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# GEOENVIRONMENTAL APPRAISAL AND REMEDIATION STRATEGY for land at COCKLE EDGE FARM, INGBIRCHWORTH, PENISTONE, SOUTH YORKSHIRE



Prepared for

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# PHASE 2 GEOENVIRONMENTAL APPRAISAL AND REMEDIATION STRATEGY for land at COCKLE EDGE FARM, INGBIRCHWORTH, PENISTONE, SOUTH YORKSHIRE

## 1.0 INTRODUCTION.

G&M Consulting Ltd (G&M) was commissioned by the Mr Peter Cadman to undertake a geoenvironmental appraisal for land at Cockle Edge Farm, Ingbirchworth, South Yorkshire

It is understood that planning application (Ref 2019/0208) has been submitted for the development of the site with a change of use from agricultural buildings to two residential dwellings. This report has been prepared in support of the discharge of Condition 3 of the application from Barnsley Metropolitan Council.

A schematic layout drawing for the proposed development is shown on the drawing prepared by Dowen Farmer Architects, a copy of which is presented in Appendix A of this report

The location of the site is shown on Drawing No C312/1, presented in Appendix A of this report.

### 1.1 Project Brief.

The geoenvironmental appraisal of the site has been undertaken in two phases. The initial phase (Phase 1) was a preliminary investigation (desk study) which was prepared by G&M in February 2019 (Report Ref C312). Based on the results of the preliminary investigation it was proposed by G&M to undertake an intrusive site investigation of the area of development.

This report details the results of the intrusive investigation and makes recommendations with regards to the proposed development. This report should be read in conjunction with the desk study, which contains a description of the site, environmental setting and initial conceptual site model (CSM) from which the investigation rationale was derived.

Fieldwork was undertaken on 23rd March 2019 and comprised the excavation of six trial pits. Following completion of the fieldwork selected soil samples were scheduled for a range of chemical laboratory tests.

At the time of the intrusive investigation the site was occupied by three agricultural barns with associated hard standing between them. A full description of the site is given in the desk study.

### 1.2 Limitations.

This investigation report, which is designed to meet the requirements of all relevant current guidance, presents the factual information available during this appraisal, interpretation of the data obtained and recommendations relevant to the defined objectives.

The comments and opinions presented in this report are based on the findings of a review of available information and ground conditions encountered during the intrusive investigation work. There may be other conditions prevailing on the site which have not been disclosed by this investigation and which have not been taken into account by this report. Responsibility cannot be accepted for conditions not revealed by the investigation. Any diagram or opinion of the possible configuration of ground conditions between exploratory holes is conjectural and given for guidance only and confirmation of intermediate ground conditions should be considered if deemed necessary.

During the course of the works G&M did not notice the presence of any Japanese Knotweed. However, it should be noted that G&M are not qualified ecologists and as such cannot guarantee the absence of knotweed or other invasive vegetation. If necessary the possible presence of such vegetation should be confirmed by a qualified ecologist.

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## 2.0 GROUND INVESTIGATION.

### 2.1 Design and Strategy

The Phase 1 desk study prepared previously, was used as the basis for the design of an intrusive ground investigation. The main findings of the desk study were as follows:

- *Historical maps relating to the site indicate that the site has been occupied by buildings, probably associated with Cockle Edge Farm, since at least 1834; with further building added sometimes before 1903.*
- *It is considered the former and current uses are considered to be potential sources of contamination.*
- *There are no landfills within 500m of the site.*
- *The report indicates that no radon protective measures are necessary*
- *According to the CA interactive map (available online) a relatively thin 'development high risk area' running through the site. This appears to follow the coal outcrop which is shown to pass through the site on the CA map. However, the BGS online geoindex does not show a coal seam. Earlier editions of the geological maps published up to 1981 do show a coal seam. The most recent 1:50,000 map published in 2012 shows the coal to be faulted out. As a consequence of this it is considered the site is at a low risk from possible shallow workings beneath the site.*

The aim and purpose of the ground investigation was to verify the nature and depth of any shallow made ground associated with the former and current use of the site.

### 2.2 Scope of Works.

The scope of the intrusive investigation is detailed below;

| Exploratory Hole Type | Purpose |
|---|---|
| Trial Pits | To determine the general nature of shallow soils underlying the site, including the;<br>• Nature, distribution and thickness of any potential made ground.<br>• Nature, degree and extent of ground contamination.<br>• Determination of the presence of shallow underlying natural ground .<br>• To help identify and inform suitable remedial options. |

Fieldwork was undertaken on the 23rd March 2019, and comprised;

- Excavation of six trial pits, referenced TP1 to TP6 inclusive, to depths of between 0.9 m and 1.7 m below ground level (bgl).

The exploratory hole positions were set out and the fieldwork supervised by a G&M engineering geologist. The locations of the trial pits are shown on Drawing No C312/2, presented in Appendix A of this report.

The intrusive investigation was carried out in general accordance with BS10175:2011.

A full set of photographs taken of the trial pits during the fieldwork are presented in Appendix D of this report.

### 2.3 Strata Description.

Depths and descriptions of strata encountered together with details of the samples recovered are presented on the exploratory hole record sheets in Appendix B of this report. Procedures and principles contained in BS EN ISO 14688-1 (2002), as amplified by BS 5930 (2015), were followed.

The depths of strata on the record sheets are recorded from current ground levels at each location.

### 2.4 Sampling

Small disturbed samples of soil, for chemical analysis, were placed in amber glass jars as appropriate. Between trial pits, equipment was thoroughly cleaned and dried.

In accordance with best practice (BS10175:2011) samples were collected in appropriate containers, kept in a chilled cool box whilst on site, retained in a fridge (below 2°C) until the day of collection, packed in a chilled cool box on the day of collection and transported in this to the laboratory.

### 2.5 Laboratory Testing

Selected soil samples were tested for a range of potential contaminants, under a sub-contract with i2 Analytical Ltd (i2), a UKAS/MCERTS accredited laboratory. The analytes tested are listed in Section 4.2 of this report. The results of soil analysis, as received from the laboratory, are presented in Appendix C of this report.

## 3.0 GROUND CONDITIONS AND MATERIAL PROPERTIES

A complete record of all the strata encountered is given on the attached trial pit logs. In general these show a descending sequence of made ground over clay, in places lithorelicts were noted within the clay, suggesting possible weathered bedrock.

### 3.1 Made Ground

Made Ground was encountered to depths of between 0.15 m and 0.65 m. In general it comprised either compacted granular material or gravelly clay.

Granular material was encountered in TP1 and TP6 and consisted of gravel size fragments of limestone, concrete and brick proved to a depth of 0.6 m and 0.1m in TP1 and TP6 respectively. Underlying this material in TP6 was black gravel of clinker and tarmacadam fragments with fines of ash proved to a depth of 0.6m. This material had a slight smell of creosote.

The remaining trial pits encountered made ground comprising gravelly clay, sandy in places. The gravel content consisting of fragments of brick, concrete and limestone. In TP4 some black carbonaceous material was noted.

### 3.2 Natural Deposits

The made ground is underlain by firm yellow and light grey mottled clay proved to completion depth in the trial pits. In TP 2 lithorelicts of mudstone were noted in the clay below a depth of 1.1 m. In TP4 the lithorelicts were noted throughout the clay to completion depth.

### 3.3 Groundwater

A slight seepage of water was recorded in trial pits TP1 and TP2 at a depth of 1.0m. No groundwater was encountered in the other trial pits during the fieldwork.

It should be borne in mind that water levels are likely to fluctuate with season/rainfall and may therefore be substantially higher at wetter times of year than those found during this investigation.

### 3.4 Visual / Olfactory Evidence of Contamination

Ash and clinker were noted in TP6 together with a slight smell of creosote. In the remaining trial pits brick and concrete fragments were noted which can produce elevated concentrations of certain contaminants, such as toxic and phytotoxic metals, sulphate and PAH.

## 4.0 RESULTS OF CHEMICAL TESTING

### 4.1 General

For this site, measured values were compared to Generic Assessment Criteria (GAC) derived for a residential with plant up take end use.

Chemical analysis was undertaken on representative soil samples recovered from across the site. The determinands were selected to provide information on the distribution of potential contaminants. The general analytical suite was supplemented with additional analysis where former land usage, as determined from the desk study, or visual or olfactory observations suggested the presence of additional contaminants.

The majority of initial screening levels (GAC's) used in the production of this assessment have been taken from the guidelines introduced by:

- DEFRA C4SL's, DEFRA 2015.
- Joint Land Quality Management Ltd (LQM) and Chartered Institute of Environmental Health (CIEH), Generic Assessment Criteria for Human Health Risk Assessment, S4UL's, Land Quality Press 2015.

Usually statistical testing is undertaken for the Planning Scenario by the methods described in CL:AIRE & CIEH "Guidance on Comparing Soil Contamination Data with a Critical Concentration", May 2008. This statistical testing is undertaken to determine whether there was sufficient evidence that the true mean concentration of each determinand was less than the relevant critical concentration for that component. However, given the limited size of the site and number of samples tested, detailed statistical assessment of the data has not been conducted, instead individual contaminant concentrations have been compared to their relevant assessment criteria.

### 4.2 Testing Schedule

Following completion of the fieldwork samples were selected for testing as follows;

| Laboratory Analysis | Made Ground | Natural Soils |
|---|---|---|
| Total concentrations of arsenic, cadmium, chromium (Hexavalent), copper, lead, nickel, selenium, zinc, mercury | 6 | 2 |
| Total sulphate, pH | - | 2 |
| Pesticide/Herbicides Screen in Soil | 2 | - |
| Speciated PAH | 7 | 3 |
| Phenols | 7 | 1 |
| Asbestos | 3 | - |

## 4.3 Soil Analysis

The chemical analysis results and screening criteria are summarised below. The results for the topsoil and natural soils have been combined for an initial assessment.

**Summary of Total Soil Concentrations**

| Determinand | GAC (1% SOM) (mg/kg, unless otherwise stated) | No. of samples above screening value | No. of samples tested | Concentrations above GAC (mg/kg, unless otherwise stated) |
|---|---|---|---|---|
| **Metals/Metalloids** | | | | |
| Arsenic | 37 (2) | 0 | 8 | |
| Cadmium | 10 (1) | 0 | 8 | |
| Chromium (VI) | 21 (2) | 0 | 8 | |
| Chromium | 910 | 1 | 8 | 1100 (TP6 0.30m) |
| Lead | 200 (2) | 0 | 8 | |
| Mercury | 40 (1) | 0 | 8 | |
| Selenium | 250 (1) | 0 | 8 | |
| Copper | 2400 (1) | 0 | 8 | |
| Nickel | 180 (1) | 0 | 8 | |
| Zinc | 3700 (1) | 0 | 8 | |
| **Inorganics** | | | | |
| pH | <5 | 0 | 2 | |
| Water Soluble Sulphate | 0.5 g/l (3) | 0 | 2 | |
| **Organics** | | | | |
| **PAHs** | | | | |
| Acenaphthene | 210 (1) | 0 | 10 | |
| Anthracene | 2400 (1) | 0 | 10 | |
| Acenaphthylene | 170 (1) | 0 | 10 | |
| Benzo(a)anthracene | 7.2 (1) | 1 | 10 | 14 (TP1 0.20m) |
| Benzo(b)fluoranthene | 2.6 (1) | 1 | 10 | 12 (TP1 0.20m) |
| Benzo(k)fluoranthene | 77 (1) | 0 | 10 | |
| Benzo(g,h,i)perylene | 320 (1) | 0 | 10 | |
| Benzo(a)pyrene | 5.0 (2) | 1 | 10 | 13 (TP1 0.20m) |
| Chrysene | 15 (1) | 0 | 10 | |
| Dibenz(a,h)anthracene | 0.24 (1) | 0 | 10 | |
| Fluoranthene | 280 (1) | 0 | 10 | |
| Fluorene | 170 (1) | 0 | 10 | |
| Indeno(1,2,3-cd)pyrene | 27 (1) | 0 | 10 | |
| Naphthalene | 2.3 (1) | 1 | 10 | 71 (TP6 0.30m) |
| Pyrene | 620 (1) | 0 | 10 | |
| Phenanthrene | 95 (1) | 0 | 10 | |
| **Others** | | | | |
| Monohydric Phenol | 120 (1) | 0 | 9 | |

| | | | | |
|---|---|---|---|---|
| Asbestos | Fibres present | 0 | 3 | |
| Pesticide/herbicides screen | Present | 0 | 2 | |

[1] LQM/CIEH (2015) Generic Assessment Criteria for Human Health Risk Assessment. 2nd Ed. (for a sandy soil with 1% SOM and pH 7.0)
[2] DEFRA C4SL's, DEFRA 2015
[3] BRE (2005) Special Digest 1, 3rd Edition, Concrete in aggressive ground. Upper limits for DS-1 Design Sulphate Class concrete.

None of the soil samples taken from the natural sub-soils recorded concentrations in excess of the relevant screening values detailed above.

The elevated concentrations of chromium and PAH were all recorded in one sample of made ground from TP6 at 0.30m. This sample was described as containing ash and clinker and with a slight creosote smell noted.

No asbestos was recorded in the three samples tested.

As a precautionary measure and considering the previous use of the site as a farm yard, a herbicide/pesticide screen was carried out on two samples of the made ground; no presencem of these compounds was recorded.

## 5.0 QUALITATIVE RISK ASSESSMENT AND REVISED CONCEPTUAL MODEL

Following the ground investigation and results of the chemical testing presented above, the preliminary conceptual site model presented in the Phase 1 desk study report (G&M Report Ref C312, February 2019) has been revised. The revised model has been developed for the proposed future land use (residential with plant uptake).

In assessing risk, the categorisation shown below has been developed. The table is intended to be an aid to assessing the degree of risk. It should be noted that in terms of the Environmental Protection Act 1990 there is no differing degree of risk. It is either 'significant' or not.

| Term | Description |
|---|---|
| Very High Risk | There is a high probability that severe harm could arise to a designated receptor from an identified hazard at the site without appropriate remedial action |
| High Risk | Harm is likely to arise to a designated receptor from an identified hazard at the site without appropriate remedial action |
| Moderate Risk | It is possible that without appropriate remedial action harm could arise to a designated receptor. It is relatively unlikely that any such harm would be severe, and if any harm were to occur it is more likely that such harm would be relatively mild. |
| Low Risk | It is possible that harm could arise to a designated receptor from an identified hazard. It is likely that, at worst, if any harm was realised any effects would be mild. |
| Negligible Risk | The presence of an identified hazard does not give rise to the potential to cause harm to a designated receptor. |

### Identified Contaminants of Concern

- Localised elevated concentrations of chromium within the made ground from TP4.
- Localised elevated PAH speciate (Benzo(a)anthracene, Benzo(b)fluoranthene, Benzo(a)pyrene) and Naphthalene within the made ground encountered in TP4.

### Future site users

The development proposals indicate the future end use of the site to be residential and it is assumed with an area of private gardens and soft landscaping. This is considered to represent a **high** sensitivity end use.

Based on the source>pathway>receptor philosophy, and the chemical results obtained as part of this investigation, it is considered that the made ground tested locally generally poses a **moderate** risk to end users and that remedial action will be required to break this linkage.

**Construction and Maintenance Workers**
Based on the test results to date it is considered that there is a **negligible** short term risk during the groundworks to construction and maintenance workers. Also risks can be readily adequately mitigated by appropriate PPE and hygiene precautions and good working and soil management practices. It is recommended that procedures outlined in the HSE document 'Protection of Workers and the General Public during Remediation of Contaminated Land' be followed.

**Adjacent site users/site occupants during groundworks**
Provided good 'housekeeping' practises are observed during the groundworks, it is considered that there is a **negligible/low** short term risk to adjacent site users and site occupants during the works.

**Controlled Waters**
Considering the fact that only local seepages of groundwater were encountered during the investigation, the underlying soil/rock is clay/mudstone, thereby limiting any vertical or lateral migration of mobile contaminants, and that there is no significant source of contamination it is considered that the soils would pose a **low/negligible** risk to controlled waters and that no further remediation is considered necessary.

**Built development**
The chemical results for the natural soil show water soluble sulphate concentrations of 0.066 and 0.072 g/l and pH values of 5.1 and 6.7. These results indicate that a design sulphate class of DS-1 and an ACEC class of AC-1s for static groundwater and AC-3z for mobile groundwater, should be used for the design of buried concrete, in accordance with BRE Special Digest 1 (2005). This is based on brownfield site designation.

## 6.0 CONCLUSIONS AND RECOMMENDATIONS.

### 6.1 General.

This geoenvironmental appraisal has been undertaken on land at Cockle Edge Farm, Ingbirchworth, South Yorkshire. It is understood that planning application (Ref 2019/0208) has been submitted for the development of the site with a change of use from agricultural buildings to two residential dwellings. This report has been prepared in support of the discharge of Condition 3 of the application from Barnsley Metropolitan Council. The development layout drawing which accompanies the application shows associated driveway, areas of parking and private gardens.

### 6.2 Soil and Groundwater Contamination

**Risk Evaluation for the Proposed Land Use (Residential With Plant Uptake)**
The development proposals indicate the future end use of the site to be residential and areas or private gardens and soft landscaping may be present. This is considered to represent a **high** sensitivity end use.

The revised conceptual site model has been based on the interpretation of the laboratory test data. Based on this assessment, a number of pollutant linkages have been identified, although these have not necessarily been proven conclusively via statistical assessment. Additional laboratory testing and statistical interpretation may assist in conclusively identifying the presence, or otherwise, of pollutant linkages from individual determinands. However, as the concentrations were localised within the shallow made ground, and the made ground would be considered texturally unsuitable for garden or landscaped areas, it is

presumed that much if not all will be removed from site as part of a site strip. The pollutant linkages will therefore be broken and further testing would not be required other than for disposal purposes.

**Human Health Receptors**
Local elevated concentrations of chromium, and PAH speciate (Benzo(a)anthracene, Benzo(b)fluoranthene, Benzo(a)pyrene and Naphthalene) have been identified locally within the made ground. These elevated concentrations of contaminants are considered to pose a **moderate** risk to future site users if left in place. As a consequence of this remedial action is therefore considered necessary to break the potential pollutant linkages.

As discussed above it is assumed much if not all the made ground will be removed from areas of any soft landscaping/private garden, breaking the pollutant linkage. The following discussion considers the scenario where some made ground is left on site.

Where made ground is left beneath areas of proposed hardstand (building footprints and car parking etc), it is considered to pose a **negligible** risk to end users, as pathways are severed due to capping by the hardstanding.

If made ground is left on site in areas of private gardens or soft landscaping, there will be a need to import clean cover soils. This is to provide a healthy medium for plant growth and to remove any remaining pathways for exposure of end users to residual contaminants. It is recommended that a minimum of 600mm of clean capping soils (including 150mm of topsoil) are placed. This thickness is subject to regulatory approval, and discussed further in Section 7.0 of this report.

**Controlled Waters Receptors**
Based on a number of factors, discussed in Section 5.0 of this report, it is considered that the soils present on site pose a **low/negligible** risk to controlled waters.

**Construction and Maintenance Workers**
It is considered that there is a **negligible** short term risk during the groundworks to construction and maintenance workers. The primary exposure pathways are considered to be dermal contact, soil ingestion and inhalation of soil dust.

Based on the current information it is recommended that good health and safety procedures should be adopted by ground workers, including no eating or smoking on site, designated clean and wash areas and protective clothing, e.g. overalls, gloves, dust masks etc.

Any potential risks must be specifically assessed as part of the health and safety evaluation for the works to be performed in accordance with prevailing legislation. Site practices must conform to the specific legislation requirements and follow appropriate guidance (e.g. HSE, 1991; CIRIA 1996).

**Adjacent site users**
Provided good 'housekeeping' practises are observed during the groundworks, health and safety compliance is achieved, and wastes are appropriately handled, stored and disposed, then it is considered that there is a **negligible/low** short term risk to adjacent site users during the works.

**Built Development**
In accordance with BRE Special Digest 1, based on the chemical test results for water soluble sulphate, a design sulphate class of DS-1 is indicated for a brown field site. For the characteristic pH value and assuming mobile groundwater an ACEC class of AC-3z is indicated and for static groundwater AC-1s is indicated.

### 6.3 Ground Gas

Based on the fact that the site is not underlain by any significant thickness of made ground materials and that no significant putrescible materials which would be associated with ground gas generation (e.g. decaying organic matter etc) were recorded in any of the trial pits, the site is not considered to be at risk from ground gas, from these particular sources.

The site is shown not to be underlain by organic rich alluvial soils, which can give rise to the generation of ground gases.

According to the desk study report, there are no landfills within 500m of the site. Therefore, there should be no requirement for landfill gas protection for the proposed properties. Also the site lies within an area where **no** radon protective measures are necessary.

### 6.4 Watching Brief on Development Works

It is possible that areas of contamination or made ground may be encountered during the development works, which have not been identified by this report. If any areas of noxious, odorous, fibrous or liquid etc contamination are encountered, then works should stop immediately, the local authority informed and further advice sought from a suitably experienced and qualified consultant. It is recommended that a watching brief be maintained during the development work for this purpose.

### 6.5 Disposal of Unsuitable Soils

Any unsuitable materials which are to be exported from site, should be despatched to a suitably licensed landfill facility, in accordance with the requirements of the Duty of Care (DoC) Regulations, April 2006 and where appropriate, the HWR, 2005 or any superseding legislation.

## 7.0 REMEDIATION STRATEGY

The Remediation Strategy follows guidance presented in Chapters 3 and 4 of the Environment Agency Land Report 11: Model Procedures for Management of Land Contamination. (CLR11).

CLR11 recommends that remedial action proposed for the site should be justified. Remedial action has been justified due to the pollution linkages identified within this report. Also, as discussed in CLR11, the remediation options have been developed to meet the technical objectives for the development with the major drivers behind the recommendations being:

- To achieve successful remediation within a particular timescale and budget;
- Familiarity with the methodology by the developer/ground worker;
- Confidence that the remediation can be carried out by good technical practices; and,
- Likely success of the proposed method of remediation.

It has been assumed, in the preparation of this Strategy, that the proposed end use is a residential development, with areas of private garden and that development ground levels will not change significantly from those encountered during the fieldwork. If either of these assumptions are incorrect, then amendments to the suggested options within this report may be required.

### 7.1 Options Appraisal

The driver for remediation of the site is the presence of made ground soils within the proposed areas of gardens/soft landscaping that contain elevated chromium and PAH speciates (Benzo(a)anthracene, Benzo(b)fluoranthene, Benzo(a)pyrene and Naphthalene). Also the made ground is considered texturally unsuitable in areas where contaminants were not encountered.

There are no in-situ or ex-situ remediation techniques available to reduce the concentrations of these contaminants within the made ground soils to below that of the published threshold values.

The method chosen for remediation must be achievable by the ground worker, using techniques that they are familiar with. It is therefore considered that the remediation proposals should either comprise the complete removal of the contaminants source (the made ground soils), or the provision of a cover system to sever the contaminant pathways in the proposed areas of garden, where the end users may reasonably be expected to come into contact with the soils and where soil dust may be derived.

Both approaches are considered to be equally straightforward and both would be an effective approach to reducing risk to the end users of the site to an acceptable level.

### 7.2 Proposed Treatment of Existing Contamination

**Protection of Human Health**
With the proposed areas of garden, the existing made ground should be excavated to a sufficient depth to allow the placement of a cover system of at least 600mm of verified 'clean' cover soils, which includes a minimum thickness of 150mm of topsoil.

| Topsoil (mm) | Subsoil (mm) | Total (mm) |
|---|---|---|
| 150 | 450 | 600 |

Any proposed topsoil for incorporation into the works shall conform to the requirements of BS3882:2015

Any import of clean capping soils shall be subject to chemical testing with concentrations of contaminants not exceeding the maximum concentrations detailed in the Table in Section 4.3 of this report.

Should all the made ground be removed then, providing that no visual or olfactory evidence of suspected contamination is noted, within the underlying natural subsoils, no specific depth of cover would be required, beyond that needed to provide a suitable thickness of growing medium. Following removal of the made ground, further samples shall be taken on a 5 m grid across the area of the resultant in-situ natural surfaces prior to placement of the overlying sub and topsoil. Samples shall be tested against the determinands presented in Table in Section 4.3 of this report. Should any failure be recorded then further soils shall be removed from the area of the sample failure, and a further sample taken.

The depth of cover system specified represents 'two spade depths' to allow residents of the proposed gardens to dig to a reasonable depth to allow planting of trees, placement of fencing etc, without being likely to come into contact with the contaminated soils remaining at depth.

Where made ground is left beneath areas of proposed hardstand (building footprints and car parking etc), it is considered to pose a **negligible** risk to end users, as pathways are severed due to capping by the hardstanding.

Subject to confirmation from the regulators, the developer may need to submit a validation report to include details confirming the placement of clean capping soils to the areas of soft landscaping by means of chemical test results and trial pits to indicate the necessary thickness of these soils.
These works will be carried out in accordance with the following best practice guidance document:

- Validation Requirements for Cover Systems (YAHPAC) – Version 3.4, November 2017.

### 7.3 Watching Brief on Development Works

It is possible that areas of contamination or made ground may be encountered during the development works, which have not been identified by this report. If any areas of noxious, odorous, fibrous or liquid etc. contamination are encountered, then works should stop immediately, the local authority informed and further advice sought from a suitably experienced and qualified consultant. It is recommended that a watching brief be maintained during the development work for this purpose.

### 7.4 Disposal of Unsuitable Soils

Any unsuitable materials which are to be exported from site, should be despatched to a suitably licenced landfill facility, in accordance with the requirements of the Duty of Care (DoC) Regulations, April 2006 and where appropriate, the HWR, 2005 or any superseding legislation.

### 7.5 Regulatory Approval

The conclusions and recommendations presented above are considered practical based on the findings of this investigation. The conclusions and recommendations cannot, however, be guaranteed to gain regulatory approval, and therefore this report should be submitted to the regulators for their comment/approval as part of any planning process.

# APPENDIX A

DRAWINGS




**Site Location Plan** **Drawing No C312/1**

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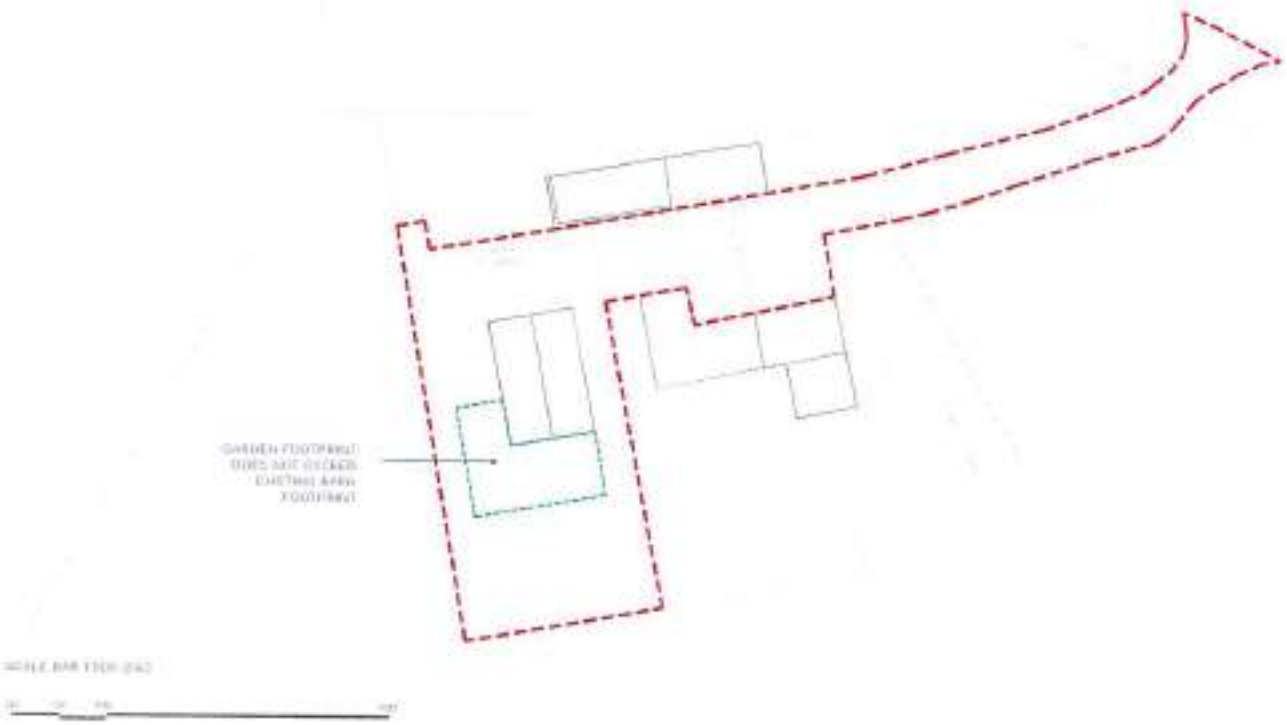
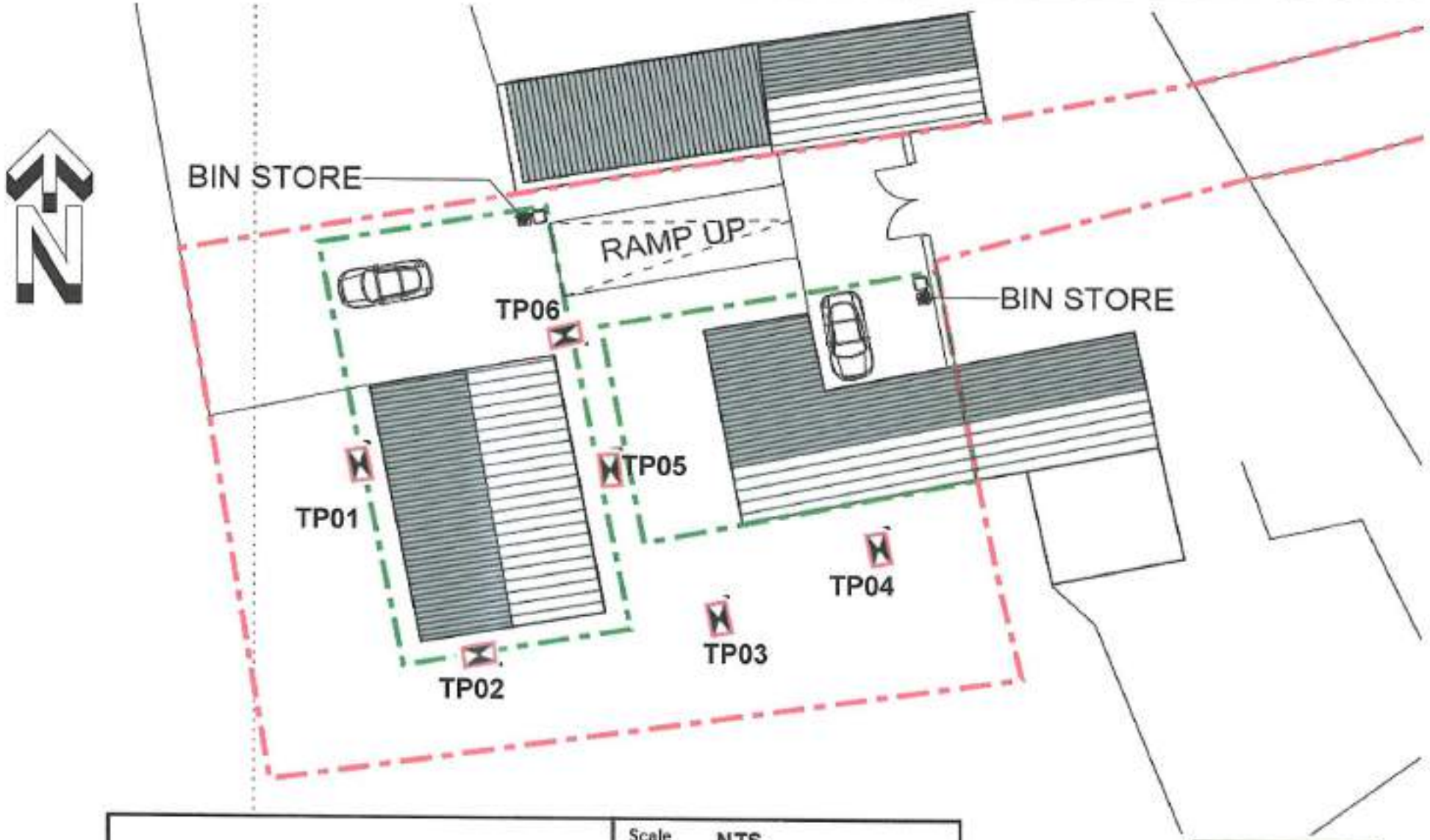
G&M CONSULTING

BLOCK PLAN

PROPOSED




SCALE BAR 1:500 @A3




| | | | |
|---|---|---|---|
| | | Scale NTS | |
| Contract | Cockle Edge Farm, Ingbirchworth | Drawn by AS | Approved GS |
| | | Drawing Name – Trial pit Location Plan | |
| Client | Mr Peter Cadman | | |

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# APPENDIX B

## EXPLORATORY HOLE LOGS

# Trial Pit Record

| | | | |
|---|---|---|---|
| TP No | 1 | | |
| Contract No | C312 | | |
| Date | 23/03/19 | | |
| Scale | 01:10 | | |
| Logged By | AS | | |

| Method: | Site | Client |
|---|---|---|
| Machine excavated trial pit using a 1.5 tonne 360° excavator. Using 450mm bucket | Cockle Edge Farm, Ingbirchworth | Mr Peter Cadman |

| Sample Details | | | Description | Depth (m) | Level (mAOD) | Legend |
|---|---|---|---|---|---|---|
| Type | Depth To-from (m) | Vane kN/m² | | | | |
| ES | 0.30 | | MADE GROUND: Light brown sandy subangular fine to coarse gravel sized fragments of limestone, concrete and brick with a medium cobble content. Sand is fine to coarse. Cobbles are subangular of brick and concrete | 0.60 | | |
| ES | 0.80 | | Firm, pale yellow mottled light grey silty CLAY. Rare 50x10mm plant rootlets. | 1.70 | | |
| | | | Trial Pit Complete At 1.70m | | | |

**Remarks**

Faces unstable during excavation
Slow ingress of water into pit at 1.00m
Pit dimension = 0.55m x 1.4m

**Sample Types**

D - Disturbed
B - Bulk
W - Water
ES - Environmental

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# Trial Pit Record

| | | | |
|---|---|---|---|
| TP No | 2 | | |
| Contract No | C312 | | |
| Date | 23/03/19 | | |
| Scale | 01:10 | | |
| Logged By | AS | | |

| | |
|---|---|
| Method: | Machine excavated trial pit using a 1.5 tonne 360° excavator. Using 450mm bucket |
| Site | Cockle Edge Farm, Ingbirchworth |
| Client | Mr Peter Cadman |

| Sample Details | | | Description | Depth (m) | Level (mAOD) | Legend |
|---|---|---|---|---|---|---|
| Type | Depth To-from (m) | Vane kN/m² | | | | |
| ES | 0.20 | | MADE GROUND: Light brown locally pale yellow slightly gravelly very sandy clay. Sand is fine to coarse, gravel sized fragments are subangular fine to medium of brick and limestone | 0.35 | | |
| ES | 0.60 | | Firm, pale yellow mottled light grey silty CLAY, Rare 50x10mm plant rootlets. | 1.10 | | |
| | | | Firm, pale yellow mottled light grey gravelly CLAY, gravel is subangular fine to coarse of very thinly bedded lithorelict mudstone. | 1.30 | | |
| | | | **Trial Pit Complete at 1.30m** | | | |

**Remarks**

Faces stable during excavation
Slow ingress of water into pit at 1.00m
Pit dimension = 0.45m x 1.3m

**Sample Types**

D - Disturbed
B - Bulk
W - Water
ES - Environmental

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# Trial Pit Record

| | | | |
|---|---|---|---|
| TP No | 3 | | |
| Contract No | C312 | | |
| Date | 23/03/19 | | |
| Scale | 01:10 | | |
| Logged By | AS | | |

**Method:** Machine excavated trial pit using a 1.5 tonne 360° excavator. Using 450mm bucket

**Site:** Cockle Edge Farm, Ingbirchworth

**Client:** Mr Peter Cadman

| Sample Details | | | Description | Depth (m) | Level (mAOD) | Legend |
|---|---|---|---|---|---|---|
| Type | Depth To-from (m) | Vane kN/m² | | | | |
| ES | 0.20 | | MADE GROUND: Dark brown slightly gravelly sandy clay. Sand is fine to coarse, gravel sized fragments are fine to medium of brick | 0.3 | | |
| ES | 0.60 | | Firm, pale yellow mottled light grey silty CLAY, Rare 50x10mm plant rootlets. | 1.10 | | |
| | | | Trial Pit Complete at 1.10m | | | |

**Remarks**
Faces stable during excavation
No groundwater encountered
Pit dimension = 0.45m x 1.3m

**Sample Types**
D - Disturbed
B - Bulk
W - Water
ES - Environmental

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# Trial Pit Record

| | | | |
|---|---|---|---|
| TP No | 4 | | |
| Contract No | C312 | | |
| Date | 23/03/19 | | |
| Scale | 01:10 | | |
| Logged By | AS | | |

| | |
|---|---|
| Method: | Machine excavated trial pit using a 1.5 tonne 360° excavator. Using 450mm bucket |
| Site | Cockle Edge Farm, Ingbirchworth |
| Client | Mr Peter Cadman |

| Sample Details | | | Description | Depth (m) | Level (mAOD) | Legend |
|---|---|---|---|---|---|---|
| Type | Depth To-from (m) | Vane kN/m² | | | | |
| ES | 0.10 | | MADE GROUND: Dark brown slightly gravelly clay. Gravel sized fragments are subangular fine of brick. Frequent 5cm pockets of black carbonaceous material. Frenquent plant rootlets. | 0.15 | | |
| ES | 0.30 | | | | | |
| ES | 0.60 | | Firm, orangish yellow mottled pale grey slightly gravelly silty CLAY. Gravel is subangular fine to coerse of very thinly bedded lithorelict mudstone. | 0.90 | | |
| | | | Trial Pit Complete at 0.90m | | | |

**Remarks**
Faces stable during excavation
No groundwater encountered
Pit dimension = 0.45m x 1.2m

**Sample Types**
D - Disturbed
B - Bulk
W - Water
ES - Environmental

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# Trial Pit Record

| | | | | | |
|---|---|---|---|---|---|
| | | | | TP No | 5 |
| | | | | Contract No | C312 |
| Method: | Machine excavated trial pit using a 1.5 tonne 360° excavator. Using 450mm bucket | Site | Cockle Edge Farm, Ingbirchworth | Date | 23/03/19 |
| | | | | Scale | 01:10 |
| | | Client | Mr Peter Cadman | Logged By | AS |

| Sample Details | | | Description | Depth (m) | Level (mAOD) | Legend |
|---|---|---|---|---|---|---|
| Type | Depth To-from (m) | Vane kN/m² | | | | |
| ES | 0.20 | | MADE GROUND: Slightly gravelly sandy clay with low cobble content. Sand is fine to coarse, gravel sized fragments are subangular fine to coarse of brick, concrete and limestone. Cobble sized fragments are subangular of brick and sandstone. Rare subangular boulder sized fragments of sandstone | | | |
| ES | 0.50 | | | 0.65 | | |
| ES | 0.80 | | Firm, pale yellow mottled light grey silty CLAY, Rare 50x10mm plant rootlets. From 1.00m rare rounded ironstone nodules | | | |
| | | | | 1.25 | | |
| | | | Trial Pit Complete at 1.25m | | | |

**Remarks**
Faces stable during excavation
No groundwater encountered
Pit dimension = 0.45m x 1.3m

**Sample Types**
D - Disturbed
B - Bulk
W - Water
ES - Environmental

G&M CONSULTING

# Trial Pit Record

| | |
|---|---|
| TP No | 6 |
| Contract No | C312 |
| Date | 23/03/19 |
| Scale | 01:10 |
| Logged By | AS |

| | |
|---|---|
| Method: | Machine excavated trial pit using a 1.5 tonne 360° excavator. Using 450mm bucket |
| Site | Cockle Edge Farm, Ingbirchworth |
| Client | Mr Peter Cadman |

| Sample Details | | | Description | Depth (m) | Level (mAOD) | Legend |
|---|---|---|---|---|---|---|
| Type | Depth To-from (m) | Vane kN/m² | | | | |
| ES | 0.30 | | MADE GROUND: Multi-Coloured, subangular fine to coarse gravel sized fragments of mixed lithologies including brick, limestone and concrete with low cobble content. Cobbles are subangular of brick and concrete. | 0.10 | | |
| ES | 0.70 | | Black, sandy subangular fine to coarse gravel sized fragments of clinker and tarmacadam. Sand sized fragments are fine to coarse of ash. (Slight Creasote odour noted) | 0.6 | | |
| | | | Firm, pale yellow mottled light grey silty CLAY, Rare 50x10mm plant rootlets. | 0.9 | | |
| | | | **Trial Pit Complete at 0.90m** | | | |

**Remarks**

Faces unstable during excavation
No groundwater encountered
Pit dimension = 0.75m x 1.3m

**Sample Types**

D - Disturbed
B - Bulk
W - Water
ES - Environmental

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# APPENDIX C

## CHEMICAL TEST RESULTS

4041

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e: reception@i2analytical.com

# Analytical Report Number : 19-34786

| | | | |
|---|---|---|---|
| **Project / Site name:** | Cockle Edge Farm, Ingbirchworth | **Samples received on:** | 26/03/2019 |
| **Your job number:** | C312 | **Samples instructed on:** | 26/03/2019 |
| **Your order number:** | | **Analysis completed by:** | 03/04/2019 |
| **Report Issue Number:** | 1 | **Report issued on:** | 03/04/2019 |
| **Samples Analysed:** | 11 soil samples | | |

**Signed:**

Rexona Rahman
Head of Customer Services
**For & on behalf of i2 Analytical Ltd.**

Standard Geotechnical, Asbestos and Chemical Testing Laboratory located at: ul. Pionierów 39, 41 -711 Ruda Śląska, Poland.

Accredited tests are defined within the report, opinions and interpretations expressed herein are outside the scope of accreditation.

Standard sample disposal times, unless otherwise agreed with the laboratory, are :

| | |
|---|---|
| soils | - 4 weeks from reporting |
| leachates | - 2 weeks from reporting |
| waters | - 2 weeks from reporting |
| asbestos | - 6 months from reporting |

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The results included within the report are representative of the samples submitted for analysis.

4041

Analytical Environmental Science

**Analytical Report Number: 19-34786**

**Project / Site name: Cockle Edge Farm, Ingbirchworth**

| Lab Sample Number | | | | 1186774 | 1186775 | 1186776 | 1186777 | 1186778 |
|---|---|---|---|---|---|---|---|---|
| Sample Reference | | | | TP3 | TP3 | TP2 | TP3 | TP3 |
| Sample Number | | | | None Supplied | None Supplied | None Supplied | None Supplied | None Supplied |
| Depth (m) | | | | 0.30 | 0.80 | 0.20 | 0.30 | 0.60 |
| Date Sampled | | | | 23/03/2019 | 23/03/2019 | 23/03/2019 | 23/03/2019 | 23/03/2019 |
| Time Taken | | | | None Supplied | None Supplied | None Supplied | None Supplied | None Supplied |
| **Analytical Parameter (Soil Analysis)** | **Units** | **Limit of detection** | **Accreditation Status** | | | | | |
| Stone Content | % | 0.1 | NONE | < 0.1 | < 0.1 | < 0.1 | < 0.1 | < 0.1 |
| Moisture Content | % | N/A | NONE | 25 | 24 | 26 | 20 | 21 |
| Total mass of sample received | kg | 0.001 | NONE | 0.47 | 0.49 | 0.84 | 0.40 | 0.47 |
| Asbestos in Soil | Type | N/A | ISO 17025 | Not detected | - | - | Not detected | - |
| **General Inorganics** | | | | | | | | |
| pH - Automated | pH Units | N/A | MCERTS | - | 8.7 | - | - | - |
| Water Soluble SO4 16hr extraction (2:1 Leachate Equivalent) | g/l | 0.00125 | MCERTS | - | 0.666 | - | - | - |
| **Total Phenols** | | | | | | | | |
| Total Phenols (monohydric) | mg/kg | 1 | MCERTS | < 1.0 | - | < 1.0 | < 1.0 | < 1.0 |
| **Speciated PAHs** | | | | | | | | |
| Naphthalene | mg/kg | 0.05 | MCERTS | < 0.05 | - | < 0.05 | < 0.05 | < 0.05 |
| Acenaphthylene | mg/kg | 0.05 | MCERTS | < 0.05 | - | < 0.05 | < 0.05 | < 0.05 |
| Acenaphthene | mg/kg | 0.05 | MCERTS | < 0.05 | - | < 0.05 | < 0.05 | < 0.05 |
| Fluorene | mg/kg | 0.05 | MCERTS | < 0.05 | - | < 0.05 | < 0.05 | < 0.05 |
| Phenanthrene | mg/kg | 0.05 | MCERTS | 1.0 | - | < 0.05 | 0.30 | < 0.05 |
| Anthracene | mg/kg | 0.05 | MCERTS | 0.28 | - | < 0.05 | < 0.05 | < 0.05 |
| Fluoranthene | mg/kg | 0.05 | MCERTS | 1.3 | - | 0.48 | 0.76 | < 0.05 |
| Pyrene | mg/kg | 0.05 | MCERTS | 1.2 | - | 0.42 | 0.62 | < 0.05 |
| Benzo(a)anthracene | mg/kg | 0.05 | MCERTS | 0.64 | - | 0.22 | 0.31 | < 0.05 |
| Chrysene | mg/kg | 0.05 | MCERTS | 0.53 | - | 0.33 | 0.35 | < 0.05 |
| Benzo(b)fluoranthene | mg/kg | 0.05 | MCERTS | 0.47 | - | 0.35 | 0.45 | < 0.05 |
| Benzo(k)fluoranthene | mg/kg | 0.05 | MCERTS | 0.15 | - | 0.23 | 0.17 | < 0.05 |
| Benzo(a)pyrene | mg/kg | 0.05 | MCERTS | 0.41 | - | 0.29 | 0.36 | < 0.05 |
| Indeno(1,2,3-cd)pyrene | mg/kg | 0.05 | MCERTS | < 0.05 | - | < 0.05 | < 0.05 | < 0.05 |
| Dibenz(a,h)anthracene | mg/kg | 0.05 | MCERTS | < 0.05 | - | < 0.05 | < 0.05 | < 0.05 |
| Benzo(ghi)perylene | mg/kg | 0.05 | MCERTS | < 0.05 | - | < 0.05 | < 0.05 | < 0.05 |
| **Total PAH** | | | | | | | | |
| Speciated Total EPA-16 PAHs | mg/kg | 0.8 | MCERTS | 5.73 | - | 2.32 | 3.32 | < 0.80 |
| **Heavy Metals / Metalloids** | | | | | | | | |
| Arsenic (aqua regia extractable) | mg/kg | 1 | MCERTS | 10 | - | 9.1 | 6.8 | 8.6 |
| Cadmium (aqua regia extractable) | mg/kg | 0.2 | MCERTS | 0.3 | - | 0.3 | 0.2 | < 0.2 |
| Chromium (hexavalent) | mg/kg | 4 | MCERTS | < 4.0 | - | < 4.0 | < 4.0 | < 4.0 |
| Chromium (aqua regia extractable) | mg/kg | 1 | MCERTS | 36 | - | 24 | 20 | 32 |
| Copper (aqua regia extractable) | mg/kg | 1 | MCERTS | 27 | - | 32 | 26 | 33 |
| Lead (aqua regia extractable) | mg/kg | 1 | MCERTS | 52 | - | 51 | 45 | 15 |
| Mercury (aqua regia extractable) | mg/kg | 0.3 | MCERTS | < 0.3 | - | < 0.3 | < 0.3 | < 0.3 |
| Nickel (aqua regia extractable) | mg/kg | 1 | MCERTS | 18 | - | 18 | 17 | 27 |
| Selenium (aqua regia extractable) | mg/kg | 1 | MCERTS | < 1.0 | - | < 1.0 | < 1.0 | < 1.0 |
| Zinc (aqua regia extractable) | mg/kg | 1 | MCERTS | 293 | - | 160 | 170 | 61 |
| **Pesticide and Herbicide Screen** | | | | | | | | |
| Pesticides/Herbicides Screen in Soil | P/A | N/A | NONE | - | - | - | Absent | - |



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The results included within the report are representative of the samples submitted for analysis.

**Analytical Report Number: 19-34786**

**Project / Site name: Cockle Edge Farm, Ingbirchworth**

| Lab Sample Number | | | | 1186779 | 1186780 | 1186781 | 1186782 | 1186783 |
|---|---|---|---|---|---|---|---|---|
| Sample Reference | | | | TP4 | TP4 | TP5 | TP5 | TP6 |
| Sample Number | | | | None Supplied | None Supplied | None Supplied | None Supplied | None Supplied |
| Depth (m) | | | | 0.10 | 0.60 | 0.20 | 0.50 | 0.30 |
| Date Sampled | | | | 23/03/2019 | 23/03/2019 | 23/03/2019 | 23/03/2019 | 23/03/2019 |
| Time Taken | | | | None Supplied | None Supplied | None Supplied | None Supplied | None Supplied |
| **Analytical Parameter (Soil Analysis)** | Units | Limit of detection | Accreditation Status | | | | | |
| Stone Content | % | 0.1 | NONE | < 0.1 | < 0.1 | < 0.1 | < 0.1 | < 0.1 |
| Moisture Content | % | N/A | NONE | 23 | 18 | 22 | 26 | 5.5 |
| Total mass of sample received | kg | 0.001 | NONE | 0.65 | 0.97 | 0.46 | 0.44 | 0.50 |
| Asbestos in Soil | Type | N/A | ISO 17025 | - | - | Not-detected | - | - |
| **General Inorganics** | | | | | | | | |
| pH - Automated | pH Units | N/A | MCERTS | - | 8.1 | - | - | - |
| Water Soluble SO4 16hr extraction (2:1 Leachate Equivalent) | g/l | 0.00125 | MCERTS | - | 0.072 | - | - | - |
| **Total Phenols** | | | | | | | | |
| Total Phenols (monohydric) | mg/kg | 1 | MCERTS | < 1.0 | < 1.0 | < 1.0 | < 1.0 | < 1.0 |
| **Speciated PAHs** | | | | | | | | |
| Naphthalene | mg/kg | 0.05 | MCERTS | < 0.05 | < 0.05 | < 0.05 | < 0.05 | 71 |
| Acenaphthylene | mg/kg | 0.05 | MCERTS | < 0.05 | < 0.05 | < 0.05 | < 0.05 | 3.5 |
| Acenaphthene | mg/kg | 0.05 | MCERTS | < 0.05 | < 0.05 | < 0.05 | < 0.05 | 150 |
| Fluorene | mg/kg | 0.05 | MCERTS | < 0.05 | < 0.05 | < 0.05 | < 0.05 | 160 |
| Phenanthrene | mg/kg | 0.05 | MCERTS | < 0.05 | < 0.05 | < 0.05 | < 0.05 | 640 |
| Anthracene | mg/kg | 0.05 | MCERTS | < 0.05 | < 0.05 | < 0.05 | < 0.05 | 150 |
| Fluoranthene | mg/kg | 0.05 | MCERTS | < 0.05 | < 0.05 | < 0.05 | 0.27 | 600 |
| Pyrene | mg/kg | 0.05 | MCERTS | < 0.05 | < 0.05 | < 0.05 | 0.26 | 450 |
| Benzo[a]anthracene | mg/kg | 0.05 | MCERTS | < 0.05 | < 0.05 | < 0.05 | < 0.05 | 200 |
| Chrysene | mg/kg | 0.05 | MCERTS | < 0.05 | < 0.05 | < 0.05 | < 0.05 | 190 |
| Benzo(b)fluoranthene | mg/kg | 0.05 | MCERTS | < 0.05 | < 0.05 | < 0.05 | < 0.05 | 150 |
| Benzo(k)fluoranthene | mg/kg | 0.05 | MCERTS | < 0.05 | < 0.05 | < 0.05 | < 0.05 | 200 |
| Benzo(a)pyrene | mg/kg | 0.05 | MCERTS | < 0.05 | < 0.05 | < 0.05 | < 0.05 | 150 |
| Indeno(1,2,3-cd)pyrene | mg/kg | 0.05 | MCERTS | < 0.05 | < 0.05 | < 0.05 | < 0.05 | 59 |
| Dibenz(a,h)anthracene | mg/kg | 0.05 | MCERTS | < 0.05 | < 0.05 | < 0.05 | < 0.05 | 28 |
| Benzo(ghi)perylene | mg/kg | 0.05 | MCERTS | < 0.05 | < 0.05 | < 0.05 | < 0.05 | 63 |
| **Total PAH** | | | | | | | | |
| Speciated Total EPA-16 PAHs | mg/kg | 0.8 | MCERTS | < 0.80 | < 0.80 | < 0.80 | < 0.80 | 3200 |
| **Heavy Metals / Metalloids** | | | | | | | | |
| Arsenic (aqua regia extractable) | mg/kg | 1 | MCERTS | 16 | 6.5 | 12 | - | 2.7 |
| Cadmium (aqua regia extractable) | mg/kg | 0.2 | MCERTS | < 0.2 | < 0.2 | < 0.2 | - | < 0.2 |
| Chromium (hexavalent) | mg/kg | 4 | MCERTS | < 4.0 | < 4.0 | < 4.0 | - | < 4.0 |
| Chromium (aqua regia extractable) | mg/kg | 1 | MCERTS | 20 | 31 | 25 | - | 1100 |
| Copper (aqua regia extractable) | mg/kg | 1 | MCERTS | 23 | 30 | 20 | - | 40 |
| Lead (aqua regia extractable) | mg/kg | 1 | MCERTS | 71 | 15 | 47 | - | 16 |
| Mercury (aqua regia extractable) | mg/kg | 0.3 | MCERTS | < 0.3 | < 0.3 | < 0.3 | - | < 0.3 |
| Nickel (aqua regia extractable) | mg/kg | 1 | MCERTS | 19 | 28 | 18 | - | 17 |
| Selenium (aqua regia extractable) | mg/kg | 1 | MCERTS | < 1.0 | < 1.0 | < 1.0 | - | < 1.0 |
| Zinc (aqua regia extractable) | mg/kg | 1 | MCERTS | 100 | 69 | 81 | - | 45 |
| **Pesticide and Herbicide Screen** | | | | | | | | |
| Pesticides/Herbicides Screen in Soil | N/A | N/A | NONE | - | - | - | - | Absent |



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The results included within the report are representative of the samples submitted for analysis.

**Analytical Report Number: 19-34786**

**Project / Site name: Cockle Edge Farm, Ingbirchworth**

| Lab Sample Number | | | | 1186784 | | | | |
|---|---|---|---|---|---|---|---|---|
| Sample Reference | | | | TP6 | | | | |
| Sample Number | | | | None Supplied | | | | |
| Depth (m) | | | | 0.70 | | | | |
| Date Sampled | | | | 25/03/2019 | | | | |
| Time Taken | | | | None Supplied | | | | |
| **Analytical Parameter (Soil Analysis)** | Units | Limit of detection | Accreditation Status | | | | | |
| Stone Content | % | 0.1 | NONE | < 0.1 | | | | |
| Moisture Content | % | N/A | NONE | 20 | | | | |
| Total mass of sample received | kg | 0.001 | NONE | 0.46 | | | | |
| Asbestos in Soil | Type | N/A | ISO 17025 | - | | | | |
| **General Inorganics** | | | | | | | | |
| pH - Automated | pH Units | N/A | MCERTS | - | | | | |
| Water Soluble SO4 16hr extraction (2:1 Leachate Equivalent) | g/l | 0.00125 | MCERTS | - | | | | |
| **Total Phenols** | | | | | | | | |
| Total Phenols (monohydric) | mg/kg | 1 | MCERTS | - | | | | |
| **Speciated PAHs** | | | | | | | | |
| Naphthalene | mg/kg | 0.05 | MCERTS | < 0.05 | | | | |
| Acenaphthylene | mg/kg | 0.05 | MCERTS | < 0.05 | | | | |
| Acenaphthene | mg/kg | 0.05 | MCERTS | < 0.05 | | | | |
| Fluorene | mg/kg | 0.05 | MCERTS | < 0.05 | | | | |
| Phenanthrene | mg/kg | 0.05 | MCERTS | 0.67 | | | | |
| Anthracene | mg/kg | 0.05 | MCERTS | 0.29 | | | | |
| Fluoranthene | mg/kg | 0.05 | MCERTS | 1.1 | | | | |
| Pyrene | mg/kg | 0.05 | MCERTS | 0.88 | | | | |
| Benzo(a)anthracene | mg/kg | 0.05 | MCERTS | 0.49 | | | | |
| Chrysene | mg/kg | 0.05 | MCERTS | 0.41 | | | | |
| Benzo(b)fluoranthene | mg/kg | 0.05 | MCERTS | 0.42 | | | | |
| Benzo(k)fluoranthene | mg/kg | 0.05 | MCERTS | 0.23 | | | | |
| Benzo(a)pyrene | mg/kg | 0.05 | MCERTS | 0.47 | | | | |
| Indeno(1,2,3-cd)pyrene | mg/kg | 0.05 | MCERTS | < 0.05 | | | | |
| Dibenz(a,h)anthracene | mg/kg | 0.05 | MCERTS | < 0.05 | | | | |
| Benzo(ghi)perylene | mg/kg | 0.05 | MCERTS | < 0.05 | | | | |
| **Total PAH** | | | | | | | | |
| Speciated Total EPA-16 PAHs | mg/kg | 0.8 | MCERTS | 4.86 | | | | |
| **Heavy Metals / Metalloids** | | | | | | | | |
| Arsenic (aqua regia extractable) | mg/kg | 1 | MCERTS | - | | | | |
| Cadmium (aqua regia extractable) | mg/kg | 0.2 | MCERTS | - | | | | |
| Chromium (hexavalent) | mg/kg | 4 | MCERTS | - | | | | |
| Chromium (aqua regia extractable) | mg/kg | 1 | MCERTS | - | | | | |
| Copper (aqua regia extractable) | mg/kg | 1 | MCERTS | - | | | | |
| Lead (aqua regia extractable) | mg/kg | 1 | MCERTS | - | | | | |
| Mercury (aqua regia extractable) | mg/kg | 0.3 | MCERTS | - | | | | |
| Nickel (aqua regia extractable) | mg/kg | 1 | MCERTS | - | | | | |
| Selenium (aqua regia extractable) | mg/kg | 1 | MCERTS | - | | | | |
| Zinc (aqua regia extractable) | mg/kg | 1 | MCERTS | - | | | | |
| **Pesticide and Herbicide Screen** | | | | | | | | |
| Pesticides/Herbicides Screen in Soil | N/A | N/A | NONE | - | | | | |



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The results included within the report are representative of the samples submitted for analysis.

**Analytical Report Number : 19-34786**

**Project / Site name: Cockle Edge Farm, Ingbirchworth**

* These descriptions are only intended to act as a cross check if sample identities are questioned. The major constituent of the sample is intended to act with respect to MCERTS validation. The laboratory is accredited for sand, clay and loam (MCERTS) soil types. Data for unaccredited types of solid should be interpreted with care.

Stone content of a sample is calculated on the % weight of the stones not passing a 10 mm sieve. Results are not corrected for stone content.

| Lab Sample Number | Sample Reference | Sample Number | Depth (m) | Sample Description * |
|---|---|---|---|---|
| 1186774 | TP1 | None Supplied | 0.10 | Brown clay and loam with vegetation. |
| 1186775 | TP1 | None Supplied | 0.80 | Light brown clay. |
| 1186776 | TP3 | None Supplied | 0.20 | Brown clay and loam with vegetation. |
| 1186777 | TP3 | None Supplied | 0.30 | Brown loam and clay with gravel and vegetation. |
| 1186778 | TP3 | None Supplied | 0.60 | Light brown clay. |
| 1186779 | TP4 | None Supplied | 0.10 | Brown clay and sand. |
| 1186780 | TP4 | None Supplied | 0.60 | Light brown clay and sand. |
| 1186781 | TP5 | None Supplied | 0.20 | Brown clay and sand. |
| 1186782 | TP5 | None Supplied | 0.50 | Brown clay and sand. |
| 1186783 | TP6 | None Supplied | 0.10 | Black tar with gravel. ** |
| 1186784 | TP6 | None Supplied | 0.70 | Light brown clay. |

** Non MCerts Matrix



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Environmental Science

**Analytical Report Number : 19-34786**

**Project / Site name: Cockle Edge Farm, Ingbirchworth**

**Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Water (PrW)**

| Analytical Test Name | Analytical Method Description | Analytical Method Reference | Method number | Wet / Dry Analysis | Accreditation Status |
|---|---|---|---|---|---|
| Asbestos identification in soil | Asbestos identification with the use of polarised light microscopy in conjunction with dispersion staining techniques. | In house method based on HSG 248 | A081-PL | D | ISO 17025 |
| Hexavalent chromium in soil | Determination of hexavalent chromium in soil by extraction in water then by acidification, addition of 1,5 diphenylcarbazide followed by colorimetry. | In-house method | L080-PL | W | MCERTS |
| Metals in soil by ICP-OES | Determination of metals in soil by aqua-regia digestion followed by ICP-OES. | In-house method based on NRWMN 2009 Methods for the Determination of Metals in Soil. | L038-PL | D | MCERTS |
| Moisture Content | Moisture content, determined gravimetrically. | In-house method based on BS1377 Part 2, 1990, Chemical and Electrochemical Tests | L019-UK/PL | W | NONE |
| Monohydric phenols in soil | Determination of phenols in soil by extraction with sodium hydroxide followed by distillation followed by colorimetry. | In-house method based on Examination of Water and Wastewater 20th Edition Clesceri, Greenberg & Eaton (Hosker) | L088-PL | W | MCERTS |
| Pesticides and Herbicides in soil screening | In-house method | In-house method | | W | NONE |
| pH in soil (automated) | Determination of pH in soil by addition of water followed by automated electrometric measurement. | In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests | L099-PL | D | MCERTS |
| Speciated EPA-16 PAHs in soil | Determination of PAH compounds in soil by extraction in dichloromethane and hexane followed by GC-MS with the use of surrogate and internal standards. | In-house method based on USEPA 8270 | L064-PL | D | MCERTS |
| Stones content of soil | Standard preparation for all samples unless otherwise detailed. Gravimetric determination of stone > 10 mm as % dry weight. | In-house method based on British Standard Methods and MCERTS requirements. | L019-UK/PL | D | NONE |
| Sulphate, water soluble, in soil (16hr extraction) | Determination of water soluble sulphate by ICP-OES. Results reported directly (leachate equivalent) and corrected for extraction ratio (soil equivalent). | In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests, 2:1 water:soil extraction, analysis by ICP-OES. | L030-PL | D | MCERTS |

**For method numbers ending in 'UK' analysis have been carried out in our laboratory in the United Kingdom.**
**For method numbers ending in 'PL' analysis have been carried out in our laboratory in Poland.**
**Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC.**


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# APPENDIX D

PHOTOGRAPHS



Trial Pit TP1



Trial Pit TP2



Trial Pit TP3



Trial Pit TP4



Trial Pit TP5



Trial Pit TP6