10 GROUND CONDITIONS AND CONTAMINATION

10.1 INTRODUCTION

10.1.1 This chapter presents a technical assessment of the likely significant effects of the development with respect to ground conditions and contamination. In particular, consideration is given to the likely effects of any existing ground contamination on human health and the environment.

10.1.2 This assessment provides a summary of relevant legislation, planning policy and guidance and a description of the methods used in the assessment of likely significant effects. This is followed by a description of the relevant baseline conditions of the Application Site and surrounding area and an assessment of the likely significant effects of the Proposed Development during the demolition and construction works and once the Proposed Development is completed and operational. Mitigation measures are designed to avoid, reduce or offset any adverse effects identified. The assessment concludes with a section examining the nature and significance of likely residual effects.

10.1.3 This assessment refers to the findings of the Preliminary Environmental Risk Assessment (PERA) (see **Appendix 10.1**).

ASSESSMENT APPROACH

Methodology

10.1.4 A desk-based (PERA)[1] (see **Appendix 10.1**) has been undertaken to establish the potential for significant ground contamination to exist at the Proposed Site and the likely risk posed to a range of sensitive receptors, including human health, property and controlled waters.

10.1.5 The PERA was undertaken in general accordance with the Model Procedure for Management of Land Contamination (Contaminated Land Report CLR11)) and has been informed by:

- A Landmark Information Group Envirocheck Report[2] which contains historical Ordnance Survey (OS) extracts, environmental data sheets and sensitivity plans;
- A review of available and relevant historical, geological and hydrogeological information sources publically available;
- British Geological Survey (BGS) Geology maps 1:50,000 scale Geological Map, Sheet 281, Chipping Norton Edition; and
- A review of early Ordnance Survey maps and pre-Ordnance Survey maps.

10.1.6 The PERA includes a conceptual site model which identifies the likely significant pollutant linkages. Consideration is given in the conceptual model to the potential sources of contamination, migration pathways and sensitive receptors. Likely significant effects of ground contamination upon human health, property and controlled waters were assessed as part of the PERA using this source-pathway-receptor approach.

10.1.7 The findings of the PERA have been used to inform the qualitative assessment presented in this assessment of likely significant effects to and from any potential ground

[1] Waterman, Preliminary Environmental Risk Assessment (WIB14371-100-R-2.2.3.EB) June 2016.
[2] Landmark Envirocheck Report (2013)

contamination likely to exist at the Application Site. In accordance with guidance, the conceptual site model within the PERA reflects the Proposed Development.

Assessment of Significance

10.1.8 A seven point scale has been adopted in this assessment to identify any likely significant environmental effects (see **Table 10.2**). The scale is derived from the interaction of the receptor sensitivity and magnitude of change of effect.

10.1.9 There are no published criteria for assessing the significant potential effects from ground conditions and contamination. Significant criteria have therefore been developed using criteria outlined in contaminated land guidance and professional expert judgement (see **Table 10.2**).

10.1.10 An adverse likely significant effect in respect of ground contamination relies on the presence of a source, pathway and receptor pollutant linkage. The significance of the effect depends on the value of the resource, the sensitivity of the receptor and the ways in which the Proposed Development can provide a pathway to the receptor. The significance of an effect partly depends on the timescales involved i.e. short, medium or long term and the extent of the area affected.

Table 10.2: Significance Criteria for Ground Conditions and Contamination Assessment.

Significance	Significance Criteria
Major Adverse	High risk site classification – acute or severe chronic effects to human health and / or animal / plant populations predicted. Effect to a potable groundwater or surface water resource of regional importance e.g. Principal Aquifer, public water reservoir or inner Source Protection Zone (SPZ) of a public supply borehole.
Moderate adverse	Medium risk site classification and proven pollutant linkages with human health and / or animal / plant populations, with harm from long-term exposure. Effect to a potable groundwater or surface water resource at a local level e.g. effect to an outer groundwater SPZ or Principal Aquifer, which is not abstracted locally. Temporary alteration to the regional hydrological or hydrogeological regime or permanent alteration to the local regime.
Minor adverse	Low risk site classification and potential pollutant linkages with human health and / or animal / plant populations identified. Reversible, localised reduction in the quality of groundwater or surface water resources used for commercial or industrial abstractions. Secondary Aquifer.
Neutral / Not Significant	Low risk site classification – no appreciable effects to human, animal or plant health, potable groundwater or surface water resources.

Significance	Significance Criteria
Minor beneficial	Risk to human, animal or plant heath are reduced to acceptable levels. Minor local scale improvement to the quality of groundwater or surface water resources used for commercial or industrial abstraction.
Moderate beneficial	Risks to human, animal or plant health are reduced to acceptable levels. Moderate local improvements to the quality of potable groundwater or surface water resources. Significant improvement to the quality of groundwater or surface water resources used for public water supply.
Major beneficial	Major reduction in risk to human, animal or plant health. Regional scale improvement to the quality of potable groundwater or surface water. Whole Site

Legislative and Policy Framework

Legislation

10.1.11 Land contamination is regulated under several regimes, including environmental protection, pollution prevention and control, waste management, planning and development control and health and safety. There are a number of key legislative drivers for dealing with risks to human health and risk of pollution of the environment from land contamination, including:

- Part IIA of the Environmental Protection Act (EPA) 1990[3] (the Contaminated Land Regime);
- Contaminated Land (England) Regulations, 2006[4];
- Contaminated Land (England) (Amendment) Regulations, 2012[5];
- The Water Act, 2003[6];
- The Water Resources Act 1991[7]; and
- The Environmental Damage (Prevention and Remediation) Regulations, 2009[8].

10.1.12 Each are considered as follows:

Environmental Protection Act 1990

10.1.13 Under Part IIA of the EPA, 1990, sites are identified as "**contaminated land**" if they are causing harm or if there is a significant possibility of significant harm or if the Proposed Development is causing, or could cause, significant pollution of controlled waters. Part IIA mostly applies to the existing use of a site, and is invoked by the Local Planning Authority (LPA). However, national planning policy applied to new developments suggests

[3] Statutory Instrument (1990) Environmental Protection Act, HMSO.
[4] Statutory Instrument (2006) Contaminated Land (England) Regulations, HMSO.
[5] Statutory Instrument (2012) Contaminated Land (England) (Amendment) Regulations, HMSO
[6] Statutory Instrument (2003) Water Act, HMSO
[7] Statutory Instrument (1991) Water Resources Act, HMSO
[8] Statutory Instrument (2009) Environmental Damages (Prevention and Remediation) Regulations, HMSO.

that as a minimum, newly developed sites should not be able to be classed as contaminated land as defined as Part IIA of EPA.

10.1.14 Part IIA of the EPA 1990 endorses the principle of a "**suitable for use**" approach for contaminated land, where remedial action is only required if there is unacceptable risk to human health or risk of pollution to the environment, taking into account the use of the land and its environment setting.

10.1.15 The contaminated land statutory guidance describe the risk assessment methodology in terms of significant contamination and **"contaminated linkages within a source-pathway-receptor"** model of a site. For the land to be determined as contaminated in a regulatory sense, and thereby require remediation, all these elements (source-pathway=receptor) of a significant contaminant linkage must be present.

Contaminated Land (England) Regulations, 2006 and Contaminated Land (England (Amendment) Regulations 2012

10.1.16 The Contaminated Land (England) Regulations, 2006 elaborate on various details of the Part IIA regime, such as dealing with "**special sites**", public registers, remediation notices, and the rules for how appeals can be made against decisions taken. The Contaminated Land (England) (Amendment) Regulations, 2012 amend the Contaminated Land (England) Regulations 2006 by:

- Limiting the application of Regulation 11 (modification of a remediation notice);
- Clarifying that the existing special site protection applies to waters classified as protected areas under the Water Framework Directive; and
- Taking account of the updated definition of "controlled waters" in section 78A (9) of the EPA 1990.

The Water Act, 2003

10.1.17 The Water Act, 2003 makes numerous provisions, including some related to contaminated land. The Act (and various commencement orders) brings into effect changes to the definition of contaminated land in the EPA, 1990 so that, in relation to the pollution of controlled waters, for land to be determined as contaminated it must cause significant pollution or the significant possibility of such pollution of controlled waters.

The Water Resources Act, 1991 (as amended)

10.1.18 The Water Resources Act 1991 (as amended) seeks to protect the quality of water by settling out the functions of the Environment Agency (EA) and describing offences relating to water, discharge consents and defences to the offences. The EA has the power to bring criminal charges against people or companies responsible for crimes concerning water.

The Environmental Damage (Prevention and Remediation) Regulations, 2009

10.1.19 The Environmental Damage (Prevention and Remediation) Regulations, 2009 implements the associated European Union (EU) Directive 2004/35 in respect of environmental liability and remedying environmental damage. The regulations introduced obligation to ensure that the polluter pays for damage caused.

10.1.20 Various enforcing authorities are empowered by the Regulations, including the EA in relation to water damage, Natural England (NE) in relation to biodiversity, LPAs in relation to land damage and the Marine and Fisheries Agency for damage to biodiversity at sea. In the case of the EA, damage to water includes surface and groundwater

("**controlled waters**") and in the latter case refers to damage sufficient to lower the status of the water body.

National Planning Policy

National Planning Policy Framework, 2012

10.1.21 The National Planning Policy Framework (2012)[9] (NPPF) states in Section 11 "**Conserving and Enhancing the Natural Environment**" that:

> **"...Where a site is affected by contamination, responsibility for securing a safe development rests with the developer and/or landowner"**

10.1.22 The NPPF states that local planning policies and decisions should ensure that:

> **"...the site is suitable for its new use taking account of ground conditions and land instability, including from natural hazards or former activities such as mining, pollution arising from previous uses and any proposals for mitigation including land remediation or impacts on the natural environment arising from that remediation".**

10.1.23 This is consistent with the practical requirements that a site under planning, for an intended or proposed use, should not be able to be classed as contaminated under Part IIA when the site is occupied and in use.

10.1.24 The NPPF defines site investigation information as including:

> **"...a risk assessment of land potentially affected by contamination"**.

10.1.25 It states that all investigations of land potentially affected by contamination should be carried out in accordance with established procedures. The minimum information that should be provided by an applicant is the report of a desk-based study and site reconnaissance.

10.1.26 It is also stated that within the overarching roles that the planning systems ought to play as set of core land-use planning principles should underpin both plan-making and decision-taking. These include contributing to the conservation and enhancement of the natural environment and to the reduction of pollution.

10.1.27 Section 11 of the NNPF also states

"... the planning system should contribute to and enhance the natural and local environment by preventing both new and existing development from contributing to or being put at unacceptable risk from, or being adversely affected by unacceptable levels of soils, air or water pollution and remediating and mitigating despoiled, degraded, derelict and contaminated land, where appropriate".

Local Planning Policy

Adopted Cherwell Local Plan 1996

[9]Communities and Local Government (2012) National Planning Policy Framework: Technical Guidance, HSSO.

10.1.28 The adopted Cherwell Local Plan, 1996[10] contains policies relating to contaminated land and water quality. Saved Policy EN12 '*Contaminated Land*' stipulates that **"…where land is known, or is suspected to be contaminated, adequate measures should be taken to remove the risk of contamination to future site users"**. Development would only be permitted where it is not likely to result in the contamination of surface or underground water resources. This is supported by saved Policy EN7 '*Water Quality*' which states that **"…developments which would adversely affect the quality of surface waters and groundwater would not be permitted"**. Both these policies are reiterated in the '*Non Statutory Cherwell Local Plan 2011'*.

Adopted Cherwell Local Plan 2011 – 2031 Part 1

10.1.29 The adopted Cherwell Local Plan 2011 – 2031[11] was previously known as the Core Strategy and is part of the Statutory Development Plan. The Plan provides the strategic planning policy framework and sets out strategic site allocations for the District to 2031. The plan contains policy's relating to contaminated land, water quality and protection of the natural environment. Saved Policy ESD 8 'Water *Resources*' indicates that **"…some developments can remediate contaminated land which may be having an adverse impact on controlled water and human health…"** this stipulates that development should not result in any deterioration in the status of water bodies. Policy ESD 10 '*Protection and Enhancement of Biodiversity and the Natural Environment*' states that **"previously developed land can also make an important contribution to biodiversity. Some development can remediate contaminated land which may be having an adverse impact on ecology"**.

10.1.30 Policy Villages 5 is associated with former RAF Upper Heyford and states **"the removal or remediation of contamination or potential sources of contamination will be required across the whole site"**.

10.1.31 The Plan (C.250) details the approach to provide development in the rural areas and states that the Council seek to "**deliver a new settlement at the former RAF Upper Heyford to enable conservation and environmental improvements and to contribute in meeting Cherwell's wide and local housing needs".**

Non Statutory Cherwell Local Plan 2011

10.1.32 The Non Statutory Cherwell Local Plan 2011[12] contains policies specific to developing the Application Site. Policy UH2(iii) stipulates proposals for the onsite treatment of contaminated liquids and materials including soil where that would accord with the good environmental practice and have no detrimental environmental impacts arising. It is suggested that is the above is implemented for the discharge of conditions only.

Cherwell Local Plan 2011 - 2031 Part 2 (in preparation)

10.1.33 There are no relevant policies associated with contaminated land in the emerging Cherwell Local Plan[13], specific to the Application Site. However, the Banbury and North Cherwell Sustainability Appraisal states a plan objective to **"…improve the quality of the built environment and increase the use of previously developed land through regeneration of vacant and underused land"** to assist in **"reducing levels of contamination that may be present in brownfield sites"**.

[10] Adopted Cherwell Local Plan 1996 (November 1996).
[11] Adopted Cherwell Local Plan 2011 – 2031 (July 2015), published online, http://www.cherwell.gov.uk
[12] Non Statutory Cherwell Local Plan 2011 (December 2004), published online, http://www.cherwell.gov.uk
[13] Cherwell Local Plan 2011 - 2031 Part 2 (in preparation), published online, http://www.cherwell.gov.uk

Guidance

10.1.34 Guidance on assessing risks to human health and the environment under planning and development control is principally described in technical policy and guidance documents such as those provided by the EA, British Standards or other professional organisations. There is extensive published national guidance. A selection of key guidance used to inform the assessment is provided below:

National Planning Practice Guidance (NPPG)

10.1.35 The NPPF Planning Practice Guidance (PPG) was published on 6th March 2014[14], however this Planning Practice Guidance is not considered to materially affect the assessment of Ground Conditions and Contamination.

Environment Agency, Model Procedures for the Management of Land Contamination, Contaminated Land Report, 11, 2004[15]

10.1.36 The Model Procedures for the Management of Land Contamination (CLR11) set out the technical framework for structured decision making about land affected by contamination. The technical approach is designed to apply to a range of regulatory and non-regulatory situations including assessments under the planning regime, Part IIA of the EPA, 1990 and voluntary investigation and remediation. The model procedures present the risk management framework for the management of land contamination and set out the processes of risk assessment, remediation options appraisal, and implementation of the remediation strategy through to verification.

Environment Agency, Guiding Principles for Land Contamination 1 to 3, 2010[16]

10.1.37 The good practice (as defined by the EA) in characterising risks to controlled waters from contaminated land is set out in the Guiding Principles for Land Contamination. This aligns with, and uses similar terms and structure to, the model procedures and provides guidance in respect of clarifying roles and responsibilities, describing good practice to promote compliance with regulatory requirements and signposting authoritative guidance. The guidance focuses mostly on water issues which is the main areas of responsibility for the EA in relation to land contamination.

Other Best Practice Guidance

10.1.38 Best Practice for the investigation, assessment and remediation of land affected by contamination is set out in a wide range of technical guidance. A number of the most relevant key documents are listed below:

- EA, 2006, Remedial Targets Methodology: Hydrogeological Risk Assessment for Land Contamination[17]: this defines the EA's approach to assessing risks to controlled waters;
- EA, 2009, Contaminated Land Exposure assessment (CLEA) Model Version 1.06[18]: this sets out the UK approach to quantitively assessing risks to human health;

[14] Planning Practice Guidance, published online http://planningguidance.planningportal.co.uk.
[15] Defra/Environment Agency (September 2004) model Procedures for the Management of land, Contaminated Land, Environment Agency, Report 11.
[16] Environment Agency (2010) Guiding Principles for Land Contamination, Environment Agency
[17] Environment Agency (2006): Remedial Targets Methodology: Hydrogeological Risk Assessment for Land Contamination, Environment Agency.
[18] Environment Agency (2009): Contaminated Land Exposure Assessment (CLEA) Model Version 1.06, Environment Agency.

- EA 2009, Human Health Toxicological Assessment of Contaminants in Soil, Science Report SC050021/SR2[19]: this provides the basis of choosing toxicological data to use in the CLEA model;
- CL:AIRE, 2011, The Definition of Waste: Development Industry Code of Practice Version 2[20]: this provides a clear, consistent and streamlined process which enables the legitimate reuse of excavated materials on Site or their movement between sites with a significantly reduced regulatory burden;
- CL:AIRE, 2010, A Framework for Assessing the Sustainability of Soil and Groundwater Remediation[21]: this sets out the link between the principles of sustainable development and the criteria (environmental, social and economic) for selecting optimum land use design with sustainable remediation strategies and treatments;
- Construction Industry Research and Information Association (CIRIA) Guidance C665, 2007, Assessing Risks Posed by Hazardous Ground Gases to Buildings[22]: this defines a number of approaches to assessing risks to human health from ground gas; and
- BS1075, 2011, Investigation of Potentially Contaminated Sites Code of Practice[23]: this sets out a code of practice for desk based and intrusive investigations of potentially contaminated land.

10.2 BASELINE CONDITIONS

Applicant Site Description and Context

10.2.1 As described in earlier assessments (see **Chapter 3**), the existing Application Site is part of the wider former RAF Upper Heyford and is currently occupied by the disused former secondary school and baseball field to the east. A supply line for the former Petroleum Oil Lubricant (POL) system is present beneath the east of the Application Site. The POL system was previously used to store and supply aviation fuel to the wider former RAF Upper Heyford.

10.2.2 Land uses immediately surrounding the Application Site comprise of Camp Road to the north with the former RAF Upper Heyford Flying Field beyond. OS maps east of the Application Site identify residential housing, a hospital and shop. These were historically used by families when the base was occupied by the United States Air Force (USAF). This area is now in the process of being substantially demolished and redeveloped into new residential housing. Land to the south is used for agriculture, whilst land to the west is also predominantly agricultural with Upper Heyford village beyond.

10.2.3 It is proposed that demolition and clearance of the former secondary school and associated structures will occur. With subsequent construction of up to 300 houses. Vehicle access from Camp Road, highway improvements, internal access roads, pedestrian linkages, service areas and parking, utilities and infrastructure, landscaping and associated other works is also expected to be implemented as part of the Proposed Development.

[19] Environment Agency (2009): Human Health Toxicological Assessment of Contaminants in Soil, Science Report SC0650021/SR2, Environment Agency.
[20] CL:AIRE (2011): The Definition of Waste: Development Industry Code of Practice Version 2, CL:AIRE.
[21] CL:AIRE (2010): A Framework for Assessing the Sustainability of Soil and Groundwater Remediation, CL:AIRE.
[22] Construction Industry Research and Information Association (CIRIA) Guidance C665 (2007): Assessing Risks Posed by Hazardous Ground Gases to Buildings, CIRIA
[23] BS10175 (2011): Investigation of Potentially Contaminated Sites Code of Practice, British Standards Institution.

Baseline Survey Information

Historical Land Uses of the Site and Surrounding Area

10.2.4 Details of the history of the Application Site and surrounding areas have been drawn from Ordnance Survey (OS) map extracts. Reference should be made to the maps and the detailed history of the Application Site and its surrounds which are set out in the PERA. A summary is provided below:

10.2.5 Historically land uses on the Application Site and surrounding areas have been primarily agricultural. The earliest available OS map from 1884 – 1885 shows the Application Site is used as agricultural farmland. This use continues until the early 1900's. It is known the construction of the former RAF Upper Heyford Flying Field to the north of the Application Site began in 1916. It was occupied by the Royal Air Force throughout World War II (WWII).

10.2.6 The 1945 aerial photograph does not show the former RAF Upper Heyford to be developed as an airbase and is still identified as agricultural farmland. This is likely to be due to the restricted aerial status of the area during the war period.

10.2.7 The 1955 OS map indicates that the Application Site remains undeveloped, but is referred to as former RAF Upper Heyford by 1966. Roads and taxiways associated with the flying field to the north are located across the Application Site.

10.2.8 Between 1974 and 1982 the Application Site underwent further development and is now occupied by the USAF. The Application Site now consists of small buildings, including an Electricity Sub Station and Water Tower. The buildings were originally used as houses for families living on the airbase. Once the airbase was expanded in 1982, these were converted into the 'Upper Heyford American High School' with a playing field to the south. A pipeline feeds into the Application Site from the south which supplies the POL system on the Flying Field. It is known a boiler house and associated underground storage tanks (USTs) and above ground storage tanks (ASTs) were present during this period.

10.2.9 In 1993 operations at the airbase were closed. Residential dwellings in the surrounding areas were still occupied and the area remained relatively unchanged. It is thought that the school was no longer used once the airbase was closed.

10.2.10 The high school buildings are still present on the OS map in 2006 and 2014, but are now in a state of disrepair. The POL supply pipeline that stored and supplied aviation fuel to various areas of the airbase has been cleaned and made safe by this time. Is has also been disconnected from the national fuel pipe network.

Geology

10.2.11 BGS Geology maps and former information from intrusive investigations indicate that the Application Site is underlain by a series of interbedded limestones, sandstones, mudstones and siltstones of varying thickness which is underlain at depth by a significant deposit of mudstone.

10.2.12 BGS records also indicate a significant thickness of Made Ground associated with the building up of ground levels.

Table 10.3: Likely Geological Sequence Beneath the Site

Stratum	Location	Approximate thickness	Typical Description
Topsoil	Whole Site	0.1 – 0.3 m	Sandy gravelly topsoil.
Made Ground	Whole Site	0.3 – 0.5 m	Reworked material, very gravelly Clay with many limestone cobbles and the occasional fragment of tarmac, concrete, brick and Limestone.
Sandy Gravel	Whole Site	2.8 – 3.0 m	Sandy gravel with Limestone cobbles becoming increasingly dense at depth.
Limestone	Whole Site	Proved to 10 m	Occasionally fissured pale grey crystalline Limestone with occasional shell fragments, weathered at top of strata.
Sandstone	Whole Site	Proved to 13 m	Occasionally fissured yellow and pale grey calcareous sandstone with occasional shell fragments.
Siltstone/Mudstone	Whole Site	Proved to 7 m	Grey Siltstone and pale grey Mudstone, occasional bands of coarse shelly limestone.

Hydrogeology

10.2.13 Following a review of the geological and hydrological information from previous intrusive investigations, the hydrogeology for the Application Site can be described as a two aquifer system separated by a mudstone/siltstone layer of significantly lower permeability. However evidence for leakage between the aquifers is present.

Hydrology

10.2.14 There are no surface water courses on the Application Site. However a small stream (Gallos Brook) leads from the southern boundary of the Application Site which eventually discharges into the River Cherwell. A surface water oil interceptor is also located on the south of the Application Site which discharges directly into Gallos Brook.

10.2.15 There are no discharge consents or abstraction licences registered to the Application Site.

Previous Reports Pertaining to the Application Site

10.2.16 Previous reports including a Ground Investigation Report and Hydrogeological Assessment have been undertaken across the wider former RAF Upper Heyford, including the Application Site. The ground investigation was undertaken by others and reported by Aspinwall (1997). The Hydrological Assessment was undertaken by Waterman in 2012 – 2013.

10.2.17 A review of the relevant trial pits and boreholes carried out as part of the 1997 investigation indicated that the underlying drift consisted of a clayey, sandy, silty deposit with varying quantities of limestone gravels and cobbles. Made Ground on the Application Site predominantly consisted of reworked material with quantities of concrete, breeze block and metal wire.

10.2.18 The Aspinwall Report (1997) identified USTs and ASTs. Trial pits were undertaken in the vicinity of these tanks and number of soil samples were submitted for chemical analysis as part of the investigation. A hydrocarbon odour was reported in a borehole excavated adjacent to the POL supply pipeline. None of the contaminant concentrations detected exceeded Generic Assessment Criteria (GAC) at this time.

10.2.19 As part of the 1997 investigation, samples were also submitted for a range of organic analysis including Dichlorin Methanol, Solvent Extractable Matter, Mineral Oil, Total Non-Volatile Aromatics, Non Specific Organics/Resins, Diesel Range Organics, Total Solvent Extract and Total Volatiles. These methodologies are predominately generic types of organic analysis and include the combined concentrations of many different organic compounds. More recent risk characterisation has been undertaken to define the hazards associated with individual Poly Aromatic Hydrocarbons and Total Petroleum Hydrocarbon (TPH) fractions. Consequently, the results of the previously completed analysis cannot be compared to the current GACs.

10.2.20 Ground gas monitoring was also carried out as part of the 1997 investigation, although not within the Application Site. The results of the gas monitoring indicated that significant concentrations of ground gases were not being generated. The geology of the area where monitoring took place is similar to the Application Site. It is therefore considered that the Application Site is not capable of generating significant quantities of ground gas.

10.2.21 Waterman undertook a Hydrological Assessment of the former RAF Upper Heyford, including the east of the Application Site. Groundwater sampling from the one borehole on the Application Site and boreholes in the surrounding areas indicated that marginal TPH and phenol impact was present in the shallow aquifer. As a result, quarterly sampling of this borehole and surrounding boreholes across the former RAF Upper Heyford Site was recommended. This was to further investigate the fluctuating levels of TPH after the decommissioning of the POL system. This approach was agreed with the EA.

Potential Contamination Sources

10.2.22 Potential sources of contamination relating to historical and current uses of the Application Site have been identified via the conceptual site model presented in the PERA. The following historical and current potential sources of contamination may have resulted in localised contamination of the underlying soils and groundwater.

- Made Ground is likely to be present over the entire Application Site as a result of the historical uses and has been identified in trial pits;
- Hydrocarbon odours were observed in one borehole next to the POL supply pipeline on the south of the Application Site during the 1997 investigation;
- Elevated levels of TPH and phenols were identified in shallow groundwater from the borehole to the south of the Application Site, as a result of historical uses, during the 2012 – 2013 Waterman Hydrological Assessment;
- Impact of UST's and AST's leaking into shallow soils and shallow groundwaters; and
- Impact of potentially poorly maintained surface water interceptor contaminating surround soils, shallow groundwater and Gallos Brook.

10.2.23 Overall the PERA concludes that there is a Medium risk for potential significant ground contamination to be present on the Application Site.

Potential Contamination Pathways

10.2.24 Potential contamination pathways which may exist on the Proposed Site, or which could be established during demolition and construction works and/or once the Development is completed are as follows:

- Inhalation and ingestion – contamination present in the Made Ground could result in ingestion or inhalation of contaminants;
- Permeable soils – the gravels and limestones underlying the Application Site are considered to be relatively permeable and could allow vertical migration of any potential contamination; and
- Direct contact – building materials which are in contact with potentially contaminated soils and groundwater and dermal contact with contaminated soil and dust.

Potential Receptors

10.2.25 The potential receptors relevant to the Application Site are considered to be:

- Human health (future users of the Proposed Site, including visitors, occupants, construction and maintenance workers and off-site users);
- Property (on-site and off-site structures including buried foundations and services);
- Controlled water (groundwater and Principal Aquifer); and
- Local Wildlife (Flora and Fauna).

10.3 ASSESSMENT OF LIKELY SIGNIFICANT EFFECTS

Demolition and Construction

Likely Effects to Human Health from Ground Contamination

10.3.1 During the demolition and construction works, workers on the Application Site would be more likely to be exposed to sources of contamination, since the area comprising the demolition and construction works would not be accessible to the public.

10.3.2 The demolition works and construction works, including the demolition of existing buildings containing potentially hazardous materials, the removal and break up of hard standing (including Made Ground, re-grading and foundation design) and potential removal of USTs and ASTs could expose the Application Site workers to some or all of the potential contamination sources described earlier in the assessment. This is via the creation of plausible pollutant linkages including dermal contact, inhalations and/or ingestion pathways. However, workers on the Application Site would be subject to mandatory health and safety requirements of the Control of Substances Hazardous to Health (COSHH) Regulations, 2003. Construction workers and Application Site visitors would therefore be required to use appropriate personal protective equipment (PPE) and respiratory protection equipment (RPE) thereby minimising the risk of exposure to potential contamination from soils, dust, ground gas and other potential contamination sources.

10.3.3 Adherence to the legislative requirements described above would adequately reduce the potential health risk posed to Application Site workers and visitors from ground contamination. As such, the likely effect is considered to be **negligible**.

10.3.4 Certain activities during the demolition and construction works and where materials may be stockpiled on the Application Site, could generate dust during dry and windy conditions. Under these conditions the general public using the surrounding areas immediately adjacent to the Application Site could temporarily be exposed to contamination via the inhalation of potentially contaminated dust. Owing to the fact that members of the public would not be wearing PPE or RPE, at worst the likely significant effect is considered **direct, short-term, temporary and of minor adverse significance.**

Likely Effects to Controlled Waters from Ground Contamination

10.3.5 With reference to the Proposed Development, it is anticipated that strip and/or pad foundations are used as appropriate to the final land use mix, overall design code and ground conditions. It is considered unlikely that these shallow foundations would create a significant contamination pathway to the underlying Principal Aquifers. However if the foundation design and depth significantly changed and in the absence of mitigation, the effect is likely to be **direct**, **short term** and of **moderate adverse significance**.

10.3.6 During demolition and lifting of ground slabs previously capped contaminated material, for example fuels leaking from UST's, could be exposed to infiltration which could affect underlying groundwater quality. Contractors should be briefed on the actions that should occur if unforeseen contamination is encountered and should undertake measures to limit its exposure to infiltration. However without these protective procedures in place the likely effect is considered to be **direct**, **short term**, **temporary**, and of **moderate adverse significance**.

10.3.7 During the demolition and construction works, it is likely that a new source of contamination would be introduced and stored on the Application Site in the form of, for example, diesel fuel, oils, chemicals and other construction materials. As a result, there would be a risk of leakages or spillages directly or indirectly (for example via surface water drainage systems) into the ground and the Principal Aquifer or the drainage system that discharges to the Gallo's Brook to the south of the Application Site. In such circumstances, the likely effects, in the absence of mitigation, would be **direct**, **temporary**, **short-term** and of **major significance**.

Operation

Effects to Human Health from Ground Contamination

10.3.8 The groundworks and excavations required to facilitate the Proposed Development (e.g. re-grading of the Application Site) may result in some contaminated Made Ground being capped by the Proposed Development. However in the absence of a site investigation to confirm the contamination status of the Application Site and determine the necessary remedial activities, contaminated soil and made ground may pose a risk to future Proposed Development users. The likely effects in the absence of mitigation could be **direct**, **long term permanent adverse major significance**.

Effects to Controlled Waters from Ground Contamination

10.3.9 The Proposed Development would involve capping of the Application Site with the built development and/or paved areas and the installation of drainage. Therefore potentially contaminated material would be protected from infiltration, preventing the migration of contaminants to the groundwater aquifer. However, if unforeseen contaminated material is reused on the Application Site that was previously capped by current development or paved areas, the contaminants could leachate to underlying

aquifers, effecting their quality. Therefore in the absence of mitigation measures the effect could be **direct**, **long term**, **permanent adverse moderate significance**.

10.3.10 Any hazardous materials kept on the Proposed Site would be stored and maintained in accordance with relevant legislation, which aims to reduce the contamination risks. Whilst accidental spillages cannot be ruled out (for example from the storage of hazardous materials/ and or fuel spillages). The Proposed Development would be designed with the implementation of surface water drainage traps/attenuation where required with appropriate arrangements or discharge and/or collection. This would avoid discharge of any fuels or oils into the underlying groundwater. As such, the likely effects from contamination because of the normal operations to controlled waters at the occupation stage would be **negligible**.

Effects to Building Structure and Services from Ground Contamination

10.3.11 Without undertaking a SI, or developing procedures with respect to unforeseen contamination, potentially contaminated material may still underlie the Application Site at the Operational Development stage. Therefore there is the potential for an adverse effect to on-site buried services. In the absence of mitigation, at worst the likely effect is considered to be **permanent**, **direct**, **long term** and of **moderate adverse significance**.

Likely Effects to Vegetation from Ground Contamination

10.3.12 Without undertaking a SI or developing procedures with respect to unforeseen contamination, potentially contaminated material may still underlie the Application Site at the Operational Development stage. Therefore there is the potential for adverse effects to the vegetation in landscaped area. In the absence of mitigation, at worst the likely effect is considered to be **permanent**, **direct**, **long term** and of **moderate adverse significance**.

10.4 MITIGATION AND ENHANCEMENT

Mitigation by Design

10.4.1 A further intrusive Site Investigation (SI) would be undertaken prior to the demolition and construction works to further quantitatively assess the contamination status of soil and groundwater underlying the Application Site.

10.4.2 The methodology would be agreed in consultation with the EA and Cherwell district Council (CDC) to include:

- Soil sampling and chemical analysis of samples collected from Made Ground and natural deposits;
- Groundwater sampling and chemical analysis of samples collected from the shallow aquifer; and
- Preparation of a Generic Quantitative Environmental Risk Assessment report to further assess the risks identified in the PERA.

10.4.3 The findings of the Generic Quantitative Environmental Risk Assessment (GQRA) would be used to prepare a Remediation Strategy. The strategy would be prepared in agreement with the EA and Cherwell District Council and would detail how identified pollutant linkages would be broken during the construction and development works and during the Application Site's operation. Remedial measures may include, but not be limited to the following:

- Removal of contaminated material from the Application Site;

- Appropriate reuse of material beneath buildings, paved areas of cover systems;
- and
- Treatment of soil prior to reuse or disposal.

10.4.4 A Verification Report detailing the results of testing, audits, as built plans and duty of care documents would demonstrate identified linkages have been broken. This report and would be provided on completion of the Proposed Development.

10.4.5 The Remediation Strategy would also include a requirement that if during the demolition or construction works unforeseen contamination is encountered, the work at that location ceases. Following assessment of the unforeseen contamination, a strategy would be devised to ensure that any identified potential effects to receptors will be mitigated. This may include the removal of the material from the Application Site or appropriate reuse of the material on the Application Site in such a way the identified contamination receptor, pathway is broken.

10.4.6 A Foundation Works Risk Assessment (FWRA) would be prepared, in consultation with the EA and CDC to establish the appropriate foundation design methodology to minimise contamination risks to the underlying Principal Aquifers.

10.4.7 The results of the SI would allow the concrete class of the foundations and the buried structures to be designed to resist ground conditions. Buried services would be designed to resist chemical attack and if required include protective sheathing.

Additional Mitigation

10.4.8 During the Demolition and Construction works, the contractor will be required to take appropriate measures to prevent fugitive emissions. This may include but would not be limited to the following:

- Dust monitoring and taking preventative measures to control dust;
- The provision of adequate drainage to manage surface water run-off and minimise contaminated water reaching the groundwater;
- The handling and storage of any potential hazardous liquids/materials in accordance with relevant legislation and EA pollution prevention guidance;
- The use of appropriately tanked and bunded storage areas for fuels, oils and other chemicals;
- Procedures for the management of materials, spillage and spill clean-up, use of best practice construction methods and monitoring;
- Installation of a wheel wash; and
- Protection of drainage and monitoring of the oil interceptor.

Demolition and Construction with Mitigation

Likely Effects to Human Health from Ground Contamination

10.4.9 The SI and subsequent remediation of the Application Site (as necessary) and employing the above appropriate measures during the demolition and construction phase, would ameliorate all likely significant sources of contamination that are not already removed as part of the normal legislative controls. In addition, during the demolition and construction works, precautions would be taken to minimise the exposure of proposed Site workers and the general public to potentially harmful substances.

10.4.10 Providing the above mitigation measures are implemented, this risk of harm to human health during construction would be low. Therefore, the likely residual effect on

human health during the demolition and construction works would be **negligible**. This would be the case for on-site worker, site visitors and members of the public using the surrounding areas.

Likely Effects to Controlled Waters from Ground Contamination

10.4.11 The previous Hydrogeological Assessment undertaken by Waterman only covered the eastern part of the Application Site. It is considered necessary for additional groundwater sampling to be undertaken at the Application Site as part of the SI. The results of the SI and remediation works (if needed) would influence the type and extent of remedial measures required to break identified source receptor linkages during the demolition and construction phase of works.

10.4.12 Following implementation of the above measures with respect to potential contamination, control of fugitive measures, SI and appropriate site and works management and the preparation of a Foundation Works Risk Assessment, the likely residual effect to controlled waters during demolition and construction would be considered **negligible**.

Likely Effects to Building Structures and Services from Ground Contamination

10.4.13 Based on the results of the SI, the concrete class of foundations and the buried structure would be designed to prevent chemical attack. Specifications of services would be selected and designed using results of the SI. Potable water supply pipes would be selected in accordance with relevant guidance. Providing these measures are adhered to, the likely effect would be **negligible**.

Likely Effects to Vegetation and Services from Ground Contamination

10.4.14 Following completion of the Proposed Development soil in landscaped areas will have been confirmed to be suitable for use. Unsuitable material will have been removed from the Application Site or remediated and subject to appropriate reuse ensuring contamination pathways have been broken. Therefore, likely residual effect of the Operational Development to vegetation would be **negligible**.

Table 10.3: Mitigation

Ref	Measure to avoid, reduce or manage any adverse effects and/or to deliver beneficial effects	How measure would be secured		
		By Design	By S.106	By Condition
1	Site Investigation.			X
2	Foundation Works Risk Assessment.			X
3	Remediation Statement.			X
4	Validation Report.			X
5	Procedures followed during demolition and construction to reduce the effect of fugitive emissions.	X		
7	Procedures to deal with unforeseen contamination.	X		
8	Design of foundations, buried structures and buried services to ensure protection from ground conditions.	X		

9	Design of landscaped areas to ensure suitability for use.	X		

10.5 CUMULATIVE AND IN-COMBINATION EFFECTS

10.5.1 Effects relating to Ground Conditions and Contamination are typically site specific. As such it is considered unlikely that cumulative and in-combination effects would result from the Development and the cumulative schemes. The potential for contamination and associated risks and effects would be identified by the applicants of all cumulative schemes to ensure that each development would be 'suitable for use' in accordance with the mandatory legislative requirements of Part IIA of the Environmental Protection Act, 1990 and planning conditions. An intrusive ground investigation of the Flying Field area to the north concluded the impact of the operation of the NATO air base on the site did not have a significant impact on groundwater quality and the risk to off-site controlled waters was considered not to be significant. The EA reviewed the assessment and agreed with the findings. All demolition and construction activities would also be tightly controlled and managed via the implementation of both relevant legislative requirements and best practice guidance. This would minimise contamination risks and effects to the environment (including human receptors) to acceptable levels. It is assumed that the relevant planning authority has required or would require each of the cumulative schemes to implement a CEMP, where relevant, to avoid potential detrimental effects to and away from potential sources of contamination. The likely demolition and construction related ground conditions and contamination effects would therefore remain as for the Proposed Development in isolation, i.e. **negligible**.

Completed Proposed Development

10.5.2 As noted above, effects relating to ground conditions and contamination are typically site-specific. The Proposed Development and all cumulative schemes would need to adhere to mandatory legislative requirements to ensure that the Proposed Development's end use and the cumulative schemes do not cause unacceptable contaminative activities. Therefore **negligible** cumulative effects are anticipated with respect to ground conditions at the completed Proposed Development stage.

SUMMARY

Introduction

10.5.3 This technical assessment presents an assessment of the likely significant effects of the construction and demolition phase of the Proposed Development and of the Operational Development with respect to ground conditions and contamination. In particular, consideration is given to the likely significant effects of any existing ground contamination on human health and the environment.

Baseline Conditions

10.5.4 The Application Site is part of the former RAF Upper Heyford airbase and currently comprises a former school and associated buildings. The school was previously in use when the airbase was occupied by the United States Air Force (USAF) and is now in a state of disrepair. A pipeline which was used to supply the POL on the flying field to the north crosses the east of the Application Site. A surface water oil interceptor is also located at the southern boundary.

10.5.5 The earliest historical map from 1884 – 1885 shows the Application Site is used as agricultural farmland. This use continues until the early 1900's. It is known that the

construction of former RAF Upper Heyford began in 1916, Upper Heyford was occupied by the Royal Air Force (RAF) throughout World War II (WWII), although the aerial photograph from 1945 does not show the land to be occupied. By 1966 the Application Site is referred to as RAF Upper Heyford and roads and taxiways associated with the flying field to the north are located across the Application Site. In 1974 the Application Site was subject to further development with the building of housing, a water tower, electricity substation and boiler house for families living at the airbase. It is known above ground storage tanks (AST's) and underground storage tanks (UST's) were present at this time. By this period the Application Site and former RAF Upper Heyford were occupied by USAF. The wider airbase underwent further expansion in 1982 and the houses were converted into the 'Upper Heyford American High School' with associated playing fields and baseball pitches. In 1993 operations at the airbase were closed, and the school was no longer occupied. The school buildings, water tower and electricity substation were still present on the 2006 and 2014 Ordnance Survey (OS) maps, but are now in state of disrepair. The POL system and supply pipeline has been cleaned and made safe by this time.

10.5.6 Geology maps and the findings of former Site Investigation (SI) indicate that the Application Site is underlain by made ground underlain by a series of interbedded Limestones, Sandstones and Siltstones of varying thickness which is underlain by a significant thickness of Mudstone.

10.5.7 Hydrogeology at the Application Site can be described as a two aquifer system separated by a Mudstone/Siltstone later of lower permeability. A small stream (Gallo's Brook) adjacent to the southern boundary of the Application Site issues into the River Cherwell. Potential contamination sources on the Application Site includes the likelihood of made ground across the Application Site, contamination present as a result of the Application Site's history including the ASTs and USTs. It is considered that human health, property, controlled water and vegetation are the main receptors. Contamination pathways include direct contact, inhalation and ingestion, migration of contaminants through permeable soils, runoff and spillage.

Likely Significant Effects

10.5.8 It is determined that there would be negligible effect to construction workers from the demolition and construction works. Health and Safety Regulations should be adhered to and appropriate Personal Protection equipment (PPE) and Respiratory Protective Equipment (RPE) worn.

10.5.9 The general public may be exposed to contaminated dust during demolition and construction works. A Construction Environmental Management Plan (CEMP) will be implemented on the Application Site and at worst the likely significant effect is considered to be indirect, short-term and of minor significance.

10.5.10 Controlled waters may be affected during the demolition and construction phase with the introduction of fuels and chemicals to the Application Site and the lifting of ground slabs exposing previously covered contamination. Without appropriate mitigation this effect could be indirect, short-term and of major significance. A CEMP should be implemented during the construction and demolition phase for the appropriate storage of fuels and chemicals.

10.5.11 In relation to the completed Proposed Development without mitigation and due to the Application Site being part of a former airbase and having potentially contaminating sources in both the soils and controlled waters, including potential buried tanks, it is considered that the likely contamination effect on future users as a result of direct contact, inhalation of dust and vapours would be long term, permanent adverse and major significance.

10.5.12 In relation to the completed Proposed Development, without mitigation and due to the Application Site being part of a former airbase, this could create potentially contaminating sources which could affect controlled waters, vegetation and building structures. This would arise as a result of newly exposed contamination previously capped by existing buildings being mobilised and migrating to controlled water and contamination being in direct contact with vegetation in landscaped areas and with buried structures and services. Therefore the effect would be permanent, direct, long-term and of moderate significance.

Mitigation

10.5.13 A SI would be carried out prior to demolition and construction; this would provide the basis for a detailed assessment including a Remediation Strategy. The Remediation Strategy aims to break the pollutant linkages by source pathway-receptor control through mitigation measures.

10.5.14 Mitigation procedures and assessments would likely include the following:

- Procedures for dealing with unforeseen contamination;
- Procedures for the management of materials, spillage and spill clean-up, use of best practice construction methods and monitoring; and
- Preparation of a Foundation Works Risk Assessment (FWRA).

10.5.15 Resulting mitigation actions during demolition and construction would likely comprise the following:

- Removal of contaminated material from the Application Site;
- Advice on appropriate reuse of material beneath buildings, paved areas, and cover systems;
- Dust monitoring and taking preventative measures to control dust during demolition and construction works;
- The provision of adequate drainage to manage surface water run-off and minimise contaminated water reaching the ground;
- The handling and storage of any potential hazardous liquids/materials in accordance with relevant legislation and EA pollution prevention guidance;
- The use of appropriately tanked and bunded storage areas for fuels, oils and other chemicals;
- Installation of a wheel wash; and
- Protection of drainage and monitoring the oil interceptor.

10.5.16 Following implementation and adherence to mitigation recommendations, the contamination risk to identified receptors would be negligible.

Conclusions

10.5.17 As demonstrated following the implementation of appropriate mitigation measures, the effect of contamination on the Proposed Development and future users would be reduced to acceptable levels.

Table 10.4: Summary of Effects, Mitigation and Residual Effects.

Receptor / Receiving Environment	**Description of Effect**	**Nature of Effect** *	**Sensitivity Value** **	**Magnitude of Effect** **	**Geographical Importance** ***	**Significance of Effects** ****	**Mitigation / Enhancement Measures**	**Residual Effects** ****
Construction								
Construction Workers	Contaminated Dust	Direct, Short Term, Temporary	N/A	N/A	L	Negligible	PPE and RPE and legislation to be adhered to	Negligible
Offsite users	Contaminated Dust	Direct, Short Term, Temporary	N/A	N/A	L	Minor adverse	Control measures to mitigate fugitive emissions	Negligible
Controlled Waters	Foundation Design	Direct, Short Term	N/A	N/A	B	Moderate adverse	Control measures to mitigate fugitive emissions	Negligible
Controlled Waters	Exposing contaminant previously capped by buildings and paved areas	Direct, Short Term	N/A	N/A	B	Moderate adverse	Control measures to mitigate fugitive emissions	Negligible
Controlled Waters	Introduction of potential contaminants on the Application Site	Direct, Short Term, Temporary	N/A	N/A	B	Major Adverse	Control measures to mitigate fugitive emissions	Negligible

Operation								
Human Receptors	Future Proposed Development users exposed to contamination	Direct, Long Term and permanent	N/A	N/A	L	Major Adverse	Contaminated material removed or remediated, soil in landscaped areas confirmed suitable for use	Negligible
Controlled waters	Migration of contaminants to controlled waters	Direct, Long Term, permanent	N/A	N/A	B	Moderate Adverse	Removal or remediation of contaminated soil, monitoring of oil interceptor	Negligible
Buried structure and services	Effects of contaminants on buried structure and buried services	Direct, Long Term, Permanent	N/A	N/A	L	Moderate Adverse	design of buried structure and services to account for ground conditions	Negligible
Vegetation	Effect of contaminants on vegetation	Direct, Long Term, Permanent	N/A	N/A	L	Major Adverse	Soil landscaped areas will be confirmed suitable for use	Negligible
Cumulative and In-combination								
Human Health	Future and existing users	N/A	N/A	N/A	L	N/A	N/A	Negligible
Controlled Waters	Migration of contaminants to controlled waters	N/A	N/A	N/A	L	N/A	N/A	Negligible

Buried structure and services	Effects of contaminants on buried structure and buried services	N/A	N/A	N/A	L	N/A	N/A	Negligible
Vegetation	Effect of contaminants on vegetation	N/A	N/A	N/A	L	N/A	N/A	Negligible

Notes:

* Enter either: Permanent or Temporary / Direct or Indirect

** Only enter a value where a sensitivity v magnitude effects has been used – otherwise 'Not Applicable'

*** Enter either: International, European, United Kingdom, Regional, County, Borough/District or Local

**** Enter either: Major / Moderate / Minor / Negligible AND state whether Beneficial or Adverse (unless negligible)