

Elemental GI Ltd

REPORT: REMEDIAL METHOD STATEMENT FOR LAND NORTH OF STONEGATE, COWBIT

CLIENT: ARK PROPERTY CENTRE

Project No: E22208
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REMEDIAL METHOD STATEMENT:
LAND NORTH OF STONEGATE, COWBIT

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Semi-Technical Summary

The reader is referred to the terms and conditions which accompany this report, and which are presented at the end of this document.

This semi-technical summary provides a brief overview of the main conditions which have been noted on site. These features / factors (alongside others) are explained fully in the following report and the following should therefore not be referred to in isolation. **No reliance should be placed on the summary until the whole report and related documents have been read in full.**

Contamination	Asbestos and PAHs were identified at the site during our Phase 2 Investigation.
Conceptual Site Model	Potential pollutant linkages exist which relate to the asbestos and PAH contamination and to the future residential end users. These need to be broken in order to ensure that risks to future site users are negated.
Remediation Specification	All soft landscaped areas (including private gardens) should be capped with a 600mm capping layer including a 'marker' membrane (or similar). Validation of these areas will then be required to verify the success of these remedial works.

1.0 INTRODUCTION

1.1 Report Status

Elemental GI Ltd were appointed by Ark Property Centre (hereafter referred to as 'the Client') to prepare a Remedial Method Statement ("RMS") for the Investigation for land north of Stonegate, Cowbit (hereafter referred to as 'the site').

This report has been prepared on the understanding that the site is to undergo redevelopment to support residential housing. We have been supplied with a copy of the proposed layout Ref: 551.LTP.03 and extracts of this plan are presented in the Proposed Site Layout Plan (Drawing 001) in Appendix I.

This report has been prepared in accordance with our notes concerning the terms and conditions of these works and of our engagement, which are presented at the end of this report. This version of our report (Rev. 4) has been updated to incorporate the most recent regulatory discussions, which are summarised in Section 6.3.

Should the development proposals alter, then the recommendations in this report may be subject to change. Whilst it may be utilised by others for reference purposes at the Client's discretion, it has not been prepared for any other purposes (e.g. waste classification etc.) and therefore additional works may be required by third parties dependent upon their own requirements / works. Users of any / all of our reports, letters etc. must always ensure that they are reading the latest version / revision before undertaking any works and / or making any assessments, designs, decisions or related ventures. Please stop and check that this is the latest version for this site / project before proceeding any further.

All recommendations are subject to the approval of the relevant Regulatory Authorities, and copies of this document should be submitted for approval by the Client before the start of any works on site.

It should be noted that this RMS has not been written to consider risks arising from the completion of foundation construction works (e.g. piling) and that risks from such works should be considered fully by the relevant contractor once their designs are confirmed. Approval may be required from the relevant regulators / warranty providers for such works.

1.2 Previous Reports

Elemental GI Ltd have prepared the following reports for the subject site:

- Elemental GI Ltd: Phase 1 Geo-Environmental Assessment for Land North of Stonegate, Cowbit (Ref. E22208/1/0 dated Jan. 2023); and
- Elemental GI Ltd: Phase 2 Geo-Environmental Investigation for Land North of Stonegate, Cowbit (Ref. E22208/2/1 Rev. 1 dated Jan. 2023).

The above referenced documents have not been reproduced herein, and they should be referred to in full alongside this report.

1.2.1 Summary of Previous Reports

Elemental GI Ltd Phase 1 Report

Drift deposits were recorded beneath the site on 1:50,000 scale mapping comprising Tidal Flat Deposits (clay and silt). These were recorded to be underlain by Oxford Clay Formation, mudstone. The drift deposits recorded beneath the site are classified as an 'Unproductive Aquifer'. The bedrock geology recorded beneath the site is classified as an 'Unproductive Aquifer'.

The site is not in an area known to be at risk from radon gas, although potential ground gas sources were identified on site.

The site was shown to support open ground with small structures present and a marshland / furze area in the north of the site in the 1880's. The site was also shown to be situated alongside a railway shown to the east of the site. The site underwent changes from 1904 onwards with the absence of the marshland. The removal of the onsite structures was shown from 1969 and the railway nearby is shown to be disused from 1976, after which the site was shown to correspond to its current layout. From 1988 the railway tracks were no longer shown running alongside the site.

Our preliminary human health conceptual site model listed potential sources of contamination at the site including made ground, topsoil / waste stockpiles, derelict machinery and off-site historic industry / made ground. It is understood that the stockpiles noted in our Phase I Report are no longer present at the site and have therefore been removed from the site's conceptual site model.

Elemental GI Ltd Phase 2 Report

Our Phase II Report for the subject site described the completion of the following works:

- Completion of 6 No. window sampler boreholes to depths of up to 5.00m below existing ground level (begl).
- Analysis of soils for various determinands including:
    - Heavy metals;
    - Polycyclic Aromatic Hydrocarbons ('PAHs');
    - Speciated Total Petroleum Hydrocarbons ('TPH');
    - Semi-Volatile and Volatile Organic Compounds (SVOCs / VOCs);
    - Polychlorinated Biphenyls ('PCBs'); and
    - Asbestos.

Made ground was encountered in all areas of the site to a maximum total depth of 1.40m below existing ground level (begl). This generally comprised ashy gravel or reworked topsoil overlying either gravel of brick, concrete etc., or reworked natural soils containing variable amounts of brick, concrete and clinker. Bands of brick and concrete fragments were also noted locally. Topsoil was not encountered in any of the exploratory holes completed during the investigation.

The natural soils at the subject typically comprised soft brown and / or greyish brown slightly sandy to very sandy clay / silt soils overlying very soft grey and brown clay / silt which was sandy in places and which contained occasional pockets of organic material. These are considered to be representative of the Tidal Flat Deposits.

Water was recorded at the following locations:

- WS01: Water encountered at 2.80m depth during drilling;
- WS04: Water encountered at 3.20m depth during drilling; and
- WS05: Water encountered at 3.00m depth during drilling.

Return visits undertaken to site recorded water ranging from 1.13m to 3.40m begl in monitoring wells.

Our Phase II Report compared the results of the soil analyses to conservatively-selected screening values based on the proposed residential end-use with private gardens. This revealed the following exceedances:

- 1 No. exceedance of asbestos comprising:
  - Samples from WS01 of made ground at 0.50m begl;
- 3 No. exceedances of PAHs and SVOCs (including benzo(a)pyrene and dibenzo(a,h)anthracene) including:
  - Samples from WS02 of made ground at 0.40m begl;
  - Samples from WS03 of made ground at 0.05m begl; and
  - Samples from WS05 of made ground at 0.10m begl.

It is noted that the exceedances summarised above were all within samples retrieved from made ground materials. No exceedances from samples retrieved from the underlying natural soils were encountered. The asbestos exceedance related to a thin (<10cm) band of asbestos-containing materials within the made ground at / around 0.5m depth at the location of borehole WS01.

Based on these results, remediation works to protect human health were therefore considered necessary. Risks to controlled waters were not identified at the site. Ground gas is discussed in Section 6 of this report.

2.0 SITE SETTING

2.1 Location

The address and location of the subject site are shown in Table 2.0 below:

Table 2.0: Site Location and Dimensions

Site Address	Land north of Stonegate, Cowbit
National Grid Ref.	526565, 318088
Area (Approx.)	0.25 ha
Access	Site can be accessed through locked gate off Stonegate.



2.2 Geo-Environmental Setting

The site is recorded to be underlain by Tidal Flat Deposits (clay and silt) which is classified as an 'Unproductive Aquifer'.

The site is not recorded to be within an Environment Agency source protection zone for the total catchment and no entries relating to potable abstractions are recorded within a 2000m radius of the site.

2.2.1 Site:

- The site forms an irregular shaped but broadly rectangular parcel of land mainly covered by grass / vegetation with mature tree borders / hedgerows along the boundaries with a gravel track running along the centre of the site;
- A drainage ditch is situated alongside the western boundary of the site. This was observed to be 'dry' at the time of our investigation. A drain also runs immediately adjacent to the far northern boundary of the site (partially culverted) which was observed to be holding water at the time of our investigation;
- No obvious overall topographical gradients were noted across the site;
- Large stockpiles containing mixed topsoil and waste materials were noted in the northern end of the site;
- General construction waste including bricks, plastic and concrete were found along the eastern boundary of the site as well as derelict machinery and other stockpiles containing wood;
- A small tyre stockpile and derelict trailers were found along the western boundary of the site; and
- A small compost shed with a vegetation stockpile was observed near the gate in the southern area of the site.

2.2.2 Surrounding Area:

- The site is set within a mixed residential, commercial, industrial and agricultural area;
- Land to the north of the site supports open fields and a plant nursery;
- Land to the east of the site supports a derelict railway station / sidings which is mostly overgrown. A single dilapidated brick structure remains;
- Land to the south of the site supports residential housing and Stonegate (road), beyond which is further residential housing;
- Land to the west of the site supports residential housing; and
- Land in the wider area surrounding the site supports a similar mix of housing and open fields with some nurseries and small industrial premises also present.

2.3 Ground Conditions

Reference should be made to the report(s) referenced in section 1 of this RMS for a full description of the site's ground conditions, but in summary made ground was encountered in all areas of the site to a maximum total depth of 1.40m below existing ground level (begl). This generally comprised ashy gravel or reworked topsoil overlying either gravel of brick, concrete etc., or reworked natural soils containing variable amounts of brick, concrete and clinker. Bands of brick and concrete fragments were also noted locally. Topsoil was not encountered in any of the exploratory holes completed during the investigation.

The natural soils at the subject typically comprised soft brown and / or greyish brown slightly sandy to very sandy clay / silt soils overlying very soft grey and brown clay / silt which was sandy in places.

2.4 Contamination Summary

Our Phase II Report compared the results of the soil analyses to conservatively-selected screening values based on the proposed residential end-use with private gardens. This revealed the following exceedances:

- 1 No. exceedance of asbestos comprising:
  - Samples from WS01 of made ground at 0.50m begl;
- 3 No. exceedances of PAHs and SVOCs (including benzo(a)pyrene and dibenzo(a,h)anthracene) including:
  - Samples from WS02 of made ground at 0.40m begl;
  - Samples from WS03 of made ground at 0.05m begl; and
  - Samples from WS05 of made ground at 0.10m begl.

Regarding ground gas, 3 No. gas visits were initially undertaken at the site as part of our Phase 2 works. Our Client conservatively chose to simply install 'CS2' protection in all new dwellings after the 3rd monitoring visit regardless. This was considered conditionally suitable based on the results up to that point, although it was noted that a full BS8485 classification was not suitable, although it this may have been off-set through the general conservatism of the building proposals (i.e. very robust protection was being installed regardless).

3.0 CONCEPTUAL SITE MODEL

3.1 Sources

As summarised in Section 2.4 above, exceedances have been recorded at the site comprising asbestos and various PAH compounds.

These are considered to comprise 'sources' within the site's conceptual site model (CSM).

As noted in previous sections, the asbestos exceedance related to a thin (<10cm) band of asbestos-containing materials within the made ground at / around 0.5m depth at the location of borehole WS01.

3.2 Pathways

The following potential pathways have been identified at the site in relation to the above sources should they remain unchanged / *in situ*:

- Dermal Contact;
- Ingestion of Soil;
- Ingestion of Site-Grown Fruit / Vegetables;
- Ingestion of Soil Attached to Site-Grown Fruit / Vegetables;
- Inhalation of Dust.

The vapour inhalation pathways have been omitted at this stage because of the likely low volatility risks associated with the PAHs identified. In addition it is noted that the PAHs appear to have been associated with anthropogenic materials in the made ground in ash / clinker type materials which are typically relatively inert in relation to breakdown / volatilisation risks.

3.3 Receptors

This report has been prepared on the understanding that the site is to undergo redevelopment to support residential housing. This includes 5 No. Plots with private gardens, open landscaped areas and access / parking areas.

The main / primary receptors considered within this CSM comprise future residential end users. However, other secondary receptors have also been considered, including ecology, groundwater, construction workers and neighbouring sites.

It is recommended that construction companies involved in any demolition / enabling / construction works should undertake their own health and safety risk assessments in relation to their own works and with due regards to the findings of the previous ground investigations.

3.4 Pollutant Linkages

Based on the above sections, sources, pathways and receptors have been identified at the site and therefore feasible pollutant linkages are considered to have been identified.

This RMS will present steps through which these pollutant linkages may be broken.

4.0 REMEDIATION SPECIFICATION

Elemental GI Ltd have discussed the site and the redevelopment proposals with our Client, and it is understood that the identified pollutant linkages shall be broken through the following steps:

- Step 1 – Placement of a 600mm 'clean' capping layer (topsoil and subsoil) in all gardens and soft landscaped areas (site won natural materials may be used subject to appropriate testing, permits / exemptions and regulatory approval) incorporating a robust semi-permeable geo-textile marker (e.g. the TERRAM Hi-Vis Geotextile);
- Step 2 – Removal of contaminated materials from site for disposal (e.g. from excavated hotspots and any construction excavations);
- Step 3 – Validation of remedial measures (e.g. placement of capping materials) following their placement by Engineers (e.g. from Elemental GI Ltd).

Exploratory hole WS01 was completed in an area which shall support the rear garden of Plot 1. Because the asbestos exceedance at location WS01 related to a thin (<10cm) band of asbestos-containing materials within the made ground at / around 0.5m depth, the presence of a 600mm capping layer above this level is considered to provide a sufficient thickness as it would mean that over 1000mm of soils / materials would be present between these materials and finished garden levels, subject to regulatory / warranty provider approval.

With regards to planting it is understood that 'tree pits' shall be excavated around new plants to ensure that made ground is not present within 600mm of final levels in any soft landscaped areas of the site. Further details may be requested from the Client's landscaping contractor.

4.1 Excavation Works

It is understood that remedial excavations are not required on site going forwards, although as always it is recommended that the following are undertaken where any such excavations are necessary:

- **Either** materials should be excavated and loaded directly into wagons for off-site disposal;
- **Or** materials should be excavated and placed on an impermeable membrane on site (with a system in place to contain and remove all run-off fluids) awaiting removal. If materials are stored on site, they must be fully covered with an impermeable membrane until their removal to prevent the creation of additional leachate and to prevent migration of dust etc.

Other 'best practice' rules and requirements will apply (as usual) with regards to the removal etc. of materials, which should be confirmed with the Client prior to the start of works.

4.2 Capping Works

Our recent Phase II investigation confirmed that the natural underlying soils at the site are 'clean' and have recorded concentrations of determinands below the selected screening values.

Subject to the approval of the Local Authority and Warranty Providers, site-won natural soil may therefore be re-used for capping if required, although (as always) the movement, import/export and deposition of all soils must be undertaken in accordance with all relevant permits / exemptions (U1, MMP etc.).

Your geo-environmental engineer should be notified once suitable soils are identified for these capping works.

5.0 VALIDATION REQUIREMENTS

5.1 General Procedures

It will be necessary to confirm that the full extent of the significant contamination has been removed from the ground and that areas have been successfully capped etc.

The following validation steps are recommended. Where further contamination is encountered (or where insufficient capping thicknesses are recorded) then these steps should be repeated in full until no further contamination is recorded (to be reviewed by Supervising Engineer).

- Validation Step 1 – The testing certificates for imported topsoil / subsoil and the origin of site-won subsoil should be checked by a geo-environmental engineer and submitted to the Local Authority for approval prior to importation / re-use;
- Validation Step 2 - Thicknesses of capping materials to be verified in each rear garden and in every other front garden (e.g. Plots 2 and 4);
- Validation Step 3 – Validation reports to be submitted to the Local Authority and Warranty Providers for sign-off on a plot-by-plot basis.

5.2 Screening Criteria and Testing Rates

As noted in section 6.3, we have informed the Client that the most recent YALPAG guidance must be used where soils are imported. A test ratio hasn't been specified within this RMS as the YALPAG guidance tailors this to the source, so this is therefore left open until such time as the sources are known, but the recommendation to adhere fully to the guidance remains.

The following main screening criteria have been suggested for delineation / validation purposes at this stage in the central wide wooded area (see Tables 5.0 and 5.1 overleaf):

Table 5.0: General Screening Values – Gardens

Analyte	Screening Values (mg/kg)
Arsenic	37.0[b]
Cadmium	11.0[b]
Chromium (Total)	910.0[b]
Chromium VI	6.0[b]
Lead	200.0[a]
Selenium	250.0[b]
Nickel	130.0[b]
Copper	2,400.0[b]
Zinc	3,700.0[b]
Mercury	1.20[b]
Benzo(a)pyrene	2.2[b]
Dibenzo(a,h)anthracene	0.24[b]
Asbestos	D[c]

[a] DEFRA C4SL values for a 'residential with gardens' end-use;
[b] Third party UK screening values e.g. CIEH, CL:AIRE, Elemental GI Ltd and LQM 'S4UL' values for a ''residential with gardens' end-use (licence S4UL3849);
[c] 'D' = 'Detected', which is an Elemental GI Ltd general screening level. ***A threshold of >0.001% is applicable if / when asbestos is detected as an action level beyond which further remediation should be considered.***
Further Testing may be required depending upon the hotspot / source / regulatory requirements.
Testing in accordance with BS3882 may be required where topsoil requires formal verification

Table 5.1: General Screening Values – Public Open Space 'POS1' Areas

Analyte	Screening Values (mg/kg)
Arsenic	79.0[b]
Cadmium	120.0[b]
Chromium (Total)	1,500.0[b]
Chromium VI	7.7.0[b]
Lead	630.0[a]
Selenium	1100.0[b]
Nickel	230.0[b]
Copper	12,000.0[b]
Zinc	81,000.0[b]
Mercury	16.0[b]
Benzo(a)pyrene	5.7[b]
Dibenzo(a,h)anthracene	0.57[b]
Asbestos	D[c]

[a] DEFRA C4SL values for a 'POS1' end-use;
[b] Third party UK screening values e.g. CIEH, CL:AIRE, Elemental GI Ltd and LQM 'S4UL' values for a 'POS1 end-use (licence S4UL3849);
[c] 'D' = 'Detected', which is an Elemental GI Ltd general screening level. ***A threshold of >0.001% is applicable if / when asbestos is detected as an action level beyond which further remediation should be considered.***
Further Testing may be required depending upon the hotspot / source / regulatory requirements.
Testing in accordance with BS3882 may be required where topsoil requires formal verification

6.0 RECOMMENDATIONS AND OTHER CONSIDERATIONS

6.1 Ground Gas

The site is in an area where less than 1% of homes are estimated to be at or above the Action Level. Therefore, radon protective measures are not required, subject to regulatory approval.

The site's CSM indicated that potential risks were present from ground gas sources. An initial ground gas monitoring exercise (3 No. visits) was therefore commissioned by the Client to assess potential risks. Elevated methane was recorded (please see our Phase 2 report for further information).

Our previous RMS (Rev. 3) aimed to set a general set of gas protection recommendations for overall approval, with specific details then submitted either as a pre-verification plan or within the verification reports themselves. However, recent discussions with SHDC indicated that further data was required, and 2 No. weeks of continuous sub-floor void monitoring has therefore been commissioned (initialising / ongoing at the time of writing). The data from this shall be combined with the 3 weeks of borehole monitoring already undertaken as this may be considered to be a relatively robust data set upon which the gas regime and suitability of the GPMs may be assessed.

It is recommended that this be addressed under separate cover as a bespoke ground gas classification letter report with 2 No. likely conclusions (to be confirmed based upon the findings of the continuous monitoring):

Scenario 1: If no significant bulk gas (methane, carbon dioxide) *is not detected* then it may be concluded that a 'CS1' classification would have been appropriate overall based on the entire and combined data set and therefore protection measures would not be necessary and verification steps would be rendered redundant.

Scenario 2: If significant bulk gas (methane, carbon dioxide) *is detected* then the appropriate corresponding classification should be established, agreed with the regulators and then applied to the site's structures.

For clarity we have been informed that the Client conservatively installed / shall install gas protection measures including the following:

- Construction of suitable, unobstructed and correctly installed adequate external venting (i.e. in accordance with relevant guidance), comprising 'periscope' venting;
- All joints and penetrations sealed and with;
    - Plots 1 and 2: Beam and block or pre-cast concrete floor with suitable membrane across flooring areas (stopping before cavity, please see enclosed

engineer's design detail drawing) and underfloor venting. Venting of cavity to be enabled through fitting of additional 'air bricks' to provide preferential pathway for migration of any accumulated ground gas;

- Remaining Plots: Beam and block or pre-cast concrete floor with suitable membrane across flooring areas (extending across cavity) and underfloor venting.

Piled foundations are known to require careful consideration in the context of ground gas risks and it is therefore recommended that all final gas protection measures should be verified with the Local Authority and Warranty Providers by the Client before the completion of any irrecoverable works.

6.1.1 General Gas Protection Measures Pre-Verification Plan

The Client has informed Elemental GI Ltd that a specialist fitter has been appointed to fit all gas protection measures at the site (MB Membranes).

It is understood that the fitters shall hold sufficient qualifications (NVQ or similar) and be sufficiently experienced.

It is also understood that the specialist fitters shall keep a record of their own works including (but not limited to) daily site record sheets, a photographic record of their works and listed records of any defects noted before, during or after installation.

In accordance with the latest NHBC guidance, BS 8485:2015 and CIRIA C735, appropriate verification should be undertaken to ensure that the required ground gas protection measures have been correctly installed and maintained (i.e. to prevent damage etc.) for all structures at the site. It is recommended that site staff develop, maintain and update an appropriate installation and verification site record folder in accordance with the aforementioned guidance documents to complement this.

Verification proposals will be dependent upon the final ground gas classification (see section 6.1) although the following are recommended in general for the site in accordance with the guidance documents listed above.

- NHBC General Requirements:
  - Verification (Construction Drawings) – Showing position of membrane; sealing details and ventilation points to be provided.
  - Verification (Membrane Specification) – Technical data sheet(s) for gas membrane (including gas permeability data) to be provided.
  - Verification (Installation) – Photographic evidence of installed membrane may be requested.

- CIRIA C735 Requirements (assuming that the gas protection measures and most importantly the membrane were installed by a qualified and experienced installer):
    - Verifier (consultant or third party qualified and experienced installer) to conduct a thorough visual verification inspection prior to 25% - 50% of concrete pours (min. one visit, installer to supply sign-off sheets (verification evidence) including photographs to independent verifier for other pours.

Should the above apply, it would be recommended that an independent engineer is invited to site to inspect the gas protection measures prior to the pouring of concrete / 'screed' for the very first plots, and then for at least 50% of the remaining plots at regular and representative intervals.

For clarity the engineer should attend the site at regular intervals during the construction works.

6.2 General Considerations / Assumptions: The following assumptions have been made concerning the site and the remedial works described herein:

- It always remains possible that ground and groundwater conditions may change between each exploratory hole and therefore such variations cannot be discounted. Seasonal variations may also be expected in relation to groundwater observations etc.
- We have assumed that the Client and their appointed contractors will follow all relevant regulatory requirements including health and safety and demolition works (e.g. Construction (Design and Management) Regulations 2015).
- A suitable environmental advisor (i.e. Elemental GI Ltd) should be appointed to supervise and validate all works described herein. However, a geo-environmental engineer may not always be on site and cannot verify / approve works which they have not seen or been informed of. Other advisors / contractors may be involved with the site (e.g. remedial contractors) and they would be wholly responsible for their own works as agreed with the Client.
- The importation and re-location of all soils (site-won or otherwise) must be undertaken in full accordance with the relevant permits / exemptions / regulations. The Client / developer should ensure that these are all in place in advance of relevant works. Where soils are re-used on site, or are imported onto site, it is assumed that they will be tested for suitable determinands prior to their re-use / importation. Please contact us for further advice in advance of all such works.
- Any previously unexpected / unidentified contamination should be reported to a geo-environmental engineer immediately, and works may need to stop until we can

review and discuss the associated risks with you. The regulatory authorities should also be informed.

- The Client / developer should discuss utility construction requirements with the appropriate providers prior to the start of works.
- All soil samples must be retrieved by a geo-environmental engineer and should be scheduled for analysis at a suitably accredited laboratory.
- The excavation, movement or any other disturbance of contaminated soils could result in the spreading of contamination to other areas of the site. Suitable management procedures should be put in place prior to all such works (e.g. dust suppression) to manage this at all times.
- Site staff are responsible for ensuring that all relevant environmental management procedures are in place throughout the works. This includes the safe an appropriate storage of contaminated soils (e.g. on suitable membranes) to ensure that cross-contamination and off-site contamination (e.g. through dust migration) are not possible.
- The Client is responsible for ensuring that their site staff are sufficiently protected from health and safety risks associated with the works outlined herein.

6.3 Local Regulatory Requirements / Discussions:

South Holland District Council (SHDC) have made the following documents available on / through their 'Contaminated Land' web guidance pages:

- Yorkshire and Lincolnshire Pollution Advisory Group ('YALPAG'): Development on Land Affected by Contamination: Technical Guidance for Developers, Landowners and Consultants (Version 11.2 – June 2020);
- Yorkshire and Lincolnshire Pollution Advisory Group ('YALPAG'): Verification Requirements for Cover Systems: Technical Guidance for Developers, Landowners and Consultants (Version 4.1 – June 2021).

With reference to the 'flow chart' presented in the June 202 YALPAG guidance document, this RMS has been produced following completion of Phase 2 works (across accessible areas), and unacceptable risks have been identified which require remediation. Contingencies including assessment, analysis and remediation steps relating to uninvestigated areas have also been outlined and it can be confirmed that these shall be undertaken under engineer supervision.

In November 2023 representatives of SHDC provided the following comments relating to the previous version (Rev. 3) of this RMS (NB comments have been reproduced but abbreviated):

1. *"[The remaining gas]… monitoring visits have not been reported and therefore the ground gas regime cannot be considered adequately characterised. It is not therefore*

possible to design the ground gas protection measures. In addition, the RMS presented does not contain the usual details expected - there is no classification of the site under BS8485 and the design proposed lacks the necessary details. No membrane has been specified, and whilst appendix 1 does contain some drawings detailing the relationship between the floor slab, membrane, walls etc. they are not referenced in the text, nor does the membrane cross the cavity wall.

2. *"Proposed cover system - I request further clarification regarding the thickness of the proposed cover system, and the likely effectiveness of the formal barrier. The maximum recorded concentration of Benzo(a)pyrene (at 10 times the selected screening level) would be at just 0.7m depth in the proposed development, with another sample showing roughly 5 times the screening value at 0.65m depth. No details of the formal barrier have been given, other than a 'robust semi-permeable geotextile marker/ break layer'. No details of, for example, tree pits etc have been given, will future residents be restricted on garden use? has consideration been given to a physical 'no dig' barrier? No specification of sampling rates for imported soil has been given."*

It can be confirmed that this version of our RMS (Rev. 4) has been updated to incorporate updates (which have been agreed by representatives of SHDC) for each of the above points as follows:

1. Updates relating to ground gas have been integrated into this report and the main changes may be found in sections 2.4, 6.1 and 6.1.1.
2. Updates relating to capping soil test ratios and the garden membrane have been integrated into this report and the main changes may be found in sections 4.0 and 5.2.

Terms and Conditions

We have obtained and reviewed information relating to the site, but this may not be complete, and liability cannot be accepted for information not available to Elemental GI Ltd at the time of writing this report. This report has been written in consideration of construction / development proposals (or similar) as described in Section 1.0 of this report. If any of these proposals change (e.g. layout), then this report may be subject to change.

This report has been prepared for the sole use and reliance of the Client. No other third party may rely upon or reproduce the content of this report without our prior written approval. If any unauthorised third party comes into possession of this report, they rely upon it entirely at their own risk and the authors do not owe them any warranty, duty of care or skill.

Our report, including the conclusions and recommendations, are considered reasonable based on the findings of the Phase I assessment. However, these cannot be guaranteed to gain regulatory approval and therefore the Client should submit it to them (as necessary) for their comments and approval prior to undertaking any irrecoverable works associated with the subject site.

The findings and recommendations made in this report are based on published information (as presented in the accompanying appendices). Elemental GI Ltd cannot accept responsibility for the reliability and authenticity of published information or reports prepared by third parties. There may be conditions prevailing on site which have not been revealed by this assessment and which have not been taken into account by this report. Responsibility cannot be accepted for any conditions not revealed by this investigation and assessment. It should be noted that groundwater levels etc. may vary due to seasonal and other effects. Whilst it may be utilised by others for reference purposes at the Client's discretion, it has not been prepared for any other purposes (e.g. waste classification, drainage excavations etc.) and therefore additional works may be required by third parties dependent upon their own requirements / works. Any works which are proposed at greater depths than reported herein may require confirmatory investigation works as necessary.

The conclusions and recommendations presented herein are considered reasonable based on the assessments of the site undertaken by Elemental GI Ltd. However, these cannot be guaranteed to gain regulatory approval and therefore copies of this report should be sent to the appropriate regulatory authorities and / or other organisations (as appropriate) by the Client for their comments and approval prior to undertaking any irrecoverable works associated with the site.

The possibility of significant variation in ground conditions existing between / beneath test locations / depths cannot be discounted and must be considered within the design proposals for the subject site. All soakaway designs should be approved by the relevant statutory authority prior to implementation and must adhere to the standard design and ground setting requirements, upon which your appointed drainage design engineers should advise you.

Where comments / recommendations have been made relating to specific depths it cannot be guaranteed that ground conditions shall be similar at surrounding / underlying depths, which should be taken into consideration as necessary by other.

With respect to the document to which this sheet is appended, the warranty provided with our works / reports etc. shall only apply once all invoices that we have sent in relation to the same site / project discussed herein (i.e. the site discussed within this document) have been paid by the Client

Standard Risk Assessment – Considerations and Methodology

Elemental GI Ltd have based our standard risk assessment methodology upon current legislation and prevailing best practice and available guidance. This includes the following:

- DEFRA / EA document 'Contaminated Land Report 11 (CLR11) Model Procedures for the Management of Land Contamination' (2004) [*withdrawn but used for general reference purposes*];
- NHBC / EA / CIEH document 'Guidance for the Safe Development of Housing on Land Affected by Contamination' (2008);
- DEFRA 'Environmental Protection Act 1990: Part 2A – Contaminated Land Statutory Guidance (2012); and
- Environment Agency 'Collection: Land Contamination Technical Guidance (2014) held at:
  - https://www.gov.uk/government/collections/land-contamination-technical-guidance

Construction of Conceptual Site Model

Elemental GI Ltd have based our standard risk assessment methodology upon current legislation and prevailing best practice and available guidance. This includes the assessment of potentially contaminated land in terms of 'significant pollutants' and 'pollutant linkages', using SOURCE-PATHWAY-RECEPTOR' scenarios for the site. For a pollutant linkage to exist all three of these elements must be present. These have been clearly defined in the guidance as follows:

- …..potential source as 'a contaminant which is in, or under the land and which has the potential to cause significant harm or to cause pollution of controlled waters'.
- …..potential pathway as 'one or more routes or means by, or through, which a receptor is being exposed to, or affected by a contaminant, or could be so exposed or affected'.
- …..potential receptor as 'a living organism, a group of living organisms, an ecological system or a piece of property which is being or could be, harmed by a contaminant or controlled waters which are being, or could be, polluted by a contaminant'.

Within this report, pathways including the following have been considered:

- Ingestion of soil;
- Ingestion of site-grown vegetables;
- Ingestion of site-reared livestock / fish;
- Dermal contact with soils;
- Inhalation of vapours;
- Inhalation of soil-derived dust.

The receptors which we have considered are described in Section 1.0 of this report.

Risk Assessment Methodology

Our risk assessment methodology is based upon a phased approach, which takes the following steps:

1. Hazard Identification and Assessment:
    a. Establishing potential contaminant sources through the derivation of initial conceptual site model (CSM); and
    b. Analysing the potential for unacceptable risks (what pathways and receptors could be present, what pollutant linkages could result and what could the effects be).

2. Risk Estimation and Evaluation:
    a. Prediction of the magnitude and probability of the possible consequences;
    b. Investigation of the potential risks;
    c. Completion of Generic Quantitative Risk Assessment (GQRA); and
    d. Evaluation of risks / confirmation of pollutant linkages (leading onto step '3' if identified).

3. Remediation Design / Implementation / Verification:
    a. Completion of Detailed Quantitative Risk Assessment (DQRA) if necessary;
    b. Collation of remedial strategy;
    c. Implementation of remedial strategy / validation; and
    d. Final reporting.

Risk terminology and classification is defined through standard wording and descriptions, as contained in the documents referenced above. This includes the balance, comparison and assessment of risk as a dynamic categorisation / classification of probability vs. possible consequence(s), as shown in the table A1 below:

Table A1: Risk Categorisation

Probability (Likelihood)		Consequence			
		Severe	Medium	Mild	Minor
	High Likelihood	Very High Risk	High Risk	Moderate Risk	Moderate / Low Risk
	Likely	High Risk	Moderate Risk	Moderate / Low Risk	Low Risk
	Low Likelihood	Moderate Risk	Moderate / Low Risk	Low Risk	Very Low Risk
	Not likely	Moderate / Low Risk	Low Risk	Very Low Risk	Very Low Risk

Risk levels are described as follows:

Table A2: Risk Level Descriptions

Term	Description
Very High Risk	A high probability exists that severe / significant harm could arise to someone or something from the hazard which has been identified. Remedial action is required.
High Risk	Harm is likely to arise to someone or something from the hazard which has been identified. Remedial action is usually required.
Moderate Risk	Harm could potentially arise to someone or something from the hazard which has been identified without remedial action, although it is considered to be relatively unlikely that such harm would be severe.
Low Risk	Harm could theoretically arise to someone or something from the hazard which has been identified without remedial action, although it is considered that any effects would be mild.
Very Low Risk	Harm is not likely to arise to someone or something from the hazard which has been identified.

The NHBC / EA / CIEH document 'Guidance for the Safe Development of Housing on Land Affected by Contamination' (2008) defines the following (reproduced verbatim):

"**Severity** (consequence) can be defined as the adverse effects (or harm) arising from a defined hazard, which impairs the quality of human health or the environment in the short or longer term. For example a consequence defined as "Severe" could be defined as "Highly elevated concentrations likely to result in 'significant harm' to human health as defined by the EPA 1990, Part 2A, if exposure occurs". The type and form of the contaminant needs to be known in order to understand the effect on humans and therefore severity of potential harm. For instance different forms of cyanide behave differently. Complex cyanide ("blue billy") is relatively "non toxic" whereas free cyanide is "highly toxic" (Environment Agency 2002b).

Probability can be defined as the chance of a particular event occurring in a given period of time. For example, a "High Likelihood" could be defined as "where an event would appear very likely in the short-term and almost inevitable over the long-term, or there is evidence at the receptor of harm or pollution"."

APPENDIX I

DRAWINGS

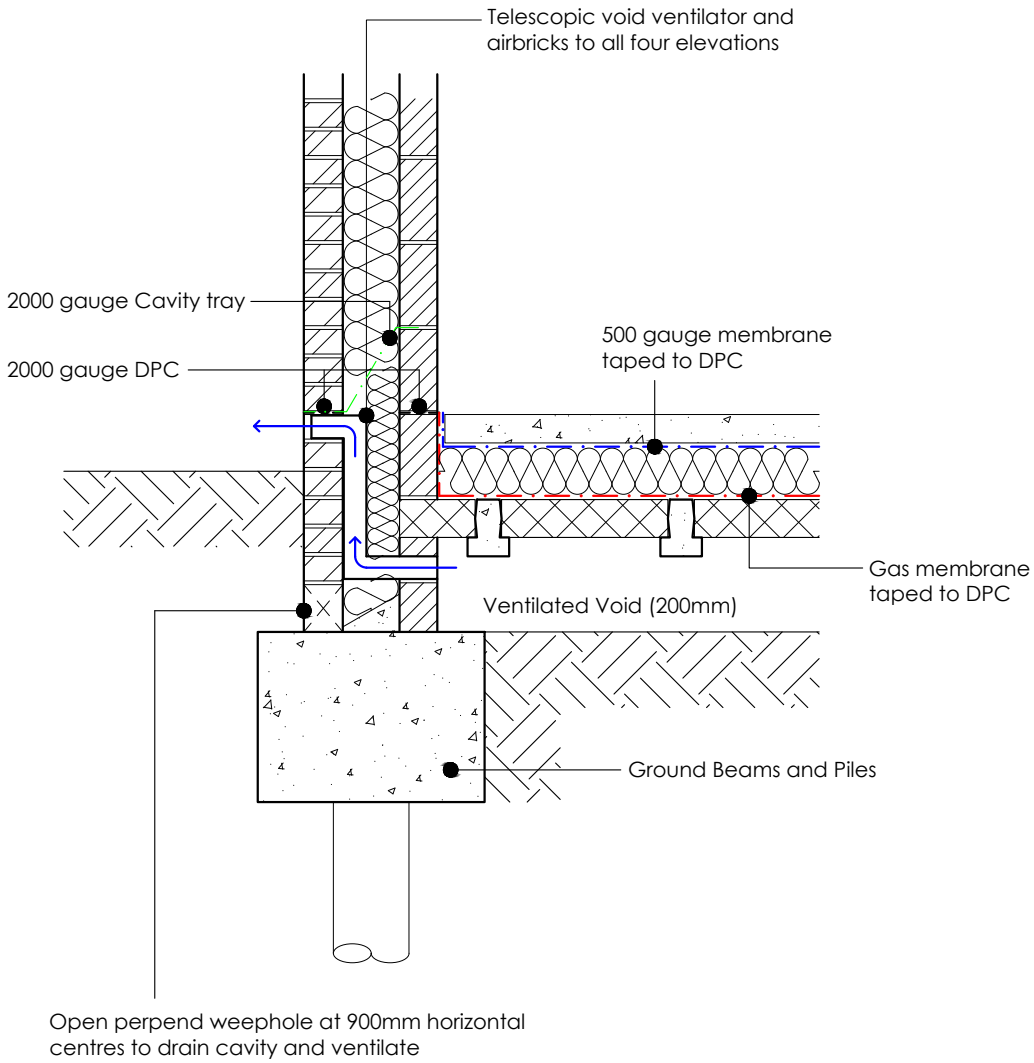


CLIENT:	TITLE:	DATE:	SCALE@SIZE:	
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		DRAWING No: E22208_001	DESIGN/DRAWN: JR	

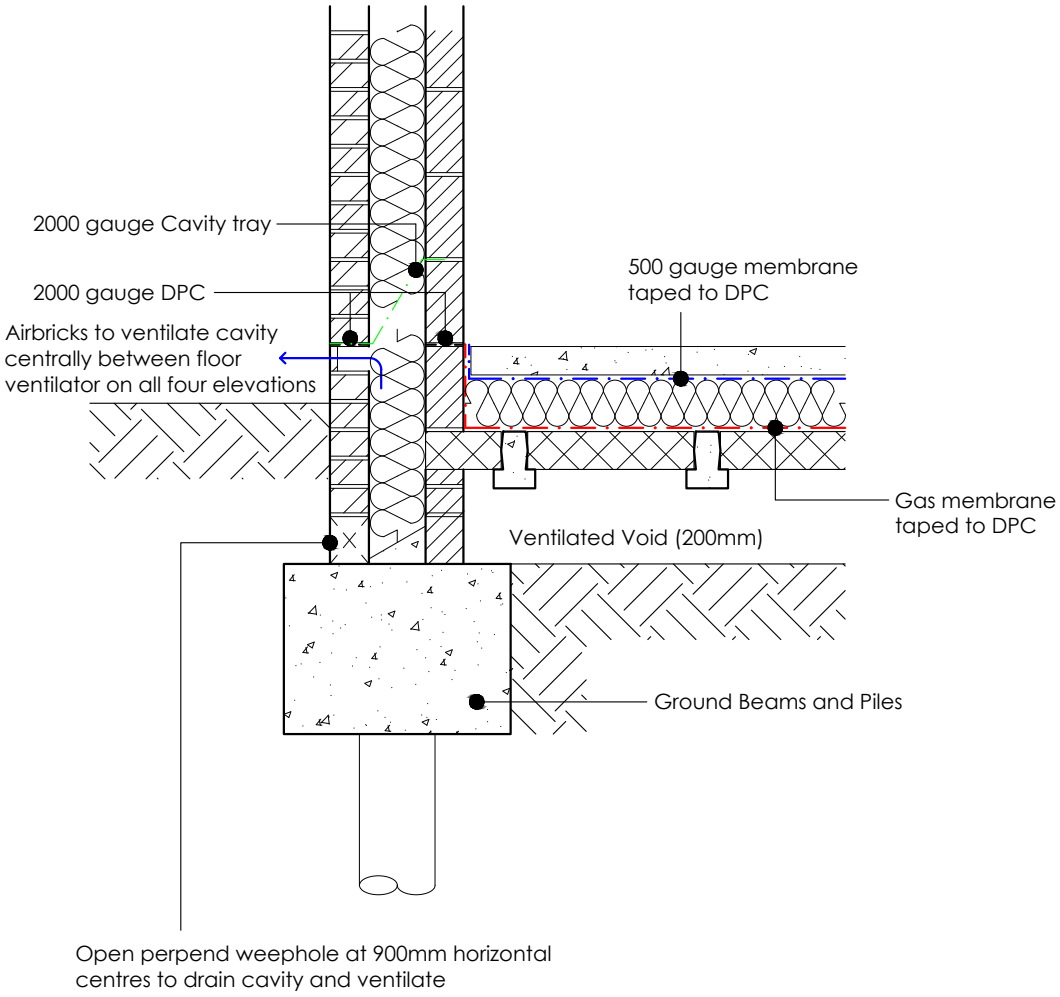


CLIENT: ARK PROPERTY	TITLE: Exploratory Hole Layout Plan	DATE: July 2023	SCALE@SIZE: NOT TO SCALE
		DRAWING No: E22208_005r	DESIGN/DRAWN: JR

Elemental GI Ltd



Section at Telescopic Floor Ventilator
Scale 1:20



Section at Cavity Ventilator

Scale 1:20