

MICA ENVIRONMENTAL LTD



Land to the East of Brynlwarch Gardens, Pentre, Kerry, Powys

Phase One and Two Environmental Risk Assessment Report

May 2018

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Date:

May 2018

Our Reference:

MENV07115RD01

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CONTENTS

1	Introduction	1
1.1	Terms of Reference	1
1.2	Objectives.....	1
1.3	Sources of Information	1
1.4	Report Layout.....	2
1.5	Limitations.....	2
2	Land Use and Site Setting	4
2.1	Site Location.....	4
2.2	Site Description	4
2.2.1	Current	4
2.2.2	Proposed Layout	4
2.3	Surrounding Land Use.....	5
2.3.1	North and East	5
2.3.2	West	5
2.3.3	South	5
2.4	Site Walkover	5
2.5	Previous Investigations	5
3	Environmental Setting	5
3.1	Geology	5
3.2	Hydrogeology.....	6
3.3	Hydrology.....	6
3.3.1	Pollution Incidents to Controlled Waters	6
3.4	Ecological and Heritage Designations	7
3.5	Waste Management and Landfill Activities	7
3.6	Radon	7
3.7	Environmental Permits, Consents, Licences, and Authorisations.....	7
4	Site History.....	7
4.1	Historical Map Review	7
4.2	Other Site History Sources	8
4.2.1	Anecdotal Information	8
4.2.2	Internet Searches - Planning History.....	8
4.3	Summary History.....	9
5	Regulatory Background.....	9
6	Conceptual Site Model.....	11
6.1	Sources.....	11
6.2	Pathways.....	11

6.3	Receptors	11
6.4	Tabular Preliminary Conceptual Site Model and Risk Estimation.....	12
6.4.1	Feasible Pollutant Linkages and Risk Estimation	12
6.4.2	Assessment	13
7	Site Investigation.....	17
7.1	Trial Holes	17
7.2	Observations	17
7.3	Sampling.....	17
8	Generic Assessment Criteria and Analytical Results.....	18
8.1	General.....	18
8.2	Generic Assessment Criteria (GAC).....	18
8.2.1	Human Health	18
8.3	Statistical Tests.....	18
8.4	Results – Inorganics	21
8.4.1	Metals	21
8.4.2	pH.....	21
8.4.3	Asbestos Screen	21
8.5	Results- Organics.....	21
8.5.1	Polyaromatic Hydrocarbons (PAHs).....	21
8.5.2	Semi-volatile organic compounds.....	21
8.5.3	Petroleum Hydrocarbons.....	21
9	Revised Conceptual Site Model and Risk Assessment.....	21
10	Summary.....	24
11	Conclusions & Recommendations	24

TABLES

Table 1:	Historical Map Review.....	8
Table 2:	Classification Definition.....	12
Table 3:	Consequence –Likelihood Matrix.....	13
Table 4:	Risk Estimation Classification	13
Table 5:	Summary of Potential Feasible Pollutant Linkages and Preliminary Risk Estimation	15
Table 6:	Chemical Data Summary	19
Table 7:	Petroleum Hydrocarbon (TPH CWG) Results	20
Table 8:	Summary of Potential Feasible Pollutant Linkages and Risk Estimation following Site Investigation	22

FIGURES

Figure 1	Site Location Plan
Figure 2	Current Site Layout
Figure 3	Proposed Site Layout
Figure 4	Trial Pit Location Plan

APPENDICES

Appendix A	Photographs
Appendix B	Landmark Envirocheck Data
Appendix C	Trial Hole Logs
Appendix D	Laboratory Data

1 Introduction

1.1 Terms of Reference

Mica Environmental Limited has prepared this Site Report on behalf of Mr K Harris following instruction from Gwynfor Humphreys on 29th March 2018. The report relates to a plot of land to the east of Brynllwarch Gardens, Pentre, Kerry, Powys SY16 4 PD where outline planning permission has been granted under two separate applications for two affordable three-bedroom homes.

The investigation was undertaken in accordance with Mica Environmental Ltd's proposal dated 15th March 2018.

Outline planning consent was granted for the eastern part of the site on 30th August 2016 under reference P2016/0937 for 'erection of an affordable dwelling including new access and installation of sewage treatment plant.'

On 21st June 2017 outline planning consent was granted for the western part of the site for 'erection of affordable dwelling, installation of sewage treatment plant and formation of vehicular access.'

Both outline planning consents were subject to conditions, including phased condition number 7 (on both), which stated 'An investigation and risk assessment, in addition to any provided with the planning application must be completed in accordance with a scheme to assess the nature and extent of any contamination on the site, whether or not it originates on the site....'

1.2 Objectives

This combined Phase One and Two report (Desk Study with Intrusive Investigation) aims to meet the initial requirements of Condition 7 of the outline planning conditions referenced above, by assessing the nature and extent of possible contamination on the site and establish whether remedial actions will be necessary in order for the proposed residential development.

1.3 Sources of Information

The following sources of information have been consulted during the preparation of this report:

- Observations made during site visits on 16th, 19th and 23rd April 2018 (see Appendix A)
- Ordnance Survey Explorer Map 214, Llanidloes & Newtown, 1:25 000-scale.
- Landmark Envirocheck Report (see Appendix B).
- Historical and current maps at 1:10560, 1:10000 and 1:2500 scales dating from 1884 to 2018 within Landmark Report (see Appendix B).
- British Geological Survey website lexicon www.bgs.ac.uk/lexicon/
- ALS Laboratory Report Number 180424-86 (Appendix D)

- Ecological Assessment prepared by Turnstone Ecology dated August 2016
- <https://historicwales.gov.uk/#zoom=6&lat=289351.80117&lon=315802.14307&layers=BTTTTTFFTTT>

1.4 Report Layout

The report is laid out as follows:

This section details the terms of reference, objectives and sources of information used in the assessment. Sections 2, 3 and 4 present the factual data relating to site layout, environmental setting and history of the site. Section 5 outlines the regulatory background to the assessment and Section 6 presents the conceptual site model. Details of the site investigation works undertaken are presented in Section 7, with results discussed in Section 8. A revised conceptual site model is presented in Section 9. A Summary is presented in Section 10 and Conclusions and Recommendations are presented in Section 11.

Figures are presented following the text.

Site photographs, where referenced in the text, are presented in Appendix A. The Landmark Environmental dataset, including historical maps, are provided in Appendix B. Appendix C contains the logs of the site investigation holes. The analytical laboratory report is contained in Appendix D.

1.5 Limitations

This report provides available factual data for the site obtained only from the sources described in the text and related to the site on the basis of the location information provided by the client. Where any data or information supplied by the client or other external source, including that from previous desk studies or report, has been used, it has been assumed that the information is correct. No responsibility can be accepted by Mica Environmental Limited for inaccuracies within this data or information.

Information obtained during the site reconnaissance represents only visually obtainable data. There may be other conditions prevailing at the site, which have not been accessible and have therefore not been taken into account in this report. Trial holes by their very nature only investigate a small fraction of the whole site, as a balance needs to be struck between disturbance to the site, cost, and the confidence that can be gained from the assessment. Whilst the holes excavated on site are considered likely to represent the overall true characteristics of the site to the depth investigated, it remains possible that different conditions may pertain in the areas between sample locations or at considerably deeper locations.

The recommendations made relate to the Statutory Guidance at the time of report production, and the risk-based approach adopted by the Environment Agency (EA) and other regulatory authorities. The recommendations may need to be re-visited if significant changes are made to the risk-based approach currently adopted or the proposed development is altered.

This report provides an assessment of the potential risks from contamination issues only. Other issues such as slope stability are beyond the scope of this assessment.

This report is produced solely for the benefit of the client, and no liability is accepted for any reliance placed upon it by any other party unless specifically agreed in writing with Mica Environmental Limited.

2 Land Use and Site Setting

2.1 Site Location

The site is located at NGR 315380 289330 approximately 800m to the southeast of Kerry and 5km to the southeast of Newtown, Powys, as shown on Figure 1.

The subject site is the northern part of a larger rectangular plot of land which sits to the east of a lane off a C road which leads between Kerry and Pentre. It can be accessed via the lane in its northwest corner, (see Photo 1) or via the larger plot's access to the south (See Photo 2)

The site is located between two residential plots (to the northwest and southeast) and agricultural pasture land to the north and east. It is at an elevation of approximately 110m above sea level.

2.2 Site Description

2.2.1 Current

The site of some 0.14 hectares is an irregular pentagon shape with maximum dimensions of approximately 40m by 42.5m. The current site layout is indicated on Figure 2.

There is a considerable slope of about 1 in 8 downwards from the northwest corner towards the southeast. The natural slope in the southwest corner has been cut into for a length of approximately 9m to form a vertical slope with a flat area in front. A face up to 2m high of the natural mudstone rock is exposed, in the location indicated on Figure 2, also see Photo 3 in Appendix A. This flat area is partly roofed with a temporary structure and currently is occupied by a touring caravan in poor repair, packets of insulation material and corrugated metal panels. (See Photos 4 and 5).

The site is predominantly unmaintained grassed pastureland (See Photo 6). In the northwest corner a shallow layer of hardcore has been placed on a geofabric at the entrance gate, to a distance of 5 to 10m (visible in Photo 1). In the south west of the site a small area of concrete pavement is present – this extends into the landholding to the south of the site (visible in Photo 2).

An area recently used for a bonfire was noted in the central south of the site, some limited charring of the earth was noted.

The client reports there are no current buried services present on the site.

2.2.2 Proposed Layout

The proposed location on site of the new dwellings is not finalised, being in outline stage. However, the site is divided into two separate plots as shown on Figure 3. It is intended that the dwellings will be served by a mini treatment plant and soakaway, with the drainage field to the south of the development site.

2.3 Surrounding Land Use

2.3.1 North and East

Fields to the north and east of the site are pasture. It was noted that a horse and some cattle were grazing during the site walkover. Beyond this field to the north the property was noted to be a small haulage business.

2.3.2 West

Immediately to the west of the site is a lane serving the surrounding residential dwellings. Beyond the lane and in an elevated position is the dwelling known as Brynlllywarch Garden. Further west is a wooded area and within that at a distance of some 500m, Brynlllywarch School.

2.3.3 South

South of the subject site is land currently in the same landholding as the subject site. There is a static caravan and metal sheds. Also present is much stored materials such as tiles, two cars, trailer, touring caravan, insulation materials, metal sheets, tyres, timber, bicycle parts, dog kennel, metal shelving, ladders, paving slabs, metal gates, garden ornaments. Also noted was a disused double skinned oil tank in good condition, which is not installed on site, but is merely being stored at present.

2.4 Site Walkover

Site was initially visited on 16th April 2018 for a meeting with the client and a site walkover, and again on 23rd April to undertake trial pitting investigation. Observations are discussed above in section 2.2 and 2.3. Observations associated with the intrusive site investigation are discussed later in Section 7.

Photographs taken on both visits are presented in Appendix A and Appendix C (trial pit logs).

2.5 Previous Investigations

Mica Environmental is not aware of any previous site investigations undertaken specifically for contamination assessment at the site. However, an Ecological Assessment Report was prepared for the site by Turnstone Ecology in August 2016 which was submitted in support of planning application P/2016/0937.

3 Environmental Setting

3.1 Geology

The Geology Report within the Landmark information indicates an absence of significant drift geology (shallow deposits) at the site. This suggests bedrock is likely to be close to surface.

The bedrock at the site is indicated as the Gyfenni Wood Shale Formation. The BGS lexicon indicates this to be silty mudstone of grey brown colour when weathered, less than 100m thick. At its lower boundary the Gyfenni Wood Shale formation passes into undifferentiated Nantglyn Flags formation, also mudstone. Permeability of both units is likely to be low.

3.2 Hydrogeology

The solid geology of the Gyfenni Wood Shale Formation is classified as a Secondary (B) Aquifer: These are generally predominantly lower permeability layers which may store and yield limited amounts of groundwater due to localised features such as fissures, thin permeable horizons and weathering. These are generally the water-bearing parts of the units formerly classified as non-aquifers.

There are no groundwater abstraction licences or source protection zones recorded within 500m of the site.

Brynllwarch School, some 255m to the west of site, has a consent to discharge final/treated sewage effluent to land. The receiving water is listed as groundwater.

The site falls within an area of relatively low groundwater sensitivity; there is no groundwater vulnerability classification assigned.

3.3 Hydrology

The nearest surface water feature to site is the Nant Meheli, a stream flowing in a roughly north-easterly direction, at its nearest point some 77m to the south east of site, and at an elevation some 15m lower. This stream is part of the River Severn Catchment. The main River Severn flows in an easterly direction some 4km to the north of the site.

There is no Environment Agency River Quality data available within 500m of the site.

Lower Brynllwarch Farm has a licence to abstract surface water from Meheli Brook for general farming and domestic purposes at a point 100m to the east of site. There are no other surface water abstraction licences recorded within 1km of the site.

There is a single discharge consent within 250m of the site; Barn G Brynllwarch Farm has a discharge consent for domestic final treated effluent into a stream to the River Meheli. There are no current licensed discharge consents to surface water within 500m of the site.

3.3.1 Pollution Incidents to Controlled Waters

The Environment Agency has two records of pollution incidents within 1km of the site, and Natural Resources Wales has an additional one:

- 400m to the east of site- July 1998- Domestic property with grass cuttings in the brook affecting an abstraction, Minor incident
- 540m to the NE of site -August 1995- Cattle slurry into watercourse, fish killed, significant incident
- 250m to the NE of site – August 2005 – Agricultural Materials and Wastes, Slurry and Dilute Slurry, significant incident

However, these incidents will not have affected the subject site.

3.4 Ecological and Heritage Designations

There are no Special Protection Areas (SPA), Special Areas of Conservation (SAC), Environmentally Sensitive Areas (ESA), Ramsar sites, National Nature Reserves (NNR), Local Nature Reserves (LNR), Areas of Outstanding Natural Beauty (AONB) or World Heritage Sites within 1km of the site.

There are some areas of Ancient Woodland within 200m of the site, to the north and northwest. These are not considered feasible receptors from potential contamination at the site.

Historic Wales website indicates that there are no archaeological features or scheduled monuments within 250m of the centre of the site.

The site is not in a particularly sensitive location with regard to ecological and heritage designations.

3.5 Waste Management and Landfill Activities

There are no operational or non-operational landfills, waste treatment, transfer or waste disposal sites recorded within 500m of the site.

3.6 Radon

The site is in a higher probability radon area as 10-30% of homes are above the action level. Consequently, the Building Research Establishment (as described in BR211) indicates that the site is in an area where full radon protective measures are required for new properties or extensions.

3.7 Environmental Permits, Consents, Licences, and Authorisations

There are no historic Industrial Pollution Control, Part A(1), Part A(2), Part B or IPPC activities or enforcements recorded within 500m of the site.

There are no COMAH or NIHHS sites recorded within 500m of the site.

There are no sites determined as Contaminated Land under Part IIa of the EPA 1990 within 500m of the site.

4 Site History

4.1 Historical Map Review

Historical Maps at 1:10560, 1:10000 and 1:2500 scales dating from 1884 to 2018 were reviewed. These maps are presented in Appendix B. A summary of the findings is presented in Table 1 below.

Table 1: Historical Map Review

Date/Map Scale	Site	Surrounding Area
1884-85 1:10560 1886 1:2500 1889 1:10560	Western part of the site is shown as having a stand of fir trees present. Eastern half of the site is part of a larger enclosed field.	250m to the west of site is a large property with what appears to be formal gardens, labelled as Bryn Llywarch. 50m or so to the southwest, a cluster of buildings are present which are labelled as Lower Bryn-llywarch. To their east is an orchard. Beyond them some 200m to the southwest a small reservoir water feature is labelled. Some 150m to the northeast a mill pond is shown, together with a Mill Race and associated Llyn Mawr Corn Mill, presumably water powered. 400m to the northwest of site a Saw Mill (also presumably water-powered) is labelled.
1903 1:10560 1903 1:2500	No discernible change	No major changes
1938 1:10560	No discernible change	Some woodland is no longer present to the southeast, else no major changes
1953 1:10560 1963-64 1:10560	No discernible change	No major changes
1983 1:2500 1983-84 1:10000	No trees shown on site area any more. Site is all blank, contained within a larger field.	Brynlwarch Hall is now labelled Brynlwarch School. A timber yard is shown 100m to the southwest of site.
1994: 1:2500	No discernible change	No major changes
2000 Aerial Photography	Aerial photography shows grassed area in the north, east and south of the site. Part of the site in the southwest appears to contain hardstanding and is edged by shrubs or trees.	To the north and east of site green fields are evident. A house has been constructed immediately beyond the lane to the west.
2000 1:10000	Mapping shows blank site.	Mapping shows open fields surrounding site. House is not indicated to the west.
2006 1:10000	Map now depicts a rectangle in the location of the hardstanding visible on the aerial photograph	Map shows Brynllywarch Garden, the house to the west of the site has been built.
2018 1:10000	No discernible change	No major changes

4.2 Other Site History Sources

4.2.1 Anecdotal Information

The client advises that he purchased the wider site around 15 years ago from the farm holders who live in the nearby house, Lower Brynllywarch. He has stored various items at the wider site including quite a few cars which he dismantled for electrical parts such as the headlight fittings. He states he has not undertaken commercial operations at the site, and his hobbying was small scale. As he has recently moved house he is storing quite a few household items in the temporary sheds on the wider site.

4.2.2 Internet Searches - Planning History

The Powys planning web pages were skimmed for relevant information regarding the site. It is noted that a memo was sent regarding planning reference P/2016/0937 from the

Contaminated Land Officer (CLO) to the Planning Department in February 2017: Information indicates that historic ordnance survey maps held on record do not identify any potential land contamination issues associated with the application site. The outline planning application form indicates that the last use of the site was agricultural -formerly a silage pit and paddock area, which was confirmed as having ceased on 01/01/2007. However, the Contaminated Land Officer notes that the Turnstone Ecology Ecological Assessment Report (ref TT2040 dated 26 August 2016) submitted in support of the planning application P/2016/0937 states, 'an area of hardstanding and bordering disturbed ground is present at the southwestern end of the plot. There are storage structures, damaged cars and piles of tyres, timber, rubble and building materials stored on the hardstanding with some spilling over into patches of disturbed ground and associated sparse vegetation'.

In addition, the CLO's memo notes that there was a previous retrospective Planning Application (M/2007/0732 Erection of a static caravan and shed for storage use (retrospective) on the land adjoining the application site. An objection raised against Planning Application P/2016/0937 in the letter dated 10/10/2016 provides anecdotal evidence that the site was known locally as a 'car workshop and scrap yard'. The CLO further indicates that a visit undertaken in February 2017 confirmed the site has been used for storage and activities other than agriculture.

4.3 Summary History

Historically the site has been in agricultural use, as a paddock and an area in the southwest that was part of a silage pit. This area in the southwest appears to have been excavated at some point (a wedge cut out of the shale rock slope to form flat area). More recently the southwest corner and north west to some extent (aerial photos) have received parked cars and storage of building supplies and scrap materials. The site walkover noted storage of building materials such as tiles, insulation panels, corrugated steel, tyres and scrapped engine-driven hand operated tool such as rotovators, lawn mowers etc.

The storage of materials and parking of vehicles does not appear to have encroached onto the north-eastern part of the site.

5 Regulatory Background

Part IIA of the 1990 Environmental Protection makes provisions for a risk-based framework for the identification, assessment and management of contaminated land within Wales.

This statutory contaminated land regime was introduced specifically to address the historical legacy of land contamination and provides a definition for contaminated land which applies where an 'unacceptable risk' (Significant Possibility of Significant Harm) to specific receptors is demonstrated based on current use.

Guidance on the Part IIA regime was issued by the Welsh Government – "Contaminated Land Statutory Guidance 2012". This Guidance introduced a new four-category system for classifying land under Part 2A for cases of a Significant Possibility of Significant Harm to human health, where Category 1 includes land where the level of risk is clearly unacceptable and

Category 4 includes land where the level of risk posed is acceptably low. In relation to the 4-category system, land is determined as 'contaminated land' under Part 2A if it falls within Categories 1 or 2, such that the Category 2/3 border defines the point at which land is determined under the legislation.

Statutory control for development on land affected by contamination is applied by the planning system under guidance in Planning Policy Wales (PPW) (current issue edition 9 November 2016). Generally, once development is complete, the land should not be capable of being determined as contaminated land under Part IIA:

'13.6.1 Local planning authorities should take into account the nature, scale and extent of contamination which may pose risks to health. Land contamination must be considered in the preparation of development plans to ensure that:

- new development is not undertaken without an understanding of the risks, including those associated with the previous land use, mine and landfill gas emissions, and rising groundwater from abandoned mines;*
- development does not take place without appropriate remediation;*
- consideration is given to the potential impacts which remediation of land contamination might have upon the natural and historic environments.*

....

13.7.4 A development proposal may introduce changes to a site which may result in land being designated as contaminated under Part IIA, where such land would not be considered contaminated in its existing state under the provision of the regime. The onus will remain with the developer to ensure that the development of the site will not result in designation as contaminated land under Part IIA. The local planning authority will need to ensure that the land is suitable for its proposed use.

Guidance considers both the proposed development and the land, on the principle of 'suitable for use'. In this context, the sensitivity of the proposed end use is implicitly considered within the risk assessment process. The process of risk assessment is an evaluation of the probability of harm, and comprises the identification of sources of contamination (hazards), receptors that may be affected by the contamination and pathways by which the receptors may be harmed. Risk is defined as: 'a combination of probability, or frequency, of occurrence of a defined hazard and the magnitude of the consequences of the occurrence'.

Current best practice involves the development of a conceptual site model, identifying potential sources of contamination, receptors, contaminant migration or exposure pathways and whether potential 'pollutant linkages' exist, and thus the potential for 'significant risk'. This requires the identification of hazards associated with contamination and an assessment of the risk associated with these hazards in view of the end usage of the site.

6 Conceptual Site Model

6.1 Sources

Previous uses of the site may potentially have led to a low risk of metals, oils, fuels and other car engine fluids being present near surface due to the storage/dismantling of vehicles. It is noted that cars have been observed in the southwest corner of the site and also towards the centre of the site from past aerial photographs. Although there was no evidence of its presence on site, given the extent of storage of recovered building materials there is also a possibility that asbestos-containing materials may have inadvertently been brought on to site (or the adjoining part just beyond the south-western boundary) in the past. Potentially there may be acidic conditions from silage leachate from part of the site's former use as a silage pit (again in the southwest corner). Some bonfires were noted to have taken place at the site, potentially leading to elevated concentrations of metals or polyaromatic hydrocarbons. However, none of the sources are considered likely to have resulted in widespread contamination across the whole of the development site, and the potential for significant contamination is considered low.

Radon gas from the underlying geology is noted as a potential risk as the HPA define the property as being in an area where between than 10 and 30% of properties are above the action level.

6.2 Pathways

Potential pathways are the means by which an identified hazard can migrate or encounter any receptors. Typically, such migration pathways to humans (e.g. development workers or residents of the future property) can include inhalation of indoor vapours, inhalation of outdoor vapours, inhalation/ingestion of dust, dermal contact, ingestion of contaminants through fruit and vegetable consumption grown in contaminated soil, migration of ground gasses via fissures in underlying geology.

Should contaminated soils be present, development workers would be more likely to encounter these via inhalation/ingestion of dust, and dermal contact.

There is limited soil overlying the bedrock, and the underlying Gyfenni Shales are considered to have a very low leaching potential, being negligibly permeable. Movement of contamination via leaching of contaminants and transport in underlying groundwater is not considered a feasible pathway.

6.3 Receptors

Residential use is one of the most sensitive end-uses for a site, and the future site residents would be regarded as sensitive receptors. Construction workers can also be considered as a potential receptor, especially as they are most likely to be digging in the ground on site.

Nearby residents could potentially be impacted by dust movements migrating off site during redevelopment if not appropriately managed.

Building materials can potentially be affected by contaminants. The identified potential contamination includes hydrocarbons and organics which can impact on plastic water pipes and concrete materials.

There are no controlled water receptors considered as feasible targets from the potential contamination on site.

There are no ecological designations likely to be affected by the potential contamination.

6.4 Tabular Preliminary Conceptual Site Model and Risk Estimation

6.4.1 Feasible Pollutant Linkages and Risk Estimation

A two-stage assessment has been carried out based on the identified contaminants, pathways and receptors. As no site investigation data is available at this preliminary stage, this is based on professional judgement, with an estimate of the potential for a substance to be present on site, and in what potential concentration/quantity; at this stage the estimates are conservative. Initially, the column designated as 'Potential Consequence of Hazard' gives an indication of the sensitivity of a given receptor to a particular source/contaminant of concern (CoC) being considered. It is a worst-case classification and is based on full exposure via the particular linkage being examined. The derivation of the classes used to rank this particular aspect is as follows:

Table 2: Classification Definition

Classification	Human Health	Controlled Water	Ecological	Built Environment
Severe	Permanent damage to human health	Extensive pollution of sensitive water resources	Extensive change to the number of one or more species or ecosystems	Permanent damage to buildings, structures or the environment
Moderate	Non-permanent health effects to humans	Pollution of non-sensitive water resources or minor / localised pollution of sensitive water resources	Change to population densities of non-sensitive species	Damage to sensitive buildings, structures or the environment
Mild	Minor short-term health effects to humans	Minor / localised impact to non-sensitive water resources	Some change to population densities but with no negative effects on the function of the ecosystem	Easily repairable effects of damage to buildings or structures
Negligible	No measurable effects on humans	Insubstantial impact to non-sensitive water resources	No significant changes to population densities in the environment or in any ecosystem	Very slight non-structural damage or cosmetic harm to buildings or structures

Subsequently, in the column entitled 'Likelihood', an assessment is made of the probability of the selected source and receptor being linked by the identified pathway. This assessment is ranked based on site specific conditions as follows:

- Very unlikely 0 to 5%;
- Unlikely 5 to 45%;
- Possible 45 to 55%;
- Likely 55 to 95%;
- Almost Certain 95 to 100% (i.e. impact noted during the investigation).

The 'Risk Estimation' column is an overall assessment of the actual risk, which considers the likely consequence of a given risk being realised and the likelihood of that risk being realised. The risk classifications are assigned using the following consequence/likelihood matrix:

Table 3: Consequence –Likelihood Matrix

Consequence		Risk				
	Severe	Low	Low to moderate	Moderate to high	Very High	Very High
	Moderate	Negligible to low	Low	Moderate	Moderate to high	High
	Mild	Negligible	Low	Low	Low to moderate	Moderate
	Negligible	Negligible	Negligible	Negligible to low	Low	Low
	Likelihood:	Very Unlikely	Unlikely	Possible	Likely	Almost Certain

Table 4 below details risk estimation classification scenarios.

Table 4: Risk Estimation Classification

Potential Significance – Risk Estimation Classification	Definition
Very High	There is a high probability that severe harm could arise to a designated receptor from an identified hazard at the site without remediation action OR there is evidence that severe harm to a designated receptor is already occurring. Realisation of that risk is likely to present a substantial liability to be site owner/or occupier. Investigation is required as a matter of urgency and remediation works likely to follow in the short-term.
High	Harm is likely to arise to a designated receptor from an identified hazard at the site without remediation action. Realisation of the risk is likely to present a substantial liability to the site owner/or occupier. Investigation is required as a matter of urgency to clarify the risk. Remediation works may be necessary in the short-term and are likely over the longer term.
Moderate	It is possible that harm could arise to a designated receptor from an identified hazard. However, it is either relatively unlikely that any such harm would be severe, and if any harm were to occur it is more likely, that the harm would be relatively mild or localised. Further investigative work is normally required to clarify the risk and to determine the potential liability to site owner/occupier. Some remediation works may be required in the longer term.
Low	It is possible that harm could arise to a designated receptor from identified hazard, but it is likely at worst, that this harm if realised would normally be mild. It is unlikely that the site owner/or occupier would face substantial liabilities from such a risk. Further investigative work (which is likely to be limited) to clarify the risk may be required. Any subsequent remediation works are likely to be relatively limited.
Negligible	The presence of an identified source does not give rise to the potential for significant harm.

6.4.2 Assessment

The highest identified risks (of low to moderate) relate to the potential source pathway receptor linkage between elevated metals, PAHs/Oils/Fuels concentrations in near surface soils on site and future site users. A similar risk was identified for construction workers and the PAHs/Oils/Fuels. A low risk was identified for future site users, construction workers and

nearby off-site residents from potential asbestos-containing soil during earthworks. A low risk was identified in respect of the potential for contaminants to impair building fabric and underground services. See Table 5 below.

An intrusive site investigation comprising trial pits and sampling was proposed to gather more information on the potential sources and to allow a revision of the preliminary risk assessment once empirical data was available. The background to this is that the client's own family will be living in the proposed development and he wishes to be confident that the site is suitable. The investigation is detailed in Section 7.

Table 5: Summary of Potential Feasible Pollutant Linkages and Preliminary Risk Estimation

Contaminant (Source)	Pathway(s)	Receptor	Potential Consequence of Hazard	Likelihood of Source-Pathway-Receptor Linkage&	Risk Estimation	Comments
Near-surface soils on site containing potentially elevated concentrations of metals	inhalation/ingestion of dust, dermal contact, ingestion of contaminants through fruit and vegetable consumption grown in contaminated soil	Humans (Future site users)	Severe	Unlikely	Low to Moderate	
Near-surface soils on site containing potentially elevated concentrations of metals	inhalation/ingestion of dust, dermal contact	Humans (Construction Workers)	Severe	Very Unlikely	Low	
Near-surface soils on site containing potentially elevated concentrations of metals, PAHs/Oils/Fuels	inhalation/ingestion of dust	Off-site residents	Severe	Very Unlikely	Low	
Soils on site containing potentially elevated concentrations of PAHs/Oils/Fuels	inhalation/ingestion of dust, inhalation of indoor vapours, inhalation of outdoor vapours, dermal contact, ingestion of contaminants through fruit and vegetable consumption grown in contaminated soil	Humans (Future site users)	Severe	Unlikely	Low to Moderate	

Contaminant (Source)	Pathway(s)	Receptor	Potential Consequence of Hazard	Likelihood of Source-Pathway-Receptor Linkage&	Risk Estimation	Comments
Soils on site containing potentially elevated concentrations of PAHs/Oils/Fuels	Inhalation/ingestion of dust, inhalation of indoor vapours, inhalation of outdoor vapours, dermal contact	Humans (Construction Workers)	Moderate-Severe	Unlikely	Low to Moderate	
Soils on site containing potentially elevated concentrations of PAHs/Oils/Fuels	Direct Contact	Building Materials Plastic Pipes	Mild	Unlikely	Low	
Soils on site potentially containing asbestos	Inhalation of fibres	Humans (Future Residents, Construction Workers, Off-site residents)	Severe	Very Unlikely	Low	
Naturally occurring Radon gas	Migration through ground and build up of gas in enclosed spaces	Humans (Future Residents)	Severe	Unlikely	Low to Moderate	Risk can be managed through installation of appropriate radon gas protection measures during build

7 Site Investigation

7.1 Trial Holes

Intrusive site work was undertaken by Mica Environmental on the 23rd April 2018.

Nine trial holes were excavated using a mini mechanical excavator to a maximum depth of 0.75m bgl. Samples were collected directly from the trial pits using a stainless-steel trowel which was washed down with clean water between locations.

The trial hole locations are as indicated on Figure 4. These were selected to provide an overall coverage across the site, but with a greater coverage towards the south of the site near the identified area of silage storage and storage of vehicles and tyres.

Trial hole logs are presented in Appendix C.

7.2 Observations

No Made Ground was identified on site, and all the ground was logged as natural. The ground was found to comprise topsoil of a thickness of between 0.25m and 0.35m overlying weathered mudstone, although topsoil was absent in TP4 and TP6.

No visual or olfactory evidence of oil contamination was encountered.

No perched water or groundwater was encountered at any of the locations.

7.3 Sampling

One soil sample was collected from near surface at each of the trial holes.

The samples were all analysed for a toxic metals suite and pH. In addition, four samples were analysed for speciated polyaromatic hydrocarbons, three for asbestos screen, two for Total Petroleum Hydrocarbons and two for a semi-volatile organic suite. One sample was also analysed for soil organic matter.

Samples were dispatched the same day by courier for delivery to the UKAS and MCERTS accredited laboratory, ALS in Hawarden, Flintshire, along with a chain of custody form detailing the analysis required.

8 Generic Assessment Criteria and Analytical Results

8.1 General

Table 7 below summarises the main results. The full ALS laboratory certificates and analytical data set is presented in Appendix D.

8.2 Generic Assessment Criteria (GAC)

8.2.1 Human Health

An initial assessment of the data has been made against appropriate screening criteria representing concentrations of a substance where the level of risk posed to human health is acceptably low. The criteria used are shown below in Table 7.

There are different criteria according to land-use (residential, allotments, commercial) because people use land differently and this affects who and how people may be exposed to soil contamination. The criteria selected have been based on the assumption that the site is to be redeveloped for residential use, with the possibility of consumption of home-grown produce.

These assessment criteria do not assess other types of risk to human health such as fire, suffocation, explosion, or short-term and acute exposures. They also cannot be used to assess risks to controlled waters, property, pets and livestock, or ecological receptors. Professional judgement has been used to consider these other risks and identify feasible ones.

8.3 Statistical Tests

If soils were uniformly contaminated at concentration x , acceptance (or otherwise) with respect to a Screening Criterion (SC) would simply depend on whether x was less than or greater than SC. In reality, contaminant concentrations vary across a site, and the measured mean concentration, derived from a limited number of samples, may not equal the “true” mean. In any event it will have uncertainty associated with it. Because of this, simple comparisons of the measured mean value with the SC could be misleading. The approach here is to identify the 95% confidence limits of the measured mean and to compare the upper 95th percentile (US_{95} value) with the SC using the mean value test as described in CLR7 (DEFRA and the EA, 2002).

The data for the main contaminants are summarised in the table together with the minimum value, maximum value, arithmetic mean value, standard deviation and US_{95} value.

It has been assumed that the data sets have a normal distribution, although this has not been tested statistically, due to project constraints.

Table 6: Chemical Data Summary

Test	Units	No of samples analysed	Min Value	Max Value	Mean	Standard Deviation	Upper Confidence 95 th percentile	No. of exceedences of Assessment criterion	Assessment Criterion
pH	pH units	9	5.34	7.33	n.c.	n.c.	n.c.	n.c.	-
Arsenic	mg/kg	9	6.45	10.6	9.05	1.33	9.88	0	37 ^{1,2}
Cadmium	mg/kg	9	0.392	0.502	0.459	0.036	0.481	0	22 ¹
Chromium (total)	mg/kg	9	18.6	23.2	21.1	1.43	22.0	0	910 ^{2**}
Copper	mg/kg	9	21	47.5	26.5	8.28	31.7	0	2400 ²
Lead	mg/kg	9	16.2	56.5	37.3	12.3	44.9	0	200 ¹
Mercury	mg/kg	9	<0.14	<0.14	n.c.	n.c.	n.c.	0	40 ²
Nickel	mg/kg	9	27.2	45.3	33.1	5.36	36.4	0	130 ³
Selenium	mg/kg	9	<1	<1	n.c.	n.c.	n.c.	0	250 ²
Zinc	mg/kg	9	94.5	126	114	12.0	121	0	3700 ²
Acenaphthene	ug/kg	6	<8	<100	n.c.	n.c.	n.c.	0	510000 ²
Acenaphthylene	ug/kg	6	<12	<100	n.c.	n.c.	n.c.	0	420000 ²
Anthracene	ug/kg	6	<16	<100	n.c.	n.c.	n.c.	0	5400000 ²
Benz(a)anthracene	ug/kg	6	20.1	722	194	261	409	0	11000 ²
Benzo(a)pyrene	ug/kg	6	21.9	1730	390	934	662	0	5000 ^{1/2700} 2
Benzo(b)fluoranthene	ug/kg	6	37.7	2480	556	954	1341	0	2600 ²
Benzo(g,h,i)perylene	ug/kg	6	<24	1700	386	650	921	0	340000 ²
Benzo(k)fluoranthene	ug/kg	6	<14	<14	216	319	478	0	93000 ²
Chrysene	ug/kg	6	21.2	763	203	277	431	0	22000 ²
Dibenzo(a,h)anthracene	ug/kg	6	<23	330	105	116	200	1	280 ²
Fluoranthene	ug/kg	6	35.5	982	258	359	553	0	560000 ²
Fluorene	ug/kg	6	<10	<100	n.c.	n.c.	n.c.	0	400000 ²
Indeno(1,2,3-cd)pyrene	ug/kg	6	<18	1370	315	521	744	0	36000 ²
Naphthalene	ug/kg	6	<9	<100	n.c.	n.c.	n.c.	0	5600 ²
Phenanthrene	ug/kg	6	<15	109	66.1	42.0	101	0	220000 ²
Pyrene	ug/kg	6	28.5	1050	272	386	590	0	1200000 ²

1: C4SL value – SP1010 Development of Final Category 4 Screening Levels for Land Affected by Contamination Policy Companion Document (DEFRA, 2014)

2: LQM/CIEH S4UL Copyright Land Quality Management Limited reproduced with permission; publication number S4UL3470. All rights reserved.

3: LQM/CIEH S4UL revised Aug 2105 ^ 2.5% soil organic matter (4.17% measured) n.c.=not calculated

Where results <limit of detection (LOD), statistics have been calculated using the LOD Residential with home-grown produce scenario criteria used

Table 7: Petroleum Hydrocarbon (TPH CWG) Results

Test	Units	No of samples analysed	TP4 0.05-0.15m	TP5 0.05-0.15m	Mean	No. of exceedances of Assessment criterion	Assessment Criterion
Aliphatics >C5-C6	ug/kg	2	<10	<10	n.c.	0	78000 ¹
Aliphatics >C6-C8	ug/kg	2	<10	<10	n.c.	0	230000 ¹
Aliphatics >C8-C10	ug/kg	2	<10	<10	n.c.	0	65000 ¹
Aliphatics >C10-C12	ug/kg	2	<10	<10	n.c.	0	330000 ¹
Aliphatics >C12-C16	ug/kg	2	<100	<100	n.c.	0	2400000 ¹
Aliphatics >C16-C35	ug/kg	2	12460	5210	8835	0	92000000 ¹
Aliphatics >C35-C44	ug/kg	2	<100	<100	n.c.	0	92000000 ¹
Aromatics >EC5-EC7	ug/kg	2	<10	<10	n.c.	0	140000 ¹
Aromatics >EC7-EC8	ug/kg	2	<10	<10	n.c.	0	290000 ¹
Aromatics >EC8-EC10	ug/kg	2	<10	<10	n.c.	0	83000 ¹
Aromatics >EC10-EC12	ug/kg	2	<10	<10	n.c.	0	180000 ¹
Aromatics >EC12-EC16	ug/kg	2	<100	1940	1020	0	330000 ¹
Aromatics >EC16-EC21	ug/kg	2	<100	6170	3135	0	540000 ¹
Aromatics >EC21-EC35	ug/kg	2	3200	33400	18300	0	1500000 ¹
Aromatics >EC35-EC44	ug/kg	2	2790	13330	n.c.	0	1500000 ¹
Methyl Tertiary Butyl Ether	ug/kg	2	<10	<10	n.c.	0	n.c.
Benzene	ug/kg	2	<9	<9	n.c.	0	170 ¹
Toluene	ug/kg	2	<7	<7	n.c.	0	290000 ¹
Ethyl Benzene	ug/kg	2	<4	<4	n.c.	0	110000 ¹
Xylenes	ug/kg	2	<20	<20	n.c.	0	130000 ¹

1: LQM/CIH S4UL Copyright Land Quality Management Limited reproduced with permission; publication number S4UL3470. All rights reserved.

Where results <limit of detection (LOD), statistics have been calculated using the LOD Residential with home-grown produce scenario criteria used

2.5% soil organic matter used

n.c. : not calculated

8.4 Results – Inorganics

8.4.1 Metals

A suite of toxic metals comprising arsenic, cadmium, total chromium, copper, lead, mercury, nickel, selenium and zinc was tested in all nine samples. All recorded metal concentrations were below their respective criteria.

8.4.2 pH

All samples were analysed for pH. Results ranged from a slightly acidic pH of 5.34 in the organic rich topsoil of TP2, to a neutral pH of 7.33 in the sample collected from TP6 where topsoil was absent.

8.4.3 Asbestos Screen

The samples from TP4, TP5 and TP7 were screened for fibres and asbestos identification. No fibres were detected.

8.5 Results- Organics

8.5.1 Polyaromatic Hydrocarbons (PAHs)

Four samples were analysed for specified 16 PAHs, and in addition a general SVOC suite (which includes PAHs) was analysed on an additional two samples. All samples reported all of the individual PAHs well below their screening criterion, with the exception of the sample collected from TP3 which showed a single result for dibenzo(ah) anthracene of 330ug/kg compared with the screening criterion of 280ug/kg. The mean and US₉₅ concentrations for the dibenzo(ah)anthracene data set are 105ug/kg and 200ug/kg respectively; well below the assessment criterion. A maximum value test undertaken at the 10% (conservative) level indicated the 330ug/kg result was not an outlier. The result is therefore not considered to indicate any particular issue at the site.

8.5.2 Semi-volatile organic compounds

Two samples (TP6 and TP9) were analysed for the general suite of semi-volatile organic compounds. The results for the standard suite library substances were all reported below the limit of detection of 100ug/kg.

8.5.3 Petroleum Hydrocarbons

Two samples (TP4 and TP5), from the area near the car storage, were analysed for a suite of banded petroleum hydrocarbons and BTEX (benzene, toluene, ethylbenzene and xylenes). There were no exceedences of the screening criteria and all values were low.

9 Revised Conceptual Site Model and Risk Assessment

The preliminary conceptual model and risk assessment has been revised to take into account the information obtained from the site investigation and is presented below. No significant contamination was identified at the site, and so the likelihood of source-pathway-receptor linkages from contaminants in the soil has been able to be reduced to very unlikely (0-5%).