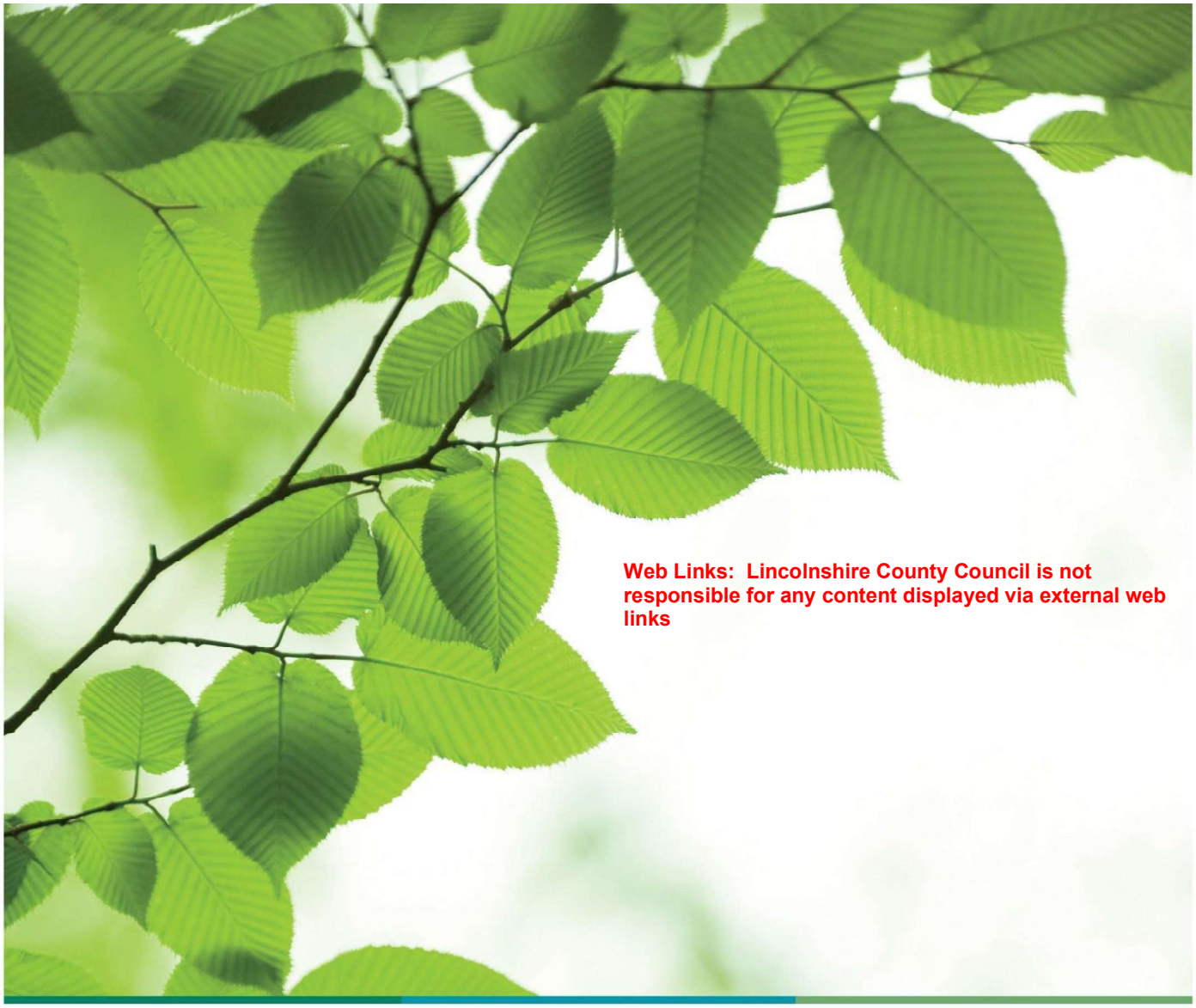


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Remediation Strategy

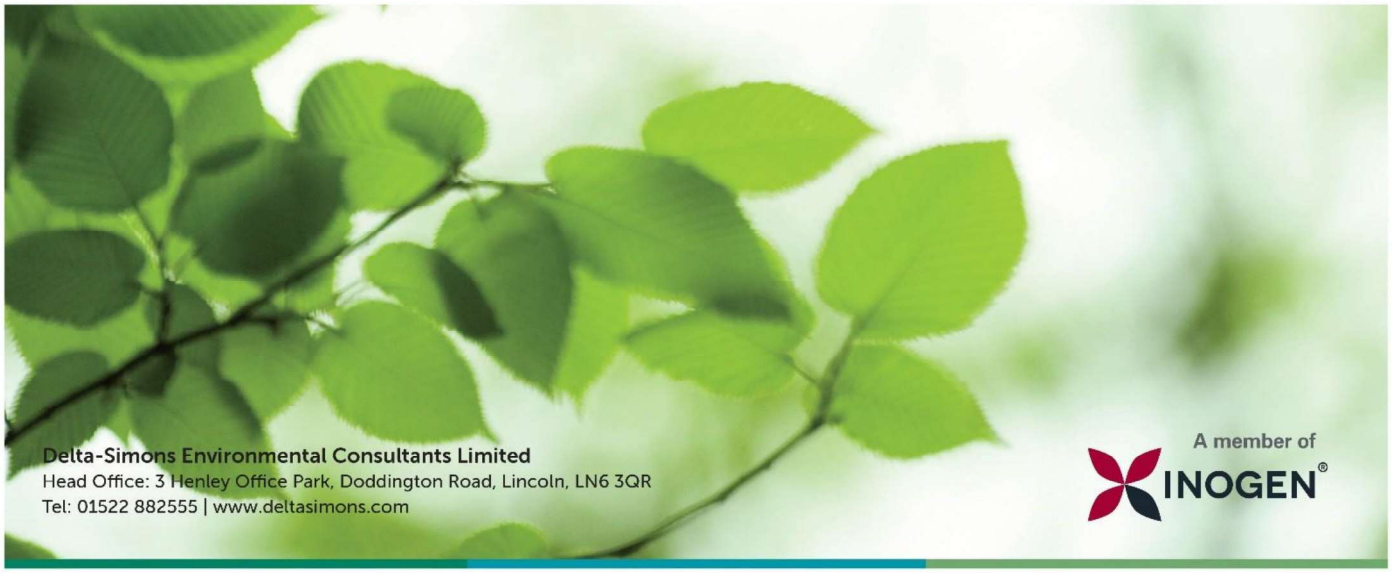
Spalding Academy, Neville Avenue, Spalding

Presented to **Lincolnshire County Council**

Issued: November 2020

Delta-Simons Project No. 20-1718.01

deltasimons



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Report Details

Client	Lincolnshire County Council
Report Title	Remediation Strategy
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Quality Assurance

Issue No.	Status	Issue Date	Comments	Author	Technical Review	Authorised
1	Final	26/11/2020		Jessica Rowe Consultant	Paul Huteson Associate	Paul Huteson Associate

About us

Delta-Simons is a trusted, multidisciplinary environmental consultancy, focused on delivering the best possible project outcomes for customers.

Specialising in Environment, Health & Safety and Sustainability, Delta-Simons provide support and advice within the property development, asset management, corporate and industrial markets. Operating from ten locations - Lincoln, Birmingham, Bristol, Dublin, Leeds, London, Manchester, Newcastle, Norwich and Nottingham - we employ over 100 environmental professionals, bringing experience from across the private consultancy and public sector markets.

Delta-Simons is proud to be a founder member of the Inogen® Environmental Alliance, a global corporation providing multinational organisations with consistent, high quality and cost effective environmental, health, safety, energy and sustainability solutions. Inogen assists multinational clients by resolving liabilities from the past, addressing today's requirements and delivering solutions for the future. With more than 200 offices located on every continent, more than 6,430 staff worldwide, and projects completed in more than 120 countries, Inogen provides a single point of contact for diverse markets as Automotive, Chemical, Consumer Products & Retail, Financial, Food & Beverage, Healthcare, Insurance, Manufacturing, Non Profit Organisations, Oil & Gas, Real Estate, Services Firms, Technology and Transportation, among others.

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Appendix A Limitations

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1.0 Introduction, Context and Purpose

Delta-Simons Environmental Consultants Limited (Delta-Simons) has been instructed by Lincolnshire County Council (the 'Client') to prepare a Remediation Strategy (RS) prior to the commencement of development at Spalding Academy, Neville Avenue, PE11 2EJ (hereafter referred to as the 'Site').

The purpose of this document is to provide a formal statement for the proposed construction phase mitigation requirements to facilitate the development following the completion of a geo-environmental investigation by Delta-Simons. For information on the Site setting, and full details of intrusive investigations completed at the Site, this remediation strategy should be read in conjunction with the previous report relating to the Site:

- Preliminary Geo-Environmental Risk Assessment, Spalding Academy, Neville Avenue, Spalding, Delta-Simons Project No. 20-1718.01, dated October 2020; and
- Geo-Environmental Assessment, Spalding Academy, Neville Avenue, Spalding, Delta-Simons Project No. 20-1718.01, dated November 2020.

It is understood that the Site is proposed for the development of a two-storey teaching block. There are currently three options/areas under consideration as detailed on the Proposed Development Plan included as Drawing 1. It is understood that Option 1 in the eastern area of the Site is the preferred option at this stage. No additional landscaped areas are proposed.

2.0 Limitations.

The standard limitations associated with this assessment are presented in Appendix A.

3.0 Previous Report Review

Preliminary Geo-Environmental Risk Assessment, September 2020

At the time of the walkover the Site comprised an active school. The Option1 area comprised an area of concrete hardstanding and vegetation associated with the historical teaching of brick laying skills, however, has not been in use for a number of years. The Option 2 and 3 areas comprised a mixture of asphalt hardstanding and grassed soft landscaping.

Historic mapping indicates that all three areas comprised likely agricultural land prior to forming part of the wider school by the late 1950's. An infilled swimming pool is located between the Option 1 and Option 2 development area.

From the British Geological Survey online viewer, the Site is indicated as being underlain by Superficial Tidal Flat Deposits (Clay and Silt). The underlying bedrock is mapped as the Oxford Clay Formation (Mudstone). The EA classify the superficial and bedrock strata as Unproductive.

Potential sources of contamination were limited to potential Made Ground associated with historical development and demolition, organic materials within the underlying natural superficial deposits and the potential for on and off-Site infilled land.

An environmental investigation was recommended to assess the nature and composition of soils at the Site for geotechnical and environmental information. Including a ground gas risk assessment.

Geo-Environmental Report, November 2020

Delta-Simons undertook an intrusive investigation in November 2020 to provide chemical and geotechnical data for all three potential development areas.

The intrusive investigation comprised the advancement of 5 No. dynamic sampler boreholes (DS101 to DS105), 2 No. rotary boreholes (BH101 and BH102). Two boreholes were installed for groundwater and ground gas monitoring. Following appropriate sampling heavy metals and TPHs were not identified above the applied Generic Assessment Criteria (GAC) for a residential without plant uptake end use. Three marginally elevated concentrations of individual PAH compounds were identified with a sing sample at 0.40-0.45 m bgl within BH101. Given this area will be located beneath the proposed building or be retained beneath the existing concrete slab, the risk to future Site users was considered very low.

Following three rounds of ground gas monitoring elevated methane concentration have been recorded at a maximum of 23.1%v/v within BH101. Carbon dioxide was recorded at a maximum concentration of 4.7%v/v and low steady flow rates have been recorded. As such, the Site was classified as a Characteristic Situation 2 (CS2), where ground has protection measures are required.

4.0 Remediation Requirements and Methodology

Following Delta-Simons contamination assessments, the following construction phase remediation mitigation measures were considered appropriate:

- Additional, unidentified localised areas of contamination may exist at the Site and an appropriate 'hotspot' protocol should be in place for groundworkers to act upon should such contamination be identified during the construction process;
- Groundworkers who are required to perform sub-surface work at the Site should be made aware of the known low-level contaminants in soil and groundwater and the possibility of encountering additional localised low levels of contamination (including Asbestos Containing Materials (ACM)). Therefore, good standards of personal hygiene should be observed and appropriate levels of personal protective equipment (PPE) and respiratory protective equipment (RPE) utilised where necessary;
- Confirmation should be sought from the Local Water Authority as to whether they will require upgraded pipework to be installed for new service installations; and
- Ground Gas Protection measures consummate with Characteristic Situation 2.

5.0 Protocol for Addressing Previously Unidentified 'Hotspots' of Contamination

As with any brownfield development, there is a possibility that unknown area(s) of soil or groundwater contamination, including asbestos, may be encountered during excavation works. Should an area of contamination beyond that anticipated from the investigations be identified by visual or olfactory means the following procedure shall be followed:

- Immediately stop all works in the area where contamination is suspected;
- Immediately inform the Site Project Manager who should then contact Delta-Simons;
- Delta-Simons will judge each occurrence on merit and should it be deemed necessary Delta-Simons shall attend Site to oversee the excavation of the 'hotspot' and the collection of validation samples;
- Any excavated material shall be isolated from all other material at the Site and, if deemed appropriate, be disposed of to a suitably licensed facility. Delta-Simons should be supplied with consignment notes for all off-Site disposal;
- The excavation should remain open until the validation has been completed; and
- Any identified hotspot would need to be appropriately classified prior to disposal to landfill (or transferred to a treatment centre). If material is identified as hazardous then the Site needs to be registered with the Environment Agency as a producer of hazardous waste. This can be done online and requires the company's registration code and a code that relates to the industry type.

Please note; should contamination be encountered at variance to the characteristics in the investigation reports it should be reported to the planning authority as soon as possible for further consideration. Action taken would be recorded as part of the validation.

6.0 Mitigation of Risks to Groundworkers during Development

Low levels of contamination have been identified at the Site and as with any Brownfield development there is the potential for further previously unidentified hotspots of contamination to be present at the Site.

As such, it is recommended that the Contractor provides appropriate inductions to all groundworkers who are required to perform sub-surface work at the Site in order to ensure they are made aware of the possibility of encountering contamination at the Site. In addition, good standards of personal hygiene should be observed and appropriate levels of PPE and RPE, where applicable, provided and utilised in order to mitigate the potential for direct contact.

7.0 Upgrading of Potable Water Supply Pipes

Given the presence of PAH within underlying soils, potable water pipes may require upgrading with 'Protectaline' water pipe, or similar. Confirmation should be sought from the Water Authority, and evidence of any upgraded pipework collected by the Contractor for inclusion within the verification report.

8.0 Ground Gas Protection

Following three ground gas monitoring events, the Site has been classified as Characteristic Situation 2. Furthermore, organic peat deposits have been identified underlying the Site and as such, ground gas measures are recommended as per Table 7 of BS8485:2015. Relevant pages from BS8485:2015 are included as Appendix B.

BS:8485 provides a scoring system to determine the appropriate protection measures for a proposed development in accordance with the identified ground gas regime. Table 3 of BS:8485 summarises typical UK building types, which for this development will comprise Type B (public). Table 4 details the points required for the Characteristic Situation, which for CS2 is 3.5. This can be achieved by a combination of the following:

- Structural barriers (Table 5)
- Ventilation (Table 6)
- Gas Membrane (Table 7)

The above should be considered in conjunction with the proposed foundation/floorslab design to achieve the minimum score required within BS:8485.

The above assessment relates solely to future occupants. Given the nature of the ground gas regime at the Site, no further works are considered necessary to protect 3rd parties/surrounding occupiers. Entry to excavations/confined spaces should be restricted to personnel with relevant Confined Spaces training and with prior conformation of atmospheric conditions.

A cast in-situ ground-bearing floor slab (with only nominal mesh reinforcement) provides a 0.5 score, and a gas resistant membrane, satisfying all the criteria in Table 7 on BS8485:2015 - including being verified in accordance with CIRIA C735, provides an additional score of 2.0. As such, these two gas protection measures designs provide the necessary minimum protection score required to mitigate the risks associated with the CS2 ground gas regime characterisation and satisfy BS8485:2015 guidance.

The final design of the measures and responsibility sits with the Contractor / Designer, the above is provided only as guidance.

It is recommended that the selected ground gas membrane is confirmed as suitable by the Local Authority prior to installation.

BS8485:2015 requires that membranes are verified in accordance with CIRIA C735 (N1) by an independent and qualified specialist. Where the membrane forms part of the protection measures, the Contractor shall commission the independent and qualified specialist to undertake and certify the installed membranes and provide the certification to Delta-Simons for inclusion in the Verification Report.

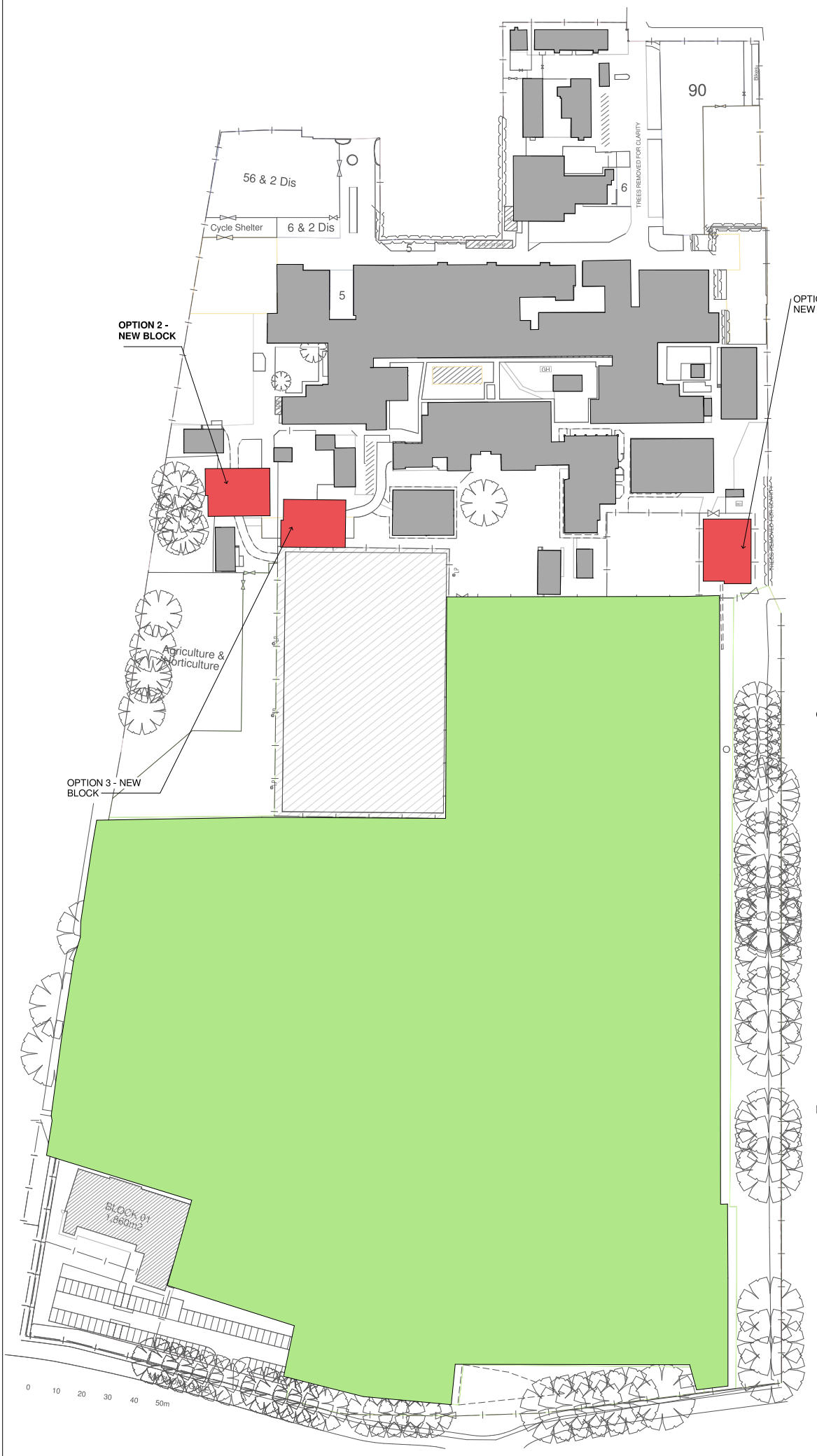
Photographic evidence of the gas membrane's installation should be provided for submission in the verification report.

9.0 Validation Reporting

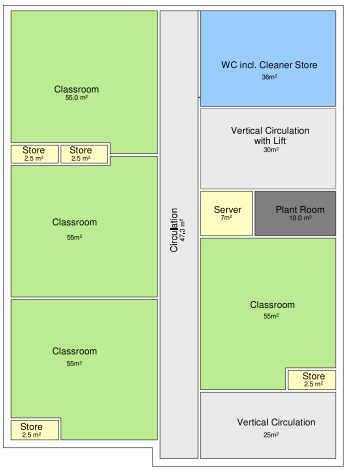
The validation report should comprise the following items of verification that the Remediation Strategy has been complied with:

1. Details and verification of any Hotspots encountered (Main Contractor and Delta-Simons);
2. Upgraded water supply pipe delivery tickets, if required. (Client's Contractor);
3. As built drawings, photographs and certification of the installation of the ground gas membrane as per CIRIA C735 (Contractors Specialist); and
4. Brief report containing the above. (Delta-Simons).

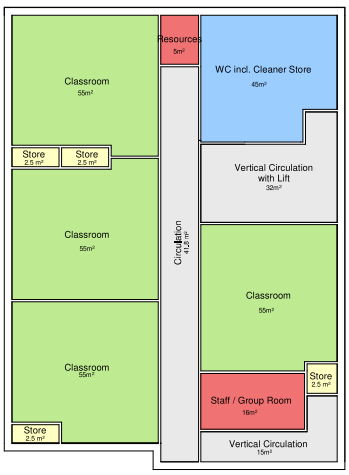
Drawing 1 – Proposed Development Plan



Proposed Options Site Block Plan
1 : 500



Ground Floor Proposed Block Layout
1 : 100



First Floor Proposed Block Layout
1 : 100

Accommodation Key

- Circulation
- Classroom
- Storage
- Toilets & Changing
- Staff & Admin
- Plant Room

KIER

Project Name: Spalding Academy - 1FE Expansion
Drawing Title: Proposed Block Location Plan
Scale: As indicated
Original Size: A0
RIBA 3/11 Stage: Stage 0
Date: 24/09/20
Drawn: RMo
Checked: RMo
Approved: NR
Drawing Number: XXXXX-DBS-XX-XX-DR-A-SK002
Status: S0
Revision: P01

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Appendix A - Limitations

Limitations

The recommendations contained in this Report represent Delta-Simons professional opinions, based upon the information listed in the Report, exercising the duty of care required of an experienced Environmental Consultant. Delta-Simons does not warrant or guarantee that the Site is free of hazardous or potentially hazardous materials or conditions.

Delta-Simons obtained, reviewed and evaluated information in preparing this Report from the Client and others. Delta-Simons conclusions, opinions and recommendations has been determined using this information. Delta-Simons does not warrant the accuracy of the information provided to it and will not be responsible for any opinions which Delta-Simons has expressed, or conclusions which it has reached in reliance upon information which is subsequently proven to be inaccurate.

This Report was prepared by Delta-Simons for the sole and exclusive use of the Client and for the specific purpose for which Delta-Simons was instructed. Nothing contained in this Report shall be construed to give any rights or benefits to anyone other than the Client and Delta-Simons, and all duties and responsibilities undertaken are for the sole and exclusive benefit of the Client and not for the benefit of any other party. In particular, Delta-Simons does not intend, without its written consent, for this Report to be disseminated to anyone other than the Client or to be used or relied upon by anyone other than the Client. Use of the Report by any other person is unauthorised and such use is at the sole risk of the user. Anyone using or relying upon this Report, other than the Client, agrees by virtue of its use to indemnify and hold harmless Delta-Simons from and against all claims, losses and damages (of whatsoever nature and howsoever or whensoever arising), arising out of or resulting from the performance of the work by the Consultant.

Appendix B - BS8485:2015 Extracts

Appendix B - BS8485:2015 Extracts

The following sections have been extracted from BS8485:2015 (© British Standards Institute), they are provided for information only and reference should be made to the full document in the preparation of designs for gas protection measures. The reader is directed to purchase a full copy of BS8485 from the British Standards website.

Table 3 Building types

	Type A	Type B	Type C	Type D
Ownership	Private	Private or commercial/ public, possible multiple	Commercial/ public	Commercial/ industrial
Control (change of use, structural alterations, ventilation)	None	Some but not all	Full	Full
Room sizes	Small	Small / medium	Small to Large	Large industrial / retail park style

Type A building: private ownership with no building management controls on alterations to the internal structure, the use of rooms, the ventilation of rooms or the structural fabric of the building. Some small rooms present. Probably conventional building construction (rather than civil engineering). Examples include private housing and some retail premises.

Type B building: private or commercial property with central building management control of any alterations to the building or its uses but limited or no central building management control of the maintenance of the building, including the gas protection measures. Multiple occupancy. Small to medium size rooms with passive ventilation of rooms and other internal spaces throughout ground floor and basement areas. May be conventional building or civil engineering construction. Examples include managed apartments, multiple occupancy offices, some retail premises and parts of some public buildings (such as schools, hospitals, leisure centres) and parts of hotels.

Type C building: commercial building with central building management control of any alterations to the building or its uses and central building management control of the maintenance of the building, including the gas protection measures. Single occupancy of ground floor and basement areas. Small to large size rooms with active ventilation or good passive ventilation of all rooms and other internal spaces throughout ground floor and basement areas. Probably civil engineering construction. Examples include offices, some retail premises, and parts of some public buildings (such as schools, hospitals, leisure centres and parts of hotels).

Type D building: industrial style building having large volume internal space(s) that are well ventilated. Corporate ownership with building management controls on alterations to the ground floor and basement areas of the building and on maintenance of ground gas protective measures. Probably civil engineering construction. Examples are retail park sales buildings, factory shop floor areas, warehouses. (Small rooms within these style buildings should be separately categorized as Type B or Type C).

NOTE 2 Type A buildings are those where the risk of failure of the gas protection measures is likely to be most significant to the safety of the occupants and Type D buildings are those where this same risk is likely to be least significant.

From the design CS and the type of building (A, B, C or D) the minimum level of gas protection (score) in the range 0 to 7.5 should be determined in accordance with Table 4.

Table 4 Gas protection score by CS and type of building

Characteristic Situation	Minimum gas protection score (points)			
	High Risk		Medium Risk	Low Risk
	Type A building	Type B building	Type C building	Type D building
1	0	0	0	0
2	3.5	3.5	2.5	1.5
3	4.5	4	3	2.5
4	6.5 (A)	5.5 (A)	4.5	3.5
5	-- (B)	6.5 (A)	5.5	4.5
6	-- (B)	-- (B)	7.5	6.5

(A) Residential buildings should not be built on CS4 or higher sites unless the type of construction or site circumstances allow additional levels of protection to be incorporated, e.g. high-performance ventilation or pathway intervention measures, and an associated sustainable system of management of maintenance of the gas control system, e.g. in institutional and/or fully serviced contractual situations.

(B) The gas hazard is too high for this empirical method to be used to define the gas protection measures.

NOTE 3 The NHBC has published guidance [8] for use on residential developments, which utilizes an alternative classification ("traffic light") system. This guidance typically applies to Type A buildings utilizing beam and block floor constructions with clear void ventilation. The design choice variables are limited to decisions relating to the membrane specification and verification recommendations (see Table 7). Designers utilizing this system would therefore need to refer to the NHBC [8] to assess compliance for specific recommendations.

When the minimum gas protection score has been determined for the building as a whole, or for each part of the building, then a combination of two or more of the following three types of protection measures should be used to achieve that score:

- the structural barrier of the floor slab, or of the basement slab and walls if a basement is present;
- ventilation measures; and
- gas resistant membrane.

NOTE 4 The method of selecting the combination of these types of protection measures for a particular building is given in 7.2.

Once the types of protection measures have been decided, the detailed design and specification of the measures should be undertaken (see 7.3).

NOTE 5 In some cases, the designer might be of the opinion at this stage that the extent of the protection measures is potentially more than is needed, because of limitations in the scope of the site investigation [these limitations having led to a more conservative GSV and CS than is likely from the conceptual site model (see 6.3.7.2 and 6.3.7.3)]. In this case, further site investigation could be carried out to check the GSV. Only if there is sufficient time to carry out additional site investigation and gas monitoring would this step be useful.

The detailed design and specification of the protection measures should be recorded in a design report (see 8.3).

7.2 Selection of appropriate protection measures

7.2.1 General

Having determined the minimum gas protection score for the building, or each different part of the building, from Table 4, an element or combination of elements should be chosen from Table 5, Table 6, and Table 7 with a combined score achieving the minimum recommended gas protection. No more than one element of each type (i.e. from each table) should be combined to achieve the recommended gas protection score.

The gas protection system should consist of at least two different elements; for example, a barrier element with either a membrane or a ventilation or dilution element (or both). 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.

NOTE For low sensitivity buildings on low risk sites it might sometimes be possible to rely solely on a membrane or slab; for example, where internal ventilation provides secondary protection.

The selection process should be transparent in that all interested parties can see the approach taken, understand the various steps and decisions made, and

be confident that a robust risk-assessed solution has been designed and installed commensurate with the construction and site constraints.

Where the CS is CS4 or higher, the site should have a comprehensive assessment done to support the adequacy of the proposed protection measures. Reliance should not be placed solely on Table 5, Table 6 and Table 7.

7.2.2 Structural barrier

The first step in the methodology should be the assessment of the gas protection score of the structural barrier, since the construction of the floor slab has usually already been decided at the time the gas protection measures are being designed.

NOTE The floor slab design, and any basement design, are usually determined by geotechnical and constructability factors.

The common types of floor slab and substructure design and their relative performance as a structural barrier to ground gas ingress are described in Annex A. The structural barrier score should be assigned in accordance with Table 5; further guidance is given in Annex A.

Table 5 Gas protection scores for the structural barrier

Floor and Substructure (see Annex A)	Score [A]
Precast suspended segmental subfloor (i.e. beam and block)	0
Cast in situ ground-bearing floor slab (with only nominal mesh reinforcement)	0.5
Cast in situ monolithic reinforced ground bearing raft or reinforced cast in situ suspended floor slab with minimal penetrations	1 or 1.5 [B]
Basement floor and walls conforming to BS 8102:2009, Grade 2 waterproofing [C]	2
Basement floor and walls conforming to BS 8102:2009, Grade 3 waterproofing [C]	2.5

[A] The scores are conditional on breaches of floor slabs, etc., being effectively sealed.

[B] To achieve a score of 1.5 the raft or suspended slab should be well reinforced to control cracking and have minimal penetrations cast in (see A.2.2.2).

[C] The score is conditional on the waterproofing not being based on the use of a geosynthetic clay liner waterproofing product (see C.3, Note 4).

Table 6 Gas protection scores for ventilation protection measures

Protection Element/System	Score	Comments
(a) Pressure relief pathway (usually formed of low fines gravel or with a thin geocomposite blanket or strips terminating in a gravel trench external to the building)	0.5	Whenever possible a pressure relief pathway (as a minimum) should be installed in all gas protection measures systems. If the layer has a low permeability and/or is not terminated in a venting trench (or similar), then the score is zero.
(b) Passive sub floor dispersal layer: Very good performance: Good performance: Media used to provide the dispersal layer are: ▲ Clear void ▲ Polystyrene void former blanket ▲ Geocomposite void former blanket ▲ No-fines gravel layer with gas drains ▲ No-fines gravel layer	 2.5 1.5	Performance criteria for methane and carbon dioxide are shown in Figure B.6 and Figure B.7, respectively. The ventilation effectiveness of different media depends on a number of different factors including the transmissivity of the medium, the width of the building, the side ventilation spacing and type and the thickness of the layer. The selected score should be assigned taking into account the recommendations in Annex B. Passive ventilation should be designed to meet at least "good performance", see Annex B.
(c) Active dispersal layer, usually comprising fans with active abstraction (suction) from a subfloor dilution layer, with roof level vents. The dilution layer may comprise a clear void or be formed of geocomposite or polystyrene void formers	1.5 to 2.5	This system relies on continued serviceability of the pumps, therefore alarm and response systems should be in place. There should be robust management systems in place to ensure the continued maintenance of the system, including pumps and vents. Active ventilation should always be designed to meet at least "good performance", as described in Annex B.
(d) Active positive pressurization by the creation of a blanket of external fresh air beneath the building floor slab by pumps supplying air to points across the central footprint of the building into a permeable layer, usually formed of a thin geocomposite blanket	1.5 to 2.5	This system relies on continued operation of the pumps, therefore alarm and response systems should be in place. The score assigned should be based on the efficient "coverage" of the building footprint and the redundancy of the system. Active ventilation should always be designed to meet at least "good performance".
(e) Ventilated car park (floor slab of occupied part of the building under consideration is underlain by a basement or undercroft car park)	4	Assumes that the car park is vented to deal with car exhaust fumes, designed to Buildings Regulations 2000, Approved Document F [9].

7.2.4 Membranes

Gas resistant membranes should be:

a) sufficiently impervious to methane and carbon dioxide;

b) capable after installation of providing a complete barrier to the entry of the relevant gas.

c) sufficiently durable to remain serviceable for the anticipated life of the building and duration of gas emissions;

d) sufficiently strong to withstand in service stresses (e.g. due to ground settlement if placed below a floor slab);

e) sufficiently strong to withstand the installation process and following construction activities until covered (e.g. penetration from steel fibres in fibre reinforced concrete, penetration of reinforcement ties, tearing due to working above it, and dropping tools); and

f) chemically resistant to degradation by other contaminants that might be present.

NOTE 1 A methane gas transmission rate of <40.0 ml/day/m2/atm (average) for sheet and joints (tested in accordance with the manometric method in BS ISO 15105-1) is usually considered sufficient.

NOTE 2 Guidance on the relevant properties relating to a), c) and e) is provided in CIRIA C748 [10].

There are many gas resistant membrane types available and membrane choice should be made according to the resistance of the material to the passage of the challenge gas and the resistance to site damage during and after installation in the designed position. The designer specifying the membrane should consider the combination of a particular membrane's properties to assess whether it is suitable in any given situation. The specified membrane and the reasons for its selection should be described in the design stage report (see 8.1).

NOTE 3 Advice on membrane selection is given in Annex C.

NOTE 4 The installation and subsequent protection of the membrane are key factors in its performance. A poorly installed membrane cannot perform, however well detailed and irrespective of the performance of the material. Historically, reference has been made to verification and integrity testing without having any referenced documents against which to judge. The verification process is now described in CIRIA C735 [N1] and as such, confidence in the installed solution can be measured. The process removes the uncertainty of unqualified or inexperienced installation operatives by requiring a verification plan to be drawn up prior to the installation, with frequency and type of verification being dependent upon the qualifications of the installation operatives, site risk and design criteria.

A verification plan for the installation of the membrane should be part of the detailed design (see 8.3.2).

NOTE 5 Current guidance on verification recommendations takes into account the risk of the overall design and confidence in its installation, and sets a frequency and level of verification appropriate.

A gas protection score (see Table 4) should only be assigned to a membrane which is formed of a material with suitably low gas permeability and which has been installed so it completely seals the foundation (including effective seals around all penetrations) and does not sustain damage from in-service stresses. The criteria which should be met to assign a gas protection score of two points is set out in Table 7.

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 to the gases with a methane gas transmission rate <40.0 ml/day/m^2/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 [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. For example, a minimum 0.4 mm thickness (equivalent to 370 g/m^2 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.