OLD MAIN ROAD, FLEET HARGATE

GAS PROTECTION MEASURES VERIFICATION PLAN FOR BELMONT CONTRACTORS LTD

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Prepared for:
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This report has been prepared in accordance with GRM's Accredited Quality Procedures.

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1.0 INTRODUCTION

1.1 PREAMBLE

GRM Development Solutions Ltd (GRM) was instructed by Belmont Contractors Ltd to produce a Gas Protection Measures Verification Plan covering the development of Old Main Road, Fleet Hargate.

GRMs standard limitations of reporting are provided in Appendix A of this report.

The following reports have been used in the preparation of this document:

- GeoDyne, Old Main Road, Fleet, Hargate, Combined Phase I Desk Study and Phase II Exploratory Investigation, ref: D37124, dated October 2017.

- GeoDyne, Old Main Road, Fleet, Hargate, Ground Gas Report, ref: D37124/PK, dated September 2020.

The site is located approximately 15km to the east of Spalding town centre. The approximate grid reference for the centre of the site is TF 39514 25059. The site occupies an area of around 0.44ha.

1.2 PROPOSED DEVELOPMENT

The development layout provided by the Client, on which this report is based, is presented in Appendix B.

1.3 OBJECTIVES OF THIS ASSESSMENT

The principal aims of the Gas Protection Measures Verification Plan are as follows:

a) Report the existing information relating to the ground gas regime within the area of the site.

b) 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.

Whilst every effort has been made to pre-empt the likely requirements of the Local Authority, they may have specific requirements that will need to be discussed and addressed at a later date.

2.0 SUMMARY OF GROUND GAS RISK ASSESSMENT

2.1 PHASE I REPORT

The following is a summary of information presented in the GeoDyne Phase I and Phase II Exploratory Investigation Report.

- The Site has remained as undeveloped agricultural land since the earliest map reviewed (1880s).
- Historically a pond was situated on the northern boundary, which was not recorded after the 1970s. The pond was presumed to have been backfilled and therefore a potential source of ground gas.
- Superficial geology comprises Terrington Beds (sandy silt, sand and clay) overlying the Barrowby Drove Beds (soft clays with organic material), which form part of the Fenland Formation.
- Solid geology comprises the Ampthill Clay Formation (mudstone).
- There are no current or historic landfill sites within 250m of the site boundary.
- The site is not within an area where radon protection measures are required.

2.2 PHASE II REPORT

The following is a summary of information identified by GeoDyne during Phase II works and supplementary ground gas investigation.

2.2.1 Made Ground

Made Ground was encountered in two locations at the northern end of the site where a pond was previously situated. The depth of made ground was recorded to be between 1.55m and 1.95m and comprised loose to medium dense silty sand and soft to firm very sandy silt. An organic layer including black leaves was recorded at the base of the made ground.

2.2.2 Topsoil

Topsoil was encountered at the surface of all exploratory holes with the exception of the two locations in the former pond, it was recorded to depths of between 0.20m and 0.60m below existing ground level (begl) with an average thickness of approximately 0.40m.

2.2.3 Natural Geology

Superficial Deposits

Natural Strata was recorded beneath the made ground and topsoil initially as a sandy silt or clay, becoming a silty organic sand to depths of between 9.3m and 12.7m begl.

The sand was underlain by firm and stiff gravelly clay or sandy gravel which were considered to be representative of the Fenland Formation.

Solid Geology
Cable percussion boreholes recorded stiff sandy gravelly clay to depths of 17m begl, which was considered to be representative of the Ampthill Clay Formation.

2.2.4 Ground Gas

Gas monitoring was undertaken across two separate investigations: three visits in 2017 during the initial Phase II work and three visits in 2020 during the additional Ground Gas Investigation. The third visit on both investigations recorded falling pressure during the monitoring period.

Concentrations of methane ranging between 0%v/v and 2%v/v and carbon dioxide ranging between 1.6%v/v and 11.2%v/v were recorded.

No flow above the instrument's lower limit of detection was recorded during the monitoring.

2.3 GROUND GAS RISK ASSESSMENT

2.3.1 Sources of Ground Gas

Ground gas sources were limited to the infilled pond located at the northern boundary.

2.3.2 Risk Assessment

Based on the information presented by GeoDyne the hazardous flow rates (Qhg) for methane and carbon dioxide have been calculated based upon the maximum gas concentrations recorded and default flow rate of 0.1l/hr, as follows:

- Methane ($QhgCH_4$) – 0.002l/hr.
- Carbon dioxide ($QhgCO_2$) – 0.0112l/hr.

Based on the above, and assuming a worst case scenario, the GSV for the site is 0.0112l/hr l/hr.

Therefore, as the maximum concentration of methane is >1%v/v, the maximum concentration of carbon dioxide is >5%, but the GSV is <0.07l/hr, the site has been assessed by GeoDyne as 'Characteristic Situation 2' as outlined in BS8485:2015+A1:2019, for which gas protection measures are required.

Accordingly, the site has been assessed by GeoDyne as Characteristic Situation 2 for which gas protection measures are required.

3.0 GAS PROTECTION MEASURES

As discussed in Section 2, GeoDyne have advised that 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'.

3.1 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 will comprise Type A buildings (private residential buildings.

In accordance with Table 3 of BS8485:2015+A1:2019, it is considered that the gas protection score for this building type is:

- **CS2 Type A** building = **3.5 points**.

3.2 DETERMINATION OF PROTECTION MEASURES

A combination of two or more of the following protection measures should be used to achieve the Gas Protection Score.

- Structural barrier (floor slab).
- Ventilation measures.
- Gas resistant membrane.

3.2.1 Floor Slab

For the proposed residential buildings, the floor slab will comprise a suspended beam and block floor. Based on Table 5 of BS8485:2015+A1:2019, this will achieve a gas protection score of **0 points**.

3.2.2 Ventilation Measures

For the proposed development, it is intended to include a minimum 150mm deep ventilated sub-floor void, with ventilation provided via telescopic vents air vents around the perimeter of each property. The number of vents is to be confirmed but will meet or exceed the building regulations requirements of 1,500mm²/m run of wall. 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**. The design provided to GRM is presented in Appendix C.

3.2.3 Gas Resistant Membrane

A low permeability methane and carbon dioxide resistant membrane which meets all of the requirements of Table 7 of BS8485:2015+A1:2019 (reproduced below) will achieve a score of **2 points**.

GRM have been informed that a Juta GP1 membrane combined with GP1 Self Adhesive Membrane (SAM) will be used for the proposed development. The specification sheet for the JUTA GP1 membrane is presented in Appendix D.

The timber frame design will include double sided butyl tape under the soleplates and a welded joint to join laps around doorways, services, and corners. A hood will also be installed around the airbricks to create a continuous seal.

Table 7 — *Gas protection score for the gas resistant membrane*

Protection element/system	Score	Comments
Gas resistant membrane meeting all of the following criteria: • sufficiently impervious 〈A1〉, both in the sheet material [A] and in the sealing of sheets and sealing around sheet penetrations, to prevent any significant passage of methane and/or carbon dioxide through the membrane; 〈A1〉 • sufficiently durable to remain serviceable for the anticipated life of the building and duration of gas emissions; • 〈A1〉 *Text deleted* 〈A1〉 • sufficiently strong 〈A1〉 [B] 〈A1〉 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); 〈A1〉 and to withstand in-service stresses (e.g. settlement if placed below a floor slab); 〈A1〉 • capable, after installation, of providing a complete barrier to the entry of the relevant gas; and • verified in accordance with CIRIA C735 [N1].	2	The performance of membranes is heavily dependent on the quality and design of the installation, resistance to damage after installation and integrity of joints. 〈A1〉 *Text deleted* 〈A1〉 If a membrane is installed that does not meet all the criteria in column 1 then the score is zero.

[A] 〈A1〉 A membrane with a methane gas transmission rate <40.0 ml/day/m²/atm (average) for sheets and joints (tested in accordance with BS ISO 15105-1:2007 manometric method) is regarded as sufficiently impervious.

[B] For example, reinforced LDPE (virgin polymer) membranes having a minimum mass per unit area of 370 g/m² and not significantly less than 0.4 mm thickness between the reinforcement scrim (tested in accordance with Procedure D (2 mm diameter tip) of BS EN ISO 9863-1:2016) installed above floor slabs are considered sufficiently strong to meet the performance criteria (see also **C.3**). Thicker and more robust membranes or an additional membrane protection layer should be installed directly beneath cast-in-situ floor slabs. 〈A1〉

3.2.4 Gas Protection Score Summary

By implementing the above measures, the Gas Protection Score would be as follows:

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

4.0 VERIFICATION PLAN

In order to achieve the acceptance of the warranting bodies a validation process for the installation of the gas membranes is required.

For sites that are assessed as compliant with **Characteristic Situation 2** conditions gas resistant membranes can be installed by a general builder or ground worker with no relevant qualification, although the verification requirements are typically more stringent. Alternatively, membranes can be installed by a suitably qualified installer, the workmanship typically being better quality and thus the requirement for verification can be less (assuming initial indications report an acceptable standard of work).

On this basis, two options for verification are considered suitable:

Option 1: General Builder/Ground Worker

Installer	Verification requirements
General Builder/Ground Worker with No relevant Qualification	Independent verifier to conduct thorough visual inspection of **all** the plots **prior to placement of the insulation and floor screed**.

Option 2: Qualified Installer

Installer	Verification requirements
Qualified to NVQ Level 2 Diploma in Substructure Work Occupations – Installation of Gas Membranes	Independent verifier to conduct thorough visual inspection and integrity testing prior to placement of the insulation and floor screed. · Visual inspections should be carried out for the first plot. If the standard of installation is acceptable the inspection requirement can be reduced to 1 in 4 (minimum of 2 other plots). Specialist/qualified installer to supply sign-off sheets and photographs to independent verifier preferably **prior to floor screeding for submission to regulators**.

GRM have been informed that the membrane will be installed by the builder (not qualified to NVQ Level 2), and therefore independent verification will be required for all plots.

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 additional testing (Air Lancing and / or Tracer Gas may be required. Accordingly, thorough record keeping, including comprehensive photographic evidence, is recommended.

5.0 REPORTING

Reporting of the verification activities will be covered in a single verification report submitted when the installation of the gas protection measures is complete on all of the relevant plots.

The completion verification report will summarise the extent to which the remedial methods have been achieved, supporting documentation to include site plans and membrane photographs, details of the qualified installer who will also provide sign-off sheets and photographs to support the verification report by the independent consultant.

IT SHOULD BE NOTED THAT IF THE INSTALLER FAILS TO PROVIDE SUFFICIENT EVIDENCE AS TO THE QUALITY OF THE MEMBRANES THAT HAVE NOT BEEN INDEPENDENTLY VERIFIED, DELAYS TO THE COMPLETION PROCESS AND ADDITIONAL COSTS MAY BE INCURRED.

APPENDIX A

GENERAL APPRAISAL COMMENTS

i INFORMATION SOURCES

Where available the following sources have been used for the identification and assessment of potential ground hazards:

- Relevant British Standards
- British Geological Survey (BGS) Geology Map Scale 1:10,000 for local area
- British Geological Survey (BGS) Geology Map Scale 1:50,000/1:63,320
- BGS Memoir
- BGS Borehole Records: https://mapapps2.bgs.ac.uk/geoindex/home.html
- BGS online viewer: https://geologyviewer.bgs.ac.uk
- Magic Groundwater Vulnerability Maps
- Historical Ordnance Survey (OS) Maps
- Environmental Data Report
- Environment Agency Website: http://www.environment-agency.gov.uk/
- Guidance for the Selection of Water Supply Pipes to be used in Brownfield Sites, UKWIR, 2010.
- Coal Authority Records / Coal Mining Report
- DEFRA/Environment Agency Contaminated Land publications and DoE Industry Profiles
- BRE Guide BR211 (2023), 'Radon: Guidance on protective measures for new buildings (including supplementary advice for extensions, conversions and refurbishment projects)'
- UK HAS Radon Maps: https://www.ukradon.org/information/ukmaps
- CIRIA C665 'Assessing risks posed by hazardous ground gases to buildings'
- BS8485:2015 +A1: 2019, 'Code of Practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings'
- Other technical references used throughout this document are detailed in the text.

ii CONTAMINANTS OF CONCERN

The DoE Industry Profiles are normally used to assess likely contaminants from past land use and potential nearby industrial sources. For land uses where no profile is available, likely contaminants of concern are selected by GRM based on past experience of similar sites, a general screening suite of contaminants covered by CLEA and common contaminants from the Industry Profiles.

- Arsenic
- Cadmium
- Chromium
- Lead
- Mercury
- Selenium
- Copper
- Nickel
- Zinc
- Phenols
- cyanide (total)
- pH
- Water soluble sulphate
- PAH (polycyclic aromatic hydrocarbons)

Asbestos and PCBs are listed in the vast majority of profiles. PCBs are listed as the profiles expect electricity substations and switch boxes on all industrial sites. There is the potential for asbestos containing material to be mixed up with made ground, following any demolition works.

iii CONCEPTUAL MODEL METHODOLOGY

The consideration of contamination is based upon the principles of risk assessment, using the 'source-pathway-receptor' model in order to establish the presence, or potential presence, of a pollutant linkage.

To create a risk, contamination must have the potential to cause harm to susceptible targets or receptors such as humans, the water environment or the built environment. The potential for harm to occur requires three conditions to be satisfied to form a pollutant linkage:

- The presence of substances that may cause harm (SOURCE).
- The presence of a target which may be harmed (RECEPTOR).
- The existence of a plausible migration route between the source and the receptor (PATHWAY).

In the absence of a plausible pollutant linkage there is no risk. Where a potential linkage is identified in order for it not to pose a risk to the identified receptor it must be broken.

iv INTRUSIVE INVESTIGATION SAMPLING METHODOLOGY

The ground investigation (including fieldwork, sampling, monitoring and laboratory analyses) has been designed to identify and assess potential ground related problems and to allow cost effective solutions to be advised. It has been planned on the basis of the desk study, site inspection and the proposed development layout (where available). All fieldwork and soil descriptions were carried out in general accordance with relevant British Standards.

The exploratory holes have been positioned and advanced to depths to determine the general ground/groundwater/gas conditions below the site. A general grid pattern has been adopted, where possible, to provide sufficient information based on the current proposed layout scheme. Some holes have been targeted at particular hazards identified in the Phase I assessment. The resultant exploratory hole density is considered to be commensurate with the complexity of the site conditions and detail of information required for this phase of the investigation.

v GROUND GAS RISK ASSESSMENT METHODOLOGY

Gas monitoring programmes undertaken by GRM are designed to broadly comply with the recommendations outlined in CIRIA Report C665 'Assessing risks posed by hazardous ground gas to buildings' (2007) and BS8576 'Guidance on Investigations for ground gas – Permanent gases and Volatile Organic Compounds (VOCs) (2013).

To assess the risks posed by ground gases such as radon, carbon dioxide and methane, the relevant current guidance has been used. For radon the site has been assessed following the guidelines in 'Radon: guidance on protective measures for new dwellings (including supplementary advice for extensions, conversions and refurbishment projects) (BR211: 2023)'. For methane and carbon dioxide the primary guidance document used to determine if protection measures are required is *BS8485:2015 Code of practice for the design of protective measures from methane and carbon dioxide ground gases for new buildings*. This uses hazardous gas flow rates (Q_{hg}), which are gas concentrations multiplied by borehole flow rates, to derive a Gas Flow Rate (GSV) for the site. The gas regime is then determined based on the GSV and other limiting factors such as gas concentrations.

Where flow is not recorded during the monitoring a default flow rate of 0.1l/hr will be used in the assessment to produce a positive result.

vi HUMAN HEALTH RISK ASSESSMENT METHODOLOGY

Guidance contained in the Environment Agency's CLEA Reports has been used to assess the risks posed to human health.

For residential developments that include domestic gardens the default Tier 1 Assessment Criteria (TAC) for 'residential land with plant uptake' are used, i.e. a female with a start age class of one and an end age class of six. All pathways are considered including the consumption of home-grown vegetables.

For residential developments that do not include domestic gardens the default Tier 1 Assessment Criteria (TAC) for 'residential land without plant uptake' are used, i.e. a female with a start age class of one and an end age class of six. All pathways are considered except the consumption of home-grown vegetables. For commercial/industrial developments the default Tier 1 Assessment Criteria (TAC) for 'commercial/industrial' are used, i.e. a female with a start age class of sixteen and an end age class of eighteen. All pathways are considered except the consumption of home-grown vegetables.

The TAC used by GRM include Category 4 Screening Levels (C4SLs) published by DEFRA, values calculated by GRM using the CLEA v1.071 risk assessment, and values and Suitable for Use Levels (S4UL) developed by LQM/CIEH. The TAC used in the assessment are selected based on the lowest site specific SOM values returned as part of the chemical analysis.

Where soil chemical analysis results are found to exceed the TAC, Site-Specific Risk Assessments may be undertaken using the CLEA v1.071 risk assessment software using the age classes and pathways described above.

vii RISK TO SITE WORKERS – GENERAL COMMENTS

The risks to site workers are similar to those posed to site end users, although likely to be less severe due to the site workers' shorter exposure to the identified contamination. However, site workers (particularly groundworkers) are more likely to come into direct contact with contaminated soils due to the nature of their work. On this basis ground and construction workers should be provided with basic Personal Protective Equipment based on the site's general health and safety risk assessment, but including as a minimum safety footwear, gloves and overalls.

A site specific risk assessment should be carried out for all hazards identified within the ground investigation in accordance with current health and safety legislation. This assessment should identify any measures required to further reduce risks i.e. providing further Personal Protective Equipment, welfare facilities and if necessary preventing access to certain areas.

Demolition and dismantling of existing structures on the site must be carried out to a safe and acceptable standard, in accordance with current UK guidance and best practice. Whilst not ground related, asbestos and hazardous substances surveys should be conducted prior to any demolition.

Any unusual colours, odours and suspicious ground should be reported immediately to site management and then GRM.

Whilst this appraisal has considered the long-term effects of contamination, GRM can also help during the formulation of Health and Safety documentation, if required.

viii CONTROLLED WATERS RISK ASSESSMENT METHODOLOGY

Where the desk study and fieldwork do not reveal a potential source of contamination no leachate or groundwater testing will be performed. Where a potential source is identified the testing will comprise leachate testing on the material considered most likely to pose a risk, groundwater testing will be undertaken if water is present at shallow depth.

The UK Drinking Water Standards (UKDWS) or Environmental Quality Standards (EQS) are usually adopted for comparison with the leachate/groundwater test results. When the most sensitive receptor is considered to be the aquifer (groundwater) UKDWS will be adopted as the Initial Tier 1 screening values.

Where the most sensitive receptor is a surface water feature the EQS values will be used as Initial Tier I Screening values.

ix CONSTRUCTION MATERIALS RISK ASSESSMENT METHODOLOGY

The 'screening levels' adopted for the assessment of risk to construction materials are taken from the following documents:

- UK Water Industry Research (UKWIR) Contamination thresholds for sub-surface water pipes, for the protection of buried pipes.
- Building Research Establishment (BRE) Special Digest SD1 (2005), 'Concrete in Aggressive Ground', for the protection of buried concrete.

x WASTE DISPOSAL, SITE WASTE MANAGEMENT PLANS AND MATERIAL MANAGEMENT PLANS

Under current Waste Management Regulations, waste soil materials produced from the site will require characterisation to enable it to be disposed of correctly.

The chemical analysis results included in this report should be provided to the relevant landfill operators to establish the characterisation of the waste, confirm its suitability for landfill disposal and provide estimated costings. If material is classified as hazardous, then the site will need to be registered with the Environment Agency prior to the movement of the waste. Depending on the receiving landfill's current permit, further chemical analysis, incorporating Waste Acceptance Criteria (WAC) leachate analysis, may be required.

All materials removed from the site will be classified as 'waste' and therefore must be removed by a suitably licensed carrier of waste. This applies whether or not the waste is contaminated. All waste removed to landfill will attract Landfill Tax.

The developer/builder is likely to be classed as the waste producer and therefore, has a duty of care to ensure that all waste is disposed of appropriately. This includes ensuring the waste carrier is licensed and disposes of the waste to a suitably licensed landfill site. They are also required to keep a paper trail from 'cradle to grave' including copies of the waste disposal tickets.

Efficient materials management on site is recommended as it can lead to significant cost savings when compared to the traditional side casting or single stockpile of arisings. GRM can assist in the production of Material Management Plans under the CL:AIRE Definition of Waste: Code of Practice. The DoWCoP enables:

- The direct transfer and re-use of clean naturally occurring soil materials between sites, and
- The re-use of both contaminated and uncontaminated materials on their site of origin and between sites within defined Cluster projects.

GRM can also undertake the role of Qualified Person and submit the DoW CoP project Declaration.

Likewise making the site as volume neutral as possible will reduce the costs of development. Whilst not a statutory requirement, Site Waste Management Plans allow better waste management practices, help to reduce the amount of waste produced and identify best environmental disposal options. Implementing a Site Waste Management Plan (SWMP) can reduce costs (increasing business profits) and maximise resource efficiency.

xi GEOTECHNICAL ASSESSMENT GENERAL COMMENTS

Where finished floor levels of proposed structures have not been provided by the Client, then for the purposes of initial assessment, GRM will assume that finished levels will not vary appreciably from the existing ground levels. If the depths of any underground engineering works (i.e. sewers, pumping stations etc.) are unknown they will not be taken in to account in the assessment and it will be assumed that any such works will not compromise foundation or ground stability.

Should the development proposals or finished levels be different from these assumptions then the comments/recommendations in the Geotechnical Assessment may require revising.

It should be noted that the results of window sampling and/or cable percussive boreholes may not give a true indication of a soils actual engineering properties (i.e. stability, mass structure etc). GRM consider that that prior to development trial pitting should be undertaken to confirm the recommendations in the Geotechnical Assessment.

xii GEOTECHNICAL ASSESSMENT – ENGINEERING GROUND TREATMENT

Near surface soils have the potential to be disturbed by weathering and site traffic. Precautions should always be taken to avoid this, as excessive disturbance may leads to more onerous floor slab designs, road cap thickness and increased amounts of off-site disposal etc.

Near surface soils may need treatment or reinforcing to allow safe movement of construction plant and labour. An assessment by the contractor should be undertaken once the type of machinery/plant needed to complete the development is known.

xiii GEOTECHNICAL ASSESSMENT – EXCAVATIONS

Excavation instability (over-break) can result in damage to existing services or structures (e.g. foundations, roads or boundary walls/fences) both on and off-site, as well as increased foundation concrete costs. In order to minimise this, all excavations deeper than 1.2m deep (or any excavation within 1.5m of any existing structure or service) should be supported. Full support should be provided to the full depth of all near vertically sided excavations in made ground, soft and very soft clays and granular soils. A reduction to intermediate support should be acceptable within firm and stiffer natural clays.

Wherever possible, man entry into excavations should be prevented; however, where this is not possible, entry to, and time spent in, excavations should be kept to a minimum.

The build program should be tailored to reflect the impact that deep excavations through potentially unstable strata can have on adjacent properties, so that they are not undermined.

All excavations on site should be in accordance with HSE guidelines and stability should be practically maintained at all times. Reference should be made to HSE construction information sheet No. 8 (Revision 1) 'Safety in Excavations'.

Care should be taken to ensure that falls from excavation faces do not adversely affect the integrity of foundation concrete.

If contaminated water enters excavations it should be removed and transported to an appropriate treatment facility by a suitably licensed carrier before construction begins.

xiv GEOTECHNICAL ASSESSMENT – SUBSTRUCTURES

Where practicable, existing buried construction should be fully removed; however, if this is not practicable all new foundations should be carried down to fully penetrate it and it should be broken well away from all new structures.

There may be existing structures and/or infrastructure in close proximity to the proposed development. New build foundations may be constructed next to pavements with existing underground services beneath them, or excavations may be required near existing footings associated with adjacent properties. These potential hazards need to be taken into consideration when designing foundations and the groundworker needs to be made aware of their potential impact during the redevelopment works. Foundations close to existing underground services or buildings may require alternative foundation techniques (such as piling) to protect the integrity of these structures.

The contractor for the works should carry them out in such a fashion so as to not cause excessive overbreak, concrete usage or undermine existing buildings/roads/ services that are to be retained.

xv GEOTECHNICAL ASSESSMENT – SOAKAWAYS

Soakaway testing in trial pits by GRM is broadly carried out in accordance with BRE DG 365 (2016). The testing comprises the excavation of a test pit to a suitable depth, and the placement of water into the pit. The level of water present is then monitored over time. For borehole installations, the permeability testing (falling head/rising head) is undertaken in accordance with BS5930.

If it is decided to proceed with the use of soakaway drainage, then the following general points should be noted:

- Soakaways should not be placed so that water can be discharged through potentially contaminated made ground.
- The Environment Agency may require soakaways to be sealed systems such that only roof run off falls to soakaway.
- Interceptors are likely to be required for soakaways for highway drainage. The adopting authority for the highways should be consulted at the earliest opportunity regarding the use of soakaways for highways drainage.
- Consideration of site levels and slopes should be taken into account during the design.
- The construction of all soakaways should be in accordance with the current building regulations.
- Soakaways should not be placed within 5m of a proposed building.
- Placement of soakaways needs to be considered so as to avoid ponding of water down slope.
- The base of a soakaway should not be below the highest recorded water level.
- The Environment Agency prefer 1m of dry soil to be present between the base of a soakaway and the water table to provide attenuation for contamination.

xvi GEOTECHNICAL ASSESSMENT – FOUNDATIONS

If soft or hard spots are encountered during foundation excavation then they should be replaced with suitably compacted material or the footings deepened to suitable strata, to avoid differential settlement.

If strata of differing bearing character (e.g. sand and clay) are encountered at foundation levels within the excavations for a single plot then the excavation depths should be altered as appropriate to ensure the foundations rest on a single stratum, or strata that will not induce differential settlement. Where this is impractical then GRM should be contacted to assess a reinforced concrete detail or an alternative foundation solution (e.g. piles or vibro-replacement).

NOTES ON LIMITATIONS

General

GRM Development Solutions Limited has prepared this report solely for the use of the Client and those parties with whom a warranty agreement had been executed, or with whom an assignment had been agreed. Should any third party wish to use or rely upon the contents of the report, written approval must be sought from GRM Development Solutions Limited; a charge may be levied against such approval.

GRM Development Solutions Limited accepts no responsibility or liability for:

a) the consequences of this document being used for any purpose or project other than for which it was commissioned, and

b) the consequences of this document being used by any third party with whom an agreement has not been executed.

Phase I Environmental Audits/ Desk Studies

The work undertaken to provide the basis of this report comprised a study of available documented information from a variety of sources (including the Client), together with (where appropriate) a brief walk over inspection of the site and meetings and discussions with relevant authorities and other interested parties. The opinions given in this report have been dictated by the finite data on which they are based and are relevant only to the purpose for which the report was commissioned. The information reviewed should not be considered exhaustive and has been accepted in good faith as providing true and representative data pertaining to site conditions. Should additional information become available which may affect the opinions expressed in this report, GRM Development Solutions Limited reserves the right to review such information and as considered necessary and appropriate to modify the opinions accordingly. It should be noted that any risks identified in a Phase 1 report are perceived risks based on the information reviewed; actual risks can only be assessed following a physical investigation of the site.

Phase II Environmental Audits (Contamination Investigations)

The investigation of the site has been carried out to provide sufficient information concerning the type and degree of contamination, ground and groundwater conditions to allow a reasonable risk assessment to be made. The objectives of the investigation have been limited to establishing the risks associated with potential human targets, building materials, and controlled waters.

The amount of exploratory work and chemical testing undertaken has necessarily been restricted by the short timescale available, and the locations of exploratory holes have been restricted to the areas unoccupied by the building(s) on the site and by buried services. A more comprehensive investigation may be required if the site is to be redeveloped as, in addition to risk assessment, a number of important engineering and environmental issues need to be resolved.

For these reasons if costs have been included in relation to site remediation these must be considered as provisional only and must, in any event, be confirmed by a commercial adviser.

The exploratory holes undertaken, which investigate only a small volume of the ground in relation to the size of the site, can only provide a general indication of site conditions. Whilst exploratory testing is intended to gain an accurate representation of the site, the very nature of sampling and testing is such that it cannot ensure that all localised conditions are detected

The risk assessment and opinions provided take in to consideration, inter alia, currently available guidance relating to acceptable contamination concentrations; no liability can be accepted for the retrospective effects of any future changes or amendments to these values.

Phase II Geo-environmental Investigations (Combined Geotechnical and Contamination Investigations)

The investigation of the site has been carried out to provide sufficient information concerning the type and degree of contamination, geotechnical characteristics, and ground and groundwater conditions to provide a reasonable assessment of the environment risks together with engineering and development implications. If costs have been included in relation to site development a commercial adviser must confirm these.

The exploratory holes undertaken, which investigate only a small volume of the ground in relation to the size of the site, can only provide a general indication of site conditions. The opinions provided and recommendations given in this report are based on the ground conditions apparent at the site for each of the exploratory holes. There may be exceptional ground conditions elsewhere on the site which have not been disclosed by this investigation and which have therefore not been taken into account in this report.

The comments made on groundwater conditions are based on observations made at the time the site work was conducted. It should be noted that groundwater levels will vary owing to seasonal, tidal and weather related effects.

The scope of the investigation was selected on the basis of the specific development proposed by the Client and may be inappropriate to another form of development or scheme.

The risk assessment and opinions provided take in to consideration, inter alia, currently available guidance relating to acceptable contamination concentrations; no liability can be accepted for the retrospective effects of any future changes or amendments to these values.

APPENDIX B

STUDIO 11 architecture

Do not scale directly from this drawing. All discrepancies are to be brought to the attention of the below office.

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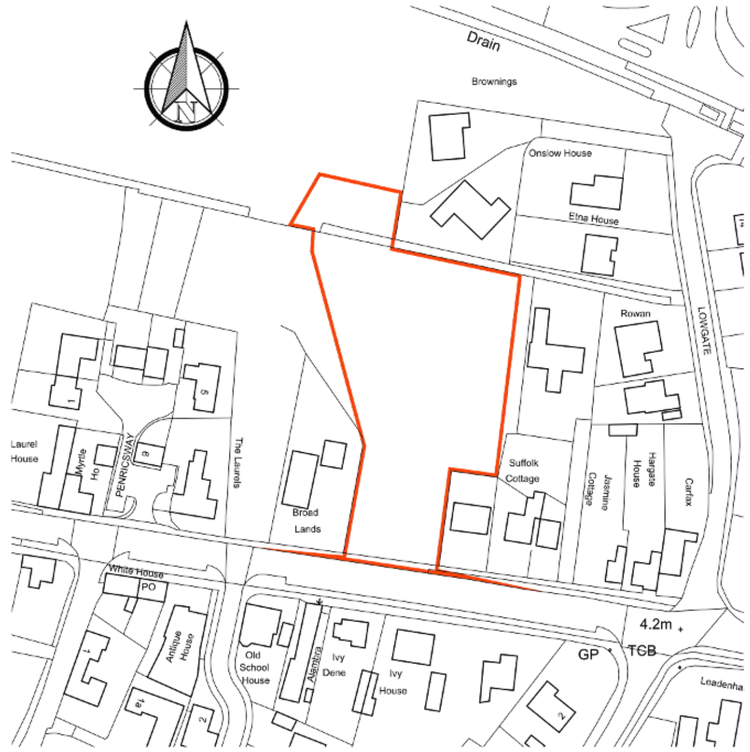
Housetype Schedule

3 Bedroom House			
The Hylton	820ft²	Plots 2, 3, 6, 7	4
The Lancaster	934ft²	Plots 4, 9	2
			6
4 Bedroom House			
The Lincoln	1068ft²	Plots 1	1
The Colchester	1376ft²	Plot 5, 8	2
			3
			Total 9

Gross Site Area 0.44 hectares (1.09acres)



Site Layout 1:500



Location Plan 1:1250

Landscaping Key

	Existing Tree		Proposed shrub planting		1.8m Garden Wall
	Proposed Tree		Exiting Hedge/Landscaping to be Removed.		1.8m Close Board Fence
	Existing Hedge/ Landscaping to be Retained		1.8m Panel Fence between plots		Timber Deck & Steps

Chartered Institute of Architectural Technologists

Measurement Bar - When printed correctly this line measures 100mm.

PLANNING APPLICATION

REVISION	DATE	DRAWN	DESCRIPTION
E	23.11.2021	EG	Proposed water course removed and new note added.
D	02.11.2021	EG	Decking areas added to plots.
C	23.01.2019	SJB	Position of Plots 5, 6 & 7 revised to suit
B	29.11.2018	CLH	Road layout amended and layout revised to suit.
A	20.07.2018	EG	Proposed water course and existing drain amended with notes added.

CLIENT	Seagate Homes Ltd
PROJECT	Proposed residential development at Land off Old Main Road, Fleet Hargate
DRAWING	Site Layout and Location Plan
SCALE	1:500&1:1250 @ A2 **DRAWN** BCP **DATE** 10.01.2018

STUDIO 11 architecture

DRAWING NO. 356.PL.03

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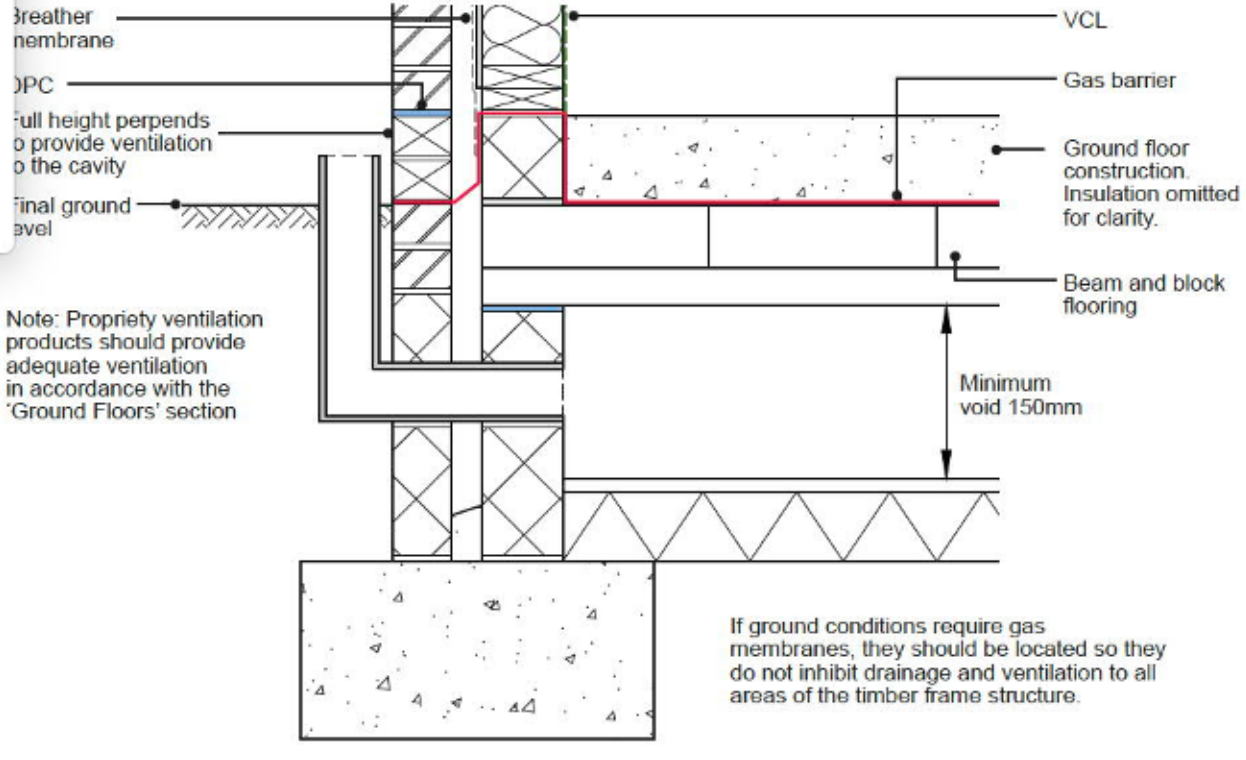
APPENDIX C

6.2.4 TIMBER FRAME: Typical gas membrane details

Ventilation for timber frame structures

t is important that whilst setting out the walls below ground that suitable forethought is given to the subsequent construction above DPC. The cavity should be constructed so that the appropriate widths are achieved in line with the appropriate relevant Building Regulations and our Warranty requirements. For timber frame structures early consideration of ventilation and drainage is key. Radon barriers should be positioned in such a way to not impair or restrict ventilation to any part on the timber frame structure.

Possible gas membrane detail



APPENDIX D

GROUND GAS PROTECTION
GP®1 TECHNICAL DATA SHEET

JUTA | TITANTECH



GP®1

GP®1 proprietary gas resistant damp proof membrane (DPM) is a multi-layer, low density polyethylene membrane, reinforced with a polypropylene reinforcing grid with an integral aluminium foil. GP®1 is specifically designed and manufactured to perform as a methane, carbon dioxide, radon, ground gas, air & moisture protection system.

Thickness	0.6 mm
Width	Various m
Length	Various m
Weight	370 g/m²

TITANTECH®
For developers of brownfield and contaminated sites the TITANTECH® family of products represent a major step forward in safeguarding projects against gaseous and chemical contamination.

Handling
Roll weights can be in excess of 20 kg and hence appropriate care and equipment is required for unloading and handling.

Storage
Rolls of GP®1 should be stored on stable/level ground and stacked not more than five rolls high, with no other material stacked on top. The rolls can be stored outdoors when packaged, but should be protected from exposure to UV.

Installation
GP®1 should be installed in accordance with the product installation guidelines, and in accordance with BS 8485:2015.

BBA

CE UK CA

GROUND GAS PROTECTION
GP®1 TECHNICAL DATA SHEET

GP®1

Feature	Characteristics	Test Method	GP®1
Physical Properties	Thickness	EN 1849-2	0.6 mm
	Thickness - between Scrim	BS EN ISO 9863-1:2016	0.4 mm
	Width	EN 1849-2	Various m
	Length	EN 1849-2	Various m
	Weight	EN 1849-2	370 g/m²
Hydraulic Press	Water Column	EN 20811	> 300
	Resistance to Water Penetration	EN 13967, EN 1928	Pass
	Water Tightness	EN 11296, EN 1367, EN 1928	Pass
Mechanical Properties	Resistance to Static Load	EN 12730-B	20 kg
	Tensile Strength (MD)	EN 12311-1	600 N/50mm
	Tensile Strength (CMD)	EN 12311-1	480 N/50mm
	Tensile Elongation (MD)	EN 12310-1	20%
	Tensile Elongation (CMD)	EN 12310-1	20%
	Puncture Resistance	EN 12236	1.25 kN
	Resistance to Tearing (Nail Shank) MD	EN 12310-1	330 N
	Resistance to Tearing (Nail Shank) CMD	EN 12310-1	400 N
Durability and Chemical Resistance	Transmission Rate of Volatile Liquids - Diesel	ISO 6179:2010 (B)	0.246 g/m²/h
	Transmission Rate of Volatile Liquids - Xylene	ISO 6179:2010 (B)	0.571 g/m²/h
	Transmission Rate of Volatile Liquids - Toluene	ISO 6179:2010 (B)	0.583 g/m²/h
	Transmission Rate of Volatile Liquids - Petrol	ISO 6179:2010 (B)	0.135 g/m²/h
Gas Permeability	Methane Permeability	BS EN ISO 15105-1	< 0.09 ml/m²/day/atm
	Carbon Dioxide Permeability	BS EN ISO 15105-1	< 0.09 ml/m²/day/atm
	Radon Permeability	K124/02/95	8.0 x 10^{-15} m²/s
Compliance and Certification	CE Mark - EN13967:2012 (A1 2017)		
	NHBC Standards Compliant		
	Conforms to BS 8485:2015 + A1 2019		
	BBA Certified - Certificate No. 20/5728		

JUTA UK

Please contact JUTA UK Directly for more information on GP®1

Jointing and Sealing

It is recommended GP®1 be heat welded where possible, with welding carried out by competent personnel with suitable qualifications in accordance with best practice, and guidance contained within BS 8485:2015.

Accessory Products

- GP®1 Starter Band
- GP® Tape
- GP® Self Adhesive Membrane
- GP® Primer
- GP® Top Hats and Preformed Corners
- GP® Protection Fleece
- GP® Void Vent (24/40mm)

GROUND GAS PROTECTION
GP®1 SAM
TECHNICAL DATA SHEET

JUTA | TITANTECH



GP®1 SAM, gas protection self adhesive membrane, is a bituminous gas proof and water proof sheet, composed of self-adhesive SBS polymer modified bitumen incorporating GP®1 with an upper surface finish of black reinforced LDPE, and a lower surface finish of siliconized release film. GP®1 SAM is used for the gas/ waterproofing of underground structures where harmful ground gasses are anticipated, and as a self adhesive accessory to GP®1.

Thickness	1.2 mm
Width	0.9 m or 0.3 m
Length	20 m
Weight	1100 g/m²

TITANTECH®
For developers of brownfield and contaminated sites the TITANTECH® family of products represent a major step forward in safeguarding projects against gaseous and chemical contamination.

Handling
Roll weights can be in excess of 20 kg (approx 33 kg/roll) and hence appropriate care and equipment is required for unloading and handling. This product is non-toxic nor flammable.

Storage
Rolls of GP®1 SAM should be stored on in a cool, dry place, and be protected from exposure to rain, sun, heat and cold temperatures prior to installation. Exposure to sunlight for extended period of time could cause difficulty with removal of the release film.

BBA
CE UK CA

GROUND GAS PROTECTION
GP®1 SAM
TECHNICAL DATA SHEET

GP®1 SAM

Feature	Characteristics	Test Method	GP®1 SAM
Physical Properties	Thickness	EN 1849-2	1.2 mm
	Width	EN 1849-2	0.9 or 0.3 m
	Length	EN 1849-2	20 m
	Weight	EN 1849-2	1100 g/m^2
Hydraulic Press	Water Tightness	EN 1928	Pass
	Water Vapour Transmission	EN 1931	0.013 g/m^2/day
Mechanical Properties	Tensile Strength (MD/CMD)	EN 12311-2 (A)	500 N/50mm
	Elongation (MD/CMD)	EN 12311-2 (A)	> 12 %
	Resistance to Static Load	EN 12370	20 kg
	Joint Strength	EN 12317-2	> 30 N
	Durability and Water Tightness (Ageing and Chemicals) 60 kPa	EN 1847	Pass
	Resistance to Nail Tear (MD/CMD)	EN 12310-1	> 300 N
	Resistance to Fire	EN 13501	F Euro Class
Gas Permeability	Methane Permeability	EN ISO 15105-1	< 0.68 ml/m^2/day/atm
	Carbon Dioxide Permeability	EN ISO 15105-1	< 2.81 ml/m^2/day/atm
	Radon Permeability	K124/02/95	8.0 x 10^{-15} m^2/S
Compliance and Certification	CE Mark - EN13967:2012 + A1:2017 Type (A/T)		
	BS 8485:2015 Compliant (Methane and Carbon Dioxide Barrier)		

JUTA UK

Please contact JUTA UK Directly for more information on GP®1 SAM

Installation

GP®1 SAM should be installed in accordance with the product installation guidelines, and in accordance with BS 8485:2015, and/or BS 8102:2009.

It is recommended that GP®1 SAM is not applied in temperatures below 10°C, in colder weather the material can be warmed slightly to aid adhesion.

Accessory Products

- GP® Primer
- GP® Protection Board
- GP® Protection Fleece



GRM

We understand land

GRM provide specialist ground, environmental, structural and design services for landowners and developers across the UK.

Our experience spans a wide range of sectors including private residential, social housing, healthcare, education, commercial, and industrial.Our sole aim is to maximise the potential of the site and thereby the commercial return for our clients.

Land Appraisal

Phase I Desk Studies | Phase II Site Investigations
Soakaway Testing | Specialist Land Surveys

Environmental

Preliminary Risk Assessments | Detailed Quantitative Risk Assessments
Ground Gas Assessments | Material Management Plans
Environmental Impact Assessments & Reports
Remediation Strategies & Validation | Due Diligence Audits

Geotechnical

Geotechnical Investigations | Earthworks | Slope Stability
Retaining Wall Design | Ground Stability | Vibration Assessments
Value Engineering

Design

Budget Foundation Schedules | Detailed Foundation Design
Structural Design | Structural Surveys

Mining

Coal Mining Risk Assessments | Coal Mining Investigations | Treatment of Mine Workings | Mine Shafts | Subsidence | Mineral Resource Assessments

Site Services

Foundation Inspections | Gas Membrane Verification
Remediation Validation | Structural Inspections

We also work with key partners to deliver a range of other support services and surveys including topographical, ecology, tree, archaeological, flood risk, and utilities.

Please contact us for an informal discussion on how we can save both time and money on your development project:

www.grm-uk.com | 01283 551249 | info@grm-uk.com