

Bicester Heritage Centre

Phase 1 Land Contamination and Ground Condition Report

**In support of a Planning Application for a Mixed Use
Development at Bicester Heritage Centre, Buckingham
Road, Bicester, Oxfordshire
OX27 8AL**

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Produced by Crestwood Environmental Ltd.

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1 INTRODUCTION

1.1 BACKGROUND

1.1.1 Crestwood Environmental Limited has been instructed by Bicester Heritage Centre (**'the Client'**), to undertake a Phase 1 Land Contamination report to assess the potential of land contamination and ground condition impacts of a proposed Mixed Use Development (**'the Site'**) at the Bicester Heritage Centre, Buckingham Road, Bicester, Oxfordshire, OX27 8AL.

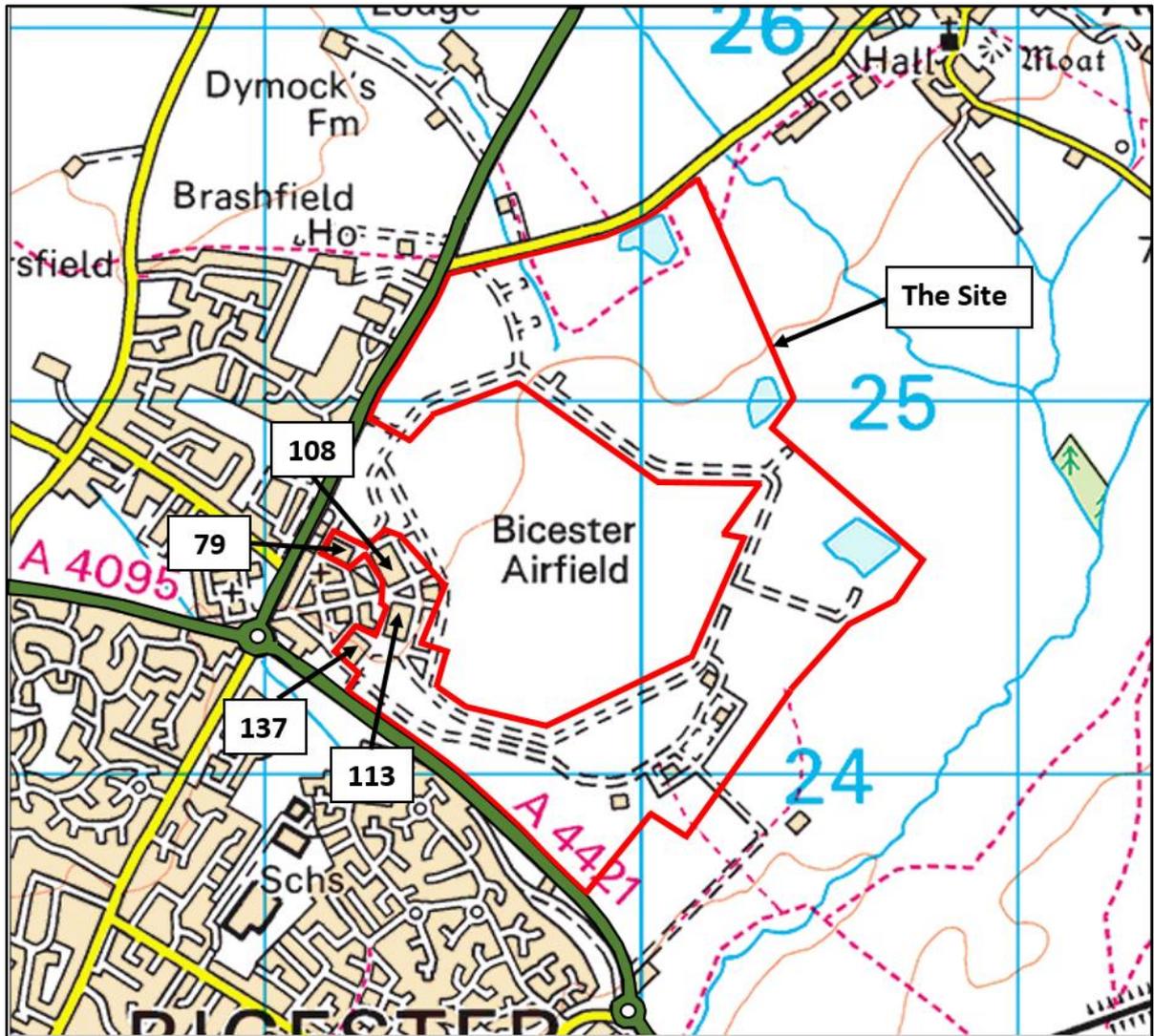
1.1.2 The Site is located partly within and partly adjacent to the Bicester Heritage Centre. It is located around the north western, northern, north eastern , eastern and south eastern peripheries of the former RAF Bicester airfield (the RAF vacated the airfield in 2004 and since then it has been occupied by a local gliding club). The Site comprises former RAF Bicester buildings numbered 79, 108, 113, 137, 108, 121 (enclosed, brick built structures incorporating concrete floors), areas of maintained grassland, former quarried areas, a former ordnance storage depot (which incorporates disused storage bunkers and surrounding blast walls), fishing lakes and areas of wild grasses and scrub.

1.1.3 This Report addresses the environmental quality of the land conditions at the Site and establishes the impact and extent of any potential contamination in addition to any risks they may pose. It accompanies submission of an application for outline permission for a Mixed Use Development.

1.2 THE SITE

1.2.1 The red line boundary shown on Diagram 1 below indicates the extent of the proposed development area (**'the Site'**).

Diagram 1 Site Location and Boundary



- 1.2.2 The Site is currently accessible by road from the A4421 at the entrance to the Bicester Heritage Centre; internal roads then provide further access to the areas of the proposed development.
- 1.2.3 The ground of the Site varies according to former land use. RAF Bicester buildings numbered 79, 108, 113, 137, 108 and 121 are still used for activities and storage associated with the Bicester Heritage Centre. As the buildings are enclosed and incorporate concrete floors there are no pathways to underlying soils and groundwater. Areas of maintained grassland are flat. Former quarried areas have been largely infilled and colonised by wild grasses, flowers and shrubs, although there are various deposits of demolition and construction waste consisting of hardcore, bricks, concrete, bitumen, soils and some scrap metal (mainly steel reinforcing bars). Fishing lakes have been formed in parts of the former quarry site. The ordnance storage depot incorporates various derelict brick built storage depots with surrounding blast walls. Photographs of the Site and ground conditions were taken on 29 May 2018 during a Site Walkover Survey. They are attached as Appendix 1 to this Report.

- 1.2.4 In addition to the town of Bicester to the south of the Site, villages in the vicinity include Caversfield to the north-west, Stratton Audley to the north-east and Launton to the south-east

1.3 THE STUDY AREA

- 1.3.1 The Study Area comprises the planning application boundary for the Mixed Use development and surrounding environs to an extent and distance that might reasonably be judged to constitute source material with potential to impact on the Proposed Development.

1.4 REPORT PURPOSE

- 1.4.1 The purpose of a Phase 1 Land Contamination and Ground Condition Report is to examine and establish the previous uses of the land at and near the Site and to identify potential sources of contamination, receptors and pathways. Information is then examined to indicate which likely source-pathway-receptor relationships can be identified and used to formulate a conceptual model. A Phase 1 report is a staged process involving data collection and interpretation. This is followed by reporting with recommendation of any further investigation which may be necessary.

1.5 LIMITATIONS

- 1.5.1 Crestwood Environmental Ltd have had access to third party data for Phase II Land Quality Assessments and accompanying Technical Notes in consideration of this Phase 1 Report. These intrusive ground investigations were conducted by Carl Bro in 2003 with an updated investigation re-evaluating the findings undertaken in 2008 by Grontmij (formerly Carl Bro). Results of these assessments have been accepted on face value and have not been verified by Crestwood Environmental. We can accept no liability for issues arising out of the accuracy of these results although it is considered unlikely that conditions on Site have altered significantly since these investigations were completed.
- 1.5.2 We have undertaken a basic review of the potential for buried ordnance at the Site. A Preliminary Unexploded Ordnance Risk Assessment of the Site was purchased from Groundsure in June 2018. This reports a Medium Risk of British/Allied unexploded ordnance in proximity to the Site and a low risk of German unexploded ordnance. The 'Phase 2 Land Quality Assessment' prepared by Carl Bro in February 2003 states that the Armament Support Unit carried out an explosive ordnance disposal exercise of the former ordnance storage area prior to intrusive site investigation works being undertaken 2003. However, 'The Land Quality Assessment Phase 2 Technical Note' prepared by Grontmij in June 2008 states that two items of ordnance were identified during the intrusive site investigations of the former ordnance store area and it is considered likely that more ordnance is present in the area.

2 METHODOLOGY AND APPROACH

2.1.1 The Phase 1 Report reviews information using a variety of sources of guidance as a basis, including the Environment Agency's Model Procedures for Management of Land Contamination CLR11 (Environment Agency, 2004), Section 2 of BS5930 (BSi, 2015) and Section 6 of BS10175 (BSi, 2013).

2.1.2 The Crestwood Environmental Ltd. methodology and approach aims to deliver a transparent and objective consideration toward assessment and evaluation of risk. The following process steps are followed to build up a preliminary model:

1. Assess the environmental setting;
2. Identify potential sources of contamination;
3. Identify receptors;
4. Formulate a conceptual model;
5. Assess information to inform likely source-pathway-receptor relationships; and
6. Evaluate risk.

2.1.3 Potential sources of contamination can be categorised according to the level of hazard (i.e. potential to lead to harm or pollution) as classified in Table 1.

Table 1 Classification of sources of contamination

Category	Examples of source potential for causing pollution/harm
Very Low	Greenfield land / Inert fill / made ground.
Low	Residential / office business / retail development on previously greenfield land.
Moderate	Light industry / engineering plant / pre-control landfill (pre mid-1970's).
High	Chemical works / heavy industrial works / non inert landfill (post 1970's).

2.1.4 Receptors can be classified as shown in the Table 2.

Table 2 Categorisation of receptors

Sensitivity	Examples of receptors by category
Very Low	Non-aquifer / low sensitivity watercourse / no WFD issues / no ecological designations / no business or properties.
Low	Minor aquifer / no WFD issues for surface water / industrial premises / low human exposure.
Moderate	Major aquifer / moderately sensitive water course / possible WFD compliance issues / human exposure (business / office).
High	Major aquifer-source protection zone / highly sensitive surface water / WFD compliance issues / SSSI or similar / extensive human access / residential land.

2.1.5 Desk top study, the Site Walkover Survey in 29th May 2018 and previous reports have been used to examine the Site setting, Site history, Site usage (historical and current), geology,

hydrogeology and surface water drainage.

2.1.6 It is recognised that, depending on terrain and characteristics of both source and pathways (including geological atmospheric and hydrological factors), pollutants can potentially migrate away from a source distant to a site and have the potential to create impacts on receptors.

2.1.7 A conceptual model is then created which summarises the overall characteristics of the site under investigation relating the geology, drainage, sources of contamination, pathways and receptors. Assessment is then made of the effectiveness of pollutant linkages in providing a pathway for any identified sources of contamination (hazards) being potentially transferred to a receptor. Pollution linkage is categorised in terms of degrees of likelihood as shown in Table 3.

Table 3 Probability of pollutant linkage

Category	Definition (where pollutant linkage may be present)
High Likelihood	Long-term risk of occurrence almost certain or already evident.
Likely	Long-term risk of occurrence probable.
Low Likelihood	Long-term risk of occurrence possible, without certainty of any occurrence.
Unlikely	Circumstances for harm to occur are improbable.

2.1.8 Risk assessment is then carried out by use of a Risk Model which combines the relationship between the Source of contamination (the Hazard) and the Receptor which can be rated as potential severity of impact (or consequence of effect) categorised from severe to minor. This is shown in Table 4 with definitions of categories of severity.

Table 4 Potential severity of impact

Category	Definition
Severe	Acute risks to human health, catastrophic damage to property, major pollution of controlled waters.
Medium	Chronic risk to human health, pollution of controlled waters, significant damage to property.
Mild	Minor pollution of controlled waters, minor damage to property.
Minor	No measurable effect on humans or property, no observable effect on water quality or ecosystems.

2.1.9 The resulting risk is then evaluated for each receptor by considering the combined effects of potential severity of impact (Table 4) and the likelihood of effective pollutant linkage (Table 3). The overall Risk evaluation is shown in Table 5.

Table 5 Resultant risk

Probability ↓	Potential severity of impact			
	Severe	Medium	Mild	Minor
High Likelihood	Very high	High	Moderate	Moderate - Low
Likely	High	Moderate	Moderate - Low	Low
Low Likelihood	Moderate	Moderate - Low	Low	Negligible
Unlikely	Moderate - Low	Low	Negligible	Negligible

3 SITE HISTORY

- 3.1.1 Reference to historical maps and Groundsure Enviro-Insight Report obtained in June 2018 show records from 1881 and indicates the Site and proximal environs to be predominantly agricultural land adjacent to the Roman Way to the west (now A4421). There is a minor quarry to the south-east of the Site. There is evidence of quarrying in the far north of the Site. Hungerford Farm is shown close to this quarry and also within the Site boundary.
- 3.1.2 On the 1923 map, there are a number of buildings on the western boundary of the Site. The use of these buildings is unmarked. They are no longer shown from 1938 onwards.
- 3.1.3 The 1938 to 1952 map does not show the RAF Bicester building or airfield, which are known to have been in existence at the time (it is assumed that during this time the buildings and infrastructure were not shown on publically available maps for security reasons). The map of 1955 does not show the RAF Bicester buildings either, although the `Airfield` is marked. Hungerhill Farm is no longer shown from 1955 onwards.
- 3.1.4 Maps from 1968 to present day show the RAF Bicester buildings and infrastructure and airfield as correctly represented at the time and as virtually unchanged from present day.
- 3.1.5 It is known that part of the Site was first occupied by the Royal Flying Corps in 1920 and the RAF in 1928. The Site was used as a logistical centre and training facility by the RAF in World War II and thereafter for storage, maintenance, repair and salvage of aircraft and equipment until 1976, when RAF Bicester ceased being an active station. The United States Air Force reopened the facility in 1978 until 1994. However, the airfield continued to be used by the RAF until 2004 (see above).

4 SITE SETTING

4.1 LANDFORM

- 4.1.1 The Site currently forms a portion of the Bicester Heritage Centre (formerly RAF Bicester) and adjacent environs. The Site comprises a largely level topography of 78mAOD predominantly comprising grassland and rather unkempt shrubs, hedgerow and tress. Towards the north and west the landform elevates slightly to 84m AOD and 86m AOD respectively.
- 4.1.2 Landform to the east and north are surrounded by gradually sloping land lowering

marginally from 79mAOD on the Airfield to 73mAOD further towards the Langford Brook and tributaries to the east.

4.2 LOCAL ENVIRONS AND RECEPTORS

4.2.1 Located within a predominantly rural setting, the north, north-east and east of the Site is predominantly bounded by agricultural land, whereas areas to the south and west of the Site are predominantly urbanised.

4.3 GEOLOGY

4.3.1 The British Geological Survey maps (BGS, 2016), for the area indicate that the bedrock geology of the Site predominantly comprises Limestone of the Cornbrash Formation, formed approximately 164 to 168 million years ago in the Jurassic Period. The bedrock geology of the former quarries includes areas of the White Limestone Formation, again formed during the Jurassic Period.

4.3.2 There are no superficial deposits or drift geology recorded that overlie the Cornbrash or the White Marble Formations. Artificial ground and made deposits cover the bedrock strata with infilled ground interspersed locally.

4.4 HYDROGEOLOGY

4.4.1 The bedrock and solid geology of the Cornbrash Formation is designated a Secondary A aquifer of variable permeability which relates to the strata from which water abstractions are viable at some horizons. Yields however are temporally and spatially variable therefore intergranular and/or fracture flow would be moderate with the corresponding permeability modest.

4.4.2 Secondary A aquifers are generally considered to be minor aquifers consisting of permeable strata capable of potentially supporting water supply at a local level rather than a strategic level and in some cases form an integral source of base flow for rivers.

4.4.3 Groundwater flow in the Cornbrash Formation is unconfined and flows in a south easterly direction.

4.4.4 The bedrock and solid geology of the White Limestone Formation, as encountered predominantly in the former quarried areas, is designated a Principal aquifer of high intergranular and/or fracture permeability, usually providing a high level of water storage. It is considered that groundwater in the White Limestone Formation is confined by clay layers in the upper strata.

4.4.5 There are no Source Protection Zones (designated protection zones around public water supply abstractions) within the Site or within a 500m buffer zone.

4.5 WATER ABSTRACTIONS

4.5.1 Table 6 below lists the ten identified historical and active Groundwater Abstraction

Licences that have been granted within a 2km buffer zone of the Site.

Table 6 Groundwater Abstractions

Licence Number	Licence Holder	Point of Abstraction	Annual Volume (m ³)	Use
28/39/14/0291	Brashfield Management Ltd	Brashfield House, Nr Bicester	Not Specified	Household Purposes
28/39/14/0315	Elworthy	Fringford Lodge Farm, Bicester	Not Specified	Household Purposes
28/39/14/0311	O`Neill	Stratton Audley, Bicester	Not Specified	General Farming and Domestic
28/39/14/0034	Sunlight Services Group Ltd	Buckingham Road, Bicester	Not Specified	General Use
28/39/14/0333	Gibbs Holdings Ltd	Buckingham Road, Bicester	Not Specified	General Use
28/39/14/0172	Gosling	Stratton Audley, Broughton	5683	General Farming and Domestic
28/39/14/0322	Deeley	Moat Farm, Caversfield	Not Specified	General Farming and Domestic
28/39/14/0348	W V Malins & Sons	Lords Farm	17520	General Farming and Domestic
28/39/14/0073	P A Evans & Son	Hareleys Farm, Laughton	Not Specified	General Farming and Domestic
28/39/14/0289	P A Evans & Son	Hareleys Farm, Laughton	Not Specified	General Farming and Domestic

4.5.2 There are also two Potable Water Abstraction Licences within 2km of the Site which utilise groundwater as the source. Table 7 below provides details. The nearest potable water abstraction is circa 150m West of the Site boundary at the nearest point.

Table 7 Potable Water Abstraction Licences

Licence Number	Licence Holder	Point of Abstraction	Annual Volume	Use
28/39/14/0291	Brashfield Management	Brashfield House, Nr Bicester	Not Specified	Household Purposes
28/39/14/0315	Elworthy	Fringford Lodge Farm, Bicester	Not Specified	Household Purposes

4.5.3 Within a 2km radius of the Site there is one Surface Water Abstraction Licence recorded, the details of which are shown in Table 8 below.

Table 8 Surface Water Abstractions

Licence Number	Licence Holder /	Point of Abstraction	Annual Volume	Use
28/39/14/0335	PASKIN	West End, Launton (tributary of the River Ray)	Not Specified	Make-Up or Top-Up Water

4.6 SURFACE WATER

4.6.1 Three surface water bodies are located within 1km of the Site. These comprise a spring to the south-east, Audley Brook (a tributary of the Langford Brook) located to the north east, and Langford Brook, which is located to the south east of the Site

4.7 COAL MINING

4.7.1 The Groundsure Report purchased in June 2018 details Coal Authority records and states that there are no coal mining areas or associated brine affected areas within 75m of the Site; likewise there are no non-coal mining activities within 50m of the Site. No records of geological disturbances have been identified and no evidence in Coal Authority documentation of recent coal mining likely to affect the Proposed Development.

4.8 ENVIRONMENTALLY SENSITIVE SITES

4.8.1 Records show that there is a geological Site of Special Scientific Interest, the Stratton Audley Quarries, located within part of the former quarried area of the Site. The Stratton Audley Quarries SSSI is formed of two parts, both located within the Site. The Natural England citation states that a large part of the Jurassic White Limestone, as well as the entire Forest Marble and Lower Cornbrash Limestone were exposed by quarrying. The quarry was an important location for studying facies changes which occur in the upper part of the White Limestone and in the Forest Marble. They were probably deposited as lime muds in restricted, brackish to freshwater lagoons. Natural England records go on to state: *“Both parts of the SSSI are completely submerged. The southern part has been largely infilled with waste material and the remaining area has filled with water so that even if an exposure had been retained along the south or eastern edges of the pit, it is completely inaccessible and there is no visible exposure. The northern part has also completely filled with water to form a large lake.”* It further states there are no practical means of restoring access to the interest feature and therefore the features must be assessed as ‘destroyed’.

4.8.2 There are relatively small isolated pockets of Priority Habitat – Deciduous Woodland within the northern, eastern and south eastern peripheries of the Site. There is a small area of ancient woodland outside the Site, but immediately adjacent to a small stretch of the eastern boundary.

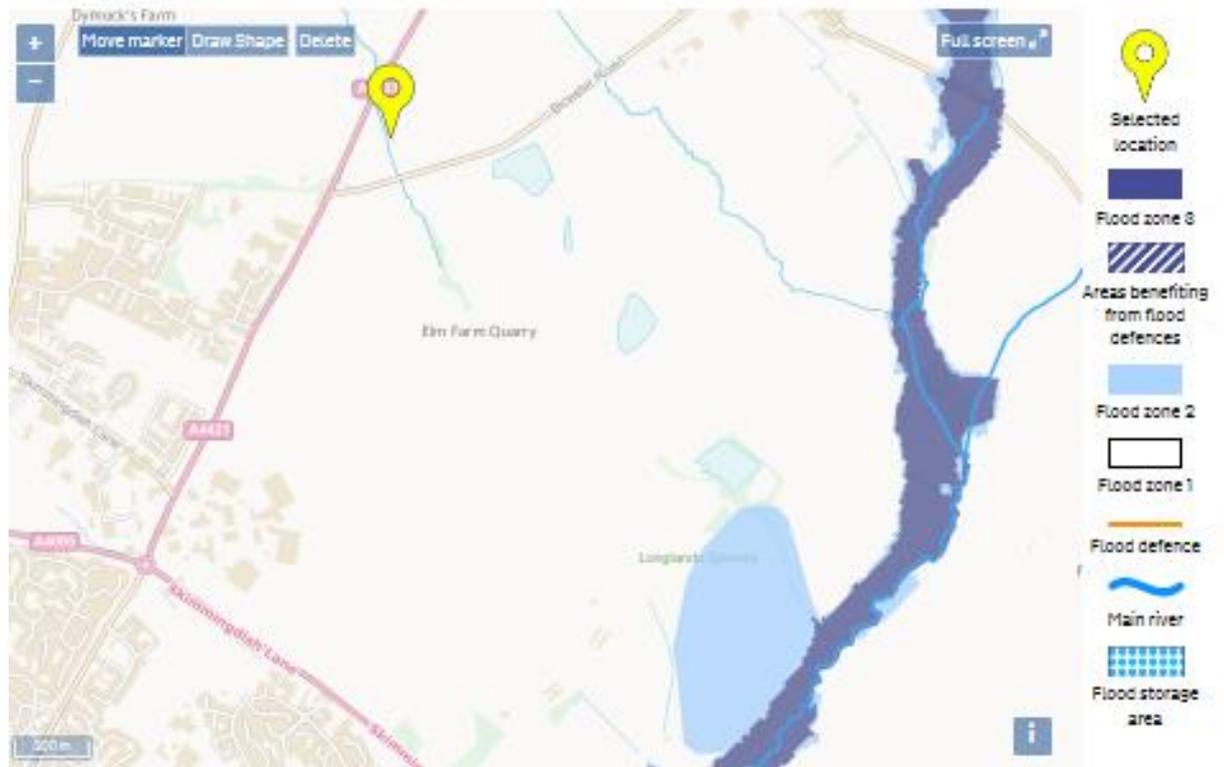
4.8.3 A Local Nature Reserve (LNR), Bure Park, is also located circa 1.8km to the south-west of the Site at the closest point.

4.8.4 Natural England specify that The Upper Thames Tributaries, positioned 1.5km to the south-east are Designated Environmentally Sensitive Areas and, according to DEFRA, the Site itself is sited on an existing Nitrate Vulnerable Zone. No other designated environmentally sensitive sites such as National Nature Reserves (NNR), Special Areas of Conservation (SAC), Special Protection Areas (SPA), World Heritage Sites, Areas of Outstanding Natural Beauty (AONB), National Parks (NP), Green Belt Land or Ramsar Sites occupy any areas within a radius of 2km.

4.9 FLOOD RISK

The Environment Agency's Flood Risk Maps for Planning <https://flood-map-for-planning.service.gov.uk/> places the Site within a Flood Zone 1 where the risk of flooding is less than 0.1% which indicates properties in this location are likely to be at low probability of flooding (less than 1 in 1000 chance of surface water flooding in any given year). When a Site is positioned in Flood Zone 1, a flood risk assessment is not required unless it is greater than 1ha and is unaffected by sources of flooding other than rivers or seas, for instance, surface water drains. The Langford Brook which is aligned to the east and west of the Site is attributed to both medium and high risk of flooding (i.e. Flood Zone 1 and 2) as shown in the map extract below (red circle denotes the location of the Site).

Diagram 2 Flood Risk Map



4.10 RADON

4.10.1 Although the Site is in a Radon Affected Area as defined by the Health Protection Agency

(HPA), the percentage of homes above the Action Level equate to 1 and 3%. Radon Protection measures are therefore not required for new properties or extensions to existing ones in this area as described in publication BR211 by the Building Research Establishment.

5 INTERPRETATION AND ASSESSMENT

5.1 POTENTIAL SOURCES OF CONTAMINATION

- 5.1.1 Previous intrusive site investigation work undertaken in 2002/2003 and 2007 indicated the presence of hydrocarbon and polycyclic aromatic hydrocarbon (PAH) contamination around former RAF Bicester building 113 and nearby buildings 135 and 136, which are just outside the Site boundary). It is considered that contamination is likely associated with former fuel storage and use at the Site.
- 5.1.2 Elevated concentrations of arsenic were encountered in the made ground within the former ordnance storage area, although Carl Bro considered that the area would be suitable for redevelopment for commercial or industrial purposes.
- 5.1.3 Other localised contaminants such as BTEX compounds, metals and phenols were found within the RAF Bicester complex.
- 5.1.4 The potential exists for asbestos to be present in buildings and within any Made Ground where asbestos was present in construction or demolition wastes deposited at the Site. Grontmij (2008) state that a Type 2 asbestos survey was undertaken by AIMS Group Services in June/July 2002. The survey recorded the presence of asbestos within 33 No buildings at the former RAF Bicester facility and recommended that access should be restricted to 10 No buildings until the asbestos containing materials present were made safe. The report recommended asbestos removal in 23 No buildings. However, Crestwood Environmental is not aware if the asbestos survey recommendations have been fully implemented at the Site.
- 5.1.5 The former quarried areas have been used for significant waste infill and near surface evidence indicates that demolition and construction waste, hardcore, bricks, concrete, bitumen, soils and some scrap metal have been deposited (see Appendix 1). The intrusive site investigation works undertaken in 2002/2003 and 2007 did not include the former quarry areas. Other parts of the Site, particularly in the vicinity of the former RAF Bicester buildings and the ordnance storage area have been subject to detailed intrusive site investigation and it is considered that ground conditions in these areas are unlikely to have changed significantly since the previous work was undertaken.
- 5.1.6 At this stage, any locations or features from which there may be a potential source of contamination, i.e. a hazard which in certain circumstances could cause harm or pollution, are identified in Table 9.

Table 9 Identification of potential sources and associated pollutants

	Source	Associated Contaminants
Historic Sources	Construction of buildings	Asbestos
	Waste deposits in former quarried areas	Unknown, potential for asbestos, BTEX compounds, PAH`s, TPH`s and metals
	Fuel Storage / Use of solvents & oils etc	BTEX compounds, PAH`s, TPH`s and metals
Current Sources	None	Persistent contaminants

5.1.7 The Groundsure Report (June 2018) records a Category 3 ‘Minor’ pollution incident in September 2002 at the former quarried area due to a diesel spillage.

5.2 RECEPTORS

5.2.1 The Receptors for consideration within the Site are:

- Construction-related operatives, during development of the Site;
- Future use workers/residents of the proposed development;
- Ecological systems;
- Groundwater beneath Site;
- Surface water on or in the vicinity of the Site; and
- Buildings at Site.

5.3 CONCEPTUAL MODEL

5.3.1 A conceptual model is a descriptive/diagrammatic representation of the subject site which examines both above and below ground aspects and which identifies and considers surrounding areas for potential impacts on the subject site. To do this potential sources of contamination (hazards) are identified, the pathways for possible transmission of contaminants are considered and the potential receptors are identified.

5.3.2 At the Phase 1 site investigation stage, the conceptual model is based upon a preliminary site walkover and a desk based study examining the evidence compiled from historical surveys and available data searches described in previous sections.

5.3.3 A descriptive representation of the model is presented in Table 10 below which identifies the pollutant (hazard), the possible pathway, the potential receptor and the risk.

Table 10 Conceptual Model (Descriptive)

Pollutant (Hazard)	Receptor	Pathway	Potential Risk	Justification
Elevated levels of benzene, toluene and xylene, PAH's, TPH,'s, arsenic, cadmium, nickel, copper and zinc	Humans (current use)	Inhalation, ingestion and direct contact	Low	Due to localised extent of contamination and nature of current land use
	Humans (future commercial use)	Inhalation, ingestion and direct contact	Low	Exposure will be limited by hardstanding
	Humans (during development)	Inhalation, ingestion and direct contact	Moderate-Low	H&S Procedures and use of PPE will mitigate against exposure
	Groundwater (Minor Aquifer)	Migration through unsaturated zone and shallow groundwater	Moderate -Low	Localised contamination within Minor Aquifer. Impermeable clay layers will impede migration into Major Aquifer
	Groundwater (Major Aquifer)	Likely flow is prevented by low permeability layer	Low	Impermeable clay layers will impede migration into Major Aquifer
	Groundwater (during development)	Migration through unsaturated zone and shallow groundwater	Moderate-Low	Management of run-off and limit the time excavations remain open and exposed
	Surface Water (Langford and Audley Brook)	Migration from shallow groundwater and leaching from soils	Low	Distance from the Site allows contaminant dilution
	Surface Water (Spring)	Migration from shallow groundwater and leaching from soils	Moderate-Low	Distance from the Site allows contaminant dilution
Asbestos	Humans (current use)	Airborne, leading to inhalation	Moderate-Low	Risks to people should be managed by appropriate health and safety provisions
	Humans (future commercial use)	Airborne, leading to inhalation	Moderate-Low	Risks to people should be managed by appropriate health and safety provisions
	Humans (during development)	Airborne, leading to inhalation	Moderate-Low	Risks to people should be managed by appropriate health and safety provisions
Unexploded ordnance	Humans (current use)	Ground and shock waves through air	Moderate-Low	Ordnance disposal exercise previously carried out in the ordnance storage area by Armament Support

Pollutant (Hazard)	Receptor	Pathway	Potential Risk	Justification
				Unit. No visual evidence on ground of unexploded ordnance.
	Humans (future commercial use)	Ground and shock waves through air	Moderate-Low	Ordnance disposal exercise previously carried out in the ordnance storage area by Armament Support Unit. No visual evidence on ground of unexploded ordnance.
	Humans (during development)	Ground and shock waves through air	Moderate-Low	Ordnance disposal exercise previously carried out in the ordnance storage area by Armament Support Unit. No visual evidence on ground of unexploded ordnance.

5.4 MIGRATION PATHWAYS

5.4.1 The pathways for consideration which might allow transfer (migration) of potentially harmful pollutants between source and receptors are:

- From made ground and soil deposits beneath the Site;
- Airborne emissions of dust and fibres;
- Lateral migration through geological strata and groundwater.

5.4.2 It is noted that in addition to the contamination being very localised there are impermeable strata horizons within the minor aquifer and separating it from the major aquifer. As a consequence the likelihood of vertical migration is reduced making it unlikely that there is an effective connective pollutant linkage to the major aquifer. Any contamination of the minor aquifer is likely to migrate with filtration to surface waters.

5.5 PRELIMINARY RISK ASSESSMENT

5.5.1 The assessment and preliminary evaluation of risk from the information gained through desk study and the Site Walkover Survey on 29 May 2018 have been used to identify potential risk, as set out in Table 11. This sets out the relationships between source and receptor and combines potential severity of impact and likelihood of the event occurring. This is then summated into an overall preliminary risk assessment, referencing the Resultant Risk Matrix (see Table 5).

Table 11 Preliminary Phase 1 Risk Evaluation

Source	Pathway	Receptor	Severity	Probability	Risk
Ground gas from natural strata	Migration in to excavations	Site workers	Severe	Unlikely	Low
	Migration in to properties	Occupiers	Severe	Unlikely	Low
Ground gas from made ground & waste deposits	Migration in to excavations	Site workers	Severe	Low	Mod / Low
	Migration in to properties	Occupiers	Severe	Low	Mod / Low
Asbestos in buildings and made ground deposits	Inhalation of asbestos fibres	Site workers	Severe	Low	Mod / Low
	Inhalation of asbestos fibres	Occupiers	Severe	Low	Mod / Low
Petroleum hydrocarbon compounds and associated organic and volatile organic compounds within shallow soil	Inhalation of vapour	Site workers / Occupiers	Severe	Low	Mod / Low
	Ingestion and absorption		Severe	Low	Mod / Low
	Migration by liquid flow	Surface water	Minor	Unlikely	Negligible
		Groundwater	Mild	Low	Low
	Plant uptake	Ecosystems	Minor	Unlikely	Negligible
Solvents and degreasing agents associated with vehicle/aircraft maintenance	Migration in to excavations	Site workers	Severe	Unlikely	Low
	Migration in to properties	Occupiers	Severe	Unlikely	Low
	Migration by flow	Groundwater	Minor	Unlikely	Negligible
	Migration by flow	Surface Water	Minor	Unlikely	Negligible

6 CONCLUSION

- 6.1.1 There is evidence to suggest that localised areas of the Site in the vicinity of the former RAF Bicester building 113 and the ordnance storage area may contain some contamination, as identified during previous intrusive site investigations in 2002/2003 and 2007. It is not known whether contamination concentrations encountered at the time have diminished in the intervening years, although it is considered unlikely that there would have been significant additional contamination, as military operations at the Site ceased in 2004.
- 6.1.2 Principally, this contamination is associated with historic fuel storage, although during the Site Walkover Survey on 29 May 2018 there was no visual or olfactory evidence of contamination.
- 6.1.3 In terms of petroleum hydrocarbons potentially migrating through the ground and affecting the Site, there is a recorded spillage at RAF Bicester building 113. Assessment of the hydrological regime indicates that over time, any spillages would drain into the shallow groundwater to be eventually discharged into surface water bodies. There is no evidence of any impact on local surface water, consequently this consideration is rated as low risk.
- 6.1.4 Crestwood Environmental is not aware if the former quarry area at the Site has been subject to intrusive site investigation. As extensive waste infilling has incurred at the former quarry and it is apparent that that demolition and construction waste, hardcore, bricks,

concrete, bitumen, soils and some scrap metal have been deposited it may be prudent to carry out Phase 2 site investigation of the area.

- 6.1.5 The assessment undertaken is a preliminary Phase 1 study which is intended to give an indication of conditions within the Site. On this basis, the risk of the proposed development being adversely affected by the condition of the land has been considered qualitatively based upon walkover survey and desk study. Assuming that any asbestos in buildings or asbestos contamination of the made ground is adequately controlled through proper health and safety procedures, it is considered unlikely that ground conditions or potential pollutant sources identified would have any significant impact on industrial or commercial development and the associated receptors identified, although some additional Phase 2 site investigation of the former quarry is likely to be required.

7 SUMMARY

- 7.1.1 A review of the Site setting and available information has been undertaken in relation to proposed development of the Mixed Use Development. The review has been further developed into an assessment of a source-pathway-receptor model.
- 7.1.2 The main sources of pollutants identified as having the potential to impact receptors at the Site were determined as the residual substances from aircraft maintenance, fuel storage and the construction of buildings. The fuel spillage in the vicinity of the RAF Bicester building 113 is a potential contributor to contamination. In addition, there may be isolated pockets of asbestos fibre contamination in the Made Ground of the ordnance storage area. Crestwood Environmental is unaware of the present day potential for asbestos in the old RAF Bicester buildings, although it is known that buildings have been subject to asbestos survey in the past and recommendation for asbestos removal.
- 7.1.3 The former quarry area has been extensively tipped and there is visual evidence of demolition and construction waste, hardcore, bricks, concrete, bitumen, soils and some scrap metal. Whether or not these waste materials are contaminated is unknown, as is the potential for historic waste deposits to give rise to landfill gas.
- 7.1.4 There is no indication of intensive farming practice affecting the Site which might otherwise affect the ground condition present.
- 7.1.5 Although the identified contaminants may persist for many years, the pathways for vertical migration from the Site are restricted by impermeable bedrock horizons. There is a possibility of lateral migration of contaminants in shallow groundwater, albeit this is seen as low risk.
- 7.1.6 Of particular importance in terms of risk is the redevelopment phase which potentially poses the greatest extent of exposure. However, with appropriate H&S procedures and PPE, the impacts are reduced significantly. Once construction is completed, the impermeable hardstanding surfaces will limit the pathway effectiveness of contamination source to receptors.

Appendix 1 Photographs

Plate 1 **RAF Building No 137**



Plate 2 **RAF Building 113**



Plate 3 **RAF Building No 79**



Plate 4 **Concrete Hardstanding External to RAF Building**



Plate 5 **Concrete Hardstanding Internal to RAF Building**



Plate 6 **Concrete Hardstanding External to RAF Building (Looking Towards Airfield)**



Plate 7 ***Liquefied Petroleum Gas Storage Tank***



Plate 8 ***Grassland Areas on Western Site Boundary***



Plate 9 ***Grassland Areas Near Western Site Boundary***



Plate 10 ***Grassland and Shrub Colonisation of Former Quarry***



Plate 11 **Wild Flower Colonisation of Former Quarry**



Plate 12 **Waste Deposits in Former Quarry**



Plate 13 **Waste Deposits in Former Quarry**



Plate 14 **Waste Deposits in Former Quarry**



Plate 15 **Scrap Metal Deposits in Former Quarry**



Plate 16 ***Large Waterbody in Former Quarry***



Plate 17 ***Fishing Lake in Former Quarry***



Plate 18 **Entrance to Former Ordnance Storage Area**



Plate 19 **Building Within Former Ordnance Storage Area**



Plate 20 ***Building Within Former Ordnance Storage Area***



Plate 21 ***Blast Walls Within Former Ordnance Storage Area***

