



Elemental GI Ltd

REPORT: PHASE 2 GEO-ENVIRONMENTAL
INVESTIGATION FOR SITE OFF ROMAN
BANK, SPALDING

CLIENT: ARK PROPERTY CENTRE

PHASE II GEO-ENVIRONMENTAL INVESTIGATION: SITE OFF ROMAN BANK, SPALDING

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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 following summary until the whole report has been read in full.**

Ground Conditions / Foundations	The site is underlain by variable thicknesses of made ground which is underlain by natural silt / sand soils. Groundwater was recorded beneath the site during the recent investigation and subsequent monitoring. The natural shallow soils are typically of very low strength and will not be suitable to support the proposed multi-storey residential housing on shallow footings. Alternative foundations (e.g. piled foundations) will therefore be required for the proposed development.
Contamination	There are elevated heavy metals, PAHs and asbestos in made ground at the site. Communal gardens and other soft landscaping will need to be capped if the made ground is not removed or otherwise encapsulated, and remediation of asbestos impacted materials by a specialist will also be necessary. Elevated ground gas has been detected and protection measures may be needed in all new buildings at this stage, subject to the completion of further ground gas monitoring visits.
Other issues	Initial drainage feasibility tests indicate that this site is <u>not</u> likely to be suitable to support soakaways.
Recommendations	▪ Completion of further investigation works (as required by specialist contractors / designers) to confirm deeper ground conditions in relation to alternative foundation strategies; ▪ Production of a Remedial Method Statement (RMS) confirm remediation requirements across the site; ▪ Appointment of specialist remediation contractor to advise on asbestos control measures and to undertake remediation of asbestos contaminated materials; ▪ Verification of appropriate utility construction materials with the relevant providers; and ▪ Where soils are to be removed from site for disposal it is recommended that advice is sought from the appointed contractors to determine any requirements for specific testing etc.

1.0 INTRODUCTION

1.1 Report Status

A Phase I Geo-Environmental Assessment has been undertaken for the site by ourselves. Please see section 1.2 below for further information.

Elemental GI Ltd were appointed by Ark Property Centre (hereafter referred to as 'the Client') to undertake a Phase II Geo-Environmental Investigation for Site off Roman Bank, Spalding (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 (multi-storey apartments). We have been supplied with a copy of the proposed layout REF: 562.CSL.01, 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.

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.

1.2 Previous Reports

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

- Elemental GI Ltd: Phase 1 Geo-Environmental Assessment for Site off Roman Bank, Spalding (Ref. E22209/1/0 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

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 developed from open ground in the 1960's (with an adjacent mill encroaching on to the northern areas of the site of a mill from the 1880's). Structures on site from the 1960's are shown to be unlabelled on historic mapping, but the site is assumed to have been developed into an industrial business. Historic mapping shows tanks present in the southern area of the site from 1986 to 1992. From 2010 the site has undergone significant change with no structures present and is now shown to support its current layout.

Our preliminary human health conceptual site model listed potential sources of contamination at the site including made ground, waste materials, historic tanks, asbestos sheeting and off-site made ground and off-site historic industry.

1.3 The Site

The site is situated off Roman Bank, Spalding. The site is roughly centred at National Grid Reference 525747, 323866.

1.3.1 Site:

- The site is approximately 0.05ha in area;
- The site forms a broadly rectangular parcel of land covered mainly by mixed probable demolition materials;
- Wooden fencing was found along the site's northern boundary with heras fencing along the site's western and eastern boundary. Metal sheet fencing was found along the southern boundary;
- The site slopes downward from its eastern boundary towards the centre of the site. Along the western boundary the site starts to slope upward in the direction of a strip of vegetation towards the river's embankment;
- Mixed waste materials including scrap metal, plastics, construction waste and general waste were found on the surface of the ground in the northern area of the site. A metal shed and 2 No. skips were found in the north-western corner of the site containing mixed waste materials;
- Suspected asbestos bound cement sheeting was found in the north-western corner of the site between the metal shed and the site's boundary; and
- 2 No. manhole covers were found along the eastern boundary of the site;
- The site is set within a mixed residential, commercial and industrial area;
- Land to the north of the site supports residential housing;
- Land to the east of the site supports residential housing and Roman Bank (road) beyond which is further residential housing;
- Land to the south of the site supports open land with dense vegetation;

- Land to the west of the site supports an embankment (present at a higher topographical elevation to the site) beyond which the River Welland is found. Beyond this an industrial estate is present; and
- Land in the wider area surrounding the site supports a mix of commercial properties including a supermarket and small businesses, residential housing and industrial premises including a print company and a food manufacturer.

The appendices contained in this report include a Site Location Plan (Drawing 002), Site Features Plan (Drawing 003) and a General Photographic Record (Drawing 004). A Site Investigation Plan is also presented (Drawing 005).

The description of the site provided above is taken following a relatively brief visit and should not be taken as a full and thorough description of all of the site's features, some of which may also have been obscured during our visit in inaccessible areas, hidden by vegetation etc.

2.0 SCOPE OF PHASE II INVESTIGATION

2.1 Potential Areas of Concern

The Phase I Report identified the following potential areas of concern at the site which would merit further inspection / investigation:

- Made Ground,
- Waste Materials;
- Historic Tanks;
- Asbestos Sheeting; and
- Off-Site Historic Industry / Made Ground.

Elemental GI Ltd can confirm that the potential sources / contaminants listed above are reasonable and should remain unchanged.

2.2 Site Investigation Layout

The following exploratory holes have been positioned at the site:

Table 2.1: Site Investigation Layout

Potential Source / Issue	Exploratory Holes
General Site Coverage	ALL HOLES
Historic Tanks	WS05
Made Ground	ALL HOLES
Waste Materials	WS01, WS02
Asbestos Sheeting	WS01
Off-Site Industry / Made Ground	ALL HOLES
Infiltration Feasibility Tests	WS03, WS04
Ground Gas Monitoring Wells	WS01, WS05

Whilst all reasonable efforts will be made to ensure sufficient coverage of the site / potential areas of concern, it should be noted that ground conditions may vary between exploratory positions. The reader is referred to the terms, conditions and notes which are presented at the end of this report in relation to its potential limitations.

All arisings shall be inspected following completion of each exploratory hole, and samples will be selected for analysis on the basis of their appearance (including visual or olfactory evidence of contamination). Elemental GI Ltd shall arrange for samples to be delivered to a suitably accredited laboratory for subsequent testing.

Samples shall be tested for a general range of contaminants (in accordance with NHBC Standards Chapter 4.1 'Land Quality - managing ground conditions' and CLR 8 'Potential Contaminants for the Assessment of Land' (withdrawn but used for reference purposes where applicable)). Where appropriate they shall also be analysed for specific / targeted analyses, and at the subject site this shall include:

- Heavy metals;
- Polycyclic aromatic hydrocarbons (PAHs);
- Phenols;
- pH;
- Total petroleum hydrocarbons (TPH); and
- Asbestos.

3.0 SITE INVESTIGATION WORKS

3.1 Completion of Works

The recent site investigation works were completed by Elemental GI Ltd in general accordance with BS 5930:2015+A1: 2020.

3.2 Site Investigation Details

The exploratory holes were completed by Elemental GI Ltd at the site as listed in Table 2.1 (above). These were completed to a maximum total depth of 5.00m below existing ground level (begl). Table 3.1 (below) presents a summary of the works completed:

Table 3.1: Site Investigation Summary

Exploratory Hole(s) ID	Maximum Final Depth (m)	Notes
WS01 to WS05	5.00	Window Sampler Drilling Locations

A copy of the exploratory hole records from these works is presented in Appendix VI.

3.3 *In Situ* Soakaway Testing

Following completion of drilling, 2 No. exploratory locations (WS03 and WS04) were selected for initial infiltration feasibility testing. In general accordance with BRE365, the 2 No. test locations were measured before being filled (to the surface) with water and subsequently monitored. Table 3.2 below presents a summary of the findings of these works. Exploratory hole logs are enclosed within Appendix VI.

Table 3.2: Soakaway Testing Summary

Exploratory Hole(s) ID	Infiltration Observations	Comments
WS03	Water level fell from 0.00m to 1.09m in 3.5 hrs.	Water levels fell rapidly until they reached c. 1.09m depth, after which significant / rapid discharge was not recorded.
WS04	Water level fell from 0.00m to 0.59m in 2.0 hrs.	Water levels fell rapidly until they reached c. 0.55m depth, after which significant / rapid discharge was not recorded.

It is noted that at both of the test locations the water levels ‘fell’ promptly until they reached a certain depth, after which the rate of discharge reduced suddenly. It is considered likely that the discharge up to these elevations was through granular made ground etc., which provided favourable discharge routes, but the deeper strata / soils provided much reduced infiltration conditions.

At this stage it is considered likely that site soils will not prove suitable for *in situ* drainage options (e.g. soakaways) subject to review by your appointed drainage engineer and regulatory comments, which should be considered cautiously and conservatively within any future drainage strategies.

4.0 GEOTECHNICAL ASSESSMENT

4.1 General Ground Conditions

4.1.1 Made Ground

Made ground was encountered in all areas of the site to a maximum total depth of 1.70m below existing ground level (begl). This generally comprised reworked very gravelly silt overlying either gravel of brick, concrete etc., or reworked natural soils containing variable amounts of concrete, clinker, limestone, ceramic, brick and slag). The made ground at location WS01 was recorded as a sandy silt overlying further made ground of silty sand containing fragments of brick.

Bands of glass, tarmac and other materials were noted locally at some locations within made ground.

4.1.2 Topsoil

Topsoil was not encountered in any of the exploratory holes completed during the recent investigation.

4.1.3 Natural Soils / Bedrock

The natural soils at the subject typically comprised very soft sandy silt or very loose silty sands. These are considered to be representative of the Tidal Flat Deposits.

The soils were recorded at all locations, extending to the base of each exploratory hole.

4.1.4 Groundwater and Stability

Water was recorded at the following locations:

- WS01: Water encountered at 1.70m depth during drilling;
- WS02: Water encountered at 1.77m depth during drilling;
- WS03: Water encountered at 1.38m depth during drilling;
- WS04: Water encountered at 1.41m depth during drilling; and
- WS05: Water encountered at 1.30m depth during drilling.

Return visits undertaken to site so far have recorded water ranging from 0.67m to 1.18m begl in monitoring wells.

Based on the above, it is considered likely that dewatering or other forms of water management will be required for shallow short term excavations at the site.

In general, the exploratory holes which were recently completed as part of our investigation did not exhibit good stability after completion of drilling, with several collapsing shortly afterwards. This should be considered carefully in the context of health and safety and trench

support as part of all future construction works (see Exploratory Hole records presented in Appendix VI for further information).

4.2 Geotechnical Laboratory Testing

The geotechnical laboratory testing was carried out in general accordance with BS EN 14688 ‘Geotechnical Investigation and Testing - Identification and Classification of Soil’. Full details of the test results are presented in Appendix VI.

Table 4.1 (below) presents a summary of the plasticity index (PI) testing completed:

Table 4.1: Summary of Plasticity Testing

Exploratory Hole ID	Depth (m)	Strata*	Modified PI Result (%)
WS01	1.40	Silty Clay.	19.0 (Low)
WS04	3.00	Sandy Clay.	11.0 (Low)

*Please note that this is a laboratory description as shown on the test certificates and it may not be compliant with BS:5930

Based on the above results, the cohesive soils on site have been assigned an overall low volume change potential.

Selected soil samples were analysed to determine their particle size distribution. Results are presented in Appendix VI. It is noted from these tests that soils were variable in their composition (specifically in terms of their silt and sand content) and therefore additional grading tests to confirm particle size distributions are recommended where further works are completed at the site (e.g. deeper drilling for pile design etc.).

4.3 In Situ Testing

Equivalent SPTs (standard penetration tests) were undertaken in all boreholes at appropriate depths at the site. The following results were recorded:

Table 4.2: In Situ SPT ‘N’ Value Results v Strata Type

Strata	‘N’ Value Range Reported	Comment
Made Ground	6 to 9	N/A
Natural Sand / Silt	1 to 26	Generally Very Loose / Very Soft

In general, it was noted that SPT results generally varied with depth. However, significantly higher SPT N values were recorded at 5.0m depth at locations WS04 and WS05, with values in excess of 20 reported.

4.4 Geotechnical Assessment

It is understood that the site is to be redeveloped to support a residential end use. The following potential hazards have been identified at the site which may need to be considered by developers and their partners (including groundworkers, designers and other specialist engineers):

- Granular Soils / Groundwater - Granular soils and / or soils which may exhibit engineering properties of granular soils are present beneath the site. Groundwater is also present beneath the site. Alternative foundation strategies should be considered as groundwater will reduce the bearing capacity of these materials.
- Variable Ground Conditions - Selected soil samples were analysed to determine their particle size distribution. Results are presented in Appendix VI. It is noted from these tests that soils were variable in their composition (specifically in terms of their silt and sand content) and therefore additional grading tests to confirm particle size distributions are recommended where further works are completed at the site (e.g. deeper drilling for pile design etc.).
- Soft / Loose Soils - Very soft / loose soils have been encountered across the site. These will need to be taken into account as part of any redevelopment.
- Made Ground / Buried Structures - Made ground has been encountered across parts of the site. Foundations will need to be deepened to bear on the undisturbed natural strata where made ground is identified.
- Services / Obstructions - Foundations / layouts may need to compensate for / avoid these features appropriately, or alternatively diversions etc. may be required.

4.5 Foundation Recommendations

Untreated made ground and low strength natural soils are typically considered unsuitable as a bearing stratum and all new foundations should be carried down through them to found on more competent natural strata. Based on the findings of the recent investigation works it is considered likely that piled foundations terminating within suitable natural are likely to be suitable for the proposed multi-storey residential end use. It is recommended that all such foundations must be deepened through all made ground and locally soft / loose shallow natural soils to terminate within deeper / competent natural soils. Due to the depth of soft / loose soils recorded during our initial investigation works, alternative foundation options such as piling will therefore be required at this site. It is recommended that advice should be sought from specialist contractors, who are likely to require additional investigation of deeper ground conditions (deep drilling).

It is strongly recommended that the specialist piling contractors should liaise with remediation contractors and regulators to ensure that risks from the creation of contamination pathways for hydrocarbons are avoided during completion of piling.

Foundations terminating within cohesive soils or within an influencing depth of cohesive soils would usually need to be deepened within the influencing distance of trees due to the recorded low volume change potential of cohesive soils, although this may not be a significant issue if alternative (piled) foundation options are considered although heave precautions etc. may still need to be considered.

Further caution is recommended with regards to other construction works and features (e.g. service / drainage runs), which may also require consideration of some sort of ground improvement / piling support, which you should discuss with your appointed relevant specialist designers.

5.0 ENVIRONMENTAL ASSESSMENT

5.1 Selection of Screening Values

The current UK screening values for the comparison of soil test data are presented by DEFRA within their 'Category 4 Screening Levels' (C4SLs). This includes screening values for a selected range of end-uses for 6 No. determinands, and is supplemented by the CL:AIRE 'Phase 2 C4SLs', which provide screening values for a further 3 No. determinands. These screening values have been derived using an LLTC and are used as the primary comparison for risks from determinands within soil samples from the site. Where appropriate we have also reviewed and utilised screening values from other authoritative parties (e.g. LQM, CIEH etc.) who have calculated further screening values for additional determinands, although it is noted that these providers typically generate screening values which are based upon health criteria values (HCVs; as opposed to LLTCs) which represent a lower (minimal) risk level and are therefore more conservative.

A review of the proposed site layout (shown on the Proposed Site Layout Plan (Drawing 001) in Appendix I) indicates that the site will not support significant / extensive areas of soft landscaping, or private gardens although communal soft landscaped areas are present. At this stage screening values which assess the concentrations of determinands in comparison to a residential without plant uptake end-use have therefore been adopted, which is considered to be appropriate for the proposed end-use at the site. However, alternative screening values (e.g. Public Open Space 1 or 2) may also be used where appropriate.

5.2 Environmental Laboratory Testing

Soil samples from the site were retrieved and submitted for laboratory analysis in accordance with Section 2.2 and Table 2.1 of this report.

Laboratory testing certificates are presented in Appendix VII, with Table 5.1 (overleaf) presenting a summary of the test data.

Table 5.1: Laboratory Analysis of Soil Samples

Analyte	Concentrations Detected (mg/kg)	Screening Values (mg/kg)	No. of Samples	No. of Exceedances
Arsenic	4.70 - 78.0	40.0 ^b	5	1
Cadmium	<0.1 - 1.2	85.0 ^b	5	0
Chromium (Total)	14.0 - 44.0	910.0 ^b	5	0
Chromium VI	<0.50*	6.0 ^b	5	0
Lead	34.0 - 540.0	310.0 ^a	5	2
Selenium	0.43 - 1.50	430.0 ^b	5	0
Nickel	13.0 - 78.0	180.0 ^b	5	0
Copper	15.0 - 280.0	7100.0 ^b	5	0
Zinc	29.0 - 830.0	3700.0 ^b	5	0
Mercury	0.11 - 0.74	1.2 ^b	5	0
Benzo(a)pyrene	<0.1 - 31.0	3.2 ^b	5	1
Dibenzo(a,h)anthracene	<0.1 - 2.80	0.31 ^b	5	2
TPH Aliphatic EC ₅ -EC ₆	<0.05	42.0 ^b	5	0
TPH Aliphatic EC ₆ -EC ₈	<0.10	100.0 ^b	5	0
TPH Aliphatic EC ₈ -EC ₁₀	<0.05 - 0.99	27.0 ^b	5	0
TPH Aliphatic EC ₁₀ -EC ₁₂	2.0 - 78.0	130.0 ^b	5	0
TPH Aliphatic EC ₁₂ -EC ₁₆	1.0 - 140.0	1100.0 ^b	5	0
TPH Aliphatic EC ₁₆ -EC ₃₅	5.0 - 216.0	65000.0 ^b	5	0
TPH Aromatic EC ₅ -EC ₇	<0.05*	370.0 ^b	5	0
TPH Aromatic EC ₇ -EC ₈	<0.05*	860.0 ^b	5	0
TPH Aromatic EC ₈ -EC ₁₀	<0.05 - 0.24	47.0 ^b	5	0
TPH Aromatic EC ₁₀ -EC ₁₂	1.0 - 66.0	250.0 ^b	5	0
TPH Aromatic EC ₁₂ -EC ₁₆	1.0 - 92.0	1800.0 ^b	5	0
TPH Aromatic EC ₁₆ -EC ₂₁	2.0 - 50.0	1900.0 ^b	5	0
TPH Aromatic EC ₂₁ -EC ₃₅	2.0 - 44.0	1900.0 ^b	5	0
Benzene	<0.01*	0.380 ^b	5	0
Toluene	<0.01*	880.0 ^b	5	0
Ethylbenzene	<0.01 - 0.03	83.0 ^b	5	0
Xylene (sum of isomers)	<0.01 - 0.01	79.0 ^b	5	0
pH	7.5 - 8.4	N/A	N/A	N/A
Asbestos	ND - D	D ^c	3	2

^a DEFRA C4SL values for a Residential end-use without gardens;

^b Third party UK screening values e.g. CIEH, CL:AIRE, Elemental GI Ltd and LQM 'S4UL' values for a residential end-use without private gardens (licence S4UL3849);

^c Elemental GI Ltd general screening level;

^d See sections below table

* Contaminants all recorded below laboratory limits of detection; and
DL = Detection Limits, N/A = Not Applicable, ND = Not Detected, D = Detected.

Table 5.1 has identified the following exceedances in relation to the selected screening values (residential without private gardens):

- 1 No. exceedance of arsenic comprising:
 - Samples from WS02 of made ground at 1.00m begl;
- 2 No. exceedances of lead including:
 - Samples from WS02 of made ground at 1.00m begl; and
 - Samples from WS05 of made ground at 0.50m begl.
- 2 No. exceedances of PAHs (benzo(a)pyrene and dibenzo(a,h)anthracene) including:
 - Samples from WS02 of made ground at 1.00m begl; and
 - Samples from WS05 of made ground at 0.50m begl.
- 2 No. detections of asbestos including:
 - Samples from WS02 of made ground at 1.00m begl; and
 - Samples from WS05 of made ground at 0.50m 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.

Given the site's history it is possible that currently unidentified areas of contamination or potentially contaminative features may be present which will be encountered during redevelopment. Please contact us for further advice immediately if this happens.

5.3 Sulphate Classification

In accordance with BRE Guidance Special Digest 1 (2005) for soils assuming mobile groundwater conditions and a brownfield site, the characteristic values of water soluble sulphate concentration and pH for soils indicates a Design Sulphate Class DS-1 and an Aggressive Chemical Environment for Concrete (ACEC) classification of AC-1. Minimum concrete specification should be in accordance with NHBC Standards, Section 3.1.

Additional testing / classification of deeper soils is likely to be required to confirm the status of these materials in relation to deeper foundations (e.g. piles).

5.4 Statistical Assessment

Statistical assessment of soil test data is only appropriate where a sufficient sample population is present. This requires a minimum number of soil samples from the same averaging zone. The data currently available for the subject site is not considered to be suitable for statistical assessment as the results may not prove reliable. As a conservative alternative the direct comparison of soil test data to the selected screening values (as outlined in the sections above) shall be adopted at this stage.

5.5 Radon and 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 comprising:

- Potential made ground beneath the site and in surrounding areas which may be present associated with historic industrial activities;
- Potential made ground / unknown construction materials forming the adjacent embankment of the River Welland;
- Potential peat layers that may be present within the superficial deposits underlying the site and nearby; and
- Organic materials which may have accumulated beneath and around the River Welland running alongside the western site boundary.

An initial ground gas monitoring exercise comprising 3 No. gas monitoring visits was therefore commissioned by the Client to assess potential risks further. A copy of our gas monitoring records taken to date is presented in Appendix VIII. In summary the following concentrations / flows have been recorded thus far:

- Carbon dioxide (CO₂) recorded up to a maximum of 4.4% v/v;
- Methane (CH₄) recorded up to a maximum of 0.0% v/v;
- Oxygen (O₂) recorded to range from 18.5% v/v and 19.5% v/v; and
- Flow recorded up to a maximum of 3.0 l/hr.

It is noted that the highest ground gas concentration (CO₂ at 4.4% v/v in WS01) was not recorded in the same location as the highest flow rate (3.0 l/hr in WS05), although the combined / overall worst-case volumetric flow rate which combines these readings has been used at this stage (producing a flow rate of 0.132 l/hr). It is also noted that the flow rate was recorded within a 'flooded' borehole in which the water levels were higher than the 'slotted' pipe. Further monitoring may allow the classification to be downgraded if these factors can be shown to be anomalous / unrepresentative, although at this stage in accordance with our standard ground gas assessment methodology the site would be indicatively classified as:

- CS2 or Amber 1

At this stage ground gas protection measures may therefore be required for new structures at the site based on the initial gas monitoring results.

The actual ground gas precautions used will depend upon final monitoring results, construction details and regulatory / warranty provider approval. However, for general reference purposes it can be confirmed that CIRIA C665 (one of the main ground gas assessment documents) recommends the following general precautions for this classification:

- Suitable, unobstructed and correctly installed adequate external venting to be present (i.e. in accordance with relevant guidance), such as ‘periscope’ venting;
- All joints and penetrations sealed and with either;
- Reinforced concrete cast *in situ* floor slab (suspended, non-suspended or raft) with suitable membrane and underfloor venting; or
- Beam and block or pre-cast concrete floor with suitable membrane and underfloor venting.

Other assessment / guidance documents (e.g. BS8485) may be used in the final classification / design reports.

Whilst analysis of soil samples has not recorded elevated concentrations of TPH / BTEX, it is recommended that future structures should incorporate sub-floor venting and properly-fitted hydrocarbon resistant membranes (i.e. generally fitted in accordance with a ‘CS2’ classification) into their construction to fully ensure that residual risks from hydrocarbons are not present following completion of redevelopment works.

6.0 UPDATED CONCEPTUAL SITE MODEL

The initial CSM was formed to set a basis for the assessment and investigation across the subject site. This has been used to provide focus and direction for certain parts of the site investigation works, and the data gathered from these works (including laboratory analyses and visual / olfactory observations) can now be used to update the CSM.

6.1 Human Health CSM

The site was developed from open ground in the 1960's (with an adjacent mill encroaching on to the northern areas of the site of a mill from the 1880's). Structures on site from the 1960's are shown to be unlabelled on historic mapping, but the site is assumed to have been developed into an industrial business. Historic mapping shows tanks present in the southern area of the site from 1986 to 1992. From 2010 the site has undergone significant change with no structures present and is now shown to support its current layout.

The site is underlain by variable thicknesses of made ground which is underlain by natural silt / sand soils. Groundwater was recorded beneath the site during the recent investigation and subsequent monitoring.

The laboratory testing of soil samples indicated that the following exceedances are present in relation to the chosen initial screening values:

- 1 No. exceedance of arsenic comprising:
 - Samples from WS02 of made ground at 1.00m begl;
- 2 No. exceedances of lead including:
 - Samples from WS02 of made ground at 1.00m begl; and
 - Samples from WS05 of made ground at 0.50m begl.
- 2 No. exceedances of PAHs (benzo(a)pyrene and dibenzo(a,h)anthracene) including:
 - Samples from WS02 of made ground at 1.00m begl; and
 - Samples from WS05 of made ground at 0.50m begl.
- 2 No. detections of asbestos including:
 - Samples from WS02 of made ground at 1.00m begl; and
 - Samples from WS05 of made ground at 0.50m begl.

In accordance with our standard risk assessment methodology (presented at the end of this report), the following sources, pathways and receptors have been identified at the subject site at this stage (see overleaf):

Table 6.1: Updated Human Health CSM

<i>Investigated Onsite Sources</i>	Pathways	Receptors	Comment / Risk Rating [#]
Made Ground	• Migration in Soils • Groundwater • Ground Gas Migration • Direct Contact • Plant Uptake • Dust Inhalation • Ingestion	• End Users • Groundwater	MODERATE Elevated Concentrations of Heavy Metals, PAHs and Asbestos Recorded. Remedial Works Are Required.
Waste Materials	• Migration in Soils • Groundwater • Ground Gas Migration • Direct Contact • Plant Uptake • Dust Inhalation • Ingestion	• End Users • Groundwater	LOW Removal From Site by Specialists for Appropriate Disposal is Required
Historic Tanks	• Migration in Soils • Groundwater • Vapour Migration • Direct Contact • Plant Uptake • Ingestion	• End Users • Groundwater	LOW Laboratory Analysis Shows that Concentrations are Below Human Health Screening Values
Asbestos Sheeting	• Migration in Soils • Dust Inhalation	• End Users	LOW Removal From Site by Specialists for Appropriate Disposal is Required
<i>Investigated Offsite Sources</i>			
Made Ground (Offsite)	• Migration in Soils • Groundwater • Ground Gas Migration	• End Users • Groundwater	ABSENT / LOW No Issues Identified
Historical Industry	• Migration in Soils • Groundwater • Ground Gas Migration	• End Users • Groundwater	ABSENT / LOW No Issues Identified

[#] Risk ratings are described in Table A1 within the 'Standard Risk Assessment - Considerations and Methodology' section at the end of this report.

6.2 Potential Pollutant Linkages:

For an identified / confirmed pollutant linkage to be present, potential sources, pathways and receptors must be present. With reference to the proposed residential end use, feasible potential pollutant linkages have been identified at the site as outlined in table 6.1 above. Remediation works are therefore considered necessary to break these linkages to the satisfaction of the Client and regulatory authorities (and other parties, as appropriate e.g. NHBC).

6.3 Controlled Waters Summary

The site is primarily set upon an 'Unproductive aquifer'. The site is not recorded to be within an Environment Agency Source Protection Zone. There are no abstraction licences recorded within a 500m radius of the site. Abstractions for potable water are not recorded locally. The nearest surface water feature is the River Welland which is situated 16m west of the site.

As summarised in section 6.1, exceedances have been recorded within soils at the site although these are for relatively immobile compounds (heavy metals, asbestos and PAHs) within stable materials in made ground, which are likely to have a very low mobility / leaching potential. Soil test results have also not recorded elevated concentrations of TPH hydrocarbons in relation to human health screening values. However, a hydrocarbon sheen and odour was observed in some soil samples during the recent site works, and groundwater exhibited similar impacts in some areas. Whilst the results recorded to date are below the human health screening values it is considered likely that the regulators (and their consultees) may require confirmation that controlled waters are not being impacted through the sampling and analysis of groundwater from the site.

6.4 Model Status and Uncertainty

The potential significant linkages discussed in this section are based on available data reviewed to date.

7.0 RECOMMENDATIONS

A review of the available site information (as discussed herein) has been undertaken to inform the following conclusions and recommendations. However, this report should be submitted to the appropriate regulators (and other stakeholders, as necessary) by the Client prior to the start of any irrecoverable works associated with the site.

7.1 Foundations and Enabling Works

Untreated made ground and low strength natural soils are typically considered unsuitable as a bearing stratum and all new foundations should be carried down through them to found on more competent natural strata. Based on the findings of the recent investigation works it is considered likely that piled foundations terminating within suitable natural soils are likely to be suitable for the proposed multi-storey residential end use. It is recommended that all such foundations must be deepened through all made ground and locally soft / loose shallow natural soils to terminate within deeper / competent natural soils. Due to the depth of soft / loose soils recorded during our initial investigation works, alternative foundation options such as piling will therefore be required at this site. It is recommended that advice should be sought from specialist contractors, who are likely to require additional investigation of deeper ground conditions.

It is recommended that the specialist piling contractors should liaise with remediation contractors and regulators to ensure that risks from the creation of contamination pathways for hydrocarbons are avoided during completion of piling.

Please see section 4.0 for further information.

7.2 Groundwater

Water is generally present at shallow depths beneath the site. At this stage it is considered likely that dewatering (or similar) will be required for excavations during construction. Consideration must be given to the management of potentially contaminated water removed from excavations.

Please see section 6.0 for further information.

7.3 Road Construction

Literature sources typically suggest that CBR values of less than 2% can be anticipated in the made ground and topsoil and values between 2% and 5% can be anticipated in the underlying natural soils subject to *in situ* testing. All road construction proposals should be agreed with the Local Authority prior to finalising designs, and it is recommended that the soft natural soils encountered at the subject site should be assessed specifically and cautiously with regards to roads, services etc.

7.4 Drainage

Elemental GI Ltd completed initial *in situ* drainage feasibility testing at selected locations at the site during the recent investigation. It was noted that water discharge rates appeared to slow significantly at certain shallow elevations during testing, potentially indicating that natural soils are not capable of supporting *in situ* soakaway devices. It was also noted that the elevation(s) of groundwater recorded in some areas of the site would be likely to significantly reduce the attenuation potential of any water discharged to the ground through soakaways. These comments should be discussed with your appointed drainage engineer, but at this stage it is considered that the soils beneath the site would not be suitable for *in situ* soakaways.

7.5 Radon and Ground Gas

The site is not set within an area which is known to be at risk from radon gas and therefore no precautions are necessary, subject to regulatory approval.

An initial ground gas monitoring programme has been commissioned for the site comprising 3 No. visits. Elevated ground gas flow rates have been recorded during 1 No. visit which would indicatively indicate a 'CS2' or 'Amber 1' ground gas classification. At this stage it is considered likely that ground gas protection measure would be recommended to a 'CS2' classification level, subject to regulatory approval and completion of final monitoring visits.

Further monitoring may allow this classification to be reduced, although we have recommended the incorporation of a hydrocarbon resistance membrane and ventilated sub-floor void regardless to fully mitigate risks to future residents from residual hydrocarbons beneath the site as a precautionary measure.

7.6 Excavations

In general, the exploratory holes which were recently completed as part of our investigation did not exhibit good stability after completion of drilling, with several collapsing shortly afterwards. This should be considered carefully in the context of health and safety and trench support as part of all future construction works (see Exploratory Hole records presented in Appendix VI for further information). All future excavations should therefore be assumed to be unstable as a conservative and risk-averse measure. The Client and / or site operators should assess risks associated with entry into excavations based upon these observations and should apply suitably safe working practices / support measures (in accordance with current best practice / guidance) to avoid risks to site workers / construction activities.

It is also recommended that the conditions which were encountered at the site should be assessed by the Client and their appointed groundworkers etc. in relation to future excavations of foundations, utility / service trenches etc. Further inspections (i.e. to assess

trench stability) should also be undertaken by other stakeholders as required by them to confirm specific ground conditions to their own satisfaction.

7.7 Contamination

The Phase II Conceptual Model and the Qualitative Risk Assessment outlined herein indicate that feasible pollutant linkages have been identified. This relates to elevated concentrations of various PAH compounds, heavy metals and asbestos in made ground samples. Analysis of soil samples indicates that the odour / staining noted during our site works was not accompanied by exceedances of the human health specific screening values, although some precautionary remedial measures / construction considerations have been recommended to fully mitigate any risks from residual hydrocarbons beneath the site.

With regards to the detections of asbestos, any future construction works must fully consider the risks from cross-contamination and creation of 'pathways'. Recommendations and guidance should be sought by the Client from specialist remediation / asbestos contractors who should be appointed to prepare the site before and during construction works.

7.8 Remediation

Remediation works to protect human health are considered necessary. It is recommended that a remedial method statement (RMS) is produced to guide future remedial works.

A review of the proposed site layout (shown on the Proposed Site Layout Plan (Drawing 001) in Appendix I) indicates that the site will not support significant / extensive areas of soft landscaping, or private gardens although communal soft landscaped areas are present. The majority of contaminated materials shall therefore be encapsulated by buildings / hardstanding etc., although it is considered that external soft landscaped areas shall require remedial works subject to confirmation of final levels (i.e. if ground levels are raised significantly then these materials may be encapsulated by construction materials, breaking the related exposure pathways).

Some suspected asbestos containing materials will still require removal from site under controlled conditions as part of the development works. This includes the waste materials present at the site which have been 'tipped', and potentially any contaminated made ground materials which are removed from the ground as part of the construction works.

Pending confirmation of the above, capping of communal soft landscaping will be required. Works associated with the disturbance / removal of asbestos will need to be undertaken by a specialist remediation contractor, who should also be able to provide advice on general precautions associated with construction works in relation to the control / suppression of potentially contaminated dusts and other cross-contamination risks.

7.9 Topsoil

Topsoil was not encountered during the recent investigation, and importation of additional topsoil is therefore considered likely to be necessary.

As with all schemes / sites, all movements of soils (including their re-use on site, importation and exportation) must be undertaken in full compliance with all relevant licenses / permits / exemptions etc. as applicable (i.e. U1, MMP etc) and with all necessary regulatory permissions. Retrospective implementation of such applications may not be permitted and therefore this should be established by the Client prior to the start of construction works.

Any soils which are brought onto site should be suitably tested and approved by the Local Authority in advance (this may include classification of 'topsoil' against standards such as BS3882: 2015 'Specification for Topsoil').

7.10 Further Works

Further works have been recommended in this report, including the following main recommendations:

- Completion of further investigation works (as required by specialist contractors / designers) to confirm deeper ground conditions in relation to alternative foundation strategies;
- Production of a Remedial Method Statement (RMS) confirm remediation requirements across the site;
- Appointment of specialist remediation contractor to advise on asbestos control measures and to undertake remediation of asbestos contaminated materials;
- Verification of appropriate utility construction materials with the relevant providers; and
- Where soils are to be removed from site for disposal it is recommended that advice is sought from the appointed contractors to determine any requirements for specific testing etc.

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. Whilst we have endeavoured to assess and investigate the site in accordance with the scope of these works, it always remains possible that ground conditions will vary between and beneath locations. This may include ground type, strength and groundwater conditions. There may therefore 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

Elemental GI Ltd - Our Standard Risk Assessment Approach

We have used various guidelines and current legislation in the preparation of this report. This includes (but is not limited to) 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 'Land contamination risk management (LCRM)' (2020, last updated April 2021) held at:
 - <https://www.gov.uk/government/publications/land-contamination-risk-management-lcrm>

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, common pathways including (but not limited to) the following have been considered (amended on a site-specific basis):

- 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.

Receptors will be considered on a site-specific basis, but will usually include the current / future users of the site itself as well as users of surrounding sites. Other receptors including controlled waters will also be considered and assessed.

Risk Assessment Methodology

Our risk assessment methodology is based upon a phased approach which is created through the construction of the sites conceptual site model, and which takes the following steps (taken from LCRM Guidance):

1. *Identify the hazard - establish contaminant sources.*
2. *Assess the hazard - use a source-pathway-receptor (S-P-R) linkage approach to find out if there is the potential for unacceptable risk.*
3. *Estimate the risk - predict what degree of harm or pollution might result and how likely it is to occur by using the tiered approach to risk assessment.*
4. *Evaluate the risk - decide whether a risk is unacceptable.*

The meaning of the terms are:

- *hazard - a property or situation that in particular circumstances could lead to harm or pollution;*
- *risk - a combination of the probability, or frequency of occurrence of a defined hazard and the magnitude of the consequences of the occurrence;*
- *risk assessment - the formal process of identifying, assessing and evaluating the health and environmental risks that may be associated with a hazard;*
- *risk management - the formal process to identify, assess and determine the risks, and to select and take action to mitigate them.*

Our definitions and classification matrix for risk descriptions have been taken from the NHBC document “Guidance for the Safe Development of Housing on Land Affected by Contamination” (Ref. R&D P66, dated 2008)

Table A1: Risk Categorisation (Adapted from Table 1.8 of NHBC, R&D P66 (2008))

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

The R&D P66 document goes on to provide further descriptions of these risk levels, which are also reproduced below:

Table A2: Risk Level Descriptions (Adapted from Table 1.9 of NHBC, R&D P66 (2008))

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 <u>unlikely</u> 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.

APPENDIX I

Proposed Site Layout Plan

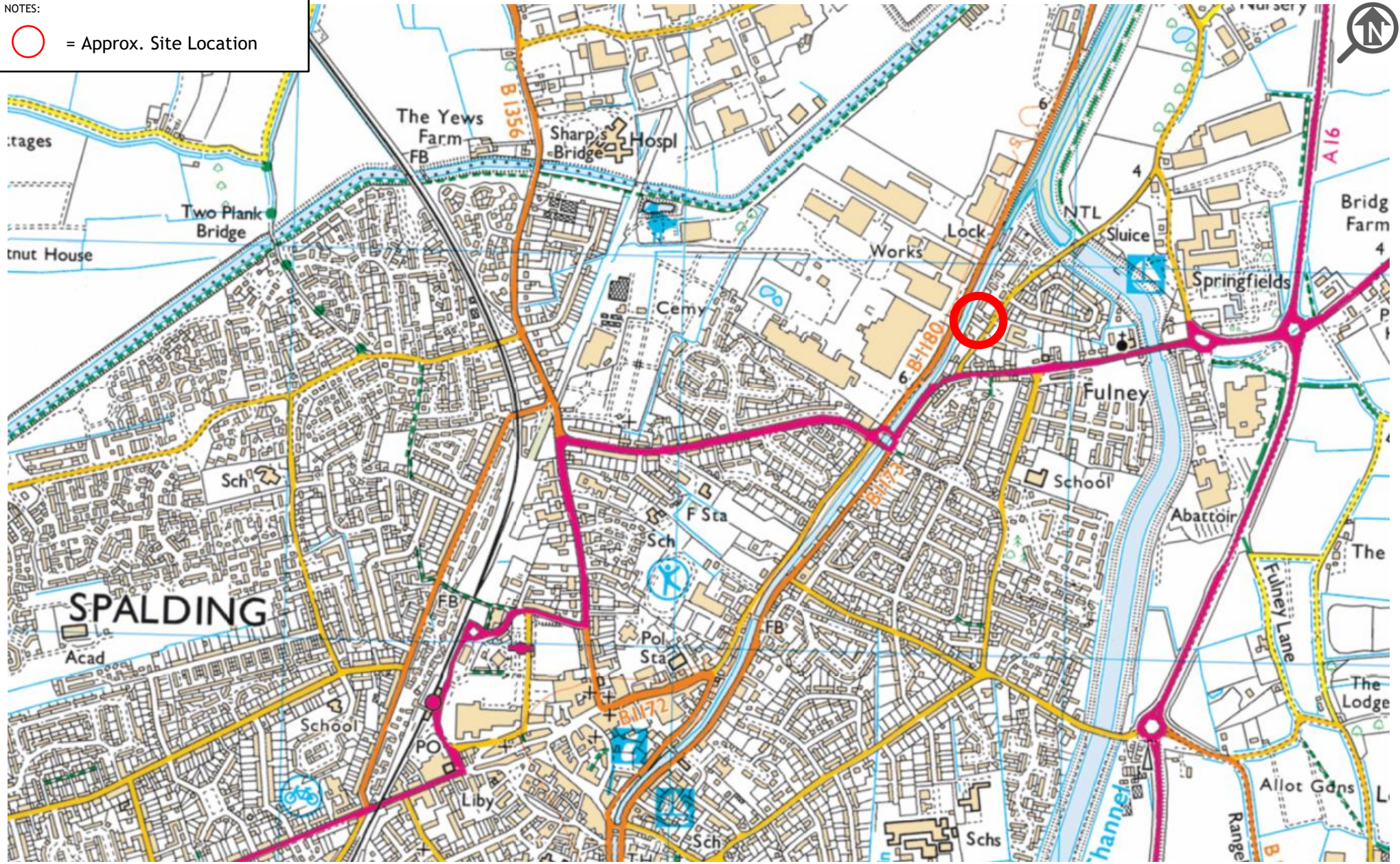


CLIENT: 	TITLE: Proposed Site Layout Plan	DATE: Jan. 2023	SCALE@SIZE: NOT TO SCALE	Elemental GI Ltd
		DRAWING No: E22209_001	DESIGN/DRAWN: JR	

APPENDIX II

Site Location Plan

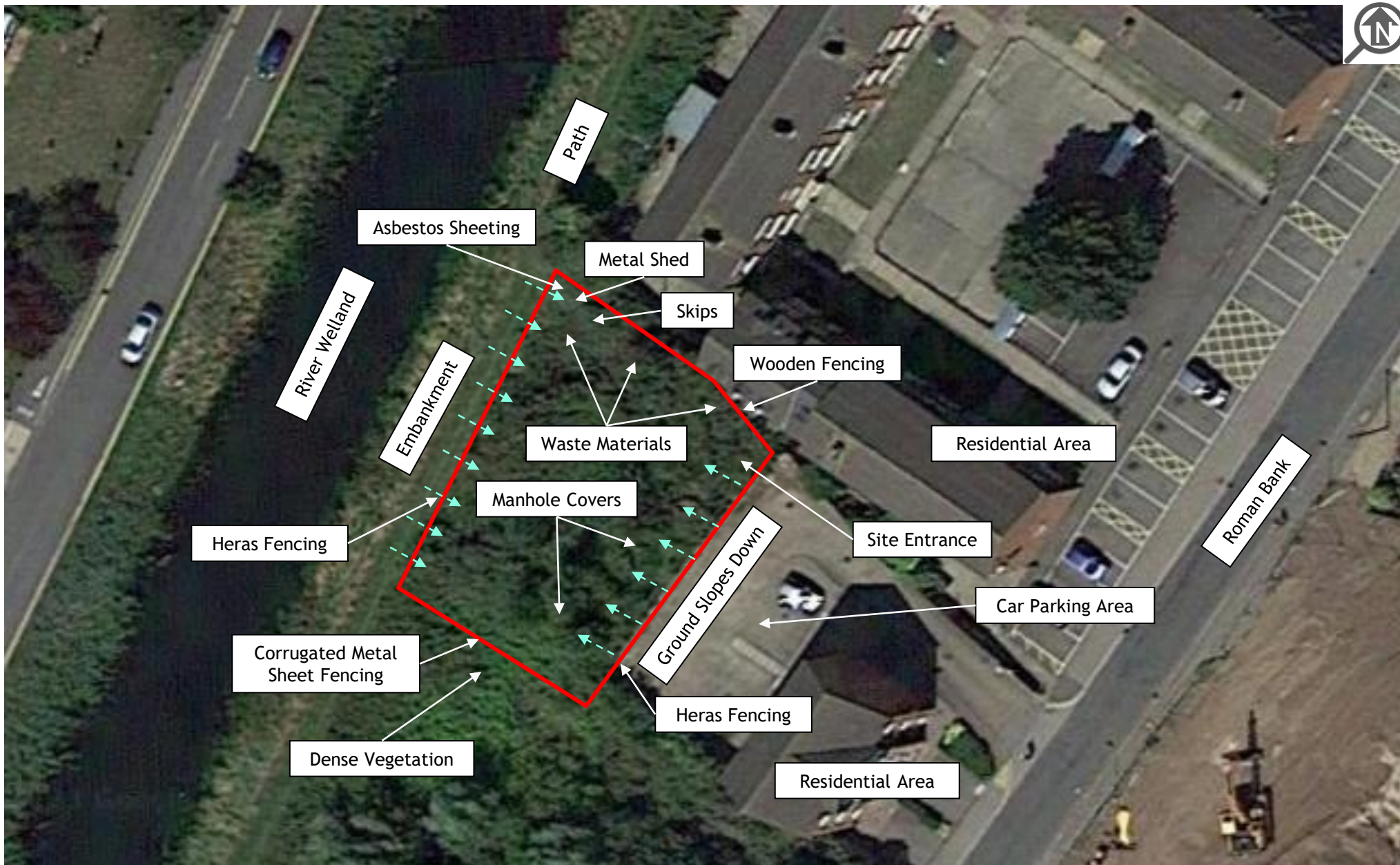
NOTES:
 = Approx. Site Location



	TITLE: Site Location Plan	DATE: Jan. 2023	SCALE@SIZE: NOT TO SCALE	
		DRAWING No: E22209_002	DESIGN/DRAWN: JR	

APPENDIX III

Site Features Plan



CLIENT: 	TITLE: Site Features Plan	DATE: Jan. 2023	SCALE@SIZE: NOT TO SCALE	Elemental GI Ltd
		DRAWING No: E22209_003	DESIGN/DRAWN: JR	

APPENDIX IV

General Photographic Record



Photo 1 - View of Site Entrance.



Photo 2 - View Overlooking Site Southwards.



Photo 3 - View Overlooking Site Eastwards.



Photo 4 - View Overlooking Site Northwards.

CLIENT:



TITLE:

General Site Photographs

DATE:

Jan. 2023

DRAWING No:

E22209_004a

SCALE@SIZE:

NOT TO SCALE

DESIGN/DRAWN:

JR

Elemental GI Ltd



Photo 5 - Photo of Shed, Skips and Waste Materials.



Photo 6 - Asbestos Sheetting Found in North-Western Corner.



Photo 7 - WS05.



Photo 8 - WS01.

CLIENT:



TITLE:

General Site Photographs

DATE:

Jan. 2023

DRAWING No:

E22209_004b

SCALE@SIZE:

NOT TO SCALE

DESIGN/DRAWN:

JR

Elemental GI Ltd

APPENDIX V

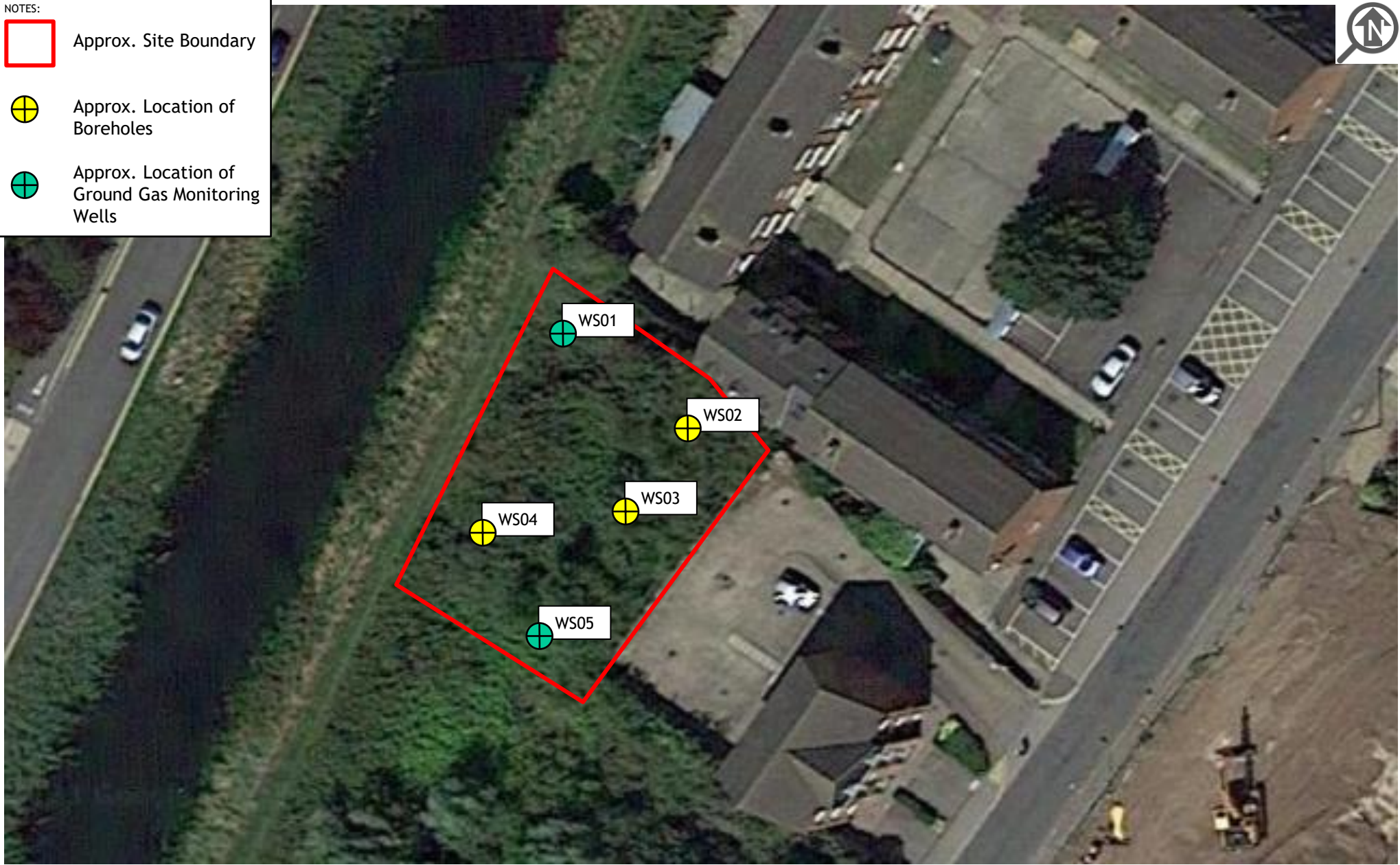
Site Investigation Plan

NOTES:

 Approx. Site Boundary

 Approx. Location of Boreholes

 Approx. Location of Ground Gas Monitoring Wells

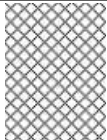
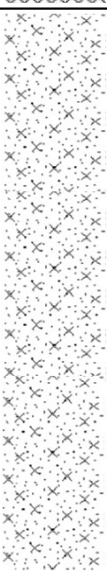


CLIENT: 	TITLE: Exploratory Hole Layout Plan	DATE: Jan. 2023 DRAWING No: E22209_005	SCALE@SIZE: NOT TO SCALE DESIGN/DRAWN: JR	Elemental GI Ltd
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APPENDIX VI

Exploratory Hole Logs

Site:		Site off Roman Bank, Spalding		Elemental GI Ltd	
Client:		Ark Property Centre			
Contractor: RP Drilling			Project No: E22209		Sheet: 1 of 1
Equipment: Window Sampler Drilling Rig			Logged by: JR		Date: 13th December 2022
Field Monitoring and Sampling			Strata		Legend Well
Depth	Type	Result	Depth	Description	
(m)		(SPT)(HSV)	(m)		
0.00	T		0.10	MADE GROUND (Comprising brown sandy silt with rootlets and wooden debris).	
0.20	JT			MADE GROUND (Comprising reworked brown slightly silty fine sand with rare medium subangular fragments of brick).	
0.60	JTB	HSV @ 0.50m = 12			
		HSV @ 0.80m = 16			
		N = 7	1m		
1.40	VB	HSV @ 1.50m = 4	1.30	Soft brown very sandy SILT.	
		HSV @ 1.75m = 8	1.60	... with a slight hydrocarbon odour present between 1.20m and 1.60m depth.	
		N = 2	2m	Very soft to loose grey sandy SILT.	
		N = 3	3m	... becoming light grey from 2.00m depth.	
		N = 6	4m	... becoming brown from 2.55m depth.	
		N = 17	5.00	... becoming greyish brown from 3.55m depth with rare natural black stained banding present.	
				Borehole completed at 5.00m depth.	
Water Observations: Water encountered at 1.70m depth during drilling.					
Remarks: 1) Borehole terminated on completion of testing at 5.00m depth. 2) Borehole completed as a monitoring well. 3) Borehole cased to 1.00m depth.					
Where unaccompanied by in situ tests, strength descriptions of soils are based on Engineer's field description(s) and must not be relied upon. HSV = Hand Shear Vane (kPa). PP = Pocket Penetrometer (daN/cm ²)					

Site:		Site off Roman Bank, Spalding			Elemental GI Ltd			
Client:		Ark Property Centre						
Contractor: RP Drilling			Project No: E22209		Sheet: 1 of 1		WS02	
Equipment: Window Sampler Drilling Rig			Logged by: JR		Date: 13th December 2022			
Field Monitoring and Sampling			Strata				Legend	Well
Depth	Type	Result	Depth	Description				
(m)		(SPT)(HSV)	(m)					
0.20	T	N = 9	0.55	MADE GROUND (Comprising brown and light brown slightly silty very sandy gravel. Gravel is fine to coarse of mixed lithology including clinker and limestone).				
1.00	JT		1m	MADE GROUND (Comprising brown slightly silty gravelly fine sand. Gravel is subangular and fine to coarse of brick, clinker with glass fragments). ... with gravel mostly absent from 1.30m depth.				
1.60-2.00	JTB		1.70	Very soft brown slightly sandy SILT.				
		HSV @ 1.80m = 4 HSV @ 1.90m = 2 N = 7	2m					
		HSV @ 2.50m = 2	3m					
		N = 1						
		N = 3	4.00	... becoming grey from 3.65m depth. ... with a thin band of dark grey staining (possibly natural/organic) present between 3.80m and 3.85m depth.				
				Borehole completed at 4.00m depth.				
			5m					
Water Observations: Water encountered at 1.77m depth during drilling. No odour or sheen noted.								
Remarks: 1) Borehole terminated on completion of testing at 4.00m depth. 2) Borehole collapsed to 1.66m depth after drilling.								
Where unaccompanied by in situ tests, strength descriptions of soils are based on Engineer's field description(s) and must not be relied upon. HSV = Hand Shear Vane (kPa), PP = Pocket Penetrometer (daN/cm ²)								

Site:	Site off Roman Bank, Spalding			Elemental GI Ltd		
Client:	Ark Property Centre					
Contractor: RP Drilling		Project No: E22209		Sheet: 1 of 1	WS03	
Equipment: Window Sampler Drilling Rig		Logged by: JR		Date: 13th December 2022		
Field Monitoring and Sampling			Strata		Legend	Well
Depth (m)	Type	Result (SPT)(HSV)	Depth (m)	Description		
0.10	JT			MADE GROUND (Comprising brown sandy gravelly silt. Gravel is subangular and fine to medium of brick, concrete, clinker with glass fragments and metal strips also present).		
			0.45			
0.60	B			Loose dark brown very silty fine SAND / very sandy SILT. ... becoming light brown from 0.70m depth. ... appears reworked to 0.70m depth with brick fragments present.		
1.00	JT	HSV @ 0.90m = 16 N = 8	1m			
1.35	JV	HSV @ 1.50m = 0				
		HSV @ 1.80m = 6 N = 2	2m			
		N = 3	3m	... with small pockets of dark grey staining (possibly natural/organic) present between 2.75m and 2.80m depth.		
				... with small pockets of dark grey staining (possibly natural/organic) present between 3.40m and 3.45m depth.		
		N = 2	4.00			
				Borehole completed at 4.00m depth.		
			5m			
Water Observations: Water encountered at 1.38m depth during drilling. No odour or sheen noted.						
Remarks: 1) Borehole terminated on completion of testing at 4.00m depth. 2) Borehole collapsed to 1.56m depth after drilling.						
Where unaccompanied by in situ tests, strength descriptions of soils are based on Engineer's field description(s) and must not be relied upon. HSV = Hand Shear Vane (kPa), PP = Pocket Penetrometer (daN/cm ²)						

Site:	Site off Roman Bank, Spalding			Elemental GI Ltd		
Client:	Ark Property Centre					
Contractor: RP Drilling		Project No: E22209		Sheet: 1 of 1	WS04	
Equipment: Window Sampler Drilling Rig		Logged by: JR		Date: 13th December 2022		
Field Monitoring and Sampling			Strata		Legend	Well
Depth (m)	Type	Result (SPT)(HSV)	Depth (m)	Description		
0.40	JT		0.70	MADE GROUND (Comprising brown slightly sandy very gravelly silt. Gravel is subangular to subrounded and fine to coarse of mixed lithology including concrete, clinker, limestone, ceramic, brick and slag). ... with a band of tarmac present between 0.35m and 0.40m depth. ... with frequent clay pockets from 0.50m depth. ... with a c.5cm width red brick cobble present at 0.55m depth.		
		HSV @ 0.90m = 18 N = 3	1m	Very soft greyish brown and black mottled sandy SILT with black hydrocarbon staining and a moderate to strong hydrocarbon odour.		
1.40	JV	HSV @ 1.50m = 10	2m	... possibly reworked to 1.40m depth with occasional fragments of concrete and clinker present. ... with black hydrocarbon staining absent from 1.40m depth. ... with black hydrocarbon staining present between 1.70m and 1.90m depth.		
		N = 3	3m	... with black hydrocarbon staining present between 2.60m and 2.70m depth.		
		N = 3	4m	... with black hydrocarbon staining present between 2.60m and 2.70m depth.		
3.00-4.00	B	N = 5	4m	... with black hydrocarbon staining present between 2.60m and 2.70m depth.		
		N = 5	4m	... with black hydrocarbon staining present between 2.60m and 2.70m depth.		
		N = 21	5.00	... with black hydrocarbon staining present between 4.00m and 4.40m depth.		
				Borehole completed at 5.00m depth.		
Water Observations: Water encountered at 1.41m depth during drilling. Odour and sheen noted on water.						
Remarks: 1) Borehole terminated on completion of testing at 5.00m depth. 2) Borehole collapsed to 1.80m depth after drilling.						
Where unaccompanied by in situ tests, strength descriptions of soils are based on Engineer's field description(s) and must not be relied upon. HSV = Hand Shear Vane (kPa), PP = Pocket Penetrometer (daN/cm ²)						

Site:		Site off Roman Bank, Spalding		Elemental GI Ltd			
Client:		Ark Property Centre					
Contractor: RP Drilling			Project No: E22209		Sheet: 1 of 1	WS05	
Equipment: Window Sampler Drilling Rig			Logged by: JR		Date: 13th December 2022		
Field Monitoring and Sampling			Strata			Legend	Well
Depth	Type	Result	Depth	Description			
(m)		(SPT)(HSV)	(m)				
0.50	JVT	N = 6	1m	MADE GROUND (Comprising brown slightly sandy very gravelly silt. Gravel is subangular to subrounded and fine to coarse of mixed lithology including concrete, clinker, limestone, ceramic, brick and slag). ... with rare rootlets present to 0.15m depth. ... with glass fragments present at 0.75m depth.			
1.50	JV B	HSV @ 1.50m = 2	1.40	Very soft greyish brown and black mottled sandy fine SILT with black hydrocarbon staining and a moderate to strong hydrocarbon odour. ... with a thin band of decayed roots present between 1.52m and 1.54m depth. ... with a thin band of decayed roots present between 1.95m and 1.96m depth. ... with a thin band of decayed roots present between 2.35m and 2.37m depth. ... with a thin band of decayed roots present between 2.55m and 2.57m depth. ... with brick fragments present at 2.65m depth (possible redrive).			
1.60		HSV @ 1.80m = 9	2m				
		N = 3	3m				
		HSV @ 2.50m = 2					
		N = 2	4m				
3.00-4.00	JV	N = 14					
		N = 26	5.00				
				Borehole completed at 5.00m depth.			

APPENDIX VII

Laboratory Testing Data



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Final Report

Report No.: 22-48095-1
Initial Date of Issue: 16-Jan-2023
Client Elemental GI Ltd

Project E22029 Roman Bank, Spalding

Quotation No.: Q22-27689

Date Received: 15-Dec-2022

Order No.: E22029/Spalding

Date Instructed: 15-Dec-2022

No. of Samples: 9

Turnaround (Wkdays): 10

Results Due: 04-Jan-2023

Date Approved: 16-Jan-2023

Approved By:



Details: Stuart Henderson, Technical
Manager

Results - Soil

Project: E22029 Roman Bank, Spalding

Client: Elemental GI Ltd	Chemtest Job No.:				22-48095	22-48095	22-48095	22-48095	22-48095	22-48095	22-48095	22-48095
Quotation No.: Q22-27689	Chemtest Sample ID.:				1565169	1565170	1565171	1565172	1565173	1565174	1565175	1565176
	Sample Location:				WS05	WS05	WS04	WS03	WS03	WS02	WS01	WS01
	Sample Type:				SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
	Top Depth (m):				0.50	1.50	1.40	1.00	1.35	1.00	0.00	0.20
	Date Sampled:				13-Dec-2022	13-Dec-2022	13-Dec-2022	13-Dec-2022	13-Dec-2022	13-Dec-2022	13-Dec-2022	13-Dec-2022
	Asbestos Lab:				DURHAM					DURHAM	DURHAM	
Determinand	Accred.	SOP	Units	LOD								
ACM Type	U	2192		N/A	Fibres/Clumps					Fibres/Clumps	-	
Asbestos Identification	U	2192		N/A	Chrysotile					Chrysotile	No Asbestos Detected	
Moisture	N	2030	%	0.020	19	26	21	21	23	13		20
pH	U	2010		4.0	7.5	7.6		7.5		8.3		8.4
Sulphate (2:1 Water Soluble) as SO4	U	2120	g/l	0.010	0.082	0.018		0.19		0.21		0.015
Arsenic	U	2455	mg/kg	0.5	18	4.7		11		78		13
Cadmium	U	2455	mg/kg	0.10	0.51	< 0.10		0.10		1.2		< 0.10
Chromium	U	2455	mg/kg	0.5	27	14		15		44		14
Copper	U	2455	mg/kg	0.50	68	17		22		280		15
Mercury	U	2455	mg/kg	0.05	0.22	0.49		0.31		0.74		0.11
Nickel	U	2455	mg/kg	0.50	32	16		16		78		13
Lead	U	2455	mg/kg	0.50	540	34		80		430		39
Selenium	U	2455	mg/kg	0.25	0.93	0.43		0.56		1.5		0.45
Zinc	U	2455	mg/kg	0.50	670	160		67		830		59
Chromium (Hexavalent)	N	2490	mg/kg	0.50	< 0.50	< 0.50		< 0.50		< 0.50		< 0.50
Aliphatic VPH >C5-C6	N	2780	mg/kg	0.05	< 0.05	< 0.05	< 0.05		< 0.05			
Aliphatic VPH >C6-C7	N	2780	mg/kg	0.05	< 0.05	< 0.05	< 0.05		< 0.05			
Aliphatic VPH >C7-C8	N	2780	mg/kg	0.05	< 0.05	< 0.05	< 0.05		< 0.05			
Aliphatic VPH >C8-C10	N	2780	mg/kg	0.05	< 0.05	0.99	0.31		< 0.05			
Total Aliphatic VPH >C5-C10	N	2780	mg/kg	0.25	< 0.25	0.50	< 0.25		< 0.25			
Aliphatic EPH >C10-C12	N	2690	mg/kg	2.00	< 2.0	78	69		< 2.0			
Aliphatic EPH >C12-C16	N	2690	mg/kg	1.00	1.2	37	140		< 1.0			
Aliphatic EPH >C16-C21	N	2690	mg/kg	2.00	< 2.0	< 2.0	120		< 2.0			
Aliphatic EPH >C21-C35	N	2690	mg/kg	3.00	< 3.0	< 3.0	96		< 3.0			
Aliphatic EPH >C35-C40	N	2690	mg/kg	1.00	< 1.0	< 1.0	7.8		< 1.0			
Total Aliphatic EPH >C10-C35	N	2690	mg/kg	5.00	< 5.0	120	420		< 5.0			
Aromatic VPH >C5-C7	N	2780	mg/kg	0.05	< 0.05	< 0.05	< 0.05		< 0.05			
Aromatic VPH >C7-C8	N	2780	mg/kg	0.05	< 0.05	< 0.05	< 0.05		< 0.05			
Aromatic VPH >C8-C10	N	2780	mg/kg	0.05	< 0.05	< 0.05	0.24		< 0.05			
Total Aromatic VPH >C5-C10	N	2780	mg/kg	0.25	< 0.25	< 0.25	< 0.25		< 0.25			
Aromatic EPH >C10-C12	N	2690	mg/kg	1.00	< 1.0	38	66		< 1.0			
Aromatic EPH >C12-C16	N	2690	mg/kg	1.00	1.1	13	92		< 1.0			
Aromatic EPH >C16-C21	N	2690	mg/kg	2.00	12	< 2.0	50		< 2.0			
Aromatic EPH >C21-C35	N	2690	mg/kg	2.00	44	< 2.0	22		< 2.0			
Aromatic EPH >C35-C40	N	2690	mg/kg	1.00	< 1.0	< 1.0	1.9		< 1.0			
Total Aromatic EPH >C10-C35	N	2690	mg/kg	5.00	58	54	230		< 5.0			
Total VPH >C5-C10	N	2780	mg/kg	0.50	< 0.50	< 0.50	< 0.50		< 0.50			
Total EPH >C10-C35	N	2690	mg/kg	10.00	62	170	650		< 10			

Results - Soil

Project: E22029 Roman Bank, Spalding

Client: Elemental GI Ltd	Chemtest Job No.:				22-48095	22-48095	22-48095	22-48095	22-48095	22-48095	22-48095	22-48095
Quotation No.: Q22-27689	Chemtest Sample ID.:				1565169	1565170	1565171	1565172	1565173	1565174	1565175	1565176
	Sample Location:				WS05	WS05	WS04	WS03	WS03	WS02	WS01	WS01
	Sample Type:				SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
	Top Depth (m):				0.50	1.50	1.40	1.00	1.35	1.00	0.00	0.20
	Date Sampled:				13-Dec-2022	13-Dec-2022	13-Dec-2022	13-Dec-2022	13-Dec-2022	13-Dec-2022	13-Dec-2022	13-Dec-2022
	Asbestos Lab:				DURHAM					DURHAM	DURHAM	
Determinand	Accred.	SOP	Units	LOD								
Total Organic Carbon	U	2625	%	0.20	3.4	1.0		1.6		4.1		1.2
Benzene	U	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0		< 1.0			
Toluene	U	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0		< 1.0			
Ethylbenzene	U	2760	µg/kg	1.0	< 1.0	< 1.0	25		< 1.0			
m & p-Xylene	U	2760	µg/kg	1.0	< 1.0	< 1.0	2.6		< 1.0			
o-Xylene	U	2760	µg/kg	1.0	< 1.0	< 1.0	3.8		< 1.0			
Naphthalene	U	2800	mg/kg	0.10	0.14	0.51		< 0.10		1.1		0.10
Acenaphthylene	N	2800	mg/kg	0.10	0.14	< 0.10		< 0.10		1.0		< 0.10
Acenaphthene	U	2800	mg/kg	0.10	0.14	1.0		< 0.10		2.9		0.14
Fluorene	U	2800	mg/kg	0.10	0.11	0.66		< 0.10		2.9		0.15
Phenanthrene	U	2800	mg/kg	0.10	0.99	2.0		< 0.10		24		1.2
Anthracene	U	2800	mg/kg	0.10	0.36	0.40		< 0.10		9.1		0.46
Fluoranthene	U	2800	mg/kg	0.10	3.0	1.4		0.19		48		2.2
Pyrene	U	2800	mg/kg	0.10	2.9	1.2		0.14		40		1.8
Benzo[a]anthracene	U	2800	mg/kg	0.10	1.8	0.51		< 0.10		22		0.92
Chrysene	U	2800	mg/kg	0.10	2.0	0.47		< 0.10		20		0.80
Benzo[b]fluoranthene	U	2800	mg/kg	0.10	3.4	0.65		< 0.10		32		1.5
Benzo[k]fluoranthene	U	2800	mg/kg	0.10	1.3	0.23		< 0.10		12		0.32
Benzo[a]pyrene	U	2800	mg/kg	0.10	2.9	0.45		< 0.10		31		1.3
Indeno(1,2,3-c,d)Pyrene	U	2800	mg/kg	0.10	2.6	0.35		< 0.10		18		0.78
Dibenz(a,h)Anthracene	N	2800	mg/kg	0.10	0.44	< 0.10		< 0.10		2.8		0.16
Benzo[g,h,i]perylene	U	2800	mg/kg	0.10	2.6	0.31		< 0.10		16		0.71
Total Of 16 PAH's	N	2800	mg/kg	2.0	25	10		< 2.0		280		13
Total Phenols	U	2920	mg/kg	0.10	< 0.10	< 0.10		< 0.10		< 0.10		< 0.10

Results - Soil

Project: E22029 Roman Bank, Spalding

Client: Elemental GI Ltd	Chemtest Job No.:		22-48095		
Quotation No.: Q22-27689	Chemtest Sample ID.:		1565177		
	Sample Location:		WS01		
	Sample Type:		SOIL		
	Top Depth (m):		1.40		
	Date Sampled:		13-Dec-2022		
	Asbestos Lab:				
Determinand	Accred.	SOP	Units	LOD	
ACM Type	U	2192		N/A	
Asbestos Identification	U	2192		N/A	
Moisture	N	2030	%	0.020	20
pH	U	2010		4.0	
Sulphate (2:1 Water Soluble) as SO4	U	2120	g/l	0.010	
Arsenic	U	2455	mg/kg	0.5	
Cadmium	U	2455	mg/kg	0.10	
Chromium	U	2455	mg/kg	0.5	
Copper	U	2455	mg/kg	0.50	
Mercury	U	2455	mg/kg	0.05	
Nickel	U	2455	mg/kg	0.50	
Lead	U	2455	mg/kg	0.50	
Selenium	U	2455	mg/kg	0.25	
Zinc	U	2455	mg/kg	0.50	
Chromium (Hexavalent)	N	2490	mg/kg	0.50	
Aliphatic VPH >C5-C6	N	2780	mg/kg	0.05	< 0.05
Aliphatic VPH >C6-C7	N	2780	mg/kg	0.05	< 0.05
Aliphatic VPH >C7-C8	N	2780	mg/kg	0.05	< 0.05
Aliphatic VPH >C8-C10	N	2780	mg/kg	0.05	< 0.05
Total Aliphatic VPH >C5-C10	N	2780	mg/kg	0.25	< 0.25
Aliphatic EPH >C10-C12	N	2690	mg/kg	2.00	< 2.0
Aliphatic EPH >C12-C16	N	2690	mg/kg	1.00	< 1.0
Aliphatic EPH >C16-C21	N	2690	mg/kg	2.00	< 2.0
Aliphatic EPH >C21-C35	N	2690	mg/kg	3.00	< 3.0
Aliphatic EPH >C35-C40	N	2690	mg/kg	1.00	< 1.0
Total Aliphatic EPH >C10-C35	N	2690	mg/kg	5.00	< 5.0
Aromatic VPH >C5-C7	N	2780	mg/kg	0.05	< 0.05
Aromatic VPH >C7-C8	N	2780	mg/kg	0.05	< 0.05
Aromatic VPH >C8-C10	N	2780	mg/kg	0.05	< 0.05
Total Aromatic VPH >C5-C10	N	2780	mg/kg	0.25	< 0.25
Aromatic EPH >C10-C12	N	2690	mg/kg	1.00	< 1.0
Aromatic EPH >C12-C16	N	2690	mg/kg	1.00	< 1.0
Aromatic EPH >C16-C21	N	2690	mg/kg	2.00	< 2.0
Aromatic EPH >C21-C35	N	2690	mg/kg	2.00	< 2.0
Aromatic EPH >C35-C40	N	2690	mg/kg	1.00	< 1.0
Total Aromatic EPH >C10-C35	N	2690	mg/kg	5.00	< 5.0
Total VPH >C5-C10	N	2780	mg/kg	0.50	< 0.50
Total EPH >C10-C35	N	2690	mg/kg	10.00	< 10

Results - Soil

Project: E22029 Roman Bank, Spalding

Client: Elemental GI Ltd	Chemtest Job No.:		22-48095		
Quotation No.: Q22-27689	Chemtest Sample ID.:		1565177		
	Sample Location:		WS01		
	Sample Type:		SOIL		
	Top Depth (m):		1.40		
	Date Sampled:		13-Dec-2022		
	Asbestos Lab:				
Determinand	Accred.	SOP	Units	LOD	
Total Organic Carbon	U	2625	%	0.20	
Benzene	U	2760	µg/kg	1.0	< 1.0
Toluene	U	2760	µg/kg	1.0	< 1.0
Ethylbenzene	U	2760	µg/kg	1.0	< 1.0
m & p-Xylene	U	2760	µg/kg	1.0	< 1.0
o-Xylene	U	2760	µg/kg	1.0	< 1.0
Naphthalene	U	2800	mg/kg	0.10	
Acenaphthylene	N	2800	mg/kg	0.10	
Acenaphthene	U	2800	mg/kg	0.10	
Fluorene	U	2800	mg/kg	0.10	
Phenanthrene	U	2800	mg/kg	0.10	
Anthracene	U	2800	mg/kg	0.10	
Fluoranthene	U	2800	mg/kg	0.10	
Pyrene	U	2800	mg/kg	0.10	
Benzo[a]anthracene	U	2800	mg/kg	0.10	
Chrysene	U	2800	mg/kg	0.10	
Benzo[b]fluoranthene	U	2800	mg/kg	0.10	
Benzo[k]fluoranthene	U	2800	mg/kg	0.10	
Benzo[a]pyrene	U	2800	mg/kg	0.10	
Indeno(1,2,3-c,d)Pyrene	U	2800	mg/kg	0.10	
Dibenz(a,h)Anthracene	N	2800	mg/kg	0.10	
Benzo[g,h,i]perylene	U	2800	mg/kg	0.10	
Total Of 16 PAH's	N	2800	mg/kg	2.0	
Total Phenols	U	2920	mg/kg	0.10	

Test Methods

SOP	Title	Parameters included	Method summary
2010	pH Value of Soils	pH	pH Meter
2030	Moisture and Stone Content of Soils(Requirement of MCERTS)	Moisture content	Determination of moisture content of soil as a percentage of its as received mass obtained at <37°C.
2040	Soil Description(Requirement of MCERTS)	Soil description	As received soil is described based upon BS5930
2120	Water Soluble Boron, Sulphate, Magnesium & Chromium	Boron; Sulphate; Magnesium; Chromium	Aqueous extraction / ICP-OES
2192	Asbestos	Asbestos	Polarised light microscopy / Gravimetry
2455	Acid Soluble Metals in Soils	Metals, including: Arsenic; Barium; Beryllium; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Vanadium; Zinc	Acid digestion followed by determination of metals in extract by ICP-MS.
2490	Hexavalent Chromium in Soils	Chromium [VI]	Soil extracts are prepared by extracting dried and ground soil samples into boiling water. Chromium [VI] is determined by 'Aquakem 600' Discrete Analyser using 1,5-diphenylcarbazide.
2625	Total Organic Carbon in Soils	Total organic Carbon (TOC)	Determined by high temperature combustion under oxygen, using an Eltra elemental analyser.
2690	EPH A/A Split	Aliphatics: >C10–C12, >C12–C16, >C16–C21, >C21– C35, >C35– C40 Aromatics: >C10–C12, >C12–C16, >C16– C21, >C21– C35, >C35– C40	Acetone/Heptane extraction / GCxGC FID detection
2760	Volatile Organic Compounds (VOCs) in Soils by Headspace GC-MS	Volatile organic compounds, including BTEX and halogenated Aliphatic/Aromatics.(cf. USEPA Method 8260)*please refer to UKAS schedule	Automated headspace gas chromatographic (GC) analysis of a soil sample, as received, with mass spectrometric (MS) detection of volatile organic compounds.
2780	VPH A/A Split	Aliphatics: >C5–C6, >C6–C7,>C7–C8,>C8-C10 Aromatics: >C5–C7,>C7-C8,>C8–C10	Water extraction / Headspace GCxGC FID detection
2800	Speciated Polynuclear Aromatic Hydrocarbons (PAH) in Soil by GC-MS	Acenaphthene*; Acenaphthylene; Anthracene*; Benzo[a]Anthracene*; Benzo[a]Pyrene*; Benzo[b]Fluoranthene*; Benzo[ghi]Perylene*; Benzo[k]Fluoranthene; Chrysene*; Dibenzo[ah]Anthracene; Fluoranthene*; Fluorene*; Indeno[123cd]Pyrene*; Naphthalene*; Phenanthrene*; Pyrene*	Dichloromethane extraction / GC-MS
2920	Phenols in Soils by HPLC	Phenolic compounds including Resorcinol, Phenol, Methylphenols, Dimethylphenols, 1-Naphthol and TrimethylphenolsNote: chlorophenols are excluded.	60:40 methanol/water mixture extraction, followed by HPLC determination using electrochemical detection.

Report Information

Key

U	UKAS accredited
M	MCERTS and UKAS accredited
N	Unaccredited
S	This analysis has been subcontracted to a UKAS accredited laboratory that is accredited for this analysis
SN	This analysis has been subcontracted to a UKAS accredited laboratory that is not accredited for this analysis
T	This analysis has been subcontracted to an unaccredited laboratory
I/S	Insufficient Sample
U/S	Unsuitable Sample
N/E	not evaluated
<	"less than"
>	"greater than"
SOP	Standard operating procedure
LOD	Limit of detection

Comments or interpretations are beyond the scope of UKAS accreditation

The results relate only to the items tested

Uncertainty of measurement for the determinands tested are available upon request

None of the results in this report have been recovery corrected

All results are expressed on a dry weight basis

The following tests were analysed on samples as received and the results subsequently corrected to a dry weight basis TPH, BTEX, VOCs, SVOCs, PCBs, Phenols

For all other tests the samples were dried at < 37°C prior to analysis

All Asbestos testing is performed at the indicated laboratory

Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1

Sample Deviation Codes

- A - Date of sampling not supplied
- B - Sample age exceeds stability time (sampling to extraction)
- C - Sample not received in appropriate containers
- D - Broken Container
- E - Insufficient Sample (Applies to LOI in Trommel Fines Only)

Sample Retention and Disposal

All soil samples will be retained for a period of 30 days from the date of receipt

All water samples will be retained for 14 days from the date of receipt

Charges may apply to extended sample storage

If you require extended retention of samples, please email your requirements to:

customerservices@chemtest.com

TEST CERTIFICATE

DETERMINATION OF LIQUID AND PLASTIC LIMITS

Tested in Accordance with: BS 1377-2:1990: Clause 4.4 and 5

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

Client: Elemental GI LTD

Client Reference: E22209

Job Number: 22-13089

Date Sampled: Not Given

Date Received: 14/12/2022

Date Tested: 02/01/2023

Sampled By: Client - JR

Site Address: Roman Bank, Spalding

Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

Test Results:

Laboratory Reference: 2532200

Hole No.: WS04

Sample Reference: Not Given

Sample Description: Brownish grey very sandy slightly silty CLAY

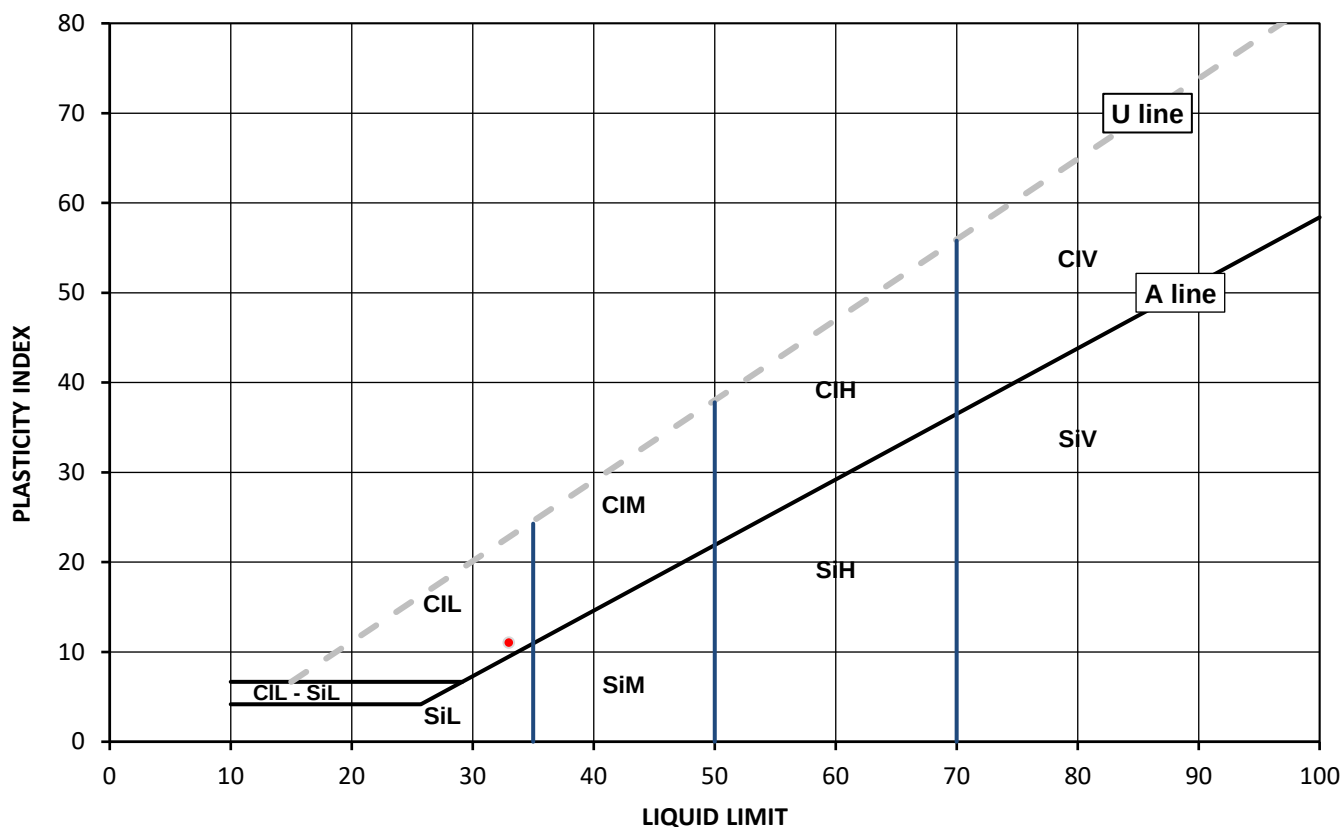
Depth Top [m]: 3.00

Depth Base [m]: 4.00

Sample Type: B

Sample Preparation: Tested in natural condition

As Received Water Content [W] %	Liquid Limit [WL] %	Plastic Limit [Wp] %	Plasticity Index [Ip] %	% Passing 425µm BS Test Sieve
30	33	22	11	100



Legend, based on BS EN ISO 14688 2:2018 Geotechnical investigation and testing – Identification and classification of soil

	Plasticity	Liquid Limit
Cl Clay	L Low	below 35
Si Silt	M Medium	35 to 50
	H High	50 to 70
	V Very high	exceeding 70
	O Organic	append to classification for organic material (eg CIHO)

Note: Water Content by BS 1377-2: 1990: Clause 3.2

Remarks:

Signed:

Katarzyna Koziel
Reporting Specialist
for and on behalf of i2 Analytical Ltd

Opinions and interpretations expressed herein are outside of the scope of the UKAS Accreditation. This report may not be reproduced other than in full without the prior written approval of the issuing laboratory. The results included within the report relate only to the sample(s) submitted for testing.

Client: Elemental GI LTD

Client Reference: E22209

Job Number: 22-13089

Date Sampled: Not Given

Date Received: 14/12/2022

Date Tested: 03/01/2023

Sampled By: Client - JR

Site Address: Roman Bank, Spalding

Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

Test Results:

Laboratory Reference: 2532202

Hole No.: WS01

Sample Reference: Not Given

Sample Description: Dark brown sandy CLAY

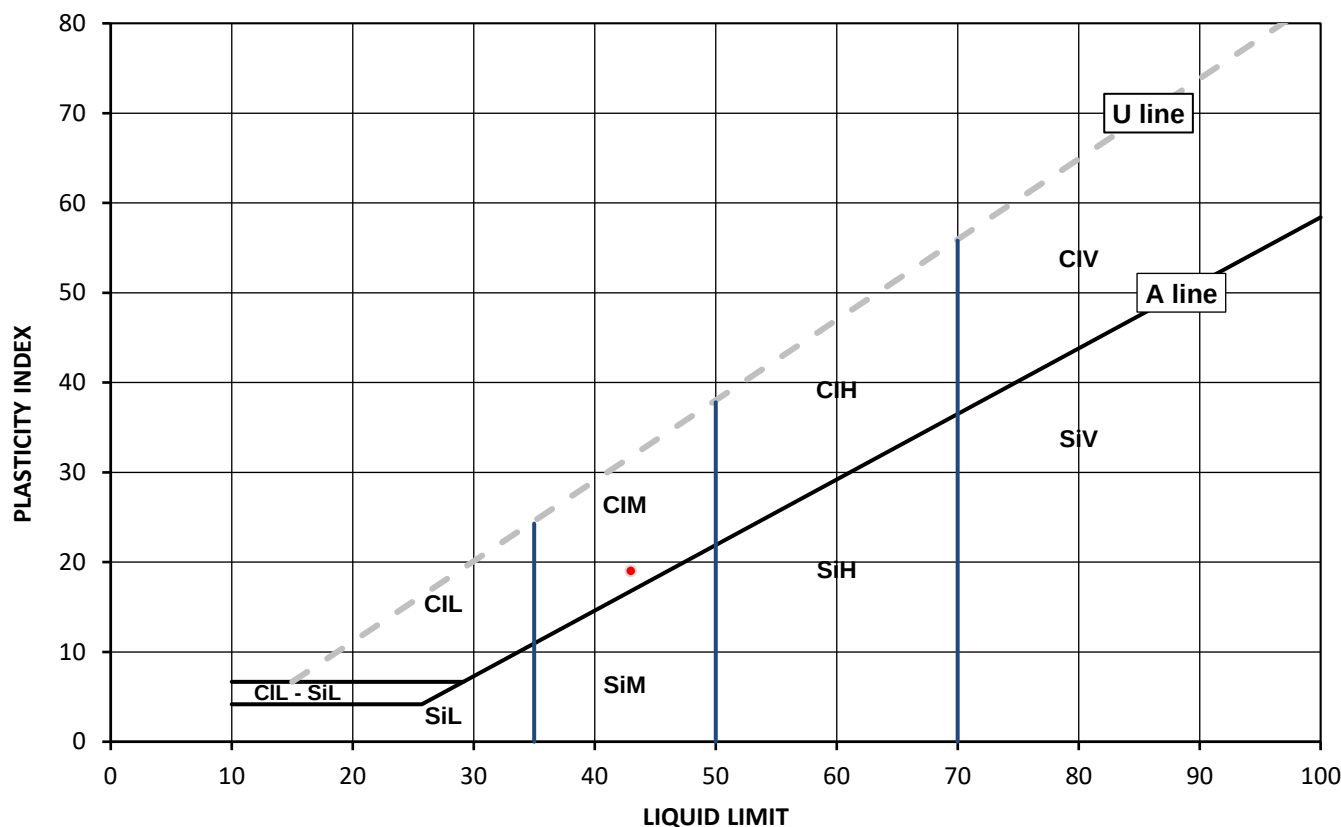
Depth Top [m]: 1.40

Depth Base [m]: Not Given

Sample Type: B

Sample Preparation: Tested in natural condition

As Received Water Content [W] %	Liquid Limit [WL] %	Plastic Limit [Wp] %	Plasticity Index [Ip] %	% Passing 425µm BS Test Sieve
33	43	24	19	100



Legend, based on BS EN ISO 14688 2:2018 Geotechnical investigation and testing – Identification and classification of soil

Cl	Clay	Plasticity	L	Low	Liquid Limit	below 35
Si	Silt		M	Medium		35 to 50
			H	High		50 to 70
			V	Very high		exceeding 70
			O	Organic		append to classification for organic material (eg CIHO)

Note: Water Content by BS 1377-2: 1990: Clause 3.2

Remarks:

Signed:

Katarzyna Koziel
Reporting Specialist
for and on behalf of i2 Analytical Ltd

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4041

Client:

Elemental GI LTD

Site Address: Roman Bank, Spalding

Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

SUMMARY REPORT

SUMMARY OF CLASSIFICATION TEST RESULTS

Tested in Accordance with:

Water Content by BS 1377-2:1990: Clause 3.2; Atterberg by BS 1377-2: 1990:
Clause 4.3 (4 Point Test), Clause 4.4 (1 Point Test) and 5; PD by BS 1377-2:
1990: Clause 8.2

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB



Environmental Science

Client Reference: E22209

Job Number: 22-13089

Date Sampled: Not Given

Date Received: 14/12/2022

Date Tested: 02/01 - 03/01/2023

Sampled By: Client - JR

Test results

Laboratory Reference	Hole No.	Sample				Description	Remarks	Water Content BS 1377-2 [W] %	Water Content BS EN ISO 17892-1 [W] %	Atterberg				Density			Total Porosity# %		
		Reference	Depth Top m	Depth Base m	Type					% Passing 425um %	WL %	Wp %	Ip %	bulk Mg/m3	dry Mg/m3	PD Mg/m3			
2532200	WS04	Not Given	3.00	4.00	B	Brownish grey very sandy slightly silty CLAY	Atterberg 1 Point	30		100	33	22	11						
2532202	WS01	Not Given	1.40	Not Given	B	Dark brown sandy CLAY	Atterberg 1 Point	33		100	43	24	19						

Note: # Non accredited; NP - Non plastic

Comments:

Signed:

Katarzyna Koziel

Katarzyna Koziel
Reporting Specialist
for and on behalf of i2 Analytical Ltd

Opinions and interpretations expressed herein are outside of the scope of the UKAS Accreditation. This report may not be reproduced other than in full without the prior written approval of the issuing laboratory. The results included within the report relate only to the sample(s) submitted for testing.



4041

Client:

Elemental GI LTD

SUMMARY REPORT

DETERMINATION OF WATER CONTENT

Tested in Accordance with: BS 1377-2: 1990: Clause 3.2

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB



Environmental Science

Client Reference: E22209

Job Number: 22-13089

Date Sampled: Not Given

Date Received: 14/12/2022

Date Tested: 02/01 - 03/01/2023

Sampled By: Client - JR

Site Address: Roman Bank, Spalding

Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

Test results

Laboratory Reference	Hole No.	Sample				Description	Remarks	WC	Sample preparation / Oven temperature at the time of testing			
		Reference	Depth Top m	Depth Base m	Type							
2532200	WS04	Not Given	3.00	4.00	B	Brownish grey very sandy slightly silty CLAY		30	Sample was quartered, oven dried at 106.1 °C			
2532202	WS01	Not Given	1.40	Not Given	B	Dark brown sandy CLAY		33	Sample was quartered, oven dried at 106 °C			

Comments:

Signed:

Katarzyna Koziel
Reporting Specialist
for and on behalf of i2 Analytical Ltd

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TEST CERTIFICATE

DETERMINATION OF PARTICLE SIZE DISTRIBUTION

Tested in Accordance with: BS 1377-2: 1990

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

Client: Elemental GI LTD

Client Reference: E22209
Job Number: 22-13089
Date Sampled: Not Given
Date Received: 14/12/2022
Date Tested: 03/01/2023
Sampled By: Client - JR

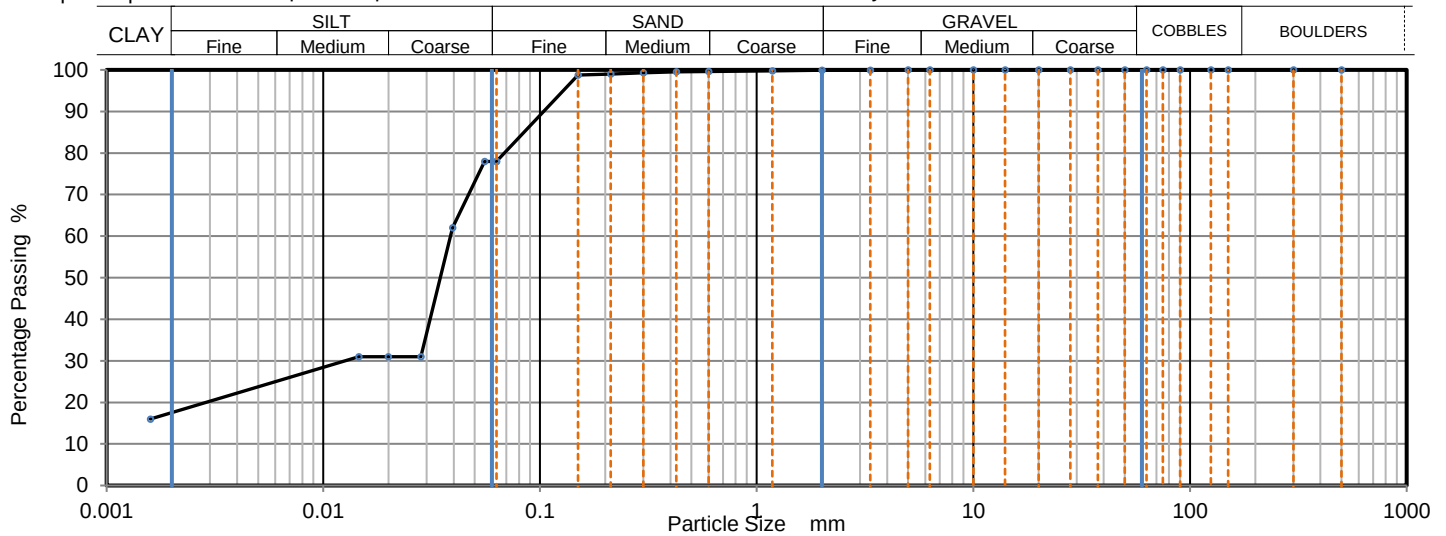
Site Address: Roman Bank, Spalding

Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

Test Results:

Laboratory Reference: 2532199
Hole No.: WS05
Sample Reference: Not Given
Sample Description: Brownish grey clayey SILT
Sample Preparation: Sample was quartered, oven dried at 106.0 °C and broken down by hand.

Depth Top [m]: 1.60
Depth Base [m]: Not Given
Sample Type: B



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
500	100	0.0630	78
300	100	0.0556	78
150	100	0.0395	62
125	100	0.0282	31
90	100	0.0200	31
75	100	0.0146	31
63	100	0.0118	16
50	100		
37.5	100		
28	100		
20	100		
14	100		
10	100		
6.3	100		
5	100		
3.35	100		
2	100		
1.18	100		
0.6	100		
0.425	100		
0.3	99		
0.212	99		
0.15	99		
0.063	78		

Sample Proportions	% dry mass
Very coarse	0
Gravel	0
Sand	22
Silt	61
Clay	17

Grading Analysis	
D100	mm
D60	mm
D30	mm
D10	mm
Uniformity Coefficient	> 24
Curvature Coefficient	

Uniformity Coefficient calculated in accordance with BS EN ISO 14688-2:2018

Note: Tested in Accordance with BS1377:Part 2:1990, clauses 9.2 and 9.5

Remarks:

Signed:

Katarzyna Koziel

Katarzyna Koziel
Reporting Specialist
for and on behalf of i2 Analytical Ltd

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TEST CERTIFICATE

DETERMINATION OF PARTICLE SIZE DISTRIBUTION

Tested in Accordance with: BS 1377-2: 1990

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

Client: Elemental GI LTD

Client Reference: E22209

Job Number: 22-13089

Date Sampled: Not Given

Date Received: 14/12/2022

Date Tested: 03/01/2023

Sampled By: Client - JR

Site Address: Roman Bank, Spalding

Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

Test Results:

Laboratory Reference: 2532201

Hole No.: WS02

Sample Reference: Not Given

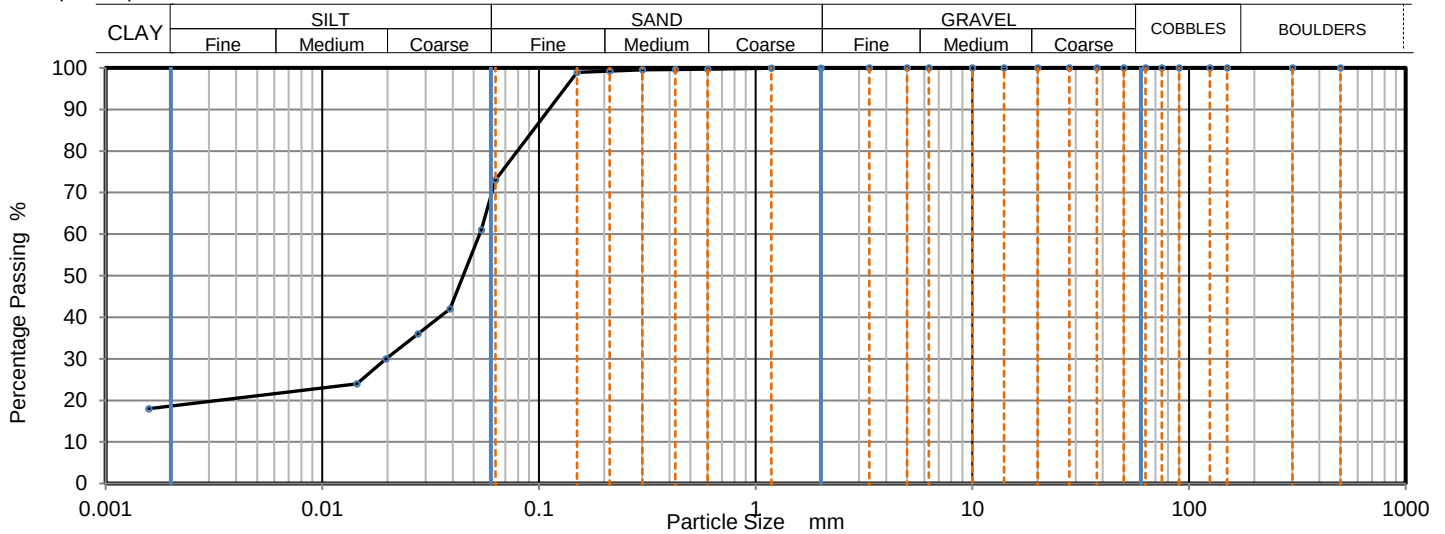
Sample Description: Brown silty CLAY

Sample Preparation: Sample was quartered, oven dried at 106.0 °C and broken down by hand.

Depth Top [m]: 1.60

Depth Base [m]: 2.00

Sample Type: B



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
500	100	0.0630	73
300	100	0.0541	61
150	100	0.0389	42
125	100	0.0276	36
90	100	0.0197	30
75	100	0.0144	24
63	100	0.0116	18
50	100		
37.5	100		
28	100		
20	100		
14	100		
10	100		
6.3	100		
5	100		
3.35	100	Particle density (assumed) 2.65 Mg/m3	
2	100		
1.18	100		
0.6	100		
0.425	100		
0.3	100		
0.212	99		
0.15	99		
0.063	73		

Sample Proportions	% dry mass
Very coarse	0
Gravel	0
Sand	27
Silt	54
Clay	19

Grading Analysis	
D100	mm
D60	mm
D30	mm
D10	mm
Uniformity Coefficient	> 34
Curvature Coefficient	

Uniformity Coefficient calculated in accordance with BS EN ISO 14688-2:2018

Note: Tested in Accordance with BS1377:Part 2:1990, clauses 9.2 and 9.5

Remarks:

Signed:

Katarzyna Koziel
Reporting Specialist
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APPENDIX VI

Gas and Groundwater Monitoring Sheets

GROUND GAS MONITORING RECORD

Site:	E22209 - Site off Roman Bank, Spalding	Engineer / Technician:	JR
Date:	20 th December 2022	Pressure (Start):	1004 mb
Equipment:	GFM 456 Gas Analyser and Dipmeter	Pressure (End):	1003 mb
Weather Observations:	Sunny, clear, dry and still.		

Borehole:	Methane (CH ₄ % v/v)		Carbon Dioxide (CO ₂ % v/v)		Oxygen (O ₂ % v/v)		Flow (l/hr)		Hydrogen Sulphide (H ₂ S ppm)	Carbon Monoxide (CO ppm)	Depth to Water (m)	Depth to Base (m)
	Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady				
(Ambient)	-	0.0	-	0.0	-	20.6	N/A	N/A	0	0	N/A	N/A
WS01	0.0	0.0	3.2	3.2	19.1	19.1	0.0	0.0	0	0	1.18	2.92
WS05	0.0	0.0	2.1	2.1	18.9	18.9	0.0	0.0	0	0	1.01	2.57

Comments:

NOTES:

- Peak readings are the maximum results recorded for flow, CH₄ or CO₂ and the minimum results recorded for O₂.
- Steady readings are the values recorded after approx. 90 to 120 seconds of monitoring. Where values fluctuate then this period will have been lengthened.
- Gas analyser calibration certificates are available upon request.

GROUND GAS MONITORING RECORD

Site:	E22209 - Site off Roman Bank, Spalding	Engineer / Technician:	JR
Date:	5 th January 2023	Pressure (Start):	1016 mb
Equipment:	GFM 456 Gas Analyser and Dipmeter	Pressure (End):	1015 mb
Weather Observations:	Slightly cloudy, slightly breezy and dry.		

Borehole:	Methane (CH ₄ % v/v)		Carbon Dioxide (CO ₂ % v/v)		Oxygen (O ₂ % v/v)		Flow (l/hr)		Hydrogen Sulphide (H ₂ S ppm)	Carbon Monoxide (CO ppm)	Depth to Water (m)	Depth to Base (m)
	Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady				
(Ambient)	-	0.0	-	0.0	-	20.6	N/A	N/A	0	0	N/A	N/A
WS01	0.0	0.0	4.4	4.4	18.6	18.6	0.0	0.0	0	0	1.10	2.86
WS05	0.0	0.0	2.1	2.1	18.9	18.9	0.0	0.0	0	0	0.86	2.55

Comments:

NOTES:

- Peak readings are the maximum results recorded for flow, CH₄ or CO₂ and the minimum results recorded for O₂.
- Steady readings are the values recorded after approx. 90 to 120 seconds of monitoring. Where values fluctuate then this period will have been lengthened.
- Gas analyser calibration certificates are available upon request.

GROUND GAS MONITORING RECORD

Site:	E22209 - Site off Roman Bank, Spalding	Engineer / Technician:	JR
Date:	11 th January 2023	Pressure (Start):	1006 mb
Equipment:	GFM 456 Gas Analyser and Dipmeter	Pressure (End):	1005 mb
Weather Observations:	Sunny, breezy and dry.		

Borehole:	Methane (CH ₄ % v/v)		Carbon Dioxide (CO ₂ % v/v)		Oxygen (O ₂ % v/v)		Flow (l/hr)		Hydrogen Sulphide (H ₂ S ppm)	Carbon Monoxide (CO ppm)	Depth to Water (m)	Depth to Base (m)
	Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady				
(Ambient)	-	0.0	-	0.0	-	20.6	N/A	N/A	0	0	N/A	N/A
WS01	0.0	0.0	4.3	4.3	18.5	18.5	0.0	0.0	0	0	1.02	2.85
WS05	0.0	0.0	1.8	1.8	19.5	19.5	3.0	1.5	0	0	0.67	2.57

Comments:

NOTES:

- Peak readings are the maximum results recorded for flow, CH₄ or CO₂ and the minimum results recorded for O₂.
- Steady readings are the values recorded after approx. 90 to 120 seconds of monitoring. Where values fluctuate then this period will have been lengthened.
- Gas analyser calibration certificates are available upon request.