

Phase 1 Geo-Environmental Desk Study Report
Ducks Nest Farm, Arborfield, Berkshire RG2 9PJ
David Wilson Homes Southern



Environmental Management Solutions – EMS Geotech

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Phase 1 Geo-Environmental Desk Study Report

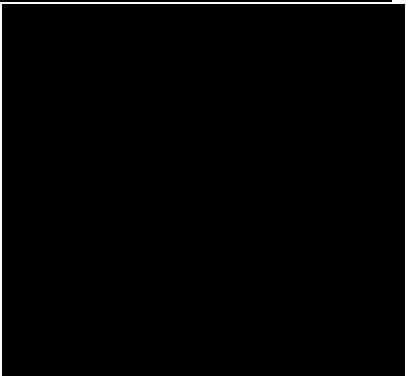
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E28112 – Ducks Nest Farm, Arborfield, Berkshire RG2 9PJ

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SUMMARY REPORT

SUBJECT	COMMENTS
CURRENT USE & DESCRIPTION	Irregular in plan, the site covers approximately 18 hectares, is relatively flat and includes four large grass covered/ cropped fields (Fields 1 to 4) that are separated with hedgerows, trees and post and wire fencing. The site generally slopes towards the southeast. Ducks Nest Farm Industrial Estate sits on the eastern boundary between Fields 1 and 2. A drainage ditch, or stream, flows along the boundaries between Fields 1, 2, 4 and the Ducks Nest Farm Industrial Estate. Hedgerows, trees and wooden post and rail fencing generally delineates the site on all sides. Arborfield Court, open fields and the residential outskirts to Arborfield Cross bound the site to the north. Eversley Road bounds the site to the east, beyond which are open fields, Targetts Farm, Langley Common and a residential and commercial/light industrial estate. Observer Way (A327) and open fields bound the site to the southwest.
PROPOSED USE	It is proposed to develop the eastern half of the site for residential purposes with associated access roads, parking areas, gardens and open space.
HISTORICAL SUMMARY	The site has remained undeveloped green fields with Ducks Nest Farm and the existing Eversley Road in their existing locations since at least 1876. Brick kilns were present at Targetts Farm to the east of the site up to 1900. From 1911, land to the east that includes Targetts Farm, Langley Common and the former Arborfield Garrison was developed. Arborfield Court, to the northwest was also constructed around this time. Ducks Nest Farm was developed into the existing industrial estate around 1968 and Observer Way (A327) to the south, was constructed around 2020.
PUBLISHED GEOLOGY	It is anticipated that Head Deposits are present on high ground forming the northwest site periphery. The higher ground to the northwest is underlain with granular strata belonging to the Bagshot Formation. The lower two thirds of the site are underlain with clay rich strata belonging to the London Clay Formation.
COAL MINING AND MINERAL EXTRACTION	The site is not situated within an area of coal mining or mineral extraction.
GROUND STABILITY	The site is unlikely to be affected by ground instability hazards.
RADON GAS	The site is not within an area where radon protection measures are required in new dwellings.

HYDROGEOLOGY	The underlying Head Deposits and Bagshot Formation are designated a Secondary A Aquifer and the London Clay Formation as Unproductive Strata. The site is not located within a groundwater Source Protection Zone.
HYDROLOGY	The closest water feature to the site is the existing stream/ drainage ditch running along the boundaries between Fields 1, 2, 4 and the Ducks Nest Farm Industrial Estate. The site is not in an area indicated to be at risk from flooding.
PREVIOUS GROUND REPORTS	EMS is not aware of any previous ground investigations having been conducted at the site.

PRELIMINARY CONTAMINATION RISK ASSESSMENT

No significant potential contaminative sources have been identified for the site from this assessment. Therefore, the risk posed human health and groundwater is low and that for surface water courses and buildings, buried structures and services is very low.

PRELIMINARY GEOTECHNICAL ASSESSMENT

The site should be suitable for employing traditional shallow footings, founded within the London Clay Formation strata. Clay rich soils can be susceptible to volume changes with fluctuating moisture contents, particularly in the vicinity of existing or proposed trees, which may complicate foundation design and drive them deeper. Aggressive ground conditions could lead to attack of buried concrete structures.

The London Clay Formation strata is likely to be clay rich in nature and expected to exhibit low permeability. Therefore, it is considered unlikely that soakaways will be feasible at the site.

RECOMMENDATIONS

Phase 2 Contamination Assessment	it would be prudent to collect general shallow soil samples, during future geotechnical intrusive investigation works, to confirm that contamination is absent on-site.
Geotechnical Ground Investigation	It is recommended that intrusive geotechnical investigation works are undertaken to characterise the underlying ground conditions and to aid with foundation design.

It is recommended that this desk study report is passed to the relevant Environmental Health Department for comment as soon as possible.

1. Introduction

1.1 General

Environmental Management Solutions Limited (EMS) have been commissioned to undertake a Phase 1 Geo-Environmental Desk Study for proposed residential development at Ducks Nest Farm, Arborfield, Berkshire RG2 9PJ. Hereafter, referred to as 'the site'. The works have been commissioned directly by David Wilson Homes Southern (the Client).

It is understood that the client intends to develop the site for residential purposes and open space.

The purpose of this Phase 1 Geo-Environmental desk study is to assess the likely contamination constraints associated with the proposed development in order to meet with likely planning conditions. The report also provides a preliminary assessment of ground conditions in terms of likely geotechnical constraints that could impact on the proposed development.

1.2 Scope of Works

The agreed work scope for this Phase 1 Desk Study was:

- Purchasing a Landmark Mining and Ground Stability report and historical Ordnance Survey Maps.
- Interpreting the historical, geological, hydrogeological, hydrological and environmental site setting.
- A suitably experienced Geo-Environmental Engineer to undertake a site walkover involving inspecting the site and surrounding area for indications of contamination and other ground related issues.
- Providing information relating to past and current site uses and those from the surrounding area and the nature of any related hazards and physical constraints.
- Identifying current and likely future receptors, potential contamination sources and likely pathways, and features of immediate concern, including those that could be introduced in future.
- Producing a preliminary conceptual model for the site along with a preliminary contamination risk assessment in accordance with the Environment Agency's Land Contamination Risk Management guidance, dated October 2020.
- Assessing potential geotechnical ground constraints that could impact on the proposed development.

This report represents the findings of the first stage of the site investigation process for the works commissioned by the Client. Recommendations for follow-on Phase 2 intrusive investigation works where required are provided within this report. The findings of the Phase 2 intrusive investigation works will be reported separately.

1.3 Management Limitations

- This report has been prepared under the express instructions and solely for the use of the Client and the Client's agents in performance of EMS's duties under its contract with the Client. Should the Client wish to release this report to a Third Party for that party's reliance, EMS agree to such release provided that EMS assumes no duties, liabilities or obligations to the Third Party, that the Third Party does not acquire any rights whatsoever against EMS, and EMS accepts no responsibility for any loss incurred by the Client through the Client's release of the report to the Third Party.
- Copyright of this report is held by EMS.
- The findings of this report represent the professional opinion of experienced contaminated land consultants. EMS relied on the accuracy of Third Party documentary information contained in the consulted and is in no circumstances responsible for the accuracy of such information or data supplied. When considering this report due regard should be given to the terms and conditions of EMS's contract with the Client under which the report was prepared.
- EMS does not provide legal advice and the advice of legal professionals may also be required. All advice, opinions or recommendations within this report should be read and relied upon only in the context of the report as a whole. The advice within the report is based upon the information made available to EMS within the financial and timeframe constraints imposed.
- All work carried out in preparing this report has utilised and is based upon EMS's current professional knowledge and understanding of current relevant UK standards and codes, technology and legislation. Changes in this legislation and guidance may occur at any time in the future and cause any conclusions to become inappropriate or incorrect. EMS does not accept responsibility for advising the Client or other interested parties of the facts or implications of any such changes.
- The report is limited to the site boundaries identified by the Client and confirmed within this report. All boundary lines depicted on plans included within this report are approximate only and do not imply legal land ownership.
- The extent of the investigation was designed in-line with the Client's budget, which is considered suitable, and not limiting, for the proposed development.
- The recommendations, interpretations and conclusions within this report are based solely on desk study information and a site walkover. This report represents the conditions and findings on the date of desk study. Over time, site conditions may alter.
- All observations relating to tree species, asbestos containing materials within structures or invasive weeds, such as Japanese Knotweed, does not constitute a formal survey of such features. The identification of such features is therefore tentative only. The report does not consider whether sensitive ecology or archaeology is present as these require consideration by professionals specialising in these matters. It should be recognised that the collection of desk study information may not be exhaustive and that other information pertinent to the site may be available.

- It is emphasised that a desk study and walkover can only indicate the potential for risks relating to on-site contamination, certain types of ground conditions and geotechnical hazards. This study aims to highlight potential pollutant linkages and / or ground related risks in line with current guidance.
- Only through undertaking intrusive investigation works can the plausibility of pollution linkages and other ground related risks be proven. The scope of this investigation excludes a formal slope stability study and any observations made regarding slopes are for information only.
- Following final issue of this report, EMS has no further obligation to advise the Client on any matters such as changes in legislation or codes of practice that may affect the advice contained within the report.

2. Land Use and Site Setting

2.1 Site Location

The site is situated approximately 4.5km southwest of Reading town Centre at Ducks Nest Farm, Arborfield, Berkshire RG2 9PJ.

The National Grid Reference (NGR) for the approximate site center is E: 476160, N: 166300.

A Site Location Plan is included in Appendix A.

2.2 Site Description

Irregular in plan, the site covers approximately 18 hectares, is relatively flat, includes four large fields (Fields 1 to 4) that are separated with hedgerows, trees and post and wire fencing. Field 1 is roughly triangular in plan and forms the northern part of the site with a hedgerow splitting it into a larger western and smaller eastern section. Field 2 is irregular in plan and forms the eastern part of the site and Field 3 is rectangular in plan and forms the southern part of the site. Forming the northern part of the site is Field 4, which is roughly square in plan. Overhead electricity cables run roughly north-south through the eastern half of the site and across Fields 3 and 4. A drainage ditch, or stream, flows along the boundary between Fields 1 and 4. Hedgerows, trees and wooden post and rail fencing generally delineates the site.

Bounding the site to the north are open fields and the northern residential outskirts to Arborfield Cross. The Ducks Nest Farm Industrial Estate separates Field 1 from Field 2 on the eastern site periphery but does not form part of the site itself. Eversley Road bounds the site to the east with open fields, Targetts Farm, Langley Common and a residential and commercial/light industrial estate, formerly known as Arborfield garrison, beyond. Observer Way (A327) and open fields bound the site to the southwest and the buildings and grounds to Arborfield Court bound it to the northwest.

The site is situated on elevated ground forming the eastern edge to the River Loddon Valley. On-site ground elevations fall from approximately 80m Above Ordnance Datum (mAOD) along the western site periphery to 59m AOD in the east.

A plan showing the existing site layout is included in Appendix A.

2.3 Site Walkover

An EMS Geo-Environmental Engineer undertook a site walkover on 21st April 2022. During the walkover the following observations were made:

- Hawthorn and oak hedgerow and trees split Field 1 into its eastern and western sections. Both fields were grass covered and slope gently towards the southeast. Hawthorn hedge and post and wire fencing generally delineated the field with a section of Leylandii forming the eastern end to the southern boundary and separating it from the Ducks Nest Industrial Estate beyond. The stream or ditch along the western section to the southern boundary was dry. A power cable ran roughly east to west through the northern half of Field 1.

- Field 2 to the east and south of the Ducks Nest Industrial Estate was relatively flat with a very slight slope towards the southeast and grass covered. The Leylandii hedge and wood post and rail fencing separated this field from the Ducks Nest Industrial Estate beyond. Hedgerow, trees and post and wire fencing delineated the remainder of the field and separated it from Field 3 and 4. The stream/ drainage ditch along the boundary between Fields 1 and 4, continued along the boundary between Field 2 and the Ducks Nest Farm Industrial Estate, to a culvert that continued eastwards beneath Eversley Road. A rough track ran roughly east to west, centrally through Field 2. Bonfire remains from burning timber, possibly fallen trees, were present along the southern field boundary.
- Field 3 in the southern part of the site was flat with trees, hedgerow and post and wire fencing separating it from Fields 2 and 4 to the northeast and northwest, respectively. Wooden post and rail fencing delineated the southern boundary with Observer Way (A327) and open beyond. The northern section of the field was covered with rough grass that formed a sacrificial strip where the overhead electricity cables ran through the field. The southern two-thirds were being used for growing crops. Access into Field 3 could be gained from Observer Way.
- In Field 4 the ground sloped more steeply relative to the other fields towards the southeast and was grass covered with a mature Oak tree in the northern corner. A track and earth mounds used for mountain biking, snaked its way around the field. Hawthorn hedge and trees delineated the northern field boundary and post and wire fencing the southeast boundary. Wooden post and rail fencing delineated the southwest boundary and a public footpath and mature trees the western boundary.
- The Ducks Nest Farm Industrial Estate was covered with commercial and light industrial units with tarmac hardstanding, used for parking and turning, covering external areas. Access was gained off Eversley Road.
- No obvious evidence for contamination or contaminative sources were observed during the walkover.

Photographs showing the site and adjacent area, taken during the walkover, are included in Appendix B.

2.4 Site History

Copies of the historical Ordnance Survey OS Maps contained within the Envirocheck Report, reference 294110078_1_1, are included in Appendix C. The maps have been used to determine the historical use of the site and surrounding area, which is summarized in the following table:

MAPPED HISTORY		
DATE RANGE	ON-SITE	SURROUNDING AREA
1876 to 2021	No significant development has occurred on the site, which has remained as the same four fields throughout its history.	Ducks Nest Farm was shown from the earliest maps, dated 1876, and was developed into the existing industrial estate from around 1968.

MAPPED HISTORY		
DATE RANGE	ON-SITE	SURROUNDING AREA
		Arborfield Cross was shown as a small settlement approximately 450m north on early maps and had expanded southwards to the northern site boundary by 1968. An unidentified road, the existing Eversley Road, bounded the site to the east with Targetts Farm, open fields belonging to Langley Common beyond. Brick kilns were shown immediately east of the site on maps dating from 1876. The brick kilns were no longer shown on maps dated 1900 onwards. From 1911 onwards, Langley Common and land to the southeast was gradually developed with the current road layout, a School of Engineering, Barracks, playing fields, Arborfield Garrison and existing housing. Open fields were shown to the south of the site with Observer Way (A327) appearing on the latest map dated 2021. Open fields bounded the site to the west before 1900 with Arborfield Court appearing on maps dated from 1911 onwards.

The earliest Google Earth image dated December 2003 shows the site as four fields and the surrounding area as it currently appears. The mountain bike track in Field 4 was clearly visible. The image dated April 2020 shows Observer Way (A327) under construction along the southern site boundary.

2.5 Proposed Development

It is proposed to develop the eastern half of the site for residential purposes with associated access roads, parking areas, gardens. Residential development will be restricted to the eastern half of the site due to the clearance zone required for the overhead high voltage electricity cables. The western half of the site will be formed into Suitable Alternative Natural Greenspace (SANG), which generally comprises open space with some ponds and paths running through it.

A plan showing the proposed site layout is included in Appendix A.

2.6 Published Geology

The site is situated on elevated ground forming the eastern edge to the River Loddon Valley that in turn is situated on the northern edge to the London Basin. Ground elevations slope generally towards the southeast.

The published British Geological Survey (BGS) map Sheet 268, 'Reading', shows the site to be generally devoid of superficial deposits. However, a thin ribbon of superficial Head Deposits is shown along the high ground forming the northwest periphery to the site. These deposits result from the downhill movement of shallow weathered bedrock due to solifluction and/or gelifluction processes. The BGS lexicon (www.webapps.bgs.ac.uk/lexicon), generally describes these deposits as 'poorly sorted and poorly stratified, angular rock debris and/or clayey hillwash and soil creep, mantling a hillslope'.

The underlying bedrock is shown to be Bagshot Formation (part of the Bracklesham Group And Barton Group (Undifferentiated)) and London Clay Formation (part of the Thames Group). The Bagshot Formation forms a ridge that underlies the more elevated ground forming the northwest periphery to the site (Field 4). Eocene in age, this stratum was deposited under fresh water and shallow marine conditions and sits unconformably above the London Clay Formation. The BGS Lexicon generally describes this stratum as 'pale yellow-brown to pale grey or white, locally orange or crimson, fine- to coarse-grained sand that is frequently micaceous and locally clayey, with sparse glauconite and sparse seams of gravel'.

The London Clay Formation underlies the more gently sloping southeast half of the site, i.e. Fields 1, 2, 3 and part of Field 4. Deposited within tropical or subtropical forests bordering warm shallow seas, this stratum is also Eocene in age. The BGS Lexicon generally describes this stratum as 'bioturbated or poorly laminated, blue-grey or grey-brown, slightly calcareous, silty to very silty clay, clayey silt and sometimes silt, with some layers of sandy clay'.

Whether Made Ground is present on-site is not shown on the published BGS geological map. However, given the site history as open fields it is considered that Made Ground is unlikely to be present.

Numerous historical BGS exploratory hole (borehole and trial pit) records are situated to the east and southeast of the site. The closest records being between 100m and 340m distance. The records show a thin Made Ground and Topsoil cover to between 0.15m and 1.00m depth overlying clay rich bedrock. Interpreted as the London Clay Formation and encountered to a minimum 15.00m depth, this stratum was generally described as soft to firm and stiff light grey to brown, occasionally mottled, silty sandy clay and sandy clayey silt. The exploratory holes were generally dry, and one record shows a groundwater strike, probably perched, at 1.30m depth.

No faults or other major geological structures are shown either on-site or within 250m.

Information summarizing the geology pertinent to the site is presented within the Envirocheck Report, reference 294110078_1_1, included in Appendix D.

2.7 Hydrogeology

Information summarizing the hydrogeological, hydrological and environmental site setting is contained within the Envirocheck Report, reference 297188414_1_1, included in Appendix E.

The site is situated on elevated ground that slopes south-eastwards from 80mAOD in the northwest to 59m AOD in the east. Published and historical topographical and geological information indicates that groundwater occurs at depth, below the London Clay Formation bedrock, and flows towards the northwest in hydraulic continuity with the River Loddon. It is expected that perched groundwater is present within the Bagshot Formation strata forming the ridge on the north-western site periphery, which daylights where this stratum contacts the underlying London Clay Formation downslope.

The Environment Agency have classed both the superficial Head Deposits and the Bagshot Formation bedrock as Secondary A Aquifers. The underlying London Clay Formation is classed as Unproductive Strata.

The site is not located within a groundwater Source Protection Zone.

MAGIC website (www.magic.defra.gov.uk), indicates that the site is located within a drinking water safeguard zone for groundwater.

There are no groundwater abstraction entries recorded either on-site or within 250m of the site.

The Bagshot Formation is shown as having medium groundwater vulnerability, which is anticipated to be due to its granular nature and therefore, expected good permeability. The London Clay Formation is shown as Unproductive.

2.8 Hydrology

The site is situated on elevated ground that forms the eastern edge to the River Loddon Valley. The ground generally slopes towards the southeast and is covered with rough grass or crops. Depending on the underlying geology, surface water is expected to either percolate directly into the ground, i.e. over the Bagshot Formation, or occur as overground flow to local water courses, i.e. the over the London Clay Formation.

The nearest surface water course is a stream or drainage ditch, that was dry during the walkover, which is located along the boundaries between Fields 1, 2 and 4 and the Ducks Nest Farm Industrial Estate. This watercourse daylights in the northwest where the Bagshot Formation contacts the underlying London Clay Formation before flowing southeast and down topographic gradient to flow beneath Eversley Way. This watercourse is one of several in the immediate area that eventually drain northwards to intersect an unnamed stream that flows northwest as a tributary to the River Loddon, which is situated more than 2km northwest of the site.

The MAGIC website indicates that the site is located within a drinking water safeguard zone for surface waters.

A single discharge consent entry is recorded within 250m of the site. Located 6m northwest, the entry is a domestic property - New Bungalow At Arbourfield Court, Arborfield Cross, Berks, for Sewage Discharges - Final/Treated Effluent - Not Water Company. To discharge to Land/Soakaway. The status is given as Authorisation revoked.

According to the Environment Agency Flood Map For Planning Risk (www.apps.environment-agency.gov.uk) the site is located within a Flood Zone 1 with a low probability risk from fluvial flooding. BGS information indicates no potential risk from groundwater flooding on site. Environment Agency information indicates a potential low to high risk from surface water flooding associated with the drainage

ditch between Fields 1, 2 and 4 and the Ducks Nest Farm Industrial Estate. The surface water flooding extents continue along the boundary between Fields 2, 3 and 4 and centrally into Field 1. Because the site area is greater than 1 hectare a site specific flood risk assessment will be required for the proposed development.

2.9 Mining and Mineral Extraction

Information pertaining to mining and mineral extraction and ground stability relating to the site is presented in the Envirocheck Mining and Ground Stability Report included in Appendix F.

The site is not located within an area expected to be at risk from coal mining.

No mineral extraction industry entries are given on-site. A single BGS recorded mineral site entry is given within 250m and located 98m to the east. Associated with Targets Farm Brick Field, the commodity extracted is given as Common Clay and Shale (London Clay Formation) and the status given as ceased.

2.10 Ground Stability

The potential risk for the site to be impacted by compressible ground or ground dissolution is recorded as no hazard. For collapsible ground and landslides, the risk is recorded as very low. The risk for running sands is given as very low to low and for shrinking or swelling clays as no hazard to low.

2.11 Radon

The site is situated within a lower probability radon area (where less than 1% of homes are estimated to be at or above the action Level). Therefore, no radon protection measures are required in the construction of new dwellings or extensions.

2.12 Soil Geochemistry

The site is situated within an area where naturally elevated metal background concentrations have been recorded for arsenic (15 – 25 mg/kg), chromium (60 – 90 mg/kg) and nickel (15 – 30 mg/kg).

2.13 Landfills and Infilled Land

No entries for Historical Landfill or Local Authority Recorded Landfill Sites, Licensed Waste Management Facilities or Registered Waste Transfer, Treatment or Disposal Sites are recorded either on-site or within 250m of the site.

A single Potentially Infilled Land (Non-Water) entry is recorded within 250m of the site. Located 70m east, it is anticipated that it corresponds with the same entry for the Targets Farm Brick Field. The use is given as Unknown Filled Ground (Pit, quarry etc) and it was last mapped in 1990. Historical maps show this site was developed with existing housing around 1911. Therefore, it is considered unlikely to pose a potential risk to the proposed development.

2.14 Pollution Incidents to Controlled Waters

A single entry for pollution incidents to controlled waters is recorded within 250m of the site. Situated 35m east, the entry is located at Arborfield for oils – unknown and the receiving water not given. The incident severity was Category 3 – Minor Incident.

2.15 Registered Hazardous Sites

There are no entries for registered hazardous sites recorded either on-site or within 250m of the site.

2.16 Contemporary Trade Directories and Fuel Sites

There are 4 No. recorded contemporary trade directory entries within 250m of the site, of which one is identified as being active and three as inactive. The contemporary trade directory entries identified and their distance / direction from the site are presented in the following table:

Trade Entry	Distance / Direction from the Site
Active Entries:	
Downton Motor Engineering - Car Body Repairs.	61m E.
Inactive Entries:	
Dunaways Scrap Cars - Scrap Yards.	91m N.
A Cleaner Carpet - Carpet, Curtain & Upholstery Cleaners.	121m SE.
Arborfield Tyres Ltd - Tyre Dealers.	238m N.

There are no recorded fuel station entries within 250m of the site.

By its very nature the active entry for Downton Motor Engineering is likely to use and store potentially contaminative substances during their daily on-site operations. Such substances could potentially be subjected to leakages and spillages that are likely to be small scale and localised. Procedures for dealing with such leaks and spills will also be included within the company policies and procedures and health & safety documentation. Therefore, given the entry's distance from the site, it is considered unlikely that it would pose a potential risk to the proposed development.

2.17 Unexploded Ordnance

According to the ZeticaUXO website (www.zeticauxo.com), the site is located within an area indicated to be at low risk (15 bombs per 1000 acres or less) from unexploded ordnance.

2.18 Ecologically Sensitive Land Uses

A single entry for ancient and semi-ancient woodland is recorded for the site and associated with Spring Copse located 102m to the west.

2.19 Previous Investigations

EMS is not aware of any previous ground investigation works having been undertaken at the site.

3. Preliminary Contamination Risk Assessment

The methodology for undertaking the contamination risk assessment is included within the supplementary information at the back of this report.

3.1 Potential Contamination Sources

3.1.1 Invalid Sources

An active entry for Downton Motor Engineering has been recorded 61m east of the site that is likely to use and store potentially contaminative substances during daily on-site operations. Such substances could potentially be subjected to leakages and spillages that are likely to be small scale and localised. Procedures for dealing with such leaks and spills will also be included within the company policies and procedures and health & safety documentation. Therefore, given the entry's distance from the site, it is considered unlikely that it would pose a potential risk to the proposed development.

3.1.2 On-site Sources

No significant potential on-site contamination sources have been identified for this site.

3.1.3 Off-site Sources

No significant potential off-site contamination sources have been identified for the surrounding area.

3.1.4 Ground Gas

No significant potential ground gas sources (methane and carbon dioxide) have been identified for this site.

3.2 Potential Receptors

The assessed land use category for the site is residential.

It is proposed to develop the eastern half of the site for residential purposes with associated access roads, parking areas, gardens. The western half of the site will be formed into open space.

3.2.1 Human Health

The most significant potential receptors with respect to human health are considered likely to be end users and construction workers. However, given the lack of identified potential contaminative sources on-site, it is considered that the potential risk to posed human health is low.

3.2.2 Controlled Waters

The underlying superficial Head Deposits and the Bagshot Formation bedrock are classed as Secondary A Aquifers, with medium groundwater vulnerability, and the London Clay Formation as Unproductive Strata. Groundwater is anticipated to occur at depth below the London Clay Formation.

However, given the lack of identified potential contaminative sources on-site, it is considered that the potential risk to posed groundwater is low.

A stream or drainage ditch is situated on-site and flows along the boundaries between Fields 1, 2 and 4 and the Ducks Nest Farm Industrial Estate. The site is located within a Flood Zone 1 with a low probability risk from fluvial flooding but a potential low to high risk from surface water flooding. However, given the lack of identified potential contaminative sources on-site, it is considered that the potential risk posed to surface water courses is very low.

3.2.3 Buildings, Buried Structures and Services

No significant potential contamination sources have been recorded for the site that are likely to pose a risk to buried buildings, buried structures or services.

3.3 Potential Pathways

The most significant potential pathways considered likely to transfer chemicals from contaminant sources to receptors are:

- Ingestion, inhalation, or direct contact with contaminated soils and dust.
- Vertical contaminant leaching to groundwater.
- Horizontal contamination migration via overground flow in surface water.

3.4 Preliminary Conceptual Site Model

No significant historical or current potential contamination or ground gas sources have been identified for the site.

The site is being developed for residential use and open space with associated access, gardens and parking.

Given the lack of potentially significant historical or current contamination / ground gas sources associated with the site, it is considered that there is a very low to low risk posed to human health, controlled waters or buildings, buried structures and services.

A diagrammatic form of the preliminary conceptual site model is presented in Appendix A.

3.5 Preliminary Contamination Risk Assessment

The following table identifies the potential risks that exist to the receptors through each of the identified pollutant linkages in the conceptual site model. It should be noted that the numbers referred to for each pathway refers to the numbered pollutant linkages from the diagrammatic conceptual site model presented in Appendix A.

Potential Sources and contaminants	Pathways (Reference from Model)	Receptors	Hazard Severity	Probability of Occurrence	Potential Risk
None Identified.	Ingestion. Inhalation. Direct Contact.	Site end-users. and Construction Workers.	Human health effects. [Medium]	No significant contaminative sources identified on-site. [Unlikely]	Low.
	Vertical migration.	Groundwater within the Bagshot Formation.	Secondary A Aquifer. [Medium]		Low.
	Horizontal migration.	On-site drainage ditch.	Minor water course. [Mild]		Very Low.
	Direct Contact.	Buildings, Buried Structures and Services.	Chemical attack of buried structures and tainted water supplies. [Minor]		Very Low.

3.6 Recommendations

No significant potential contaminative sources have been identified for the site from this assessment. Therefore, the risk posed human health and groundwater is low and that for surfaces water courses and buildings, buried structures and services is very low.

It is considered that no specific Phase 2 intrusive investigation works are required for contamination assessment purposes. However, it would be prudent to investigate on-site soils for geotechnical purposes in order to characterise the underlying ground conditions to aid with foundation design. During

these works it would be prudent to collect general shallow soil samples to confirm that contamination is absent on the site.

It is recommended that this desk study report is passed to the relevant Environmental Health Department for comment as soon as possible.

4. Preliminary Geotechnical Assessment

4.1 Geotechnical Considerations

The proposed development will include constructing new houses across the eastern half of the site with associated access, parking and gardens. The western half will be developed for public open space with a clearance zone to allow for overhead high voltage electricity cables.

Potential geotechnical hazards that are considered likely to have an impact upon the proposed development, include:

- Clay rich soils, such as the London Clay Formation has potential to change volumetrically with variations in moisture content that can complicate foundation design and drive them deeper. Particularly where existing or proposed trees are nearby.
- Aggressive chemical environment for concrete, e.g. expansive slag or high sulphate soils, may affect sub-surface structure design and construction.

4.2 Preliminary Assessment of Geotechnical Risks

The site should be suitable for employing traditional shallow footings, founded within the London Clay Formation strata. Clay rich soils can be susceptible to volume changes with fluctuating moisture contents, particularly in the vicinity of existing or proposed trees, which may complicate foundation design and drive them deeper. Aggressive ground conditions could lead to attack of buried concrete structures.

The London Clay Formation strata is likely to be clay rich in nature and expected to exhibit low permeability. Therefore, it is considered unlikely that soakaways will be feasible at the site.

For all developments, EMS recommend that intrusive ground investigation works are undertaken to characterize and determine what the nature and extent of underlying ground conditions are. Intrusive ground investigation works will aid with foundation design.

4.3 Construction Considerations

As with all construction sites, where anomalous or asbestos containing materials are encountered during the redevelopment then expert environmental advice should be sought.

References

- British Geological Survey (BGS) sheet 268 “Reading” Solid and Drift edition (1:50,000) published 2000.

SUPPORTING INFORMATION

This section provides background details of a generic nature together with specific technical approaches adopted by EMS and details of the guidance documents that are commonly referenced in the report. The section also includes explanations of technical terms to assist non-specialist readers in understanding the Technical Report. It should be noted that not all the information within this section is necessarily applicable to this specific report.

SITE CHARACTERISTICS

The site characteristics are collated from various information sources, including but not limited to Ordnance Survey, British Geological Survey (BGS), GOV.UK / DATA.GOV.UK websites and local authorities.

EMS generally commission the Landmark Information Group to produce an Envirocheck Report for study sites and where employed this is included in the Appendices. It should be noted that some of the data provided in the Envirocheck report is not considered within EMS's interpretation for the site characteristics as it is not relevant, including:

- *Nitrate Sensitive Zones and Nitrate Vulnerable Zones are ignored as these are only applicable to agricultural activities relating to the application of manure and fertilisers to land.*
- *River Quality is ignored as at this preliminary stage of risk assessment as all surface water bodies are considered equally sensitive to contamination risks.*

In assessing site characteristics, EMS also consider the area within a surrounding 250m buffer zone extending from the site boundary.

HISTORY

Mapped History

The site history summarises the changes in use or layout of the site over time and is largely developed from a study of available Ordnance Survey maps. It should be noted that changes to the site may have occurred between the editions of the maps employed to assess the history of the site. Historical information of relevance within the 250m surrounding the site is also discussed in a separate section. The historical plans referred to in the text are generally included in an Appendix.

Aerial photography

As a minimum, current and historical aerial images of the site and surrounding areas are studied from the Google Earth program. Where additional historic aerial photographs have been purchased then these are referenced within the technical report.

Internet Searches

A simple search of the internet for relevant material relating to the use or history of the site is made. Information obtained from internet searches has been accepted as fact without validation by EMS

except for ensuring the source is reputable. It should be recognised that due to programme and budgetary constraints the search conducted may not have revealed all the information available.

GEOLOGY

The geology relating to the site is assessed using information contained within the Envirocheck report and / or reference to the relevant British Geological Survey (BGS) 1:50,000 scale sheet in Bedrock and Superficial (historically Solid and Drift) edition. Many of these geological maps are relatively old with superseded terminology and descriptions. EMS therefore employ the BGS Open Geoscience website to determine current nomenclature of strata and to assist in determining geological boundaries against current topographic features. EMS also employ BGS Regional Geology Guides to assist in understanding the geological context of the site.

Ground Stability Hazards

Ground stability hazards caused by mining, ground dissolution, landslide potential, collapsible ground and natural cavities are identified by the Envirocheck database search of records held by The Coal Authority, British Geological Survey and studies completed by Ove Arup and Peter Brett Associates.

The Envirocheck database ground stability hazard entries for compressible ground, running sands and shrinking or swelling clays are not discussed directly. This is because these hazards are very common and are considered within the preliminary geotechnical assessment where necessary.

Radon

Radon is a naturally occurring colourless and odourless gas that is radioactive. It is formed by the radioactive decay of radium which in turn is derived from the radioactive decay of uranium, both of which are minerals that can be found in many soil types. Whilst it is recognised that the air inside every house contains radon, some houses built in certain defined areas of the country might have unacceptably high concentrations and require special precautions to be taken during construction to reduce this risk.

Radon can move through cracks and fissures in the soil into the atmosphere or into dwellings via basements and/or underfloor voids. If radon enters the living space of dwellings its concentration can potentially increase and provide a risk to human health as the inhalation of the radioactive decay products of radon gas can increase the risk of developing lung cancer.

The maps contained within BRE211:2007 'Radon: guidance on protective measures for new buildings' identify areas where no radon protection measures are necessary or where higher concentrations are present that either basic or full radon protection measures are required to be fitted to all new dwellings. However, some local authorities have local bylaws, that EMS may not be aware of, that insist on radon protection to all new dwellings within their area regardless of the recommendations of the BRE211 Radon report.

Basic radon protection measures comprise incorporation of a continuous gas resistant membrane sealed at joints and around service entries into the floor construction and extended across the cavity tray.

Full radon protection measures comprise incorporating a continuous gas resistant membrane into the floor construction together with a ventilated sub-floor void through either the use of suspended floor

construction or a 'radon sump'. The membrane is sealed at joints and around service entries into the floor and extended across the cavity tray.

BRE211 should be referred to for detail on the construction of the protective measures.

HYDROGEOLOGY

Aquifer Designations

The Environment Agency's Groundwater Protection Policy uses designations that reflect the importance of aquifers in terms of groundwater as a drinking water resource, but also their role in supporting surface water flows and wetland ecosystems.

In defining groundwater vulnerability, both the superficial (drift) deposits and bedrock (solid) geology are considered separately with the following aquifer designations:

- **Principal Aquifers:** These are layers of rock or drift deposits that have high intergranular and/or fracture permeability - meaning they usually provide a high level of water storage. They may support water supply and/or river base flow on a strategic scale.
- **Secondary Aquifers:** These include a wide range of rock layers or drift deposits with an equally wide range of water permeability and storage. Secondary aquifers are subdivided into two types:
 - **Secondary A** - 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.
 - **Secondary B** - predominantly lower permeability layers which may store and yield limited amounts of groundwater due to localised features such as fissures, thin permeable horizons and weathering.
- **Secondary Undifferentiated** - has been assigned in cases where it has not been possible to attribute either category A or B to a rock type.
- **Unproductive Strata:** These are rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow.

Source Protection Zones

The Environment Agency (EA) has defined Source Protection Zones for groundwater sources, such as boreholes and springs, that are used for public water supply. The EA uses the zones to target pollution prevention measures and monitor the activities of potential polluters within the affected area. There are three types Source Protection Zone:

- **Zone 1 (Inner Protection Zone)** is the most sensitive area within which pollution could reach the borehole within 50 days. Alternatively it is defined by a minimum 50m radius around the borehole.
- **Zone 2 (Outer Protection Zone)** are defined by the area within which pollution could reach the borehole within 400 days or 25% of the total catchment area.
- **Zone 3 (Total Catchment)** are defined by the total area required to support the removal of water from the borehole.

HYDROLOGY

Flooding

The Environment Agency has zoned England and Wales in respect of the risk from flooding from 'highly unlikely' in Zone 1 to 'likely' in Zone 3. The zones ignore the presence of flood defences or certain other manmade structures and channel improvements.

National Planning Policy Framework, Department for Communities and Local Government, dated March 2012 states "A site-specific flood risk assessment is required for proposals of 1 hectare or greater in Flood Zone 1; all proposals for new development (including minor development and change of use) in Flood Zones 2 and 3, or in an area within Flood Zone 1 which has critical drainage problems (as notified to the local planning authority by the Environment Agency); and where proposed development or a change of use to a more vulnerable class may be subject to other sources of flooding".

ENVIRONMENTAL ASPECTS

Landfill

The database of the Environment Agency of active and historic landfills is searched for all sites. Sometimes additional historic landfill data is available from the British Geological Society and local authorities to identify nearby landfill sites. It should be noted that landfill sites that closed prior to 1974 and unlicensed disposal activities will not necessarily be revealed by this search.

Pollution Incidents

The Environment Agency ceased recording 'Pollution Incidents to Controlled Waters' in 2000, when they commenced the replacement 'Substantiated Pollution Incident Register'. EMS do not consider any 'Category 3 – Minor Incident' on the 'Pollution Incidents to Controlled Waters' database as relevant to assessing the site due to the time elapsed and the low level of impact that occurred. Again, due to the time elapsed and the fact that remedial measures would have been undertaken at the time, 'Category 1 – Major Incident' and 'Category 2 – Significant Incident' are only considered relevant if the impacted controlled water was on or immediately adjacent to the site.

On the 'Substantiated Pollution Incident Register', EMS approach to this information in the following manner:

- *Pollution incidents impacting 'air' only are not considered relevant.*
- *Pollution incidents to 'water' are only considered where the surface water impacted is either on, flows through or is immediately adjacent to the site.*
- *Pollution incidents to 'land' are only considered where these are on or immediately adjacent to the site unless there are grounds to consider that the incident had the potential to impact groundwater that may have migrated beneath the site.*
- *Category 4 potential pollutant incidents are recorded, but upon investigation were found to have had no impact and accordingly are not considered relevant.*

Ecologically Sensitive Land Use

The land uses that are identified as ecologically sensitive are those identified as Sites of Special Scientific Interest (SSSI), Special Areas of Conservation, Special Protection Areas, Ramsar sites, Natural Parks, Natural Nature Reserves, Marine Nature Reserves, Local Nature Reserves, Green Belt, Forest Parks, Environmentally Sensitive Areas, or Areas of Outstanding Natural Beauty.

Unexploded Ordnance

Guidance in CIRIA C681 'Unexploded Ordnance, A Guide for the Construction Industry' recommends that a preliminary risk assessment, comprising desk-based consideration of factors that affect the potential for unexploded ordnance (UXO) to be present, is undertaken at all sites at an early stage. This assessment ascertains whether specialist advice is required prior to ground disturbing activities. The assessment involves consideration of the site's location, history and planned investigation activities. The aim of the assessment is principally to avoid loss of life or injury in the rare event that unexploded ordnance is encountered. However, it is also extremely useful to consider this issue at an early stage to avoid costly delays in construction programmes later down the line.

At the date of publication of this CIRIA document there have been no recorded deaths in the UK resulting from UXO in recent decades (although there have been some fatalities in Europe). However, it is estimated that 15,000 items of ordnance (5 % estimated to be live) were removed from UK construction sites between 2006 and 2008.

The following table summarises the risk factors for a site against the potential for UXO to be present:

		Potential for aerial delivered UXO to be present			
		LOW	HIGH		
Indicators of potential aerial delivered UXO hazards					
Data item	Site location	Rural	Small towns	Brownfield sites Large towns	Cities
	Site description and historical land use	Greenfield site or agricultural land only	Near to wartime site of: Previous military use Railway marshalling yard Power station Gas works Port Industrial centre	Adjacent to wartime site of: Previous military use Railway marshalling yard Power station Gas works Port Industrial centre	Site of previous military use: Former wartime Site of previous military use Railway marshalling yard Power station Gas works Port Industrial centre
	History of WWII bombardment	No history of WWII bombing	Near to area of known WWII bombing	Area of known WWII bombing	Area of high intensity WWII bombing
Post-war development and the potential to remove aerial delivered UXO hazards					
Nature of development		Wholesale excavation			
		Significant post-war development			
		Moderate post-war development			

			Minimal post-war development	
		No evidence of post-war development		
<i>Construction activities and the potential to encounter aerial delivered UXO</i>				
Activity	Borehole drilling			
	Shallow trial pits			
	Excavations for services			
	Low density driven piles			
	Shallow excavations over extended area			
		Sheet piling		
		Deep excavations over limited area		
			High density piles	
			Deep excavation over extended area	

Notes: 1. Adapted from CIRIA C681.

Reference to the ZeticaUXO website (<https://zeticauxo.com>) also provides additional information with respect to the risk of unexploded ordnance beneath a site.