Environmental
Geotechnical
Specialists

GEOTECHNICAL
ENVIRONMENTAL

PHASE 3 REMEDIATION REPORT

job number C406/19/E/1734 – Rev 1	date 30/09/2020

site address
Pentlands,
New Mill Road,
Holmfirth,
HD9 7LN

written by M.Cook	checked by C.Mason
issued by M.Cook	

Rogers Geotechnical Services Ltd
Telephone 0843 50 666 87 Fax 0843 51 599 30
Email enquiries@rogersgeotech.co.uk
www.rogersgeotech.co.uk
Offices 1 & 2, Barncliffe Business Park, Near Bank, Shelley,
Huddersfield, West Yorkshire HD8 8LU.

Environmental Geotechnical Specialists

Contents

Environmental Geotechnical Specialists

Phase 3: Remediation Statement

Location:	Pentlands, New Mill Road, Holmfirth, HD9 7LN		
For:	Priestroyd Construction Limited		
Report No.	C406/19/E/1734 – Rev 1	Report date:	September 2020

For and on behalf of **Rogers Geotechnical Services Ltd**

Dr. Mike Cook BSc PhD
Environmental Engineer

Charlotte Mason BSc FGS
Geo-environmental Engineer

1. Introduction

Further to the site specific risk assessment provided within the geo-environmental report (C406/19/E/610, August 2020), it is considered that some remediation will be required at this site. This letter provides the strategy for that remediation.

In view of the site specific risk assessment it is considered that it will not be necessary to undertake any remediation at this site in relation to soil contamination. However, with respect to migration of bulk ground gasses, Characteristic Situation Level 2 has been adopted for the site, thus protection from bulk ground gasses (CO_2) will be required with respect to the intended end use (construction of a number of new residential properties).

In addition, careful inspection of the subgrade should be made during the groundworks. Should areas of contamination be detected then further testing may become necessary.

2. Remediation Strategy

2.1 Remediation Objectives

Based on the site specific risk assessment provided in the geo-environmental report and gas monitoring letter, the object of remediation at the site is as follows:

- To protect operatives and end users from accumulations of carbon dioxide.

2.2 Development Requirements.

The site is to be developed by construction of a number of new residential properties with associated garden areas and access roads.

3. Scope

In order to fulfill the objectives defined above the following remedial strategy will be utilised. A pragmatic approach will be undertaken, with observational techniques being employed at each stage of the work.

3.1 Groundworks

During the ground-works phase of the development, good building practice will be maintained. The risk to site operatives is considered under the Health and Safety at Work Act 1974, together with regulations made under the act, which includes the Control of Substances Hazardous to Health (COSHH) regulations. Therefore the risks to site personnel will be considered under the Construction Design and Management (CDM) regulations at the planning stage and be included in the contractor's Health and Safety Plan and site specific Method Statements. These documents shall include the following main elements.

- Site operatives at all levels shall be made aware of the hazards of working in an area where accumulations of bulk ground gasses (carbon dioxide) could occur.
- Site operatives at all levels should be made aware of the fundamental principles of identifying potentially contaminated soils and the hazards of working with such soils not identified by the ground investigation.
- Personal hygiene facilities, including washing and messing, will be provided and site operatives will be encouraged to use them.
- Where work is undertaken in dry weather the site will be dampened down to avoid dust.
- Dust masks will be provided to all site operatives for use at all times.
- Where vehicles are transferring soil to the landfill site they will be covered to prevent any potential contamination of the surrounding area by dust.
- Any stockpiles of soil on site will be sheeted over to prevent excessive amounts of airborne dust.
- Where work is undertaken in wet weather, vehicle and wheel washing facilities will be provided to ensure that the vehicles leaving the site do not transfer contamination to surrounding areas.

On completion of the ground-works a careful site inspection of the sub-grade will take place. Should visual or olfactory evidence of contamination be revealed, then suitably qualified specialists will be consulted. Further testing and updates to the site specific ground model, risk assessment, and remediation strategy will be undertaken where necessary.

3.2 Construction

During the construction phase of the project, clean inert granular sub-base shall be employed beneath buildings, pavements and hard-standings.

3.3 Gas Protection Measures

In order to assess the protection measures required BS8485: 2015: Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings has been employed. In accordance with Table 3, Building types, of the code, the development may be considered to conform to Type A. Therefore, on the basis of Table 4 Gas protection score by CS and type of building, the minimum gas protection score (points) is 3.5. The gas protection system should consist of at least two different elements. The elements work independently and collaboratively, and a single element should not be used because there would be no redundancy to allow for defects in the component.

In order to achieve this score the following shall be undertaken.

Table 1: Combination of protection elements (BS8485: 2015) for CS2

Reference	Protection Element	Score
Table 5	*Precast suspended segmental sub-floor (i.e. beam and block).*	0
Table 6	*Passive sub-floor dispersal layer: good performance (**Note 1**) (see Annex B of the Code for detail)* *Good Performance*	*1.5*
Table 7	*Gas resistant membrane complying with the requirements given in Table 7 (**Note 2**)*	2
	Total Score	**3.5**

Note 1:
Dispersal layers could include:

- Clear void.
- Polystyrene void former blanket.
- Geocomposite void former blanket.
- No-fines gravel layer with gas drains.
- No-fines gravel layer.

Whilst finalised plans of the foundation construction are not currently available, it is understood, based on communication with Priestroyd Construction Limited, that the dispersal layer will be linked to external air with vents.

Note 2:
Details of the membrane to be installed, as per communication with Priestroyd Construction Limited, are included within Appendix 1. In addition, it should be considered that the gas resistant membrane shall meet the following criteria (from Table 7, BS 8485: 2015):

- Sufficiently impervious (methane gas transmission rate <40.0ml/day/m^2/atm (average) BS ISO 15105-1 manometric method).
- Sufficiently durable and strong to remain serviceable for the anticipated life of the building, to withstand in-service stresses and installation process.
- Capable, after installation, of providing a complete barrier to the entry of the relevant gas.
- Verified in accordance with CIRIA C735: 2014: *Good practice on the testing and verification of protection systems of buildings against hazardous ground gasses.*
- Chemically resistant to degradation by other contamination that might be present.

It should be appreciated that if the membrane installed does not meet all the criteria above, then the score for the membrane is considered to be zero.

In addition to the above, the following points shall be noted.

- Technical drawings of the incorporation of the gas protection measures into the sub-structure will be provided by a suitably qualified engineer/architect and produced in accordance with the guidance given in BRE 414.
- The sequence of construction indicating when the gas protection system has been installed will be included with the verification report. Where possible the installation of membranes will take place as a unique activity on site and shall not take place until sub-structure construction is complete.
- During and following the installation of the membrane, all parties in attendance at the site shall be made aware that a gas protection system is to be employed within the construction. Such communications should include, but not be limited to, the CDM documentation for the site and site inductions.
- The installation of the membrane shall be carried out only by suitable personnel and the qualifications or experience/training will be included as part of the remediation statement. The suitability of personnel will be assessed in accordance with Annex 1 of CIRIA C735.
- The installation shall be in strict accordance with manufacturer specifications and recommendations, which shall also be included as part of the remediation statement.
- The membrane system employed will not be an ensemble (i.e. a system comprising a mixture of products from different manufacturers will not be employed).
- Membranes shall be supplied to site on a single wound roll, creased product will not be accepted or employed.
- Whilst membranes are exposed, signage will be provided to indicate the access to the installation area is prohibited unless authorised. Footwear will be checked prior to accessing the membrane surface to ensure no sharp objects are apparent, such as stones caught in treads. The use of sharp objects or hot-works around the exposed membrane will be strictly prohibited unless the risk of damaging the membrane has been full assessed and mitigated.
- Non-conformance of manufacturer recommendations shall be discussed and agreed as acceptable, in writing, with a suitably qualified person from the manufacturer.

3.4 Fill Materials

It is not anticipated that, any materials will be imported to be used as fill at the site. However, should any fill materials be imported, these will be subjected to the following assessment to determine its suitability.

Fill materials will be initially screened, by a suitably qualified engineer, for the following.

- It is a suitable growing medium where is to be employed as such, including compliance with BS3882 (2015)
- It is free from obvious contamination i.e. visual or olfactory evidence
- It has not come from areas where Japanese Knotweed or other invasive or injurious plants are suspected to be growing
- It is not a statutory nuisance, such as being odorous
- It is free from unsuitable material i.e. whole bricks, brick ties, timber or glass.

It should also be appreciated that any fill will be subjected to validation testing to assess its suitability. The following table has been taken from YALPAG[1] documentation and will be used in the first instance. Depending on the origin and nature of the material, not all fill will require the sampling frequency and testing indicated, although this will be in agreement with any regulatory bodies (such as the Local Authority).

Table 2: Validation sampling and testing

Fill Type	Frequency	Minimum Determinands
Virgin Quarried Material	1 or 2 depending on the type of stone (to confirm the inert nature of the material)	Standard metals/metalloids (As, Cd, Cr, Cr(VI), Cu, Hg, Ni, Pb, Se, Zn)
Crushed Hardcore, Stone, Brick	Minimum 1 per 1000m³	Standard metals/metalloids as above plus PAH (16 USEPA) and Asbestos
Greenfield/ Manufactured Soils	The greater of a minimum of 3 or 1 per 250m³	Standard metals/metalloids as above plus PAH (16 USEPA) and Asbestos
Brownfield/ Screened Soils	The greater of a minimum of 6 or 1 per 100m³	Standard metals/metalloids as above plus PAH (16 USEPA), TPH (CWG banded) and Asbestos Any additional analysis dependant on the history of the donor site.

[1] *YALPAG Technical Guidance for Developers, Landowners and Consultants – Verification Requirements for Cover Systems V3.3* Appendix 1a, October 2016.

Table 3: Fill Screening Values			
Contaminant	Screening Value (Residential with Plant Uptake) (mg/kg)		Reference
	1% SOM	6% SOM	
As	37	37	Atrisk^{SOIL} SSVs
Cd	22.1	22.1	Atrisk^{SOIL} SSVs
Cr(VI)	3.62	3.63	Atrisk^{SOIL} SSVs
Cu	4730	4790	Atrisk^{SOIL} SSVs
Hg	8.81	15.8	Atrisk^{SOIL} SSVs
Ni	136	136	Atrisk^{SOIL} SSVs
Pb	200	200	Atrisk^{SOIL} SSVs
V	136	138	Atrisk^{SOIL} SSVs
Zn	20000	20300	Atrisk^{SOIL} SSVs

The about screening values should be considered with respect to the Soil Organic Matter (SOM) of the subject material i.e. 1% SOM would be typical for granular fill and 6% SOM for topsoil. Testing will comply with UKAS and MCERTS, where applicable, and undertaken by an accredited laboratory.

Where the material has been derived from a commercial company, certificates or other industry quality protocol compliance i.e. WRAP shall be obtained. However, it will be necessary to ensure that this documentation is specifically related to the material being imported, is no more than two months old and complies with the screening and frequency requirements given above.

Suitable fill materials will either be placed immediately or sufficiently quarantined to prevent cross-contamination. If it is necessary, the quarantined material will be placed on appropriate sheeting and covered to prevent it becoming mixed with contaminated soils or dust, or penetrated by mobile contaminants.

4. Verification Report

In order to demonstrate that the remediation has been sufficiently carried out and risks highlighted in the conceptual ground model are mitigated, a verification report will be produced and submitted to any statutory authorities.

The report will be produced by a suitably qualified engineer or engineers and will include the following:

4.1 Ground Gas Protection System

In order to assess the performance of the ground gas protection, verification of the system will be carried out throughout the installation process and the following will be included in a report to be produced at the end of the construction process:

- The qualifications or relevant experience/training of the persons carrying out the installation.
- The independence of the person carrying out the verification, along with evidence of their qualifications or relevant experience/training.

- Details of the verification process.
- Signed statements to confirm that protection measures were constructed as agreed. These statements shall also include confirmation that:
    - Membranes were free from tears and punctures, and installed in accordance within manufacturer guidelines.
    - Underfloor voids were clear and free from debris.
- Clear photographic evidence of the construction of membranes and/or underfloor voids, which should include key details such as air vents, membrane penetrations etc.
- Details of non-conformances and how they were rectified.
- A declaration that remedial objectives set out in the conceptual site model have been achieved.

4.2 Fill Materials

Should fill materials be imported to site, characterisation of the suitability of the clean material including the derivation of the material, comments from a visual screen and the test results of chemical screening. Delivery tickets should also be included where appropriate and the conditions by which the clean material has been stored and handled on site.

We trust that this information is of interest, clearly Rogers Geotechnical Services Ltd would be happy to offer advice with respect to the above and assist where necessary.

Environmental
Geotechnical
Specialists

Appendix 1

Visqueen Membrane Datasheet

Technical support: +44 (0) 333 202 6800

Version: v1.0

Visqueen Gas Barrier

Features and benefits

- BBA certified - third party accreditation
- Complies with BS 8485:2015 + A1:2019 - industry standard for methane and carbon dioxide protection
- Flexible - easy to detail and install on site
- Multi functional - also acts as a radon and damp proof membrane
- Dual jointing methods - lap joints can be taped or heat welded

Product description

Visqueen Gas Barrier is a multi-layer reinforced polyethylene gas barrier with a 20 micron aluminium foil. The barrier is coloured blue on the upper surface and silver on the reverse. The product is supplied in single wound rolls (not folded), 2m x 50m.

Approvals and standards

- Third party accreditation (BBA 13/5069)
- Conforms to the specification requirements of BS 8485:2015 + A1:2019
- Suitable for all Characteristic Gas Situation (CS) ground gas regimes
- Conforms to the specification requirements of NHBC Amber 1 and Amber 2 applications
- Conforms to the specification requirements of BR 211:2015
- CE Mark EN 13967:2017
- Quality Management System ISO 9001:2015
- Occupational Health and Safety System ISO 18001:2007
- Environmental Management System ISO 14001:2015

Usage

Visqueen Gas Barrier is suitable for use in all types of buildings to prevent the ingress of harmful levels of ground gases e.g.methane, carbon dioxide and radon.

The barrier can be positioned above or below a solid concrete ground floor slab or above a precast suspended segmental ground floor system, e.g. beam and block floor.

The barrier can also be used as a high performance radon membrane and/or damp proof membrane.

The product is not intended for use where there is a risk of hydrostatic pressure.

System components

- VisqueenPro Double Sided Jointing Tape, 50mm x 10m
- Visqueen Gas Resistant Foil Lap Tape, 75mm x 50m
- Visqueen Ultimate GR Lap Tape, 150mm x 10m
- Visqueen Ultimate Top Hat Units
- Visqueen Preformed Units
- VisqueenPro Detailing Strip, 300mm x 10m, 500mm x 10m
- Visqueen TreadGUARD 300, 2m x 75m
- Visqueen TreadGUARD 1500, 1m x 2m

Find your local stockist

Heanor Gate Road, Heanor, Derbyshire, DE75 7RG
+44 (0) 333 202 6800 I enquiries@visqueen.com I www.visqueen.com

Technical support: +44 (0) 333 202 6800

Version: v1.0

Visqueen Gas Barrier

Storage and handling

Visqueen Gas Barrier should be stored horizontally, under cover in its original packaging.

Care should be taken when handling the product in line with current manual handling regulations.

Preparation

Visqueen Gas Barrier should be installed on a smooth continuous surface e.g. grouted beam and block floor, a compacted blinding layer e.g. 50mm thick sand blinding, or smooth concrete blinding. The substrate should be free from irregularities such as voids or protrusions.

The barrier can be cut with a sharp retractable safety knife or robust scissors.

Installation

Visqueen Gas Barrier should be loose laid on the substrate with the blue side up so as to avoid sunlight glare.

The barrier should be clean and dry at the time of jointing. It should be overlapped by at least 150mm, bonded with Visqueen Pro Double Sided Jointing Tape and sealed with Visqueen Foil Lap Tape. In demanding site conditions seal lap joints with Visqueen Ultimate GR Lap Tape.

Alternatively lap joints can be heat welded to achieve an effective seal. Welded lap joints can be less than 150mm provided the joint integrity is not compromised.

Airtight seals should be formed around all service entry points. Visqueen Preformed Top Hat Units should be used for sealing service entry pipes. The base of the top hat and the upstand should be bonded using Visqueen Pro Double Sided Jointing Tape and sealed with Visqueen Foil Lap Tape. The upstand should be secured with the supplied jubilee clip.

Forming an effective barrier to gases may give rise to complex three-dimensional detailing where, it is recommended Visqueen Preformed Units are used e.g. corners. Alternatively Visqueen Pro Detailing Strip can be used to seal awkward junctions.

If the barrier is punctured or perforated a patch of the same material should be lapped at least 150mm beyond the limits of the puncture and bonded with Visqueen Pro Double Sided Jointing Tape and sealed with Visqueen Foil Lap Tape. Alternatively a patch can be formed using Visqueen Pro Detailing Strip and lapped at least 150mm beyond the extents of the puncture.

The barrier should be covered by a protective layer as soon as possible after installation to prevent damage e.g. from following trades. Care should be taken to ensure that the membrane is not punctured, stretched or displaced when applying a screed or final floor covering. A minimum thickness of 50mm screed is recommended. When reinforced concrete is to be laid over the barrier the wire reinforcements and spacers must be prevented from puncturing the barrier. Where there is a high risk of potential damage, the barrier should be covered with Visqueen TreadGuard protection, screed, or other approved protection material before positioning the reinforcement.

Usable temperature range

It is recommended that Visqueen Gas Barrier and all associated system components should not be installed below 5°C.

Additional information

When used in accordance BS8485:2015 + A1:2019 a subfloor ventilation system or pressure relief maybe required
Where hydrocarbon or VOC contamination is present use Visqueen Ultimate VOC or HC Blok gas protection systems
To assist build sequencing, Visqueen GR DPC is available for gas protection through the wall constructions
For suspended beam and block floor detailing see GB-01
Visqueen Preformed Top Hat Units should be used at service pipe penetrations see GB-51
For internal and external corners Visqueen Ultimate Preformed Units should be used see PFU-553
To seal around steel columns use Visqueen Pro Detailing Strip see GB-52
For additional detailing information, contact Visqueen Technical Services +44 (0) 333 202 6800

Heanor Gate Road, Heanor, Derbyshire, DE75 7RG
+44 (0) 333 202 6800 I enquiries@visqueen.com I www.visqueen.com

Technical support: +44 (0) 333 202 6800

Version: v1.0

Visqueen Gas Barrier

Property	Test method	Units	Compliance criteria	Result
Dimensions	EN 1848-2	m		2 x 50
Overall thickness including scrim mesh	EN 1849-2	mm		0.66
Effective thickness in between scrim mesh	EN 9863-1	mm		0.4
Mass	EN 1849-2	g/m^2	-0%/+5%	400
Tensile strength - MD	EN 12311	N	MDV	391
Tensile strength - CD	EN 12311	N/mm^2	MDV	588
Tensile elongation - MD	EN 12311	%	MDV	20
Tensile elongation - CD	EN 12311	%	MDV	21
Joint strength	EN 12317-2	N	MLV	332
Watertightness 2kPa	EN 1928	-	Pass/Fail	Pass
Resistance to impact	EN 12691	mm	MLV	200
Dart impact	BS 2782	g	MDV	731
Low temperature flexibility	EN 495-5	°C	MDV	-40
Durability against ageing	EN 1296 and EN 1928	-	Pass/Fail	Pass
Durability chemical resistance	EN 1847	-	Pass/Fail	Pass
Resistance to tearing (nail shank) CD	EN 12310-1	N	MDV	358
Resistance to tearing (nail shank) MD	EN 12310-1	N	MDV	368
Resistance to static loading	EN 12730	kg	MLV	20
Water vapour transmission - resistance	EN 1931	MNs/g	MDV	7000
Water vapour transmission - permeability	EN 1931	g/m^2/d	MDV	0.03
Visible defects	EN 1850 -2	-	Pass/Fail	Pass
Reaction to fire	EN 13501-1	Class	MDV	F
BS 8485:2015 + A1:2019 testing requirements				
Mass	EN 1849-2	g/m^2	Average >370	400
Methane permeability	ISO 15105-1	mls/m^2/d/atm	Pass/Fail	<0.15
Puncture CBR	BS EN ISO 12236	N	MDV	1114
Impact resistance	EN 12691	mm	MDV	1000
Tensiles yield strength MD	ASTM D4885-01	kN/m	MDV	12.5
Tensiles yield strength CD	ASTM D4885-02	kN/m	MDV	7.3
Resistance to static loading	EN 12730	kg	>MLV	20
Yield elongation CD	ASTM D4885-04	%	MDV	19
Tear resistance - trouser method A - MD	BS ISO 34-1	kN/m	MDV	48.2
Tear resistance - trouser method A - CD	BS ISO 34-1	kN/m	MDV	44.8
Tear resistance - angle method B - MD	BS ISO 34-1	N	MDV	53.5
Tear resistance - angle method B - CD	BS ISO 34-1	N	MDV	60.6

Health and safety information

Refer to the Visqueen Gas Barrier material safety datasheet (MSDS).

Heanor Gate Road, Heanor, Derbyshire, DE75 7RG
+44 (0) 333 202 6800 I enquiries@visqueen.com I www.visqueen.com

Technical support: +44 (0) 333 202 6800

Version: v1.0

Visqueen Gas Barrier

About Visqueen

The Visqueen name has long been recognised as one of the leading manufacturers of high quality advanced membrane technologies and design based solutions by specifiers, distributors, builders merchants and contractors throughout the UK and Europe.

For further guidance on the Visqueen services shown below, please refer to the relevant section of the Visqueen website (www.visqueen.com) or contact Visqueen Technical Services on +44 (0) 333 202 6800 or enquiries@visqueen.com

Complete Range, Complete Solution

Structural Waterproofing | Gas Protection | Damp Proof Membrane | Tapes | Damp Proof Course | Stormwater | Vapour Control

Visqueen Technical Support

Visqueen combine an extensive product portfolio with industry leading levels of service and support which includes guidance over the phone, bespoke CAD drawings to help with complex detailing, electronic NBS specifications and access to a dedicated team of highly knowledgeable and experienced field based Technical Support Managers.

Visqueen Technical Support is available to all our customers including architects, specifiers, distributors, builders merchants, contractors and end users. All of our technical team have been awarded the industry recognised qualification Certificated Surveyor in Structural Waterproofing (CSSW).

Visqueen CPD Seminars

The Visqueen Continuing Professional Development (CPD) Seminars provide up-to-date information on changes within Building Regulations/Building Standards and nationally recognised industry guidance affecting damp proofing, water vapour control, hazardous ground gas protection and below ground structural waterproofing.

The one hour seminars have been produced for design specialists within the construction sector and are delivered by our team of Technical Support Managers.

Visqueen PI designs and special projects

From initial design to the completed project, Visqueen are with you every step of the way. Whether it be hazardous ground gas protection and/or below ground waterproofing protection employing barrier, structurally integral or drained systems, Visqueen can offer professional indemnity (PI) insurance for bespoke Visqueen design solutions.

Visqueen Technical Support Managers work with all stakeholders to provide cost effective Visqueen solutions offering complete peace of mind throughout the construction phase and beyond.

Visqueen Training Academy

Based at our manufacturing facility in Derbyshire, the Visqueen Training Academy is available to support Visqueen customers throughout the UK by providing a wide range of both theory and practical skills related training.

Courses include one day product awareness training for our distributors and builders merchants to help them in their day-to-day jobs, through to intensive three day courses giving detailed hands-on training in the practical skills required for safe and robust product installation.

Heanor Gate Road, Heanor, Derbyshire, DE75 7RG
+44 (0) 333 202 6800 I enquiries@visqueen.com I www.visqueen.com