



## Phase 1 Desk Study Site Investigation Report

<b>LOCATION</b>	Proposed Development, Land at Hemlington North, Middlesbrough TS8 9DE
<b>ISSUE DATE</b>	12 <sup>th</sup> July 2018
<b>FOR</b>	Mr N Carr – Middlesbrough Council
<b>CLIENT REF.</b>	PO 8094369
<b>OUR REF.</b>	G18222a

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## 1. Introduction

In accordance with your instruction, Geoinvestigate Ltd. has carried out a Phase 1 Desk Study Investigation of a plot of land adjacent and to the northwest of the Gables Public House, Hemlington Grange, Middlesbrough TS8 9DE.

The site currently comprises an area of land some 0.71ha in size with access from Stainton Way to the north. The site is currently undeveloped.

It is understood that it is proposed to develop the site as a housing site.

The purpose of the Phase 1 Desk Study investigation was to review the historical land use information on the site in order to provide an assessment of the potential geotechnical/foundation problems together with a qualitative contamination and ground gas risk assessment.

The location of the site is shown on the Groundsure EnviroInsight, GeoInsight environmental reports in the Appendices of this report.

## 2. Scope of Works

The investigation comprised a review of the following information;

- An extract from the 1: 50,000 Solid & Drift geological map (BGS Sheet 33 - Stockton).
- Historical OS maps of various scales dating back to 1857 (presented in Appendix 1).
- Observations from a walkover study carried out by Stuart Howe of Geoinvestigate.
- A GroundSure EnviroInsight Report, and Groundsure GeoInsight Report. These reports are included in Appendices 2 and 3 respectively.

## 3. Findings of Phase 1 Investigation

### 3.1 Anticipated Geology

The extract of the 1:50,000 Solid & Drift geological map (BGS Sheet 33 – Stockton) indicates the site to be underlain by superficial deposits of Devensian Till (Diamicton) with a bedrock geology of the Mercia Mudstone Group.

No BGS borehole records exist within 500m of the site but records to the east, south and southwest suggest that up to 10m of sandy gravelly clay (boulder clay) might be present, with records to the west and northwest reporting silty clay and occasionally clay with organic inclusions at shallow depths.

### 3.2 Historical OS Maps and Historical Land Use

Copies of historical OS maps were obtained for the site covering the period 1857 to 2014. Historical land uses and major features located within the site boundary and externally but potentially within influencing distance are summarised in Table 1 on the following page. The earliest OS map of 1857 shows the site to be undeveloped/open space.

**Table 1:** Summary of Historical OS Map Land Use & Potential Hazard Identification

Map Feature	Location	Appears	Absent	Notes
Residential Development	60m Southeast	1892	Remains Present	Initially single developments such as Haggergate. Further individual developments by 1928, then a larger development by 1978. Likely includes utilities and services.
Buildings	On Site	1928-29	1979	Several small buildings across middle of site, most removed by 1966 before all removed by 1979. Unknown use, possibly pig sheds or similar.
Road Development	Adjacent East	1966	Remains Present	Small road/track present from 1892, major works begin by 1966. Further developed by 1978. Includes ground workings.
Gas Pressure Station	130m East	1978	2014	Unlikely to affect site.
Electricity Substation	80m Northwest	1979	Remains Present	Probably too distant to affect site.

NB. Arbitrary potential hazard assessment: Higher (amber), Moderate (yellow), Lower (green), Very Low (uncoloured)

A review of the historical OS maps and the land uses shown has highlighted the land uses most likely to present a hazard or source of potentially harmful contamination to the study area. These are limited but primarily comprise the construction and removal of several small buildings on the site. Residential and road developments near to the site are also noted but expected to be less likely to have resulted in contamination of the study site itself.

### 3.3 GroundSure EnviroInsight Report

The GroundSure EnviroInsight Report presented in Appendix 2 provides listings of potentially contaminative current and past land uses together with possible pathway and receptor information. It also covers other potential risks to the site including ground hazards associated with the area's natural geological setting and man-made hazards such as those arising from development activities. A summary of the relevant EnviroInsight Report findings is presented in Table 2 below:

**Table 2:** GroundSure EnviroInsight Summary: Potential Contaminative Uses/Pathways/Receptors

Details	Feature	Location relative to site
<b>Historical Land Use</b>		
Potentially Contaminative Uses	Unspecified Ground Workings (1) Gas Pressure Station (2) Cuttings (2) Sewage Works (2) Sewage Beds (2) Unspecified Tanks (1)	89m East 124m East (Closest) 313m East (Closest) 418m South (Closest) 428m South (Closest) 464m South
Historical Tanks Database	Unspecified Tank (4)	148m East (Closest)
Historical Energy Features Database	Electricity Substation (9) Gas Pressure Station (3)	72m Northwest (Closest) 123m East (Closest)
Potentially infilled land	Unspecified Ground Workings (1) Cutting (2) Sewage Works (2) Sewage Beds (2)	89m East 313m East (Closest) 418m South (Closest) 428m South (Closest)
<b>Environmental Permits Incidents and Registers and Landfill and Other Waste Sites</b>		
Licensed Discharge Consents	Sewage Discharges – Treated (6)	44m Southeast (Closest)
NIRS List 2 Records	Final Effluent – Minor air and water impact (1)	9m Southwest
Environment Agency historic landfill sites	Inert, Commercial (3) Inert (1)	794m West (Closest) 1382m Northwest

Table 2 is continued on the following page.

NB Arbitrary potential hazard assessment: potentially significant (yellow), lower risk (green), or unlikely to be significant (uncoloured). Potential receptors for contamination are highlighted blue.

**Table 2 (ctd.):** GroundSure EnviroInsight Summary: Potential Contaminative Uses/Pathways/Receptors

<b>Current Land uses</b>		
Potentially Contaminative Industrial Sites	Electricity Substation (1) Gas Pressure Station (1) Telecommunication Features (1) Ambulance Station (1) Industrial Products (1) Territorial Army Centre (1)	79m Northwest 133m East 136m East 187m East 218m East 245m East
<b>Hydrogeology and Hydrology</b>		
Bedrock Geology	Mercia Mudstone Group – Secondary B Aquifer	On Site
Superficial Geology	Devensian Till (Diamicton) – Secondary Undifferentiated	On Site
River Quality	The chemical quality of Blue Bell Beck (968m Northwest) is noted as 'D' or 'Very Poor' in the most recent survey.	
Waterway Network	Unnamed waterway (34) Blue Bell Beck (2)	On Site (Closest) 414m West (Closest)
Surface Water Features	Three (3)	On Site (Closest)
<b>Flooding</b>		
RoFRaS rating	Very Low	On site/50m
Groundwater flooding susceptibility	Superficial Deposits Flooding – Potential at surface	On site/50m
<b>Designated Environmentally Sensitive Areas</b>		
Local Nature Reserves	Stainton Quarry (1)	1535m West
<b>Natural Ground Subsidence</b>		
Very Low and Negligible Risk	Shrink swell clays, soluble rocks, collapsible rocks, Landslides, Compressible Ground, Running sand	On Site
Low	Shrink-swells	On Site
Radon	The property is not in a radon affected area <1% of properties are above the action level	

NB Arbitrary potential hazard assessment: potentially significant (yellow), lower risk (green), or unlikely to be significant (uncoloured). Potential receptors for contamination are highlighted blue

No new potentially contaminative land uses or natural risks listed in the EnviroInsight report beyond those already discussed in the review of the historical map record. Other identified features are considered to be too distant or historical to pose significant risk to the study site. Potential geotechnical hazards are discussed in more detail in the GeoInsight Report (see Section 3.4 below).

A possible receptor is identified in records of a surface waterway on the site. This is inferred to be a ditch on the western boundary of the site which appears to run north from south of the site, and may be culverted below Stainton Way and the housing estate to the north, eventually joining Blue Bell Beck some 425m west of the site. See walkover survey notes later for more details.

### 3.4 Groundsure GeolInsight Report

The GroundSure GeolInsight Report (Appendix 3) provides additional detailed information on potential geological hazards. A summary of the relevant GeolInsight Report findings is presented in Table 3 below:

**Table 3:** Groundsure GeolInsight Summary: Potential Geological Hazards

Details	Feature	Location relative to site
<b>Geology</b>		
Made ground	No (0) records within 500m	N/A
Bedrock Geology	Mercia Mudstone Group – Low permeability	On Site
Faults	No (0) records within 500m	N/A
Superficial Geology	Devensian Till (Diamicton) – High to Low permeability	N/A
Landslips	No (0) records within 500m	N/A
Radon risk	Area not affected (<1% of properties above action level).	
<b>Mining and Ground Workings</b>		
Historical surface ground workings	No (0) records within 500m	N/A
Historical Underground Workings	No (0) records within 500m	N/A
Current Ground Workings	No (0) records within 500m	N/A
Historical Mining	No (0) records within 500m	N/A
<b>Natural Ground Subsidence</b>		
Very Low and Negligible Risk	landslides, soluble rocks, compressible, collapsible deposits, running sands	On Site
Low	Shrink-swell clays	On Site
<b>Estimated Background Soil Chemistry</b>		
No unusually high levels of listed potential contaminants anticipated in local natural soils, although slightly elevated levels of Chromium and Nickel might be expected.		

NB Arbitrary potential hazard assessment: possibly a significant hazard (yellow) or unlikely to be hazardous (uncoloured)

The GeolInsight report has highlighted no additional potential risks to the site or the intended development arising due to the geological setting beyond those already discussed. Shrink-swell clays are the only geotechnical hazard of higher than very low risk; therefore, some investigation of this and the potential for vegetation influence might be appropriate in any future intrusive site investigation works.

### 3.5 Walkover Survey Observations

A site reconnaissance visit was undertaken on the 27<sup>th</sup> June 2018 by Stuart Howe of Geoinvestigate.

The site was as described in Section 1 of this report, an area of land some 0.71ha in size with access from Stainton Way to the north and currently undeveloped. The site slopes gently downwards from south to north. The surface is mostly short, well-managed grass with some trees/shrubs around the edges of site. A road acts as the boundary to the north of site while a drainage ditch acts as the western boundary and a tree line marks the southern and eastern boundaries with the carpark for the Gables public house beyond to the south. Overhead electricity cables were noted crossing the southwest corner of the site.

The drainage ditch at the western boundary is culverted to the north below Stainton Way and mapping suggests that it eventually joins Blue Bell Beck some 425m to the west of the site. This could feasible provide a medium for contaminant transport both in and out of the site.

In summary, the inspection of the surface of the site found no obvious evidence of physical hazards or odours, staining, or residues that might be indicative of the presence of chemical (including hydrocarbon) contamination. On the basis of the walkover inspection only, the risk of a serious contamination hazard

occurring at this site would be assessed to be very low given the current condition of the site and use. The hazardous gas risk at the site, based solely on the findings of the walkover survey, would also be assessed to be very low given it is unlikely any substantial gas source (such as significant deposits of made ground) exists beneath the site.

It is noted however that despite the apparent lack of evidence of any contamination encountered during the visual inspection described above, any planning application is likely to require confirmation that no contamination is likely to have occurred. Photographs taken during the walkover survey are presented below:

**Photograph 1:** Southwest of site.



**Photograph 1:** Northwest of site and Stainton Way which acts as the northern boundary.



**Photograph 3:** Southwest of site and adjacent property.



**Photograph 4:** Southeast corner of site and Looking towards Gables pub.



## 4. Qualitative Risk Assessment

### 4.1 Method

In order to assess the potential risks to the site, information obtained on the potential sources of hazard identified in Section 3 have been reviewed and applied to a model of the site. This allows an assessment of the potential sources of contamination to be made by examining the potential pollutant linkages between these and the receptors at the site.

The risk assessment presented comprises a source-pathway-receptor model developed in the context of the intended end use of the site (Residential use).

It is noted that an alternative land use would present different pollutant linkages with more or less vulnerable receptors and differing pathways for exposure. Were the intended land use to be changed at the site a revised risk assessment would be required.

Identified potential sources of hazard or contamination, vulnerable receptors and possible pathways by which they may be exposed are presented in the Conceptual Ground Hazard Model (CGHM) presented in Figure 1, see Section 4.2.

In addition to risks to human health and controlled waters and aquifers posed by contamination and ground gas, the CGHM examines the potential risks to the construction of the development including its buildings from geological or geotechnical hazards.

It allows an overall assessment to be made of the potential hazards and risks to the site and the proposed development with respect to “fitness for purpose”. The superficial and bedrock geology which is anticipated to underlie the site is assumed to exhibit a variable High to Low, and Low permeability respectively.

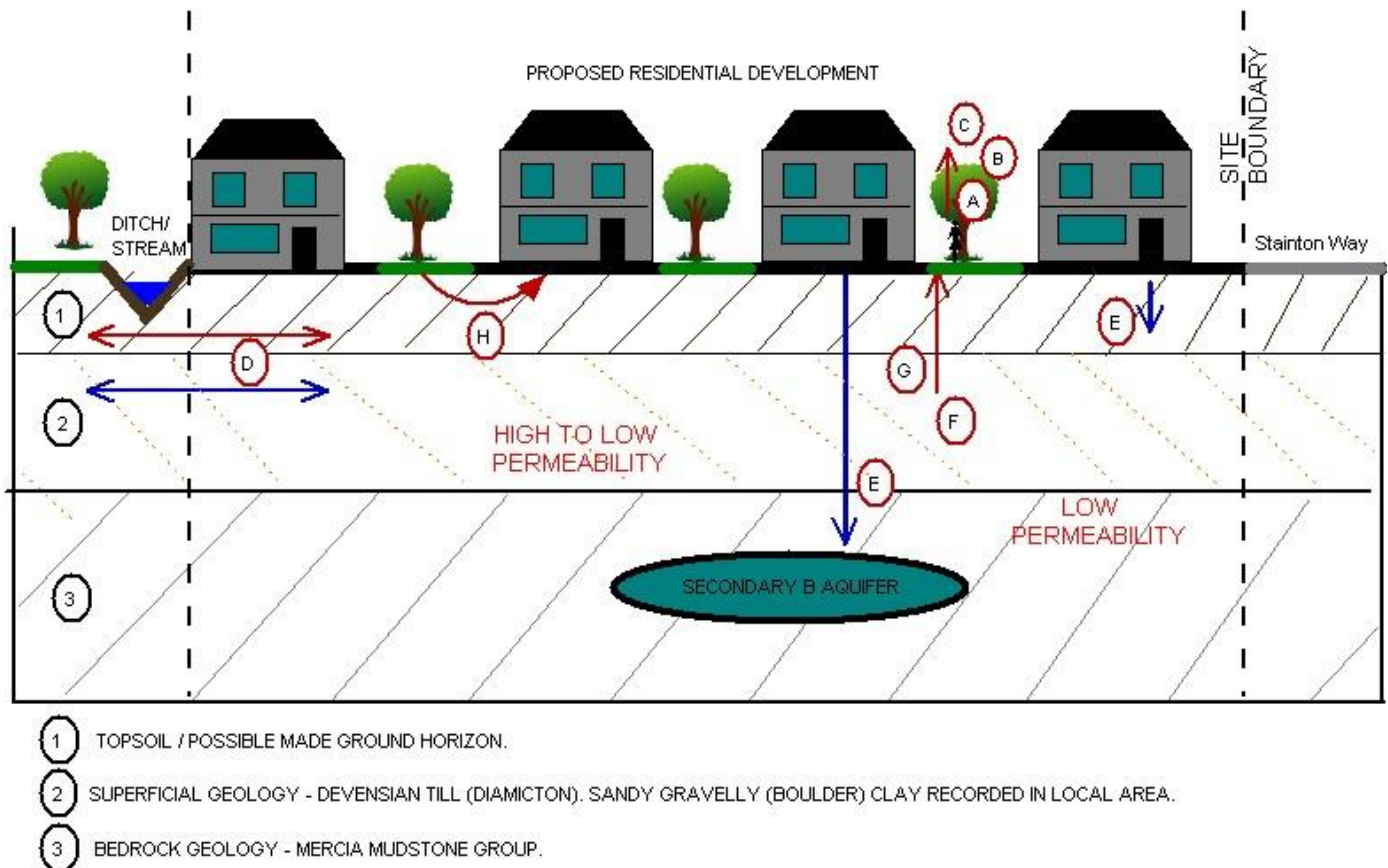
### 4.2 Risk Assessment

The desk study has highlighted the presence of possible sources of contamination potentially affecting the site primarily comprising construction and demolition of a number of small buildings on the site with more minor risk inferred associated residential and road developments close to the site.

Contamination from external sources would require a favourable pathway for migration into the site and the majority of external sources of contamination are likely to be too distant or minor to pose any significant risk. The BGS extract records superficial geology as Devensian Till (Diamicton) with an expected permeability of High to Low. While BGS borehole records show the superficial geology in the surrounding area consists mostly of stiff clay, which would suggest the likelihood of mobilisation of contamination via pathways in the superficial geology is reduced, there remains a possibility that sand and/or gravel pockets or horizons may exist. A more feasible medium for potential contaminant transport (both in and out of the site) would be the ditch/stream on the western boundary of the site which is culverted below the road and housing estate to the north/northwest and eventually joins Blue Bell Beck some 425m west of the site.

Potential receptors at the site would include the end users of the site (residents), workers employed in the construction of the new development, the buildings themselves and their services, plants and vegetation, neighbouring sites (and their users/occupants), nearby surface water and ground water at depth. A representation of the potential hazards and pollutant linkages is shown in Figure 1 overleaf.



**Figure 1 – Conceptual Ground Hazard Model of site including a Source, Pathway and Receptor Model****IDENTIFIED HAZARDS Including Potential CONTAMINATION SOURCES**

- On site buildings and removal.
- Development of roadways and residential areas nearby.
- Hazardous gas sources from possible made ground within or near to site.
- Ground instability via shrink-swell clays.

**IDENTIFIED RECEPTORS and ASSOCIATED PATHWAY**

- A - End Users through Direct Contact / Inhalation / Ingestion. Buildings and hard-standing may encompass some of the site, removing any pathway to end users through direct contact in these areas.
- B - Plants and Trees through uptake.
- C - End Users through cultivation and consumption of vegetables / fruit. Possible given the intended layout and end use of the site.
- D - Neighbouring Sites through lateral migration (in soil and water, including surface water run-off).
- E - Ground water through leaching of sub-soil.
- F - Buildings and services through direct contact.
- G - End users and buildings through ground gas migration.
- H - Ground instability via shrink-swell deposits (low, but non-negligible, risk)

The CGHM and the summary table below (Table 4) show that past and current land uses located both within and near to the property could feasibly give rise / have given rise to contamination of the site.

These activities could feasibly have given rise to harmful and potentially mobile contamination of natural deposits which underlie the site. Superficial geology is recorded as Devensian Till (diamicton) with an expected variable high to low permeability. BGS borehole records nearby to site show the superficial geology mostly comprises stiff clay through which pathways for contaminant migration would be unlikely. However, sand and gravel pockets in the superficial geology could feasibly allow contaminant migration, though these are currently thought unlikely based on available borehole logs.

Therefore, assuming the worst-case scenario, the potential for harmful contamination to exist at the site from historical sources is assessed to be **Very Low** owing to the potentially contaminative activities located within/near the study area (primarily concerning Residential developments nearby to site and buildings on site plus the major development of the roads nearby.)

The gas risk is also assessed to be **Very Low** due to lack of apparent sources nearby to site.

The actual current level of risk to the development and its users can only be ascertained for certain through confirmation of the ground conditions by a Phase 2 intrusive investigation, potentially including a contamination and gas monitoring survey (though the latter is unlikely to be required).

**Table 4: Summary of Conceptual Ground Hazard Model**

Potential Source	Nature of Hazard	Associated Contaminants	Pathway	Receptor	Preliminary Risk Rating
Buildings on site and subsequent removal  Development of roadway and residential area nearby	Inorganic and organic chemical contaminants within soil.	-Trace metals -PAHs -Petroleum Hydrocarbons -Asbestos	-Direct contact -Ingestion of soil -Ingestion of dust -Inhalation of vapour -Leaching into ground water	-Site Operatives -End Users -Vegetation -Controlled waters -Structures and services -Neighbouring sites/users	Very Low
Possible made ground on or close to site	Ground gas migration.	Hazardous Gas (CO <sub>2</sub> , CH <sub>4</sub> )	-Inhalation -Explosion risk	-Site Operatives -End Users -Structures	Very Low
Shrink-swell clays	Ground movement through vegetation influence	N/A	Direct	Buildings and structures	Low

NB. Arbitrary potential hazard assessment: High (red), Moderate (amber), Low (yellow), very Low (green)

## 5. Conclusions

A summary of the anticipated conditions, risks and implications based on the findings of Sections 3 and 4 of this report is presented in Table 5 below:

**Table 5:** Summary of Phase 1 Desk Study Findings

Concern	Desk Study Finding	Initial Risk Assessment	Potentially Useful Action in a Phase 2 Site Investigation
Radon Gas	N/A	Negligible	None
Normal Foundations	Stiff clay superficial geology expected below site to unknown depth (>10m).	Potentially suitable	Borehole investigation to confirm strength of ground with regard to supporting building loads.  Soil analysis should also be included to establish risk with regard to shrink-swell clay to rule out vegetation influence.
Soakaways	Superficial geology of low anticipated permeability.	Unlikely to be suitable	Water infiltration testing to quantify permeability of superficial deposits <u>if</u> granular strata are encountered
Chemical Contamination	Historical nearby and on-site land use potentially giving rise to a range of inorganic and organic contaminants including asbestos and PAHs.  Unlikely to be any significant made ground deposits based on walkover observations so no significant risk currently anticipated.	Very Low	Chemical analysis for potential contaminants in soil samples. Samples should be recovered from made ground (if found) and topsoil, and also underlying natural sub soils to check for potential leaching and migration into the site from potential external sources.
Hazardous Gas	Potential for hazardous gas to migrate from possible made ground within or close to site considered but thought to be unlikely.	Very Low	No action likely to be needed.  Ground gas monitoring wells in shallow boreholes to monitor CO <sub>2</sub> , CH <sub>4</sub> content etc. may be required if significant (>1m deep) made ground is encountered at the site.
Ground Instability/ subsidence	Shrink-swell clays	Low	Borehole investigation and soil analyses to confirm shrinkage potential of clay soils.

The initial risk assessment provided above is tentative as it is based only on the Phase 1 desk study. The risks will need to be reassessed and may perhaps change significantly becoming higher or lower depending on the results of the Phase 2 intrusive investigation and contamination survey, should these be undertaken.

## 6. Recommendations

In light of the Phase 1 desk study findings it is recommended that a Phase 2 investigation including a ground investigation and contamination and gas testing is carried out at the site to establish the actual site conditions and to properly assess the risks from the geology of the site and its historical land use.

The Phase 2 investigation should be designed to focus on the potential contaminants highlighted in the CGHM (Figure 1 and Table 4). As it is unlikely that there is any potential for hazardous gas to exist at the site, a gas survey is considered unlikely to be required but should be allowed for if significant made ground deposits are encountered.

**Table 6: Proposed Phase 2 Site Investigation Specification**

Action	Quantities	Justification/Details
Window Sampling Boreholes	8-10 boreholes. (up to 4m in depth – if achievable)	<p>Establish actual ground conditions and confirm strength of ground.</p> <p>Retrieve samples of possible made ground and natural soils for geotechnical testing and contamination analysis. Potentially recover ground water samples if encountered.</p> <p>Installation of ground gas monitoring wells (if appropriate). Only considered necessary if significant depths of made ground are encountered.</p>
Cable Percussion Boreholes	Up to 3 boreholes up to 20m deep (if achievable)	Establish deeper ground conditions and confirm strength of ground.
Chemical Contamination Analysis of Soils and Leachate	6-8 No. samples from made ground at shallow depth (<1m) and deeper natural strata or made ground (if encountered).	<p>Quantify risk posed to receptors identified in CGHM (see Figure 1) for revised risk assessment.</p> <p>Determinands should include a range of metals and other inorganic chemicals, speciated PAH content, petroleum hydrocarbon content, asbestos presence and soil organic matter content (to aid in revised risk assessment).</p>
Gas monitoring	Up to 6 No. visits over 3 months. Preferably including occasions of <1000mb and after sharp drop (may only be required in made ground encountered at site).	<p>If significant depths of made ground (&gt;1m) are encountered installation and monitoring of gas wells may be required; currently considered unlikely to be required.</p> <p>Possible analysis of Total Organic Carbon (TOC) content of soils at site in lieu of gas monitoring and/or to support gas measure recommendations.</p>
Geotechnical Testing	<p>Up to 80 No.</p> <p>Up to 6 No.</p>	<p>Moisture content determination to classify nature of soils.</p> <p>Atterberg Limit determinations to assess the shrinkage and swelling characteristics of the ground should clay soils be encountered.</p>
Provision of Factual and Interpretive Report	N/A	<p>Presentation of findings and implications including:</p> <ul style="list-style-type: none"> <li>• Site plan</li> <li>• Borehole logs</li> <li>• Results of geotechnical testing</li> <li>• Contamination analysis results</li> <li>• Ground gas measurements (if appropriate)</li> <li>• Revised CGHM and chemical contamination risk assessment including appropriate soil assessment criteria.</li> <li>• Advice regarding any necessary remediation/validation</li> <li>• Advice regarding foundation design etc.</li> </ul>

It should be noted that the scope, extent and cost of the Phase 2 work may increase if extensive ground contamination, or extensive amounts of made ground or drift deposits were found to exist at the site and/or the Local Authority or the Environment Agency require additional information.

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**END OF REPORT**

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