ELLUC Projects Ltd

Curtins consulting

Geo-Environmental Appraisal
Phase 2 – Intrusive Investigation

For

Site of the former Greenwood Tree P.H.
Greenwood Road
Wythenshaw

On behalf of

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Thelwall

By

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REPORT STATUS SHEET

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Curtins Consulting Engineers plc

EXECUTIVE SUMMARY

In September 2006 Curtins Consulting Engineers were instructed by ELLUC Projects Limited to undertake a Phase 2 Intrusive Investigation of the site of the former Greenwood Tree, Greenwood Road, Wythenshaw. The strategy for this investigation was developed to provide a satisfactory overview of site conditions.

It is understood that the site is to be re-developed for residential end-use. At this stage it is not known whether the residential properties will have associated gardens and hence the report assumes a residential with gardens end-use.

Rotary Test Drilling Limited under instruction from Curtins Consulting undertook fieldwork in August 2006 which comprised the excavation of one light cable percussion borehole. Curtins Consulting undertook additional fieldwork comprising five trial holes in October 2006. The locations of the exploratory holes are recorded on Curtins Consulting drawing no. 50151/L001 in Appendix A2.

Made-ground was revealed in all of the exploratory locations, the maximum depth observed being 3.0 m in trial pit TP2. Made-ground was encountered across the site at varying depths of between 2.0m to 2.5m. Made-ground generally consists of stone and brick fragments with pale brown clayey sand.

Natural deposits are variable and comprise of light to dark brown / grey occasionally sandy clay and mudstone to depth. Moderately strong grey sandstone was encountered beneath the possible weathered mudstones at 3.0m. The sandstone was proven to a depth of 4.0m.

No groundwater ingress was recorded within any of the exploratory holes.

There is evidence of elevated concentrations of potential contaminants within the made-ground such that a risk of significant harm could potentially be presented to an end user. These elevated contaminants are, the hydrocarbon benzo[a]pyrene, total PAH and the toxic metal arsenic.

To prevent future end users of the site coming into contact with this contaminative material two remedial actions can be considered.

- It is recommended that a clean and inert capping layer (with geotextile demarcation) of 600mm thickness comprising topsoil and subsoil be provided. In managed landscaped areas it is envisaged that this could be reduced to 300mm.
- If the proposed development levels dictate that raising of site levels is not permissible the affected ground in private garden areas could be excavated and disposed of to a suitably licensed landfill site.

Leachable analysis was not undertaken on any soil samples given the lack of elevated contaminants recorded within the underlying natural strata.

There is no evidence of either toxic metal or phytotoxic metal or hydrocarbon contamination present within the underlying natural strata.

EXECUTIVE SUMMARY, continued

At this stage assessment by CIRA 149 suggests a site characteristic situation of CS1. Subject to further rounds of gas monitoring, to be issued as an addendum report, it is considered that no gas protection measures will be required.

The made-ground and soft and soft to firm clays in their present condition are not considered suitable for the support of proposed development(s) on the site owing to the risk of unacceptable amounts of total and differential settlement occurring.

Spread foundations taken down into the firm grey and brown clays (possible weathered mudstone) encountered below 1.20m and designed on an allowable bearing pressure (ABP) of 100kN/m2 may be suitable for the support of the proposed development(s). If greater bearing pressures (up to 150kN/m2) are required then spread foundations deepened by trench fill (backfilled with mass concrete) and formed into the very stiff clays encountered below 2.00m may be suitable. Spread foundations deepened by trench fill and taken into the sandstones encountered at 3.00m could be designed on ABPs of up to 250kN/m2.

Suspended floorslabs should be incorporated into the proposed development(s) should deep made-ground be encountered (>0.60m).

Should sandstone rockhead be exposed in the foundation excavations then in order to avoid potential problems with differential settlement all foundations should be emplaced onto the sandstone.

Groundwater is unlikely to represent a particular problem to the redevelopment of this site. However, it should be recognized that slight seepages and minor water entries may combine in any long trench excavations to create a significant volume of water which may cause local problems during the construction phase. Any significant standing water within excavations made upon this site may be removed by simple pumping operations.

Based on the pH and sulphate results presented above well compacted buried concrete should be designed in accordance with Class DS-1 requirements as specified in BRE Digest 1: 2005 (Third Edition) "Concrete in aggressive ground: Part C: Assessing the aggressive chemical environment". The ACEC class for the site is AC-1.

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1.0 INTRODUCTION

1.1 Project Background

In September 2006 Curtins Consulting Engineers were instructed by ELLUC Projects Limited to undertake a Phase 2 Intrusive Investigation of the site of the former Greenwood Tree, Greenwood Road, Wythenshaw.

The strategy for this investigation was developed to provide a satisfactory overview of site conditions.

It is understood that the site is to be re-developed for residential end-use. At this stage it is not known whether the residential properties will have associated gardens and hence the report assumes a residential with gardens end-use.

1.2 Scope of Works

The intrusive investigation was undertaken to determine,

a) If there is a risk of significant harm being presented to the proposed end user from potential contamination that maybe present on the site.
b) If there is a significant risk of pollution to groundwater and or surface water from potential contamination that maybe present on the site.
c) If there is a risk to the end user from landfill type gases that could potentially accumulate under the proposed buildings.
d) Recommendations for the design of foundations and building ground floor slabs.
e) Recommendations for the specification of sub-structure concrete.

2.0 SUMMARY OF PREVIOUS DESK TOP STUDY – PHASE 1 INVESTIGATION

A Phase 1 investigation undertaken by ELLUC Projects Ltd, which was not available for review, has been included within Appendix A7 of this report.

3.0 SITE INVESTIGATION PROPOSALS – PHASE 2 INVESTIGATION

A strategy for a Phase 2 intrusive investigation has been undertaken in order to investigate and assess these potential risks and comprised the following operations,

- Excavation, logging and sampling of representative soils in three light percussion boreholes and eight machine excavated trial pits giving sufficient coverage of the site.
- Environmental Chemistry Analysis for a broad suite of determinants on an adequate number of samples representative of the made-ground and natural materials encountered.
- Installation of pipe work within the cable percussion boreholes to allow monitoring of soil gases and sampling of groundwater if present/necessary.
- Monitoring of oxygen, methane, carbon dioxide, atmospheric pressure and gas flow on six occasions over three months initially.

4.0 FIELDWORK

4.1 General

Rotary Test Drilling Limited under instruction from Curtins Consulting undertook fieldwork in August 2006 which comprised the excavation of one light cable percussion borehole.

Curtins Consulting undertook additional fieldwork comprising five trial holes in October 2006.

The locations of the exploratory holes are recorded on Curtins Consulting drawing no. 50151/L001 in Appendix A2.

4.2 Cable Percussive Borehole

One cable percussive borehole was undertaken on the site by Rotary Test Drilling Limited under the supervision of a suitably experienced engineer. All boreholes were logged in general accordance with BS5930:1999.

The borehole was advanced to 4.00m below existing ground level.

Groundwater was not encountered during the investigation or during the groundwater monitoring period.

A gas monitoring well was installed within the borehole and gas monitoring is ongoing.

The response zone for the gas monitoring in the borehole is as shown in Table 4.2.1 below.

Table 4.2.1

Exploratory Hole	Response Zone (m bgl)	Strata	Underlying Strata
BH1	1.00-4.00	Boulder Clay and possible weathered Mudstone	Sandstone

The borehole logs can be referred to in Appendix A3 of this report.

4.3 Trial Pits

Five machine excavated trial pits were undertaken on the site by Curtins Consulting. All trial pits were logged in general accordance with BS5930: 1999.

These exploratory holes were completed to between 2.0m and 2.5m below existing ground level.

No perched water or groundwater ingress was observed in the made-ground in trial pits.

4.0 FIELDWORK

4.3 Trial Pits, continued

Ten soil samples (two from each trial pit) representative of the made-ground and natural strata encountered were taken and forwarded to the laboratory for environmental chemistry analysis.

The trial pit logs can be referred to in Appendix A3 of this report.

5.0 LABORATORY TESTING

5.1 Environmental Chemistry Testing

A programme of environmental chemistry testing was scheduled reflecting the findings of the desk study.

5.1.1 Soil

The soil samples were analysed for the determinants shown in Table 5.1.1 below.

Table 5.1.1 Environmental Chemistry Analysis Suite: Soils

Suite Reference	Environmental Chemistry Analysis
A1 (solid)	Total metals : Arsenic, cadmium, chromium, lead, mercury, selenium, copper, nickel, zinc, water soluble boron; Total and USEPA 16 PAH by GC EPH/DRO (C8-C40) by GC banded and with tentative ID Total cyanide and If total cyanide >25mg/kg, free cyanide If total cyanide >50mg/kg, thiocyanate; Total monohydric phenols Total sulphate Free sulphur Sulphide pH
A2 (Solid)	Asbestos screening Soil Organic Matter

All soil samples were tested for Suite S1.

Soil samples originating from the top 500mm of each exploratory hole were tested for Suite A2.

The results of the environmental chemistry analyses can be referred to in Appendix A4 of this report.

Sufficient volumes of water could not be obtained from the exploratory holes to allow chemical analysis.

6.0 GROUND CONDITIONS

6.1 Made-Ground

Made-ground was revealed in all of the exploratory locations, the maximum depth observed being 3.0 m in trial pit TP2.

Made ground was encountered across the site at varying depths of between 2.0m to 2.5m.

Made-ground generally consists of stone and brick fragments with pale brown clayey sand.

6.2 Natural Deposits

Natural deposits are variable and comprise of light to dark brown / grey occasionally sandy clay and mudstone to depth.

Moderately strong grey sandstone was encountered beneath the possible weathered mudstones at 3.0m. The sandstone was proven to a depth of 4.0m.

6.3 Groundwater

No groundwater ingress was recorded within any of the exploratory holes.

7.0 GEOTECHNICAL ASSESSMENT

7.1 Foundation Assessment

Made ground was encountered across the site to varying depths of between 2.0m to 2.5m.

Made-ground generally consists of stone and brick fragments with pale brown clayey sand.

Natural deposits are variable and comprise of light to dark brown / grey occasionally sandy clay and mudstone to depth.

Grey sandstone was encountered beneath the possible weathered mudstones at 3.0m. The sandstone was proven to a depth of 4.0m.

These deposits were of moderate strength and were generally described in the field as being moderately strong. Sands were typically loose or medium dense.

7.2 Foundation and Floor slab Recommendations

7.2.1 Foundations

The made-ground and soft and soft to firm clays in their present condition are not considered suitable for the support of proposed development(s) on the site owing to the risk of unacceptable amounts of total and differential settlement occurring.

Spread foundations taken down into the firm grey and brown clays (possible weathered mudstone) encountered below 1.20m and designed on an allowable bearing pressure (ABP) of 100kN/m2 may be suitable for the support of the proposed development(s). If greater bearing pressures (up to 150kN/m2) are required then spread foundations deepened by trench fill (backfilled with mass concrete) and formed into the very stiff clays encountered below 2.00m may be suitable. Spread foundations deepened by trench fill and taken into the sandstones encountered at 3.00m could be designed on ABPs of up to 250kN/m2.

The above foundation recommendations should be reviewed following the receipt of a proposed development plan and further exploratory holes could be advised to prove the nature of the ground conditions over the wider site area. Higher ABPs may be available for the natural soils if further site investigation works are undertaken.

7.2.2 Floorslab

If the site is to be developed out for a residential end usage then the following advice is appropriate.

Suspended floorslabs should be incorporated into the proposed development(s) should deep made-ground be encountered (>0.60m).

7.0 GEOTECHNICAL ASSESSMENT, continued

7.2.2 Floorslab, continued

Ground bearing floorslabs may be suitable where the made-ground is 0.60m provided the following points are borne in mind

i. the made-ground is removed;
ii. the existing subgrade is checked for the presence of any soft spots which, if found, should be removed and replaced with a compacted inert granular fill;
iii. exposed subgrades are not subjected to the detrimental effects of inclement weather.
iv. the overlying sub-base construction is suitably proof-rolled.

Assuming that the made-ground presents a low risk to human health, once excavated it could be sorted to remove unsuitable material, and then re-laid, being compacted in layers up to the proposed formation level. The made-ground once re-laid in a controlled manner should be a suitable formation for a lightly loaded ground bearing slab.

7.2.3 General

Should sandstone rockhead be exposed in the foundation excavations then in order to avoid potential problems with differential settlement all foundations should be emplaced onto the sandstone.

Based on the results of this limited investigation it is considered unlikely that the shoring up of deep excavations will be required. However, any excavation should be completed in accordance with recommendations made in CIRIA Report97 - Trenching Practice.

Groundwater is unlikely to represent a particular problem to the redevelopment of this site. However, it should be recognized that slight seepages and minor water entries may combine in any long trench excavations to create a significant volume of water which may cause local problems during the construction phase. Any significant standing water within excavations made upon this site may be removed by simple pumping operations.

7.2.4 Concrete Design

Based on the pH and sulphate results presented above well compacted buried concrete should be designed in accordance with Class DS-1 requirements as specified in BRE Digest 1: 2005 (Third Edition) "Concrete in aggressive ground: Part C: Assessing the aggressive chemical environment". The ACEC class for the site is AC-1.

8.0 GEOCHEMICAL GROUND AND GROUNDWATER ASSESSMENT

8.1 Overall Assessment

The intrusive investigation was undertaken in order to identify any potential contamination present on the site which may present a risk of significant harm to the proposed residential with gardens end user, associated utilities and the wider environment.

Curtins Consulting use a tiered approach in assessing the risk from potential contamination on the site such assessment being based on the known history of the site as determined by the desk study. Consequently the assessment is based solely on the results of the chemical and other testing data obtained as part of Curtins Consulting investigation.

Under the Contaminated Land (England) Regulations 2000 a Local Authority has from time to time to survey the land within its boundaries to identify "Contaminated Land". This is land "in such condition, by reason of substances in, on, or under the land, that: significant harm is being caused, or pollution of controlled waters is being or likely to be caused".

In guidance published by the Environment Agency, the determination of significant harm or the likelihood of pollution of controlled waters being caused is that there is a pollutant linkage between a source of contamination and a sensitive receptor such as house occupants, plants grown in gardens or groundwater abstracted for drinking. This is termed a source-pathway-receptor relationship.

With respect to this investigation the source is taken as being a point or area of contamination within the ground. The pathway is a mechanism by which the contamination could reach the receptor. For instance this could be through eating contaminated soil or plants contaminated through taking up contamination in the soil through their roots, inhaling contaminated dust or drinking contaminated water. Other pathways include directly causing degradation of buried building materials such as plastic or concrete. Further indirect pathways include groundwater transporting contamination to a groundwater abstraction point or to a river or stream and thus causing it to become contaminated.

In order to assess whether a potential pollutant linkage is significant with respect to human health, the Environment Agency and the Department of the Environment, Food and Rural Affairs (DEFRA), published in 2002 guidance referred to as the Contaminated Land Exposure Assessment Model (CLEA).

This follows the Environment Agency's publication "Methodology for the Derivation of Remedial Targets for Soil and Groundwater to Protect Water Resources R&D Publication 20", commonly known as P20. This provides a model for assessing the potential for pollution of controlled waters and for deriving a safe concentration in ground and groundwater.

The two publications have a common approach, which is one of a tiered assessment. At each stage of the assessment further detail can be applied to the model to provide a detailed interpretation on a site by site basis. This is to determine whether the criteria are being met to prevent contamination of controlled waters and to protect human health and the environment.

This assessment is the first tier in the process. It is a comparison between various sets of generic criteria and the result of testing from the investigation. Where available these criteria are drawn from the CLEA guidance itself in the form of Soil Guideline Values (SGV's).

8.0 GEOCHEMICAL GROUND AND GROUNDWATER ASSESSMENT

8.1 Overall Assessment, continued

These values have been derived from lengthy research applying knowledge of the toxicity and carcinogenicity of substances and the mechanism by which each acts in the environment.

There are currently SGV's published for only nine determinants and consequently Curtins Consulting utilise in-house derived guidance to supplement these for the Tier 1 assessment as shown in Appendix A5 of this report.

Currently there are no Tier 1 assessment values published for a wide range of organic compounds such as PCBs, petroleum hydrocarbons, volatile and semi-volatile organic compounds. Therefore other guidance from outside the UK maybe referred to, for example the TPH Criteria Working Group series of documents.

In relation to the standards for controlled waters, there are currently no generic groundwater standards or surface water standards that are necessarily applicable to all sites. However, dependant on the receptor identified as being at risk, the Surface Water (Abstraction for Drinking Water) and or the Environment Agency's national Environmental Quality Standards (EQS's) are considered appropriate (and are considered acceptable to the Regulators) and are used in this Tier 1 assessment.

In addition, and in particular where the groundwater or surface water could not be found or sampled in sufficient quantity, a soil leaching test (NRA R&D 301) can be undertaken to provide a preliminary assessment of the potential for contaminants in the soil to pollute ground or surface water. The results of these tests are initially compared against the Environment Agency Leachate Quality Thresholds published in their document 'Guidance on the disposal of contaminated soils' , Version 3, April 2001 but may dependant on the receptor identified as being at risk, be further assessed against the EA EQS's and or UK Drinking Water Standards.

Once contaminants of concern have been identified by this Tier 1 assessment, qualitative and or quantitative risk assessments maybe undertaken to determine whether a viable source-pathway-receptor linkage is present.

8.2 Site Soils

As discussed previously six exploratory holes were undertaken and representative samples of the made-ground and natural soils were taken from the trial pits.

Ten soil samples representative of the made-ground and natural soils were subjected to environmental chemistry analysis for a broad suite of potential contaminants.

The chemistry analysis results, which can be referred to in Appendix A4, have been compared with the Tier 1 criteria as shown in Appendix A5, for soils with respect to human health in a residential housing.

The majority of these Tier 1 criteria are published CLEA Soil Guideline Values (SGV's) the exceptions are benzo[a]pyrene and naphthalene which do not have a published SGV and therefore site specific guideline values are determined using the CLEA 2002 software.

8.0 GEOCHEMICAL GROUND AND GROUNDWATER ASSESSMENT

8.2 Site Soils, continued

These calculations have been undertaken allowing for the values of Soil Organic Matter (SOM) and pH determined in the made-ground for the particular sample. Data for the specific chemical has been obtained from DEFRA R&D Publications (TOX) where available, USEPA database and the Groundwater Services Incorporated (GSI) database.

Tier 1 Thresholds have been exceeded in the shallow soils in a number of soil samples and as such the made-ground across the site can be generally defined as "contaminated" with respect to presenting a significant risk of harm to the proposed residential with private gardens end use.

Generally these elevated contaminants are the toxic metal arsenic and the Polyaromatic Hydrocarbon (PAH) benzo(a)pyrene. There is also an isolated value of elevated total PAH. The results also show that the deeper underlying strata have not been adversely affected.

The locations where these thresholds have been exceeded are shown in Table 8.2.1 below.

Table 8.2.1

Location	Depth (m)	Strata	Contaminant	Conc'n (mg/kg)	Tier 1 (mg/kg)
TP 1	0.3	Made-ground	PAH Benzo(a)pyrene	60 10.9	40 1.3*
TP 2	0.4	Made-ground	Arsenic Benzo(a)pyrene	21 1.7	20 1.3*
TP 3	0.4	Made-ground	Arsenic Benzo(a)pyrene	27 3.1	20 1.3*
TP 4	0.4	Made-ground	Benzo(a)pyrene	1.6	1.3*
TP 5	0.4	Made-ground	Benzo(a)pyrene	1.2	1.3*

* Tier 1 value derived from CLEA 2002 software.

8.0 GEOCHEMICAL GROUND AND GROUNDWATER ASSESSMENT

8.2.1 Hydrocarbons – PAH's

There is evidence of elevated concentrations of potential contaminants within the made-ground across the site of interest such that a risk of significant harm could potentially be presented to an end user. Generally, these elevated contaminants are hydrocarbons in particular Benzo(a)pyrene.

The analysis results show that the immediately underlying natural strata have not been significantly impacted upon.

8.2.1.2 Benzo[a]pyrene

In soils sampled from the made-ground benzo[a]pyrene concentrations have exceeded the calculated site specific threshold values in all trial holes locations, TP1, TP2, TP3, TP4 and TP5 suggesting relatively widespread impact and as such could present a risk of significant harm to a residential end user.

Statistical analysis, as presented in Appendix A6 demonstrates that the elevated levels of benzo[a]pyrene within TP1 can be considered a 'hotspot' value, which corresponds with the similarly elevated level of total PAH within the sample.

To prevent future end users of the site coming into contact with this contaminative material two remedial actions can be considered.

- It is recommended that a clean and inert capping layer (with geotextile demarcation) of 600mm thickness comprising topsoil and subsoil be provided. In managed landscaped areas it is envisaged that this could be reduced to 300mm.

- If the proposed development levels dictate that raising of site levels is not permissible the affected ground in private garden areas could be excavated and disposed of to a suitably licensed landfill site.

There is no evidence of benzo[a]pyrene or PAH contamination present within the underlying natural strata.

8.2.2 Toxic Metals

8.2.2.1 Arsenic

Arsenic was observed at a concentration within the made ground, which could present a risk to the residential end user of the site in two samples, TP2 and TP3. Statistical analysis, as presented in Appendix A6 demonstrates that these elevated levels of arsenic can be considered to have a site wide impact.

To prevent future end users of the site coming into contact with this contaminative material two remedial actions can be considered.

- It is recommended that a clean and inert capping layer (with geotextile demarcation) of 600mm thickness comprising topsoil and subsoil be provided. In managed landscaped areas it is envisaged that this could be reduced to 300mm.

- If the proposed development levels dictate that raising of site levels is not permissible the affected ground in private garden areas could be excavated and disposed of to a suitably licensed landfill site.

There is no evidence of arsenic contamination present within the underlying natural strata.

8.3 Groundwater Quality and Surface Water Quality

Slow rates of recharge and insufficient water prevented water samples from being obtained.

Additionally, leachable analysis has not been undertaken given that the natural strata underlying the Made Ground has not been impacted upon.

8.4 Soil Gases

Gas monitoring installations were incorporated within the borehole, BH1 and to date one round of monitoring has been undertaken.

The monitoring results indicate no methane and a maximum carbon dioxide of 0.90% $^{v}/_{v}$ within BH1.

No hydrogen sulphide was detected during the monitoring visit and no flow was detected within the exploratory hole.

At this stage assessment by CIRA 149 suggests a site characteristic situation of CS1. Subject to further rounds of gas monitoring, to be issued as an addendum report, it is considered that no gas protection measures will be required.

Gas monitoring results can be referred to in Appendix A4.

9.0 PRE-REMEDIATION CONSTRAINTS AND OUTLINE REMEDIATION STRATEGY

This section of the report describes the general constraints to development currently thought to exist on the site of interest.

9.1 Invasive Plants

Although the presence of the invasive plants, Japanese Knotweed and or Giant Hogweed, were not apparent during the fieldwork it is recommended that a specialist be commissioned to undertake a survey of the site for such plants.

9.2 Services

Service plans were provided by the client.

9.3 Buildings and hardstanding

The site is covered in part by hardstanding; no buildings were present on site.

9.4 Land Condition

There is evidence of elevated concentrations of potential contaminants within the made-ground such that a risk of significant harm could potentially be presented to an end user. These elevated contaminants are, the hydrocarbon Benzo[a]pyrene, total PAH and the toxic metal arsenic.

To prevent future end users of the site coming into contact with this contaminative material two remedial actions can be considered.

- It is recommended that a clean and inert capping layer (with geotextile demarcation) of 600mm thickness comprising topsoil and subsoil be provided. In managed landscaped areas it is envisaged that this could be reduced to 300mm.

- If the proposed development levels dictate that raising of site levels is not permissible the affected ground in private garden areas could be excavated and disposed of to a suitably licensed landfill site.

Leachable analysis was not undertaken on any soil samples given the lack of elevated contaminants recorded within the underlying natural strata.

At this stage assessment by CIRA 149 suggests a site characteristic situation of CS1. Subject to further rounds of gas monitoring, to be issued as an addendum report, it is considered that no gas protection measures will be required.

APPENDIX

A1 – SITE LOCATION PLAN

A2 – EXPLORATORY HOLE LOCATION PLAN

A3 – EXPLORATORY HOLE LOGS

A4 – LABORATORY ANALYSIS AND GAS RESULTS

A5 – TIER 1 THRESHOLDS

A6 – STATISTICAL ANALYSIS

A7 – PHASE 1 INVESTIGATION

A1 – SITE LOCATION PLAN

Greenwood Road, Wythenshaw



Key

Approximate site boundary

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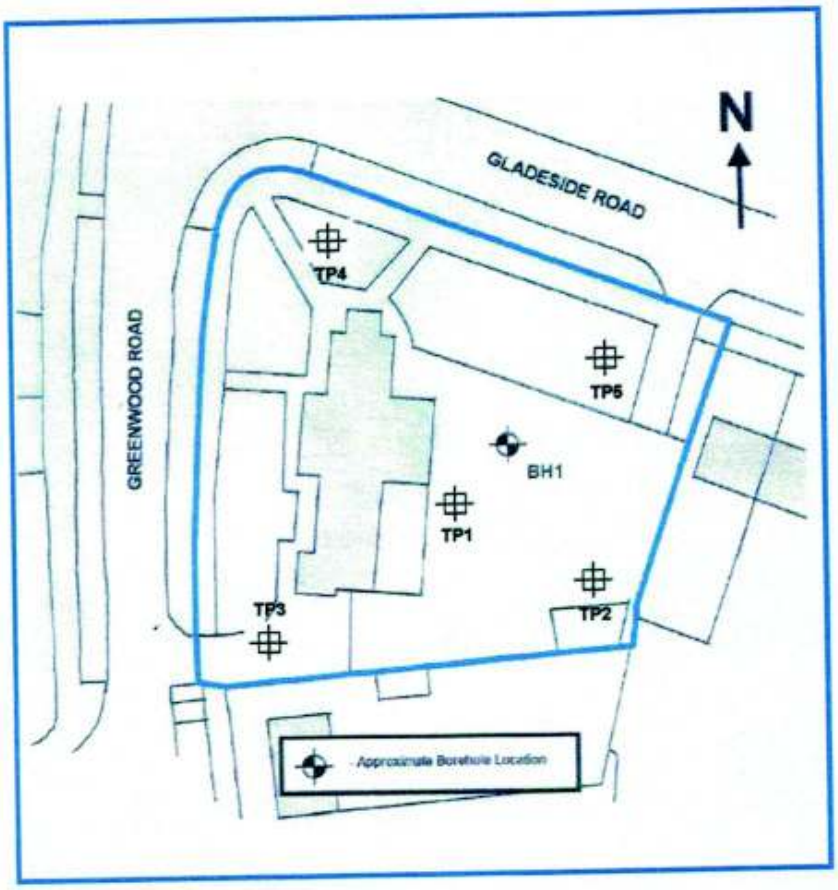
Project	Job Reference	Author
Greenwood Road, Wythenshaw	50160	RGB
Drawing Title	**Date**	**Checked**
Appendix A1 - Site Location Plan	19.12.2006	DM

A2 – EXPLORATORY HOLE LOCATION PLAN

Site of the former Greenwood Tree P.H., Greenwood Road, Wythenshaw



Key

- Borehole Location
- Trial Hole Location

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Project	Job Reference	Author
Greenwood Road, Wythenshaw	50160	RGB
Drawing Title	**Date**	**Checked**
Appendix A2 - 50160/L001	18.12.2006	DM

A3 – EXPLORATORY HOLE LOGS

Curtins Consulting
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TRIAL PIT LOG

Project: Greenwood Road, Wythenshaw				Exploratory Hole No.
Job No. 50160	Date 18/12/06	Today's Conditions Overcast but Dry	Previous Conditions Mostly Wet	TP1
Client: ELLUC Projects Limited				Sheet 1

SAMPLES & TESTS			STRATA			Water
Depth	Type No.	Test Result	Legend	Depth	Description	
				(0.2 m)	MADEGROUND: Tarmac and hardcore	
0.3 m	D			(0.8 m)	MADEGROUND: Dark brown/grey soft/firm CLAY with occasional layers of light grey firm mudstone clay and brick fragments	
1.0 m	D			(1.0 m)	Light grey firm MUDSTONE / CLAY	

Groundwater Ingress	No
Rate of groundwater ingress	N/A
Excavation Stable	Yes

Observations
• Trial pit terminated at 2.0m bgl due to concrete slab.

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TRIAL PIT LOG

Project: Greenwood Road, Wythenshaw				Exploratory Hole No. TP2
Job No. 50160	Date 18/12/06	Today's Conditions Overcast but Dry	Previous Conditions Mostly Wet	
Client: ELLUC Projects Limited				Sheet 1

SAMPLES & TESTS			STRATA			Water
Depth	Type No.	Test Result	Legend	Depth	Description	
				(0.2 m)	MADEGROUND: Tarmac and hardcore	
				(0.3 m)	MADEGROUND: Dark brown/grey firm CLAY with occasional brick fragments	
0.4 m	D					
1.0 m	D				Light brown soft CLAY getting firmer with depth	
				(2.0 m)		

Groundwater Ingress	No
Rate of groundwater ingress	N/A
Excavation Stable	Yes

Observations

- Trial pit terminated at 2.5m bgl.

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Curtins consulting

TRIAL PIT LOG

Project: Greenwood Road, Wythenshaw				Exploratory Hole No.
Job No. 50160	Date 18/12/06	Today's Conditions Overcast but Dry	Previous Conditions Mostly Wet	TP3
Client: ELLUC Projects Limited				Sheet 1

SAMPLES & TESTS			STRATA			Water
Depth	Type No.	Test Result	Legend	Depth	Description	
				(0.2 m)	MADEGROUND: Tarmac and hardcore	
				(0.3 m)	MADEGROUND: Dark brown/grey soft sandy CLAY with occasional brick fragments.	
0.4 m	D					
1.0 m	D				Light brown very sandy firm CLAY getting firmer with depth	
				(1.7 m)		

Groundwater Ingress	No
Rate of groundwater ingress	N/A
Excavation Stable	Yes

Observations
• Trial pit terminated at 2.2m bgl

Curtins Consulting
10 Oxford Court
Bishopsgate
Manchester M2 3WQ
Tel: 0161 236 2394

TRIAL PIT LOG

Project: Greenwood Road, Wythenshaw				Exploratory Hole No.
Job No. 50160	Date 18/12/06	Today's Conditions Overcast but Dry	Previous Conditions Mostly Wet	TP4
Client: ELLUC Projects Limited				Sheet 1

SAMPLES & TESTS			STRATA			Water
Depth	Type No.	Test Result	Legend	Depth	Description	
0.4 m	D			(0.5 m)	TOPSOIL: Capped with grass	
1.0 m	D			(1.7 m)	Dark brown/grey firm CLAY / MUDSTONE getting firmer with depth	

Groundwater Ingress	No
Rate of groundwater ingress	N/A
Excavation Stable	Yes

Observations
• Trial pit terminated at 2.2m bgl

Curtins Consulting
10 Oxford Court
Bishopsgate
Manchester M2 3WQ
Tel: 0161 236 2394

TRIAL PIT LOG

Project: Greenwood Road, Wythenshaw				Exploratory Hole No.
Job No. 50160	Date 18/12/06	Today's Conditions Overcast but Dry	Previous Conditions Mostly Wet	TP5
Client: ELLUC Projects Limited				Sheet 1

SAMPLES & TESTS			STRATA			Water
Depth	Type No.	Test Result	Legend	Depth	Description	
0.4 m	D			(0.5 m)	TOPSOIL: Capped with grass	
1.0 m	D			(1.7 m)	Dark brown/grey firm CLAY / MUDSTONE getting firmer with depth	

Groundwater Ingress	No
Rate of groundwater ingress	N/A
Excavation Stable	Yes

Observations
• Trial pit terminated at 2.2m bgl

ROTARY TEST DRILLING

Marshes Farm, Coach Road, off Wigan Road,
Hart Common, West Houghton, Bolton BL5 2BT
Tel: 01942 - 810348 Fax: 01942 - 840543

Site The Greenwood Tree/Wythenshawe | Job No. 63/06

Client Curtins | Borehole 1

Date 19/10/06 | O.D. Level

Page 1 of 1

Day	Water Level	Casing Depth	Strata Depth	Description of Strata	Leg-end	Inst.	Reduced Level	Sample Type	Sample Depth	'N' Value
			G.L.							
			0.20	MADE GROUND Tarmac (0.20)						
				MADE GROUND Compact ash, brick and stone fill (0.40)				1J	0.30	
			0.60	Soft to firm brown sandy boulder CLAY becomming soft at 1.0m (0.60)				2B	0.70 - 1.00	
								3U	1.00 - 1.45	
			1.20	Firm grey and brown marley CLAY (0.80)						
		1.5M						4J	1.45	
			2.00	Very stiff grey and brown silty sandy gravelly marley CLAY (1.00)				5N	2.00 - 2.45	16
								6B	2.60 - 2.80	
			3.00	Moderately strong grey SANDSTONE (1.00)				7N	3.00 - 3.45	118
			4.00	Base of Borehole				8N	3.80 - 4.00	ref

Symbols U - undisturbed sample J - jar sample B - bulk sample W - water sample
N - Standard Penetration Test ⧖ - Water entry ▲ - Water level

Ground Water Entry	Estimated Rate of Entry	Observation Time (mins)	Water Level Rising to	Depth of Casing at Entry	Depth of Casing to Seal	Date	Standing Water Level	Condition of Borehole Cased / Open
NON								

Remarks

Break-out/drill hard surface
Chiselling 2.5 Hrs
Installed to 4.0m

A4 – LABORATORY ANALYSIS AND GAS RESULTS

Chemistry Laboratory Certificate

Client: Curtins Consulting Engineers
10 Oxford Court, Bishopsgate, Manchester, M2 3WQ
Site: Site at Greenwood Road, Wythenshawe
Date Tested: 17/10/06, 18/10/06, 19/10/06, 24/10/06, 25/10/06
Methodology: Asb vis, CTP01, CTP07, CTP11a, CTP11b, CTP11h, CTP11i, CTP12, CTP14, CTP16, CTP18c, CTP20, CTP22, SOP02 GC-MS, SOP04 SVOC, SOP11 S, Stones, TPH (GC)/DRO
Date Reported: 25 October, 2006
Date Received: 13 October, 2006
Sample Type: Solid

Certificate No: 06/4279/50/C1
File No: 06/4279/50
Client Ref: 50160/RA/7733

Lab sample ref	B334983	B334984	B334985	B334986	B334987
Client sample ref	TP1 - 0.3	TP2 - 0.4	TP3 - 0.4	TP4 - 0.4	TP5 - 0.4
Date sampled					
Sample matrix (see notes page)	S	S	S	S	S

Analyte	Units	ISO17025	MCERTS	LOD					
pH		Y	Y		7.5	7.5	7.5	7.1	7.2
Sulphate (total) S	mg/kg	Y	Y	200	740	810	730	<200	300
Sulphide SM	mg/kg	Y	N	2	5	4	5	4	4
Sulphur (elemental) S	mg/kg	Y	Y	20	29	46	<20	<20	<20
Cyanide (total) SM	mg/kg	Y	Y	10	<10	<10	<10	<10	<10
PAH (total) S	mg/kg	N	N	1	60	13	16	27	10
Phenols (screen) SM	mg/kg	Y	Y	1	<1	<1	<1	<1	<1
Organic Matter S	g/kg	N	N/A	0.1	99.7	56.2	80.8	27.2	36.3
Arsenic S	mg/kg	Y	Y	5	11	21	27	11	12
Boron (water soluble) S	mg/kg	Y	N	1	<1	<1	<1	<1	<1
Cadmium S	mg/kg	Y	N	0.5	<0.5	1.0	0.6	<0.5	<0.5
Chromium (total) S	mg/kg	Y	Y	5	13	23	14	17	17
Copper S	mg/kg	Y	Y	5	24	114	76	32	29
Lead S	mg/kg	Y	Y	5	40	354	111	59	67
Mercury S	mg/kg	Y	N	0.5	<0.5	<0.5	<0.5	<0.5	0.5
Nickel S	mg/kg	Y	Y	5	19	42	43	15	17
Selenium S	mg/kg	Y	N	5	<5	<5	<5	<5	<5
Zinc S	mg/kg	Y	N	5	42	345	64	70	72
Asbestos Screen		N	N/A		ND	ND	ND	ND	ND
PAH (USEPA 16) SM		Y	N		#	#	#	#	#
TPH (GC) Banded SM		Y	N/A		#	#	#	#	#
Product Identification					#	#	#	#	#

Notes
1. Analyses suffixed 'S' were performed on the sample dried at 35°C.
2. Analyses suffixed 'SM' were performed on the sample as received.
3. All results are expressed as dry weight.
4. MCERTS accreditation applicable to Sample Matrix 'S' only.
5. Natural stones (pebbles, gravels etc.) which do not pass a 10mm sieve are excluded from air dried analyses and results corrected accordingly.
6. # indicates separate report appended.
7. Tests marked * indicate subcontracted analyses.
8. ND denotes none detected

Prepared by:

S Blemings
Account Manager

Approved by:

P Chadwick
Operations Manager

UKAS TESTING
0871

Client	Curtins Consulting Engineers, 10 Oxford Court, Bishopsgate, Manchester, M2 3WQ
Contract / Site	Site at Greenwood Road, Wythenshawe
Sample Matrix	Solids
File Number	06/4279/50/C1
Date Received	13-Oct-06
Date Tested	19-Oct-06
Methodology	Laboratory Developed In-House Method - 'Determination of SVOC' by GC-MS

All Values in mg/kg **POLYNUCLEAR AROMATIC HYDROCARBONS**

Sample Ref.	334983	334984	334985	334986	334987
Client Ref.	TP1 0.3m	TP2 0.4m	TP3 0.4m	TP4 0.4m	TP5 0.4m
Name					
naphthalene	<0.1	<0.1	<0.1	<0.1	<0.1
acenaphthylene	0.1	<0.1	<0.1	0.3	<0.1
acenaphthene	<0.1	<0.1	<0.1	0.1	<0.1
fluorene	<0.1	<0.1	<0.1	<0.1	<0.1
phenanthrene	0.4	0.5	<0.1	1.8	0.5
anthracene	0.4	0.3	0.2	0.9	0.3
fluoranthene	6.0	2.9	1.1	6.0	1.7
pyrene	6.4	2.4	1.5	4.8	1.7
benz[a]anthracene	4.5	1.2	1.2	2.6	0.9
chrysene	5.6	1.4	1.6	2.8	1.1
benzo[b]fluoranthene	11.9	2.0	3.5	3.6	1.4
benzo[k]fluoranthene	4.3	0.8	1.3	1.6	0.6
benzo[a]pyrene	10.9	1.7	3.1	3.1	1.2
indeno[1,2,3-cd]pyrene	8.6	1.4	2.7	2.3	1.0
dibenz[a,h]anthracene	1.7	0.2	0.5	0.4	0.2
benzo[ghi]perylene	7.2	1.1	2.2	1.6	0.8

Analysed by:

Mike Parry
Section Leader

Authorised by:

David Darlow
Chemist

UKAS TESTING
0871

Client	Curtins Consulting Engineers, 10 Oxford Court, Bishopsgate, Manchester, M2 3WQ
Contract/Site	Site at Greenwood Road, Wythenshawe
Sample Matrix	Solids
File No.	06/4279/50/C1
Date Received	13-Oct-06
Date Tested	19-Oct-06
Methodology	Laboratory Developed In-House Method-'SOP03-Determination of Diesel Range Organics' by GC-FID

All Values in mg/Kg

DIESEL RANGE ORGANICS

Compound	334983 TP1 0.3m	334984 TP2 0.4m	334985 TP3 0.4m	334986 TP4 0.4m	334987 TP5 0.4m
C8-C15	<12.5	<10	<12.5	<10	<10
>C15-C20	34	37	31	<10	<10
>C20-C30	221	214	290	26	24
>C30-C36	71	56	127	14	<10
Chain lengths	C15-C40	C15-C40	C15-C40	C15-C40	C15-C40
ID	Tar/Motor oil	Tar/Motor oil	Tar/Motor oil	Tar/Motor oil	Tar/Motor oil

Analysed by:

Mike Parry
Section Leader

Authorised by:

David Darlow
Chemist

Rotary Test Drilling Ltd
MONITORING FOR LANDFILL GAS.

Units 1% Gas volume = 10,000PPM
Sample types A = Accumulated SS = Steady State

All Samples Type A
except * = Steady State

Site: **Greenwood Tree, Wythenshaw.** Ref: **63/06** Date: **26/10/06**
Weather: **Clear/Dry** Visit: **1**

DATE & TEST	FLOWLt/hr	METHANE CH4 %LEL	%VOL	CARBON DIOXIDE	OXYGEN %O2	BAROM PRESSURE mb/weather	HYDROGEN SULPHIDE H2S	H20 LEVEL
1	0	0	0.00	0.90	19.90	980	0	Dry

Rotary Test Drilling Ltd
MONITORING FOR LANDFILL GAS.

Units 1% Gas volume = 10,000PPM
Sample types A = Accumulated SS = Steady State

All Samples Type A
except * = Steady State

Site: **Greenwood Tree, Wythenshaw.** Ref: **63/06** Date: **03/11/06**
Weather: **Sunny/Clear** Visit: **2**

DATE & TEST	FLOWLt/hr	METHANE CH4 %LEL	%VOL	CARBON DIOXIDE	OXYGEN %O2	BAROM PRESSURE mb/weather	HYDROGEN SULPHIDE H2S	H20 LEVEL
1	0	0	0.00	1.00	19.40	1020	0	Dry

Rotary Test Drilling Ltd
MONITORING FOR LANDFILL GAS.

Units 1% Gas volume = 10,000PPM
Sample types A = Accumulated SS = Steady State

All Samples Type A
except * = Steady State

Site: **Greenwood Tree, Wythenshaw.** Ref: **63/06** Date: **17/11/06**
Weather: **Broken Cloud/Showers** Visit: **3**

DATE & TEST	FLOWLt/hr	METHANE CH4 %LEL	%VOL	CARBON DIOXIDE	OXYGEN %O2	BAROM PRESSURE mb/weather	HYDROGEN SULPHIDE H2S	H20 LEVEL
1	0	0	0.00	1.10	19.20	981	0	Dry

Rotary Test Drilling Ltd
MONITORING FOR LANDFILL GAS.

Units 1% Gas volume = 10,000PPM
Sample types A = Accumulated SS = Steady State

All Samples Type A
except * = Steady State

Site: **Greenwood Tree, Wythenshaw.** Ref: **63/06** Date: **01/12/06**
Weather: **Overcast/Dry** Visit: **4**

DATE & TEST	FLOWLt/hr	METHANE CH4 %LEL	%VOL	CARBON DIOXIDE	OXYGEN %O2	BAROM PRESSURE mb/weather	HYDROGEN SULPHIDE H2S	H20 LEVEL
1		UNABLE TO TEST SPOIL OVER MONITORING POINT						

A5 – TIER 1 THRESHOLDS

Tier 1 Thresholds - Soil Contaminants: Initial Assessment of Risk Sheet 1

Table 1, Table 2 and Table 3 below can be used for the initial assessment with regard to the potential for the identified contaminants to present a risk of significant harm to the proposed site end user.

The list of determinands is non-industry specific and it should be recognised that additional site specific determinands may need to be accounted for.

Table 1

Site End Use:

- **RESIDENTIAL WITH NO PRIVATE GARDENS OR ACCESS TO ALLOTMENTS**
- **RESIDENTIAL WITH NO PRIVATE GARDENS BUT ACCESS TO LARGE AREAS OF PUBLIC OPEN SPACE**

Contaminants	Threshold Trigger Concentration For Planned End Use	
	Source	Value (mg/kg)
Arsenic	CLEA SGV for Residential without Plant Uptake end use	20
Cadmium	CLEA SGV for Residential without Plant Uptake end use	30
Chromium	CLEA SGV for Residential without Plant Uptake end use	200
Lead	CLEA SGV for Residential without Plant Uptake end use	450
Mercury	CLEA SGV for Residential without Plant Uptake end use	15
Nickel	CLEA SGV for Residential without Plant Uptake end use	75
Selenium	CLEA SGV for Residential without Plant Uptake end use	260
Copper	ICRCL 70/90 Table III Risk of Phytotoxicity	250
Zinc	ICRCL 70/90 Table III Risk of Phytotoxicity	1000
Boron	Recognised threshold to prevent phytotoxic affects	3
PAH	Recognised screening threshold for total PAH's	40
Benzo(a)Pyrene	Refer to separate sheet	
Naphthalene	Refer to separate sheet	
Phenols	Recognised threshold for protection of services	5
Cyanide (Free)	CLEA SGV for Residential without Plant Uptake end use	135
Sulphate	Recognised threshold for protection of sub-surface concrete	2400
Sulphur (Free)	Recognised threshold for all end uses	5000
Sulphide	Recognised threshold for all end uses	250
DRO C_8–C_{35}	Curtins Consulting in-house assessment based on RBCA/RISC	500
pH	Typical value in uncontaminated soils	6-8

Notes

1. All CLEA SGV's are based on sandy soil as defined in CLR10.
2. The above tables are for guidance only and must be read in conjunction with relevant source documentation.

Tier 1 Thresholds - Soil Contaminants: Initial Assessment of Risk Sheet 2

Table 2

Site End Use:

- **RESIDENTIAL WITH GARDENS OR ACCESS TO ALLOTMENTS**

Contaminants	Threshold Trigger Concentration For Planned End Use		
	Source	Value (mg/kg)	
Arsenic	CLEA SGV for Residential with Plant Uptake end use	20	
Cadmium	CLEA SGV for Residential with Plant Uptake end use	pH 6	1
		pH 7	2
		pH 8	8
Chromium	CLEA SGV for Residential with Plant Uptake end use	130	
Lead	CLEA SGV for Residential with Plant Uptake end use	450	
Mercury	CLEA SGV for Residential with Plant Uptake end use	8	
Nickel	CLEA SGV for Residential with Plant Uptake end use	50	
Selenium	CLEA SGV for Residential with Plant Uptake end use	35	
Copper	ICRCL 70/90 Table III Risk of Phytotoxicity	250	
Zinc	ICRCL 70/90 Table III Risk of Phytotoxicity	1000	
Boron	Recognised threshold to prevent phytotoxic affects	3	
PAH	Recognised screening threshold for total PAH's	40	
Benzo(a)Pyrene	Refer to separate sheet		
Naphthalene	Refer to separate sheet		
Phenols	Recognised threshold for protection of services	5	
Cyanide (Free)	CLEA SGV for Residential with Plant Uptake end use	130	
Sulphate	Recognised threshold for protection of sub-surface concrete	2400	
Sulphur (Free)	Recognised threshold for all end uses	5000	
Sulphide	Recognised threshold for all end uses	250	
DRO C_8 –C_{35}	Curtins Consulting in-house assessment based on RBCA/RISC	500	
pH	Typical value in uncontaminated soils	6-8	

Notes

1. All CLEA SGV's are based on sandy soil as defined in CLR10.
2. The above tables are for guidance only and must be read in conjunction with relevant source documentation.

Tier 1 Thresholds - Soil Contaminants: Initial Assessment of Risk Sheet 3

Table 3

Site End Use:

- **COMMERCIAL / INDUSTRIAL**

Contaminants	Threshold Trigger Concentration For Planned End Use	
	Source	Value (mg/kg)
Arsenic	CLEA SGV for Commercial/Industrial	500
Cadmium	CLEA SGV for Commercial/Industrial	1400
Chromium	CLEA SGV for Commercial/Industrial	5000
Lead	CLEA SGV for Commercial/Industrial	750
Mercury	CLEA SGV for Commercial/Industrial	480
Nickel	CLEA SGV for Commercial/Industrial	5000
Selenium	CLEA SGV for Commercial/Industrial	8000
Copper	ICRCL 70/90 Table III Risk of Phytotoxicity	250
Zinc	ICRCL 70/90 Table III Risk of Phytotoxicity	1000
Boron	Recognised threshold to prevent phytotoxic affects	3
PAH	Recognised screening threshold for total PAH's	40
Benzo(a)Pyrene	Refer to separate sheet	37
Naphthalene	Refer to separate sheet	6.5
Phenols	Recognised threshold for protection of services	5
Cyanide (Free)	CLEA SGV for Commercial/Industrial	13900
Sulphate	Recognised threshold for protection of sub-surface concrete	2400
Sulphur (Free)	Recognised threshold for all end uses	5000
Sulphide	Recognised threshold for all end uses	250
DRO C_8 –C_{35}	Curtins Consulting in-house assessment based on RBCA/RISC	500
pH	Typical value in uncontaminated soils	6-8

Notes

1. All CLEA SGV's are based on sandy soil as defined in CLR10.
2. The above tables are for guidance only and must be read in conjunction with relevant source documentation.

Tier 1 Thresholds - Soil Contaminants: Initial Assessment of Risk Sheet 4

Site End Use: All Uses for Toluene and Ethylbenzene

Table 4.1: Toluene

Standard Land Use [d]	Soil Guideline Value [a, b, c, e] (mg/kg dry weight soil)		
	1% SOM	2.5% SOM	5% SOM
Residential with Plant Uptake	3	7	14
Residential without Plant Uptake	3	8	15
Allotments	31	73	140
Commercial/Industrial	150	350	680

Notes:

a. Based on total toluene concentration in the soil.
b. Based on sandy soil as defined in R&D Publication CLR10 (Defra and Environment Agency 2002d) and subsequently revised in Environment Agency (2004b).
c. Soil Guideline Values for toluene will vary according to soil organic matter content (SOM) for all land uses.
d. Based on the integration of the provisional guideline values (see paragraphs 3.7 to 3.9 of SGV 15).
e. Soil Guideline Values assume that free phase contamination is not present.

Table 4.2: Ethylbenzene

Standard Land Use	Soil Guideline Value [a, b, c, f] (mg/kg dry weight soil)		
	1% SOM	2.5% SOM	5% SOM
Residential with Plant Uptake [d]	9	21	41
Residential without Plant Uptake [d]	16	41	80
Allotments [d]	18	43	85
Commercial/Industrial [e]	48000		

Notes:

a. Based on total ethylbenzene concentration in the soil.
b. Based on sandy soil as defined in R&D Publication CLR10 (Defra and Environment Agency 2002d) and subsequently revised in Environment Agency (2004b).
c. Soil Guideline Values for ethylbenzene will vary according to soil organic matter content (SOM) for all land uses with the exception of commercial/Industrial.
d. Based on the integration of the provisional guideline values (see paragraphs 3.7 to 3.10 of SGV 16).
e. Based on the sum of oral, dermal contact and inhalation exposure compared with the inhalation TDSI value (see paragraphs 3.10 to 3.11 of SGV 16).
f. Soil Guideline Values assume that free phase contamination is not present (with the exception of the commercial / Industrial land-use).

Tier 1 Thresholds - Soil Contaminants: Initial Assessment of Risk Sheet 5

Site End Use: All Uses for Naphthalene and Benzo(a)Pyrene

Table 5.1: Naphthalene

Standard Land Use	Soil Guideline Value (mg/kg dry weight soil)			
	1% SOM		5% SOM	
	Oral	Inhalation	Oral	Inhalation
Residential with Plant Uptake	45	0.6	207	2.9
Residential without Plant Uptake	1490	0.6	1450	2.9
Commercial/Industrial	36340	1.3	36650	6.5

Notes:

a. Based on sandy soil as defined in R&D Publication CLR10 (Defra and Environment Agency 2002d) and subsequently revised in Environment Agency (2004b).
b. Soil Guideline Values will vary according to soil organic matter content (SOM) for all land uses.

Table 5.2: Benzo(a)pyrene

Standard Land Use	Soil Guideline Value (mg/kg dry weight soil)			
	1% SOM		5% SOM	
	Oral	Inhalation	Oral	Inhalation
Residential with Plant Uptake	0.3	7.8	0.85	25
Residential without Plant Uptake	0.4	7.8	1.0	25
Commercial/Industrial	37	19	37	86

Notes:

a. Based on sandy soil as defined in R&D Publication CLR10 (Defra and Environment Agency 2002d) and subsequently revised in Environment Agency (2004b).
b. Soil Guideline Values will vary according to soil organic matter content (SOM) for all land uses.

Tier 1 Thresholds – Leachate Quality Threshold Sheet 6

From EA Guidance on the Disposal of "Contaminated Soils", Version 3, April 2001

Table 6

Contaminants	Value (mg/l)	Value (µg/l)
Arsenic	0.01	10
Cadmium	0.001	1
Chromium	0.05	50
Lead	0.05	50
Mercury	0.001	1
Nickel	0.05	50
Selenium	0.01	10
Copper	0.02	20
Zinc	0.5	500
Boron	2	2000
PAH	0.0002	0.2
COD	30	
Ammonia	0.5	
Phenols	0.0005	0.5
Cyanide (Free)	0.05	50
Sulphate	150	
Sulphur (Free)	150	
Sulphide	150	
Iron	0.1	100
Chloride	200	
pH	5.5 – 9.5	

A6 – STATISICAL ANALYSIS

Maximum Value Test

Project: ELLUC Projects Limited
Site: Greenwood Road, Wythenshaw

The Maximum Value Test has been performed on data sets that failed the Mean Value Test.
The test involves the following steps:
(i) Calculate log values of each sample, y
(ii) Calculate sample mean, $\underline{y}$
(iii) Calculate unbiased sample standard deviation of log transformed values, S_y
(iv) Calculate maximum test value, T as,
$T = (y_{max} - \underline{y}) / S_y$
T is then compared with a critical value, T_{crit}, related to the chance that the sample represents an outlier.

Sample data (log values)

Maximum values within those data sets failing the Mean Value Test are shown in bold with shaded cells.

Location	Depth (m)	As		B(a)P
TP1	0.3	11.00		10.90
TP2	0.4	21.00		1.70
TP3	0.4	27.00		3.10
TP4	0.4	11.00		3.10
TP5	0.4	12.00		1.20

Statistical parameters (only shown for relevant contaminants)

No of samples	n	5		5
Arithmetic mean	$\underline{y}$	16.40		4.00
Standard deviation	sy	7.26636		3.94842
Critical value	T_{crit}	1.6		1.6

Results (T Values)

Contaminant	As		B(a)P
T	1.46		1.75
Pass or fail Maximum Value Test?	Pass		FAIL

Mean Value Test

Project: ELLUC Projects Limited

Site: Greenwood Road, Wythenshaw

The Mean Value Test identifies the 95% confidence limit of the measured mean of the data set for comparison with the Soil Guideline Value. The calculation involves the following five steps:
(i) Calculate the arithmetic mean, $\bar{x}$
(ii) Calculate the sample standard deviation, s
(iii) Select t value from reference tables for applicable confidence limit (in this case 95%)
(iv) Calculate upper bound value of 95th percentile as:
$US_{95} = \bar{x} + t.s/\sqrt{n}$

Sample data

Location	Depth (m)	As		B(a)P										
TP1	0.3	11.00		10.90										
TP2	0.4	21.00		1.70										
TP3	0.4	27.00		3.10										
TP4	0.4	11.00		3.10										
TP5	0.4	12.00		1.20										

Statistical Parameters

No of samples	n	5		5										
Mean	x	15.2		2.9										
Standard deviation	s	7.27		3.95										
t value	t	2.132		2.132										

Arithmetic mean values shown, except for lead for which geometric mean value is used in calculations, in accordance with CLEA guidance
Concentrations reported as below detection limit are assumed to equal detection limit, in accordance with CLEA guidance

Results

Upper bound value (UBV)	22.17		6.69										
SGV	20		1.3										
Pass or fail Mean Value test?	FAIL		FAIL										

* Dutch action value used for Zn and Cu

A7 – PHASE 1 INVESTIGATION