



Your Environment

PHASE 1: DESKTOP STUDY AND PRELIMINARY RISK ASSESSMENT REPORT FOR 2 CROFT COTTAGES, PIER ROAD, LITTLEHAMPTON, BN17 5LS

For Bishop & Cammell Properties Ltd

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Appendices

Appendix A - Proposed Redevelopment and Location Plans

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Appendix C - Historical Ordnance Survey Maps

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Executive Summary

Summary of Contamination Recommendations

The below table shows a snapshot of the recommendations concerning ground contamination within this report. It is advised that the report is read in its entirety to gain a better understanding of our findings and recommendations. This section is relevant to Contamination ONLY and further recommendations concerning other aspects may be presented later in this report.

Potential Linkage	No Investigation Recommended	Investigation Recommended
Soil Contamination		
Ground Gas		

Investigation Recommended

We have identified one or more potential material sources of contamination within the site itself or in the surrounding area that may, if present, represent a risk of harm to users of the development. Investigation of the site is recommended to enable a robust assessment of this risk to be made, and we would further recommend that further development works on the site do not take place until this investigation has been completed and reported.

1.0 Introduction

YourEnvironment (YE) was instructed by Mr H. Cammell on behalf of Bishop & Cammell Properties Ltd to produce a Phase 1: Desktop Study and Preliminary Risk Assessment Report for the site located at 2 Croft Cottages, Pier Road, Littlehampton, BN17 5LS (grid ref: 502748 101853; area: 0.02ha).

We understand current plans for the redevelopment of the site comprise:

- New maisonette over parking area, extend crossover & alterations to rear fenestration.

The purpose of this report is to support the planning application Ref: LU/159/19/PL submitted to Arun District Council. Specifically, the report aims to satisfy condition 9 as set out by the local authority.

A proposed site plan provided to YE, at the time of issuing this report can be reviewed within Appendix A.

Objectives

The objectives of this Phase 1 report are to:

- Establish the environmental setting, including sensitivity in relation to human health, surface water, groundwater and ecological receptors
- Review historical and recent uses to assess the potential for contamination to be present from past and current land-use
- Assess by qualitative means the potential nature and extent of contamination from those uses and the environmental risk and liabilities which may affect the site redevelopment
- Identify the prevalent source-pathway-receptor linkages present on site by means of a Tier 1 contamination risk assessment which incorporates the formulation of a Conceptual Site Model

Information Sources

During the production of this report the following primary information sources have been utilised:

- Enviro + Geo Insight data obtained from Groundsure
- Historical Ordnance Survey mapping at scales ranging from 1:1,250 to 1:10,560, obtained from Groundsure

The full information from these sources can be reviewed within Appendices B & C.

2.0 Environmental and Geological Setting

Information on the environmental and geological setting of the site is presented in a Groundsure Enviro + Geo Insight Report prepared for the site, a copy of this report is reproduced in Appendix B.

2.1 Site Geology

Site geology has been assessed by reference to information from British Geological Survey mapping summarised in the Groundsure Enviro + Geo Insight data. Information from these sources referenced in this report has been predominantly limited to that identified within 50m of the site (underlying geology) or 250m of the site (structural features, borehole records), in order to focus on the information directly relevant to the site. Information from outside these radii will be referenced when deemed relevant.

Superficial Ground and Drift Deposits

The superficial ground deposits underlying the study site Raised Beach deposits (Gravel).

Bedrock Geology

Underlying the superficial drift deposits is bedrock comprises the Nodular, Seaford, Newhaven, Culver and Portsdown Chalk formations..

Landslips

There are no records within 250m.

Linear Features

There are no records within 250m.

Natural Ground Subsidence

The following hazard ratings applicable to the site and land within 50m are presented in the Enviro + Geo Insight Report:

Shrink swell clays	Negligible
Running sands	Very Low
Compressible deposits	Negligible
Collapse deposits	Very low
Landslides	Very low
Ground dissolution	Very Low

Table 2.1: Natural Ground Subsidence

2.2 Site Hydrogeology and Hydrology

These records are derived by Groundsure from Environment Agency and British Geological Survey data. Details of the source and coverage of specific records are provided in the Enviro + Geo Insight Report. Information from these sources referenced in this report has been predominantly limited to that identified within 250m of the site (aquifers, surface water) or 1000m of the site (abstractions), in order to focus on the information directly relevant to the site. Information from outside these radii will be referenced when deemed relevant.

Table 2.2 presents Environment Agency aquifer designations:

Principal Aquifer	Layers with high intergranular and/or secondary permeability capable of supporting water supplies at strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as Major Aquifers.
Secondary (A) Aquifer	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. These are generally aquifers formerly classified as Minor Aquifers.
Secondary (B) Aquifer	Predominantly lower permeability layers which may store/yield limited amounts of groundwater due to localised features such as fissures, thin

	permeable horizons and weathering. These are generally the water bearing parts of former Non-Aquifers.
Secondary Undifferentiated Aquifer	Layers that cannot be attributed to a category A or B rock type. These layers could have previously been described as a minor or a non-aquifer due to their variable characteristics.
Unproductive strata	Rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow.

Table 2.2: Aquifer Designations

Aquifer within Superficial Deposits

As a consequence of the superficial geology on site, Raised Beach deposits are designated as a Secondary (A) aquifer.

Permeability of Superficial Deposits

The minimum permeability is recorded as being high with the maximum permeability recorded as being very high.

Aquifer within Bedrock Geology

As a result of the bedrock geology on site, the underlying chalk formations are designated as a Principal aquifer.

Water Framework Directive Groundwater Bodies

The site is within the Littlehampton Anticline East groundwater body.

Permeability of Bedrock Deposits

Both the minimum and maximum permeabilities are recorded as being very high.

Groundwater Vulnerability

Table 2.3 presents Environment Agency groundwater vulnerability definitions:

High Vulnerability	Areas able to easily transmit pollution to groundwater. They are likely to be characterised by high leaching soils and the absence of low permeability superficial deposits.
Medium Vulnerability	Intermediate between high and low vulnerability.
Low Vulnerability	Areas that provide the greatest protection from pollution. They are likely to be characterised by low leaching soils and/or the presence of superficial deposits characterised by a low permeability.

Table 2.3: Groundwater Vulnerability Definitions

The groundwater vulnerability in the vicinity of the site is classified as high due to the superficial aquifer and bedrock aquifers underlying the site.

Groundwater Abstraction Licences

There is one groundwater abstraction licence within 1000m. 953m west there is an historical record for General washing/process washing from the River Arun Estuary.

Surface Water Abstraction Licences

There are no licensed surface water abstractions within 1000m.

Potable Water Abstraction Licences

There are no potable abstraction licences within 1000m.

Source Protection Zones

The study site is not located within any Source Protection Zone.

Ordnance Survey Water Network

There is one record 91m south west referring to a tidal river or stream named River Arun.

Surface Water Features

The River Arun is located 91m south west.

Water Framework Directive Surface Water Bodies and Catchments

There are no records within 250m.

2.3 Environmentally Sensitive Areas

These records are derived by Groundsure from Environment Agency, Natural England, Historic England, English Heritage, Forestry Commission and UK Government data. Details of the source and coverage of specific records are provided in the Enviro + Geo Insight Report. Information from these sources referenced in this report has been predominantly limited to that identified within 500m of the site (environmental designations) or 250m of the site (habitat, visual and cultural designations), in order to focus on the information directly relevant to the site. Information from outside these radii will be referenced when deemed relevant.

Environmental and Habitat Designations

There are no records within 250m.

Visual and Cultural Designations

There are eleven (11no.) records of grade 2 listed buildings within 250m of the site. The closest of which are 'Floyds Croner' 167m north west, 'Cairo Club' 171m north west and 'Old Quay House' 172m north west. All other records are over 180m from the site.

There is one record of a conservation area 124m north named Littlehampton (River Road).

3.0 Past Land Use and Potential Contaminant Sources

Information on past land use and potential contaminant sources is presented in a Groundsure Enviro + Geo Insight Report prepared for the site, a copy of this report is reproduced in Appendix B.

3.1 Land Use Records

These records are derived by Groundsure from historical mapping and each record corresponds to a particular map revision date. Thus, several records may refer to the same feature where it is present over time. Groundsure has in some cases grouped such records in the Enviro + Geo Insight report. Differences in distances quoted from the study site may be due to expansion of the feature over time or geolocation errors.

Information from these sources referenced in this report has been predominantly limited to that identified within 250m of the site, in order to focus on the information directly relevant to the site. Information from outside this radius will be referenced when deemed relevant.

Historical Industrial Land Uses

There are two onsite records for a sawmill.

Off site there are a further twenty-six records within 250m of the site. Twenty-one of these records refer to wharfs, from 10m to 227m from the site. Ranging in directions south west, west, and north west. The majority of these entries are unspecified wharfs. However, there are also records for a ballast wharf, coal wharfs and a timber wharf.

74m north there is a single entry for a sawmill, 120m south a record for a Gas works with a Gasometer located 145m south. The final two entries refer to a timberyard 223m north west and unspecified its 248m south.

Historical Tanks

There are ten records of historical tanks within 250m. The closest of which is 44m north for an unspecified tank, with three further entries for unspecified tanks 94m north and 152m south. A AGs works is recorded 87m south with a gasometer located 100m south. The final four entireties referred to as tanks are located 238m to 242m north west.

Historical Energy Features

There are 10 records of energy features within 250m of the site. Eight of these refer to electricity substations, the closest of which is 87m south. Contaminants associated with these features are of low mobility and therefore considered not to present a risk on site.

The remaining two entries refer to the previously identified gasometer and gas works to the south.

Historical Petrol Stations

There are no records of historical petrol stations within 250m.

Historical Garages

There are two records within 250m, the first is 189m north and the other is 203m north.

Historical Military Land

There are no records of historical military land within 250m.

Current or Recent Industrial Land Uses

There are twenty records within 250m of the site. Six of which refer to moorings and unloading facilities between 86m and 250m of the site.

Four records refer to previously identified substations.

The remaining entries refer to; a Foot passenger ferry, slipways, Sign spraying, an angling club, a tank and electrical engineers. All of which are over 120m from the site.

Current or Recent Petrol Stations

There are no records of current or recent petrol stations within 250m.

Electricity Cables

There are no records of high voltage underground electricity cables within 250m.

Gas Pipelines

There are no records of high pressure underground gas pipelines within 250m.

Railway Infrastructure

There are no records of historical or current railway infrastructure or projects within 250m.

3.2 Environmental Permits, Incidents and Registers

These records are derived by Groundsure from local authority, Health and Safety Executive and Environment Agency data. Details of the source and coverage of specific records are provided in the Enviro + Geo Insight Report. Information from these sources referenced in this report has been predominantly limited to that identified within 250m of the site, in order to focus on the information directly relevant to the site. Information from outside this radius will be referenced when deemed relevant.

Sites Determined as Contaminated Land

There are no records of sites determined as contaminated land under Part 2A of the Environmental Protection Act 1990 within 250m.

Control of Major Accident Hazards (COMAH)

There are no records within 250m.

Regulated Explosive Sites

There are no records within 250m. Note that details of some sites may be redacted for security reasons.

Planning Hazardous Substances Consents

There are no records within 250m.

Records of Historic IPC Licensed Activities

There are no records within 250m.

Records of Part A (1) Licensed Activities

There are no records within 250m.

Records of Part A (2)/B Licensed Activities and Pollutant Release

There are no records within 250m.

Records of Radioactive Substance Authorisations

There are no records within 250m.

Licensed Discharges to Controlled Waters

There are two records within 250m. The closest is 110m south and refers to a sewage discharge to an unnamed tributary of Rover Rother. The other records is 142m south west for a sewage discharge to a receiving water controlled sea.

Pollutant release to Surface Waters (Red List)

There are no records within 250m.

Pollutant Release to Public Sewer

There are no records within 250m.

List 1 and List 2 Dangerous Substances

There are no records within 250m.

Substantiated Pollution Incidents

There are four records of pollution incidents within 250m. The closest is 41m north west, the pollutant is described as smoke and had a minor impact to air. At 81m west, there is a record of a diesel pollution with a minor impact to water.

There is a record of household waste pollution 136m north which had a minor impact to land. The final entry is 162m north for firefighting runoff, which had a minor impact to land, air and water.

Pollution Inventory Substances

There are no records within 250m.

Pollution Inventory Waste transfers

There are no records within 250m.

Pollution Inventory Radioactive Waste

There are no records within 250m.

3.3 Waste and Landfill

These records are derived by Groundsure from Environment Agency, British Geological Survey, Ordnance Survey (interpreted by Groundsure) and local authority data. Details of the source and coverage of specific records are provided in the Enviro + Geo Insight Report.

Information from these sources referenced in this report has been predominantly limited to that identified within 500m of the site (landfills) or 250m of the site (non-landfill waste operations), in order to focus on the information directly relevant to the site. Information from outside these radii will be referenced when deemed relevant.

Active or Recent Landfill

There are no records.

Historical Landfill

There are no records.

Non-Landfill Waste Records

There are twenty-three waste exemption records within 250m of the site. Waste exemptions are made available for certain specified activities considered to pose a low risk to the environment and allowable waste types and quantities are limited. The closest four records refer to the same site, 207m to the north and refer to either *Treatment of waste toner cartridges* or *Storage of waste in a secure place*.

Seventeen records refer to a site 209m south for the use of waste, and the remaining two entries refer to a site 229m south west.

3.4 Mining, Ground Workings and Natural Cavities

These records are derived by Groundsure from British Geological Survey, Ordnance Survey (interpreted by Groundsure), Coal Authority, Peter Brett Associates, Johnson Poole and Bloomer, Cheshire Brine Subsidence Compensation Board, British Gypsum, Mining Searches UK, Kaolin and Ball Clay Association and local authority data. Details of the source and coverage of specific records are provided in the Enviro + Geo Insight Report.

Information from these sources referenced in this report has been predominantly limited to that identified within 250m of the site, in order to focus on the information directly relevant to the site. Information from outside these radii will be referenced when deemed relevant.

Natural Cavities

There are no records within 250m.

Mining Cavities

There are no records within 250m.

BritPits Data (Surface and Underground Mineral Workings)

There is are no records within 250m.

Historical Mineral Planning Areas

The no records within 250m.

Surface Ground Workings

There are thirty-three records within 250m. Thirty-two of which refer to previously identified wharfs from 10m. The entry refers to unspecified pits 248m south.

Underground Workings

There are no records within 250m.

Coal Mining

There are no records held by the Coal Authority or by Johnson Poole and Bloomer within 250m.

Non-Coal Mining

There are no records within 250m for brine extraction or gypsum, tin or clay mining.

3.5 Radon and Background Soil Chemistry

These records are derived by Groundsure from British Geological Survey and Public Health England data. Details of the source and coverage of specific records are provided in the Enviro + Geo Insight Report. Information from these sources referenced in this report has been predominantly limited to that identified on or within 50m of the site.

Radon

The study site is located within a Radon Affected Area, as between 1% and 3% of properties are above the Radon Action Level. No radon protective measures are necessary for new properties or extensions to existing ones as described in publication BR211 by the Building Research Establishment.

Background Soil Chemistry

Values estimated by BGS for background concentrations of five potentially harmful elements are provided as follows:

Arsenic	15 mg/kg
Bio-accessible arsenic	No data
Lead	100 mg/kg
Bio-accessible lead	60 mg/kg
Cadmium	1.8 mg/kg
Chromium	60-90 mg/kg
Nickel	15-30 mg/kg

Table 3:1 Background Soil Chemistry

These values are not considered to be elevated with respect to guideline values for residential end-uses.

4.0 Historical Mapping Study

The object of this search was to report on the evidence of site history and redevelopment of the site and its environs from available County Series and Ordnance Survey Maps at scales ranging from 1:1,250 to 1:10,560 dating from the mid to late 19th Century to the present day, and Getmapping PLC aerial photography dating from the late 1990s to the recent past, as provided by Groundsure.

Information in the historical mapping study has been predominantly limited to that identified on the site or within 100m of the site, in order to focus on the information directly

relevant to the site. Information from outside this radius will be referenced when deemed relevant.

Each map or photographs only represents a “snap-shot” of the site and its environs at the date of the survey. Changes that had occurred at other times may not have been recorded on the maps and could represent an unidentified hazard to the site.

The information reported might not represent all pertinent information that could be obtained. The interpretation of the maps and/or other data commented on in this report is subjective.

Year	On site	Off site
1876 to 1979	Site appears to part of a field of presumed agricultural use.	Coal Wharf - 30m west Timber wharf - 40m north west Ballast Wharf - 50m south Saw Mills - 80m north Pond - 90m north east Gas Works - 115m south Timber Yard - 250m north west Wharf - 250m west
1896 to 1898	Site remains undeveloped but assumed it is no longer agricultural use	Saw mills has extended - 20m east/north east Timber wharf now Norfolk Wharf - 40m north west Fire engine station - 250m north east Gas works no longer present.
1910 to 1912	No discernible changes	Saw Mill extended - adjacent east Tank - 50m north Wharf - 200m north west
1932 to 1938	Building on western part of the site. Saw mill encroaching on eastern boundary.	Allotments - 250m south east
1957 to 1958	On site building labelled Croft cottages	Ruin - 150m north west Smithy - 150m north west Wharfs - 15m west, 150m north west and 170m north west.
1968 to 1974	No discernible change.	Timber yard (formerly mill) - adjacent east. Sawmill (assumed part of previous mill) - 50m north. Substation - 100m north, 175m north and 250m south east Works - 125m south Garage - 175m north west Engineering works - 175m north east Builders yard x2 - 250m north east
1978	No discernible changes.	No significant changes.
1984	No discernible changes.	Garage now a market - 250m north west
1993	No discernible changes.	No significant changes.
2001 to 2003	No discernible changes.	No significant changes.
2010	No discernible changes.	No significant changes.
2021	No discernible changes.	No significant changes.

Table 4.1: Historical Mapping Review

The Historical Ordnance Survey Maps were obtained from Groundsure and are available for review within Appendix C. The aerial photographs are included in the Groundsure Enviro + Geo Insight Report and are available for review within Appendix B.

5.0 Walkover Survey

Your Environment attended the site on January 07th 2021, and the weather was overcast at the time.

Current Site Use

The site currently comprises a semi detached property with associated parking and soft landscaped area.

Access

The site is directly accessible from Pier Road.

Topography

The site is flat.

Buildings and Structures

2 Croft cottages, a semi-detached property part of a block of two houses.

Hard Surfaced Areas

The majority of the site is underneath the footprint of the property. The remaining area is mainly grass with some paving slabs.

Landscaped and Vegetated Areas

Hedge at eastern boundary

Surface Permeability / Ground Covering

70 % impermeable

Drainage Features

Not observed.

Other Services

It is assumed there are water, electricity and gas entering the site for the existing property.

Direction	Description of Site boundary
North	1 Croft cottages
East	1.5m panel fence
South	2.5m panel fence
West	0.5m brick wall and pavement

Table 5.1: Summary of site boundaries

Direction	Description of Surrounding Land Use
North	1 Croft cottages
East	Travis Perkins
South	Residential and Travis Perkins
West	Pier Road

Table 5.2: Summary of Surrounding Land Uses

Potentially Contaminative Land Uses

On site sources:

- None observed

Off site sources:

- Builders yard

Photographs taken during the walkover of the site and surrounds, can be reviewed within Appendix D.

6.0 Framework for Assessment of Contamination

Environmental risks are assessed within the risk management framework established in Part IIA of the Environmental Protection Act (EPA) 1990 introduced by Section 57 of the Environment Act 1995 which provides a statutory definition of contaminated land. To fall within this definition it is necessary that, as a result of the condition of the land, substances may be present on or under the land such that:

- (a) Significant harm is being caused or there is a significant possibility of such harm being caused; or*
- (b) Pollution of controlled water is being or is likely to be caused.*

Risk from contamination is assessed by consideration of possible linkages between contaminant sources and potential receptors which could be harmed or polluted.

The key aspect of the framework is the development of a Conceptual Site Model (CSM) which illustrates the spatial interaction between the potential sources and receptors on site.

The information presented in this report was collated and evaluated to develop an initial CSM to assess ground contamination issues at the site.

For a risk of pollution or environmental harm to occur as a result of ground contamination, **all** of the following elements must be present:

- A source - a substance that is capable of causing pollution or harm
- A receptor - something which could be adversely affected by the contaminant
- A pathway - a route by which the contaminant can reach the receptor

If one of these elements is absent there can be no significant risk. If all are present then the magnitude of the risk is a function of the magnitude and mobility of the source, the sensitivity of the receptor and the nature of the migration pathway.

Potential sources, pathways and receptors are identified in the sections below and the risks associated with possible pollutant linkages outlined.

7.0 Possible Contaminant Sources

On Site Sources

The following possible on site sources have been identified from the historical study:

- Historical saw mill
- Made ground associated with historical development

The following on site sources have been identified from the site walkover:

- None identified

The following possible on site sources have been identified from the Enviro + Geo Insight data:

- Saw mill

Off Site Sources

The following off site sources have been identified from the historical study:

- Saw Mill - adjacent
- Various wharfs - 15m west, 30m west, 40m north west, 50m south, 150m north west, 170m north west and 200m north west
- Tank - 50m north
- Gas Works - 115m south
- Works - 125m south
- Smithy - 150m north west
- Engineering works - 175m north east
- Garage - 175m north west
- Builders Yard - 250m north east

There are further entries present but these are considered far enough from the site to pose no risk.

The following off site sources have been identified from the site walkover:

- Builders Merchant and Yard - adjacent east and south

The following possible off site sources have been identified from the Enviro + Geo Insight data:

- Gas works - 87m to 120m south
- Gasometer - 100 to 145m south
- Tanks - 44m north, 94m north and 152m south, 238m north

Sources Summary

The **main sources** of potential contamination that have been identified at the site or in the vicinity of the site are summarised below:

Source	Location	Description
Made ground associated with historical development of the site	On	Previous development of the site may have results in small quantities of made ground to be present on site. These soils, if present, may contain a variety of contaminants, most notably heavy metals and asbestos
Saw Mill	On and Off site	A variety of contaminants may be associated with this land use, machinery may produce TPH, Heavy metals and PAH. PACM may have been present in the construction of the mill given its age.
Historical industrial land uses surrounding the site; wharfs tanks, builders yard, engineering works, works, smithy, garage, Gas works and Gasometer.	Off site	A broad variety of industrial land uses have been identified in the area, as such there is a broad spectrum of contaminants that can be associated with these activities such as BTEX, MTBE, PAH, TPH, heavy metals, VOCs, SVOCs and asbestos. Given the relatively close proximity of some of these uses, there is the potential of migration to site. The former gas works also presents a ground gas risk from any ground filling activities involved in the decommission of the works.

Table 7.1: Sources Summary

The following contaminants are potentially associated with the on-site sources:

- Heavy Metals
- TPH
- PAH
- PACM
- Ground Gas

The following contaminants are potentially associated with the off-site sources:

- Heavy Metals
- PAH
- TPH
- VOCs
- SVOCs
- BTEX
- MTBE
- Ground gas - from decomposition of organic carbon in infilled material, leading to generation of methane and carbon dioxide

In practice, a broad contaminant screen should be analysed for in any intrusive investigation recommended to ensure that potential contaminants are not omitted.

8.0 Possible Pathways and Receptors

Pathways

In order for contaminants to reach potential receptors, there has to be a viable **pathway** for the contaminant. Potential pathways that may affect the migration of contaminants are listed below:

Pathway	Medium	Properties
Direct Contact	Dust, solid and liquid phase	There may be direct contact with potentially impacted soil and Made Ground across the site. There is a possibility of dust fumes being produced during earthworks in the construction phase. Dermal contact and ingestion of potentially contaminated soils during construction or operational phase of the site.
Leaching through Made Ground	Unsaturated flow	Potential for leaching and migration of potential contaminants along preferential flow paths in the ground.
Foundations and Underground Infrastructure and Obstructions	Preferential flow	Contaminants will flow the path of least resistance which can be gaps around foundations, services, and floor construction
Migration of Ground Gas.	Gaseous flow	Infilled land material is likely to be variable in composition. Migration through granular material within superficial deposits is possible.

Table 8.1: Pathways

Receptors

The site specific **receptors** that could be potentially affected by the contamination hazards identified during this preliminary appraisal are summarised below:

Category	Receptor	Properties
Humans	End users (such as residents and visitors)	Potential contact with contaminated soils in existing/proposed soft landscaping areas, however it is understood that the site will be asphalt surfaced. Potential contact with ground gas within enclosed buildings
	Construction workers	Reworking of contaminant impacted materials in underlying soil during construction works can expose workers to contamination.
Property	Materials and site structures	Foundations and site services may be damaged by potentially aggressive compounds present in soils.
Controlled Waters	Underlying superficial / bedrock Aquifer and surface water	The site is recorded as having a Secondary (A) Aquifer within the superficial deposits and a Principal Aquifer within the bedrock underlying the site.
Plant (species and uptake) and Wildlife	Various	Attributes will be influenced by factors such as relative quality, scale, rarity and substitutability; however it is understood that the site is proposed to be asphalt surfaced.

Table 8.2: Receptors

9.0 Qualitative Risk Assessment

Potential pollutant linkages are identified using the source-pathway-receptor framework detailed above. An assessment of the potential significance of each linkage is then made by consideration of the likely magnitude and mobility of the source, the sensitivity of the receptor and nature of the migration/exposure pathways.

This qualitative risk assessment has been undertaken in accordance with Annex 4 of the National House Building Council/Environment Agency/Chartered Institute of Environmental Health R&D publication 66, Guidance for the Safe Development of Housing on Land Affected by Contamination (NHBC/EA/CIEH, 2008) which updates and supersedes CIRIA C552: Contaminated Land Risk Assessment, A Guide to Good Practice (Rudland et al., 2001).

An assessment of the likelihood of the risk being realised and the magnitude of potential risk is presented below to give an estimation of the significance of each potential pollutant linkage identified. Where it is considered that there is no credible linkage, this is indicated in the table. In accordance with the R&D66 guidance, if there is no pollution linkage then there is no need to apply tests for probability and consequence.

The assessment is undertaken based on the current proposals for the site, at the time of issuing this report, which would be classed as a generic end land use of 'residential (with consumption of homegrown produce)'. Any change in the development proposals for the site involving a change in end use class may result in a requirement for this assessment to be revised.

10.0 Preliminary Conceptual Site Model

Contaminant Source	Pathways	Receptor	Potential Severity	Probability of Risk	Level of Risk	Justification
On Site: Made Ground soils on site possibly containing elevated metals, other organics such as TPH, PAH, phenols.	Ingestion, dermal contact, inhalation of dusts/vapours	Future end users and site visitors	Medium	Low Likelihood	Moderate/Low ●●	A moderate/low risk rating has been assessed due to the history of potentially contaminative land uses on site although the contamination potential is not considered to be high. Contact is likely between future residential occupiers/visitors and contaminants in the shallow soil in garden areas of the site, soil/dust tracked back into the house, from ingestion of homegrown produce and from vapour intrusion.
		Construction Workers	Medium	Low Likelihood	Moderate/Low ●●	Construction workers are likely to come into direct contact with soils during groundworks. Safe working practices should be implemented and appropriate personal protective equipment (PPE) should be used to mitigate any potential risk from contact with soils and shallow/perched groundwater.
	Leaching through soils and migration via groundwater or soil pore moisture	Controlled Waters	Mild	Low Likelihood	Low ●	A low risk rating has been assessed due to the presence of potentially contaminative sources on site and the presence of a Secondary (Undifferentiated) Aquifer within the superficial deposits and a Principal Aquifer within the bedrock underlying the site.
	Permeation of water pipes	Construction materials, future end users and site visitors	Medium	Low Likelihood	Moderate/Low ●●	Hydrocarbons, especially aromatics are known to permeate plastic pipes. Provision of water supply pipes and connectors formed from proprietary "barrier pipe" materials (eg polyethylene-aluminium-polyethylene) may be required by the water supply company.
	Uptake	Plant and Wildlife	Mild	Low Likelihood	Low ●	Contact is possible between wildlife and potentially contaminated soils in proposed garden areas of the development.
On Site: Asbestos at/near ground surface in Made Ground soils.	Inhalation of fibres in airborne dust	Future end users and site visitors	Medium	Low Likelihood	Moderate/Low ●●	A moderate/low risk rating has been assessed due to the commercial history of the site creates potential for asbestos contact may be possible in areas of proposed soft landscaping.
		Construction Workers	Severe	Low likelihood	Moderate ●	During groundworks, safe working practices should be implemented and appropriate personal protective equipment (PPE) should be used to mitigate any potential risk from residual asbestos in soils.

On Site: Ground Gases (CH ₄ , CO ₂) from on site Made Ground.	Gas migration and build up within buildings (explosion/ asphyxiation risk)	Future end users and building structures.	Mild	Low likelihood	Low ●	A low risk rating has been assessed due to the limited thickness and lack of organic and/or degradable content assumed to be present in the made ground. Such made ground is generally classified as very low risk in terms of potential for gas generation.
Off Site: Historical land uses and activities, Made Ground/infilled material possibly containing elevated metals, other inorganics, TPH, PAH, phenols, BTEX, MTBE, VOC and SVOCs.	Leaching through soils and migration via groundwater or soil pore moisture	Future end users and site visitors	Medium	Likely	Moderate ●	Given the variable permeability of the underlying geology and hydrogeology, there is a moderate risk for the leaching and migration of contaminants. This combined with the presence of gasworks and tanks in the surrounding area upgradient of the site with a high contamination potential create a risk for contamination on site.
	Ingestion, dermal contact, inhalation of dusts/vapours	Future end users and site visitors	Medium	Low likelihood	Moderate/ Low ●●	A very low level of risk rating has been assessed as the potentially contaminative land uses/activities in proximity to the site have been subject to redevelopment and are now predominantly hard surfaced.
Off Site: Ground Gases (CH ₄ , CO ₂ , H ₂ S) from off site historical landfilling activities.	Gas migration and build up within buildings (explosion/ asphyxiation risk)	Future end users and building structures.	Mild	Low likelihood	Low ●	A low risk rating has been assessed as no land filling activities have been identified in the area surrounding the site.

Table 10.1: Preliminary Conceptual Site Model

11.0 Recommendations

11.1 Proposed Site Investigation

Based on the information obtained for formation of this report, we would recommend that an intrusive contaminated land investigation is undertaken to determine the actual pollution linkages and to quantify the risk to the receptors as outlined with the Preliminary Conceptual Site Model.

The intrusive investigation may reveal on-site sources of contamination that were not established by the Phase I Desk Study and Site Walkover and thus require modification of the conceptual site model.

The proposed scope of investigation is outlined below.

Scope of Proposed Investigation

Testing Regime

The testing regime has been devised in accordance with BS10175:2017 Guidelines for the Code of Practice for Contaminated Land and CLR Report No. 4 Sampling Strategies. The objective at this stage of the report is to attempt to identify the extent of any possible contamination that may exist at the site by using intrusive soil sampling and testing techniques.

Sampling Strategy

A service search should be completed prior to any subsequent investigation to determine the service locations by lifting up any manhole/drain covers; therefore, locations may be subject to change depending upon these results.

The SI should incorporate the drilling of three (3no.) machine excavated trial pits in order to gain a suitable spread of the site and enable adequate analysis of the soil conditions. This will be completed to a maximum depth of 2 metres below ground level (mbgl) or refusal or where groundwater is encountered.

All positions should be logged, and samples removed in accordance with current protocol. In addition, groundwater conditions, if encountered, shall be logged and visual/olfactory observations noted.

We would recommend that the test locations be based on the findings contained with this report, to enable a broad coverage of the site.

Laboratory Analysis

An appropriate and consistent analytical suite of contaminants should be applied to any soil samples retrieved from the site.

Based on the findings contained within this report, we would recommend that a comprehensive range of testing should be undertaken to comprise of heavy metals, speciated Total Petroleum Hydrocarbons (TPH CWG Aromatic/aliphatic split) and speciated Polycyclic Aromatic Hydrocarbons (PAH) including the more carcinogenic benzo(a)pyrene

(BaP) and naphthalene, soil organic matter (SOM) content, VOCs, SVOCs, BTEX, MTBE pH, and sulphates.

In addition, selected samples retrieved from the Made Ground, if encountered, will also be submitted for a screen to determine the presence, or otherwise, of asbestos.

It should be noted that not all samples retrieved from the proposed investigative works will be laboratory analysed and a UKAS and MCERTS accredited laboratory testing organisation should carry out all analysis.

Guidance

The results from the proposed SI shall be compared against standards, such as the revised LQM/CIEH S4UL criteria¹ where available.

Results from gas monitoring shall be used to calculate a Gas Screening Value (GSV) in accordance with BS8485: 2015.

11.2 Consultees

It is highly recommended that this report be forwarded to the relevant Local Authority Environmental Health and Planning Departments to seek their comments and subsequent approval, otherwise further works may be required.

11.3 Groundworks Watching Brief

If during construction works any material is noted to show visual and/or olfactory signs of contamination an environmental consultant should be contacted to supervise/guide further works.

If any landscaping materials are to be imported on site they should be tested to check that they are suitable for the intended use.

11.4 Flood Risk Assessment

This report does not replace a full hydrogeological survey and specialist studies may need to be undertaken to ascertain the risks posed from flooding. Further details on site flood information can be found within the appendices.

12.0 Limitations and Uncertainties

This report has been prepared by YE with all reasonable skill, care and diligence. The work undertaken to provide the basis of this report comprised a study of available documented information from a variety of sources, together with a site walkover inspection of the site.

The opinions given in this report have been dictated by the finite data on which they are based and are relevant only to the purpose for which the report was commissioned.

¹ Nathanail et al. (2015) The LQM/CIEH S4ULs for Human Health Risk Assessment. Land Quality Press, 2015. Copyright Land Quality Management Limited reproduced with permission; Publication Number S4UL3495

Information reviewed should not be considered exhaustive and accepted in good faith as providing true and representative data with respect to site conditions. Should additional information become available which may influence the opinion expressed in this report, YE reserves the right to review such information and, if warranted, to alter the opinions accordingly.

It should be noted that any risks identified in this report are perceived risks based on the information reviewed; actual risks can only be assessed following a physical investigation of the site. This report is an environmental phase 1 report and does not consider the geotechnical implications for the site, its redevelopment and proposed future use. Further advice should be sought on geotechnical investigation requirements for the proposed development.