Chapter 1
Ground Conditions and Soils

Milton Keynes East Environmental Statement

Chapter I: Ground Conditions & Soils

March 2021

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I1.0 Introduction

I1.1 This Chapter forms part of the Milton Keynes East Environmental Statement ('ES') which sets out the findings of an Environmental Impact Assessment ('EIA') of the proposed development of a sustainable urban extension to Milton Keynes. It relates to land to the east of the M1 motorway and to the south of Newport Pagnell. A description of the background to the proposal; the relationship of this chapter to the wider ES; and a description of the Development Site and the development is provided at Chapters A to C of this ES.

I1.2 This Chapter reports the outcome of the assessment of likely significant environmental effects arising from the Proposed Development in relation to ground conditions and soils.

I1.3 This Chapter, and its associated appendices, is intended to be read as part of the wider ES with particular reference to the introductory chapters of this ES (Chapters A - C), as well as Chapter P: Cumulative Effects Assessment.

I1.4 The Chapter should be read alongside the following appendix provided in Volume 2 to this ES:-

- Appendix I1 - WSP (2021) Geo-Environmental Preliminary Risk Assessment, Milton Keynes East.

About the Author

I1.5 This Chapter of the ES has been prepared by the Ground & Water Team at WSP which has completed many assessments of this kind previously. This Chapter was written and checked by competent professionals comprising chartered members of the Institution of Environmental Sciences (IES) and Geological Society of London.

Table I1.1 About the Author

Technical Area:	**Chapter I Ground Condition and Soils**	
	Lead Author	**Reviewer**
Name	Roisin Lindsay	Reena Gohel
Qualifications / Accreditations relevant to technical area and EIA:	MSc Environmental Hydrogeology Chartered Environmentalist (MIEnvSC CEnv)	BSc (Hons) Geology Chartered Geologist (CGEOL FGS)
Years technical experience:	10 years	17 years

I2.0 Policy Context

Legislative Framework

National Policy and Legislation

I2.1 The applicable legislative framework is summarised as follows:

1 The Environmental Protection Act (EPA) (1990): Part 2A Section 78 (HMSO, 1990)[Ref 1];

2 The Environment Act (HMSO, 1995) [Ref 2];

3 Control of Substances Hazardous to Human Health Regulations (As Amended) (HMSO, 2002) [Ref 3];

4 The Contaminated Land Regulations (HMSO, 2012a) [Ref 4];

5 The Control of Asbestos Regulations (HMSO, 2012b) [Ref 5];

6 The Construction (Design & Management) Regulations (HMSO, 2015a) [Ref 6].

7 The Environmental Damage (Prevention and Remediation) (England) Regulations (HMSO, 2015b) [Ref 7];

8 The Environmental Permitting Regulations (HMSO, 2016) [Ref 8];

9 The Water Environment (Water Framework Directive) (England and Wales) Regulations (HMSO, 2017) [Ref 9];

10 The Groundwater Directive 2006/118/EC [Ref 10]; and

11 Water Resources Act (1991) [Ref 11].

I2.2 The following applicable guidance documents have been used during the preparation of this Chapter:

12 National Planning Policy Framework (NPPF) 2019 Paragraphs 178 to 180 [Ref 12];

13 Land Contamination Risk Management (LCRM), Environment Agency (2020) [Ref 13]; and

14 R & D 66 'Guidance for the Safe Development of Housing on Land Affected by Contamination' (2008) (R&D 66) [Ref 14].

Regional Policy

I2.3 No regional policy information relevant to Ground Conditions and Soils is currently published by Buckinghamshire County Council.

Local Policy

I2.4 MKC adopted a new Local Plan in March 2019 known as 'Plan:MK' [Ref 15]. Of relevance to this assessment are the following policy:

i. <u>Policy ER7 Controlling the Risk of Pollution:</u>

"Planning permission will be granted for development if all of the following criteria are met:

1. Ground water, surface water and soil are protected

2. Suitable controls are proposed to deal with air pollution and noise

3. Suitable controls are proposed to deal with vibration, smell, fumes, smoke, soot, ash, dust grit, gases, heat ,light and visual intrusion

4. The site and surrounding land are protected from contamination

5. The proposed use is compatible with existing or potential surrounding uses."

I2.5 MKC has published a number of policy and guidance documents relevant to Ground Conditions and Soils as follows:

- Contaminated Land Inspection Strategy (August 2001) [Ref 16]. This document details how the Council aims to fulfil its statutory duty to inspect all land in its area for possible contamination under the legislative framework.
- Contaminated Land Strategy (August 2001) [Ref 17]. The document details the Council's strategy, objectives and priorities to manage contaminated land in the context of sustainable development and how the Council's contaminated land inspection strategy will be carried out.
- Development on Potentially Contaminated Land and/or For a Sensitive End Use: Technical Guidance for Planning Applicants and Developers (August 2008, last updated September 2018) [Ref 18]. The document provides guidance to developers submitting planning applications for land which may be affected by contamination or has sensitive end users.
- MKC has published a Contaminated Land Register however this has not been updated since January 2013 [Ref 19].

Other Guidance

I2.6 Other relevant guidance is as follows:

1 Health and Safety Executive (HSE) (1991) Guidance Note HS (G) 66, Protection of Workers and the General Public during the Development of Contaminated Land [Ref 20];

2 CIRIA C532 (2001) Control of Pollution from Construction Sites [Ref 21];

3 HSE (2006) INDG258 Safe Work in Confined Spaces [Ref 22];

4 CIRIA C665 (2007) Assessing Risks Posed by Hazardous Gases to Buildings [Ref 23];

5 CIRIA C682 (2009) The VOCs Handbook [Ref 24];

6 BS 10175:2011+A2 (2017) Investigation of Potentially Contaminated Sites – Code of Practice [Ref 25];

7 DEFRA, Contaminated Land Statutory Guidance April 2012 [Ref 26];

8 BS 8576 (2013) Guidance on Investigations for Ground Gas – Permanent Gases and Volatile Organic Compounds [Ref 27];

9 CIRIA C552 (2001) Contaminated Land Risk Assessment. A Guide to Good Practice [Ref 28]; and

10 CIRIA C733 (2014) Asbestos in soil and made ground: a guide to understanding and managing risks [Ref 29].

I3.0 Assessment Methodology & Significance Criteria

Assessment Methodology

Methodology

I3.1 Risks arising from land potentially affected by contamination have been assessed with due regard to Part 2A [Ref 1], guidance from land contamination risk management set out in LCRM [Ref 13], NPPF [Ref 12] and CDM 2015 [Ref 6].

I3.2 Potential sources and receptors have been identified following a desk study review and ground investigation in order to assess the possibility for land to be contaminated, thereby enabling an evaluation of the potential for pathways to exist between them to form complete contaminant linkages under baseline conditions, during construction and during operation of the Proposed Development.

I3.3 The likely significance of the risk for each plausible linkage has then be assessed to determine the beneficial and adverse effects of the Proposed Development against baseline conditions. The ground investigation has been used to establish if the Development Site is suitable for the Proposed Development (as required under NPPF [Ref 12]) and that a minimum would not be determinable as 'contaminated land' under Part 2A [Ref 1].

Significance Criteria

I3.4 Potential land contamination will be assessed with due regard to the NPPF [Ref 12], Part 2A [Ref 1], best practice guidance from land contamination risk management set out in LCRM [Ref 13] and in R&D 66 [Ref 14].

I3.5 The significance criteria have been derived in general accordance with R&D 66 [Ref 14]. The guidance was specifically developed to assess risks from land contamination for housing, but its principles are more widely applicable to other land uses. Each contaminant linkage will be assessed according to the probability and severity of likely impact. Table I3.1 resents the classification of consequence (magnitude) that has been modified from R&D 66 [Ref 14] and takes into account the potential severity of the hazard through the likely nature and extent of the likely contaminants of concern and the sensitivity of the receptor. Table I3.2 presents the classification of likelihood (probability) for the plausible contaminant linkages that are identified and takes into account the presence of the hazard and receptor and the integrity of the plausible pathway.

Table I3.1 Classification of Magnitude of Effect

Magnitude of Effect	Example Criteria
Large	Change in soil quality or ground gas regime for a large area (>20ha) of land, sufficient to alter land use (e.g. remediation of 20ha of industrial land sufficient to enable mixed residential / commercial use). Change in groundwater conditions sufficient to change aquifer use (e.g. contamination that prevents abstraction for potable supplies, or remediation of impacted aquifer sufficient to enable potable abstractions). Generation of large volumes of non-inert waste materials for disposal off-site to landfill.

Magnitude of Effect	Example Criteria
Medium	Change in soil quality or ground gas regime for a moderate area of land (<20ha) to a degree sufficient to alter land use in localised portions of the Site or to a degree requiring a change in management / mitigation measures for Site use. **Change in groundwater conditions that may be sufficient to change local groundwater regime and potential aquifer uses (e.g. localised contaminant impact, localised change in groundwater levels).**
Small	Measurable but relatively small-scale change in an area of contaminated land or ground gas regime, but insufficient to alter end land use. Change in groundwater conditions that are insufficient to change status or potential use of the water body.
Negligible	Very limited mass of contamination mobilised – just detectable. Very limited change in area of agricultural land. Very limited barely discernible change to groundwater regime.

Table I3.2 Classification of likelihood (probability) for ground conditions and contamination

Category	Definition
High likelihood	Harm or pollution very likely in the short-term, almost inevitable in the long term, or there is already evidence of harm or pollution to the receptor.
Likely	Probable that harm or pollution will occur but not inevitable.
Low likelihood	Possible that harm or pollution could occur, but not certain.
Unlikely	Circumstances under which harm or pollution would occur are improbable.

I3.6 The significance level attributed to each effect has been assessed based on the sensitivity/value of the affected receptor(s) and the magnitude of change arising from the Proposed Development, as well as a number of other factors that are outlined in more detail in Chapter B: Scope and Methodology. Risk, probability and consequence inform the magnitude of change (CIRIA C552 guidance; [Ref 28].

I3.7 Table I3.3 indicates the general approach taken in determining the sensitivity of identified receptors as part of this assessment. The 'Negligible' sensitivity category has been removed as it is deemed irrelevant, as no receptor (in terms of ground conditions and contamination) is classed as negligible.

Table I3.3 Classification of Sensitivity

Sensitivity	Criteria	Examples
High	Receptor has a high quality and / or rarity on local scale	Construction and maintenance workers (where extensive earthworks, and demolition of buildings are proposed); and Groundwater aquifers currently used, or likely to be suitable for use as public potable supplies (e.g. Principal Aquifers, Source Protection Zone for a potable groundwater supply), such as the Principal Aquifer; and Controlled water bodies with national or international ecological designations.
Medium	Receptor has a medium quality and / or rarity on local scale	Construction workers (where limited earthworks, are proposed); Groundwater aquifer providing abstraction water for agricultural or industrial use (groundwater); Commercial landscaping or open space areas; and Buildings, including services and foundations.

Sensitivity	Criteria	Examples
Low	Receptor has a low quality and / or rarity on local scale.	Construction and maintenance workers (Minimal disturbance of ground); Unproductive strata (groundwater) such as Made Ground; No local surface water features; and Infrastructure (roads, bridges, railways).

I3.8 Significance criteria have been developed based on professional judgement, best practice guidance and relevant experience. They are determined using the matrix based on magnitude of change and the sensitivity of the receptor, with the likely duration of the effect and likelihood of the effect occurring also considered when assessing each effect.

I3.9 The sensitivities which may affect a potential receptor have been assigned based on professional judgement and experience. Factors that may affect the sensitivity of the likely receptor include:

1 Age, weight, sex, duration on-site and distance from the Site. (Human receptors).

2 Distance from the Site and resource potential. (Controlled Waters receptors).

Effect Significance

I3.10 As set out in Chapter B: Scope and Methodology, effects are considered to be 'significant' where the results of the magnitude and sensitivity equate to a moderate or major adverse or beneficial effect. Significance has been determined based upon professional judgement.

I3.11 Table I3.4 describes the terms that have been used to define the significance of the effects identified based upon professional judgement.

Table I3.4 Defining Significance of Effects Criteria

Criteria	Description
Substantial Adverse	High risk site classification – acute or severe chronic effects to human health and / or animal / plant populations predicted. Effect on a potable groundwater or surface water resource of regional importance e.g. Principal Aquifer, public water reservoir or inner protection zone of a public supply borehole.
Moderate Adverse	Medium risk site classification and proven (or likely significant) pollutant linkages with human health and / or animal / plant populations, with harm from long-term exposure. Effect on a potable groundwater or surface water resource at a local level e.g. effect on an outer groundwater Source Protection Zone. Temporary alteration to the regional hydrological or hydrogeological regime or permanent alteration to the local regime.
Minor Adverse	Medium 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, etc.
Negligible	Low risk site classification – no appreciable effect on human, animal or plant health, potable groundwater or surface water resources.
Minor Beneficial	Risks to human, animal or plant health are reduced to acceptable levels. Local scale improvement to the quality of groundwater or surface water resources used for commercial or industrial abstraction.
Moderate Beneficial	Significant reduction in risks to human, animal or plant health, to acceptable levels. Significant local improvement 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.

Criteria	Description
Substantial Beneficial	Substantial reduction in risks to human, animal or plant health. Significant regional scale improvement to the quality of potable groundwater or surface water resources.

I3.12 A summary of the significance matrix can be seen in Table I3.5.

Table I3.5 Matrix for Determining the Significance of Effects

		Magnitude of Change/Effect			
		Large	**Medium**	**Small**	**Negligible**
Sensitivity of Receptor	**High**	Substantial	Moderate to Substantial	Minor to moderate	Negligible
	Medium	Moderate to Substantial	Moderate	Minor	Negligible
	Low	Minor to Moderate	Minor	Negligible to Minor	Negligible
	Negligible	Negligible	Negligible	Negligible	Negligible

Consultation

I3.13 Table I3.6**Error! Reference source not found.** provides a summary of the consultation activities undertaken in support of the preparation of this chapter.

Table I3.6 Summary of consultation undertaken in support of this chapter

Body / organisation	Individual / stat body / organisation	Meeting dates and other forms of consultation	Summary of outcome of discussions
Milton Keynes Council	Nicola Adshead Practitioner - Environmental Health	Request for pertinent information submitted 23/07/2020	Response received 10/03/2021. No areas of the Development Site, or within 500 metres of the Development Site, have been determined as contaminated land as defined under Part 2A of the Environmental Protection Act 1990. MKC currently have no evidence to suggest that the Development Site could be determined as contaminated land. No areas of the Development Site have been identified for inspection as part of Milton Keynes Council's contaminated land inspection strategy. Within 500 metres of the Development Site there are 3 Industrial Estates. We have no reason to believe that the Development Sites are not suitable for their current use and have no evidence to suggest they could impact on the Development Site in question. Details for a number of tanks, most notably: a record for a petroleum licence held by Hermitage Farm (south of the Development Site) for a 500-gallon petroleum tank, converted to a diesel tank license in 1995. Unknown as to whether the tank is still operational or whether it is above or below ground.

Body / organisation	Individual / stat body / organisation	Meeting dates and other forms of consultation	Summary of outcome of discussions
			Two further locations surrounding the Development Site boarder were identified as infilled ground (south and north west of the Development Site). There are a number of small sites surrounding the Development Site that have had minor contamination requiring remediation mitigation to satisfy planning conditions following a change of use. These sites are described by the Council as not considered likely to have an impact on the Development Site.
Environment Agency	Customers and Engagement Officer	Request for pertinent information submitted 23/07/2020	Response received 20/08/2020. The EA stated that they do not hold any records for soil or groundwater contamination or remedial works beneath the Development Site or within a 250 m radius, they hold no records of spills or leaks from above ground storage tanks, and not have any water quality monitoring sites within a 1 km radius of specified site.

Scope of the Assessment

I3.14 The scope of this chapter has been established through a scoping process. Further information can be found in Chapter B: Scope and Methodology.

I3.15 The EA's guidance LCRM (2020) [Ref 13] advocates the use of a conceptual risk assessment model (Conceptual Site Model). The basis of this approach comprises three elements: a source, a pathway and a receptor. Further details of this methodology are provided in paragraphs I3.1 to I3.3

I3.16 The potential effect of the Proposed Development on ground conditions, and/or the effect of ground conditions on the Proposed Development, has been assessed during Construction. The significance level attributed to each effect has been assessed based on the magnitude of change due to the Proposed Development and the importance/sensitivity of the affected receptor / receiving environment to change.

I3.17 Elements Scoped out of the Assessment. The following elements are not considered to give rise to likely significant effects as a result of the Proposed Development and have therefore not been considered within this ES.

During Operation

I3.18 It is anticipated that any contaminants found during construction will be remediated in line with the proposed uses. It is assumed that clean cover layers (and any imported material), if required, will be validated for depth and chemical quality prior to occupation. This negates the requirement for consideration of potential impacts to future site users, adjacent site users and plants during operation of the Proposed Development. Therefore, the potential exposure of future site users, adjacent site users, plants and potable water supply to contamination during operation will be insignificant and will not be assessed within this assessment.

I3.19 It is assumed that any potential affects arising from ground gas (including radon and volatile vapours) will be appropriately mitigated prior to the completion of the construction phase. Therefore, the potential for the presence of ground gas to pose an increased risk to future site users (explosive and asphyxiant) during operation is considered to be insignificant and will not be assessed within the Ground Conditions and Soils chapter.

Elements Scoped into the assessment

During Construction

I3.20 The following elements are considered to have the potential to give rise to potential significant effects during construction of the Proposed Development and have therefore been considered within this assessment. Potential significant effects during the Construction Phase include:

1 Potential effect on construction workers from pre-existing contamination within the underlying soils (if present);

2 Potential effect on adjacent sensitive site users from potential contamination within the underlying soils during construction activities; and

3 Potential effect on Controlled Waters during construction activities.

I3.21 This chapter sets out the assessment of the potential effects from chemical contamination on Controlled Waters. Potential effects relating to physical contamination (i.e. sediment) and changes to groundwater recharge and flow will be considered within the Water Resources and Flooding Chapter.

Extent of the Study Area

I3.22 The Study Area considered for the purpose of this assessment will comprise the Site and surrounding area within 250m. This distance has been used based on professional judgement in general practice and it is considered that within this radius the surrounding area may be affected by or may affect the Site. This distance is extended up to 1km from the Site boundary when considered potential effects to groundwater source protection zones.

Method of Baseline Data Collation

Desk Study

I3.23 Data for the baseline conditions at the Development Site was taken from the Preliminary Risk Assessment (PRA) [Ref 30] provided in Appendix I1. The desk study includes a Groundsure Insights Report (Ref: GSIP-2020-10326-1095) which is also included within Appendix I1.

I3.24 Information has been requested from the MKC Environmental Health Officer and the Environment Agency to supplement this baseline information. The information provided by these consultees has been reviewed and is not considered to alter the assessment of the baseline conditions.

Site Visit and Surveys

I3.25 A walkover of the Site was carried out on 11th February 2020 by representatives of WSP undertaking the PRA report.

Assumptions and Limitations

I3.26 To ensure transparency within the EIA process, the following limitations and assumptions have been identified:

1 The work undertaken to provide the basis of this assessment comprised a study of available documented information from a variety of sources and discussions with relevant authorities and other interested parties.

2 Although the works of third parties has been used to inform this chapter, WSP cannot warrant the work of third parties.

3 It should be noted that any risks identified in this chapter are perceived risks based on the information reviewed; actual risks can only be assessed following further surveys and intrusive investigation of the Development Site.

4 It should be noted that any risks identified in this chapter are perceived risks based on the information reviewed; actual risks can only be assessed following further surveys and intrusive investigation of the Development Site.

I4.0 Baseline Conditions

Existing Conditions

Site Description

I4.1 The site consists of a series of fields and agricultural land with occasional small scale developments/properties. The site is bound to the north by the A422 road, the east and west cut southbound through fields, and in the south the boundary mostly runs along the M1 motorway, though also includes the parcel of land and roads to the southwest of junction 14 of the M1. Properties that lie within the greater site boundary including the hotel and furniture store are excluded from the planning site boundary.

I4.2 The London Road A509 cuts through the centre of the Development Site running in a north-south orientation and joins the M1 at junction 14. The River Ouzel flows through the centre of the Development Site draining offsite to the north at Newport Pagnell. Several small watercourse/land drains drain into the river.

I4.3 The property off the A509 in the northern central part of the Development Site appears to consist of a residential dwelling, farm buildings and areas of stockpiled waste materials and farm equipment. At the back of a property is a rectangular parcel of heavily vegetated land / marsh land with a further refuse pile. Further farm buildings are located to the south west of the above property adjacent to the A509.

Surrounding Site Use

I4.4 The town of Newport Pagnell is located approximately 2 km to the north / northwest of the Development Site and Milton Keynes Central is located approximately 2 km to the southwest. Further agricultural land and fields extend to the east of the Development Site within the civil parish of Moulsoe. The land immediately to the southwest and south of the Development Site contains serval industrial land uses including industrial estates and sewage works.

I4.5 The central reservation of the Development Site where the River Ouzel runs forms the lowest levels of the Development Site at roughly 56 m AOD. From there the Development Site levels gently increase on either side of the flood plain to a general grade of 60 m AOD. The eastern extent of the Development Site gradually increases in grade to around 80 m AOD.

I4.6 The site is predominantly covered by farm land and grassland that is separated by mature hedgerows.

Site History

I4.7 Historical maps (included within Appendix I1) were reviewed to identify potentially contaminative former land uses on site and within a 500 m radius of the Development Site boundary.

I4.8 It is understood that the Development Site has seen little anthropogenic development through history and has remained predominantly as agricultural land and grassland. On-site development has been limited to farms and occasional residential dwellings. The section of the M1 motorway passing through the south western extent of the Development Site was constructed by 1959. Several small-scale man-made surface water features are dotted across the Development Site. A summary of the pertinent on-site and off-site features relevant to contaminated land are presented in Table I4.1 and Table I4.2 below.

Table I4.1 Summary of Pertinent History of the Site

Date of Historical Map / Imagery	Land Use on Site
1881	The A509 road is present running roughly north to south through the centre of the Development Site. A brick works with associated brick kilns and clay pits is present in the northern central region of the Development Site adjacent to the road. A refuse heap is also listed at the Development Site. A farm labelled as 'Cottage Farm' is present in the south of the Development Site. An unspecified tank is recorded in the west of the Development Site in proximity to the River Ouse.
1924	A plot of allotments is labelled on the map along the south eastern perimeter of the Development Site (no longer labelled in 1976).
1925	The brick works are no longer labelled on the map and new structures have been established on the Development Site. The associated clay pits to the east of the buildings appear to be infilled and the land is demarked as marshland / vegetated. A new building has been constructed to the south of the former brick works on the western side of the A509. The Cottage Farm is relabelled as 'Waitworths Farm'.
1969	The former brick works site has been further developed with structures and a 'pump' is labelled on the map associated with the structures. A tank is labelled on the marshes behind the structures in 1972 mapping. Waitworths Farm has been further developed and relabelled as 'Hermitage Farm'. Tanks are recorded to be associated with the development.
1970 - Present	The site appears to remain largely the same as present day.

Table I4.2 Summary of Pertinent History Off site and in Surrounding Land

Date of Historical Map	Off-site Feature (within 500 m)
1881	Within the centre of the Development Site at the location of the current Holiday Inn hotel complex (outside of planning application boundary) the farm estate 'Moulsoe Buildings' is present. Approximately 100 m south of the southern site boundary is an 'Old Gravel Pit' flanking the A509.
1886	South west: Occasional farms, small town of Willen from 200 m including church with burial yard. South: The town of Broughton from approximately 450 m including a burial yard and farms. East: The town of Moulsoe from 250 m including a church burial yard and gravel pits, and various small farm complexes. North east: fields and occasional farm complex. North west: The outskirts of Newport Pagnell (from approximately 400 m) including a Work House, farm fields, a gravel pit and farm complexes. West: Area of Caldecote with associated farm, Caldecote Mill and numerous wells.
1924	An unspecified tank is recorded on the mapping associated with the former Moulsoe Buildings (1924 – 1963). An area of allotments and an Anglo-Saxon Burial Ground are noted from approximately 80 to the north west of the Development Site in Newport Pagnell.
1963	The M1 motorway is seen to be constructed running through the south western extent of the Development Site in a south east to north west orientation.

Date of Historical Map	Off-site Feature (within 500 m)
1969	The gravel pit to the south of the Development Site is now shown to be infilled and covered by vegetation. A pumping station is labelled on the map approximately 130 m to the west of the Development Site at Caldecote
1970	A Council Yard has been established located adjacent to the western site boundary and bound to the west by Willen Road.
1972	The Moulsoe Buildings farm have been developed into a hotel complex. A tank associated with an off-site farm, 'Cotton Valley Farm', is located adjacent to the southern border. A 'disused pit' is noted on the map approximately 420 m south of the Development Site. To the north west, multiple 'works' have been developed from approximately 400 m. A pumping station is labelled on the map (possibly first constructed by 1938) located approximately 180 m from the western site boundary.
2000	A quarry has been established approximately 100 m to the south east of the Development Site.
(Google Earth Satellite Imagery)	By the 1970s, Milton Keynes had been largely developed to the west / south west of the Development Site. Associated development within 500 m of the Development Site boundary includes: the expansion and redevelopment of the town of Willen to the west, the development of the industrial complex of Tongwell also to the west, the construction of Willen Lake from approximately 80 m to the south west, the Cotton Valley sewage treatment works (first established 1974) immediately to the south of the Development Site and Northfield Industrial complex immediately to the south of the A509 including various warehouses, light industrial units, a coach station and fuel filling stations.
2000	A quarry has been established approximately 100 m to the south east of the Development Site.
2001	By 2001 the A509 has been extended beyond the northern and southern areas of the Development Site: from junction 14 of the M1 to run east – west along the southern perimeter and partially through the Development Site; and, in the north connecting to the A422 and passing to north east forming part of the northern site boarder. An industrial estate (Interchange Park) has been developed adjacent to the north of the northern A509.
2016	By 2010 the quarry to the south east is shown to be mostly backfilled / decommissioned and by 2016 the area is seen to be reinstated as a featureless field.

Environmental Setting

Geology

I4.9 British Geological Survey (BGS) Geological map Sheet No. 203, Bedford, 1:50,000 Bedrock and Superficial Edition (2010) (online); BGS 'Geology of Britain' online viewer; and available nearby historic borehole records and geological publications were reviewed.

I4.10 The superficial geology of the Development Site and greater area is dictated largely by glacial erosional and depositional environments altering old river channels and flood plains. The site is drained by the River Ouzel, a major tributary of the Ouse river located downstream to the northwest at Newport Pagnell. The Ouzel flood plain extends across the Development Site and is filled by alluvium sediments that are entrenched into the First Terrace gravels. Sheets of periglacial head deposits blanket the First Terrace gravels on the sides of the alluvium and up to

the valley sides. At the eastern extent of the Development Site and extending further eastwards are diamicton and glaciofluvial deposits formed in glacial conditions during the Quaternary Period. Superficial deposits are mapped as locally absent in most of the east of the Development Site. There is a deep buried channel feature present roughly in the centre of the Development Site running to the north-west, filled with glaciofluvial deposits.

I4.11 Bedrock deposits on site are that of the Oxford Clay Formation consisting of thick deposits of mudstones (21 - 24 m) with siltstone and sandstones at the base, underlain by silici-silty or silici-sandy mudstones of the Kellaways Sand Formation, underlain by the Great Oolite Group consisting of interbedded limestones and subordinate sandstones and mudstones. In turn the geology is underlain by the Lias Group made up of substantial thicknesses of mudstones.

I4.12 Four major faults are present within the area with faulting also inferred to be present on site.

I4.13 A summary of the anticipated geology, anticipated distribution and typical description is presented in Table I4.3.

Table I4.3 Anticipated Ground Profile with Material Description

Stratum [(1)(2)(5)(6)]	**Distribution**	**Typical Thickness of Strata (m bgl)** [(1)]	**Typical Strata Description** [(1)(2)]	**Aquifer** [(2)(3)]
Made Ground	Limited to areas of previous development.	Unknown.	Unknown, anticipated to be highly variable.	Not Classified
Superficial Geology				
Head	Central region of the Development Site.	Where present, up to 2.1 m [(6)]	Poorly sorted and poorly stratified Clay sand and gravel, locally with lenses of silt or peat and organic material	Secondary Undifferentiated Aquifer
Diamicton	East only	Variable up to 20 m, typically 1 – 7m	Grey, weathering brown, characterised by Cretaceous and Jurassic rock fragments; subordinate lenses of sand and gravel, clay and silt.	Unproductive
Glaciofluvial Deposits	Centre and east of site.	Up to 15 m [(5)] (inferred)	Sand and gravel.	Secondary 'A' Aquifer
Alluvium	Central region of the Development Site.	Where present, up to 2.5 m [(6)]	Normally soft to firm consolidated, compressible silty Clay, but can contain layers of silt, sand, peat and basal gravel.	Unproductive Strata
Felmersham Member - First Terrace: River Terrace Gravels	Central region of the Development Site.	3	Gravel with sand.	Secondary 'A' Aquifer
Bedrock Geology				
Stewartby Member– Oxford Clay Formation	Far south-eastern extent only	22 – 27 m	Pale to medium grey, commonly smooth, variably silty, calcareous, blocky Mudstones.	Unproductive Strata
Peterborough Member - Oxford Clay Formation	All site except for far eastern /	21 – 24 m [(5)]	Brownish-grey, fissile, organic-rich (bituminous) Mudstones.	Unproductive Strata

Stratum [1][2][5][6]	Distribution	Typical Thickness of Strata (m bgl) [1]	Typical Strata Description [1][2]	Aquifer [2][3]
	north-eastern extent			
Kellaways Sand Formation	All site	5 – 8 m	Mudstone, grey, commonly silici-silty or silici-sandy, with (predominantly in the upper part) beds of calcareous Siltstone and Sandstone.	Secondary 'A' Aquifer
Great Oolite Group	All site	65 to 71 m	Limestones, Mudstones and Siltstones	Predominantly Unproductive Strata

Notes: (1) Based on available historical exploratory hole logs.
(2) BGS online portal and mapping.
(3) Environment Agency online portal.
(4) Groundsure Report
(5) BGS Publication – Horten A, 1974
(6) Previous ground investigation reports.

Hydrology

I4.14 The site is located within the Great Ouse catchment area, falling both in the smaller Ouzel & Milton Keynes and Bedford operational catchments. The River Ouzel (also referred to as River Lovat) runs through the Development Site in broadly a south to north direction, draining into the Great Ouse to the north. The River Ouzel its self has been heavily modified historically within the area and on-site there are networks of drains and historically manipulated watercourses flowing to the river from surrounding directions on-site. In addition, there are several small ponds, disused wells and other small-scale surface water features dotted across the Development Site. Off-site to the south west is Willen Lake (from approx. 70 m), one of two major balancing lakes within the River Ouzel flood management scheme.

I4.15 The site is located within a Nitrate Protection Zone in relation to the Great Ouse.

Hydrogeology

I4.16 The Glaciofluvial Deposits and the Felmersham Member Deposits are classified by the EA as Secondary A Aquifers. The Head deposits are classified as a Secondary Undifferentiated aquifer.

I4.17 The Alluvium and Diamicton deposits are both classified by the EA as Unproductive strata.

I4.18 The bedrock deposits of Oxford Clay are described as Unproductive strata. The Kellaways Sand Formation is classified as a Secondary A Aquifer. The underlying Great Oolite Group is generally classified as Unproductive strata at the Development Site.

I4.19 The Oxford Clay Formation is anticipated to largely act as an aquitard limiting the flow of water from superficial aquifers to the bedrock aquifers. The Oxford Clay Formation is not mapped to be present in the west of the Development Site and it is therefore possible that the superficial aquifers in this area are in hydraulic continuity with the underlying aquifer within the Kellaways Sand Formation.

I4.20 The Made Ground is not classified by the EA, however groundwater may be present as discontinuous pockets or as a perched water body.

I4.21 Groundwater was encountered at shallow depths within the Head deposits, within the glacial Diamicton deposits and also within the Oxford Clay deposits during the WSP ground investigations in the centre and south east of the Development Site.

I4.22 It is anticipated that the groundwater largely drains towards the River Ouzel in the centre of the Development Site and ultimately the River Ouse, to the north.

Abstraction Points

I4.23 There are four historical licensed groundwater abstraction sites within a 500 m radius of the Development Site, one of which is within the Development Site boundary, as detailed in Table I4.4 below.

Table I4.4 Licensed Groundwater Abstractions Summary

Abstraction Point	Licence Number	Approximate Distance and Direction	Use	Status
Well Moulsoe Buildings	6/33/10/*G/0002	On site, centre	General Farming & Domestic.	HISTORIC
Well at Caldecote Farm	6/33/10/*G/0007	276m, north	General Farming & Domestic	HISTORIC
Gravel pit at Newport Pagnell	6/33/10/*G/0010	279m, west	Mineral Washing	HISTORIC
Gravel pit at Broughton Barns	6/33/09/*G/0022	360m, south	Mineral Washing	6/33/09/*G/0022

I4.24 There is one licenced surface water abstraction point listed within 500m of the Development Site boundary. It is a historical abstraction license that is located on-site at the River Ouzel, as described in Table I4.5 below.

Table I4.5 Licensed Surface Water Abstractions Summary

Abstraction Point	Licence Number	Approximate Distance and Direction	Use	Status
River Ouzel at Moulsoe	6/33/10/*S/0009	On site, centre/northwest	Spray Irrigation - Direct	HISTORIC Permit last active 2002.

Radon

I4.25 Public Health England defines affected areas as those with a 1% chance or more of a house having a radon concentration at or above the action level of 200 Bq/m^3. The site is reported to lie in an area where less than 1% of properties are above the action level therefore no radon protective measures are considered necessary.

Regulatory Database

I4.26 It is considered that the information listed in Table I4.6 and Table I4.7 represents data of potential relevance in relation of contamination at the Development Site.

Table I4.6 Summary of Database Searches: Pollution incidents

Descriptor	On-site	0-249m	250-500m	Details
Licensed Pollution Release	0	2	4	The closest registered pollution release site is located approximately 207m southeast of the Development Site at Esca Food Solutions Ltd for the processing of meat products. The remaining sites are located to the east and southwest of the Development Site relating to permits for surface cleaning, incineration and combustion, manufacturing of non-alcoholic beverages and for coating processes.
Licensed Discharges to Controlled Waters	11	12	9	The on-site discharge consents are listed as for the discharge of final/treated sewage effluent, agricultural discharge and miscellaneous discharges to surface waters.
Pollutant Release to Public Sewer	0	1	1	As discharges of Special Category Effluents to the public sewer. The closest record is associated with the Cotton Valley Wastewater Treatment Works for Alpheus Environmental Limited.
List 1 Dangerous Substances	0	2	0	The closest record is approximately 95m east at Chemetall Plc for the release of Cadmium and Mercury to the River Ouse. Active permit.
Pollution Incidents (Category 3 'Minor' and above)	1	3	2	The onsite incident occurred in 2003 and involved the release of inorganic chemicals / products, specifically alkalis resulting in a Minor impact to Land (Category 3). The remaining offsite incidents were mostly recorded as Category 3 incidents impacting either land, water or air. The exception is one Significant incident (Category 1) that took place in 2017 involving the release of a microbial pollutant that was recorded to impact Water. The incident took place approximately 99m southwest of the Development Site.
Pollution Inventory Substances	1	1	1	The pollution inventory (substances) includes reporting on annual emissions of certain regulated substances to air, controlled waters and land. The data consist of the most recent complete year available. The onsite inventory permits relate to operations at the Cotton Valley Wastewater Treatment Station. The off-site permits are registered to Alpheus Environmental and Coca-Cola Partners.
Part 2(A) Licensed Industrial Activities	0	2	1	The licensed industrial activities within 250m of the Development Site are associated with the Cotton Valley Waste Treatment Centre for various related processes. The remaining off-site license site is located from approximately 319 m southeast associated with the Coca-cola Enterprises.

Table I4.7 Summary of Database Searches: Waste Facilities

Feature	On-site	0-249m	250-500m	Details
Historical Landfill Sites	0	5	1	The closest historically active landfill site is located from approximately 32 m southeast of the Development Site. Where data is provided, the landfills are listed to have accepted inert and or industrial waste. The landfills are recorded to the southeast, west and south of the Development Site boundary.
Historical Waste Sites	0	2	0	Closest record is of a Waste Transfer Station located from approximately 9m east of the Development Site at Cotton Valley Sewage Works. The second record is of a Recycling Works for aggregates registered from approximately 227 m north of the Development Site.
Licensed Waste Sites	2	8	11	As active or recently closed waste sites under Environment Agency/Natural Resources Wales regulation. The first of the two on-site licensed waste facilities is located in the southwest of the Development Site and is the registered active Cotton Valley Waste Transfer Station receiving household, commercial and industrial waste. Six further offsite waste licenses are associated with the Cotton Valley works including that for sewage sludge treatment, non-biodegradable waste and for landfill gas use. The second onsite license is at Hermitage Farm for the use of waste in construction. This license was surrendered in 2014. The remaining offsite waste licenced sites are held for waste activities associated with mineral mining (generally associated with Willen Road Quarry to the north), waste landfilling or waste transfer stations.
Waste Exemptions	5	9	11	As activities involving the storage, treatment, use or disposal of waste that are exempt from needing a permit.

I4.27 Numerous recent industrial or potentially contaminative land uses were identified within 250m of the Development Site. A summary is presented in Table I4.8, below.

Table I4.8 Summary of Database Searches: Recent Industrial Land uses

Distance from Site	Potentially contaminative recent land uses
On-site or in the immediate vicinity	Water pumping station, silos, electricity substations.
>100m	Electricity substations, water pumping stations, sewage pumping, settling tanks, generic storage tanks, warehouses.
101 – 250m	Tanks, vehicle service centres including sales and hire services and repairs garages, distribution centre, electricity substations, retail businesses, construction services, business park, electricity substations, quarries and mechanical engineers.

Sensitive Land Uses

I4.28 There are no ecological or other sensitive land uses identified within 500 m of the Development Site. There are no Sites of Special Scientific or Areas of Outstanding Natural Beauty Interest within 1 km of the Development Site.

I4.29 The Moulsoe Buildings Farmhouse located in the centre of the Development Site off-site is a Grade II listed building.

Unexploded Ordnance (UXO)

I4.30 Following a preliminary consultation of online UXO threat hazard maps by Zetica (21/07/20), the Development Site appears to be in an area of Low threat from unexploded ordnance.

I4.31 A Pre UXO Desk Study undertaken by Zetica on 18th November 2020 (included within Appendix I.1) reports that a detailed threat assessment is not considered essential for this site.

Previous Reports

I4.32 The Milton Keynes East (MKE) phase 1 geo-environmental Interpretative report Ref 31 and Caldecote Farm Geo-Environmental Interpretative report Ref 32, have been consulted to obtain baseline data to support this preliminary risk assessment. Details relevant to the current site risk assessment are summarised in the below.

Geo-Environmental and Geotechnical Assessment Interpretative Report, Milton Keynes East Phase 1. WSP, 2012

I4.33 The site in question is located at the south east of the masterplan site and comprises what is referred to as Phase 1 of the MKE site. The report includes the findings from a geo-environmental and geotechnical intrusive ground investigation and the following Phase 2 risk assessment.

I4.34 The geology of the area was confirmed to generally match that of the published BGS mapping with the upper most bedrock being that of the Oxford Clay Formation. Superficial geology was described as Glacial Till covering the majority of surface, Head deposits in the west of the Development Site, and undifferentiated sands encountered across the vast majority of the exploratory locations. Made Ground was found at no greater than 0.20 m thickness. Groundwater was encountered at shallow depths at around 1 m bgl within the Head deposits and also at around 7 m bgl within the Oxford Clay Formation.

I4.35 The intrusive works comprised multiple methods of investigation including trial pits, window sampler boreholes, cable percussive boreholes and various geotechnical testing. Monitoring wells were installed for assessment of ground gas and groundwater and samples were collected for laboratory testing. Results for the soils assessment were included within the report however groundwater samples were not, reportedly due to timescales and availability.

I4.36 Overall, the assessment found that the soils tested did not present evidence of contaminants of concern at significantly elevated concentrations. Selected soil samples were shown to contain aromatic and aliphatic hydrocarbons above guideline assessment criteria thresholds however these were marginal. Further, one marginally elevated concentration of semi-volatile 2,4-Dinitrophenol was encountered, however also considered to be of low significance to the risk.

I4.37 Preliminary ground gas monitoring indicated that the risk from ground gas on the Proposed Development is considered to be very low.

Geo-Environmental and Geotechnical Interpretative Report, Caldecote Farm, Newport Pagnell. WSP, 2007

I4.38 The report is of a phase 2 site investigation at the Development Site referred to as 'Caldecote Farm, Newport Pagnell', falling mostly within in the centre of the current site boundary between London Road and Willen Road and covering an approximate area of 260Ha.

I4.39 The intrusive investigation comprised a total of 27 trial pits excavated to prove ground conditions, undertaken in-situ testing and to take soil samples.

I4.40 Soil samples were analysed for a number of geotechnical parameters in addition to a limited scope of chemical analysis including for heavy metals, polyaromatic hydrocarbons, pH and sulphide.

I4.41 The ground investigation found that the geology encountered mostly matched that of the published BGS mapping with the exception of the presence of Head deposits overlying the River Terrace Gravels and the absence of Glacial Lake Deposits.

I4.42 The soils contamination assessment was undertaken using Soil Guideline Values (SGVs) valid at the time of reporting and that have since been superseded. When compared with SGVs for a residential with home grown produce land-use, the report finds a limited number of exceedances within samples of the topsoil, Alluvium and Head deposits. The exceeding analytes included cadmium and arsenic, and in all cases, the results were deemed to be either reflective of background concentrations or a non-significant anomaly. When compared to guideline assessment criteria in line with current industry standard, no contaminants of concern exceed their thresholds within the dataset available.

Baseline Assessment

I4.43 Table I4.9 provides a summary of the potential sources of contamination that may be present at the Development Site, as well as the likely nature of such sources.

Table I4.9 Potential Sources of Contamination

Potential Source	Potential Contaminants of Concern	Likely / Anticipated Distribution
On-Site		
Recent and Historical Agricultural land including farm infrastructure	Various contaminants including pesticides, herbicides, nitrates, asbestos, petroleum hydrocarbons and heavy metals.	Site wide, notably surrounding farm boundaries and infrastructure in the centre, south and north.
Historical Brick Works with brick kilns, clay pits and refuse heap	A wide range of possible contaminants including: asbestos, heavy metals (namely lead from the brick works), inorganics inc. cyanide, solvents, petroleum hydrocarbons, polyaromatic hydrocarbons (PAH), BTEX (benzene, toluene, ethylbenzene and xylene) and ground gases (methane, hydrogen sulphide and carbon dioxide).	North, centre.
Historical and recent Tanks	A range of contaminants, namely: petroleum hydrocarbons, PAH, BTEX, volatile organic compounds (VOCs) and semi volatile organics (SVOCs), heavy metals and solvents.	Various locations.
Historical Allotments	A range of possible contaminants including asbestos, heavy metals, inorganics (e.g. cyanide), petroleum hydrocarbons, PAH and ground gases (methane and carbon dioxide).	South eastern extent.
Organic rich soils – Alluvium (peat)	Ground gases including methane and carbon dioxide.	Central region of the Development Site.

Potential Source	Potential Contaminants of Concern	Likely / Anticipated Distribution
Off-Site		
Historical land-uses off-site but within this greater site boundary, including: farm infrastructure, tanks and hotel complex.	Asbestos, heavy metals, petroleum hydrocarbons, PAHs, BTEX, solvents, pesticides and herbicides, nitrates, VOCs and SVOCs.	Central, northern and south western points within the greater land boundary.
Further historical land-uses to the west including: M1 construction works, pumping station, wells and council yard.	A wide range of contaminants including: asbestos, heavy metals, petroleum hydrocarbons, PAHs and BTEX.	West.
Historical Allotments	A range of possible contaminants including asbestos, heavy metals, inorganics (e.g. cyanide), petroleum hydrocarbons, PAH and ground gases (methane and carbon dioxide).	All surrounding, closest south east and east.
Historical burial grounds and church yards	Various possible contaminants, namely asbestos, pathogens, formaldehyde, PAHs, heavy metals and ground gases (methane, hydrogen sulphide and carbon dioxide).	All surrounding, closest from 200 m east
Historical gravel pits and unspecified infilled pits	A wide range of possible contaminants relating to surrounding land uses, including: asbestos, heavy metals, inorganics, petroleum hydrocarbons, PAHs, VOCs & SVOCs, and ground gases (methane and carbon dioxide).	All surrounding, closest from 100 m south.
Historical landfill sites / Infilled land	A wide range of potential contaminants relating to the surrounding previous land uses, including: asbestos, heavy metals, inorganics (e.g. cyanide), petroleum hydrocarbons, PAHs, BTEX, mineral oils, PCBs, solvents, microbial, VOC and SVOCs and ground gases (methane, carbon dioxide and hydrogen sulphide).	Various locations, primarily located to the north west, south and south east of the Development Site.
Historical and recent farm land and associated infrastructure	Namely pesticides & herbicides, nitrates, asbestos, heavy metals, petroleum hydrocarbons and PAHs.	All surrounding.
Historical and recent Tanks	A range of contaminants, namely: petroleum hydrocarbons, PAH, BTEX, volatile organic compounds (VOCs) and semi volatile organics (SVOCs), heavy metals and solvents.	Various locations.
Recent industrial / commercial land uses including:		
Development associated with the expansion of Milton Keynes, including: Cotton Valley Sewage	A wide range of potential contaminants including: asbestos, heavy metals, inorganics (e.g. cyanide), petroleum hydrocarbons, PAHs, BTEX, mineral oils, PCBs, solvents, pathogens, VOC and SVOCs and ground gases (methane, carbon dioxide and hydrogen sulphide).	Adjacent to the west / south of the Development Site.

Potential Source	Potential Contaminants of Concern	Likely / Anticipated Distribution
Works, various industrial complexes including Northfield Industrial park and Tongwell.		
Car Dealers; Road Haulage Services; Garage.	Waste oils (PAHs), heavy metals, brake fluids and fuels.	Multiple locations to the south, west and north of the Development Site.
Miscellaneous industrial/commercial facilities Inc. distribution centres, warehouses, and light goods manufacturers.	A wide range of possible contaminants, including: asbestos, heavy metals, inorganics (e.g. cyanide), petroleum hydrocarbons, PAHs and ground gases (methane and carbon dioxide).	Multiple locations to the south, west and north of the Development Site.

Sensitive Receptors

I4.44 The following sensitive receptors have been identified and assessed within the ES:

1 Construction workers;

2 Controlled waters (groundwater, surface water);

3 Future site users (including occupiers, visitors and maintenance workers);

4 Off-site receptors in the immediate vicinity (nearby residents and members of public); and

5 Underground services infrastructure.

Future Baseline

I4.45 In the absence of the Proposed Development it is likely that the Development Site conditions will remain as they are reported within this chapter, no significant change to the current baseline would be predicted.

I5.0 Potential Effects

During Construction

Potential effect on construction workers from pre-existing contamination within the underlying soils (if present)

I5.1 Construction workers could be exposed to any unexpected contaminants that are present in any Made Ground, or that are present in the ground after migrating from contaminant sources, during any earthworks or site clearance that includes disturbing or clearing any Made Ground. Off-site residents could also be exposed to any contaminants that are present in Made Ground during construction works and earth movements. There is potential for exposure to asbestos or other contaminants during any earthworks or site clearance if it is present in any Made Ground. The construction workers and off-site residents will be affected by inhalation of dusts, gases or vapours, dermal contact with soil and groundwater; and ingestion of soil and dust. However, the length of direct exposure will be limited to the duration of site works in which they are directly involved, and thus the effect will be short term. Any health effects from the potentially contaminated soil and groundwater could have a medium to long term effect.

I5.2 The sensitivity of construction workers and off-site residents is medium to high and the magnitude of change, prior to mitigation, is large. Therefore, there is likely to be a direct, permanent, medium to long-term adverse effect which is considered to be **moderate** to **substantial**.

Potential effect on adjacent sensitive site users from potential contamination within the underlying soils during construction activities

I5.3 Excavation of potentially contaminated soils could pose a health risk to the general public in the immediate vicinity of the Development Site, through inhalation of contaminated dusts and particulate matter generated by excavation activities or site clearance that includes disturbing or clearing the Made Ground.

I5.4 The potential risk to adjacent site users would be dependent on the type and nature of contamination, if present, and the characteristics of receptor and duration of exposure. If these receptors are exposed to contaminants above threshold concentrations there is potential for both temporary and permanent health problems to arise. Exposure can be direct or indirect.

I5.5 The sensitivity of existing adjacent sensitive site users is high and the magnitude of change, prior to mitigation, is large. Therefore, there is likely to be a direct, permanent, medium to long-term substantial adverse effect (significant) on existing site occupiers and adjacent sensitive site prior to the implementation of mitigation measures.

Potential effect on Controlled Waters during construction activities.

I5.6 Construction work has the potential to increase the rate of infiltration of rainfall and therefore leaching of unexpected contaminants from shallow materials (such as Made Ground) by decreasing the thickness of the unsaturated zone during any striping of topsoil/grass cover.

I5.7 There is the potential for the generation of preferential pathways through construction techniques (e.g. piling or deeper foundations) to the Secondary Undifferentiated Aquifer (within the Head Deposits), and Secondary A Aquifers (within the Glaciofluvial Deposits, Felmersham Member, and Kellaway Sand Formation).

I5.8 The use of machinery and plant associated with construction activities (including the establishment of a site construction compound and storage of chemicals or fuels) could give rise

to localised contamination that may represent a risk to local surface waters through accidental fuel / oil and chemical spills and leaks via surface runoff, including hydrocarbon contamination, associated with the operation of vehicles. This has the potential to create overland migration pathways to surface water features (on-site ponds, field drains and River Ouzel).

I5.9 The sensitivity of Controlled Waters is considered to be medium, and the magnitude of change, prior to mitigation is medium. Therefore, there is likely to be a direct, temporary, long-term, adverse effect that is considered to be **moderate** prior to mitigation.

During Operation

I5.10 No significant effects are anticipated during operation and further assessment has been scoped out.

I6.0 Mitigation and Monitoring

During Construction

Potential effect on construction workers from pre-existing contamination within the underlying soils (if present)

I6.1 Ground investigations will be carried out to identify potential contaminant linkages prior to commencement of the Construction Phase which are also likely to be conditioned as part of the planning permission for the Proposed Development. If the ground investigation identifies contaminant linkages a Remediation Strategy will be produced for the Development Site to specify protective measures for the construction phase of the development. This will be undertaken port-determination.

I6.2 In order to mitigate against the potential effects of the Proposed Development with respect to ground contamination, a Construction Environmental Management Plan (CEMP) will set out the principles of contaminated land mitigation. The CEMP will describe suitable containment measures and procedures for the storage and handling of materials and wastes, both on the construction site and within the construction compound, to ensure that spills or contaminant releases do not enter the ground or surface water courses in line with relevant regulations and good practice guidance. Measures that will be included and expanded upon within the CEMP include:

1 General good construction working practices such as dust suppression (damping down), windbreak netting around excavations and/or perimeter fencing, covering stockpiles with tarpaulins and road sweeping to prevent local residents and employees in the vicinity of the earthworks from being exposed to windblown dusts, vapours and asbestos fibres.

2 Appropriate stockpile segregation, locations and containment measures to minimise the exposure of surface water and groundwater from contaminated run-off and local neighbours from windblown dusts, vapours and asbestos fibres.

3 A protocol for managing unexpected ground contamination that may be encountered during construction. This may require additional investigations, sampling, risk assessment and remediation to ensure the protection of the possible receptors.

4 Construction workers would be required to wear PPE such as gloves and face masks (where appropriate) to prevent dermal contact and inhalation or ingestion. Appropriate site hygiene facilities will be put in place and the presence of contaminants and the associated risks will be explained to ground workers before they begin work.

5 Water can be sprayed onto material being worked to damp down any potentially contaminated dust and prevent it from becoming airborne where it may affect construction workers and Off-site residents. Wheel washing of site vehicles may also be implemented to prevent tracking of contaminated material off-site.

6 Fuel storage on-site to be carried out under best practice i.e. integrally bunded containers. Plant refuelling to be carried out using best practice techniques and any spills to be controlled with spill kit.

7 Dust suppression measures (e.g. damping down) will be implemented to minimise the potential for dust generation. Wheel washing of site vehicles will be carried out in order to minimise the potential for dust generation. Appropriate covering of onsite stockpiled materials and during transport to/from the Site to prevent dust generation.

I6.3 Contaminated ground materials that cannot be reused will be suitably managed to prevent mobilisation to the environment and to minimise the potential to impact sensitive receptors, prior to disposal. A Materials Management Plan will be produced, if necessary, following the Contaminated Land: Applications in Real Environments (CL:AIRE) 'Definition of Waste: Development Industry Code of Practice' [Ref 33], or exemptions/environmental permits, to ensure that soil re-use and imported materials are suitable for their intended use and will not significantly affect human health or the environment.

I6.4 An earthworks specification will include protocols for testing and limiting values to ensure that imported materials are suitable for their intended use in terms of their chemical quality.

I6.5 Any below ground tanks, structures and/or pipework encountered during construction will be appropriately decommissioned and removed to ensure that contaminants do not enter the ground.

I6.6 Disused services will be decommissioned appropriately to ensure that no preferential pathways for contamination remain.

I6.7 New service trenches will be designed to prevent the migration of contaminants if identified.

Potential effect on adjacent sensitive site users from potential contamination within the underlying soils during construction activities

I6.8 Following the ground investigation an assessment of contamination risk should be undertaken prior to any site works taking place to ensure all the contamination risks associated with the Site are fully understood and the appropriate mitigation measures can be put in place. If necessary, further remediation of affected areas should be completed prior to site works.

I6.9 Construction would be carried out using current best practice to prevent the generation of dust. This may include measures such as damping down of stockpiles and wheel washing of site vehicles.

I6.10 Any imported materials and reused materials will be suitable for use within areas of soft landscaping.

Potential effect on Controlled Waters during construction activities.

I6.11 The ground investigation carried out in compliance post determination planning conditions will identify areas of contamination in shallow soils which will be appropriately remediated prior to the construction phase.

During Operation

I6.12 No significant effects are anticipated and no mitigation is required during operation.

I7.0 Residual Effects

During Construction

Potential effect on construction workers from pre-existing contamination within the underlying soils (if present)

I7.1 The sensitivity of construction workers and off-site residents is medium to high and the magnitude of change, following mitigation, is **negligible**. Therefore, there is likely to be a direct, permanent, medium to long-term adverse residual effect which is considered to be **negligible**.

I7.2 This effect is not considered to be significant.

Potential effect on adjacent sensitive site users from potential contamination within the underlying soils during construction activities

I7.3 The sensitivity of existing site occupiers and adjacent sensitive site users is high and the magnitude of change, following mitigation, is **negligible**. Therefore, there is likely to be a **negligible** effect on sensitive site users.

I7.4 This effect is not considered to be significant.

Potential effect on Controlled Waters during construction activities.

I7.5 The sensitivity of Controlled Waters is medium and the magnitude of change, following mitigation, is **negligible**. Therefore, there is likely to be a direct, temporary, medium to long-term residual effect that is considered to be **negligible**.

I7.6 This effect is not considered to be significant.

During Operation

I7.7 No significant effects are anticipated during operation.

I8.0 Summary & Conclusions

Summary

I8.1 The site consists of a series of fields and agricultural land with occasional small scale developments/properties. The site is bound to the north by the A422 road, the east and west cut southbound through fields, and in the south the boundary mostly runs along the M1 motorway, though also includes the parcel of land and roads to the southwest of junction 14 of the M1. Properties that lie within the greater site boundary including the hotel and furniture store are excluded from the planning site boundary.

I8.2 Historically, the Development Site has seen limited development with the land predominantly existing as open fields and agricultural space. The exceptions include a brick works with associated refuse heap and clay pits in the centre north of the Development Site, occasional tanks, allotments in the south and small-scale farm complexes. The surrounding land to the north, west and south have included various industrial and commercial uses both historically and in recent time, including the development associated with the expansion of Milton Keynes, Cotton Valley Sewage Works, Tongwell industrial area and Northfield industrial complex. The majority of the land to the east of the Development Site remains as largely agricultural.

I8.3 The superficial geology of the Development Site and greater area is dictated largely by glacial erosional and depositional environments altering old river channels and flood plains of the Great Ouse River. Superficial deposits mapped on-site include Head deposits, Glaciofluvial Deposits, Diamicton, Alluvium, and River Terrace Gravels (Felmersham Member).

I8.4 Bedrock deposits on-site are that of the Oxford Clay Formation (thick deposits of mudstones with siltstone and sandstones at the base), underlain by silici-silty or silici-sandy mudstones of the Kellaways Sand Formation, underlain by the Great Oolite Group consisting of interbedded limestones and subordinate sandstones and mudstones. There is a deep buried glacial channel mapped in the centre and north-west of the Development Site reportedly filled with glaciofluvial deposits. Four major faults are present within the area with faulting also inferred to be present on site.

I8.5 The River Ouzel flows through the centre of the Development Site draining off-site to the north to the Great Ouse. Its tributaries extend across the Development Site on either side of the river, and in addition multiple small historically manipulated watercourses and land drains are present across the Development Site.

I8.6 There are a number of shallow aquifer bodies mapped by the EA to be present on-site: Secondary A Aquifers of the Glaciofluvial Deposits and the Felmersham Member Deposits, and the Secondary Undifferentiated Aquifer of the Head deposits. The Alluvium and Diamicton deposits are both classified by the EA as Unproductive strata.

I8.7 The bedrock deposits of Oxford Clay are described as Unproductive strata. The Kellaways Sand Formation is classified as a Secondary A Aquifer. The underlying Great Oolite Group is generally classified as Unproductive strata at the Development Site. The Oxford Clay Formation is anticipated to largely act as an aquitard limiting the flow of water from superficial aquifers to the bedrock aquifers.

I8.8 Sensitive receptors identified include:

1 Construction workers;

2 Controlled waters (groundwater, surface water);

3 Future site users (including occupiers, visitors and maintenance workers);

4 Off-site receptors in the immediate vicinity (nearby residents and members of public); and

5 Underground services infrastructure.

I8.9 Proposed mitigation measures include (to be implemented through planning conditions):

1 Use of appropriate Personal Protective Equipment and hygiene regime by construction workers during development through the implementation of a Construction Environmental Management Plan (CEMP);

2 Dust suppression during the construction stage, through the implementation of a CEMP;

3 Appropriate fuel storage and good practice during fuelling of Site vehicles during development, through the implementation of a CEMP;

4 Appropriate Site drainage including use of interceptor systems in areas where motor vehicles are used, through the implementation of a CEMP;

5 Undertaking a pilling risk assessment. Selection of appropriate piling technique will be important to limit vertical migration of contaminants;

6 A ground investigation will be carried out to identify potential contaminant linkages as a condition of planning. If the ground investigation identifies contaminant linkages a Remediation Strategy will be produced for the Development Site to specify protective measures for the construction stage of the development;

7 If potential contaminant linkages are identified following the ground investigation a remediation strategy will be produced in agreement with the Regulators and National House Building Council on that strategy and subsequent verification report requirements (In accordance with LCRM) as a condition of planning; and

8 Chemical validation of imported soils for soft landscaping areas.

I8.10 The majority of residual effects during operation have all been assessed as **not significant**, based upon the above mitigation measures being implemented appropriately.

I8.11 Table I8.1 provides a summary of the effects, residual effects and a conclusion as to whether the effect is significant or not significant.

Table I8.1 Summary of Effects, Mitigation and Residual Effects

Description of Effects	Receptor	Significance and Nature of Effects Prior to Mitigation	Summary of Mitigation	Significance and Nature of Residual Effects
During Construction				
Potential effect on construction workers from pre-existing contamination within the underlying soils (if present)	Construction Workers	Moderate to Substantial (Significant) - / P / D / LT	Ground Investigation and Remediation Strategy CEMP Measures (as referred to in **section I6.2**)	Negligible (Not Significant) N/A / T / D / MT
Potential effect on adjacent sensitive site users from potential contamination within the underlying soils during construction activities	Adjacent site users	Substantial (Significant) - / P / D / MT-LT	Intrusive Site Investigation and Remediation Strategy Water spray to damp down any potentially contaminated dust. Wheel Washing facilities	Negligible (Not Significant) N/A / T / D / MT

Description of Effects	Receptor	Significance and Nature of Effects Prior to Mitigation	Summary of Mitigation	Significance and Nature of Residual Effects
			Covered Stockpiles.	
Potential effect on Controlled Waters during construction activities.	Controlled Waters	Moderate (Significant) - / P / D / LT	Intrusive Site Investigation and Remediation Strategy Piling Risk Assessment Fuel storage on-site to be carried out under best practice	Negligible (Not Significant) N/A / T / D / MT
During Operation				
No significant effects anticipated				

Key: + / - = Beneficial or Adverse P / T = Permanent or Temporary, D / I = Direct or Indirect, ST / MT / LT = Short Term, Medium Term or Long Term, N/A = Not Applicable

I9.0 Abbreviations & Definitions

- BGS - British Geological Survey
- BS - British Standard
- BTEX - Benzene, Toluene, Ethylbenzene and Xylene
- CDM - Construction Design and Management
- CEMP - Construction Environmental Management Plan
- CIRIA - Construction Industry Research and Information Association
- CL:AIRE - Contaminated Land: Applications in Real Environments
- CSM - Conceptual Site Model
- DEFRA - Department for Environment Food & Rural Affairs
- EA - Environment Agency
- EPA - Environmental Protection Act
- ha - Hectares
- HSE - Health and Safety Executive
- IES - Institution of Environmental Sciences
- LCRM - Land Contamination Risk Management
- M bgl - Meters Below Ground Level
- MKC - Milton Keynes Council
- NPPF - National Planning Policy Framework
- PAH - Polyaromatic Hydrocarbons
- PPE - Personal Protective Equipment
- PRA - Preliminary Risk Assessment
- SGV - Soil Guideline Values
- SPZ - Source Protection Zone
- SVOC - Semi Volatile Organic Compounds
- UXO - Unexploded Ordnance
- VOC - Volatile Organic Compounds

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