



Phase 1 Desk Study Site Investigation Report

LOCATION	Proposed Development, Land at the Southlands Centre, Middlesbrough TS3 0HG
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1. Introduction

In accordance with your instruction, Geoinvestigate Ltd has carried out a Phase 1 Desk Study Investigation of Land at the Southlands Centre, Middlesbrough TS3 0HG

The site currently comprises an area of land some 4.25ha in size with access from Ormesby Road to the west. The site currently consists of the Southlands Centre, Southlands Leisure Centre, all weather pitch, access road and open grassed area.

It is understood that it is proposed to demolish the buildings on 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.

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 1856 (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 underlying bedrock geology comprising the Mercia Mudstone Group and Penarth Group (Mudstone).

No BGS borehole records exist within 450m of the site. Borehole logs further afield show a varied possible near surface geology. One log 480m southeast shows that below concrete surface, made ground of clay fill is present to 0.60m followed by natural sandy clay to termination at 1.75m. Logs 480m southwest show initial topsoil of sandy clay to 0.55m followed by sandy clay becoming silty to termination at 4.50m.

Borehole logs 550m northeast show below initial topsoil of 0.30m thickness is clay to 0.83m then laminated clay to 1.98m. Below this is clay with stones to 7.48m then shale to termination at 7.62m

3.2 Historical OS Maps and Historical Land Use

Copies of historical OS maps were obtained for the site covering the period 1856 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 usable OS map of 1857 shows the site as undeveloped land.

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

Map Feature	Location	Appears	Absent	Notes
Keld House Farm	200m Northwest	1857	1960	Proximity to site may suggest site was used as farmland. If so may have been exposed to pesticides, fuels and fertilisers.
Residential Development	10m Southeast	1960	Present	1960 – Large housing estate present 10m SW 1968 – Development extends to east becoming adjacent south of site and 10m east. Likely includes utilities and services.
Southlands School/Centre	On Site	1968	Present	Initially Secondary school becoming 'Southlands centre' by 1992. Large building taking up half of entire site. Extended north by 1982.
Electrical Substation	On Site	1968	Present	Likely constructed to support Southlands school/centre.
All weather pitch	On Site	1992	Present	

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 however, do comprise the development of the site as the Southlands School/Centre plus possible historic use as a farm, nearby residential development and on-site substation.

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 on the following page:

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

Details	Feature	Location relative to site
Historical Land Use		
Potentially Contaminative Uses	Sewage Works (2) Unspecified Tank (2)	121m Southeast (Closest) 174m East (Closest)
Historical Tanks Database	Tanks (2) Unspecified Tanks (1)	162m East (Closest) 171m Southeast
Historical Energy Features Database	Electricity Substation (30) Gas Governor House (3)	On Site (Closest) 310m South (Closest)
Historical Garage and Motor Vehicle repair Database	Garage (2)	388m East (Closest)
Potentially infilled land	Sewage Works (2)	121m Southeast (Closest)
Environmental Permits Incidents and Registers and Landfill and Other Waste Sites		
Part A(2) and Part B Activates	Unloading of Petrol into storage (1)	288m South
Environment Agency historic landfill sites	Inert, Commercial (1) Unknown Waste type (1)	1383m North 1478m South
Waste treatment, transfer and disposal	Clinical Waste transfer station (7)	1169m West (Closest)
Current Land uses		
Potentially Contaminative Industrial Sites	Electrical substation (5) Electrical equipment repair (1) Electrical Equipment retail (1) Furniture retail (1)	On Site (Closest) On Site On Site On Site
Petrol and Fuel Sites	Shell – obsolete (1) Unknown – obsolete (1)	310m South 458m East
Hydrogeology and Hydrology		
Bedrock Geology	Mercia Mudstone Group – Secondary B Aquifer Penarth Group (Mudstone) - Secondary Undifferentiated aquifer	On Site On Site
Superficial Geology	Devensian Till (Diamicton) – Secondary Undifferentiated aquifer	On Site
Groundwater Abstraction Licences	None within 2000m of study area	N/A
Surface Water Abstraction Licences	None within 2000m of study area	N/A
Potable Water Abstraction	None within 2000m of study area	N/A
Groundwater Vulnerability and Soil Leaching Potential	Minor Aquifer/High Leaching potential	111m Southeast
Waterway network	Middle Beck (14)	8m Northeast (Closest)
Surface Water features	Three (3)	8m Northeast (Closest)
Flooding		
River and Coastal Flooding Zones	Zone 2 – Fluvial/Tidal models (1) Zone 3 – Fluvial Models (3)	On Site On Site (Closest)
RoFRaS rating	High (2) Medium (10) Low (1)	On site/50m On site/50m On site/50m
Groundwater flooding susceptibility	Superficial Deposits Flooding - Potential at surface	On site/50m
Designated Environmentally Sensitive Areas		
Local Nature Reserves	Berwick Hills (1)	1356m West
Natural Ground Subsidence		
Very Low and Negligible Risk	Soluble rocks, collapsible rocks, Landslides, Compressible Ground, Running sand	On Site
Low	Shrink swell clays	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.

The high RoFRaS rating only relates to a small section of the site to the very east of the site area. 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).

3.4 Groundsure GeoInsight Report

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

Table 3: Groundsure GeoInsight Summary: Potential Geological Hazards

Details	Feature	Location relative to site
Geology		
Made ground	No (0) records within 500m	N/A
Bedrock Geology	Mercia Mudstone Group – Low Permeability Penarth Group – Low Permeability	On Site On Site
Faults	No (0) records within 500m	N/A
Superficial Geology	Devensian Till (Diamicton) – High to Low Permeability	On Site
Landslips	No (0) records within 500m	N/A
Radon risk	Area not affected (<1% of properties above action level).	
Mining and Ground Workings		
Historical surface ground workings	Sewage Works (2)	121m Southeast (Closest)
Natural Ground Subsidence		
Very Low and Negligible Risk	Landslides, soluble rocks, compressible, collapsible deposits, running sands	On Site
Low	Shrink Swell clays	On Site
Estimated Background Soil Chemistry		
No unusually high levels of listed potential contaminants anticipated in local natural soils, although slightly elevated levels of Lead are expected.		

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

The GeoInsight 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 clay risk has been noted as Low rather than Very Low/Negligible.

3.5 Walkover Survey Observations

A site reconnaissance visit was undertaken on the 5th October 2018 by Stuart Howe of Geoinvestigate.

The site was as described in Section 1 of this report, an area of land some 4.25ha in size with access from Ormesby Road to the west housing the large southlands centre, associated carpark, all weather sports pitch and access road to Ormesby Road. The site surface, outside of building footprints, consists of hardstanding or well-kept grass. Some trees are present on site also. A low metal fence acts as the site boundary in each direction. An electricity substation was noted on site, as well as multiple drains and an entry point for gas into the building.

The all-weather pitch was noted as being slightly raised above the level of the rest of the site. The Material used to build up the pitch is unknown.

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 Low - Moderate 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 Low – Moderate given the possibility of made ground below 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: shows the carpark which makes up most of the hardstanding area on site as well as the all-weather pitch and a small section of lawn area.



Photograph 2: shows some of the Southlands Centre building on site as well as the trees on site which line the southern boundary.



Photograph 3: shows the substation building on site.



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 (Likely 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.

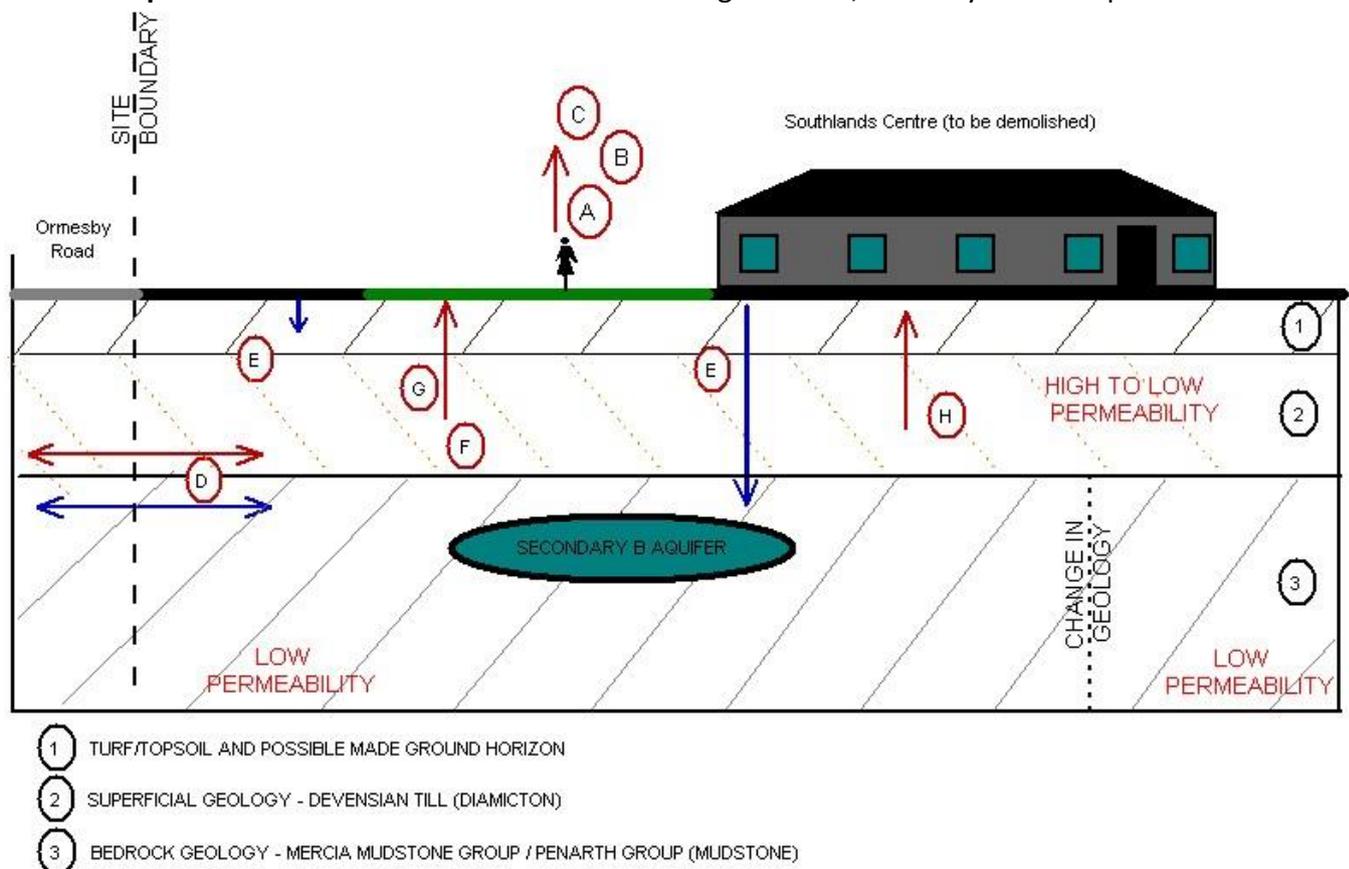
It allows an overall assessment to be made of the potential hazards and risks to the site and the proposed development with respect to “fitness for purpose”. The superficial and bedrock geology which is anticipated to underlie the site is assumed to exhibit High to Low and Low permeability respectively.

4.2 Risk Assessment

The desk study has highlighted the presence of possible sources of contamination potentially affecting the site primarily comprising the development of the site as the Southlands School/Centre plus possible historic use as a farm, nearby residential development and on-site substation.

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 the superficial geology as Devensian Till (Diamicton) with a highly variable expected permeability (High to Low). The closest BGS borehole logs each show a superficial geology of predominantly clay or sandy clay. As such this would not provide a favourable medium for contamination migration through the superficial geology.

Potential receptors at the site would include the end users of the site (potentially 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 previous agricultural fields - possible exposure to fuels, pesticides and fertilisers.
- On Site development of Southlands School / Centre.
- On Site electrical substation.
- Nearby residential development likely including utilities and services.
- Possible made ground also associated with residential development nearby
- Ground surface instability via shrink swell clays

IDENTIFIED RECEPTORS and ASSOCIATED PATHWAY

- A - End Users through Direct Contact / Inhalation / Ingestion. Buildings and hard-standing will 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 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 - Building and services through direct contact.
- G - End users and buildings through ground gas migration.
- H - Buildings and structures via Ground surface instability due to shrink swell clays (low 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 is recorded as Devensian Till (Diamicton) with a highly variable expected permeability (High to Low). The closest BGS borehole logs each show a superficial geology of predominantly clay or sandy clay. As such this would not provide a favourable medium for contamination migration through the superficial geology.

Therefore, assuming the worst-case scenario, the potential for harmful contamination to exist at the site from historical sources is assessed to be **Low - Moderate** owing to the potentially contaminative activities located within/near the study area (primarily concerning the development of the site as the Southlands School/Centre plus possible historic use as a farm, nearby residential development and on-site substation.)

The gas risk is assessed to be **Low - Moderate** due to possible made ground below the site associated with the development of site and possible material used to build up the level of the all-weather pitch.

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.

Table 4: Summary of Conceptual Ground Hazard Model

Potential Source	Nature of Hazard	Associated Contaminants	Pathway	Receptor	Preliminary Risk Rating
Historical land use and development (Possible farm use). Possible made ground. Residential Development. Electricity Substation	Inorganic and organic chemical contaminants within soil.	-Trace metals -PAHs -Petroleum Hydrocarbons -Possible fertilisers and pesticides -PCBs	-Direct contact -Ingestion of soil -Ingestion of dust -Inhalation of vapour -Leaching into ground water (As above)	-Site Operatives -End Users -Vegetation -Controlled waters -Structures and services -Neighbouring sites/users (As above)	Low - Moderate
Possible made ground on site and nearby	Ground gas migration.	Hazardous Gas (CO ₂ , CH ₄)	-Inhalation -Explosion risk	-Site Operatives -End Users -Structures	Low - Moderate
Shrink Swell Clays	Ground Instability		Direct contact	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	Unknown drift depth and competency below the site	Unknown if 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, or assess strength of the potentially weak soils.
Soakaways	Superficial geology recorded as expected highly variable permeability. BGS borehole records suggest predominantly clayey nature	Unlikely to be suitable	Water infiltration testing to quantify permeability of superficial deposits if 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 pesticides and PAHs. Unlikely to be any significant made ground deposits based on walkover observations so significant risk currently anticipated.	Low - Moderate	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 nearby made ground considered but thought to be unlikely.	Low - Moderate	Ground gas monitoring wells in shallow boreholes to monitor CO ₂ , CH ₄ content etc.
Ground Instability/ subsidence	Shrink Swell clays	Low	Borehole investigation to confirm strength of both natural and made ground and 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 there is potential for hazardous gas to exist at the site is, a gas survey may be necessary.

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.

END OF REPORT



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