Land to the Rear of 26 Cross Lane, Royston

Phase 1 Site Investigation Report

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Phase 1 Site Investigation Report

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Executive Summary

Site Location	The site is located off Cross Lane, Royston, Barnsley and covers an area of 0.4 hectares. The National Grid Reference is 437280, 411570.	
Current Site Use	The site is grassed with several areas of trees and bushes. An access track crosses the north of the site, leading to a garage / barn and a stable. The site is currently used as pasture for horses.	
Previous Site Uses	The site was used as allotments from approximately 1917 to 1962, with the western part being an orchard from 1962 until approximately 1994.	
Proposed Site Use	The proposed site use is for residential housing with gardens.	
Geology	Drift:	None present in the vicinity of site.
	Solid:	Carboniferous Pennine Middle Coal Measures.
	Faults:	One shown immediately north of site.
Environmental Consideration	Landfills:	Three historic landfills within 250m of the site, including one within 20m.
	Radon:	No radon protection measures required.
	Pollution:	No pollution incidents recorded that would affect the site.
	Groundwater:	Underlying solid strata are a Secondary A Aquifer. Not within a groundwater Source Protection Zone. No abstraction points for potable water within 1km.
	Surface Water:	No significant surface watercourses in the vicinity of the site.
Preliminary Contamination Assessment	There is a potential for soil contamination to be present as a result of previous uses of the site and adjoining areas. There is also a risk for potential contaminant linkages to human health to exist following residential redevelopment. Sulphates could be present in sub-soils, which would pose a risk to sub-surface concrete for proposed structures. There is a low risk from pollution of controlled waters from the site. A former landfill site is located 20m to the north-east of the site, which could be a source of ground gases.	
Recommendations	A Phase 2 site investigation is recommended in order to determine the actual risks from the potential contamination linkages identified. Window sampling should be carried out in order to allow sampling of site soils for laboratory testing, the installation of gas monitoring wells and to provide information for a geotechnical assessment. Gas monitoring should be undertaken on 12 occasions over a 6 month period, subject to review following several monitoring visits.	

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1 Introduction

1.1 Terms of Reference

1.1.1 Ecus Ltd (hereafter Ecus) was commissioned by William Smith (Wakefield) Ltd to provide a Phase 1 Site Investigation for a site to the rear of 26 Cross Lane, Royston, Barnsley, hereafter referred to as 'the site'.

1.1.2 To complete the Phase 1 Site Investigation, a site walkover and assessment of current activities has been undertaken, together with an investigation into land use history and a review of local environmental conditions.

1.1.3 The results of the investigation are presented in Section 2 of this report and Section 3 draws together a preliminary conceptual model and risk assessment. Section 4 presents conclusions and recommendations. Appendices A - D provide supporting information.

1.2 Objectives of the Phase 1 Site Investigation

1.2.1 The assessment has been carried out in general accordance with the requirements of British Standard BS10175 (2011) – Code of Practice for the Investigation of Potentially Contaminated Sites.

1.2.2 The general objectives of the assessment are as follows:

- To provide information on past and current uses of the site and surrounding area, and the nature of hazards and physical constraints;
- To identify receptors, potential sources of contamination, likely pathways and any features of immediate concern;
- To provide information on the geology, hydrogeology and hydrology of the site to assist in establishing the conceptual model;
- To provide an initial conceptual model of the nature and extent of potential contamination;
- To provide recommendations for the development of the site based on the information obtained.

1.3 Future Site Use

1.3.1 It is understood that proposals for the site are to construct a number of residential houses with associated access roads, gardens etc. A proposed site layout plan has been provided; this is presented as Figure A3 in Appendix A.

1.3.2 This report has been produced with that end use in mind; any proposed change in use may result in a need for additional assessment.

1.4 Sources of Information

1.4.1 Table 1 presents sources of information that have been consulted during this assessment.

Table 1: Sources of Information

Source	Details
Project architect	The architect provided information on proposed site development plans and on the former uses of the site.
Site Walkover	Information about the site was gained from visual inspection during a site walkover.
Landmark Envirocheck Report	Presented in Appendix C and containing historical mapping and records of environmental information for the surrounding area.
British Geological Survey (BGS)	BGS 1:50,000 scale Geological Map No. 87, Barnsley (Bedrock & Superficial Deposits edition) was consulted for geological information relating to the site and surrounding area.

2 Findings of the Phase 1 Investigation

2.1 Site Location and Current Condition

2.1.1 The site is approximately 0.4 hectares in area, and is situated off Cross Lane, Royston, Barnsley. Figure A1, Appendix A shows the location of the site which centres on National Grid Reference 437280, 411570.

2.1.2 A site walkover was carried out on 13th June 2012. Figure A2, Appendix A shows the current layout of the site. Photographs of the site are presented in Appendix B.

2.2 Site Description

2.2.1 The site is an approximately rectangular plot of land lying to the rear of 26 Cross Lane. The site also encompasses 26 Cross Lane and its curtilage, including an access track located to the north of the house.

2.2.2 The site to the rear of the house comprises part of an open area consisting of a grassed field with several areas of mature and semi-mature trees around the site boundaries and adjacent to the access track. The site is currently used as pasture for horses.

2.2.3 There are some temporary wooden structures on the site as a whole, including two open-sided garages / barns and a stable. Only the garage / barn structure and the stable nearest to Cross Lane are actually located within the proposed development site.

2.2.4 The site is bounded by wooden and post and mesh fences, with some stretches of overgrown bushes acting as rough hedges. Some wood and wire pens / cages are present adjacent to the northern and southern boundaries; these are believed to have been used to keep birds.

2.3 Topography and Ground Cover

2.3.1 The site lies at an elevation of approximately 50m above Ordnance Datum (AOD) at the furthest south-eastern corner. From here, the site slopes gently up towards the north and west, with the current site entrance off Cross Lane being the highest point, at approximately 53m AOD.

2.3.2 The north of the site comprises a rough asphalt-surfaced track, leading from Cross Lane to the garage-structure off site to the east. Apart from the house and garden, the rest of the site is grass-surfaced with trees and bushes.

2.4 Underground Structures and Services

2.4.1 Apart from the drainage from, and services to the house, no underground structures or services were indicated to be present by the client's representative.

2.5 Potential Contaminant Sources Noted During the Site Walkover

2.5.1 The following potential sources of contamination were noted during the site walkover:

- Some areas of the site were being used for storage of waste items, including buildings materials;
- Given the presence of the access track and the garage structures, it is likely that vehicles will have been parked on the site in the past, which could potentially have been a source of hydrocarbon contamination.

2.6 Visual Evidence of Contamination Noted During the Site Walkover

2.6.1 No visual evidence of gross soil contamination was noted during the site walkover survey.

2.7 Current Surrounding Land Use

2.7.1 Current land use directly surrounding the site is outlined in Table 2.

Table 2: Current Surrounding Land Use

Direction	Land Use
North	Residential housing and gardens adjacent to Cross Lane.
East	Continuation of site, with horse ménage, with railway beyond.
South	New development of residential housing.
West	Residential housing and gardens adjacent to Cross Lane.

2.8 Historical Land Use

2.8.1 Historical Ordnance Survey mapping was obtained by commissioning a Landmark Envirocheck report for the site.

2.8.2 The historical maps are presented in Appendix C. A description of the historical use of the site is presented in Table 3. Table 3 also describes surrounding land uses where it is considered that these may influence the contamination potential of the site.

Table 3: Historical Use of the Site and Surrounding Land (all distances are approximate)

Map Date	Land use within the site boundary	Potentially significant surrounding land use
1854	Site is undeveloped; comprises part of a field.	The Barnsley Canal is shown c. 55m north-west at its nearest point. The Midland Railway is c. 75m east of the site.
1893-95	No significant changes shown.	Cross Lane is present to the west, with some housing shown to the north-west of the site. Monckton Main Colliery shown c. 500m north. Canal now marked as Aire & Calder Navigation (Barnsley Branch).
1906-08	No significant changes shown.	Sewage Works present immediately south of site. Further railway lines with station and goods shed present to within 35m of the site's eastern boundary. Gasometer marked c. 180m north. Colliery shown to cover larger area, with spoil heaps to south.
1917-18	Site marked as Allotment Gardens.	Houses shown immediately north of the site access track.
1932-33	No significant changes shown.	No significant changes shown.
1938-48	No significant changes shown.	Further housing shown to south of Sewage Works.
1956	No significant changes shown.	No significant changes shown.
1962	House (No. 26 Cross Lane) shown on west of site. Main part of site shown split into two parcels of land, with west side shown as Orchard and the east marked as having Non-coniferous trees and Scrub groundcover.	Sewage Works no longer shown. Further housing development along Cross Lane, to the west of the site.
1966	No significant changes shown.	No significant changes shown.
1975-77	No significant changes shown.	Further housing development to west of Cross Lane. Much of the railway, including the station no longer shown.
1981	No significant changes shown.	No significant changes shown.
1990-93	No significant changes shown.	No significant changes shown.
1994-95	Track shown crossing north of site, leading to building off site to the east.	No significant changes shown.
2006	No significant changes shown.	Monckton Main Colliery shown as Mine (disused).
2012	No significant changes shown.	No significant changes shown.

Summary of Site History

2.8.3 The earliest available maps show that the site was undeveloped, comprising part of a field. The site was in use as allotment gardens by 1917 and part of the site as an orchard by 1962. By 1994 a track is shown crossing the north of the site.

2.8.4 Off-site, there has been much development of residential housing, with some nearby areas of industrial land use (railways, sewage works, coal mine etc.).

2.9 Geology, Hydrogeology and Hydrology

Geology

2.9.1 The geological map for the area has been studied to infer the likely geology of the site and surrounding area.

2.9.2 The site is shown to be underlain by solid strata of the Carboniferous Pennine Middle Coal Measures Formation, comprising mudstone, siltstone and sandstone. No drift deposits are shown to affect the site.

2.9.3 No coal seams are shown in the immediate vicinity of the site. The Sharlston Top seam is shown approximately 500m south of the site, dipping towards the north, beneath the site. An assessment of the likely dip of the coal seam has indicated that the coal is likely to lie at a depth of over 100m below ground level (bgl) in the vicinity of the site.

2.9.4 One fault is shown in the vicinity, lying to the north of the site. This trends east-west in this area, with the northern side being downthrown.

Hydrogeology

2.9.5 The solid strata underlying the site are classified by the Environment Agency (EA) as a Secondary A Aquifer (formerly a Minor Aquifer). The EA describe these aquifers as 'permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers'.

2.9.6 The site is not located within a groundwater Source Protection Zone, set by the Environment Agency for the protection of potable groundwater resources.

2.9.7 The Envirocheck report indicates that there are no currently licensed groundwater abstractions within 1km of the site.

2.9.8 The Envirocheck report does not list any licensed discharge consents to groundwater located within 500m of the site.

Hydrology

2.9.9 The Envirocheck report indicates that the nearest surface water feature to the site is a canal, located approximately 55m to the north-west; the former Aire and Calder Navigation (Barnsley Branch) which is now disused. Also present is a small watercourse, located approximately 75m north-east of the site, which passes beneath the railway line and into Sandybridge Dike, a tributary of the River Dearne.

2.9.10 The Envirocheck report indicates that there are no currently licensed surface water abstractions within 500m of the site.

2.9.11 The Envirocheck shows that there are no active discharge consents to surface water which relate to the site.

2.10 Pollution Incidents

2.10.1 There are no recorded instances of pollution of controlled waters recorded within the Envirocheck report which relate to the site or are considered likely to have affected the contamination status of the site.

2.11 Landfill Sites and Waste Management Licences

2.11.1 There are three historical landfill site within 250m of the site recorded within the Envirocheck report, as detailed below:

- Land off Cross Lane, 20m north-east. Deposited wastes include Household Waste.
- Poplar Terrace, 90m north. No further information given.
- Land off Midland Road, 140m north. Deposited wastes include Inert & Commercial Waste.

2.11.2 There are three Local Authority recorded landfill sites within 250m of the site. The nearest two relate to the first two sites recorded above. One further site is located 124m south-east and appears to form part of a historical landfill site known as Cudworth North Junction. Wastes deposited included Inert, Industrial, Commercial, Household, Special Waste and Liquid Sludge.

2.11.3 There is one registered waste treatment site in the vicinity, located 95m to the north. This relates to the storage of spent iron oxide from the desulphurisation of coke oven gas at Monckton Coke and & Chemical Co. Ltd.

2.11.4 There are no currently registered waste transfer sites located in the vicinity of the site.

2.12 Sensitive Land Uses

2.12.1 The Envirocheck report indicates that the site is not located in proximity to a sensitive land use, such as a local nature reserve or site of special scientific interest.

2.13 Radon

2.13.1 The Envirocheck report states that the site is located within an area where no radon protective measures are required for new dwellings.

2.14 Flood Risk

2.14.1 According to the Envirocheck report, the site is located within Flood Zone 1, the lowest risk category in the Environment Agency's classification system.

2.15 Coal Mining

2.15.1 A Coal Authority Mining Report was obtained for the site, a copy of which is included in Appendix D.

2.15.2 In summary, the report states that:

- The property is in the likely zone of influence from workings in 3 seams of coal at 270m to 410m depth and last worked in 1960. Any ground movement from these should have stopped by now.
- The property is not in the likely zone of influence of any present or planned future underground workings. However, reserves of coal exist in the locality which could be worked at some time in the future.
- There are no known coal mine entries within, or within 20 metres of, the boundary of the property.
- The property is not within the boundary of, or within influence of, any past, present or planned future opencast coal mine.

3 Preliminary Conceptual Model and Risk Assessment

3.1 Potential Contaminants and Sources

3.1.1 The following sections provide an indication of the potentially contaminative activities that have been carried out throughout the historical use of the site and the surrounding land. Likely associated contaminants are also identified. It should be noted that the activities identified may not necessarily have resulted in contamination of the ground.

On-Site

3.1.2 The site is known to have been used as allotment gardens since before 1917 and as an orchard from sometime between 1917 and 1962. It is known that allotment soils can contain a range of potential contaminants due to either atmospheric deposition from industrial sources, or from substances introduced by the allotment holder such as wood ash, chimney soot or inorganic pesticides[1]. In addition, orchard soils can contain various contaminants, such as lead and arsenic, due to their use in pesticides[2]. The use of lead-arsenate pesticides was diminishing by the 1960s[3], but it is possible that these or other potentially contaminating pesticides were used at the site. Asbestos can also be associated with allotments due to the use of asbestos-cement sheeting in the construction of temporary structures.

3.1.3 An asphalt access track is present crossing the north of the site. This leads to a barn-style building which is likely to have been used for parking of vehicles.

3.1.4 Some waste materials were noted to be stored behind the barn in the centre of the site; however, no specific evidence for contamination related to these materials was noted (see Photographs in Appendix B).

Off-Site

3.1.5 The site is within 250m of three closed landfill sites, including one within 20m, which was used for putrescible household waste. Migration of landfill gases onto the site, including methane and carbon dioxide from the landfills is possible[4].

3.2 Potential Pathways and Receptors

3.2.1 Table 4 details and discusses the potential pathways and receptors identified during the Phase 1 investigation for any contaminants that may be present in the ground at the site.

3.2.2 Some pathway-receptor linkages highlighted in the table are not considered likely to be active for the reasons specified in the comments section.

[1] Alloway, B.J., 2004. *Contamination in Soils in Domestic Gardens and Allotments: A Brief Overview*. Land Contamination & Reclamation, 12 (3), 2004. EPP Publications Ltd. Available from: http://www.gros.co.uk/Contamination%20of%20soils%20in%20domestic%20gardens%20and%20allotments-%20A%20brief%20overview.pdf [Accessed July 2012].

[2] Martin, I., De Burca, R., Morgan, H., 2009. *Soil Guideline Values for Arsenic in Soil. Science Report SC050021 / arsenic SGV*. Environment Agency. Available from: http://www.environment-agency.gov.uk/static/documents/Research/SCHO0409BPVY-e-e.pdf [Accessed July 2012].

[3] ATSDR, 2007. *Toxicological profile for arsenic*. Atlanta, GA: US Department of Health and Human Services, Agency for Toxic Substances and Disease Registry. Available from: http://www.atsdr.cdc.gov/toxprofiles/tp2.pdf [Accessed June 2012].

[4] The Building Regulations 2000. *Approved Document C: Site Preparation and Resistance to Contaminants and Moisture.*

Table 4: Potential Pathways and Receptors

Potential Pathway	Potential Receptor	Comment
Dermal contact with soil.	Future residents.	Future residents and site users could come into contact with contaminated soils in garden and soft landscaped areas.
Intake via direct ingestion of soil and contaminated dusts indoors and outdoors.	Future residents.	See above. Contaminated soils can be tracked indoors to form dusts which are inhaled and ingested.
Intake via consumption of fruit and vegetables grown on the site, and attached soils.	Future residents.	Exposure to contaminated soils may occur via consumption of home-grown produce and any attached soils.
Intake via inhalation of soil vapours and ground gases indoors and outdoors / methane explosion.	Future residents.	Soils contaminated by volatile contaminants, e.g., petrol, have potential to release hazardous vapours into future buildings, which can then be inhaled by residents and site users. Ground gases can also be generated by landfilled material. These can migrate through the sub-surface and collect within confined spaces, e.g. buildings.
Direct contact with site soils.	Foundations of proposed buildings.	Some contaminants, including sulphates and acids, may adversely affect building foundations.
Migration through soil / groundwater.	Controlled waters: groundwater.	The underlying strata are classified as a Secondary Aquifer, likely to be overlain by clay soils of low to moderate leaching potential. The site is not located within a Source Protection Zone.
	Controlled waters: surface water.	There are no significant water courses located within close proximity to the site.
	Off-site residents.	Residential properties are located to the north, west and south of the current development site, which could be affected if contamination migrates off the site.

3.3 Preliminary Conceptual Model

3.3.1 The conceptual model for the site identifies potential pollutant linkages based on the information collated in this Phase 1 Site Investigation, and an understanding of the way that the potential contaminants at the site are likely to behave in the environment. The comments presented in Table 4 have been considered in producing the model and source-pathway-receptor linkages that are not likely to be active have not been included.

3.3.2 For the purpose of the conceptual model, groups of contaminants that (in most circumstances) behave in a similar way in the environment have been grouped and linked to potential pathways and receptors. Table 5 shows the identified potential organic contaminants and Table 6 shows the potential inorganic contaminants that have been identified. Not all potential contaminants have been included in the conceptual model, only those that are considered significant at this stage.

3.3.3 The key for Tables 5 and 6 is as follows:

KEY: LOW – potential risks associated with the presence of the contaminant linkage are low and further assessment or remediation is not considered necessary.

MOD – potential risks associated with the presence of the contaminant linkage are moderate and further assessment or remediation should be considered.

HIGH – potential risks associated with the presence of the contaminant linkage are high and further assessment or remediation is considered necessary.

N/A – The contaminant has no potential to affect the receptor via this exposure pathway.

Table 5: Summary Conceptual Model and Risk Assessment - Organic Contaminants

Receptors and pathways	Petroleum Hydrocarbons	PAH	Ground Gases (Methane & CO^2)	Notes
Human health (on site)				
Dermal contact with soil	MOD	HIGH	N/A	Topsoil present within allotment gardens and/or orchards can potentially contain a range of contaminants, including PAHs.
Direct ingestion of soil & dusts	MOD	HIGH	N/A	It is possible that topsoil present on the site may be re-used within garden areas following redevelopment of the site.
Intake via consumption of fruit and vegetables grown on the site, and attached soils.	MOD	HIGH	N/A	The site is located within 250m of three former landfill sites, with the closest being located within 20m of the site.
Intake via inhalation of soil vapours and ground gases indoors and outdoors / methane explosion.	MOD	MOD	HIGH	Migration of landfill gases including methane and carbon dioxide from the landfills is possible.
Human health (off site)				Residential properties are located in proximity to the site. Migration of contaminants off site may occur if groundwater pathways are active.
Migration of contaminants, gases and vapours off-site through soil / groundwater to neighbouring properties, followed by exposure via pathways described above.	LOW	LOW	N/A	However, the site is likely to be underlain by low-permeability clay soils which would prevent or retard off-site migration of contaminants via groundwater flow.
Buildings				High concentrations of hydrocarbon contamination can prevent concrete curing correctly, although this is considered unlikely to be present.
Concrete foundations	MOD	LOW	N/A	
Controlled Waters				No gross hydrocarbon contamination encountered.
Migration to groundwater within Minor Aquifer	LOW	LOW	N/A	Groundwater below the site is considered to have moderate to low sensitivity due to being a secondary aquifer and distant from any groundwater abstractions or significant surface water courses.
Migration to surface water via groundwater	LOW	LOW	N/A	

Table 6: Summary Conceptual Model - Inorganic Contaminants

Receptors and pathways	Heavy Metals	Sulphates	pH	Asbestos	Notes
Human health (on site)					Topsoil present within allotment gardens and/or orchards can potentially contain a range of inorganic contaminants, including Heavy Metals and Asbestos.
Dermal contact with soil	HIGH	N/A	N/A	N/A	
Direct ingestion of soil & dusts	HIGH	N/A	N/A	HIGH	It is possible that topsoil present on the site may be re-used within garden areas following redevelopment of the site.
Intake via consumption of fruit and vegetables grown on the site, and attached soils.	HIGH	N/A	N/A	N/A	Fruit and vegetables may take up Heavy Metals from contaminated soils, but not Asbestos.
Intake via inhalation of soil vapours and ground gases indoors and outdoors / methane explosion.	LOW	N/A	N/A	N/A	The inorganic contaminants potentially present on site do not have the potential to release hazardous vapours.
Human health (off site)					Residential properties are located in proximity to the site. Migration of contaminants off site may occur if groundwater pathways are active.
Migration of contaminants, gases and vapours off-site through soil / groundwater to neighbouring properties, followed by exposure via pathways described above.	LOW	N/A	N/A	LOW	However, the site is likely to be underlain by low-permeability clay soils which would be expected to prevent or retard off-site migration of contaminants via groundwater flow.
Buildings					Sulphates and soil pH can adversely affect sub-surface concrete.
Concrete foundations	N/A	HIGH	HIGH	N/A	Other inorganic contaminants potentially present do not have the potential to have adverse effects on concrete.
Controlled Waters					Groundwater below the site is considered to have moderate to low sensitivity due to being a secondary aquifer and distant from any groundwater abstractions or significant surface water courses.
Migration to groundwater within Minor Aquifer.	LOW	LOW	LOW	N/A	
Migration to surface water via groundwater flow.	LOW	LOW	LOW	N/A	Asbestos is insoluble and does not affect water quality.

3.4 Risk Assessment Summary

Human Health

3.4.1 It is considered possible that the historical uses of the site may have introduced some potential organic and inorganic contaminants into shallow soils at the site.

3.4.2 Should topsoil currently present on the site be re-used in garden areas of the development, this could be a source of contamination following redevelopment.

3.4.3 There are three historical landfill sites located within 250m of the site. Given the proximity of the nearest landfill to the site (20m), plus the source of waste being given as household waste, the risk from landfill gases is considered to be high at this stage.

Controlled Waters

3.4.4 The strata underlying the site are classified as being a Secondary A Aquifer (formerly Minor Aquifer). The site is not within a groundwater source protection zone. No gross contamination was encountered at the site, and groundwater resources at the site are not considered to be a sensitive environmental receptor. Therefore the risk from groundwater pollution is considered low.

3.4.5 Due to the distance between the site and surface water courses, the risk from migration of contaminants to surface waters is considered to be low.

Building Materials

3.4.6 Coal Measures strata are known to potentially contain high concentrations of sulphates with the potential to adversely affect sub-surface concrete, including foundations[5]. It is therefore recommended that samples of the likely founding strata are taken and submitted for chemical analysis for sulphates and pH, in line with BRE Special Digest 1, in order to specify a suitable concrete type.

[5] BRE (2005) Special Digest 1 – Concrete in Aggressive Ground.

4 Conclusions and Recommendations

4.1 Conclusions

4.1.1 The Phase 1 Site Investigation has revealed that:

- In 1854 the site was undeveloped, comprising part of a field. The site was in use as allotment gardens by 1917 and part of the site as an orchard by 1962. By 1994 a track is shown crossing the north of the site.
- Off-site, there was much development of residential housing with some areas of industrial land use (including railways, sewage works, coal mine and coking works).
- The site currently comprises a plot of grassed land with several areas of trees and bushes, used as pasture for horses.
- The topsoil present on site has been identified as a potential source of contamination, due to the site's past uses as allotment gardens and an orchard.
- There is considered to be a potential risk to sub-surface concrete (foundations etc.) from sulphates in sub-soils.
- The risk of pollution of controlled waters is considered to be low.
- The former landfill sites located in the vicinity of the site have been identified as a potential source of ground gases.

4.2 Recommendations

4.2.1 A Phase 2 intrusive site investigation is recommended in order to determine the actual risks from the potential contaminant linkages identified in this report, and to provide sufficient geotechnical information for the safe and economical design of foundations and ground floor slabs, etc. for the proposed development.

4.2.2 It is recommended that the site investigation comprises a number of small diameter, window sample boreholes to allow sampling of site soils for laboratory analysis and to install groundwater and gas monitoring wells. Standard penetration tests (SPTs) and hand shear vane readings should be undertaken in clay soils.

4.2.3 Sampling of site soils should be undertaken with analysis of a range of chemical parameters and potential contaminants. These should include heavy metals, speciated petroleum hydrocarbons, polycyclic aromatic hydrocarbons (PAH) and asbestos.

4.2.4 Soil testing for pH, water soluble sulphate, acid soluble sulphate and total sulphur should be undertaken during construction in order to specify a suitable concrete mix for the sulphate concentration within site soils, in accordance with BRE Special Digest 1.

4.2.5 In accordance with CIRIA guidance on hazardous ground gases[6], the potential source of ground gases is of Moderate generation potential (old landfill), with the sensitivity of development being classified as High (residential with gardens).

4.2.6 Therefore, gas monitoring should ideally be undertaken on twelve occasions over a six-month period in order to determine the extent of gas protection measures required. However, it is possible that the monitoring period could be modified should initial gas monitoring visits prove an absence of landfill gas under ideal atmospheric conditions (i.e. low and falling pressure) on several occasions.

[6] CIRIA Report C665. 2007. Assessing risks posed by hazardous ground gas to buildings.