PSA DESIGN

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CIVIL, STRUCTURAL, GEOTECHNICAL, TRANSPORT

Mr Ronald Jackson

Land off Chatburn Old Rd, Chatburn

Gas Risk Assessment

D1350-R-02

19th August 2013

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Document Control Sheet

Land off Chatburn Old Road, Chatburn

Gas Risk Assessment

Job	Date	Issue	Copy
D1350	*19th August 2013*	*D1350-R-02-o*	

Originator... *.... Dr JS Birtwhistle BSc PhD FGS CGeol*

Checker. *.. DL Wallbank BEng CEng MICE*

Approver... *.. Dr JS Birtwhistle BSc PhD FGS CGeol*

CONTENTS

DRAWINGS

APPENDICES

1.0 INTRODUCTION

1.1 PSA Design were commissioned by Mr Ronald Jackson to provide a Gas Risk Assessment of the site, following on from the recommendations of the Phase 1 Land Quality Assessment (D1350-R-01Rev1, Dec 2010). It is understood that consideration is being given to the redevelopment of the site as a *residential* development with associated highway, car parking and gardens.

1.2 The site is located off (Chatburn) Old Road, Chatburn, Clitheroe. BB74AB. (NGR 376610 444000). Site occupies an area of approximately 0.97 hectares.

1.3 At the time of the assessment the site was empty, with the surrounding land generally agricultural land.

1.4 The investigation and report was required to satisfy concerns set out by the local authority planning department regarding the potential gas risk from a historic landfill site, located north of the proposed site development.

1.5 This report details the gas risk assessment for the proposed new development.

2.0 SITE DESCRIPTION

General

2.1.1 The site location is shown on Drawing Number D1350/01. Site details are summarised in the Table below. Current site layout plan shown in Drawing Number D1350/02.

Detail	Remarks
Location	Within E outskirts of Chatburn.
Address	Chatburn Old Road, Chatburn, Clitheroe. BB7 4AB.
NGR	376600 444000
Area	0.42 ha
Known services	To date, no services plans have been made available.

2.2 Site Features

2.2.1 A PSA Design Engineer completed a walkover survey of the site on the 11th August 2010 and the salient features are presented below.

2.2.2 The existing site is currently unused.

2.2.3 Grassland vegetation covers the site, with various mature trees along the perimeter.

2.2.4 Ground sloping down from NW to SE.

2.2.5 Access to site off highway, Chatburn Old Road.

2.2.6 Limestone rock outcrop within site.

2.2.7 Existing salient features are summarised in the Table below and shown in Drawing Number D1350/02.

Feature	Remarks
Current Access	Chatburn Old Rd, to the N.
Topography	Sloping NW to SE.
Approximate areas	4200 m^2 – grassland
Nature of boundaries	Fence and hedging/trees along current boundary, with wall along N border with highway.
Surrounding land uses	West – Quarry South – Woodland –Rural- Residential East – Residential North – Woodland.

2.3 Site Operations

2.3.1 No current operations on site and therefore not considered to represent a significant source of ground contamination.

3.0 GROUND CONDITIONS

3.1 General

3.1.1 A full ground investigation has yet to be carried out on the site, however a basic ground model can be ascertained from the desk study exercise.

3.1.2 Geological maps show the site to have no drift deposits overlying Chatburn limestone rock. The site walkover confirmed this information, with limestone outcropping at the surface in localised areas, but is likely to be generally overlain by a thin topsoil layer.

3.1.3 No data is available on the thickness of the Chatburn landfill, to the north, however it is likely that the fill deposits are at least 15metres thick, with no lining materials. The type of fill recorded is mixed waste.

3.1.4 A preliminary conceptual model has been created, illustrated in Drawing D1350-G-05.

4.0 GAS TESTING & ASSESSMENT

4.1 Introduction

4.1.1 In order to characterise the ground gas regime within the locality of the site, Ronald Jackson contacted Lancashire County Council's Laboratory, who carry out monthly monitoring of Chatburn Landfill and received the previous year's monitoring data for the site.

4.2 Gas Data

4.2.1 The landfill contains six boreholes (BH1-BH6), of unknown depth (BH2, 4 and 5 at least 15m deep, BH6 at least 6m deep, BH1&3 not known) and one usable shallow probe (3). The boreholes are spread across the southern area of the landfill close to Chatburn Old Road, with borehole BH1, 2, 3 & 5, plus probe 3 within the SE area, close to the existing properties, with borehole BH4 in the central area and borehole BH6 in the SW corner of the landfill. No further information regarding response zone, ground conditions within the boreholes etc was provided. The plan of the borehole and probe positions is located in Appendix B.

4.2.2 Twelve months' monitoring data has been provided by Lancashire County Council's Laboratory to our client (Appendix B). The data consists of gas meter (GA2000CM7.68) readings for the seven hole locations, with several of the boreholes having multiple piezometers, to varying depths, 5,10,15mbgl etc., giving a comprehensive depth coverage of gas values. Weather conditions are recorded, including atmospheric pressure. Gas values are recorded for methane, carbon dioxide and oxygen. No flow readings were taken. Trish Hodson, Environmental Manager at Lancashire County Council Laboratory (LCCL) stated that "we do not record flow readings at this site as the results show no methane and only low levels of carbon dioxide".

4.3 Current Guidance

4.3.1 Current guidance for the assessment of risk associated with the presence of methane and carbon dioxide within ground gas is provided by four recent publications; "*A pragmatic Approach to Ground Gas Risk Assessment*" CL:AIRE RB17 (2012), the "*Ground Gas Handbook*" Wilson, Card & Haines (2009), the NHBC *"Guidance on Evaluation of Development Proposals on sites where Methane and Carbon Dioxide are present"* (2007) and CIRIA Report C665 *"Assessing risks posed by hazardous ground gases to building"* (2007). These reports have developed from previous publications such as:

- BS8485:2007 "*Code of Practice for the characterization and remediation from ground gas in affected developments*"
- Waste Management Paper 27
- BRE Report 212 *"Construction of new buildings on gas-contaminated land"*
- CIRIA Report 149 "*Protecting Development from methane"*

- CIRIA Report 152 "*Risk assessment for methane and other gases from the ground*"
- CIRIA Report 152 "*Methane investigation strategies*"
- Wilson & Card, Ground Engineering "*Reliability and risk in gas protection design*".

4.3.2 As indicated in these documents, the level of potential risk associated with a given ground gas regime not only depends upon ground gas composition, but also upon ground gas pressure, as this is a significant driving force for gas migration, either horizontally or vertically through the sub-surface environment. Measurement of gas pressure within or gas flow from, a monitoring standpipe provides useful data which can be used, together with ground gas compositional analysis, to provide a more robust estimation of the level of risk posed to the building development, than consideration of gas composition data alone.

4.4 Monitoring Results

4.4.1 The results of the LCCL monitoring for the period August 2012 to July 2013 (12 months) are presented in Appendix B. An assessment was made of the worst case gas concentration reading each month across the various borehole and probes.

4.4.2 The monitoring results show that across all of the boreholes & probe, monitoring recorded the very low concentrations of methane during the entire monitoring period. The range of values was 0.0-0.1 %v/v.

4.4.3 The results for carbon dioxide show low-medium maximum concentrations in the wells, ranging from 3.1-7.8%v/v. Eight of the twelve CO_2 readings were above 5% v/v. Oxygen concentrations were depleted corresponding to the elevated carbon dioxide levels.

4.4.4 No flow rates were recorded in the boreholes as part of the LCCL procedure. Due to the lack of readings, although LCCL stated that the flow is minimal, we will have to assume a flow reading of *10 l/hr*, which should be a conservative value for a landfill of this age and size. The real figure may be lower, but without actual readings the flow value is unknown and a safe (high) value will be taken.

4.5 Source of Gas

4.5.1 The presence of historic landfill close to the northern edge of the site represents a low/medium risk of elevated concentrations of ground gas at the site.

4.6 Frequency of Monitoring

4.6.1 The proposed end use for the development is classed as a *residential* development. The sensitivity of the development has been classed as *high* with the generation potential of the source as *moderate* (based on age and size of landfill).

4.6.2 The frequency of monitoring should be based on current guidance as set in the following table.

Typical minimum periods and frequency of monitoring (CIRIA 2006)

		Generation potential of source				
		Very Low	Low	Moderate	High	Very High
Sensitivity of development	Low	4/1	6/2	6/3	12/6	12/12
	Moderate	6/2	6/3	9/6	12/12	24/24
	High	6/3	9/6	12/6	24/12[2]	24/24[3]

1. First number is minimum number of readings and second number is minimum period, for example 4/1 – Four sets of readings over 1 month

2. At least two sets of readings must be at low and falling atmospheric pressure (<1000mb)

3. The acceptability of placing high sensitivity end use on a high gas hazard site is not normally acceptable unless source is removed or treated to reduce gassing potential

4.6.3 Potential temporal variable were accommodated within the monitoring regime with monitoring undertaken on *seven* occasions at barometric pressures below 1000mb when the pressure was falling.

4.7 Gas Screening Values (GSVs)

4.7.1 Gas Screening Values (GSV's), which equate to the borehole gas volume flow rate, as defined by Wilson & Card (1999) as the borehole flow rate multiplied by the concentration in the air stream of the particular gas being considered have been calculated from a risk-based methodology for deriving threshold concentrations for gas flow rates. The Gas Screening Value (GSV) of a particular ground gas being considered equates to:

- GSV (l/hr) = borehole flow rate (l/hr) x gas concentration(%v/v).

4.7.2 Maximum methane concentration on site was 0.1% v/v. The maximum carbon dioxide concentration of 7.8%v/v with a worst case flow rate of 10 l/hr (for arithmetic purposes). The GSV can thus be calculated as:

- Methane 0.001 x 10 = ***0.01 l/hr***
- Carbon Dioxide 0.078 x 10 = ***0.78 l/hr***

4.8 Traffic Light System of Gas Assessment

4.8.1 The NHBC guidance has set out a series of 'Traffic Lights' that can be applied to gas risk assessments specific to low-rise housing developments. Although this development is commercial the general criteria of the approach is similar for residential/commercial gas risk. This is a risk-based approach that is designed to allow quick and easy design of gas protection for a low-rise development by comparing the measured gas emission rates to generic Traffic Lights. The Traffic Lights include 'Typical Maximum Concentrations' are provided for initial screening purposes and risk-based Gas Screening Values (GSVs) for consideration for situations where the Typical Maximum Concentrations are exceeded. The GSV's equate to the borehole gas volume flow rate, as defined by Wilson & Card (1999) as the borehole flow rate multiplied by the concentration in the air stream of the particular gas being considered. The calculations are carried out for both methane and carbon dioxide and the worst-case adopted in order to establish the appropriate protection measures. The table below sets out the gas risk assessment criteria:

GRA_Traffic Lights with Typical Max Concentrations and GSVs

Traffic Light Classification	Methane [1]		Carbon Dioxide [2]	
	Typical Maximum Concentration [3] (%v/v)	Gas Screening Value [2,4] (l/hr)	Typical Maximum Concentration [3] (%v/v)	Gas Screening Value [2,4] (l/hr)
Green	1	0.13	5	0.78
Amber 1	5	0.63	10	1.60
Amber 2	20	1.60	30	3.10
Red				

Notes:

1. The worst-case ground gas regime identified on the site, either methane or carbon dioxide, at the worst-case temporal conditions that the site may be expected to encounter will be the decider as to what Traffic Light is allocated;

2. Borehole Gas Volume Flow Rate, in litres per hour as defined in Wilson and Card (1999), is the borehole flow rate multiplied by the concentration in the air stream of the particular gas being considered;

3. The Typical Maximum Concentrations can be exceeded in certain circumstances should the Conceptual Site Model indicate it is safe to do so;

4. The Gas Screening Value thresholds should not generally be exceeded without the completion of a detailed ground gas risk assessment taking into account site-specific conditions.

4.8.2 The GSV for the site has been calculated as 0.78 l/hr which puts the site in the Amber 2 Classification with the typical carbon dioxide concentrations, being >5.0%.

4.8.3 The results are from within the landfill site and it would be expected that these would be the maximum values and that the readings underneath the site should be lower due to distance, surface venting and material buffering. However, due to the lack of ground investigation within the site (no gas wells) and the lack of flow data from LCCL, plus the likelihood of fissures and cavities within the limestone, potentially acting as a pathway from the landfill to the house foundations, the site has been classed as a moderate risk from gas.

4.9 Gas Protection Measures

4.9.1 Based upon the Traffic Light classification the ground gas protection measures required can be defined as presented in the Table below:

Ground Gas Protection Measures

Traffic Light	Ground Gas Protection Measures Required
Green	Ground gas protection measures are not required.
Amber 1	Low-level ground gas protection measures are required, using a membrane and ventilated sub-floor void that creates a permeability contrast to limit the ingress of gas into buildings. Gas protection measures are to be installed as prescribed in BRE 414. Ventilation of the sub-floor void should be designed to provide a minimum of one complete volume change per 24 hours.
Amber 2	High-level ground gas protection measures are required, creating a permeability contrast to prevent ingress of gas into buildings. Gas protection measures are to be installed as prescribed in BRE 414. Membranes used should always be fitted by a specialist contractor and should be fully certified (see Appendix E). As with Amber 1, ventilation of the sub-floor void should be designed to provide a minimum of one complete volume change per 24 hours.
Red	Standard residential housing is not normally acceptable without further Ground Gas Risk Assessment and/or possible remedial mitigation measures to reduce/remove the source of the ground gases. In certain circumstances, active protection methods could be applied, but only when there is a legal agreement assuring the management and maintenance of the system for the life of the property.

4.9.2 On the basis of the Traffic Light Classification it is recommended that for the site development gas protection measures are required. It is recommended that medium level gas protection measures are installed, a characteristic situation 3 (Wilson et al 2006/2007) or amber 2 (NHBC, 2007). Suitable gas protection measures for this level of risk should be designed and implemented into the house foundation detailing. This would typically comprise of:

- ventilation of confined spaces within buildings
- well constructed ground slab
- low permeability (CO_2 & radon-resistant) proprietary gas resistant membrane, (eg, Visqueen CO_2 Barrier, or similar approved, which is also suitable for use as a damp proof membrane).
- ventilated underfloor void
- minimum penetration of ground slab by services
- all joints and penetration sealed

4.9.3 The gas membrane must be installed in accordance with the manufacturer's recommendations and BRE Report 414 'Construction of Buildings on Gas Contaminated Land'.

4.9.4 Membrane to be installed by specialist contractor and the membrane and ventilation to be certified as being installed correctly. This requires that the membrane is installed under a CQA regime by a specialist and is tested after installation. Either the local authority Building Control Officer or NHBC representative should oversee/verify all the gas protection measures installed.

5.0 CONCLUSIONS

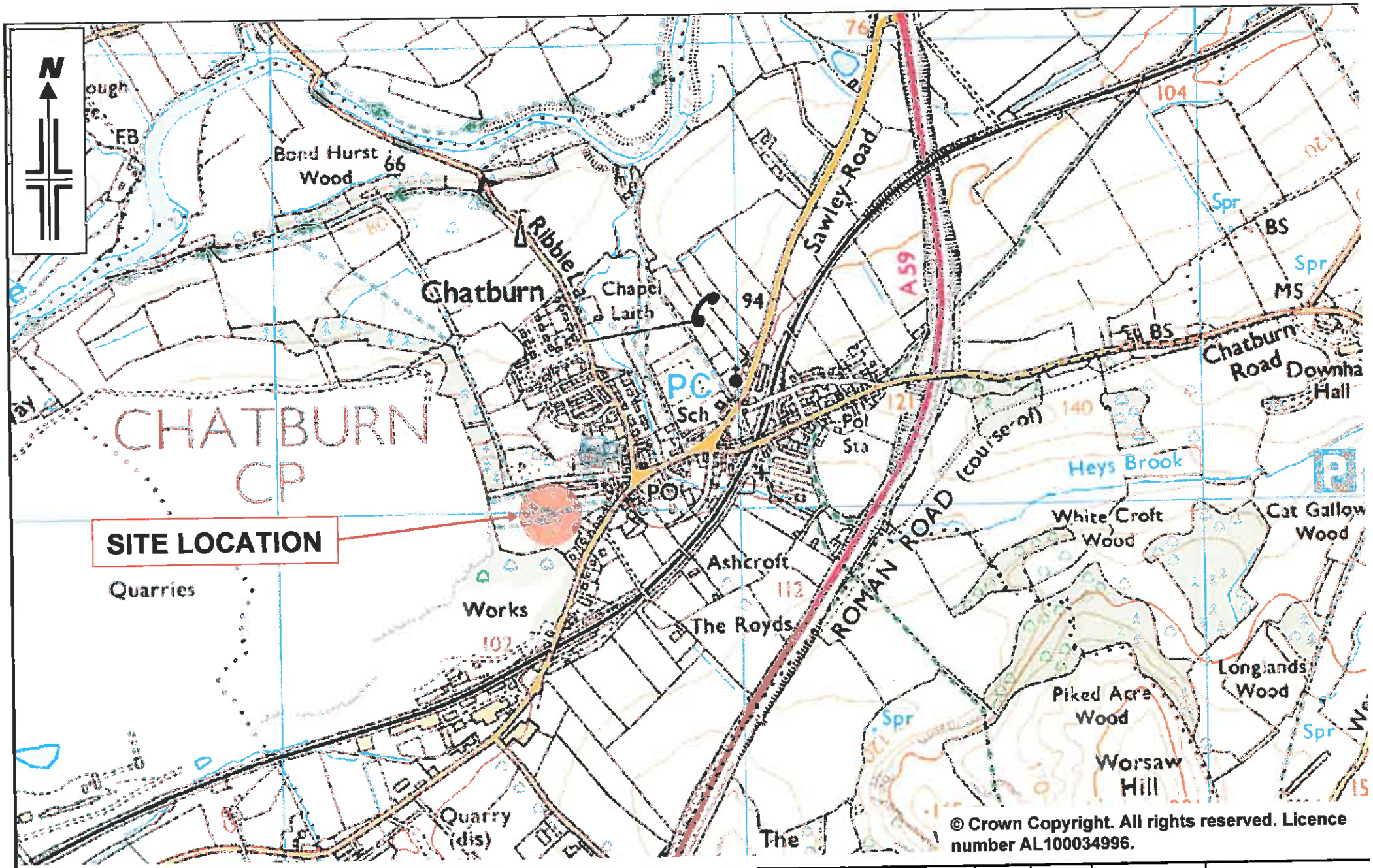
5.1 It is concluded that the risks posed by the presence of gas underlying the site is moderate. The residential development is classified as a characteristic situation 3 (Wilson et al 2006/2007) or amber 2 (NHBC, 2007).

5.2 As such, gas protection measures will be required for the scheme. Gas protection measures should be certified by a specialist gas membrane third party checker. Warranties on the materials and installation of the gas membranes in buildings at the site will be provided by the suppliers and installers of the gas membrane. As part of the validation works a third party checker for the gas installer will the local authority with the necessary certification records to show that the gas protection measures were installed correctly. This will also include photographic evidence.

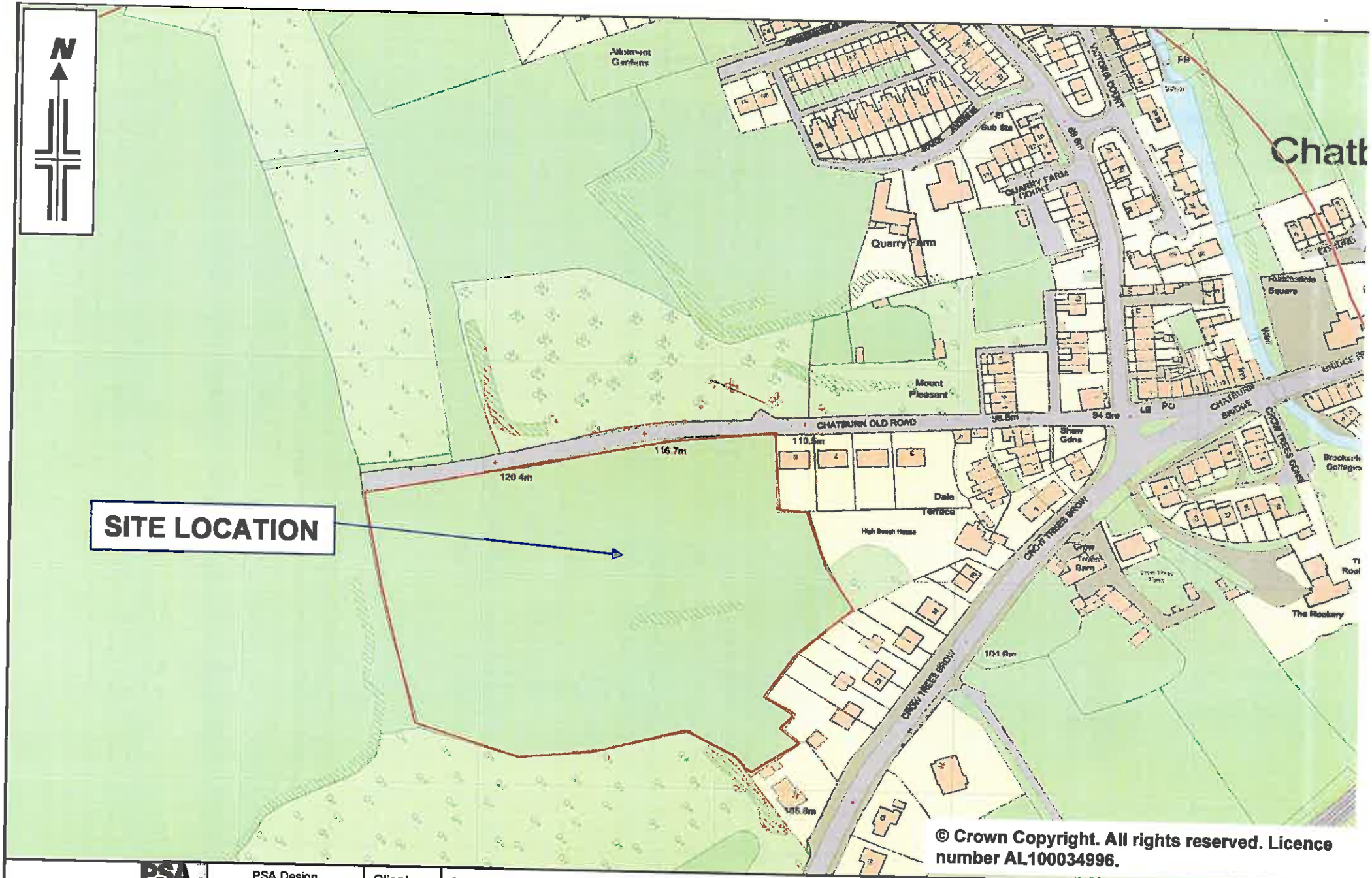
5.3 The gas risk assessment carried out is based on gas monitoring information from the actual landfill boreholes, rather than from within the site. As such, it is concluded that the gas concentrations are likely to be lower than within the actual gas source area, ie Chatburn Landfill. Due to the lack of flow data from LCCL's results, the gas risk classification has used a conservative flow rate of 10 l/hour, which leads to the recommended gas protection measures for a moderate risk site.

APPENDICES

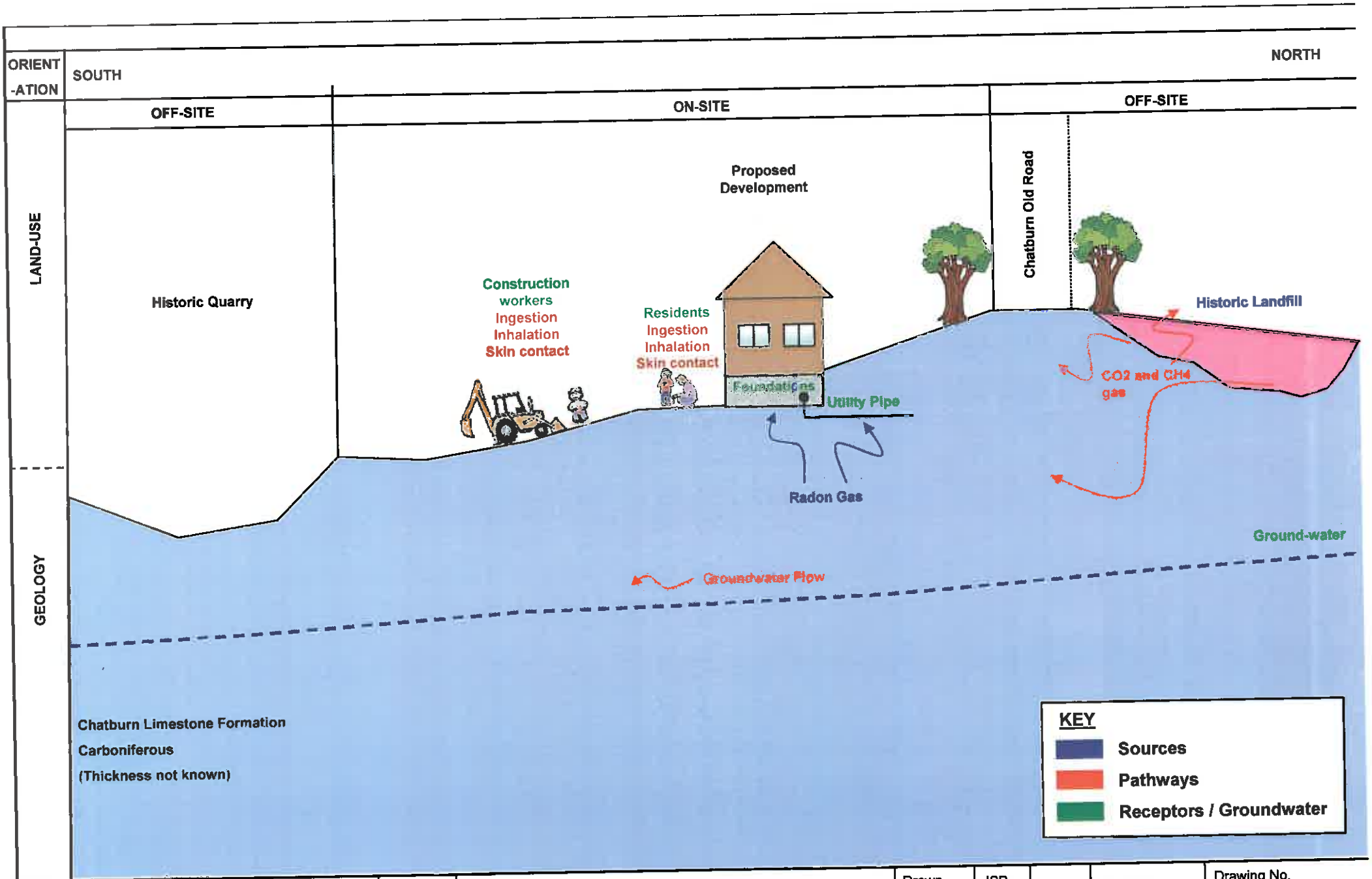
APPENDIX A DRAWINGS



PSA Design The Old Bank House 6 Berry Lane, Longridge Preston, PR3 3JA Tel. 01772 786066	Client	Mr R Jackson	Drawn	PJB	Date	02.09.10	Drawing No. D1350-01
	Job	Land off Chatburn Old Road, Chatburn, Lancashire	Checked		Scale	NTS	Rev
	Title	Regional Location Plan	Approved				

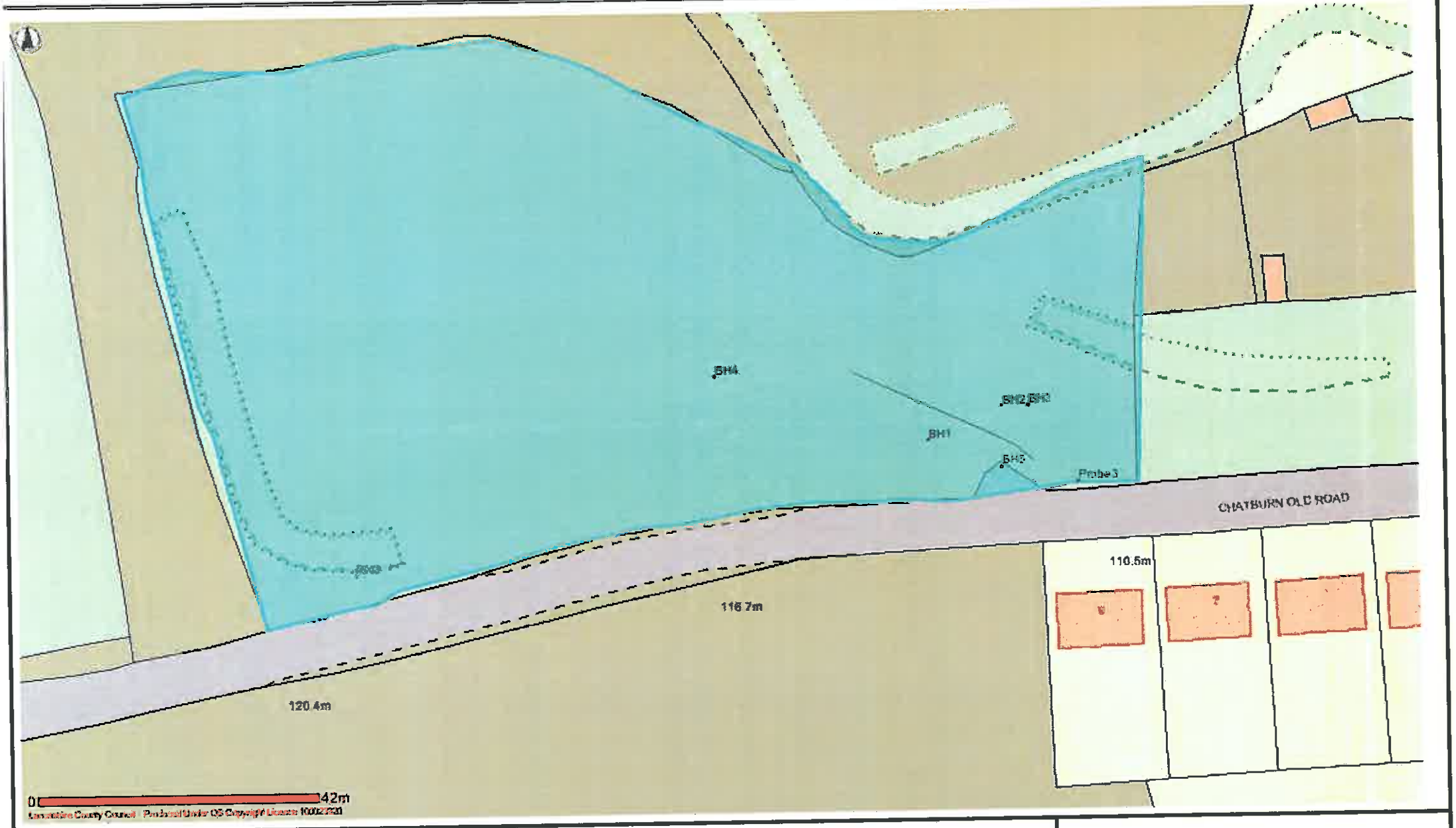


PSA DESIGN engineering your environment CIVIL STRUCTURAL GEOTECHNICAL TRANSPORT	PSA Design The Old Bank House 6 Berry Lane, Longridge Preston, PR3 3JA Tel. 01772 786066	Client	Mr R Jackson	Drawn	JB	Date	20.09.10
		Job	Land off Chatburn Old Road, Chatburn, Lancashire	Checked			Drawing No. D1350-02
		Title	Current Site Features Plan	Approved		Scale	NTS
							Rev



PSA Design The Old Bank House 6 Berry Lane, Longridge Preston, PR3 3JA Tel. 01772 786066	Client	Mr R Jackson	Drawn	JSB	Date	20.09.10	Drawing No. D1350-05
	Job	Land off Chatburn Old Road, Chatburn, Lancashire	Checked		Scale	Not to Scale	Rev
	Title	Conceptual Model	Approved				

APPENDIX B LANCASHIRE COUNTY COUNCIL GAS DATA



Chatburn

Lancashire County Council

Date: 24/01/2008

L.C.C. COUNTY LABORATORY

CHATBURN

BOREHOLE MONITORING RECORD SHEET

Date	13/08/2012
Weather	Overcast
Pressure (mb)	997
Temperature (°c)	19
Sampler	A Connolly

Gas Instrument and number
GA2000CM7.68

Location (BHs)	Methane (%)	Oxygen (%)	Carbon Dioxide (%)
BH 1	0.10	19.20	2.50
BH 2 piezo 1 15m	0.10	19.70	1.40
BH 2 piezo 2 10m	0.10	17.50	2.30
BH 2 piezo 3 5m	IPP0.10	20.70	0.10
BH 3	0.10	18.40	3.10
BH 4 piezo 1 15m	0.10	20.20	0.90
BH 4 piezo 2 10m	0.10	20.20	0.80
BH 4 piezo 3 5m	0.10	20.20	0.90
BH 5 piezo 1 15m	0.10	16.70	5.90
BH 5 piezo 2 10m	0.10	16.70	5.90
BH 5 piezo 3 5m	0.10	16.70	5.90
BH 6 piezo 1 6m	0.10	11.90	7.00
BH 6 piezo 2 3m	0.10	14.80	5.70
Shallow probe 3	0.10	20.60	0.10
Shallow probe 4	Removed		

Comments

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CHATBURN

BOREHOLE MONITORING RECORD SHEET

Date	05/09/2012
Weather	Bright
Pressure (mb)	990
Temperature (°c)	17
Sampler	A Connolly

Gas Instrument and number
GA2000CM7.68

Location (BHs)	Methane (%)	Oxygen (%)	Carbon Dioxide (%)
BH 1	0.00	18.30	2.40
BH 2 piezo 1 15m	0.00	20.10	1.10
BH 2 piezo 2 10m	0.00	16.50	2.10
BH 2 piezo 3 5m	IPP0.00	20.80	0.00
BH 3	0.00	18.40	3.20
BH 4 piezo 1 15m	0.00	20.10	0.80
BH 4 piezo 2 10m	0.00	20.10	0.80
BH 4 piezo 3 5m	0.00	20.10	0.80
BH 5 piezo 1 15m	0.00	17.10	6.10
BH 5 piezo 2 10m	0.10	17.20	6.10
BH 5 piezo 3 5m	0.10	16.50	5.80
BH 6 piezo 1 6m	0.10	12.50	7.80
BH 6 piezo 2 3m	0.10	15.20	5.50
Shallow probe 3	0.00	20.80	0.00
Shallow probe 4	Removed		

Comments

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CHATBURN

BOREHOLE MONITORING RECORD SHEET

Date	03/10/2012
Weather	Bright
Pressure (mb)	1001
Temperature (°c)	10
Sampler	A Connolly

Gas Instrument and number
GA2000CM7.68

Location (BHs)	Methane (%)	Oxygen (%)	Carbon Dioxide (%)
BH 1	0.00	19.40	2.00
BH 2 piezo 1 15m	0.00	20.40	0.10
BH 2 piezo 2 10m	0.00	15.20	1.50
BH 2 piezo 3 5m	IPP0.00	21.10	0.00
BH 3	0.00	19.80	1.40
BH 4 piezo 1 15m	0.00	20.30	0.50
BH 4 piezo 2 10m	0.00	20.10	0.40
BH 4 piezo 3 5m	0.00	20.30	0.50
BH 5 piezo 1 15m	0.00	16.50	6.30
BH 5 piezo 2 10m	0.00	16.20	6.30
BH 5 piezo 3 5m	0.00	16.00	1.10
BH 6 piezo 1 6m	0.00	12.60	5.10
BH 6 piezo 2 3m	0.00	16.80	4.10
Shallow probe 3	0.00	20.50	0.10
Shallow probe 4	Removed		

Comments

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CHATBURN

BOREHOLE MONITORING RECORD SHEET

Date	05/11/2012
Weather	Sunny
Pressure (mb)	1007
Temperature (°c)	2
Sampler	A Connolly

Gas Instrument and number
GA2000CM7.68

Location (BHs)	Methane (%)	Oxygen (%)	Carbon Dioxide (%)
BH 1	0.00	18.60	2.10
BH 2 piezo 1 15m	0.00	20.00	0.80
BH 2 piezo 2 10m	0.00	17.90	2.50
BH 2 piezo 3 5m	IPP0.00	20.80	0.10
BH 3	0.00	18.10	2.90
BH 4 piezo 1 15m	0.00	18.30	3.50
BH 4 piezo 2 10m	0.00	19.00	3.10
BH 4 piezo 3 5m	0.00	18.20	3.50
BH 5 piezo 1 15m	0.00	18.30	3.50
BH 5 piezo 2 10m	0.00	18.30	3.50
BH 5 piezo 3 5m	0.00	18.30	3.50
BH 6 piezo 1 6m	0.00	16.30	5.90
BH 6 piezo 2 3m	0.00	18.10	3.60
Shallow probe 3	0.00	20.60	0.10
Shallow probe 4	Removed		

Comments

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CHATBURN

BOREHOLE MONITORING RECORD SHEET

Date	03/12/2012
Weather	Windy, showers
Pressure (mb)	992
Temperature (˚c)	5
Sampler	A Connolly

Gas Instrument and number
GA2000CM7.68

Location (BHs)	Methane (%)	Oxygen (%)	Carbon Dioxide (%)
BH 1	0.10	19.20	1.50
BH 2 piezo 1 15m	0.10	20.20	0.70
BH 2 piezo 2 10m	0.10	17.90	2.30
BH 2 piezo 3 5m	IPP0.10	20.90	0.10
BH 3	0.10	18.50	2.10
BH 4 piezo 1 15m	0.10	18.40	3.20
BH 4 piezo 2 10m	0.10	18.50	3.20
BH 4 piezo 3 5m	0.10	18.40	3.20
BH 5 piezo 1 15m	0.00	18.50	3.10
BH 5 piezo 2 10m	0.00	18.50	3.20
BH 5 piezo 3 5m	0.00	18.50	3.20
BH 6 piezo 1 6m	0.10	16.00	6.80
BH 6 piezo 2 3m	0.10	18.50	3.20
Shallow probe 3	0.10	21.00	0.00
Shallow probe 4	Removed		

Comments

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CHATBURN

BOREHOLE MONITORING RECORD SHEET

Date	09/01/2013
Weather	Fog
Pressure (mb)	1002
Temperature (°c)	2
Sampler	A Connolly

Gas Instrument and number
GA2000CM7.68

Location (BHs)	Methane (%)	Oxygen (%)	Carbon Dioxide (%)
BH 1	0.10	19.20	1.10
BH 2 piezo 1 15m	0.10	19.80	0.50
BH 2 piezo 2 10m	0.10	18.20	2.40
BH 2 piezo 3 5m	IPP0.10	21.00	0.10
BH 3	0.00	18.70	2.40
BH 4 piezo 1 15m	0.10	18.20	3.40
BH 4 piezo 2 10m	0.10	18.10	3.40
BH 4 piezo 3 5m	0.10	18.10	3.30
BH 5 piezo 1 15m	0.00	18.70	3.00
BH 5 piezo 2 10m	0.00	18.60	3.20
BH 5 piezo 3 5m	0.00	18.60	3.20
BH 6 piezo 1 6m	0.10	13.40	7.10
BH 6 piezo 2 3m	0.10	18.70	3.00
Shallow probe 3	0.00	21.00	0.00
Shallow probe 4	Removed		

Comments

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CHATBURN

BOREHOLE MONITORING RECORD SHEET

Date	20/02/2013
Weather	Overcast
Pressure (mb)	1001
Temperature (˚c)	3
Sampler	A Connolly

Gas Instrument and number
GA2000CM7.68

Location (BHs)	Methane (%)	Oxygen (%)	Carbon Dioxide (%)
BH 1	0.00	19.00	0.60
BH 2 piezo 1 15m	0.10	20.10	0.40
BH 2 piezo 2 10m	0.10	18.40	2.00
BH 2 piezo 3 5m	IPP0.00	21.00	0.00
BH 3	0.10	18.50	2.10
BH 4 piezo 1 15m	0.10	18.50	3.20
BH 4 piezo 2 10m	0.10	18.50	3.20
BH 4 piezo 3 5m	0.10	18.30	3.00
BH 5 piezo 1 15m	0.00	18.60	3.10
BH 5 piezo 2 10m	0.00	18.60	3.10
BH 5 piezo 3 5m	0.00	18.70	3.10
BH 6 piezo 1 6m	0.00	16.50	6.30
BH 6 piezo 2 3m	0.00	19.40	2.10
Shallow probe 3	0.10	21.00	0.10
Shallow probe 4	Removed		

Comments

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CHATBURN

BOREHOLE MONITORING RECORD SHEET

Date	07/03/2013
Weather	Light rain
Pressure (mb)	985
Temperature (°c)	6
Sampler	A Connolly

Gas Instrument and number
GA2000CM7.68

Location (BHs)	Methane (%)	Oxygen (%)	Carbon Dioxide (%)
BH 1	0.10	19.20	0.90
BH 2 piezo 1 15m	0.10	19.50	1.00
BH 2 piezo 2 10m	0.10	18.60	2.40
BH 2 piezo 3 5m	0.10	20.90	0.10
BH 3	0.10	18.60	2.40
BH 4 piezo 1 15m	0.10	18.30	3.00
BH 4 piezo 2 10m	0.10	18.50	2.80
BH 4 piezo 3 5m	0.10	18.50	2.80
BH 5 piezo 1 15m	0.10	17.90	3.40
BH 5 piezo 2 10m	0.10	17.90	3.40
BH 5 piezo 3 5m	0.10	18.00	3.40
BH 6 piezo 1 6m	0.10	16.50	6.30
BH 6 piezo 2 3m	0.10	18.30	2.00
Shallow probe 3	0.10	20.80	0.10
Shallow probe 4	Removed		

Comments

L.C.C. COUNTY LABORATORY

CHATBURN

BOREHOLE MONITORING RECORD SHEET

Date	10/04/2013
Weather	Bright
Pressure (mb)	994
Temperature (°c)	2
Sampler	A Connolly

Gas Instrument and number
GA2000CM7.68

Location (BHs)	Methane (%)	Oxygen (%)	Carbon Dioxide (%)
BH 1	0.00	19.90	1.60
BH 2 piezo 1 15m	0.00	19.70	0.70
BH 2 piezo 2 10m	0.00	19.70	1.50
BH 2 piezo 3 5m	IPP0.00	20.00	0.10
BH 3	0.00	19.30	2.20
BH 4 piezo 1 15m	0.00	19.70	1.90
BH 4 piezo 2 10m	0.00	19.60	1.40
BH 4 piezo 3 5m	0.00	19.40	1.90
BH 5 piezo 1 15m	0.00	20.00	0.90
BH 5 piezo 2 10m	0.00	19.90	0.90
BH 5 piezo 3 5m	0.00	19.90	0.90
BH 6 piezo 1 6m	0.00	18.70	3.80
BH 6 piezo 2 3m	0.00	18.90	2.70
Shallow probe 3	0.00	20.10	0.20
Shallow probe 4	Removed		

Comments

L.C.C. COUNTY LABORATORY

CHATBURN

BOREHOLE MONITORING RECORD SHEET

Date	14/05/2013
Weather	Bright
Pressure (mb)	993
Temperature (°c)	10
Sampler	A Connolly

Gas Instrument and number
GA2000CM7.68

Location (BHs)	Methane (%)	Oxygen (%)	Carbon Dioxide (%)
BH 1	0.00	20.20	1.10
BH 2 piezo 1 15m	0.00	19.50	0.70
BH 2 piezo 2 10m	0.10	20.20	1.20
BH 2 piezo 3 5m	!PP0.00	20.20	0.10
BH 3	0.00	19.30	2.10
BH 4 piezo 1 15m	0.10	20.10	1.80
BH 4 piezo 2 10m	0.10	20.00	1.80
BH 4 piezo 3 5m	0.10	20.00	1.80
BH 5 piezo 1 15m	0.00	20.00	1.00
BH 5 piezo 2 10m	0.00	19.80	1.00
BH 5 piezo 3 5m	0.00	19.80	1.00
BH 6 piezo 1 6m	0.00	17.50	3.20
BH 6 piezo 2 3m	0.00	19.40	1.80
Shallow probe 3	0.00	20.80	0.10
Shallow probe 4	Removed		

Comments

L.C.C. COUNTY LABORATORY

CHATBURN

BOREHOLE MONITORING RECORD SHEET

Date	20/06/2013
Weather	Showers
Pressure (mb)	1002
Temperature (°c)	17
Sampler	A Connolly

Gas Instrument and number
GA2000CM7.68

Location (BHs)	Methane (%)	Oxygen (%)	Carbon Dioxide (%)
BH 1	0.00	20.30	1.10
BH 2 piezo 1 15m	0.00	20.30	0.40
BH 2 piezo 2 10m	0.00	20.30	1.50
BH 2 piezo 3 5m	IPP0.00	20.80	0.10
BH 3	0.00	19.50	2.00
BH 4 piezo 1 15m	0.00	19.70	1.30
BH 4 piezo 2 10m	0.00	19.70	1.30
BH 4 piezo 3 5m	0.00	19.70	1.30
BH 5 piezo 1 15m	0.00	19.50	1.20
BH 5 piezo 2 10m	0.00	19.40	1.10
BH 5 piezo 3 5m	0.00	19.40	1.10
BH 6 piezo 1 6m	0.00	18.60	3.10
BH 6 piezo 2 3m	0.00	19.10	1.50
Shallow probe 3	0.00	20.70	0.10
Shallow probe 4	Removed		

Comments

L.C.C. COUNTY LABORATORY

CHATBURN

BOREHOLE MONITORING RECORD SHEET

Date	02/07/2013
Weather	Overcast
Pressure (mb)	995
Temperature (°c)	18
Sampler	A Connolly

Gas Instrument and number
GA2000CM7.68

Location (BHs)	Methane (%)	Oxygen (%)	Carbon Dioxide (%)
BH 1	0.00	19.60	0.70
BH 2 piezo 1 15m	0.00	19.80	1.10
BH 2 piezo 2 10m	0.00	19.50	1.60
BH 2 piezo 3 5m	IPP0.00	20.50	0.10
BH 3	0.00	19.30	2.10
BH 4 piezo 1 15m	0.00	20.10	1.20
BH 4 piezo 2 10m	0.00	19.80	1.20
BH 4 piezo 3 5m	0.00	19.70	1.20
BH 5 piezo 1 15m	0.00	19.20	1.40
BH 5 piezo 2 10m	0.00	19.20	1.40
BH 5 piezo 3 5m	0.00	19.20	1.40
BH 6 piezo 1 6m	0.00	17.50	4.00
BH 6 piezo 2 3m	0.00	19.40	1.30
Shallow probe 3	0.00	20.50	0.10
Shallow probe 4	Removed		

Comments