



Wilson Designer Homes Limited

90 ROSE GREEN ROAD, ALDWICK

Preliminary Geo-Environmental Risk Assessment



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CONFIDENTIAL

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Wilson Designer Homes Limited

90 ROSE GREEN ROAD, ALDWICK

Preliminary Geo-Environmental Risk Assessment

WSP

Regus House

Southampton International Business Park, George Curl Way

Southampton, Hampshire

SO18 2RZ



WSP.com



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Prepared by	N. Mustafa
Signature	
Checked by	C.D. Summers
Signature	
Authorised by	Dr R. Hares
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CONTENTS

1	INTRODUCTION	2
1.1	TERMS OF REFERENCE	2
1.2	AIMS	2
1.3	DEVELOPMENT PROPOSAL	2
1.4	PROJECT SCOPE	2
1.5	LEGISLATIVE CONTEXT AND GUIDANCE	3
1.6	SOURCES OF INFORMATION	3
1.7	LIMITATIONS	3
1.8	UNDERSTANDING RISK	4
2	SUMMARY OF THE SITE AND SURROUNDING AREA	5
2.1	SITE DESCRIPTION AND CURRENT USE	5
3	SITE HISTORY	7
3.1	HISTORICAL MAPS	7
4	ENVIRONMENTAL SETTING	9
4.1	GEOLOGY	9
4.2	HYDROGEOLOGY AND HYDROLOGY	10
4.3	ENVIRONMENTALLY SENSITIVE SITES	10
4.4	FLOODING	10
4.5	RADON	10
4.6	PRELIMINARY HYDROGEOLOGICAL MODEL	10
5	REGULATORY INFORMATION AND CONSULTATION	11
5.1	REGULATORY DATABASE	11
5.2	LOCAL AUTHORITY	12

5.3	ENVIRONMENT AGENCY	12
5.4	PLANNING HISTORY	12
5.5	UNEXPLODED ORDNANCE (UXO)	ERROR! BOOKMARK NOT DEFINED.
6	PRELIMINARY CONCEPTUAL SITE MODEL	14
6.1	INTRODUCTION	14
6.2	POTENTIAL SOURCES OF CONTAMINATION	14
6.3	POTENTIAL RECEPTORS	15
6.4	PLAUSIBLE CONTAMINANT LINKAGES	16
7	CONCLUSIONS AND RECOMMENDATIONS	20
7.1	CONCLUSIONS	20
7.2	RECOMMENDATIONS	20

APPENDICES

APPENDIX A

FIGURES AND DRAWINGS

APPENDIX B

REPORT LIMITATIONS

APPENDIX C

CIRIA RISK DEFINITIONS

APPENDIX D

PHOTOGRAPH LOG

APPENDIX E

ENVIROCHECK

APPENDIX F

SUMMARY OF PLANNING APPLICATIONS



EXECUTIVE SUMMARY

WSP was instructed by Wilson Designer Homes Limited ('the Client') to undertake a desk-based assessment of geo-environmental liabilities and constraints to support the redevelopment of 90 Rose Green Road. It is understood that the Site is to be redeveloped for residential use.

The key aim of this Geo-Environmental Risk Assessment is to develop a preliminary Conceptual Site Model (CSM) to identify potential contamination associated with the Site through evaluation of possible contaminated land exposure pathways and their potential significance on identified receptors.

At the time of the site walkover, the Site comprised a bungalow, timber stables, a storage shed, site office, greenhouse and sawing shed. Historical maps indicate that until the 1930s the Site existed as open grassland. From the 1930s until present, there have been residential buildings located on Site, as well as a saw mill and several timber/masonry stables. The surrounding area has a history of industrial, agricultural and residential use.

BGS maps indicate the underlying geology at the Site to comprise River Terrace Deposits (Secondary A Aquifer) underlain by the London Clay Formation (Unproductive Stratum) at depth. Made Ground is likely to be present in the areas of the former and existing buildings. Groundwater present within the aquifers is considered likely to flow towards the south-west.

Given the history of the Site and the surrounding area and the sensitivity of the development there is a **Moderate** risk to human health, a **Low to Moderate** risk to controlled waters and a **Low** risk to buildings and underground structures.

The risk to construction workers is considered to be **Moderate** since there is greater likelihood that workers will come into contact with potential asbestos or contaminated soils. The risks to workers should be managed through health and safety protocols under Construction (Design and Management) Regulations 2015.

Based on the findings of the Preliminary Contaminated Land Risk Assessment the following is recommended:

- ✧ An intrusive ground investigation should be undertaken at the Site including a Generic Quantitative Risk Assessment (GQRA) to allow the assessment of identified plausible contaminant linkages and if remedial measures may be required.
- ✧ If not already completed, an asbestos survey should be undertaken on the buildings prior to demolition to confirm if Asbestos Containing Material (ACM) is present and to allow an assessment of mitigation procedures required.

1 INTRODUCTION

1.1 TERMS OF REFERENCE

WSP was instructed by Wilson Designer Homes Limited ('the Client') to undertake a Preliminary Desk Study assessment of Geo-environmental liabilities and constraints to support the residential redevelopment of 90 Rose Green Road, Bognor Regis ('the Site'). The Site location and current layout are presented as **Drawing 1** and **Drawing 2** in **Appendix A**.

1.2 AIMS

The overall project aim is to undertake a desk-based assessment of the Site with respect to ground contamination.

The key aims of this assessment are to:

- ✧ Develop a preliminary Conceptual Site Model (CSM) to identify potential contamination and geotechnical risks associated with the potential redevelopment of the Site; and
- ✧ Evaluate likely contaminated land exposure pathways and their potential significance on identified receptors and provide risk management advice to support redevelopment.

1.3 DEVELOPMENT PROPOSAL

WSP understand that the report is required to support the redevelopment of the Site. It is understood that the Site is to be redeveloped for residential use comprising:

- ✧ At least four residential properties;
- ✧ Areas of soft landscaping and trees;
- ✧ Block paving driveways; and
- ✧ Compacted gravel roads.

A copy of the proposed layout is presented as **Drawing 3** in **Appendix A**.

1.4 PROJECT SCOPE

To assist in meeting the aims as stated in Section 1.2, the scope of this assessment comprised:

- ✧ A review of relevant previous reports pertaining to the Site, where available;
- ✧ A review of publicly available historical maps and Site plans (where available) to identify former land uses and potential contaminative activities on and surrounding the Site;
- ✧ A review of relevant regulatory databases and contact with relevant regulatory authorities including: Local Council planning website, the Contaminated Land Officer (CLO) and Environment Agency (EA);
- ✧ A review of relevant publicly available information relating to hydrological features, hydrogeology, neighbouring land use, ecologically sensitive uses and geology in order to establish the environmental setting of the Site;
- ✧ Develop a preliminary CSM via the source-pathway-receptor contaminant linkage approach;



- ※ Outline the environmental risks and / or opportunities, with respect to ground, groundwater and ground gas conditions, which may potentially arise as liabilities or constraints associated with future use of the Site; and,
- ※ Preparation of a Preliminary Contaminated Land Risk Assessment Desk Study Report.

This report forms part of the Health and Safety file for the Site.

1.5 LEGISLATIVE CONTEXT AND GUIDANCE

The assessment was undertaken in the legislative context of:

- ※ Part 2A of The Environmental Protection Act (1990); and,
- ※ The National Planning Policy Framework (2019).

The following good practice and statutory guidance was considered and the assessment was undertaken in general accordance with:

- ※ Environment Agency 'Model Procedures for the Management of Land Contamination', CLR11 (2004); and,
- ※ CIRIA C552 'Contaminated Land Risk Assessment. A guide to good practice' (2001).

1.6 SOURCES OF INFORMATION

The following relevant sources of information were used in the production of this report:

- ※ Landmark Envirocheck report, dated 1 July 2019, Order Ref: 209313757_1_1;
- ※ British Geological Survey (BGS) Online Viewer (<https://www.bgs.ac.uk/discoveringGeology/geologyOfBritain/viewer.html>) accessed 1 July 2019;
- ※ Flood Maps for Planning Service (<https://flood-map-for-planning.service.gov.uk/>) accessed 1 July 2019;
- ※ MAGIC (<https://magic.defra.gov.uk/MagicMap.aspx>) accessed 1 July 2019;
- ※ Environment Agency Catchment Data Explorer, (<https://environment.data.gov.uk/catchment-planning/>) accessed 1 July 2019;
- ※ Public Health England, UK Maps of Radon (<https://www.ukradon.org/information/ukmaps>) accessed 1 July 2019;
- ※ Arun District Council Planning Applications (<https://www.arun.gov.uk/planning-building-control-site-searches>) accessed 29 June 2019; and,

The report contains British Geological Survey materials ©NERC 2018 and Environment Agency information ©Environment Agency and database right.

1.7 LIMITATIONS

This report is addressed to and may be relied upon by Wilson Designer Homes Limited and may not be relied upon or transferred to any other parties without the express written agreement of WSP UK Ltd.

This report should be read and used in full. No responsibility will be accepted where this report is used, in its entirety or in part, by any other party. WSP cannot be held liable for third party information. Full details of the limitations are provided as **Appendix B**.

1.8 UNDERSTANDING RISK

It is important to understand that any risks identified during a preliminary assessment, such as the one presented in this document, are perceived risks based on the information reviewed. A more detailed assessment of the actual risks can only be assessed following further intrusive investigations. The preliminary assessments presented herein are qualitative based on professional judgements following the review of available data and within the context of the existing/proposed use. Those risk categories presented (very low, low, low to moderate, moderate, high and very high) follow guidance presented in CIRIA Publication C552, Contaminated Land Risk Assessment – A Guide to Good Practice. CIRIA states that the risk levels should be based on an understanding of both the probability (likelihood) of a risk occurring and the magnitude of the potential consequence (severity) of a risk. CIRIA defines four levels of probability and four levels of severity with relation to contaminated land, as presented in **Appendix C**.

2 SUMMARY OF THE SITE AND SURROUNDING AREA

2.1 SITE DESCRIPTION AND CURRENT USE

Site location and current layout plans are presented as **Drawing 1** and **Drawing 2** in **Appendix A**.

Table 1 provides details obtained from a Site walkover. Photographs from the walkover undertaken 20 July 2016 are presented in **Appendix D**. A review of Ordnance Survey (OS) mapping, online aerial photography and relevant regulatory information obtained from the Envirocheck report is also summarised below, where applicable. The Envirocheck report is included as **Appendix E**.

Table 1 – Summary of Site Details

Detail	Comment
Name and Address of Site	90 Rose Green Road, Bognor Regis, PO21 3EQ
Location and Access	The Site is located north east of Bognor Regis, West Sussex.
National Grid reference	490250, 993500
Site Description and Current Use	Approximately a third of the Site is occupied by redundant buildings in various states of decay. These include a detached former single storey residential home located in the north-west corner of the Site and a number of out buildings scattered across the remaining central and east sections of the Site. The latter buildings include former stables (along the northern boundary), stores and sheds. A collapsed wooden structure near the south entrance to the Site is a former saw mill building. Many of the roofs have collapsed and the wooden side panel, frames and doors have rotted or have been removed. Inside the buildings, there is evidence of wood storage, old lighting, rusted machinery and roofing and other metals associated with the former use as a saw mill. Additionally, batteries and tins of paint and grease were identified during the walkover. Scattered metal and wood are located within the grass areas with occasional asbestos cement products on the site surface. An abandoned caravan was located in the north east of the Site. Fences and gates are located on site. One gate includes a 'danger' warning sign.
Area	Approximately 0.2 hectares.
Site Setting and Surrounding Area	Located within a residential setting with open farmland to the north.
Topography and Ground Cover	The site is predominantly flat with soft landscaping, overgrown areas of grass. Concrete hardstanding is located in areas, such as the north east of the Site. There are areas of gravel on site.
Boundaries	Residential properties are located east, south and west of the Site. Open fields/farming fields are located on the northern boundary. The Site is accessed from the south, from Rose Green Road.

Detail	Comment
Asbestos	Corrugated roofs containing asbestos, of which some have collapsed. Fragments of former asbestos containing panelling, corrugated sheeting and pipework are found within the grassed areas.

3 SITE HISTORY

3.1 HISTORICAL MAPS

Historical maps were obtained as part of the Envirocheck report (**Appendix E**) and were reviewed to identify potentially contaminative former land uses on Site and within a 500-m radius of the Site boundary.

A summary of on-site and off-site features relevant to contaminated land are presented in **Table 2**.

Table 2 – Summary of Pertinent History in the Surrounding Area

Historical Map (Scale and Date)	On-site Feature	Off-site Feature
1875-1877 (1:2,500)	The Site comprises open fields.	The surrounding area comprises predominantly open fields. A road runs parallel to the southern boundary of the Site. Houses are located approximately 120 m south west of the Site and 130 m west of the Site.
1979-1880 (1:10,560)	No significant change.	Willow hall Farm is located 490 m south of the Site. Covets farm is located 120 m south west of the Site.
1898 (1:2,500) 1899 (1:10,560)	No significant change.	Residential properties are located 10 m south of the Site. Rose green Farm is located 130 m west of the Site.
1912 (1:2,500) 1912-1914 (1:10,560)	No significant change.	No significant change.
1933 (1:2,500) 1933-1934 (1:10,560)	A building is located in the north-west corner of the Site.	Residential properties and associated gardens are located in east, south west and west of the Site. Properties are located directly on the southern boundary of the Site. The north of the Site still comprises open fields. A fence has been erected parallel to the western boundary of the Site, it extends up to the north.
1961 (1:10,000) 1962 (1:2,500) 1963-1965 (1:2,500)	The building in the north west of the Site has expanded and changed in shape.	A garage is located 90 m west of the Site. A works is located 90 m west of the Site.

Historical Map (Scale and Date)	On-site Feature	Off-site Feature
	Four new buildings are located on Site. Two in the north east, one in the south east and one in the centre of the Site. Tracks are shown linking the buildings.	A second garage is located 130 m west of the Site. A new road layout is shown south of the Site. Residential properties are located around the Site, with the exception of the north.
1969 (1:10,000)	No significant change.	No significant change.
1970-1980 (1:1,500) 1973-1979 (1:10,000)	A building in the centre of the Site has been removed. Stables have been erected along the northern boundary of the Site. A new building is located in the centre of the Site. A second smaller new building is located in the west of the Site. Fences have been erected on site.	Directly to the east of the Site, Riding Stables are labelled. 50 m west of the Site, a factory is located. A builder's yard is located 120 m south west of the Site. An electrical substation is located 150 m north west of the Site. An electrical substation is located 100 m north east of the Site.
1990-1995 (1:10,000) 1994 (1:1,250)	The building in the north west of the Site has changed in shape/part of the building has been demolished.	A works is located approximately 10 m from the Site in the west. A second works is located 120 m west of the Site.
1999 Aerial Photograph	Aerial photograph shows three large buildings (one in the north west, one in the centre and one in the south east).	No significant change.
2000 (1:10,000)	No significant change.	No significant change.
2006 (1:10,000)	No significant change.	Racing stables located 500 m north west of the Site.
2019	No significant change.	The works on the west of the Site have been demolished and replaced with residential properties.

4 ENVIRONMENTAL SETTING

4.1 GEOLOGY

British Geological Survey (BGS) maps and the 'Geology of Britain' online viewer indicate that the geology underlying the Site predominantly comprises the superficial River Terrace Deposits overlying the London Clay Formation. In the north east of the Site, the Bognor Sand Member is mapped to overlie the London Clay Formation. **Table 3** provides a summary of the underlying geology.

Table 3 – Summary of Geological Strata

Stratum	Thickness*	Aquifer Designation**	Description
Made Ground	N/A	N/A	
River Terrace Deposits	Unknown.	Secondary A Aquifer	Sand and gravel, locally with lenses of silt, clay or peat.
Bognor Sand Member (north east of the Site only)	5-10 m.	Secondary A Aquifer	Glauconitic bioturbated or cross-bedded fine- and medium-grained sands, partially cemented.
London Clay Formation	Up to 150 m.	Unproductive Strata	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.

*Thickness from the BGS Lexicon.

** Environment Agency aquifer designation.

The closest BGS log is approximately 785 m west of the Site (ref: SZ89NE4). The log indicates drift deposits to overlie London Clay.

Information regarding potential ground hazards assessed within the Envirocheck report are summarised in **Table 4**.

Table 4 – Summary of Ground Hazards on Site

Feature	Hazard
Collapse Ground	Low
Compressible Ground Stability	No Hazard
Ground Dissolution	No Hazard
Landslide Ground Stability	Very Low
Running Sand Ground Stability	Low
Shrinking or Swelling Clay Ground Stability	Low

4.2 HYDROGEOLOGY AND HYDROLOGY

The River Terrace Deposits and Bognor Sand Member are classified as a Secondary A Aquifer and the London Clay Formation is classified as an Unproductive Strata. The Site is located within an area classified by the EA as being of high vulnerability with respect to potential groundwater pollution, having soils of high leaching potential.

The Site is not situated within a groundwater Source Protection Zone (SPZ).

There are no operational groundwater or surface water abstraction licences within 1 km of the Site.

The nearest surface water feature is a drain located 159 m south, running along the northern boundary of Avisford Park. The Pagham Rife River is located approximately 1.4 km west of the Site and flows towards the south west. Several drainage ditches are located in the surrounding area.

The Site is located within the Western Streams operational catchment. The Pagham Rife is the closest water body. In 2016 the Pagham Rife was recorded by the Environment Agency to have Moderate Ecological classification and Good Chemical Classification. The overall classification given in 2016 was Moderate. The downstream water body listed is Pagham Harbour.

4.3 ENVIRONMENTALLY SENSITIVE SITES

The Envirocheck report states there are no environmentally sensitive sites within 500 m.

There are two Grade II Listed buildings <10 m south of the Site.

4.4 FLOODING

A review of the flood map for planning website indicates that the Site is located within Flood Zone 1 (land having a low probability of flooding).

The Envirocheck report states that there is potential for groundwater flooding to occur at the surface.

4.5 RADON

A review of the UK Radon Map has confirmed the Site to have 1-3% maximum radon potential. The Envirocheck report states no radon protective measures are necessary in the construction of new dwellings or extensions.

4.6 PRELIMINARY HYDROGEOLOGICAL MODEL

Groundwater is likely to be present within the superficial River Terrace Deposits. River Terrace Deposits comprise sand and gravel, with lenses of silt, clay or peat, it is likely that water is able to flow through the deposits. Groundwater is likely to flow towards the south-west in accordance with the surface water flow direction near the Site. The underlying London Clay Formation is likely to exist as an aquiclude.

Made Ground is anticipated to be present due to the historical redevelopment, although the thickness and composition are likely to be highly variable. Perched groundwater may exist as isolated pockets of water associated with permeable lenses within the Made Ground.

5 REGULATORY INFORMATION AND CONSULTATION

5.1 REGULATORY DATABASE

The Envirocheck report includes information and data collected from several organisations including the Environment Agency (EA), the Local Authority, the British Geological Survey (BGS), Department for Environment, Food & Rural Affairs (Defra) and Health & Safety Executive (HSE).

It is considered that the information listed in **Table 5** represents those of potential concern in relation of contamination at the Site. The full Envirocheck report is provided in **Appendix E**.

Table 5 – Summary of Database Searches (all distances are approximate)

Descriptor	On-site	0-249 m	250-500 m	Details
Discharge Consents	0	0	3	The closest discharge consent is for discharge of public sewage into controlled sea operated by Southern Water Services Ltd, located 271 m south of the Site.
Local Authority Pollution Prevention and Controls (PCC)	0	0	1	The closest PCC is for Rose Green Service station (petrol filling station), located 408 m east of the Site.
Pollution Incidents to Controlled Waters	0	0	1	The closest pollution incident to controlled waters occurred 321 m west. The pollutant was identified as chemicals (paints/dyes). It was classified as a Category 3 (Minor Incident).
OS Water Network Lines	0	3	26	Closest OS water network line is 160 m south of the Site.
Potentially Infilled Land (Non-water)	0	1	0	Unknown filled ground (pit, quarry etc.) in 1976, located 162 m south west of the Site.
Potentially Infilled Land (Water)	0	0	4	Unknown filled ground (pond, marsh, river, stream and dock), mapped in 1914. Located 381 m south east of the Site.
Fuel Station Entries	0	0	1	Rose Green Service Station (Esso Petrol Station) is located 408 m east of the Site.
Contemporary Trade Directory Entries	0	2	13	The closest active trade directory entries include refrigeration equipment manufacturers (261 m west), computer manufacturers (373 m east) and cleaning surfaces (491 m east).

5.2 LOCAL AUTHORITY

Arun District Council was contacted by WSP via email on 1 July 2019 regarding environmentally pertinent information held relating to the Site. A response was not received within the reporting timeframe. Any pertinent information will be provided as an addendum once a response has been received.

5.3 ENVIRONMENT AGENCY

The Environment Agency (EA) was contacted by WSP via email on 1 July 2019 regarding environmentally pertinent information relating to the Site. A response was not received within the reporting timeframe. Any pertinent information will be provided as an addendum once a response has been received.

5.4 PLANNING HISTORY (POST 1987)

A search of the Arun District Council Planning Portal was undertaken on 29 June 2019, for applications relating to the site and surrounding area. The search results are given in **Appendix F**. Of the applications reviewed, the following applications have potential contamination significance:

- ※ **Application reference: AW/102/87.** Proposal: Demolition of part of existing factory and redevelopment to match recently modernized factory. Address: Osborne Refrigeration Ltd, Rose Green Road. Status: Approved on 7 April 1987;
- ※ **Application reference: AW/21/91.** Proposal: Demolition of part of existing factory and redevelopment (warehousing) to match existing with car parking. Address: Osborne Refrigeration Ltd, Rose Green Road. Status: Approved on 27 February 1991;
- ※ **Application reference: AW/154/94.** Proposal: Demolition of existing office and store area. Replacement with new offices and storage area with revised car parking. Address: Osborne Refrigeration Ltd, Rose Green Road. Status: Approved on 18 November 1994;
- ※ **Application reference: AW/245/07.** Proposal: Demolition of existing factory, office building and nos. 120, 122, 130 and 132 Rose Green Road and redevelopment of site by the erection of 90 dwellings, comprising 32 flats and 58 houses, with amended access, parking and open space (This application is a departure from the development plan & also falls within the parish of Pagham). Address: 124 Rose Green Road. Status: Approved on 4 October 2007;
 - Application involved a Site Investigation and Assessment by Bureau Veritas issued December 2006;
 - Historically the site was found to have been a workshop and servicing garage and fuel filling station;
 - Investigation works concluded the presence of benzene, toluene, xylene and total petroleum hydrocarbons (TPHs) in groundwater;
 - TPHs, diesel range organics (DRO) and chlorinated solvents in soils; and
 - Remediation works were outlined.
- ※ **Application reference: AW/77/14/DOC.** Proposal: Application for approval of details reserved by conditions 4 (landscaping), 8 (stationing of vehicles), 9 (turning of vehicles), 10 (visibility splays), 12 (layout of roads, footpaths, casual parking, water drainage), 13 (Green Travel Plan), 14 (surface and foul water drainage) and 16 (contamination) following a grant of planning permission AW/245/07. Address: Osbourne Refrigeration Rose Green Road Aldwick. Status: Approved on 1 April 2014.



- Completion Report by Wilson Bailey Geotechnical and Environmental issued July 2009;
- Conclusions included: southern area of the site identified as a former fuel filling station with underground fuel storage tanks and pumps, central eastern area as oil and paint storage with the presence of solvents and hydrocarbon contaminants and the remainder of the site as light industrial uses;
- Remedial works were undertaken to remove contamination sources;
- Monitoring and on-site bioremediation of hydrocarbon impacted soils in accordance with the Materials Management Plan; and
- Supervision and documentation of the reuse on site of remediating soils following completion of the bioremediation.

The planning applications provided above outline potential contaminative sources. Demolition of buildings is likely to create Made Ground, of which may contain contaminants (particularly asbestos). Applications relating to Osbourne Refrigeration have identified the site to have been previously contaminated, and since remediated prior to the construction of residential properties.

As groundwater is flowing towards the south west, groundwater contamination west of the Site is unlikely to have adverse effects on the subject Site.

6 PRELIMINARY CONCEPTUAL SITE MODEL

6.1 INTRODUCTION

The preliminary CSM is based upon the environmental conditions of the Site as described in the previous sections and was developed in the context of a continued commercial use.

The assessment followed a risk-based approach; with the potential environmental risk assessed qualitatively using the 'source-pathway-receptor' contaminant linkage concept introduced in the guidance documents (principally the EA's CLR 11) on the practical implementation of the Environmental Protection Act 1990.

Environmental risk can be defined as the combination of the consequence of a harmful effect and the probability of its occurrence. The existence of a contaminant linkage is primarily dependant on site usage and environmental conditions.

The environmental risk assessment has been carried out by identifying and evaluating the significance of the following:

- ※ Potential sources of contamination: these include actual or potentially contaminating materials and activities, located either on or in the vicinity of the Site;
- ※ Potential receptors of contamination: these include Site users, groundwater and surface waters; and,
- ※ Potential pathways for contamination migration: these are the routes or mechanisms by which contaminants may migrate from the source to the receptor.

6.2 POTENTIAL SOURCES OF CONTAMINATION

Table 6 provides a summary of the potential sources of contamination that may be present at the Site, as well as the likely nature of such sources.

Table 6 – Potential Sources of Contamination

Potential Source	Potential Contaminants of Concern	Likely / Anticipated Distribution
ON-SITE		
Made Ground	Petroleum hydrocarbons, polycyclic aromatic hydrocarbons (PAHs), heavy metals, inorganics, asbestos, organic matter.	Made Ground may be present across the Site, particularly where former and current buildings / structures are present.
Building fabric	Asbestos containing materials.	Any buildings located on site.
Saw Mill	Machinery associated with the saw mill, gives the potential for metals, fuels and oils.	South east of the Site.
On-site Storage Areas	Unknown what was stored here potential for polycyclic aromatic hydrocarbons (PAHs), heavy metals, inorganics, and organic matter.	Central Site.



Potential Source	Potential Contaminants of Concern	Likely / Anticipated Distribution
OFF-SITE		
Agricultural Land	A range of contaminants including various chemicals (e.g. pesticides and herbicides) petroleum hydrocarbons and sewage waste.	Formerly surrounding the Site. Currently north of the Site.
Refrigerator Manufacturer	Ammonia, metals, oils, paints, solvents asbestos (in the building).	Directly west of the Site, <30 m.
Garages	Metals and metal compounds, waste oil, brake fluids, acid batteries, solvents (white spirit), fuels (e.g. diesel), paints containing lead, zinc, isocyanates and ketones. Inorganic compounds such as asbestos.	65 m, west of the Site.
Electrical Substations	Polychlorinated biphenyls, mineral oils and asbestos.	100 m north east of the Site. 150 m north east of the Site.
Builder's Yard	Unknown what was stored here, potential for petroleum hydrocarbons, polycyclic aromatic hydrocarbons (PAHs), heavy metals, solvents, inorganics, organic matter, VOCs and polychlorinated biphenyls.	120 m south west of the Site.
Former Fuel Filling Station	Metals, waste oils, brake fluids, hydrocarbons and volatile organic compounds (VOCs).	120 m west of the Site.
Former Paint Storage	Metals and metalloids, inorganic compounds and organic compounds (e.g. aliphatic, aromatic and halogenated solvents).	60 m west of the Site.

Sources of contamination located down-hydraulic gradient of the Site or greater than 250 m from the Site have been discounted from further assessment.

6.3 POTENTIAL RECEPTORS

In the context of residential use of the Site, the following potential receptors were identified:

HUMAN HEALTH

- ✧ Residential Site users;
- ✧ Construction and maintenance workers; and,
- ✧ Third party neighbours;

INFRASTRUCTURE

- ✧ Buildings and underground structures.

VEGETATION

- ✧ Trees and plants.

CONTROLLED WATERS

- ✧ Streams and drainage ditches;
- ✧ River Terrace Deposits (Secondary A Aquifer); and,

» Bognor Sand Member (Secondary A Aquifer).

The Pagham Rife has been discounted as a receptor due to distance from the Site (1.4 km west).

6.4 PLAUSIBLE CONTAMINANT LINKAGES

Table 7 provides an evaluation of the potential contaminant linkages that are considered to be plausible on the basis of the information currently available for the site and the proposed residential end use.

Table 7 – Plausible Contaminant Linkages

Potential Contaminants	Potential Pathways	Potential Receptors	Comments
ON-SITE			
Free asbestos fibres in soil	» Inhalation of asbestos fibres.	» Future Site users and visitors, and adjacent site users.	Moderate Risk. Asbestos is present within the building structures and could also be present within Made Ground on-site. Exposure to asbestos fibres will be restricted due to the proposed development containing large areas of hardstanding.
		» Construction / maintenance workers.	There is considered a Moderate Risk to construction and maintenance workers who are more likely to encounter asbestos fibres.
Made Ground (potential for a range of contaminants to be present e.g. metals, oils, and asbestos).	» Dermal contact, ingestion and inhalation of impacted Made Ground and soil particles.	» Future Site users and visitors, and adjacent site users.	Moderate Risk. Asbestos is present within the building structures and could also be present within Made Ground on-site. Exposure to asbestos fibres will be restricted due to the proposed development containing large areas of hardstanding.
		» Construction/ maintenance workers.	There is considered a Moderate risk to construction and maintenance workers who are more likely to encounter asbestos fibres.

Potential Contaminants	Potential Pathways	Potential Receptors	Comments
	♦ Migration along drains. ♦ Vertical leaching from impacted soils. ♦ Lateral migration of contaminants within groundwater.	♦ Secondary A Aquifers ♦ Surface water drains and ditches	Contamination in the overlying Made Ground may leach into the underlying Secondary A Aquifer. The proposed site includes areas of soft landscaping. This will allow rain water infiltration to leach contaminants through soils into the aquifer. The risk to groundwater is Low to Moderate. The risk to surface water drains and ditches is Low to Moderate, as there are numerous drains within 250 m of the Site, The Site is not located in a Source Protection Zone (SPZ). Additionally, processes such as degradation, attenuation, dilution and dispersion are likely to occur over the distances to controlled water receptors.
	♦ Root uptake.	♦ Plants and vegetation.	The risk to plants and vegetation is considered to be Low, given the vegetation on-site does not indicate signs of distress.
	♦ Direct contact.	♦ Buried concrete structures. ♦ Below ground services.	Contamination present in the Made Ground may affect below ground services, particularly plastic water supply pipes as contaminants may permeate through the pipes and affect potable water supplies. The risk is considered to be Low.
Vapours and gases generated from Made Ground on-site	♦ Vertical and lateral migration through unsaturated soil pore space. ♦ Ingress into buildings via service penetrations, floor construction and cracks, wall cavities etc. resulting in accumulation in enclosed spaces within buildings. ♦ Migration via preferential pathways such as below ground service trenches.	♦ Future Site users ♦ Construction/ maintenance workers	No significant ground gas source (other than the potential for Made Ground) has been identified on-site. The risk to future Site users is considered to be Very Low Risk. There is considered to be a Low Risk to construction workers due to working within enclosed spaces (i.e. excavations).

OFF-SITE

Potential Contaminants	Potential Pathways	Potential Receptors	Comments
Made Ground (especially on former industrial site to the west)	* Dermal contact, ingestion and inhalation of impacted Made Ground and soil particles.	* Site Users * Construction and Maintenance workers	Very Low Risk. The area surrounding site was predominantly covered with hardstanding. The former factory site has been redeveloped for residential housing.
	* Migration along drains. * Vertical leaching from impacted soils. * Lateral migration of contaminants within groundwater	* Secondary A Aquifers * Surface waters	Very Low Risk. The areas with Made Ground of concern are situated down gradient from the site. Therefore, it is unlikely groundwater will flow from these sources onto the Site. The off-site contamination has the potential to migrate to surface water features, as there are numerous located within 250 m of the Site.
	* Root uptake.	* Plants and vegetation.	The risk to plants and vegetation is considered to be Low, given the vegetation on-site does not indicate signs of distress
	* Direct contact	* Below ground services.	Very Low Risk The former factory site has been redeveloped for residential housing.
Gases and Vapours	* Vertical and lateral migration through unsaturated soil pore space. * Ingress into buildings via service penetrations, floor construction and cracks, wall cavities etc. resulting in accumulation in enclosed spaces within buildings. * Migration via preferential pathways such as below ground service trenches.	* Future site users * Construction/ maintenance workers	Very Low Risk. Contaminants identified west of the Site have the potential to partition into vapours. It is unlikely that vapours from off-site sources will affect future site users or construction workers. The residential redevelopment to the west of the site has had installation of hydrocarbon resistant protection measures as a precaution into new buildings constructed in the former filling station area only.
Off-site sources <250 m from the Site: agricultural land, garages, electrical substations, builder's yard, engineering	* Dermal contact, ingestion and inhalation of impacted Made Ground and soil particles.	* Site Users * Construction and Maintenance workers	Very Low Risk. The area surrounding site is predominantly covered with hardstanding, as there are many roads and driveways. It is unlikely

Potential Contaminants	Potential Pathways	Potential Receptors	Comments
works, and refrigerator manufacturers.			humans will come into contact with subsurface contamination in these areas. There is a great distance between some of the given sources and the receptors.
	• Migration along drains. • Vertical leaching from impacted soils. • Lateral migration of contaminants within groundwater	• Secondary A Aquifers • Surface waters	Very Low Risk. The areas with Made Ground of concern are situated down gradient from the site. Therefore, it is unlikely groundwater will flow from these sources onto the Site.
	• Root uptake.	• Plants and vegetation.	The risk to plants and vegetation is considered to be Low , given the vegetation on-site does not indicate signs of distress
	• Direct contact	• Below ground services.	Low Risk The areas with Made Ground of concern are situated down gradient from the site. Therefore, it is unlikely groundwater will flow from these sources onto the Site.

7 CONCLUSIONS AND RECOMMENDATIONS

Based on the findings of the Site walkover and the desk based assessment, WSP make the following conclusions and recommendations in the context of the proposed development on the Site.

7.1 CONCLUSIONS

At present, the Site comprises a bungalow, timber stables, a storage shed, site office, greenhouse and sawing shed. Historical maps indicate that until the 1930s the Site existed as open grassland. From the 1930s until present, there have been residential buildings located on Site, as well as a saw mill and numerous timber stables. The surrounding area has a history of industrial, agricultural and residential use.

BGS maps and historical logs indicate the underlying geology at the Site to comprise River Terrace Deposits (Secondary A Aquifer) underlain by the London Clay Formation (Unproductive Stratum) at depth. Made Ground is likely to be present in the areas of the former and existing building.

The nearest surface water feature is a drain located 159 m south. The closest river, Pagham Rife is located 1.4 km west of the Site. Groundwater present within the aquifers is considered likely to flow towards the south-west.

Given the history of the Site and the surrounding area and the sensitivity of the development and, there is a **Moderate** risk to human health, a **Low to Moderate** risk to controlled waters and a **Low** risk to buildings and underground structures.

The risk to construction workers is considered to be **Moderate** since there is greater likelihood that workers will come into contact with potential asbestos or contaminated soils. The risks to workers should be managed through health and safety protocols under Construction (Design and Management) Regulations 2015.

7.2 RECOMMENDATIONS

Based on this Preliminary Risk Assessment, WSP recommends the following:

- ⌘ An intrusive ground investigation should be undertaken at the Site. The ground investigation should be compliant with current UK guidance e.g. BS10175 and include a Generic Quantitative Risk Assessment (GQRA) to allow the assessment of identified plausible contaminant linkages and if remedial measures may be required. Geotechnical testing could also be undertaken to inform foundation and road design. It is recommended that the ground investigation is designed based on the following technical objectives:
 - ⌘ Characterisation of the ground and groundwater conditions underlying the Site;
 - ⌘ Soil sampling for contamination testing;
 - ⌘ Provision of a GQRA to assess risks to human health and controlled waters.
- ⌘ If not already completed, an asbestos survey should be undertaken on the buildings prior to demolition to confirm if Asbestos Containing Material (ACM) is present and to allow an assessment of mitigation procedures required.