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SITE INVESTIGATION & GROUND ASSESSMENT

LODEMATIC, PRIMROSE ROAD, CLITHEROE, LANCASHIRE

Report Ref BEK-19568-1 September 2019

Report Prepared for

RIBBLE VALLEY PROPERTY DEVELOPMENT LTD
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Project Quality Assurance Information Sheet

SITE INVESTIGATION & CONTAMINATION ASSESSMENT

Lodematic, Primrose Road, Clitheroe

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1. INTRODUCTION

1.1 Appointment

1.1.1 BEK Enviro Limited (BEK) has been commissioned by Mr Rob Evans to carry out a site investigation and contamination assessment for the land located at Lodematic Works, Primrose Road, Clitheroe, BB7 1BS (hereafter referred to as 'the site'). The investigation will inform a quantitative risk assessment with respect to contamination and ground gas at the site considering change of use to residential.

1.2 Background Information

1.2.1 The site is occupied by a vacant mill building/s that was until recently used as an engineering works (manufacturing metallic components). The site is dominated by three main buildings (orientated east/west) on multiple levels. The buildings were originally separate but have become adjoined over time.

1.2.2 The southern building is a multi-storey structure constructed of stone, with the upper two northern buildings built of similar materials, but with fewer floors and lower roof height, reflecting the changes in ground levels from south to north. The two most northern units are large open rooms, which were the main manufacturing areas of the engineering works. A separate outer works building is located in the north-east corner of the site, adjacent to (an off-site) electrical sub-station.

1.2.3 The works building generally has concrete floors throughout, which in localised areas show signs of staining from oils. A disused derelict stone cottage building is connected to the west edge of the northern main building, with an overgrown associated garden located in the north-west corner of the site, bounded to the west by a stone wall.

1.2.4 The site location and layout is illustrated on BEK Drawing No 19568-1 and 19568-2, copies of which are presented in Appendix D.

1.3 Proposed Development

1.3.1 Ribble Valley Council has granted planning permission (subject to conditions) for the 'demolition of existing workshops buildings (other than workshop 3), conversion of workshop 3 to provide 14 residential apartments the erection of 4 residential apartments, erection of cycle/refuse store, laying out of parking and circulation areas, and associated landscaping.'

1.3.2 The proposed development is presented on Sunderland Peacock Architecture drawing titled 'Proposed Site Plan' (Drawing No 5857-19), a copy of which is presented in Appendix D.

1.3.3 This report has been prepared to satisfy Part 2 of Planning Condition 15. The full requirements of Condition No 15 are presented below:

'Prior to each phase of development approved by this planning permission no development (or such other date or stage in development as may be agreed in writing with the Local Planning Authority), shall take place until a scheme that includes the following components to deal with the risks associated with contamination of the site shall each be submitted to and approved, in writing, by the local planning authority:

1) A preliminary risk assessment which has identified:

- *All previous uses*
- *Potential contaminants associated with those uses*
- *A conceptual model of the site indicating sources, pathways and receptors*
- *Potentially unacceptable risks arising from contamination at the site*

2) A site investigation scheme, based on (1) to provide information for a detailed assessment of the risk to all receptors that may be affected, including those off site.

3) The results of the site investigation and detailed risk assessment referred to in (2) and, based on these, an options appraisal and remediation strategy giving full details of the remediation measures required and how they are to be undertaken.

4) A verification plan providing details of the data that will be collected in order to demonstrate that the works set out in the remediation strategy in (3) are complete and identifying any requirements for longer-term monitoring of pollutant linkages, maintenance and arrangements for contingency action. Any changes to these components require the express written consent of the local planning authority. The scheme shall be implemented as approved.'

1.3.4 It should be noted that the work required to satisfy Part 1 of the Planning Condition No 15 has been carried out by PSA Design and is detailed in their 'Phase 1 Land Quality Assessment' prepared for the site in February 2015 (Report Ref: D1990-GR-01B).

1.4 Objective & Scope of Work

1.4.1 The objective of the site investigation and assessment is to quantify the potential risks identified in the Phase 1 Land Quality Assessment (Phase 1).

1.4.2 The site investigation was undertaken by BEK during May 2019 in accordance with the recommendations detailed in the Phase 1.

1.4.3 This report provides a summary of the site details and ground conditions encountered as well as a quantitative assessment of the potential pollutant linkages considering a change of use to residential.

1.4.4 The Phase 1 report should be read in conjunction with this report.

1.5 Limitations

1.5.1 The conclusions and recommendations presented in this report are the result of our professional interpretation of the information currently available. BEK reserve the right to amend the conclusions and recommendations if further information becomes available.

1.5.2 However, it should be noted that much of the information has been derived from reports written by others and BEK takes no responsibility for the accuracy of that information. Notwithstanding the above, the reports reviewed have all been written by professional environmental consultants with a duty of care to provide relevant and accurate information.

1.5.3 The comments given in this report and the opinions expressed are based on review of reports provided to BEK, ground conditions encountered during site works and the results of tests made in the field and in the laboratory. However, there may be conditions pertaining to the site that have not been disclosed by the investigations and therefore could not be taken into account.

2. BACKGROUND INFORMATION

2.0.1 This section provides an overview of the findings and recommendations presented in the Phase 1 Report.

2.1 Site Location & History

Site Location/Description

The site details are summarised in the table below:

Detail	Remarks
Location	Within SW outskirts of Clitheroe (Dwg D1990-01).
Address	Lodematic Works, Primrose Road, Clitheroe, BB7 1BS
NGR	37371SE, 440750N
Area	0.260 ha
Known Services	No services plan have been provided/made available for the scheme

Table 1: *Summary of Site Details – Extract from Phase 1 Report*

2.1.1 The site is occupied by a vacant mill building/s that was until recently used as an engineering works (manufacturing metallic components). The site is dominated by three main buildings (orientated east/west) on multiple levels. The buildings were originally separate but have become adjoined over time.

2.1.2 The southern building is a multi-storey structure constructed of stone, with the upper two northern buildings built of similar materials, but with fewer floors and lower roof height, reflecting the changes in ground levels from south to north. The two most northern units are large open rooms, which were the main manufacturing areas of the engineering works. A separate outer works building is located in the north-east corner of the site, adjacent to (an off-site) electrical sub-station.

2.1.3 The works building generally has concrete floors throughout, which in localised areas show signs of staining from oils. A disused derelict stone cottage building is connected to the west edge of the northern main building, with an overgrown associated garden located in the north-west corner of the site, bound to the west by a stone wall.

2.1.4 Tarmac and concrete surfacing throughout yard/parking areas. Various service covers throughout, with an assumed complex underground drainage system.

2.1.5 Minor vegetation observed, generally wild growth of scrub species within small pockets of disused land surrounding the building, mainly prevalent in the north-west and north-east corners of the site.

2.1.6 The ground drops significantly from north (72.5 m AOD) to south (64.5 m AOD). The level changes have been accommodated within the original building construction, with the lower southern building set on a lower (basement) level (66.5mAOD), which is still approximately 2 m higher than the outer car park level, to the south. The general operating plant floor, housing the main works, occurs on a higher level (approximately 70.5 m AOD).

2.1.7 Access to the site is from the highway, Primrose Road to the east. The access road to the lower level car park has a steep gradient. Ramped vehicle access into northern building.

2.1.8 Various pedestrian entrances into building, generally by steps, accommodating the change in levels across the site, from north to south.

2.1.9 Disused above ground oil tank located outside the north-east access of the main building.

2.1.10 A large housing development is located to the north of the site (up gradient). Part of the southern boundary is made up of the office building of Primrose Studios, with Primrose House, residence to the south-west. The large ex-mill building, Primrose Business Park, hosts many different businesses (carpet storage, gym etc), located down-slope, south and east of the site. A mill race runs along the southern edge of the access road, at a lower level, fed from the reservoir to the north-east, flowing to the south-west.

Contaminative Operations

2.1.11 There are various current site operations that are considered to represent a potential source of current ground contamination. Various oils are used in the manufacturing process that, although the works area will have a drainage/cleaning process to prevent major leakages, will potentially have permeated into the upper surface of the concrete floors over time. Oil drums were present within the lower basement area of the south building along with a boiler room. The central building housed a paint shop within the west area of the building.

Site History

2.1.12 Based on the earliest available maps dating from 1846 the site has been developed as part of the north-west area of Primrose Print Works. Two large long thin rectangular buildings east/west were present across the full length of the site with small buildings in the north-west corner. On 1884 maps, additional buildings were constructed connecting two large buildings at the site. Part of the eastern edge of the northern building had been demolished. The configuration of the site has remained this way until present.

2.1.13 The offsite site history includes a print works to the south and east of the site, cotton mills to the north, infilled filter beds and lodge to east and landfill to north-west throughout the site history.

2.2 Environmental Setting

Geology

2.2.1 The British Geological Survey map for the area indicates that the site is underlain by alluvial which overlies Glacial Till (boulder clay). This overlies bedrock comprising 'Clitheroe Limestone & Hodder Mudstone Formation'.

Mining and Ground Stability

2.2.2 BGS/OS Mapping confirms the site is not within an area which may be affected by mining.

Hydrogeology

2.2.3 The Environment Agency Groundwater Vulnerability map indicates that the site is not located within a groundwater source protection zone. The site is underlain by a Secondary A Aquifer/unproductive superficial aquifer and a Secondary (B) bedrock aquifer.

2.2.4 No groundwater abstractions are located within 2 km of the site. The nearest surface water abstraction is located 53 m north-east of the site (general usage).

Hydrology

2.2.5 The nearest watercourse is Mearley Brook an engineered watercourse 12 m east of the site fed from reservoir to the north-east. Pendleton Brook is located some 67 m south of the site.

2.2.6 Two pollution incidents are located within 500 m of the site, the closest of which is located some 260 m south-west of the site and included a minor impact from crude sewage into Pendleton Brook.

2.2.7 There is one active discharge consent located within a 250 m radius of the site which refers to a trade discharge some 14 m south of the site at Primrose Lodge.

2.2.8 Environment Agency Maps indicate that the site is not located within a floodplain

Contaminated Land & Landfills

2.2.9 A small historic landfill is located approximately 161 m north-west of the site. This was located at the former Stalwart Dying Company, Kemple View and the waste type is unknown.

2.2.10 Historic OS Plans and the EA website indicate that the site was formerly used for the manufacturing of metal components with oils usage and paint spraying, although concrete floors are present throughout and standard H & S protocol have been in place for any pollution incident.

2.2.11 One above ground tank is present on site and an electrical substation is present on the north-east boundary of the site.

Radon

2.2.12 The BRE Report BR211 BGS Stage 2 Report indicates that less than 1 % of homes are above the Radon Action Level, therefore no protective measures are necessary in the construction of new dwellings or extensions.

2.3 Hazard Assessment: Sources of Contamination

2.3.1 The industrial processes and activities undertaken on or adjacent to the site that may act as potential historical or current sources of environmental hazard are shown in Table 1.

Type of Issue	SOURCE-Specific Issue	HAZARD-Remarks
Potential on-site contamination sources HISTORICAL	1. Print Works. 2. Paper Mill. 3. Fuel Tank. 4. Made Ground beneath site.	1-4. Potential sources of contamination from metalloids, hydrocarbons & PAH into soil and groundwater. 4. Risk of ground gas production (CO_2 & CH_4).
Potential off-site contamination sources HISTORICAL	1. Print Works to S&E. 2. Cotton Mills to N. 3. Infilled filter beds and lodge to E and landfill to NW.	1,2&4. Potential sources of migration of metalloids, sulphates, hydrocarbons PCB & PAH into soil and groundwater. 3. Risk of ground gas production (CO_2 & CH_4).
Potential on-site contamination sources CURRENT	1. Engineering Plant 2. Asbestos in building fabric.	1. Potential sources of contamination from metalloids, hydrocarbons SVOC, VOC & PAH into soil and groundwater. 2. Asbestos represents human health risk (inhalation).
Potential off-site contamination sources CURRENT	1. Electricity Sub-Station.	1. Potential sources of migration of metalloids, hydrocarbons & PCB into soil and groundwater.
Potential geotechnical hazards	1. Possible fill beneath site. 2. Steeply sloping site. 3. Conversion & demolition. 4. Underground services & relict foundations. 5. Proximity of adjoining properties.	1. Deeper foundation for building. 2. Possible retaining structures required and slope stability issues. 3. Stability issues for new development require structural assessment. 4. Obstructions. 5. Stability & party wall concerns.

Table 2: Potential Sources of Contamination

2.4 Hazard Assessment: Pathways

2.4.1 Five pollutant receptors have been identified for the site and are listed in Table 2 below, together with the pathways through which they may be linked to pollutant sources.

Receptor	Pathways
HUMAN HEALTH Re-development workers End users-residents	Inhalation, ingestion, skin contact
WATER ENVIRONMENT Controlled Waters	Groundwater
FAUNA & FLORA Landscaping	Root uptake
BUILT ENVIRONMENT Buildings and services	Diffusion of vapours through ground. Diffusion of landfill gas through ground and collection in confined spaces. Direct contact with contaminated soil and groundwater.

Table 3: Potential Pathways and Receptors

2.5 Conceptual Site Model

2.5.1 This section identifies the potential contaminants of concern, sources, pathways and receptors that may be associated with the site based on its known history and the current condition and with respect to the redevelopment of the site for commercial use. The preliminary conceptual model is summarised in the following table extracts from the Phase 1 report.

2.5.2 The preliminary conceptual model is summarised in the following table:

Source	Pathway	Receptor	Consequence	Probability	Risk Classification
On-site historic sources of ground contamination arising from fuel tank & fuel/oil spillage from Print Works/Paper Mill including metalloids, PAHs, hydrocarbons, SVOC & VOC's	Inhalation, ingestion, skin contact	Re-development workers	medium	low	**Low/medium risk**
		End users- residents	medium	low	**Low/medium risk**
	Root Uptake	Landscaping Vegetation	minor	likely	low risk
	Groundwater	Controlled Waters	medium	unlikely	low risk
	Diffusion of vapour	Buildings and Services	minor	likely	low risk
	Direct Contact	Buildings and Services	medium	low	**Low/moderate risk**
On-site current sources of ground contamination arising from Lodematic Engineering Plant including metalloids, PAHs, hydrocarbons, SVOC & VOC's	Inhalation, ingestion, skin contact	Re-development workers	medium	low	**Low/medium risk**
		End users- residents	medium	low	**Low/medium risk**
	Root Uptake	Landscaping Vegetation	minor	likely	low risk
	Groundwater	Controlled Waters	medium	unlikely	low risk
	Diffusion of vapour	Buildings and Services	minor	likely	low risk
	Direct Contact	Buildings and Services	medium	low	**Low/moderate risk**
On & off-site sources of ground contamination (gas) arising from on site infill and off site infill to E & NW of site (CO_2 and CH_4 gas).	Inhalation, ingestion, skin contact	Re-development workers	Severe	unlikely	**Low/moderate risk**
		End users- residents	Severe	unlikely	**Low/moderate risk**
	Direct Contact	Buildings and Services	Medium	unlikely	Low risk
On site sources of ground contamination from asbestos building materials.	Inhalation, ingestion, skin contact	Re-development workers	medium	low	**Moderate/low risk**
		End users	medium	unlikely	Low risk
On-site historic sources of ground contamination arising from potential fill materials and relicts of historic building foundations including metalloids, PAHs.	Inhalation, ingestion, skin contact	Re-development workers	medium	low	**Moderate/low risk**
		End users- residents	medium	low	**Moderate/low risk**
	Root Uptake	Landscaping Vegetation	minor	likely	low risk
	Groundwater	Controlled Waters	medium	unlikely	low risk
	Direct Contact	Buildings and Services	medium	low	**Moderate/low risk**
Off-site historic & current sources of ground contamination arising from migration of leakages of Mills to N, Print Works S/E of site & electricity sub-station including metalloids, PAH, PCB & hydrocarbons	Inhalation, ingestion, skin contact	Re-development workers	medium	unlikely	Low risk
		End users- residents	medium	unlikely	Low risk
	Root uptake	Landscaping	minor	unlikely	Very low risk
	Groundwater	Controlled waters	medium	unlikely	Low risk
	Diffusion of vapour	Buildings and Services	minor	unlikely	Very low risk
	Direct Contact	Buildings and Services	medium	unlikely	Low risk

Table 4: Preliminary Conceptual Model

2.6 Conclusions & Recommendations (from Phase 1 Report)

Contamination

2.6.1 Several potential sources of contamination have been identified for the site, which are associated with:

- The potential risk of contamination from the on-site *historical* sources (print works/paper mill) is assessed as of low/medium risk for several receptors across the site
- The potential risk of contamination from the on-site *current* sources (engineering works) is assessed as of low/medium risk for several receptors across the site
- The potential presence of asbestos within the fabric of the buildings poses a risk which can be overcome by an initial survey and, if found, careful disposal and clearance of the site by a specialist contractor
- The potential for unknown contaminated fill deposits beneath the surface of the site area. The likely presence of contaminated shallow Made Ground is considered to be at relatively low/moderate risk of elevated levels of localised contaminants and should be investigated further
- The potential for migration of off-site historic sources (print works/mills). The presence of contaminated material on the site from this source is considered unlikely due to various reasons, reducing the probability of migration

2.6.2 It is advised that further investigation works are required to assess soil contamination within the site, as it has been assessed of being at a *low/medium* risk from soils contamination. A targeted investigation of the various potential pollutant sources should be conducted to resolve the uncertainty of contamination affecting the sensitive receptors.

2.6.3 The likely contamination risk can be managed by a suitable condition set out by the regulator in the planning permission.

Hazardous Gas

2.4.4 The presence of infilled ground on and off-site landfill would suggest that further investigation is required to assess the gas risk at the site.

2.6.5 Based on the nature of the proposed commercial development, and with reference to CIRIA C665 and the Ground Gas Handbook [2009], it is recommended that *six* monitoring visits must be undertaken over a *three* month monitoring period (*High* sensitivity and *very low* generation potential of source (*CIRIA 2007 Recommended Monitoring Periods*)).

2.6.6 Provision of gas protection measures in the building development should be considered but not specified until full monitoring results are analysed.

Mining & Quarrying

2.6.7 The site is not in a mining area. There are no quarries within 250 m of the site.

Further Investigation

2.6.8 Whilst the site is considered suitable for its current and proposed use, the proposed change in use will require intrusive investigation.

2.6.9 This would include window sampler borehole drilling and/or trial pits to determine near surface ground conditions including depth to competent strata, presence of buried obstructions, groundwater and stability. Monitoring wells will be installed across the site to facilitate monitoring ground gas concentrations and flow rates and groundwater levels.

2.6.10 An appropriate schedule of chemical testing and groundwater monitoring should be carried out on materials to assess the significance of any contamination within the soils and groundwater, if any, at the site as a result of former potentially contaminative land use.

2.6.11 Proposed exploratory hole locations would be selected to provide a representative view of the strata beneath the site and to target potential areas of interest identified in the conceptual model. Additional exploratory locations may be scheduled in light of the ground conditions encountered. The number of representative samples taken would be reflective of the geological complexity encountered during the intrusive investigation.

2.6.12 Gas installation, monitoring and assessment should make reference to the CIRIA Publication C665 "*Assessing risks posed by hazardous ground gases to buildings*", 2007 and NHBC document "*Guidance on evaluation of development proposals on sites where methane and carbon dioxide are present",* Ed 4, March 2007 and BS8576:2013 "*Guidance on investigations for ground gas. Permanent gases and Volatile Organic Compounds".*

2.6.13 Following completion of the site investigation, it will be necessary to undertake a quantitative risk assessment, and dependent upon the outcome provide a remediation statement for approval by the regulatory authorities. A validation report will be required to demonstrate that the remedial measures have been undertaken in accordance with the approved plan.

2.7 BEK Comments

2.7.1 BEK considers the Phase 1 report to be concise and well written and generally the assessment conforms with current guidance on the assessment of potential risks associated with contamination.

2.7.2 However the Environment have raised concerns regarding the conceptual model and controlled waters. The Environment Agency comments are available within the Planning Application documents (EA Ref: NO/2016/109105/01-L01) with the following comments:

The conceptual model does not correctly consider controlled waters as a vulnerable receptor. To satisfy Point (1) of the first condition below, a conceptual model should be submitted that meets the required standard.

1) A preliminary risk assessment which has identified:

- *All previous uses*
- *Potential contaminants associated with those uses*
- *A conceptual model of the site indicating sources, pathways and receptors*
- *Potentially unacceptable risks arising from contamination at the site.*

The Preliminary Risk Assessment completed by PSA Design identified five potential receptors including Controlled Waters – Groundwater however a watercourse (Mearley Brook) is located some 12 m east of the site and was not referenced as a potential receptor within the original Preliminary Risk Assessment.

2.7.3 BEK considers that Mearley Brook is a potential receptor, however, based on the following information presented in the Phase 1 report, BEK considers the risks to water quality within the Brook are considered to be low:

- Assumed lack of mobility of pollutants due to ground and made ground composition
- The impermeability of local drift deposits (i.e. Boulder Clay)
- Distance to receptor
- Presence of concrete slabs throughout the buildings, and tarmac/concrete surfacings in the yard areas will have protected the underlying ground from any major spillages.

2.7.4 As such the risks to controlled waters (Mearley Brook) is considered to be low and has been considered further within Section 4.4 of this report.

3. SITE INVESTIGATION

3.1 General

3.1.1 This section provides a summary of the site investigation works undertaken by BEK during May 2019.

3.1.2 The site investigation has been designed to provide indicative information for the ground conditions across the site and to provide a quantitative assessment of potential risks associated with contamination and ground gas and to provide recommendations with respect to foundation design. However, it should be noted that there were areas of the site that were inaccessible at the time of the investigation.

3.1.3 All exploratory locations were set out by the site engineer and the exploratory locations are illustrated on BEK Drawing No 19568-3, a copy of which is presented in Appendix D.

3.2 Window Sample Boreholes

3.2.1 Six window sample boreholes were drilled using a window sampler drilling rig to a maximum depth of 5.45 m. The borehole locations were set out by an engineer from BEK in order to establish representative conditions at the site. In-situ testing (SPTs) were carried out in each borehole where possible.

3.2.2 The ground conditions were recorded by an engineer from BEK and copies of the window sample borehole records are presented in Appendix A.

3.2.3 Samples were recovered for chemical testing in accordance with the requirements set out in the Phase 1 report.

3.2.4 The window sample borehole locations are illustrated on BEK Drawing No 19568-3, a copy of which is presented in Appendix D.

3.3 Laboratory Testing

Soil Chemical Testing

3.3.1 Following a review of the ground conditions, BEK selected 6 made ground samples and 2 natural samples for chemical testing based on the recommendations set out in the Phase 1 report and with consideration to the ground conditions encountered during the investigation.

3.3.2 The samples were delivered to the UKAS laboratory of Exova for the following analysis:

Arsenic (Total), Cadmium (Total), Copper (Total), Lead (Total), Nickel (Total), Zinc (Total), Chromium (Total), Selenium (Total), Mercury (Total), Boron (Soluble), Hexavalent Chromium, Cyanide (Total), pH, 16 EPA Poly-Aromatic Hydrocarbons (PAH), Total Phenols, Total Sulphate, Sulphate 2:1 extract, Soil Organic Matter, TPH CWG and asbestos.

3.3.3 Copies of the chemical test results are presented in Appendix B.

3.4 Ground Conditions

3.4.1 Made ground was identified in all of the boreholes investigated at the site and was generally between 0.1 and 0.6 m thick. However, made ground was proven to a depth of 1.75 m in Borehole No WS4. The made ground comprised of 2 subtypes (with exception of concrete or tarmac) which were generally described as:

Black/brown/grey fine to coarse sand with occasional fine to medium gravel and much ash – This strata was encountered at the surface of one exploratory location in the north-west of the site (Borehole No WS3) and below the concrete/tarmac in one location in the west (Borehole No WS2) and one location in the south-east of the site (Borehole No WS6). The strata varied in thickness from 0.3 to 0.6 m.

Soft brown/grey silty clay and brick fragments – This strata was encountered below the concrete in the location of Borehole No WS4 and measured approximately 1.7 m in thickness.

3.4.2 The superficial deposits underlying the made ground generally comprised 'soft to stiff slightly sandy, occasionally gravelly clays' which generally increased in stiffness with depth. A pocket of 'brown fine to coarse gravel with clayey pockets was encountered from depth 1.5 m to the base of Borehole No WS1. A thin layer of 'brown fine to medium sand and fine to coarse sub-angular gravel' (0.2 m thickness) was encountered below the made ground and above the clay strata in the location of Borehole No WS2. This strata is considered to represent the Boulder Clay with possible sandy/gravel lenses. The bedrock was not encountered during the site investigation works.

3.4.3 Visual or olfactory evidence of contamination was not identified in the material encountered at any of the exploratory locations.

3.4.4 Groundwater was not encountered during the site investigation.

3.5 Environmental Monitoring

3.5.1 Gas and groundwater monitoring has been carried out on 5 occasions with consistent readings throughout. This is considered sufficient to assess the potential risks from ground gas.

3.5.2 A summary of the monitoring undertaken to date is provided below.

Groundwater

3.5.3 Groundwater levels have been monitored in the boreholes are summarised in the following table:

Borehole Location	Recorded Water Level (m bgl)	Depth to base (m)
WS1	1.1 – 1.45	2.45 – 2.6
WS2	DRY	0.89 – 1.0
WS3	0.9 – 1.19	4.3 – 4.56
WS4	1.27 – 1.94	3.1 - 3.2
WS5	2.2 – 3.23	3.8 - 3.83
WS6	DRY	1.72 - 1.74

Table 5: Summary of Water Levels in Boreholes

3.5.4 It can be seen from the above table that shallow water is only present in 4 of the 6 boreholes when monitored and Borehole No WS2 and WS6 were dry on each monitoring occasion.

3.5.5 Based on the above information, the water depth encountered in the boreholes is likely to reflect water perched within less permeable horizons within the superficial deposits and the groundwater body is considered to be discontinuous across the site.

3.5.5 Note that seasonal variations in water levels cannot be accounted for over the short monitoring period. Laterally continuous perched water is no considered to be present.

Gas Monitoring

3.5.6 Ground Gas results for the monitoring visits carried out to date are summarised in the following table:

Location	Concentrations (% v/v)			Flow Rate (l/hr)
	Carbon Dioxide	Methane	Oxygen	
WS1	2.3 – 2.9	0	10.4 – 15.9	0
WS2	1.6 – 2.3	0	15.6 – 17.8	0
WS3	2.0 – 5.5	0	12 – 18.2	0 – 44.5
WS4	2.8 – 5.3	0	11.8 – 17.5	0
WS5	1.1 – 1.6	0	17 – 18.6	0
WS6	0.2– 1.8	0	12.8 – 17.4	0

Table 6: Summary of Gas Monitoring Data

3.5.7 It can be seen from the above table that all the gas flow rates are zero l/hr with the exception of an initial peak in Borehole No WS3 during the initial motioning visit, although the steady flow was zero l/hr after 20 seconds.

3.5.8 Furthermore, the typical maximum values as provided in the guidance document CIRIA C665 (Assessing Risks Posed by Hazardous Ground Gases to Buildings). An interpretative assessment of the risks from ground gas is provided within Section 4.3 of this report.

4. QUANTITATIVE RISK ASSESSMENT

4.1 Potentially Significant Pollutant Linkages

4.1.1 Potentially significant pollutant linkages have been identified in the PSA as listed below:

(i) Human Health – risks to end users associated with contamination in the made ground: risk via ingestion (soil or home-grown produce), inhalation (soil or dust) or direct contact

(ii) Human Health – risks to groundworkers associated with the inhalation of asbestos fibres during the re-development works

(iii) Human Health – risks associated with harmful gases entering buildings (on site or off site): risk via inhalation or explosion

(iv) Controlled Waters – risks associated with contamination in the made ground and/or natural strata affecting water quality in Mearley Brook and the superficial Secondary A Aquifer present within the Alluvial deposits. Risks to the bedrock Secondary A Aquifer (where impermeable Boulder Clay is absent) also exist. Risk are associated with dissolution of contamination into perched water/leachate and lateral/vertical migration to water receptors.

(v) Property (including services and flora) – risks associated contamination affecting concrete, service pipes and flora

4.2 Risk Assessment: Human Health Risks from Exposure to Contaminated Soil

4.2.1 The risks to human health have been assessed by inspection of shallow soils for the presence of elevated contaminants based on the expected contaminant findings detailed in the conceptual model and completion of a quantitative risk assessment.

4.2.2 The soil contamination concentrations have initially been compared to a range of generic assessment criteria that have been prepared to allow the assessment of contamination relative to uncontaminated and/or background levels.

4.2.3 These include the use of the Land Quality Management and Chartered Institute of Environmental Health assessment criteria (S4ULs), the Category 4 Screening Levels (C4SLs). These assessment criteria have been derived using the CLEA model and fully justified input parameters for residential land use.

4.2.4 The following table summarises the chemical test results for the samples tested and lists the relevant assessment criteria and the samples with a concentration in excess of the assessment criteria. Note that only determinands with a concentration above the laboratory limit of detection are presented in the table below:

Determinands	Range of Concentrations (mg/kg)	Assessment Criteria (mg/kg)	Samples Fail
Arsenic	6.3 - 52.2	40[1]	WS3 (0.5 m)
Cadmium	0.1 - 1.1	11[1]	---
Chromium	13.7 - 32.8	910[1]	---
Copper	14 - 379	2400[1]	---
Lead	18 - 2300	330[2]	WS3 (0.5 m)
Nickel	21.8 - 62.6	180[1]	---
Selenium	<1 - 3	250[1]	---
Water Soluble Boron	0.6 -3	290[1]	---
Zinc	60 - 318	3700[1]	---
Naphthalene	<0.04 - 0.52	2.3[1]	---
Acenaphthylene	<0.03 - 0.04	170[1]	---
Acenaphthene	<0.05 - 0.2	210[1]	---
Fluorene	<0.04 - 0.32	170[1]	---
Phenanthrene	<0.03 - 3.7	95[1]	---
Anthracene	<0.04 - 0.97	2400[1]	---
Fluoranthene	<0.03 - 6.48	280[1]	---
Pyrene	<0.03 - 5.68	620[1]	---
Benzo(a)anthracene	<0.06 - 3.13	7.2[1]	---
Chrysene	<0.02 - 3.17	15[1]	---
Benzo(a)pyrene	<0.04 - 3.07	5[2]	---
Indeno(123cd)pyrene	<0.04 - 1.97	27[1]	---
Dibenzo(ah)anthracene	<0.04 - 0.43	0.32[1]	WS6 (0.3 m)
Benzo(ghi)perylene	<0.04 - 1.96	320[1]	---
Benzo(b)fluoranthene	<0.05 - 4.14	4.0[1]	WS6 (0.3 m)
Benzo(k)fluoranthene	<0.02 - 1.61	77[1]	---
Aliphatic Hydrocarbons>C12-C16	<4 - 7	1100[1]	---
Aliphatic Hydrocarbons>C16-C21	<7 - 44	65000[1]*	---
Aliphatic Hydrocarbons>C21-C35	<7 - 143	65000[1]*	---
Aromatic Hydrocarbons>EC16-EC21	<7 - 47	1900[1]	---
Aromatic Hydrocarbons>EC21-EC35	<7 - 237	1900[1]	---
Asbestos ID	0 of 8 samples	N.A.D	---

Table 7: Summary of Contamination Assessment

1 CIEH/LQM Derived Assessment Criteria (S4ULs based on 1% SOM)
2 Category 4 Screening Levels

4.2.5 It can be seen from the above table that there are elevated concentrations of arsenic, lead and two PAH compounds (dibenzo(ah)anthracene and benzo(b)fluoranthene) in the made ground at the site. None of the samples tested proved positive for the presence of asbestos.

4.3 Risk Assessment: Human Health Risks from Exposure to Hazardous Gases

4.3.1 Potential risks from ground gas have been identified within the Phase 1 report due to the possible presence of on-site infill, an off-site landfill and an infilled mill pond within 250 m of the site.

Gas Monitoring & Assessment

4.3.2 An engineer from BEK has monitored the boreholes on 5 occasions between 11th June to 8 August 2019 in order to assess the potential risks for the generation and migration of potentially hazardous ground gas. Based on ground conditions encountered (no significant on-site source of gas identified) and a review of the monitoring results, this monitoring program is considered to be sufficient to characterise the ground gas regime at the site.

4.3.3 The gas risk assessment has been undertaken in accordance with CIRIA 665 'Assessing Risks Posed by Hazardous Ground Gases to Buildings'. The method of assessment requires the calculation of the Gas Screening Value (GSV) for both carbon dioxide and methane.

4.3.4 The gas concentrations and borehole flow rates are used to calculate the GSV to provide a litres of gas per hour. This equals the maximum borehole flow rate (l/hr) x maximum gas concentration (v/v). The gas monitoring results and the calculated GSVs are presented in the following table. It should be noted that the steady state flow rate has been used in accordance with British Standard BS8576.

Monitoring Location	Range of Concentrations (% v/v)			Steady Flow Rate (l/hr)	Gas Screening Value (GSV) (based on maximum values) (l/hr)	
	Carbon Dioxide	Methane	Oxygen		Carbon Dioxide	Methane
WS1	2.3 – 2.9	0	10.4 – 13.5	0	0	0
WS2	1.6 – 2.3	0	15.6 – 17.8	0	0	0
WS3	2.4 – 5.5	0	12 – 17.8	0	0	0
WS4	2.9 – 5.3	0	11.8 – 16.7	0	0	0
WS5	1.4 – 1.6	0	17 – 17.8	0	0	0
WS6	0.6 – 1.8	0	12.8 – 17.3	0	0	0

Table 8: Summary of Assessment of the BEK Gas Monitoring Data

4.3.5 From the above table it can be seen that the Gas Screening Values (GSVs) for all of the boreholes were zero with respect to both carbon dioxide and methane.

4.3.6 It can be seen from the monitoring results (Appendix C) that peak positive flow rate of 44.5 l/hr and was recorded in Borehole No WS3 on 11th June 2019 and on 11th July 2019. However, in accordance with British Standard BS8576, steady flow rates have been used within the assessment.

4.3.7 Consideration has also been given to the maximum concentrations recorded during the gas monitoring program. CIRIA 665 provides 'typical maximum' concentration of 5% for carbon dioxide and 1% for methane (Modified Wilson and Card classification) and if these typical maximum concentrations are exceeded then consideration should be given to increasing the risk factor.

4.3.8 Concentrations of carbon dioxide marginally exceeded the typical maximum concentration of 5% on the first monitoring visit in two locations (5.5 % in Borehole No WS3 and 5.3 % in Borehole No WS4). Given the marginal nature of the elevations, the presence of impermeable boulder clay at depth across the site (which will inhibit lateral migration of gas) and that no elevations of the typical maximum values were encountered in the final four monitoring visits, the marginal elevations are not considered further.

4.3.9 The ground gas monitoring results are presented in Appendix C.

4.4 Risk Assessment: Controlled Waters

4.4.1 Potential risks to the quality of groundwater have been identified in the ground conceptual model. Furthermore, BEK has identified Mearley Brook, located some 12 m east of the site, which is a potential receptor.

4.4.2 The conceptual site model identified risks to the 'Secondary A/unproductive Aquifer', 'Secondary B bedrock Aquifer' and Mearley Brook located some 12 m east of the site.

4.4.3 The results of the chemical testing of soils indicates that the soil contaminant levels are low. Furthermore, impermeable Boulder Clay was identified within all exploratory borehole locations at the site.

4.4.4 Monitoring of groundwater levels within the boreholes has confirmed that laterally continuous groundwater is not present, with water only encountered in 4 of the 6 boreholes. The borehole at the lowest elevation (Borehole No WS6) and closest to Mearley Brook was dry on each monitoring occasion.

4.4.5 Given the nature of the ground conditions encountered during the site, the contamination assessment herein (minimal contamination identified) and the absence of laterally continuous perched water (dry conditions in the southernmost borehole (lowest elevation), potential risks to controlled waters are considered to be very low and are not considered further.

4.5 Risk Assessment: Buildings

4.5.1 Risks to buildings include the assessment of the aggressive nature of the shallow ground with respect to concrete, the risks to the degradation of water pipes and flora due to contamination.

Risk to Concrete

4.5.2 To assess the potential risks to concrete, BEK has compared the previous site investigation data to assessment criteria presented in the BRE Special Digest 1: Concrete in Aggressive Ground.

4.5.3 The sulphate concentrations (water soluble 2:1) in the shallow ground range between 0.0177 to 0.7981 g/l which fall below the maximum concentration for the BRE 2:1 water/soil extract concentration of 1.2 g/l for Class DS-1 concrete.

4.5.4 With consideration to the range of pH values (8.28 to 8.86), the concrete classification suitable for the site would be DS-1 AC-1s.

Risks to Services

4.5.5 Potable water supply pipes can be at risk from degradation if the shallow ground consists of specific organic contamination. Guidance published by UKWIR includes a methodology for the site investigation and risk assessment to determine pipe specification.

4.5.6 For brownfield sites, site investigation may be required along the intended route of the water pipeline and samples recovered from specific depths and tested for specific contaminants of concern.

4.5.7 On the basis of the ground conditions encountered, risks to water supply pipelines are considered to be low to medium, however it is recommended that consultation is undertaken with the water service supplier to confirm this.

Risks to Flora

4.5.8 Copper, nickel and zinc are toxic to plants. The effects of copper, nickel and zinc are often regarded as additive. The assessment criteria used for copper, nickel and zinc, are 'pseudo total concentrations' are derived from BS3882:2007 as follows:

Phytotoxic Contaminant	pH Range		
	<6.0	6.0 to 7.0	>7.0
Zinc (nitric acid extractable)	<200	<200	<300
Copper (nitric acid extractable)	<100	<135	<200
Nickel (nitric acid extractable)	<60	<75	<110

Table 9: Limits for Phytotoxic Contaminants (Units mg/kg)

4.5.9 By comparing the chemical test results (Appendix B) to the concentrations in the above table, it can be seen that there is an elevated concentration of phytotoxic copper within Borehole No WS3 at depth 0.5 m (379 mg/kg versus 200 mg/kg)

4.6 Risk Assessment: Conclusions

4.6.1 The site investigation encountered made ground across the site with concrete or tarmac located at the surface in five out of six exploratory locations overlying 'black/brown/grey fine to coarse with occasional fine to medium gravel and much ash' or 'soft brown/grey/silty clay with much brick'. Depths of the made ground generally vary from 0.1 to 0.6 m, although is was proven to a depth of 1.7 m in Borehole No Borehole No WS4. Beneath the made ground there was natural strata which generally comprised of soft to stiff slightly sandy occasionally gravelly clay (Boulder Clay).

4.6.2 Representative samples recovered from site investigation have been tested for a wide range of contaminants of concern n accordance with the recommendations outlined within the Phase 1 report and based on the observations made during the site investigation. The chemical test results have been compared to relevant generic assessment criteria to identify potential contaminants of concern.

4.6.3 Based on the contamination assessment herein and with respect to the change of use to residential with communal gardens, the made ground contains elevated concentrations of arsenic, lead and PAH compounds (dibenzo(ah)anthracene and benzo(b)fluoranthene).

4.6.4 The potential risks to human health are summarised in the table below:

Receptor	Contaminants of Concern	Strata	Significant Pathway	Secondary Pathway
Human Health	Lead	Made Ground	Ingestion of soil and indoor dust	
	Arsenic			
	PAH Compounds			

Table 10: Summary of Active Risk Pathways

4.6.5 Risks to controlled waters are considered to be very low.

4.6.6 Potential risk to service pipes are considered to be low but advice should be sought from the water supply provider.

4.6.7 Risks to concrete are considered to be low and concrete classification of DS-1 AC1s will be suitable.

5. CONCLUSIONS & RECOMMENDATIONS

5.1 This report provides an assessment of the ground conditions based on the assessment of available site investigation information and quantifies the potential risks associated with contamination and ground with consideration to the proposed change of use to residential.

5.2 It should be noted that there were access restrictions across the site (particularly in the east-south-east and west of the site).

5.3 Representative samples recovered from site investigation have been tested for a wide range of contaminants of concern and the results have been assessed as part of a quantitative risk assessment using appropriate assessment criteria derived for residential use with communal gardens.

5.4 The contamination assessment has identified concentrations of arsenic, lead and PAH compounds (dibenzo(ah)anthracene and benzo(b)fluoranthene) within the made ground which pose a potential risk to human health. In addition, the made ground encountered in Borehole No WS3 has phytotoxic copper.

Recommendations

5.5 As a minimum a visual assessment of the ground conditions should be carried out in the areas currently inaccessible to inspect ground conditions. Additional site investigation (trial pits) may be required to confirm ground conditions are as anticipated.

5.6 The potential risks identified with respect to human health will be mitigated against by the hardstanding road/pavement/flooring surrounding/within the buildings. The hardstanding surfaces will form a physical barrier, breaking the pathway between the end user and the source of contamination preventing ingestion of soil and dust.

5.7 The only potentially significant pollutant link is associated with soft landscaping areas (risks to human health and flora). Any soft landscaped areas should be capped with a minimum of 600 mm of sub/topsoil suitable for use. The suitability of the imported soils must be independently assessed.

5.8 In addition to the above, BEK recommends the following:

- All groundworkers adopt standard PPE when on site and remain vigilant during ground excavations for the presence (or suspected presence) of contamination. If visual or olfactory evidence of contamination is encountered then works should cease and specialist advice sought.

- Consideration to be given to the requirements of the water supply provider. They are likely to require the UKWIR risk assessment to be completed to determine the specification for the water pipes. BEK recommends that the water supply provider is contacted and enquiries made. If barrier pipe is required, then the installation should be independently validated.

- Any material recovered from the site should be disposed of in accordance with appropriate legislation and regulations, including the Duty of Care Regulations.

Waste Soils

5.9 Any waste soils generated during the redevelopment should be removed from site under an appropriate Duty of Care with consignment notes retained on site. If it is the intention of the developer to retain soils on site then this should be managed through exemption for Permitting (if appropriate) or through the preparation of a Material Management Plan as part of compliance with the Definition of Waste:Code of Practice (DoW:CoP).

Water Pipe Specification

5.10 Consideration should be given to the requirements of the water supplier and the specification for the water pipes. It is recommend that the water supplier is consulted.

APPENDIX A

Window Sample Borehole Records

GEO-ENVIROMENTAL CONSULTING ENGINEERS

GEO-ENVIRONMENTAL CONSULTANTS

PROJECT NUMBER 19568
PROJECT NAME Lodematic Works, Clitheroe
CLIENT Lodematic

DATE 20th May 2019
DRILLING METHOD Window Sample Borehole
BOREHOLE NO WS1
SHEET 1/6

COMPLETION **CASING** uPVC **SCREEN** uPVC Factory Slotted

COMMENTS Borehole dry

Depth (m)	Depth (m)	Samples/ Test	Field Records	Water	Well Instal.	Graphic Log	Material Description	Additional Observations	Elevation (m)
0.2							Concrete		0.2
0.4							Soft brown slightly sandy clay with occasional fine to medium rounded gravel		0.4
0.6									0.6
0.8									0.8
1	1 - 1.45	SPT (C) N=28	3,5/5,5,8,10						1
1.2									1.2
1.4									1.4
1.6							Brown fine to coarse gravel and fine to coarse sub-rounded gravel with frequent clayey pockets		1.6
1.8									1.8
2	2 - 2.45	SPT (C) N=26	3,5/5,7,7,6						2
2.2									2.2
2.4									2.4
2.6									2.6
2.8									2.8
3	3 - 3.45	SPT (C) N=29	3,5/7,7,7,8						3
3.2									3.2
3.4									3.4
3.6									3.6
3.8									3.8
4	4 - 4.45	SPT (C) N=30	3,4/6,7,7,10						4
4.2									4.2
4.4									4.4
4.6							Termination Depth at: 4.45 m		4.6
4.8									4.8

GEO-ENVIROMENTAL CONSULTING ENGINEERS

GEO-ENVIRONMENTAL CONSULTANTS

PROJECT NUMBER 19568
PROJECT NAME Lodematic Works, Clitheroe
CLIENT Lodematic

DATE 20th May 2019
DRILLING METHOD Window Sample Borehole
BOREHOLE NO WS2
SHEET 2/6

COMPLETION **CASING** uPVC **SCREEN** uPVC Factory Slotted

COMMENTS Borehole Dry

Depth (m)	Depth (m)	Samples/ Test	Field Records	Water	Well Instal.	Graphic Log	Material Description	Additional Observations	Elevation (m)
0							Concrete		0
0.2							Black/brown/grey fine to coarse gravel and fine to coarse angular gravel and much ash (Made Ground)		0.2
0.4							Brown fine to medium sand and fine to coarse sub-angular gravel		0.4
0.6							Stiff brown clay		0.6
0.8									0.8
1	1 - 1.45	50 for no movement							1
1.2									1.2
1.4									1.4
1.6							Termination Depth at: 1.45 m		1.6
1.8									1.8
2									2
2.2									2.2
2.4									2.4
2.6									2.6
2.8									2.8
3									3
3.2									3.2
3.4									3.4
3.6									3.6
3.8									3.8
4									4
4.2									4.2
4.4									4.4
4.6									4.6
4.8									4.8

GEO-ENVIROMENTAL CONSULTING ENGINEERS

GEO-ENVIRONMENTAL CONSULTANTS

PROJECT NUMBER 19568
PROJECT NAME Lodematic Works, Clitheroe
CLIENT Lodematic

DATE 20th May 2019
DRILLING METHOD Window Sample Borehole
BOREHOLE NO WS3
SHEET 3/6

COMPLETION **CASING** uPVC **SCREEN** uPVC Factory Slotted

COMMENTS Borehole Dry

Depth (m)	Depth (m)	Samples/ Test	Field Records	Water	Well Instal.	Graphic Log	Material Description	Additional Observations	Elevation (m)
0.5							Grass overlying black/grey fine to medium sand with fine to coarse angular gravel and much ash (Made ground)		0.5
1	1 - 1.45	SPT (C) N=16	2,2/4,6,3,3				Very stiff brown clay with occasional fine rounded gravel		1
1.5							Very stiff brown clay		1.5
2	2 - 2.45	SPT (C) N=17	2,3/4,4,4,5						2
2.5							Very stiff grey clay with rare fine rounded gravel		2.5
3	3 - 3.45	SPT (C) N=19	2,3/4,4,5,6						3
3.5									3.5
4	4 - 4.45	SPT (C) N=28	3,5/6,6,8,8						4
4.5									4.5
5	5 - 5.45	SPT (C) N=28	3,4/7,7,7,7						5
5.5							Termination Depth at: 5.45 m		5.5

GEO-ENVIROMENTAL CONSULTING ENGINEERS

GEO-ENVIRONMENTAL CONSULTANTS

PROJECT NUMBER 19568
PROJECT NAME Lodematic Works, Clitheroe
CLIENT Lodematic

DATE 20th May 2019
DRILLING METHOD Window Sample Borehole
BOREHOLE NO WS4
SHEET 4/6

COMPLETION **CASING** uPVC **SCREEN** uPVC Factory Slotted

COMMENTS Borehole Dry

Depth (m)	Depth (m)	Samples/ Test	Field Records	Water	Well Instal.	Graphic Log	Material Description	Additional Observations	Elevation (m)
0							concrete		0
							Soft brown/grey sandy silty clay with much brick fragments (Made Ground)		
0.5									0.5
1	1 - 1.45	SPT (C) N=17	2,3/4,4,4,5						1
1.5									1.5
2	2 - 2.45	SPT (C) N=19	3,5/5,5,4,5				Very Stiff grey clay with occasional fine to medium sub-rounded gravel		2
2.5									2.5
3	3 - 3.45	SPT (C) N=25	3,4/7,7,7,6				Very stiff grey clay with rare fine rounded gravel		3
3.5									3.5
4	4 - 4.45	50 for no movement							4
4.5							Termination Depth at: 4.45 m		4.5
5									5
5.5									5.5

GEO-ENVIROMENTAL CONSULTING ENGINEERS

GEO-ENVIRONMENTAL CONSULTANTS

PROJECT NUMBER 19568
PROJECT NAME Lodematic Works, Clitheroe
CLIENT Lodematic

DATE 20th May 2019
DRILLING METHOD Window Sample Borehole
BOREHOLE NO WS5
SHEET 5/6

COMPLETION **CASING** uPVC **SCREEN** uPVC Factory Slotted

COMMENTS Borehole Dry

Depth (m)	Depth (m)	Samples/ Test	Field Records	Water	Well Instal.	Graphic Log	Material Description	Additional Observations	Elevation (m)
0							concrete		0
							Soft brown/grey silty clay with occasional fine to medium sub-rounded gravel		
0.5									0.5
1	1 - 1.45	SPT (C) N=18	2,2/4,4,4,6				Very stiff brown/grey silty clay with occasional fine to medium sub-rounded gravel		1
1.5									1.5
2	2 - 2.45	SPT (C) N=23	2,4/4,6,6,7				Very stiff grey clay with rare fine rounded gravel		2
2.5									2.5
3	3 - 3.45	SPT (C) N=25	4,6/7,7,7,9						3
3.5	4 - 4.45	50 for no movement							3.5
4							Termination Depth at: 3.95 m		4
4.5									4.5
5									5
5.5									5.5

GEO-ENVIROMENTAL CONSULTING ENGINEERS

GEO-ENVIRONMENTAL CONSULTANTS

PROJECT NUMBER 19568
PROJECT NAME Lodematic Works, Clitheroe
CLIENT Lodematic

DATE 20th May 2019
DRILLING METHOD Window Sample Borehole
BOREHOLE NO WS6
SHEET 6/6

COMPLETION **CASING** uPVC **SCREEN** uPVC Factory Slotted

COMMENTS Borehole Dry

Depth (m)	Depth (m)	Samples/ Test	Field Records	Water	Well Instal.	Graphic Log	Material Description	Additional Observations	Elevation (m)
0.5							Tarmac		0.5
							Black/grey fine to coarse sand and fine to medium angular gravel with occasional coarse gravel with much ash (Made Ground)		
1	1 - 1.45	SPT (C) N=18	1,2/5,5,3,2				Stiff brown clay with occasional fine sub-rounded gravel		1
1.5							Very stiff brown/grey clay with rare rounded gravel		1.5
2	2 - 2.45	SPT (C) N=50	7,12/14,16,16,4						2
2.5							Termination Depth at: 2.45 m		2.5
3									3
3.5									3.5
4									4
4.5									4.5
5									5
5.5									5.5

APPENDIX B

Chemical Test Results

Exova Jones Environmental

Registered Office: Exova Environmental UK Limited, 10 Lower Grosvenor Place, London, SW1W 0EN. Reg No. 11371415

Unit 3 Deeside Point
Zone 3
Deeside Industrial Park
Deeside
CH5 2UA

Tel: +44 (0) 1244 833780
Fax: +44 (0) 1244 833781

BEK Enviro Limited
Suite One
No 3 Mitton Road Business Park
Mitton Road
Whalley
Lancashire
BB7 9YE

Attention :	Michael Buckley
Date :	4th June, 2019
Your reference :	
Our reference :	Test Report 19/8334 Batch 1
Location :	Lodematic, Clitheroe
Date samples received :	23rd May, 2019
Status :	Final report
Issue :	1

Eight samples were received for analysis on 23rd May, 2019 of which eight were scheduled for analysis. Please find attached our Test Report which should be read with notes at the end of the report and should include all sections if reproduced. Interpretations and opinions are outside the scope of any accreditation, and all results relate only to samples supplied.
All analysis is carried out on as received samples and reported on a dry weight basis unless stated otherwise. Results are not surrogate corrected.

Compiled By:

Paul Boden BSc
Senior Project Manager

Client Name: BEK Enviro Limited
Reference:
Location: Lodematic, Clitheroe
Contact: Michael Buckley
JE Job No.: 19/8334

Report : Solid

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

J E Sample No.	1-2	3-5	6-7	8-9	10-11	12-13	14-15	16-17			LOD/LOR	Units	Method No.
Sample ID	WS1	WS2	WS3	WS4	WS5	WS5	WS6	WS6					
Depth	0.30	0.30	0.50	0.50	0.30	2.00	0.30	2.00					
COC No / misc													
Containers	J T	J T	J T	J T	J T	J T	J T	J T					
Sample Date	20/05/2019	20/05/2019	20/05/2019	20/05/2019	20/05/2019	20/05/2019	20/05/2019	20/05/2019					
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil					
Batch Number	1	1	1	1	1	1	1	1					
Date of Receipt	23/05/2019	23/05/2019	23/05/2019	23/05/2019	23/05/2019	23/05/2019	23/05/2019	23/05/2019					
Arsenic #	7.0	13.0	52.2	7.7	6.3	6.3	11.6	6.5			<0.5	mg/kg	TM30/PM15
Cadmium #	0.6	0.6	1.0	0.8	0.7	1.1	0.1	0.8			<0.1	mg/kg	TM30/PM15
Chromium #	17.1	19.8	32.8	16.5	15.5	14.3	24.6	13.7			<0.5	mg/kg	TM30/PM15
Copper #	33	118	379$_{AA}$	48	17	15	103	14			<1	mg/kg	TM30/PM15
Lead #	26	122	2300	28	18	19	127	21			<5	mg/kg	TM30/PM15
Nickel #	29.3	35.8	62.6	23.2	24.0	23.4	45.8	21.8			<0.7	mg/kg	TM30/PM15
Selenium #	<1	3	2	<1	<1	<1	1	<1			<1	mg/kg	TM30/PM15
Total Sulphate as SO4 #	886	2973	1275	361	408	488	479	342			<50	mg/kg	TM50/PM29
Water Soluble Boron #	0.8	1.8	0.9	0.8	0.9	3.0	1.2	0.6			<0.1	mg/kg	TM74/PM32
Zinc #	106	169	318	101	107	116	60	96			<5	mg/kg	TM30/PM15
Mercury CVAF	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5			<0.5	mg/kg	TM61/PM62
PAH MS													
Naphthalene #	<0.04	0.13	0.09	<0.04	<0.04	<0.04	0.52	<0.04			<0.04	mg/kg	TM4/PM8
Acenaphthylene	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	0.40	<0.03			<0.03	mg/kg	TM4/PM8
Acenaphthene #	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.20	<0.05			<0.05	mg/kg	TM4/PM8
Fluorene #	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	0.32	<0.04			<0.04	mg/kg	TM4/PM8
Phenanthrene #	<0.03	0.21	0.61	<0.03	<0.03	<0.03	3.70	<0.03			<0.03	mg/kg	TM4/PM8
Anthracene #	<0.04	<0.04	0.12	<0.04	<0.04	<0.04	0.97	<0.04			<0.04	mg/kg	TM4/PM8
Fluoranthene #	<0.03	0.13	0.78	<0.03	<0.03	<0.03	6.48	<0.03			<0.03	mg/kg	TM4/PM8
Pyrene #	<0.03	0.11	0.71	<0.03	<0.03	<0.03	5.68	<0.03			<0.03	mg/kg	TM4/PM8
Benzo(a)anthracene #	<0.06	0.08	0.37	<0.06	<0.06	<0.06	3.13	<0.06			<0.06	mg/kg	TM4/PM8
Chrysene #	<0.02	0.10	0.45	<0.02	<0.02	<0.02	3.17	<0.02			<0.02	mg/kg	TM4/PM8
Benzo(bk)fluoranthene #	<0.07	0.22	0.64	<0.07	<0.07	<0.07	5.75	<0.07			<0.07	mg/kg	TM4/PM8
Benzo(a)pyrene #	<0.04	0.06	0.28	<0.04	<0.04	<0.04	3.07	<0.04			<0.04	mg/kg	TM4/PM8
Indeno(123cd)pyrene #	<0.04	0.09	0.21	<0.04	<0.04	<0.04	1.97	<0.04			<0.04	mg/kg	TM4/PM8
Dibenzo(ah)anthracene #	<0.04	<0.04	0.05	<0.04	<0.04	<0.04	0.43	<0.04			<0.04	mg/kg	TM4/PM8
Benzo(ghi)perylene #	<0.04	0.10	0.21	<0.04	<0.04	<0.04	1.96	<0.04			<0.04	mg/kg	TM4/PM8
PAH 16 Total	<0.6	1.2	4.5	<0.6	<0.6	<0.6	37.8	<0.6			<0.6	mg/kg	TM4/PM8
Benzo(b)fluoranthene	<0.05	0.16	0.46	<0.05	<0.05	<0.05	4.14	<0.05			<0.05	mg/kg	TM4/PM8
Benzo(k)fluoranthene	<0.02	0.06	0.18	<0.02	<0.02	<0.02	1.61	<0.02			<0.02	mg/kg	TM4/PM8
PAH Surrogate % Recovery	92	95	99	79	92	99	95	85			<0	%	TM4/PM8
TPH CWG													
Aliphatics													
>C5-C6 #	<0.1	<0.1^{SV}	<0.1^{SV}	<0.1	<0.1	<0.1	<0.1^{SV}	<0.1			<0.1	mg/kg	TM36/PM12
>C6-C8 #	<0.1	<0.1^{SV}	<0.1^{SV}	<0.1	<0.1	<0.1	<0.1^{SV}	<0.1			<0.1	mg/kg	TM36/PM12
>C8-C10	<0.1	<0.1^{SV}	<0.1^{SV}	<0.1	<0.1	<0.1	<0.1^{SV}	<0.1			<0.1	mg/kg	TM36/PM12
>C10-C12 #	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2			<0.2	mg/kg	TM5/PM8/PM16
>C12-C16 #	<4	<4	<4	<4	<4	<4	7	<4			<4	mg/kg	TM5/PM8/PM16
>C16-C21 #	<7	<7	11	<7	44	<7	22	<7			<7	mg/kg	TM5/PM8/PM16
>C21-C35 #	<7	143	24	<7	62	<7	58	<7			<7	mg/kg	TM5/PM8/PM16
Total aliphatics C5-35	<19	143	35	<19	106	<19	87	<19			<19	mg/kg	TM5/TM36/PM8/PM12/PM16

Please see attached notes for all abbreviations and acronyms

Client Name: BEK Enviro Limited
Reference:
Location: Lodematic, Clitheroe
Contact: Michael Buckley
JE Job No.: 19/8334

Report : Solid

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

J E Sample No.	1-2	3-5	6-7	8-9	10-11	12-13	14-15	16-17			LOD/LOR	Units	Method No.
Sample ID	WS1	WS2	WS3	WS4	WS5	WS5	WS6	WS6					
Depth	0.30	0.30	0.50	0.50	0.30	2.00	0.30	2.00					
COC No / misc													
Containers	J T	J T	J T	J T	J T	J T	J T	J T					
Sample Date	20/05/2019	20/05/2019	20/05/2019	20/05/2019	20/05/2019	20/05/2019	20/05/2019	20/05/2019					
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil					
Batch Number	1	1	1	1	1	1	1	1					
Date of Receipt	23/05/2019	23/05/2019	23/05/2019	23/05/2019	23/05/2019	23/05/2019	23/05/2019	23/05/2019					
TPH CWG													
Aromatics													
>C5-EC7 #	<0.1	<0.1 SV	<0.1 SV	<0.1	<0.1	<0.1	<0.1 SV	<0.1			<0.1	mg/kg	TM36/PM12
>EC7-EC8 #	<0.1	<0.1 SV	<0.1 SV	<0.1	<0.1	<0.1	<0.1 SV	<0.1			<0.1	mg/kg	TM36/PM12
>EC8-EC10 #	<0.1	<0.1 SV	<0.1 SV	<0.1	<0.1	<0.1	<0.1 SV	<0.1			<0.1	mg/kg	TM36/PM12
>EC10-EC12 #	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2			<0.2	mg/kg	TM5/PM8/PM16
>EC12-EC16 #	<4	<4	<4	<4	<4	<4	11	<4			<4	mg/kg	TM5/PM8/PM16
>EC16-EC21 #	<7	<7	<7	<7	29	<7	47	<7			<7	mg/kg	TM5/PM8/PM16
>EC21-EC35 #	<7	51	<7	<7	107	<7	237	<7			<7	mg/kg	TM5/PM8/PM16
Total aromatics C5-35 #	<19	51	<19	<19	136	<19	295	<19			<19	mg/kg	TM5/TM36/PM8/PM12/PM16
Total aliphatics and aromatics(C5-35)	<38	194	<38	<38	242	<38	382	<38			<38	mg/kg	TM5/TM36/PM8/PM12/PM16
MTBE #	<5	<5 SV	<5 SV	<5	<5	<5	<5 SV	<5			<5	ug/kg	TM31/PM12
Benzene #	<5	<5 SV	<5 SV	<5	<5	<5	<5 SV	<5			<5	ug/kg	TM31/PM12
Toluene #	<5	<5 SV	<5 SV	<5	<5	<5	<5 SV	<5			<5	ug/kg	TM31/PM12
Ethylbenzene #	<5	<5 SV	<5 SV	<5	<5	<5	<5 SV	<5			<5	ug/kg	TM31/PM12
m/p-Xylene #	<5	<5 SV	<5 SV	<5	<5	<5	<5 SV	<5			<5	ug/kg	TM31/PM12
o-Xylene #	<5	<5 SV	<5 SV	<5	<5	<5	<5 SV	<5			<5	ug/kg	TM31/PM12
Phenol #	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01			<0.01	mg/kg	TM26/PM21
Natural Moisture Content	16.3	10.1	18.7	10.7	10.1	9.1	11.3	11.0			<0.1	%	PM4/PM0
Hexavalent Chromium #	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3			<0.3	mg/kg	TM38/PM20
Sulphate as SO4 (2:1 Ext) #	0.1140	0.7981	0.2757	0.0316	0.0300	0.0534	0.0496	0.0177			<0.0015	g/l	TM38/PM20
Total Cyanide #	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5			<0.5	mg/kg	TM89/PM45
Organic Matter	1.3	17.4	22.3	0.7	0.7	0.6	30.5	0.6			<0.2	%	TM21/PM24
pH #	8.86	8.29	8.28	8.64	8.74	8.68	8.42	8.79			<0.01	pH units	TM73/PM11

Please see attached notes for all abbreviations and acronyms

Client Name: BEK Enviro Limited
Reference:
Location: Lodematic, Clitheroe
Contact: Michael Buckley

Note:

Asbestos Screen analysis is carried out in accordance with our documented in-house methods PM042 and TM065 and HSG 248 by Stereo and Polarised Light Microscopy using Dispersion Staining Techniques and is covered by our UKAS accreditation. Detailed Gravimetric Quantification and PCOM Fibre Analysis is carried out in accordance with our documented in-house methods PM042 and TM131 and HSG 248 using Stereo and Polarised Light Microscopy and Phase Contrast Optical Microscopy (PCOM). Samples are retained for not less than 6 months from the date of analysis unless specifically requested.

Opinions, including ACM type and Asbestos level less than 0.1%, lie outside the scope of our UKAS accreditation.

Where the sample is not taken by a Jones Environmental Laboratory consultant, Jones Environmental Laboratory cannot be responsible for inaccurate or unrepresentative sampling.

Signed on behalf of Jones Environmental Laboratory:

Ryan Butterworth
Asbestos Team Leader

J E Job No.	Batch	Sample ID	Depth	J E Sample No.	Date Of Analysis	Analysis	Result
19/8334	1	WS1	0.30	2	28/05/2019	**General Description (Bulk Analysis)**	Soil/Stones
					28/05/2019	**Asbestos Fibres**	NAD
					28/05/2019	**Asbestos ACM**	NAD
					28/05/2019	**Asbestos Type**	NAD
					28/05/2019	**Asbestos Level Screen**	NAD
19/8334	1	WS2	0.30	5	28/05/2019	**General Description (Bulk Analysis)**	Soil/Stones
					28/05/2019	**Asbestos Fibres**	NAD
					28/05/2019	**Asbestos ACM**	NAD
					28/05/2019	**Asbestos Type**	NAD
					28/05/2019	**Asbestos Level Screen**	NAD
19/8334	1	WS3	0.50	7	28/05/2019	**General Description (Bulk Analysis)**	Soil/Stones
					28/05/2019	**Asbestos Fibres**	NAD
					28/05/2019	**Asbestos ACM**	NAD
					28/05/2019	**Asbestos Type**	NAD
					28/05/2019	**Asbestos Level Screen**	NAD
19/8334	1	WS4	0.50	9	28/05/2019	**General Description (Bulk Analysis)**	Soil/Stones
					28/05/2019	**Asbestos Fibres**	NAD
					28/05/2019	**Asbestos ACM**	NAD
					28/05/2019	**Asbestos Type**	NAD
					28/05/2019	**Asbestos Level Screen**	NAD
19/8334	1	WS5	0.30	11	28/05/2019	**General Description (Bulk Analysis)**	Soil/Stones
					28/05/2019	**Asbestos Fibres**	NAD
					28/05/2019	**Asbestos ACM**	NAD
					28/05/2019	**Asbestos Type**	NAD
					28/05/2019	**Asbestos Level Screen**	NAD
19/8334	1	WS5	2.00	13	28/05/2019	**General Description (Bulk Analysis)**	Soil/Stones
					28/05/2019	**Asbestos Fibres**	NAD
					28/05/2019	**Asbestos ACM**	NAD
					28/05/2019	**Asbestos Type**	NAD
					28/05/2019	**Asbestos Level Screen**	NAD
19/8334	1	WS6	0.30	15	28/05/2019	**General Description (Bulk Analysis)**	Soil/Stones
					28/05/2019	**Asbestos Fibres**	NAD
					28/05/2019	**Asbestos ACM**	NAD

Client Name: BEK Enviro Limited
Reference:
Location: Lodematic, Clitheroe
Contact: Michael Buckley

J E Job No.	Batch	Sample ID	Depth	J E Sample No.	Date Of Analysis	Analysis	Result
19/8334	1	WS6	0.30	15	28/05/2019	**Asbestos Type**	NAD
					28/05/2019	**Asbestos Level Screen**	NAD
19/8334	1	WS6	2.00	17	28/05/2019	**General Description (Bulk Analysis)**	Soil/Stones
					28/05/2019	**Asbestos Fibres**	NAD
					28/05/2019	**Asbestos ACM**	NAD
					28/05/2019	**Asbestos Type**	NAD
					28/05/2019	**Asbestos Level Screen**	NAD

Client Name: BEK Enviro Limited
Reference:
Location: Lodematic, Clitheroe
Contact: Michael Buckley

J E Job No.	Batch	Sample ID	Depth	J E Sample No.	Analysis	Reason
No deviating sample report results for job 19/8334						

Please note that only samples that are deviating are mentioned in this report. If no samples are listed it is because none were deviating.
Only analyses which are accredited are recorded as deviating if set criteria are not met.

NOTES TO ACCOMPANY ALL SCHEDULES AND REPORTS

JE Job No.: 19/8334

SOILS

Please note we are only MCERTS accredited (UK soils only) for sand, loam and clay and any other matrix is outside our scope of accreditation.

Where an MCERTS report has been requested, you will be notified within 48 hours of any samples that have been identified as being outside our MCERTS scope. As validation has been performed on clay, sand and loam, only samples that are predominantly these matrices, or combinations of them will be within our MCERTS scope. If samples are not one of a combination of the above matrices they will not be marked as MCERTS accredited.

It is assumed that you have taken representative samples on site and require analysis on a representative subsample. Stones will generally be included unless we are requested to remove them.

All samples will be discarded one month after the date of reporting, unless we are instructed to the contrary.

If you have not already done so, please send us a purchase order if this is required by your company.

Where appropriate please make sure that our detection limits are suitable for your needs, if they are not, please notify us immediately.

All analysis is reported on a dry weight basis unless stated otherwise. Results are not surrogate corrected. Samples are dried at 35°C ±5°C unless otherwise stated. Moisture content for CEN Leachate tests are dried at 105°C ±5°C.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

Where a CEN 10:1 ZERO Headspace VOC test has been carried out, a 10:1 ratio of water to wet (as received) soil has been used.

% Asbestos in Asbestos Containing Materials (ACMs) is determined by reference to HSG 264 The Survey Guide - Appendix 2 : ACMs in buildings listed in order of ease of fibre release.

Negative Neutralization Potential (NP) values are obtained when the volume of NaOH (0.1N) titrated (pH 8.3) is greater than the volume of HCl (1N) to reduce the pH of the sample to 2.0 - 2.5. Any negative NP values are corrected to 0.

The calculation of Pyrite content assumes that all oxidisable sulphides present in the sample are pyrite. This may not be the case. The calculation may be an overesitimate when other sulphides such as Barite (Barium Sulphate) are present.

WATERS

Please note we are not a UK Drinking Water Inspectorate (DWI) Approved Laboratory .

ISO17025 accreditation applies to surface water and groundwater and usually one other matrix which is analysis specific, any other liquids are outside our scope of accreditation.

As surface waters require different sample preparation to groundwaters the laboratory must be informed of the water type when submitting samples.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

DEVIATING SAMPLES

All samples should be submitted to the laboratory in suitable containers with sufficient ice packs to sustain an appropriate temperature for the requested analysis. The temperature of sample receipt is recorded on the confirmation schedules in order that the client can make an informed decision as to whether testing should still be undertaken.

SURROGATES

Surrogate compounds are added during the preparation process to monitor recovery of analytes. However low recovery in soils is often due to peat, clay or other organic rich matrices. For waters this can be due to oxidants, surfactants, organic rich sediments or remediation fluids. Acceptable limits for most organic methods are 70 - 130% and for VOCs are 50 - 150%. When surrogate recoveries are outside the performance criteria but the associated AQC passes this is assumed to be due to matrix effect. Results are not surrogate corrected.

DILUTIONS

A dilution suffix indicates a dilution has been performed and the reported result takes this into account. No further calculation is required.

BLANKS

Where analytes have been found in the blank, the sample will be treated in accordance with our laboratory procedure for dealing with contaminated blanks.

NOTE

Data is only reported if the laboratory is confident that the data is a true reflection of the samples analysed. Data is only reported as accredited when all the requirements of our Quality System have been met. In certain circumstances where all the requirements of the Quality System have not been met, for instance if the associated AQC has failed, the reason is fully investigated and documented. The sample data is then evaluated alongside the other quality control checks performed during analysis to determine its suitability. Following this evaluation, provided the sample results have not been effected, the data is reported but accreditation is removed. It is a UKAS requirement for data not reported as accredited to be considered indicative only, but this does not mean the data is not valid.
Where possible, and if requested, samples will be re-extracted and a revised report issued with accredited results. Please do not hesitate to contact the laboratory if further details are required of the circumstances which have led to the removal of accreditation.

REPORTS FROM THE SOUTH AFRICA LABORATORY

Any method number not prefixed with SA has been undertaken in our UK laboratory unless reported as subcontracted.

ABBREVIATIONS and ACRONYMS USED

#	ISO17025 (UKAS Ref No. 4225) accredited - UK.
SA	ISO17025 (SANAS Ref No.T0729) accredited - South Africa.
B	Indicates analyte found in associated method blank.
DR	Dilution required.
M	MCERTS accredited.
NA	Not applicable
NAD	No Asbestos Detected.
ND	None Detected (usually refers to VOC and/SVOC TICs).
NDP	No Determination Possible
SS	Calibrated against a single substance
SV	Surrogate recovery outside performance criteria. This may be due to a matrix effect.
W	Results expressed on as received basis.
+	AQC failure, accreditation has been removed from this result, if appropriate, see 'Note' on previous page.
++	Result outside calibration range, results should be considered as indicative only and are not accredited.
*	Analysis subcontracted to an Exova Jones Environmental approved laboratory.
AD	Samples are dried at 35°C ±5°C
CO	Suspected carry over
LOD/LOR	Limit of Detection (Limit of Reporting) in line with ISO 17025 and MCERTS
ME	Matrix Effect
NFD	No Fibres Detected
BS	AQC Sample
LB	Blank Sample
N	Client Sample
TB	Trip Blank Sample
OC	Outside Calibration Range
AA	x5 Dilution

JE Job No: 19/8334

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS/SANAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
PM4	Gravimetric measurement of Natural Moisture Content and % Moisture Content at either 35°C or 105°C. Calculation based on ISO 11465 and BS1377.	PM0	No preparation is required.			AR	
TM4	Modified USEPA 8270 method for the solvent extraction and determination of 16 PAHs by GC-MS.	PM8	End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required.			AR	Yes
TM4	Modified USEPA 8270 method for the solvent extraction and determination of 16 PAHs by GC-MS.	PM8	End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required.	Yes		AR	Yes
TM5	Modified 8015B method for the determination of solvent Extractable Petroleum Hydrocarbons (EPH) within the range C8-C40 by GCFID. For waters the solvent extracts dissolved phase plus a sheen if present.	PM8/PM16	End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required/Fractionation into aliphatic and aromatic fractions using a Rapid Trace SPE.	Yes		AR	Yes
TM5/TM36	please refer to TM5 and TM36 for method details	PM8/PM12/PM16	please refer to PM8/PM16 and PM12 for method details			AR	Yes
TM5/TM36	please refer to TM5 and TM36 for method details	PM8/PM12/PM16	please refer to PM8/PM16 and PM12 for method details	Yes		AR	Yes
TM21	Modified BS 7755-3:1995, ISO10694:1995 Determination of Total Organic Carbon or Total Carbon by combustion in an Eltra TOC furnace/analyser in the presence of oxygen. The CO2 generated is quantified using infra-red detection. Organic Matter (SOM) calculated as per EA MCERTS Chemical Testing of Soil, March 2012 v4.	PM24	Dried and ground solid samples are washed with hydrochloric acid, then rinsed with deionised water to remove the mineral carbon before TOC analysis.			AD	Yes
TM26	Determination of phenols by Reversed Phased High Performance Liquid Chromatography and Electro-Chemical Detection.	PM21	As received solid or water samples are extracted in Methanol: Sodium Hydroxide (0.1M NaOH) (60:40) by orbital shaker.	Yes		AR	Yes
TM30	Determination of Trace Metal elements by ICP-OES (Inductively Coupled Plasma - Optical Emission Spectrometry). Modified US EPA Method 200.7, 6010B and BS EN ISO 11885 2009	PM15	Acid digestion of dried and ground solid samples using Aqua Regia refluxed at 112.5 °C. Samples containing asbestos are not dried and ground.	Yes		AD	Yes
TM31	Modified USEPA 8015B. Determination of Methyltertbutylether, Benzene, Toluene, Ethylbenzene and Xylene by headspace GC-FID.	PM12	Modified US EPA method 5021. Preparation of solid and liquid samples for GC headspace analysis.	Yes		AR	Yes

JE Job No: 19/8334

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS/SANAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
TM36	Modified US EPA method 8015B. Determination of Gasoline Range Organics (GRO) in the carbon chain range of C4-12 by headspace GC-FID. MTBE by GCFID co-elutes with 3-methylpentane if present and therefore can give a false positive. Positive MTBE results can be confirmed using GCMS.	PM12	Modified US EPA method 5021. Preparation of solid and liquid samples for GC headspace analysis.			AR	Yes
TM36	Modified US EPA method 8015B. Determination of Gasoline Range Organics (GRO) in the carbon chain range of C4-12 by headspace GC-FID. MTBE by GCFID co-elutes with 3-methylpentane if present and therefore can give a false positive. Positive MTBE results can be confirmed using GCMS.	PM12	Modified US EPA method 5021. Preparation of solid and liquid samples for GC headspace analysis.	Yes		AR	Yes
TM38	Soluble Ion analysis using Discrete Analyser. Modified US EPA methods 325.2 (Chloride), 375.4 (Sulphate), 365.2 (o-Phosphate), 353.1 (TON), 354.1 (Nitrite), 350.1 (NH4+) comparable to BS ISO 15923-1, 7196A (Hex Cr)	PM20	Extraction of dried and ground or as received samples with deionised water in a 2:1 water to solid ratio using a reciprocal shaker for all analytes except hexavalent chromium. Extraction of as received sample using 10:1 ratio of 0.2M sodium hydroxide to soil for hexavalent chromium using a reciprocal shaker.	Yes		AD	Yes
TM38	Soluble Ion analysis using Discrete Analyser. Modified US EPA methods 325.2 (Chloride), 375.4 (Sulphate), 365.2 (o-Phosphate), 353.1 (TON), 354.1 (Nitrite), 350.1 (NH4+) comparable to BS ISO 15923-1, 7196A (Hex Cr)	PM20	Extraction of dried and ground or as received samples with deionised water in a 2:1 water to solid ratio using a reciprocal shaker for all analytes except hexavalent chromium. Extraction of as received sample using 10:1 ratio of 0.2M sodium hydroxide to soil for hexavalent chromium using a reciprocal shaker.	Yes		AR	Yes
TM50	Acid soluble sulphate (Total Sulphate) analysed by ICP-OES	PM29	Dried and ground solid sample is boiled with dilute hydrochloric acid, the resulting liquor is then analysed.	Yes		AD	Yes
TM61	Modified US EPA methods 245.7 and 200.7. Determination of Mercury by Cold Vapour Atomic Fluorescence.	PM62	Acid digestion of as received solid samples using Aqua Regia refluxed at 112.5 °C.			AR	Yes
TM65	Asbestos Bulk Identification method based on HSG 248.	PM42	Solid samples undergo a thorough visual inspection for asbestos fibres prior to asbestos identification using TM065.	Yes		AR	
TM73	Modified US EPA methods 150.1 and 9045D and BS1377:1990. Determination of pH by Metrohm automated probe analyser.	PM11	Extraction of as received solid samples using one part solid to 2.5 parts deionised water.	Yes		AR	No
TM74	Analysis of water soluble boron (20:1 extract) by ICP-OES.	PM32	Hot water soluble boron is extracted from dried and ground samples using a 20:1 ratio.	Yes		AD	Yes
TM89	Modified USEPA method OIA-1667. Determination of cyanide by Flow Injection Analyser. Where WAD cyanides are required a Ligand displacement step is carried out before analysis.	PM45	As received solid samples are extracted with 1M NaOH by orbital shaker for Cyanide and Thiocyanate analysis.	Yes		AR	Yes

APPENDIX C

Ground Gas Monitoring Results

Ground Gas Monitoring Record

Borehole	Gas Flow (l/hr)	Gas Flow (l/hr)	Borehole Pressure (Pa)	Methane (% v/v)		Methane (%LEL*)		Carbon Dioxide (%v/v)		Oxygen (%v/v)		H2S PPM		CO PPM		Depth to water (m bgl)	Depth to Base (m bgl)	Atmospheric Pressure (mB)	Comments
	Initial	Steady		Initial	Steady	Initial	Steady	Initial	Steady	Initial	Steady	Initial	Steady	Initial	Steady				
WS1	0.0	0.0		0.0	0.0			2.7	2.8	10.7	10.4	0.0	0.0	0	0	1.45	2.6	1009	
WS2	0.0	0.0		0.0	0.0			1.6	1.6	17.6	17.8	0.0	0.0	0	0	Dry	0.91	1009	
WS3	44.5	0.0		0.0	0.0			5.3	5.5	12.2	12	0.0	0.0	0	0	1	4.56	1008	Flow reduced to 0 in 20 Seconds
WS4	0.0	0.0		0.0	0.0			5.2	5.3	12.2	11.8	0.0	0.0	0	0	1.27	3.2	1009	
WS5	0.0	0.0		0.0	0.0			1.4	1.4	17	17.5	0.0	0.0	0	0	3.23	3.83	1009	
WS6	0.0	0.0		0.0	0.0			0.9	0.9	13.8	13.5	0.0	0.0	0	0	Dry	1.74	1009	

Notes:
Monitoring should be for not less than 3 Minutes. However, if high concentrations of gases initially recorded, monitoring should be for up to 10 mins.
* LEL = Explosive Limit = 5%v/v
ND - Not Detected

Relevant Information at times of monitoring

Monitored by:	Alice Molyneux
Weather :	Overcast, Drizzle
Equipment used:	GFM436 Gas Analyser
Visible signs of vegetation stress:	None
Boreholes sampled for laboratory analysis:	None
Other comments / observations:	None

GEO-ENVIRONMENTAL CONSULTING ENGINEERS

Contract:	**Lodematic, Clitheroe**
Date:	**11/06/19**
Job No.	19568
Sheet No.	**1**

Ground Gas Monitoring Record

Borehole	Gas Flow (l/hr)	Gas Flow (l/hr)	Borehole Pressure (Pa)	Methane (% v/v)		Methane (%LEL*)		Carbon Dioxide (%v/v)		Oxygen (%v/v)		H2S PPM		CO PPM		Depth to water (m bgl)	Depth to Base (m bgl)	Atmospheric Pressure (mB)	Comments
	Initial	Steady		Initial	Steady	Initial	Steady	Initial	Steady	Initial	Steady	Initial	Steady	Initial	Steady				
WS1	0.0	0.0		0.0	0.0			2.3	2.4	13.5	12.6	0.0	0.0	0	0	1.14	2.53	1008	
WS2																			Skip placed over BH
WS3	0.0	0.0		0.0	0.0			3	4	15.1	13.3	0.0	0.0	0	0	0.9	4.56	1008	
WS4	0.0	0.0		0.0	0.0			3.6	3.9	15.5	15.6	0.0	0.0	0	0	1.94	3.2	1009	
WS5	0.0	0.0		0.0	0.0			1.6	1.5	17.6	17.8	0.0	0.0	0	0	2.2	3.83	1009	
WS6	0.0	0.0		0.0	0.0			1.3	1.4	14.2	15.3	0.0	0.0	0	0	Dry	1.74	1009	

Notes:
Monitoring should be for not less than 3 Minutes. However, if high concentrations of gases initially recorded, monitoring should be for up to 10 mins.
* LEL = Explosive Limit = 5%v/v
ND - Not Detected

Relevant Information at times of monitoring

Monitored by:	Alice Molyneux
Weather :	Overcast
Equipment used:	GFM436 Gas Analyser
Visible signs of vegetation stress:	None
Boreholes sampled for laboratory analysis:	None
Other comments / observations:	None

GEO-ENVIRONMENTAL CONSULTING ENGINEERS

Contract:	**Lodematic, Clitheroe**
Date:	**24/06/19**
Job No.	19568
Sheet No.	**2**

Ground Gas Monitoring Record

Borehole	Gas Flow (l/hr)	Gas Flow (l/hr)	Borehole Pressure (Pa)	Methane (% v/v)		Methane (%LEL*)		Carbon Dioxide (%v/v)		Oxygen (%v/v)		H2S PPM		CO PPM		Depth to water (m bgl)	Depth to Base (m bgl)	Atmospheric Pressure (mB)	Comments
	Initial	Steady		Initial	Steady	Initial	Steady	Initial	Steady	Initial	Steady	Initial	Steady	Initial	Steady				
WS1	0.0	0.0		0.0	0.0			2.5	2.9	12.3	11.5	0.0	0.0	0	0	1.2	2.53	1005	
WS2	0.0	0.0		0.0	0.0			2.2	2.2	15.6	16.4	0.0	0.0	0	0	Dry	0.89	1005	
WS3	26.1	0.0		0.0	0.0			2.6	3	15.7	15.4	0.0	0.0	0	0	1	4.55	1004	Flow reduced to 0 in 20 seconds
WS4	0.0	0.0		0.0	0.0			2.9	3.3	16.5	16.3	0.0	0.0	0	0	1.36	3.2	1005	
WS5																			BH covered
WS6	0.0	0.0		0.0	0.0			1.8	1.7	13.9	12.8	0.0	0.0	0	0	Dry	1.74	1005	

Notes:
Monitoring should be for not less than 3 Minutes. However, if high concentrations of gases initially recorded, monitoring should be for up to 10 mins.
* LEL = Explosive Limit = 5%v/v
ND - Not Detected

Relevant Information at times of monitoring

Monitored by:	Alice Molyneux
Weather :	Overcast, rain
Equipment used:	GFM436 Gas Analyser
Visible signs of vegetation stress:	None
Boreholes sampled for laboratory analysis:	None
Other comments / observations:	None

GEO-ENVIRONMENTAL CONSULTING ENGINEERS

Contract:	**Lodematic, Clitheroe**
Date:	**11/07/19**
Job No.	19568
Sheet No.	**3**

Ground Gas Monitoring Record

Borehole	Gas Flow (l/hr)	Gas Flow (l/hr)	Borehole Pressure (Pa)	Methane (% v/v)		Methane (%LEL*)		Carbon Dioxide (%v/v)		Oxygen (%v/v)		H2S PPM		CO PPM		Depth to water (m bgl)	Depth to Base (m bgl)	Atmospheric Pressure (mB)	Comments
	Initial	Steady		Initial	Steady	Initial	Steady	Initial	Steady	Initial	Steady	Initial	Steady	Initial	Steady				
WS1	0.0	0.0		0.0	0.0			2.6	2.8	13.3	12.1	0.0	0.0	0	0	1.42	2.46	1004	
WS2	0.0	0.0		0.0	0.0			2.2	2.3	16.1	16.4	0.0	0.0	0	0	Dry	0.9	1005	
WS3	0.0	0.0		0.0	0.0			2.4	2.4	17.8	17.6	0.0	0.0	0	0	1.13	4.5	1005	
WS4	0.0	0.0		0.0	0.0			3	3.1	16.7	16.5	0.0	0.0	0	0	1.4	3.2	1004	
WS5																			BH covered
WS6	0.0	0.0		0.0	0.0			1	0.6	16	17.3	0.0	0.0	0	0	DRY	1.74	1005	

Notes:
Monitoring should be for not less than 3 Minutes. However, if high concentrations of gases initially recorded, monitoring should be for up to 10 mins.
* LEL = Explosive Limit = 5%v/v
ND - Not Detected

Relevant Information at times of monitoring

Monitored by:	Alice Molyneux
Weather :	Overcast, warm
Equipment used:	GFM436 Gas Analyser
Visible signs of vegetation stress:	None
Boreholes sampled for laboratory analysis:	None
Other comments / observations:	None

GEO-ENVIRONMENTAL CONSULTING ENGINEERS

Contract:	**Lodematic, Clitheroe**
Date:	**17/07/19**
Job No.	19568
Sheet No.	**4**

Ground Gas Monitoring Record

Borehole	Gas Flow (l/hr)	Gas Flow (l/hr)	Borehole Pressure (Pa)	Methane (% v/v)		Methane (%LEL*)		Carbon Dioxide (%v/v)		Oxygen (%v/v)		H2S PPM		CO PPM		Depth to water (m bgl)	Depth to Base (m bgl)	Atmospheric Pressure (mB)	Comments
	Initial	Steady		Initial	Steady	Initial	Steady	Initial	Steady	Initial	Steady	Initial	Steady	Initial	Steady				
WS1	0.0	0.0		0.0	0.0			2.4	2.4	15.9	15.9	0.0	0.0	0	0	1.44	2.45	998	
WS2	0.0	0.0		0.0	0.0			2.2	2.2	17.5	17.5	0.0	0.0	0	0	Dry	1	998	
WS3	0.0	0.0		0.0	0.0			2	2	18.2	18.2	0.0	0.0	0	0	1.19	4.3	998	
WS4	0.0	0.0		0.0	0.0			2.8	2.8	17.5	17.5	0.0	0.0	0	0	1.48	3.1	998	
WS5	0.0	0.0		0.0	0.0			1.1	1.1	18.6	18.6	0.0	0.0	0	0	2.5	3.8	998	
WS6	0.0	0.0		0.0	0.0			0.3	0.2	17.4	17.4	0.0	0.0	0	0	DRY	1.72	998	

Notes:
Monitoring should be for not less than 3 Minutes. However, if high concentrations of gases initially recorded, monitoring should be for up to 10 mins.
* LEL = Explosive Limit = 5%v/v
ND - Not Detected

Relevant Information at times of monitoring

Monitored by:	Michael Buckley
Weather :	Sunny
Equipment used:	GFM436 Gas Analyser
Visible signs of vegetation stress:	None
Boreholes sampled for laboratory analysis:	None
Other comments / observations:	None

GEO-ENVIRONMENTAL CONSULTING ENGINEERS

Contract:	**Lodematic, Clitheroe**
Date:	**08/08/19**
Job No.	19568
Sheet No.	**5**

APPENDIX D

Drawings

LEGEND

SITE LOCATION

REV	DESCRIPTION	DATE	BY

GEO-ENVIRONMENTAL CONSULTING ENGINEERS
Suite One, No 3 Mitton Road Business Park, Mitton Road, Whalley, Lancashire BB7 9YE
Tel: 01254 377622 Mob: 07906753583
Email: mbuckley@bekenviro.co.uk
Web: www.bekenviro.co.uk

CLIENT.
LODEMATIC

JOB TITLE.
LODEMATIC, CLITHEROE

DRAWING TITLE.
SITE LOCATION PLAN

SCALE @ A3.	DRAWN BY.	APPROVED BY.	DATE.
NTS	D.E.	M.B.	04/09/19

DRAWING No. 19568-1

REV. -

LEGEND

SITE FOOTPRINT

REV	DESCRIPTION	DATE	BY

GEO-ENVIRONMENTAL CONSULTING ENGINEERS
Suite One, No 3 Mitton Road Business Park, Mitton Road, Whalley, Lancashire BB7 9YE
Tel: 01254 377622 Mob: 07906753583
Email: mbuckley@bekenviro.co.uk
Web: www.bekenviro.co.uk

CLIENT.
LODEMATIC

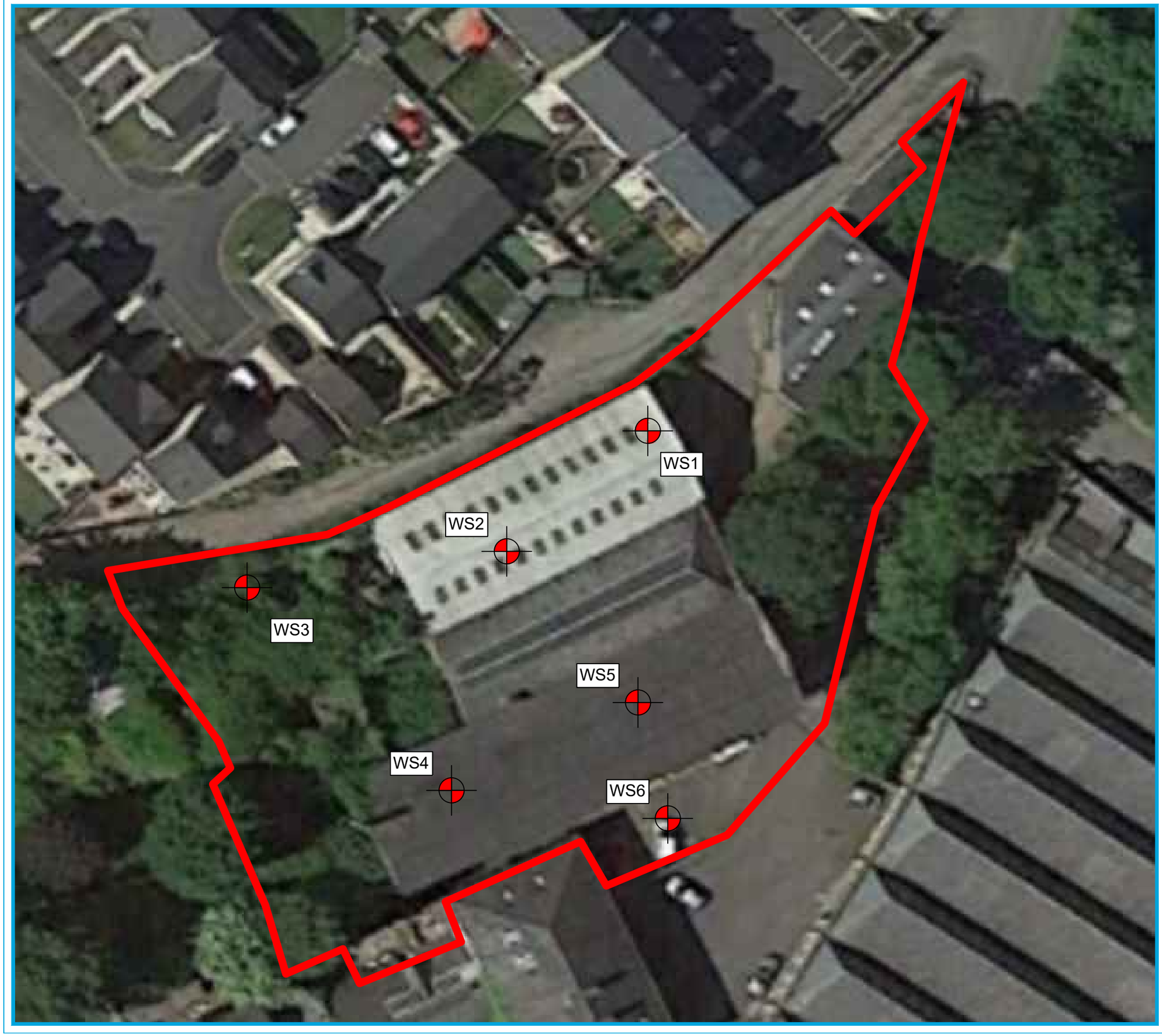
JOB TITLE.
LODEMATIC, CLITHEROE

DRAWING TITLE.
SITE LAYOUT PLAN

SCALE @ A3.	DRAWN BY.	APPROVED BY.	DATE.
NTS	D.E.	M.B.	04/09/19

DRAWING No. 19568-2

REV. -



LEGEND

Window Sample Borehole

REV	DESCRIPTION	DATE	BY

GEO-ENVIRONMENTAL CONSULTING ENGINEERS
Suite One, No 3 Mitton Road Business Park, Mitton Road, Whalley, Lancashire BB7 9YE
Tel: 01254 377622 Mob: 07906753583
Email: mbuckley@bekenviro.co.uk
Web: www.bekenviro.co.uk

CLIENT.
LODEMATIC

JOB TITLE.
LODEMATIC, CLITHEROE

DRAWING TITLE.
SITE INVESTIGATION PLAN

SCALE @ A3.	DRAWN BY.	APPROVED BY.	DATE.
NTS	D.E.	M.B.	04/09/19

DRAWING No. 19568-3

REV. -

SCHEDULE OF APARTMENTS

BLOCK A : 5 X 1 BED APARTMENTS	PARKING SPACES: 5
BLOCK A : 12 X 2 BED APARTMENTS	PARKING SPACES: 24
BLOCK B : 7 X 1 BED APARTMENTS	PARKING SPACES: 7
TOTAL: 24 APARTMENTS	**PARKING SPACES: 36** (Excluding 3 no. visitor parking spaces. Making parking total 39)

PROPOSED SITE PLAN
SCALE 1:100

1:100 Scale 0 2 4 6m

Client
Mr Rob Evans

Job Title
Development and Conversion of the former Lodematic Premises at Primrose Road, Clitheroe

Drawing Title
PROPOSED SITE PLAN

Scale	Date	Drawn
1:100 @ A1	June 2019	Ben Turner

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