



constructiveevaluation

site investigation • building pathology

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PHASE 2: SITE INVESTIGATION REPORT Revision 1

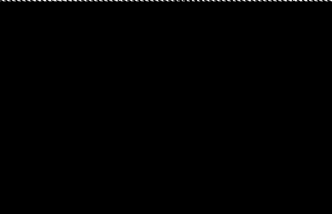
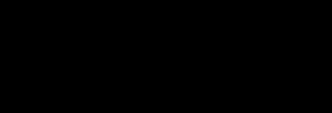
Sack Lane Dairy

FOR

RJCA Chartered Architects

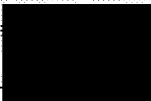
CONSTRUCTIVE EVALUATION
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Professional Interpretation

The recommendations made and opinions expressed in the report are based on the conditions revealed by the site works together with an assessment of the data from the in situ and laboratory testing or in respect of the desktop reports. No responsibility can be accepted for conditions that have not been revealed by the research, site works and testing.

The Client is advised that the conditions observed on site by Constructive Evaluation Limited at the time of any site survey may be subject to change. Certain indicators of the presence of hazardous substances may have been latent at the time of the most recent site reconnaissance and they may subsequently have become evident. It is not possible to assess areas which are inaccessible or where access is not granted and CE accept no liability for risks subsequently identified therein.

The conceptual model, Risk assessment and sampling regime has been formulated in accordance with current UK guidance at time of production based upon the relevant information gained from Phase 1 and Phase 2 investigations. While the model and assessment offer opinions and interpretations of these guidelines, the comments made are for guidance only and no liability can be accepted for their accuracy. It is possible that aspects of desktop study may need to be altered to conform to the requirements of the statutory regulatory bodies.

Intrusive Field Operations

The data collected through direct operations in the production of this report has been so obtained, unless directly otherwise stated, in accordance with current UK guidance, law or accepted industry practice, including but not limited to: BS 5930: 1990 Code of Practice for Site Investigations (Amendment 2: 2010), BS 10175:2011+A1:2013 Investigations into Potentially Contaminated Sites, and BS 8576:2013 Guidance on Investigations for Ground Gas - Permanent Gases and Volatile Organic Compounds. Exact exploratory locations will depend upon access conditions, site use and plant capability. CE do not accept liability for issues arising from material identified between or outside of the area of exploratory locations.

Laboratory Testing

Unless stated otherwise within the text, all geotechnical and material laboratory tests have been performed in accordance with the relevant British Standard Documents. Laboratory testing for contaminated land assessment is completed under the UKAS / MCERTS accreditation schemes, unless identified as otherwise in this report.

Human Health Risk Assessment Criteria

The Environment Agency has recently undertaken revision of the Soil Guideline Values (SGVs) which are partially complete. Where standards are available using the "new" approach, these have been utilised for correlative purposes. Where standards have not yet been revised, guidance following the "old" approach has been utilised. Please note that upon release of the remaining guidelines, the standards contained within this report may be subject to change. In addition, the second edition of the LQM CEH guidance has now been released and will be utilised in favour of previously published guideline values.

Third Parties

The findings and opinions conveyed in this report are based on information obtained from a variety of sources, including that from previous Site investigations and chemical testing laboratories. Constructive Evaluation Limited has assumed that such information is correct. Constructive Evaluation Limited cannot and does not guarantee the authenticity or reliability of the information it has relied upon and can accept no responsibility for inaccuracies with the data supplied by other parties.

The accuracy of the historical map extracts supplied can not be guaranteed and it should be noted that different conditions may have existed between mapping sheet editions. Therefore, there can be no certainty that all areas of contamination have been identified during the Phase 1 investigation.

Definitions

Reference to the word "contamination" in this report does not relate to the statutory definition of contaminated land under 1990 Environmental Protection Act unless otherwise stated. The definition used in this report is: "Land that contains substances that, when present in sufficient quantities or concentrations, are likely to cause harm, directly or indirectly, to man, to the environment, or on occasion to other targets" (NATO CCMS, 1985).

CE Ltd 2014

1.0 INTRODUCTION

Constructive Evaluation (CE) Limited were instructed by RJCA Chartered Architects (the Architect) on behalf of Melanie Jenkins Farming Ltd (the Client) to carry out a 'Phase 2: Site Investigation' (EQ12518, dated: March 2018; EQ12601, dated: April 2018) at the Dairy Buildings, Sack Lane, Aldingbourne, West Sussex, PO22 9PE (hereafter referred to as the "site").

The site has recently been entirely cleared, leaving only unmade ground and areas of demolition material.

Proposals include the construction of 3no. live/work units with associated gardens and parking within the northern half of site. The southern half of site is to be turned into new pasture land.

Intrusive works were conducted on 5th and 23rd April 2018 and comprised the following:

- Four windowless sample boreholes advanced with a tracked dynamic sampling rig, completed to a maximum depth of 4.00mbgl (metres below ground level);
- Installation of monitoring standpipes within two of the boreholes to allow for continued groundwater and ground gas monitoring;
- Five machine excavated trial pits, completed using a JCB 3CX;
- Three rounds of subsequent groundwater and ground gas monitoring.

CE have previously completed a Phase 1: Environmental Risk Assessment (Ref: 17.9382, Dated: January 2017), which should be read in conjunction with this report.

The purposes of this investigation are two-fold, 1) to provide necessary design parameters for the underlying ground conditions to allow temporary and permanent geotechnical design, and 2) refine the potential pollutant linkages as identified within the Phase 1 Report.

2.0 SITE DESCRIPTION

Site Address	the Dairy Buildings, Sack Lane, Aldingbourne, West Sussex, PO22 9PE
Grid Reference	494550, 102370
Site Area	0.30 hectares

The site has recently been entirely cleared, leaving only unmade ground and areas of demolition material. It is assumed that the demolition occurred after the Phase 1 walkover of the 11th of January 2017. Reference should be made to the site description within the aforementioned Phase 1 Report for a detailed description of the former use; in summary, the site was previously used for agricultural purposes and included a barn composed of a concrete frame with cement profile sheet cladding (presumably ACM). In addition, a mound/stockpile of crushed concrete was identified (potential source of ACMs) at the south of the barn.

2.1 Surroundings

The site is set within a predominantly agricultural area. Approximately 300m west of the site are industrial sized greenhouses and approximately 250m east of the site is the Bognor Regis Branch Railway Line orientated north east to south west.

3.0 PHYSICAL SETTING

3.1 Published Geology

The Geology of Britain Viewer (BGS, 2018) indicates the site is underlain by Superficial Deposits of River Terrace Deposits (undifferentiated) over Bedrock Geology of the White Chalk Subgroup (Upper Chalk).

River Terrace Deposits (Undifferentiated) – Sand and gravel, locally with lenses of silt, clay or peat.

White Chalk Subgroup (Upper Chalk) – Chalk with flints, with discrete marl seams, nodular chalk, sponge-rich and flint seams throughout.

3.2 Historical Boreholes

Following review of a historical borehole (Ref: SU90SW53, approximately 250m north of the site), the underlying chalk is expected at a depth of approximately 6.00m below ground level (mbgl). Groundwater was not encountered during the sinking of this borehole.

3.3 Hydrogeology and Hydrology

Aquifer within Superficial Deposits – Secondary A – Permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers.

Aquifer within Bedrock Geology – Principal – Layers of rock or drift deposits that have high intergranular and/or fracture permeability - meaning they usually provide a high level of water storage. They may support water supply and/or river base flow on a strategic scale.

Groundwater Abstraction Licences – There are five records within 2000m of the site, the closest of these is located approximately 1650m west detailed as an abstraction for direct spray irrigation; as no permit end date has been provided it is assumed that this licence is still active.

Surface Water Abstraction Licences – There are twenty one records within 2000m of the site. The closest of these are three records associated with Ashmarden Ltd, all detailed as licences for direct spray irrigation from a surface water source located approximately 500m north east; it is assumed that as no permit end date has been provided that these licence are all still active. The next closest records are two licences both associated with Hochtief UK Construction Ltd for dust suppression, both assumed to be still active and located approximately 500m south east along Lidsey Rife. The remaining records are over 850m from site.

Potable Water Abstraction Licences – There are no records within 2000m of the site.

Source Protection Zones (SPZs) – There are no SPZs within 2000m of the site.

Groundwater Vulnerability and Soil Leaching Potential – On site is classified as having soils of intermediate leaching potential – soils which can possibly transmit a wide range of pollutants.

Surface Water Features – The nearest surface water feature is located approximately 140m north east considered to be a drainage channel associated with the surrounding agricultural area. Three similar drainage channels are located within approximately 400m of the site.

BGS Groundwater Flooding Susceptibility – The site is classified as having soils with limited potential for groundwater flooding to occur. However, soils with potential for groundwater flooding of property situated below ground level have been identified approximately 60m north east of site.

Extreme Flooding from Rivers of Sea without Defences – An area approximately 70m north of the site has been identified, likely associated with the surrounding drainage channels that flow into Lidsey Rife.

4.0 PREVIOUS REPORTS

4.1 Phase 1: Environmental Risk Assessment – Constructive Evaluation Ltd

A Phase 1: Environmental Risk Assessment Report was completed by CE in January 2017 (Ref: 17.9382). The purpose of the Environmental Risk Assessment was to provide information on the following: the expected geology and hydrogeology; the development history and most recent uses of the site; potential sources of contamination; and, to enable the development of a preliminary Conceptual Site Model (CSM) and risk assessment.

Potential receptors identified within the Phase 1 Report include end users (residents, site workers and visitors), site workers (during development, in particular groundworkers), proposed development, services and groundwater (underlying aquifers).

The final development includes private gardens, thus creating potential pollutant linkages to residential end users. This is particularly pertinent in regards to direct ingestion, inhalation and dermal contact from exposure to contaminated soils. In addition, impacted soils present a pollutant linkage to proposed development and groundwater, through ground gas / soil vapour and migration of contaminants, respectively.

Following a site walkover, review of historical maps, and information on public record, potential sources of contamination have been identified:

1. Infrastructure and processes associated with the agricultural setting/buildings, including the use of pesticides and fertilisers, any maintenance of farm equipment and/or vehicles and possibility of Made Ground and biological contaminants (*Bacillus anthracis*) related to the on-site slurry tank. Potential contaminants include, but are not restricted to, heavy metals, petroleum hydrocarbons, solvents, biological contaminants, ground gas and asbestos.
2. Possibility of asbestos within potential ACM and concrete stockpile on site. Potential contaminants include asbestos.
 - Since the coalition of the Preliminary CSM, this source (i.e. stockpile) has been subsequently removed from site. Although, the demolition material and areas of unmade ground identified are acknowledged, and may represent a portion of the original stockpile/mound.
3. Unknown pollutants (other matter) related to the discharge licence located approximately 30m north west; assumed to be associated with the site.

A summary of the Preliminary Conceptual Site Model (CSM) and risks perceived to above Low are shown in the tables overleaf. An explanation of categories is provided below the CSM table within Section 10.2.

Source	Pathway	Receptor	Potential Risk
1.	Inhalation, ingestion and dermal contact from exposure to contaminated soils.	End users.	Moderate
		Site workers (during development).	Moderate
	Impacted soils.	Future Services.	Low to Moderate
	Volatilisation of hydrocarbons in underlying soils and groundwater to indoor and/or outdoor air.	End users and proposed development.	Moderate
	Migration of ground gas through the soil pores of the underlying geology.	End users and proposed development.	Moderate
	Infiltration and migration of contaminants through the underlying geology.	Bedrock Principal Aquifer and Superficial Secondary (A) Aquifer underlying the site.	Moderate

Source	Pathway	Receptor	Potential Risk
2.	Inhalation, ingestion and dermal contact from exposure to contaminated soils.	End users.	Moderate
		Site workers (during development).	Moderate to High

Source	Pathway	Receptor	Potential Risk
3.	Inhalation, ingestion and dermal contact from exposure to contaminated soils.	End users.	Moderate
	Impacted soils.	Future Services.	Low to Moderate
	Volatilisation of hydrocarbons in underlying soils and groundwater to indoor and/or outdoor air.	End users and proposed development.	Moderate
	Migration of ground gas through the soil pores of the underlying geology.	End users and proposed development.	Moderate

4.1 Recommendations following Preliminary CSM

Based on the findings of the Phase 1 Report, it was deemed that a Site Investigation would be required in order to assess/refine the potential pollutant linkages identified within the preliminary CSM. It was detailed that the aims of the Site Investigation were to assess the risks to end users within proposed private gardens; allow the vertical delineation of potentially impacted soils; and to assess risk to the underlying aquifers.

Further details of recommendations can be viewed within the previously issued report. Actual fieldworks conducted, are detailed in Section 5.0 of this report.

5.0 FIELDWORKS

5.1 Site Management and Preparation

Suitably experienced CE staff supervised the investigation which was undertaken during a two day operation on 5th April and 23rd April 2018. The works were carried out in accordance with statutory guidance including BS5930:1999 *Code of Practice for Site Investigations (Amendment 3: 2015)* and BS 10175:2011+A1:2013 *Investigation of Potentially Contaminated Sites: Code of Practice*.

Prior to any excavations taking place a Cable Avoidance Tool (CAT) was used to check for the position of any underlying electrical services. In addition, starter pits were excavated to 1.00 metres below ground level (mbgl) to clear test locations prior to any intrusive work, where possible.

A plan indicating intrusive locations can be viewed in **Appendix A**. Photographs of the Site Investigation are within **Appendix B**.

5.2 Windowless Sample Boreholes

- Four windowless sample boreholes (WS01-WS04) were completed through the base of their respective starter trial pits, to a maximum depth of 4.00mbgl, using a tracked dynamic sampling rig. The boreholes were located to target the footprint of the proposed building.
- On completion, two of the boreholes (WS01 and WS04) were installed as dual purpose gas and groundwater monitoring wells, constructed with 50mm internal diameter HDPE plain and slotted pipe. The response zone of the wells were designed to target groundwater as well as to acquire gassing levels from the underlying natural soils.
- A filter pack of washed gravel was placed in the well annulus to just above the screen sections, and the annulus sealed to the surface with bentonite. The monitoring wells were finished with raised steel covers or raised pipe.

5.3 Trial Pits

- Five machine excavated trial pits (TP1-TP5) were advanced with a JCB 3CX excavator to a maximum depth of 3.00mbgl (in the case of TP4). The trial pits were positioned to provide site coverage for geo-environmental assessment, as well within areas likely to accommodate future proposed soakaways.
- Infiltration testing was completed within all trial pits, in general accordance to BRE365 or BS6297.
- All trial pits were backfilled with arisings on completion.

5.4 Soil Sample Collection

- All intrusive locations were logged, visual and/or olfactory evidence of contamination noted, and representative soil samples removed on accordance with current protocol for geotechnical and geo-environmental parameters.

- Selected samples were placed in sealed glass jars or plastic tubs (dependent on the exact laboratory requirements and analysis to be undertaken) and stored in a temperature controlled environment before transit. Samples were handled using a fresh pair of nitrile gloves.

6.0 GROUND CONDITIONS

6.1 Soil

The following strata conditions were encountered during the intrusive works.

Made Ground – For the most part, the surface cover was found to be unmade and/or comprised of probable demolition material. Made Ground was only identified within six of the nine intrusive locations (TP1, TP2, TP3, WS01, WS02 and WS03) from ground level to a maximum depth of 0.40mbgl. This emplaced material was described as brown clayey sandy Gravel and or dark brown silty gravelly Clay, with the gravel portion identified as concrete, brick and flint. Occasional cobbles of flint and brick were identified.

Silty/sandy Clay/Silt – Natural superficial soils, considered to be representative of River Terrace Deposits, were initially described as a soft to firm consistency brown silty, locally sandy, Clay, often with rare to occasional angular gravels of flint. This was encountered to variable depths across site, from ground level in WS04 and underlying Made Ground soils elsewhere, extending to a maximum of a maximum depth of 2.50mbgl in WS01.

Sandy/Gravelly Clay – The remaining superficial soils, likely further River Terrace Deposits, were described as soft to firm consistency light greyish white/brown silty sandy very gravelly Clays, where the gravel is fine flint and chalk. At the base of WS01 and WS02, from 3.60-4.00mbgl, soils became more of an orange/cream colour.

Chalk – Chalk of the White Chalk Subgroup was identified exclusive to WS03 and WS04 from a shallowest depth of 1.40mbgl to a maximum of 4.00mbgl is each position. This material was recovered as a structureless chalk composed of white sandy very gravelly Silt, where the gravel portion is medium weak, high density white and cream (Grade Dm, CIRIA).

Please refer to the stratigraphic logs contained within Appendix C for a more detailed description.

6.2 Groundwater

Groundwater level data is presented in the table below. No groundwater was encountered within WS03 or the trial pits.

HOLE ID	GW Level (mbgl)					Gauge Round Notes
	During Drilling	Following Observation Period	During Monitoring			
	05/04/2018	05/04/2018	11/04/2018	19/04/2018	23/04/2018	
WS01	2.70	1.98	1.52	1.82	1.90	Turbid, creamy
WS02	2.00	1.60	N/A	N/A	N/A	N/A
WS04	1.25	1.15	1.10	1.60	1.65	Turbid, creamy

6.3 Field Evidence of Contamination

Other than the anthropogenic materials (i.e. brick and concrete) noted within the Made Ground soils, no other visual and/or olfactory evidence of contamination was recorded during the investigation works.

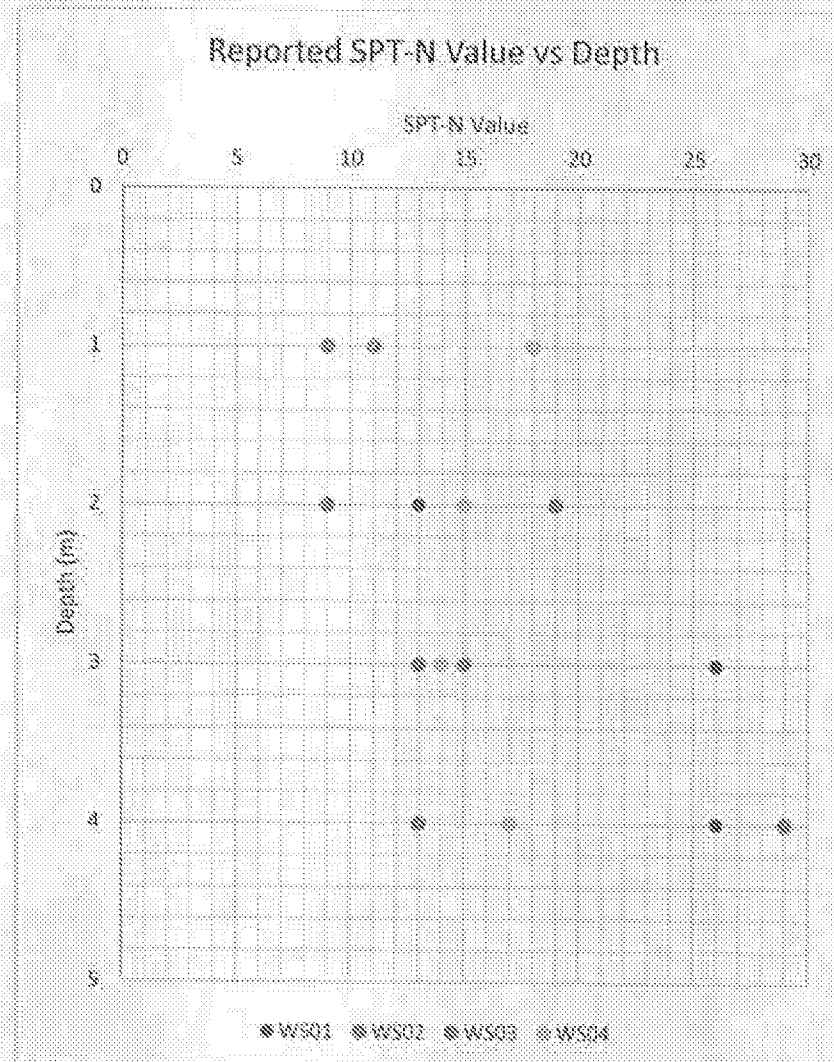
6.4 In-situ Testing

6.4.1 Standard Penetration Testing (SPT's)

Standard Penetration testing was completed throughout the drilling of WS01-WS04 at 1.00m centres. This form of testing is completed using a 63.5kg drop hammer weight, over a 750mm drop, measuring the blow counts for six, 75mm increments. The first two values are recorded as seating blows, with the remaining four values, added together to provide an 'N-value'.

N-values are split with WS01 and WS02 increasing with depth, and WS03 and WS04 decreasing after 1.00mbgl. Generally values of N=9-18 were recorded at 1.00mbgl, maintaining N=9-19 at 2.00mbgl. Reductions in values in WS03 and WS04 may reflect the change in geology to the structureless Chalk (grade Dm) recorded in these locations.

Results are presented in the graph below.



6.5 Soakaway Testing

6.5.1 BRE 365 Soil Infiltration Testing

Soil infiltration testing was completed in three machine excavated trial pits (TP1, TP2 and TP4) in accordance with BRE 365 methods. This test involves squaring of the pit walls, followed by the rapid filling of potable water and subsequent monitoring of the rate of decline in the head of water. The soil infiltration rate is calculated by the rate of outflow from 75% to 25% effective fill depth. The table below summarises the results:

Trial Hole ID	Test	Pit Depth (m)	Time at 75% (mins)	Time at 25% (mins)	Permeability Coefficient (m/s)	Drainage Conditions
TP1	1	1.50	312	1400†	$2.30 \times 10^{-6} \dagger$	Poor
TP2	1	1.50	N/A	N/A	N/A	Practically impervious*
TP4	1	3.00	N/A	N/A	N/A	Practically impervious*

*Within TP2 and TP4 water levels remained approximately the same for the duration of the test period. † Invalid test; infiltration rate and time at 25% extrapolated from graph.

The only result calculated from tests completed indicate initial rates of 2.30×10^{-6} . However, three consecutive tests were not completed during the time allowed, and in addition, two of the trial pits (TP2 and TP4) were found to be practically impervious.

The results calculated correspond to low end of 'poor' drainage conditions. (Ref: Soil Mechanics in Engineering practice by Karl Terzaghi, Ralph B. Peck and Gholamreza Mesri; Table 14.1 Permeability and drainage characteristics of soils (after casagrande and Fadum 1940)). Result sheets can be viewed within **Appendix D**.

6.5.2 BS 6297:2007 Infiltration/Percolation Testing

Soil Infiltration testing was conducted in TP3 and TP5 in general accordance with BS6297:2007 percolation test methods; following the mechanical excavation of a 1.30m pit, a further hand excavated pit was completed to dimensions of 300mm³. Following the squaring of the pit sides, the trial pits were filled rapidly with potable water and the subsequent fall in water level monitored over time. The aim of the test is to reach 75% and 25% fill depth marker to determine an infiltration rate for the soil.

Trial Hole ID	Test	Start Time	Finish Time	Time at 75% (seconds)	Time at 25% (seconds)	Elapsed Time (seconds)	Vp (s/mm)
TP3	1	09:58	N/A	N/A	N/A	N/A	N/A†
TP5	1	09:50	~14:30	3900	12000	8100	54

† Invalid test, testing period over 6 hour time limit.

Result sheets can be viewed within **Appendix D**.

7.0 GROUND GAS/ SOIL VAPOUR MONITORING

7.1 Design of Gas Monitoring Program

In accordance with BS8576:2013 *Guidance on investigations for ground gas – permanent gases and volatile organic compounds*, the extent of monitoring that was deemed necessary was based on the generation potential of the source, i.e. what is the risk that large volumes of gas can be generated and can plausibly migrate to pose a credible hazard to the identified receptors. The following points were pertinent in the design of the gas monitoring program:

- Soils contain relatively low organic matter; Made Ground = avg. 3.73%, shallow natural soils = avg. 0.70%;
- Made Ground contained a low degradable organic content (i.e. no wood, paper, rags, food or other degradable waste), and were found no deeper than 0.40mbgl; and,
- No landfill sites have been identified within the immediate vicinity.

Further to this, the site was classified as having a 'Low' gas generation potential, and therefore, the gas monitoring program was devised on the basis of a screening exercise of the natural soils only – It was deemed prudent to conduct monitoring within close proximity of the development footprint.

Monitoring was conducted in accordance with BS5930:1999/2015 and BS8576:2013, over three monitoring rounds on 11th, 19th and 23rd April 2018. All boreholes were monitored for the presence of soil gases including oxygen, carbon dioxide, methane and VOCs. In addition gas flow rates, downhole pressure and atmospheric pressure were also measured using a GA2000+ gas analyser. Gas monitoring was completed over a three minute period recording the steady and peak concentrations of each gas.

7.2 Monitoring Results

The results from the three monitoring rounds are summarised in the table below and overleaf, and detailed in Appendix E. To summarise, the highest flow rate was 1.2L/hr recorded during Monitoring Round 1 (MR1). A maximum methane concentration of 4.9% was recorded during MR1 within WS01. A maximum carbon dioxide concentration of 8.3% was recorded during MR1 within WS01. VOCs were consistently below 6.0ppm during all monitoring rounds. It should be noted that oxygen levels were recorded as 6.0% during the first monitoring round (MR1). Atmospheric pressure was steady during all three monitoring rounds.

Worst Case Scenario Taken During all Monitoring Rounds	WS01	WS02
Pressure Trend	Steady	Steady
Flow Rate (L/hr)	0.0	1.2
Peak CH ₄ (%)	4.9	0.1
Peak CO ₂ (%)	8.3	3.5
Minimum O ₂ (%)	6.0	16.0
VOCs (ppm)	4.3	5.6
H ₂ S (ppm)	0	0
CO (ppm)	9	12

7.2.1 Gas Screening Value (GSV)

It is considered that the worst case scenario in terms of gas production would be during Monitoring Round 1 due to the highest flow rate and maximum peak CO₂ and CH₄ concentrations. Worst case maximum gas levels and flow rates recorded will be used to calculate a Gas Screening Value (GSV).

The GSV will be subsequently compared to CIRIA Values supplied within CIRIA Document C665 *Assessing Risks posed by hazardous ground gases to buildings* (2007).

Methane GSV

$$GSV = \left[\frac{\text{Worst case CH}_4 \text{ concentration}}{100} \right] \text{Worst Case Flow Rate}$$

$$0.059\text{L/hr} = \left[\frac{4.9\%}{100} \right] 1.2\text{L/hr}$$

Carbon Dioxide GSV

$$GSV = \left[\frac{\text{Worst case CO}_2 \text{ concentration}}{100} \right] \text{Worst Case Flow Rate}$$

$$0.100\text{L/hr} = \left[\frac{8.3\%}{100} \right] 1.2\text{L/hr}$$

7.3 Significance of Results

The maximum calculated GSV is 0.100L/hr and therefore, the site can be classified as Characteristic Situation 2 (CS2) – as it falls below the CS2 threshold of <0.70mbgl. According to guidance, results are indicative of natural soils with high peat/organic content, or 'typical' Made Ground.

Based on these results (i.e. maximum GSV=0.100L/hr and both maximum CO₂ and CH₄ concentrations), the site would fall into a 'Low' risk category (or NHBC – Amber 1).

VOCs were consistently below 10.0ppm during all monitoring rounds in all wells, and compliment the absence of any vapours and/or odours encountered during the investigation works.

The higher values recorded during Monitoring Round 1 may be somewhat attributable to drilling disturbance. As a result, it may prudent to undertake additional monitoring to determine if this is the case.

8.0 LABORATORY TESTING

8.1 Geotechnical Testing

8.1.1 Natural Moisture Content and Plasticity Index

Seven samples of overburden material were submitted for determination of their Natural Moisture Content (NMC), and Plasticity Index (PI). These were selected from natural River Terrace Deposits from WS01-WS04 between depths of 1.00-3.80mbgl

NMC values were found to range between 15-21%. Two samples were returned as non-plastic; of the remaining samples, Liquid Limit values were recorded of 19-29% and Plastic Limits of 14-20%. Taking into account the portion of the sample retained upon the 425µm sieve (5-7%) the modified Plasticity Index results are 3-8%.

The materials tested indicate a Low plasticity classification, and are below the lowest threshold for shrinkage potential in accordance with NHBC guidance, Chapter 4.2 'Building near Trees'.

Comparison of the natural moisture content to 40% of the respective Liquid Limit (corrected for granular content) – which is used as a statistical measurement of desiccation; do not show any signs of desiccation.

8.1.2 Sulphate and pH Analysis

2no. samples were forwarded to the laboratory for water soluble sulphate and pH determination.

Water soluble sulphate concentrations within the soils were found to range from 21mg/ to 171mg/l, with pH levels ranging from 7.8 to 8.7.

8.1.3 Particle Size Distribution and Hydrometer Sedimentation

Two samples from WS01 and TP2 at 0.50mbgl were submitted for classification testing by wet sieving and hydrometer sedimentation to determine the percentage and range of grain sizes.

The results are summarised in the table below.

Sample	% Sample – Dry Mass			
	Gravel	Sand	Silt	Clay
WS02 0.50mbgl	0.3	16.4	59.2	24.1
TP2 0.50mbgl	0.4	20.1	42.8	36.6

8.1.4 Saturation Moisture Content

Two samples from WS03 and WS04 from 3.00-4.00mbgl were submitted for determination of their Intact Dry Density and Saturation Moisture Content. Only one suitable sample was recovered for testing, results indicate intact dry density of 1.69Mg/m³, and saturation moisture content of 22%. These results are indicative of medium borderline high density Chalk.

Full details of this analysis can be found on the test certificates in Appendix F.

8.2 Geo-Environmental Analysis

8.2.1 Soil Analysis

Six soil samples obtained from depths ranging between 0.30 and 0.70mbgl were submitted to DETS (QTS Environmental), a UKAS and MCERTS accredited laboratory testing facility, for a screen of contamination testing from both the Made Ground and shallow underlying natural soils. Samples were tested against a contamination suite, including an asbestos screen, heavy metals and hydrocarbons including speciated Total Petrol Hydrocarbons (TPH CWG aromatic/aliphatic split), BTEX, MTBE and speciated Polycyclic Aromatic Hydrocarbons (PAH), as well as a background suite of pH, SOM, total cyanide, and total phenols.

Rationale for Analysis

Specific soil samples were selected in order to fully refine previously identified contamination pollutant linkages and specifically based on contaminants of concern highlighted within the Phase 1 Report. Sample rationale is detailed in the subsequent table.

Source/ Location	Hole ID	Sample Depth (mbgl)	Analysis	Rationale for Sample/ Analysis
Proposed garden	TP1	0.30	TPH, PAHS, BTEX, MTBE, heavy metals and asbestos screen.	Sampled from Made Ground and therefore probably worst case scenario. In addition targeting pollutant linkage associated with end users and private gardens.
Proposed areas of soft-landscaping.	TP2	0.30		Sampled from Made Ground and therefore probably worst case scenario
		0.70		Taken below sample above (Made Ground) to vertically delineate any potential contamination.
	WS01	0.30		Sampled from Made Ground and therefore probably worst case scenario
		0.60		Taken below sample above (Made Ground) to vertically delineate any potential contamination.
Site coverage	WS04	0.30		Selected to provide site coverage and assess the chemical composition of shallow natural soils.

Screening Criteria

The results of this laboratory testing have been compared to published guidance criteria, widely referred to by consultants and Regulatory Authorities within the industry, and include the following:

- The UK Soil Guideline (SGVs) for selected metals, BTEX and phenols, produced by the EA and the Department of Environment, Food and Rural Affairs (DEFRA), 2009;
- Suitable 4 Use Levels (S4ULs) Generic Assessment Criteria (GAC) for 82no. contaminants developed by the Chartered Institute of Environmental Health (CIEH) in partnership with Land Quality Management Ltd (2015). It is anticipated that this screening criteria will be applied by the Local Authorities, but it should be noted that the CIEH S4ULs have not been issued through the EA or DEFRA;
- A further set of GAC for 35no. mainly organic contaminants not already covered by SGV or S4ULs produced by the CIEH and published by Contaminated Land:

Applications In Real Environments (CL:AIRE) in conjunction with the Association of Geotechnical and Environmental Specialists (AGS) and the Environmental Industries Commission (EIC), 2010; and,

- Provisional Category 4 Screening Levels (pC4SL) for lead, which have been produced by CL:AIRE (2014).

Comparisons were made against guidance criteria for the 'residential with home-grown produce' land use setting, based on the end use and proposed areas of private gardens. A conservative Soil Organic Matter (SOM) value of 1% is used for organic contaminants (i.e. TPH and PAH) as a worst case scenario, unless otherwise stated.

8.2.2 Soil Results

Results have not been subject to statistical analysis due to the targeted nature of the sampling strategy. Referring to guidance only systematic or unbiased sampling data should be subject to statistical testing.

A summary of soil results is presented in the following tables, with a discussion of results below.

Organic Matter and Asbestos

Organic matter content ranged from 1.40 - 6.00% in Made Ground (Avg. 3.73%), and 0.50 - 0.80% (Avg. 0.70%) in shallow natural soils. Asbestos was not identified within any of the analysed samples following the asbestos screen.

Heavy Metals

There were no exceedances of the screening values for any of the heavy metal determinands from all tested soil samples. In addition, two of the heavy metal determinands: mercury and selenium, were recorded below their respective laboratory Level/Limit of Detection (LOD) for all tested soil samples.

PAHs

There were no exceedances of the screening values for any of the PAH determinands from all tested soil samples. Furthermore, all PAH determinands from all but one of the tested soil samples (TP2 at 0.30m) were below their respective laboratory LOD.

TPH

There were no exceedances of the associated screening criteria for any of the tested TPH determinands from all soil samples. Furthermore, all TPH determinands from all tested soil samples were returned below their respective laboratory LOD.

BTEX/ MTBE

There were no exceedances of the screening values for any of the BTEX/MTBE determinands from all tested soil samples. Furthermore, all BTEX/MTBE determinands from all but one of the tested soil samples (TP1 at 0.30m) were below their respective laboratory LOD.

Laboratory certificates can be viewed in Appendix F.

8.2.3 Groundwater Analysis

Groundwater sampling and analysis was not deemed necessary due to the lack of soil exceedances, depth of Made Ground (maximum depth 0.40mbgl) and depth to groundwater (>1.00mbgl).

9.0 GEOTECHNICAL DISCUSSION

9.1 Soil Engineering Properties

The current proposal for the site includes the construction of 3 no. live/work units with associated gardens and parking within the northern half of site. The southern half of site is to be created into new pasture land. The exact proposed loadings are not known, however they are expected to be moderate on the basis of the anticipated low rise nature of the development.

Surficial cover largely comprised of probable demolition material. Made Ground was only identified within six of the nine intrusive locations (TP1, TP2, TP3, WS01, WS02 and WS03) from ground level to a maximum depth of 0.40mbgl. This emplaced material was described as brown clayey sandy Gravel and or dark brown silty gravelly Clay, with the gravel portion identified as concrete, brick and flint. Occasional cobbles of flint and brick were identified.

Natural superficial soils, considered to be representative of River Terrace Deposits, were initially described as a soft to firm consistency (N=9-13) brown silty, locally sandy, Clay, often with rare to occasional angular gravels of flint. This was encountered to variable depths across site, from ground level in WS04 and underlying Made Ground soils elsewhere, extending to a maximum of a maximum depth of 2.50mbgl in WS01.

The remaining superficial soils, likely further River Terrace Deposits, were described as soft to firm consistency light greyish white/brown silty sandy very gravelly Clays, where the gravel is fine flint and chalk. At the base of WS01 and WS02, from 3.60-4.00mbgl, soils became more of an orange/cream colour suggesting approach of the basal contact with the Chalk. These soils recorded the highest SPT values of N=26-29 from 3.00-4.00mbgl.

Laboratory testing has indicated that the superficial deposits are of a Low plasticity classification, and are below the lowest threshold for shrinkage potential in accordance with NHBC guidance, Chapter 4.2 'Building near Trees'.

Chalk of the White Chalk Subgroup was identified exclusive to WS03 and WS04. This material was recovered as a structureless chalk composed of white sandy very gravelly Silt, where the gravel portion is medium weak, high density white and cream chalk (Grade Dm). SPTs within this material recorded N=14-19, supporting the description of structureless.

Saturation moisture content testing has indicated that the intact chalk clasts are generally of borderline medium to high density, suggesting a more durable material than is indicated by hand specimen description. However the Chalk is assessed to be present in a structureless condition and would not be expected to perform as a high density Chalk if used as fill material or for earthworks. Owing to the generally silt grade, comminuted, matrix this material would be considered to be generally unsuitable for use as an engineering fill.

Groundwater records indicate that water was encountered at 1.25-2.70mbgl during drilling, rising to a shallowest depth of 1.15mbgl. Subsequent monitoring visits recorded levels of 1.10-1.90mbgl. Levels appear to be variable as no groundwater was encountered within WS03 or the trial pits.

9.2 Shallow Foundations

Any foundations formed within Made Ground soils would be expected to be subject to total and differential settlement beyond tolerable limits. These soils are frequently present in a variable and inconsistent nature such that would render them unsuitable as a founding stratum.

The superficial deposits, whilst not considered to be inherently weak, have been encountered in variable thicknesses across the site area, with the underlying Chalk bedrock measured at shallow depths in WS03 and WS04. However, this material was submitted to a good level of insitu testing, and foundations within these soils would be acceptable.

As these soils were recorded as below the lowest shrinkability category, in accordance with NHBC guidance, there is no minimum recommended foundation depth for these cohesive soils. However, as there is no data above 1.00mbgl, this depth would be considered the most appropriate horizon. At this level, for traditional strip foundations, allowing for variable groundwater levels, a safe bearing pressure of 75kN/m² is considered appropriate. Foundations should use suitable reinforcement to account for variability in soils.

9.3 Floor Slab

The floor slab design will depend on the final foundation designs and is dependent on the underlying materials, including bearing capacity and the presence of any cohesive or Made Ground Soils.

Given the fact that any superficial soils are below the lowest shrinkability threshold, and assuming any fill associated with the removal of soft spots will not exceed 0.60m, a ground bearing slab could be considered for the development.

9.4 Excavations and Groundwater

It is likely that excavations of less than 1.20mbgl will locally require support to their faces due to the potentially high granular content of the cohesive soils encountered. Should excavations be taken below this, particularly due to the groundwater recorded below 1.20mbgl then adequate support should be provided in order to satisfy statutory safety regulations.

Groundwater levels are dependent upon seasonal variations and levels may change after periods of heavy rainfall or prolonged drought. Groundwater was encountered at 1.25-2.70mbgl during drilling, rising to a shallowest depth of 1.15mbgl, and subsequent monitoring visits recorded levels of 1.10-1.90mbg. Open excavations will likely be subject to the pooling of water, indeed surface water had pooled in a number of locations across site. Where groundwater or surface water is encountered within any excavations during the construction phase it should be dealt with appropriately and removed using good engineering practices.

Open excavations in chalk may also be susceptible to frost action in cold weather, which may result in local instability.

The design of any temporary retaining structures to support excavation faces should be made assuming the following moderately conservative parameters (overleaf):

Material	Effective angle of friction (ϕ°)	Effective Cohesion, c' (kPa)	Bulk Density kN/m^3
Made Ground	22-24	0	16-17
River Terrace Deposit	24-26	0	17-18
Grade Dm Chalk	26-28	0	18-19

9.5 Pavements and Services

BRE 365 soakaway tests recorded soils to be of poor drainage to practically impervious. Careful consideration should be given to siting of any soakaways.

9.6 Concrete in Aggressive Ground

The results of laboratory testing have indicated that a design class of DS-1 and subclass of AC-1s will be suitable for buried concrete on this site. This is in response to a maximum water soluble sulphate concentration of 171mg/l and a minimum pH value of 8.7.

10.0 GEO-ENVIRONMENTAL DISCUSSION

A discussion of findings is detailed below with subsequent refined pollutant linkages detailed in the Conceptual Site Model in Section 10.2.

10.1 Discussion of Findings

Based on the findings of the Phase 1 Report, it was deemed that a Site Investigation would be required in order to assess/ refine the potential pollutant linkages identified within the preliminary CSM. In summary, the aims of the Site Investigation were to assess the risks to end users within proposed private gardens; allow the vertical delineation of potentially impacted soils; and to assess risk to the underlying aquifers.

The site has been cleared and buildings demolished since the formulation of the Preliminary CSM, leaving areas of unmade ground and demolition material. As a result, a number of the sources within the Preliminary CSM may not be wholly present, or if present, localised to the demolition material and Made Ground soils on site.

During intrusive works Made Ground soils were found to comprise the surface cover of the site; consisting of unmade and/or probable demolition material. These soils were found to contain concrete, brick and flint, and encountered to a maximum depth of 0.40mbgl. This emplaced material was only identified within six of the nine intrusive locations; somewhat localised to the northern areas of the site – where the former buildings were once sited. Presumably this material is a product of the demolition of these structures.

Laboratory analysis of the Made Ground soil samples returned no exceedances of the applicable screening criteria. Furthermore, a proportion of the determinands (inclusive of heavy metals, PAH, TPH and BTEX/MTBE) were returned below laboratory LOD. In addition, asbestos was not identified within these samples, or in the soils encountered during the intrusive works.

Whilst no exceedances have been identified within the Made Ground soils, it is considered that these soils are not physically suitable for use as topsoil (BS3882:2015), due to the anthropogenic materials (i.e. brick and concrete) within.

Three samples of the underlying shallow (<0.70mbgl) natural soils were submitted for the same contamination suite as the Made Ground samples. Results have reported no exceedances of the applicable screening criteria, and in fact, all PAH, TPH and BTEX/MTBE determinands are below their respective laboratory LOD. Asbestos was not identified within these samples.

Groundwater was identified at depths ranging 1.10m - 2.70mbgl during the entirety of the investigation, inclusive of the monitoring rounds. Analysis of the underlying groundwater was not deemed necessary due to the lack of the soil exceedances, maximum depth of Made Ground (<0.40mbgl) and absence of visual and/or olfactory evidence identified on/within the groundwater. In light of the above, the risk to the underlying aquifers is currently considered Low.

A gas monitoring program was devised on the basis of a screening exercise only; it was deemed prudent to conduct three rounds of monitoring within close proximity of the development footprint.

Following monitoring, the maximum calculated GSV returned was 0.10L/hr and therefore, below the CS2 threshold of <0.70mbgl. According to guidance, results are indicative of natural soils with high peat/organic content, or 'typical' Made Ground. However, given that the monitoring wells were installed within natural soils, it is thought that this GSV is attributable to the natural soils and not the Made Ground. This is particularly pertinent with respect to the organic matter values of the soils. Based on these results (i.e. maximum GSV=0.100L/hr and both maximum CO₂ and CH₄ concentrations), the site would fall into a 'Low' risk category (or NHBC – Amber 1). As a result, nominal gas protective measures are required in the design of the proposed development.

It should be noted that oxygen levels were recorded as 6.0% during the first ground gas monitoring round. These concentrations may present some concern in poorly ventilated and confined areas.

VOCs were consistently below 7.0ppm during all monitoring rounds in all wells, and compliment the absence of any vapours and/or odours encountered during the investigation works.

10.2 Conceptual Site Model

The refined Conceptual Site Model (CSM) has been formulated in accordance with BS 10175:2011+A1:2013 and following information collated within the Site Investigation conducted. In this instance, it is used to assess the significance of contaminative sources associated with underlying ground gas levels and Made Ground soils identified on site, receptors, and the validity of the pathway between them. As such, whilst other pollutant linkages may have been acknowledged within the Preliminary CSM, these will not be included within the updated CSM and Risk Assessment. An explanation of categories is provided below the CSM table.

Source	Pathway	Receptor	Risk Level Considered	Mitigation Required	Residual Risk Following Mitigation
Limited Made Ground soils identified across the site.	Inhalation, ingestion and dermal contact from exposure to potentially contaminated soils.	End users.	Low. Whilst no exceedances have been identified there is a possibility that unidentified areas of contamination exist within the Made Ground soils – albeit these Made Ground soils are fairly limited. The proposed development includes areas of private gardens and therefore a pollutant linkage is likely.	Removal of Made Ground soils in areas proposed as soft landscaping, as required, and importation of certified 'clean' topsoil (in accordance with BS3882:2015). Further details are provided in Section 11.0.	Negligible to Low.
		Site workers (during development).	Low. The likelihood of direct contact during groundworks increases this risk, but conversely the short exposure time reduces it. It is possible unidentified areas of contamination exist.	Good working practices including the use of appropriate PPE, wash and mess facilities and specific training, should be incorporated into the construction phase plan, or similar.	Low.
	Impacted soils.	Services.	Low. Levels of corrosive elements are generally low.	None specifically required. Nevertheless, the Water Regulatory Advice Scheme guidelines should be adhered to especially as potable water pipes are likely to be installed.	Low.
	Migration of ground gas through the soil pores of the underlying geology.	End users and proposed development.	Negligible to Low. Low organic matter/content and shallow depth of Made Ground soils (<0.40mbgl).	None specifically required.	N/A.
		Site workers (during development).	Negligible. The risk rating can be reduced from that detailed above based on the temporary and external work setting.		
	Infiltration and migration of contaminants through the underlying geology.	Superficial Secondary (A) and Bedrock Principal Aquifers underlying the site.	Low. Soil results have returned no exceedances of the screening criteria; absence of visual/olfactory evidence of contamination in/within groundwater; relatively shallow depth of Made Ground.		
Gassing levels within the shallow natural soils.	Migration of ground gas through the soil pores of the underlying geology.	End users and proposed development.	Low. Based on three rounds of monitoring the site has been classified as Characteristic Situation 2.	One of the following: 1) reinforced concrete cast in situ floor slab (suspended, non-suspended or raft) with at least 1200 gauge DPM and underfloor venting; or, 2) Beam and block or pre-cast concrete and 2000 gauge DPM/ reinforced gas membrane and underfloor venting. All joints and penetrations to be sealed.	Negligible.
		Site workers (during development).	Negligible. The risk rating can be reduced from that detailed above based on the temporary and external work setting.	None specifically required.	
Negligible Risk		Defined as the site should be considered suitable for the present or future use and environmental setting. Contaminants unlikely to be present, which might have unacceptable impact on key targets.			
Low Risk		Defined as the site should be considered suitable for the present or future use and environmental setting. Contaminants may be present but unlikely to have unacceptable impact on key targets.			
Moderate Risk		Defined as the site may not be suitable for the present or future use and environmental setting. Contaminants are probably present and might have unacceptable impact on key targets.			
High Risk		Defined as the site is probably or certainly not suitable for the present or future use and environmental setting. Contaminants are probably or certainly present and likely to have unacceptable impact on key targets.			

11.0 GEO-ENVIRONMENTAL RECOMMENDATIONS

The following recommendations are based on the plans proposed at the time of writing this report and may be subject to change.

11.1 Remedial Strategy

Subsequent report sections detail required remedial works. The Local Authority must be contacted to confirm whether a standalone Remedial Options Appraisal and Strategy Report is required.

11.1.1 Record Keeping

Any actions must be adequately documented in order that an accurate Validation Report may be issued to the statutory authorities upon request.

The table below summarises actions currently identified as necessary, how and by whom the implementation of these should be recorded. Further details are provided in subsequent report sections.

Action Required	Detail Required for Validation	Party to Record Action
Removal of appropriate thickness of Made Ground soils from proposed areas of soft landscaping and private gardens, as required.	Photographic record showing excavations, including depth detail.	Site manager/ developer's nominated person.
Importation of suitable, certified topsoil to bring areas of private gardens and soft-landscaping to level.	Test certificates to prove suitability (BS3882:2015). Photographic record including depth detail.	Site manager/ developer's nominated person. Testing completed by Environmental Consultant.
Disposal of excess earth spoils from groundworks.	Waste classification testing, waste transfer notes / dockets.	Site manager / developer's nominated person.
Installation of gas mitigation measures as detailed in Section 11.1.2.	Photographs of installation. Gas membrane specification. Detailed drawings of design. Confirmation of installation.	Site manager / developer's nominated person.

Concise records of these actions must be kept for submission to the Local Authority within a Validation Report upon request.

11.1.2 Ground Gas Mitigation Measures

Based on monitoring results, the following protective measures must be implemented into the design of the development:

- All joints and penetrations must be sealed;
- Reinforced concrete cast in situ floor slab (suspended, non-suspended or raft) with at least 1200 gauge DPM and underfloor venting; or,
- Beam and block or pre-cast concrete and 2000 gauge DPM/ reinforced gas membrane and underfloor venting.

Passive underfloor venting is deemed suitable for the site, as opposed to an active system (i.e. extraction pumping systems). The choice of the desired passive system will vary depending on the floor slab; options include open voids, granular venting layers and/or synthetic voids. The decision will likely be to the requirements of the design engineer.

Construction details and designs must be made available for incorporation into a Validation Report, where required. Similarly, photographic evidence of implementation of measures will be required.

11.1.3 Removal of Made Ground

Whilst no exceedances have been identified within the Made Ground soils, it is considered that this material is not physically suitable for use as topsoil (BS3882:2015), due to the anthropogenic materials (i.e. brick and concrete) within. As private gardens and landscaped areas are to be incorporated in the development, it is recommended that, if present, Made Ground is removed in these areas, and the importation certified 'clean' topsoil (in accordance with BS3882:2015) is undertaken.

Once the Made Ground soils have been removed, the underlying soils in-situ should be tested against a basic contamination suite to ensure that these soils are suitable for use. The results should be compared to the GAC detailed in Section 8.2.1, where applicable.

In addition to the certification to BS3882:2015, it is recommended that the topsoil is tested for basic contamination suite (detailed in Section 11.1.5), and the results compared to applicable standards/GAC (e.g. SGVs).

11.1.4 Watching Brief

A watching brief should be maintained on site, particularly during ground works. This must be undertaken as part of good working practices and in case there are any areas of unidentified contamination.

During any ground works, an appraisal of the exposed soils should be made by the on-site manager or developer's nominated person. If any material is noted to show visual and/or olfactory sign of contamination this material should be stockpiled separately and tested prior to its appropriate removal off site or re-use where necessary. A suitably qualified environmental specialist should be contacted to advise what further work is required.

The on-site manager / developer's nominated person should be able to display the relevant level of qualification and/or experience in managing construction works.

11.1.5 Imported Material

Any material intended to be used as subsoil or engineered fill should be analysed in order to confirm it is suitable for use.

As a minimum, sampling should consist of at least three samples for each source used. Validation testing of imported materials should be carried out in-situ, after materials have been imported to site, and further to this, imported materials should be stored in designated on site areas.

Specific contaminants that should be tested and associated screening criteria are detailed in the table overleaf.

Soil Type	Chemical Testing Required	Testing Frequency
Topsoil – Proven greenfield source.	Heavy Metals, TPH, PAH, BTEX, MTBE + BS3882 physical testing.	On site: 1 per 200m ³
Topsoil – Unknown/ mixed/ brownfield source.	Heavy Metals, TPH, PAH, BTEX, MTBE, Asbestos Screen + BS3882 physical testing.	On Site: 1 per 50m ³
Subsoil – Proven greenfield source.	Heavy Metals, TPH, PAH, BTEX, MTBE, Asbestos Screen.	On site: 1 per 200m ³
Engineered Fill.	Heavy Metals, TPH, PAH, BTEX, MTBE, Asbestos Screen.	On site: 1 per 200m ³

11.1.6 Waste Disposal

An explanation of Waste Disposal Guidance is presented below.

According to Technical Guidance WM3 – *Waste Classification: Guidance on the classification and assessment of waste* (2015), as part of Duty of Care, waste must be classified:

- Before it is collected, disposed of or recovered;
- To identify the controls that apply to the movement of the waste;
- To complete waste documents and records;
- To identify suitably authorised waste management options; and
- To prevent harm to people and the environment.

Before waste can be accepted at a landfill site, the landfill operator must be satisfied that the waste meets permit conditions, the waste acceptance procedures (WAP) and waste acceptance criteria (WAC).

Waste Acceptance Procedures

The WAP consist of three steps to identify and periodically check the main characteristics of the waste.

Level 1: basic characterisation – before waste is sent to landfill, its composition and properties must be verified to determine it is suitable for acceptance and at which class of site.

Level 2: compliance testing – if production of waste is regular, waste must be periodically checked to ensure that properties have not changed.

Level 3: on-site verification – each delivery must be checked to ensure that it is the expected waste and that it has not been contaminated in storage or transport.

Waste Acceptance Criteria

The European Waste Catalogue (List of Waste Regulations) should be used in the determination of whether a waste is hazardous.

Waste producers must characterise waste for the Duty of Care Description whether or not it is intended to send it to landfill. This includes making an assessment of its hazardousness (is it classified hazardous waste or not) unless it is an absolute non-hazardous entry waste. This is achieved by reference to the List of Waste Regulations.

Note, WAC testing can not be used to make an assessment of whether a waste is hazardous.

Summary

Before a waste producer can take waste to a landfill site for disposal, they must check the landfill has the appropriate permit, and must have completed the following:

- Duty of Care transfer note/ Hazardous Waste consignment note;
- Pre-treatment declaration form;
- Waste code (using List of Wastes);
- Composition of the waste (by testing, if necessary); and
- WAC testing (if required).

Requirements are considered in more detail within *Waste Acceptance at Landfills* (2010).

It is prudent to ascertain the testing requirements of the waste facility prior to the movement of any spoil. All relevant dockets will need to be kept to provide evidence of the removal of waste. If in doubt, the Environment Agency should be contacted for advice at an early stage to avoid any delays.

A copy of such documentation should be retained and forwarded to CE for inclusion into a verification/validation report, where required.

11.1.7 Services

Based on the concentrations of contaminants identified, and in accordance with WRAS (2002), there are no special requirements regarding the type of pipework that is deemed suitable to be used on site. Nevertheless, it is recommended that the local water board are contacted to confirm this.

It is recommended the services are situated within lined trenches. The trenches should be lined with a geotextile membrane and backfilled with clean fill, such as pea shingle, which will demarcate the services from the surrounding soils, protecting both the services and the future maintenance workers.

11.2 Decommissioning of Monitoring Wells

The client or site owner should ensure that the installed monitoring wells and their protective covers are not damaged or covered until such time as data is no longer required from them. Additional costs may be incurred if it is necessary to reinstate damaged wells.

Nevertheless, the monitoring wells installed on site will require eventual decommissioning. CE should be consulted prior to decommissioning. This process should be completed in accordance with the EA's (2012) guidance document '*Good Practice for Decommissioning Redundant Boreholes and Wells*'.

The above referenced document provides the following guidance - The ground should be restored as closely as possible to its pre-drilled condition. The well should be backfilled with clean (washed), uncontaminated materials so that the permeability of the selected materials are similar to the properties of the geological strata against which they are placed. The backfilled well will then mimic the surrounding natural strata and groundwater flow, and quality will be protected.

11.3 Statutory Consultees

We would recommend that this report be forwarded to the relevant Statutory Consultees including the Local Council's Environmental Health and Planning Department to seek their comments and subsequent approval prior to works commencing on site.

The Statutory Authorities may require a Validation and/or closure report providing documentation/audit trail for the Importation/removal/reuse of material on site and any other remedial works completed on site.

APPENDICES

Appendix A – Site Plans

Appendix B – Photographic Log

Appendix C – Stratigraphic Logs

Appendix D – Testing Sheets

Appendix E – Monitoring Sheets

Appendix F – Laboratory Certificates



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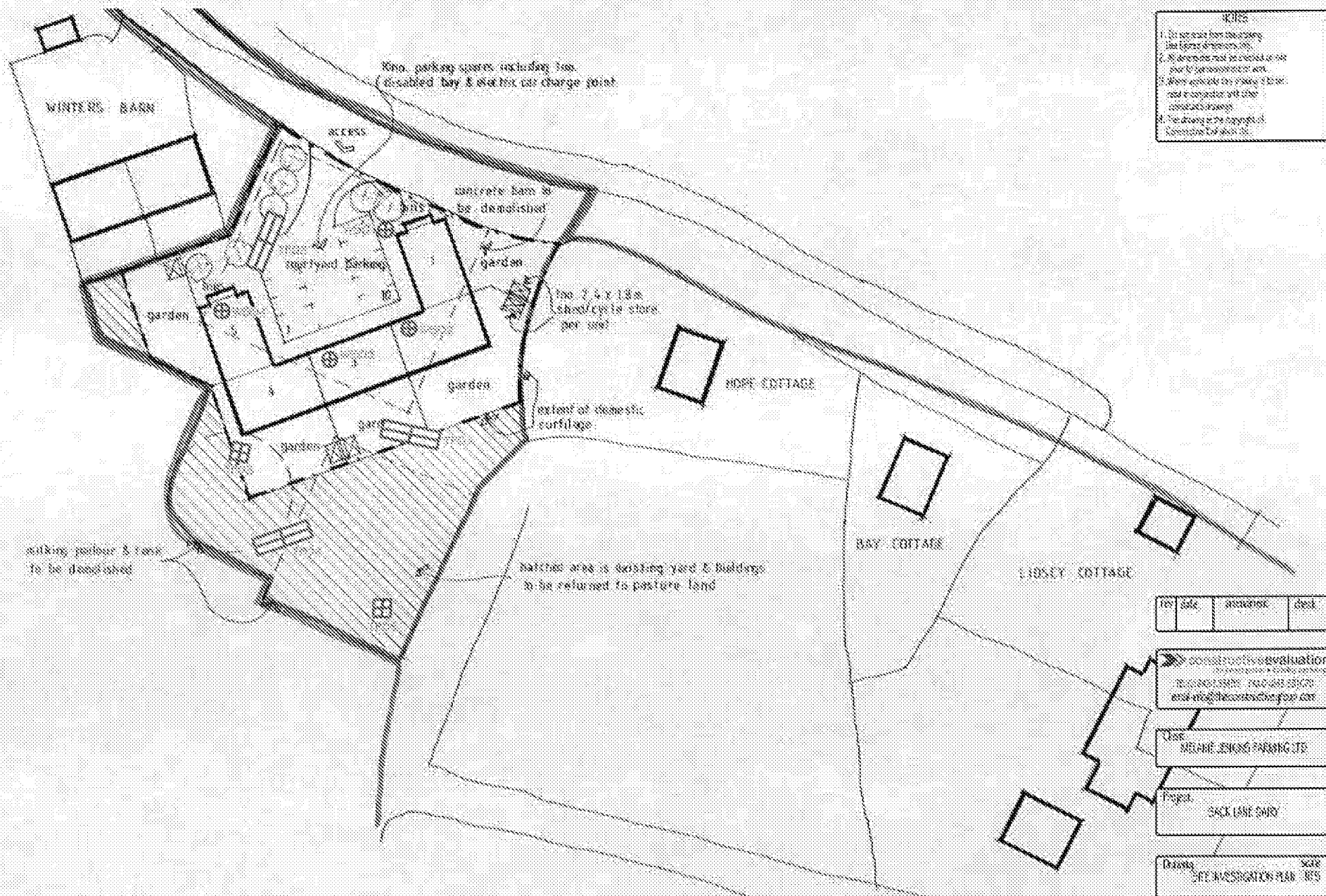
APPENDIX A

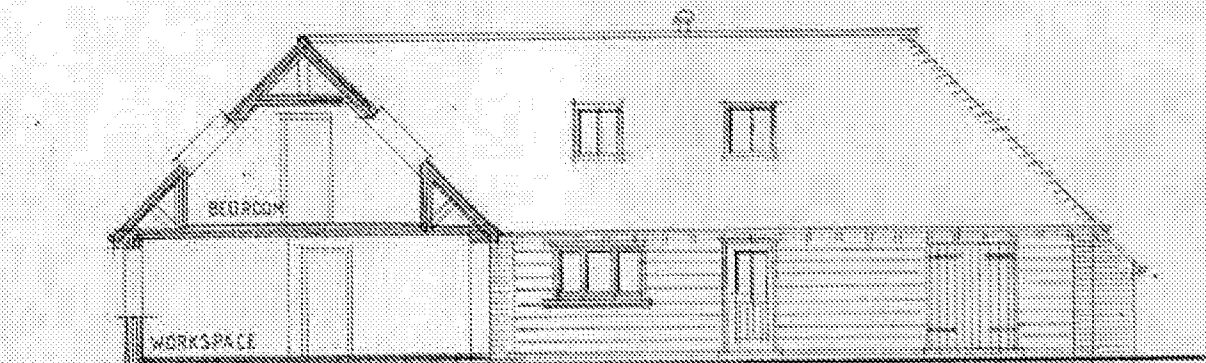
Site Plans



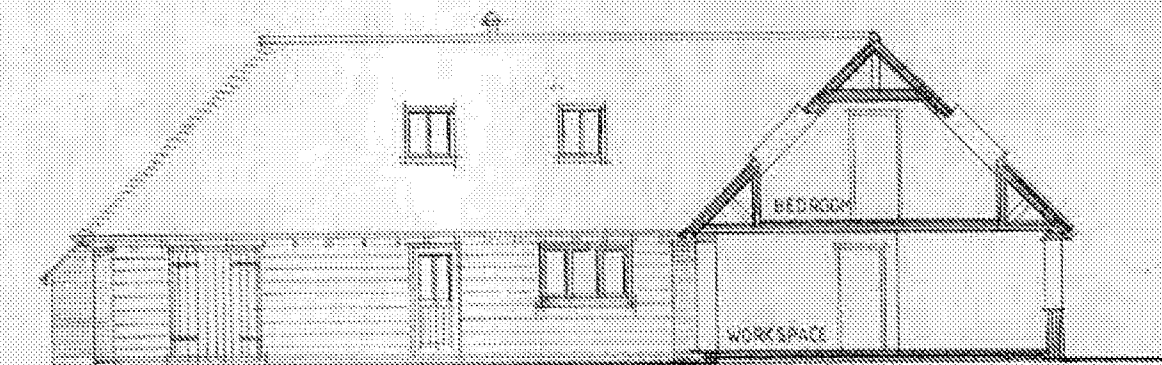
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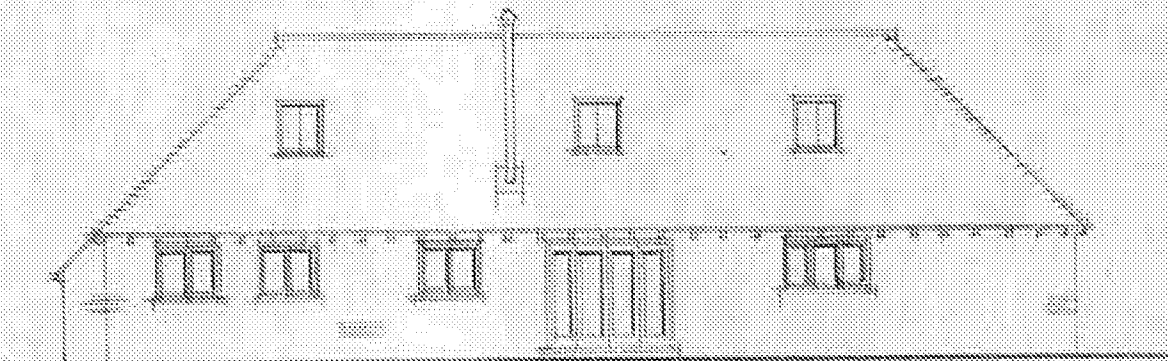




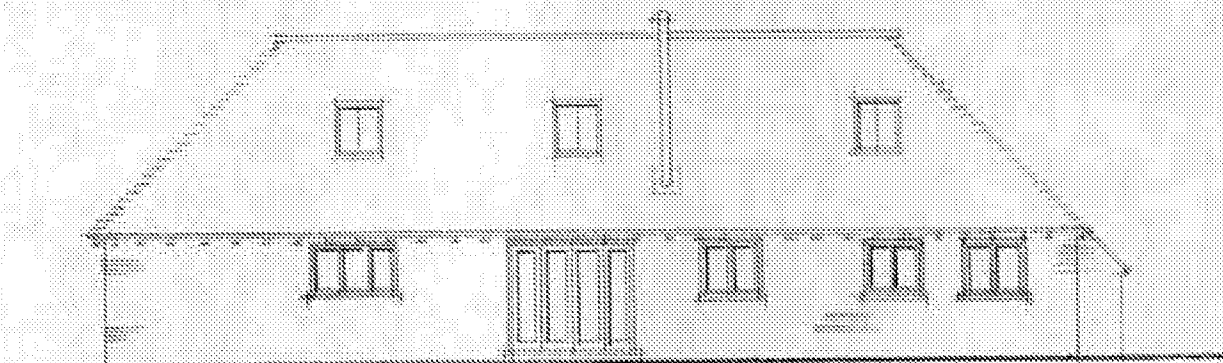
Courtyard East elevation



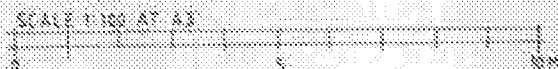
Courtyard West elevation



West elevation



East elevation



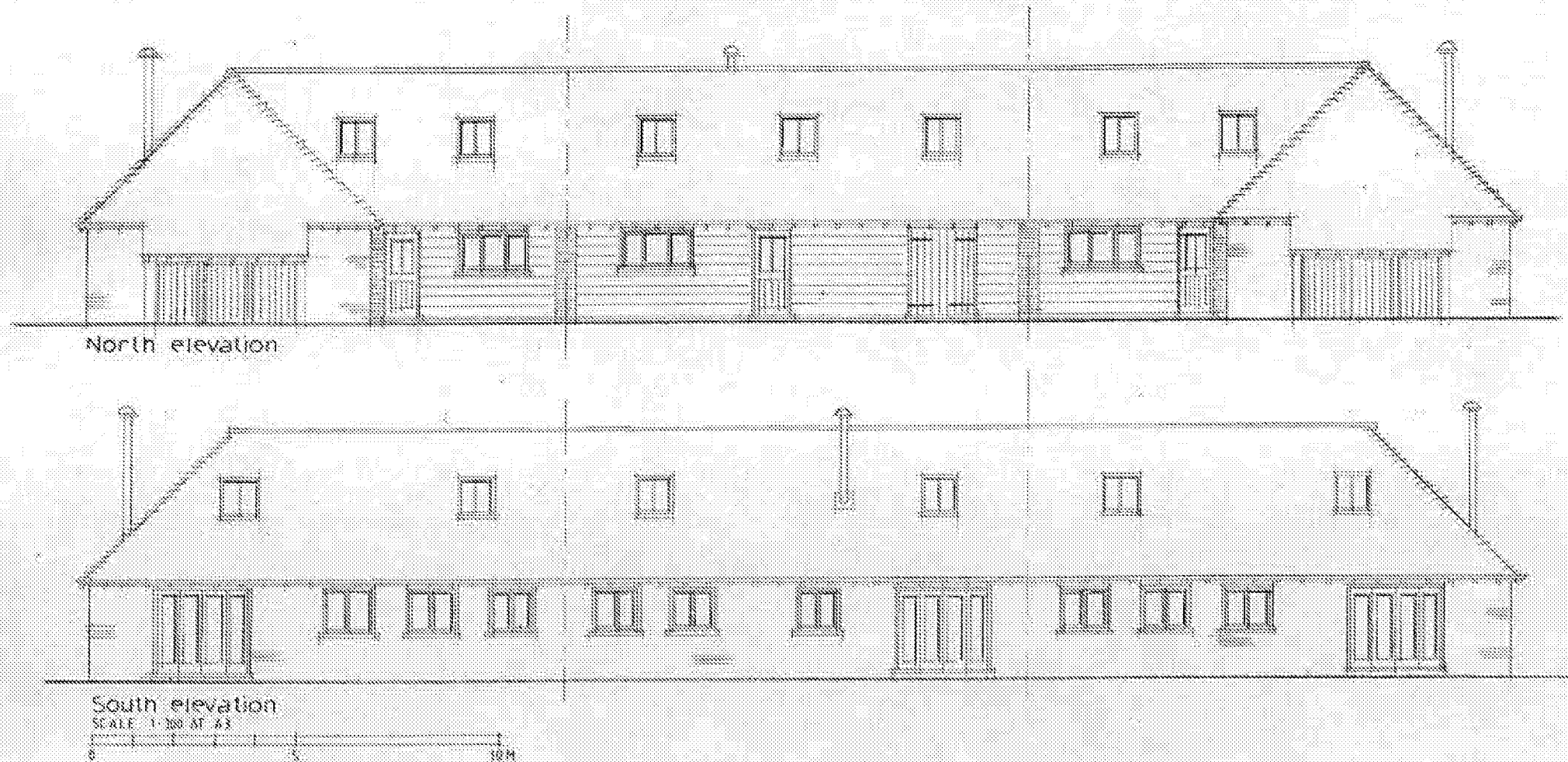
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Project Name: Sack Lane Dairy, Lidsey

Drawing: 5no. live/work units (Scale 1:100 @ A3)

Drawing Number: 2015/15/19 Rev.



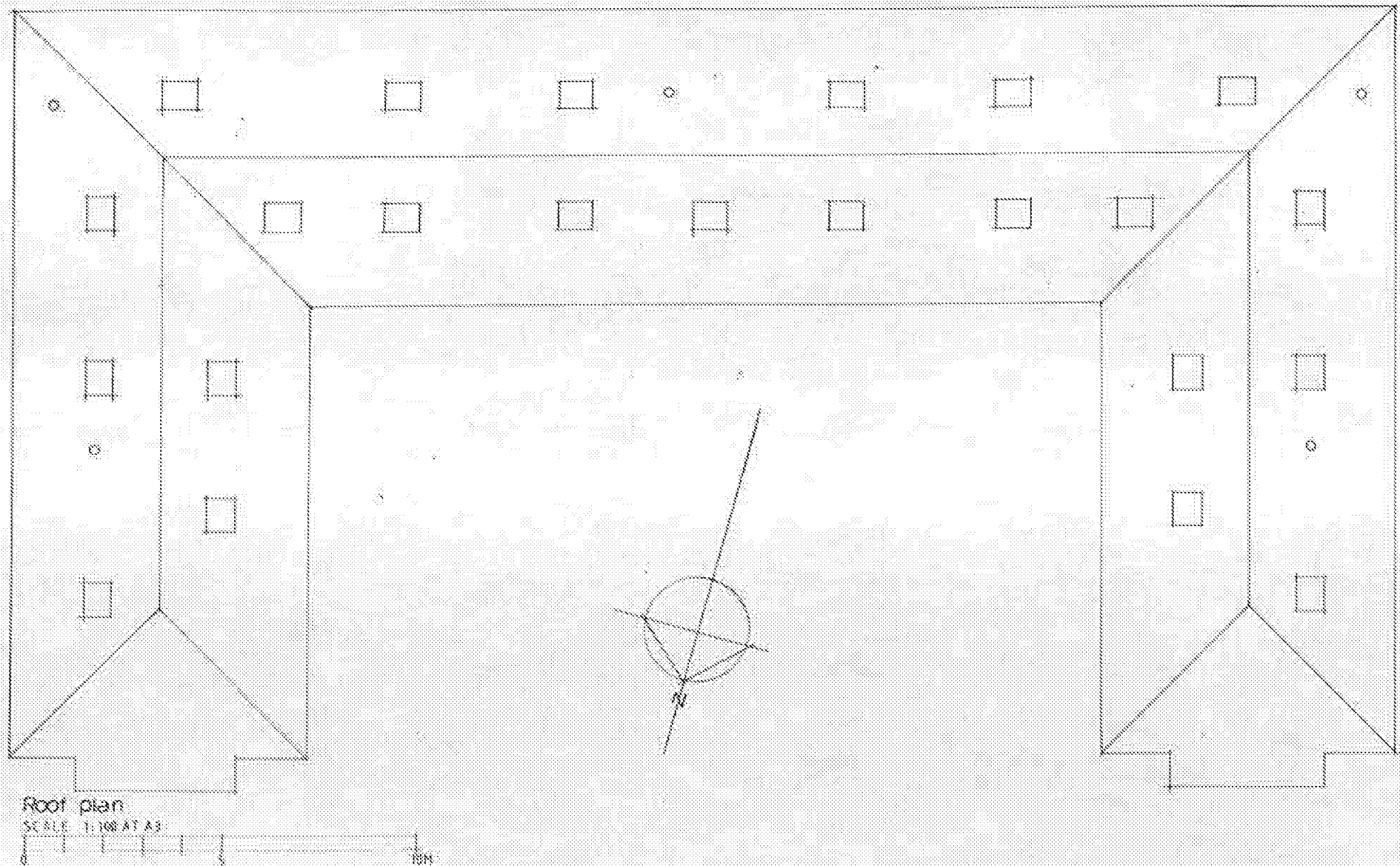
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Drawing Number: 2015/15/18 Rev.



Roof plan

SCALE 1:100 @ A3



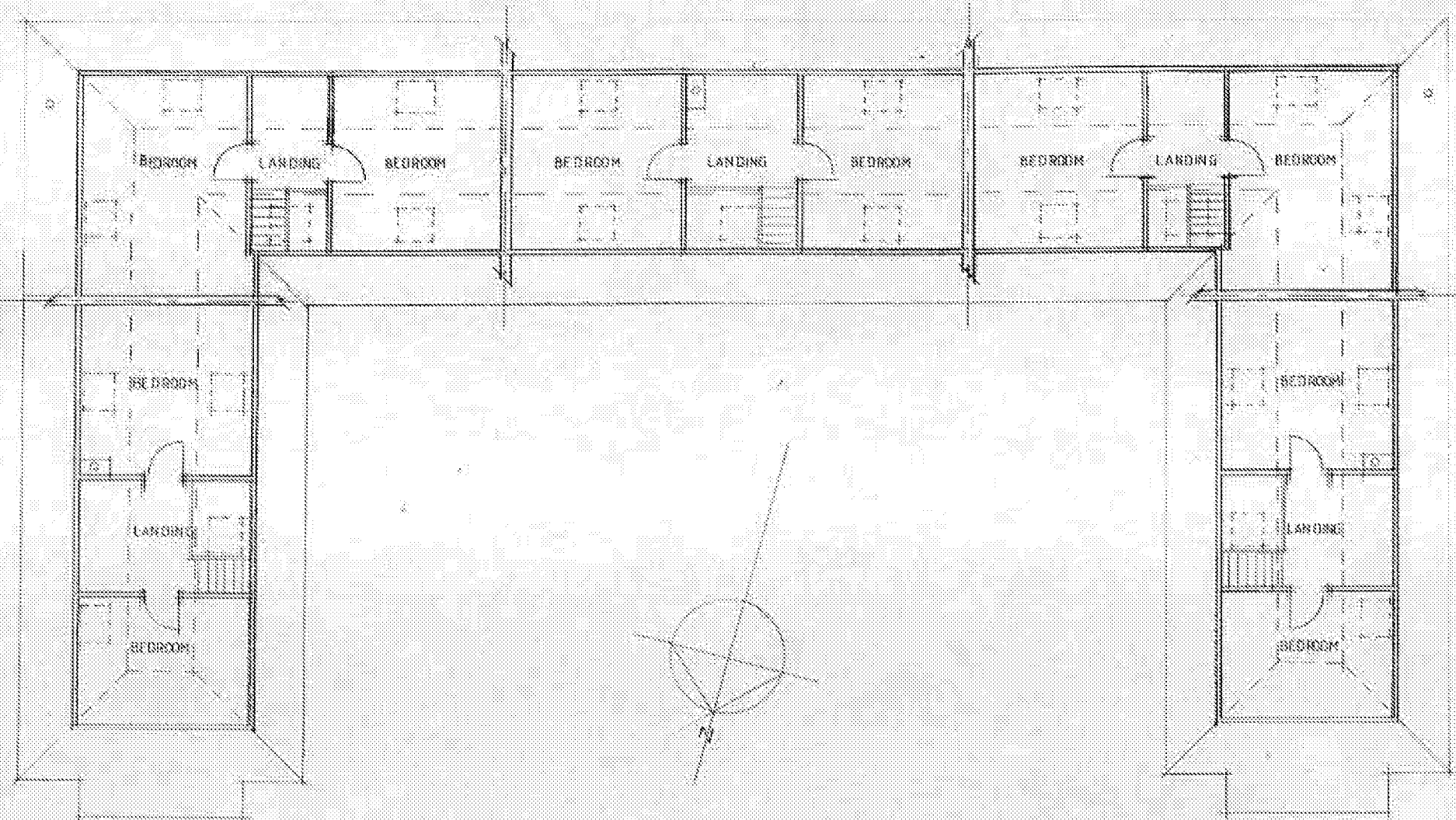
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 Chichester, West Sussex PO19 5RQ
 Tel: 01243 778600
 Mobile: 07973435493
 Email: rjcatkinson@btinternet.com

Project Name: Sack Lane Dairy, Lidsey

Drawing: 5no. live/work units (Scale 1:100 @ A3)

Drawing Number: 2015/15/17 Rev.



First floor plan

SCALE 1:100 AT A1



RJCA Chartered Architects

The White House, 2 Lavant Road
Chichester, West Sussex PO19 8RQ

Tel: 01243 779680

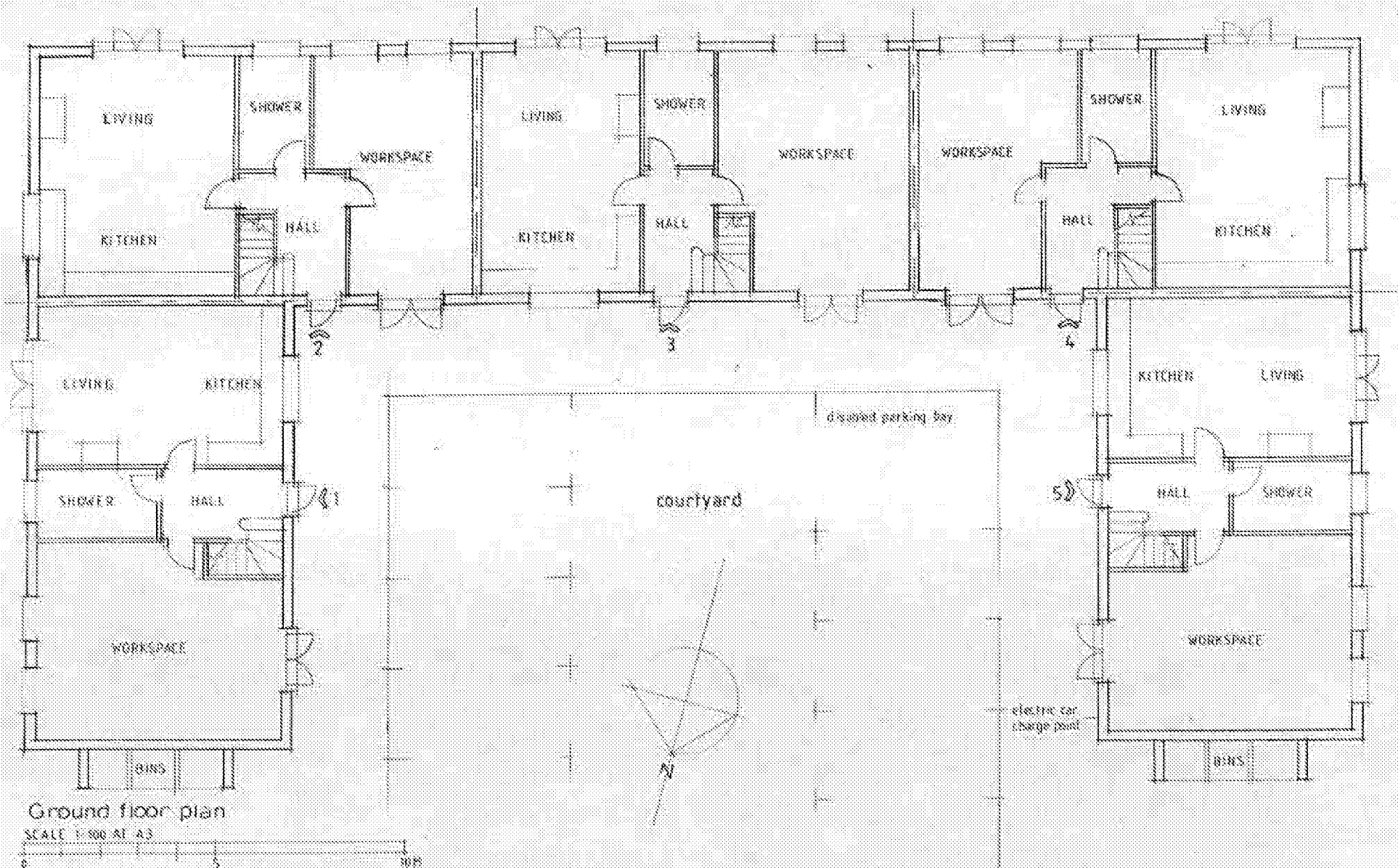
Mobile: 07973435493

Email: rjcatkinson@btinternet.com

Project Name: Sack Lane Dairy, Lidsey

Drawing: 5no. live/work units (Scale 1:100 @ A3)

Drawing Number: 2015/15/16 Rev.



RJCA Chartered Architects

The White House, 2 Lavant Road
 Chichester, West Sussex PO19 5RQ
 Tel: 01243 779600
 Mobile: 07973435493
 Email: rjcatkinson@btinternet.com

Project Name: Sack Lane Dairy, Lidsey

Drawing: 5no. live/work units (Scale 1:100 @ A3)

Drawing Number: 2015/15/15 Rev.

APPENDIX B

Photographic Log



constructiveevaluation

site investigation • building pathology

Investigation Photographs

Project Ref: 18.9862

Site Name: Sack Lane Dairy

1.



2.



3.



4.

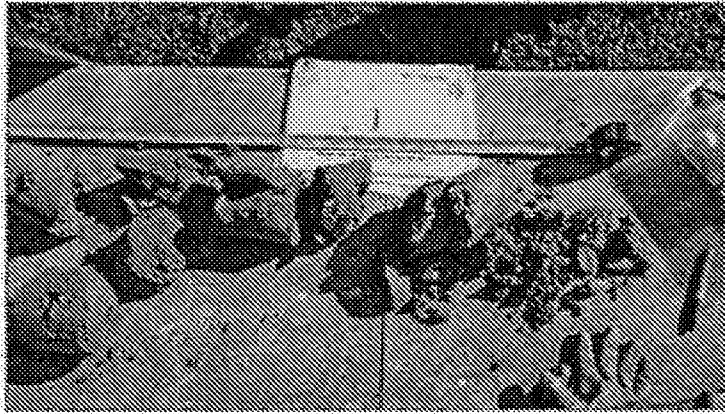


- 1) Site.
- 2) Site.
- 3) Site
- 4) Site.

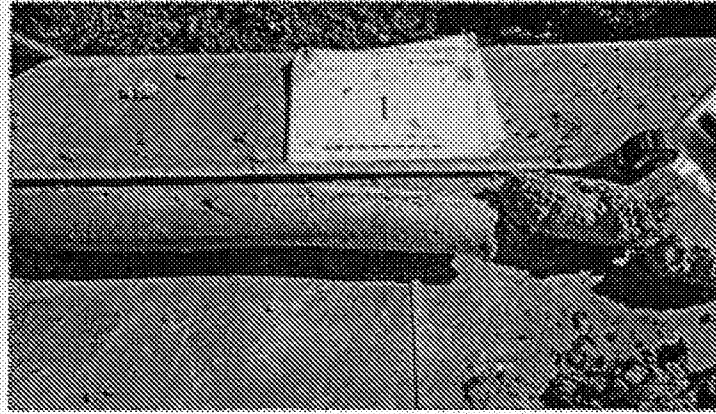
Investigation Photographs

Project Ref: 18.9862
Site Name: Sack Lane Dairy

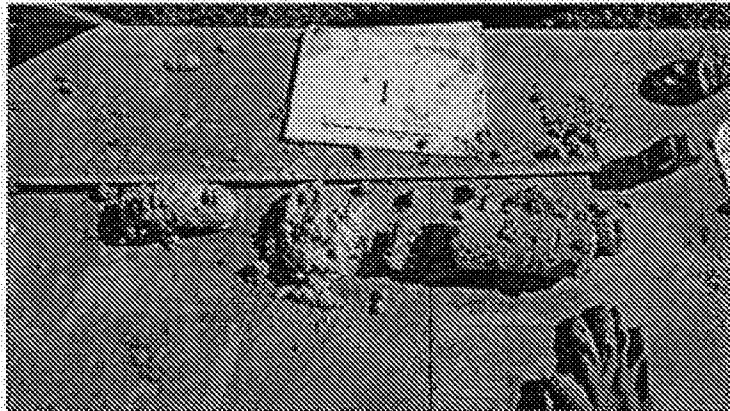
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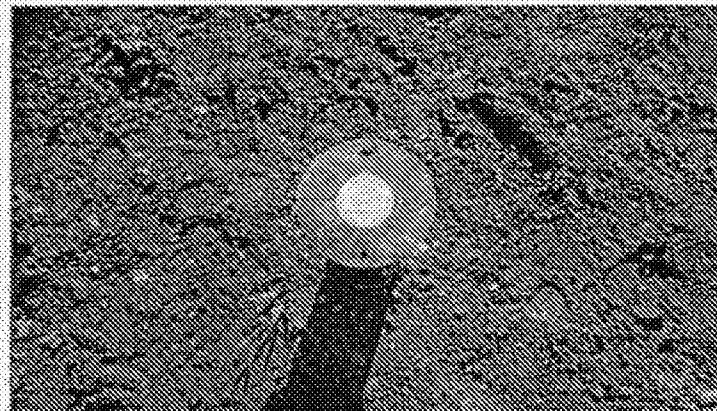
6.



7.



8.



- 5) WS01 1-2mbgl.
- 6) WS01 2-3mbgl.
- 7) WS01 3-4mbgl.
- 8) Monitoring well installation within WS01.

Investigation Photographs

Project Ref: 18.9862

Site Name: Sack Lane Dairy

9.



10.



9) WS02 1-2mbgl.

10) WS02 2-3mbgl.

11) WS02 3-4mbgl.

12) WS03 1-2mbgl.

11.



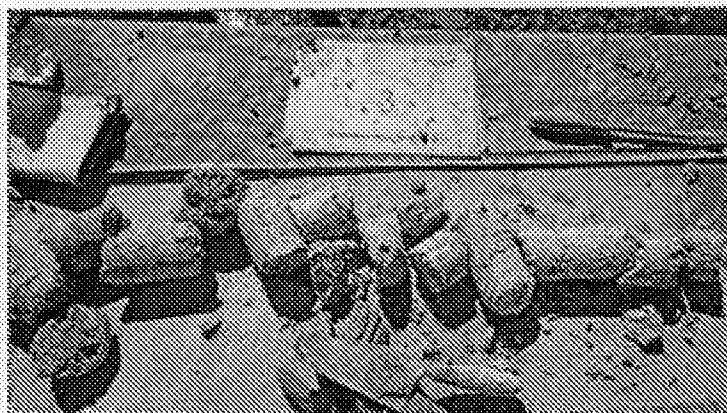
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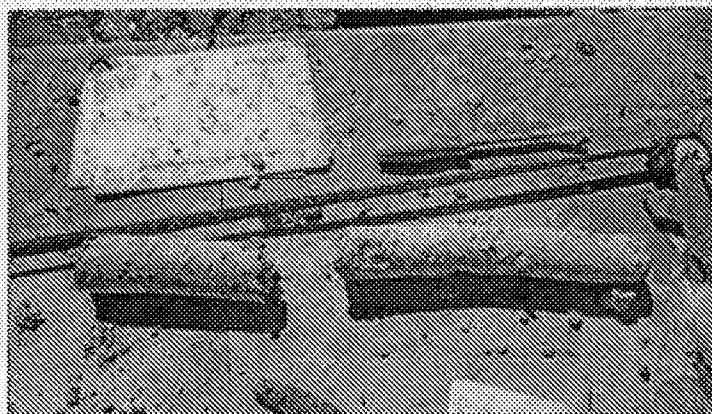
Investigation Photographs

Project Ref: 18.9862
Site Name: Sack Lane Dairy

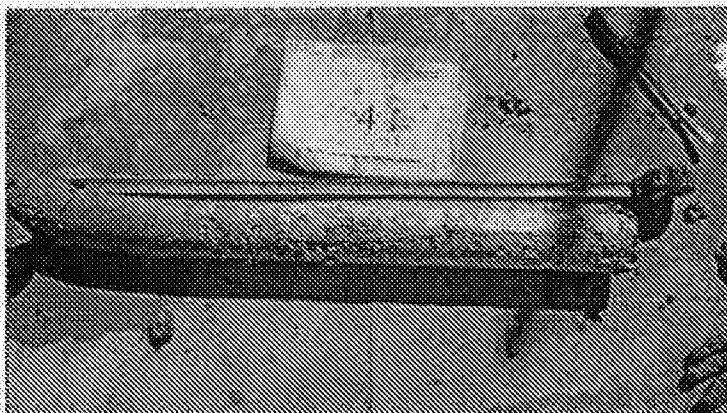
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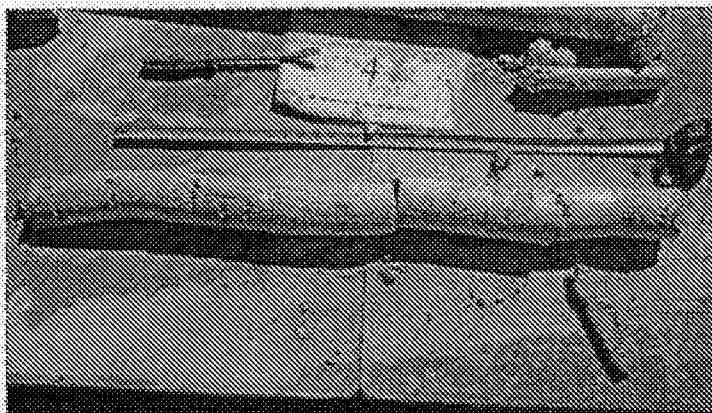
14.



15.



16.



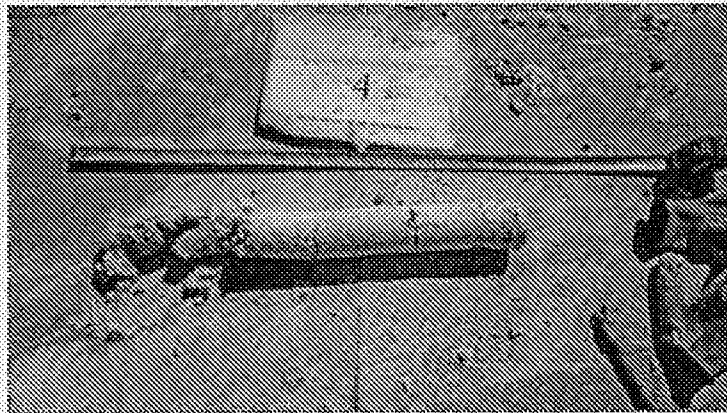
- 13) WS03 2-3mbgl.
- 14) WS03 3-4mbgl.
- 15) WS04 1-2mbgl.
- 16) WS04 2-3mbgl.

Investigation Photographs

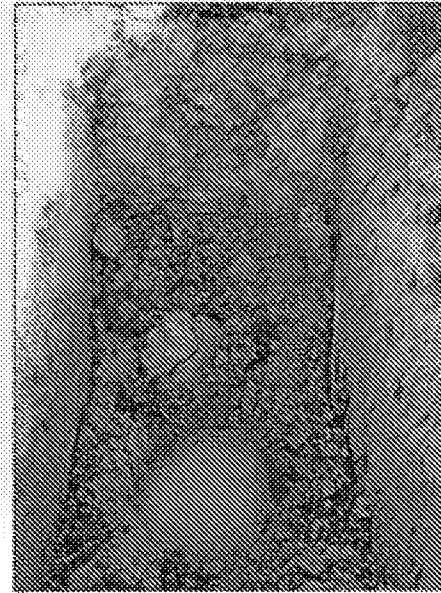
Project Ref: 18.9862

Site Name: Sack Lane Dairy

17.



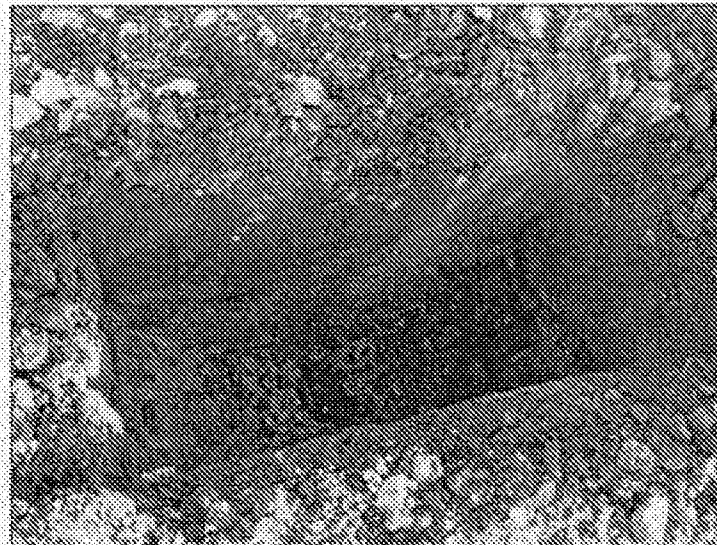
18.



19.



20.



- 17) WS04 3-5mbgl
- 18) BS 6297:2007 methods completed on site.
- 19) BRE 365 methods completed on site.
- 20) TP1.

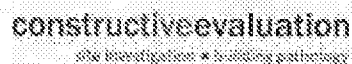
APPENDIX C

Stratigraphic Logs



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Barabara W.

WS01

Sheet 1 of 1

Project Name: Seck Lane Dairy

Project No.	16-9852
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CA-0035

Nov 4, 1900

555 556

Location: Aldingbourne, PC22 SPE

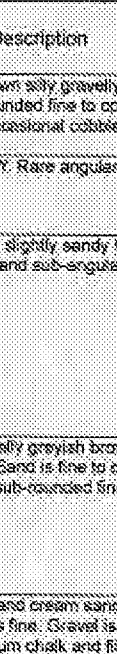
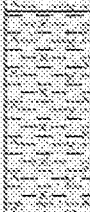
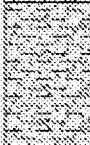
1. செய்து

Scale
3.50

Client: Melanie Jenkins Farming Ltd

Date: 05/04/2018

Logged By
RCE

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.40			MADE GROUND: Dark brown silty gravelly Clay. Gravel is angular to sub-rounded fine to coarse concrete, brick and flint. Occasional cobbles of flint and brick.	
		1.00 1.00	SPT	HVP=26 N=9 (1,2/2,2,3,2)	1.10			Soft to firm brown silty CLAY. Rare angular medium and coarse gravels of flint.	1 -
		2.00 2.00	SPT	HVP=48 N=13 (1,1/2,3,4,4)	2.60			Soft to firm brown grey silty slightly sandy CLAY. Sand is fine. Occasional angular and sub-angular fine and medium gravels of flint.	2 -
		3.00	SPT	N=26 (2,3/3,6,9,8)	3.60			Firm light grey off-white locally greyish brown silty sandy very gravelly CLAY. Sand is fine to coarse. Gravel is sub-angular and sub-rounded fine flint and chalk.	3 -
		4.00	SPT	N=26 (2,2/6,6,7,7)	4.00			Soft light brownish orange and cream sandy slightly gravelly SILT/CLAY. Sand is fine. Gravel is angular to sub-rounded fine and medium chalk and flint. End of Borehole at 4.000m	4 -
									5 -
									6 -
									7 -
									8 -
									9 -
									10 -

Remarks

CAT scanned prior to excavation. Hand dug inspection pit to 1.00mbgl. Groundwater strike at 2.70mbgl, rising to 1.38mbgl after two hours. Borshole collapsed to 3.00mbgl following completion.





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Borehole Log

Borehole No.

WS02

Sheet 1 of 1

Project Name: Sack Lane Dairy

Project No.
18.8862

Co-ords:

Hole Type

WLS

Location: Aldingbourne, PO22 9PE

Level:

Scale

1:50

Client: Melanie Jenkins Farming Ltd

Dates: 05/04/2018

Logged By

RG

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.15			MADE GROUND: Dark brown silty gravelly Clay. Gravel is angular to sub-rounded fine to coarse flint and brick. Firm greenish brown silty CLAY and SILT/CLAY.	
		1.00	SPT	N=4 (1.2/1.3/3.2)	0.90			Soft to firm grey speckled white silty gravelly CLAY. Gravel is angular to sub-rounded fine and medium chalk and flint.	1
		1.50		NYP=25					
		2.00	SPT	N=9 (2.2/2.3/2.2)	2.10			Firm light grey speckled white silty very gravelly CLAY. Gravel is angular to sub-rounded fine and medium chalk.	2
		3.00	SPT	N=13 (1.3/4.3/3.3)	2.90			Firm light grey off-white locally greyish brown silty sandy very gravelly CLAY. Sand is fine to coarse. Gravel is sub-angular and sub-rounded fine flint and chalk.	3
		4.00	SPT	N=29 (2.5/6.7/7.9)	3.80 4.00			Firm light brownish orange and cream sandy slightly gravelly SILT/CLAY. Sand is fine. Gravel is angular to sub-rounded fine and medium chalk and flint. End of Borehole at 4.00m	4
									5
									6
									7
									8
									9
									10

Remarks

CAT scanned prior to excavation. Hand dug inspection pit to 1.00mbgl. Groundwater strike at 2.00mbgl, rising to 1.60mbgl after twenty minutes. Borehole collapsed to 3.00mbgl following completion.



 constructiveevaluation site investigation • building pathology		Borehole Log		Borehole No. WS03 Sheet 1 of 1	
Project Name: Sack Lane Dairy		Project No. 18 9862		Co-ords:	
Location: Aidingbourne, PO22 9PE		Level:		Hole Type WLS	
Client: Melanie Jenkins Farming Ltd		Dates: 05/04/2018		Scale 1:50	
Logged By RG					

Well	Water Sinkes	Sample and In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.10			MADE GROUND: Dark brown silty gravelly Clay. Gravel is angular to sub-rounded fine to coarse flint and brick. Firm greenish brown silty CLAY and SILTCLAY.	
		0.50		HVP=22					
		1.00	SPT	N=11 (1,2/3,3,2,0)	1.30			Firm to stiff light grey speckled white silty slightly sandy very gravelly CLAY. Sand is fine to coarse. Gravel is angular to sub-rounded fine to coarse chalk and flint.	1
		2.00	SPT	N=19 (3,3/4,4,5,0)	1.90			Recovered as: Structureless CHALK composed of soft to firm greyish white sandy slightly gravelly SILT. Sand is fine to coarse chalk. Gravel is angular to sub-rounded fine and medium, low and medium density chalk. (Grade Dm).	2
		3.00	SPT	N=15 (3,3/4,4,4,3)					3
		4.00	SPT	N=13 (2,2/3,3,3,4)	4.00			End of Borehole at 4.00m	4
									5
									6
									7
									8
									9
									10

Remarks CAT scanned prior to excavation. Hand dug inspection pit to 1.00mbgl. Groundwater not encountered.		
---	--	---



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site investigation • building pathology

Borehole Log

Borehole No.

WS04

Sheet 1 of 1

Project Name: Sack Lane Dairy

Project No.
18 9862

Co-ords:

Hole Type

W.S

Location: Aldingbourne, PO22 9PE

Level:

Scale

1:50

Client: Melanie Jenkins Farming Ltd

Dates: 05/04/2018

Logged By

RG

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.50		HVP=73				Firm to stiff brown silty CLAY. Occasional sub-angular coarse gravels of flint.	
		1.00	SPT	N=15 (3,7/5,4,4,5)	0.90			Firm to stiff grey mottled orangish brown sandy very gravelly CLAY. Sand is fine to coarse. Gravel is angular to sub-rounded fine and medium chalk and flint.	1
					1.40			Recovered as: Structureless CHALK composed of soft to firm greyish white sandy slightly gravelly SILT. Sand is fine to coarse chalk. Gravel is angular to sub-rounded fine and medium, low and medium density chalk. (Grade 0m)	2
		2.00	SPT	N=15 (3,3/3,4,4,4)					
		3.00	SPT	N=14 (2,3/3,4,3,4)					3
		4.00	SPT	N=17 (2,3/4,4,4,5)	4.00			End of Borehole at 4.000m	4
									5
									6
									7
									8
									9
									10

Remarks

CAT scanned prior to excavation. Hand dug inspection pit to 1.00mbgl. Groundwater strike at 1.25mbgl, rising to 1.15mbgl after twenty minutes. Borehole collapsed to 3.00mbgl following completion.



				Trial Pit Log			Tripit No TP1 Sheet 1 of 1		
Project Name: Sack Lane Dairy				Project No: 18.9862		Co-ords: - Level:		Date 05/04/2018	
Location: Aldingbourne, PO22 9PE				Dimensions (m): Depth: 1.50		2.2 		Scale: 1:25 Logged LC	
Client: Melanie Jenkins Farming Ltd									
Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description		
	Depth	Type	Results						
	0.20	D				 MADE GROUND: Brown clayey silty sandy angular to sub-rounded fine to coarse Gravel of concrete, brick and flint. Sand is fine and medium. Occasional cobbles of flint.			
	0.30	ES							
	0.40	D		0.40					
	0.40	ES		0.50					
	0.80	D							
	1.00	B							
	1.40	D							
				1.50					
End of pit at 1.50m									

Remarks: CAT scanned prior to excavation. Excavated using a JCB 3CX.

Stability: Stable

				Trial Pit Log			Trialpit No TP3 Sheet 1 of 1		
Project Name: Sack Lane Dairy				Project No: 18.9862		Co-ords: - Level:		Date 05/04/2018	
Location: Aldingbourne, PO22 9PE				Dimensions (m): 1.9 0.6		Scale 1:25		Logged LC	
Client: Melanie Jenkins Farming Ltd				Depth 1.30					
Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description		
	Depth	Type	Results						
	0.20	D					MADE GROUND: Dark brown clayey silty sandy angular to sub-rounded fine to coarse Gravel of concrete, brick and flint. Sand is fine and medium. Soft to firm yellowish brown silty sandy CLAY. Sand is fine and medium. Firm orange brown speckled white very sandy SILT/CLAY with frequent sub-angular fine gravels of chalk.		
	0.30	ES		0.30					
	0.40			0.40					
	0.50	D							
	0.60	ES							
	0.70	D							
	1.00	D							
	1.30	D		1.30			End of pit at 1.30 m		

Remarks: **CAT scanned prior to excavation. Excavated using a JCB 3CX.**

Stability: **Stable**

				Trial Pit Log				Trialpit No TP4 Sheet 1 of 1	
Project Name: Sack Lane Dairy				Project No: 18.9962		Co-ords: - Level:		Date: 23/04/2018	
Location: Aidingbourne, PO22 9PE						Dimensions (m): 1.5		Scale: 1:25	
Client: Melanie Jenkins Farming Ltd						Depth: 3.00		Logged: RG	

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
				0.20			Firm to stiff brown silty CLAY. Occasional sub-angular medium and coarse gravels of flint. Light brown locally light grey speckled greyish white slightly sandy very clayey SILT. Sand is fine and medium. Occasional gravels of flint.	1
								2
				3.00			End of pit at 3.00 m	3
								4
								5

Remarks:	CAT scanned prior to excavation. Excavated using a JCB 3CX.	
Stability:	Stable	

ARUN DISTRICT COUNCIL AL/60/18/DOC

APPENDIX D

Testing Sheets



constructiveevaluation
site investigation • building pathology

Test 1

WEARNING DOES NOT HAVE TO BE OF MANY DEPTH - But to search them for calculation

2,297,971-26

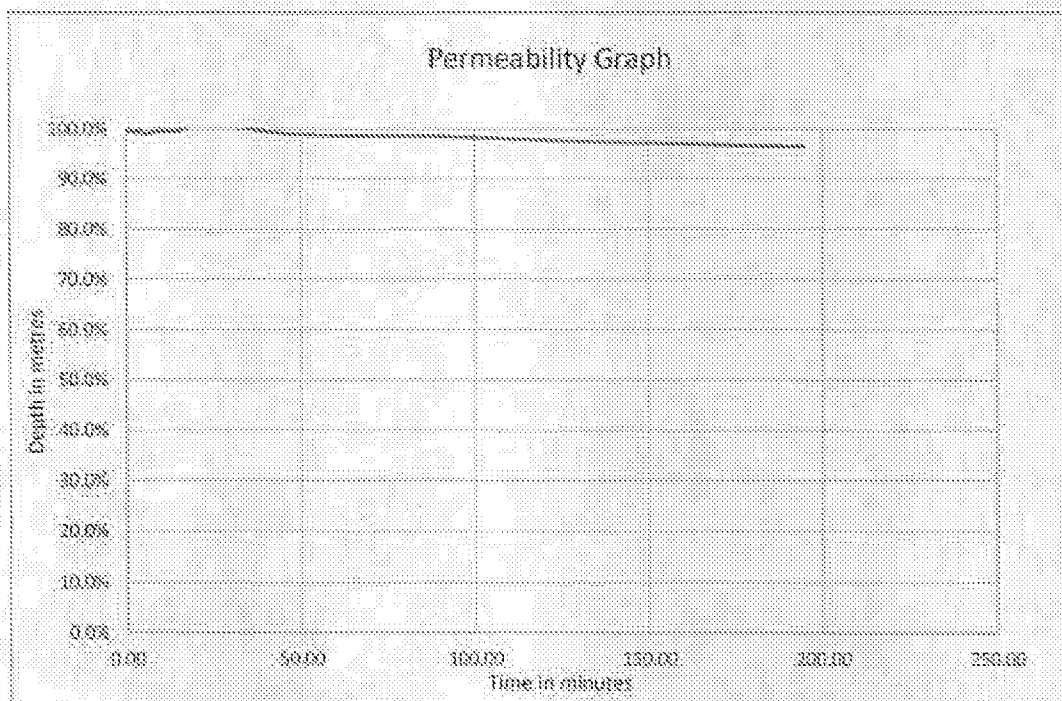
Construction Evaluation

Trial Hole: TP2

133

Washburn, 2009; Hays et al., 2009; O'Leary et al., 2010). Refers to exact sheet for information.

Infiltration Rate	from 75%-25%	not valid
-------------------	--------------	-----------



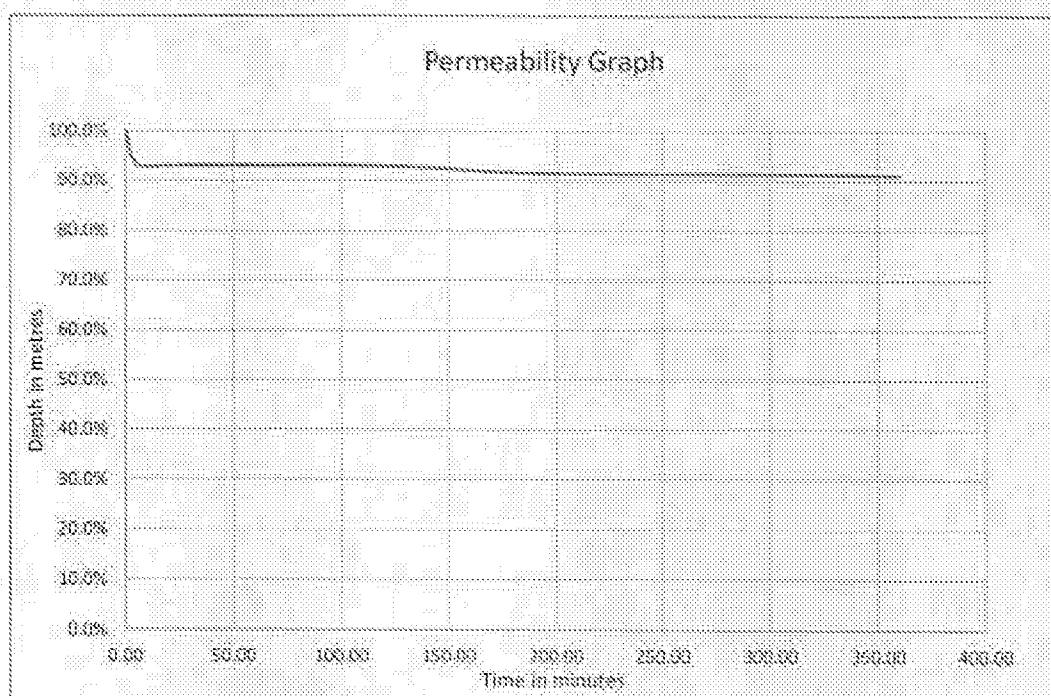
constructive evaluation

Trial Hole: TP3

from

WARNING DOES NOT AGG. TO 15% OF START DEPTH. Refer to manual sheet for explanation.

Infiltration Rate	from 75%-25%	not valid
-------------------	--------------	-----------



constructiveevaluation
an international journal of research and practice

Test Hole: TP4

Test 1

[illegible]

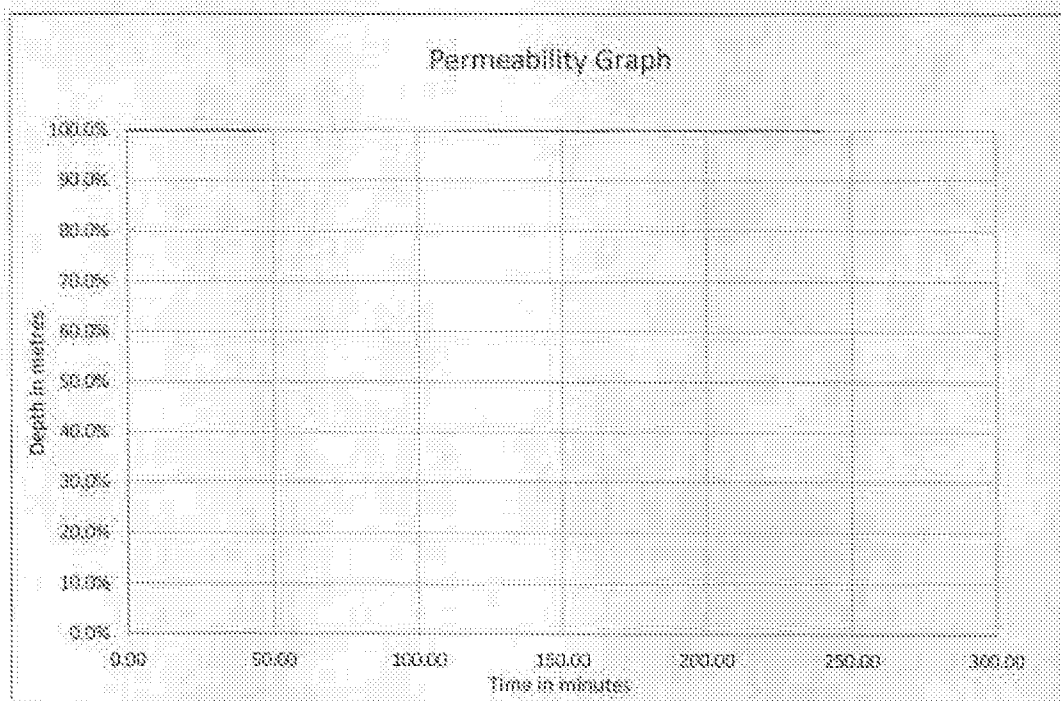
WARNING DOES NOT FALL TO 25% OF START DEPTH - Refer to graph sheet for calculation

Pit size		Time in mins
Length	1.50	75%
Width	0.60	25%
Depth	3.00	

Infiltration Rate

from 75%-25%

not valid



Soakaway Test Results & Soil Infiltration Rate



Site: Sack Lane

Job No: 18.9862

Trial Hole: TP5

Test 1

Time in minutes	Depth in metres to water surface	Depth in metres of water	Percentage of water depth at start
0.00	0.000	0.30	100.0%
0.50	0.000	0.30	100.0%
1.00	0.020	0.28	93.3%
1.50	0.020	0.28	93.3%
2.00	0.020	0.28	93.3%
2.50	0.020	0.28	93.3%
3.00	0.020	0.28	93.3%
3.50	0.020	0.28	93.3%
4.00	0.020	0.28	93.3%
4.50	0.020	0.28	93.3%
5.00	0.020	0.28	93.3%
10.00	0.030	0.27	90.0%
15.00	0.030	0.27	90.0%
20.00	0.030	0.27	90.0%
25.00	0.040	0.26	86.7%
30.00	0.050	0.25	83.3%
40.00	0.060	0.24	80.0%
50.00	0.070	0.23	76.7%
60.00	0.080	0.22	73.3%
75.00	0.090	0.21	70.0%
90.00	0.110	0.19	63.3%
120.00	0.130	0.17	56.7%
150.00	0.160	0.14	46.7%
180.00	0.180	0.12	40.0%
210.00	0.240	0.06	20.0%
250.00	0.260	0.04	13.3%
280.00	0.270	0.03	10.0%
290.00	0.270	0.03	10.0%

INFILTRATION CALCULATED FROM 75%-25% WATER DEPTH RANGE

PERMITS	
Length	0.30
Width	0.30
Depth	0.30

Time in mins

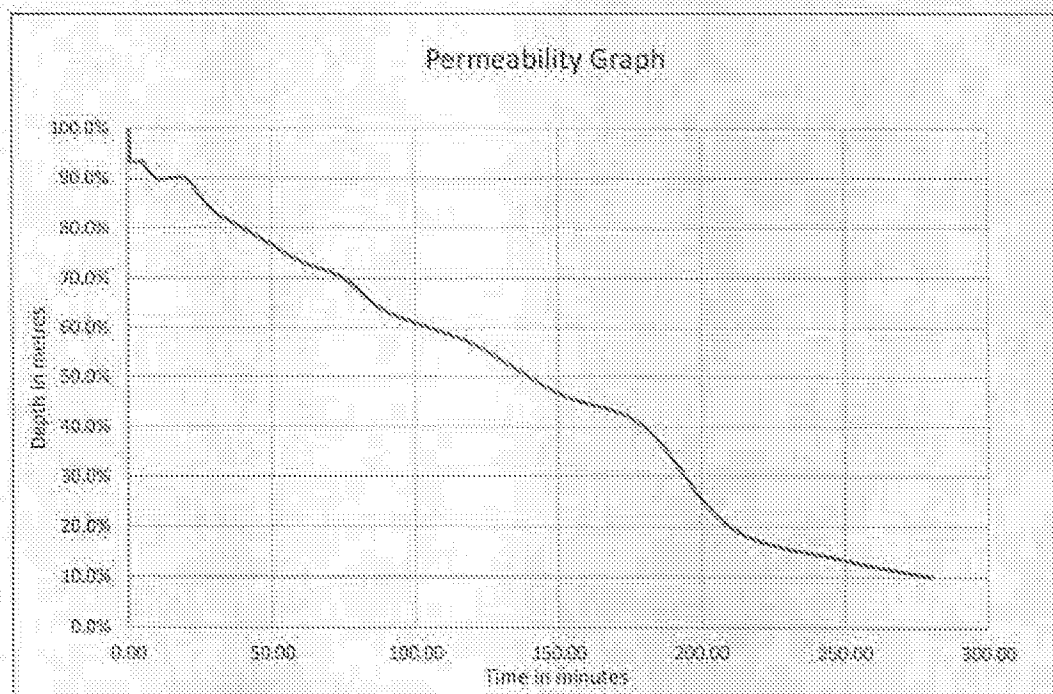
65: 75%

200: 25%

Infiltration Rate

from 75%-25%

6.17284E-06



APPENDIX E

Monitoring Sheets



constructiveevaluation

site investigation • building pathology

Ground Gas Monitoring

Job Name: Sack Lane Dairy

Job Number: 18.9862



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Unit 15 & 16 Ford Lane Business Park, Ford,
Arun, West Sussex, BN18 0UE

Monitoring Point		Flow Rate (l/hr)	Oxygen (%)		Carbon Dioxide (%)			Methane (%)			LEL (%)	Air Temp (°C)
			Low	Steady	Peak	Steady	GSV	Peak	Steady	GSV		
MR1 11/04/2018	WS1	0.0	6.0	6.0	8.3	8.3	0.000	4.9	4.9	0.000	1	15
	WS4	1.2	17.4	17.4	0.4	0.4	0.005	0.0	0.0	0.000	0	15
MR2 19/04/2018	WS1	0.0	10.0	10.1	6.1	6.0	0.000	2.7	2.7	0.000	1	25
	WS4	0.0	11.4	11.4	1.9	1.9	0.000	0.0	0.0	0.000	0	25
MR3 23/04/2018	WS1	0.0	20.0	20.1	0.8	0.7	0.000	0.4	0.4	0.000	7	12
	WS4	-0.2	10.0	10.0	3.5	3.4	-0.007	0.1	0.1	0.000	1	12
Worst Case Result		1.2	6.0		8.3		0.100	4.9		0.059	7	25

Monitoring Round		Time	ATMP (mbar)	Downhole P (mbar)	VOCs (ppm)	H2S (ppm)	CO (ppm)	Hydrogen	Weather	Ground Conditions	Atmospheric Pressure Trend	
MR1	11/04/2018	WS1	13:15:00	1008	16.17	4.3	0	9	Low	Sunny	Damp	Steady
		WS4	13:10:00	1008	16.07	4.8	0	12	Low	Sunny	Damp	
MR2	19/04/2018	WS1	13:00:00	1024	0.20	0.7	0	0	Low	Sunny	Dry	Steady
		WS4	12:50:00	1024	0.06	1.7	0	7	Low	Sunny	Dry	
MR3	23/04/2018	WS1	08:15:00	1016	-0.64	3.5	0	0	Low	Cloudy	Damp	Steady
		WS4	08:00:00	1016	-0.77	5.6	0	2	Low	Cloudy	Damp	

VOC - Measured using a Mini Rae 2000 Photoionising Detector (Calibration certificates supplied on request)

Gas Readings - Measured using a Geotech GA2000 gas analyser (Calibration certificates supplied on request)

APPENDIX F

Laboratory Certificates



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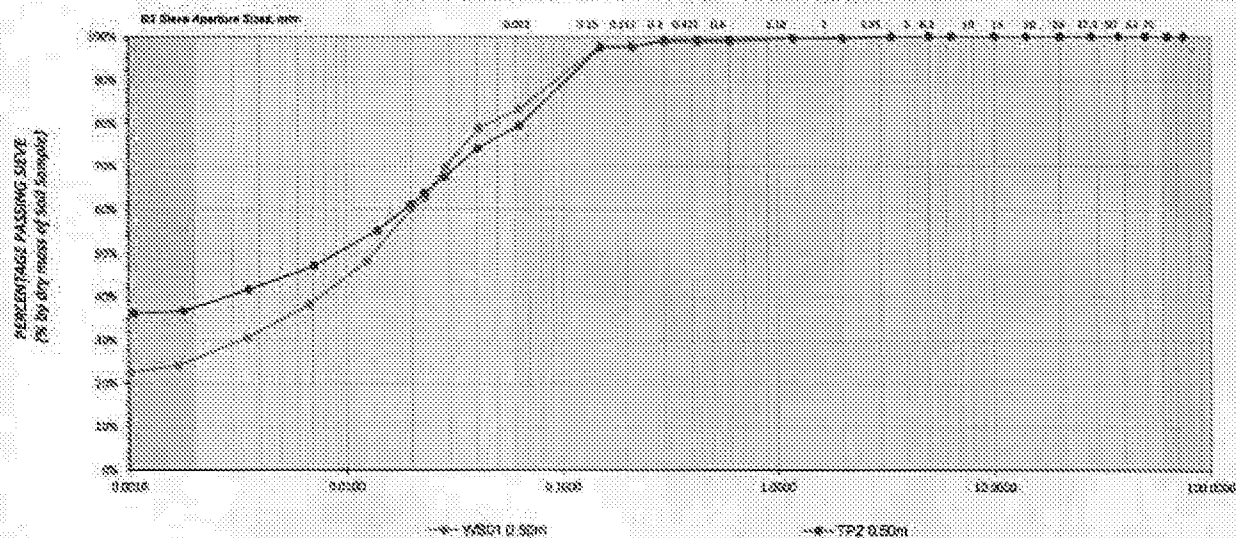
site investigation • building pathology



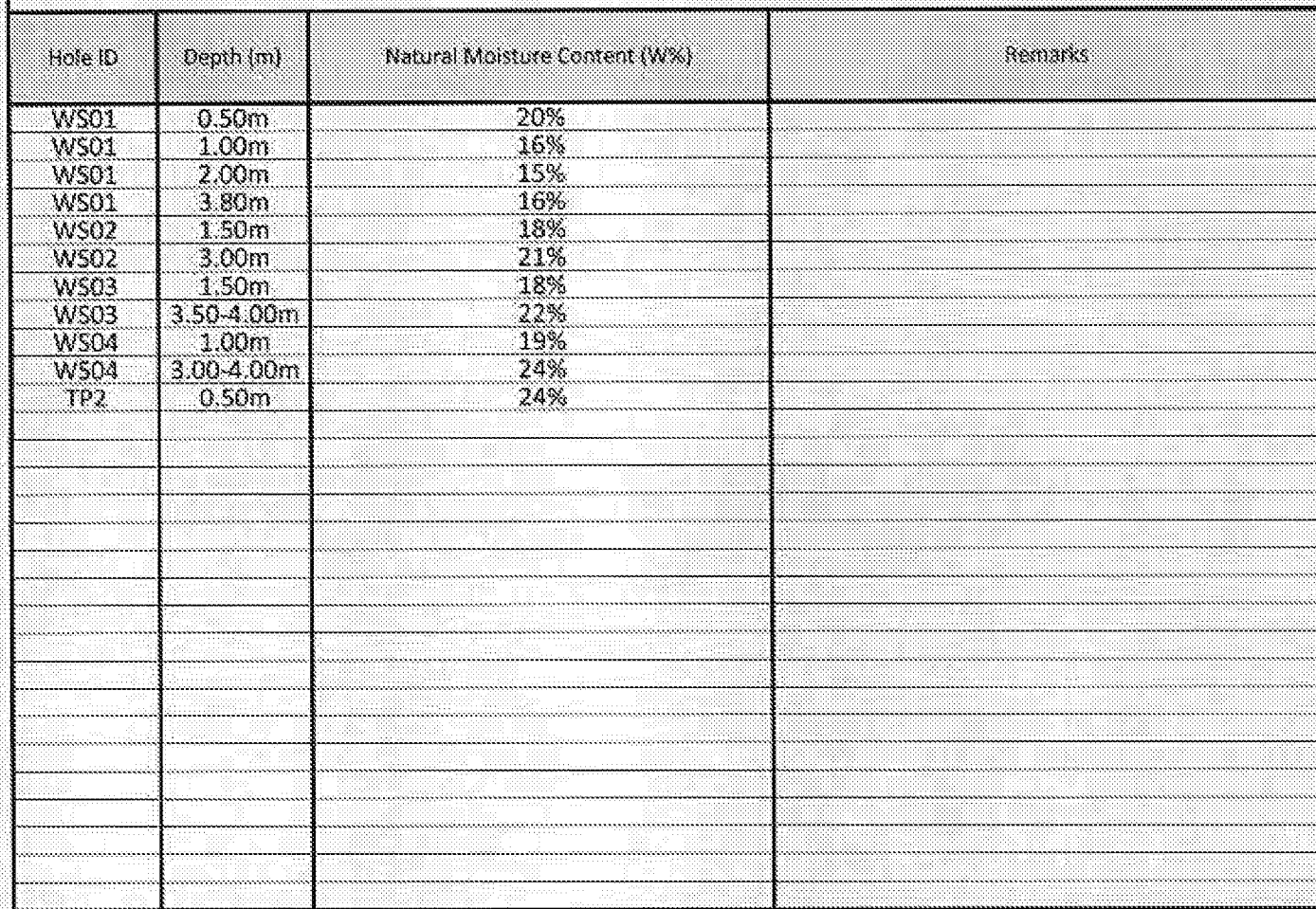
Project No	18.9862
Project Name	Sack Lane Dairy
Client	Melanie Jenkins Farming Ltd

Particle Size (mm)	% Passing							
	W501	TP2						
	0.50m	0.50m						
	Heavily Graded (Slightly Coarse) Silt	Moderately Graded (Slightly Sand) Clayey Silt						
75	100.0%	100.0%						
63	100.0%	100.0%						
50								
37.5								
28								
20								
14								
10	99.7%	99.6%						
6.3								
5								
3.35								
2								
1.18								
0.6	98.8%	99.3%						
0.425								
0.3	97.8%	97.5%						
0.212								
0.15								
0.063	83.3%	79.4%						
0.020 (Coarse Silt)	60.2%	61.1%						
0.006 (Medium Silt)	38.1%	47.1%						
0.002 (Fine Silt)	24.1%	36.6%						
0	0.0%	0.0%						
NMC (W%)	20%	24%						
Cobbles	0.0%	0.0%						
Gravels	0.3%	0.4%						
Sands	16.4%	20.1%						
Silt	59.2%	42.8%						
Clay	24.1%	36.6%						

PARTICLE SIZE DISTRIBUTION CURVE FOR SOIL SAMPLES



Client: Melanie Jenkins Farming Ltd





Ryan Gunn
Constructive Evaluation Ltd
Unit 15 & 16
Ford Lane Business
Ford Lane
Ford
Arundel
BN18 0JZ

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Unit 1
Rose Lane Industrial Estate
Rose Lane
Lentham Heath
Kent
ME17 2JN



DETS Report No: 18-73312

Site Reference: Sack Lane Dairy

Project / Job Ref: 18.9862

Order No: 18.9862/RG

Sample Receipt Date: 09/04/2018

Sample Scheduled Date: 09/04/2018

Report Issue Number: 1

Reporting Date: 13/04/2018

Authorised by:



Russell Jarvis
Associate Director of Client Services

Authorised by:



Dave Ashworth
Deputy Quality Manager



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Soil Analysis Certificate						
QTS Environmental Report No: 18-73312	Date Sampled	05/04/18	05/04/18	05/04/18	05/04/18	05/04/18
Constructive Evaluation Ltd	Time Sampled	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Site Reference: Sack Lane Dairy	TP / BM No	TP1	TP2	TP2	W501	W501
Project / Job Ref: 18/9862	Additional Refs	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Order No: 18.9862/RG	Depth (m)	0.30	0.30	0.76	0.30	0.60
Reporting Date: 13/04/2018	QTS Sample No	326715	326716	326717	326718	326719

Determinand	Unit	RL	Accreditation					
Ashesha Screen (S)	N/a	N/a	ISO17025	Not Detected	Not Detected	Not Detected	Not Detected	Not Detected
pH	pH Units	N/a	MCERTS	7.8	8.0	8.0	8.6	8.7
Total Cyanide	mg/kg	< 2	NONE	< 2	< 2	< 2	< 2	< 2
W/S Sulphate as SO ₄ (2:1)	mg/l	< 10	MCERTS	167	87	21	171	57
W/S Sulphate as SO ₄ (2:1)	g/l	< 0.01	MCERTS	0.17	0.07	0.02	0.17	0.06
Organic Matter	%	< 0.1	MCERTS	8	3.8	0.8	1.4	0.8
Arsenic (As)	mg/kg	< 2	MCERTS	13	7	8	9	8
Cadmium (Cd)	mg/kg	< 0.2	MCERTS	0.4	0.3	0.4	< 0.2	< 0.2
Chromium (Cr)	mg/kg	< 2	MCERTS	26	18	25	24	22
Copper (Cu)	mg/kg	< 4	MCERTS	29	13	12	14	11
Lead (Pb)	mg/kg	< 3	MCERTS	16	20	12	15	13
Mercury (Hg)	mg/kg	< 1	NONE	< 1	< 1	< 1	< 1	< 1
Nickel (Ni)	mg/kg	< 3	MCERTS	32	12	24	31	22
Selenium (Se)	mg/kg	< 3	NONE	< 3	< 3	< 3	< 3	< 3
Zinc (Zn)	mg/kg	< 3	MCERTS	77	75	68	58	46
Total Phenols (monohydric)	mg/kg	< 2	NONE	< 2	< 2	< 2	< 2	< 2

Analysis results are expressed on a dry weight basis where samples are assessed dried at less than 30°C.
Subtracted analysis (S)



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Soil Analysis Certificate

QTS Environmental Report No: 18-73312	Date Sampled	05/04/18				
Constructive Evaluation Ltd	Time Sampled	None Supplied				
Site Reference: Sack Lane Dairy	TP / BH No:	V504				
Project / Job Ref: 18.9862	Additional Refs	None Supplied				
Order No: 18.9862/RG	Depth (m)	0.30				
Reporting Date: 13/04/2018	QTS Sample No	326723				

Determinand	Unit	RL	Accreditation				
Asbestos Screen ³²	N/a	N/a	ISO17025	Not Detected			
pH	pH Units	N/a	MCERTS	7.8			
Total Cyanide	mg/kg	< 2	NONE	< 2			
W/S Sulphate as SO ₄ (2:1)	mg/g	< 10	MCERTS	26			
W/S Sulphate as SO ₄ (2:1)	g/g	< 0.01	MCERTS	0.03			
Organic Matter	%	< 0.1	MCERTS	0.6			
Arsenic (As)	mg/kg	< 2	MCERTS	12			
Cadmium (Cd)	mg/kg	< 0.2	MCERTS	< 0.2			
Chromium (Cr)	mg/kg	< 2	MCERTS	29			
Copper (Cu)	mg/kg	< 4	MCERTS	15			
Lead (Pb)	mg/kg	< 3	MCERTS	12			
Mercury (Hg)	mg/kg	< 1	NONE	< 1			
Nickel (Ni)	mg/kg	< 3	MCERTS	23			
Selenium (Se)	mg/kg	< 3	NONE	< 3			
Zinc (Zn)	mg/kg	< 3	MCERTS	59			
Total Phenols (monohydric)	mg/kg	< 2	NONE	< 2			

Analytical results are expressed on a dry weight basis where samples are analysed/dried at less than 30°C.

Subcontracted analysis (3)



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Soil Analysis Certificate - Speciated PAHs

QTS Environmental Report No: 18-73312	Date Sampled	05/04/18	05/04/18	05/04/18	05/04/18	05/04/18
Constructive Evaluation Ltd	Time Sampled	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Site Reference: Sack Lane Dairy	TP / BH No	TP1	TP2	TP2	WS01	WS01
Project / Job Ref: 18-9862	Additional Refs	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Order No: 18-9862/RIS	Depth (m)	0.30	0.30	0.30	0.30	0.30
Reporting Date: 13/04/2018	QTS Sample No	326715	326716	326717	326718	326719

Determinand	Unit	RI	Accreditation					
Naphthalene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Acenaphthylene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Acenaphthene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Fluorene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Phenanthrene	mg/kg	< 0.1	MCERTS	< 0.1	0.16	< 0.1	< 0.1	< 0.1
Anthracene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Fluoranthene	mg/kg	< 0.1	MCERTS	< 0.1	0.20	< 0.1	< 0.1	< 0.1
Pyrene	mg/kg	< 0.1	MCERTS	< 0.1	0.16	< 0.1	< 0.1	< 0.1
Benzo(a)anthracene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Chrysene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(b)fluoranthene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(k)fluoranthene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(a)pyrene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Indeno(1,2,3-cd)pyrene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Dibenz(a,h)anthracene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(g,h,i)perylene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Total EPA 16 PAHs	mg/kg	< 1.6	MCERTS	< 1.6	< 1.6	< 1.6	< 1.6	< 1.6

Analytical results are expressed on a dry weight basis where samples are oven-dried at less than 30°C



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Soil Analysis Certificate - Speciated PAHs

QTS Environmental Report No: 18-73312	Date Sampled	05/04/18			
Constructive Evaluation Ltd	Time Sampled	None Supplied			
Site Reference: Sack Lane Dairy	TP / BH No	W504			
Project / Job Ref: 18.9862	Additional Refs	None Supplied			
Order No: 18.9862/RG	Depth (m)	0.35			
Reporting Date: 13/04/2018	QTS Sample No	326728			

Determinand	Unit	RI	Accreditation			
Naphthalene	mg/kg	< 0.1	MCERTS	< 0.1		
Acenaphthylene	mg/kg	< 0.1	MCERTS	< 0.1		
Acenaphthene	mg/kg	< 0.1	MCERTS	< 0.1		
Fluorene	mg/kg	< 0.1	MCERTS	< 0.1		
Phenanthrene	mg/kg	< 0.1	MCERTS	< 0.1		
Anthracene	mg/kg	< 0.1	MCERTS	< 0.1		
Fluoranthene	mg/kg	< 0.1	MCERTS	< 0.1		
Pyrene	mg/kg	< 0.1	MCERTS	< 0.1		
Benzo(a)anthracene	mg/kg	< 0.1	MCERTS	< 0.1		
Chrysene	mg/kg	< 0.1	MCERTS	< 0.1		
Benzo(b)fluoranthene	mg/kg	< 0.1	MCERTS	< 0.1		
Benzo(k)fluoranthene	mg/kg	< 0.1	MCERTS	< 0.1		
Benzo(a)pyrene	mg/kg	< 0.1	MCERTS	< 0.1		
Indeno(1,2,3-cd)pyrene	mg/kg	< 0.1	MCERTS	< 0.1		
Dibenz(a,h)anthracene	mg/kg	< 0.1	MCERTS	< 0.1		
Benzo(ghi)perylene	mg/kg	< 0.1	MCERTS	< 0.1		
Total EPA-16 PAHs	mg/kg	< 1.6	MCERTS	< 1.6		

Analytical results are expressed on a dry weight basis where samples are analysed dried at less than 30°C



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Soil Analysis Certificate - TPH CWG Banded

QTS Environmental Report No: 18-73312	Date Sampled	05/04/18	05/04/18	05/04/18	05/04/18	05/04/18
Constructive Evaluation Ltd	Time Sampled	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Site Reference: Sack Lane Dairy	TP / BH No	TP1	TP2	TP2	WS01	WS01
Project / Job Ref: 18.9862	Additional Refs	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Order No: 18.9862/RG	Depth (m)	0.30	0.30	0.70	0.30	0.60
Reporting Date: 13/04/2018	QTS Sample No	326715	326716	326717	326718	326719

Determinand	Unit	RL	Accreditation					
Aliphatic >C5 - C6	mg/kg	< 0.01	NONE	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Aliphatic >C6 - C8	mg/kg	< 0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Aliphatic >C8 - C10	mg/kg	< 2	MCERTS	< 2	< 2	< 2	< 2	< 2
Aliphatic >C10 - C12	mg/kg	< 2	MCERTS	< 2	< 2	< 2	< 2	< 2
Aliphatic >C12 - C16	mg/kg	< 3	MCERTS	< 3	< 3	< 3	< 3	< 3
Aliphatic >C16 - C21	mg/kg	< 3	MCERTS	< 3	< 3	< 3	< 3	< 3
Aliphatic >C21 - C34	mg/kg	< 10	MCERTS	< 10	< 10	< 10	< 10	< 10
Aliphatic (C5 - C34)	mg/kg	< 21	NONE	< 21	< 21	< 21	< 21	< 21
Aromatic >C5 - C7	mg/kg	< 0.01	NONE	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Aromatic >C7 - C8	mg/kg	< 0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Aromatic >C8 - C10	mg/kg	< 2	MCERTS	< 2	< 2	< 2	< 2	< 2
Aromatic >C10 - C12	mg/kg	< 2	MCERTS	< 2	< 2	< 2	< 2	< 2
Aromatic >C12 - C16	mg/kg	< 2	MCERTS	< 2	< 2	< 2	< 2	< 2
Aromatic >C16 - C21	mg/kg	< 3	MCERTS	< 3	< 3	< 3	< 3	< 3
Aromatic >C21 - C35	mg/kg	< 10	MCERTS	< 10	< 10	< 10	< 10	< 10
Aromatic (C5 - C35)	mg/kg	< 21	NONE	< 21	< 21	< 21	< 21	< 21
Total >C5 - C35	mg/kg	< 42	NONE	< 42	< 42	< 42	< 42	< 42

Analytical results are expressed on a dry weight basis where samples are assisted dried at less than 30°C.



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Soil Analysis Certificate - TPH CWG Banded

QTS Environmental Report No: 18-73312	Date Sampled	05/04/18				
Constructive Evaluation Ltd	Time Sampled	None Supplied				
Site Reference: Sack Lane Dairy	TP / BH No	W504				
Project / Job Ref: 18.9862	Additional Refs	None Supplied				
Order No: 18.9862/RG	Depth (m)	0.30				
Reporting Date: 13/04/2018	QTS Sample No	326728				

Determinand	Unit	RL	Accreditation				
Aliphatic >C5 - C6	mg/kg	< 0.01	NONE	< 0.01			
Aliphatic >C6 - C8	mg/kg	< 0.05	NONE	< 0.05			
Aliphatic >C8 - C10	mg/kg	< 2	MCERTS	< 2			
Aliphatic >C10 - C12	mg/kg	< 2	MCERTS	< 2			
Aliphatic >C12 - C16	mg/kg	< 3	MCERTS	< 3			
Aliphatic >C16 - C21	mg/kg	< 3	MCERTS	< 3			
Aliphatic >C21 - C34	mg/kg	< 10	MCERTS	< 10			
Aliphatic (C5 - C34)	mg/kg	< 21	NONE	< 21			
Aromatic >C5 - C7	mg/kg	< 0.01	NONE	< 0.01			
Aromatic >C7 - C8	mg/kg	< 0.05	NONE	< 0.05			
Aromatic >C8 - C10	mg/kg	< 2	MCERTS	< 2			
Aromatic >C10 - C12	mg/kg	< 2	MCERTS	< 2			
Aromatic >C12 - C16	mg/kg	< 2	MCERTS	< 2			
Aromatic >C16 - C21	mg/kg	< 3	MCERTS	< 3			
Aromatic >C21 - C35	mg/kg	< 10	MCERTS	< 10			
Aromatic (C5 - C35)	mg/kg	< 21	NONE	< 21			
Total >C5 - C35	mg/kg	< 42	NONE	< 42			

Analytical results are expressed on a dry weight basis where samples are air-dried or dried at less than 30°C.



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Soil Analysis Certificate - BTEX / MTBE

QTS Environmental Report No: 18-73312	Date Sampled	05/04/18	05/04/18	05/04/18	05/04/18	05/04/18
Constructive Evaluation Ltd	Time Sampled	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Site Reference: Sack Lane Dairy	TP / BFI No	TP1	TP2	TP2	WS01	WS01
Project / Job Ref: 18.9862	Additional Refs	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Order No: 18.9862/RG	Depth (m)	0.38	0.30	0.70	0.30	0.60
Reporting Date: 13/04/2018	QTS Sample No	326715	326716	326717	326718	326719

Determinand	Unit	RI	Accreditation					
Benzene	ug/kg	< 2	MCERTS	< 2	< 2	< 2	< 2	< 2
Toluene	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5	< 5
Ethylbenzene	ug/kg	< 2	MCERTS	< 2	< 2	< 2	< 2	< 2
p & m-xylene	ug/kg	< 2	MCERTS	< 2	< 2	< 2	< 2	< 2
o-xylene	ug/kg	< 2	MCERTS	< 2	< 2	< 2	< 2	< 2
MTBE	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5	< 5

Analytical results are expressed on a dry weight basis where samples are assessed-dried at less than 30°C.



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Soil Analysis Certificate - BTEX / MTBE

QTS Environmental Report No: 18-73312	Date Sampled	05/04/18				
Constructive Evaluation Ltd	Time Sampled	None Supplied				
Site Reference: Sack Lane Dairy	TP / BH No	WS04				
Project / Job Ref: 18.9862	Additional Refs	None Supplied				
Order No: 18.9862/RG	Depth (m)	0.30				
Reporting Date: 13/04/2018	QTS Sample No	326720				

Determinand	Unit	RI	Accreditation			
Benzene	ug/kg	< 2	MCERTS	< 2		
Toluene	ug/kg	< 5	MCERTS	< 5		
Ethylbenzene	ug/kg	< 2	MCERTS	< 2		
p & m-xylene	ug/kg	< 2	MCERTS	< 2		
o-xylene	ug/kg	< 2	MCERTS	< 2		
MTBE	ug/kg	< 5	MCERTS	< 5		

Analyst: results are expressed on a dry weight basis where samples are oven-dried at less than 30°C.



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Soil Analysis Certificate - Sample Descriptions

QTS Environmental Report No: 18-73312

Constructive Evaluation Ltd

Site Reference: Sack Lane Dairy

Project / Job Ref: 18.9862

Order No: 18.9862/RG

Reporting Date: 13/04/2018

QTSE Sample No	TP / BH No	Additional Refs	Depth (m)	Moisture Content (%)	Sample Matrix Description
326715	TP1	None Supplied	0.30	16.5	Brown sandy clay
326716	TP2	None Supplied	0.30	15.3	Brown sandy clay with vegetation and chalk
326717	TP2	None Supplied	0.70	14.7	Brown sandy clay with stones and chalk
326718	WS01	None Supplied	0.30	13.3	Brown sandy clay with chalk and brick
326719	WS01	None Supplied	0.50	10.0	Brown sandy clay
326720	WS04	None Supplied	0.30	17	Brown sandy clay

Moisture content is part of procedure 2023 & is not an accredited test

Insufficient Sample ^{15%}

Insufficient Sample ^{15%}

Soil Analysis Certificate - Methodology & Miscellaneous Information

QTS Environmental Report No: 18-73312

Constructive Evaluation Ltd

Site Reference: Sack Lane Dairy

Project / Job Ref: 18.9862

Order No: 18.9862/RG

Reporting Date: 13/04/2018

Matrix	Analysed On	Determinand	Brief Method Description	Method No
Soil	D	Boron - Water Soluble	Determination of water soluble boron in soil by 2:1 hot water extract followed by ICP-OES	E012
Soil	AR	BTEX	Determination of BTEX by headspace GC-MS	E001
Soil	D	Cations	Determination of cations in soil by aqua-regia digestion followed by ICP-OES	E002
Soil	D	Chloride - Water Soluble (2:1)	Determination of chloride by extraction with water & analysed by ion chromatography	E009
Soil	AR	Chromium - Hexavalent	Determination of hexavalent chromium in soil by extraction in water then by acidification, addition of 1,5 diphenylcarbazide followed by colorimetry	E016
Soil	AR	Cyanide - Complex	Determination of complex cyanide by distillation followed by colorimetry	E015
Soil	AR	Cyanide - Free	Determination of free cyanide by distillation followed by colorimetry	E015
Soil	AR	Cyanide - Total	Determination of total cyanide by distillation followed by colorimetry	E015
Soil	D	Cyclohexane Extractable Matter (CEM)	Gravimetrically determined through extraction with cyclohexane	E011
Soil	AR	Diesel Range Organics (C10 - C24)	Determination of hexane/acetone extractable hydrocarbons by GC-FID	E004
Soil	AR	Electrical Conductivity	Determination of electrical conductivity by addition of saturated calcium sulphate followed by electrometric measurement	E022
Soil	AR	Electrical Conductivity	Determination of electrical conductivity by addition of water followed by electrometric measurement	E023
Soil	D	Elemental Sulphur	Determination of elemental sulphur by solvent extraction followed by GC-MS	E020
Soil	AR	EPH (C10 - C40)	Determination of acetone/hexane extractable hydrocarbons by GC-FID	E004
Soil	AR	EPH Product ID	Determination of acetone/hexane extractable hydrocarbons by GC-FID	E004
Soil	AR	EPH TEXAS (C6-C8, C9-C10, C11-C12, C13-C16, C17-C21, C22-C40)	Determination of acetone/hexane extractable hydrocarbons by GC-FID for C6 to C40, C6 to C8 by headspace GC-MS	E004
Soil	D	Fluoride - Water Soluble	Determination of fluoride by extraction with water & analysed by ion chromatography	E009
Soil	D	FOC (Fraction Organic Carbon)	Determination of fraction of organic carbon by oxidising with potassium dichromate followed by titration with iron (II) sulphate	E010
Soil	D	Loss on Ignition @ 450°C	Determination of loss on ignition in soil by gravimetrically with the sample being ignited in a muffle furnace	E019
Soil	D	Magnesium - Water Soluble	Determination of water soluble magnesium by extraction with water followed by ICP-OES	E025
Soil	D	Metals	Determination of metals by aqua-regia digestion followed by ICP-OES	E002
Soil	AR	Mineral Oil (C10 - C40)	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge	E004
Soil	AR	Moisture Content	Moisture content; determined gravimetrically	E003
Soil	D	Nitrate - Water Soluble (2:1)	Determination of nitrate by extraction with water & analysed by ion chromatography	E009
Soil	D	Organic Matter	Determination of organic matter by oxidising with potassium dichromate followed by titration with iron (II) sulphate	E010
Soil	AR	PAH - Speciated (EPA 16)	Determination of PAH compounds by extraction in acetone and hexane followed by GC-MS with the use of surrogate and internal standards	E005
Soil	AR	PCB - 7 Congeners	Determination of PCB by extraction with acetone and hexane followed by GC-MS	E008
Soil	D	Petroleum Ether Extract (PEE)	Gravimetrically determined through extraction with petroleum ether	E011
Soil	AR	pH	Determination of pH by addition of water followed by electrometric measurement	E007
Soil	AR	Phenols - Total (monophenols)	Determination of phenols by distillation followed by colorimetry	E021
Soil	D	Phosphate - Water Soluble (2:1)	Determination of phosphate by extraction with water & analysed by ion chromatography	E009
Soil	D	Sulphate (as SO4) - Total	Determination of total sulphate by extraction with 10% HCl followed by ICP-OES	E013
Soil	D	Sulphate (as SO4) - Water Soluble (2:1)	Determination of sulphate by extraction with water & analysed by ion chromatography	E009
Soil	D	Sulphate (as SO4) - Water Soluble (2:1)	Determination of water soluble sulphate by extraction with water followed by ICP-OES	E014
Soil	AR	Sulphide	Determination of sulphide by distillation followed by colorimetry	E018
Soil	D	Sulphur - Total	Determination of total sulphur by extraction with aqua-regia followed by ICP-OES	E024
Soil	AR	SvOC	Determination of semi-volatile organic compounds by extraction in acetone and hexane followed by GC-MS	E006
Soil	AR	Thiocyanate (as SCN)	Determination of thiocyanate by extraction in caustic soda followed by acidification followed by addition of ferric nitrate followed by colorimetry	E017
Soil	D	Toluene Extractable Matter (TEM)	Gravimetrically determined through extraction with toluene	E011
Soil	D	Total Organic Carbon (TOC)	Determination of organic matter by oxidising with potassium dichromate followed by titration with iron (II) sulphate	E010
Soil	AR	TPH CWG (ar: C5-C6, C6-C8, C9-C10, C11-C12, C13-C16, C17-C21, C22-C34, ar: C5-C7, C7-C9, C9-C10, C11-C12, C13-C16, C17-C21, C22-C35)	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge for C6 to C35, C5 to C8 by headspace GC-MS	E004
Soil	AR	TPH LQM (ar: C5-C6, C6-C8, C9-C10, C11-C12, C13-C16, C17-C21, C22-C34, ar: C5-C7, C7-C9, C9-C10, C11-C12, C13-C16, C17-C21, C22-C35, C35-C40)	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge for C6 to C40, C5 to C8 by headspace GC-MS	E004
Soil	AR	VOCs	Determination of volatile organic compounds by headspace GC-MS	E001
Soil	AR	VPH (C6-C8 & C9-C10)	Determination of hydrocarbons C6-C8 by headspace GC-MS & C9-C10 by GC-FID	E001

D Dried
AR As Received