

**Phase 3 Remediation Strategy
and Verification Plan**

for

**Proposed Demolition of Barn &
Outbuilding and Erection of 1 No.
Dwelling & Associated Car
Parking and Retention of
Countryside to Domestic Garden**

on the site of

**The Barn, No.9 The Green,
Croft, Blaby,
Leicester LE9 3EQ**

Date: March 2022

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Final Report

Reference:

1615K P3 Elliot - Croft

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1.0 QUALITY ASSURANCE

Castledine & Co confirm that all reasonable efforts have been made to ensure that the information outlined within this report is accurate.

Castledine & Co would further confirm that due care, attention and technical skill were used in the creation of this report.

For and on behalf of Castledine & Co.

Kevin Castledine

(Proprietor)

2.0 LIMITATIONS

The conclusions and recommendations made in this report are limited to those based on the findings of the investigation. Where comments are made based on information obtained from third parties, Castledine & Co assumes that all third-party information is true and correct. No independent action has been undertaken to validate the findings of third parties. The assessments and interpretation have been made in line with legislation and guidelines in force at the time of writing, representing best practice at the time.

There may be other conditions prevailing at 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.

3.0 INTRODUCTION

Castledine & Co have been appointed by Mr. S. Elliot to undertake a Phase 3 remediation Strategy and Verification Plan on land at The Barn, No.9 The Green, Croft, Leicestershire LE9 3EQ.

The following reports previous reports on the site are

- Phase 1 Land Contamination Risk Assessment, Ref 1609D P1 Elliot – Croft, dated 4th Jan 2021 by Castledine & Co.

4.0 SCOPE

Castledine & Co have prepared this report for the sole use and reliance of Mr. S. Elliot and his appointees for the purpose of ensuring compliance with:

- Paragraph(s) 174, 179, 183 & 184 of the National Planning Policy Framework 2021
- part C1 of the building regulations.
- Condition of Planning Approval No.19/0439/FUL

This report may not be used or relied upon by any unauthorised third party, or for any other proposed use than that specified above, without the explicit written agreement of Castledine & Co.

The report consists of a Remediation Strategy and Verification Plan in accordance with

- BS10175:2011+A2:2017, Investigation of potentially contaminated sites. Code of practice
- BS 8485:2015+A1:2019 Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings
- CLR11 “Model Procedures for the Management of Land Contamination”.
- LCRM “Land Contamination Risk Management”.

The objectives of the report are:-

- Report the existing information relating to the soil contamination and the ground gas regime within the area of the site.
- Set out the remediation measures and validation processes to be followed on site to ensure the site development does not pose a risk to human health.

5.0 SITE DESCRIPTION

The site is located in Croft, Leicestershire at National Grid Reference: 451374,295986 and is approximately 0.17ha in area.

The site is irregularly shaped and is generally orientated north west to south east. The site is directly bounded by field to the south and south east, The Green to the north west and neighbouring dwellings and gardens to the north and north east. The main pit of Croft Quarry is located approximately 126m north west of site and the main industrial area of the quarry is located approximately 32m east of site.

The site interior comprises the site access track, a dwelling, a parking and turning area, a redundant barn structure and garden areas. The site access leads south east off The Green, was seen to be gravelled and leads to a parking area and to the south east of site. The dwelling is located in the north west of site and is terraced with housing extending northwards from here. The dwelling was seen to be constructed of brick and stone with tiled roofing and two-storey in height. The barn structure is located in the central area of site, with a gravelled parking/turning area located between the dwelling and barn. A row of redundant lean-to structures are arrayed along the northern boundary, immediately north of the parking area. They were seen to be constructed of timber and corrugated metal with timber and debris contained within (likely arising from the damage to the barn). The barn was noted to be in a poor and dangerous state of repair and as such, access was not possible. The barn was noted to be constructed of red-brick, concrete and brick flooring with timber structures and blue-tiled roofing. There were 2 No. large wooden

barn doors noted on the western face of the building. The interior was occupied by timber, brick and tiled debris from damage to the barn. The site access track then leads past the southern face of the barn to the rear garden area to the east of the barns. This area was noted to be in use for the storage of materials such as stone, brick and timber along with garden furniture. The remaining area of this garden area was noted to be occupied by lawn, garden furniture and a small fish pond. The remaining area on site is a second garden / allotment area located in the southern extent of site, to the south of the access track. This area was noted to be largely concreted with areas of paving stone and planting beds along with a shed and a small, well-maintained chicken coop.

Topographically, the site is level with the land located to the south at a slightly lower height with a flood-barrier bund separating this area and the site itself. No significant sources of contamination were noted on the site walkover.

Photos of the site are present in Appendix D of the phase 1 report.

6.0 OVERVIEW OF FINDINGS AND RECOMMENDATIONS FROM PREVIOUS REPORTS

The following previous reports have been referred to and should be read in conjunction with this report

- Phase 1 Land Contamination Risk Assessment, Ref 1609D P1 Elliot – Croft, dated 4th Jan 2021 by Castledine & Co.

The most pertinent information is summarised in the following sections.

6.1 SUMMARY OF GROUND GAS REGIME

Potential sources of ground gas including proximate alluvial deposits, adjacent made ground deposits and a landfill record beyond made ground areas have been identified. Due to the nature of the geology in the area, the made ground located between site and the former refuse heap along with the made ground itself, the site is considered to be at a moderate risk from ground gas ingress. Furthermore, the site is known to be in an area

where flooding occurs and as such, changes in the ground water regime and flooding regime mean that site conditions and the ground gas regime may change over time.

Accordingly, gas protection measures for carbon dioxide and Methane are required for this development

7.0 GAS PROTECTION MEASURES DESIGN

As discussed in Section 6.1, gas protection measures are required for the proposed development. These have been designed in line with the current British Standard BS8485:2015+A1:2019 'Code of Practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings'.

7.1 DETERMINATION OF GAS PROTECTION SCORE

When determining the gas protection score, the Characteristic Situation and building type are taken into account. As discussed, the site has been characterised as CS2. The proposed development comprises private residential property and so represents a Type A building, as per Table 3 of BS8485:2015+A1:2019.

Taking into account the gas regime and the building type, using Table 4 in BS8485:2015+A1:2019, the minimum Gas Protection Score required is 3.5 points.

7.2 DETERMINATION OF PROTECTION MEASURES

A combination of two or more of the following protection measures should be used to achieve the Gas Protection Score, as determined in Section 4.3.1 of BS8485:2015+A1:2019:

- Structural barrier, or basement slab and wall if present.
- Ventilation measures.
- Gas resistant membrane.

7.2.1 FLOOR SLAB

The property is to have a beam and block floor slab. Based on Table 5 of BS8485:2015+A1:2019, this will achieve a Gas Protection Score of 0 points.

Notes:-

- There should be no movement joints in the substructure masonry below the membrane level and all perpend, gaps and openings should be sealed to avoid gas migration
- Before laying the membrane, the beam-and-block floor should be thoroughly wetted and all joints grouted with a 4:1 sand and cement grout brushed into all the joints. All projections that may puncture or damage the membrane must be removed. A layer of sacrificial polyethylene could be used.

7.2.2 VENTILATION MEASURES

The properties are to have a minimum 150mm clear ventilated sub floor void, with ventilation provided via telescopic air vents around the perimeter of each block at 2m centres.

The number of telescopic vents is to be confirmed but will meet or exceed the building regulations requirements of 1,500mm²/m run of wall.

The void should be well cross-ventilated (airbricks located on opposite walls) and if there are sleeper walls or other obstructions (change in levels etc) then there should be four or five times the area of the side vents provided in the obstruction.

This should be sufficient to provide very good performance. Based on Table 6 of BS8485:2015+A1:2019, this will achieve a gas protection score of 2.5 points.

7.2.3 GAS RESISTANT MEMBRANE

A gas resistant membrane which meets all of the requirements of Table 7 of BS8485:2015+A1:2019 (reproduced as Table 1) will achieve a score of 2 points.

TABLE 1. BS8485:2015 TABLE 7 GAS PROTECTION SCORE FOR THE GAS RESISTANT MEMBRANE REPRODUCED FROM BS8485:2015

Protection element/system	Score	Comments
<p>Gas resistant membrane meeting all of the following criteria:</p> <ul style="list-style-type: none"> • sufficiently impervious to the gases with a methane gas transmission rate <40.0 ml/day/m²/atm (average) for sheet and joints (tested in accordance with BS ISO 15105-1 manometric method); • sufficiently durable to remain serviceable for the anticipated life of the building and duration of gas emissions; • sufficiently strong to withstand in-service stresses (e.g. settlement if placed below a floor slab); • sufficiently strong to withstand the installation process and following trades until covered (e.g. penetration from steel fibres in fibre reinforced concrete, penetration of reinforcement ties, tearing due to working above it, dropping tools, etc); • capable, after installation, of providing a complete barrier to the entry of the relevant gas; and • verified in accordance with CIRIA C735 	2	<p>The performance of membranes is heavily dependent on the quality and design of the installation, resistance to damage after installation and integrity of joints. For example, a minimum 0.4 mm thickness (equivalent to 370 g/m² for polyethelene) reinforced membrane (virgin polymer) meets the performance criteria in Table 7 (see C.3). If a membrane is installed that does not meet all the criteria in column 1 then the score is zero.</p>

As designers, Castledine & Co have specified a membrane which is considered to be suitable for use as a gas barrier at the site and this is

- Visqueen Gas Barrier

Suitable accessories are

- Visqueen Doubled Sided Jointing Tape
- Visqueen Gas Resistant (GR) Foil Tape
- Visqueen Top Hat Units
- Visqueen GR DPC
- Visqueen Pro Detailing Strip

If an alternative product is proposed, then the manufacturer, membrane name and specification sheet should be forwarded to Castledine & Co and the EHO for assessment and approval prior to installation.

The membrane shall be extended across cavities and sealed around joints/service entries. Joints can be heat welded or taped with Double sided butyl joint tape. Joints are to be overlapped by min 100mm and if joint tape is being used then it must be applied using a silicone roller to remove trapped air. Visqueen self-adhesive Gas Membrane or Visqueen Top Hats and preformed corners should be used for sealing around protuberances.

If lap tape is to be used then it should not be fitted until the double-sided jointing tape has been verified

7.2.4 GAS PROTECTION SCORE SUMMARY

By implementing the above measures, the Gas Protection Score would be

TABLE 2. CALCULATION OF GAS PROTECTION SCORE

Protection Measures	Score
Precast suspended beam and block floor	0
Ventilation measures	2.5
Gas resistant membrane	2
Total	4.5

7.3 OTHER ELEMENTS

The gas membrane is to be installed when the construction is at slab level and then the insulation and screed placed upon it. This will protect the membrane from on-going site activities.

The cavity should be filled to a level where it will support the membrane across the cavity. Any exposed sections across the cavity wall will be protected using sacrificial sheeting or DPM while any cavity work is undertaken.

Ground Gas Membrane is degraded by light and therefore if it is to be left exposed for two weeks or more it should be protected by covering with black plastic. Centre fold membranes must not be used.

8.0 VERIFICATION PLAN**8.1 GAS PROTECTION**

In order to achieve the points claimed for the gas resistant membrane above, a validation procedure must be in place. The validation should be undertaken in line with CIRIA C735. Membranes installed by a suitably qualified installer are more robust, require less verification (assuming that the work is to an acceptable standard) and are likely to be more cost effective.

If the installation is to be carried out by a qualified and experienced installer then one visit should be carried out immediately following the fitting of the membrane. If the fitting is to be carried out by the builder / groundworker then an extra visit will be required when the site has been prepared for the membrane but before it is fitted.

On this basis, verification will be required as follows:

TABLE 3. REQUIRED VERIFICATION OF MEMBRANE

Gas regime /risk	Slab type	Installer experience	Suggested levels of verification and integrity testing
Low risk CS2 (*with venting) Basic radon protection area	Non reinforced All slabs	General builder/ groundworker / landfill operative (no relevant qualification)'	Verifier (consultant or qualified and experienced installer') to conduct a thorough verification (visual) inspection prior to all concrete pours. Contractor to supply sign off sheets (verification evidence) including photographs to independent verifier.
		Qualified and experienced installer (minimum one operative to hold qualification	Verifier (consultant' or third party qualified and experienced installer) to conduct a thorough verification (visual) inspection prior to 25 to 50 per cent of concrete pours (min one visit). Installer to supply sign off sheets (verification evidence) including photographs to independent verifier for all other pours.
Intermediate risk CS2 (no venting) or CS3 (*with venting) Full radon protection area		General builder/ groundworker/ landfill operative (no relevant qualification)'	Verifier (consultant' or qualified and experienced installer}' to conduct a thorough verification (visual) inspection prior to all concrete pours. All joints, pipe penetrations etc. independently air lanced to ASTM 04437. Contractor to supply sign off sheets (verification evidence) including photographs to verifier. Consideration given to need for/scope of integrity testing (eg initially on say 25 to 50 per cent of pours then falling to 10 to 25 per cent if acceptable results obtained and no concerns raised by visual inspections).
Intermediate risk CS2 (no venting) or CS3 (*with venting) Full radon protection area		Qualified and experienced installer (minimum one operative to hold qualification}	Verifier (consultant' or third party qualified and experienced installer}') to conduct a thorough verification (visual) inspection prior to 25 to 50 per cent of concrete pours (min two visits). 25 per cent all joints, pipe penetrations etc. independently air lanced to ASTM D 4437. Remaining 75 per cent joints, pipe penetrations etc tested to recognised standard by installer (as detailed in method statement/CQA plan). Installer to supply sign off sheets (verification evidence) to verifier for all other pours. Consideration given to need for/scope of integrity testing (eg initially on 10 to 25 per cent of pours then falling to 0 to 10 per cent if acceptable results obtained and no concerns raised by visual inspections).

If during the initial or subsequent inspections or based on the installer supplied information the quality of the installation is not deemed to be to a sufficient standard, then additional visits and integrity testing may be required.

9.0 WATCHING BRIEF

It remains possible that previously unexpected soil conditions may be encountered during the construction process. Examples may include oily pockets within the soil, potential for asbestos containing materials, black ashy materials, soils exhibiting strong odours, brightly coloured materials, and former demolition materials.

Should previously undiscovered contamination be encountered during the demolition/construction of the new buildings the following course of action should be adhered to:

1. The ground workers should report any suspected contamination immediately to the Client's site supervisor. The supervisor should contact the Client or their appointed agent who will in turn contact Castledine & Co to request an engineer to visit the site to assess the extent of the 'contamination'.
2. Castledine & Co shall make records of their inspection, and pass details of these to the Local Authority.
3. Where the conditions revealed differ from those previously anticipated, Castledine & Co shall take samples as deemed appropriate to be dispatched for appropriate chemical testing.
4. Depending on the results of the testing either:
 - a. no further work will be required;
 - b. a further detailed risk assessment will be required; and/or
 - c. Localised specific remedial measures will be necessary.
Appraisal criteria will vary depending on the nature of the assessment.
5. The results of any such testing will be sent to the Local Authority Pollution Control Section, Local Authority development control section, and the appointed building inspector. If remediation is

required, the LA/Building inspector will be informed of the date and time of the proposed works.

6. Remediation will be undertaken in accordance with a method statement submitted for approval. The works shall be supervised where necessary by Castledine & Co who shall provide a Verification Report for the Local Authorities.
7. A copy of the discovery strategy (Appendix B) should be lodged on site and provisions made to ensure that all workers are made aware of their responsibility to observe, report and act on any potentially suspicious or contaminated materials they may encounter.

10.0 REPORTING

10.1 GAS PROTECTION

Reporting of the verification activities will be completed after inspection and will contain details of the verification activities undertaken. Details of the inspection results along with supporting documentation will be provided for each plot.

The verification report will summarise the extent to which the remedial methods have been achieved and supporting documentation to include site plans and membrane photographs.

11.0 REFERENCES**11.1 LEGISLATION AND REGULATIONS****11.1.1 ACTS**

- [1] Environmental Protection Act 1990, Part IIA: inserted by Environment Act 1995, Section 57. See Environment Act 1995 for text of Part IIA.

11.1.2 PLANNING REGULATIONS

- [2] The Town and Country Planning (Environmental Impact Assessment) (England and Wales) Regulations 1999 SI1999/No.293
- [3] The Town and Country Planning (Environmental Impact Assessment) (England and Wales) (Amendment) Regulations 2000 SI2000/No.2867

11.1.3 CONTAMINATED LAND REGULATIONS

- [4] The Contaminated Land (England) Regulations 2000. SI2000/No.227
- [5] The Contaminated Land (England) (Amendment) Regulations 2001 SI2001/No.663
- [6] The Contaminated Land (England) Regulations 2006 SI2006/No.1380

11.2 STATUTORY GUIDANCE

- [7] Department of Environment, Food and Rural Affairs. 2012. *Environmental Protection Act 1990: Part 2A Contaminated Land Statutory Guidance*. Department of Environment, Food and Rural Affairs
- [8] Communities and local Government, 2012: National Planning Policy Framework.

11.2.1 CL:AIRE

- [9] Card G, Wilson S, Mortimer S. 2012. *A Pragmatic Approach to Ground Gas Risk Assessment*. CL:AIRE Research Bulletin RB17. CL:AIRE, London, UK. ISSN 2047- 6450 (Online)

11.3 BRITISH STANDARDS

- [10] BS 5930:2015 Code of practice for site investigations
- [11] BS 10175:2011+A2:2017 Investigation of potentially contaminated sites - Code of practice
- [12] BS 8485:2015 +A1:2019 - Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings
- [13] BS 8576:2013 Guidance on investigations for ground gas. Permanent gases and Volatile Organic Compounds (VOCs)

11.4 NON STATUTORY TECHNICAL GUIDANCE**11.4.1 ENVIRONMENT AGENCY**

- [14] Cassella Stranger, 2002. Model Procedures for the Management of Contaminated Land, Contaminated Land Report (CLR) 11, Department for Environment, Food, and Rural Affairs.

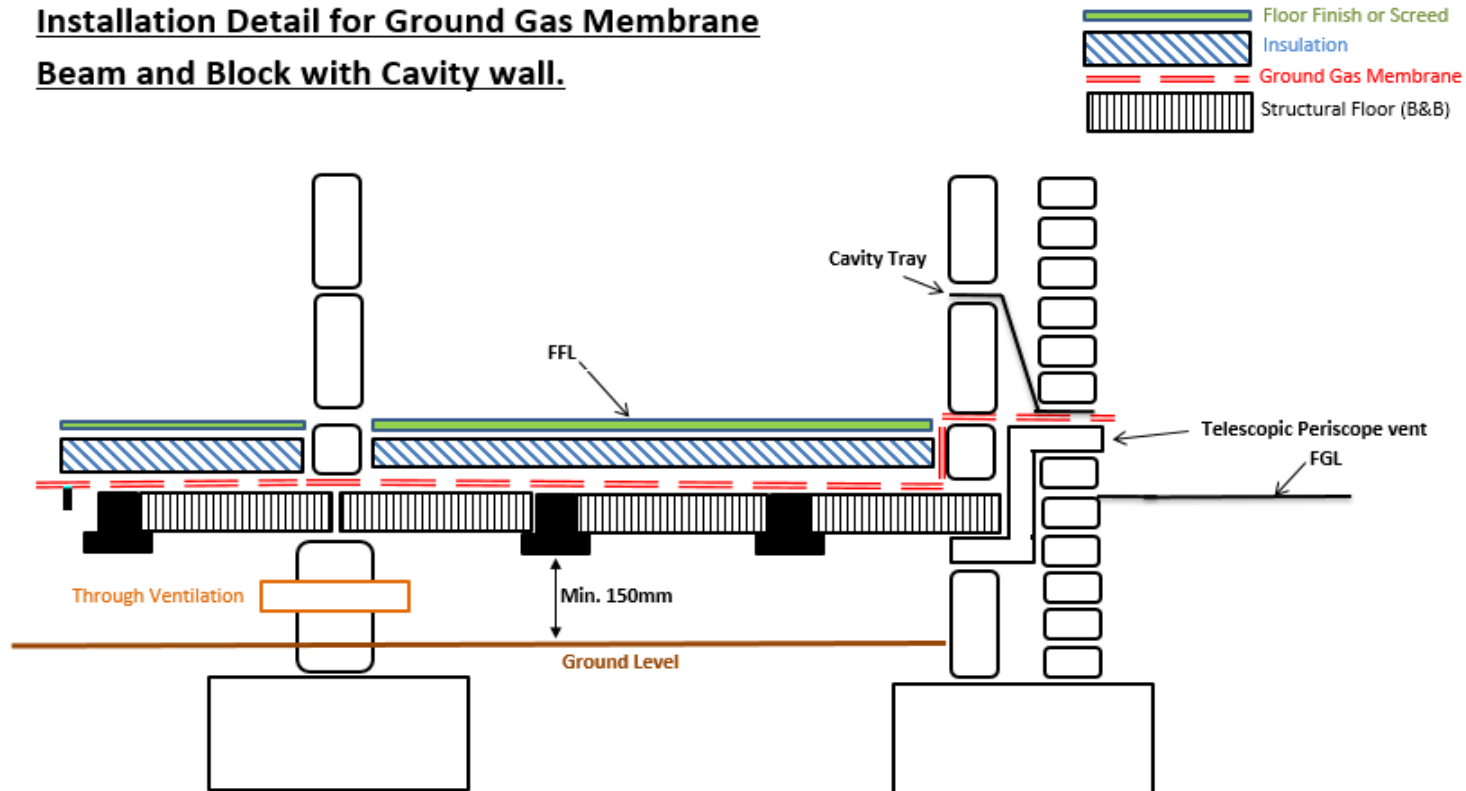
11.4.2 CIRIA PUBLICATIONS

- [15] Wilson, S., Oliver, S., Mallett, H., Hutchings, H., and Card, G.. 2007, *C 665 Assessing risks posed by hazardous ground gases to buildings* London: Construction Industry Research and Information Association
- [16] Mallett, H., Cox, L., Wilson, S. and ,Corban M... 2014, *C 735 Good practice on the testing and verification of protection systems for buildings against hazardous ground gases* London: Construction Industry Research and Information Association
- [17] Wilson, S., Sopp, G., Mallett, H., Happold, B., Card, C., CBCard & Partners...2020, *CIRIA C795 Retrofitting hazardous ground protection measures in existing or refurbished buildings*. London: Construction Industry Research and Information Association

12.0 APPENDICES

APPENDIX A GAS PROTECTION PLAN

**Installation Detail for Ground Gas Membrane
Beam and Block with Cavity wall.**



All structural detail to be confirmed by Architect

CASTLEDINE ENVIRONMENTAL
Beam and Block over 150mm Void Space
Drawing not to scale

APPENDIX B

DISCOVERY STRATEGY

