

PROJECT REFERENCE: 17.9382

January 2017

PHASE 1: ENVIRONMENTAL RISK ASSESSMENT

The Dairy Buildings,
Sack Lane

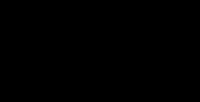
FOR

RJCA Chartered Architects

CONSTRUCTIVE EVALUATION
UNIT 15/16 FORD LANE INDUSTRIAL ESTATE
FORD LANE
ARUNDEL
BN18 0JZ

Document Approval

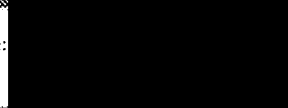
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REPORT REVISED (response to significant changes in client requirements, methods of work etc)

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Trading Terms

Unless specifically stated within the tender/quotation or unless identified within the introduction to this report it is confirmed that this report has been compiled wholly in accord with Constructive Evaluation Limited's terms of engagement. This report is provided for sole use by the Client and is confidential to them. No responsibility whatsoever for the contents of the report will be accepted to anyone other than the Client.

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Context

This report is written in the context of an agreed scope of work between Constructive Evaluation Limited and the Client and should not be used in a different context. In light of additional information becoming available, improved practices and changes in legislation amendment or re-interpretation of the report in whole or part may be necessary after its original submission.

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 insitu 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. 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 the 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 CIEH 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 cannot 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 Ltd (CE) were instructed by RJCA Chartered Architects (the Architect) on behalf of Melanie Jenkins Farming Ltd (the Client) to carry out a 'Phase 1: Environmental Risk Assessment' (EQ11554, dated: January 2017) at the Dairy Buildings, Sack Lane, Aldingbourne, West Sussex, PO22 9PE (hereafter referred to as the "site").

The site consists of a barn used for storing agricultural machinery, milking equipment and for keeping cattle. Surrounding the barn are areas of hard standing, a slurry tank, associated pipe work and a stockpile of crushed concrete.

Proposals include the demolition of existing barns and structures and 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 a new area of pasture land.

Existing site plans and proposed site plans can be viewed in **Appendix A**.

On behalf of the Client, the Architect instructed CE to undertake a Phase 1: Environmental Risk Assessment to enable determination of the potential source – pathway – receptor linkages associated with the site and the surrounding environs in the current and historical context. This aids in the formulation of a suitable targeted Site Investigation in the future.

The purpose of this Environmental Risk Assessment was to provide information on:

- 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.

This report presents assessment of historical Ordnance Survey maps and published geological and hydrogeological maps, as well as information from various sources such as Envirocheck.

The report has been formulated in accordance with BS10175:2011:2013+A1 *Investigations into Potentially Contaminated Sites – Code of Practice* and CLR11 – *Model Procedures for the Management of Land Contamination*, and from Planning Policy Statement (PPS) 23 – *Planning & Pollution Control*.

2.0 PHYSICAL SETTING

The following observations are taken from the Envirocheck Report (**Appendix B**) and the British Geological Survey (BGS).

The site is located on National Grid Reference (NGR) 494550, 102370 with an area of approximately 0.30 hectares (Ha).

2.1 Geology and Hydrogeology

The Geology of Britain Viewer (BGS, 2017) indicates the site is underlain by Superficial Deposits of River Terrace Deposits (undifferentiated) over Bedrock Geology of the White Chalk Subgroup

(Upper Chalk). The table below identifies the expected composition of the published strata and the associated aquifer classification.

Superficial Deposits	
Unit Name	River Terrace Deposits (undifferentiated).
Geology Description	Sand and gravel, locally with lenses of silt, clay or peat (generic description).
Aquifer Class	Secondary (A) Aquifer.
Aquifer Description	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.
Bedrock / Solid Geology	
Unit Name	White Chalk Subgroup – Upper chalk.
Geology Description	Chalk with flints, with discrete marl seams, nodular chalk, sponge-rich and flint seams throughout.
Aquifer Class	Principal Aquifer.
Aquifer Description	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.

2.1.1 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.

2.1.2 Geological Hazards

The BGS has provided the available published Geological Hazard directory information for the study site. The information returned is displayed in the table below.

Process	Risk Level	BGS Description
Shrink swell clays.	Low.	Ground conditions predominantly medium plasticity.
Running sands.	Low.	Possibility of running sand problems after major changes in ground conditions.
Collapsible Ground.	Low.	Deposits with potential to collapse when loaded and saturated are possibly present in places.
Ground dissolution of soluble rocks.	Very Low.	Soluble rocks are present but unlikely to cause problems except under exceptional conditions.
Landslides.	Very low.	Slope instability problems are unlikely to be present.
Compressible Ground.	Negligible.	No indicators for compressible deposits identified.

2.1.3 Radon

The site is in a lower probability radon area (as less than 1% of homes are estimated to be at or above the action level). As a result, it is considered that no radon protective measures are necessary in the construction of new dwellings or extensions.

2.2 Hydrology

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.

2.3 Controlled Waters

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.

3.0 SITE CONDITIONS

3.1 Site Description

An Environmental Scientist from CE completed a walkover survey of the site on 11th January 2017.

The site is accessed from a private track leading from Sack Lane. The site consists of a barn used for storing agricultural machinery, milking equipment and for keeping cattle. Surrounding the barn are areas of hard standing, a slurry tank, associated pipe work and a stockpile of crushed concrete.

The barn is of concrete frame with cement profile sheet cladding, presumed to be potentially asbestos containing material (ACM). The north eastern area of the barn is constructed with three rooms and accessed via doors in the north and west of the barn. The southern and eastern elevations of the barn are not clad at ground level. In the east and north-east a king post-type clamp/trap wall formed of railway sleepers is noted. The southern side of the site has metal agricultural fencing along the perimeter.

Two of the rooms in the north east of the barn appear to have previously been used as a dairy, evidenced by the presence of milking machinery/equipment. The milking machinery consisted of two rows of seven milking stations, however not all the machinery appears to be present. Between the two milking stations there is a pit in which the dairy workers are presumed to work. The third room appeared unused at the time of the walkover survey. The rest of the barn is split into pens with metal fencing and is used to house cattle. At the time of the walkover survey there were approximately 40 cows housed within the barn.

South of the barn is an industrial-sized above ground open storage tank (AST), this galvanized tank is assumed to have been used, or being used, for slurry. The tank has notable scores and holes within the top. Between the storage tank and the barn is a pool of water with pipework leading to and from it surrounded by metallic fencing. The use of this is unknown, however the water within the pool appears brown with an effluent odour and potentially associated with the slurry tank.

East of the storage tanks is an area of crushed concrete, the concrete is assumed to come from the removal of a previous on-site structures as identified in section 4.0. The crushed concrete could potentially contain ACMs, there is also noted to be utilities/services still within this area.

3.2 Surroundings

The site is set within a predominantly agricultural area with a number (approx. 5-10no.) of residential properties. 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.

Photographs relating to the observations made during the walkover can be viewed within **Appendix C**.

3.3 Potential Sources of Contamination – Walkover Survey

Potential Sources of Contamination Considered a Risk to the Site	
Feature	Location
Possible ACMs.	On site.
Spillages and leakages farm vehicles.	On site.
Made Ground associated with on-site slurry tank.	On site.
Biological contaminants (<i>Bacillus anthracis</i>) around slurry tank.	On site.
Pesticides and fertilisers associated with agricultural land use.	On site.

Potential Sources Not Considered Further	
Feature	Justification
Railway located approx. 250m east.	Distance from site.
Greenhouses, infrastructure and processes located approx. 300m west.	Distance from site.

4.0 SITE HISTORY AND HISTORICAL CONTAMINATIVE SOURCES

The following observations are made based on the available historical map extracts presented in **Appendix B** of which the most significant points have been discussed in relation to the site and surrounding environs.

Mapping Date	Observations
1876 - 1899	The earliest available maps show the site to be divided into two parts, with the majority of the site considered to be an agricultural field. The north eastern edge of the site comprises a track and a portion of what is likely to be residential curtilage associated with the neighbouring building. A well is located immediately adjacent east of the site. The surrounding area is predominantly agricultural, comprising Sack Barn (located approx. 70m east), Lidsey Lodge (located approx. 250m north west), Lidsey Farm (located approx. 750m north west) and what is assumed to be agricultural fields. London-Brighton & South Coast Railway is located approximately 250m east from site.
1912 – 1914	The site and surrounds remain relatively unchanged.
1938 – 1962	The site remains unchanged. During this period there has been some development along Shripney Road, located approximately 750m west, assumed to be residential dwellings. A Nursery is present from 1951 onwards located approximately 300m west. The remaining surrounds are relatively unchanged. Limited 1:2,500 map sheets and information for the site and immediate surrounds.
1974 – 1980	There is now a rectangular building on site, considered to be a farm building associated with the agricultural surrounds. The well located immediately adjacent east of site is no longer present. Lidsey Lodge Farm, with associated farm buildings, is located approximately 150m north. There are now 3no. greenhouses included with the Nursery located approximately 300m west from site. A Works with associated tanks is located approximately 900m north. The remaining surrounds are relatively unchanged. Limited 1:10,000 map sheet and information for the site and surrounds.

1992 – 1994	There are now 2no. additional features included on site: a circular tank and another rectangular building, both of which are considered be associated with the agricultural surrounds. The tank is assumed to be the present day slurry tank. There are now a total of 6no. greenhouses included within the Nursery located approximately 300m west from site. There is further development along Shripney Road, located approximately 750m west. The remaining surrounds are relatively unchanged.
2000	The site remains unchanged. The surrounds remain relatively unchanged. Lack of 1:2,500 map sheets and information for the site and surrounds.
2016	The site remains unchanged. The A259 road is now located approximately 300m south from site. The remaining surrounds are relatively unchanged. Lack of 1:2,500 map sheets and information for the site and surrounds.

4.1 Potential Contamination Sources - Historical

Potential Sources of Contamination Considered a Risk to the Site		
Feature	Distance, Direction	Dates Present
Infrastructure and processes associated with the farm buildings, including potential Made Ground and biological contaminants related to the on-site slurry tank.	On site.	1974 until present day.

Potential Sources Not Considered Further	
Feature	Justification
Lidsey Lodge Farm and associated processes and infrastructure located approx. 150m north.	Distance from site and relatively low contamination potential.
Railway located approx. 250m east.	Distance from site.
Nursery and associated greenhouses, infrastructure and processes located approx. 300m west.	Distance from site.
Construction of the A259 road including possible Made Ground.	Distance from site and relatively low contamination potential.
Works with associated tanks located approx. 900m north.	Distance from site.

5.0 INFORMATION ON PUBLIC RECORD

5.1 Envirocheck Public Record Search

The following information has been obtained from public archive via the data supplier Envirocheck or by direct application. The full Envirocheck Report is presented in **Appendix B**.

Discharge Consents – There are forty-seven records within 1000m of the site. The closest of these is located approximately 30m north west detailed as a now revoked (revocation date: March 1997) licence for the discharges of other matter to a controlled sea. Note; this discharge licence is considered to be associated with the site given its location and proximity.

Two records both associated with the farm barns on Sack Lane are located closest to site at approximately 160m north, detailed as the discharges of final treated sewage effluent to a freshwater stream and into land, dated 1995 and 1993, respectively. As no permit end date or revocation date has been provided it is assumed that these licences are still active. The remaining records are over 300m from site.

Integrated Pollution Prevention and Control – There are three records within 1000m of the site, two of which are associated with Lidsey Well Site (Lidsey Oilfield) located approximately 920m north, for the loading, storage and treatment etc. of crude oil; one of these permits is still effective superseding the other. The remaining record is located over 950m from site.

Local Authority Pollution Prevention and Controls – There is one record within 1000m of the site located approximately 810m north west at Marine Pack Ltd National Bait company detailed as a now revoked authorisation for maggot breeding processes; no revocation date has been provided.

Pollution Incidents to Controlled Waters – There are two records within 1000m of the site. The closest of these occurred in February 1996 located approximately 800m south west at the Holding, Shripney Road detailed as leaking heating oil (Oils – diesel) from a storage tank to a drainage ditch causing a minor incident (Category 3) to controlled waters; no information has been provided as to the volume of pollutant. The remaining record is located over 950m from site.

Historical Landfill Sites – There is one record within 1000m of the site, located approximately 900m north operating and accepting deposited waste including inert waste from 1950 to 1960, labelled as 'Disused Canal East of A27'.

Local Authority Recorded Landfill Sites – There is one record within 1000m of the site, assumed to be the aforementioned record of a landfill, 'Disused Canal East of A27' located approximately 900m north.

BGS Recorded Mineral Sites – There is one record within 1000m of the site associated with the aforementioned Lidsey Oil Site located approximately 920m north. This record is detailed as an active mineral site for oil extraction located approximately 890m north.

Contemporary Trade Directory Entries – There are fourteen records within 1000m of the site. The closest of these is detailed as an inactive waste disposal services located approximately 730m west. The closest active entry is a refrigeration equipment manufacturers and distributors located approximately 950m south.

Nitrate Vulnerable Zones (NVZ) – A surface water NVZ is identified on site.

5.2 Information from Local Authority

Environmental information relating to the site and surrounds can be acquired at a cost of £42.00 by contacting Kate Simons from Chichester District Council at kgovey@chichester.gov.uk or on 01243 785166. CE have not actioned the release of this information.

5.3 Potential Sources of Contamination – Public Records

Potential Sources of Contamination Considered a Risk to the Site		
Feature	Distance, Direction	Dates Present
Revoked licence for the discharges of other matter (unknown pollutant) to a controlled sea.	Approximately 30m north west. However, assumed to be associated with the site.	Operating until March 1997.

Potential Sources Not Considered Further	
Feature	Justification
Discharge licence of final treated effluent to a freshwater stream into land located approximately 160m north.	Distance from site and relatively low contamination potential.
Processes, infrastructure and spillages associated with Lidsey Oilfield located approximately 890-920m north.	Distance from site.
Pollution Incidents to Controlled Waters.	Distance from site and/or incidents having only a minor incident.
Marine Pack Ltd National Bait company detailed as a now revoked authorisation for maggot breeding processes located approximately 810m north west.	Distance from site.
Historical Landfill Site – ‘Disused Canal East of A27’ located approximately 900m north.	Distance from site.
Contemporary Trade Directory Entries	Distance from site and/or relatively low contamination potential.

6.0 PRELIMINARY CONCEPTUAL SITE MODEL & RISK ASSESSMENT

The Preliminary Conceptual Site Model (CSM) has been formulated in accordance with BS10175:2011:2013+A1. It is used to assess the significance of the environmental hazards identified at the site, the potential receptors and the pathway between them.

6.1 Sources

6.1.1 On Site

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.

6.1.2 Off Site

3. Unknown pollutants (other matter) related to the discharge licence located approximately 30m north west; assumed to be associated with the site.

6.2 Receptors

- End Users – Residents, site workers and visitors.
- Site Workers (during development) – There is the potential of exposure to contaminated soils and vapour especially during groundworks.
- Proposed Development – Vapour from impacted soils that may accumulate in confined, poorly ventilated areas of the proposed buildings.
- Services – Any buried services installed for the proposed development.
- Groundwater – Bedrock Principal Aquifer and Superficial Secondary (A) Aquifer underlying the site. Note; the historical well adjacent east to site (as detailed in Section 4.0) is acknowledged as a preferential vertical pollutant pathway to groundwater.

6.2.1 Potential Receptors Not Considered Further

Surface water is not deemed a receptor further due to the distance of the nearest surface water feature to site (approx. 140m).

6.3 Potential for Ground Gas and Soil Vapour Generation

The potential for Made Ground on-site and presence of the River Terrace Deposits, specifically the possibility of peat underlying the site, is pertinent with regard to generation of ground gas. However, this is thought to be somewhat limited.

A number of hydrocarbon specific sources have been identified, including general maintenance of vehicles and equipment associated with the agricultural setting, congruous to the possibility of soil vapour on site.

6.4 Preliminary Conceptual Site Model

The Preliminary CSM has been formulated in accordance with BS10175:2011:2013+A1 to provide information regarding the possible sources of contamination that may impact the site, the pathway in which the contamination can migrate, and any vulnerable receptors, all of which need to be present for there to be a risk. The risk assessment has been carried out by assessing the severity of the potential consequence, taking into account both the potential severity of the hazard and the sensitivity of the target. An explanation of categories is provided below the CSM tables.

Source	Pathway	Receptor	Likelihood	Potential Risk	Proposed Action
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.	Inhalation, ingestion and dermal contact from exposure to contaminated soils.	End users.	Likely.	Moderate. The likelihood of exposure is high considering the residential scenario and areas of private gardens.	Intrusive investigation to further refine risks (as detailed in Section 8.1 of this report). Adequate site coverage must be achieved, with particular focus to areas within proximity to the slurry tank. In addition, at least 1no. position should be located per private garden. Soil sampling will be based on field observations, coverage and in order to refine the identified source-pathway-receptor linkages. It will be necessary to install at least 1no. monitoring well, with the completion of subsequent soil vapour / ground gas and groundwater monitoring. Groundwater analysis will be based on field observations (i.e. staining, odour and presence of groundwater) and initial soil analysis.
		Site workers (during development).	Likely.	Moderate. The possibility of a pollutant linkage given the likelihood of direct contact with contaminated soils as well as the contamination potential increases the risk. The short exposure time is acknowledged.	
	Impacted soils.	Services.	Likely.	Low to Moderate. There is a possibility of exposure given the on-site location of the source and the option of new potable water supply pipework/services.	
	Volatilisation of hydrocarbons in the underlying soils and groundwater to indoor and/or outdoor air.	End users and proposed development.	Possible.	Moderate. The residential end use increases the risk.	
		Site workers (during development).	Unlikely.	Negligible to Low. Temporary external work setting and short exposure time reduces this risk.	
	Migration of ground gas through the soil pores of the underlying geology.	End users and proposed development.	Possible.	Moderate. The residential end use increases the risk.	
Site workers (during development).		Unlikely.	Negligible to Low. Temporary external work setting and short exposure time reduces this risk.		
Potential contaminants include, but are not restricted to, heavy metals, petroleum hydrocarbons, solvents, biological contaminants, ground gas and asbestos.	Infiltration and migration of contaminants through the underlying geology and historical well adjacent east to site.	Bedrock Principal Aquifer and Superficial Secondary (A) Aquifer underlying the site.	Possible.	Moderate. The risk is increased by the presence of the Bedrock Principal Aquifer. However, it should be noted that the sensitivity is reduced as there are no potable water abstraction licences and SPZs within 2000m of the site.	

Source	Pathway	Receptor	Likelihood	Potential Risk	Proposed Action
Possibility of asbestos within potential ACM and concrete stockpile on site.	Inhalation, ingestion and dermal contact from exposure to contaminated soils.	End users.	Possible.	Moderate. The likelihood of exposure is high considering the residential scenario and areas of private gardens.	An asbestos identification survey targeting the potential ACM, to determine the presence of asbestos, may wish to be undertaken. This should be completed by a suitably qualified person equipped with the correct PPE. It will be necessary to complete a series of shallow trial pits within the affected areas.
		Site workers (during development).	Likely.	Moderate to High. A potential pollutant linkage is based on the possibility of direct contact with contaminated soils and possible ACMs during works.	
Potential contaminants include asbestos.					

Source	Pathway	Receptor	Likelihood	Potential Risk	Proposed Action
Unknown pollutants (other matter) related to the discharge licence located approximately 30m north west; assumed to be associated with the site.	Inhalation, ingestion and dermal contact from exposure to contaminated soils.	End users.	Possible.	Moderate. The unknown contamination potential and residential end use increases the risk.	Intrusive investigation to further refine risks (as detailed in Section 8.1 of this report). Adequate site coverage must be achieved. Soil sampling will be based on field observations, coverage and in order to refine the identified source-pathway-receptor linkages. It will be necessary to install at least 1no. monitoring well, with the completion of subsequent soil vapour / ground gas and groundwater monitoring. Groundwater analysis will be based on field observations (i.e. staining, odour and presence of groundwater) and initial soil analysis.
		Site workers (during development).	Likely.	Low. The risk is increased given the unknown contamination potential and possibility of a pollutant linkage given the likelihood of direct contact with contaminated soils. The short exposure time reduces the risk somewhat.	
	Impacted soils.	Services.	Likely.	Low to Moderate. There is a possibility of exposure given the option of new potable water supply pipework/services. The unknown contamination potential increases the risk.	
	Volatilisation of hydrocarbons in the underlying soils and groundwater to indoor and/or outdoor air.	End users and proposed development.	Possible.	Moderate. The unknown contamination potential and residential end use increases the risk.	
		Site workers (during development).	Unlikely.	Negligible to Low. Temporary external work setting and short exposure time reduces this risk.	
	Migration of ground gas through the soil pores of the underlying geology.	End users and proposed development.	Possible.	Moderate. The unknown contamination potential and residential end use increases the risk.	
		Site workers (during development).	Unlikely.	Negligible to Low. Temporary external work setting and short exposure time reduces this risk.	

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.

7.0 CONCLUSIONS

The site consists of a barn used for storing agricultural machinery, milking equipment and for keeping cattle. Surrounding the barn are areas of hard standing, a slurry tank, associated pipe work and a stockpile of crushed concrete.

Proposals include the demolition of existing barns and structures and 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 created into a new area of pasture land.

The Geology of Britain Viewer (BGS, 2017) indicates the site is underlain by Superficial Deposits of River Terrace Deposits (undifferentiated) over Bedrock Geology of the White Chalk Subgroup (Upper Chalk).

Following a site reconnaissance, 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.
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 possible pollutant linkages identified within the Preliminary CSM is below:

End Users

At present, there is considered to be a **Moderate** risk to end users through inhalation, ingestion and dermal contact, the volatilisation of hydrocarbons and migration of ground gas from exposure to contaminated soils, including potential ACM, associated with the identified sources.

Site Workers (during development)

At present, there is considered to be a **Moderate to High** risk to site workers through inhalation, ingestion and dermal contact from exposure to possible ACMs and contaminated soils on site.

Services and Development

In general, there is considered to be a **Low to Moderate** risk to services and development from exposure to impacted soils associated with the on- and off-site sources.

Groundwater

In general, there is considered to be a **Moderate** risk to the underlying aquifers (Bedrock Principal Aquifer and Superficial Secondary A Aquifers) through infiltration and migration of contaminants through the underlying geology from exposure to the on-site source.

It will be necessary to conduct a Site Investigation to further refine the identified pollutant linkages.

8.0 RECOMMENDATIONS

The following recommendations are specific to the plans received at the time of writing this report. Any alterations to the plans may warrant a reassessment of the risk.

It will be necessary to conduct a Site Investigation in order to further refine the potential risks identified within the Preliminary CSM. Details can be found within Section 8.1 of this report.

It will be necessary to conduct a Watching Brief on site, in order to detect any areas of unidentified contamination during groundworks, if present. Further details can be found in Section 8.2 of this report.

It is recommended that this report is submitted to the Local Authorities and the Environment Agency for comment and approval.

8.1 Proposed Site Investigation

In accordance with Sections 7.0 and 8.0, an intrusive Site Investigation is required to further refine the potential pollution linkages identified in the Preliminary CSM. In summary, the Site Investigation should involve the following:

- At least 3no. trial pits, with at least 1no. location per residential garden;
- At least 2no. trial pits within proximity to the concrete stockpile;
- At least 2no. window sample and/or standard shell and auger boreholes; and,
- At least 1no. monitoring well installation.

Further details regarding the investigations considered necessary to assess the potential risks is tabulated below and overleaf.

Investigation Proposed	Purpose(s)
As per Section 6.4, the identified on-site source must be specifically targeted by intrusive locations positioned within the proposed residential gardens. At least 3no. intrusive locations, with at least 1no. location per residential garden. These should be either hand-dug or machine-dug trial pits, completed to approximately 1.00mbgl. Soil sampling will be based on field observations, coverage and in order to refine the identified pollutant linkages.	Collect representative soil samples and assess visual/olfactory evidence of impacted soils within proposed private gardens, in order to assess the risks to end users from the identified source.

Investigation Proposed	Purpose(s)
As per Section 6.4, the identified on-site source (possibility of ACM) must be specifically targeted by intrusive locations positioned within close proximity to the concrete stockpile. At least 2no. intrusive locations within close proximity to the concrete stockpile. These should be hand-dug trial pits completed to approximately 1.00mbgl. Soil sampling will be based on field observations, coverage and in order to refine the identified pollutant linkages.	Collect representative soil samples and assess visual/olfactory evidence of impacted soils within proximity to the concrete stockpile, in order to assess the risks to end users and site workers from exposure to possible ACM.
As per Section 6.4, the pollutant linkages identified with the on- and off-site sources must be refined. At least 2no. intrusive locations, which should be either window sample boreholes or standard shell and auger boreholes, arranged in order to provide suitable vertical and horizontal coverage with particular attention to the slurry tank. Soil sampling will be based on field observations, coverage and in order to refine the identified pollutant linkages.	Collect representative soil samples and assess visual/olfactory evidence of impacted soils, in order to assess the risks from the identified sources. To allow for at least 1no. monitoring well installation and subsequent soil vapour, ground gas and groundwater monitoring.
As per Section 6.4, at least 1no. monitoring well installation within the aforementioned borehole(s) to allow for soil vapour, ground gas and groundwater monitoring. At least 2no. rounds of monitoring should be completed, preferably during periods of decreasing atmospheric pressure.	Completion of ground gas and soil vapour monitoring to refine pollutant linkages to end users. To assess the groundwater regime and to allow the collection of groundwater samples. If deemed necessary, groundwater analysis will be undertaken in order to refine the risks to the underlying aquifers.

Recovered samples will be analysed/assessed as part of the investigation, which will aid in refining the Preliminary CSM, based on the identified source-pathway-receptor linkages.

The testing regime has been devised in accordance with BS10175:2011:2013+A1 *Guidelines for the Code of Practice for Contaminated Land* and CLR Report No.4 *Sampling Strategies*.

8.1.1 Analysis

Analysis of soil samples is suggested in order to determine the completeness of the potential pollutant linkages identified in the Preliminary CSM. The following testing regime overleaf is considered appropriate for a selection of recovered samples.

Material	Chemical Testing Required
Made Ground	Heavy metals, speciated Total Petroleum Hydrocarbons (TPH – aliphatic and aromatic C ₅ – C ₄₀), speciated PAH, BTEX, MTBE, pH, Soil Organic Matter, biological contaminants (<i>Bacillus anthracis</i>) and Asbestos Screen. The need for VOC/SVOC analysis and an organochlorine pesticide suite will be based on initial soil analytical results and visual olfactory evidence of contamination.
Natural Soils	Heavy metals, speciated Total Petroleum Hydrocarbons (TPH – aliphatic and aromatic C ₅ – C ₄₀), speciated PAH, BTEX, MTBE, pH and Soil Organic Matter. The need for VOC/SVOC analysis and an organochlorine pesticide suite will be based on initial soil analytical results and visual olfactory evidence of contamination.
Groundwater	If deemed necessary; analytical suite will mirror that of soil testing – including, but not exclusive to, heavy metals, speciated Total Petroleum Hydrocarbons (TPH – aliphatic and aromatic C ₅ – C ₄₀), speciated PAH, BTEX, MTBE and pH.

8.1.2 Guidance

The results from the Site Investigation will be compared against relevant Generic Assessment Criteria (GAC) including Soil Guideline Values (SGVs), Provisional Category 4 Screening Levels (C4SLs) and LQM CIEH GAC using the equivalent 'Residential' classification on the basis that the end use includes residential dwellings and private gardens.

If necessary, groundwater results will be compared against the most applicable standard for each determinand from either: UK Drinking Water Standards, the Water Framework Directive (WFD), the New Dutch List and/or US EPA Drinking Water Advisory.

8.2 Watching Brief

We would recommend that a watching brief is maintained on site, particularly during any planned groundworks stage. 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. If any material is noted to show visual and/or olfactory signs 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 should be appointed by the contractor and it would be recommended that this person be able to display the relevant level of qualification and/or experience in managing major construction works on contaminated land.

8.3 Waste Disposal

As surplus arisings will likely be generated as part of the build programme, it is recommended that a copy of the laboratory results are given to the waste contractors and/or landfill operators involved to discuss the requirements with regards to removal of surplus subsoils from the site and the acceptance of the waste at the landfill. All surplus arisings should be appropriately classified as 'hazardous' or 'non hazardous' prior to its movement off site.

All materials must be transported in compliance with the Duty of Care Regulations by authorising movements with Carrier's individually numbered Duty of Care conveyance notes, complete with

the appropriate EWC Codes. All relevant dockets will need to be kept to provide evidence of the removal.

It may be necessary depending upon the initial classification and the specific requirements of the waste carrier and the accepting landfill facility to complete Waste Acceptance Criteria (WAC) testing; it is prudent to ascertain the testing requirements of each prior to the movement of any spoil.

Contaminated soil that is, or must be disposed of, is waste. Therefore, its handling, transport, treatment and disposal is subject to waste management legislation, which includes:

- Duty of Care Regulations 1991
- Hazardous Waste (England and Wales) Regulations 2005
- Environmental Permitting (England and Wales) Regulations 2010
- The Waste (England and Wales) Regulations 2011

The client should ensure that all contaminated materials are adequately characterised both chemically and physically in line with British Standard BS EN 14899:2005 'Characterization of Waste – Sampling of Waste Materials – Framework for the Preparation and Application of a Sampling Plan' and that the permitting status of any proposed treatment or disposal activity is clear. If in doubt, the Environment Agency should be contacted for advice at an early stage to avoid any delays.

If the total quantity of waste material to be produced or taken off site as hazardous waste is 500kg or greater in any 12 month period then the developer will need to register with the EA as a hazardous waste producer.

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

8.4 Services

We would recommend that if new services are to be included into the design of this development, the local water board are contacted to determine the type of pipework that should be used on this site.

All services and in particular potable water supply pipes should be made out of suitable materials with respect to contamination, particularly materials with respect to contamination, particularly organic contaminants, which are known to degrade polymeric materials from which services are often made.

It would be prudent to situate services 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.

This approach is largely to ensure that the risks to future service maintenance workers are mitigated, with respect to potential dermal contact, inhalation and ingestion pathways. Upon determination of the design, agreement should be sought from the Local Authority by way of a Remediation Strategy prior to commencement of groundworks.

It is recommended that a suitably qualified Environmental Scientist attends site to validate the construction of the service trenches, to take photographic records which should be included within a Validation Report or similar documentation.

8.5 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.