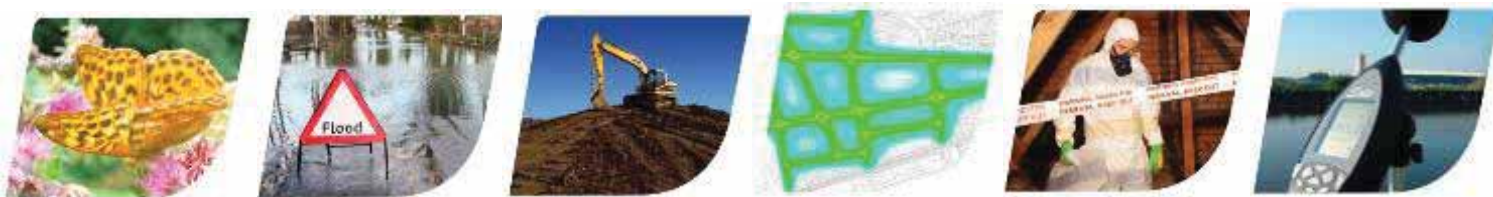




**GEO-ENVIRONMENTAL SITE INVESTIGATION  
CHANCERY HOUSE  
PARADISE STREET  
LIVERPOOL**

**REC REFERENCE: 45924P1R0**






**REPORT PREPARED FOR: CIVIC ENGINEERS  
MARCH 2015**



## QUALITY ASSURANCE

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EXECUTIVE SUMMARY	
Site Address	Chancery House, Paradise Street, Liverpool, L1 2HE
Grid Reference	334520, 389930
Site Area	0.11 Ha
Current Site Use	The proposed development site located in Liverpool City Centre is roughly triangular in shape and bound by Hanover Street to the north, Price Street to the east and Paradise street to the west. Chancery House, a Grade II listed 3-storey red brick building occupies the eastern section of the site and is currently unused. The north west corner of the site is currently used as a public car park and is surfaced in asphalt. Mature trees border the northern and western perimeter of the car park.
Intrusive Ground Investigation	
Ground Conditions	<p><b>Made Ground</b> The car park was surfaced in asphalt between 0.03m and 0.10m thick, which was underlain by limestone sub base generally 0.3m thick.</p> <p>Made Ground deposits were encountered across the car park and consisted of grey slightly gravelly sand or reddish brown sandy gravel to depths of between 2.00 and 2.60m below ground level. The Made Ground comprised demolition rubble including brick, concrete, tile, metal, glass and coal along with large concrete boulders.</p> <p>The granular Made Ground was underlain by extremely low to low strength, soft to firm dark grey clay deposits. The clay was found to be organic-rich with large pieces of rotting timber present and a strong organic odour.</p> <p><b>Solid</b> The weathered sandstone horizon was encountered at a depth of 8.0m below ground level. Grey fine to medium sandstone was encountered at a depth of 9.1m below ground level.</p> <p><b>Groundwater</b> During the Ground Investigation, only a limited volume of perched groundwater was encountered in WS101 at a depth of 4.0m bgl.</p>
Tier 1 Contaminated Land Risk Assessment	
Human Health	The Tier I Human Health Risk has identified elevated concentrations of lead and arsenic. Chrysotile asbestos fibres were detected in three samples of Made Ground, quantification testing of these samples is currently underway and will be reported as a revision to this report.
Controlled Waters	The results of this direct comparison indicates that the Environmental Quality Standard (EQS) for surface water was exceeded for sulphate and polycyclic aromatic hydrocarbons.
Ground Gas	Ground gas monitoring is on-going a full assessment of the risks will be made once the monitoring period is complete.

Geotechnical Assessment	
Allowable Bearing Capacity (ABC)	<p>A review of published literature on the allowable bearing capacities of sandstone indicates that unweathered sandstone should provide an approximate allowable bearing capacity of between 4000 kN/m<sup>2</sup> and 6000 kN/m<sup>2</sup>.</p> <p>It is considered that the loads for the proposed development would be in the region of 1850 kN/m<sup>2</sup> and on this basis the published literature indicates that the unweathered sandstone should provide a more than adequate allowable bearing capacity for end-bearing pile foundations.</p>
Foundation Options	<p>It is considered that a suitable foundation option at this location would be to extend the loadings of the proposed five storey development via a piled foundation solution through the Made Ground and low strength cohesive deposits into the underlying sandstone bedrock. An end bearing pile foundation, socketed into the unweathered sandstone bedrock should be adopted.</p>
Soak-away Drainage	<p>The presence of substantial depths of Made Ground and soft clays across the site may result in excessive or differential settlement. It is therefore recommended that drain runs are designed using steeper gradients and flexible joints to allow for some differential settlement.</p> <p>In-situ variable (falling) head permeability tests were undertaken within the three monitoring well installations. Soil infiltration rates were between 2.49x10<sup>-5</sup>m/s and 5.57x10<sup>-5</sup>m/s; and in accordance with CIRIA C515 (2000) indicates a medium to low permeability.</p>
Sulphate Assessment	Sulphate Class DS-2, (ACEC) AC-1s
Developed Conceptual Site Model (CSM)	
<p>The Tier I Human Health Risk has identified elevated concentrations of lead, arsenic and asbestos fibres present in the granular Made Ground deposits.</p> <p>The main exposure pathway for arsenic and lead is soil ingestion. It is considered that on the basis that the development does not include soft landscaped areas that the exposure pathway to future residents does not exist and hence the risk posed is negligible.</p> <p>Chrysotile asbestos fibres were detected in three samples of Made Ground. The main exposure pathway is dust inhalation. It is considered that while future residents would not be at risk from asbestos due to the lack of soft landscaping within the development, there is a risk to construction workers and off-site receptors during the development of the site and therefore, an asbestos management plan should be in place during the construction work.</p> <p>The risk to groundwater and surface water receptors from the above determinands is considered <b>low</b> based on the following rationale;</p> <ul style="list-style-type: none"> <li> Significantly elevated PAHs and sulphate were not recorded within the site soils;</li> <li> Only a minimal volume of groundwater was encountered during the site investigation and therefore, it is considered that nearby surface water receptors are unlikely to be in hydraulic continuity with the sites shallow groundwater;</li> <li> The entire site will be surfaced in hardstanding which will reduce the leaching of any potentially impacted material;</li> <li> A layer of impermeable clay is present between the granular Made Ground deposits and the underlying sandstone bedrock; and,</li> <li> No groundwater abstractions are located within 1km radius of the site.</li> </ul>	

Ground gas monitoring is on-going a full assessment of the risks will be made once the monitoring period is complete.

#### Recommendations

REC recommends that further investigation is undertaken utilising rotary techniques to investigate the bedrock at depth to assist in the design of piled foundations. It is considered that boreholes are advanced to a depth of at least 15m bgl in order to recover cores of the unweathered bedrock to allow an assessment of the Rock Quality Designation (RQD) and to obtain samples for laboratory strength testing. It is recommended that the depth of the rotary boreholes is confirmed with a specialist piling contractor to ensure that suitable information is obtained to aid in the piling design.

An Asbestos Management Plan is required to mitigate the risk to construction workers and off-site receptors from the identified asbestos fibres during the development of the site.

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## **1.0 INTRODUCTION**

### **1.1 Background**

Resource and Environmental Consultants (REC) Ltd have been commissioned by Civic Engineers on behalf of Chancery House Liverpool LLP to undertake a Phase II Site Investigation at Chancery House, Liverpool. A site location plan is presented as drawing No 45924-001 in Appendix III.


The scope of the Phase II Ground Investigation comprised three window sample probeholes, one cable percussive borehole and five trial pits. The window sample probeholes were completed as environmental monitoring installations. The scope of works also comprised targeted chemical and geotechnical laboratory analysis and a factual and interpretive report.

### **1.2 Proposed Development**

Chancery House Liverpool LLP intends to construct a 5-storey extension to the existing Grade II listed Chancery House building with the ground level a commercial unit and the higher levels apartments. The proposed development plan drawing No 45924-002 is contained in Appendix III.

### **1.3 Previous Reports**






The following reports have been provided to REC for review:

-  Clancy Consulting, Phase I Geo-environmental Desk Study, August 2014 (report ref: 10/0641/001)

This report has been designed to supplement the previous report and therefore, this report should be read in conjunction with the Phase I report.

### **1.4 Objectives**

The objectives of the geo-environmental Phase II investigation are to:

-  Undertake a preliminary stage of sampling and analysis to provide an overview of environmental issues identified;
-  Assess the implications of any potential environmental risks, liabilities and development constraints associated with the site in relation to the future use of the site and in relation to off-site receptors;
-  Assess the geotechnical information and provide preliminary recommendations in relation to foundations;
-  Provide an assessment of the soakage of the underlying soils to assist in the design of infiltration based SuDS; and,
-  Provide recommendations regarding future works required.

### **1.5 Risk Classification**

REC Ltd has utilised the available data to classify the site on the basis of its likely contaminated land liability and potential for geotechnical constraints in relation to the property development. The risk



classification definitions are summarised below:

Risk	Definition
Low	There are unlikely to be significant contaminated land liabilities/geotechnical constraints associated with the property.
Low-Moderate	There are unlikely to be significant contaminated land liabilities/geotechnical constraints associated with the property with regard to the proposed use. However, minor issues may require further consideration in the event of a future redevelopment of the site etc.
Moderate	Some potential contaminated land liabilities/geotechnical constraints are likely to affect the property as a result of historical and/or current activities. The risks identified are unlikely to pose an immediate significant issue but the purchaser/developer may wish to make further enquiries of the vendor or undertake further environmental improvements. Redevelopment of the site will likely require further site investigation.
Moderate-High	Some potentially significant contaminated land liabilities/geotechnical constraints have been identified at the property that requires further assessment including intrusive ground investigations.
High	Significant potential contaminated land liabilities/geotechnical constraints have been identified at the property. Further assessment including intrusive ground investigation will be required to determine to level of risk and associated liability.

## 1.6 Limitations of the Study

The limitations of this report are presented in Appendix I.

## 1.7 Confidentiality

REC has prepared this report solely for the use of the Client and those parties with whom a warranty agreement has been executed, or with whom an assignment has been agreed. Should any third party wish to use or rely upon the contents of the report, written approval must be sought from REC; a charge may be levied against such approval.

## 2.0 SITE SETTING

### 2.1 Site Details

Site Address	Chancery House, Paradise Street, Liverpool, L1 2HE
National Grid Reference	334520, 389930
Site Area	0.11 Ha

All acronyms used within this report are defined in the Glossary presented in Appendix II.

A site location plan drawing No 45924-001 is presented in Appendix III.

### 2.2 Current Site Use

#### Site Description

The proposed development site located in Liverpool City Centre is roughly triangular in shape and bound by Hanover Street to the north, Price Street to the east and Paradise street to the west. The site is located approximately 200m to the east of Liverpool Docks and is adjacent to the south west of the historic Old Dock, which was backfilled in 1826.

Chancery House, a Grade II listed 3-storey red brick building occupies the eastern section of the site and is currently unused. The north west corner of the site is currently used as a public car park and is surfaced in asphalt. The site appears to have an even topography.

Mature trees border the northern and western perimeter of the car park, REC understands that the trees are under a protection order and will be relocated as part of the development of the site.

### 2.3 Surrounding Area

The surrounding land uses are summarised below:

Direction	Land Use
North	Hanover Street, retail / commercial unit.
East	Price Street, multi-storey car park.
South	Paradise Street, commercial units and residential dwellings.
West	Paradise Street, electric substation and commercial units.

### 3.0 SITE INVESTIGATION

#### 3.1 Desk Study Information

Potential contamination sources have been identified from the Clancy Consulting desk study (ref: 10/0641/001) and these are listed in Table 3.1 below:

**Table 3.1 Summary of Potential Contaminant Sources**

Potential Source	Potential Contaminants	Potential Impact
Made Ground associated with construction and demolition of former buildings.	Metals, asbestos, hydrocarbons, phenols, sulphate, cyanide, polycyclic aromatic hydrocarbons, carbon dioxide and methane.	Human health, controlled waters and buildings.

#### 3.2 Site Investigation Rationale

Exploratory holes have been advanced to provide information on Made Ground and baseline conditions across the site.

Trial pitting and window sampling was undertaken between the 9<sup>th</sup> and 10<sup>th</sup> February 2015 and the cable percussive borehole was completed between 3<sup>rd</sup> and 4<sup>th</sup> March 2015. The works are summarised in Table 3.2, below.

**Table 3.2 Summary of Fieldwork**

Location Hole	Potential Source/Rationale	Type	Maximum Depth (m bgl)	Monitoring Wells Response Zone
WS101	Made Ground and baseline conditions	Window Sample	6.45	2.00 – 5.00
WS102			5.45	0.50 – 1.50
WS103			6.45	2.00 – 5.00
TP101		Trial Pit	3.00	N/A
TP102			2.20	
TP103			3.90	
TP104			1.00	
TP105			1.80	
BH101		Cable Percussive	9.31	N/A

#### Notes

m bgl – metres below ground level.

The investigation has been used to collect environmental samples for chemical analysis and geotechnical information to assist in the design and construction of the proposed development.

All samples were collected using appropriate PPE and sampling equipment that was cleaned at each sampling location. A detailed copy of REC Ltd sampling methodology, QA procedures and laboratory chain of custody forms can be provided upon request.

### **3.3 In-Situ Testing**

#### **3.3.1 Standard Penetration Tests**

Standard Penetration Tests (SPT) were carried out in 1m intervals within the window sample and cable percussive boreholes. The testing was carried out to provide validation of ground consistency and strength observations.

#### **3.3.2 Soil Infiltration In-Situ Testing**

In-situ variable (falling) head permeability tests were undertaken within the three monitoring well installations (WS101, WS102 and WS103). The results of the in-situ testing are presented in Appendix VII and discussed in Section 6.

### **3.4 Laboratory Analysis**

#### **3.4.1 Soil Chemical Analysis**

Selected soil samples were submitted for a range of chemical analysis comprising, metals, pH, total sulphate, water soluble sulphate (2:1 extract), cyanide, phenols, total and speciated polycyclic aromatic hydrocarbons (PAHs), asbestos, BTEX and speciated banded total petroleum hydrocarbons (TPH).

Scientific Analysis Laboratories (SAL) Ltd of Manchester undertook the analytical work, the results of which are included in Appendix V and discussed in Section 5.

#### **3.4.2 Water Chemical Analysis**

A groundwater sample taken from WS101 was analysed for a range of determinands comprising metals, speciated PAHs, banded and speciated TPH and hardness.

SAL Ltd undertook the analytical work, the results of which are included in Appendix V and discussed in Section 5.

#### **3.4.3 Geotechnical Laboratory Analysis**

Selected soil samples were submitted to Professional Soil Laboratories (PSL) Ltd of Doncaster to test for Atterberg limits determinations. The results of the geotechnical analysis are presented in Appendix VI and discussed in Sections 4 and 6.

Chemical analysis on soil samples included pH and sulphate (2:1 extraction) analysis to aid concrete design. The results of these tests are included within the soil chemical test data in Appendix V and discussed in Sections 4 and 6.

### **3.5 Gas and Groundwater Monitoring**

Following the intrusive phase of site works, gas and groundwater monitoring was undertaken from the 23<sup>rd</sup> February 2015. It is proposed to undertake a total of six monitoring visits within a two month period; however, to date only two monitoring visits have been completed.

Concentrations of methane (CH<sub>4</sub>), carbon dioxide (CO<sub>2</sub>) and Oxygen (O<sub>2</sub>) were measured using an infra-red gas analyser (GFM 435), calibrated to a reference standard (before and after each survey)

and gas flow rates were measured using an attached flow pod. Gas measurements were recorded for a minimum of sixty seconds at each location, at which point the maximum concentration of CH<sub>4</sub> and CO<sub>2</sub> together with the lowest concentration of O<sub>2</sub> were recorded.

Groundwater monitoring was undertaken using an electronic dip meter to record the depth to groundwater.

Ground gas results are discussed in Section 5.3 and the recorded groundwater levels are summarised in Section 4.2 and discussed within Section 6.

## 4.0 GROUND AND GROUNDWATER CONDITION

### 4.1 Ground Conditions

#### 4.1.1 Summary of Ground Conditions

The ground investigation identified the strata set out in Table 4.1 below.

**Table 4.1 Summary of Strata**

Strata	Typical Description	Min Depth to Top of Strata (m)	Max Depth to Top of Strata (m)	Max Thickness (m)
Made Ground: Asphalt	Asphalt	0.00	0.00	0.10
Made Ground: Limestone sub base	Light grey slightly sandy medium to coarse sub-angular to sub-rounded limestone GRAVEL.	0.03	0.10	0.30
Made Ground: Demolition rubble	Reddish brown sandy medium to coarse sub-angular to sub-rounded GRAVEL of brick, concrete, metal and tile with a high cobble content of angular brick and concrete.	0.30	0.30	1.90
Made Ground: Demolition Rubble	Grey slightly gravelly fine to medium SAND with low to high cobble content of angular brick and concrete. Gravel is medium to coarse angular to sub-angular of brick, concrete, metal, limestone, glass and coal.	0.30	0.40	2.20
Possible Made Ground: Organic-rich CLAY	Extremely low to low strength, soft to firm dark grey slightly sandy CLAY. Strong organic odour and occasional timber present.	2.00	2.60	5.60
Dense grey SAND – Weathered sandstone	Dense grey slightly silty fine to medium SAND.	8.20	8.20	0.90
SANDSTONE	Grey fine to medium grained SANDSTONE	9.10	9.10	N/A

#### 4.1.2 Made Ground

The car park was surfaced in asphalt between 0.03m and 0.10m thick, which was underlain by a limestone sub base generally 0.3m thick.

Made Ground deposits were encountered across the car park and consisted of grey slightly gravelly sand or reddish brown sandy gravel to depths of between 2.00 and 2.60m bgl. The Made Ground comprised demolition rubble including brick, concrete, tile, metal, glass and coal along with large concrete boulders.

A former concrete slab was encountered at a depth of between 1.60m and 2.00m bgl in the eastern section of the car park.

The granular Made Ground was underlain by extremely low to low strength, soft to firm dark grey clay deposits. The clay was found to be organic-rich with large pieces of rotting timber present and a strong organic odour. It is considered that the clay deposit may be a possible Made Ground associated with the in-filling of a channel during the construction of the Old Dock in 1715.

#### **4.1.3 Solid Geology**

The BGS geological map indicates that the site is underlain by the Wilmslow Sandstone Formation.

The weathered sandstone horizon was encountered at a depth of 8.0m below ground level. Grey fine to medium sandstone was encountered at a depth of 9.1m below ground level.

#### **4.1.4 Soil Consistency**

The granular Made Ground deposits (up to 2.5m bgl) were found to be generally medium dense in consistency. The underlying organic-rich clay was found to be generally extremely low to low strength.

Results of the Standard Penetration Tests, including undrained shear strengths derived from SPTs are included on Table 4.2, overleaf.

**Table 4.2 Standard Penetration Test Results**

Boreholes	Depth (m bgl) (f)	Material Field Description	CPT/SPT "N" Value	Corrected "N" Value (N <sub>1,60</sub> )	Terzaghi & Peck Relative Density (Sands)	Eurocode Soil strength	Consistency	Approximate Undrained Shear Strength (kN/m <sup>2</sup> )
WS101	1.00	Made Ground: slightly gravelly SAND	25	25.20	Medium Dense	Not Applicable (N/A)	N/A	N/A
	2.00	Slightly Sandy Clay	5	4.57	N/A	Low strength	Firm	22.84
	3.00	Slightly Sandy Clay	6	5.22	N/A	Low strength	Firm	26.09
	4.00	Slightly Sandy Clay	4	3.38	N/A	Very low strength	Soft	16.90
	5.00	Slightly Sandy Clay	4	3.32	N/A	Very low strength	Soft	16.59
	6.00	Slightly Sandy Clay	5	4.10	N/A	Low strength	Firm	20.50
WS102	1.00	Made Ground: slightly gravelly SAND	8	8.07	Loose	N/A	N/A	N/A
	2.00	Slightly Sandy Clay	2	1.83	N/A	Extremely low strength	Very Soft	9.14
	3.00	Slightly Sandy Clay	2	1.74	N/A	Extremely low strength	Very Soft	8.70
	4.00	Slightly Sandy Clay	5	4.22	N/A	Low strength	Firm	21.12
	5.00	SAND	24	19.91	Medium Dense	N/A	N/A	N/A
	1.20	Made Ground: slightly gravelly SAND	8	7.85	Loose	N/A	N/A	N/A
WS103	2.00	Made Ground: slightly gravelly SAND	2	1.83	Very Loose	N/A	N/A	N/A
	3.00	Slightly Sandy Clay	6	5.22	N/A	Low strength	Firm	26.09
	4.00	Slightly Sandy Clay	5	4.22	N/A	Low strength	Firm	21.12
	5.00	Slightly Sandy Clay	4	3.32	N/A	Very low strength	Soft	16.59
	6.00	Slightly Sandy Clay	7	5.74	N/A	Low strength	Firm	28.70
	1.00	Made Ground: slightly gravelly SAND	50	50.41	Very Dense	N/A	N/A	N/A
BH101	2.00	Made Ground: slightly gravelly SAND	4	3.65	Very Loose	N/A	N/A	N/A
	3.00	Slightly Sandy Clay	3	2.61	N/A	Very low strength	Soft	13.04
	4.00	Slightly Sandy Clay	3	2.53	N/A	Very low strength	Soft	12.67
	5.00	Slightly Sandy Clay	5	4.15	N/A	Low strength	Firm	20.74
	6.00	Slightly Sandy Clay	3	2.46	N/A	Very low strength	Soft	12.30
	7.00	Slightly Sandy Clay	6	4.88	N/A	Low strength	Firm	24.41
	8.00	SAND	47	38.04	Dense	N/A	N/A	N/A
	9.00	SAND	50	40.34	Dense	N/A	N/A	N/A
	9.20	SANDSTONE	>50	N/A	N/A	N/A	N/A	N/A



#### 4.1.5 Soil Infiltration

In-situ variable (falling) head permeability tests were undertaken within the three monitoring well installations and the results are presented in Table 4.3, below.

**Table 4.3 Soil Infiltration Results**

Location	Response Zone (m)	Groundwater Level (m)	Material	Soil Infiltration Rate (m/s)
WS101	2.0 – 5.0	2.43	Soft to firm CLAY	$2.91 \times 10^{-5}$
WS102	0.5 – 2.0	Dry	Granular Made Ground	$2.49 \times 10^{-5}$
WS103	2.0 – 5.0	1.98	Soft to firm CLAY	$5.57 \times 10^{-5}$

#### 4.1.6 Soil Plasticity

The Atterberg Limits determinations summarised in Table 4.4 below, show the clay to be of intermediate plasticity with a low to medium volume change potential.

**Table 4.4 Summary of Plasticity Index Test Results**

Location	Depth (m)	Natural Moisture Content (%)	Plastic Limit (%)	Liquid Limit (%)	Plasticity Index (%)	Percentage passing 425µm sieve (%)	Modified Plasticity Index
WS101	3.00	24	19	38	19	94	18
WS102	2.00	30	22	43	21	82	17
WS102	3.00	32	23	46	23	95	22
WS103	3.00	33	21	43	22	82	18

#### 4.1.7 pH and Sulphate

Chemical analyses for pH and soluble sulphate content contained in Appendix V (summarised below in Table 4.5), shows that concrete should be designed to meet Class DS-2, Aggressive Chemical Environment for Concrete Classification (ACEC) AC-1s in accordance with BRE Special Digest 1 (2005).

**Table 4.5 Summary of pH and Sulphate Data**

Location	Depth (m)	SO <sub>4</sub> in 2:1 water / soil (g/l)	pH Value
TP101	0.6	<0.1	8.5
TP101	2.4	<0.1	8.2
TP102	1.5	0.6	8.1
TP103	0.7	0.3	8.1
TP103	2.8	0.1	8.3
TP105	1.0	<0.1	8.3
WS101	0.8	0.5	7.9
WS103	3.0	0.3	8.3

## 4.2 Groundwater Conditions

The location and depth of groundwater strikes and standing water levels are summarised in Table 4.6, below.

**Table 4.6 Summary Groundwater Strikes and Standing Water**

Location	Depth to strike (m)	Depth to standing water (m)
WS101	4.00	2.3
WS102	-	Dry
WS103	-	2.0
BH101	-	N/A

Groundwater monitoring was undertaken using an electronic dip meter to record the depth to standing water level. The groundwater levels recorded are summarised in Table 4.7, overleaf.

## 4.3 Ground Gas

The results of the ground gas monitoring are presented in Table 4.7, overleaf.

**Table 4.7 Summary of ground gas and groundwater monitoring results**

Well	Date	CH <sub>4</sub> Initial %v/v	CH <sub>4</sub> Steady %v/v	CH <sub>4</sub> GSV l/hr	CO <sub>2</sub> Initial %v/v	CO <sub>2</sub> Steady %v/v	CO <sub>2</sub> GSV l/hr	O <sub>2</sub> %v/v	Atmos(mb)	Atmos. Dynamic	Flow (l/hr)	Response Zone (mbgl)	Depth to Base (mbgl)	Depth to Water (mbgl)
WS101	23/02/2015	0.1	0.1	0.0001	1.1	1.1	0.0011	19.8	986	Falling	0.1	2.00 – 5.00	5.26	2.33
	04/03/2015	0.1	0.1	0.0001	0.8	0.8	0.0008	20.0	1032	Rising	0.1		5.08	2.38
WS102	23/02/2015	0.1	0.1	0.0001	0.6	0.6	0.0006	19.7	986	Falling	0.1	0.50 – 2.00	1.98	DRY
	04/03/2015	0.1	0.1	0.0001	0.4	0.4	0.0004	20.3	1032	Rising	0.1		1.98	DRY
WS103	23/02/2015	0.1	0.1	0.0001	0.1	0.1	0.0001	20.2	986	Falling	0.1	2.00 – 5.00	4.73	1.98
	04/03/2015	0.1	0.1	0.0001	0.1	0.1	0.0001	20.5	1032	Rising	0.1		4.73	2.02

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## **5.0 TIER 1 QUALITATIVE CONTAMINATED LAND RISK ASSESSMENT**

REC has undertaken a Tier 1 qualitative risk assessment to determine if any potential contaminants within the underlying soils and groundwater pose an unacceptable level of risk to the identified receptors.

### **5.1 Human Health Risk Assessment**

At a Tier 1 stage the long term (chronic) human health toxicity of the soil has been assessed by comparing the on-site concentrations of organic and inorganic compounds with reference values published by the EA (Contaminated Land Exposure Assessment (CLEA) Soil Guideline Values (SGV)) and where absent, Generic Assessment Criteria (GACs) published by LQM/CIEH (2<sup>nd</sup> edition). As the development will comprise residential apartments above the commercial floor the more conservative residential end-use without plant uptake has been adopted.

At the end of March 2014, the Department for Environment and Rural Affairs (DEFRA) issued details of the outcome of a "Category 4 Screening Levels Project" which is aimed at providing a simple test for deciding when land is "suitable for use" from a human health perspective and more specifically for defining when land is definitely not contaminated land. Category 4 Screening Levels (C4SL's) were published for six substances which were selected based upon their ubiquity in contaminated land risk assessment and because they covered a range of exposure pathways and toxicological effects. C4SL's have been published for these six substances in relation to various land uses, namely residential (both with and without home-grown produce), allotments, commercial and two alternative types of Public Open Space.

The Category 4 Screening Levels (C4SL's) in effect update the current approach to the assessment of contaminated land risk in relation to Part IIa but will also influence the assessment of land affected by contamination that is dealt with through the planning process. At some stage these new levels may replace the current SGV's albeit that they prescribe different levels of risk. As the C4SL's describe a higher level of risk than the current SGVs it suggests in general that higher levels of contamination may be acceptable before remediation is required. However, the risk posed by any particular substance is specific to any given site and its environmental setting and therefore dependent upon the outcome of site specific risk assessment.

For the purpose of this report REC has based the assessment on the current SGV's and associated CLEA approach, albeit that C4SL's, where published, have also been taken into account. In situations where SGV's and/or C4SL's are exceeded and particularly where remediation measures are potentially required we recommend that the site is discussed with the Local Authority, and the Environment Agency where necessary, in order that definitive solutions can be agreed.

It should be noted that these changes do not apply to the assessment of risk to Controlled Waters.




The results of this comparison have been summarised within Table 5.1 (overleaf).

**Table 5.1 Summary of Generic Human Health Assessment for a Residential End Use without Plant Uptake**

Determinand	Units	GAC	n	MC	Loc. of Ex	Path way	Assessment
<b>Inorganics</b>							
<b>Arsenic</b>	mg/kg	40 <sup>(i)</sup>	8	73	TP103 (0.7m)	1	Further Action
Cadmium	mg/kg	85 <sup>(i)</sup>	8	<1	N/A	5	No Further Action
Chromium (VI)	mg/kg	6 <sup>(i)</sup>	8	<1		1	
<b>Lead</b>	mg/kg	200 <sup>(iii)</sup>	8	3900	TP101 (0.6m), TP102 (1.5m), TP103 (0.7m), WS101 (0.8m)	1	Further Action
Mercury	mg/kg	56 <sup>(i)</sup>	8	21	N/A	2	No Further Action
Nickel	mg/kg	180 <sup>(i)</sup>	8	47		1	
Selenium	mg/kg	430 <sup>(i)</sup>	8	<3		1, 5	
Copper	mg/kg	7100 <sup>(i)</sup>	8	170		1, 5	
Zinc	mg/kg	40,000 <sup>(i)</sup>	8	840		5	
Cyanide - Total	mg/kg	791 <sup>(iii)</sup>	8	1		1	
<b>Asbestos</b>	-	N.D.	5	Detected	TP103 (0.7m), TP105 (1.0m), WS101 (0.8m)	4	Further Action
<b>Organics – PAHs &amp; Phenols</b>							
Phenols	mg/kg	750 <sup>(i)</sup>	8	<1	N/A	1, 4	No Further Action
Naphthalene	mg/kg	2.3 <sup>(i)</sup>	8	0.29		2	
Acenaphthylene	mg/kg	2900 <sup>(i)</sup>	8	0.02		3	
Acenaphthene	mg/kg	3000 <sup>(i)</sup>	8	1.3		1	
Fluorene	mg/kg	2800 <sup>(i)</sup>	8	0.62		1	
Phenanthrene	mg/kg	1300 <sup>(i)</sup>	8	4.2		3	
Anthracene	mg/kg	31,000 <sup>(i)</sup>	8	0.69		3	
Fluoranthene	mg/kg	1500 <sup>(i)</sup>	8	4.1		3	
Pyrene	mg/kg	3700 <sup>(i)</sup>	8	4.8		3	
Benzo(a) Anthracene	mg/kg	11 <sup>(i)</sup>	8	1.8		3	
Chrysene	mg/kg	30 <sup>(i)</sup>	8	1.6	N/A	3	No Further Action
Benzo(b/k) Fluoranthene	mg/kg	3.9 <sup>(i)</sup>	8	3.3		3	
Benzo(a)Pyrene	mg/kg	3.2 <sup>(i)</sup>	8	2.1		3	
Indeno (123-cd)Pyrene	mg/kg	45 <sup>(i)</sup>	8	1.1		3	
Dibenzo(a,h) Anthracene	mg/kg	0.31 <sup>(i)</sup>	8	0.20		3	

Determinand	Units	GAC	n	MC	Loc. of Ex	Path way	Assessment
Benzo(ghi) Perylene	mg/kg	360 <sup>(i)</sup>	8	1.5		3	
Organics - TPH							
TPH C <sub>5</sub> -C <sub>6</sub>	mg/kg	42 <sup>(i)</sup>	8	<0.10	N/A	2	No Further Action
TPH C <sub>6</sub> -C <sub>8</sub>	mg/kg	100 <sup>(i)</sup>	8	<0.10		2	
TPH C <sub>8</sub> -C <sub>10</sub>	mg/kg	27 <sup>(i)</sup>	8	<0.10		2	
TPH C <sub>10</sub> -C <sub>12</sub>	mg/kg	130 <sup>(i)</sup>	8	24		2	
TPH C <sub>12</sub> -C <sub>16</sub>	mg/kg	1100 <sup>(i)</sup>	8	230		1	
TPH C <sub>16</sub> -C <sub>21</sub>	mg/kg	1900 <sup>(i)</sup>	8	370		1	
TPH C <sub>21</sub> -C <sub>35</sub>	mg/kg	1900 <sup>(i)</sup>	8	420		1	
<b>Notes</b> Pathway: 1 = Soil Ingestion, 2 = Vapour Inhalation (indoor), 3 = Dermal Contact & Ingestion, 4 = Dust Inhalation 5 = Consumption of home-grown produce and attached soils  Abbreviations: GAC = General Assessment Criteria, C4SL = Category 4 Screening Level, n = number of samples, MC = Maximum Concentration; Loc of Ex = Location of Exceedance; N.D = not detected  <b>GAC Tier 1 Origin</b> (i) LQM/CIEH Suitable For Use Level S4UL – Conservative Assessment of 1% SOM for organics; (ii) CLEA 1.06 Derived Value; (iii) DEFRA Category 4 Screening Level (C4SL)							

Referring to Table 5.1, the results of this direct comparison indicates that the screening values have been exceeded for the following determinands:

-  Lead;
-  Arsenic; and,
-  Asbestos.

### Lead and Arsenic

The main exposure pathway for arsenic and lead is soil ingestion. It is considered that on the basis that the development does not include soft landscaped areas that the exposure pathway to future residents does not exist and hence the risk posed is negligible.

### Asbestos

Chrysotile asbestos fibres were detected in three samples of Made Ground. The main exposure pathway is dust inhalation. It is considered that while future residents would not be at risk from asbestos due to the lack of soft landscaping within the development, there is a risk to construction workers and off-site receptors during the development of the site and therefore, an asbestos management plan should be in place during the construction work.

## 5.2 Controlled Waters

The groundwater vulnerability map shows the site to be located over a Principal Aquifer (Wilmslow Sandstone Formation). The sandstone bedrock was encountered at a depth of 9.0m below ground level. The bedrock was found to be overlain by soft organic-rich clay which in turn is overlain by granular Made Ground. The closest surface water feature is Salthouse dock located 200m west of the site. The River Mersey is located approximately 600m west of the site.

The groundwater sample taken from WS101 was screened for a range of determinands. A Tier I risk assessment has been undertaken with the concentrations of determinands compared with the relevant thresholds using a hardness of 1200mg/l CaCO<sub>3</sub> presented in Table 5.2, below. As no drinking water receptors are recorded within 1km of the site, the drinking water screening values have been omitted from the risk assessment.

**Table 5.2: Controlled Waters**

Determinand	Units	Hardness Banding (mg/l CaCO <sub>3</sub> )	Surface Water Screening Values	WS101
Arsenic	µg/l	-	50 <sup>(1)</sup>	19
Cadmium	µg/l	> 200	0.25 <sup>(3)</sup>	0.02
Chromium	µg/l	-	0-50	<1
Copper	µg/l	> 250	28 <sup>(1)</sup>	11
Cyanide	µg/l	-	50	<50
Lead	µg/l	-	7.2 <sup>(4)</sup>	4.3
Mercury	µg/l	-	0.05 <sup>(3)</sup>	<0.05
Nickel	µg/l	-	20 <sup>(4)</sup>	17
Selenium	µg/l	-	10	16
Sulphate (SO <sub>4</sub> )	mg/l	-	400 <sup>(5)</sup>	1000
Zinc	µg/l	>250	125 <sup>(1)</sup>	46
pH	µg/l	-	6-9 <sup>(6)</sup>	7.5
Phenol	µg/l	-	7.7 <sup>(1)</sup>	<100
Benzo(a)Pyrene	µg/l	-	0.05 <sup>(3)</sup>	0.21
Benzo[b&k]fluoranthene	µg/l	-	0.03 <sup>(3)</sup>	0.35
Benzo(ghi)perylene & Indeno(123-cd) pyrene	µg/l	-	0.02 <sup>(3)</sup>	0.47
Anthracene	µg/l	-	0.1 <sup>(3)</sup>	0.14
Fluoranthene	µg/l	-	0.1 <sup>(4)</sup>	0.35
Naphthalene	µg/l	-	2.4 <sup>(4)</sup>	0.16

**Notes for Table 5.2**







# Solubility <0.01µg/l

1. Council Directive of 4 May 1976 on pollution caused by certain dangerous substances discharged into the aquatic environment of the Community (76/464/EEC). Official Journal of the European Communities 18.5.76 L129/23
2. The Surface Waters (Dangerous Substances) (Classification) Regulations 1989. SI 2286/89
3. The Surface Waters (Dangerous Substances) (Classification) Regulations 1992. SI 337/92
4. These represent non-statutory changes made in the 1990's which may be used by regulatory authorities. They are more conservative than the original 1985 values.
5. EC Dangerous Substances - List 1 parameters
6. EC Dangerous Substances - List 2 parameters as listed in Dangerous Substances Regulations of 1997 and 1998, and the DoE Circular 7/89
7. Circular from the Department of the Environment (7/89) and the Welsh Office (SI 16/89). 30 March 1989. Water and the Environment: The implementation of European Community Directives on pollution caused by certain dangerous substances discharged into the aquatic environment.
8. The Surface Waters (Dangerous Substances) (Classification) Regulations 1997. SI 2560/97
9. The Surface Waters (Dangerous Substances) (Classification) Regulations 1998. SI 389/98
10. WHO DWS for Toluene and Ethylbenzene – odour/taste/colour (Human Health Risk)
11. Specified compounds are benzo[b]fluoranthene (CAS 205-99-2), benzo[k]fluoranthene (CAS 207-08-9), benzo[g,h,i]perylene (CAS 191-24-2) and indeno[1,2,3-c,d]pyrene (CAS 193-39-5). The parametric value applies to the sum of the concentrations of the individual compounds detected and quantified in the monitoring process.

### Controlled Waters Risk Assessment

Referring to Table 5.2, the results of this direct comparison indicates that the surface water screening values have been exceeded for sulphate and polycyclic aromatic hydrocarbons.

The risk to groundwater and surface water receptors from the above determinands is considered **low** based on the following rationale;

-  Only marginally elevated concentrations were recorded on site;
-  Significantly elevated PAHs and sulphate were not recorded within the site soils;
-  Only a minimal volume of groundwater was encountered during the site investigation and therefore, it is considered that nearby surface water receptors are unlikely to be in hydraulic continuity with the sites shallow groundwater;
-  The entire site will be surfaced in hardstanding which will reduce the leaching of any potentially impacted material;
-  A layer of perceived impermeable clay is present between the granular Made Ground deposits and the underlying sandstone bedrock; and,
-  No groundwater abstractions are located within 1km radius of the site.

In addition, analysis of the site soils only recorded elevations of lead and arsenic within the granular Made Ground which are considered to have low leachability and mobility. The groundwater analysis did not indicate that these contaminants were elevated above the relevant threshold.

As there are no drinking water receptors within influencing distance of the site, there is considered to be no significant risk to drinking water receptors from the migration of contaminants at the site.

### 5.3 Ground Gas

The potential impact on the development from ground gases has been assessed with reference to standards and guidelines published in CIRIA Report 665 (*Assessing risks posed by hazardous ground gases to buildings*, 2007).



During the two monitoring visits completed to date, no significantly elevated concentrations of methane or carbon dioxide were recorded.

In accordance with the methodology outlined with the CIRIA publication C665, REC have utilised the results of the ground gas monitoring surveys to calculate a tentative Gas Screening Value (GSV). The maximum GSV calculated for methane was 0.0001l/hr and for carbon dioxide was 0.0011l/hr.

The GSV has been compared to the criteria outlined with CIRIA C665 to determine the level of risk to the proposed development and to ensure the appropriate remedial options are incorporated into any future building design in this area. CIRIA C665 states that the maximum GSV for carbon dioxide and methane is <0.07l/hr for Characteristic Situation 1 / Green in line with the NHBC Traffic Light System and therefore, at this stage of the monitoring period the site would fall into this bracket and not require any gas protection measures.

This is an interim assessment based on preliminary ground gas readings, the final classification will be supplied as an addendum to this report on completion of the remaining monitoring visits.

## 5.4 Revised Conceptual Site Model

The revised conceptual site model has been developed for the proposed future land use, this summarises the understanding of surface and sub-surface features, the potential contaminant sources, transport pathways and receptors, as detailed below and summarised in Table 5.3, below.

**Table 5.3 Revised Conceptual Site Model**

Receptor	Potential Risk	Current Residual Risk	Mitigation
Human Health	<i>Ingestion</i>	YES	The entire site will be surfaced in hardstanding thus breaking the pathway to future residents.
	<i>Inhalation</i>	YES	The entire site will be surfaced in hardstanding thus breaking the pathway to future residents. An Asbestos Management Plan is required during the development of the site to protect construction workers and off-site receptors from asbestos fibres.
	<i>Skin contact</i>	YES	The entire site will be surfaced in hardstanding thus breaking the pathway to future residents.
	<i>Irradiation</i>	NO	Site is not within an area where radon gas is present in any significant quantities.
	<i>Fire and explosion</i>	Unknown	The ground gas monitoring period is on-going and will be assessed upon completion of the monitoring programme.
Buildings	<i>Fire and explosion</i>	Unknown	The ground gas monitoring period is on-going and will be assessed upon completion of the monitoring programme.
	<i>Chemical attack on building materials and services</i>	YES	Soils present at the site are consistent with design sulphate class DS-2 and ACEC AC-1s. Water supply pipes – A risk assessment is required.
Natural Environment	<i>Contamination of Controlled waters</i>	YES	The risk to waters is considered low. The entire site will be surfaced in hardstanding reducing the risk of leaching.

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## **6.0 GEOTECHNICAL ASSESSMENT**

### **6.1 Proposed Development**

Chancery House Liverpool LLP intends to construct a 5-storey extension to the existing Grade II listed Chancery House building with the ground level comprising a commercial unit and the higher levels apartments.

### **6.2 Summary of Ground Conditions**




Ground conditions identified at the site are summarised in Section 4.1 and essentially comprise granular Made Ground (demolition rubble) to approximately 2.0m bgl over soft to firm organic-rich clay (possible Made Ground) which in turn overlies a weathered sandstone profile from 8.00m over sandstone bedrock encountered at a depth of 9.1m bgl.

#### **Groundwater**

During the Ground Investigation, only a limited volume of perched groundwater was encountered in WS101 at a depth of 4.0m bgl. Monitoring of the standpipe installed within the 3 No. window sample probeholes indicated that no significant volume of standing groundwater was present.

### **6.3 Site Preparation**

The site should be cleared and any vegetation below areas of proposed development stripped in accordance with Series 200 of the Specification for Highway Works. This should include:

-  Roots present below the footprint of proposed structures and infrastructure should be grubbed out and the resulting void infilled with suitable compacted engineered fill;
-  Redundant services should be sealed off and grubbed out and replaced with suitable compacted engineered fill; and,
-  Buried structures and relict foundations are anticipated on the site and should be excavated from below the proposed development footprint with the resulting void backfilled.

### **6.4 Foundation Conditions**

It is considered that a suitable foundation option at this location would be to extend the loadings of the proposed five storey development via a piled foundation solution through the Made Ground and low strength cohesive deposits into the underlying sandstone bedrock. Sandstone was encountered at a depth of 8.00m bgl and comprised completely/highly weathered sand horizons to circa 9.1m bgl. The sandstone below 9.10m becomes more competent and it is considered that an end bearing pile foundation, socketed into the unweathered sandstone bedrock should be adopted.

A review of published literature on the allowable bearing capacities of sandstone indicates that unweathered sandstone should provide an approximate allowable bearing capacity of between 4000 kN/m<sup>2</sup> (British Standard BS 8004:1986) and 6000 kN/m<sup>2</sup> (Handbook of Geotechnical Investigation and Design Tables, Burt Look, 2007, Table 6.14).

It is considered that the loads for the proposed development would be in the region of 1850 kN/m<sup>2</sup> and on this basis the published literature indicates that the unweathered sandstone should provide a more than adequate allowable bearing capacity for end-bearing pile foundations.

In order to confirm the ultimate and allowable bearing capacity of the sandstone, it is recommended that cores of the sandstone are recovered to allow geotechnical laboratory testing for unconfined compressive strength (UCS) and point load testing (IS50) to be undertaken on core samples. It is further recommended that advice should be sought from a specialist piling contractor.

The underlying clay has been classified as being of intermediate plasticity with a low to medium volume change potential. Therefore, the clay is considered to be susceptible to shrink and swell caused by fluctuations in moisture content due to the presence of trees or seasonal effects. However, given the clay deposits are not encountered till a depth of 2.0m bgl it is considered unlikely for a volume change potential to be displayed by this material at this depth.

## **6.5 Ground Floor Slabs**

Consideration may need to be given to a suspended floor slab as opposed to a ground bearing slab due to the significant depths of Made Ground encountered. It is recommended that advice is sought from the Structural Engineer to determine the requirement for a suspended ground floor slab.

## **6.6 Drainage**

The presence of substantial depths of Made Ground and soft clays across the site may result in settlement. It is therefore recommended that drain runs are designed using steeper gradients and flexible joints to allow for some differential settlement.

In-situ variable (falling) head permeability tests were undertaken within the three monitoring well installations. Soil infiltration rates were between  $2.49 \times 10^{-5}$  m/s and  $5.57 \times 10^{-5}$  m/s; and in accordance with CIRIA C515 (2000) indicates a medium to low permeability.

## **6.7 Concrete Durability**

Based upon the results of the chemical analyses summarised in Table 4.5, it is considered that subsurface concrete can be designed in accordance with Design Sulphate Class DS-1, Aggressive Chemical Environment for Concrete Classification (ACEC) AC-1s in accordance with the recommendations provided in BRE Special Digest 1 (2005).

## **6.8 Excavations**

Site observations indicated that excavations should be feasible in the near surface with normal plant; however, obstructions were identified in the near surface including relict foundations and concrete floor slab. It is anticipated that any obstructions will be grubbed out during the reduced level dig for the sub structure works.

During the Ground Investigation, a shallow groundwater strike was only made in WS101 at a depth of 4.0m bgl. It is considered that conventional sump pumping should be adequate.

Due to the variability of the Made Ground it is considered that all excavations are supported or battered back in accordance with guidance contained in CIRIA RR97.

The presence of potential contamination including asbestos fibres should be addressed as part of the Construction Stage Health and Safety Plan and should include an Asbestos Management Plan to design out the risks, reduce their impact and finally the use of appropriate Personnel Protective Equipment (PPE).

## **6.9 Further Works**

REC recommends that further investigation is undertaken utilising rotary techniques to investigate the bedrock at depth to assist in the design of piled foundations. It is considered that boreholes are drilled to a depth of at least 15m bgl in order to recover cores of the unweathered bedrock to allow an assessment of the Rock Quality Designation (RQD) and to obtain samples for laboratory strength testing. It is recommended that the depth of the rotary boreholes is confirmed with a specialist piling contractor to ensure that suitable information is obtained to aid in the piling design.

## 7.0 CONCLUSIONS & RECOMMENDATIONS

### Geotechnical Assessment

It is considered that a suitable foundation option at this location would be to extend the loadings of the proposed five storey development via a piled foundation solution socketed into the underlying sandstone bedrock.

A review of published literature on the allowable bearing capacities of sandstone indicates that unweathered sandstone should provide an approximate allowable bearing capacity of between 4000 kN/m<sup>2</sup> and 6000 kN/m<sup>2</sup>.

It is considered that the loads for the proposed development would be in the region of 1850 kN/m<sup>2</sup> and on this basis the published literature indicates that the unweathered sandstone should provide a more than adequate allowable bearing capacity for end-bearing pile foundations.

In order to confirm the ultimate and allowable bearing capacity of the sandstone, it is recommended that cores of the sandstone are recovered to allow geotechnical laboratory testing for unconfined compressive strength and point load testing to be undertaken.

The underlying clay has been classified as being of intermediate plasticity with a low to medium volume change potential. However, given the clay deposits are not encountered till a depth of 2.0m bgl it is considered unlikely for a volume change potential to be displayed by this material at this depth.






### Revised Conceptual Site Model

The Tier I Human Health Risk has identified elevated concentrations of lead, arsenic and asbestos fibres present in the granular Made Ground deposits.

The main exposure pathway for arsenic and lead is soil ingestion. It is considered that on the basis that the development does not include soft landscaped areas that the exposure pathway to future residents does not exist and hence the risk posed is negligible.

Chrysotile asbestos fibres were detected in three samples of Made Ground. The main exposure pathway is dust inhalation. It is considered that while future residents would not be at risk from asbestos due to the lack of soft landscaping within the development, there is a risk to construction workers and off-site receptors during the development of the site and therefore, an asbestos management plan should be in place during the construction work.

The risk to groundwater and surface water receptors from the above determinands is considered **low** based on the following rationale;

-  Significantly elevated PAHs and sulphate were not recorded within the site soils;
-  Only a minimal volume of groundwater was encountered during the site investigation and therefore, it is considered that nearby surface water receptors are unlikely to be in hydraulic continuity with the sites shallow groundwater;
-  The entire site will be surfaced in hardstanding which will reduce the leaching of any potentially impacted material;
-  A layer of impermeable clay is present between the granular Made Ground deposits and the underlying sandstone bedrock; and,
-  No groundwater abstractions are located within 1km radius of the site.

Ground gas monitoring is on-going a full assessment of the risks will be made once the monitoring period is complete.

### Recommendations

REC recommends that further investigation is undertaken utilising rotary techniques to investigate the bedrock at depth to assist in the design of piled foundations. It is considered that boreholes are drilled to a depth of at least 15m bgl in order to recover cores of the unweathered bedrock to allow an assessment of the Rock Quality Designation (RQD) and to obtain samples for laboratory strength testing. It is recommended that the depth of the rotary boreholes is confirmed with a specialist piling contractor to ensure that suitable information is obtained to aid in the piling design.

An Asbestos Management Plan is required to mitigate the risk to construction workers and off-site receptors from the identified asbestos fibres during the development of the site.

***END OF REPORT***

**APPENDIX I**  
**LIMITATIONS**



1. This report and its findings should be considered in relation to the terms of reference and objectives agreed between REC Ltd and the Client as indicated in Section 1.2.
2. For the work, reliance has been placed on publicly available data obtained from the sources identified. The information is not necessarily exhaustive and further information relevant to the site may be available from other sources. When using the information it has been assumed it is correct. No attempt has been made to verify the information.
3. This report has been produced in accordance with current UK policy and legislative requirements for land and groundwater contamination which are enforced by the local authority and the Environment Agency. Liabilities associated with land contamination are complex and requires advice from legal professionals.
4. During the site walkover reasonable effort has been made to obtain an overview of the site conditions. However, during the site walkover no attempt has been made to enter areas of the site that are unsafe or present a risk to health and safety, are locked, barricaded, overgrown, or the location of the area has not be made known or accessible.
5. Access considerations, the presence of services and the activities being carried out on the site limited the locations where sampling locations could be installed and the techniques that could be used.
6. In addition to the above REC Ltd note that when investigating, or developing, potentially contaminated land it is important to recognise that sub-surface conditions may vary spatially and also with time. The absence of certain ground, ground gas, and contamination or groundwater conditions at the positions tested is not a guarantee that such conditions do not exist anywhere across the site. Due to the presence of existing buildings and structures access could not be obtained to all areas. Additional contamination may be identified following the removal of the buildings or hard standing.
7. Site sensitivity assessments have been made based on available information at the time of writing and are ultimately for the decision of the regulatory authorities.
8. Where mention has been made to the identification of Japanese Knotweed and other invasive plant species and asbestos or asbestos-containing materials this is for indicative purposes only and do not constitute or replace full and proper surveys.
9. The executive summary, conclusions and recommendations sections of the report provide an overview and guidance only and should not be specifically relied upon without considering the context of the report in full.
10. This report presents an interpretation of the geotechnical information established by excavation, observation and testing. Whilst every effort is made in interpretative reporting to assess the soil conditions over the Site it should be noted that natural strata vary from point to point and that man made deposits are subject to an even greater diversity. Groundwater conditions are dependent on seasonal and other factors. Consequently there may be conditions present not revealed by this investigation.
11. REC can not be held responsible for any use of the report or its contents for any purpose other than that for which it was prepared. The copyright in this report and other plans and documents prepared by REC is owned by them and no such plans or documents may be reproduced, published or adapted without written consent. Complete copies of this may, however, be made and distributed by the client as is expected in dealing with matters related to its commission. Should the client pass copies of the report to other parties for information, the whole report should be copied, but no professional liability or warranties shall be extended to other parties by REC in this connection without their explicit written agreement there to by REC.
12. Rather, this investigation has been undertaken to provide a preliminary characterisation of the existing sub-surface geotechnical characteristics and make up and the findings of this study are our best interpretation of the data collected, within the scope of work and agreed budget. New information, revised practices or changes in legislation may necessitate the re-interpretation of the report, in whole or in part.
13. This investigation has been undertaken to reasonably characterise existing sub-surface conditions and the findings of this study are our best interpretation of the data collected, within the scope of work and agreed budget. New information, revised practices or changes in legislation may necessitate the re-interpretation of the report, in whole or in part.

**APPENDIX II**

**GLOSSARY**

## TERMS

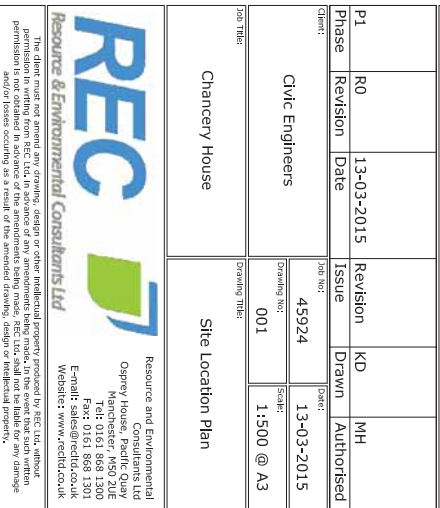
AST	Above Ground Storage Tank
BGS	British Geological Survey
BSI	British Standards Institute
BTEX	Benzene, Toluene, Ethylbenzene, Xylenes
CIEH	Chartered Institute of Environmental Health
CIRIA	Construction Industry Research Association
CLEA	Contaminated Land Exposure Assessment
CSM	Conceptual Site Model
DNAPL	Dense Non-Aqueous Phase Liquid (chlorinated solvents, PCB)
DWS	Drinking Water Standard
EA	Environment Agency
EQS	Environmental Quality Standard
GAC	General Assessment Criteria
GL	Ground Level
GSV	Gas Screening Value
HCV	Health Criteria Value
ICSM	Initial Conceptual Site Model
LNAPL	Light Non-Aqueous Phase Liquid (petrol, diesel, kerosene)
ND	Not Detected
LMRL	Lower Method Reporting Limit
NR	Not Recorded
PAH	Poly Aromatic Hydrocarbon
PCB	Poly-Chlorinated Biphenyl
PID	Photo Ionisation Detector
QA	Quality Assurance
SGV	Soil Guideline Value
SPH	Separate Phase Hydrocarbon
Sp.TPH (CWG)	Total Petroleum Hydrocarbon (Criteria Working Group)
SPT	Standard Penetration Test
SVOC	Semi Volatile Organic Compound
UST	Underground Storage Tank
VCCs	Vibro Concrete Columns
VOC	Volatile Organic Compound
WTE	Water Table Elevation

## UNITS

m	Metres
km	Kilometres
%	Percent
%v/v	Percent volume in air
mb	Milli Bars (atmospheric pressure)
l/hr	Litres per hour
µg/l	Micrograms per Litre (parts per billion)
ppb	Parts Per Billion
mg/kg	Milligrams per kilogram (parts per million)
ppm	Parts Per Million
mg/m <sup>3</sup>	Milligram per metre cubed
m bgl	Metres Below Ground Level
m bcl	Metre Below Cover Level

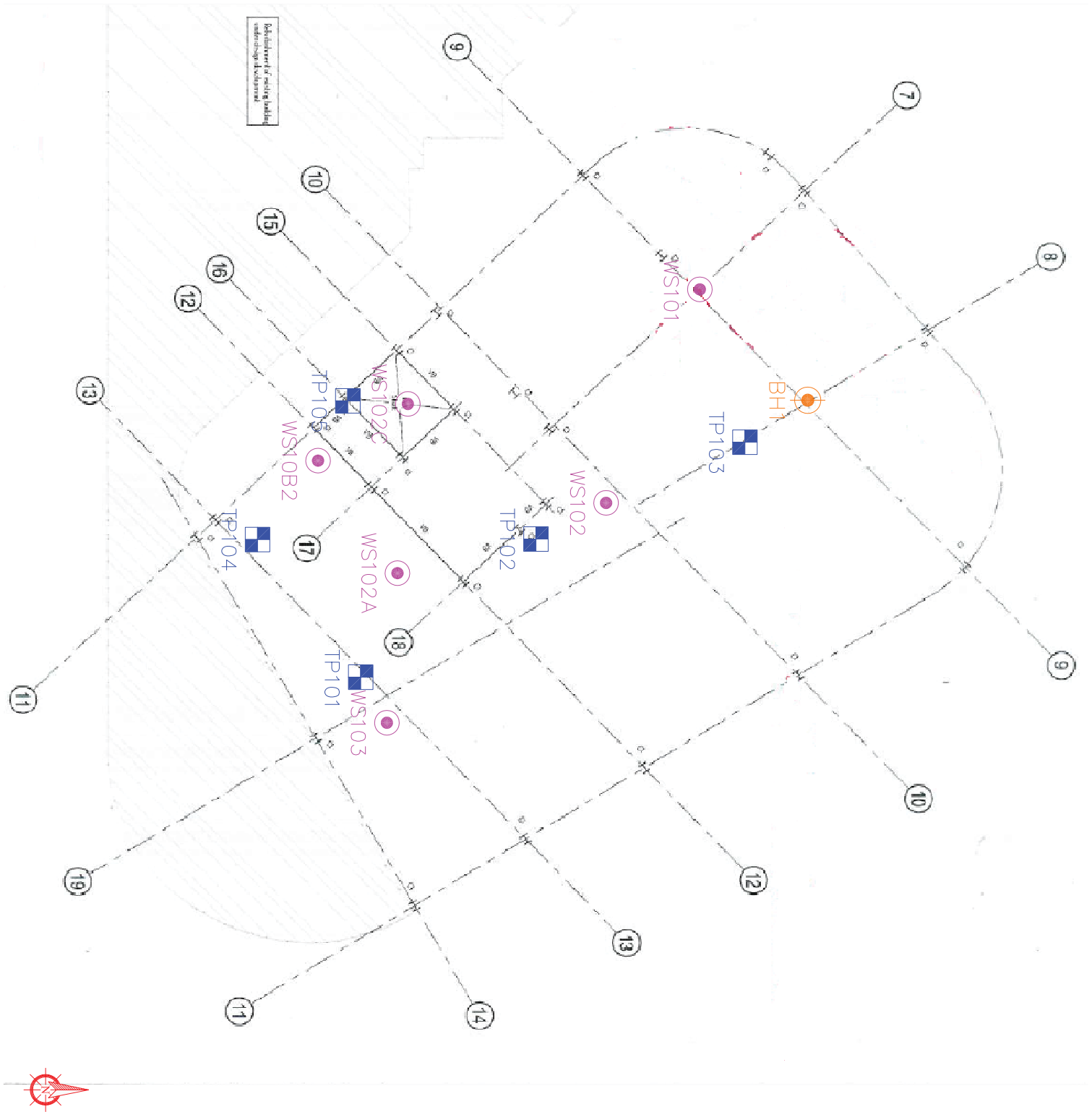
mAOD	Metres Above Ordnance Datum (sea level)
kN/m <sup>2</sup>	Kilo Newtons per metre squared
µm	Micro metre

**APPENDIX III**  
**DRAWINGS**









- WS101 Approximate Window Sample Probehole Location
- TP101 Approximate Trial Pit Location
- BS1 Approximate Borehole Location

Notes:

P1	R0	13-03-2015	Revision	KD	MH
Phase	Revision	Date	Issue	Drawn	Authorised
Client:	Civic Engineers	Job No:	45924	Date:	13-03-2015
		Drawing No:	003	Scale:	N.T.S
Job Title:	Chancery House	Drawing Title:	Exploratory Hole Location Plan		



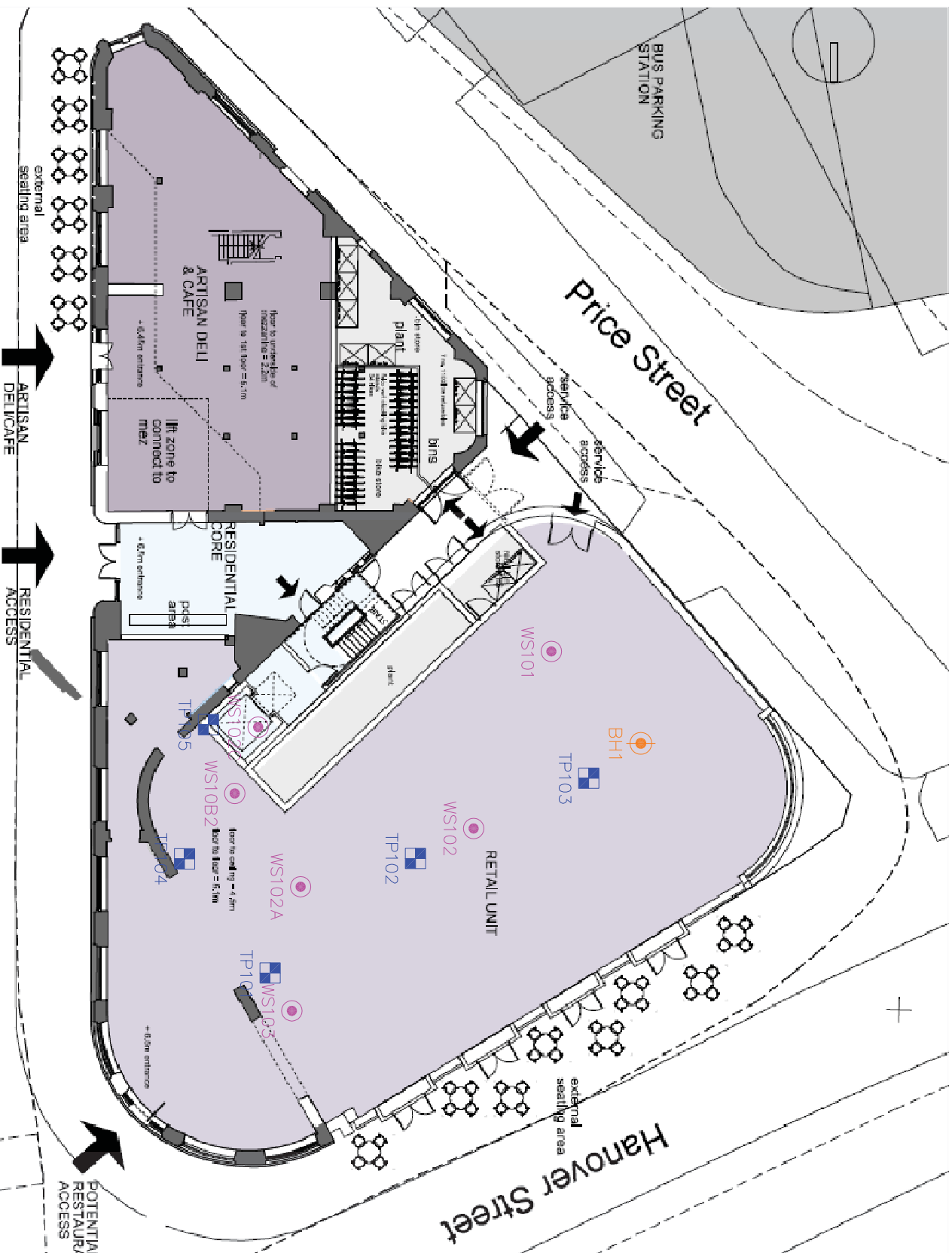
**Resource & Environmental Consultants Ltd**

Osprey House, 150-152, Oldham Road, Manchester, M20 2UE  
Tel: 0161 868 1300  
Fax: 0161 868 1301  
E-mail: sales@rec.co.uk  
Website: www.rec.co.uk

Resource and Environmental Consultants Ltd  
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Paradise Street

Price Street

Hanover Street

FALCONER  
CHESTER

- WS101 Approximate Window Sample Probehole Location
- TP101 Approximate Trial Pit Location
- BH1 Approximate Borehole Location

Notes:

P1	RO	13-03-2015	Revision	KD	MH
Phase	Revision	Date	Issue	Drawn	Authorised
Civic Engineers			45924	13-03-2015	
			003-A	N.T.S	

Job Title: Chanery House

Drawing Title: Exploratory Hole Location Plan

**REC** Resource & Environmental Consultants Ltd

Resource and Environmental Consultants Ltd  
Osprey House, 150-152, Market Street, Manchester, M50 2UE  
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**APPENDIX IV**  
**EXPLORATORY HOLE LOGS**

# Borehole Log

Borehole No.

**BH101**

Sheet 1 of 1

Project Name: Chancery House

Project No.  
45924

Co-ords: -

Hole Type  
CP

Location: Liverpool

Level:

Scale  
1:50

Client: Civic Engineers




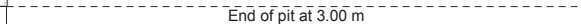
Dates: 02/03/2015 - 03/03/2015



Logged By  
B.T.



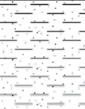
Back fill / Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.04			MADE GROUND: Asphalt.	
					0.30			MADE GROUND: Light grey slightly sandy medium to coarse subangular to subrounded limestone GRAVEL.	
		0.50	ES					MADE GROUND: Grey slightly gravelly fine to medium SAND with high cobble content of angular brick and concrete. Gravel is medium to coarse subangular to subrounded of brick, tile and concrete.	1
		1.00	ES		1.00				
		1.00	CPT	50 (5,4/50 for 130mm)					
		2.00	SPT	N=4 (3,0/1,1,1,1)	2.00				2
		2.50	ES		2.40				
		3.00	SPT B	N=3 (1,0/1,0,1,1)	3.00			MADE GROUND: Very low to low strength soft to firm grey slightly sandy CLAY with strong organic odour and bands of organic matter.	3
		3.00 - 3.45							
		4.00	SPT	N=3 (1,0/1,0,1,1)	4.00				4
		5.00	SPT	N=5 (1,0/1,0,2,2)	5.00			From 5.00m: Becomes slightly gravelly, gravel is fine to medium subangular to subrounded of brick.	5
		6.00	ES		6.00				6
		6.00	SPT B	N=3 (1,0/1,0,1,1)					
		6.00 - 6.45							
		7.00	SPT	N=6 (1,1/1,1,2,2)	7.00				7
		8.00	SPT B	N=47 (2,3/4,9,16,18)	8.00			Brown slightly sandy SILT with abundant organic matter.	8
		8.00 - 8.45			8.00			Very dense grey slightly silty slightly gravelly fine to medium SAND. Gravel is fine to coarse subangular to subrounded of sandstone	
		9.00	SPT	50 (25 for 70mm/50 for 65mm)	9.00				9
		9.20	D		9.10			Grey fine to medium grained SANDSTONE.	
		9.20	SPT	50 (25 for 65mm/50 for 45mm)	9.20				
					9.31			End of borehole at 9.31 m	10





## Remarks

Borehole terminated due to refusal on bedrock at 9.31m, overnight water rose to 7.80m from a borehole depth of 8.70m.



			<h1 style="text-align: center;">Trial Pit Log</h1>			Trialpit No <b>TP101</b> Sheet 1 of 1	
Project Name: Chancery House			Project No. 45924		Co-ords: - Level:		Date 09/02/2015
Location: Liverpool			Dimensions (m):		<div style="border: 1px solid black; width: 100px; height: 30px; margin: 5px auto;"></div>		Scale 1:20
Client: Civic Engineers			Depth 3.00				Logged B.T.
Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
Depth	Type	Results					
0.60	ES		0.10			MADE GROUND: Asphalt.	
			0.40			MADE GROUND: Light grey slightly sandy medium to coarse subangular to subrounded limestone GRAVEL.	
2.40	ES		2.00			MADE GROUND: Grey slightly gravelly fine to medium SAND with a low cobble content of angular brick. Gravel is medium to coarse, subangular to subrounded of brick and concrete.	
			3.00			Soft dark grey slightly sandy CLAY with strong organic odour and abundant rotting timber (possible Made Ground).	
			<div style="text-align: center;">             End of pit at 3.00 m              </div>				
Remarks: No groundwater encountered.							
Stability:							

			<h1 style="text-align: center;">Trial Pit Log</h1>			Trialpit No <b>TP102</b> Sheet 1 of 1	
Project Name: Chancery House			Project No. 45924		Co-ords: - Level:		Date 09/02/2015
Location: Liverpool			Dimensions (m):		<div style="border: 1px solid black; width: 100px; height: 30px; margin: 5px auto;"></div>		Scale 1:20
Client: Civic Engineers			Depth 2.20				Logged B.T.
Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
Depth	Type	Results					
1.50	ES		0.03			MADE GROUND: Asphalt. MADE GROUND: Light grey slightly sandy medium to coarse subangular to subrounded limestone GRAVEL.	
			0.30			MADE GROUND: Reddish brown sandy medium to coarse, subangular to subrounded GRAVEL of metal, brick, tile and concrete with high cobble content of subangular to angular brick and occasional concrete boulders.	
			2.00			MADE GROUND: Concrete slab.	
			2.20			End of pit at 2.20 m	
Remarks: No groundwater encountered.							
Stability:							

			<h1 style="text-align: center;">Trial Pit Log</h1>			Trialpit No <b>TP103</b> Sheet 1 of 1	
Project Name: Chancery House			Project No. 45924		Co-ords: - Level:		Date 09/02/2015
Location: Liverpool			Dimensions (m):		<div style="border: 1px solid black; width: 100px; height: 30px; margin: 5px auto;"></div>		Scale 1:20
Client: Civic Engineers			Depth 3.90				Logged B.T.
Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
Depth	Type	Results					
0.70	ES		0.03			MADE GROUND: Asphalt. MADE GROUND: Light grey slightly sandy medium to coarse subangular to subrounded limestone GRAVEL.	
			0.30			MADE GROUND: Reddish brown sandy medium to coarse, subangular to subrounded GRAVEL of metal, brick, tile and concrete.	
2.80	ES		2.20			Soft dark grey slightly sandy CLAY with strong organic odour (possible Made Ground).	
			3.90			<div style="border: 1px solid black; padding: 2px; display: inline-block;">           Water seepage at 3.00m.         </div>	
						End of pit at 3.90 m	
Remarks: Groundwater seepage encountered at 3.00m							
Stability:							

			<h1 style="text-align: center;">Trial Pit Log</h1>			Trialpit No <b>TP104</b> Sheet 1 of 1	
Project Name: Chancery House			Project No. 45924		Co-ords: - Level:		Date 09/02/2015
Location: Liverpool			Dimensions (m):		<div style="border: 1px solid black; width: 100px; height: 30px; margin: 0 auto;"></div>		Scale 1:20
Client: Civic Engineers			Depth 1.00				Logged B.T.
Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
Depth	Type	Results					
0.40	ES		0.10			MADE GROUND: Asphalt.	
			0.30			MADE GROUND: Light grey slightly sandy medium to coarse subangular to subrounded limestone GRAVEL.	
						MADE GROUND: Light grey slightly gravelly fine to medium SAND. Gravel is medium to coarse subangular to subrounded of brick and limestone.	
			1.00			End of pit at 1.00 m	
Remarks: No groundwater encountered.							
Stability:							



			<h1 style="text-align: center;">Trial Pit Log</h1>			Trialpit No <b>TP105</b> Sheet 1 of 1	
Project Name: Chancery House			Project No. 45924		Co-ords: - Level:		Date 09/02/2015
Location: Liverpool			Dimensions (m):		<div style="border: 1px solid black; width: 100px; height: 30px; margin: 5px auto;"></div>		Scale 1:20
Client: Civic Engineers			Depth 1.80				Logged B.T.
Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
Depth	Type	Results					
1.00	ES		0.03			MADE GROUND: Paving slab. MADE GROUND: Light grey slightly sandy medium to coarse subangular to subrounded limestone GRAVEL.	
			0.30			MADE GROUND: Grey slightly gravelly fine to medium SAND with low cobble content of angular brick. Gravel is medium to coarse, subangular to subrounded of brick and concrete.	
					1.80		
Remarks: No groundwater encountered.							
Stability:							

Waterstrike at 4.00m

Waterstrike at 4.00m

# Borehole Log

Borehole No.

**WS102**

Sheet 1 of 2

Project Name: Chancery House

Project No.  
45924

Co-ords: -

Hole Type  
WS

Location: Liverpool

Level:

Scale  
1:25

Client: Civic Engineers

Dates: 10/02/2015 - 10/02/2015

Logged By  
B.T.

Back fill / Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.03			MADE GROUND: Asphalt.	
					0.30			MADE GROUND: Light grey slightly sandy medium to coarse subangular to subrounded limestone GRAVEL.	
		0.60	ES					MADE GROUND: Brownish grey slightly gravelly medium to coarse SAND. Gravel is medium to coarse subangular to subrounded of brick, tile and concrete.	
		1.00	SPT	N=8 (2,2/2,2,2,2)	1.00				1
		1.80	D		1.80				
		2.00	ES		2.00			MADE GROUND: Extremely low strength soft brown slightly sandy slightly gravelly CLAY. Gravel is medium to coarse subangular to subrounded of brick and concrete.	2
		2.00	SPT	N=2 (0,1/0,1,0,1)					
					2.30			Extremely low to low strength soft to firm dark grey slightly sandy CLAY with strong organic odour (possible Made Ground).	
		3.00	SPT	N=2 (1,0/1,0,1,0)	3.00				3
		3.40	D						
		3.50	ES						
		4.00	SPT	N=5 (1,1/1,2,1,1)	4.00				4
		4.90	D		4.80			Medium dense greyish black slightly clayey fine to medium SAND.	
		5.00	SPT	N=24 (2,3/4,5,7,8)	5.00				5
Continued on next sheet									

Remarks

No groundwater encountered.

Remarks  
No groundwater encountered.

# Borehole Log

Borehole No.

**WS103**

Sheet 1 of 2

Project Name: Chancery House

Project No.  
45924

Co-ords: -

Hole Type  
WS

Location: Liverpool

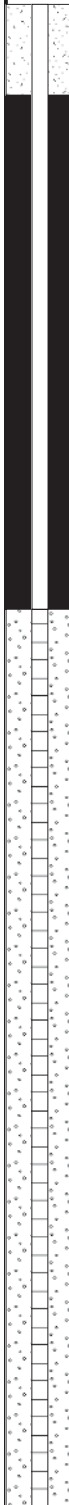



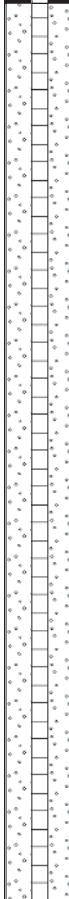

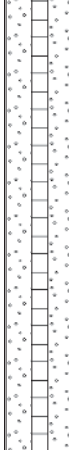
Level:

Scale  
1:25

Client: Civic Engineers

Dates: 10/02/2015 - 10/02/2015


Logged By  
B.T.

Back fill / Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.03			MADE GROUND: Asphalt.	
					0.30			MADE GROUND: Light grey slightly sandy medium to coarse subangular to subrounded limestone GRAVEL.	
								MADE GROUND: Loose grey slightly gravelly fine to medium SAND with low cobble content of angular brick and concrete. Gravel is medium to coarse subangular to subrounded of brick and concrete.	
		1.20	SPT	N=8 (4,2/2,1,2,3)	1.20				1
		2.00	SPT	N=2 (1,2/0,1,0,1)	2.00				2
					2.50			MADE GROUND: Black slightly sandy fine to medium subangular to subrounded GRAVEL of coal, slag and brick.	
					2.60			Very low to low strength soft to firm dark grey slightly sandy CLAY with strong organic odour (possible Made Ground).	
		3.00 3.00 3.00	D ES SPT	N=6 (1,1/1,2,1,2)	3.00				3
		4.00	SPT	N=5 (1,1/1,2,1,1)	4.00				4
		5.00	SPT	N=4 (1,1/1,1,1,1)	5.00			4.70m: Becomes brown with abundant decomposing organic matter.	5

Continued on next sheet

Remarks

No groundwater encountered.

				<h1>Borehole Log</h1>				Borehole No. <b>WS103</b>	
Project Name: Chancery House				Project No. 45924		Co-ords: -		Sheet 2 of 2 Hole Type WS	
Location: Liverpool				Level:		Scale 1:25			
Client: Civic Engineers				Dates: 10/02/2015 - 10/02/2015		Logged By B.T.			
Back fill / Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		5.60	D						
		6.00	SPT	N=7 (1,1/2,1,2,2)	6.00				6
					6.45			End of borehole at 6.45 m	
									7
									8
									9
									10
Remarks No groundwater encountered.									

# Borehole Log

Borehole No.

**WS103A**

Sheet 1 of 1

Project Name: Chancery House

Project No.  
45924

Co-ords: -

Hole Type  
WS

Location: Liverpool







Level:

Scale  
1:25

Client: Civic Engineers

Dates: 10/02/2015 - 10/02/2015

Logged By  
B.T.

Back fill / Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.03			MADE GROUND: Asphalt.	
					0.30			MADE GROUND: Light grey slightly sandy medium to coarse subangular to subrounded limestone GRAVEL.	
								MADE GROUND: Grey slightly gravelly fine to medium SAND with low cobble content of angular brick and concrete. Gravel is medium to coarse subangular to subrounded of brick and concrete.	
					1.60			MADE GROUND: Possible concrete slab.	2
					1.65			End of borehole at 1.65 m	
									3
									4
									5

Remarks

No groundwater encountered, borehole terminated due to refusal at 1.60m.



# Borehole Log

Borehole No.

**WS103B**

Sheet 1 of 1

Project Name: Chancery House

Project No.  
45924

Co-ords: -

Hole Type  
WS

Location: Liverpool






Level:

Scale  
1:25

Client: Civic Engineers

Dates: 10/02/2015 - 10/02/2015

Logged By  
B.T.

Back fill / Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.03			MADE GROUND: Asphalt.	1
					0.30			MADE GROUND: Light grey slightly sandy medium to coarse subangular to subrounded limestone GRAVEL.	
								MADE GROUND: Grey slightly gravelly fine to medium SAND with low cobble content of angular brick and concrete. Gravel is medium to coarse subangular to subrounded of brick and concrete.	
					1.60			MADE GROUND: Possible concrete slab.	2
					1.65			End of borehole at 1.65 m	
									3
									4
									5

Remarks

No groundwater encountered, borehole terminated due to refusal at 1.60m.

# Borehole Log

Borehole No.

**WS103C**

Sheet 1 of 1

Project Name: Chancery House

Project No.  
45924

Co-ords: -

Hole Type  
WS

Location: Liverpool





Level:

Scale  
1:25

Client: Civic Engineers

Dates: 10/02/2015 - 10/02/2015

Logged By  
B.T.

Back fill / Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.03			MADE GROUND: Asphalt.	1
					0.30			MADE GROUND: Light grey slightly sandy medium to coarse subangular to subrounded limestone GRAVEL.	
								MADE GROUND: Grey slightly gravelly fine to medium SAND with low cobble content of angular brick and concrete. Gravel is medium to coarse subangular to subrounded of brick and concrete.	
					1.60				2
					1.65			MADE GROUND: Possible concrete slab. End of borehole at 1.65 m	
									3
									4
									5

Remarks

No groundwater encountered, borehole terminated due to refusal at 1.60m.

**APPENDIX V**  
**CHEMICAL TESTING RESULTS**



# Scientific Analysis Laboratories Ltd

## Certificate of Analysis

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

Scientific Analysis Laboratories is a  
limited company registered in England and  
Wales (No 2514788) whose address is at  
Hadfield House, Hadfield Street, Manchester M16 9FE

**Report Number:** 456011-1

**Date of Report:** 19-Feb-2015

**Customer:** Resource Environmental Consultants Ltd  
Osprey House  
Pacific Quay  
Broadway  
Salford  
M50 2UE

**Customer Contact:** Miss Sabine Sargeant

**Customer Job Reference:** 45924

**Customer Purchase Order:** 15/M/096/45924/SS

**Customer Site Reference:** Chancery House

**Date Job Received at SAL:** 11-Feb-2015

**Date Analysis Started:** 16-Feb-2015

**Date Analysis Completed:** 19-Feb-2015

The results reported relate to samples received in the laboratory  
Opinions and interpretations expressed herein are outside the scope of UKAS accreditation  
This report should not be reproduced except in full without the written approval of the laboratory  
Tests covered by this certificate were conducted in accordance with SAL SOPs  
All results have been reviewed in accordance with QP22



Report checked  
and authorised by :  
Emma Spear  
Project Management

Issued by :  
Emma Spear  
Project Management

<b>SAL Reference:</b> 456011 <b>Project Site:</b> Chancery House <b>Customer Reference:</b> 45924  <b>Soil</b> Analysed as Soil <b>REC Ltd 002S</b>									
<b>SAL Reference</b>				<b>456011 001</b>	<b>456011 002</b>	<b>456011 003</b>	<b>456011 004</b>	<b>456011 005</b>	
<b>Customer Sample Reference</b>				<b>TP101 0.6</b>	<b>TP101 2.4</b>	<b>TP102 1.5</b>	<b>TP103 0.7</b>	<b>TP103 2.8</b>	
<b>Bottom Depth</b>				<b>0.6</b>	<b>2.4</b>	<b>1.5</b>	<b>0.7</b>	<b>2.8</b>	
<b>Date Sampled</b>				<b>09-FEB-2015</b>	<b>09-FEB-2015</b>	<b>09-FEB-2015</b>	<b>09-FEB-2015</b>	<b>09-FEB-2015</b>	
<b>Determinand</b>	<b>Method</b>	<b>Test Sample</b>	<b>LOD</b>	<b>Units</b>					
Arsenic	T6	AR	1	mg/kg	32	16	21	73	18
Cadmium	T6	AR	1	mg/kg	<1	<1	<1	<1	<1
Chromium	T6	AR	1	mg/kg	22	27	34	44	38
Lead	T6	AR	1	mg/kg	3900	54	2300	1900	29
Mercury	T6	AR	1	mg/kg	1	<1	<1	21	<1
Selenium	T6	AR	3	mg/kg	<3	<3	<3	<3	<3
Copper	T6	AR	1	mg/kg	93	20	97	170	17
Nickel	T6	AR	1	mg/kg	46	26	23	47	34
Zinc	T6	AR	1	mg/kg	150	110	780	360	89
pH	T7	AR			8.5	8.2	8.1	8.1	8.3
SO4(Total)	T6	AR	0.01	%	0.14	0.14	2.4	0.38	0.20
SO4(2:1)	T6	AR	0.1	g/l	<0.1	<0.1	0.6	0.3	0.1
Cyanide(Total)	T4	AR	1	mg/kg	<1	<1	<1	1	<1
Phenols(Mono)	T4	AR	1	mg/kg	<1	<1	<1	<1	<1
Chromium VI	T6	AR	1	mg/kg	<1	<1	<1	<1	<1

<b>SAL Reference:</b> 456011 <b>Project Site:</b> Chancery House <b>Customer Reference:</b> 45924							
<b>Soil</b>		<b>Analysed as Soil</b>					
<b>REC Ltd 002S</b>							
<b>SAL Reference</b>					<b>456011 007</b>	<b>456011 008</b>	<b>456011 014</b>
<b>Customer Sample Reference</b>					<b>TP105 1.0</b>	<b>WS101 0.8</b>	<b>WS103 3.0</b>
<b>Bottom Depth</b>					<b>1.0</b>	<b>0.8</b>	<b>3.0</b>
<b>Date Sampled</b>					<b>09-FEB-2015</b>	<b>10-FEB-2015</b>	<b>10-FEB-2015</b>
<b>Determinand</b>	<b>Method</b>	<b>Test Sample</b>	<b>LOD</b>	<b>Units</b>			
Arsenic	T6	AR	1	mg/kg	20	21	13
Cadmium	T6	AR	1	mg/kg	<1	<1	<1
Chromium	T6	AR	1	mg/kg	13	30	30
Lead	T6	AR	1	mg/kg	510	2000	160
Mercury	T6	AR	1	mg/kg	3	1	<1
Selenium	T6	AR	3	mg/kg	<3	<3	<3
Copper	T6	AR	1	mg/kg	72	100	21
Nickel	T6	AR	1	mg/kg	17	18	28
Zinc	T6	AR	1	mg/kg	130	840	130
pH	T7	AR			8.3	7.9	8.3
SO4(Total)	T6	AR	0.01	%	0.10	0.73	0.21
SO4(2:1)	T6	AR	0.1	g/l	<0.1	0.5	0.3
Cyanide(Total)	T4	AR	1	mg/kg	<1	1	<1
Phenols(Mono)	T4	AR	1	mg/kg	<1	<1	<1
Chromium VI	T6	AR	1	mg/kg	<1	<1	<1

<b>SAL Reference:</b> 456011 <b>Project Site:</b> Chancery House <b>Customer Reference:</b> 45924  <b>Soil</b> Analysed as Soil <b>Total and Speciated USEPA16 PAH</b>									
<b>SAL Reference</b>					<b>456011 001</b>	<b>456011 002</b>	<b>456011 003</b>	<b>456011 004</b>	<b>456011 005</b>
<b>Customer Sample Reference</b>					<b>TP101 0.6</b>	<b>TP101 2.4</b>	<b>TP102 1.5</b>	<b>TP103 0.7</b>	<b>TP103 2.8</b>
<b>Bottom Depth</b>					<b>0.6</b>	<b>2.4</b>	<b>1.5</b>	<b>0.7</b>	<b>2.8</b>
<b>Date Sampled</b>					<b>09-FEB-2015</b>	<b>09-FEB-2015</b>	<b>09-FEB-2015</b>	<b>09-FEB-2015</b>	<b>09-FEB-2015</b>
<b>Determinand</b>	<b>Method</b>	<b>Test Sample</b>	<b>LOD</b>	<b>Units</b>					
Naphthalene	T149	AR	0.01	mg/kg	<b>0.12</b>	<0.01	<b>0.04</b>	<b>0.17</b>	<0.01
Acenaphthylene	T149	AR	0.01	mg/kg	<0.01	<0.01	<0.01	<b>0.01</b>	<0.01
Acenaphthene	T149	AR	0.01	mg/kg	<b>0.35</b>	<0.01	<b>0.05</b>	<b>0.13</b>	<0.01
Fluorene	T149	AR	0.01	mg/kg	<b>0.27</b>	<0.01	<b>0.01</b>	<b>0.06</b>	<0.01
Phenanthrene	T149	AR	0.01	mg/kg	<b>2.1</b>	<b>0.01</b>	<b>0.68</b>	<b>0.86</b>	<b>0.01</b>
Anthracene	T149	AR	0.01	mg/kg	<b>0.42</b>	<0.01	<b>0.10</b>	<b>0.14</b>	<0.01
Fluoranthene	T149	AR	0.01	mg/kg	<b>2.7</b>	<b>0.01</b>	<b>1.7</b>	<b>1.5</b>	<b>0.01</b>
Pyrene	T149	AR	0.01	mg/kg	<b>2.5</b>	<b>0.01</b>	<b>1.6</b>	<b>1.6</b>	<b>0.01</b>
Benzo(a)Anthracene	T149	AR	0.01	mg/kg	<b>0.79</b>	<b>0.01</b>	<b>0.56</b>	<b>0.77</b>	<b>0.01</b>
Chrysene	T149	AR	0.01	mg/kg	<b>0.77</b>	<b>0.01</b>	<b>0.64</b>	<b>0.74</b>	<0.01
Benzo(b/k)Fluoranthene	T149	AR	0.01	mg/kg	<b>1.3</b>	<b>0.01</b>	<b>1.3</b>	<b>1.3</b>	<b>0.01</b>
Benzo(a)Pyrene	T149	AR	0.01	mg/kg	<b>0.76</b>	<b>0.01</b>	<b>0.73</b>	<b>0.79</b>	<0.01
Indeno(123-cd)Pyrene	T149	AR	0.01	mg/kg	<b>0.45</b>	<0.01	<b>0.52</b>	<b>0.40</b>	<0.01
Dibenzo(ah)Anthracene	T149	AR	0.01	mg/kg	<b>0.09</b>	<0.01	<b>0.09</b>	<b>0.09</b>	<0.01
Benzo(ghi)Perylene	T149	AR	0.01	mg/kg	<b>0.60</b>	<0.01	<b>0.74</b>	<b>0.50</b>	<0.01
PAH(total)	T149	AR	0.01	mg/kg	<b>13</b>	<b>0.07</b>	<b>8.8</b>	<b>9.1</b>	<b>0.05</b>

<b>SAL Reference:</b> 456011							
<b>Project Site:</b> Chancery House							
<b>Customer Reference:</b> 45924							
<b>Soil</b>		Analysed as Soil					
<b>Total and Speciated USEPA16 PAH</b>							
<b>SAL Reference</b>				<b>456011 007</b>	<b>456011 008</b>	<b>456011 014</b>	
<b>Customer Sample Reference</b>				<b>TP105 1.0</b>	<b>WS101 0.8</b>	<b>WS103 3.0</b>	
<b>Bottom Depth</b>				<b>1.0</b>	<b>0.8</b>	<b>3.0</b>	
<b>Date Sampled</b>				<b>09-FEB-2015</b>	<b>10-FEB-2015</b>	<b>10-FEB-2015</b>	
<b>Determinand</b>	<b>Method</b>	<b>Test Sample</b>	<b>LOD</b>	<b>Units</b>			
Naphthalene	T149	AR	0.01	mg/kg	0.29	0.04	<0.01
Acenaphthylene	T149	AR	0.01	mg/kg	0.02	0.01	<0.01
Acenaphthene	T149	AR	0.01	mg/kg	1.3	0.08	<0.01
Fluorene	T149	AR	0.01	mg/kg	0.62	0.02	<0.01
Phenanthrene	T149	AR	0.01	mg/kg	4.2	1.1	0.01
Anthracene	T149	AR	0.01	mg/kg	0.69	0.24	<0.01
Fluoranthene	T149	AR	0.01	mg/kg	4.1	4.6	0.03
Pyrene	T149	AR	0.01	mg/kg	4.1	4.8	0.02
Benzo(a)Anthracene	T149	AR	0.01	mg/kg	1.4	1.8	0.01
Chrysene	T149	AR	0.01	mg/kg	1.5	1.6	0.01
Benzo(b/k)Fluoranthene	T149	AR	0.01	mg/kg	2.3	3.3	0.01
Benzo(a)Pyrene	T149	AR	0.01	mg/kg	1.3	2.1	0.01
Indeno(123-cd)Pyrene	T149	AR	0.01	mg/kg	0.57	1.1	<0.01
Dibenzo(ah)Anthracene	T149	AR	0.01	mg/kg	0.15	0.20	<0.01
Benzo(ghi)Perylene	T149	AR	0.01	mg/kg	0.70	1.5	<0.01
PAH(total)	T149	AR	0.01	mg/kg	23	22	0.10

SAL Reference					456011 001	456011 002	456011 003	456011 004	456011 005
Customer Sample Reference					TP101 0.6	TP101 2.4	TP102 1.5	TP103 0.7	TP103 2.8
Bottom Depth					0.6	2.4	1.5	0.7	2.8
Date Sampled					09-FEB-2015	09-FEB-2015	09-FEB-2015	09-FEB-2015	09-FEB-2015
Determinand	Method	Test Sample	LOD	Units					
EthylBenzene	T54	AR	1	µg/kg	<1	(110) <2	(110) <2	(110) <4	<1
O Xylene	T54	AR	1	µg/kg	<1	(110) <2	(110) <2	(110) <4	<1
Toluene	T54	AR	1	µg/kg	<1	(110) <2	(110) <2	5	<1
M/P Xylene	T54	AR	1	µg/kg	<1	(110) <2	(110) <2	(110) <4	<1
Methyl tert-Butyl Ether	T54	AR	1	µg/kg	<1	(110) <2	(110) <2	(110) <4	<1
Benzene	T54	AR	1	µg/kg	(13) <1	(110,13) <2	(110,13) <2	(110,13) <4	(13) <1

SAL Reference				456011 007	456011 008	456011 014	
Customer Sample Reference				TP105 1.0	WS101 0.8	WS103 3.0	
Bottom Depth				1.0	0.8	3.0	
Date Sampled				09-FEB-2015	10-FEB-2015	10-FEB-2015	
Determinand	Method	Test Sample	LOD	Units			
EthylBenzene	T54	AR	1	µg/kg	<1	(110) <2	<1
O Xylene	T54	AR	1	µg/kg	<1	(110) <2	<1
Toluene	T54	AR	1	µg/kg	<1	(110) <2	1
M/P Xylene	T54	AR	1	µg/kg	<1	(110) <2	<1
Methyl tert-Butyl Ether	T54	AR	1	µg/kg	<1	(110) <2	<1
Benzene	T54	AR	1	µg/kg	(13) <1	(110,13) <2	(13) <1

SAL Reference					456011 001	456011 002	456011 003	456011 004	456011 005
Customer Sample Reference					TP101 0.6	TP101 2.4	TP102 1.5	TP103 0.7	TP103 2.8
Bottom Depth					0.6	2.4	1.5	0.7	2.8
Date Sampled					09-FEB-2015	09-FEB-2015	09-FEB-2015	09-FEB-2015	09-FEB-2015
Determinand	Method	Test Sample	LOD	Units					
TPH (C5-C6)	T54	AR	0.10	mg/kg	<0.10	<sup>(110)</sup> <0.20	<sup>(110)</sup> <0.20	<sup>(110)</sup> <0.40	<0.10
TPH (C6-C8)	T54	AR	0.10	mg/kg	<0.10	<sup>(110)</sup> <0.20	<sup>(110)</sup> <0.20	<sup>(110)</sup> <0.40	<0.10
TPH (C8-C10)	T54	AR	0.10	mg/kg	<0.10	<sup>(110)</sup> <0.20	<sup>(110)</sup> <0.20	<sup>(110)</sup> <0.40	<0.10
TPH (C10-C12)	T8	AR	1	mg/kg	<1	<1	24	2	<1
TPH (C12-C16)	T8	AR	1	mg/kg	3	<1	230	7	<1
TPH (C16-C21)	T8	AR	1	mg/kg	13	<1	370	13	<1
TPH (C21-C35)	T8	AR	1	mg/kg	68	<1	420	46	<1

<b>SAL Reference:</b> 456011							
<b>Project Site:</b> Chancery House							
<b>Customer Reference:</b> 45924							
<b>Soil</b>		<b>Analysed as Soil</b>					
<b>REC Suite C (Banded TPH C5-C35)</b>							
<b>SAL Reference</b>				<b>456011 007</b>	<b>456011 008</b>	<b>456011 014</b>	
<b>Customer Sample Reference</b>				<b>TP105 1.0</b>	<b>WS101 0.8</b>	<b>WS103 3.0</b>	
<b>Bottom Depth</b>				<b>1.0</b>	<b>0.8</b>	<b>3.0</b>	
<b>Date Sampled</b>				<b>09-FEB-2015</b>	<b>10-FEB-2015</b>	<b>10-FEB-2015</b>	
<b>Determinand</b>	<b>Method</b>	<b>Test Sample</b>	<b>LOD</b>	<b>Units</b>			
TPH (C5-C6)	T54	AR	0.10	mg/kg	<0.10	<sup>(110)</sup> <0.20	<0.10
TPH (C6-C8)	T54	AR	0.10	mg/kg	<0.10	<sup>(110)</sup> <0.20	<0.10
TPH (C8-C10)	T54	AR	0.10	mg/kg	<0.10	<sup>(110)</sup> <0.20	<0.10
TPH (C10-C12)	T8	AR	1	mg/kg	<1	<sup>(9)</sup> <10	<1
TPH (C12-C16)	T8	AR	1	mg/kg	1	<sup>(9)</sup> <10	<1
TPH (C16-C21)	T8	AR	1	mg/kg	5	42	<1
TPH (C21-C35)	T8	AR	1	mg/kg	27	400	<1

<div>SAL Reference: 456011 Project Site: Chancery House Customer Reference: 45924</div> <div>Soil Asbestos ID</div> <div>Analysed as Soil</div>												
SAL Reference			456011 001		456011 003		456011 004		456011 007		456011 008	
Customer Sample Reference			TP101 0.6		TP102 1.5		TP103 0.7		TP105 1.0		WS101 0.8	
Bottom Depth			0.6		1.5		0.7		1.0		0.8	
Date Sampled			09-FEB-2015		09-FEB-2015		09-FEB-2015		09-FEB-2015		10-FEB-2015	
Determinand		Method	Test Sample	LOD	Units							
Asbestos ID		T27	AR			N.D.	N.D.	Chrysotile Fibres Detected	Chrysotile Fibres Detected	Chrysotile Fibres Detected		

## Index to symbols used in 456011-1

<b>Value</b>	<b>Description</b>
AR	As Received
N.D.	Not Detected
9	LOD raised due to dilution of sample
13	Results have been blank corrected.
110	LOD raised due to low internal standard recovery.
S	Analysis was subcontracted
U	Analysis is UKAS accredited
N	Analysis is not UKAS accredited

## Method Index

<b>Value</b>	<b>Description</b>
T4	Colorimetry
T27	PLM
T54	GC/MS (Headspace)
T149	GC/MS (SIR)
T6	ICP/OES
T8	GC/FID
T7	Probe

## Accreditation Summary

<b>Determinand</b>	<b>Method</b>	<b>Test Sample</b>	<b>LOD</b>	<b>Units</b>	<b>Symbol</b>	<b>SAL References</b>
Benzene	T54	AR	1	µg/kg	U	001-005,007-008,014
EthylBenzene	T54	AR	1	µg/kg	U	001-005,007-008,014
M/P Xylene	T54	AR	1	µg/kg	U	001-005,007-008,014
Methyl tert-Butyl Ether	T54	AR	1	µg/kg	U	001-005,007-008,014
O Xylene	T54	AR	1	µg/kg	U	001-005,007-008,014



Determinand	Method	Test Sample	LOD	Units	Symbol	SAL References
Toluene	T54	AR	1	µg/kg	U	001-005,007-008,014
Arsenic	T6	AR	1	mg/kg	U	001-005,007-008,014
Cadmium	T6	AR	1	mg/kg	U	001-005,007-008,014
Chromium	T6	AR	1	mg/kg	U	001-005,007-008,014
Lead	T6	AR	1	mg/kg	U	001-005,007-008,014
Mercury	T6	AR	1	mg/kg	U	001-005,007-008,014
Selenium	T6	AR	3	mg/kg	U	001-005,007-008,014
Copper	T6	AR	1	mg/kg	U	001-005,007-008,014
Nickel	T6	AR	1	mg/kg	U	001-005,007-008,014
Zinc	T6	AR	1	mg/kg	U	001-005,007-008,014
pH	T7	AR			U	001-005,007-008,014
SO4(Total)	T6	AR	0.01	%	N	001-005,007-008,014
SO4(2:1)	T6	AR	0.1	g/l	N	001-005,007-008,014
Cyanide(Total)	T4	AR	1	mg/kg	U	001-005,007-008,014
Phenols(Mono)	T4	AR	1	mg/kg	U	001-005,007-008,014
Chromium VI	T6	AR	1	mg/kg	N	001-005,007-008,014
TPH (C5-C6)	T54	AR	0.10	mg/kg	N	001-005,007-008,014
TPH (C6-C8)	T54	AR	0.10	mg/kg	N	001-005,007-008,014
TPH (C8-C10)	T54	AR	0.10	mg/kg	N	001-005,007-008,014
TPH (C10-C12)	T8	AR	1	mg/kg	U	001-005,007-008,014
TPH (C12-C16)	T8	AR	1	mg/kg	U	001-005,007-008,014
TPH (C16-C21)	T8	AR	1	mg/kg	U	001-005,007-008,014
TPH (C21-C35)	T8	AR	1	mg/kg	U	001-005,007-008,014
Naphthalene	T149	AR	0.01	mg/kg	U	001-005,007-008,014
Acenaphthylene	T149	AR	0.01	mg/kg	U	001-005,007-008,014
Acenaphthene	T149	AR	0.01	mg/kg	U	001-005,007-008,014
Fluorene	T149	AR	0.01	mg/kg	U	001-005,007-008,014
Phenanthrene	T149	AR	0.01	mg/kg	U	001-005,007-008,014
Anthracene	T149	AR	0.01	mg/kg	U	001-005,007-008,014
Fluoranthene	T149	AR	0.01	mg/kg	U	001-005,007-008,014
Pyrene	T149	AR	0.01	mg/kg	U	001-005,007-008,014
Benzo(a)Anthracene	T149	AR	0.01	mg/kg	U	001-005,007-008,014
Chrysene	T149	AR	0.01	mg/kg	U	001-005,007-008,014
Benzo(b/k)Fluoranthene	T149	AR	0.01	mg/kg	U	001-005,007-008,014
Benzo(a)Pyrene	T149	AR	0.01	mg/kg	U	001-005,007-008,014
Indeno(123-cd)Pyrene	T149	AR	0.01	mg/kg	U	001-005,007-008,014
Dibenzo(ah)Anthracene	T149	AR	0.01	mg/kg	U	001-005,007-008,014
Benzo(ghi)Perylene	T149	AR	0.01	mg/kg	U	001-005,007-008,014
PAH(total)	T149	AR	0.01	mg/kg	U	001-005,007-008,014
Asbestos ID	T27	AR			SU	001,003-004,007-008



# Scientific Analysis Laboratories Ltd

## Certificate of Analysis

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

Scientific Analysis Laboratories is a  
limited company registered in England and  
Wales (No 2514788) whose address is at  
Hadfield House, Hadfield Street, Manchester M16 9FE

**Report Number:** 459451-1

**Date of Report:** 04-Mar-2015

**Customer:** Resource Environmental Consultants Ltd  
Osprey House  
Pacific Quay  
Broadway  
Salford  
M50 2UE

**Customer Contact:** Mr Mark Hamill

**Customer Job Reference:** 45924

**Customer Site Reference:** Chancery House

**Date Job Received at SAL:** 23-Feb-2015

**Date Analysis Started:** 02-Mar-2015

**Date Analysis Completed:** 04-Mar-2015

The results reported relate to samples received in the laboratory  
Opinions and interpretations expressed herein are outside the scope of UKAS accreditation  
This report should not be reproduced except in full without the written approval of the laboratory  
Tests covered by this certificate were conducted in accordance with SAL SOPs  
All results have been reviewed in accordance with QP22



Report checked  
and authorised by :  
Emma Spear  
Project Management

Issued by :  
Emma Spear  
Project Management

<b>SAL Reference:</b> 459451 <b>Project Site:</b> Chancery House <b>Customer Reference:</b> 45924  <b>Water</b> Analysed as Water <b>REC Ltd 002W</b>					
<b>SAL Reference</b>				<b>459451 001</b>	
<b>Customer Sample Reference</b>				<b>WS101</b>	
<b>Date Sampled</b>				<b>23-FEB-2015</b>	
<b>Determinand</b>	<b>Method</b>	<b>Test Sample</b>	<b>LOD</b>	<b>Units</b>	
As (Dissolved)	T281	AR	0.2	µg/l	<b>19</b>
Cd (Dissolved)	T281	AR	0.02	µg/l	<b>0.02</b>
Cr (Dissolved)	T281	AR	1	µg/l	<1
Pb (Dissolved)	T281	AR	0.3	µg/l	<b>4.3</b>
Hg (Dissolved)	T281	AR	0.05	µg/l	<0.05
Se (Dissolved)	T281	AR	0.5	µg/l	<b>16</b>
Cu (Dissolved)	T281	AR	0.5	µg/l	<b>11</b>
Ni (Dissolved)	T281	AR	1	µg/l	<b>17</b>
Zn (Dissolved)	T281	AR	2	µg/l	<b>46</b>
pH	T7	AR			<b>7.5</b>
Cyanide(Total)	T4	AR	50	µg/l	<50
Phenols(Mono)	T4	AR	100	µg/l	<100
Chromium VI	T686	AR	3	µg/l	<3
Sulphate	T686	AR	500	µg/l	<b>1000000</b>

<b>SAL Reference:</b> 459451 <b>Project Site:</b> Chancery House <b>Customer Reference:</b> 45924  <b>Water</b> Analysed as Water <b>Total and Speciated USEPA16 PAH</b>					
<b>SAL Reference</b>				<b>459451 001</b>	
<b>Customer Sample Reference</b>				<b>WS101</b>	
<b>Date Sampled</b>				<b>23-FEB-2015</b>	
<b>Determinand</b>	<b>Method</b>	<b>Test Sample</b>	<b>LOD</b>	<b>Units</b>	
Naphthalene	T149	AR	0.01	µg/l	<b>0.16</b>
Acenaphthylene	T149	AR	0.01	µg/l	<b>0.04</b>
Acenaphthene	T149	AR	0.01	µg/l	<b>0.85</b>
Fluorene	T149	AR	0.01	µg/l	<b>0.17</b>
Phenanthrene	T149	AR	0.01	µg/l	<b>0.20</b>
Anthracene	T149	AR	0.01	µg/l	<b>0.14</b>
Fluoranthene	T149	AR	0.01	µg/l	<b>0.35</b>
Pyrene	T149	AR	0.01	µg/l	<b>0.32</b>
Benzo(a)Anthracene	T149	AR	0.01	µg/l	<b>0.13</b>
Chrysene	T149	AR	0.01	µg/l	<b>0.13</b>
Benzo(b/k)Fluoranthene	T149	AR	0.01	µg/l	<b>0.35</b>
Benzo(a)Pyrene	T149	AR	0.01	µg/l	<b>0.21</b>
Indeno(123-cd)Pyrene	T149	AR	0.01	µg/l	<b>0.22</b>
Dibenzo(ah)Anthracene	T149	AR	0.01	µg/l	<b>0.05</b>
Benzo(ghi)Perylene	T149	AR	0.01	µg/l	<b>0.25</b>
PAH(total)	T149	AR	0.01	µg/l	<b>3.6</b>

<b>SAL Reference:</b> 459451 <b>Project Site:</b> Chancery House <b>Customer Reference:</b> 45924  <b>Water</b> Analysed as Water <b>REC Suite C (Banded TPH C5-C35)</b>					
<b>SAL Reference</b>				<b>459451 001</b>	
<b>Customer Sample Reference</b>				<b>WS101</b>	
<b>Date Sampled</b>				<b>23-FEB-2015</b>	
Determinand	Method	Test Sample	LOD	Units	
TPH (C5-C6)	T215	AR	10	µg/l	<10
TPH (C6-C8)	T215	AR	10	µg/l	<10
TPH (C8-C10) DW	T215	AR	10	µg/l	<10
TPH (C10-C12) DW	T81	AR	10	µg/l	<b>10</b>
TPH (C12-C16) DW	T81	AR	10	µg/l	<b>54</b>
TPH (C16-C21) DW	T81	AR	10	µg/l	<b>110</b>
TPH (C21-C35) DW	T81	AR	10	µg/l	<b>420</b>

<b>SAL Reference:</b> 459451 <b>Project Site:</b> Chancery House <b>Customer Reference:</b> 45924  <b>Water</b> Analysed as Water <b>Hardness</b>					
<b>SAL Reference</b>				<b>459451 001</b>	
<b>Customer Sample Reference</b>				<b>WS101</b>	
<b>Date Sampled</b>				<b>23-FEB-2015</b>	
Determinand	Method	Test Sample	LOD	Units	
Hardness expressed as CaCO3	T6	AR	10000	µg/l	<b>1200000</b>

## Index to symbols used in 459451-1

Value	Description
AR	As Received
U	Analysis is UKAS accredited
N	Analysis is not UKAS accredited

## Method Index

Value	Description
T281	ICP/MS (Filtered)
T4	Colorimetry
T686	Discrete Analyser
T81	GC/FID (LV)
T149	GC/MS (SIR)
T6	ICP/OES
T7	Probe
T215	GC/MS (Headspace)(LV)

## Accreditation Summary

Determinand	Method	Test Sample	LOD	Units	Symbol	SAL References
Hardness expressed as CaCO3	T6	AR	10000	µg/l	N	001
As (Dissolved)	T281	AR	0.2	µg/l	U	001
Cd (Dissolved)	T281	AR	0.02	µg/l	U	001
Cr (Dissolved)	T281	AR	1	µg/l	U	001
Pb (Dissolved)	T281	AR	0.3	µg/l	U	001
Hg (Dissolved)	T281	AR	0.05	µg/l	U	001
Se (Dissolved)	T281	AR	0.5	µg/l	U	001
Cu (Dissolved)	T281	AR	0.5	µg/l	U	001
Ni (Dissolved)	T281	AR	1	µg/l	U	001
Zn (Dissolved)	T281	AR	2	µg/l	U	001
pH	T7	AR			U	001
Cyanide(Total)	T4	AR	50	µg/l	U	001

Determinand	Method	Test Sample	LOD	Units	Symbol	SAL References
Phenols(Mono)	T4	AR	100	µg/l	U	001
Chromium VI	T686	AR	3	µg/l	U	001
Sulphate	T686	AR	500	µg/l	U	001
TPH (C5-C6)	T215	AR	10	µg/l	N	001
TPH (C6-C8)	T215	AR	10	µg/l	N	001
TPH (C8-C10) DW	T215	AR	10	µg/l	N	001
TPH (C10-C12) DW	T81	AR	10	µg/l	U	001
TPH (C12-C16) DW	T81	AR	10	µg/l	U	001
TPH (C16-C21) DW	T81	AR	10	µg/l	U	001
TPH (C21-C35) DW	T81	AR	10	µg/l	U	001
Naphthalene	T149	AR	0.01	µg/l	U	001
Acenaphthylene	T149	AR	0.01	µg/l	U	001
Acenaphthene	T149	AR	0.01	µg/l	U	001
Fluorene	T149	AR	0.01	µg/l	U	001
Phenanthrene	T149	AR	0.01	µg/l	U	001
Anthracene	T149	AR	0.01	µg/l	U	001
Fluoranthene	T149	AR	0.01	µg/l	U	001
Pyrene	T149	AR	0.01	µg/l	U	001
Benzo(a)Anthracene	T149	AR	0.01	µg/l	U	001
Chrysene	T149	AR	0.01	µg/l	U	001
Benzo(b/k)Fluoranthene	T149	AR	0.01	µg/l	U	001
Benzo(a)Pyrene	T149	AR	0.01	µg/l	U	001
Indeno(123-cd)Pyrene	T149	AR	0.01	µg/l	U	001
Dibenzo(ah)Anthracene	T149	AR	0.01	µg/l	U	001
Benzo(ghi)Perylene	T149	AR	0.01	µg/l	U	001
PAH(total)	T149	AR	0.01	µg/l	U	001



**APPENDIX VI**  
**GEOTECHNICAL TESTING RESULTS**



# LABORATORY REPORT



4043

**Contract Number: PSL15/0954**

Client's Reference:

Report Date: 03 March 2015

Client Name: REC Manchester  
Osprey House  
Pacific Quay  
Broadway  
Manchester  
M50 2UE

**For the attention of: Sabine Sargeant**

Contract Title: Chancery House

Date Received: 25/2/2015

Date Commenced: 25/2/2015

Date Completed: 3/3/2015

**Notes: Opinions and Interpretations are outside the UKAS Accreditation**

A copy of the Laboratory Schedule of accredited tests as issued by UKAS is attached to this report. This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service. The results reported herein relate only to the material supplied to the laboratory. This certificate shall not be reproduced in full, without the prior written approval of the laboratory.

Checked and Approved Signatories:

R Gunson  
(Director)

A Watkins  
(Director)

M Beastall  
(Laboratory Manager)

D Lambe  
(Senior Technician)

S Royle  
(Senior Technician)

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Doncaster DN4 0AR  
tel: +44 (0)844 815 6641  
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awatkins@prosoils.co.uk

Page 1 of

# SUMMARY OF LABORATORY SOIL DESCRIPTIONS

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(B.S. 1377 : PART 2 : 1990)

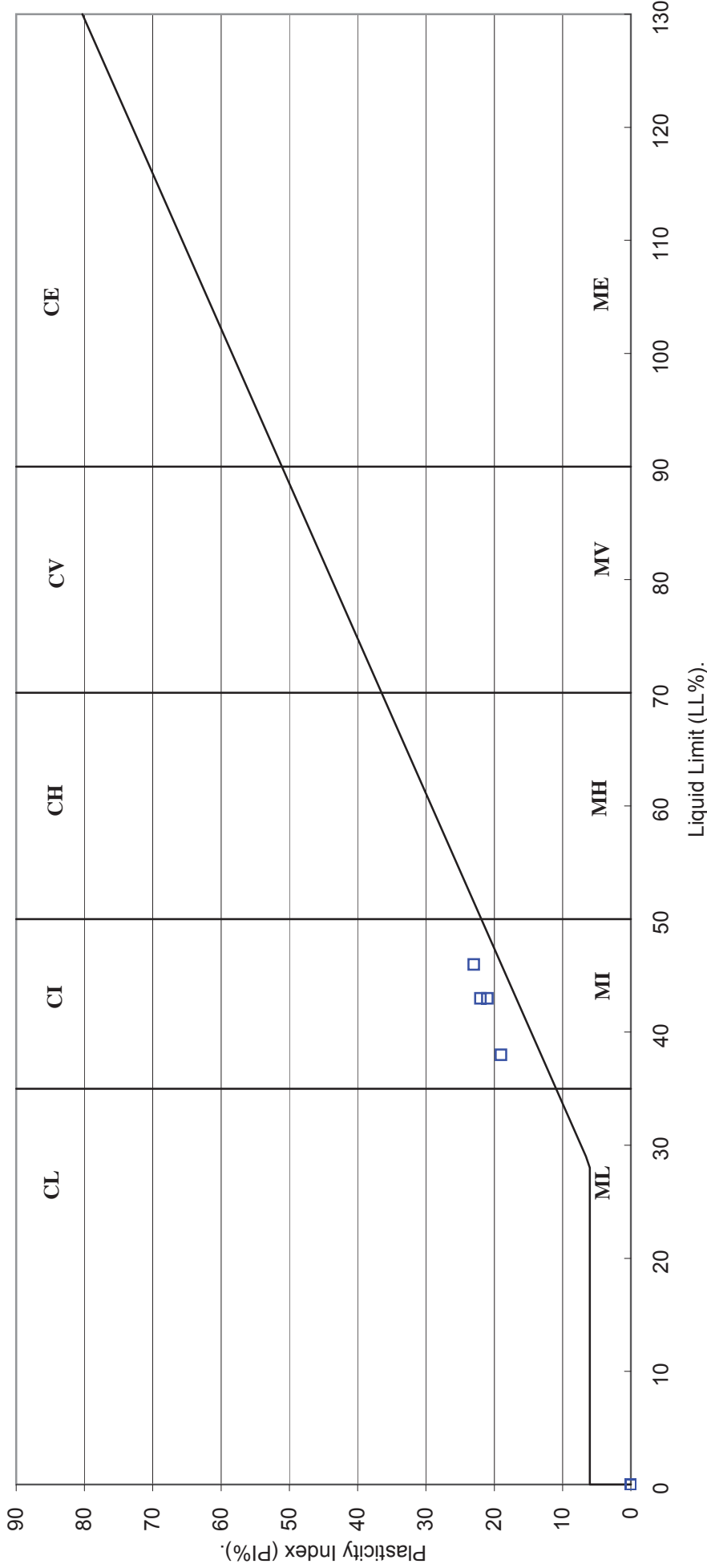
**SYMBOLS: NP : Non Plastic**

**\*\* : Liquid Limit and Plastic Limit Wet Sieved.**

PSLR002 Issue 1

# PLASTICITY CHART FOR CASAGRANDE CLASSIFICATION.

(B.S.5930 : 1999)



**APPENDIX VII**  
**IN-SITU TESTING RESULTS**

# Falling Head Test

Borehole: WS101

Test No: 1 of 1

Contract No:	45924	Diameter	92 mm
Contract Title:	Chancery House	Top Of Response Zone	2.00 m
Date of Test:	10/03/2015	Base of Response Zone	5.00 m
		Groundwater Level	2.43 m

Recorded Time			Total Time (secs)	Depth (m)	H/Ho
Hours	Minutes	Seconds			
0	0	0	0	0.00	1.000
0	0	15	15	1.23	0.494
0	0	30	30	1.50	0.383
0	0	45	45	1.57	0.354
0	1	0	60	1.61	0.337
0	1	30	90	1.67	0.313
0	2	0	120	1.70	0.300
0	2	30	150	1.84	0.243
0	3	0	180	1.87	0.230
0	3	30	210	1.92	0.210
0	4	0	240	1.96	0.193
0	4	30	270	1.98	0.185
0	5	0	300	2.01	0.173
0	6	0	360	2.07	0.148
0	7	0	420	2.10	0.136
0	8	0	480	2.10	0.136
0	9	0	540	2.13	0.123
0	10	0	600	2.14	0.119
0	15	0	900	2.20	0.095
0	30	0	1800	2.25	0.074
0	45	0	2700	2.29	0.058
1	0	0	3600	2.31	0.049
1	30	0	5400	2.34	0.037

$H_0 = 2.430$

$H_1 = 0.494$

$H_2 = 0.243$

$t_1 = 15$

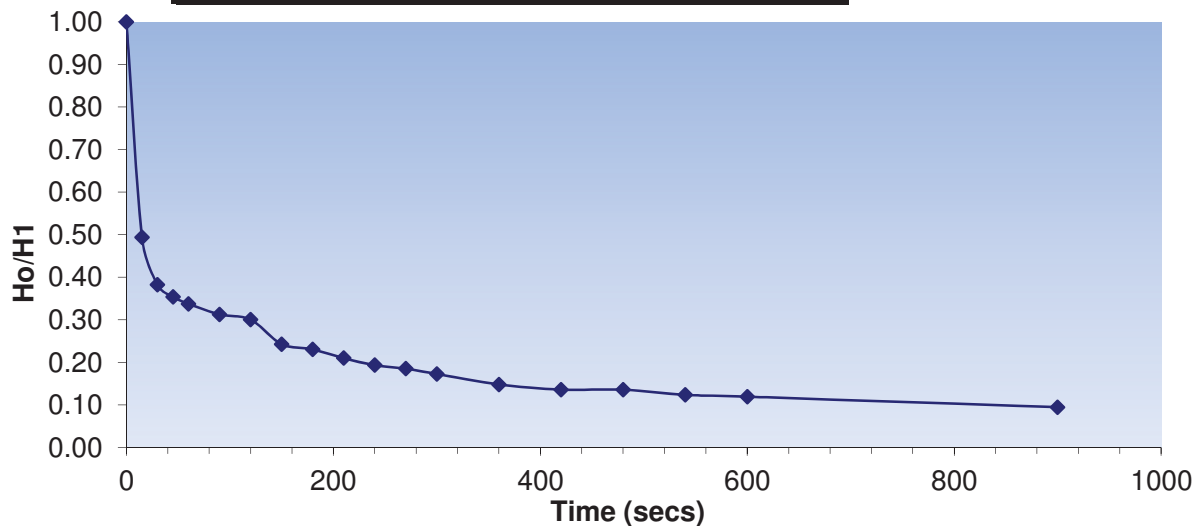
$t_2 = 150$

$F = 1$

$A = 0.007$

## Coefficient of Permeability (k) (m/s)

2.91E-05



### Key:

**k** = Coefficient of Permeability - calculated from the general approach in 25.4.6; Method 1 (BS5930)

**F** = Intake Factor - calculated from Equation D, Figure 6 from BS5930

**A** = Cross Sectional Area of well pack

**H<sub>1</sub>** = variable head measured at time  $t_1$  after commencement of test

**H<sub>2</sub>** = variable head measured at time  $t_2$  after commencement of test

# Falling Head Test

Borehole: WS102

Test No: 1 of 1

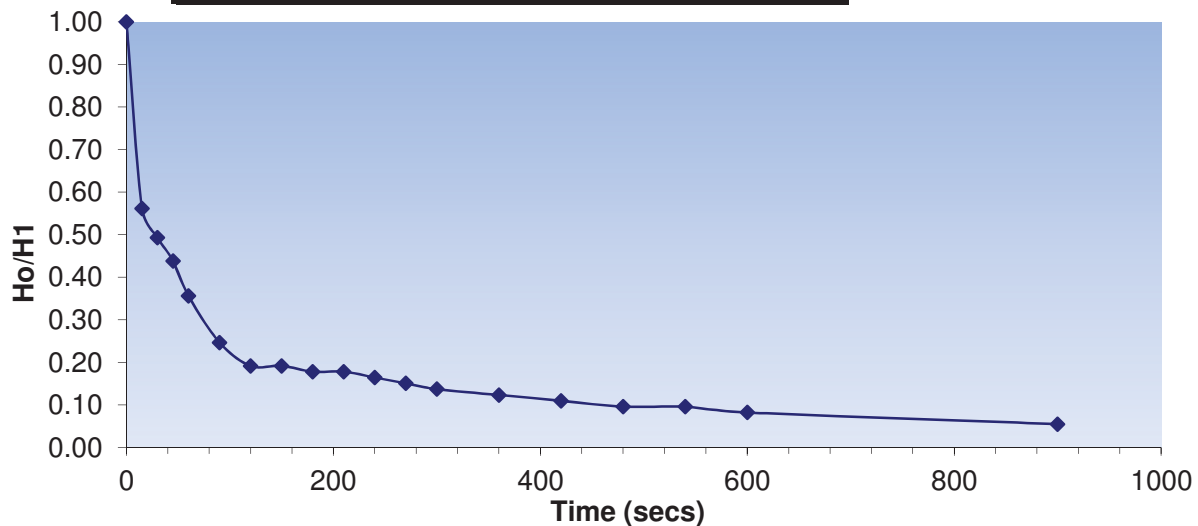
Contract No:	45924	Diameter	92 mm
Contract Title:	Chancery House	Top Of Response Zone	0.50 m
Date of Test:	10/03/2015	Base of Response Zone	2.00 m
		Groundwater Level	2.00 m

Recorded Time			Total Time (secs)	Depth (m)	H/H <sub>0</sub>
Hours	Minutes	Seconds			
0	0	0	0	1.27	1.000
0	0	15	15	1.59	0.562
0	0	30	30	1.64	0.493
0	0	45	45	1.68	0.438
0	1	0	60	1.74	0.356
0	1	30	90	1.82	0.247
0	2	0	120	1.86	0.192
0	2	30	150	1.86	0.192
0	3	0	180	1.87	0.178
0	3	30	210	1.87	0.178
0	4	0	240	1.88	0.164
0	4	30	270	1.89	0.151
0	5	0	300	1.90	0.137
0	6	0	360	1.91	0.123
0	7	0	420	1.92	0.110
0	8	0	480	1.93	0.096
0	9	0	540	1.93	0.096
0	10	0	600	1.94	0.082
0	15	0	900	1.96	0.055
0	30	0	1800	1.98	0.027

H <sub>0</sub> =	0.730
H <sub>1</sub> =	0.562
H <sub>2</sub> =	0.356
t <sub>1</sub> =	15
t <sub>2</sub> =	60
F =	3
A =	0.007

## Coefficient of Permeability (k) (m/s)

2.49E-05



### Key:

**k** = Coefficient of Permeability - calculated from the general approach in 25.4.6; Method 1 (BS5930)

**F** = Intake Factor - calculated from Equation D, Figure 6 from BS5930

**A** = Cross Sectional Area of well pack

**H<sub>1</sub>** = variable head measured at time t<sub>1</sub> after commencement of test

**H<sub>2</sub>** = variable head measured at time t<sub>2</sub> after commencement of test

# Falling Head Test

Borehole: WS103

Test No: 1 of 1

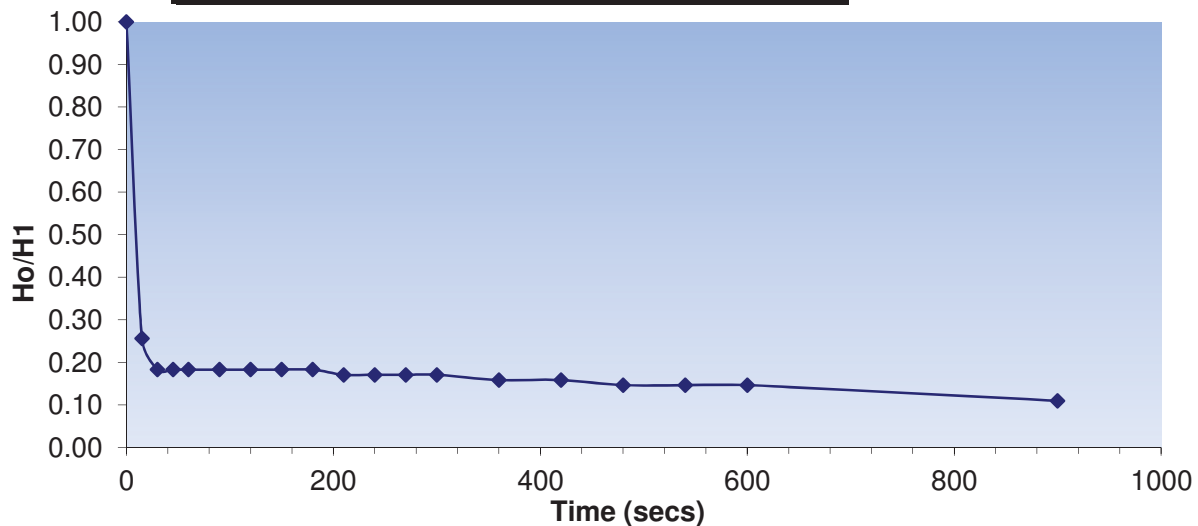
Contract No:	45924	Diameter	92 mm
Contract Title:	Chancery House	Top Of Response Zone	0.50 m
Date of Test:	10/03/2015	Base of Response Zone	5.00 m
		Groundwater Level	1.98 m

Recorded Time			Total Time (secs)	Depth (m)	H/Ho
Hours	Minutes	Seconds			
0	0	0	0	1.16	1.000
0	0	15	15	1.77	0.256
0	0	30	30	1.83	0.183
0	0	45	45	1.83	0.183
0	1	0	60	1.83	0.183
0	1	30	90	1.83	0.183
0	2	0	120	1.83	0.183
0	2	30	150	1.83	0.183
0	3	0	180	1.83	0.183
0	3	30	210	1.84	0.171
0	4	0	240	1.84	0.171
0	4	30	270	1.84	0.171
0	5	0	300	1.84	0.171
0	6	0	360	1.85	0.159
0	7	0	420	1.85	0.159
0	8	0	480	1.86	0.146
0	9	0	540	1.86	0.146
0	10	0	600	1.86	0.146
0	15	0	900	1.89	0.110
0	30	0	1800	1.91	0.085

$H_0 = 0.820$   
 $H_1 = 0.256$   
 $H_2 = 0.183$   
 $t_1 = 15$   
 $t_2 = 30$   
 $F = 3$   
 $A = 0.007$

## Coefficient of Permeability (k) (m/s)

5.57E-05



### Key:

**k** = Coefficient of Permeability - calculated from the general approach in 25.4.6; Method 1 (BS5930)

**F** = Intake Factor - calculated from Equation D, Figure 6 from BS5930

**A** = Cross Sectional Area of well pack

**H<sub>1</sub>** = variable head measured at time  $t_1$  after commencement of test

**H<sub>2</sub>** = variable head measured at time  $t_2$  after commencement of test

**APPENDIX VIII**

**PHOTOGRAPHS**



**PLATE 1: TYPICAL MADE GROUND (DEMOLITION RUBBLE)**



**PLATE 2: EXISTING BRICK FOOTING CHANCERY HOUSE (TP105)**





**PLATE 3: TYPICAL SOFT ORGANIC CLAY WITH TIMBER**



**PLATE 4: TP101**