circumstances of the land, and returning such land to a condition where such risks no longer arise; the contaminated land regime provides the regulatory mechanisms to achieve this;

(b) ensuring that land is made suitable for any new use, as planning permission is given for that new use - in other words, assessing the potential risks from contamination, on the basis of the proposed future use and circumstances, before official permission is given for the development and, where necessary to avoid unacceptable risks to human health and the environment, remediating the land before the new use commences; this is the role of the town and country planning and building control regimes; and

(c) limiting requirements for remediation to the work necessary to prevent unacceptable risks to human health or the environment in relation to the current use or future use of the land for which planning permission is being sought - in other words, recognising that the risks from contaminated land can be satisfactory assessed only in the context of specific uses of the land (whether current or proposed), and that any attempt to guess what might be needed at some time in the future for other uses is likely to result either in premature work (thereby running the risk of distorting social, economic and environmental priorities) or in unnecessary work (thereby wasting resources).

The mere presence of pollutants does not therefore necessarily warrant action, and consideration must be given to the scale of risk involved for the current and proposed end use of the site.

RISK ASSESSMENT METHODOLOGY

Current practice recommends that the determination of potential liabilities that could arise from land contamination be carried out using the process of risk assessment, whereby "risk" is defined as:

"(a) The probability, or frequency, or occurrence of a defined hazard; and
(b) The magnitude (including the seriousness) of the consequences."

The UK's approach to the assessment of environmental risk is set out in by the Department of the Environment (2000) publication "A Guide to Risk Assessment and Risk Management for Environmental Protection." This established an iterative, systematic staged process which comprises:

(a) Hazard identification
(b) Hazard assessment
(c) Risk estimation
(d) Risk evaluation
(e) Risk Assessment

At each stage during the investigation process the above steps are repeated as more detailed information becomes available for the site.

CLR11- 'Model Procedures for the Management of Land Contamination', a document published by the Department for Environment, Food and Rural Affairs (DEFRA) and the Environment Agency (EA) outlines a tiered approach to the assessment of risks posed by contaminated land, as summarised hereunder:

Tier 1: Preliminary Risk Assessment

A Preliminary Risk Assessment is usually undertaken as part of a desk study, outlines potential risks posed by potential contamination to all receptors by defining plausible "pollution linkages" and developing a preliminary conceptual model (PCM). The purpose of this model is to define all possible complete pollution linkages, where the requisite source – pathway – target elements are present, and these elements being defined as:

- a contaminant (source) is a hazardous substance or agent, present at levels that have the potential to cause harm or damage a receptor
- a pathway is the means by or through which a contaminant comes into contact with, or otherwise affects, the receptor
- a receptor (target) is an entity (human being, aquatic environment, flora and fauna etc) that is vulnerable to the adverse effects of the contaminant

This relationship is termed a "pollution linkage". It should be recognised that for a health or environmental risk to exist, all three elements of the relationship or linkage must be present, i.e.

- if there is no contaminant, or contaminant present at levels below those considered to be harmful or damaging to a receptor, then there can be no adverse effect on a receptor
- if there is no receptor present that can be adversely affected by a contaminant, no harm or damage can arise
- even where both a contaminant and a receptor are present, no harm or damage will occur if there is no pathway by or through which a linkage between the two can be established

The absence of one or more of each component (source, pathway, receptor) would prevent a pollutant linkage being established and there would be no significant environmental risk.

The PCM is subject to continual refinement as additional data becomes available. As part of a Phase I Investigation (Desk Study and site walk over) a PCM is formed. Based on the PCM, potential pollutant linkages can be assessed. If the PCM and hazard assessment indicate that a pollution linkage is not of significance then no further assessment or action is required due to this linkage. For each significant and possible linkage a risk assessment is carried out. The linkages which potentially pose significant risks may require a variety of responses ranging from immediate remedial action or risk management or, more commonly, further investigation and risk assessment. This next stage is usually termed a Phase II Main Site Investigation and should provide additional data to allow refinement of the PCM and assess the level of risk from each pollutant linkage. Risk assessment will usually include Tier 2 Generic Quantitative Risk Assessment and / or, if necessary, a Tier 3 Detailed Quantitative Risk Assessment.

Tier 2: Generic Quantitative Risk Assessment (GQRA)

GQRA requires an intrusive investigation in order to characterise the site assisting in the re-assessment of the source-pathway receptor linkage. The conceptual model should be refined accordingly.

Upon completion of an intrusive investigation a it must be decided whether Generic Assessment Criteria (GAC) are suitable for assessing the risk posed by potential contaminantion at the site. If GAC are deemed unacceptable for risk assessment purposes or cannot be developed a Tier 3 Detailed Quantitative Risk Assessment (DQRA) is required.

If GQRA reveals that unnacceptable risks are not present then no further action is required. If GQRA identifies a possibility of risk, a decision must be made whether further work is required or necessary for the purposes of risk assessment. If further risk assessment is is deemed not suitable not required an Options Appraisal should be undertaken. If further risk assessment is required, the scope nature of further risk assessment must be decided – it is possible that a Tier 3 DQRA will be undertaken in this scenario.

Where the Environment Agency have published an SGV for a contaminant, this will be used in lieu, if the SGV is suitable for the subject site, of the GAC derived by ***CC GEOTECHNICAL LTD.*** For contaminants where an SGV has not been published

and a GAC has been published by LQM, then this GAC will be used. In house derived GAC's will only be used for contaminants where there is no SGV or LQM GAC.

Tier 3: Detailed Quantitative Risk Assessment (DQRA)
DQRA is used when pollutant linkages require further assessment. DQRA is often undertaken for pollutant linkages where GAC are unavailable or inappropriate for or more conservative than the actual circumstances of the site. Site specific data is used to create Site Specific Assessment Criteria (SSAC) and enable a more accurate assessment of the risks. Further investigation may or may not be required to formulate SSAC depending on the site specific conditions and information alrerady obtained.

If DQRA reveals that unnacceptable risks are not present then no further action is required. If DQRA identifies a possibility of risk, a decision must be made whether further work is required or necessary for the purposes of risk assessment. If further risk assessment is is deemed not suitable not required an Options Appraisal should be undertaken. If further risk assessment is required, the scope and nature of further risk assessment must be decided at this point.

NOTE: A Tier 1 Preliminary Risk Assessment is undertaken as part of a Desk Study Report and a Preliminary Conceptual Model is devloped for all pollutant linkages. However, the methodologies for assessing the risks to human health, risks to controlled waters and risk posed by ground gas using quantative techniques vary considerably, therefore GQRA and DQRA for human health, controlled waters and ground gas must be undertaken seperately. The risk assessment methodologies where quantative assessment is used for risks to human health, risks to controlled waters and risks posed by ground gas, if relevant, are described hereunder.

BACKGROUND INFROMATION, CURRENT GUIDANCE AND RISK ASSESSMENT METHODOLOGY FOR RISKS POSED TO HUMAN HEALTH

Background
In March 2002, the Department for Environment, Food and Rural Affairs (DEFRA) and the EA published the Contaminated Land Exposure Assessment (CLEA) Model and a series of related reports. These were designed to provide a scientifically based framework for the assessment of chronic risks to human health from contaminated land. These reports (CLR7-10) together with associated "SGV" documents have since been withdrawn (August 2008) and the following documents have been published as revised guidance to the CLEA assessment:

- Environment Agency : 2008: Updated Technical Background to the CLEA model Science Report SC050021/SR3
- Environment Agency : 2008: Human Health Toxicological Assessment of Contaminants in Soil SC050021/SR2

Additional guidance on statistical assessment replacing CLR 7 is provided in:

- CL:AIRE :2008 Guidance on Comparing Data With a Critical Concentration

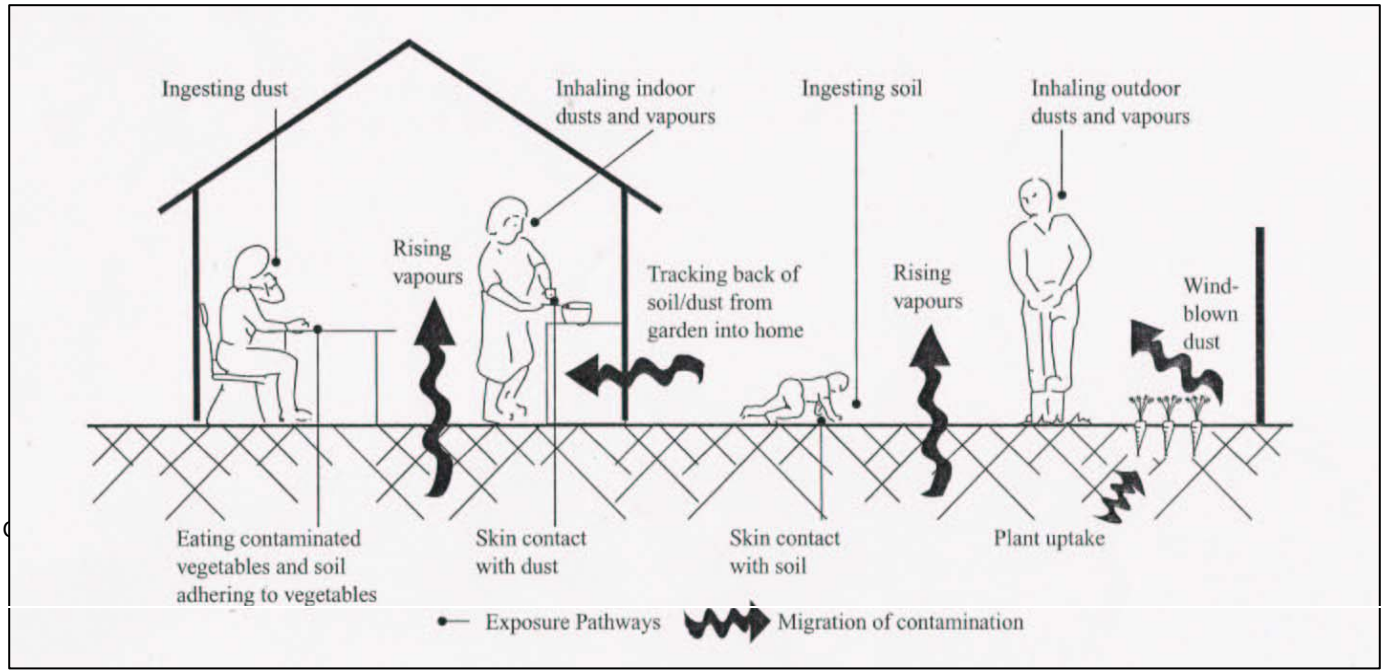
Other guidance/software used in spatial / statistical assessment is provided in:

- USEPA 2006: Data Quality Assessment: Statistical Methods for Practitioners
- Spatial Analysis and Decision Assistance (SADA) – The University of Tennessee

A different approach to the statistical appraisal of data is required depending on whether the assessment of risk is to assess whether land is Contaminated Land in accordance with regulations, or whether the assessment is to determine whether the site is suitable for new development in according with Planning guidance. This is discussed further in CL:AIRE :2008 "Guidance on Comparing Data With a Critical Concentration".

A program for the derivation of GAC`s based on the above guidance is provided by the Environment Agency and is entitled "CLEA Software Version 1.06".

The CLEA model has been developed to calculate an estimated tolerable daily soil intake (TDSI) for site users given a set 'default' exposure pathways. Ten human exposure pathways are covered in the CLEA model as presented below:



Ingestion
- ingestion of outdoor soil
- ingestion of indoor dust
- ingestion of home grown produce
- ingestion of soil attached to home grown produce

Dermal Contact
- dermal contact with outdoor soil
- dermal contact with indoor dust

Inhalation
- inhalation of outdoor dust
- inhalation of indoor dust
- inhalation of outdoor soil vapour
- inhalation of indoor soil vapour

It should be noted that there are other potential exposure pathways on some sites not included in the CLEA model e.g. certain organic compounds can pass through plastic water pipes into drinking water supply.

Where contaminated water is present at a depth less than 2.00mbgl and there is a potential risk of inhalation of vapours (only when volatile compounds are present) the risk from inhalation of vapours from soil water will be assessed using a UK compliant version of BP Risc v4.02.

The presence and/or significance of each of the above exposure pathways are dependent on the type of land use being considered and the nature of the contaminant under scrutiny. Accordingly, the CLEA model considers for principle 'default' land use types and makes a series of 'default' assumptions with regard to human exposure frequency, duration and critical human target groups for each land use considered:

- residential
- allotments
- commercial / industrial land use

The above land use categories defined in the CLEA are detailed below:

Residential: This generic scenario assumes a typical residential property consisting of a two-storey house built on a ground-bearing slab with a private garden consisting of lawn, flowerbeds, and a small fruit and vegetable patch. The occupants are assumed to be parents with young children, who make regular use of the garden area.

Allotments: This generic scenario assumes a plot of open space (about 250 m2), commonly made available by the local authority to tenants to grow fruit and vegetables for their own consumption. There are usually several plots to a site and the overall site area may cover more than a hectare. The tenants are assumed to be parents or grandparents and that young children make occasional accompanied visits to the plot.

Commercial / Industrial: There are many different kinds of workplace and work-related activities. This generic scenario assumes a typical commercial or light industrial property consisting of a threestorey building at which employees spend most time indoors and are involved in officebased or relatively light physical work.

Human Health Risk Assessment Methodolgy
Assessment of risk for the protection of human health is undertaken using the methodology as outlined previously, and summarised hereunder:

- Tier 1 Preliminary Risk Assessmnent
- Tier 2 Generic Quantitative Risk Assessment
- Tier 3 Detailed Quantitative Risk Assessment

The Tier 1 Preliminary Risk Assessment is undertaken as part of the desk study report and includes the development of a Preliminary Conceptuel Model. Tier 2 and Tier 3 Quantitative Risk Assessments are undertaken in order to develop and refine the Preliminary Conceptual Model aiding a more detailed assessment of the risk posed by contaminants revelaed by site investigation and soil / soil water chemical analyses.

The methods used by ***CC GEOTECHNICAL LTD*** to derive assessment criteria, to statistically analyse chemical data and to compare chemical data to the derived assessment criteria are discussed herunder.

Derivation of Generic Assessment Criteria (GAC) and Site Specific Assessment Criteria (SSAC)
GAC`s are derived on the basis of the proposed land use and the associated applicable exposure pathways. It should be noted that there are difficulties in establishing soil concentrations of contaminants beyond which risks from exposure to these contaminants would be 'unacceptable' and the GAC value does not necessarily equate to the level for "significant possibility of significant harm" as defined in Part IIA of The Environmental Protection Act (1990) to determine whether land is "contaminated." This ultimately requires detailed 'toxicological' information of the health effects of individual contaminants and also a scientific judgement on what constitutes an 'unacceptable' risk. The primary purpose of the CLEA derived GAC's are as 'minimal risk thresholds' for the assessment of human health risks in relation to land use.

Minimal risk thresholds calculated using generic input parameters for each of the above land uses are termed Generic Assessment Criteria (GAC) and are used for Generic Quanatative Risk Assessment (GQRA). However, further assessment may be required taking into consideration site specific factors such as the way the land is used, the soil type, the building

characteristics and the exact nature of the receptor, to determine whether there is a significant possibility of risk to human health to site users. Such an assessment is known as a Detailed Quantitative Risk Assessment (DQRA) and the resultant threshold concentrations are known as Site Specific Assessment Criteria (SSAC). Such assessments should be conducted with the agreement of the local authority (or the Environment Agency) since it is the authority that determines whether land is Contaminated Land or whether Planning Permission for a new development may be granted.

For the purposes of this report, assessment criteria have been derived in accordance with current guidance based on the conceptual model for the proposed land use using the CLEA v1.06 software. These criteria are not intended to indicate whether the site may be contaminated land nor do they replace any published soil guideline values. However, the values are intended to provide guidance for the local authority on whether the site may be considered uncontaminated. If, based on the site's proposed future use, the site would be considered by the local authority to be uncontaminated and therefore, on the basis of soil concentrations, fit for purpose, then no further risk assessment based on soil concentrations and the risk to human health would be necessary. However, should these criteria be exceeded or the conceptual site model vary from the model used in the risk assessment to derive these values then the risk assessment should be updated accordingly.

For contaminants routinely analysed where inhalation is a significant pathway (naphthalene, phenanthrene, Aromatic EC5-EC7, Aromatic EC7-EC8, Aromatic EC8-EC10, Aromatci EC10-EC12, Aromatic EC12-EC16, Aliphatic EC5-EC6, Aliphatic EC8_EC10, Aliphatic EC10-EC12, Aliphatic EC12-EC16), plots of the GAC as a function of Soil Organic Matter (SOM) are used to determine if they pose a potential risk to human health, which are presented hereunder. Where there is an exceedance further assessment may be undertaken.

Statistical Assessment of Soil Contamination Data & Comparison of Contamination Data to Threshold Values

In any site investigation only a small fraction of the soil on the site is analysed. Therefore the mean derived from the contamination data for a contaminant may not be the same as the true mean for the contaminant distribution on the site. To improve the reliability of any assessment a statistical analyses is undertaken in line with the CL:AIRE document "Guidance on Comparing Soil Contamination Data with a Critical Concentration".

Statistical assessment of soil data is undertaken using programs based on the guidance in the CL:AIRE document or the USEPA software ProUCL v4.0.

Where the number of results in a dataset is less than four, a statistical assessment is not undertaken, and the assessment is performed by comparison of the maximum value(s) with a Health Criteria Value (HCV), such as Generic Assessement Criteria value(s).

For the Planning situation, the regulator needs to check whether the concentration of contaminants is low compared to the HCV. This decision is based on whether there is at least a 95% confidence level that the true mean of the dataset is lower than the HCV.

For the Part IIA scenario the regulator needs to determine whether the concentration of contaminants is greater than the HCV. This decision is based on whether there is at least a 95% confidence level that the true mean of the dataset is higher than the HCV. However, the regulator may proceed with determination if there is just a 51% probability, "on the balance of probabilities".

The Outlier Test used in the statistical assessment may not be able identify separate populations if numerous populations are present. Inorder to ensure that this is not the case a spatial assessment of the data will be undertaken using SADA.

If the screening levels are exceeded then more sophisticated quantitative risk assessment or remedial action may be undertaken. The benefits of undertaking a quantitative risk assessment must be weighed against the likelihood that it will bring about cost savings in the proposed remediation.

BACKGROUND INFORMATION, CURRENT GUIDANCE AND RISK ASSESSMENT METHODOLOGY FOR RISKS POSED TO CONTROLLED WATER

Definition of Controlled Waters

The term 'controlled waters' is defined in Section 104 of the Water Resources Act 1991 as:

"Territorial Waters…which extend seawards for three miles…, coastal waters…, inland freshwaters, waters in any relevant lake or pond or of so much of any relevant river or watercourse as is above the freshwater limit, and ground waters, that is to say, any waters contained in underground strata."

Note that the definition of groundwater under the Water Resources Act 1991 includes all water within underground strata (including soil / pore water in the unsaturated zone). The definition of groundwater under the Groundwater Directive however is limited to water in the saturated zone. For the purposes of Part IIA of the Environmental Protection Act 1990, the Environment Agency recommends that the groundwater within the saturated zone only is considered as the receptor (rather than soil / pore water).

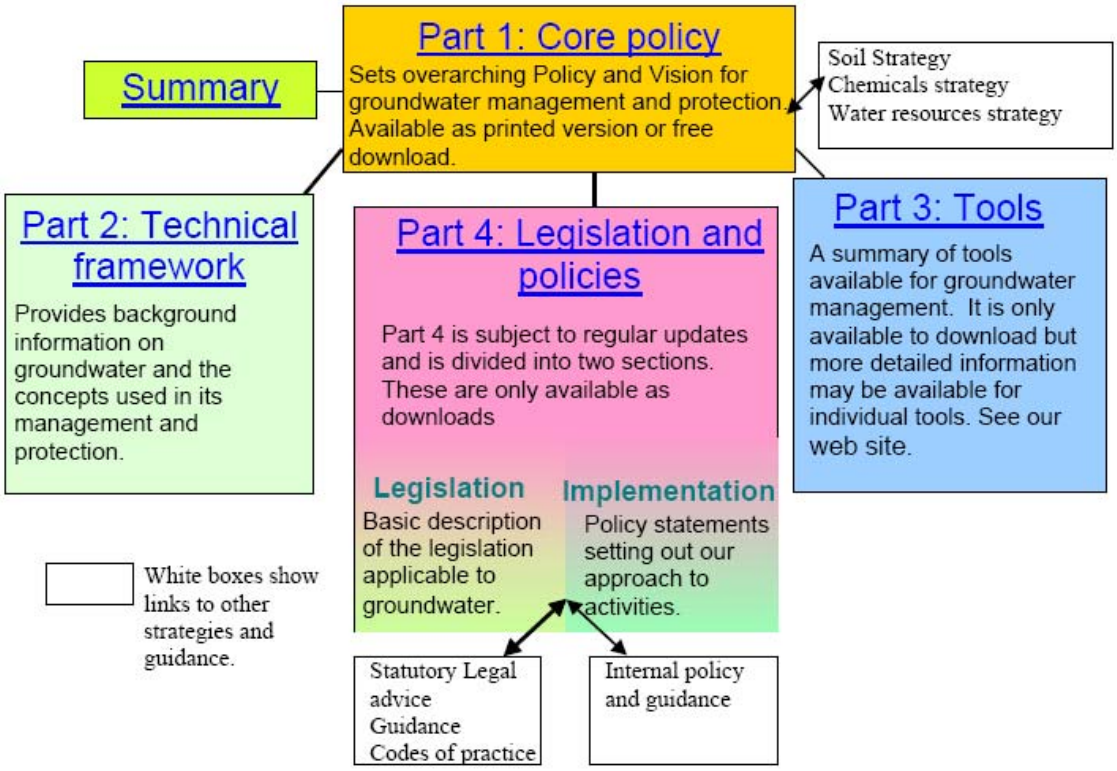
Environment Agency Guidance

Legislation and guidance surrounding the protection of controlled waters in the UK is abundant and can be complex. The Environment Agency's overall position on groundwater is *"To protect and manage groundwater resources for present and future generation in ways that are appropriate for the risks that we identify"* (Groundwater Protection : Policy and Practice GP3, 2006). In brief, the core objectives of the existing legislation serve to enforce this position.

In 1992, the National Rivers Authority published their Policy and Practice for the Protection of Groundwater (PPPG), this document was influential as it provided a focus for key developments such as Source Protection Zones (SPZs) and

Groundwater Vulnerability Maps. The Policy was then revised in 1998, since which there have been substantial changes in legislation, driven by Europe. Key European Directives relating to groundwater include the Groundwater Directive (80/68/EEC) and the Water Framework Directive (2000/60/EC). Aspects of these directives are controlled by primary UK legislation such as the Water Resources Act 1991. Further to legislative changes, gaps identified in the 1998 PPPG required addressing. These changes are reflected in the forthcoming Environment Agency Policy document entitled *Groundwater Protection : Policy and Practice (GP3)*, a draft version of which was available for public consultation (Parts 1 to 3) ending July 2006 with Part 4 issued in March 2008. Part 4 includes a section on key groundwater legislation and the Environment Agency's interpretation of it.

The following gives a breakdown of the structure of the document (taken from the Environment Agency GP3 draft consultation document, 2006)



Controlled Water Risk Assessment Methodology

The risk posed to controlled water is assessed by ***CC GEOTECHNICAL*** in accordance with current guidance as outlined hereunder.

In order for a developer of a potentially contaminated site to fulfil their obligations under the legislation, a site assessment would be required to be undertaken in order to identify any potential risks to controlled waters and to derive suitable clean-up criteria if necessary to ensure the protection of controlled waters. The general approach for Groundwater Protection is detailed further in Part 3 of GP3.

When assessing groundwater impact the Environment Agency advocate the application of their framework methodology "Remedial Targets Methodology – Hydrogeological Risk Assessment for Land Contamination" Environment Agency (2006). The methodology has four levels of assessment as described below:

- **Level 1** considers whether contaminant concentrations in "pore water" in contaminated soil are sufficient to impact on the receptor, ignoring dilution, dispersion and attenuation along the pathway. The "pore water" concentration is determined from:

  i) measured "pore water" concentrations or perched water quality
  ii) soil leaching tests
  iii) theoretical calculations based on soil/water partitioning equations

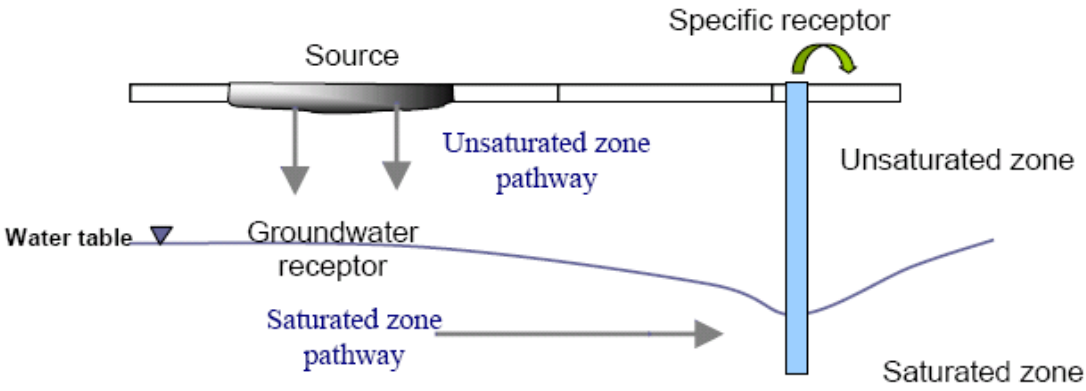
- **Level 2** considers dilution by the receiving groundwater or surface water body and whether this is sufficient to reduce contaminant concentrations to acceptable levels. The remedial target is defined as the target concentration multiplied by a dilution factor (DF).

- **Levels 3 and 4** consider whether natural attenuation (including dispersion, retardation and degradation) of the contaminant as it moves through the unsaturated and saturated zones to the receptor are sufficient to reduce contaminant concentrations to acceptable levels. The remedial target is defined as target concentration multiplied by a dilution factor (DF) and attenuation factor (AF). In **Level 3** simple analytical models are used to calculate the significance of attenuation. The Environment Agency has released a "Remedial targets worksheet v3.1" to carry out basic calculations using a conservative approach up to **Level 3** using basic principles assuming a simple migration of contaminants from the

source zone into the aquifer receptor. **Level 4** assessment uses more sophisticated numerical models, and allows for the introduction of additional geological horizons and is used mainly to determine whether soil contaminants will reach their target within a specified timeframe. Use of such software should only be used once agreement has been obtained from the Environment Agency.

Three main stages apply to any risk assessment of controlled waters, these are:

1. **Risk Screening (Tier 1 Preliminary Risk Assessment):** The understanding of the Conceptual Site Model (CSM) is the key to assessing any site. Using a robust CSM, potential pathways or receptors may be screened out from any further assessment at an early stage. For example if the pathway through the unsaturated zone is blocked by the presence of a significant thickness of low permeability clay. A greater understanding of the CSM is achieved with each tier of risk assessment. An example of a basic CSM is given below (taken from the Environment Agency GP3 draft consultation document, 2006):



2. **Generic Hydrogeological Risk Assessment (EA Remedial Targets Methodology Level 1):** When undertaking the Generic Hydrogeological Risk Assessment (EA Remedial Targets Methodology Tier 1), comparison of chemical analytical results is made with screening criteria. Published values of screening criteria with which chemical test results can be compared are published in the following guidance:

   - Water Supply (Water Quality) Regulations 2000
   - The Private Water Supplies Regulations 1991
   - Environmental Quality Standards for surface waters based on The EC Dangerous Substnaces Directive (76/464/EEC and Daughter Directives)
   - The Surface Waters(Abstraction for Drinking Water Classification) Reguslations 1996
   - World Health Organisation Drinking Water Standards 2004

   Should the Level 1 assessment indicate threshold levels to be exceeded, then there are three alternative ways in which to proceed:

   - To devise suitable remedial solutions
   - To carry out more investigation, sampling and analysis
   - To conduct a site specific Detailed Quantitative Risk Assessment (DQRA) to determine determine if the materials are suitable for thair proposed use, or devise site specific clean-up level

3. **Detailed Quantitative Risk Assessment (EA Remedial Targets Methodology Levels 2 to 4):** The decision to carry out a DQRA will be dependant on the extent and implications of the initial qualitative and generic assessment. The scope of any such assessment will be accurately defined by the outcomes of the previous levels of assessment. The conceptual model will be sufficiently refined by this stage that only certain contaminants of concern, certain pathways and certain receptors will require further assessment, the remainder having been screened out.

   Additional site specific data is normally required for this stage of assessment, as explained above, more processes that are capable of affecting contaminant concentrations are considered (such as dilution and attenuation).

   Remediation criteria, if derived, will therefore be specific to each site and will be based on a detailed assessment of the potential impact at the identified receptor or *compliance point*. A greater level of confidence can be placed on the predicted impact on the compliance point following a DQRA.

BACKGROUND INFORMATION, CURRENT GUIDANCE AND RISK ASSESSMENT METHODOLOGY FOR RISKS POSED BY GROUND GAS

Background

Origin of Ground and Landfill Gases

When carrying out a ground gas risk assessment, the origin or source of the gases is important as potential risks will vary depending on the source. This Appendix relates to the risk of the two main ground gases of concern; methane and carbon dioxide, and does not apply to other ground gases (e.g. radon or vapours from hydrocarbon spills). Methane and carbon dioxide are major constituents of landfill gas but can also occur from a variety of anthropogenic and natural sources, as summarised in Table 5 below:

Gas	Source	Comments
Landfill Gas	Anaerobic decomposition of degradable waste within landfill sites. Typically 60% methane and 40% carbon dioxide during methanogenic phase.	Composition varies over time, particularly in early stages. Contains a range of minor constituents (particularly carbon monoxide and hydrogen sulphide).
Landfill Associated Gases	- Anaerobic degradation of leachate external to the site; - Degassing of dissolved gases in groundwater; - Evolution of gases following interaction between leachate and groundwater	Can result in secondary (external) production of methane or carbon dioxide.
Made Ground	Anaerobic degradation of organic components	Very variable depending on source
Sewer Gas, Cess Pits	Anaerobic degradation of organic components of sewage producing methane and carbon dioxide.	Often characterised by hydrogen sulphide odour.
Mains Gas	Leakage from underground pipework or storage tanks. Mainly methane but often contains higher alkanes.	An odouriser is added to permit detection of leaks. Typically 90% CH_4, but 1 to 27% C_2-C_4 alkanes, May also contain other trace gases e.g. CO, helium and CO_2 (from degradation of CH_4 in the ground).
Other Anthropogenic Sources	- Degradation of leaked or spilled hydrocarbons or other industrial chemicals; - Anaerobic degradation of organic contaminants in groundwaters (e.g. silage liquor); - Reactions between monitoring well construction components and environment; - Burial grounds/cemeteries.	Hydrocarbon spillages often have an 'oily' odour. Fuel spillages common – Petrol or Diesel and can contain a wide range of VOC's. Can degrade to produce methane / carbon dioxide.
Alluvium / Marsh / Peat Gas	Anaerobic microbial degradation of organic material (usually waterlogged vegetation / peat). Often associated with the presence of alluvial deposits or dredgings.	
Geogenic Gas	Natural seepages of carbon dioxide and hydrocarbon gases derived from geologic sources such as coal seams and deep oil / gas source formations. Can be present in solution in groundwaters.	Methane most common but can contain carbon dioxide and higher alkanes.
Mine Gases	Various types. Most common is "fire damp" with high methane, produced by the desorption of gas trapped in coal. "Black damp" (Stythe gas) with high carbon dioxide and denser than air. "White damp" is high in carbon monoxide.	Methane most common. Can contain higher alkanes, carbon dioxide and carbon monoxide. Often low in oxygen.
Natural Shallow Ground Gas	Various types - high carbon dioxide formed by subsurface aerobic activity leading to depleted oxygen and elevated carbon dioxide; - chemical degradation of rocks (e.g. carbonates) producing carbon dioxide; - carbon dioxide production in root zone of soils by plants.	Gases can be emitted from ground under falling barometric pressure conditions.

Table 5. Potential Sources of Ground Gases

This Appendix does not provide guidance for the assessment of risk when other gases are present due to 'Other Sources' from the above table (particularly organic compounds such as BTEX and VOC's or for the risk from radon or hydrogen sulphide).

To determine the origin of the gas a range of factors must be considered together, including;

1. Proximity of likely sources
2. Ground conditions (geology, hydrogeology, anthropogenic pathways etc)
3. Properties of gases present including:
   - Chemical composition
   - Physical properties
   - Ratios of components e.g. methane : carbon dioxide
4. Timeframe of activities such as infilling periods, capping works, installation of gas control systems etc

Identification of the originating source may be problematic given that there may be more than one source present and trace gas analysis may be required. Identification of the sources of the gases encountered during monitoring is usually carried out through a process of eliminating the most unlikely potential sources (given the site setting) and selecting those which are most likely.

Hazards Associated with Presence of Methane

Methane gas is combustible and potentially explosive. When the concentration of methane in air is between the limits of 5.0%v/v and 15.0%v/v an explosive mixture is formed. The Lower Explosive Limit (LEL) of methane is 5.0%v/v, which is equivalent to 100% LEL. The 15.0%v/v limit is known as the Upper Explosive Limit (UEL), but concentrations above this level cannot be assumed to represent safe concentrations. Further, the LEL and UEL will vary (up and down) depending upon the proportion of other gases (including oxygen). However, the fact that methane is a colourless, odourless gas means that there

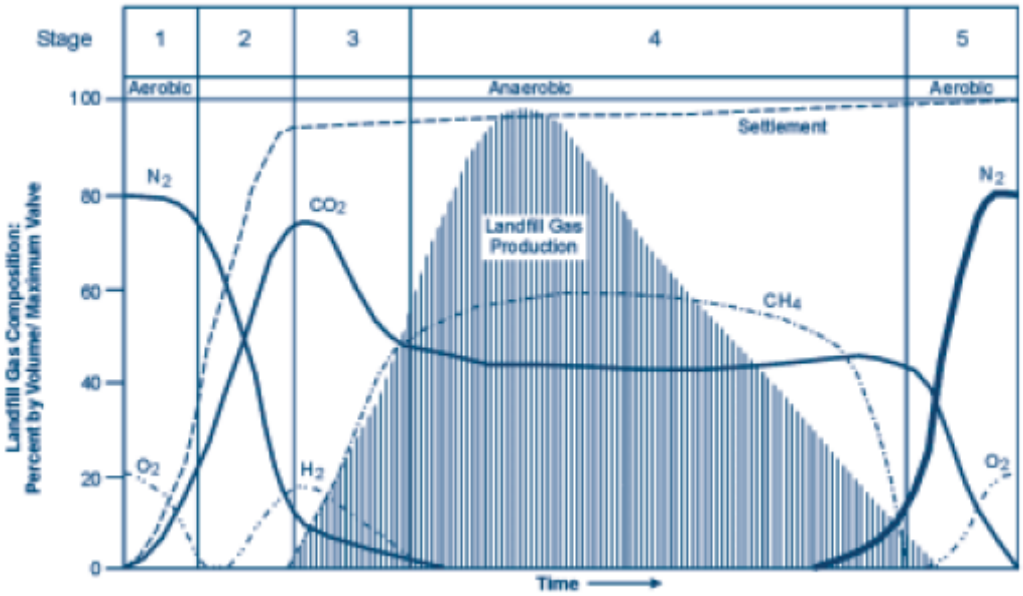
is no simple indicator of the presence of the gas until such a time as explosive limits are reached and an incident occurs. Methane is lighter than air and has a low toxicity. However, at high concentrations it can result in asphyxiation due to oxygen displacement.

Hazards Associated with Presence of Carbon Dioxide

Carbon dioxide is a colourless, odourless gas, which, although non-flammable, is both toxic and an asphyxiant. As carbon dioxide is denser than air, it will collect in low points and depressions. The UK Health & Safety Executive (HSE) has published information relating to concentrations of carbon dioxide that humans may be exposed to, which uses concentrations contained in the Control of Substances Hazardous to Health Regulations 2002 (as amended). These are the Long Term Occupational Exposure Limit (LTOEL, 8 hour period) and the Short Term Occupational Exposure Limit (STOEL, 15 minute period), which are 0.5% and 1.5% carbon dioxide, respectively.

Parameters Influencing the Rate of Ground Gas Production

The figure below is taken from EA guidance document LFTGN 03 illustrates typical ground gas generation curves from biodegradable materials:



The production of methane and carbon dioxide at a landfill site may be expected to be considerable and ongoing. Concentrations of methane will eventually decrease, followed by concentrations of carbon dioxide, but the duration and rate of gas production can vary markedly between sites. Five distinct phases of gas production occur during the process which are, in order of event as marked above, as follows:

1. An aerobic phase involving oxygen depletion and temperature increase through aerobic respiration;
2. The establishment of anaerobic conditions and the evolution of carbon dioxide and hydrogen through acidogenic activity;
3. Commencement of methanogenic activity; the establishment of populations of methanogenic bacteria;
4. A phase of stable methanogenic activity, which may go on for many tens of years;
5. A phase of decreasing methanogenic activity, representing depletion of the organic material and a return to aerobic conditions.

The time scale for the return to the normal ground gas concentrations will be highly variable, depending upon the types and quantities of materials present. In addition, the optimum parameters influencing the rate of decomposition and ground gas production within the ground at a site are as follows:

- High water content with adequate rainfall and water infiltration to provide moisture content between approximately 20 to 26%;
- Conditions that either are or are very close to anaerobic;
- High proportion of biodegradable materials;
- A pH between 6.5 and 8.5, ideally verging slightly on the acidic between pH 6 to 7;
- Temperature between 25°C and 55°C;
- The ratio of the biochemical and chemical oxygen demands (BOD:COD);
- High permeability;
- Small particle size, as finer subsurface materials possess a greater surface area to provide a growing 'face' for the micro-organisms but high fines levels reduces permeability and reduces decomposition rate.

For this reason, it is vital that sources of methane and carbon dioxide are identified prior to the commencement of any work on a construction site, and that the ground gas regime is characterised at the worst temporal conditions a site may experience. From this, a risk assessment is carried out to identify the risk at the site from ground gases so that suitable protection measures can be designed and incorporated into a development to prevent a dangerous build-up of gas occurring.

Factors Influencing the Migration and Behaviour of Ground Gases

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There are many factors that influence the migration of ground gases which can effect the risk from a gassing source:

- driving force – pressure differential along a pathway, diffusion and dissolved in solution;
- meteorological conditions – short term and seasonal conditions including atmospheric pressure changes (e.g. rapidly falling pressure causes gas to expand increasing emission rates), rainfall, frozen ground and thawing, temperature;
- geological and groundwater conditions – these can have the over riding influence on the direction/pathways and quantity of migrating gas;
- anthropogenic influences – man-made pathways include mine shafts, service runs/drains, foundation piles, underground voids/pits/basements, foundation/building design/construction

Current Guidance
Previous versions of Building Regulations Approved Document C provided statutory guidance stating that consideration should be given to appropriate action and / or specific solutions in situations where methane concentration exceeded 1%v/v or carbon dioxide concentrations exceeded 5%v/v. The latest Building Regulations Approved Document C (DoE 2004) no longer endorses this approach and recommends the use of a risk based approach to interpreting a gas monitoring survey. This is in line with current EA guidance for landfill gas (LFTGN 03, 2004) which recommends the use of a structured risk based approach similar to that outlined in CLR 11. On this basis, recent guidance has been produced in 2006 and 2007 with the aim of providing up to date advice in relation to residential and commercial development. The guidance does not address issues associated with gas derived from landfills, for this refer to *"Guidance on the Management of Landfill Gas"* (Environment Agency 2004) for an overview.

Recent guidance relevant to gas assessments for residential and commercial development includes;

- **Wilson *et al.* (CIRIA C665, December 2007) *"Assessing Risks Posed by Hazardous Ground Gases for Buildings."***
  This document provides up to date advice on all aspects of ground gas risk assessment such as investigation, monitoring programmes, data collection and interpretation. The guidance presents separate methodologies for the characterisation of:
  - All development types except low rise housing with gardens (Situation A)
  - Low rise housing with gardens (Situation B)

- **Boyle and Witherington (NHBC / RSK Group, Report 10627-R01(04) January 2007) *"Guidance on the Evaluation of Development Proposals on Sites where Methane and Carbon Dioxide are Present."***
  This document presents the "Traffic Lights System" detailed below and is relevant only for low rise properties (e.g. bungalows and town houses) that have a ventilated sub-floor void (i.e. Situation B as described in CIRIA C665).

- **British Standard (BS 8485, December 2007) *"Code of Practice for the Characterization and Remediation from Ground Gas in Affected Developments"***
  This document provides an overview of gas characterisation and assessment. The Standard is intended to be used by designers of gas protection measures and regulators involved in the assessment of design solutions.

Further guidance, **Wilson and Card (CIEH) *"Ground Gas Handbook for Designers and Regulators"*** providing practical guidance on ground gas assesments and the design and evaluation of protection measures, is expected to be published in March 2009.

Each of these documents continues to highlight the importance of, and give further guidance towards, carrying out a tiered risk-based decision-making process in accord with government policy on dealing with contamination from historic or natural sources and highlight the importance of the Conceptual Model in site characterisation.

Ground Gas Risk Assessment Methodology
Assessment of risk posed by ground gas is undertaken using the methodology as outlined previously, and summarised hereunder:

- Tier 1 Preliminary Risk Assessmnent
- Tier 2 Generic Quantitative Risk Assessment
- Tier 3 Detailed Quantitative Risk Assessment

The methodology used in each of the above assessments with concern to ground gas is discussed hereunder.

<u>Tier 1 Preliminary Risk Assessment</u>
All potential sources of methane and carbon dioxide are identified in the Preliminary Conceptual Model and the generation potential determined. The background information discussed earlier is referred to in order to determine the potential for a source to generate ground gas.

CIRIA C665 provides idealised monitoring frequency / period dependant upon generation potential of gas source and sensitivity of the proposed land use as below:

Idealised Frequency and Period of Monitoring (after Table 5.5a and 5.5b, CIRIA C665)

		Generation Potential of Source				
		Very Low	**Low**	**Moderate**	**High**	**Very High**
Sensitivity of Development	**Low** (Commercial)	4/1	6/2	6/3	12/6	12/12
	Moderate (Flats)	6/2	6/3	9/6	12/12	24/24
	High (Residential with Gardens)	6/3	9/6	12/6	24/12	24/24

Notes
1. First number is the number of readings and the second is the minimum period in months (e.g. 6/2 – six sets of readings over two months).
2. At least two sets of readings must be at low (preferably under 1,000 mb) and falling pressure.

The monitoring programme is decided using the above table prior to the intrusive site investigation. However, if the intrusive investigation reveals that a the potential source is better or worse than anticipated the monitoring programme should be modified accordingly. For example, if the made ground contains no evidence of organic material and comprises entirely granular brick fill, the potential for that made ground to generate ground gas is reduced considerably.

Tier 2 Generic Quantitative Risk Assessment
Generic Quantitiative Risk Assessment is undertaken upon completion of the required gas monitoring period.

All three current guidance documents propose that both ground gas concentrations and flow rates are used to calculate the limiting gas well gas volume flow rates for methane and carbon dioxide, based on the ground gas conditions monitored for during the worse-case temporal conditions. This limiting gas well volume flow rate is termed the Gas Screening Value (GSV, note that this was termed borehole gas volume flow), and is calculated as follows:

$$\textbf{GSV}\ (\text{l/hr}) = \frac{[\text{gas well gas concentration (\%v/v)}] \times [\text{gas well flow rate (l/hr)}]}{100}$$

GSV's are compared to typical max concentrations and limiting gas screening values derived for either Situation A - All development except low rise housing with gardens, or Situation B low rise housing with gardens (NHBC Traffic Light System). Table 8.5 from CIRIA C665 is used for comparison of gas screening values for "Situation A Developments" and is presented hereunder:

Characteristic Situation (CIRIA R149)	Comparable Partners in Technology gas Regime (see Box 8.2)	Risk Classification	Gas Screening Value (CH_4 or CO_2) (l/hr)[1]	Additional Factors	Typical Source of Generation
1	A	Very low risk	<0.07	Typically methane ≤ 1% and/or carbon dioxide ≤ 5%. Otherwise consider increase to Situation 2	Natural soils with low organic content "Typical" made ground
2	B	Low risk	<0.7	Borehole air flow rate not to exceed 70l/hr. Otherwise consider increase to characteristic Situation 3	Natural soil, high peat/organic content. "Typical" made ground
3	C	Moderate risk	<3.5		Old landfill, inert waste, mineworking flooded
4	D	Moderate to high risk	<15	Quantitative risk assessment required to evaluate scope of protective measures.	Mineworking susceptible to flooding, completed landfill (WMP 26B criteria)
5	E	High risk	<70		Mineworking unflooded inactive with shallow workings near surface
6	F	Very high risk	>70		Recent landfill site

Table 8.5 from CIRIA C665 Modified Wilson and Card Classification

Table 8.7 is used for comparison of gas screening values for "Situation B Developments" and is presented herunder:

Traffic Light	Methane[1]		Carbon Dioxide[2]	
	Typical max concentration[3] (% by volume)	Gas screening value[2,4] (litres/hour)	Typical max concentration[3] (% by volume)	Gas screening value[2,4] (litres/hour)
Green	1	0.13	5	0.78
Amber 1	5	0.63	10	1.60
Amber 2	20	1.60	30	3.10
Red				

Notes:
1. The worst-case ground gas regime identified on the site, either methane or carbon dioxide, at the worst-case temporal conditions that the site may be expected to encounter will be the decoder as to what Traffic Light is allocated;
2. Borehole Gas Volume Flow Rate, in litres per hour as defined in Wilson and Card (1999), is the borehole flow rate multiplied by the concentration in the air stream of the particular gas being considered;
3. The Typical Maximum Concentration can be exceeded in certain circumstances should the Conceptual Site Model indicate it is safe to do so;
4. The Gas Screening Value thresholds should not generally be exceeded without the completion of a detailed ground gas risk assessment taking into account site-specific conditions.

Table 8.7 from CIRIA C665 - NHBC Traffic light system for 150 mm void

Dependant on the outcome of the assessment of risk posed by ground gas it is determined whether gas protection measures are required for the proposed development, and or whether a detailed quantitative risk assessment is required for the site.

Selection & Design of Protective Measures
Table 8.6 and Box 8.4 of CIRIA C665 contain information on the detailed design of protection measures and were initially intended for the purposes of determining then level of protection measures a development requires. These tables and related text include some useful information on the design of gas protection measures, however BS84845:2007, which supersedes the guidance included within CIRIA C665, is used for selection of gas protection measures.

BS8485: 2007 uses a scoring system dependant on the Characteristic Situation / NHBC Traffic Light and proposed end use of the site. The scoring system is summarised in BS8485:2007 Table 2 as presented hereunder:

Characteristic gas situation, CS	NHBC traffic light	Required gas protection			
		Non-managed property e.g. private housing	Public building (a)	Commercial buildings	Industrial buildings (b)
1	*Green*	0	0	0	0
2	*Amber 1*	3	3	2	1 (c)
3	*Amber 2*	4	3	2	2
4	*Red*	6 (d)	5(d)	4	3
5			6(e)	5	4
6				7	6

***NOTE** Traffic light indications are taken from NHBC Report no.:10627-RO1 (04) and are mainly applicable to low-rise residential housing[1]. These are for comparative purposes but the boundaries between the traffic light indications and CS values do not coincide.*

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

[1] The NHBC guidance and CIRIA C665 guidance refers to low rise housing (which is up to three storeys without lifts) that is constructed with a 150mm ventilated sub-floor void.

BS8485:2007 Table 2 Required gas protection by characteristic gas situation and type of building

Once a score is assigned, a combination of protection systems / elements is chosen from BS8485:2007 Table 3 shown below:
CD37d

PROTECTION ELEMENT / SYSTEM		SCORE	COMMENTS
a) Venting / dilution (See Annex A BS8485)			
Passive sub floor ventilation (venting layer can be a clear void or formed using gravel, geocomposites, polystyrene void formers, etc.)[A]	Very good performance	2.5	*Ventilation performance in accordance with Annex A (BS8485)*
	Good performance	1	*If passive ventilation is poor this is generally unacceptable and some form of active system will be required.*
Subfloor ventilation with active abstraction/pressurization (venting layer can be a clear void or formed using gravel, geocomposites, polystyrene void formers, etc.)[A]		2.5	*There have to be robust management systems in place to ensure the continued maintenance of any ventilation system. Active ventilation can always be designed to meet good performance.*
Ventilated car park (basement or undercroft)		4	*Mechanically assisted systems come in two forms: extraction and positive pressurization.*
b) Barriers			
Floor slabs			
Block and beam floor slab		0	*It is good practice to install ventilation in all foundation systems to effect pressure relief as a minimum. Breaches in floor slabs such as joints have to be effectively sealed against gas ingress in order to maintain these performances.*
Reinforced concrete ground bearing slab		0.5	
Reinforced concrete ground bearing foundation raft with limited service penetrations that are cast into slab		1.5	
Reinforced concrete cast in situ suspended floor slab with minimal service penetrations and water bars around all slab penetrations and at joints		1.5	
Fully tanked basement		2	
c) Membranes			
Taped and sealed membrane to reasonable levels of workmanship/in line with current good practice with validation [B,C]		0.5	*The performance of membranes is heavily dependent on the quality of design of the installation, resistance to damage after installation, and the integrity of joints.*
Proprietary gas resistant membrane to reasonable levels of workmanship /in line with good practice under independent inspection (CQA)[B,C]		1	
Proprietary gas resistant membrane installed to reasonable levels of workmanship/in line with current good practice under CQA with integrity testing and independent validation		2	
d) Monitoring and detection (not applicable to non-managed property, or in isolation)			
Intermittent monitoring using hand held equipment		0.5	*Where fitted, permanent monitoring systems ought to be installed in the underfloor venting/dilution system in the first instance but can also be provided within the occupied space as a fail safe.*
Permanent monitoring and alarm system [A]	Installed in the underfloor venting/dilution system	2	
	Installed in the building	1	
e) Pathway Intervention			
Pathway intervention		-	*This can consist of site protection measures for off-site or on-site sources (see Annex A, BS8485)*
NOTE In practice the choice of materials might well rely on factors such as construction method and the risk of damage after installation. It is important to ensure that the chosen combination gives an appropriate level of protection			
A) It is possible to test ventilation systems by installing monitoring probes for post installation validation.			
B) If a 1 200g DPM material is to function as a gas barrier it should be installed according to BRE 212 /BRE 414 being taped and sealed to all penetrations			
C) Polymeric Materials> 1200 g (proportional to thickness) but their physical properties mean that they are more robust and resistant to damage.			

BS8485:2007 Table 3 Solution Scores

Where the gas situation is 4 or more (and for NHBC Red situations) the site requires a comprehensive risk assessment to confirm the scope of protection measures. These are higher risk sites and reliance on Table 2 and 3 alone is not sufficient.

For a site which is impacted by migratory gases from an off site source, the development may be protected by imposing pathway intervention methods, which if successfully validated, could also remove the need for further analysis. It is essential that the gas regime in these circumstances has been fully characterised and that the only source impacting the site is located off site and that the pathway is clearly defined and its interception equally proven before construction commences. Pathway intervention methods may include vertical membrane installations, venting trenches, rows of stone columns, activated trenches and various proprietary systems. These systems are particularly relevant to domestic housing where there is limited scope for foundation type solutions.

CURRENT GUIDANCE ON REMEDIATION

When risk assessment of the site has been completed and it indicates that remedial works are required, the main guidance in managing this process is set out in the DEFRA/EA publication CLR11 (2004) "Model Procedures for the Management of Land Contamination." The stages of managing remediation are as follows:

(a) Options Appraisal and develop Remediation Strategy;
(b) Develop Implementation Plan and Verification Plan;
(c) Remediation, Verification and Monitoring.

The Remediation Strategy sets out the remediation targets, identifies technically feasible remedial solutions and presents an evaluation of the options so that these can be assessed enabling that the most suitable solution is adopted. An outline of the proposed remedial method should be presented. Agreement should be sought of the appropriate statutory bodies for the Remediation Strategy before proceeding to the next stage.

The Implementation Plan is a detailed method statement setting out how the remediation is to be carried out including stating how the site will be managed, welfare procedures, health and safety considerations together with practical measures such as details of temporary works, programme of works, waste management licences and regulatory consents required. Agreement should again be sought of the appropriate statutory bodies for this Plan.

The Verification Plan sets out the requirements for gathering data to demonstrate that the remediation has met the required remediation objectives and criteria. The Verification Plan presents the requirements for a wide range of issues including the level of supervision, sampling and testing regimes for treated materials, waste and imported materials, required monitoring works during and post remediation, how compliance with all licenses and consents will be checked etc. Agreement should again be sought of the appropriate statutory bodies for the Verification Plan. On completion of the remediation a Verification Report should be produced to provide a complete record of all remediation activities on site and the data collected as required in the Verification Plan. The Verification Report should demonstrate that the remediation has met the remedial targets to show that the site is suitable for the proposed use.

APPENDIX D

SAMPLING & MONITORING PROTOCOL

SAMPLING, SAMPLE TRANSPORTATION, AND FIELD MONITORING PROTOCOLS

Soil, water and gas sampling and monitoring methodologies employed by ***CC GEOTECHNICAL LTD*** are presented hereunder.

SAMPLING OF SOIL FOR CHEMICAL ANALYSIS

Site soil samples are usually recovered during the course of intrusive site investigation by either sinking dynamic sampling boreholes or machine or manual excavation of trial pits.

Borehole equipment such as casings, sampling barrels and rods, along with hand tools such as trowels and spades are cleaned using deionised water between sample positions to avoid cross contamination.

Latex barrier gloves are changed after each sampling event.

Dynamic Sampling Boreholes

In this method of investigation samples are recovered in relatively undisturbed 1m long Perspex liners. Each liner is uniquely labelled with the Project Name / Project No / Borehole No / Depth / Date. The liner tubes are sealed by air tight caps fitted at each end, and are temporarily stored out of sunlight. Where possible, samples are immediately split, scanned by PID, logged and subsampled. In the event that splitting and logging on site is not practicable, then the liners are immediately transported to the laboratory where they are immediately split, scanned by PID, logged and subsampled

Trial Pits

Samples are taken from the bucket of an excavator and placed in appropriate airtight containers. Each container is uniquely labelled with the Project No / Trial Pit No / Depth / Date. The samples are then immediately placed in a cool box chilled by ice packs, and the boxes are sealed for transportation to the chemical laboratory.

Sampling Containers

Containers used to store soil samples are selected dependant on the required analysis. The testing laboratory will be consulted should there be any doubt as to the correct sampling container. Typically, a minimum of 1nr 1kg plastic tub, 1nr 500g plastic tub, 1nr 250g amber glass jar and 2nr glass vials are taken at each sample depth. Samples held on site awaiting same day courier collection are stored at 4^{O}C in a cool box. Only in circumstances where same day collection cannot be arranged are sampled held overnight, in this event all samples are refrigerated at 4 ^{O}C either on site (if a refrigerator is available) or at CC GEOTECHNICAL soil laboratory. Courier collection is then arranged for immediate pick up the following day.

Chain of Custody records

A Chain of Custody Record (CoC) is sent with each batch of samples submitted to the testing laboratory. A copy of the CoC is available for inspection by the client, their agents, or any requesting government authorities.

HEADSPACE ANALYSES

Duplicate subsamples of all soil samples selected for laboratory analysis, are taken for headspace analyses.

Headspace analysis is undertaken using a MiniRae 2000 Photo Ionisation Detector (PID). In the test method, an amber glass jar is half filled with soil, and the lid is sealed with aluminium foil secured by an elastic band. The jar and contents are agitated for 30 seconds and left for a minimum of 30 minutes out of direct sunlight for the headspace to achieve equilibrium. The PID then pierces the seal and the maximum reading is recorded. Prevailing weather conditions and ambient air temperature are also recorded.

The PID headspace results are recorded on the exploratory borehole or trial pit logs.

PID headspace data is then used to inform the chemical testing schedule for volatile soil analyses.

SAMPLING OF WATER FOR CHEMICAL ANALYSIS

Water is sampled from standpipes installed during borehole drilling. On completion of the construction of the standpipe, the installation is developed by removing up to 10 x the internal volume of the installation. The volume of water purged is recorded. The standpipe is then typically left for a week for hydraulic equilibrium to be restored.

Prior to sampling the standpipe, the depth to the water table, and the depth to the base of the standpipe are monitored using an electronic dipmeter. In circumstances where free phase product is suspected to be present, then an 'Interface Meter' is used to determine the free phase film thickness.

A minimum of 3 x the standpipe volume is then removed. The pH of the water is then monitored and the sample is taken when the change in pH between any two consecutive standpipe extracts is less than 10%. The volume of water removed is recorded.

A sample comprises of a minimum of 3 litres. Two litres are taken in amber glass bottles, and one litre in a plastic bottle.

To avoid cross-contamination one bailer is used per position.

The samples are uniquely labelled with Project Name / Project No / Borehole No / Depth / Date Sampled. They are placed in a cool box chilled by ice packs, and the containers are sealed for transportation to the laboratory.

Once the samples are received in the ***CC GEOTECHNICAL LTD*** laboratory, the samples are stored in a refrigerator and returned to the cool boxes once collected.

Water taken from the installations are taken back to the ***CC GEOTECHNICAL LTD*** laboratory and disposed.

Other data recorded in the sampling comprises:

- Volume of water removed during development of well
- Volume of water removed during purging of the well
- Results of on-site pH analyses
- Sample appearance – colour, suspended solids

MONITORING OF GAS

Prior to embarking on a gas-monitoring round, all equipment is checked for functionality and the calibration status is confirmed.

At the commencement of the monitoring round, the prevailing weather conditions, air temperature, barometric pressure and direction of movement of barometric pressure are recorded.

The flow meter is first attached to the standpipe valve, and the flow rate is measured (peak and steady flow) for 1 minute. The results are recorded in $l.hr^{-1}$.The flow meter tube is protected from the effects of wind by aligning the exhaust downwind.

Following measurement of borehole flow rate, the installation is left for a minimum of 10 minutes for the headspace to restore equilibrium.

Once the gas in the installation has regained equilibrium, the gas analyser is connected and monitoring commences. The peak and steady state readings for CH_4, CO_2, CO, H_2S and CO are recorded. The steady state is monitored for a minimum of one minute, and possibly up to a maximum of 10 minutes where fluctuations continue.

When the monitoring is complete, the depth to the water table, and the depth to the base of the well are monitored using an electronic dipmeter. In circumstances where free phase product is suspected to be present, then an 'Interface Meter' is used to determine the free phase film thickness.

APPENDIX E

2018 BOREHOLE LOGS

Contract Name: Monsall Road, Manchester		Client: Mangrove Estates		Borehole ID: **WS1**
Contract Number: CCG-C-18-10433	Date Started: 09/08/2018	Logged By: GR	Checked By: CB	Status: FINAL
Dynamic Sampling Borehole Log	Easting:	Northing:	Ground Level:	Plant Used: Danod Terrier Rig
Rig Crew: SG/CC	Scale: 1:25			Sheet 1 of 1
Weather:	Termination:	SPT Hammer: N/R, Energy Ratio: N/R		

Samples & In Situ Testing			Strata Details				Groundwater	
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description	Water Strike	Backfill/ Installation
0.00 - 1.00	UT1			(0.70)		Brown very gravelly slightly silty SAND. Low cobble content. gravel is fine to coarse angular to sub-angular brick and concrete (MADE GROUND)		
		HVP=40		0.70 (0.30)		Brown slightly sandy slightly gravelly silty CLAY. gravel is fine to coarse sub-angular to sub-rounded sandstone and concrete (MADE GROUND)		
1.00 - 2.00	UT2			1.00 (0.50)		Brown very clayey very sandy GRAVEL. Gravel is fine to coarse angular to sub-angular brick and concrete (MADE GROUND)		
		HVP=50		1.50		Firm becoming stiff brown slightly sandy slightly gravelly silty CLAY. Gravel is fine to medium sub-rounded sandstone, quartz and coal		
		HVP=90						
2.00 - 3.00	UT3							
		HVP=90						
		HVP=90		(2.50)				
3.00 - 4.00	UT4							
		HVP=110						
		HVP=110						
		SPT(S)N=16 (3,3/3,4,4,5)		4.00		End of Borehole at 4.00m		

1 2 3 4 5

Start & End of Shift Observations					Borehole Diameter		Casing Diameter	
Date	Time	Depth (m)	Casing (m)	Water (m)	Depth (m)	Dia (mm)	Depth (m)	Dia (mm)

Chiselling			
From (m)	To (m)	Duration	Remarks

Installation			
Top (m)	Base (m)	Type	Dia (mm)
0.00	0.50	PLAIN	50
0.50	3.50	PLAIN	50

Remarks:

Water Strikes					
Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks
0.86			0		Monitored Level 14/09/18

CCG	Contract Name: Monsall Road, Manchester		Client: Mangrove Estates		Borehole ID: **WS2**
	Contract Number: CCG-C-18-10433	Date Started: 09/08/2018	Logged By: GR	Checked By: CB	Status: FINAL
Dynamic Sampling Borehole Log	Easting:	Northing:	Ground Level:	Plant Used: Dando Terrier Rig	Rig Crew: SG/CC
					Sheet 1 of 1
					Scale: 1:25
Weather:		Termination: Refused at 0.35mbgl			

Samples & In Situ Testing			Strata Details				Groundwater	
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description	Water Strike	Backfill/ Installation
				(0.30)		Brown very gravelly SAND with medium cobble content. Gravel is fine to coarse sub-angular to angular concrete and brick (MADE GROUND)		
				0.30		CONCRETE		
				0.35		End of Borehole at 0.35m		

1 2 3 4 5

Start & End of Shift Observations					Borehole Diameter		Casing Diameter	
Date	Time	Depth (m)	Casing (m)	Water (m)	Depth (m)	Dia (mm)	Depth (m)	Dia (mm)

Chiselling			
From (m)	To (m)	Duration	Remarks

Installation			
Top (m)	Base (m)	Type	Dia (mm)

Remarks:
Attempt to core concrete refused on reinforcement

Water Strikes					
Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

Contract Name: Monsall Road, Manchester		Client: Mangrove Estates		Borehole ID: **WS3**
Contract Number: CCG-C-18-10433	Date Started: 09/08/2018	Logged By: GR	Checked By: CB	Status: FINAL
Dynamic Sampling Borehole Log	Easting:	Northing:	Ground Level:	Plant Used: Dando Terrier Rig
Rig Crew: SG/CC	Scale: 1:25			Sheet 1 of 1
Weather:	Termination:	SPT Hammer: N/R, Energy Ratio: N/R		

Samples & In Situ Testing			Strata Details				Groundwater	
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description	Water Strike	Backfill/ Installation
0.00 - 1.00	UT1					Brown/grey very gravelly silty SAND. Gravel is fine to coarse angular to sub-angular concrete, brick and limestone (MADE GROUND)		
1.00 - 2.00	UT2	SPT(S)N=6 (2,1/1,2,1,2)		(2.00)				
2.00 - 3.00	UT3	SPT(S)N=5 (2,1/1,1,2,1)		2.00		Brown very clayey very gravelly SAND. Gravel is fine to coarse angular to sub-angular concrete and limestone (MADE GROUND)		
				(0.70)				
		HVP=40		2.70		Brown slightly sandy slightly gravelly silty CLAY (MADE GROUND)		
3.00 - 4.00	UT4	SPT(S)N=8 (2,2/1,2,3,2)		(0.50)				
				3.20		Firm brown slightly sandy slightly gravelly silty CLAY		
4.00 - 5.00	UT5	SPT(S)N=10 (3,2/2,3,3,2)		(1.80)				
		SPT(S)N=12 (3,3/3,3,3,3)		5.00		End of Borehole at 5.00m		

Start & End of Shift Observations					Borehole Diameter		Casing Diameter	
Date	Time	Depth (m)	Casing (m)	Water (m)	Depth (m)	Dia (mm)	Depth (m)	Dia (mm)

Chiselling			
From (m)	To (m)	Duration	Remarks

Installation			
Top (m)	Base (m)	Type	Dia (mm)
0.00	1.00	PLAIN	
1.00	4.00	SLOTTED	

Remarks:

Water Strikes					
Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks
1.59			0		Monitored Water Level 14/09/18

Contract Name: Monsall Road, Manchester			Client: Mangrove Estates	Borehole ID: **WS4**
Contract Number: CCG-C-18-10433	Date Started: 09/08/2018	Logged By: GR	Checked By: CB	Status: FINAL
Dynamic Sampling Borehole Log	Easting:	Northing:	Ground Level:	Plant Used: Dando Terrier Rig
Rig Crew: SG/CC	Scale: 1:25	Sheet 1 of 1		
Weather:	Termination: Cored to 1.50mbgl limit			

Samples & In Situ Testing			Strata Details				Groundwater	
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description	Water Strike	Backfill/ Installation
				(0.80)		Dark brown very gravelly slightly silty SAND. Gravel is fine to coarse sub-angular to angular concrete and brick (MADE GROUND)		
				0.80		Brown very gravelly slightly silty SAND. Gravel is fine to coarse sub-angular to sub-rounded concrete, brick and sandstone (MADE GROUND)		
				1.00		CONCRETE SLAB		
				(0.50)				
				1.50		End of Borehole at 1.50m		

1 2 3 4 5

Start & End of Shift Observations					Borehole Diameter		Casing Diameter	
Date	Time	Depth (m)	Casing (m)	Water (m)	Depth (m)	Dia (mm)	Depth (m)	Dia (mm)

Chiselling			
From (m)	To (m)	Duration	Remarks

Installation			
Top (m)	Base (m)	Type	Dia (mm)

Remarks:

Cored to 1.50mbgl - concrete slab continued but rig unable to core any further

Water Strikes					
Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

APPENDIX F

2012 BOREHOLE LOGS

CC Geotechnical	Tel: 0151-545-2750 Fax: 0151-548-7892	BOREHOLE LOG	HOLE NO. BH01 Sheet 1 of 1

CLIENT	SITE
MANGROVE ESTATES LTD	MONSALL ROAD, NEWTON HEATH, MANCHESTER

DATE OF FIELDWORK	SCALE	LEVEL/POSITION	OPERATOR	LOGGED BY	JOB NO.
05/10/12-05/10/12	1:50	SEE LOCATION PLAN	NB	GR	12/6768

SAMPLE RECORD DEPTH	SAMPLE RECORD TYPE	SPT N (Cu-kN/m^2)	Standp/ Piezo	DESCRIPTION OF STRATUM (thickness)	DEPTH	REDUCED LEVEL	LEGEND
				ASPHALT (0.10)	0.10		
0.30	SD			Grey silty GRAVEL. Gravel is angular limestone (MADE GROUND) (0.40)	0.50		
				Reinforced CONCRETE (0.20)	0.70		
0.80	SD			Brown clayey very gravelly SAND with occasional cobbles. gravel is angular of brick, quarry tile and concrete with occasional whole and half brick (MADE GROUND) (0.90)			
				Firm becoming stiff brown/grey slightly sandy slightly gravelly silty CLAY (1.10)	1.60		
3.00 - 3.45	SPT	23		Brown very clayey gravelly SAND (0.60)	2.70		
3.00 - 4.00	U90			Stiff brown slightly sandy slightly gravelly silty CLAY End of trial pit at 3.30mbgl	3.30		
4.00 - 4.45	SPT	59					
4.00 - 5.00	U80			BOREHOLE TERMINATED - CONTINUED BY DYNAMIC PROBE	5.00		

GROUNDWATER AND CASING INFORMATION

DEPTH STRUCK	DEPTH CASED	ELAPSED TIME	WATER LEVEL	DEPTH SEALED	REMARKS ON GROUNDWATER AND CASING
			1.34		TP & BH DRY DURING FIELDWORK MONITORED WATER LEVEL

BORING METHOD AND REMARKS

Dando Terrier rig & crew
Pre-dug by trial pit TP01
Continued by Dynamic Probing. Results shown on DP01 result sheet.

All dimensions are in metres unless otherwise stated

CC GEOTECHNICAL LTD
Unit 1, Deltic Way, Knowsley industrial Estate, L33 7BU
Tel: 0151 545 2750 Fax: 0151 548 7892

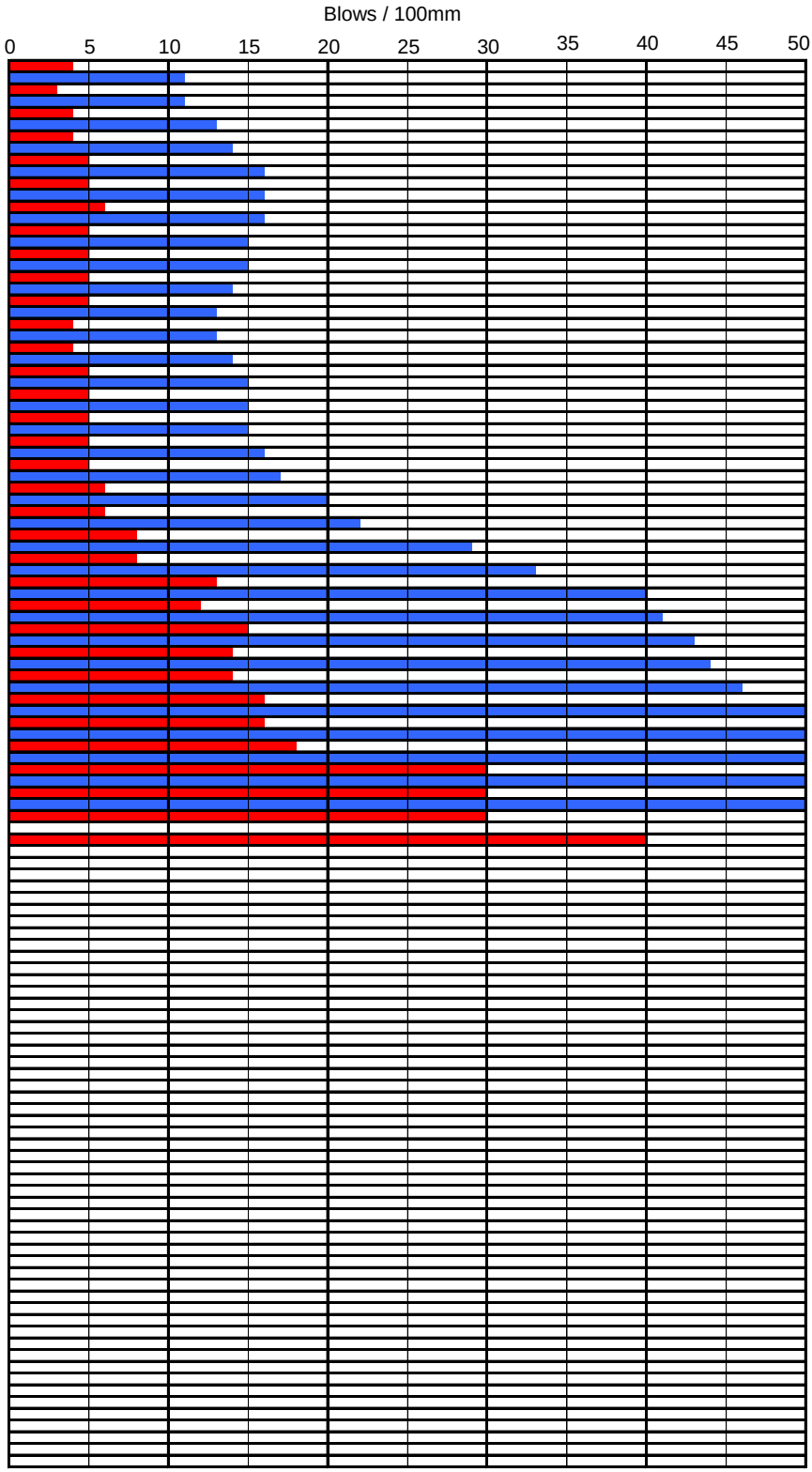
DYNAMIC PROBE TEST RESULTS SHEET

SITE:	12/6768 MONSALL ROAD, M'CR
CLIENT:	ONE VISION HOUSING
PROBE NUMBER:	DP01
DATE:	5-Oct-12

DPSH IN ACCORDANCE WITH BS 1377: PART 9: CLAUSE 3.2
CONE BURIED:
PROBE HOLE BACKFILLED:
REMARKS: CONTINUATION OF BOREHOLE BH01

NOTE: > 40 AT 8.4mbgl. PROBE TERMINATED

Depth (m)	Blows / 100mm	Equivalent SPT 'N' value
5.1	4	11
5.2	3	11
5.3	4	13
5.4	4	14
5.5	5	16
5.6	5	16
5.7	6	16
5.8	5	15
5.9	5	15
6.0	5	14
6.1	5	13
6.2	4	13
6.3	4	14
6.4	5	15
6.5	5	15
6.6	5	15
6.7	5	16
6.8	5	17
6.9	6	20
7.0	6	22
7.1	8	29
7.2	8	33
7.3	13	40
7.4	12	41
7.5	15	43
7.6	14	44
7.7	14	46
7.8	16	50
7.9	16	64
8.0	18	78
8.1	30	90
8.2	30	100
8.3	30	
8.4	40	



Dynamic probe value (Blows/100mm) Equivalent SPT 'N' value

Registered in England & Wales, Company No. 5085241
Registered Office: Units 1 & 2, Deltic Place, Deltic Way, Knowsley Industrial Estate, L33 7BU

Cert No: 7549 - ISO 9001
4914

APPENDIX G

SOIL ENGINEERING CLASSIFICATION LAB TEST RESULTS

Units 1 & 2
Deltic Place
Deltic Way
Knowsley Industrial Estate
Liverpool
L33 7BU

Telephone: (0151) 545 2750
Fax: (0151) 548 7892
Email: enquiries@ccgeotechnical.com
www.ccgeotechnical.com

CC GEOTECHNICAL LTD
Consulting Geoenvironmental and Geotechnical Engineers

LABORATORY REPORT

CONTRACT NUMBER: CCG-C-18-10433

CONTRACT TITLE: MONSALL ROAD, MANCHESTER

CLIENT: MANGROVE ESTATES
11 Warwick Road Old Trafford
Manchester
Greater Manchester
M16 0QQ

DATE RECEIVED: 22/08/18
DATE COMMENCED: 22/08/18
DATE COMPLETED: 31/08/18
REPORT DATE: 04/09/18

Test Description	Qty
Determination of Moisture Content BS 1377-2:1990 (a)	3
Determination of Plastic and Liquid Limits BS 1377Pt 3.2,4.4,5(a)	3

Notes: Observations and interpretations are not accredited by UKAS
# denotes non-accredited test
a denotes UKAS accredited test
s denotes test undertaken by approved subcontractor

This report is issued in accordance with the requirements of the United kingdom Accreditation Services and EN ISO/IEC 17025:2005. The results reported herein relate only to the material supplied to the laboratory. This report shall not be reproduced except in full, without the prior written approval of the laboratory.

Approved Signatories: Chris Bolan (Managing Director) – Daniel Kerfoot (Laboratory Manager)

CCG-CMS-FO-200 Issue 3

SUMMARY OF LABORATORY SOIL TEST RESULTS

BH / TP / WS Number	Sample Type	Depth From (m)	Depth To (m)	Moisture Content (%)	Bulk Density (Mg/m^3)	Dry Density (Mg/m^3)	Shear Strength (kN/m^2)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Passing 0.425mm (%)	Soil Classification	UKAS accredited test (Y/N)	Description / Test Method Samples described in accordance with BS EN ISO 14688-2 2004
WS1	WS	1.60	1.60	18	-	-	-	37	17	20	76	CI	Y	Brown slightly sandy slightly gravelly silty CLAY. Gravel is fine to medium grained sandstone. (BS1377Pt2:3.2,4.4,5)
WS1	WS	2.50	2.50	18	-	-	-	36	16	20	89	CI	Y	Brown slightly sandy slightly gravelly silty CLAY. Gravel is fine to medium grained sandstone. (BS1377Pt2:3.2,4.4,5)
WS2	WS	2.80	2.80	24	-	-	-	37	23	14	69	CI / MI	Y	Brown slightly sandy slightly gravelly SILT/CLAY. Gravel is fine to medium grained sandstone. (BS1377Pt2:3.2,4.4,5)

SITE: MONSALL ROAD, MANCHESTER (CCG-C-18-10433) DATE: 04.09.18

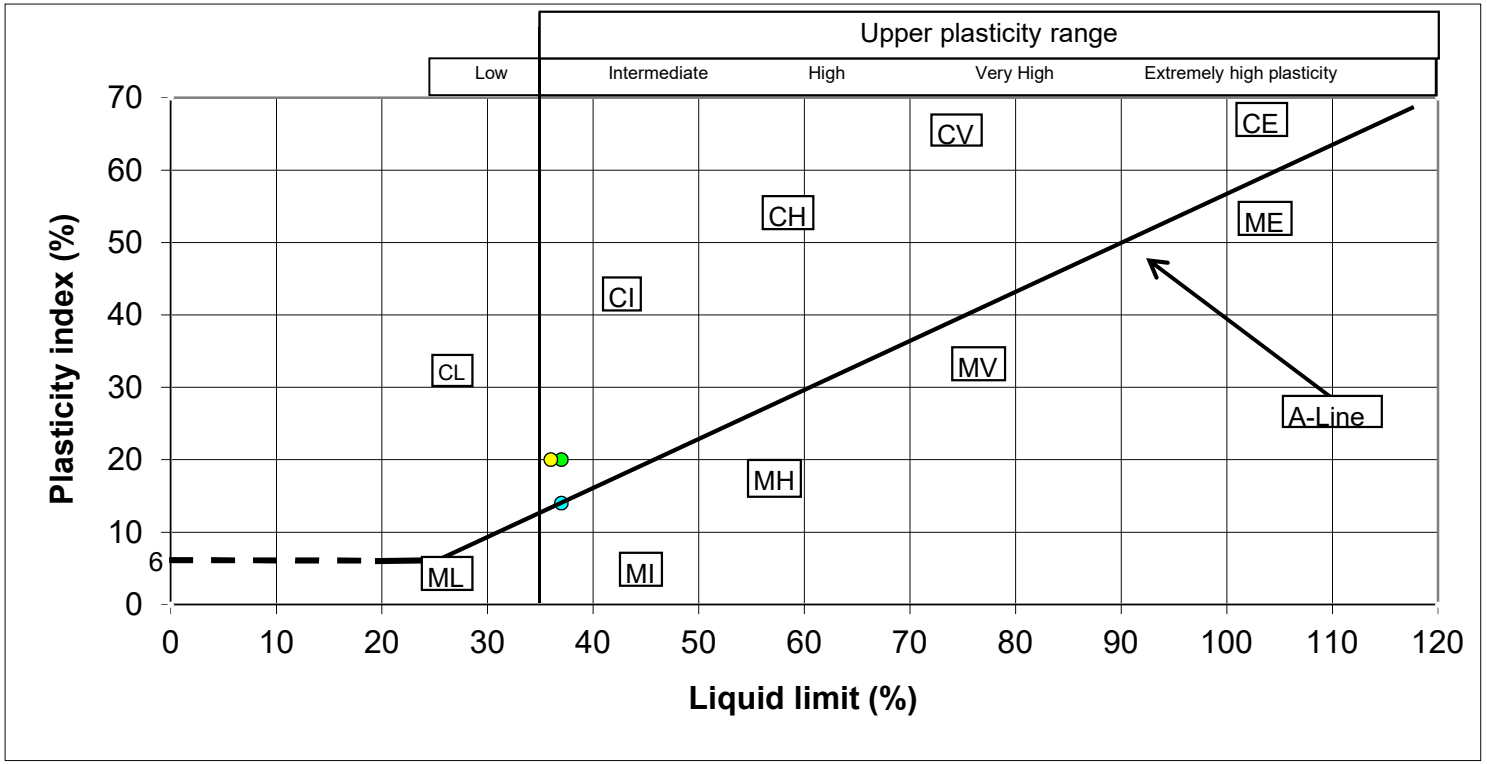
CLIENT: MANGROVE ESTATES

UKAS TESTING 4514

Key:- BD = Bulk Disturbed; SD = Small Disturbed; U100 = Undisturbed 100mm; WS = Window Sample
CL = Low Plasticity; CI = Intermediate; CH = High; CV = Very high; CE = Extremely high; NP = Non-plastic
(* Denotes Hand Shear Vane test result)
Sample description not accredited by UKAS

ATTERBERG TEST RESULT SHEET
BS 1377:Part 2:1990:cl 4.4,5

SILT (M-SOIL), M plots below A-Line , CLAY,C, plots above A-Line, M and C may be combined as FINE SOIL, F.



BH	Sample Depth	Liquid limit	Plasticity index
WS1	1.60	37.0	20.0
WS1	2.50	36.0	20.0
WS3	2.80	37.0	14.0

UKAS TESTING
4514

APPROVED BY	DK

CLIENT: MANGROVE ESTATES	SITE: MONSALL ROAD, MANCHESTER (CCG-C-18-10433)

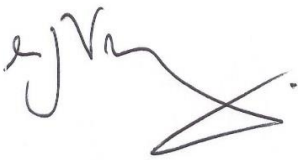
APPENDIX H

SOIL CHEMICAL ANALYSES LAB TEST CERTIFICATES

Unit A2
Windmill Road
Ponswood Industrial Estate
St Leonards on Sea
East Sussex
TN38 9BY
Telephone: (01424) 718618
Facsimile: (01424) 729911
info@elab-uk.co.uk

2683

THE ENVIRONMENTAL LABORATORY LTD

Analytical Report Number:	18-19242
Issue:	1
Date of Issue:	16/08/2018
Contact:	Graham Rooney
Customer Details:	CC Geotechnical Ltd Unit 1 & 2 Deltic Place Deltic Way Liverpool Merseyside L33 7BA
Quotation No:	Q14-00045
Order No:	CCG-PO-9307
Customer Reference:	CCG-C-18-10433
Date Received:	10/08/2018
Date Approved:	16/08/2018
Details:	Monsall Road, Manchester
Approved by:	

Mike Varley, Technical Manager

Any comments, opinions or interpretations expressed herein are outside the scope of UKAS accreditation (Accreditation Number 2683)

Sample Summary

Report No.: 18-19242

Elab No.	Client's Ref.	Date Sampled	Date Scheduled	Description	Deviations
147933	WS1 0.40	09/08/2018	10/08/2018	Sandy silty loam	
147934	WS3 0.50	09/08/2018	10/08/2018	Sandy silty loam	
147935	WS4 0.30	09/08/2018	10/08/2018	Sandy silty loam	

Results Summary

Report No.: 18-19242

			ELAB Reference	147933	147934	147935
			Customer Reference			
			Sample ID			
			Sample Type	SOIL	SOIL	SOIL
			Sample Location	WS1	WS3	WS4
			Sample Depth (m)	0.40	0.50	0.30
			Sampling Date	09/08/2018	09/08/2018	09/08/2018
Determinand	**Codes**	**Units**	**LOD**			
Metals						
Arsenic	M	mg/kg	1	6.9	5.8	8.8
Cadmium	M	mg/kg	0.5	< 0.5	< 0.5	< 0.5
Chromium	M	mg/kg	5	21.2	20.2	19.0
Copper	M	mg/kg	5	23.5	15.6	30.0
Lead	M	mg/kg	5	56.7	27.5	67.3
Mercury	M	mg/kg	0.5	< 0.5	< 0.5	< 0.5
Nickel	M	mg/kg	5	18.2	16.6	18.4
Selenium	M	mg/kg	1	< 1.0	< 1.0	< 1.0
Zinc	M	mg/kg	5	68.9	72.8	69.7
Anions						
Water Soluble Sulphate	M	g/l	0.02	0.24	0.35	0.32
Inorganics						
Free Cyanide	N	mg/kg	1	< 1.0	< 1.0	< 1.0
Hexavalent Chromium	N	mg/kg	0.8	< 0.8	< 0.8	< 0.8
Total Sulphide	N	mg/kg	2	8	< 2	< 2
Acid Soluble Sulphate (SO4)	U	%	0.02	0.21	0.25	0.29
Water Soluble Boron	N	mg/kg	0.5	0.9	0.8	0.8
Miscellaneous						
pH	M	pH units	0.1	11.5	11.5	11.4
Soil Organic Matter	U	%	0.1	1.3	1.2	2.4
Polyaromatic hydrocarbons						
Naphthalene	M	mg/kg	0.1	< 0.1	< 0.1	0.5
Acenaphthylene	M	mg/kg	0.1	< 0.1	< 0.1	< 0.1
Acenaphthene	M	mg/kg	0.1	< 0.1	0.1	0.8
Fluorene	M	mg/kg	0.1	< 0.1	< 0.1	0.6
Phenanthrene	M	mg/kg	0.1	0.2	0.6	6.1
Anthracene	M	mg/kg	0.1	< 0.1	0.1	1.7
Fluoranthene	M	mg/kg	0.1	0.4	1.2	11.0
Pyrene	M	mg/kg	0.1	0.3	1.2	10.3
Benzo(a)anthracene	M	mg/kg	0.1	0.2	0.6	4.9
Chrysene	M	mg/kg	0.1	0.2	0.8	6.1
Benzo (b) fluoranthene	M	mg/kg	0.1	0.2	0.7	5.6
Benzo(k)fluoranthene	M	mg/kg	0.1	0.2	0.7	5.2
Benzo (a) pyrene	M	mg/kg	0.1	0.2	0.6	5.1
Indeno (1,2,3-cd) pyrene	M	mg/kg	0.1	0.1	0.5	3.2
Dibenzo(a,h)anthracene	M	mg/kg	0.1	< 0.1	0.2	0.8
Benzo[g,h,i]perylene	M	mg/kg	0.1	0.1	0.5	3.0
Total PAH(16)	M	mg/kg	0.4	2.4	8.0	65.0

Results Summary

Report No.: 18-19242

			ELAB Reference	147933	147934	147935
			Customer Reference			
			Sample ID			
			Sample Type	SOIL	SOIL	SOIL
			Sample Location	WS1	WS3	WS4
			Sample Depth (m)	0.40	0.50	0.30
			Sampling Date	09/08/2018	09/08/2018	09/08/2018
Determinand	**Codes**	**Units**	**LOD**			
BTEX						
Benzene	M	ug/kg	10	< 10.0	< 10.0	< 10.0
Toluene	M	ug/kg	10	< 10.0	< 10.0	< 10.0
Ethylbenzene	M	ug/kg	10	< 10.0	< 10.0	< 10.0
Xylenes	M	ug/kg	10	< 10.0	< 10.0	< 10.0
TPH CWG						
>C5-C6 Aliphatic	N	mg/kg	0.01	< 0.01	< 0.01	< 0.01
>C6-C8 Aliphatic	N	mg/kg	0.01	< 0.01	< 0.01	< 0.01
>C8-C10 Aliphatic	N	mg/kg	1	< 1.0	< 1.0	< 1.0
>C10-C12 Aliphatic	N	mg/kg	1	< 1.0	< 1.0	1.4
>C12-C16 Aliphatic	N	mg/kg	1	< 1.0	9.2	6.6
>C16-C21 Aliphatic	N	mg/kg	1	2.5	24.3	18.5
>C21-C35 Aliphatic	N	mg/kg	1	17.8	141	115
>C35-C40 Aliphatic	N	mg/kg	1	3.8	10.4	28.6
>C5-C7 Aromatic	N	mg/kg	0.01	< 0.01	< 0.01	< 0.01
>C7-C8 Aromatic	N	mg/kg	0.01	< 0.01	< 0.01	< 0.01
>C8-C10 Aromatic	N	mg/kg	1	< 1.0	< 1.0	< 1.0
>C10-C12 Aromatic	N	mg/kg	1	< 1.0	< 1.0	3.3
>C12-C16 Aromatic	N	mg/kg	1	< 1.0	11.0	9.0
>C16-C21 Aromatic	N	mg/kg	1	4.2	31.8	35.8
>C21-C35 Aromatic	N	mg/kg	1	34.1	167	197
>C35-C40 Aromatic	N	mg/kg	1	14.1	22.9	40.0
Total (>C5-C40) Ali/Aro	N	mg/kg	1	76.4	417	456

Unit A2, Windmill Road, Ponswood Industrial Estate, St Leonards on Sea, East Sussex, TN38 9BY
Tel: +44 (0)1424 718618, Email: info@elab-uk.co.uk, Web: www.elab-uk.co.uk

Results Summary

Report No.: 18-19242

Asbestos Results

Analytical result only applies to the sample as submitted by the client. Any comments, opinions or interpretations (marked #)
in this report are outside UKAS accreditation (Accreditation No2683). They are subjective comments only which must be verified by the client.

Elab No	Depth (m)	Clients Reference	Description of Sample Matrix #	Asbestos Identification	Gravimetric Analysis Total (%)	Gravimetric Analysis by ACM Type (%)	Free Fibre Analysis (%)	Total Asbestos (%)
147933	0.40	WS1	Brown soil,Stones,brick,clinker	No asbestos detected	n/t	n/t	n/t	n/t
147934	0.50	WS3	Brown soil,Stones	No asbestos detected	n/t	n/t	n/t	n/t
147935	0.30	WS4	Brown soil,Stones,concrete,brick	No asbestos detected	n/t	n/t	n/t	n/t

Method Summary

Report No.: 18-19242

Parameter	Codes	Analysis Undertaken On	Date Tested	Method Number	Technique
Soil					
Free cyanide	N	As submitted sample	13/08/2018	107	Colorimetry
Sulphide	N	As submitted sample	14/08/2018	109	Colorimetry
Hexavalent chromium	N	As submitted sample	13/08/2018	110	Colorimetry
pH	M	Air dried sample	14/08/2018	113	Electromeric
Acid Soluble Sulphate	U	Air dried sample	14/08/2018	115	Ion Chromatography
Aqua regia extractable metals	M	Air dried sample	13/08/2018	118	ICPMS
PAH (GC-FID)	M	As submitted sample	13/08/2018	133	GC-FID
Water soluble anions	M	Air dried sample	13/08/2018	172	Ion Chromatography
Low range Aliphatic hydrocarbons soil	N	As submitted sample	14/08/2018	181	GC-MS
Low range Aromatic hydrocarbons soil	N	As submitted sample	14/08/2018	181	GC-MS
BTEX in solids	M	As submitted sample	14/08/2018	181A	GC-MS
Water soluble boron	N	Air dried sample	13/08/2018	202	Colorimetry
Aliphatic hydrocarbons in soil	N	As submitted sample	13/08/2018	214	GC-FID
Aliphatic/Aromatic hydrocarbons in soil	N	As submitted sample	15/08/2018	214	GC-FID
Aromatic hydrocarbons in soil	N	As submitted sample	13/08/2018	214	GC-FID
Soil organic matter	U	Air dried sample	13/08/2018	BS1377:P3	Titrimetry
Asbestos identification	U	Air dried sample	13/08/2018	PMAN	Microscopy

Tests marked N are not UKAS accredited

Report Information

Report No.: 18-19242

Key

U	hold UKAS accreditation
M	hold MCERTS and UKAS accreditation
N	do not currently hold UKAS accreditation
^	MCERTS accreditation not applicable for sample matrix
*	UKAS accreditation not applicable for sample matrix
S	Subcontracted to approved laboratory UKAS Accredited for the test
SM	Subcontracted to approved laboratory MCERTS/UKAS Accredited for the test
NS	Subcontracted to approved laboratory. UKAS accreditation is not applicable.
I/S	Insufficient Sample
U/S	Unsuitable sample
n/t	Not tested
<	means "less than"
>	means "greater than"

Soil sample results are expressed on an air dried basis (dried at < 30°C)
Comments or interpretations are beyond the scope of UKAS accreditation
The results relate only to the items tested
PCB congener results may include any coeluting PCBs
Uncertainty of measurement for the determinands tested are available upon request

Deviation Codes

a	No date of sampling supplied
b	No time of sampling supplied (Waters Only)
c	Sample not received in appropriate containers
d	Sample not received in cooled condition
e	The container has been incorrectly filled
f	Sample age exceeds stability time (sampling to receipt)
g	Sample age exceeds stability time (sampling to analysis)

Where a sample has a deviation code, the applicable test result may be invalid.

Sample Retention and Disposal

All soil samples will be retained for a period of one month
All water samples will be retained for 7 days following the date of the test report
Charges may apply to extended sample storage

APPENDIX I

SOIL CONTAMINATION RISK ASSESSMENT TABLES

METALS DATA SUMMARY AND RISK ASSESSMENT SHEET

Job number: **CCG-C-18-10433**
Site name: **MONSALL ROAD, MANCHESTER**
Prepared by: **GR**
Authorised by: **CB**
Proposed land use: **Residential with homegrown produce**
SOM % used: **1**

			Metals							
Contaminants			Cadmium	Chromium (total)	Chromium VI	Copper	Lead	Mercury (total)	Nickel	Zinc
Units			mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Limit of Detection			10	10	10	10	10	10	10	10
Human Health Risk Assessment (GAC)			11	3000	6	240	200	1.2	180	3700
Sample Location	Sample Depth (m)	Sample type								
WS1	0.4	SOIL	0.5	21	0.8	24	57	0.5	18	69
WS3	0.5	SOIL	0.5	20	0.8	16	28	0.5	17	73
WS4	0.3	SOIL	0.5	19	0.8	30	67	0.5	18	70
Human Health Risk Assessment (GAC)			11	3000	6	240	200	1.2	180	3700

SEMI-METALS, NON-METALS, INORGANICS AND OTHER DATA SUMMARY AND RISK ASSESSMENT SHEET

Job number: **CCG-C-18-10433**
Site name: **MONSALL ROAD, MANCHESTER**
Prepared by: **GR**
Authorised by: **CB**
Proposed land use: **Residential with homegrown produce**
SOM % used: **1**

			Semi-metals/non-m			Inorganics			Other		
Contaminants			Arsenic	Boron	Selenium	Sulphate (acid soluble)	Sulphate (water soluble)	Sulphide	Asbestos	pH (units)	Soil Organic Matter %
Units			mg/kg	mg/kg	mg/kg	mg/kg	g/l	mg/kg	mg/kg	units	units
Limit of Detection			5	10	10	10	%	-	10	10	10
Human Health Risk Assessment (GAC)			37	290	250	NA	NA	NA	NA	NA	NA
Sample Location	Sample Depth (m)	Sample type									
WS1	0.4	SOIL	6.9	0.9	1.0	0.21	0.24	8.0	NONE	11.5	1.3
WS3	0.5	SOIL	5.8	0.8	1.0	0.25	0.35	2.0	NONE	11.5	1.2
WS4	0.3	SOIL	8.8	0.8	1.0	0.29	0.32	2.0	NONE	11.4	2.4
Human Health Risk Assessment (GAC)			37	290	250	NA	NA	NA	NA	NA	NA

SPECIATED PAH'S DATA SUMMARY AND RISK ASSESSMENT SHEET

Job number: CCG-C-18-10433
Site name: MONSALL ROAD, MANCHESTER
Prepared by: GR
Authorised by: CB
Proposed land use: Residential with homegrown produce
SOM % used: 1

			PAH's														
Contaminants			Acenapthene	Acenapthylene	Anthracene	Benz[a]anthracene	Benzo[a]pyrene	Benzo[b]flouranthene	Benzo[ghi]perylene	Benzo[k]flouranthene	Chrysene	Dibenzo[ah]anthracene	Flouranthene	Flourene	Indeno[123-cd]pyrene	Napthalene	Pheanthrene	Pyrene	Total PAH's
Units			mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Limit of Detection			10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
Human Health Risk Assessment (GAC)			210	170	2400	7.2	2.2	2.6	320	77	15	0.24	280	170	27	2.3	95	620	NA
Sample Location	Sample Depth (m)	Sample type																	
WS1	0.4	SOIL	0.1	0.1	0.1	0.2	0.2	0.2	0.1	0.2	0.2	0.1	0.4	0.1	0.1	0.1	0.2	0.3	2.4
WS3	0.5	SOIL	0.1	0.1	0.1	0.6	0.6	0.7	0.5	0.7	0.8	0.2	1.2	0.1	0.5	0.1	0.6	1.2	8.0
WS4	0.3	SOIL	0.8	0.1	1.7	4.9	5.1	5.6	3.0	5.2	6.1	0.8	11.0	0.6	3.2	0.5	6.1	10.3	65.0
Human Health Risk Assessment (GAC)			210	170	2400	7.2	2.2	2.6	320	77	15	0.24	280	170	27	2.3	95	620	NA

SPECIATED TPH'S DATA SUMMARY AND RISK ASSESSMENT SHEET

Job number: **CCG-C-18-10433**
Site name: **MONSALL ROAD, MANCHESTER**
Prepared by: **GR**
Authorised by: **CB**
Proposed land use: **Residential with homegrown produce**
SOM % used: **1**

			Speciated TPH's														
			Aromatics								Aliphatics						
Contaminants			EC5-7	EC7-8	EC8-10	EC10-12	EC12-16	EC16-21	EC21-35	EC35-44	EC5-6	EC6-8	EC8-10	EC10-12	EC12-16	EC16-35	EC35-44	TOTAL TPH'S
Units			mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Limit of Detection			10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
Human Health Risk Assessment (GAC)			70	130	34	74	140	260	1100	1100	42	100	27	130	1100	65000	65000	NA
Sample Location	Sample Depth (m)	Sample type																
WS1	0.4	SOIL	0.01	0.01	1.0	1.0	1.0	4.2	34.1	14.1	0.01	0.01	1.0	1.0	1.0	20.3	3.8	76.4
WS3	0.5	SOIL	0.01	0.01	1.0	1.0	11	31.8	167	22.9	0.01	0.01	1.0	1.0	9.2	165.3	10.4	417
WS4	0.3	SOIL	0.01	0.01	1.0	3.3	9.0	35.8	197	40	0.01	0.01	1.0	1.4	6.6	133.5	28.6	456
Human Health Risk Assessment (GAC)			70	130	34	74	140	260	1100	1100	42	100	27	130	1100	65000	65000	NA

BTEX DATA SUMMARY AND RISK ASSESSMENT SHEET

Job number: **CCG-C-18-10433**
Site name: **MONSALL ROAD, MANCHESTER**
Prepared by: **GR**
Authorised by: **CB**
Proposed land use: **Residential with homegrown produce**
SOM % used: **1**

			BTEX			
Contaminants			Benzene	Toluene	Ethylbenzene	Total Xylenes
Units			mg/kg	mg/kg	mg/kg	mg/kg
Limit of Detection			10	10	10	10
Human Health Risk Assessment (GAC)			0.33	610	350	NA
Sample Location	Sample Depth (m)	Sample type				
WS1	0.4	SOIL	0.01	0.01	0.01	0.01
WS3	0.5	SOIL	0.01	0.01	0.01	0.01
WS4	0.3	SOIL	0.01	0.01	0.01	0.01
Human Health Risk Assessment (GAC)			0.33	610	350	NA

APPENDIX J

PRELIMINARY WASTE DISPOSAL ASSESSMENT

HazWasteOnline™

Waste Classification Report

96PQL-VDB2F-BVQJK

Job name

Monsall Rd, Manchester

Description/Comments

Project

CCG-C-18-10433

Site

Monsall Rd, Manchester

Waste Stream Template

CCG Soil A 2016

Classified by

Name:
Tony Gerrard
Date:
28 Sep 2018 09:46 GMT
Telephone:
0151 545 2750

Company:
CC Geotechnical Limited
Unit 1 and 2, Deltic Place
Deltic Way, Knowsley Industrial Estate
Liverpool
L33 7BU

Report

Created by: Tony Gerrard
Created date: 28 Sep 2018 09:46 GMT

Job summary

#	Sample Name	Depth [m]	Classification Result	Hazard properties	Page
1	WS1	0.4	Non Hazardous		2
2	WS3	0.5	Non Hazardous		5
3	WS4	0.3	Non Hazardous		8

Appendices	Page
Appendix A: Classifier defined and non CLP determinands	11
Appendix B: Rationale for selection of metal species	13
Appendix C: Version	14

Classification of sample: WS1

Non Hazardous Waste
Classified as **17 05 04**
in the List of Waste

Sample details

Sample Name:
WS1
Sample Depth:
0.4 m

LoW Code:
Chapter: 17: Construction and Demolition Wastes (including excavated soil from contaminated sites)
Entry: 17 05 04 (Soil and stones other than those mentioned in 17 05 03)

Hazard properties

None identified

Determinands

Moisture content: 0% Dry Weight Moisture Correction applied (MC)

#	Determinand	CLP index number	EC Number	CAS Number	CLP Note	User entered data	Conv. Factor	Compound conc.	Classification value	MC Applied	Conc. Not Used
1	arsenic { arsenic trioxide }	033-003-00-0	215-481-4	1327-53-3		6.9 mg/kg	1.32	9.11 mg/kg	0.000911 %	✓	
2	cadmium { cadmium sulfide }	048-010-00-4	215-147-8	1306-23-6	1	0.5 mg/kg	1.285	0.643 mg/kg	0.00005 %	✓	
3	chromium(III) oxide		215-160-9	1308-38-9		21 mg/kg		21 mg/kg	0.0021 %	✓	
4	copper { dicopper oxide; copper (I) oxide }	029-002-00-X	215-270-7	1317-39-1		24 mg/kg	1.126	27.021 mg/kg	0.0027 %	✓	
5	lead { lead chromate }	082-004-00-2	231-846-0	7758-97-6	1	57 mg/kg	1.56	88.909 mg/kg	0.0057 %	✓	
6	mercury { mercury dichloride }	080-010-00-X	231-299-8	7487-94-7		0.5 mg/kg	1.353	0.677 mg/kg	0.0000677 %	✓	
7	nickel { nickel dihydroxide }	028-008-00-X	235-008-5 [1] 234-348-1 [2]	12054-48-7 [1] 11113-74-9 [2]		18 mg/kg	1.579	28.431 mg/kg	0.00284 %	✓	
8	selenium { selenium compounds with the exception of cadmium sulphoselenide and those specified elsewhere in this Annex }	034-002-00-8				1 mg/kg	2.554	2.554 mg/kg	0.000255 %	✓	
9	zinc { zinc chromate }	024-007-00-3				69 mg/kg	2.774	191.416 mg/kg	0.0191 %	✓	
10	cyanides { salts of hydrogen cyanide with the exception of complex cyanides such as ferrocyanides, ferricyanides and mercuric oxycyanide and those specified elsewhere in this Annex }	006-007-00-5				1 mg/kg	1.884	1.884 mg/kg	0.000188 %	✓	
11	chromium (VI) compounds, with the exception of barium chromate and of compounds specified elsewhere in this Annex	024-017-00-8				0.8 mg/kg		0.8 mg/kg	0.00008 %	✓	
12	boron { boron tribromide/trichloride/trifluoride (combined) }			10294-33-4, 10294-34-5, 7637-07-2		0.9 mg/kg	13.43	12.087 mg/kg	0.00121 %	✓	

#		Determinand			CLP Note	User entered data		Conv. Factor	Compound conc.		Classification value	MC Applied	Conc. Not Used
		CLP index number	EC Number	CAS Number									
13		naphthalene				0.1	mg/kg		0.1	mg/kg	0.00001 %	✓	
		601-052-00-2	202-049-5	91-20-3									
14	●	acenaphthylene				0.1	mg/kg		0.1	mg/kg	0.00001 %	✓	
			205-917-1	208-96-8									
15	●	acenaphthene				0.1	mg/kg		0.1	mg/kg	0.00001 %	✓	
			201-469-6	83-32-9									
16	●	fluorene				0.1	mg/kg		0.1	mg/kg	0.00001 %	✓	
			201-695-5	86-73-7									
17	●	phenanthrene				0.2	mg/kg		0.2	mg/kg	0.00002 %	✓	
			201-581-5	85-01-8									
18	●	anthracene				0.1	mg/kg		0.1	mg/kg	0.00001 %	✓	
			204-371-1	120-12-7									
19	●	fluoranthene				0.4	mg/kg		0.4	mg/kg	0.00004 %	✓	
			205-912-4	206-44-0									
20	●	pyrene				0.3	mg/kg		0.3	mg/kg	0.00003 %	✓	
			204-927-3	129-00-0									
21		benzo[a]anthracene				0.2	mg/kg		0.2	mg/kg	0.00002 %	✓	
		601-033-00-9	200-280-6	56-55-3									
22		chrysene				0.2	mg/kg		0.2	mg/kg	0.00002 %	✓	
		601-048-00-0	205-923-4	218-01-9									
23		benzo[b]fluoranthene				0.2	mg/kg		0.2	mg/kg	0.00002 %	✓	
		601-034-00-4	205-911-9	205-99-2									
24		benzo[k]fluoranthene				0.2	mg/kg		0.2	mg/kg	0.00002 %	✓	
		601-036-00-5	205-916-6	207-08-9									
25		benzo[a]pyrene; benzo[def]chrysene				0.2	mg/kg		0.2	mg/kg	0.00002 %	✓	
		601-032-00-3	200-028-5	50-32-8									
26	●	indeno[123-cd]pyrene				0.1	mg/kg		0.1	mg/kg	0.00001 %	✓	
			205-893-2	193-39-5									
27		dibenz[a,h]anthracene				0.1	mg/kg		0.1	mg/kg	0.00001 %	✓	
		601-041-00-2	200-181-8	53-70-3									
28	●	benzo[ghi]perylene				0.1	mg/kg		0.1	mg/kg	0.00001 %	✓	
			205-883-8	191-24-2									
29		benzene				0.01	mg/kg		0.01	mg/kg	0.000001 %	✓	
		601-020-00-8	200-753-7	71-43-2									
30		toluene				0.01	mg/kg		0.01	mg/kg	0.000001 %	✓	
		601-021-00-3	203-625-9	108-88-3									
31	●	ethylbenzene				0.01	mg/kg		0.01	mg/kg	0.000001 %	✓	
		601-023-00-4	202-849-4	100-41-4									
32		xylene				0.01	mg/kg		0.01	mg/kg	0.000001 %	✓	
		601-022-00-9	202-422-2 [1] 203-396-5 [2] 203-576-3 [3] 215-535-7 [4]	95-47-6 [1] 106-42-3 [2] 108-38-3 [3] 1330-20-7 [4]									
33	●	diesel petroleum group				76.4	mg/kg		76.4	mg/kg	0.00764 %	✓	
				68334-30-5, 68476-34-6, 94114-59-7, 1159170-26-9									
34	●	TPH (C6 to C40) petroleum group				76.4	mg/kg		76.4	mg/kg	0.00764 %	✓	
				TPH									
35	●	petrol (gasoline) petroleum group				76.4	mg/kg		76.4	mg/kg	0.00764 %	✓	
36	●	heavy/residual fuel oils petroleum group				76.4	mg/kg		76.4	mg/kg	0.00764 %	✓	
37	●	crude oils petroleum group				76.4	mg/kg		76.4	mg/kg	0.00764 %	✓	
										Total:	0.0737 %		

Key

	User supplied data
	Determinand defined or amended by HazWasteOnline (see Appendix A)
	Speciated Deteminand - Unless the Determinand is Note 1, the Conversion Factor is used to calculate the compound concentration
CLP: Note 1	Only the metal concentration has been used for classification

Supplementary Hazardous Property Information

HP 3(i): Flammable "flammable liquid waste: liquid waste having a flash point below 60°C or waste gas oil, diesel and light heating oils having a flash point > 55°C and <= 75°C"

Force this Hazardous property to non hazardous because BTEX concentrations below LOD. True petroleum group concentrations significantly lower - in absence of individual concentrations, same TPH concentration value used repeatedly. True concentration not considered high enough to pose serious flammability risk.

Hazard Statements hit:

Flam. Liq. 1; H224 "Extremely flammable liquid and vapour."

Because of determinand:

petrol (gasoline) petroleum group: (conc.: 0.00764%)

Flam. Liq. 2; H225 "Highly flammable liquid and vapour."

Because of determinands:

benzene: (conc.: 1.0e-06%)
toluene: (conc.: 1.0e-06%)
ethylbenzene: (conc.: 1.0e-06%)
crude oils petroleum group: (conc.: 0.00764%)

Flam. Liq. 3; H226 "Flammable liquid and vapour."

Because of determinands:

xylene: (conc.: 1.0e-06%)
diesel petroleum group: (conc.: 0.00764%)
TPH (C6 to C40) petroleum group: (conc.: 0.00764%)

Classification of sample: WS3

Non Hazardous Waste
Classified as **17 05 04**
in the List of Waste

Sample details

Sample Name:	LoW Code:
WS3	Chapter: 17: Construction and Demolition Wastes (including excavated soil from contaminated sites)
Sample Depth:	
0.5 m	Entry: 17 05 04 (Soil and stones other than those mentioned in 17 05 03)

Hazard properties

None identified

Determinands

Moisture content: 0% Dry Weight Moisture Correction applied (MC)

#	Determinand	CLP index number	EC Number	CAS Number	CLP Note	User entered data	Conv. Factor	Compound conc.	Classification value	MC Applied	Conc. Not Used
1	arsenic { arsenic trioxide }	033-003-00-0	215-481-4	1327-53-3		5.8 mg/kg	1.32	7.658 mg/kg	0.000766 %	✓	
2	cadmium { cadmium sulfide }	048-010-00-4	215-147-8	1306-23-6	1	0.5 mg/kg	1.285	0.643 mg/kg	0.00005 %	✓	
3	chromium(III) oxide		215-160-9	1308-38-9		20 mg/kg		20 mg/kg	0.002 %	✓	
4	copper { dicopper oxide; copper (I) oxide }	029-002-00-X	215-270-7	1317-39-1		16 mg/kg	1.126	18.014 mg/kg	0.0018 %	✓	
5	lead { lead chromate }	082-004-00-2	231-846-0	7758-97-6	1	28 mg/kg	1.56	43.675 mg/kg	0.0028 %	✓	
6	mercury { mercury dichloride }	080-010-00-X	231-299-8	7487-94-7		0.5 mg/kg	1.353	0.677 mg/kg	0.0000677 %	✓	
7	nickel { nickel dihydroxide }	028-008-00-X	235-008-5 [1] 234-348-1 [2]	12054-48-7 [1] 11113-74-9 [2]		17 mg/kg	1.579	26.851 mg/kg	0.00269 %	✓	
8	selenium { selenium compounds with the exception of cadmium sulphoselenide and those specified elsewhere in this Annex }	034-002-00-8				1 mg/kg	2.554	2.554 mg/kg	0.000255 %	✓	
9	zinc { zinc chromate }	024-007-00-3				73 mg/kg	2.774	202.513 mg/kg	0.0203 %	✓	
10	cyanides { salts of hydrogen cyanide with the exception of complex cyanides such as ferrocyanides, ferricyanides and mercuric oxycyanide and those specified elsewhere in this Annex }	006-007-00-5				1 mg/kg	1.884	1.884 mg/kg	0.000188 %	✓	
11	chromium (VI) compounds, with the exception of barium chromate and of compounds specified elsewhere in this Annex	024-017-00-8				0.8 mg/kg		0.8 mg/kg	0.00008 %	✓	
12	boron { boron tribromide/trichloride/trifluoride (combined) }			10294-33-4, 10294-34-5, 7637-07-2		0.8 mg/kg	13.43	10.744 mg/kg	0.00107 %	✓	

#		Determinand			CLP Note	User entered data		Conv. Factor	Compound conc.		Classification value	MC Applied	Conc. Not Used
		CLP index number	EC Number	CAS Number									
13		naphthalene				0.1	mg/kg		0.1	mg/kg	0.00001 %	✓	
		601-052-00-2	202-049-5	91-20-3									
14		acenaphthylene				0.1	mg/kg		0.1	mg/kg	0.00001 %	✓	
			205-917-1	208-96-8									
15		acenaphthene				0.1	mg/kg		0.1	mg/kg	0.00001 %	✓	
			201-469-6	83-32-9									
16		fluorene				0.1	mg/kg		0.1	mg/kg	0.00001 %	✓	
			201-695-5	86-73-7									
17		phenanthrene				0.6	mg/kg		0.6	mg/kg	0.00006 %	✓	
			201-581-5	85-01-8									
18		anthracene				0.1	mg/kg		0.1	mg/kg	0.00001 %	✓	
			204-371-1	120-12-7									
19		fluoranthene				1.2	mg/kg		1.2	mg/kg	0.00012 %	✓	
			205-912-4	206-44-0									
20		pyrene				1.2	mg/kg		1.2	mg/kg	0.00012 %	✓	
			204-927-3	129-00-0									
21		benzo[a]anthracene				0.6	mg/kg		0.6	mg/kg	0.00006 %	✓	
		601-033-00-9	200-280-6	56-55-3									
22		chrysene				0.8	mg/kg		0.8	mg/kg	0.00008 %	✓	
		601-048-00-0	205-923-4	218-01-9									
23		benzo[b]fluoranthene				0.7	mg/kg		0.7	mg/kg	0.00007 %	✓	
		601-034-00-4	205-911-9	205-99-2									
24		benzo[k]fluoranthene				0.7	mg/kg		0.7	mg/kg	0.00007 %	✓	
		601-036-00-5	205-916-6	207-08-9									
25		benzo[a]pyrene; benzo[def]chrysene				0.6	mg/kg		0.6	mg/kg	0.00006 %	✓	
		601-032-00-3	200-028-5	50-32-8									
26		indeno[123-cd]pyrene				0.5	mg/kg		0.5	mg/kg	0.00005 %	✓	
			205-893-2	193-39-5									
27		dibenz[a,h]anthracene				0.2	mg/kg		0.2	mg/kg	0.00002 %	✓	
		601-041-00-2	200-181-8	53-70-3									
28		benzo[ghi]perylene				0.5	mg/kg		0.5	mg/kg	0.00005 %	✓	
			205-883-8	191-24-2									
29		benzene				0.01	mg/kg		0.01	mg/kg	0.000001 %	✓	
		601-020-00-8	200-753-7	71-43-2									
30		toluene				0.01	mg/kg		0.01	mg/kg	0.000001 %	✓	
		601-021-00-3	203-625-9	108-88-3									
31		ethylbenzene				0.01	mg/kg		0.01	mg/kg	0.000001 %	✓	
		601-023-00-4	202-849-4	100-41-4									
32		xylene				0.01	mg/kg		0.01	mg/kg	0.000001 %	✓	
		601-022-00-9	202-422-2 [1] 203-396-5 [2] 203-576-3 [3] 215-535-7 [4]	95-47-6 [1] 106-42-3 [2] 108-38-3 [3] 1330-20-7 [4]									
33		diesel petroleum group				417	mg/kg		417	mg/kg	0.0417 %	✓	
				68334-30-5, 68476-34-6, 94114-59-7, 1159170-26-9									
34		TPH (C6 to C40) petroleum group				417	mg/kg		417	mg/kg	0.0417 %	✓	
				TPH									
35		petrol (gasoline) petroleum group				417	mg/kg		417	mg/kg	0.0417 %	✓	
36		heavy/residual fuel oils petroleum group				417	mg/kg		417	mg/kg	0.0417 %	✓	
37		crude oils petroleum group				417	mg/kg		417	mg/kg	0.0417 %	✓	
										Total:	0.241 %		

Key	
	User supplied data
	Determinand defined or amended by HazWasteOnline (see Appendix A)
	Speciated Deteminand - Unless the Determinand is Note 1, the Conversion Factor is used to calculate the compound concentration
CLP: Note 1	Only the metal concentration has been used for classification

Supplementary Hazardous Property Information

HP 3(i): Flammable "flammable liquid waste: liquid waste having a flash point below 60°C or waste gas oil, diesel and light heating oils having a flash point > 55°C and <= 75°C"

Force this Hazardous property to non hazardous because BTEX concentrations below LOD. True petroleum group concentrations significantly lower - in absence of individual concentrations, same TPH concentration value used repeatedly. True concentration not considered high enough to pose serious flammability risk.

Hazard Statements hit:

Flam. Liq. 1; H224 "Extremely flammable liquid and vapour."

Because of determinand:

petrol (gasoline) petroleum group: (conc.: 0.0417%)

Flam. Liq. 2; H225 "Highly flammable liquid and vapour."

Because of determinands:

benzene: (conc.: 1.0e-06%)
toluene: (conc.: 1.0e-06%)
ethylbenzene: (conc.: 1.0e-06%)
crude oils petroleum group: (conc.: 0.0417%)

Flam. Liq. 3; H226 "Flammable liquid and vapour."

Because of determinands:

xylene: (conc.: 1.0e-06%)
diesel petroleum group: (conc.: 0.0417%)
TPH (C6 to C40) petroleum group: (conc.: 0.0417%)

Classification of sample: WS4

Non Hazardous Waste
Classified as **17 05 04**
in the List of Waste

Sample details

Sample Name:
WS4
Sample Depth:
0.3 m

LoW Code:
Chapter: 17: Construction and Demolition Wastes (including excavated soil from contaminated sites)
Entry: 17 05 04 (Soil and stones other than those mentioned in 17 05 03)

Hazard properties

None identified

Determinands

Moisture content: 0% Dry Weight Moisture Correction applied (MC)

#	Determinand	CLP Note	User entered data	Conv. Factor	Compound conc.	Classification value	MC Applied	Conc. Not Used
	CLP index number / EC Number / CAS Number							
1	arsenic { arsenic trioxide }		8.8 mg/kg	1.32	11.619 mg/kg	0.00116 %	✓	
	033-003-00-0 / 215-481-4 / 1327-53-3							
2	cadmium { cadmium sulfide }	1	0.5 mg/kg	1.285	0.643 mg/kg	0.00005 %	✓	
	048-010-00-4 / 215-147-8 / 1306-23-6							
3	chromium(III) oxide		19 mg/kg		19 mg/kg	0.0019 %	✓	
	215-160-9 / 1308-38-9							
4	copper { dicopper oxide; copper (I) oxide }		30 mg/kg	1.126	33.777 mg/kg	0.00338 %	✓	
	029-002-00-X / 215-270-7 / 1317-39-1							
5	lead { lead chromate }	1	67 mg/kg	1.56	104.508 mg/kg	0.0067 %	✓	
	082-004-00-2 / 231-846-0 / 7758-97-6							
6	mercury { mercury dichloride }		0.5 mg/kg	1.353	0.677 mg/kg	0.0000677 %	✓	
	080-010-00-X / 231-299-8 / 7487-94-7							
7	nickel { nickel dihydroxide }		18 mg/kg	1.579	28.431 mg/kg	0.00284 %	✓	
	028-008-00-X / 235-008-5 [1] 234-348-1 [2] / 12054-48-7 [1] 11113-74-9 [2]							
8	selenium { selenium compounds with the exception of cadmium sulphoselenide and those specified elsewhere in this Annex }		1 mg/kg	2.554	2.554 mg/kg	0.000255 %	✓	
	034-002-00-8							
9	zinc { zinc chromate }		70 mg/kg	2.774	194.19 mg/kg	0.0194 %	✓	
	024-007-00-3							
10	cyanides { salts of hydrogen cyanide with the exception of complex cyanides such as ferrocyanides, ferricyanides and mercuric oxycyanide and those specified elsewhere in this Annex }		1 mg/kg	1.884	1.884 mg/kg	0.000188 %	✓	
	006-007-00-5							
11	chromium (VI) compounds, with the exception of barium chromate and of compounds specified elsewhere in this Annex		0.8 mg/kg		0.8 mg/kg	0.00008 %	✓	
	024-017-00-8							
12	boron { boron tribromide/trichloride/trifluoride (combined) }		0.8 mg/kg	13.43	10.744 mg/kg	0.00107 %	✓	
	10294-33-4, 10294-34-5, 7637-07-2							

#		Determinand			CLP Note	User entered data		Conv. Factor	Compound conc.		Classification value	MC Applied	Conc. Not Used
		CLP index number	EC Number	CAS Number									
13		naphthalene				0.5	mg/kg		0.5	mg/kg	0.00005 %	✓	
		601-052-00-2	202-049-5	91-20-3									
14		acenaphthylene				0.1	mg/kg		0.1	mg/kg	0.00001 %	✓	
			205-917-1	208-96-8									
15		acenaphthene				0.8	mg/kg		0.8	mg/kg	0.00008 %	✓	
			201-469-6	83-32-9									
16		fluorene				0.6	mg/kg		0.6	mg/kg	0.00006 %	✓	
			201-695-5	86-73-7									
17		phenanthrene				0.1	mg/kg		0.1	mg/kg	0.00001 %	✓	
			201-581-5	85-01-8									
18		anthracene				1.7	mg/kg		1.7	mg/kg	0.00017 %	✓	
			204-371-1	120-12-7									
19		fluoranthene				11	mg/kg		11	mg/kg	0.0011 %	✓	
			205-912-4	206-44-0									
20		pyrene				10.3	mg/kg		10.3	mg/kg	0.00103 %	✓	
			204-927-3	129-00-0									
21		benzo[a]anthracene				4.9	mg/kg		4.9	mg/kg	0.00049 %	✓	
		601-033-00-9	200-280-6	56-55-3									
22		chrysene				6.1	mg/kg		6.1	mg/kg	0.00061 %	✓	
		601-048-00-0	205-923-4	218-01-9									
23		benzo[b]fluoranthene				5.6	mg/kg		5.6	mg/kg	0.00056 %	✓	
		601-034-00-4	205-911-9	205-99-2									
24		benzo[k]fluoranthene				5.2	mg/kg		5.2	mg/kg	0.00052 %	✓	
		601-036-00-5	205-916-6	207-08-9									
25		benzo[a]pyrene; benzo[def]chrysene				5.1	mg/kg		5.1	mg/kg	0.00051 %	✓	
		601-032-00-3	200-028-5	50-32-8									
26		indeno[123-cd]pyrene				3.2	mg/kg		3.2	mg/kg	0.00032 %	✓	
			205-893-2	193-39-5									
27		dibenz[a,h]anthracene				0.8	mg/kg		0.8	mg/kg	0.00008 %	✓	
		601-041-00-2	200-181-8	53-70-3									
28		benzo[ghi]perylene				3	mg/kg		3	mg/kg	0.0003 %	✓	
			205-883-8	191-24-2									
29		benzene				0.01	mg/kg		0.01	mg/kg	0.000001 %	✓	
		601-020-00-8	200-753-7	71-43-2									
30		toluene				0.01	mg/kg		0.01	mg/kg	0.000001 %	✓	
		601-021-00-3	203-625-9	108-88-3									
31		ethylbenzene				0.01	mg/kg		0.01	mg/kg	0.000001 %	✓	
		601-023-00-4	202-849-4	100-41-4									
32		xylene				0.01	mg/kg		0.01	mg/kg	0.000001 %	✓	
		601-022-00-9	202-422-2 [1] 203-396-5 [2] 203-576-3 [3] 215-535-7 [4]	95-47-6 [1] 106-42-3 [2] 108-38-3 [3] 1330-20-7 [4]									
33		diesel petroleum group				456	mg/kg		456	mg/kg	0.0456 %	✓	
				68334-30-5, 68476-34-6, 94114-59-7, 1159170-26-9									
34		TPH (C6 to C40) petroleum group				456	mg/kg		456	mg/kg	0.0456 %	✓	
				TPH									
35		petrol (gasoline) petroleum group				456	mg/kg		456	mg/kg	0.0456 %	✓	
36		heavy/residual fuel oils petroleum group				456	mg/kg		456	mg/kg	0.0456 %	✓	
37		crude oils petroleum group				456	mg/kg		456	mg/kg	0.0456 %	✓	
										Total:	0.271 %		

Key	
	User supplied data
	Determinand defined or amended by HazWasteOnline (see Appendix A)
	Speciated Deteminand - Unless the Determinand is Note 1, the Conversion Factor is used to calculate the compound concentration
CLP: Note 1	Only the metal concentration has been used for classification

Supplementary Hazardous Property Information

HP 3(i): Flammable "flammable liquid waste: liquid waste having a flash point below 60°C or waste gas oil, diesel and light heating oils having a flash point > 55°C and <= 75°C"

Force this Hazardous property to non hazardous because BTEX concentrations below LOD. True petroleum group concentrations significantly lower - in absence of individual concentrations, same TPH concentration value used repeatedly. True concentration not considered high enough to pose serious flammability risk.

Hazard Statements hit:

Flam. Liq. 1; H224 "Extremely flammable liquid and vapour."

Because of determinand:

petrol (gasoline) petroleum group: (conc.: 0.0456%)

Flam. Liq. 2; H225 "Highly flammable liquid and vapour."

Because of determinands:

benzene: (conc.: 1.0e-06%)
toluene: (conc.: 1.0e-06%)
ethylbenzene: (conc.: 1.0e-06%)
crude oils petroleum group: (conc.: 0.0456%)

Flam. Liq. 3; H226 "Flammable liquid and vapour."

Because of determinands:

xylene: (conc.: 1.0e-06%)
diesel petroleum group: (conc.: 0.0456%)
TPH (C6 to C40) petroleum group: (conc.: 0.0456%)

Appendix A: Classifier defined and non CLP determinands

chromium(III) oxide (EC Number: 215-160-9, CAS Number: 1308-38-9)

Conversion factor: 1.462
Description/Comments: Data from C&L Inventory Database
Data source: http://echa.europa.eu/web/guest/information-on-chemicals/cl-inventory-database
Data source date: 17 Jul 2015
Risk Phrases: R61 , R60 , R50/53 , R43 , R42 , R38 , R37 , R36 , R22 , R20
Hazard Statements: Aquatic Chronic 1 H410 , Aquatic Acute 1 H400 , Repr. 1B H360FD , Skin Sens. 1 H317 , Resp. Sens. 1 H334 , Skin Irrit. 2 H315 , STOT SE 3 H335 , Eye Irrit. 2 H319 , Acute Tox. 4 H302 , Acute Tox. 4 H332

dicopper oxide; copper (I) oxide (EC Number: 215-270-7, CAS Number: 1317-39-1)

CLP index number: 029-002-00-X
Description/Comments: M-factor for long-term aquatic hazard not included as per paragraph (5), ATP9
Data source: Regulation (EU) 2016/1179 of 19 July 2016 (ATP9)
Additional Risk Phrases: N R50/53 >= 0.25 %, N R50/53
Additional Hazard Statement(s): None.
Reason for additional Hazards Statement(s)/Risk Phrase(s):
10 Oct 2016 - N R50/53 >= 0.25 % risk phrase sourced from: WM3 v1 still uses ecotoxic risk phrases
10 Oct 2016 - N R50/53 risk phrase sourced from: WM3 v1 still uses ecotoxic risk phrases

salts of hydrogen cyanide with the exception of complex cyanides such as ferrocyanides, ferricyanides and mercuric oxycyanide and those specified elsewhere in this Annex

CLP index number: 006-007-00-5
Description/Comments: Conversion factor based on a worst case compound: sodium cyanide
Data source: Commission Regulation (EC) No 790/2009 - 1st Adaptation to Technical Progress for Regulation (EC) No 1272/2008. (ATP1)
Additional Risk Phrases: None.
Additional Hazard Statement(s): EUH032 >= 0.2 %
Reason for additional Hazards Statement(s)/Risk Phrase(s):
14 Dec 2015 - EUH032 >= 0.2 % hazard statement sourced from: WM3, Table C12.2

boron tribromide/trichloride/trifluoride (combined) (CAS Number: 10294-33-4, 10294-34-5, 7637-07-2)

Conversion factor: 13.43
Description/Comments: Combines the hazard statements and the average of the conversion factors for boron tribromide, boron trichloride and boron trifluoride
Data source: N/A
Data source date: 06 Aug 2015
Risk Phrases: C R35 , C R34 , T+ R26/28 , R14
Hazard Statements: Skin Corr. 1B H314 , Skin Corr. 1A H314 , Acute Tox. 2 H300 , Acute Tox. 2 H330 , EUH014

acenaphthylene (EC Number: 205-917-1, CAS Number: 208-96-8)

Description/Comments: Data from C&L Inventory Database
Data source: http://echa.europa.eu/web/guest/information-on-chemicals/cl-inventory-database
Data source date: 17 Jul 2015
Risk Phrases: R38 , R37 , R36 , R27 , R26 , R22
Hazard Statements: Skin Irrit. 2 H315 , STOT SE 3 H335 , Eye Irrit. 2 H319 , Acute Tox. 1 H310 , Acute Tox. 1 H330 , Acute Tox. 4 H302

acenaphthene (EC Number: 201-469-6, CAS Number: 83-32-9)

Description/Comments: Data from C&L Inventory Database
Data source: http://echa.europa.eu/web/guest/information-on-chemicals/cl-inventory-database
Data source date: 17 Jul 2015
Risk Phrases: N R51/53 , N R50/53 , R38 , R37 , R36
Hazard Statements: Aquatic Chronic 2 H411 , Aquatic Chronic 1 H410 , Aquatic Acute 1 H400 , Skin Irrit. 2 H315 , STOT SE 3 H335 , Eye Irrit. 2 H319

fluorene (EC Number: 201-695-5, CAS Number: 86-73-7)

Description/Comments: Data from C&L Inventory Database
Data source: http://echa.europa.eu/web/guest/information-on-chemicals/cl-inventory-database
Data source date: 06 Aug 2015
Risk Phrases: N R50/53
Hazard Statements: Aquatic Chronic 1 H410 , Aquatic Acute 1 H400

- **phenanthrene** (EC Number: 201-581-5, CAS Number: 85-01-8)

Description/Comments: Data from C&L Inventory Database
Data source: http://echa.europa.eu/web/guest/information-on-chemicals/cl-inventory-database
Data source date: 06 Aug 2015
Risk Phrases: N R50/53 , R43 , R40 , R38 , R37 , R36 , R22
Hazard Statements: Skin Irrit. 2 H315 , Aquatic Chronic 1 H410 , Aquatic Acute 1 H400 , Skin Sens. 1 H317 , Carc. 2 H351 , STOT SE 3 H335 , Eye Irrit. 2 H319 , Acute Tox. 4 H302

- **anthracene** (EC Number: 204-371-1, CAS Number: 120-12-7)

Description/Comments: Data from C&L Inventory Database
Data source: http://echa.europa.eu/web/guest/information-on-chemicals/cl-inventory-database
Data source date: 17 Jul 2015
Risk Phrases: N R50/53 , R43 , R38 , R37 , R36
Hazard Statements: Aquatic Chronic 1 H410 , Aquatic Acute 1 H400 , Skin Sens. 1 H317 , Skin Irrit. 2 H315 , STOT SE 3 H335 , Eye Irrit. 2 H319

- **fluoranthene** (EC Number: 205-912-4, CAS Number: 206-44-0)

Description/Comments: Data from C&L Inventory Database
Data source: http://echa.europa.eu/web/guest/information-on-chemicals/cl-inventory-database
Data source date: 21 Aug 2015
Risk Phrases: N R50/53 , Xn R22
Hazard Statements: Aquatic Chronic 1 H410 , Aquatic Acute 1 H400 , Acute Tox. 4 H302

- **pyrene** (EC Number: 204-927-3, CAS Number: 129-00-0)

Description/Comments: Data from C&L Inventory Database; SDS Sigma Aldrich 2014
Data source: http://echa.europa.eu/web/guest/information-on-chemicals/cl-inventory-database
Data source date: 21 Aug 2015
Risk Phrases: N R50/53 , Xi R36/37/38
Hazard Statements: Aquatic Chronic 1 H410 , Aquatic Acute 1 H400 , STOT SE 3 H335 , Eye Irrit. 2 H319 , Skin Irrit. 2 H315

- **indeno[123-cd]pyrene** (EC Number: 205-893-2, CAS Number: 193-39-5)

Description/Comments: Data from C&L Inventory Database
Data source: http://echa.europa.eu/web/guest/information-on-chemicals/cl-inventory-database
Data source date: 06 Aug 2015
Risk Phrases: R40
Hazard Statements: Carc. 2 H351

- **benzo[ghi]perylene** (EC Number: 205-883-8, CAS Number: 191-24-2)

Description/Comments: Data from C&L Inventory Database; SDS Sigma Aldrich 28/02/2015
Data source: http://echa.europa.eu/web/guest/information-on-chemicals/cl-inventory-database
Data source date: 23 Jul 2015
Risk Phrases: N R50/53
Hazard Statements: Aquatic Chronic 1 H410 , Aquatic Acute 1 H400

- **ethylbenzene** (EC Number: 202-849-4, CAS Number: 100-41-4)

CLP index number: 601-023-00-4
Description/Comments:
Data source: Commission Regulation (EU) No 605/2014 – 6th Adaptation to Technical Progress for Regulation (EC) No 1272/2008. (ATP6)
Additional Risk Phrases: None.
Additional Hazard Statement(s): Carc. 2 H351
Reason for additional Hazards Statement(s)/Risk Phrase(s):
03 Jun 2015 - Carc. 2 H351 hazard statement sourced from: IARC Group 2B (77) 2000

- **diesel petroleum group** (CAS Number: 68334-30-5, 68476-34-6, 94114-59-7, 1159170-26-9)

Description/Comments: Hazard statements taken from WM3 1st Edition 2015; Risk phrases: WM2 3rd Edition 2013
Data source: WM3 1st Edition 2015
Data source date: 25 May 2015
Risk Phrases: R66 , R65 , R51/53 , R40
Hazard Statements: Aquatic Chronic 2 H411 , STOT RE 2 H373 , Asp. Tox. 1 H304 , Carc. 2 H351 , Acute Tox. 4 H332 , Skin Irrit. 2 H315 , Flam. Liq. 3 H226

TPH (C6 to C40) petroleum group (CAS Number: TPH)

Description/Comments: Hazard statements taken from WM3 1st Edition 2015; Risk phrases: WM2 3rd Edition 2013
Data source: WM3 1st Edition 2015
Data source date: 25 May 2015
Risk Phrases: R65 , R63 , R51/53 , R46 , R45 , R10
Hazard Statements: Aquatic Chronic 2 H411 , Repr. 2 H361d , Carc. 1B H350 , Muta. 1B H340 , STOT RE 2 H373 , Asp. Tox. 1 H304 , Flam. Liq. 3 H226

petrol (gasoline) petroleum group

Description/Comments: Hazard statements taken from WM3 1st Edition 2015; Risk phrases: WM2 3rd Edition 2013
Data source: WM3 1st Edition 2015
Data source date: 25 May 2015
Risk Phrases: R67 , R65 , R63 , R51/53 , R46 , R45 , R38 , R12
Hazard Statements: Aquatic Chronic 2 H411 , Asp. Tox. 1 H304 , STOT SE 3 H336 , Repr. 2 H361d , Carc. 1B H350 , Muta. 1B H340 , Skin Irrit. 2 H315 , Flam. Liq. 1 H224

heavy/residual fuel oils petroleum group

Description/Comments: Hazard statements taken from WM3 1st Edition 2015; Risk phrases: WM2 3rd Edition 2013
Data source: WM3 1st Edition 2015
Data source date: 25 May 2015
Risk Phrases: R66 , R63 , R50/53 , R48/21 , R45
Hazard Statements: Aquatic Chronic 2 H411 , STOT RE 2 H373 , Repr. 2 H361d , Acute Tox. 4 H332 , Carc. 1B H350 , Muta. 1B H340

crude oils petroleum group

Description/Comments: Hazard statements taken from WM3 1st Edition 2015; Risk phrases: WM2 3rd Edition 2013
Data source: WM3 1st Edition 2015
Data source date: 25 May 2015
Risk Phrases: R65 , R52/53 , R45 , R10
Hazard Statements: Aquatic Chronic 2 H411 , STOT SE 3 H336 , STOT RE 2 H373 , Asp. Tox. 1 H304 , Eye Irrit. 2 H319 , Carc. 1B H350 , Flam. Liq. 2 H225

Appendix B: Rationale for selection of metal species

arsenic {arsenic trioxide}

Worst case species based on risk phrases

cadmium {cadmium sulfide}

Worst case species based on risk phrases

copper {dicopper oxide; copper (I) oxide}

Most likely common species

lead {lead chromate}

Worst case species based on risk phrases

mercury {mercury dichloride}

Worst case species based on risk phrases

nickel {nickel dihydroxide}

Worst case species based on risk phrases

selenium {selenium compounds with the exception of cadmium sulphoselenide and those specified elsewhere in this Annex}

Worst case species based on risk phrases

zinc {zinc chromate}

Worst case species based on risk phrases

cyanides {salts of hydrogen cyanide with the exception of complex cyanides such as ferrocyanides, ferricyanides and mercuric oxycyanide and those specified elsewhere in this Annex}

Worst case species

boron {boron tribromide/trichloride/trifluoride (combined)}

Worst case species based on risk phrases

Appendix C: Version

HazWasteOnline Classification Engine: WM3 1st Edition, May 2015
HazWasteOnline Classification Engine Version: 2018.270.3646.7451 (27 Sep 2018)
HazWasteOnline Database: 2018.270.3646.7451 (27 Sep 2018)

This classification utilises the following guidance and legislation:
WM3 - Waste Classification - May 2015
CLP Regulation - Regulation 1272/2008/EC of 16 December 2008
1st ATP - Regulation 790/2009/EC of 10 August 2009
2nd ATP - Regulation 286/2011/EC of 10 March 2011
3rd ATP - Regulation 618/2012/EU of 10 July 2012
4th ATP - Regulation 487/2013/EU of 8 May 2013
Correction to 1st ATP - Regulation 758/2013/EU of 7 August 2013
5th ATP - Regulation 944/2013/EU of 2 October 2013
6th ATP - Regulation 605/2014/EU of 5 June 2014
WFD Annex III replacement - Regulation 1357/2014/EU of 18 December 2014
Revised List of Wastes 2014 - Decision 2014/955/EU of 18 December 2014
7th ATP - Regulation 2015/1221/EU of 24 July 2015
8th ATP - Regulation (EU) 2016/918 of 19 May 2016
9th ATP - Regulation (EU) 2016/1179 of 19 July 2016
10th ATP - Regulation (EU) 2017/776 of 4 May 2017
POPs Regulation 2004 - Regulation 850/2004/EC of 29 April 2004
1st ATP to POPs Regulation - Regulation 756/2010/EU of 24 August 2010
2nd ATP to POPs Regulation - Regulation 757/2010/EU of 24 August 2010

APPENDIX K

MONITORING DATA

GAS & GROUNDWATER MONITORING RESULTS

	Date:	15-Aug-18	22-Aug-18	31-Aug-18	14-Sep-18								
	Visit Number	1	2	3	4								
	Atmos Press (mb)	1016	1008	1017	1017								
	Pressure Trend	Steady	Steady	Steady	Steady								
	Air Temp (°C)	20	18	17	13								
	Cloud cover	Overcast	Overcast	High cloud	Overcast								
	Wind	Windy	Windy	Light breeze	Light breeze								
	Precipitation	Dry	Dry	Dry	Dry								
	State of Ground	Dry	Dry	Dry	Dry								
WS1	CH_4 (%) (max/steady):	Nil	Nil	Nil	Nil								
	CO_2 (%) (max/steady):	Nil	Nil	Nil	Nil								
	O_2 (%) (max/steady):	18.7	18.6	18.6	18.7								
	H_2S (ppm) (max/steady):	Nil	Nil	Nil	Nil								
	CO (ppm) (max/steady):	Nil	Nil	Nil	Nil								
	PID (ppm) (max/steady)	0.0	0.0	0.0	0.0								
	Flow (l/hr) (max/steady)	<0.1	<0.1	<0.1	<0.1								
	Water Level / depth to base (m):	1.05 / 3.50	1.02 / 3.50	0.91 / 3.50	0.86 / 3.50								
WS3	CH_4 (%) (max/steady):	Nil	Nil	Nil	Nil								
	CO_2 (%) (max/steady):	Nil	Nil	Nil	Nil								
	O_2 (%) (max/steady):	20.2	20.3	20.2	20.1								
	H_2S (ppm) (max/steady):	Nil	Nil	Nil	Nil								
	CO (ppm) (max/steady):	Nil	Nil	Nil	Nil								
	PID (ppm) (max/steady)	0.0	0.0	0.0	0.0								
	Flow (l/hr) (max/steady)	<0.1	<0.1	<0.1	<0.1								
	Water Level / depth to base (m):	1.74 / 4.00	1.7 / 4.00	1.62 / 4.00	1.59 / 4.00								
BH01	CH_4 (%) (max/steady):	Nil	Nil	Nil	Nil								
	CO_2 (%) (max/steady):	Nil	0.1	Nil	Nil								
	O_2 (%) (max/steady):	20.1	20.0	20.1	20.2								
	H_2S (ppm) (max/steady):	Nil	Nil	Nil	Nil								
	CO (ppm) (max/steady):	Nil	Nil	Nil	Nil								
	PID (ppm) (max/steady)	0.0	0.0	0.0	0.0								
	Flow (l/hr) (max/steady)	<0.1	<0.1	<0.1	<0.1								
	Water Level / depth to base (m):	1.29 /5.00	1.25 / 5.00	1.19 / 5.00	1.15 / 5.00								

Job No: 18-10433 | Site: MONSALL ROAD, MANCHESTER | Instrument: GAS DATA LMXsi

GAS AND WATER MONITORING RESULTS

	Date:	12-Oct-12	22-Oct-12	04-Dec-12	14-Dec-12	08-Jan-13	15-Jan-13						
	Visit Number	1	2	3	4	5	6						
	Atmos Press mb	1002	1016	1001	971	1015	1006						
	Pressure Trend	Rising	Steady	Steady	Steady	Steady	Steady						
	Air Temp °C	8	10	5	6	8	0						
	Cloud cover	Overcast	Overcast	Overcast	Overcast	Overcast	Overcast						
	Wind velocity	Light breeze	Light breeze	Light breeze	Strong wind	Light breeze	Light breeze						
	Precipitation	Showers	Dry	Showers	Showers	Dry	Dry						
	State of Ground	Damp	Dry	Damp	Damp	Dry	Dry						
BH01	CH_4 (%) (max/steady):	NIL	NIL	NIL	NIL	NIL	NIL						
	CO_2 (%) (steady):	0.1	NIL	0.1	NIL	NIL	0.1						
	O_2 (%) (steady):	20.4	20.5	20.4	19.7	19.9	19.8						
	H_2S (ppm) (max/steady):	NIL	NIL	NIL	NIL	NIL	NIL						
	CO (ppm) (max/steady):	NIL	NIL	NIL	NIL	NIL	NIL						
	PID (ppm) (max/steady)	NIL	NIL	NIL	NIL	NIL	NIL						
	Flow (l/hr) (max/steady)	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1						
	Water Level / depth to base (m):	1.34/5.00	1.34/5.00	1.34/5.00	1.34/5.00	1.34/5.00	1.34/5.00						
BH04	CH_4 (%) (max/steady):	NIL	NIL	NIL	NIL	NIL	NIL						
	CO_2 (%) (steady):	0.1	NIL	0.1	NIL	NIL	NIL						
	O_2 (%) (steady):	20.2	20.3	20.1	19.6	19.7	19.8						
	H_2S (ppm) (max/steady):	NIL	NIL	NIL	NIL	NIL	NIL						
	CO (ppm) (max/steady):	NIL	NIL	NIL	NIL	NIL	NIL						
	PID (ppm) (max/steady)	NIL	NIL	NIL	NIL	NIL	NIL						
	Flow (l/hr) (max/steady)	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1						
	Water Level / depth to base (m):	1.30/7.00	1.30/7.00	1.30/7.00	1.30/7.00	1.30/7.00	1.30/7.00						
BH06	CH_4 (%) (max/steady):	NIL	NIL	NIL	NIL	NIL	NIL						
	CO_2 (%) (steady):	0.1	NIL	0.1	NIL	NIL	0.1						
	O_2 (%) (steady):	20.2	20.3	20.2	19.7	19.7	19.8						
	H_2S (ppm) (max/steady):	NIL	NIL	NIL	NIL	NIL	NIL						
	CO (ppm) (max/steady):	NIL	NIL	NIL	NIL	NIL	NIL						
	PID (ppm) (max/steady)	NIL	NIL	NIL	NIL	NIL	NIL						
	Flow (l/hr) (max/steady)	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1						
	Water Level / depth to base (m):	1.72/9.50	1.72/9.50	1.72/9.50	1.72/9.50	1.72/9.50	1.72/9.50						

Job No: 12-6768	Site: MONSALL ROAD, MANCHESTER

INSTRUMENT: GAS DATA LMSxi GAS ANALYSER	

TEST DATE AND CONDITIONS		
Date	20/06/2018	
Atmospheric Pressure	1000	mB
Ambient Temperature	23.4	°C
Environics Serial No.	5089	

GAS DATA LTD
Unit 4, Fairfield Court
Seven Stars Estate
Wheler Rd
Coventry
CV3 4LJ
Tel 02476303311 Fax 02476307711

GFM436 Final Inspection & Calibration Check Certificate

Customer	C C Geotechnical
Certificate Number	120242
Order Number	319979

Serial Number	12220
Software Version	G436-00.0027/0009

Recalibration DUE Date
20/06/2019

Instrument Checks					
Keyboard	✓		Display Contrast	✓	
Pump Flow In	450	*Accept > 200 cc/min*	Pump Flow @ -200mB	250	*Accept > 200 cc/min*
Clock Set / Running	✓		Labels Fitted	✓	

Gas Checks						
Sensor	CH_4		CO_2		O_2	
	Instrument Gas Readings %	True Gas Value %	Instrument Gas Readings %	True Gas Value %	Instrument Gas Readings %	True Gas Value %
	60.1	60	40.3	40	20.9	20.9
	Accept ±3.0		*Accept ±3.0*		*Accept ±0.5*	
	4.9	5	5	5	6	6
	Accept ±0.3		*Accept ±0.3*		*Accept ±0.3*	
Zero Reading 100% N2	0	0	0	0	0	0
	Accept ±0.0		*Accept ±0.0*		*Accept ±0.1*	

Optional Gas Checks						
Applied Gas & Range		Concentration Tested @ (ppm)	Instrument Readings *(ppm)*			
Gas Type	Range *(ppm)*		Zero Reading		Instrument Gas Reading	
H2S	5000	*1500*	0	*Accept ±0.0*	1500	*Accept ±5.0*
CO	2000	*1000*	0	*Accept ±0.0*	1003	*Accept ±5.0*
				Accept ±0.0		*Accept ±5.0*
				Accept ±0.0		*Accept ±5.0*
Hexane	*2.0%*	2.0%	0	*Accept ±0.0*	1.99	*Accept ±10.0*

Cross Gas Effects									
Applied Gas *(ppm)*		Instrument Readings *(ppm)*							
Gas Type	Concentration	Toxic 1:	H2S	Toxic 2:	CO	Toxic 3:			
H2S	*1500*	1500		0					
CO	*1000*	90		1003					
Hexane	*2.0%*	0		0					

Pressure Checks			
Atmospheric Pressure [AP] *(mB)*			
Current Atmospheric Pressure (mB)		Instrument Atmospheric Pressure Reading (mB)	
AP Open Ports		1000	*Accept ±2.0*
AP Port (Internal)	*+800 mB*	800	*Accept ±5.0*
	+1200mb	1200	*Accept ±5.0*

Flow Checks					
Borehole Flow			Differential Pressure		
Applied Reading *(l/h)*	Instrument Reading *(l/h)*		Applied Pressure *(Pa)*	Instrument Reading *(Pa)*	
-30	-30.9	*Accept ±3.0*	-452	-482	*Accept ±50*
-3	-3.1	*Accept ±1.0*	-19	-22	*Accept ±6.0*
0	0	*Accept ±0.0*	0	0	*Accept ±0.5*
3	3	*Accept ±0.5*	16	17	*Accept ±3.0*
30	30.9	*Accept ±3.0*	339	359	*Accept ±50*
60	61.3	*Accept ±6.0*	1023	1070	*Accept ±130*
90	91.1	*Accept ±9.0*	1998	O/R	*Accept ±250*

Temperature Checks		
Calibration Temperature Applied Temperature ^{0}C	Instrument Temperature Reading ^{0}C	
-10	-10	*Accept ±2.0*
0	0	*Accept ±1.0*
30	30	*Accept ±1.0*
60	60	*Accept ±1.0*
100	100.5	*Accept ±1.0*

Technician:	Date Tested:
Les Treece	*20/06/19*

The instrument identified by the serial number stated above has been tested by Gas Data personnel for calibration accuracy on the date and under the ambient conditions stated. Gas Data Ltd internal BS EN ISO9001:2015 compliant workshop procedures were followed to apply known calibration test gases, gas flow rates, pressures and temperatures of the values stated. The results displayed on the instrument at each stage are recorded above.

Gas Data Ltd is certified to BS EN ISO9001:2015. Certificate NQA 8374. Valid until 22/03/2019

shawcity LIMITED
Be sure. Be safe

CERTIFICATE OF CALIBRATION
Phocheck Tiger

CALIBRATION CERTIFICATE NO:

ISSUED BY: SHAWCITY LIMITED
DATE: 17.01.18

APPROVED SIGNATORY: 

NAME: Matt Jordison

CUSTOMER: CC Geotechnical Ltd
INSTRUMENT: Phocheck Tiger
SERIAL NUMBER: T-110194

CALIBRATION METHOD: CM03
AMBIENT CONDITIONS: 20°C ± 2°C and 50% (± 20%) RH

Prior to calibration the instrument was allowed to stabilise in the laboratory for at least 30 minutes.
The instrument was calibrated by exposing the sensor to known values of gas concentrations.
All gases were sampled through the complete probe and in line filter, where applicable.
The reference value is that generated by the certified source and the indicated value is that measured by the instrument.

CALIBRATION RESULTS

GAS	LOT No	REF. VALUE	INDICATED VALUE
Isobutylene	WO157807-2	100 ppm	100 ppm
Isobutylene	WO130990-1	1000 ppm	1000 ppm

COMMENTS:
The reported uncertainty is based on a standard uncertainty multiplied by a coverage factor of $k=2$.
This provides a level of confidence of uncertainty of approximately 95%.
The uncertainty of measurement is ±2 %
The results indicate that the instrument conforms to the applicable parts of the published specification.

Tel: 01793 780622
www.shawcity.co.uk
Instrument House, 91-92 Shrivenham Hundred Business Park
Watchfield, Oxfordshire, SN6 8TY
Fax: 01793 784466
service@shawcity.co.uk

shawcity LIMITED
Be sure. Be safe

SERVICE / INSPECTION SHEET

JOB NUMBER: 62624
INSTRUMENT: Phocheck Tiger

SERIAL NUMBER: T-110194
DATE RECEIVED: 15/01/2018

FIRMWARE: V.5.12

Instrument House
91-92 Shrivenham Hundred Business Park
Watchfield
Oxfordshire
SN6 8TY
Fax: 01793 784466
service@shawcity.co.uk

CUSTOMER: CC Geotechnical Ltd

ITEMS RECEIVED	CONDITION	RTN?
Instrument		✓
Rubber Boot		✓
Battery Charger		✓
Charging Cradle		✓
Operation Manual		X
Quick Start Guide		X
Spares Kit		✓
Comms Cable		✓
Probe FLEXI		X
Peli Case		X
Tubing		X
Regulator		X
Software (Memory Stick)		X
PLASTIC CASE		✓
	SIGNED:	

TESTS	AS REC'D	AFTER REPAIR
Charging Test	Ok	Ok
Battery Test	Ok	Ok
Lamp Test	Ok	Ok
Air Flow Test	Ok	Ok
Switch Test	Ok	Ok
Moisture Sensitivity	Ok	Ok
Sensor Test	Failed	Ok
Alarm Test	Ok	Ok
PC Comms Test	Ok	Ok
Datalog Test	Ok	Ok
Display Test	Ok	Ok
Physical Inspection	Ok	Ok
PAT Test	Expired	Ok
Firmware Upgrade	Expired	Ok
Software Upgrade (usb)	Ok	Ok
Function Test	Ok	Ok

Probe seal is missing on the instrument.
Filter has been replaced due to contamination.
Sensor seal replaced.
Sensor stack has been replaced.
Lamp has been cleaned with aluminium oxide.
Firmware upgraded to the latest version.
PAT test has been carried out.
Instrument has been cleaned, serviced and calibrated.
Operationally tested to manufacturer's standards.

TECHNICIAN: Matt Jordison DATE: 17.01.18