



LAND TO THE WEST OF HATFIELD

Environmental Statement – Chapter 8: Ground Conditions and Contamination

Arlington Business Parks GP Limited

CONTENTS

8	Ground Conditions and Contamination	2
8.1	Introduction	2
8.2	Methodology.....	2
8.2.1	Legislation and Planning Policy Guidance.....	2
8.2.2	Scoping Assessment.....	4
8.2.3	Assessment Methodology.....	4
8.2.4	Significance Criteria.....	6
8.3	Baseline Conditions.....	8
8.3.1	Groundwater.....	9
8.3.2	Soakaway Testing.....	9
8.3.3	Hydrogeology	9
8.3.4	Site Drainage.....	10
8.3.5	Visual/Olfactory Evidence of Soil and Groundwater Contamination	10
8.3.6	Ground Gas	10
8.3.7	Contamination	10
8.4	Conceptual Site Model (CSM)	10
8.4.1	Potential historical contaminant sources	10
8.4.2	Potential current contaminant sources	11
8.4.3	Potential pollutant linkage assessment	11
8.5	Assessment of Effects	12
8.5.1	Construction Effects.....	12
8.5.2	Operational Phase Effects.....	13
8.6	Mitigation.....	14
8.6.1	Construction Phase	14
8.6.2	General.....	15
8.6.3	Post-Construction/Operation Phase.....	15
8.7	Residual Effects	15
8.8	Summary of effects.....	15
8.8.1	Impacts of the Development upon the Land	15
8.8.2	Impacts of the Land on the Development	16
8.9	Conclusions	17

8 GROUND CONDITIONS AND CONTAMINATION

8.1 INTRODUCTION

This Chapter has been prepared by Baynham Meikle Partnership Ltd (BM) to consider the potential associated risks to human health and controlled waters through development of this site. This Chapter considers:

- The current baseline conditions at the site.
- Potential risk to human health from contact with contaminants during construction.
- Potential risk to the water environment from mobilisation of existing contaminants during construction.
- Potential risk to human health from contact with contaminants post construction.

8.2 METHODOLOGY

This section introduces the regulatory/policy context and methodologies for the two types of impact assessment carried out in relation to land quality. The assessments ensure that all potential impacts involved in the creation of this development are considered.

Any potentially significant impacts raised in the assessments are considered and impacts or risks requiring mitigation measures are discussed.

8.2.1 Legislation and Planning Policy Guidance

Whilst a large number of statutes and statutory instruments have some relevance, this chapter sets aside those on the periphery which concern water pollution and waste management to focus on the most relevant aspects of town and country planning policy and contaminated land legislation.

8.2.1.1 Environmental Protection Act 1990

The Environmental Protection Act 1990 (EPA) defines, within England and Wales and Scotland, the fundamental structure and authority for waste management and control of emissions into the environment. The Act was intended to strengthen pollution controls and support enforcement with heavier penalties. Before the Act there had been separate environmental regulation of air, water and land pollution and the Act brought in an integrated scheme that would seek the "best practicable environmental option".

8.2.1.2 The Statutory Guidance on Part 11A of the Environmental Protection Act 1990 as set out in Defra Circular 04/12

Part IIA of the Environmental Protection Act 1990 – which was inserted into that Act by section 57 of the Environment Act 1995 – provides a regulatory regime for the identification and remediation of contaminated land. In addition to the requirements contained in the primary legislation, operation of the regime is subject to regulations and statutory guidance.

The main objective underlying the introduction of the Part IIA contaminated land regime was to provide an improved system for the identification and remediation of land where contamination is causing unacceptable risks to human health or the wider environment, assessed in the context of the current use and circumstances of the land.

The statutory guidance relating to the implementation of Part IIA of the Environmental Protection Act (EPA) (DEFRA Circular 01/2006) uses the concept of a “pollutant linkage”, whereby for land to be contaminated, each of the following has to be identified:

- *“A contaminant;*
- *A relevant receptor; and*
- *A pathway by means of which either:*
 - *that contaminant is causing significant harm to that receptor, or;*
 - *there is a significant possibility of such harm being caused by that contaminant to that receptor”.*

Part IIA of the EPA 1990 defines the term ‘Contaminated Land’ as being: *‘Any area which appears to be in such a condition, by reason of substances in, on or under the land that: Significant harm is being caused, or there is a significant possibility of such harm being caused, or Pollution of controlled waters is being, or is likely to be caused’.*

Section 78A(4) EPA 1990 Part IIA defines ‘harm’ as meaning: *‘...harm to the health of a living organism or other interference with the ecological systems of which they form a part and, in the case of man, includes harm to his property’.*

However, only significant harm, or the possibility of significant harm, being caused are to be considered.

The term ‘contaminant’ is taken to mean:

‘a substance that is in, on, or under the land and which has the potential to cause harm or pollution’.

The guidance defines ‘risk’ as the combination of:

- *‘The probability, or frequency, of occurrence of a defined hazard (for example, exposure of a property to a substance with the potential to cause harm: and*
- *The magnitude (including the seriousness) of the consequences.’*

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

- A source, i.e. a substance that is capable of causing pollution or harm;
- A pathway, i.e. a route by which the contamination can reach the receptor;
- A receptor (or target) i.e. something which could be adversely affected by the contaminant.

If one of these elements is missing there can be no significant risk. If all are present then the significance 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.

Although the presence of contaminants may result in contamination of the ground, land will only be designated as Contaminated Land when the requirements of the strict definition of EPA 1990 Part IIA are met.

8.2.1.3 National Planning Policy Framework

National Planning Policy Framework (NPPF) sets out the Government's core policies and principles on the key aspects of land use planning. The policies set out in NPPF and the advice in the accompanying planning practice guidance notes should be taken into account by Local Planning Authorities (LPAs). They are also material to decisions on individual planning applications.

NPPF and the advice within the associated guidance notes give necessary legislative and technical ground to assist local authorities in implementing policy.

EPA 1990 Part IIA addresses "unacceptable risk". Part IIA applies where there is unacceptable risk, assessed on the basis of the current use and the relevant circumstances of the land. It is not directed to assessing risks in relation to a future use of the land. NPPF aims to control development and land use in the future. NPPF states that the assessment of risks arising from contamination and remediation requirements should be considered on the basis of both current use and circumstances and its proposed new use. NPPF considers the underlying approach to identifying and dealing with risk, and the overall policy objective of safeguarding human health and the environment, are similar.

8.2.1.4 The Environment Agency's Model Procedures for the Management of Land Contamination (Contamination Land Report 11) (2004)

Contaminated Land Report 11 (CLR 11) has been developed to provide the technical framework for applying a risk management process when dealing with land affected by contamination. The process involves identifying, making decision on, and taking appropriate action to deal with, land contamination in a way that is consistent with government policies and legislation within the UK. The document is consistent with the approach presented within the "Guidelines for Environment Risk Assessment and Management" published by the Department of the Environment and Health (2000), which was revised in November 2011.

8.2.1.5 The Water Resources Act 1991, as amended by the Water Act 2003 and Water Act 2014.

The Water Resources Act 1991 (WRA) replaced the corresponding sections of the Water Act 1989. The WRA sets out the responsibilities of the Environment Agency in relation to water pollution, resource management, flood defence, fisheries, and in some areas, navigation. The WRA regulates discharges to controlled waters, namely rivers, estuaries, coastal waters, lakes and groundwater's.

8.2.1.6 The Groundwater (England and Wales) Regulations 2009

The Groundwater Regulations are an environmental protection measure that complete transposition of the Groundwater Directive (80/68/EEC) and provide enhanced protection for groundwater. Under the Regulations, the Environment Agency has responsibility for the enforcement of the Regulations and decisions of their scope and effect.

8.2.2 Scoping Assessment

The professional judgment of BM has been used in the scoping of this assessment.

8.2.3 Assessment Methodology

8.2.3.1 Development Impact Assessment

The development impact assessment discusses the potential impacts of the proposed development on soils and near surface geological deposits via physical-movement and pollution. The assessment

considers impacts during construction and operation of the development. Appropriate mitigation measures are identified where predicted impacts during construction and operation are significant. Generally, it is not possible to quantify these effects, and so qualitative assessments have been carried out based on available knowledge and professional judgement.

8.2.3.2 Land Quality Assessment

The first assessment, a land quality assessment, takes account of the development proposals which introduces humans and new buildings to this site. The individual risk assessments consider the potential for existing ground conditions to harm site users, damage buildings and pollute the wider environment.

The methods to be followed in the assessment of land quality are detailed in various guidance documents. The overarching guidance document is Contaminated Land Report 11 (CLR11) entitled “Model Procedures for the Management of Land Contamination”. The Model Procedures are intended to assist all those involved in dealing with land contamination, including landowners, developers, professional advisors, regulatory bodies and financial providers. The technical approach presented in the Model Procedures is designed to be applicable to a range of non-regulatory and regulatory contexts that includes:

- development or redevelopment of land under the planning regime;
- regulatory intervention under Part 2A of the Environment Protection Act 1990;
- voluntary investigation and remediation; and
- managing potential liabilities of those responsible for individual sites or a portfolio of sites.

8.2.3.3 Unexploded Ordnance (UXO)

It should be noted that for the purposes of this Chapter UXO are briefly mentioned / assessed alongside other geohazards such as ground-based contaminants, hazardous gases, etc. In effect, UXO are treated as a “Source” of hazard in a risk-based approach. This is judged appropriate as, whilst there is no legislation specifically dealing with UXO, health and safety legislation such as the CDM Regulations and Health and Safety at Work Act effectively place obligations on the developer to:

- provide an appropriate assessment of potential UXO risks at the site (or ensure such an assessment is completed by others);
- put in place appropriate risk mitigation measures if necessary;
- supply all parties with information relevant to the risks presented by the project; and
- ensure the preparation of a suitably robust emergency response plan.

Site specification desk top and intrusive investigations have historically been carried out in the past adjacent and close to the site associated with the Ellenbrook diversion works.

The assessment of the potential for adverse environmental impact that could be associated with chemical contamination has been undertaken in accordance with legislation and policy documents referred to earlier in this report and other relevant supporting guidance.

8.2.4 Significance Criteria

8.2.4.1 Sources of contamination

The potential magnitude of source or land contamination is expressed qualitatively in categories shown in Tables 8.1 and 8.2 below.

Table 8.1

Qualitative description of source (hazard)	Previous and current land uses
Large	Previous or ongoing activity on or near to a site with high potential to cause land contamination (for example, gas works, chemical works, landfills) or site investigation data indicating widespread or severe contamination
Medium	Previous or ongoing activities with some potential to cause moderate contamination (for example, railways, collieries and scrap yards) or site investigation data indicating limited contamination.
Small	Brownfield site or site with previous / present activities with low potential to cause land contamination (for example, residential, retail or offices) or site investigation data indicating no significant contamination.
No change	Greenfield site with no ongoing or previously recorded activities with potential for land contamination.

Table 8.2

End Users (operational workers/users)	Surrounding Land Uses	Construction Workers	Controlled Waters	Ecological Systems	Built Environment
Direct or indirect ingestion of contaminated soil (operational)	Inhalation or deposition of wind-borne dust (construction stage)	Direct or indirect ingestion of contaminated soil (construction stage)	Migration of identified contaminants into controlled waters (operational and / or construction)	Phytotoxic impacts on plant species (operational and / or construction stage)	Chemical attack of buried concrete structures and permeation of volatile compounds through plastic potable water supply pipes.

Concentration of flammable or asphyxiating in- ground gases in enclosed spaces (operational)	Migration of contamination in sub-surface strata (including gases) (operational and / or construction)	Concentration of flammable or asphyxiating gases in confined spaces (construction stage)		Toxic impacts on fauna (operational and / or construction stage)	
Inhalation of harmful in-ground vapours indoors and outdoors (operational)		Inhalation of asbestos during ground works		Indirect impacts via contamination of water resources (operational and / or construction stage)	

Where hazard has been identified and sensitive receptors are present, the potential impacts are determined by considering the pathways by which the hazard may encounter the receptors.

Table 8.3 indicates the most feasible pathways that may potentially occur in relation to the development site for different classes of receptor in line with current best practice guidelines and environment impact assessment criteria. Impacts are assessed for the construction and operational stages of the proposed development. Existing use is taken to be the baseline condition.

Table 8.3

Value (importance) of Receptor	Construction workers	Site end users and neighbours (operational workers / visitors)	Surrounding land uses	Groundwater / surface water	Ecological systems
High to very High	Yes – All Levels	Residential, allotments and play areas	Greenfield Site / Residential area	Surface water in close proximity	Designated Sites (Nitrate Vulnerable Zones)
Medium		Landscaping or open space	Open space or commercial area	Secondary Aquifer	
Low Negligible		“hard” end use (e.g. industrial, car parking)	Industrial area		

8.2.4.2 Receptor identification

The presence and sensitivity of receptors at risk from contamination has been assessed as follows:

- Surrounding land uses, based on mapping and existing planning designations;
- Proposed end use, based on the nature of the proposed development;
- Type of construction methods that will be necessary as part of proposed development;
- Surrounding sites of nature conservation importance;
- Geology, hydrogeology and hydrology of the route and its surrounding area.

The value of potential receptors can be described according to the categories shown within Table 8.4.

Table 8.4

Environmental value of resource (Receptor)	Potential magnitude of Impact			
	Negligible	Small	Medium	Large
Very High	Negligible	Slight/ Moderate	Moderate/ Substantial	Very Substantial
High	Negligible	Slight	Moderate	Moderate/ Substantial
Medium	Negligible	Negligible/ Slight	Slight	Slight/ Moderate
Low	Negligible	Negligible	Negligible/ Slight	Slight

8.2.4.3 Degree of Effects

For each potential impact identified, where a pollutant linkage has been identified, an assessment has been made of the degree of the effects. This assessment consists of comparing the magnitude of the impact and the sensitivity of the receptor for each case identified, using the qualitative descriptions outlined in the Tables above. The likely degree of effect is assessed using the matrix shown within Table 5 and professional judgement of the site-specific factors that may be of relevance. Effects that are moderate or above are considered to be significant for the purposes of the EIA.

8.3 BASELINE CONDITIONS

A site specific geotechnical and geo-environmental site assessment has not been undertaken on the site at the time of writing, however historic Site Investigation was undertaken on the adjacent land within the Hatfield Business Park. The results of the intrusive investigation and subsequent laboratory analysis undertaken are detailed below. The descriptions of the strata encountered, notes regarding visual or olfactory evidence of contamination, list of samples taken, field observations of soil and groundwater, in-situ testing and details of monitoring well installations are included on the exploratory hole records presented fully in their report.

Records of Geological Mapping data indicates that the site is likely to be underlain by superficial cover deposits of the LOWESTOFT formation with differential bedrock geology associated with the LEWES NODULAR CHALK formation underlain by the SEAFORD CHALK formation.

The shallow depth geology taken from intrusive site investigations has confirmed that the ground is comprised of clay topsoil with occasional gravelly Clayey sand of approximate depth of 0.40m and evidence of some elements of made ground also. In addition, a layer of silty sandy slightly gravelly Clay is then noted of up to 1.5m in depth. Below the clay is a layer of Sand which is fine to course; gravel with a layer thickness of up to 4m can then be observed which is underlain by Glacial Sands and Gravels up to 2m at which point intrusive survey have terminated.

Groundwater levels are noted as varying across the site ranging between 1.0m through to 7m below existing ground level. These water levels are likely to be part influenced by flows passing through the on-site Ellenbrook Watercourse.

The site itself lies outside of any known areas to be affected by underground mining, however there are a number of surface sand and gravel quarries located in the Glacial Deposits to the west of the site.

The environment database reports indicate that the site is not located within a Radon affected area.

Historic tests on samples of the Clay, Sands and Gravels have revealed only low Class 1 concentrations of soluble sulphates together with nearly neutral pH levels.

8.3.1 Groundwater

Groundwater was encountered during the investigations across the site at varying depths. It should be noted that groundwater levels might fluctuate for a number of reasons including seasonal variations. Ongoing monitoring would be required to establish both the full range of conditions and any trends in groundwater levels.

The findings reflect the general groundwater table in the Lowestoft Formation, which is at an elevation of between 5.0m and 12.80m bql.

8.3.2 Soakaway Testing

Soakaway testing recently undertaken within the Lowestoft Formation achieved infiltration rates of between $5.13 \times 10^{-6} \text{m/s}$ and $2.92 \times 10^{-5} \text{m/s}$.

8.3.3 Hydrogeology

The GroundSure report indicates that the watercourse, identified on the EA website as the Ellenbrook, to the north and east of the site is classified as a Tertiary river and flows off site to the south east along the eastern boundary of the site.

The environmental database has identified surface water features, all of which relate to the Ellenbrook. In addition to these, it is known that a lined pond exists in the south-east corner of the site.

The classification of the water quality in the stretch of the Ellenbrook nearest to the site is unknown at this stage.

The base flow of the Brook is likely to be recharged by surface water run-off from the surrounding fields and shallow soils. A linkage between the Brook and any near surface ground contamination beneath the site may therefore exist.

8.3.4 Site Drainage

Surface drainage in the north and east of the site appears to be discharge directly into the Ellenbrook. Elsewhere at the Site surface water appears to discharge to ground.

8.3.5 Visual/Olfactory Evidence of Soil and Groundwater Contamination

No visual or olfactory evidence of contamination was encountered at any time during the adjacent site's investigation.

8.3.6 Ground Gas

Ground gas monitoring and testing carried out found no elevated concentrations of carbon dioxide or methane in any of the boreholes within the adjacent site. The adjacent site was given a preliminary classification of Characteristic Situation 1 (CS-1); a negligible gas regime.

8.3.7 Contamination

No significant sources of contamination or ground gases have been identified, however, made ground may be present across the site, particularly in areas of previous development.

Groundwater has been encountered at depths of between 5.0m and 12.80m bgl, and during sampling, did not show any signs of contamination such as odour or sheen.

8.4 CONCEPTUAL SITE MODEL (CSM)

The following section details the CSM and risk assessment for the site, outlining the potential sources of contamination and contaminants of concern. The risk classification has been qualitatively derived in accordance with CLR 11 and CIRIA C552.

8.4.1 Potential historical contaminant sources

For the area of the site and the adjacent areas, reference has been made to the Environment Agency (EA) publication Land Contamination: Technical Guidance on Special Sites. Within this document details are given for the types of significant contamination risks associated with a range of types of facility including airfields. The contaminants detailed below in Table 8.3.2 summarises the contaminants that may be found in the areas used by the historic Airfield.

Table 8.5

Process	Principal contaminants
Bulk chemical storage	Sulphuric, nitric and other acids Pesticides, herbicides and fungicides Chlorinated and non-chlorinated solvents Paints, asbestos
Fuel/Oil Installation (storage and distribution)	Fuel and lubricating oils
Airfield Operations	Fuel and lubricating oils, radioactive contamination, metals Solvents – degreasing agents De-icers Detergents

Laboratories (e.g. Photographic Block)	Chemicals including solvents, acids.
--	--------------------------------------

8.4.2 Potential current contaminant sources

There are many potential contaminative sources from the adjacent site uses. This includes the following:

- Petrol Station, The Pits, Fuel Tanker Stands;
- Sub Stations; Maintenance storage and vehicle areas;
- Spillages of fuel/oil in areas used as car parks; Vehicle maintenance and wash down area.

8.4.3 Potential pollutant linkage assessment

Table 8.6 provides a summary of the development plot, the history and current use of that area and therefore the potential contamination and likelihood of significant contamination being present. Information regarding the proposed development is in Chapter 3. Receptors associated with the proposed development are given in the table.

A risk rating of potential risk has been allocated to the plot, which relates to the information gathered. For example, a Low Risk is considered to be a land use with low potential for contamination e.g. field, woodland and proposed non-sensitive land use e.g. light industrial use (mainly covered with hardstanding). A High Risk would be given to a land use with high potential for contamination e.g. petrol station and a highly sensitive land use e.g. residential housing.

The last column comments on the priority of further site investigation, based on severity of potential risk and thus the timing of investigation to determine whether contamination could be a significant project risk item.

Table 8.6

Historical/Current use of each zone	Potential contaminative Sources	Potential Sensitive Receptors	Potential Pathways	Risk Rating	Priority Investigation Required
Historical Mainly Open fields Airfield Operations	Unlikely to have significant contamination at present	Workers of development plot, Maintenance Workers, Visitors Construction workers Groundwater Surface Water Buildings on Site	Accidental ingestion/Indoor and outdoor inhalation/Dermal contact Vertical and Horizontal migration of soluble contaminants/groundwater Leaching of contaminants into surface waters. Direct contact of building services	Low Risk	Yes Targeted investigation in due to lack of available information.

8.5 ASSESSMENT OF EFFECTS

8.5.1 Construction Effects

Construction works have the potential to generate the following potential effects relevant to this assessment:

- Dust generation
- Mobilisation of contamination and migration into controlled waters
- Excavated Materials

8.5.1.1 Dust generation

Whilst likely not to be contaminated, dust and silt can result from ground disturbance during construction, which can lead to accidental ingestion, dermal contact or inhalation of particles by site workers and possibly the general public (receptors of high sensitivity). In some cases, generation of dust and silt may also lead to deposition in nearby water bodies. These risks would be most severe in the event that construction works were to take place on contaminated land.

The effect is assessed to be **slight and not significant**.

8.5.1.2 Mobilisation of contamination and migration into controlled waters.

If excavation works are undertaken in areas where locally contaminated water is identified water may enter the excavations and lead to contaminants migrating vertically and horizontally. Abstraction of potentially contaminated water from excavations will need to be controlled to prevent cross

contamination of soils and potential impact upon the Secondary A Aquifer beneath the site and the Primary Aquifer located to the north of the site.

In the event that construction activities are undertaken in areas where previously unknown contamination is encountered during construction a management strategy would be devised to ensure that any risks associated with its mobilisation are minimised. If required, suitable arrangements for stockpiling could be implemented to minimise the potential for the leaching of contaminated liquids and runoff of sediment through loading and exposure to rainwater. Mitigation measures could include stockpiling in bunded areas underlain by impermeable material away from watercourses (minimum distance of 25 metres from watercourses). Stockpiles would be covered to prevent leaching of the material.

In the absence of mitigation measures the risk to controlled waters could be **moderate**.

8.5.1.3 Excavated materials

It is anticipated that in general spoil generated is likely to be suitable for use on site for creating level development platforms, landscaping or other purposes, therefore it is expected that only minimal volumes of material may require disposal off-site e.g. if found to be contaminated. The impact is assessed as negligible/slight and not significant where soils can be re-used on site and slight and not significant for soils requiring off-site disposal to landfill (without mitigation).

The handling, storage and removal of potentially contaminated material on site will be subject to current waste management legislation and guidance. Appropriate disposal or reuse of materials should be considered as part of the detailed design and a Waste Management Plan developed that seeks to maximise beneficial pre-planned re-use of suitable site materials.

Contamination testing, from intrusive investigations that have taken place on parts of the adjacent Business Park to aid with its development at different periods of time, has not identified any "sources" known as Contaminants of Potential Concern (COPC), it is not considered that construction work will lead to the exposure of construction workers and members of the public to any existing contamination present within soils. However, there is always a possibility that contaminants may be present in previously unexplored areas (for example the presence of earthwork bunds). In addition, an asbestos survey is required, indicating a potential risk to construction workers.

The impact assessed is considered to be slight to moderate and significant, depending on the nature, frequency and volume of contamination encountered, through further investigation at the appropriate time.

8.5.2 Operational Phase Effects

Potential effects that may arise post-construction are outlined below. Without mitigation measures, there is the potential risk of contamination to future occupiers and users of the site.

8.5.2.1 Risk of Contamination to Future Users of the Site

Upon the completion of the proposed development site and occupancy, a number of activities could potentially lead to adverse effects on end users. Substances that may impact upon end users include fuel and oils, metals, herbicides and other substances from the historic land use of the site and current use of the site listed previously. During operation, there may be limited potential for accidental spillage of

potentially contaminating materials from delivery locations, plant operational locations and storage of fuel/oils for refuelling vehicles and the disturbance of previously unidentified contaminated land. The impact assessed is considered to be slight to moderate and significant, depending on the nature, frequency and volume of contamination encountered, through further investigation at the appropriate time.

8.6 MITIGATION

It is likely that a full site investigation will be required for the development to comply with planning requirements. This would include (if necessary) a remediation method statement and a verification report for approval by the local authority.

8.6.1 Construction Phase

8.6.1.1 *Construction Workers*

Health and safety risks to construction workers will be mitigated by the implementation of appropriate health and safety measures. Developers of each plot or sub plot will be responsible for ensuring that members of the public and site workers are protected from the potential effects of any contamination encountered during the entire construction process. Measures utilised will be incorporated within the general construction site safety standards.

The engaged contractors will carry out a health and safety risk assessment with appropriate precautionary measures planned and recorded in advance by adequately trained and qualified persons. During all works, the principles outlined in the Protection of Workers and the General Public during Development of Contaminated Land (HSE, 1991), or prevailing best practice guidelines, will be adhered to.

Points that will be considered include:

- Advising all site personnel concerning the significance of land affected by contamination and the associated risks to human health on site prior to commencing work.
- Suitable personal protective equipment (PPE), including clothing, footwear, gloves and respiratory equipment (if necessary) should be provided for all site personnel, who should be advised on the use of PPE items on the site with the items remaining on site at all times.
- Workers should not eat, drink or smoke in the vicinity of the works. Comprehensive welfare facilities should be provided for all site staff to enable workers to wash prior to leaving the site.
- Health and Safety risks to adjacent site users relating to dust, noise, odour and vibration should be appropriately addressed prior to commencement of site works.

8.6.1.2 *Construction related activities*

Protection of the underlying groundwater and nearby surface water from construction activities will be achieved using the following mitigation methods:

- Prevention of water entering excavations, where possible;
- Use of measures such as cut off ditches, silt fences or impermeable membranes to prevent uncontrolled release of runoff from excavations or exposed ground;

- Use of adequate wheel wash facilities to contain and dispose of potentially polluted runoff;
- Regular washing of machinery and access roads and dampening to reduce dust emissions with appropriate collection and disposal runoff.

8.6.2 General

A construction environmental management plan will be prepared and implemented by the contractors of each zone prior to the commencement of the respective construction phases. Mitigation measure will be implemented during the construction phase to minimise potential effects associated with airborne dust.

Dust mitigation measures such as damping down, covering of stockpiles, use of wheel washes and covering of lorries during transportation should be implemented as part of a general good site management plan to ensure that the potential effects associated with airborne dust are minimised.

It is prudent in unexplored areas for a suitably qualified Geoenvironmental Engineer to be present during construction works tasked with a watching brief, in order to ensure that correct measures are taken if unexpected contamination is encountered.

8.6.3 Post-Construction/Operation Phase

It is considered that, following the implementation of the construction phase mitigation measures outlined above, there will be no significant residual effects associated with the post-construction phase of the proposed site. The site investigation works prior to the construction phase will either confirm the lack of – or define the extent of – a contaminant source. Should a contaminant source be identified, this will require further assessment prior to the commencement of the construction works.

8.7 RESIDUAL EFFECTS

It is considered that, following the implementation of the construction phase mitigation measures outlined above, the residual effects associated with the post-construction phase of the proposed site will be reduced to negligible and not significant.

It is usually the case that no investigation can cover the whole of a site, therefore the possibility remains that contaminants maybe present in previously unexplored areas. The likelihood of encountering unidentified contamination is significantly reduced upon completion of this assessment of risks arising from contamination and remediation requirements when considering the basis of both the current use and circumstances and its proposed use. The potential residual effect presented to future end users of the site is considered to be negligible significance. If contaminated material is encountered in previously unexplored areas of the site remedial measures would be required, appropriate to the source-pathway-receptor pollutant linkage determined.

8.8 SUMMARY OF EFFECTS

8.8.1 Impacts of the Development upon the Land

An assessment of the potential impacts of the development upon the land judged that the excavation and haulage aspect of the development has the potential to bring about nuisance-type impacts (e.g. dust, mud, etc.) at both the development site and the site(s) receiving the made ground and Natural Strata. That assessment also predicted slight or moderately significant adverse impacts upon the quality of the

Made Ground and Clay being handled during the construction stage of the development if mitigation measures were not employed.

Impacts of the land upon the development in the construction and operational stages are likely to be fully resolved by the formation and implementation of:

- a Construction Management Plan (CMP) with the core objective of minimising environmental impacts from the development works; and
- a Site Waste Management Plan (SWMP) which will include a Materials Management Plan (MMP).

8.8.2 Impacts of the Land on the Development

An assessment of the impacts of the land upon the development in the construction and operational stages will assist in the identification of a number of potential pollutant linkages:

8.8.2.1 Construction Stage

- Potential Harm to Health of Construction Workers and Neighbours during Construction from Exposure to Potential PCB in Made Ground (on site but in vicinity of off-site transformer);
- Potential Harm to Health of Construction Workers and Neighbours during Construction from Exposure to Airborne Contaminants in Dust;
- Potential Harm to Health of Construction Workers and Neighbours during Construction from Exposure to Airborne Asbestos in Dust;
- Potential Harm to Health of Construction Workers within Deep Excavation from Exposure to Gases especially Carbon Dioxide;
- PPL 4 (d): Potential Harm to Health of Construction Workers and Neighbours from Potential Contaminants in Imported Landscaping Soils;
- Potential Risks to Health or the Environment from Unidentified Sources Discovered during Construction; PPL UXO

8.8.2.2 Operational Stage

- Potential Harm to Health of Future Residents, Workers and Visitors from Exposure to (off site) Contaminants Entering Water Supply Pipework;
- Potential Damage to Future Buildings from Exposure to Aggressive Acids/Sulphates in Made Ground (off-site) and London Clay;
- Potential for Harm to Health of Future Residents, Workers and Visitors and Building Damage from Hazardous Gases (from off-site);
- Potential Harm to Human Health in future from Potential Contaminants in Imported Landscaping Soils.

The harm which could arise should these potential linkage form in the construction and operational stages can be avoided or at least minimized by the formation and implementation of:

- a Health & Safety Plan including an assessment of the potential risk to construction workers from asbestos and ground gases entering excavations, plus plans with respect to UXO based on a Site Specific Unexploded Ordnance Risk Assessment;
- Materials Management Plan including details of any supplementary testing and a section setting out procedures should the contractor unexpectedly encounter potentially hazardous

materials (which would trigger production of a Land Quality Validation Report setting out any additional remedial measures volunteered to deal with unexpectedly contamination);

- Construction Management Plan;
- Site Assessment Report leading to the specification of suitably protective water pipe material;
- a Designer's Risk Assessment concerning the potential damage to future buildings from exposure to aggressive ground leading to the specification of suitably resistant concrete structures; and
- new buildings which will be inherently gas-resistant and afford all users fresh air without special precaution regarding ground gas.

Health and Safety Plans are not a matter for the planning authority but are produced in response to legislation.

Overall, following completion of the Unexploded Ordnance Risk Assessment, Site Assessment Report and Designer's Risk Assessment and via adoption of the various Plans recommended herein, it is anticipated that the developer will be able to:

- minimise construction-stage nuisance;
- maintain the quality of materials being taken off-site for reuse; and
- implement measures designed to avoid the formation of pollutant linkages thereby:
 - protecting the health of construction workers and neighbours during construction;
 - safeguarding the local environment and that of the site(s) receiving the Made Ground and clay;
 - protecting the health of future residents, workers and visitors during the life of the development; and
 - ensuring that future buildings are not damaged by ground conditions.

8.9 CONCLUSIONS

An assessment of the potential impacts of the development upon the land judged that the development has the potential to bring about nuisance-type impacts at both the development site and the site(s) receiving excavated materials, and adversely impact the quality of the Made Ground and underlying strata if they are mishandled.

An assessment of the impacts of the land upon the development identified a number of potential pollutant linkages which could result in harm to health in the construction period and harm health and damage property during the lifespan of the development.

A small number of further risk assessment are recommended:

- Unexploded Ordnance Risk Assessment;
- Site Assessment Report regarding water pipes; and
- Designer's Risk Assessment regarding buried concrete.

All of these supplementary assessments are likely to bring about recommendations to control risk, none of the options are likely to be unusual or overly costly to implement considering the overall construction costs.

A number of plans are recommended:

- Health & Safety Plan;
- Construction Management Plan;
- Site Waste Management Plan including Materials Management Plan.

The Materials Management Plan will include details of any supplementary testing required and a section setting out procedures should the contractor unexpectedly encounter potentially hazardous materials. If remedial measures are volunteered to deal with unexpected contamination the developer will undertake to produce a Land Quality Validation Report.

By acting upon the recommendations of specialists with regard to UXO and the specification of water pipes and concrete, and via adoption of the various Plans recommended the developer will:

- minimize construction-stage nuisance;
- maintain the quality of materials being taken off-site for re-use; and
- implement measures designed to avoid the formation of harmful or damaging pollutant linkages - locally and at the site(s) receiving the Made Ground and clay.

The development should also:

- enhance the natural and local environment by preventing the new development from contributing to or being put at unacceptable risk from, or being adversely affected by unacceptable levels of soil pollution; and
- ensure that the site is suitable for its new mixed commercial and residential use taking account of ground conditions and pollution arising from previous uses and any proposals for mitigation including land remediation or impacts on the natural environment arising from that remediation. In addition, the development should bring about conditions meeting Category 3 or 4 making the site incapable of being determined as contaminated land under Part 2A of the Environmental Protection Act 1990.

It has been found through this assessment that, with the mitigation measures described above, anticipated effect of ground conditions would be negligible. This has been assessed both during and post-construction.