

Report
Title:

Phase 1 Geo-Environmental Desk Study

Project
Name:

Land at Bilsham Road, Yapton



Report Reference: **BRD2693-OR1-C**
Date: **December 2017**

REPORT CONTROL SHEET

REPORT TITLE	PHASE 1 GEO-ENVIRONMENTAL DESK STUDY
PROJECT	LAND AT BILSHAM ROAD, YAPTON
CLIENT	GLEESON STRATEGIC LAND

REPORT REFERENCE	ISSUE DETAIL	DATE	PREPARED BY	CHECKED BY
BRD2693-OR1-A	First Issue	25/04/2016	M Morgan	R Davies
BRD2693-OR1-B	Updated with revised site boundary	25/04/2017	A Neyt	M Morgan
BRD2693-OR1-C	Revision to Client name and inclusion of masterplan	06/12/2017	J Brockwell	J Brockwell

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REPORT LAYOUT

This report is divided into the following four sections: Summary Report, Technical Report, Supporting Information and Appendices.

SUMMARY REPORT

This expanded executive summary provides the main findings of the work undertaken in brief non-technical language. This section provides an overview of the key outcomes for the benefit of non-specialists and concludes with the main recommendations. This section should only be relied upon in the context of the whole report and the Technical Report should be referred to with respect to any design decisions.

TECHNICAL REPORT

The main report section is intended to provide the technical detail of the investigation and is intended to provide the level of information required by current guidance documents and practice. The Technical Report is written in a language that, in part, assumes knowledge of subject matter so that it can be written in as concise a form as possible. Its intended audience is peers, regulators and other professionals in related disciplines.

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SUPPORTING INFORMATION		
This section of the report provides background details of a generic nature together with specific technical approaches adopted by BRD 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.		
APPENDICES		
The final section of the report presents the factual data collected and employed as part of the investigation.		
APPENDIX 1	SITE PLANS & PHOTOGRAPHS	
	Site Location Plan	Ref. BRD2693-OP1-C
	Site Layout Plan	Ref. BRD2693-OP4-B
	Illustrative Detailed Masterplan	Richards Urban Design drawing ref. 1244G.03
	Walkover Photographs	Ref. BRD2693-OP2-C
	Initial Conceptual Site Model	Ref. BRD2693-OP3-C
APPENDIX 2	HISTORICAL PLANS	
	Order No. 84657229_1_1	38 x A3 pages
APPENDIX 3	ENVIROCHECK REPORT	
	Order No. 84657229_1_1	68 x A4 pages & 18 x A3 pages

SUMMARY REPORT

SUBJECT	COMMENTS
CURRENT USE & DESCRIPTION	The site consists of three adjoining ploughed agricultural fields bound by trees, hedgerows and adjacent residential properties.
PROPOSED USE	It is proposed that the site will be developed as a residential housing estate.
HISTORICAL SUMMARY	The site has remained undeveloped throughout its mapped history. A stream formerly crossed part of the site and was diverted to a culvert at the end of the 19 th century. The residential area immediately to the east has been gradually developed from the 1930s through to the 1980s.
PUBLISHED GEOLOGY	The site is shown to be underlain by superficial deposits comprising sandy, clayey silts of the Aeolian Deposits. The shallowest bedrock unit is shown to be the Upper Chalk Formation.
RADON GAS	The site is in an area where no radon protection measures are required in new dwellings.
HYDROGEOLOGY	The site is situated upon superficial deposits designated a Secondary A Aquifer. The underlying bedrock geology is designated a Principal Aquifer. The site is not located within a groundwater Source Protection Zone.
HYDROLOGY	The closest water feature to the site is the stream which runs along part of the south eastern boundary and is then diverted to culvert crossing the south western part of the site. Ditches also form part of the western boundaries.
PREVIOUS GROUND REPORTS	BRD is not aware of any previous ground investigations having been conducted at the site.
PRELIMINARY CONTAMINATION RISK ASSESSMENT	
The vast majority of the site is unlikely to be significantly contaminated. However, low to medium risks have been identified from infill of a former deep drainage ditch, fly-tipped waste around parts of the site boundary and potential pesticide residues in the soils. This limited potential contamination may be a cause for concern to human health, the water environment and water supply pipes.	

PRELIMINARY GEOTECHNICAL ASSESSMENT

The anticipated near surface geology underlying the site of Aeolian Deposits may potentially comprise low strength soils, thereby making the stratum unlikely to be suitable for the adoption of standard trench fill/strip footings. Wider, reinforced strip footings could be employed to spread loads over a wider area, or ground improvement may be required. Alternatively a piled foundation solution could be considered.

Depending on the composition of the superficial deposits i.e. should clayey or silty soils be encountered at a shallow depth, the trees and hedges along the site boundaries may have an impact on the soils, and foundations in close proximity to existing or proposed trees, may need to be deepened.

Soakaways may be viable at the site, depending on whether granular deposits are encountered within the superficial Aeolian Deposits. If the Chalk bedrock is relatively shallow and/or fractured, deeper borehole style soakaways may be feasible.

RECOMMENDATIONS

Phase 2 Contamination Assessment	For any form of development, BRD recommend that an intrusive ground investigation is undertaken in order to confirm ground conditions and allow design of the new structures.
Geotechnical Ground Investigation	It is therefore recommended that an intrusive ground investigation is completed for the site including both contamination and geotechnical assessments.

1. INTRODUCTION TO TECHNICAL REPORT

1.1. CONTRACT DETAILS

CLIENT	Gleeson Developments Limited trading as Gleeson Strategic Land.
SITE	Land situated at Bilsham Road in the village of Yapton, West Sussex.
CLIENT'S ADVISORS	BRD Environmental Limited (BRD) has been commissioned directly by the Client.
REPORT CONTEXT	It is understood that the Client intends to purchase the site and develop it for residential housing.
REPORT TYPE	Factual and interpretative geo-environmental desk study.
REPORT OBJECTIVES	The purpose of this report is to undertake a preliminary geo-environmental assessment of the site to supplement the marketing information for selling the site.

1.2. SCOPE OF WORKS

The agreed scope of works was:

- Purchase of an Envirocheck database report and historical Ordnance Survey plans.
- Interpretation of the geological, hydrogeological and hydrology setting of the site from published sources.
- A site walkover survey by a suitably experienced Geo-Environmental Consultant involving the inspection of the site and the surrounding area for indications of contamination and other ground related issues.
- Prepare a factual and interpretative report based on the information collected to identify and assess any geotechnical or contamination hazards. Where appropriate, it shall provide detailed recommendations for further work.

1.3. REPORT LIMITATIONS

Any site boundary lines depicted on plans included within this report are approximate only and do not imply legal ownership of land. Any observations of 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 contamination on the site. This study aims to highlight potential pollutant linkages in line with current guidance. The plausibility of these linkages can only be proved by an intrusive ground investigation.

It should be noted that a desk study and walkover can only reveal the potential for certain types of ground conditions and geotechnical hazards. For any form development an intrusive ground investigation is recommended. The scope of this investigation excludes a formal slope stability study and any observations made regarding slopes are for information only.

It should be noted that the site boundary as shown on the Envirocheck report and historic maps in Appendix 2 and 3 do not include the western most field which has been included for this Version C report.

2. SITE CHARACTERISTICS

2.1. SITE SETTING

SITE ADDRESS AND POST CODE	Land at Bilsham Road at the south western edge of the village of Yapton, West Sussex. The nearest post code is BN18 0HB.
NATIONAL GRID REFERENCE	497620E, 102800N.

2.2. SITE DESCRIPTION

INSPECTION DATE	19 th April 2016 and inspection of additional area on 18 th April 2017.
CURRENT USE	The site consists of three adjoining agricultural fields, two of which are ploughed, and the third being a grass field. The western (grass) field is divided from the other two fields by a hedgerow and ditch.
AREA	Approximately 11.6 hectares.
SHAPE	The overall site is irregular in shape, however, the northern field forms a square shape and the southern field forms an 'L' shape joining the northern area at its northern corner. A third, rectangular field to the west fits into the corner produced by the other two fields, all of which are orientated at 45 degrees.
ACCESS	Vehicular access is gained from the south eastern boundary of Bilsham Road. There are various other pedestrian access points most notably from a track which runs just to the north of the site and a public footpath which enters the site halfway up the eastern boundary.
BOUNDARIES	The eastern boundaries 'zig zag' north to south adjacent to the existing residential properties. These boundaries are all formed by wooden fences, with the exception of the south eastern boundary of the northern field which consists of a metal security fence. The western boundaries all border agricultural fields. The north western boundary of the northern field consists of a hedgerow and trees adjacent to a track. The south western boundary of the northern field and the north western boundary of the southern field consist of a ditch and hedgerow. The south western boundary of the southern field consists of wooden agricultural style fence with a ditch also present at the northern end. The north western and south western boundaries of the western rectangular field border agricultural fields and consist of a ditch and hedgerow.
TOPOGRAPHY	The site is relatively flat. The ditches along the western boundaries and dividing the north eastern and western fields are around 1m deep, however, there is a deeper ditch/stream along part of the eastern boundary of the southern section which is around 2m deep prior to entering a culvert.

SURFACING	The vast majority of the site is ploughed field while the rectangular field is covered with grass. There is a public right of way crossing the southern area, and most of the boundaries are well trodden by dog walkers. A few areas adjacent to the boundaries are relatively overgrown as well as a relatively large section dividing the two fields.
BUILDINGS	There are no buildings present on site.
VEGETATION	The north western boundary of the southern field, as well as the south western and north western boundaries of the northern field and the western and southern boundaries of the rectangular field consist of a mixture of trees and hedgerow. Notably there is a large oak tree adjacent to the ditch dividing the north eastern and western fields. Along the eastern boundaries adjacent to the residential properties is typically a grass verge, areas overgrown with brambles and occasional trees. Adjacent to the deeper ditch/stream is relatively overgrown with small trees and hedges. There is also an overgrown area dividing the two fields, consisting predominantly of brambles.
NOTABLE FEATURES AND OBSERVATIONS	Along most of the boundaries with the residential properties there is a relatively large amount of garden waste which had been dumped. This increased along the mid-section of the eastern boundary with additional waste, such as old tyres and various rubbish present adjacent to the boundary. As previously mentioned, there is a stream running along the south western boundary of the southern area. The stream is in a relatively deep ditch and enters a culvert with a brick headwall and crosses beneath the south western section of the field. The culvert runs a distance of around 200m and enters a deep ditch again 65m to the south west of the site boundary. In the extreme eastern area where the stream enters the site, the water was ponded, prior to it flowing beneath a small bridge where the public footpath enters the site. The soils exposed at the surface were noted to be a 'brown silty sandy slightly gravelly clay'. The soils were relatively dry, but there are a few deep ruts in the field indicating that the ground conditions can rapidly deteriorate when wet.

SURROUNDING LAND USE	The site is set on the western edge of the village of Yapton with predominantly residential houses to the east and open fields to the west.
To the North	To the north west are open fields. To the north east are residential properties.
To the East	Residential properties.
To the South	Agricultural fields.
To the West	Agricultural fields.

2.3. SITE HISTORY

MAPPED HISTORY		
DATE RANGE	SITE	SURROUNDING AREA
1876-1913	The site consists of part of three larger open fields extending across the wider area. A footpath is shown to cross the north eastern corner. What appears to be a stream/ditch is shown crossing the south western section and a ditch is present along the south eastern boundary of the northern section. By the 1898 map the stream is no longer shown on site and appears to have been culverted as it remains present 70m to the south west of the site. The ditch remains along the south eastern boundary.	The Chichester Arundel canal is shown 125m to the north of the site with the edge of the village of Yapton just beyond. The canal is shown to be disused by the 1897 map. The 1897 map also shows a brick works 150m to the north east of the site with a shallow cutting edge around the periphery. A small farm building is shown immediately adjacent to the south western boundary of the northern area.

MAPPED HISTORY		
DATE RANGE	SITE	SURROUNDING AREA
1937-Present	The 1940 map shows the northern most field to have been split into three smaller fields. By 1975 the northern most field is at its current extent. The 1989 map shows the footpath to follow the edges of the fields crossing the centre of the site.	The brickworks to the north east is no longer present and has been built over with a mixture of residential properties and a caravan park. The village of Yapton sees gradual expansion throughout this period and has expanded with residential properties including some immediately to the east of the southern section of the site by the 1940s and the remaining area immediately to the east of the site developed throughout the 1960s and 1970s. The building to the south west of the northern area is no longer shown by the 1940 map. The old canal to the north is backfilled and built over with a mixture of residential properties and roads throughout this time. The 1992 map shows a small industrial estate 80m to the south of the site. By 2016 this has been redeveloped as a small housing estate.

AERIAL IMAGERY	Various aerial images present on Google Earth, as well as the Envirocheck report confirm the use of the site as agricultural fields from 1999 onwards.
INTERNET SEARCH	No information specific to the site was identified.
ANECDOTAL	No anecdotal evidence of site history was gained during the study.

2.4. GEOLOGY

GEOLOGICAL CONTEXT	The site is located within an area of Cretaceous Bedrock which was formed between 71 million and 94 million years ago when the local environment was dominated by warm chalk seas. These conditions gave rise to various chalk strata. Superficial deposits are widespread in the area and comprise a variety of deposits including, beach/tidal flats, raised beach deposits, raised marine deposits, brick earth, head, Aeolian deposits and river terrace deposits.
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SUPERFICIAL DEPOSITS	The site is indicated to be underlain by Aeolian Deposits (formerly known as 'brickearth') which are typically described as 'sandy, silty clay with some flint gravel'.
BEDROCK GEOLOGY	The site is indicated to be underlain by the Upper Chalk Formation, which is the collective name given to chalk strata comprising the Lewes Nodular Chalk Formation, the Seaford Chalk Formation, the Newhaven Chalk Formation, the Culver Chalk Formation and the Portsdown Chalk Formation. The exact formation underlying the site is unknown but the bedrock is typically described as 'White, chalk with flints'.
BGS BOREHOLE RECORDS	A BGS borehole record for a location 290m to the north of the site encountered 'brickearth' to a depth of 3.0m which had increased gravel content from 1.9m onwards. Then at 3.9m the Upper Chalk was encountered. BRD has also completed site investigation works in other sites in Yapton and encountered the Aeolian Deposits consisting of slightly gravelly clays and sands to typical depths to between 3m to 5m overlying the Upper Chalk.
SOIL GEOCHEMISTRY	The site is not situated in an area where the natural background concentrations of metals are elevated.
RADON	The site is located in an area where radon protection measures are not required.
GROUND STABILITY HAZARDS	No significant ground hazards have been identified on the site or in close proximity to the site. Although chalk bedrock is indicated to be present beneath the site, the site is within a low risk area for ground dissolution hazards.

2.5. HYDROGEOLOGY

SUPERFICIAL AQUIFER	Secondary A aquifer.
BEDROCK AQUIFER	Principal aquifer.

AQUIFER PROPERTIES	The superficial Aeolian Deposits indicated to be present at the site, may contain granular material and therefore shallow groundwater may be present. The bedrock is part of the White Chalk Subgroup which is a highly productive aquifer. It is described as 'Principal aquifer in UK up to 450 m thick and yielding 50 to 100 L/s from large diameter boreholes and up to 300 L/s from adited systems. Hard to very hard, good quality water'. Data from a nearby site would suggest that the groundwater can rise up into the superficial deposits after periods of prolonged rainfall, but the remainder of the time the groundwater rests within the chalk at depths of greater than 4m bgl.
LICENSED GROUNDWATER ABSTRACTIONS	None within 250m from the site.
GROUNDWATER SOURCE PROTECTION ZONE (SPZ)	Not located within a SPZ.

2.6. HYDROLOGY

SITE DRAINAGE CHARACTERISTICS	Surface water will infiltrate directly into the underlying soils, or will run-off into the drainage ditches or stream.
SURFACE WATER FEATURES	A stream runs along the south eastern boundary of the southern area in a 2m deep ditch. This enters the site from a culvert in the south eastern corner of the southern field and enters a ponded area which subsequently flows into a 2m deep ditch and then into a deep culvert which crosses the field and heads off site to the south west. The water was flowing through the culvert at a relatively slow rate and the water appeared to be clear. Running between the north eastern and western field and along the north western boundary of the southern field is a another shallow drainage ditch with intermittent standing water, but no obvious flow at the time of the walkover.
SURFACE WATER ABSTRACTIONS	None within 250m from the site.
DISCHARGE CONSENTS	None relevant to consideration of the site.

FLOODING	The majority of the site consists of a Zone 1 area and is highly unlikely to be affected by flooding. Based on the Envirocheck data, the ditch and culvert area running south west across the southern area are shown to be at risk of flooding. However, detailed hydraulic modelling of this area by Odyssey Markides as part of the Flood Risk Assessment work for the proposed development has demonstrated that this is not the case and that all the residential areas are outside of flood risk areas. The EA has accepted this modelling can be used within the Flood Risk Assessment.
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2.7. ENVIRONMENTAL ASPECTS

LANDFILL	Some sections of the infilled canal to the north of the site are identified as being landfilled, however, these are in excess of 250m from the site. The infilled canal is located 125m from the site at its closest point, and although not identified as a landfill in this location, does appear to have been backfilled. The former brickworks 150m to the north east of the site is highlighted as potentially infilled ground. During the walkover, a brief inspection of the area was conducted and it could be seen that the area remains lower than its surroundings therefore, the potential for any significant infilling is reduced. Potentially infilled land (water) is also shown along the south eastern boundary adjacent to the location of the stream prior to it entering the culvert. Site inspection confirms that the stream is in a relatively deep ditch and the area has not been backfilled. However, in the location of the culvert crossing the site, there is the potential for soils to have been backfilled, especially given the depth of the stream relative to the field.
CONTEMPORARY TRADE DIRECTORY ENTRIES	No nearby contemporary trade entries of relevance to assessment of the site.
REGISTERED HAZARDOUS SITES	None within 250m of the site.
POLLUTION INCIDENTS TO CONTROLLED WATERS	There have been no recorded pollution incidents within 250m of the site.
ECOLOGICALLY SENSITIVE LAND USE	None identified within 250m.

2.8. PREVIOUS GROUND INVESTIGATIONS

BRD is not aware of any previous ground investigation at the site.

3. PRELIMINARY CONTAMINATION RISK ASSESSMENT

3.1. HAZARD IDENTIFICATION

INVALID CONTAMINATION SOURCES	
HISTORIC LAND USE	DISCUSSION AS TO WHY THE HISTORICAL USE IS NOT CONSIDERED TO PRESENT A PLAUSIBLE HAZARD
Nearby infilled ground	There is some identified nearby infilled ground associated with an old infilled canal 125m to the north as well as potentially from an old brick works 150m to the north east which could present a potential landfill gas migration risk to the site. Neither features are identified as registered landfills. The canal represents a relatively small and shallow feature which appears to have been partially backfilled over 50 years ago. The old brick works ceased operations over 70 years ago and it is evident that the area is unlikely to have been significantly backfilled. There are also extensive residential properties in the area between the site and these features which have not been affected, and coupled with the relatively low permeability clay soils in the intervening area, it is not considered that the site could be affected by these potential gas sources.

POTENTIAL ON SITE SOURCES		
HISTORIC LAND USE	DESCRIPTION OF POTENTIAL CONTAMINATION HAZARD	POTENTIAL CONTAMINANTS OF CONCERN
Potential infill for culverted stream.	Historically, a deep ditch crossed the southern part of the site, but the stream has since been culverted. The ditch has therefore been backfilled above the culvert. The historic mapping suggests that this was completed in the late 19 th century. Although visual inspection of the exposed soils did not reveal any signs of contamination, there is a small possibility that hazardous materials could be present at depth, as well as the potential presence of organic material which could generate landfill gases.	Metals. Polycyclic Aromatic Hydrocarbons (PAH). Asbestos containing materials. Landfill gases (mainly carbon dioxide and methane).
Pesticides from agricultural use.	The agricultural land use is unlikely to give rise to any significant contamination sources. However, given the site is use for arable farming, there is the potential for pesticide residues to be present in the near surface soils.	Pesticides.

POTENTIAL ON SITE SOURCES		
HISTORIC LAND USE	DESCRIPTION OF POTENTIAL CONTAMINATION HAZARD	POTENTIAL CONTAMINANTS OF CONCERN
Fly tipping along site boundary.	There is a reasonable amount of waste which has been dumped over the fences of the adjacent residential properties along parts of the eastern site boundary. There is the possibility that hazardous materials such as asbestos, or ash from bonfires could have been dumped and therefore contaminated the upper soils close to the boundary.	Metals. Polycyclic Aromatic Hydrocarbons (PAH). Asbestos containing materials.

POTENTIAL OFF SITE SOURCES		
HISTORIC LAND USE	DESCRIPTION OF POTENTIAL CONTAMINATION HAZARD	POTENTIAL CONTAMINANTS OF CONCERN
No significant potential off site contamination sources have been identified in the surrounding area.		

3.2. RECEPTOR ASSESSMENT

CONTEXT	
ASSESSMENT LAND USE CATEGORY	Residential.
DESCRIPTION OF PROPOSED LAND USE	The proposed end use of the site is for the development of a residential housing estate with associated private gardens, off street parking, new access roads and areas of open space. The proposed layout is included in Appendix 1.

RECEPTORS	
RECEPTOR	DISCUSSION
HUMAN HEALTH	Residents with zero to 6 year old child most sensitive receptor.
CONTROLLED WATERS GROUNDWATER	Underlying Secondary A and Principal aquifers.
CONTROLLED WATERS SURFACE WATER	Surface water stream crossing site and ditches around periphery.
BUILDING MATERIALS AND SERVICES	Water service pipes. Buried concrete.

3.3. INITIAL CONCEPTUAL MODEL

POLLUTANT LINKAGES	The pollutant linkages are best presented in a diagrammatic form and therefore the initial conceptual site model plan is presented in Appendix 1. The individual pollutant linkages as numbered on the plan are described further in Section 3.4.
INVALID POLLUTANT LINKAGES	It is not considered that the potential presence of pesticide residues would present any valid pollutant linkage to future building materials and services.
LIMITATIONS AND UNCERTAINTIES	The preliminary conceptual model has been developed based solely on desk based research and assessment. The only way to conclusively determine the presence or absence of contamination is with intrusive site investigation.

3.4. PRELIMINARY ASSESSMENT OF CONTAMINATION RISKS

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 of the pathways refers to the numbered pollutant linkages from the Initial Conceptual Site Model Plan, as presented in Appendix 1.

POTENTIAL SOURCES AND CONTAMINANTS	PATHWAYS (REFERENCE FROM MODEL)	RECEPTORS	HAZARD SEVERITY	PROBABILITY OF OCCURRENCE	POTENTIAL RISK
Contaminated Made Ground associated with infilled/culverted stream/ditch.	Direct contact. (1) Ingestion of soils/dusts. (1) Inhalation of dusts/vapours or gasses. (2) Consumption of homegrown produce. (1)	Future Residents	Human health effects [Medium]	Due to the age of backfill and visual appearance of the surface soils, it is considered unlikely that there is any significant contamination in this area [low likelihood]	Moderate / low
	Horizontal & vertical migration. (3)	Water Environment	Contamination of stream culverted through infill, underlying Secondary A and Principal Aquifer, however, no nearby water abstractions [medium]	Due to the age of backfill, any potential contamination would likely have leached through historically and it is unlikely that any significant leachable contamination would remain. [unlikely]	Low
	Direct Contact. (4)	Building materials and services.	Minor degradation of sub-surface structures [mild]	Due to the age of backfill and visual appearance of the surface soils, it is considered unlikely that there is any significant contamination in this area [low likelihood]	Low
Agricultural field -Pesticide residues	Direct contact. (5) Ingestion of soils/dusts. (5) Inhalation of dusts/vapours. (6) Consumption of homegrown produce. (5)	Future Residents	Human health effects [Medium]	The concentrations of pesticide residues within the near surface soils are unlikely to be significant [Low likelihood]	Moderate / low

POTENTIAL SOURCES AND CONTAMINANTS	PATHWAYS (REFERENCE FROM MODEL)	RECEPTORS	HAZARD SEVERITY	PROBABILITY OF OCCURRENCE	POTENTIAL RISK
	Horizontal & vertical migration. (7)	Water Environment	Contamination of stream culverted through potential infill, underlying Secondary A and Principal Aquifer, however, no nearby water abstractions [medium]		Moderate / low
Soil contamination associated with fly-tipped waste along boundaries.	Direct contact. (8) Ingestion of soils/dusts. (8) Inhalation of dusts/vapours. (9) Consumption of homegrown produce. (8)	Future Residents	Human health effects [Medium]	Moderate potential for hazardous materials to have been dumped but unlikely to have become significantly buried or incorporated into the soil [low likelihood]	Moderate / low
	Horizontal & vertical migration. (10)	Water Environment	Contamination of stream culverted through infill, underlying Secondary A and Principal Aquifer, however, no nearby water abstractions [medium]		Moderate / low
	Direct Contact. (11)	Building materials and services.	Minor degradation of sub-surface structures [mild]	Unlikely that contamination would extend to any significant depth within the soils, at which buried structures would be placed. [unlikely].	Negligible

3.5. RECOMMENDATIONS

Potential moderate to low contamination risks have been identified by this Phase 1 Desk Study and therefore a Phase 2 Contamination Assessment is necessary to assess the significance of these potential pollutant linkages. It is recommended that this next phase of assessment includes the following investigation elements in order to address the identified contamination sources:

- Three days of machine excavated trial pits to yield around 25-30No. trial pits to depths of around 3.0m. This will enable a detailed record of the exposed ground conditions.
- Two days of windowless sample boreholes to yield 10-12No. boreholes to depths of 4-5m to assess the in-situ density and enable the installation of gas/groundwater monitoring wells.
- A series of 6No. gas monitoring visits to be completed to assess the potential low gas risk to the site.
- A selection of samples to be taken from the exploratory points to include sampling for heavy metals, speciated Polycyclic Aromatic Hydrocarbons (PAH), banded aliphatic/aromatic Total Petroleum Hydrocarbons (TPH), Volatile Organic Compounds (VOCs), pesticides and asbestos screening.
- Provision of a combined factual and interpretative investigation report. Factual findings to include all exploratory point records, monitoring and test results. Interpretative reporting to include a Generic Quantitative Contamination Risk Assessment (GQRA) and waste classification.

4. IMPLICATIONS FOR CONSTRUCTION

4.1. GEOTECHNICAL CONSIDERATIONS

The following is a checklist summary of geotechnical hazards and their likelihood to have an impact on the proposed development of the site.

GEOTECHNICAL HAZARD	LIKELY TO AFFECT SITE?	COMMENT
Removal of existing sub-structures affecting new foundations.	✗	
Deep Made Ground.	✗	There could be up to 2m of Made Ground adjacent to the culvert, but it is unlikely that any significant development would occur in this part of the site due to the presence of this water feature.
Historic wells.	✗	
Soft or compressible natural deposits such as Alluvium or Peat.	✓	The Aeolian Deposits may comprise low strength soils which could impact on foundation design.
Changes in ground conditions within short distances.	✗	
Fine soils that have a volume change capacity.	✓	Aeolian deposits in the area known to have a low to medium volume change potential, therefore it is likely that this characteristic of the soils will have an impact on the foundation design. Existing and proposed trees will further complicate foundations.
Dissolution features or 'swallow holes'.	✗	The chalk bedrock underlying the site may be susceptible. However, the site is located within an area classified as 'very low' risk for dissolution features.
Cambering of valley sides with possibility of 'gulls'.	✗	
Risk of slope instability.	✗	
Shallow groundwater.	✓	Could present construction difficulties and have implications for the design of sub-surface structures.
Underground mining.	✗	

GEOTECHNICAL HAZARD	LIKELY TO AFFECT SITE?	COMMENT
Geological faults.	✗	
Aggressive chemical environment for concrete e.g. expansive slag or high sulphate soils.	✗	

4.2. PRELIMINARY GEOTECHNICAL ASSESSMENT

The anticipated near surface geology underlying the site of Aeolian Deposits may potentially comprise low strength soils, thereby making the stratum unlikely to be suitable for the adoption of standard trench fill/strip footings. Wider, reinforced strip footings could be employed to spread loads over a wider area, or ground improvement may be required. Alternatively a piled foundation solution could be considered.

Depending on the composition of the superficial deposits i.e. should clayey or silty soils be encountered at a shallow depth, the trees and hedges along the site boundaries may have an impact on the soils, and foundations in close proximity to existing or proposed trees may need to be deepened.

Soakaways may be viable at the site, depending on whether granular deposits are encountered within the superficial Aeolian Deposits. If the Chalk bedrock is relatively shallow and/or fractured, deeper borehole style soakaways may be feasible.

For any form of development, BRD recommend that an intrusive ground investigation is undertaken in order to confirm ground conditions and allow design of the new structures. It is recommended that the ground investigation for geotechnical assessment includes the following elements, in addition to what is proposed for the contamination assessment (Section 3.5):

- Geotechnical testing as appropriate to the nature of the ground conditions encountered.
- Inclusion of a Geotechnical Assessment report providing comments on pavement design, concrete classification, soakaway feasibility and foundation design recommendations.

4.3. CONSTRUCTION CONSIDERATIONS

As with any construction site, if any anomalous material is encountered during the redevelopment then expert environmental advice should be sought.

REPORT SPECIFIC REFERENCES

- British Geological Survey sheet 317/332 “Chichester and Bognor” Solid and Drift edition (1:50,000) published 1996.

SUPPORTING INFORMATION

SITE CHARACTERISTICS

The site characteristics are collated from various information sources, including but not limited to Ordnance Survey, British Geological Survey (BGS), Environment Agency (EA) and local authorities.

BRD 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 BRD's interpretation for the site characteristics as it is not relevant. Examples of this are:

- 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, BRD 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 BRD 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 of the site is assessed by 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. BRD therefore employ the BGS Open Geoscience website to determine current nomenclature of strata and to assist in determining geological boundaries against current topographic features. BRD 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 BRD 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'. BRD 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', BRD 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.

CONTAMINATION ASSESSMENT METHODOLOGY

UK Policy

The UK Government's policy in relation to land affected by historic contamination is based on a 'suitable for use' approach. The approach recognises that the risks presented by any given level of contamination will vary greatly according to the use of the land and a wide range of other factors, such as the underlying geology of the site. Contamination risks therefore need to be assessed on a site-by-site basis. The 'suitable for use' approach limits requirements for remediation to the work necessary to prevent unacceptable risks to human health or the environment in relation to either the current use or future use of the land.

The three main drivers for contamination assessment and remediation are:

- *Voluntary action.*
- *Development as part of the planning regime.*
- *Regulatory action to mitigate unacceptable risks e.g. Part 2A of the Environmental Protection Act 1990.*

Pollutant Linkages

For a contamination risk to exist there must be a 'pollutant linkage' from the contaminant (source) via a pathway (the route from contaminant to receptor) to a receptor (the entity that could be harmed). The absence of a contaminant, pathway or receptor breaks the pollutant linkage and therefore no contamination risk exists.

Contamination is typically present at a site (in the ground and/or in the underlying groundwater) as a result of a historic or current industrial use, usually as a result of leaks, spills or disposal of residues, wastes and excess raw materials from the industrial processes. Contamination may also be present due to:

- *The deliberate application of chemicals e.g. the spraying of herbicide/pesticide.*
- *Migration of pollutants from adjacent land.*
- *Naturally occurring processes e.g. elevated concentrations of particular heavy metals associated with specific geological strata.*

Conceptual Site Model

The conceptual site model can be defined as a textual or graphical representation of the identified pollutant linkages for a given site. The model forms the basis for designing the investigation as the aim will be to target all of the potential pollutant linkages to determine, through the subsequent phases of risk assessment, whether or not they pose an actual risk.

It is important that the conceptual site model is updated with new information as the various investigation, risk assessment and remediation works are completed.

Technical Guidance

The technical and legal framework for contamination assessment is complex. The process adopted through this report for assessing contamination risks is in general accordance with the following guidance, as listed below:

- 'Investigation of Potentially Contaminated Sites - Code of Practice - BS 10175: 2011', BSi, 2011.
- 'Model Procedures for the management of Land Contamination - CLR Document No. 11', Environment Agency, 2004.
- 'Guidance for the safe development of housing on land affected by contamination - R&D66: 2008', NHBC/Environment Agency, 2008.

Risk Assessment Methodology

In line with the technical guidance, the contamination risk assessment follows a series of phased stages for each particular site:

PHASE	DESCRIPTION	RISK ASSESSMENT STAGE
PHASE 1	Generally limited to desk based research and a site walkover survey to develop an initial conceptual site model and identify what risks, if any, are likely to be presented by the site.	Hazard Identification and Assessment A preliminary stage of risk assessment concerned with identifying and characterising the hazards that may be associated with a particular site and identifying potential pollutant linkages.
PHASE 2	This phase is concerned with establishing whether contamination is present, usually through intrusive ground investigation, and then evaluating the degree and magnitude of the associated risks.	Risk Estimation A stage concerned with estimating the likelihood that receptors will suffer adverse effects if they come into contact with, or are otherwise affected by, a hazardous substance or agent under defined conditions. Risk Evaluation A stage of risk assessment concerned with evaluating the acceptability of estimated risks, taking into account the nature and scale of the risk estimates, any uncertainties associated with the assessment and the broad costs and benefits of taking action to mitigate risks.
PHASE 3	The appraisal and selection of remediation techniques, their implementation and verification.	Risk Management The process whereby decisions are made to accept a known or assessed risk and/or the implementation of action to reduce the consequences or probabilities of occurrence.

Risk Classification

The objective of risk assessment is to identify the nature and magnitude of the potential risks and should be based on a consideration of both:

- The likelihood/probability of an event [taking into account both the presence of the hazard and receptor and the integrity of the pathway].
- The severity of the potential consequence [taking into account both the potential severity of the hazard and the sensitivity of the receptor].

There is a need for a logical, transparent and repeatable system in defining the categories of severity of consequence and likelihood as well as for the risk itself and therefore the following risk rating matrix is employed:

		SEVERITY OF CONSEQUENCE			
		SEVERE	MEDIUM	MILD	MINOR
PROBABILITY	HIGH LIKELIHOOD	Very High Risk	High Risk	Moderate Risk	Moderate/Low Risk
	LIKELY	High Risk	Moderate Risk	Moderate/Low Risk	Low Risk
	LOW LIKELIHOOD	Moderate Risk	Moderate/Low Risk	Low Risk	Negligible Risk
	UNLIKELY	Moderate/Low Risk	Low Risk	Negligible Risk	Negligible Risk

These risk classifications are defined as follows:

- **Very High Risk** - There is a high probability that severe harm could arise to a designated receptor from an identified hazard at the site without appropriate remediation action.
- **High Risk** - Harm is likely to arise to a designated receptor from an identified hazard at the site without appropriate remediation action.
- **Moderate Risk** - It is possible that without appropriate remediation action harm could arise to a designated receptor. It is relatively unlikely that any such harm would be severe, and if any harm were to occur it is more likely that such harm would be relatively mild.
- **Low Risk** - It is possible that harm could arise to a designated receptor from an identified hazard. It is likely that, at worst if any harm was realised any effects would be mild.
- **Negligible Risk** - The presence of an identified hazard does not give rise to the potential to cause harm to a designated receptor.

This preliminary risk assessment matrix and classification system is based on guidance produced by Department for Environment, Food and Rural Affairs (Defra) and the Environment Agency in connection with contaminated land assessment.

APPENDIX 1

Site Location Plan



Not to scale.

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Project Title: Land at Bilsham Road, Yapton

Client: Gleeson Strategic Land

BRD Reference: BRD2693-OP1-C

Date Issued: December 2017



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Site Layout Plan



Key: / Site Boundary

Not to scale. Imagery & map data ©2017 Google.

Project Title: Land at Bilsham Road, Yapton

Client: Gleeson Strategic Land

BRD Reference: BRD2693-OP4-B

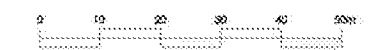
Date Issued: December 2017



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Date: 14.11.17 Scale: 1:1250@A1 Drawing ref: 1244G.03



- Site boundary
- Existing trees retained
- Existing hedgerows retained
- Proposed planting
- SuDS feature
- Existing Public Right of Way retained
- Potential location for pumping station + 15m offset
- Affordable housing unit
- Visitor parking space

Site Walkover Photographs



Plate 1: Site access off Bilsham Road.



Plate 2: Southern site area.

Project Title: Land at Bilsham Road, Yapton
Client: Gleeson Strategic Land
BRD Reference: BRD2693-OP2-C
Date Issued: April 2017



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Site Walkover Photographs



Plate 3: Stream entering culvert along south eastern boundary.



Plate 4: Stream in deep channel along south eastern boundary.

Site Walkover Photographs



Plate 5: Ponded area in eastern corner of southern field where stream enters site.



Plate 6: Various rubbish dumped at boundary.

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Site Walkover Photographs



Plate 7: Northern section of southern field looking south west.



Plate 8: Area dividing the two fields with dense brambles.

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Site Walkover Photographs



Plate 9: South east boundary of northern field.



Plate 10: Looking north east across northern field.

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